Project Title: Randle Reef Sediment Remediation Project (Stage 2)
Hamilton, Ontario

Project Number: R.050927.202

Project Date: 2017-01-15

END

DESIGN ENGINEER: Brian Riggs P.Eng., Riggs Engineering Ltd.

END

Appendices

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Section provides a general description and summary of the various Contract work elements intended to be informative and is not inclusive of the Contract's complete scope of work. This summary does not provide the technical detail for particular work activities, but describes the work as a whole, providing overall perspective to the separate tasks and their interrelationships. The complete Contract package provides the intent of the design, including proper execution and completion of the work as provided in all other section and the attachment thereto.

.2 Title and description of Work.

.3 Contract Method.

.4 Work by others.

.5 Future work.

.6 Work sequence.

.7 Contractor use of premises.

1.2 PRECEDENCE

.1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Specification.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 The Randle Reef Sediment Remediation Project Stage 2 is intended to dredge contaminated sediments and place them in the Engineered Containment Facility (ECF), to treat and dewater the ECF prior to placement of fill materials, to cap the contaminated sediments in the area known as the U.S. Steel channel, and to place a thin layer backfill/capping over some of the work area.

1.4 CONTRACT METHOD

.1 Construct work under combined price contract. All costs for work not specifically identified as a unit price item shall be included in the lump sum arrangement.

.2 Items measured for payment are in metric (SI) units.

.3 Submit requests for payment in metric units corresponding with items on the Unit Price Table.

.4 Submit supporting documents in metric units. Perform all necessary conversions required.

1.5 COST BREAKDOWN

.1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown associated with the lump sum arrangement.

.2 Show separately cost of equipment purchased exempt from Ontario Retail Sales Tax under your Ontario Sales Tax licence number.

1.6 SUBCONTRACTORS

.1 Within 48 hours of acceptance of bid submit a list of subcontractors.

1.7 WORK BY OTHERS

.1 Contractor shall for the purpose of the Ontario Occupational Health and Safety Act and Regulations for Construction Projects, and for the duration of the Work of the Contract:
.1 Assume the role of Constructor in accordance with the Authority Having Jurisdictions.
.2 Agree, in the event of two or more Contractors working at the same time and space at the work site, without limiting the General Conditions GC3.7, to the Departmental Representative's order to:
    .1 Assume, as the Constructor, the responsibility for the Departmental Representative's other Contractors;

1.8 WORK SEQUENCE

.1 Work of this Contract shall commence in a logical sequence in accordance with the approved construction schedule.

1.8 WORK SEQUENCE (Cont'd)

.2 Sequencing and schedule of the work is the responsibility of the Contractor. Allow for work restrictions, including inclement weather, and associated downtime for all construction activities, as well as downtime due to compliance with navigational requirements in Section 01 11 02.

.3 Maintain fire access/control.

1.9 CONTRACTOR USE OF PREMISES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate execution of Work.

.2 Contractor has unrestricted use of Upland Work Area until Substantial Performance except in the Staging Area, Area 2.

.3 Contractor shall limit use of Staging Area, Area 2, for Work, for storage, and for access, to allow:
  .1 Work by other contractors.

.4 Unrestricted use of Staging Area, Area 2 will be granted on January 1, 2018.

.5 Coordinate use of premises under direction of Departmental Representative.

.6 Coordinate operations within dredging area in accordance with Section 01 11 02.

.7 No material other than material dredged in this contract may be placed in the ECF without Departmental Representative written approval.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

PART 1 - GENERAL

1.1 MINIMUM STANDARDS

.1 Execute work to meet or exceed:

.1 National Building Code of Canada 2010, National Fire Code of Canada 2010, Ontario Building Code 2012, Canada Shipping Act and any other code of provincial or local application, including all amendments up to project date, provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Rules and regulations of authorities having jurisdiction.

.3 Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario 1990, Chapter O.1 as amended, O. Reg. 213/91 as amended by O. Reg. 631/94, R.R.O. 1990, Reg. 834.

.4 Environmental Protection Act, O. Reg. 102/94 and O. Reg. 103/94.

.5 Ontario Regulation 629/94 for Diving Operations.

1.2 TAXES

.1 Pay applicable Federal, Provincial and Municipal taxes.

1.3 EXAMINATION

.1 Before submitting bid, examine existing site conditions and determine conditions affecting work, including potential inclement weather and sea conditions.

.2 Obtain all information which may be necessary for proper execution of Contract.

1.4 EXISTING CONDITIONS

.1 A compilation from previous site investigations regarding the geotechnical and chemical properties of the sediments and subsurface soils is bound with these specifications in Appendix A - Geotechnical Investigations and Appendix B - Sediment Chemistry. Sediment sample locations are shown on D-2.7, D-2.8 and D-2.9.

.2 The results of a geophysical investigation regarding debris in the work area is bound with these specifications in Appendix C - Side Scan Survey.

1.4 EXISTING CONDITIONS (Cont'd)

.3 Be familiarized with all available data and scope, and price accordingly.

1.5 SITE

.1 Locate temporary buildings, roads, walks, drainage facilities, services as directed and maintain in clean and orderly manner.

.2 Access to Hamilton Harbour from Lake Ontario is through the Burlington Canal. There is a lift bridge at this canal that closes seasonally and access to the harbour from Lake Ontario is blocked. Contact PWGSC for details on operating schedule.

1.6 CONSTRUCTION & STORAGE AREA

.1 The limits of the Construction and Storage Area will be designated by the Departmental Representative prior to commencement of work unless otherwise shown on the Drawings.

.2 Confine work, including temporary structures, plant, equipment and materials to established limits of site.

1.7 DOCUMENTS

.1 Keep on site one copy of contract documents and reviewed shop drawings.

1.8 LAYOUT OF WORK

.1 Vertical and horizontal benchmark are established from benchmark number 60-U-3327, located on the southeast abutment of the Burlington Ship Canal Lift Bridge.

.2 Supply stakes and other survey markers required for this work. Employ competent personnel to lay out work in accordance with lines and grades provided.

.3 Mark floating equipment with lights in accordance with International Rules of Road and maintain radio watch on board.

.4 Place and maintain buoys, ranges, markers and light required to define work areas.

1.8 LAYOUT OF WORK (Cont'd)

.5 Departmental Representative will meet with Contractor and his survey staff to identify the established horizontal control consisting of a baseline, buoys and coordinate system with reference control monuments and vertical control consisting of water level gauges, and benchmark to define the work areas.

.6 Maintain the established horizontal and vertical control and lay out the work from these established references. Be responsible for the accuracy of work relative to established references. Provide, at own expense, survey vessel, equipment and crew to set up and maintain control for location of dredge limits.

.7 Install and maintain a water level gauges in vicinity of worksite in order that proper depth of dredging can be determined. Locate gauges so as to be clearly visible.

.8 Establish and maintain additional on-land temporary targets, markers and buoys for location and definition of designated dredge area limits as required. Remove on completion of work.

1.9 CO-OPERATION & PROTECTION

.1 Execute work with minimum disturbance to normal use of site. Make arrangements with Departmental Representative to facilitate execution of work.

.2 Maintain access and exits.

.3 Provide necessary barriers, warning lights and signs. Protect work from damage. Replace damaged existing work with material and finish to match original.

.4 Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Performance.

.5 Use equipment and procedures that prevent damage to ECF steel sheet pile walls.

.6 Conduct dredging, thin-layer backfilling/capping and isolation capping in a manner that avoids resuspension and redistribution of sediment to areas of completed Work.

1.9 CO-OPERATION & PROTECTION (Cont'd)

.7 Protect, shore, extend/trim, as necessary the culvert at Sherman Outlet. Coordinate with the Departmental Representative on this component of Work. Submit shop drawing detailing proposed sequence of work to provide necessary protection.

.8 Contractor and Departmental Representative shall review and verify condition of existing structures adjacent to the Contract Work Area prior to beginning work to ascertain existing conditions. Any damage documented as a result of the Contractor's activities will be assessed to the Contractor for repair at no additional cost to Contract.

.9 Conduct Work in a manner to protect the stability of structures on or adjacent to the Contract Work Area. Repair and clean existing structures, roads or other facilities damaged or fouled by the work or material lost through pipeline leaks. Complete repairs and clean up at no additional expense to Contract. Repairs made to damaged existing work to equal or better.

.10 Be responsible for any damage sustained to the ECF steel sheet pile wall during dredging operations. Upon completion of dredging the Verification Zones bordering the ECF (Verification Zones VZ-1, VZ-2, VZ-3 and VZ-4), Departmental Representative reserves the right, and shall be granted unfettered access, to perform structural inspections of the interior and exterior sheet pile walls to determine whether damage to the walls has occurred as a result of dredging operations. Contractor shall repair or replace damaged components to the satisfaction of the Departmental Representative.

.11 Non-HPA Owned Docks and Structures: Under no circumstances will the Contractor be allowed to dock, anchor or fender at privately owned structures including but not limited to the U.S. Steel docks without the expressed written consent of the property owner and from the HPA. Damaged docks and private structures shall be repaired or replaced to pre-damaged condition as determined by the Departmental Representative, at the Contractor's sole expense.

1.10 OVERLOADING

.1 No part of Work shall be loaded with load which will endanger its safety or will cause permanent deformation.

.2 Repair to original condition any part of work damaged due to overloading at no cost to Departmental Representative.

.3 The allowable load limit on the existing Pier 15 East adjacent to U.S. Steel is 20 kPa.

1.11 MATERIAL AND EQUIPMENT

.1 Use new products unless otherwise specified.

.2 Deliver and store material and equipment to manufacturer's instructions with manufacturer's labels and seals intact.

.3 When material or equipment is specified by standard or performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.

1.12 MISPLACED MATERIAL AND EQUIPMENT

.1 Notify, Departmental Representative immediately of misplaced materials or equipment, including description and location of the misplaced materials or equipment and when required, mark buoys until removed. If misplacement of equipment or materials reduces the available water depth in the harbour, notify Departmental Representative and HPA Harbour Master's Office.

.2 Submit report to Departmental Representative within 72 hours documenting what happened, where, what was done to remove or mitigate the misplaced materials or equipment, and what was done to prevent misplacement of equipment or materials in the future.

.3 Remove and deposit any dredged material, backfill material, cap material,or other fill material that is misplaced at no additional cost to Contract. Deposit misplaced material at location and in manner directed by Departmental Representative.

.4 Do not dump, throw overboard, sink, or misplace any material, plant machinery, or appliances.

1.12 MISPLACED MATERIAL AND EQUIPMENT (Cont'd)

.5 Follow the spill response procedures documented in the Contractor Environmental Protection Plan for misplaced equipment or material that causes environmental pollution as specified in Section 01 35 43. Activities resulting from negligence, as specified herein will be at no additional cost to Contract. Do not deposit the following, including, but not limited to, pipe, wire cable, rope, scrap metal, pilings, timbers, or any other such type of rubbish or obstructive material in any areas other than at locations approved by the Departmental Representative.

.6 Make no claims for delays associated with recovery or documentation to correct misplaced equipment and material.

1.13 INSPECTION AND TESTING

.1 Departmental Representative may employ an Inspection and Testing company to ensure work conforms with Contract Documents.

.2 When initial tests and inspections reveal work not to contract requirements, pay for tests and inspections required by Departmental Representative on corrected work.

1.14 EQUIPMENT DEMOBILIZATION

.1 Complete demobilization of equipment no later than four weeks after receiving Departmental Representative's written release from the work. Do not leave any equipment on site.

1.15 FLOATING PLANT REQUIREMENTS

.1 Dredges or other floating plants must meet the requirements described in the Floating Plant Appendix of the Bid and Acceptance Form.

1.16 NOTIFICATIONS

.1 Notice to Shipping shall be submitted to the Canadian Coast Guard (CCG) and Hamilton Port Authority Harbour Master's Office.

1.17 INTERFERENCE TO NAVIGATION

.1 Do not impede navigation during progress of work in accordance with the Collision Regulation with Canadian Modifications 1983.

1.17 INTERFERENCE TO NAVIGATION (Cont'd)

.2 Relocation of Navigation Aids: Do not remove, change the location of, obstruct, willfully damage, make fast to, or interfere with any aid to navigation except in accordance with approval of the HPA Harbour Master's Office and the CCG.

.3 Mark floating equipment with lights in accordance with Regulations for the Prevention of Collisions.

.4 Ascertain schedule of vessel movements in area affected by dredging operations including movement of vessels at adjacent wharves.

.5 Arrange operations to minimize interference with on-going shipping and navigation activities within the Work Area.

.6 Make no claim for delays resulting from the above.

.7 Departmental Representative will not be responsible for loss of time, equipment, material or any other cost related to interference with moored vessels in harbour or due to other Contractor's operations.

.8 Keep Marine Communications and Traffic services, Watchkeeper at 1-800-265-0237, Central and Arctic Region, Canadian Coast Guard (CCG), Prescott, Ontario informed of work operations in order that necessary Notices to Shipping and Notices to Mariners will be issued. Make arrangements with CCG to relocate and replace buoys for execution of work. Advise nearest Coast Guard Base of any requirements to relocate channel markers/buoys within work area.

1.18 NAVIGATION COORDINATION

.1 Submit Marine Traffic Coordination Plan to Departmental Representative for written approval at least 30 days prior to initiation of the work, submit in accordance to Section 01 33 00. The plan must address the project specifications and items listed below:
.1 Identify a single point of contact, the Marine Traffic Coordinator (MTC), who is responsible for coordinating all of the Contractors' on-water work and coordinating on-water traffic with other non-project vessels not under the direction of the Contractor. Qualifications and previous project experience of the MTC shall be included.

1.18 NAVIGATION COORDINATION (Cont'd)

.1 (Cont'd)

.2 Proposed methods for the Contractor to coordinate the movements of Contract vessels with the movements of other commercial and recreational traffic and with HPA operations.

.3 Describe communications protocols for very high frequency (VHF) radios among the Contractor's fleet and other related procedures including marine channels the Contractor will use for communication throughout the duration of the Work and shall include MTC experience and qualifications for this duty.

.4 The approach for placing, operating, maintaining, and moving marker buoys and lights constituting private Aids to Navigation.

.2 Coordinate dredging operations, isolation capping, thin layer backfill/capping and related work with ongoing navigation and shipping navigation in Hamilton Harbour. Ongoing navigation and shipping navigation will take precedence over dredging, isolation capping and thin layer backfill/capping placement and other related operations. Coordinate with HPA Harbour Master's Office on a daily basis for shipping activity and to accommodate accordingly. Coordinate with U.S. Steel on a daily basis for dredging operations, thin layer backfill/capping operations, isolation capping, work, and movements to be conducted in vicinity of U.S. Steel's wall and docks. Any concerns relative to Contractor's interactions with U.S. Steel shall be discussed with Departmental Representative rather than U.S. Steel directly unless approved by Departmental Representative.

.3 Provide control of project vessels and coordination of non-project vessels and equipment in the Work Area. This includes communication with the HPA Harbour Master and CCG for daily work planning and preparation to stay in compliance with requirements that HPA vessel traffic is not impacted.

.4 The Marine Traffic Coordinator (MTC) shall be the Contractor's single point of contact for coordinating the Contractor's vessels, vessel movement of non-project vessels, the Hamilton Port Authority (HPA) Harbour Master's Office, the Canadian Coast Guard (CCG), and Departmental Representative.

.5 Ensure that vessel operators are appropriately trained and certified, and are following

1.18 NAVIGATION COORDINATION (Cont'd)

.5 (Cont'd)
appropriate regulations for safe operations of vessels.

.6 The MTC shall maintain communication with the HPA Harbour Master's Office such that the MTC will know when non-project vessels are moving within the Work Area.

.7 Prepare Notice of Shipping's (NOTSHIP's) and distribute to the HPA Harbour Master, CCG, and Departmental Representative as required. Contractor shall provide all NOTSHIPS's throughout the duration of the Work.

1.19 MARINE SAFETY

.1 Install, maintain, and operate private Aids to Navigation, inspect private Aids to Navigation daily, and repair and replace as necessary. The private Aids to Navigation shall be arranged to facilitate safe passage of both project-related and non-project-related vessels.

1.20 LIGHTS

.1 All operations performed during the non-daylight hours shall be properly illuminated to allow for the safe and complete performance and inspection of the work and shall comply with all provincial and federal regulations. This shall consist of providing, installing, operating, maintaining, moving, and removing portable light towers and equipment-mounted lighting fixtures for night time construction operations, for the duration of night time work on the Contract. Lights for buoys that could endanger or obstruct navigation shall also be provided each work night, 30 minutes before sunset and 30 minutes after sunrise and during periods of restricted visibility, lights shall be illuminated for floating plants, ranges, and markers. Immediately repair any non-functioning light and perform a check of all lights at the start of each work shift.

1.21 DATUM

.1 Elevations and soundings shown on Drawings are expressed in metres relative to chart datum.

.2 Chart datum for Lake Ontario is 74.2 metres I.G.L.D (1985).

1.21 DATUM (Cont'd)

.3 Drawing 1501, Water Level Chart, for Lake Ontario is bound together with these specifications.

1.22 OPSS AND OPSD

.1 OPSS Ontario Provincial Standard Specifications and OPSD Ontario Provincial Standard Drawings quoted in these specifications are available online at http://www.raqsa.mto.gov.on.ca/techpubs/OPS.nsf/OPSHomepage.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Connecting to existing services.

.2 Special scheduling requirements.

1.2 EXISTING UTILITIES

.1 Establish location, protect and maintain existing buried, submerged or above ground utility lines.

.2 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.

.3 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.4 Provide for personnel pedestrian and vehicular traffic.

.5 Notify, Departmental Representative if a utility-related object is discovered during dredging operations that was not identified on the Drawings.

.6 In the event that damage is caused to a utility(ies), notify both the utility and Departmental Representative immediately and coordinate the repair of the utility(ies) with the appropriate utility company(ies). Repairs shall occur in coordination with the utility company(ies) and at the Contractor's expense. Departmental Representative may stop all work on the project until such time that repairs acceptable to the Departmental Representative are completed at the Contractor's sole expense.

1.3 ALLOWABLE WORK PERIOD

.1 Allowable working hours shall be in accordance with local by-laws, and Provincial, and Federal regulations governing hours of work.

1.3 ALLOWABLE WORK PERIOD (Cont'd)

.2 Apply to the local municipal agencies for variance from work hours and work restrictions and regulations, subject to the approval of Departmental Representative. Costs associated with applying for and receiving the variance shall be at no additional cost to Department Representative.

.3 There is no in-water fishery related timing restriction.

1.4 ACCESS AND COORDINATION

.1 Access to the Work Area and available staging areas are shown on the Drawings.

.2 Access to the Work Area shall either be via existing roads and driveways, temporary access roads to be constructed by the Contractor, via water by barge or other vessel or by rail. Be responsible for verifying that existing roads, bridges, and rail providing access to the Work Area are safe and suitable for use by the Contractor's equipment. Provide traffic controls to assure maximum 30 kilometres per hour speeds or posted speed limits on access roads and in work zones.

.3 Upland Work Area access will be via Sherman Avenue North to the staging area shown on the Drawings. Access via Sherman Avenue is controlled by the HPA. Obtain HPA security passes as required for all staff entering site. Pay any fees necessary to obtain passes. Provide and maintain in-water access to dredges, scows, tugs, and other related equipment. Ascertain conditions that can affect the access such as climate, winds, currents, waves, depths, shoaling, and scouring tendencies. Access to Hamilton Harbour from the HPA's piers must be approved by the HPA and coordinated with the HPA and HPA Harbour Master's Office.

.4 All work performed in the harbour, including launching of labour, materials, and equipment, shall be completed in accordance with the HPA Harbour Master's Office requirements and all applicable CCG rules and regulations.

.5 Fully cooperate and coordinate with other contractors and parties having business within the Work Area and with local authorities and their personnel. Cooperate and coordinate the execution of this work in such a manner as to

1.4 ACCESS AND COORDINATION (Cont'd)

.5 (Cont'd)
minimize the effect of these activities on others having business within the Work Area. Such cooperation is at no additional cost to Contract and is an obligation under the terms of this Contract.

.6 Park vehicles and construction equipment within the Staging Area.

.7 Section 01 35 43 provides additional requirements related to containment and restrictions.

.8 Commercial navigation required to pass through the work area will take precedence over dredging.

1.5 BOAT HAUL-OUT SLIP

.1 The HPA operates a boat haul-out on Pier 15.
.1 Boat haul-out activities are from 8:00 AM to 4:00 PM, Monday to Friday.
.2 Daytime work restrictions apply from 6:00 AM to 6:00 PM.
.3 No Work is permitted in Dredge Area P1-11 to P1-17 during daytime from April 12 to May 21 and September 15 to November 10 each year.
.4 Allow passage for recreation vessels to haul-out slip for two (2) days per month in June, July and August each year. Departmental Representative will give a minimum of three (3) days of notice for these events unless a marine emergency arises.
.5 Floating finger docks will be removed by others as required to accommodate work of this Contract from May 22, 2017 to September 15, 2017.
.6 Maintain a clearly marked channel 15 m wide from Pier 14 to the haul-out slip during launch and haul-out activities. The 15 m is to be measured from north side of vessels berthed on Pier 14 and 15 to north side of channel.

1.6 PIER 14 AND PIER 15

.1 The Departmental Representative will liaise with Pier 14 and 15 tenants regarding schedule of dredging in areas abutting Pier 14 and 15. The Departmental Representative may alter the dredging sequence specified on the drawings to mitigate impacts on Pier 14 and 15 tenants.

1.6 PIER 14 AND PIER 15 (Cont'd)

.2 No work is permitted within 40 m of Pier 14 and 15 from December 15 to March 31.

.3 Allow for the movement of commercial vessels at Pier 14 and 15 up to 5 times per month. Departmental Representative will typically give 5 days notice. If a marine emergency arises then the notice may be minimal.

.4 Dredging in front of Pier 14 and 15 will have to be sequenced to accommodate berthing at these sites. The maximum length that will be made available for dredging at any one time is 150 m. The sequence of dredge areas shown on the drawing shall be adjusted as required to meet this operational requirement.

1.7 WORK AREAS

.1 Limit work activities to assigned Contract Work Areas as shown on the Drawings and other areas only as necessary for approved physical access to the assigned Contract Work Areas.

.2 Fueling of work equipment shall be conducted as specified in Section 01 35 43.

1.8 ISOLATION CAPPING

.1 U.S. Steel Canada will shut off the intake for a one week period each year for their maintenance needs.

.2 Execute work required in close proximity to the intake within the shut-down period.

1.9 DREDGING

.1 Do not commence dredging of Dredge Areas P2-36 to P2-38 and Priority 3 areas until 12 months after the commencing of dredging.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Coordination Work with other contractors under administration of Departmental Representative.

.2 Scheduled preconstruction and progress meetings.

1.2 DESCRIPTION

.1 Coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities, and construction Work, with progress of Work of other contractors under instructions of Departmental Representative.

1.3 CONSTRUCTION ORGANIZATION AND START-UP

.1 Departmental Representative will arrange project meetings, set times, record and distribute minutes. Attend these meetings.

.2 Departmental Representative and Contractor will be in attendance.

.3 Submit organization chart of Key persons proposed for the project including job management and field management, and resumes for the proposed Key Persons.

.4 Do not delegate, reassign, transfer or replace the Key Person to other duties or positions such that the Key Person is no longer available to provide the project with the Key Person's Services unless Departmental Representative provides prior written consent to such delegation, re-assignment, transfer or replacement. In the event Contractor requests Departmental Representative to consent to a delegation, re-assignment, transfer or other replacement of the Key Person, Departmental Representative may interview and review the qualifications of the proposed substitute personnel before providing its consent or rejecting such replacement. Any such replacement shall have equivalent or better qualifications than the Key Person being replaced. Any replacement personnel approved by Departmental Representative will thereafter be deemed a Key Person for purposes of this Contract.

1.3 CONSTRUCTION ORGANIZATION AND START-UP (Cont'd)

.5 Comply with Departmental Representative's allocation of mobilization areas of site; for field offices and sheds, access, traffic, and parking facilities.

.6 During construction coordinate use of site and facilities through Departmental Representative's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.7 Comply with instructions of Departmental Representative for use of temporary utilities and construction facilities.

.8 Coordinate field engineering and layout work with Departmental Representative.

1.4 ON-SITE DOCUMENTS

.1 Maintain at job site, one copy each of the following:
- .1 Contract drawings.
- .2 Specifications.
- .3 Amendments and addenda.
- .4 Reviewed shop drawings.
- .5 Change orders.
- .6 Other modifications to Contract.
- .7 Field test reports.
- .8 Copy of approved Work schedule.
- .9 Manufacturers' installation and application instructions.
- .10 Labour conditions and wage schedules.
- .11 Material Safety Data Sheets.
- .12 Labour and Material Bonds.
- .13 All applicable Municipal Permits.

.2 Maintain documents in clean, dry, legible condition.

.3 Make documents available at all times for inspection by Departmental Representative.

1.5 SCHEDULES

.1 Submit preliminary construction progress schedule in accordance with Section 01 33 00.

.2 After review, revise and resubmit schedule to comply with revised project schedule.

.3 During progress of Work revise and resubmit as directed by Departmental Representative.

1.6 SUBMITTALS

.1 Make submittal to Departmental Representative for review in accordance with Section 01 33 00.

.2 Submit preliminary shop drawings, product data and samples in accordance with Section 01 33 00 for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Departmental Representative.

.3 Submit requests for payment for review, and for transmittal to Departmental Representative.

.4 Submit requests for interpretation of Contract Documents, and obtain instructions through Departmental Representative.

.5 Process substitutions through Departmental Representative.

.6 Process change orders through Departmental Representative.

.7 Deliver closeout submittals for review and preliminary inspections, for transmittal to Departmental Representative.

1.7 COORDINATION DRAWINGS

.1 Provide information required by Departmental Representative for preparation of coordination drawings.

.2 Review and approve revised drawings for submittal to Departmental Representative.

1.8 CLOSEOUT PROCEDURES

.1 Perform closeout procedures in accordance with Section 01 77 00.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Master Plan and detailed Project Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Certificate of Substantial Performance and Certificate of Completion as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Submit to Departmental Representative within 10 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.3 Submit Project Schedule to Departmental Representative within 10 working days of receipt of acceptance of Master Plan.

1.4 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule.

1.5 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

.2 Departmental Representative will review and return revised schedules within 5 working days.

.3 Revise impractical schedule and resubmit within 5 working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
- .1 Award.
- .2 Shop Drawings, Samples.
- .3 Permits.
- .4 Mobilization.
- .5 Setup of Water Treatment Plant.
- .6 Production Dredging.
- .7 Second Pass Dredging.
- .8 Treatment and Dewatering of ECF.
- .9 Fill ECF to Elevation +0.2 m.
- .10 Gabions, Underliner Drainage Pipes and Underliner Risers Placement.
- .11 Fill ECF to Final Grade.
- .12 Thin Layer Backfill/Capping.
- .13 Isolation Capping of U.S. Steel Channel.
- .14 Deconstruction of Water Treatment Plant.
- .15 Demobilization.

1.7 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Shop drawings and product data.

.2 Samples.

.3 Certificates and transcripts.

.4 Fees and permits.

1.2 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data and samples in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by

1.2 ADMINISTRATIVE (Cont'd)

.8 (Cont'd)
Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

.11 Submit number of hard copies specified for each type and format of submittal and also submit in electronic format as pdf files. Forward pdf, NMSEdit Professional spp, MS Word, MS Excel, MS Project and Autocad dwg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

1.3 AS-BUILT RECORD DRAWINGS

.1 As-Built Record Drawings shall be submitted at the completion of the Work in accordance with Section 01 78 00.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario of Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 10 working days for Departmental Representative's review of each submission.

1.4 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.

.8 Submissions shall include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.9 After Departmental Representative's review, distribute copies.

.10 Submit three hard copies and one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit three hard copies and one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit three hard copies and one electronic copy of test reports for requirements requested

1.4 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.12 (Cont'd)
in specification Sections and as requested by Departmental Representative.
.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit three hard copies and one electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit three hard copies and one electronic copy of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit three hard copies and one electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit three hard copies and one electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

1.4 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.21 Contractor's responsibility for errors, ommissions or deviations from requirements of Contract Documents is not relieved by Departmental Representative review of submittals.

.22 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
.1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.5 ADDITIONAL DRAWINGS

.1 Departmental Representative may furnish additional drawings to clarify work.

.2 Such drawings become part of Contract Documents.

1.6 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's site office.

1.6 SAMPLES (Cont'd)

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.5 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

.6 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.7 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit WSIB - Workplace Safety and Insurance Board Experience Report.

.2 Submit transcription of insurance immediately after award of Contract.

1.8 FEES, PERMITS AND CERTIFICATES

.1 Provide authorities having jurisdiction with information requested.

.2 Pay fees and obtain certificates and permits required.

.3 Furnish certificates and permits.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

1.1 REFERENCES

.1 Transportation and Dangerous Goods Regulations including SOR/2011-210 (Amendment 10) and SOR/2011-239 (Amendment 8).

.2 Canadian Council of Ministers of the Environment (CCME) Documentation.

.3 Provincial Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, and the Provincial Water Quality Objectives.

1.2 DEFINITIONS

.1 Decontaminate: to remove all visible sediment from equipment and reusable materials.

.2 Equipment: all equipment used by the Contractor that have come in contact with metals and PAH-containing materials during the performance of Work under this Contract, including, but not limited to, vessels (including barges), dredging equipment, appurtenances, accessories, tools, and vehicles.

.3 Metals and PAH-containing materials: sediments in and around the dredge areas shown on the Drawings.

.4 Non-metals and non PAH-containing materials: sediments and surface waters located outside of the 22 verification zones as shown on the Drawings.

.5 Surfactant: water-soluble compound that is used to enhance the removal of materials and includes, but is not limited to, detergents, foaming agents, and emulsifiers.

.6 Work Area: the area within the Limits of Work as shown on the Drawings.

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

1.3 SUBMITTALS (Cont'd)

.2 Submittals for Progress Meetings: make submittals at least 24 hours prior to scheduled progress meetings as follows:
.1 Updated progress schedule detailing activities. Include review of progress with respect to previously established dates for starting and stopping various stages of Work, major problems and action taken, injury reports, equipment breakdown, and material removal.
.2 Copies of health and safety air sampling results.
.3 Copies of transport manifests, trip tickets, and disposal receipts for waste materials removed from work area.
.4 Weekly copies of site entry and work area logbooks with information on worker and visitor access.
.5 Weekly results of collected air sampling data, including compliance air monitoring results.
.6 Other information required by Departmental Representative or relevant to agenda for upcoming progress meeting.

.3 Submit documentation verifying that hazardous materials employees have been trained, tested, and certified to safely and effectively carry out their assigned duties.

.4 Pre-Construction:
.1 Submit equipment decontamination procedures, products, and materials utilized in the process, and proposed methods to document decontamination of equipment.
.2 Documentation shall be provided that vessels and equipment being mobilized to and the Work Area have been properly decontaminated and do not contain metals, PAHs, or other contaminants.

.5 During Construction:
.1 Document the decontamination status of equipment.
.2 Submit an Equipment Decontamination Documentation Report to the Departmental Representative for approval 72 hours prior to the demobilization of any equipment that have contacted metals and PAH-containing materials. Certify that all equipment being demobilized from the Work Area have been decontaminated in accordance with this Section. Demobilization may not occur until the Equipment Decontamination Documentation Report is reviewed by the Departmental Representative. This includes both

1.3 SUBMITTALS (Cont'd)

.5 During Construction:(Cont'd)
.2 (Cont'd)
periodic demobilization during construction, and final demobilization from the project.

1.4 REGULATORY REQUIREMENTS

.1 Provide erosion and sediment control in accordance with Section 01 35 43.

.2 Comply with federal, provincial, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

.3 Work to meet or exceed minimum requirements established by federal, provincial, and local laws and regulations which are applicable.
.1 Contractor: responsible for complying with amendments as they become effective.

.4 In event that compliance exceeds scope of work or conflicts with specific requirements of contract notify Departmental Representative immediately.

1.5 EQUIPMENT DECONTAMINATION FACILITY

.1 Prior to commencing work involving equipment contact with potentially contaminated materials, construct equipment decontamination pad to accommodate largest piece of on-site potentially contaminated equipment.

.2 Provide, operate, and maintain suitable portable, high-pressure, low-volume decontamination wash units equipped with self-contained water storage tank and pressurizing system and capable of heating and maintaining wash waters to 80 degrees C and providing nozzle pressure of 1,035 kPa.

.3 Provide, operate, and maintain necessary equipment, pumps, and piping required to collect and contain equipment decontamination wastewater and sediment and transfer materials to approved storage facilities.

1.6 DECONTAMINATION

.1 Decontaminate equipment and reusable materials prior to their relocation within the Work Area (if relocating to a clean area), prior to

1.6 DECONTAMINATION (Cont'd)

.1 (Cont'd)
handling clean materials, and prior to their departure from the Work Area.

.2 Decontamination shall be conducted to minimize environmental impacts of all affected equipment and reusable materials in accordance with Section 01 35 43.

.3 Decontamination of equipment transporting metals and PAH-containing materials to the Engineered Containment Facility (ECF) is not required during the Work except for the removal of visible sediment from the outside of barges and tugs.

.4 Decontamination of equipment is required for a barge before it is used to transport non-metal and non-PAH-containing materials including aggregates to be used for backfilling and capping.

1.7 VEHICULAR ACCESS AND PARKING

.1 Departmental Representative may collect soil samples for chemical analyses from traveling surfaces of constructed and existing access routes prior to, during, and upon completion of Work. Excavate and dispose of soil contaminated by Contractor's activities at no additional cost to Contract.

1.8 DUST AND PARTICULATE CONTROL

.1 Execute Work by methods to minimize raising dust from construction operations.

.2 Implement and maintain dust and particulate control measures immediately during construction and in accordance with Province of Ontario regulations.

.3 Provide positive means to prevent airborne dust from dispersing into atmosphere. Use potable water for water misting system for dust and particulate control.

.4 Use chemical means for water misting system for dust and particulate control only with Departmental Representative's prior written approval.

1.8 DUST AND PARTICULATE CONTROL (Cont'd)

.5 As minimum, use appropriate covers on trucks hauling fine or dusty material. Use watertight vehicles to haul wet materials.

.6 Prevent dust from spreading to adjacent property sites.

.7 If Contractor's dust and particulate control is not sufficient for controlling dusts and particulates into atmosphere, stop work. Contractor must discuss procedures that Contractor proposes to resolve problem. Make necessary changes to operations prior to resuming excavation, handling, processing, or other work that may cause release of dusts or particulates.

1.9 EQUIPMENT DECONTAMINATION

.1 Commence Work involving equipment contact with potentially contaminated material only after Equipment Decontamination Facility is operational.

.2 Decontaminate equipment after working in potentially contaminated work areas and prior to subsequent work or travel on clean areas.

.3 Decontaminate all equipment and reusable material that come in contact with contaminated sediments.

.4 Perform equipment decontamination on existing equipment decontamination pad.

.5 Decontaminate equipment and reusable materials prior to their relocation within the Work Area (if relocating to a clean area) prior to handling clean (non-PAH and metals-containing) materials and prior to their departure from the Work Area.

.6 Decontamination of equipment transporting potential metal and PAH-containing materials to the ECF is not required during sediment dredging except for removal of visible sediment from outside of barges and tugs. Decontaminate equipment at the north end of the U.S. Steel Channel. Decontamination of equipment in contact with dredged sediments is required at the end of each work day if equipment departs from Work Area.

1.9 EQUIPMENT DECONTAMINATION (Cont'd)

.7 At minimum, perform following steps during equipment decontamination:
.1 Mechanically remove packed dirt, grit, and debris by scraping and brushing without using steam or high-pressure water to reduce amount of water needed and to reduce amount of contaminated rinsate generated.
.2 Use high-pressure, low-volume, hot water or steam. Pay particular attention to tire treads, equipment tracks, springs, joints, sprockets, and undercarriages. Scrub surfaces with long handle scrub brushes and cleaning agent. Rinse off and collect cleaning agent. Air dry equipment in Clean Zone before removing from site or travelling on clean areas. Perform assessment as directed by Departmental Representative to determine effectiveness of decontamination.

.8 Do not clean equipment in locations where debris can gain access to sewers, watercourses or aquifers.

.9 Equipment engaged in handling of contaminated materials and/or debris, that will be departing from the Work Area for temporary storage or moorage/anchorage outside of the Work Area, shall at a minimum, visibly free from contaminated material.

.10 Decontaminate in accordance with the procedures in the approved Contractor Work Plan.

.11 Maintain inspection record on site which includes: equipment descriptions with identification numbers or license plates; time and date entering decontamination facility; time and date exiting decontamination facility; and name of inspector with comment stating that decontamination was performed and completed.

.12 Each piece of equipment will be inspected by Departmental Representative after decontamination and prior to removal from site and/or travel on clean areas. Departmental Representative will have right to require additional decontamination to be completed if deemed necessary.

.13 Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens.

1.9 EQUIPMENT DECONTAMINATION (Cont'd)

.14 Decontamination water, solids, and other materials generated during equipment decontamination must be contained and not released to Hamilton Harbour or contact native materials and existing facilities, and must be managed in accordance with this section and Section 01 74 20.

.15 Collect decontamination wastewaters and sediments which accumulate on equipment decontamination pad. Transfer wastewaters to designated wastewater storage tank.

.16 Transfer sediments to ECF.

.17 Furnish and equip personnel engaged in equipment decontamination with protective equipment, as appropriate, and in accordance with Contractor's Health and Safety Plan. Contaminated protective equipment shall be bagged, placed in a designated container and managed in accordance with Section 01 74 20.

.18 Have on hand sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment. Maintain piping and connections in good condition and leak-free.

1.10 WATER CONTROL

.1 Do not discharge decontaminated water, or surface water runoff, or groundwater which may have come in contact with potentially contaminated material, off site or to municipal sewers.

.2 Prevent precipitation from infiltrating or from directly running off stockpiled waste materials. Cover stockpiled waste materials with an impermeable liner during periods of work stoppage including at end of each working day and as directed by Departmental Representative.

.3 Dispose of water in manner not injurious to public health or safety, to property, or to any part of Work completed or under construction.

.4 Provide, operate, and maintain necessary equipment appropriately sized to keep excavations, staging pads, and other work areas free from water.

1.10 WATER CONTROL (Cont'd)

.5 Contain water from stockpiled waste materials. Transfer potentially contaminated surface waters to wastewater storage tanks separate from wastewater from Personnel Hygiene/Decontamination Facility.

.6 Have on hand sufficient pumping equipment, machinery, and tankage in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment.

.7 Disposal of contaminated sediments and non-contaminated sediments into the ECF is permitted.

1.11 PROGRESS CLEANING

.1 Maintain cleanliness of Work and surrounding site to comply with federal, provincial, and local fire and safety laws, ordinances, codes, and regulations.

.2 Co-ordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials.

1.12 FINAL DECONTAMINATION

.1 Perform final decontamination of construction facilities, equipment, and materials which may have come in contact with potentially contaminated materials prior to removal from site.

.2 Perform decontamination as specified to satisfaction of Departmental Representative. Departmental Representative will direct Contractor to perform additional decontamination if required.

1.13 REMOVAL AND DISPOSAL

.1 Remove surplus materials and temporary facilities from site.

.2 Dispose of non-contaminated waste materials, litter, debris, and rubbish off site.

.3 Do not burn or bury rubbish and waste materials on site.

1.13 REMOVAL AND DISPOSAL (Cont'd)

.4 Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

.5 Do not discharge wastes into streams or waterways.

.6 Dispose of following materials at appropriate off-site facility identified by Contractor and approved by Departmental Representative:
.1 Debris including excess construction material.
.2 Non-contaminated litter and rubbish.
.3 Disposable PPE worn during final cleaning.
.4 Wastewater generated from final decontamination operations including wastewater storage tank cleaning.
.5 Lumber from decontamination pads.

.7 Dispose of materials in accordance with Section. 01 74 20.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Province of Ontario:
.1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and Regulations for Construction Projects, O. Reg. 213/91 as amended.
.2 O. Reg. 490/09, Designated Substances.
.3 Workplace Safety and Insurance Act, 1997.
.4 Municipal statutes and authorities.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
.1 Results of site specific safety hazard assessment.
.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
.3 Measures and controls to be implemented to address identified safety hazards and risks.

.3 Provide a Fire Safety Plan, specific to the work location.

.4 Contractor's and Sub-contractors' Safety Communication Plan.

.5 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations.

.6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 10 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.

.7 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.8 Submit names of personnel and alternates responsible for site safety and health.

.9 Submit records of Contractor's Health and Safety meetings when requested.

.10 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, upon requested.

.11 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, upon requested.

.12 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.

.13 Submit copies of incident and accident reports.

.14 Submit Material Safety Data Sheets (MSDS).

.15 Submit Workplace Safety and Insurance Board (WSIB)- Experience Rating Report.

1.3 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to commencement of Work.

1.4 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.6 REGULATORY REQUIREMENTS

.1 Comply with the Acts and regulations of the Province of Ontario.

.2 Comply with specified standards and regulations to ensure safe operations at site.

1.7 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:
  .1 Sediment contaminated (primarily) with Polycyclic Aromatic Hydrocarbons metals. Refer to Appendix B - Sediment Chemistry.
  .2 Silica in concrete.
  .3 Work at or near water.
    .1 Work at or near U.S. Steel's water intakes and outfalls.

1.8 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns either accepting or requesting improvements.

.3 Relief from or substitution for any portion or provision of minimum Health and Safety standards specified herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.9 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990 Chapter 0.1, as amended.

1.10 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

.3 Where applicable the Contractor shall be designated "Constructor", as defined by Occupational Health and Safety Act and Regulations for Construction Projects for the Province of Ontario.

1.11 UNFORESEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and advise Departmental Representative verbally and in writing.

.2 Follow procedures in place for Employees Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.

.3 Departmental Representative shall review the Contractor's recommended measures for remedying the factor, hazard, or condition. Limit work during the review to portions of the site not affected by the factor, hazard, or condition subject to Departmental Representative concurrence.

.4 Upon acceptance of the remedy measures, implement the recommended measures to mitigate the unsafe factor, hazard, or condition.

.5 Departmental Representative will review measures implemented before providing authorization to restart work in affected areas.

1.12 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
   - .1 Have minimum 2 years' site-related working experience specific to activities associated with nature of the work.
   - .2 Have working knowledge of occupational safety and health regulations.
   - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
   - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
   - .5 Be on site during execution of Work and report directly to and be under direction of the site supervisor.

1.13 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province of Ontario, and in consultation with Departmental Representative.
- .1 Contractor's Safety Policy.
- .2 Constructor's Name.
- .3 Notice of Project.
- .4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).
- .5 Ministry of Labour Orders and reports.
- .6 Occupational Health and Safety Act and Regulations for Construction Projects for Province of Ontario.
- .7 Address and phone number of nearest Ministry of Labour office.
- .8 Material Safety Data Sheets.
- .9 Written Emergency Response Plan.
- .10 Site Specific Safety Plan.
- .11 Valid certificate of first aider on duty.
- .12 WSIB "In Case of Injury At Work" poster.
- .13 Location of toilet and cleanup facilities.

1.14 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.16 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

.2 Assign responsibility and obligation to Health and Safety Supervisor to stop or start Work when, at Health and Safety Supervisor's

1.16 WORK STOPPAGE (Cont'd)

.2 (Cont'd) discretion, it is necessary or advisable for reasons of health or safety. Departmental Representative may also stop Work for health and safety considerations.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

.3 Sheen: sheen occurs when visible droplets of non-aqueous phase liquid (NAPL) form a visibly separate layer or film on the surface of the water.

.4 Background turbidity: refers to the turbidity measured in the harbour at a location sufficiently distant from the in-water work as determined by the Departmental Representative. The background turbidity measurements are to be taken at the same time as the in-water work being monitored.

1.2 REFERENCES

.1 Provincial Water Quality Objectives (PWQOs).

.2 Canadian Water Quality Guidelines (CWQGs).

.3 Ambient Air Quality Criteria (AAQC).

.4 International Organization for Standardization (ISO) 7027 Methodology.

1.3 ADDITIONAL REPORTS

.1 A Background Water Quality Monitoring Report detailing the results of the pre-construction background monitoring is provided in Appendix D - Water Quality Monitoring Data.

.2 A Background Air Quality Monitoring Report detailing the results of the pre-construction background monitoring is provided in Appendix E - Air Quality Monitoring Data.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets upon request and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit 2 copies of WHMIS MSDS.

.3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.

.4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

.5 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.6 Include in Environmental Protection Plan:
.1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
.2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
.3 Names and qualifications of persons responsible for training site personnel.
.4 Descriptions of environmental protection personnel training program.
.5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
.6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
.7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.

1.4 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.6 (Cont'd)

.7 (Cont'd)

.1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.

.8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.

.1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.

.12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.13 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

1.5 ENVIRONMENTAL MEASURES

.1 Meet or exceed the requirements of all environmental legislation and regulations, including all amendments in force for the duration of the work, provided that in case of conflict or discrepancy, the most stringent requirements apply.

.2 Removal of any contaminated materials from the site as defined by authorities having jurisdiction relating to environmental protection shall be transported and disposed of in a safe, legal manner to minimize danger at the site and during disposal.

1.5 ENVIRONMENTAL MEASURES (Cont'd)

.3 Environmental mitigation measures from the CEAA Comprehensive Study are bound in Appendix F - Environmental Mitigation Measures. Comply with these measures.

.4 Exerpt from the Randle Reef Sediment Remediation Project, Comprehensive Study Report, October 30, 2012, related to air dispersion modelling during mechanical dredging operations are bound in Appendix G - Air Dispersion Modelling - Exerpts from Randle Reef Sediment Remediation Project, Comprehensive Study Report.

1.6 FIRES

.1 Fires and burning of rubbish or material on site or adjacent to site is not permitted.

1.7 HANDLING OF DREDGE MATERIALS

.1 Dispose of dredge materials in designated areas in accordance with Section 35 20 34.

.2 Excavation, filling, pumping, towing, hauling, disposal and dumping operations for dredging will employ such methods and equipment to ensure no loss of materials into the waterway.

1.8 DISPOSAL OF WASTES

.1 To Section 01 74 20.

1.9 DRAINAGE

.1 Develop and submit Erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

.2 Ensure pumped water into waterways, sewer or drainage systems meets water quality requirements.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.

1.10 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties as indicated.

.2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.

1.11 WORK ADJACENT TO WATERWAYS

.1 Do not use waterway beds for borrow material.

.2 Do not allow any debris, fill, deleterious material or other foreign material to enter the waterway.

.3 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.

1.12 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

.3 Abide by local noise by-laws and regulations.

.4 Conduct refueling and maintenance of vehicles and machinery on paved surfaces at least 30 metres away from the waterway. Areas of equipment refueling and maintenance shall be graded to capture and manage runoff and equipped with adequate containers for the disposal of wastes produced from upkeep and repair.

.5 Do not refuel or maintain equipment within 30 metres of any waterway, in the water, or over water supply aquifers unless non-spill facilities are used.

.6 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

.7 Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious toxic substances and pollutants produced by construction operations.

1.12 POLLUTION CONTROL (Cont'd)

.8 Spills of deleterious substances:
.1 Be prepared at all times to intercept, clean-up and dispose of any spillage that may occur whether on land or water or air.
.2 Keep all materials required for clean-up of spillages readily accessible on site.
.3 Immediately contain, limit spread and clean up spills of oil, fuel, dredged sediment, sheen, and other deleterious substances promptly at own cost in accordance with provincial regulatory requirements.
.4 Report immediately to Ontario Spills Action Centre: 1-800-268-6060 and to Departmental Representative.
.5 Further information on dangerous goods emergency cleanup and precautions including a list of companies performing this work can be obtained from the Transport Canada 24-hour number (613) 996-6666 collect.

.9 Contact manufacturer of pollutant if known and ascertain hazards involved, precautions required, and measures used in cleanup or mitigating action.

.10 Provide spill response materials including, containers, adsorbent, shovels, and personal protective equipment. Make spill response materials available at all times in which hazardous materials or wastes are being handled or transported. Spill response materials: compatible with type of material being handled.

1.13 SPECIAL PROTECTION AND PRECAUTIONS

.1 Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials and regarding labelling and the provision of material safety data sheets acceptable to Labour Canada.

1.14 WATER QUALITY PERFORMANCE CRITERIA

.1 Particulate Matter:
.1 The maximum increase in concentration of total suspended solids over background is regulated as follows:
.1 Compliance Criteria: Maximum increase over background 100 m away from the work activity is 25 mg per litre.
.2 Performance Criteria: Maximum increase over background 50 m from work activity is 30 mg per litre.

1.14 WATER QUALITY PERFORMANCE CRITERIA (Cont'd)

.1 (Cont'd)

.2 Turbidity requirements are based on an existing correlation between turbidity and total suspended solids measured at this site. The correlation is 1 NTU = TSS of 2 mg/l. The Departmental Representative will measure total suspended solids at intervals throughout the project. The Departmental Representative may update the correlation between turbidity and total suspended solids based on result of these measurements.

- .1 Compliance Criteria:
  - .1 Turbidity will be measured for compliance with specified maximum values 100 m away from the in-water work.
  - .2 The maximum increase in turbidity above background is 12.5 NTUs.
  - .3 Turbidity measurements will be taken 1 m below water surface and 1 m above lakebed. Four (4) measures will be made at each elevations in a five (5) minutes period. The average of eight (8) measures will be compared with background values. Average values that exceed the allowable increase above background values will be deemed noncompliance.
- .2 Performance Criteria:
  - .1 Turbidity will be measured for compliance with specified maximum values 50 m away from the in-water work.
  - .2 The maximum increase in turbidity above background is 15 NTUs.
  - .3 Turbidity measurements will be taken 1 m below water surface and 1 m above lakebed. Four (4) measures will be made at each elevations in a five (5) minutes period. The average of four (4) measures at each elevations will be compared with background values. Average values that exceed the allowable increase above background values will be deemed noncompliance.

.3 Isolation Capping within U.S. Steel Channel: turbidity equivalent to a total suspended solids (TSS) concentration of 15 mg/L or less at the isolation capping compliance points. During startup, Departmental Representative will determine the turbidity required to meet the TSS criteria based on a

1.14 WATER QUALITY PERFORMANCE CRITERIA (Cont'd)

.1 (Cont'd)

.3 (Cont'd)
correlation of turbidity measurements and TSS concentrations.

.1 Departmental Representative will take water samples during first 3 days of placement of capping. A TSS/Turbidity relationship will be established from these samples. The maximum acceptable increase in turbidity is 7.5 NTUs until new relationship is established.

.2 Sheen: Any visible sheen shall be contained and subsequently removed.

1.15 AIR MONITORING PERFORMANCE CRITERIA

.1 Air monitoring will be conducted at locations along the perimeter of the U.S. Steel wharf and various locations on Pier 12, Pier 14 and Pier 15. Napthalene has been identified as the most likely air emissions. The Maximum allowable 24 hour-average Ambient Air Quality Criteria concentration of naphthalene at any of the monitoring stations is 22.5 ug/m3. Air monitoring undertaken by the Departmental Representative is not intended to be used for the Contractor's health and safety purposes.

.2 Odour: Corrective actions shall be taken if odours are detected offsite, if odour complaints are received, or if directed by the Departmental Representative.

1.16 NOTIFICATION

.1 Notify Departmental Representative in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.

.1 Take action only after receipt of written approval by Departmental Representative.

.3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.

1.16 NOTIFICATION (Cont'd)

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 CORRECTIVE ACTIONS FOR WATER

.1 When water quality is not in compliance with the required water quality performance criteria limits, stop in-water work and adjust operations to minimize turbidity. Make no claims for delays or adjustment to operations resulting from water quality exceedances.

.2 Cessation of in-water work:
.1 In-water work will cease at the first indication of a significant oil sheen or distressed or dying fish in the vicinity of the Work Area.
.2 Departmental Representative may direct Contractor to other areas of work within project limits while sheen is investigated.

3.2 CORRECTIVE ACTIONS FOR AIR

.1 If the air quality is not in compliance with the required air monitoring performance criteria limits, stop work and make appropriate modifications to the operations to alleviate the air quality impacts. Work may resume when the problem has been rectified and the air quality parameters are in compliance with performance criteria. Make no claims for delays associated with air quality exceedances, including odour complaints, or work stoppages resulting from air quality exceedances and/or odour complaints.

.2 Cessation of work: Construction activities shall stop at the first indication of an exceedance of the naphthalene AAQC. If an exceedance of air quality criterion occurs, the Contractor shall modify construction operations to alleviate the air quality impacts. Such modifications may include but are not limited to improved BMPs, such as slowing dredging or increasing ponded water depth in the ECF.

END

PART 1 - GENERAL

1.1 ABBREVIATIONS AND ACRONYMS

.1 The following abbreviations and acronyms are commonly found in the Contract Documents and represent the associated organizations or terms:
.1 AAQC: Ambient Air Quality Criteria
.2 AIS: Automatic Identification System
.3 ANSI: American National Standards Institute
.4 ASTM: American Society for Testing and Materials
.5 BEAST: Benthic Assessment of Sediment
.6 BHP: Break Horse Power
.7 BMP: Best Management Practice
.8 CCG: Canadian Coast Guard
.9 CCIL: Canadian Council of Independent Laboratories
.10 CDF: Controlled Density Fill
.11 CHS: Canadian Hydrographic Service
.12 COFI: Council of Forest Industries of British Columbia
.13 CPR: Cardiopulmonary resuscitation
.14 CQA: Construction Quality Assurance
.15 CQC: Construction Quality Control)
.16 CWQG: Canadian Water Quality Guidelines
.17 CWQO: Canadian Water Quality Objectives
.18 DGPS: Differential Global Positioning System
.19 DFO: Department of Fisheries and Oceans
.20 DR: Dimension Ratio
.21 EC: Environment Canada
.22 ECF: Engineered Containment Facility
.23 EPA: Environmental Protection Agency
.24 EPP: Environmental Protection Plan
.25 EPS: Engineering Performance Standards
.26 FRP: Fiberglass Reinforced Plastic
.27 FSP: Field Sampling Plan
.28 GC: General Conditions
.29 HASP: Health and Safety Plan
.30 HDPE: High-density Polyethylene
.31 HPA: Hamilton Port Authority
.32 HSO: Health and Safety Officer
.33 HSTS: Hydrodynamic Stormwater Treatment System
.34 IGLD: International Great Lakes Datum
.35 ISO: International Organization for Standardization
.36 LLDPE: Linear Low-Density Polyethylene
.37 LTI: Lost Time Injury
.38 LS: lump sum
.39 MARV: Minimum Average Roll Value
.40 MOE: Ministry of the Environment

1.1 ABBREVIATIONS AND ACRONYMS (Cont'd)

.1 (Cont'd)
.41 MOHS: Marine Occupational Health and Safety
.42 MOL: Ministry of Labour
.43 MSDS: Material Safety Data Sheet
.44 MSSP: Materials Source Separation Program
.45 MTC: Marine Traffic Coordinator
.46 NAD: North American Datum
.47 NAPL: non-aqueous phase liquid
.48 NEMA: National Electrical Manufacturers Association
.49 NFC: National Fire Code
.50 NOTSHIP: Notice to Shipping
.51 NTU: Nephelometric turbidity units
.52 O&M: Operations and Maintenance
.53 OHS: Occupational Health and Safety
.54 OHSA: Occupational Health and Safety Act
.55 OPSS: Ontario Provincial Standard Specifications
.56 PAH: Polycyclic Aromatic Hydrocarbons
.57 PFD: Personal Flotation Devise
.58 PP: Polypropylene
.59 PPE: Personal Protective Equipment
.60 PVC: Polyvinyl Chloride
.61 PVDF: Polyvinylidene Fluoride
.62 PWQO: Provincial Water Quality Objective
.63 QAPP: Quality Assurance Project Plan
.64 QA/QC: Quality Assurance/Quality Control
.65 QCAP: Quality Control Assurance Plan
.66 RTK: Real-Time Kinematic
.67 SP: Surface Preparation
.68 SSP: Steel Sheet Piles
.69 SSPC: Steel Structure Painting Council
.70 TCP: Turbidity Control Plan
.71 TSS: total suspended solids
.72 UTM: Universal Transverse Mercator
.73 USEPA: United States Environmental Protection Agency
.74 VHF: Very High Frequency
.75 WA: Waste Audit
.76 WHMIS: Workplace Hazardous Materials Information System
.77 WMC: Waste Management Coordination
.78 WMP: Waste Management Plan
.79 WRW: Waste Reduction Workplan
.80 WSIB: Workplace Safety and Insurance Board
.81 WTP: Water Treatment Plant
.82 US: United States

1.2 UNITS OF MEASURE

.1 The following abbreviations of units of measure are commonly found in the Contract Documents:
  .1 C: Celsius
  .2 cm: centimetre
  .3 kg: kilogram
  .4 kPa: kilopascals
  .5 kw: kilowatts
  .6 l/s: litre per second
  .7 m: metres
  .8 m^3: cubic metres
  .9 mg/kg: milligrams per kilogram
  .10 mg/L: milligrams per litre
  .11 mm: millimetres
  .12 NTU: nephelometric turbidity unit
  .13 ppm: parts per million
  .14 ug/L: micrograms per litre
  .15 sec: second
  .16 ug/m^3: micrograms per cubic metre

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mill tests.

1.2 SUBMITTALS

.1 Submit a Construction Quality Control (CQC) Plan to the Departmental Representative for review and acceptance. The plan shall identify personnel, procedures, methods, instructions, records, and forms to be used by the CQC team to control the work and verify that the work conforms to the Contract Documents.

.2 The CQC Plan shall include the following:
.1 A description of the quality control organization including an organization chart showing the various CQC team members along with their designated responsibilities and lines of authority.
.2 Acknowledgement that the CQC staff will conduct inspections for all aspects of the work specified and shall report to a CQC Supervisor, or someone of higher authority, in the Contractor's organization.
.3 The name, qualifications, duties, responsibilities, and authorities of each person assigned a primary CQC function.
.4 A summary of the delegated responsibilities of the CQC Supervisor, signed by an authorized official of the firm.
.5 Procedures for scheduling and managing submittals including those of subcontractors, off-site fabricators, and material suppliers.
.6 Testing methods, schedules, and procedures used to report quality control information to the Departmental Representative including samples of the various reporting forms.

.3 Obtain the Departmental Representative's acceptance of the CQC Plan prior to the start of work. The Departmental Representative's acceptance is conditional, based on satisfactory performance during execution of the work. The Departmental Representative reserves the right to require the Contractor to adjust the CQC Plan and/or operations as necessary to comply with

1.2 SUBMITTALS (Cont'd)

.3 (Cont'd)
the provisions of the Contract documents at no extra cost.

.4 After the Departmental Representative's acceptance of the CQC Plan, notify Departmental Representative in writing of any proposed change to the CQC Plan. Proposed changes are also subject to acceptance by the Departmental Representative.

1.3 CQC ORGANIZATION

.1 CQC Supervisor: Identify an individual within its organization, located at the Work Area, who shall be responsible to the Contractor for overall management of CQC and have the authority to act in all CQC matters for the Contractor. CQC Supervisor subject to the approval of the Departmental Representative.

.2 Personnel: Staff shall be maintained under the direction of the CQC Supervisor to perform all CQC activities on behalf of the Contractor. The actual number of the staff during any specific work period may vary to cover shift needs and rates of performance. The personnel of this staff shall be fully qualified by experience and technical training to perform their assigned responsibilities and shall be directly hired for the work by the Contractor

1.4 COORDINATION MEETING

.1 During the pre-construction meeting (discussed in Section 01 31 16) meet with the Departmental Representative and appropriate agencies to discuss the CQC system. During the meeting, a mutual understanding of the system details shall be developed including the approval of forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's inspection and control with the Departmental Representative's inspection.

.2 Allow for occasions when subsequent conferences will be called to reconfirm mutual understanding.

1.5 ACCESS TO WORK

.1 Allow the Departmental Representative and/or testing agencies access to the Work Area, staging areas, and offsite manufacturing and fabrication plants as required. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Provide clear access to work areas to be inspected and assist as required by providing safety equipment, ladders, materials, and other items necessary for these inspections, including but not necessarily limited to, dredge inspections, welding X-ray inspections, concrete testing, and compaction tests.

.3 Cooperate to provide reasonable facilities for such access.

1.6 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Provide adequate quality control to cover all construction operations, including both onsite and offsite fabrication, and will be keyed to the proposed construction sequence. Quality control shall include the following levels of inspection for all definitive features of work.

.3 Preparatory Inspection: This shall be performed prior to beginning any work or any definable feature of work. Such inspection shall be made a matter of record in the CQC documentation as required herein. Subsequent to the preparatory inspection and prior to commencement of work, the Contractor shall instruct each applicable worker as to the acceptable level of workmanship specified by the CQC Plan as necessary to meet the requirements of the Contract Documents. The preparatory inspection shall include:
  .1 A review of Contract requirements.
  .2 A check to ensure that all materials and/or equipment have been tested, submitted, and approved.
  .3 A check to ensure that provisions have been made to provide required control testing.
  .4 An examination of the Work Area to ascertain that all preliminary or previous Work has been completed.

1.6 INSPECTION (Cont'd)

.3 Preparatory Inspection:(Cont'd)

.5 A physical examination of materials, equipment, and sample Work to ensure that they conform to approved shop drawings or submittal data.

.6 A check to ensure that all materials and/or equipment are on hand.

.4 Initial Inspection: This inspection shall be performed as soon as a representative portion of the particular feature of Work has been accomplished and shall include examination of the quality of workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements. Such inspection shall be made a matter of record in the CQC documentation as required herein.

.5 Follow-up Inspections: Inspections shall be performed daily to ensure continuing compliance with contract requirements, including control testing, until completion of the particular feature of Work. Such inspections shall be made a matter of record in the CQC documentation as required herein. Follow-up inspections shall be conducted and test deficiencies corrected prior to the addition of new features of Work.

.6 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.

.7 Pre-Final and Final Inspections: See the Section 01 77 00.

.8 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.9 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with

1.6 INSPECTION (Cont'd)

.9 (Cont'd)
Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.7 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work, above and beyond those required of the Contractor. Cost of such services will be borne by Departmental Representative.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Contract. Pay costs for retesting and reinspection.

1.8 NOTICE OF NONCOMPLIANCE

.1 Departmental Representative will notify the Contractor of any noncompliance with the foregoing requirements. After receipt of such notice, Contractor shall take corrective action immediately. Such notice, when delivered to the Contractor or its representative at the Work Area, shall be deemed sufficient for the purpose of notification.

.2 If the Contractor fails or refuses to comply promptly, Departmental Representative may issue an order stopping all or any part of the work until satisfactory corrective action has been taken.

.3 Designate, in writing, the individual on each shift of work having the ability and responsibility to correct conditions of noncompliance and accept such Stop Work Orders.

.4 Make no part of the time lost due to any such Stop Work Order the subject of a claim for extension of time or for excess costs or damages.

1.9 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.10 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative may deduct from Contract Amount difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.11 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Departmental Representative and may be authorized as recoverable.

1.12 MILL TESTS

.1 Submit mill test certificates in accordance with Section 01 33 00 as requested.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.
  .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)
  .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  .2 CSA 0121-08(R2013), Douglas Fir Plywood.
  .3 CSA Z797-09(R2014), Code of practice for Access Scaffold.
  .4 CAN/CSA-Z321-96(R2006), Signs and Symbols for the Occupational Environment, withdrawn but still available from CSA, CCOHS and Techstreet.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

1.3 INSTALLATION AND REMOVAL

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.2 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

.4 Provide construction facilities in order to execute work expeditiously.

.5 Remove from site all such work after use.

1.4 SCAFFOLDING

.1 Scaffolding in accordance with CSA Z797.

1.5 SITE

.1 Confine work, including temporary structures, plant, equipment and materials to established limits of site.

.2 Locate temporary buildings, roads, walks, drainage facilities, services as directed and maintain in clean and orderly manner.

1.6 CONSTRUCTION & STORAGE AREA

.1 The limits of the Construction and Storage Area will be designated by the Departmental Representative prior to commencement of work unless otherwise shown on the Drawings.

1.7 SITE STORAGE/LOADING

.1 Confine work and operations of employees to areas defined by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.8 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of Work.

.2 Provide and maintain adequate access to project site.

1.9 TEMPORARY UTILITIES

.1 Make arrangements for the supply of water, electrical power, gas, sanitary facilities, heat, and any other temporary services required during construction and for the lifetime of any temporary facility.

.2 Make all necessary applications, obtain permits and pay for all fees, charges for service and use for all temporary utilities and services required throughout construction period.

.3 Install temporary facilities for power system such as pole lines and underground cables to approval and inspection of the local authority and Departmental Representative.

1.10 SECURITY

.1 Be responsible for site security at all times.

.2 Entry and egress point shall be secured during non-working hours.

1.11 CONTRACTOR'S OFFICE

.1 Contractor shall provide a suitable furnished temporary office for its own use.

.2 Contractor's office shall be furnished with telephone, fax and email service.

1.12 DEPARTMENTAL REPRESENTATIVES OFFICE

.1 Provide space for two sites trailers to be provided by Departmental Representative in Staging Area. Provide five parking spaces adjacent to trailers. Provide 10 metre berthing area for Departmental Representative's boat on Pier 15 East in close proximity to site trailers.

.2 Arrange and pay for setup and removal of Departmental Representative's site offices, heating and power. Pay for heating and lighting costs for Departmental Representative's field office.

1.13 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.14 SANITARY FACILITIES

.1 Provide and properly maintain a potable water supply and suitable sanitary facilities in convenient and clean condition for the Contractor's personnel as required by the Construction Safety Act and in accordance with Ministry of Labour requirements.

.2 Sanitary facilities shall be subject to approval of type, size and location by the local health authorities, the Ontario Ministry of Environment (MOE) and Departmental Representative.

1.14 SANITARY FACILITIES (Cont'd)

.3 The facilities shall be maintained with all required toilet room supplies, including paper towels and toilet paper, in a clean and sanitary condition and disinfected frequently to the Departmental Representative's satisfaction, for the duration of the contract.

.4 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.15 CONSTRUCTION SIGNAGE

.1 Provide project identification site sign comprising foundation, framing, and one 1200 x 2400 mm signboard as detailed and as described below.
.1 Foundations: 15 MPa concrete to CAN/CSA-A23.1/A23.2 minimum 200 mm x 900 mm deep.
.2 Framework and battens: SPF, pressure treated minimum 89 x 89 mm.
.3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.
.4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CGSB 1-GP-189.
.5 Fasteners: hot-dip galvanized steel nails and carriage bolts.
.6 Vinyl sign face: printed project identification, self adhesive, vinyl film overlay, supplied by Departmental Representative.

.2 Locate project identification sign as directed by Departmental Representative and construct as follows:
.1 Build concrete foundation, erect framework, and attach signboard to framing.
.2 Paint all surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
.3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.

.3 Direct requests for approval to erect a Consultant/Contractor signboard to Departmental Representative. For consideration general appearance of Consultant/Contractor signboard must conform to project identification site sign. Wording shall be in both official languages.

1.15 CONSTRUCTION SIGNAGE (Cont'd)

.4 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN/CSA-Z321.

.5 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.16 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.

.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs

.4 Protect travelling public from damage to person and property.

.5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.7 Construct access and haul roads necessary.

.8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.

.9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.10 Dust control: adequate to ensure safe operation at all times.

.11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Departmental Representative.

1.16 PROTECTION AND MAINTENANCE OF TRAFFIC (Cont'd)

.12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.13 Provide snow removal during period of Work.

.14 Remove, upon completion of work, haul roads designated by Departmental Representative.

1.17 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily and in accordance with Section 01 74 20.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 CONSTRUCTION & DEMOLITION WASTE

.1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 75% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.

.2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.
- .1 Provide facilities for collection, handling and storage of source separated wastes.
- .2 Source separate the following waste:
  - .1 Brick and portland cement concrete.
  - .2 Corrugated cardboard.
  - .3 Wood.
  - .4 Steel.
  - .5 Asphalt pavement.

.3 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.

1.2 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Protect, stockpile, store and catalogue salvaged items.

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.5 Protect structural components not removed for demolition from movement or damage.

1.2 STORAGE, HANDLING AND PROTECTION (Cont'd)

.6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.

.7 Protect surface drainage, mechanical and electrical from damage and blockage.

.8 Separate and store materials produced during dismantling of structures in designated areas.

.9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
.1 On-site source separation is recommended.
.2 Remove co-mingled materials to off-site processing facility for separation.
.3 Provide waybills for separated materials.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Do not bury rubbish and waste materials on site.

.2 Do not dispose of waste, volatile materials,mineral spirits, oil, paint thinner, into waterways, onto ground, storm, or sanitary sewers, or in other location where it will pose health or environmental hazard.

.3 Provide acceptable containers for collection and disposal of waste materials, debris and rubbish.

.4 Do not allow deleterious substances to enter the waterway.

.5 Keep records of construction waste including:
.1 Number and size of bins.
.2 Waste type of each bin.
.3 Total tonnage generated.
.4 Tonnage reused or recycled.
.5 Reused or recycled waste destination.

.6 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.7 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.8 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins

1.3 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.8 (Cont'd)
for recycling in accordance with Waste Management Plan.

.9 Fold up metal banding, flatten and place in designated area for recycling.

.10 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.11 All waste materials including containers and waste fluids associated with vehicle maintenance shall be disposed of in a legal manner at a site approved by Local Authorities.

.12 Dispose of dredged material in the designated Engineered Containment Facility as specified and indicated.

1.4 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

1.5 SCHEDULING

.1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

1.6 WASTE PROCESSING SITES

.1 Province of: Ontario.
.1 Ministry of Environment, Public Information Centre, 2nd Floor - Macdonal Block, Suite M2-22 - 900 Bay Street, Toronto, ON, M7A 1N3.
.2 General Inquiry: 416-325-4000 or 1-800-565-4923 TTY (for persons who are deaf, deafened or hard of hearing).
.3 Telephone: 416-326-9236 or 1-800-515-2759
.4 Fax: 416-325-3159.

.2 Recycling Council of Ontario: 215 Spadina Avenue, #225, Toronto, ON, M5T 2C7.
.1 Telephone: 416-657-2797
.2 Fax: 416-960-8053
.3 Email: rco@rco.on.ca.
.4 Internet: http://www.rco.on.ca/.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

.1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.
    .1 Mark containers or stockpile areas.
    .2 Provide instruction on disposal practices.

.2 On-site sale of salvaged, recovered, reusable and recyclable materials is not permitted.

.3 Divert unused paint/coating materials from landfill to official hazardous material collections site approved by Departmental Representative.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

3.4 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1 Government Chief Responsibility for the Environment.

Province	Address	General Inquiries	Fax
Ontario	Ministry of Environment, Public Information Centre 2nd Floor - Macdonal Block, Suite M2-22 900 Bay St, Toronto, ON M7A 1N3	(416) 325-4000 (800) 565-4923 (416) 326-9236 (800) 515-2759	(416) 325-3159

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.1 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
  .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
  .2 Request Departmental Representative's Inspection.

.2 Departmental Representative's Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.

.3 Completion: submit written certificate that following have been performed:
  .1 Work has been completed and inspected for compliance with Contract Documents.
  .2 Defects have been corrected and deficiencies have been completed.
  .3 Work is complete and ready for final inspection.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request reinspection.

1.2 CLEANING

.1 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 As-built, samples, reports and specifications.

.2 Final site survey.

1.2 AS-BUILTS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative one record copy of:
  .1 Contract Drawings.
  .2 Specifications.
  .3 Amendments and addenda.
  .4 Change Orders and other modifications to the Contract.
  .5 Reviewed shop drawings, product data, and samples.
  .6 Field test records.
  .7 Inspection certificates.
  .8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

.6 Turn one set, paper copy and electronic copy, of AS-BUILT drawings and specifications over to Departmental Representative on completion of work. Submit files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

.7 If project is completed without significant deviations from Contract drawings and specifications submit to Departmental

1.2 AS-BUILTS AND SAMPLES (Cont'd)

.7 (Cont'd)
Representative one set of drawings and specifications marked "AS-BUILT".

1.3 RECORDING ACTUAL SITE CONDITIONS

.1 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.2 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.3 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
.1 Measured depths of elements of foundation in relation to finish first floor datum.
.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
.4 Field changes of dimension and detail.
.5 Changes made by change orders.
.6 Details not on original Contract Drawings.
.7 References to related shop drawings and modifications.

.4 Specifications: legibly mark each item to record actual construction, including:
.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
.2 Changes made by Amendments and change orders.

.5 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.4 FINAL SURVEY

.1 Submit final site survey certificate in accordance with Section 01 33 00, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This section specifies methods and procedures for demolition and/or deconstruction of structures, or parts of structures as may required to accommodate use of the final settling cell of the ECF and mechanical water treatment facilities as employed by the Contractor to achieve target water quality. Such facilities may include, but not limited to:

.2 Backfilling and surface restoration are required at location where structures are remove/deconstructed.

1.2 MEASUREMENT PROCEDURES

.1 All items not in the unit prices will be in the Lump Sum Arrangement.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)
  .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Shop Drawings:
  .1 Provide shop drawings and product data in accordance with Section 01 33 00.
  .2 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 20 and indicate:
  .1 Descriptions of and anticipated quantities of materials to be salvaged reused, recycled and landfilled.
  .2 Schedule of selective demolition.
  .3 Number and location of dumpsters.
  .4 Anticipated frequency of tippage.
  .5 Name and address of waste facilities.

.4 Submit copies of certified weigh bills and receipts from authorized disposal sites and

1.4 SUBMITTALS (Cont'd)

.4 (Cont'd)
reuse and recycling facilities for material removed from site upon request of Departmental Representative.
.1 Written authorization from Departmental Representative is required to deviate from facilities listed in Waste Reduction Workplan.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Dispose legally off site all demolished materials.

1.6 ENVIRONMENTAL PROTECTION

.1 Ensure Work is done in accordance with Section 01 35 43 and as specified.

.2 Ensure that demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

.3 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
.1 Ensure proper disposal procedures are maintained throughout project and in accordance with Section 01 74 20.

.4 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.

1.7 PROTECTION

.1 Prevent movement, settlement or damage of adjacent parts of existing structure to remain. Make good damage and be liable for injury caused by demolition and removal.

1.8 SAFETY CODE

.1 Unless otherwise specified, carry out demolition work in accordance with CSA S350.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Leave equipment and machinery running only while in use, except where extreme temperatures prohibit shutting down.

.2 Demonstrate that tools and machinery are being used in manner which allows for salvage of materials in best condition possible.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Do Work in accordance with Section 01 35 28.

.2 Protection:
.1 Prevent movement, settlement, or damage to adjacent structures, utilities that are to remain in place. Provide bracing and shoring as required.
.2 Keep noise, dust, and inconvenience to occupants to minimum.
.3 Protect building systems, services and equipment.
.4 Provide temporary dust screens, covers, railings, supports and other protection as required.
.5 Protect existing structures from damage during demolition and removal of existing structure designated for removal. Make good all damages to original condition or better at no extra cost to Departmental Representative.

.3 Disconnect and re-route electrical, telephone and communication service lines. Post warning signs on electrical lines and equipment which must remain energized to serve other products during period of demolition. Provide ground fault interrupters for electrical rerouting where necessary.

.4 Locate and protect utility lines. Do not disrupt active or energized utilities traversing site. Post warning signs on electrical lines and equipment which must remain energized to serve navigational equipment during period of demolition and removal.

3.2 DEMOLITION/ DECONSTRUCTION

.1 Demolish/deconstruct existing structures, parts of existing structures including, but not limited to the following items:
.1 Water treatment plant and associated components such as concrete slab or other surface treatment, tanks, pumps, pipes and catch basin.

.2 If applicable, crush concrete generated due to demolition of slabs to size suitable for recycling.
.1 Where possible identify markets which will accept crushed material as aggregate.
.2 For further information regarding acceptable uses contact Provincial/Territorial aggregate producers associations and or Ministries of Transportation.

.3 Keep site clean, organized, safe and stable condition throughout demolition procedure and at the end of each day's work.
.1 Protect parts of structures not be demolished/deconstructed at all times.

.4 Demolish/deconstruct to minimize dusting. Keep materials wetted as directed by Departmental Representative.

.5 Dispose of demolished/deconstructed materials, to appropriate recycling facilities and in accordance with authority having jurisdiction.

3.3 BACKFILLING AND SURFACE RESTORATION

.1 Backfilling and surface restoration are required at location where the structures are removed/deconstruction.

.2 Backfill to Section 31 23 11.

.3 Backfill all areas having part of structures removed from below ground.

.4 Native soil and or Granular A fill used below the water treatment plant concrete slab or other surface treatment shall be used as backfill materials.

.5 Grade and reshape disturbed areas/surfaces to provide a smooth and uniform transition, but not uniformly high or low.

.6 Correct/restore surface irregularities by loosening and adding or removing material until

3.3 BACKFILLING AND SURFACE RESTORATION (Cont'd)

.6 (Cont'd) surface matches original grade prior to installation of water treatment plant concrete slab.

3.4 STOCKPILING

.1 Label stockpiles, indicating material type and quantity.

.2 Designate appropriate security resources/measures to prevent vandalism, damage and theft.

.3 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

.4 Selling of deconstructed/stockpiled materials is not permitted on site.

3.5 REMOVAL FROM SITE

.1 Transport material designated for alternate disposal to approved facilities listed in waste reduction workplan and in accordance with applicable regulations. Do not deviate from facilities listed in waste reduction workplan without prior written authorization from Departmental Representative.

.2 Dispose of materials not designated for alternate disposal in accordance with applicable regulations. Disposal facilities must be approved of and listed in waste reduction workplan. Do not deviate from disposal facilities listed in waste reduction workplan without prior written authorization from Departmental Representative.

3.6 CLEANING AND RESTORATION

.1 Keep site clean and organized throughout demolition procedure.

.2 Upon completion of project, reinstate areas affected by Work to condition which existed prior to beginning of Work.

END

PART 1 - GENERAL

1.1 MEASUREMENT PROCEDURES

.1 All items not in the unit prices will be in the Lump Sum Arrangement.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
.1 ASTM C233/C233M-10a, Standard Test Method for Air-Entraining Admixtures for Concrete.
.2 ASTM C260/C260M-10a, Specification for Air-Entraining Admixtures for Concrete.

.2 Canadian Standards Association (CSA International):
.1 CAN/CSA-A3000-13, Cementitious Materials Compendium.
.2 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
.3 CSA A23.3-14, Design of Concrete Structures.
.4 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.
.5 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
.6 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.3 ACRONYMS AND TYPES

.1 Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).
.1 Type GU or GUb - General use cement.
.2 Type MS or MSb - Moderate sulphate-resistant cement.
.3 Type MH or MHb - Moderate heat of hydration cement.
.4 Type HE or Heb - High early-strength cement.
.5 Type LH or LHb - Low heat of hydration cement.
.6 Type HS or HSb - High sulphate-resistant cement.

.2 Fly ash:
.1 Type F - with CaO content less than 8%.
.2 Type CI - with CaO content ranging from 8 to 20%.
.3 Type CH - with CaO greater than 20%.

1.3 ACRONYMS AND TYPES (Cont'd)

.3 GGBFS - Ground, granulated blast-furnace slag.

1.4 DESIGN REQUIREMENTS

.1 Alternative 1 - Performance: in accordance with CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Submit WHMIS MSDS - Material Safety Data Sheets.

.3 At least 2 weeks prior to beginning Work, submit to Departmental Representative samples of following materials proposed for use:
.1 Concrete, Alternative 1 - Performance: in accordance with CSA A23.1/A23.2 and as described in MIXES of PART 2 - PRODUCTS.
.2 Cold weather concrete protection.

.4 Submit testing results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.5 Concrete hauling time: submit for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of work and discharged after batching.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00.

.2 Submit to Departmental Representative, minimum 2 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
.1 When plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.

1.6 QUALITY ASSURANCE (Cont'd)

.3 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for review by Departmental Representative on following items:
  .1 Falsework erection.
  .2 Hot weather concrete.
  .3 Cold weather concrete.
  .4 Curing.
  .5 Finishes.
  .6 Formwork removal.

.4 Quality Control Plan: submit written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

.5 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 28.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
  .1 Modifications to maximum time limit must be agreed to Departmental Representative laboratory representative and concrete producer as described in CSA A23.1/A23.2.
  .2 Deviations to be submitted for review by Departmental Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.3 Waste Management and Disposal:
  .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
  .2 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.
  .3 Provide an appropriate area on the job site where concrete trucks can be safely washed.
  .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Departmental Representative.
  .5 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

1.7 DELIVERY, STORAGE AND HANDLING (Cont'd)

.3 Waste Management and Disposal:(Cont'd)
.6 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

.4 Be responsible for the storage and proper care of the reinforcing steel until it is incorporated into the final work. Store reinforcing steel above ground on wooden platforms, skids or racks. Take such other precautions as may be required to protect the steel from dirt or injury. If reinforcing steel becomes soiled with dirt, scale, paint, oil, grease, excessive rust or other foreign substance, clean thoroughly before its incorporation into the work.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2 and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

.1 Concrete:
.1 Cement: to CSA A3001, type GU
.2 Compressive strength: 35 MPa at 28 days.
.3 Exposure class: C-1 to CSA A23.1/A23.2.
.4 Aggregate size: 20 mm.
.5 Slump: 80 mm at time of deposit, +/-20 mm.
.6 Air content: Table 4, Category 2, 6%.
.7 Admixtures: air entraining to ASTM C233 Standard Test Method for Air-Entraining Admixtures for Concrete. Calcium chloride or compounds containing calcium chloride not permitted.
.8 Water: potable, to Table 9.

2.3 MATERIALS (Cont'd)

.2 Reinforcing:
.1 Bar steel: to CSA G30.18, grade 400R.

.3 Formwork: to CSA A23.1/A23.2.

2.4 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria in accordance with CSA A23.1/A23.2.
.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.
.2 Provide concrete mix to meet following plastic state requirements:
.1 Durability and class of exposure: C-1.
.2 Minimum compressive strength at 28 days: 35 MPa.
.3 Surface texture: non-skid finish.
.4 Geometrical requirements: slope for drainage as indicated on drawings.
.3 Provide quality management plan to ensure verification of concrete quality to specified performance.
.4 Provide concrete supplier's certification.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Contractor may choose to construct a concrete slab at the final settling cell effluent pump platform to facilitate water treatment operations. Execute work as specified.

.2 Obtain Departmental Representative's approval before placing concrete.
.1 Provide 48 hours notice prior to placing of concrete.

.3 During concreting operations:
.1 Development of cold joints not allowed.
.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

3.1 PREPARATION (Cont'd)

.5 Ensure reinforcement, inserts and monitoring well are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 NOTICE OF POUR

.1 Provide Departmental Representative 48 hours notice before each concrete pour.

3.3 PLACING REINFORCEMENT

.1 Accurately place reinforcing steel in the positions shown on the drawings and hold firmly during the placing, compacting and setting of concrete.

.2 Reinforcement must be in place and inspected by the Departmental Representative before concrete is placed.

3.4 FORMWORK

.1 Erect formwork to CSA A23.1/A23.2.

3.5 CONCRETE

.1 Do not pour concrete on soil which has been allowed to dry out. If soil is exposed to drying for three or more days, moisten by sprinkling water on it before any concrete is placed.

.2 In no case deposit concrete against frozen material.

.3 Carry out the placing of concrete continuously from joint to joint. Unless otherwise specified vibrate the concrete mechanically.

3.5 CONCRETE (Cont'd)

.4 Placement of concrete by pumping permitted only if authorized by Departmental Representative in writing.

.5 Complete work to following tolerances:
.1 Straight to 1:500.
.2 Thickness to 6 mm.
.3 Plumb to 1:600.

3.6 FINISHING

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

3.7 CURING

.1 Cure concrete in accordance with CSA A23.1/A23.2, Clause 7.4 and Table 20 Curing Type 2.

.2 Provide cold weather protection during curing period.

3.8 FIELD QUALITY CONTROL

.1 Site tests: conduct following test in accordance with Section 01 45 00 and submit report as described in PART 1 - SUBMITTALS.
.1 Concrete pours.
.2 Slump tests.
.3 Air content.
.4 Compressive strength at 7 and 28 days.
.5 Air and concrete temperature.

.2 Concrete testing: perform compressive strength concrete testing to CSA A23.1/A23.2 by CSA accredited laboratory.
.1 Ensure testing laboratory is certified in accordance with CSA A283.

.3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.

3.8 FIELD QUALITY CONTROL (Cont'd)

.4 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

END

PART 1 - GENERAL

1.3 MEASUREMENT PROCEDURES

.1 Welding will not be measured separately for payment but is considered included in the paid items as specified and indicated.

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):
.1 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
.2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

1.2 WELDER QUALIFICATIONS

.1 Use only welders qualified under CSA W47.1.

.2 Make available to Departmental Representative currently valid Canadian Welding Bureau Qualification Certificate for each welder employed on the work.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Welding materials to CSA W59.

.2 Weld electrodes: E49XX.

PART 3 - EXECUTION

3.1 WELDING GENERAL

.1 Welding: CSA W59.

.2 Do not deviate the size, length and location of welds from the design or from details shown on reviewed shop drawings without approval of Departmental Representative.

.3 Grind flush all butt welds.

3.2 PREPARATION

.1 Surfaces to be welded shall be smooth, uniform and free from fins, tears and other defects which would adversely affect the quality of the weld.

.2 Ensure areas within 50 mm of the weld are free from loose scale, slag, rust, grease, moisture, paint or other matter which would impair the quality of the weld.

.3 Remove slag before welding over previously deposited metal and brush clean weld and adjacent base. This requirement applies to successive layers, successive beads and to crater area when welding is resumed after any interruption.

.4 Before welding is started from the second side remove to sound metal the root of the initial weld of all butt welds except when produced with the aid of backing. Thoroughly fuse the weld metal with the backing in all butt welds made with the use of backing of the same material as the base metal.

3.3 ASSEMBLY

.1 Bring members to be welded into correct alignment and hold securely in position until the joint has been welded.

.2 Carefully align abutting parts joined by butt welds.

.3 Weld in a sequence that will balance the effects of applied heat of welding on various sides as the welding progresses.

3.4 WELD QUALITY

.1 Weld metal to be sound throughout with no porosity or cracks on the surface of any weld or weld pass.

.2 Ensure complete fusion between the weld metal and the base metal and between successive passes throughout the joint.

.3 Welds shall be free from overlap and the base metal free from undercutting.

.4 Fill all craters to the full cross section of the welds.

3.4 WELD QUALITY (Cont'd)

.5 Fill and grind to profile any craters at the extreme ends of fillet welds.

3.5 TESTING

.1 Give Departmental Representative 48 hours notice of when work is ready for inspection.

.2 All welds will be subject to visual inspection requirements of CSA W59.

.3 Welds which fail the visual inspection will be subject to further nondestructive testing. This testing may be either radiographic or ultrasonic. The full length of the weld will be examined.

.4 If more than 50% of the welds fail the visual inspection requirements all welds will be tested by nondestructive testing methods.

.5 Pay all costs for nondestructive testing resulting from visual inspection failure.

.6 Departmental Representative will not approve any weld until all required inspection is completed, found acceptable and marked as such.

3.6 ACCEPTANCE REQUIREMENTS

.1 Welds subject to nondestructive testing unacceptable if:
.1 There is any imperfection within 25 mm from the beginning or end of a butt weld.
.2 There is any type of crack, tear, zone of incomplete fusion or incomplete penetration regardless of size and location.
.3 Inclusion:
    .1 Occurs in any 25 mm of a welded joint containing two or more inclusions where the sum of the greatest dimensions of those inclusions exceed 5 mm;
    .2 Is greater that one-third the joint thickness but in no case larger than 19 mm.

.2 Repair defective welds by chipping, air-arc gouging or grinding out from one side or both sides. Remove all traces of defects before rewelding. Remove all traces of oxidation after air-arc gouging.

.3 Resubmit all repaired welds to nondestructive testing.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Section only apply if Contractor utilizes the space between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E as a final settling cell for water treatment process.

1.2 MEASUREMENT PROCEDURES

.1 All items not in the unit prices will be in the Lump Sum Arrangement.

1.3 REFERENCES

.1 CSA International
  .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  .2 CSA S16-14, Design of Steel Structures.
  .3 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
  .4 CSA W55.3-08(R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.

.2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Submit two copies of WHMIS MSDS to Section 01 33 00.

.3 Shop Drawings:
  .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.5 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:
.1 Store materials in designated location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

1.7 WELDER QUALIFICATIONS

.1 To Section 05 12 35.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.

.2 Steel angles: to CSA G40.20/G4.21, Grade 300W.

.3 Safety grating: rated by manufacturer with a working load capacity of 3.6 kPa for spans shown on Drawings.

.4 Welding materials and electrodes: to Section 05 12 35.

PART 3 - EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CSA S16.

.2 Welding: in accordance with CSA W59 and to Section 05 12 35.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.

3.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured in accordance with details shown on Drawings.

.2 Where possible, fit and shop assemble work, ready for erection.

.3 Components shall be joined by welding. Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.4 Fabricate structural steel in accordance with CSA S16.

.5 Finish: Neatly finish portions of work. Finish members true to line, free from twists, bends, open joints, and sharp corners and edges. Grind all sharp edges smooth.

3.3 WELDING

.1 To Section 05 12 35.

3.4 ERECTION

.1 Erect metalwork/structural steel square, plumb, straight, and true, accurately fitted, with tight joints and intersections as indicated on Drawings and in accordance with CSA S16.

.2 Field cutting or altering structural members: to approval of Departmental Representative.

.3 Weld field connection.

3.5 WALKWAY

.1 Fabricate and install walkway to details indicated.

3.6 RAILINGS

.1 Fabricate and install tube railings to details indicated.

3.7 SAFETY GRATING

.1 Supply and install safety grating in accordance with manufacturer's recommendations and to details indicated.

3.8 ECF EFFLUENT PIPE SUPPORTS

.1 Install pipe supports to details indicated.

3.9 CLEANING

.1 Leave Work area clean at end of each day.

.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.10 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Work under this section shall include, but not necessarily limited, to transporting, placing and spreading of stone fill materials in the locations and to the depth shown on the Drawings.

.2 Work under this section shall include, but not necessarily be limited to, supplying fill materials, unless specifically included in a separate specification section, according to requirements identified in this specification and in the necessary quantities to construct the particular feature in the Contract documents.

.3 Comply with applicable local, Federal, and Provincial regulations including Canadian Centre for Occupational Health and Safety (CCOHS) regulations and other health and safety requirements in accordance with Section 01 35 28.

1.2 MEASUREMENT PROCEDURES

.1 Backfilling of 19 mm clear stone between the ECF face wall and anchor wall to indicated grade at location between Stations 0+401.2E and 0+725.7E will be measured by the tonnes of material placed and accepted in the work and shall include all labour, materials and equipment necessary to supply and place as specified.

.2 Backfilling of 22-50 mm clear stone between the ECF face wall and anchor wall to indicated grade at location between Stations 0+401.2E and 0+725.7E will be measured by the tonnes of material placed and accepted in the work and shall include all labour, materials and equipment necessary to supply and place as specified.

.3 Backfilling of 75-150 mm clear stone between the ECF face wall and anchor wall to indicated grade at location between Stations 0+401.2E and 0+725.7E will be measured by the tonnes of material placed and accepted in the work and shall include all labour, materials and equipment necessary to supply and place as specified.

1.2 MEASUREMENT PROCEDURES (Cont'd)

.4 Geomembranes shall be measured under Section 31 32 19.02.

.5 Drainage stone will be measured by the tonnes of material placed and shall include all labour, materials and equipment necessary to supply, place and spread as specified. Processing and stockpiling of fill materials is considered incidental and will not be measured separately for payment.

.6 Geotextile will be measured under Section 31 32 19.01.

.7 No allowance will be made for material placed outside the limits indicated on drawings.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Submit the name, location, and quantity of each source and type of fill material proposed including a sample of each source and fill type to be sampled for volatile organic compounds (VOCs), PAHs, and metals. Provide necessary coordination with all proposed source(s) to provide samples to the Departmental Representative. The results of the analyses will be compared to the appropriate regulatory chemical analytical standards or other requirements. If such analyses indicate unacceptable chemical or physical characteristics, the Departmental Representative will reject the use of fill material(s) from the proposed source(s), and the Contractor must identify and submit a sample(s) from another fill material source.

.3 Submit samples and test reports of the material for parameters specified in Part 2 - PRODUCTS.

.4 Submit proposed Work Area, transportation, handling, storage, and installation techniques, including methods and equipment for placing drainage stone over the geogrids as shown on the Drawings.

1.4 PROTECTION

.1 Protect existing ECF walls, structures, roads, landscaping, tie rods and components not part of the Work from damages associated with Work activities. Make good of damages to match existing condition or better at no additional cost to Contract.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Divert unused fill materials from landfill to local facility to Section 01 74 20.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Fill material aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.

.2 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
.1 Crushed rock.
.2 Gravel and crushed gravel composed of naturally formed particles of stone.

.3 19 mm clear stone fill: to Ontario Provincial Standard Specification OPSS.PROV 1004, November 2012, Material Specification for Aggregates - Miscellaneous. Maximum 19.0 mm Type 2.

.4 22-50 mm clear stone fill: to Ontario Provincial Standard Specification OPSS.PROV 1004, November 2012, Material Specification for Aggregates - Miscellaneous. Uniformly graded with modified minimum size of 22 mm and a maximum size of 50 mm.

.5 75-150 mm clear stone fill: to Ontario Provincial Standard Specification OPSS.PROV 1004, November 2012, Material Specification for Aggregates - Miscellaneous. Uniformly graded with modified minimum size of 75 mm and a maximum size of 150 mm.

.6 Geomembranes: to Section 31 32 19.02.

2.1 MATERIALS (Cont'd)

.7 Drainage stone fill material: to Ontario Provincial Standard Specification OPSS.PROV 1004, November 2012, Material Specification for Aggregates - Miscellaneous. Material specified as "Drainage Stone" on the Drawings shall be a graded quarry rock free of deleterious and organic material for 53 mm Clear Stone in Tables 1 and 2, with the following exceptions:
  - .1 Coarse and fine aggregate abrasion loss is less than 15 percent.
  - .2 Sieve size gradation to LS-602 is as follows:
    - .1 200 mm: 90% to 100% passing
    - .2 150 mm: 60% to 90% passing
    - .3 100 mm: 25% to 40% passing
    - .4 100 mm: 25% to 40% passing
    - .5 53 mm: 0% to 20% passing
    - .6 26.5 mm: 0% to 5% passing
    - .7 19 mm: 0% to 2% passing
    - .8 0.075 mm: 0% passing

.8 Geotextile Type 1: to Section 31 32 19.01.

2.2 SOURCE QUALITY CONTROL

.1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.

.2 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.3 Advise Departmental Representative 4 weeks in advance of proposed change of material source.

.4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Contractor may use the space between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E as a final settling cell for water treatment process. Execute work as specified.

.2 Installation of geomembranes to details indicated and to Section 31 32 19.02 is required if Contractor chooses to utilize the space between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E as a finishing cell for water treatment process. Execute work as specified.

3.2 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative. Stockpile materials in manner to prevent segregation.

3.3 PROTECTION

.1 Protect existing features from damage during Work. Make good of all damages at no additional costs to Contract.

.2 Protect buried services that are required to remain undisturbed.

3.4 BACKFILLING OF CLEAR STONE FILL

.1 If the space between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E is utilize as a finishing cell for water treatment process:
.1 Install geomembranes and associated components to details indicated and to Section 31 32 19.02.
.2 Upon completion of dredging and water treatment operations remove installed geomembrane and any contaminated soil from the space between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E.
.3 Do not commence backfilling until areas of work to be backfilled have been inspected and approved by Departmental Representative.

.2 If the space between the ECF face wall and anchor wall at locations between Stations

3.4 BACKFILLING OF CLEAR STONE FILL (Cont'd)

.2 (Cont'd)
0+401.2E and 0+725.7E is not utilize as a finishing cell for water treatment process:
.1 Do not commence backfilling until dredging of Priority 1 and 2 is complete and approved by Departmental Representative.

.3 Areas backfilled to be free from debris, snow, ice, water or frozen ground.

.4 Backfill all spaces not occupied by parts of the structure, or other permanent works, with specified material placed as shown on the drawings.

.5 Do not backfill the ECF overflow structure.

.6 Backfill material is to be placed. End dumping and free-fall of fill is not permitted.

.7 Place fill materials to elevations and details shown on the drawings.

.8 Place fill materials in continuous horizontal layers not exceeding 300 mm depth. Use methods to prevent disturbing or damaging any part of the work. Make good any damage.

.9 Place fill uniformly between the ECF face wall and anchor wall to equalize loading. If backfilling operations result in piles movement and/or out of alignment, take corrective action and restore piling to original state.

3.5 DRAINAGE STONE PLACEMENT SEQUENCE

.1 Dredge and fill ECF to elevation +0.2 m and to Section 35 20 34.

.2 Remove and treat ponded water within the ECF to elevation +0.3 m.

.3 Place stone filled gabion baskets, underliner drainage pipes and underliner risers to details indicated and to Section 31 36 10.

.4 Place drainage stone wrapped with geotextile along the anchor wall perimeter to details indicated on the drawings and to Section 31 32 19.01.

.5 The placement of stone filled gabion baskets with underliner drainage pipes, underliner risers and drainage stone wrapped with

3.5 DRAINAGE STONE PLACEMENT SEQUENCE (Cont'd)

.5 (Cont'd)
geotextile along the anchor wall perimeter shall be placed concurrently.

.6 Resume dredging and filling of ECF to final grade.

.7 Remove and treat ponded water and pore water to final settled elevation of the underliner drainage pipes within the gabion baskets.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation of polymeric geotextiles as specified and as indicated on the drawings.

1.2 MEASUREMENT PROCEDURES

.1 Geotextiles Type 1 for placement below the drainage stone and wrapped along the perimeter of the anchor wall will be measured by the square metres of surface area covered and shall include all labour, materials and equipment necessary to supply, store and install the geotextile. No allowance will be made for seams, overlaps and anchoring.

.2 Geotextiles Type 2 for placement at the armoured sand cap mixture will be measured by the square metres of surface area covered and shall include all labour, materials and equipment necessary to supply, store and install the geotextile. No allowance will be made for seams, overlaps and anchoring.

.3 Geotextile Type 3 wrapped around the perimeter of the stone filled gabion baskets to details indicated will be measured by the square metres of surface area covered and shall include all labour, materials and equipment necessary to supply, store and install. No allowance will be made for seams, overlaps and anchoring.

1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM):
.1 ASTM D4355/D4355M-14, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
.2 ASTM D4491/D4491M-15, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
.3 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
.4 ASTM D4751-12, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

1.3 REFERENCES (Cont'd)

.1 (Cont'd)
.5 ASTM D6241-14, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for each type of geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Proposed Work Area transportation, handling, storage, and installation techniques, including methods and equipment for placing geotextile Type 1, Type 2 and Type 3.
.3 Manufacturer's standard warranty provided for each type of geotextile.

.3 Test and Evaluation Reports:
.1 Submit copies of mill test data and certificate at least weeks prior to start of Work.

1.5 QUALITY ASSURANCE

.1 Submit written certification that the delivered material meets the manufacturer's specifications.

.2 For Type 1 geotextile, provide quality control test results for seam strength at example stitched seams in accordance with accepted standards for testing strength and integrity of the seams.

.3 Provide quality control test results conducted by the manufacturer during the manufacturing of for geotextile fabric delivered to the Work Area. Test results shall identify the representative panels for geotextile Type 1 and rolls for geotextile Type 2 and Type 3 of field-delivered fabric. Provide the lot and roll number for the geotextile delivered to the Work Area.

.4 The manufacturer shall adhere to its own developed quality assurance program in the manufacture of the geotextile.

1.5 QUALITY ASSURANCE (Cont'd)

.5 Inspect and verify in writing prior to installation, that the geotextile fabric has not been damaged due to improper transportation, handling or storage.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver Type 1 geotextile pre-seamed, i.e., pre-stitched panels from the manufacturer and prepared for field seaming on-site.

.2 Deliver Type 2 and Type 3 geotextile in a protective wrapping labeled with the following information:
.1 Manufacturer's name,
.2 Product identification, lot #, roll #, and dimensions.

.3 During delivery and storage, protect geotextiles from ultraviolet light, precipitation, mud, soil, excessive dust, puncture, cutting, and/or other damaging conditions prior to and during delivery and storage in the Work Area. The geotextile shall be stored and protected in the Work Area at a location approved by the Departmental Representative.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
.1 Needle-punched construction, consist of long-chain polymeric fibers or filaments composed of polypropylene.
.2 Free of any chemical treatment that reduces permeability, and shall be inert to chemicals commonly found in soil.

.2 Minimum 85% by mass of polypropylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure for 60 days.

2.1 MATERIAL (Cont'd)

.3 Geotextile Type 1, Physical properties:
.1 Tensile strength and elongation (in any principal direction): to ASTM D4632/D4632M.
.1 Grab tensile strength: minimum 1690 N, wet condition.
.2 Elongation at break: maximum 50%.
.3 Seam strength: equal to or greater than tensile strength of fabric.
.2 Puncture CBR: to ASTM D6241, 4560 N.
.3 Permittivity: to ASTM D4491/D4491M, minimum 0.7 sec^{-1}.
.4 Apparent opening size (AOS): to ASTM D4751, 0.15 mm (Max ARV).
.5 UV resistance: to ASTM D4355/D4355M, 70% strength retained at 500 hours.
.6 Geotextile Type 1 shall be furnished in pre-seamed, i.e., pre-stitched, panels from the manufacturer and prepared for field seaming on-site.

.4 Geotextile Type 2, Physical properties:
.1 Grab tensile strength and elongation: to ASTM D4632/D4632M.
.1 Grab Tensile strength: minimum 440 N, wet condition.
.2 Elongation at break: maximum 50%.
.3 Seam strength: equal to or greater than tensile strength of fabric.
.2 Puncture CBR: to ASTM D6241, 1320 N.
.3 Permittivity: to ASTM D4491/D4491M, minimum 1.7 sec-v.
.4 Apparent opening size (AOS): to ASTM D4751, 0.212 mm (Max ARV).
.5 UV resistance: to ASTM D4355/D4355M, 70% strength retained at 500 hours.

.5 Geotextile Type 3, Physical properties:
.1 Grab tensile strength and elongation: to ASTM D4632/D4632M.
.1 Grab tensile strength: minimum 1330 N, wet condition.
.2 Elongation at break: maximum 50%.
.3 Seam strength: equal to or greater than tensile strength of fabric.
.2 Puncture CBR: to ASTM D6241, 3560 N.
.3 Permittivity: to ASTM D4491/D4491M, minimum 0.8 sec-v.
.4 Apparent opening size (AOS): to ASTM D4751, 0.15 mm (Max ARV).
.5 UV resistance: to ASTM D4355/D4355M, 70% strength retained at 500 hours.

.6 Factory seams: sewn in accordance with manufacturer's recommendations.

2.1 MATERIAL (Cont'd)

.7 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in locations indicated and retain in position.

.2 Do not install or field-seamed in adverse weather conditions. Geotextile shall be kept dry during storage and up to the time of deployment. During windy conditions, all geotextiles shall be secured with sandbags or an equivalent approved anchoring system. Removal of the sandbags or equal shall only occur upon placement of an overlying soil layer.

.3 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.4 Use proper cutting tools to cut and size the geotextile materials. Take extreme care while cutting geotextiles.

.5 Keep geotextiles free from all dirt, dust, sand, and mud to prevent clogging of geotextile. The geotextile shall be cleaned or replaced as to approval of Departmental Representative.

.6 Cover the geotextile within the time period recommended by the manufacturer.

.7 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.8 Place geotextile Type 1 directly over dredged sediment after the removal of the ponded water as specified in Section 31 23 11. Placement methods shall be used so as not to apply bearing pressure on the dredged sediments.

.9 Place geotextile Type 2 and Type 3 to details and manner indicated on drawings.

.10 Replace damaged or deteriorated geotextile to approval of Departmental Representative.

.11 Geotextile Type 1 shall be continuously sewn into panels using a polymeric thread with

3.1 INSTALLATION (Cont'd)

.11 (Cont'd)
chemical and ultraviolet resistance properties equal to or exceeding those of geotextile.

.12 Overlap each successive strip of geotextile Type 2 and Type 3 one (1) metre over previously laid strip during placement.

3.2 REPAIR PROCEDURES

.1 Repair of tears or holes in the geotextile shall require the following procedures:
.1 On slopes: A patch made from the same geotextile shall be double seamed into place; with each seam 6 to 19 mm apart and no closer than 25 mm from any edge. Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced.
.2 Non-slopes: A patch made from the same geotextile shall be spot-seamed in place with a minimum 610 mm overlap in all directions.

3.3 INSPECTION

.1 Departmental Representative may randomly inspect geotextiles before or during installation.

3.4 POST - CONSTRUCTION

.1 Submit all quality control documentation upon completing installation to Departmental Representative.

3.5 CLEANING

.1 Remove construction debris from site and dispose of debris in an environmentally responsible and legal manner.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Vehicular traffic not permitted directly on geotextile.

3.7 WARRANTY

.1 Submit manufacturer's standard warranty for the geotextiles.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Section only apply if Contractor utilizes the space between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E as a final settling cell for water treatment process.

.2 Materials and installation of geomembranes for use in containment structures as an impermeable membrane.

.3 Contractor shall be responsible for all Quality Assurance/Quality Control (QA/QC) testing specified herein and as indicated on the Drawings. All QA/QC testing, with the exception of non-destructive tests, shall be conducted by an independent laboratory at the Contractor's expense.

1.2 MEASUREMENT PROCEDURES

.1 Geomembranes for settling cell will be measured as part of the Lump Sum Arrangement and shall include all labour, material and equipment necessary to complete the Work. No allowance will be made for seams and overlaps. Providing sandbags as indicated on drawings is considered incidental and will not be measured separately for payment.

.2 Non-destructive and destructive testing of field seams is considered included in the above measured item and will not be measured separately for payment.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
.1 ASTM D792-13, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
.2 ASTM D1004-13, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
.3 ASTM D1505-10, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
.4 ASTM D1603-14, Standard Test Method for Carbon Black Content in Olefin Plastics.

1.3 REFERENCES (Cont'd)

.1 (Cont'd)
.5 ASTM D1693-15, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
.6 ASTM D4218-96(2008), Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique.
.7 ASTM D4833/D4833-07(R2013)e1, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
.8 ASTM D5199-12, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
.9 ASTM D5397-07(2012), Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
.10 ASTM D5596-03(2009), Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
.11 ASTM D6392-12, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
.12 ASTM D6693/D6693-04(2015)e1, Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
.13 ASTM D6747-15, Standard Guide for Selection of Techniques for Electrical Detection of Potential Leak Paths in Geomembrane.
.14 ASTM D7007-15, Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials.

.2 GRI GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes where reference is made to one of the above codes, standards, specifications, or publications the revisions in effect at the time of bid shall apply.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Submit the following information to Departmental Representative at least 2 weeks prior to ordering geomembrane:
.1 Geomembrane Manufacturer's corporate background and information.

1.4 SUBMITTALS (Cont'd)

.2 (Cont'd)
.2 Geomembrane Manufacturing capabilities.
.3 Quality control procedures for manufacturing.
.4 List of material properties including certified test results.
.5 A list of at least 10 completed facilities, totalling a minimum of 930,000 square metres, for which the geomembrane Manufacturer has manufactured geomembranes. For each facility, the following information shall be provided:
.1 Name and purpose of facility, its location, and date of installation.
.2 Name of Owner, Project Manager, Designer, Fabricator (if any), and Installer.
.3 Thickness and surface area of geomembrane manufactured.
.4 Origin (resin supplier's name, resin production plant) and identification (brand name, number) of the resin.
.5 Copy of Installer's letter of approval or license by the Manufacturer.
.6 Resume of the "master seamer" to be assigned to this project, including dates and duration of employment.

.3 Submit Shop Drawings for approval at least 1 week prior to installation:
.1 Installation layout plan, dimensions and details, including fabricated and field seams, anchor trenches and protrusion details.
.2 Quality control program manuals covering all phases of manufacturing and installation.
.3 Complete and detailed written instructions for the storage, handling, installation, seaming, inspection plan fail criteria for liner inspections, and QA/QC testing procedures of the liner in compliance with specifications and the condition of its warranty.
.4 Complete details listing means and methods for terminating (i.e. securing and hanging), settling cell geomembrane to the limits and specifications as shown on the Drawings.

.4 Submit installation plan including equipment and personnel to be used to Departmental Representative at least 30 days prior to the start of geomembrane installation.

1.4 SUBMITTALS (Cont'd)

.5 Submit the following to Departmental Representative for approval at least 30 days prior to start of geomembrane work:
.1 Qualifications of geomembrane installer, including proof of training and approval and/or licensing from geomembrane manufacturer, and prior relevant project experience showing
.2 Qualifications of all personnel performing seaming operations shall be including record of previous seaming experience or results of seaming tests. Qualifications for at least one seamer shall include relevant project experience seaming a minimum of 93,000 square metres of the geomembrane type specified for this project, using the same type of seaming apparatus in use at the site.
.3 Qualifications of geomembrane testing laboratory.

1.5 QUALIFICATIONS

.1 Geomembrane Manufacturer: must manufactured geomembrane for at least 10 completed facilities, totalling 1,000,000 square metres.

.2 Geomembrane installer:
.1 Must be trained and approved and/or licensed by the geomembrane Manufacturer for the installation of geomembrane.
.2 All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests. At least one seamer shall have experience seaming a minimum of 93,000 square metres of the specified geomembrane type, using the same type of seaming apparatus in use at the site.
.3 Installer must have experience installing geomembrane in submerged locations.

1.6 CERTIFICATES

.1 Submit to Departmental Representative copies of manufacturer's mill test data at least 4 weeks prior to start of work.

.2 Submit to Departmental Representative certificates, including test results, at least 2 weeks prior to delivery to job site.

1.7 DELIVERY, STORAGE AND HANDLING

.1 During delivery and storage, protect geo-membranes from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents. Make good of all damages at no extra cost to Departmental Representative.

.2 Notify Departmental Representative of anticipated delivery time.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 LLDPE Geomembrane Smooth Properties: to meet the following minimum specification values and as listed in GRI GM17:
- .1 LLDPE Geomembrane Resin:
  - .1 Specific Gravity: to ASTM D1505 and ASTM D792, 0.94.
  - .2 Carbon Black Content: to ASTM D1603 and ASTM D4218, 2.0-3.0%.
  - .3 Carbon Black Dispersion: to ASTM D5196, 9 views in Categories 1 or 2 and 1 view in Category 3.
- .2 LLDPE Geomembrane Rolls:
  - .1 Thickness: to ASTM D5199, minimum average 1.4mm to 1.5mm.
  - .2 Density: to ASTM D1505 and ASTM D792, maximum 0.939 g/cm^3.
  - .3 Tensile Strength and Elongation Properties to ASTM D6693:
    - .1 Tensile Strength at Break: minimum 40 N/mm.
    - .2 Elongation at Break: minimum 800%.
  - .4 Tear Resistance: to ASTM D1004, minimum 150 N.
  - .5 Puncture Resistance: to ASTM D4833/D4833M, minimum 370 N.
  - .6 Stress Crack Resistance: to ASTM D5397, 300 hrs.

.2 LLDPE Geomembrane Seam Properties: to meet the following minimum specification values and to ASTM D6392:
- .1 Shear Strength at Yield: 15.8 kN/m.

2.1 MATERIALS (Cont'd)

.2 LLDPE Geomembrane Seam Properties:(Cont'd)
.2 Peel Adhesion - Fusion: 13.1 kN/m and Film Tear Bond.
.3 Peel Adhesion - Extrusion: 12.6 kN/m and Film Tear Bond.

.3 Seams: welded in accordance with manufacturer's recommendations. Physical properties for resin used for welding to be same as those for resin used in manufacture of membrane.

.4 Welding Material:
.1 Resin used in the welding material must be identical to the liner material.
.2 All welding materials shall be of a type recommended and supplied by the manufacturer and shall be delivered in the original sealed containers, each with an indelible label bearing the brand name, manufacturer's mark number, and complete directions as to proper storage.
.3 Geomembrane shall be welded by manufacturer in large panels and folded or rolled to facilitate transport.

.5 Labeling geomembrane rolls or factory panel shall identify the following:
.1 Thickness of material.
.2 Length and width of the roll or factory panel.
.3 Manufacturer.
.4 Directions to unroll the material.
.5 Product identification.
.6 Lot number.
.7 Roll or field panel number.

2.2 CONFORMANCE TESTING

.1 Provide Departmental Representative with manufacturer factory conformance test results.

.2 Departmental Representative will identify samples in the field for conformance testing. Submit samples to Canadian Council of Independent Laboratories (CCIL) for testing to ensure conformance to both the design specification and the list of guaranteed properties.

.3 Geomembrane samples for material conformance testing will typically be taken at a rate of one per 9,300 square metres of geomembrane, with a minimum of one per lot shipped to the site. Samples shall be collected prior to installation. Sampling shall be conducted in a

2.2 CONFORMANCE TESTING (Cont'd)

.3 (Cont'd)
manner that is non-destructive to the geomembrane and does not compromise the integrity of the geomembrane. Geomembrane samples will be taken across the entire width of the roll. Samples will be 1-metre long by the roll width.

.4 At a minimum, material conformance tests to determine the following characteristics will be performed on the geomembrane:
- .1 Density, ASTM D1505.
- .2 Carbon black content, ASTM D1603.
- .3 Carbon black dispersion, ASTM D5596.
- .4 Thickness, ASTM D5994.
- .5 Tensile characteristics, ASTM D6693.

.5 Departmental Representative will review the results of the manufacturer factory conformance test results and the material conformance testing. Deployment of the geomembrane shall not commence until the Departmental Representative has determined that the material is acceptable.

.6 If a material conformance test result is not in conformance with a required Minimum Average Roll Value (MARV), all material from the lot represented by the failing test shall be considered out of specification and rejected. Alternatively, at the option of the Departmental Representative, additional conformance test samples may be taken to "bracket" the portion of the lot not meeting specification (note that this procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line). To isolate the out-of-specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number) will be rejected. If one or both of the additional tests fail, then the entire lot will be rejected or the procedure will be repeated with two additional tests that bracket a greater number of rolls within the lot. The additional conformance test samples will be identified by the Departmental Representative and will be submitted to the same CCIL that was used for the original conformance testing. The costs associated with the additional conformance testing will be borne by the Contractor.

2.2 CONFORMANCE TESTING (Cont'd)

.7 If the Contractor has reason to believe that failing tests may be the result of the CCIL incorrectly conducting the tests, the Contractor may request that the material in question be retested by the CCIL with a technical representative of the Manufacturer present during the testing. This retesting shall be done at the expense of the Contractor. Alternatively, the Contractor may have the material retested at two different approved CCIL at the expense of the Contractor. If both laboratories produce passing results, the material may be accepted at the discretion of the Departmental Representative. If both laboratories do not produce passing results, then the original CCIL's test results will stand.

.8 The use of the conformance testing procedures listed above to address failed test results is subject to the review of the Departmental Representative.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Installation of geomembranes is only required if the space between the ECF face wall and anchor wall is utilize as a final settling cell for Contractor's water treatment operations. Installation of geomembrances shall conformed to the clauses below.

.2 Installation of geomembrane shall be performed on surfaces that have been made as smooth and horizontal as practical.

.3 All surfaces on which the geomembrane is to be installed shall be acceptable to Departmental Representative prior to installation.

.4 The prepared surface underlying the geomembrane must not be allowed to deteriorate after acceptance, and must remain acceptable up to the time of geomembrane placement and until completion of the project.

.5 Free edges and horizontal surfaces of geomembrane shall be secured to prevent uplift and movement by buoyancy or flow within the final settling cell. Edges shall be secured with sandbags, steel wire mesh panels, or other methods approved by Departmental Representative.

3.1 INSTALLATION (Cont'd)

.6 Secure and maintain geomembrane in position against steel sheet pile wall as indicated on the drawings.

.7 Do not proceed with panel placement when ambient temperatures are below 0°C or above 40°C, during precipitation, in presence of excessive moisture (eg. fog, dew), nor in presence of high winds in excess of 32 km/hr.

.8 Place and seams panels in accordance with manufacturer's recommendations on graded surface in orientation and locations indicated. Minimize wrinkles, avoid scratches and crimps to geomembranes and avoid damage to supporting material.

.9 Wrinkles that develop from normal placement procedures must be controlled such that the underlying geomembrane does not fold over. Wrinkles that develop from normal placement procedures must be controlled such that the underlying geomembrane does not fold over. Small wrinkles, defined as having their height less than or equal to one-half their base width, may be trapped and pushed down by the overlying soil. Any wrinkle that becomes too large and uncontrollable or that folds the geomembrane over must be brought to the attention of the Departmental Representative. If necessary, the geomembrane shall be uncovered, cut, laid flat, seamed by extrusion welding, and non-destructively tested.

.10 Placement shall follow all instructions on the boxes or wrapping containing the geomembrane materials that describe the proper methods or unrolling.

.11 Visually inspect deployed geomembrane for uniformity, tears, punctures, blisters, or other damage or imperfections. Any such imperfections shall be immediately repaired and re-inspected.

.12 Protect installed membrane from displacement, damage or deterioration before, during and after placement.

.13 Replace damaged, torn or permanently twisted panels to approval of Departmental Representative. Remove rejected damaged panels from site. Replacement and or repaired geomembrane at no extra cost to Contract.

3.1 INSTALLATION (Cont'd)

.14 Assign an "identification number" to each geomembrane panel placed. The numbering system shall be simple, logical, and shall identify the relative location in the field.

.15 Upon completion of dredging and water treatment operations remove geomembrane and any contaminated soil from the spaced between the ECF face wall and anchor wall at locations between Stations 0+401.2E and 0+725.7E.

.16 Do backfilling to Section 31 23 11.

3.2 SEAMING

.1 Keep field seaming to minimum. All seams whether field or factory, shall be oriented parallel to the line of slope. Seams oriented across slope is not permitted. At liner penetrations and corners, the number of seams shall be minimized.

.2 Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.

.3 Seamed area shall be cleaned and prepared according to the procedures specified and recommended by the material manufacturer. Any abrading of the geomembrane shall not extend more than 1.3 centimetres on either side of the weld. Care shall be taken to eliminate or minimize the number of wrinkles and "fishmouths" resulting from seam orientation.

.4 Make field seam samples in accordance with requirements described in PART 2 on fragment pieces of geomembrane and test to verify that seaming condition are adequate.

.5 Do not field seam when either the air or sheet temperature is below 0°C, or when the sheet temperature exceeds 50°C, or when the air temperature is above 40°C. At air or sheet temperatures between 0°C and 4°C, seaming shall be conducted directly behind a preheating device. Do not conduct seaming during precipitation, in presence of excessive moisture (eg. fog, dew), nor in presence of high winds in excess of 32 km/hr.

.6 Seaming shall not be performed on frozen or excessively wet underlying soil or work surfaces.

3.2 SEAMING (Cont'd)

.7 Seams shall have an overlap beyond the weld large enough to perform destructive peel tests, but shall not exceed 130 mm.

.8 Perform trial seams on excess geomembrane material. A 0.3 m by 1 m seamed liner sample shall be fabricated with the seam running down the 1 m length in the center of the sample. Such trial seaming shall be conducted prior to the start of each seaming succession for each seaming crew, change in machine or every four hours, after any significant change in weather conditions or geomembrane temperature, or after any change in seaming equipment. From each trial seam, four field test specimens shall be taken. The test specimens shall be 250 mm by 300 mm strips cut perpendicular to the trial seam. Two of these specimens shall be shear tested and two shall be peel tested using a field tensiometer, and recorded as pass (failure of liner material) or fail (failure of seam). Upon initial failure, a second trial seam shall be made; if both trial seams fail, then the seaming device and its operator shall not perform any seaming operations until the deficiencies are corrected and two successive passing trial seams are produced. Completed trial seam samples cannot be used as portions of a second sample and must be discarded.

.9 Where fishmouths occur, the material shall be cut, overlapped, and an overlap weld shall be applied. Where necessary, patching using the same liner material shall be welded to the geomembrane sheet.

.10 Acceptable seaming methods:
.1 Hot wedge welding using a proven fusion welder and master seamer.
.2 Extrusion welding using extrudate with identical physical, chemical, and environmental properties.

.11 Seaming devices shall not have any sharp edges that might damage the geomembrane. Where self-propelled seaming devices are used, it shall be necessary to prevent "bulldozing" of the device into the underlying soil.

3.3 SEAM TESTING

.1 Test seams by non-destructive methods over their full length, using air pressure test or vacuum test unit. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until non-destructive testing is successful. All non-destructive tests shall be conducted under the direct observation of Departmental Representative.

.1 Air pressure testing may be used if double-track hot-wedge welding has been used to seam the geomembrane:

.1 Seal both ends of the air channel separating the double-track hot-wedge welds.

.2 Insert pressure needle into air channel and pressurize the air channel to 18 kPa.

.3 Monitor pressure gauge for three minutes and determine whether pressure is maintained without a loss of more than 14 kPa.

.4 If the pressure test fails, then localize the leak and mark the area for repair.

.2 Vacuum testing will be used on all seams not tested using air pressure testing.

.1 Vacuum box to be approved by Departmental Representative.

.2 Apply a soapy water mixture over the seam.

.3 Place vacuum box over soapy seam and form a tight seal.

.4 Create a vacuum by reducing the vacuum box pressure to 34 kPa for 10 seconds.

.5 Observe through the vacuum box window for any bubbles. Where bubbles are observed, mark seam for repair.

.6 Move vacuum box further down seam overlapping tested seam by 80 mm.

.7 Where hot-wedge seaming has been performed, the overlap must be cut back to the weld.

.2 Test seams by destructive testing:

.1 Test samples will be prepared by the Installer every 150 metres of seam length, a minimum of one test for each seaming machine per day, or more frequently at the discretion of Departmental Representative. Sample location and size will be selected by Departmental Representative. The sample size (300 x 1420 mm)

3.3 SEAM TESTING (Cont'd)

.2 Test seams by destructive testing:(Cont'd)

.1 (Cont'd)
will be large enough to produce three sets of test specimens for the following tests:

.1 Seam Shear Strength: to ASTM D 6392.

.2 Peel Adhesion: to ASTM D 6392.

.2 Ten specimens will compose a set. Five of these will be tested for peel and the other five for shear strength. Each specimen will be 250 mm wide and 760 mm long with the field seam at the center of the specimen. The 1.42 m sample length will first be cut at the ends to produce two field peel test specimens. The remaining 1.37 m will be divided up into thirds and one-third submitted to the Contractor, one-third submitted by Departmental Representative to an independent testing laboratory, and one-third to Departmental Representative for storage and future reference.

.3 Test specimens will be considered passing if the minimum values described in PART 2 are met or exceeded for four of the five test specimens tested by the independent laboratory. All acceptable seams will lie between two locations where samples have passed.

.4 If a sample fails destructive testing, the Contractor shall ensure that: the seam is reconstructed in each direction between the location of the sample that failed and the location of the next acceptable sample; or the welding path is retraced to an intermediate location at least 3 metres in each direction from the location of the sample that failed the test, and a second sample is taken for an additional field test. If this second test sample passes, the seam must then be reconstructed between the location of the second test and the original sampled location. If the second sample fails, the process must be repeated. All costs for work performed to achieve passing tests along with costs for retesting will be borne by the Contractor.

.5 If double-track hot-wedge welding is used, Departmental Representative and the Installer must agree on the track weld that will be used in the destructive testing. The weld chosen (inside or outside) must be consistently tested, and must pass according to the criteria above.

.6 All holes created by cutting out destructive samples will be patched by the Contractor immediately with an oval patch of the same material welded to the membrane using extrusion welding. The patch seams will be tested using a vacuum box and using the

3.3 SEAM TESTING (Cont'd)

.2 Test seams by destructive testing:(Cont'd)

.6 (Cont'd)
procedures described above. Work will not proceed with materials covering the geomembrane until passing results of destructive testing have been achieved.

.7 At the ends of each field seam, two 25 mm by 300 mm field test specimens shall be taken perpendicular to the seam and field tested with a field tensiometer. Both specimens must pass the field seam properties listed in PART 2 prior to terminating the membrane or continuing with additional seams. Failure of these specimens will require correcting the seaming device and repair of the preceding seam according to the failure testing and procedures described above.

3.4 GEOMEMBRANE REPAIR

.1 All imperfections, flaws, construction damage, and destructive and nondestructive seam failures shall be repaired by the Installer of the geomembrane. The appropriate methods of repair are listed below:

.1 Patching, used to repair holes, tears, undispersed raw materials, and contamination by foreign matter.

.2 Grinding and re-welding, used to repair small sections of extruded seams.

.3 Spot welding or seaming used to repair pinholes or other minor, localized flaws.

.4 Capping, used to repair large lengths of failed seams.

.5 Topping, used to repair areas of inadequate seams which have an exposed edge.

.6 Removing bad seams and replacing with a strip of new material welded into placed. This method shall be used with large lengths of fusion seams.

3.5 POST CONSTRUCTION

.1 Submit to Departmental Representative record drawings illustrating the following:

.1 Dimensions of all geomembrane field panels.

.2 Panel locations referenced to the Contract Drawings.

.3 All field seams and panels with appropriate number or code.

.4 Location of all patches, repairs and destructive testing samples.

3.6 CLEANING

.1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.7 PROTECTION

.1 No equipment used shall damage geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

.2 Do not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.

.3 Do not permit vehicular traffic directly on membrane.

3.8 WARRANTY

.1 Obtain and submit Manufacturer's standard warranty for the geomembrane to Departmental Representative.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Section specifies requirements for supply and installation of baskets fabricated from wire mesh filled with stone. A gabion structure consists of a number of baskets connected together so that joints between baskets are as strong as mesh, making a monolithic structure.

1.2 MEASUREMENT PROCEDURES

.1 Stone filled gabion baskets including perforated high-density polyethylene (HDPE) underliner drainage pipes with geotextile filter sock, HDPE underliner risers with pumps and all associated fittings will be measured by the linear metres of stone filled gabion baskets incorporated into Work and shall include all labour, materials and equipment necessary to complete the work.

.2 Geotextile Type 3 will be measured under Section 31 32 19.01.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM)
.1 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
.2 ASTM A313/A313M-13, Standard Specification for Stainless Steel Spring Wire.
.3 ASTM A764-07(2012), Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size For Mechanical Springs.
.4 ASTM F2648/F2648M-13, Standard Specification for 2 to 60 inch (50 to 1500 mm) Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert left over geotextiles from landfill to a local plastic recycling facility as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Gabion baskets:
  .1 Factory fabricated so that sides, ends, lid and internal diaphragms can be readily assembled at site into rectangular baskets of sizes as indicated.
  .2 Single unit construction or with joints having strength and flexibility equal to that of mesh.
  .3 Provide diaphragms of same mesh as gabion walls, when length exceeds horizontal width. Diaphragms to divide basket into equal cells of length not to exceed horizontal width.
  .4 Wire mesh gabions:
    .1 Wire mesh: uniform hexagonal pattern wire woven in triple twist pattern with openings of approximately 80 x 100 mm, non-ravelling.
    .2 Securely selvedge perimeter edges to form joints connecting selvedges with same strength as mesh body.
    .3 Wire to have following dimensions:
      .1 Mesh: 2.7 mm diameter.
      .2 Selvedges: 3.7 mm diameter.
      .3 Binding: 2.0 mm diameter.
    .4 Wire: hot dip galvanized with minimum coverage of 260 g/m^2 to ASTM A123/A123M.
    .5 Interlocking wire fasteners: galvanized steel to ASTM A764, finish 1, class 1, type 3.

.2 Stone fill:
  .1 Hard, durable, abrasion resistant, capable of resisting degradation from action of wetting and drying, wave action, freezing and thawing cycles.
  .2 Minimum 100 mm to maximum 200 mm dimension for individual stones.

.3 Perforated HDPE underliner drainage pipe: perforated, corrugated pipe with geotextile filter sock to ASTM F2648/F2648M. Dimension as indicated.

.4 HDPE underliner riser: non-perforated, corrugated, smooth-bore HDPE pipe to ASTM F2648/F2648M. Dimension as indicated.

.5 Fittings: shall be suitable for and compatible with the class and type of pipe with which they will be used.

2.1 MATERIALS (Cont'd)

.6 Pumps: Contractor to determine the required pump needed to pump out water within the underliner risers.

.7 Geotextile Type 3: in accordance with Section 31 32 19.01.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Prior to installation of geotextile and gabion filled baskets, remove and treat ponded water within the ECF to elevation +0.2 m.

.2 Install and place geotextile on dredge sediment at elevation +0.2 m to details indicated and to Section 31 32 19.01.

.3 Install gabions, perforated HDPE underliner drainage pipe, HDPE underliner riser, associated fittings on previously placed geotextiles to lines, grades and details as indicated and as specified. Follow manufacturer's instructions in assembling baskets.

.4 Secure gabion filled baskets to channel wale at 1 m interval using selvedges wire.

.5 Cut selvedges wire prior to placement of drainage stone.

.6 Place drainage stone wrapped with geotextile along the anchor wall perimeter to details indicated and concurrently with the placement of the stone filled gabion baskets and all underliner drainage pipes/risers system. Placement shall also be in accordance with Sections 31 32 11 and 31 32 19.01.

3.2 UNSTABLE FOUNDATIONS

.1 Ensure pipe is laid on stable foundations. Correct areas of instability when encountered.

3.3 LAYING DRAINAGE PIPES AND RISERS

.1 Replace any pipe damaged by excessive exposure to sunlight or by any other means.

.2 Place pipe with geotextile sock firmly on the bedding and secure in place to prevent any movement or disturbance during backfilling.

3.3 LAYING DRAINAGE PIPES AND RISERS (Cont'd)

.2 (Cont'd)
Install pipe with perforations on one side only with perforations down. Do not lay pipe in water or on saturated bedding.

.3 Connections between piping shall be made with prefabricated 45° elbows or pre-manufactured pipe curves as required.

.4 Install underliner risers to details indicated on drawings.

.5 Departmental Representative to inspect pipe and riser prior to backfilling.

.6 Pump and dewater from underliner riser during placement of drainage stone.

.7 Collect all pumped water and treat to discharge requirements in Section 44 01 40.

3.4 PLACING GABIONS

.1 Wherever possible, place baskets in position prior to filling with stones.

.2 Join adjacent baskets together at corners as recommended by manufacturer, to ensure joints are as strong as mesh.

3.5 FILLING BASKETS

.1 Ensure that the perforated underliner drainage pipes, underliner risers and associated components are not damaged or dislodged during the placement of gabions.

.2 Remove and replace damage pipes, risers and associated components at no additional cost to Contract.

.3 Tension gabions according to manufacturer's instructions before filling with stone. Do not release wall tension until sufficient stone fill has been placed to prevent wall slackening.

.4 On exposed faces of gabions, place stones by hand with flattest surfaces bearing against face mesh to produce satisfactory alignment and appearance.

.5 Fill gabion cells in lifts not to exceed 300 mm and connect opposite walls with two tie wires after each lift.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Requirements for isolation capping, consisting of specified materials here in.

.2 Isolation capping is to be placed along the U.S. Steel Channel as shown on the Drawings.

.3 Verification of the isolation capping will be by bathymetric survey and sediment coring.

1.2 MEASUREMENT PROCEDURES

.1 Organoclay Mat will be measured by the square metre of material placed and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.2 Sand Cap Mixture will be measured in tonnes of material placed and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.3 Geotextile Type 2 will be measured under Section 31 32 19.01.

.4 Gabion Stone Type 2 at will be measured in tonnes of material placed and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

1.3 REFERENCE

.1 American Society for Testing and Materials International (ASTM):
.1 ASTM C87/C87M-10, Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.
.2 ASTM D422-63(2007)e2, Standard Test Method for Particle-Size Analysis of Soils.
.3 ASTM D854-14, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer.
.4 ASTM D2216-10, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

1.3 REFERENCE (Cont'd)

.1 (Cont'd)
.5 ASTM D2974-14, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
.6 ASTM D3786/D3786M-13, Standard Test Method for Bursting Strength of Textile Fabrics - Diaphragm Bursting Strength Tester Method.
.7 ASTM D4129-05(2013), Standard Test Method for Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection.
.8 ASTM D4355/D4355M-14, Standard Test Method for Deterioration of Geotextile by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
.9 ASTM D4491/D4491M-15, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
.10 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
.11 ASTM D4751-12, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
.12 ASTM D7481-09, Standard Test Methods for Determining Loose and Tapped Bulk Densities of Powders using Graduated Cylinder.

.2 Canadian Standards Association (CSA International)
.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.3 Ontario Provincial Standard Specification (OPSS):
.1 OPSS 1001, November 2013, Material Specification for Aggregates - General.
.2 OPSS.PROV 1004, November 2012, Material Specifications for Aggregates - Miscellaneous.
.3 OPSS.PROV 1010, April 2013, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

.4 Ministry of Transportation (MTO), Ontario, Publications: to OPSS.PROV 1004, November 2012, 1004.02 Reference.

1.4 DEFINITIONS

.1 Grade(s) - grades based on required engineered cap thickness above existing sediment bathymetry as shown on the Drawings.

1.4 DEFINITIONS (Cont'd)

.2 Organoclay Mat - A manufactured material consisting of organoclay encapsulated between layers of geotextiles.

.3 Geotextile - Any permeable geosynthetic comprised solely of textiles.

.4 Minimum Average Roll Value (MARV) - For geosynthetics, the value calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

.5 Overlap - Where two adjacent organoclay mat panels contact, the distance measuring perpendicular from the overlying edge of one panel to the underlying edge of the other.

.6 Typical Value - The mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with one specific property.

.7 Over-placement allowance - The over-placement allowance is only applicable to the Sand Cap and the Armoured Sand Cap. The Drawings specify the required cap thickness. The allowable over-placement, beyond the required cap thickness, is minimum 0 mm to maximum 80 mm thick.

1.5 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.
- .1 Submit a shop drawing showing the concrete mat panel layout, including overlaps of organoclay mat if the Contractor elects to connect the mat to the concrete mat prior to deployment.
- .2 Submit the organoclay mat and concrete mat manufacturer's Quality Assurance/Quality Control (QA/QC) certifications for each shipment of organoclay mat and concrete mat.
- .3 Organoclay mat Quality Documentation:
  - .1 The manufacturer shall provide the Contractor with manufacturing QA/QC certifications for each shipment of organoclay mat. The certifications shall be signed by a responsible party employed by

1.5 SUBMITTALS (Cont'd)

.1 (Cont'd)

.3 (Cont'd)

the organoclay mat manufacturer and shall include:

.1 Organoclay mat lot and roll numbers supplied for the project (with corresponding shipping information).

.2 Certificates of analysis for the organically modified bentonite clay used in organoclay mat production demonstrating compliance with Part 2 - Products.

.3 Manufacturer's test data for finished organoclay mat product including mass/area, mat grab tensile and elongation strength, and mat hydraulic conductivity demonstrating compliance with Part 2 - Products.

.4 Pre-Construction:

.1 Verify U.S. Steel Intake structure location and configuration and submit a report that documents and summarizes the results of the verification, including a drawing showing the horizontal location of the intake, the vertical location of the intake openings including elevations, and the elevation of the sediment surface adjacent to the intake.

.2 Provide sample of each of the Sand Cap materials (sand, silt, and TOC amendment) with a minimum volume of a 1 litre for each of the sand cap materials to Departmental Representative at least three (3) days prior to the Pre-construction Conference.

.5 Provide sample of organoclay mat with minimum dimensions of 300 mm by 300 mm and representative sample of block, connector, and fastener materials comprising the concrete mat to Departmental Representative at least two (2) weeks prior to the Pre-construction Conference.

.6 Isolation Cap Placement Plan including the following:

.1 A complete description of proposed means and methods for the isolation capping work, including equipment details such as type, size, and number and manufacturer specifications for other equipment such as tug boats, barges, and other support vessels. The placement plan shall include sufficient detail to demonstrate that the Contractor's approach has been developed to accurately place the isolation cap

1.5 SUBMITTALS (Cont'd)

.1 (Cont'd)

.6 (Cont'd)

material. Details such as assumed production rate and schedule shall also be provided for the different work environments encountered during the work (e.g., near structures, near U.S. Steel intake). Placement methods shall include specific turbidity controls and how turbidity controls will be implemented during capping. Plan shall also include operational and mitigation measures to be implemented should capping activities cause exceedances of water quality compliance criteria specified in Section 01 35 43.

.2 Proposed approach for deployment of equipment and personnel, including mobilization of equipment utilized in the execution of the work, to the Work Area and daily deployment of personnel and vessels, refer to Section 01 14 00.

.3 Proposed approach for the Sand Cap and Armoured Sand Cap areas including thin-layer lifts to ensure no gaps in cap coverage, and proposed procedures for material placement to achieve target thickness within allowable over-placement thickness.

.7 During Construction:

.1 Submit results of all required analyses for imported materials by the Contractor's laboratory(s) prior to bringing imported materials onsite, including the specific location of the source and the date when samples were obtained, and chain-of-custody documentation.

.2 Aggregate Materials:

.1 The name, location, and quantity of each source and type of fill material proposed including a sample of each source and fill type to be sampled for volatile organic compounds (VOCs), PAHs, and metals. Provide necessary coordination with all proposed source(s) to provide samples to the Departmental Representative. The results of the analyses will be compared to the appropriate regulatory chemical analytical standards or other requirements. If such analyses indicate unacceptable chemical or physical characteristics, Departmental Representative will reject the use of fill materials from the

1.5 SUBMITTALS (Cont'd)

.2 Aggregate Materials:(Cont'd)

.1 (Cont'd)
proposed source(s), and the Contractor must identify and submit a sample(s) from another fill material source. If a fill material source is rejected by Departmental Representative, analytical testing for one additional fill material source will be performed at the expense of Departmental Representative. If additional fill material sources (more than two sources per fill material) are rejected, additional testing will be at the expense of the Contractor.

.2 Samples and test reports of the material for parameters specified in Part 2 - PRODUCTS.

.3 Submit all fill materials documentation in an organized format within a Borrow Site Characterization Report, which shall include identification of the source of each proposed fill material (including a map documenting the origin of the material) and description of material samples and characterization data (both physical and chemical analytical testing, with comparison to specification criteria demonstrating that the fill materials will meet the Contract documents.

- .1 Contractors shall provide the following tests of physical properties for fill material sources for each fill material specified, using either Ministry of Transportation Ontario Testing Manual procedures or equivalent ASTM procedure:
  - .1 Grain size analysis including gradation of both coarse-grained and fine-grained particles to LS-602 and LS-702.
  - .2 Moisture content to ASTM D2216.
  - .3 Organic content to ASTM D2974.
  - .4 Specific gravity to ASTM D854.
  - .5 Moisture-compaction density relationships for ECF cap fill materials having compaction requirements to ASTM D1557.
  - .6 Freezing and Thawing of Coarse Aggregate to LS-614.
  - .7 Aggregate permeability for
  - .8 Liquid Limit, Plastic Limit, and Plasticity Index of soils for fine-grained fraction to LS-703 and LS-704.
  - .9 Resistance of coarse and fine aggregate to degradation by abrasion to LS-618 and LS-619.
  - .10 Loose unit-weight by weighing over-sized fill materials, where

1.5 SUBMITTALS (Cont'd)

.2 Aggregate Materials:(Cont'd)

.3 (Cont'd)

over-sized is all fill materials exceeding particle limits for ASTM procedure D1557, in a separately weighed box of sufficient size to provide representative volume as approved by the Departmental Representative. Value is interior volume of box per weight of over-sized material loosely placed and contained within box.

.2 Chemical analytical testing shall include either EPA or equivalent method according to procedures identified by the MOE for chemistry testing of soil:

.1 Total Polycyclic Aromatic Hydrocarbons to US EPA Method 8270.

.2 Volatile Organic Compounds to EPA Method 8240.

.3 Polychlorinated Biphenyls to EPA Method 8080.

.4 Priority metals to EPA Method 6010.

1.6 QUALITY CONTROL

.1 Sampling, testing and inspection to Section 01 45 00.

.2 Comply with all applicable local, provincial, and federal permits, laws, regulations, and codes, including applicable health and safety protocols and practices established for this site.

1.7 NOTIFICATIONS

.1 Notify Departmental Representative and U.S. Steel at least 72 hours prior to isolation capping construction. Coordinate with U.S. Steel to reduce impacts to U.S. Steel operations.

1.8 PROTECTION

.1 Protect existing structures, roads, landscaping and components not part of the Work from damages associated with Work activities. Make good of damages at no extra cost to Contract.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Organoclay Mat:
.1 The mat shall consist of a layer of organically modified bentonite clay encapsulated between geotextiles and shall comply with all of the criteria listed in this Section.
.2 Minimum dimensions of full-size organoclay mat panels: approximately 30.5 m in length by 4.6 m in width.
.3 Organoclay properties:
.1 Bulk Density: to ASTM D7481, test frequency of 1/lot, 700-900 kg/m^3.
.2 Oil Absorption Capacity: test frequency of 1/lot, minimum 0.5kg of oil per kg of clay.
.3 Quaternary Amine Content: test frequency of 1/lot, 25-33% residue at 800°C.
.4 Finished organoclay mat properties:
.1 Organoclay Mass/Area: test frequency 1/3,700 m^2, minimum 4.0 kg/m^2.
.2 Mat Grab Strength (machine direction): to ASTM D4632, test frequency of 1/18,500 m2, MARV 400 N.
.3 Hydraulic Conductivity (at 13.8 kPa): to ASTM D4491/D4491M, test frequency of 1/lot, minimum 1x10-3 cm/s.

.2 Sand Cap Mixture:
.1 Sand Cap Mixture shall be prepared by adding a Total Organic Carbon (TOC) amendment to Winter Sand.
.2 Winter Sand to OPSS material 1004.05.07, OPSS.PROV 1004, November 2012 - Materials Specifications for Aggregates - Miscellaneous.
.3 Modify Winter Sand to include an amendment to add TOC. Gradation as follows:
.1 Minimum 70% of winter sand.
.2 Soil Amendment.
.4 Resulting mixture of winter sand and soil amendment shall have a the following properties:
.1 Minimum TOC of 3% after placement in the work, quantified using a combustion method (not a titration type of approach).
.2 Chemical Composition - the mixture of winter sand and soil amendments must meet the Lowest Effect Level from the following tables presented in the Ontario Ministry of Environment: Guidelines for Identifying, Assessing and Managing Contaminated

2.1 MATERIAL (Cont'd)

.2 Sand Cap Mixture:(Cont'd)

.4 (Cont'd)

Sediments in Ontario: An Integrated Approach, May 2008.

.1 Metals and Nutrients: to Table 1: Provincial Sediment Quality Guidelines for Metals and Nutrients.

.2 Polychlorinated biphenyls (PCBs): to Table 2a: Provincial Sediment Quality Guidelines for PCBs and Organochlorine Pesticides.

.3 Total polycyclic aromatic hydrocarbons (PAHs): to Table 2b: Provincial Sediment Quality Guidelines for Polycyclic Aromatic Hydrocarbons.

.3 Submit 5 samples of resulting mixture to accredited CCIL laboratory for bulk chemical analysis. All samples must pass Chemical Composition criteria.

.5 Departmental Representative will take core samples from the placement of sand cap mixture to verify the TOC content.

.1 The isolation cap area with be divided into 6 equal areas. The Departmental Representative will take 5 core samples from each of the 6 areas, the average of the 5 cores at each area shall have at least 3% of TOC for the area to be accepted. Cores may be taken from any elevation within the isolation cap.

.3 Geotextile Type 2: to Section 31 32 19.01.

.4 Gabion Stone Type 2: to Ontario Provincial Standard Specification, OPSS.PROV 1004, November 2012, Material Specification for Aggregates - Miscellaneous. OPSS material 1004.05.05. Gabion Stone shall be well graded stone free of deleterious and organic material, with the following exception to stone size:

.1 D100 = 115 mm (maximum stone size).

.2 D50 = 76 mm.

.3 D15 = 53 mm.

.4 Minimum stone size is 38 mm.

.5 Turbidity curtain: to Section 35 49 25.

2.2 PACKAGING

.1 Organoclay Mat:

.1 Organoclay mat shall be wound around a rigid core whose diameter is sufficient to

2.2 PACKAGING (Cont'd)

.1 Organoclay Mat:(Cont'd)
  .1 (Cont'd)
  facilitate handling and sufficiently strong to prevent collapse during transit.

.2 All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

PART 3 - EXECUTION

3.1 WORK RESTRICTIONS

.1 To Section 01 14 00.

3.2 SHIPPING, HANDLING, AND STORAGE

.1 Be responsible for shipping, unloading, handling and storage of the organoclay mat and cable concrete mat.

.2 Inspect each organoclay mat roll and each concrete mat during unloading to identify if any organoclay mat packaging and/or concrete mat have been damaged.

.3 Organoclay mat rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

.4 A dedicated storage area shall be selected at the Work Area that is away from high traffic areas and is level, dry and well drained.

.5 Organoclay mat rolls shall be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled and as recommended by the manufacturer.

.6 All stored organoclay mat materials must be covered with a plastic sheet or tarpaulin until installation.

.7 The integrity and legibility of the labels shall be preserved during storage.

3.2 SHIPPING, HANDLING, AND STORAGE (Cont'd)

.8 Aggregate Materials:
.1 Stockpile and store aggregate materials in manner to prevent segregation and completely separate from contaminated materials and debris handling areas.
.2 Stockpile on existing concrete slab in the Contractor Staging Area is not to exceed 20 kPa.

.9 Geotextile Type 2: to Section 31 32 19.01.

3.3 GENERAL

.1 Prior to construction, verify the U.S. Steel intake openings, and intake opening elevations as well as the elevation of outfalls and of the sediment surface in the vicinity of the U.S. Steel Intake. Notify Departmental Representative if the minimum distance does not meet.

.2 Do not place isolation capping materials at area indicated on Drawings until Departmental Representative have conducted a bathymetric survey of the required area. This will constitute as a pre-capping survey, and will be used to compare results of the post-capping survey to confirm isolation capping thickness.

.3 Place isolation cap materials at locations and thicknesses shown on Drawings.

3.4 DEBRIS REMOVAL

.1 Prior to isolation capping, remove all debris that protrudes above the existing sediment surface and to Section 35 20 33.

.2 Transport the debris from work area to contaminated materials storage area in the Contractor Staging Area.

.3 Disposal in accordance with Section 01 74 20.

3.5 ORGANOCLAY MAT PLACEMENT

.1 Organoclay mat placement:
.1 Rolls shall be delivered to the Work Area in their original packaging.
.2 Prior to deployment, the surface shall be approved by the Departmental Representative.
.3 Immediately prior to deployment, carefully removed packaging without damaging the organoclay mat.
.4 Rolls may be suspended and maneuvered over the surface utilizing a steel pipe placed

3.5 ORGANOCLAY MAT PLACEMENT (Cont'd)

.1 (Cont'd)

.4 (Cont'd) through the core of the roll and suspended from suitable equipment utilizing a spreader bar to prevent chaffing of the edge of the roll, and to orient the mat as it is installed to minimize interference from relatively increased flow velocities near the intake. Removable weights (e.g., sand bags) and anchor lines may be used to resist distortion of and damage to the mat as it is placed near the intakes. Removable weights and anchor lines shall be removed before concrete mats are placed.

.5 The organoclay mat panels shall be placed parallel to the direction of the slope.

.6 All organoclay mat panels shall be placed flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

.2 Overlap:

.1 Seams are constructed by overlapping adjacent edges. Seams at the ends of the panels shall be constructed such that they are shingled in the direction of the grade/slope.

.2 The minimum dimension of the longitudinal overlap shall be 300 mm. End-of roll overlapped seams shall be constructed with a minimum overlap of 600 mm.

.3 Overlaps shall be secured with removable weights if required to maintain the overlaps in installed and specified condition prior to placement of concrete mats. The removable weights shall be removed before the concrete mats are placed.

.4 Organoclay mat panels may be sewn together using standard geotextile sewing equipment prior to deployment to facilitate placement.

3.6 CONCRETE MAT PLACEMENT

.1 Prior to concrete mat placement, the organoclay mat placement shall be approved by Departmental Representative.

.2 Placement of the units shall be in accordance with manufacturer's recommendations.

.3 Concrete mat units shall be installed at the locations shown on the Drawings.

.4 The concrete mats shall be placed on the organoclay mat in such a manner as to produce a

3.6 CONCRETE MAT PLACEMENT (Cont'd)

.4 (Cont'd)
smooth plane surface in intimate contact with the organoclay mat.

.5 The organoclay mat may be secured to the concrete mat prior to deployment if sufficient overlap of the organoclay mat is provided.

.6 The concrete mats shall be placed side by side with a maximum distance between adjacent concrete mats of 150 mm, measured perpendicular to the abutting parallel edges of the concrete mats.

.7 Do not damage organoclay mat during installation of concrete mats or the concrete mat during the installation process.

.8 Ensure concrete mat boundaries are in contact with and transition to adjacent sand cap mixture as shown on the Drawings. Concrete mat boundaries shall be accessible for removal and not buried.

3.7 PLACEMENT OF SAND CAP MIXTURE AT U.S. STEEL

.1 Place sand cap mixture to lines and grades as shown on Drawings. Place sand cap mixture within a rectangular turbidity barrier that extends from the water surface to no more than 1 m from the harbour bottom. The minimum horizontal barrier shape is 10 m.

.2 Turbidity barrier in accordance with Section 35 20 35. The capping activities shall be conducted to reduce turbidity impacts in the U.S. Steel Channel and to meet the turbidity limit for capping activities specified in Section 01 35 43.

.3 The placement equipment shall not be allowed to impact the cap. Placing shall be done in such a manner as to minimize resuspension of sediments and capping material.

.4 Sand cap mixture shall be placed in no greater than 150 mm lifts and in a systematic manner that will provide uniformity throughout the full cap thickness. Individual lifts shall be placed at consistent thickness for the complete limits of the Sand Cap Mixture and Armoured Sand Cap Mixture Area for each respective lift prior to placement of the subsequent lift. Capping

3.7 PLACEMENT OF SAND CAP MIXTURE AT U.S. STEEL (Cont'd)

.4 (Cont'd)
mixture shall be placed at an appropriate rate to minimize disturbance of the sediment surface.

.5 The minimum thickness of the sand cap mixture shall be the dimension shown on the Drawings. The maximum acceptable thickness shall be the dimensions shown on the drawings plus over-placement allowance of 80 mm.

.6 There shall be no mechanical disturbance of the pre-cap sediment surface or subsequently placed lifts of capping mixture, by methods including to but not limited to a drag bar, clamshell bucket, and barge spudding, unless such disturbance is pre-approved by Departmental Representative. Obtaining core samples and anchoring of turbidity curtains shall not be considered mechanical disturbance.

.7 Sand cap mixture shall be placed only after receiving approval from Departmental Representative. Any fill placed without the approval shall be removed as directed at no extra cost to Contract.

.8 Departmental Representative will take core samples from the placement of sand cap mixture to verify the TOC content.
.1 The isolation cap area with be divided into 6 equal areas. The Departmental Representative will take 5 core samples from each of the 6 areas, the average of the 5 cores at each area shall have at least 3% of TOC for the area to be accepted.

3.8 INSTALLATION OF GEOTEXTILE AND GABION

.1 Geotextile Type 2 and gabion stone shall be placed only after receiving approval from Departmental Representative.

.2 Geotextile Type 2 and gabion stone shall be placed to the limits and grades shown on the Drawings.

.3 Gabion stone shall be placed using a clamshell bucket within a maximum 900 mm drop height of the top of the cap. Gabion stone shall not be dumped but shall be methodically placed.

3.9 DAMAGE REPAIR

.1 Concrete mats damaged during storage, handling, or installation shall be repaired in accordance with manufacturer's recommendation and in manner approved by the Departmental Representative. Replace and/or repair damaged concrete mat at no extra cost to Contract.

.2 If the organoclay mat is damaged (torn, punctured, perforated, etc.) during installation of organoclay mat and concrete mat, a patch shall be obtained from a new organoclay mat roll and shall be cut to size such that a minimum overlap of 300 mm is achieved around all of the damaged area.

.3 Geotextile Type 2: to Section 31 32 19.01.

3.10 VERIFICATION TESTING

.1 The final grade of the isolation cap shall be as indicated on Drawings, and within the over-placement allowance. If the material thickness is found to exceed the allowance, remove excess material at no cost to Contract upon request.

.2 Notify Departmental Representative when sand cap mixture placement is completed and has been verified to meet lines and grades as indicated on Drawings. Allow Departmental Representative 5 working days to conduct a post-capping survey and verification of sand cap mixture and organoclay mat thickness by means of sediment coring.

.3 Notify Departmental Representative when all isolation capping placement is completed and has been verified to meet lines and grades as indicated on Drawings. Allow Departmental Representative 5 working days to conduct a post-capping survey and verification of thicknesses by means of sediment coring.

.4 Verification will be performed by comparing the results of the pre-capping bathymetric survey to the results of the post-capping bathymetric survey, as well as with the results of the sediment cores.

3.11 DISPOSAL OF HAZARDOUS MATERIALS

.1 Dispose of surplus, waste materials and hazardous materials in accordance with Section 01 74 20.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Subaqueous thin-layer backfill/capping of specified materials shall be placed at the verification zones indicated on the drawing.

.2 Material and sequencing of placement are specified here in. The method of placement shall be approved by Departmental Representative.

.3 Verification of thin-layer backfill/capping will be by pre- and post-bathymetric surveys and sediment coring.

1.2 MEASUREMENT PROCEDURES

.1 Thin Layer Backfill of 100 mm thickness placed at dredged verification zones will be measured by the square metre of material placed and accepted and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.2 Thin Layer Capping Type 1 of 150 mm thickness placed at the Capping Areas (C1-1 to C1-6) will be measured by the square metre of material place and accepted and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.3 Thin Layer Capping Type 2 of 100 mm thickness placed at undredged Priority 3 Verification Zones will be measured by the square metre of material placed and accepted and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.4 Thin Layer Capping Type 3 of 75 mm thickness placed at undredged Priority 3 Verification Zones will be measured by the square metre of material placed and accepted and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.5 Thin Layer Capping Type 4 of 100 mm thickness placed at undredged Priority 3 Verification

1.2 MEASUREMENT PROCEDURES (Cont'd)

.5 (Cont'd)
Zones will be measured by the square metre of material placed and accepted and shall include all labour, materials and equipment necessary to complete the work. No allowance will be made for material placed outside the limits indicated on Drawings.

.6 Delay of thin layer backfilling/capping due to ongoing Navigation and Shipping Navigation in Hamilton Harbour will not be measured separately for payment.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
.1 ASTM C29/C29M-09, Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.
.2 ASTM C87/C87M-10, Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.
.3 ASTM D422-63(2007)e2, Standard Test Method for Particle-Size Analysis of Soils.
.4 ASTM D854-14, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer.
.5 ASTM D1557-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
.6 ASTM D2216-10, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
.7 ASTM D2974-14, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
.8 ASTM D4129-05(2013), Standard Test Method for Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection.
.9 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

.2 Ontario Provincial Standard Specification (OPSS), Materials:
.1 OPSS 1001, November 2013, Material Specification for Aggregates - General.
.2 OPSS.PROV 1004, November 2012, Material Specifications for Aggregates - Miscellaneous.

1.3 REFERENCES (Cont'd)

.2 (Cont'd)

.3 OPSS.PROV 1010, April 2013, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

.3 Ministry of Transportation (MTO), Ontario, Publications: to OPSS 1004.02 and OPSS 1010.04.

1.4 DEFINITIONS

.1 Thin Layer Backfill: applies to Verification Zones that have been dredged to required dredge grade as indicated on the drawings. The thickness of the thin layer backfill is as specified. Areas that have been dredged may require thin layer backfill, depending on confirmatory post-dredge sampling.

.2 Thin Layer Capping Type 1: applies to the Capping Areas (C1-1 to C1-6) as indicated on the drawings. The capping thickness is 150 mm along the Capping Areas (C1-1 to C1-6).

.3 Thin Layer Capping Type 2, 3, 4: applies to Priority 3 capping areas that have not been dredged. The capping thickness for Type 2 and 4 is 100 mm at the undredged locations of Priority 3 areas. The capping thickness for Type 3 is 75 mm.

1.5 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 A complete description of Contractor means and methods for the thin layer backfill/capping work, including equipment details such as type, size, and number and manufacturer specifications for other equipment such as tug boats, barges, and other support vessels. The placement plan shall include sufficient detail to demonstrate that the Contractor's approach has been developed to accurately place the thin layer backfill/capping material. Details such as assumed production rate and schedule shall also be provided for the different work environments encountered during the work (e.g., shoreline areas, open water, near structures). Placement methods shall include how water-column dispersion occurring during placement and suspension of bottom sediments shall be reduced to the greatest possible extent to minimize the release of contaminants and provide for effective backfilling. Plan shall also include

1.5 SUBMITTALS (Cont'd)

.2 (Cont'd)
operational measures to be applied if dispersion of sediment causes exceedances of water quality compliance criteria specified in Section 01 35 43.

.3 Proposed approach for providing complete coverage of the areas to be backfilled/capped thin-layer lifts to ensure no gaps, and proposed procedures for material placement to achieve target thickness within over-placement allowance.

.4 Proposed means and methods to verify thin layer backfill/capping thickness and horizontal coverage specified in the Drawings, including positioning equipment to be used.

.5 Verification equipment technical specifications.

.6 Aggregate Materials:
.1 The name, location, and quantity of each source and type of fill material proposed including a sample of each source and fill type to be sampled for volatile organic compounds (VOCs), PAHs, and metals. Provide necessary coordination with all proposed source(s) to provide samples to the Departmental Representative. The results of the analyses will be compared to the appropriate regulatory chemical analytical standards or other requirements. If such analyses indicate unacceptable chemical or physical characteristics, Departmental Representative will reject the use of fill materials from the proposed source(s), and the Contractor must identify and submit a sample(s) from another fill material source. If a fill material source is rejected by Departmental Representative, analytical testing for one additional fill material source will be performed at the expense of Departmental Representative. If additional fill material sources (more than two sources per fill material) are rejected, additional testing will be at the expense of the Contractor.
.2 Samples and test reports of the material for parameters specified in Part 2 - PRODUCTS.
.3 Submit all fill materials documentation in an organized format within a Borrow Site Characterization Report, which shall include identification of the source of each proposed fill material (including a map documenting the origin of the material) and description of

1.5 SUBMITTALS (Cont'd)

.6 Aggregate Materials:(Cont'd)

.3 (Cont'd)
material samples and characterization data (both physical and chemical analytical testing, with comparison to specification criteria demonstrating that the fill materials will meet the Contract documents.

.1 Provide the following tests of physical properties for fill material sources for each fill material specified, using either Ministry of Transportation Ontario Testing Manual procedures or equivalent ASTM procedure:

.1 Grain size analysis including gradation of both coarse-grained and fine-grained particles to LS-602 and LS-702.
.2 Moisture content to ASTM D2216.
.3 Organic content to ASTM D2974.
.4 Specific gravity to ASTM D854.
.5 Moisture-compaction density relationships for ECF cap fill materials having compaction requirements to ASTM D1557.
.6 Freezing and Thawing of Coarse Aggregate to LS-614.
.7 Aggregate permeability for
.8 Liquid Limit, Plastic Limit, and Plasticity Index of soils for fine-grained fraction to LS-703 and LS-704.
.9 Resistance of coarse and fine aggregate to degradation by abrasion to LS-618 and LS-619.
.10 Loose unit-weight by weighing over-sized fill materials, where over-sized is all fill materials exceeding particle limits for ASTM procedure D1557, in a separately weighed box of sufficient size to provide representative volume as approved by the Departmental Representative. Value is interior volume of box per weight of over-sized material loosely placed and contained within box.

.2 Chemical analytical testing shall include either EPA or equivalent method according to procedures identified by the MOE for chemistry testing of soil:

.1 Total Polycyclic Aromatic Hydrocarbons to US EPA Method 8270.
.2 Volatile Organic Compounds to EPA Method 8240.

1.5 SUBMITTALS (Cont'd)

.6 Aggregate Materials:(Cont'd)

.3 (Cont'd)

.3 Polychlorinated Biphenyls to EPA Method 8080.

.4 Priority metals to EPA Method 6010.

1.6 QUALITY ASSURANCE

.1 Sampling, testing and inspection to Section 01 45 00.

1.7 PROTECTION

.1 Protect existing structures and components not part of the Work from damages associated with Work activities. Make good of damages at no extra cost to Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Thin Layer Backfill 100 mm thick: to OPSS material 1004.05.07, OPSS.PROV 1004, November 2012, Materials Specifications for Aggregates - Miscellaneous. Thin layer backfill material shall be free of deleterious and organic material.

.2 Thin Layer Capping Type 1 - 150 mm thick: to Sand Cap Mixture material as specified in Section 31 80 00.

.3 Thin Layer Capping Type 2 - 100 mm thick: to OPSS material 1004.05.07, OPSS.PROV 1004, November 2012, Materials Specifications for Aggregates - Miscellaneous. Thin layer backfill material shall be free of deleterious and organic material, with the following exception to stone size:

.1 D50 = 1 mm.

.4 Thin Layer Capping Type 3 - 75 mm thick: to OPSS material 1004.05.07, OPSS.PROV 1004, November 2012, Materials Specifications for Aggregates - Miscellaneous. Thin layer backfill material shall be free of deleterious and organic material, with the following exception to stone size:

.1 D50 = 1 mm.

2.1 MATERIAL (Cont'd)

.5 Thin Layer Capping Type 4 - 100 mm thick: to OPSS material 1004.05.07, OPSS.PROV 1004, November 2012, Materials Specifications for Aggregates - Miscellaneous. Thin layer backfill material shall be free of deleterious and organic material, with the following exception to stone size:
.1 D50 = 1.8 mm.

PART 3 - EXECUTION

3.1 SHIPPING, HANDLING, AND STORAGE

.1 Aggregate Materials:
.1 Stockpile and store aggregate materials in manner to prevent segregation and completely separate from contaminated materials and debris handling areas.
.2 Stockpile on existing concrete slab in the Contractor Staging Area is not to exceed 20 kPa.

3.2 COORDINATION

.1 Coordination with Ongoing Navigation and Shipping Navigation in Hamilton Harbour in accordance with Section 01 14 00.

.2 All thin layer backfill/capping operations must accommodate on-going shipping and navigation activities.

3.3 SEQUENCE

.1 Thin layer backfill/capping will not commence until all production and second pass dredging is satisfied, refer to Section 35 20 34.

.2 Prior to placement of thin layer backfill, Departmental Representative will samples and test dredged areas for concentration of PAHs level and will direct Contractor which dredged areas to be backfill with thin layer backfill.

.3 Prior to placement of thin layer backfill/capping materials, Departmental Representative will conduct a bathymetric survey across the verification zones to be backfilled/capped. This will constitute the pre-thin layer backfill/capping survey, and will be used to compare results of the post-thin layer backfill/capping survey to confirm backfill/capping thicknesses.

3.3 SEQUENCE (Cont'd)

.4 Departmental Representative reserves the right to alter the sequence of the Contractor's work as necessary to maintain compliance with Project requirements, enable access to the property by others, or as otherwise deemed necessary by Departmental Representative.

3.4 THIN LAYER BACKFILL/CAPPING PLACEMENT

.1 Subaqueous placement of thin-layer backfill/capping materials shall be accomplished such that material deposits form a uniform layer of the required thickness over the designated area, and water quality compliance criteria specified in Section 01 35 43 are not exceeded. The thin layer backfill/capping shall be placed in a manner that suspension of bottom sediments shall be limited to prevent contamination of the backfill materials.

.2 Place thin layer backfill/capping to thicknesses and in verification zones as directed by Departmental Representative and as specified, thicknesses of thin layer backfill/capping as follows:
  - .1 Thin Layer Backfill 100 mm thick:
    - .1 Thickness: 100 mm.
    - .2 Layer: shall be placed in one lift over the entire verification zones as specified and directed by Departmental Representative, so that the resulting final grade is 100 mm above the pre-thin layer backfill grade.
    - .3 Over-placement allowance: -25 to +50 mm, for a total allowable thickness of 75 mm to 150 mm.
  - .2 Thin Layer Capping Type 1 - 150 mm thick:
    - .1 Thickness: 150 mm.
    - .2 Layer: shall be placed in one lift over the entire verification zones as specified and directed by Departmental Representative, so that the resulting final grade is 150 mm above the pre-thin layer capping grade.
    - .3 Over-placement allowance: 0 to +75 mm, for a total allowable thickness of 225 mm.
  - .3 Thin Layer Capping Type 2 - 100 mm thick:
    - .1 Thickness: 100 mm
    - .2 Layer: shall be placed in one lift over the entire verification zones as specified and directed by Departmental Representative, so that the resulting final

3.4 THIN LAYER BACKFILL/CAPPING PLACEMENT (Cont'd)

.2 (Cont'd)
  .3 (Cont'd)
    .2 Layer:(Cont'd)
    grade is 100 mm above the pre-thin layer capping grade.
    .3 Over-placement allowance: -25 to +50 mm, for a total allowable thickness of 75 mm to 150 mm.
  .4 Thin Layer Capping Type 3 - 75 mm thick:
    .1 Thickness: 75 mm
    .2 Layer: shall be placed in one lift over the entire verification zones as specified and directed by Departmental Representative, so that the resulting final grade is 75 mm above the pre-thin layer capping grade.
    .3 Over-placement allowance: -50 to +25 mm, for a total allowable thickness of 25 mm to 100 mm.
  .5 Thin Layer Capping Type 4 - 100 mm thick:
    .1 Thickness: 100 mm
    .2 Layer: shall be placed in one lift over the entire verification zones as specified and directed by Departmental Representative, so that the resulting final grade is 100 mm above the pre-thin layer capping grade.
    .3 Over-placement allowance: -25 to +50 mm, for a total allowable thickness of 75 mm to 150 mm.

.3 Select a suitable method of placing the thin-layer backfill/capping materials that meets the objectives of this specification. This may require specialized or customized equipment which accomplishes controlled placement of materials, while preventing the displacement of underlying sediments (i.e., prevents the generation of "mud waves"). Water-column dispersion occurring during placement shall be reduced to the greatest extent achievable to minimize the release of contaminants and provide for effective thin layer backfill/capping placement. Water quality during thin-layer backfill/capping activities shall be in accordance with 01 35 43.

3.5 VERIFICATION TESTING

.1 The final thicknesses of thin layer backfill/capping shall be as specified, and within the over-placement allowance.

3.5 VERIFICATION TESTING (Cont'd)

.2 Notify Departmental Representative when thin layer backfill/capping placement is completed for each Verification Zone and has been verified to meet lines and grades as indicated on Drawings. Allow Departmental Representative 5 working days to conduct a post-thin layer backfill/capping survey and verification of thin layer backfill/capping thickness by means of sediment coring.

.3 Verification will be performed by comparing the results of the pre-thin layer backfill/capping bathymetric survey to the results of the post-thin layer bathymetric survey, as well as with the results of the sediment cores.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Work under this Contract shall include furnishing, installing and maintaining temporary water pollution and erosion and sediment control measures specified herein, proposed by the Contractor and reviewed by the Departmental Representative, or ordered by the Departmental Representative as work proceeds. This work is intended for activities within the Staging Area.

.2 To perform temporary work and control pollution, erosion, stormwater runoff, and related damage, may require the including:
.1 Providing ditches, berms, culverts, and other measures to control stormwater from Contractor Staging Area.
.2 Providing sumps, storage tanks, drainage pipes, and other measures to control stormwater collected in the Water Treatment Plant.
.3 Providing sumps, storage tanks, drainage pipes, treatment, and other measures to control stormwater collected in the contaminated materials staging area.

1.2 MEASUREMENT PROCEDURES

.1 Maintain all components within the Staging area, including but not limited to material and equipment decontamination area, wheel wash station. No measurement will be made under this Section. Include costs for work of this Section under the Lump Sum Arrangement.

.2 Treatment of water that comes in contact with contaminated sediments collected in the material and equipment decontamination area and the wheel wash stations will not be measured separately for payment.

1.3 REFERENCES

.1 Greater Golden Horseshoe Area Conservation Authorities. 2006. "Erosion and Sediment Control Guideline for Urban Construction." December.

1.4 SUBMITTALS

.1 Submit to Departmental Representative for review a site specific Erosion and Sediment Control Plan detailing methods to be used to prevent and control onsite erosion and sediment

1.4 SUBMITTALS (Cont'd)

.1 (Cont'd)
migration from the Work Area during construction activities. The plan shall include but not limited to the followings:
.1 Describe measures to be taken that protect adjacent properties and waterways. At a minimum, indicate the location and details of construction entrances and methods to be used to prevent tracking of mud onto public streets by construction traffic, disposal of stormwater from the site during phases of work, and temporary erosion and sediment control methods.
.2 Provide an implementation schedule for temporary erosion and sediment control practices, including the timing of initial placement and the duration that each practice should remain in place.
.3 Cover the extent of the Work Area, including disposal sites, haul roads, and all nearby land, streams, and other bodies of water.
.4 Describe pollution prevention measures that will be used to control contaminated materials, litter, construction chemicals, soil stockpiles, and construction debris from becoming a pollutant source in stormwater discharges from the Work Area.
.5 Include an inspection form to be completed by the Environmental Monitor. Inspection forms kept onsite and provided to the Departmental Representative upon request.
.6 No earthwork shall be started before this plan is approved by Departmental Representative.

.2 Prior to ordering erosion and sediment control materials, submit to Departmental Representative for review, product data for all erosion control materials.

PART 2 - PRODUCTS

2.1 PRODUCTS

.1 Products that are required to accomplish or be incorporated into the work of this Section shall be as specified in the Drawings or as selected by the Contractor, subject to approval by the Departmental Representative.

.2 Filter berm: shall be clear stone to OPSS.PROV 1004, November 2012, Ontario Provincial Standard Specification 1004, November 2006, Material Specification for Aggregates - Miscellaneous, 53.0 mm.

PART 3 - EXECUTION

3.1 EROSION AND SEDIMENT CONTROL MEASURES

.1 Inspect and maintain temporary erosion and sediment control measures along the perimeter of the Staging Area prior to the initiation of any work within the Staging Area.

.2 Maintain all temporary erosion control measures throughout the duration of the construction activities in accordance with the Contractor's site-specific Erosion and Sediment Control Plan. If exposed areas erode, repair the damage, with eroded material where possible, and clean up any remaining material in downstream drainage facilities.

.3 If Departmental Representative anticipates water pollution or erosion problems, schedule the work so that grading and permanent erosion controls immediately follow grading work. If conditions prevent such scheduling, Departmental Representative may require temporary erosion control measures between work stages.

.4 Departmental Representative may require temporary water pollution and erosion control measures if it appears pollution or erosion may result from weather, the nature of the materials, or progress of the work. Departmental Representative may also require permanent erosion control work to be done during or immediately after grading.

.5 Remove temporary control devices when no longer needed, and restore any disturbance of the area associated with the controls or their removal, as directed by Departmental Representative.

.6 Bear full responsibility for temporary water pollution/erosion control measures for all sources of material, disposal sites, and haul roads the Contractor provides.

.7 Departmental Representative may direct additional erosion and sediment controls to be installed. Comply with Departmental Representative's request and immediately install the required controls.

3.2 FILTER BERM

.1 Inspect filter berm on a regular basis and remove and manage accumulated sediment.

.2 Sediment that is accumulated by the filter berm shall be removed to the level of the grade existing at the time the berm was constructed. Accumulated sediment shall be removed once it reaches half the height of the filter berm.

.3 Filter berm material shall be replace as needed.

.4 Filter berm shall remain in place after completion of this Contract.

3.3 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative. Stockpile materials in manner to prevent segregation.

3.4 WATER COLLECTION AND TREATMENT

.1 Stormwater that collects in the wheel wash area and material and equipment decontamination area prior to first contact with contaminated materials does not require treatment. Pump material from the catch basin in the material and equipment decontamination area and discharge on the adjacent ground in the storage area.

.2 If directed by Departmental Representative, treat all water that collects in the wheel wash station and material and equipment decontamination area after the wheel wash area or material and equipment decontamination area comes in contact with contaminated sediments.

3.5 MATERIAL AND EQUIPMENT DECONTAMINATION AREA

.1 Inspect the decontamination area with Departmental Representative at the time of substantial performance of Stage 1 Contract.

.2 Maintain decontamination area as required to the completion of the Contract.

3.6 WHEEL WASH STATION

.1 Inspect the wheel wash station with Departmental Representative at the time of substantial performance of Stage 1 Contract.

3.6 WHEEL WASH STATION (Cont'd)

.2 Maintain wheel wash station as required to the completion of the Contract.

3.7 USE OF CONTAMINATED MATERIALS STORAGE AREA AND WHEEL WASH STATION

.1 Store any material or equipment that come in contact with contaminated sediments.

.2 Decontaminate to Section 01 35 14.

.3 Decontaminate vehicles that come in contact with contaminated sediments in the wheel wash station to Section 01 35 14.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 The work specified in this Contract is to furnish and/or provide all labour, tools, materials, equipment and services, and complete all work, installed, tested and ready for use as described in the Contract documents.

1.2 MEASUREMENT PROCEDURES

.1 All items not in the unit prices will be in the Lump Sum Arrangement.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Provide all equipment needed to remove, transport and dispose of debris encountered during the work.

.2 Use appropriate debris removal and handling equipment so that resuspension and turbidity induced to the water column during debris removal operations are minimized. Departmental Representative may require controls such as turbidity barriers or other operational controls if water quality monitoring demonstrates values approaching or in excess of requirements.

PART 3 - EXECUTION

3.1 GENERAL

.1 Conduct debris removal activities in accordance with the Contractor's Turbidity Control Plan (TCP).

.2 Prior to dredging, remove obstacles and debris from sediments to be dredged as needed to minimize hydraulic dredge head interference, sediment spillage, and down time delays during dredging in association with debris composed of organic matter and/or inorganic matter.

.3 Large debris, greater than 3 m3 in size, must be placed in the ECF within 30 m of the anchor wall along the north side of the ECF.

3.1 GENERAL (Cont'd)

.4 Debris within 0 to 3 m3 in size can be placed anywhere within the ECF.

.5 All debris shall be placed within the ECF. Departmental Representative may elect to investigate and redirect debris to shore. Costs will be paid as extra to Contract price in accordance with the General Conditions. Debris that require off-site disposal shall be handled as a contaminated material, and segregated from clean materials in accordance with Section 01 74 20. Dispose in an off-site permitted facility approved by Departmental Representative.

.6 Remove and transport debris from point of generation to point of disposal using the means and methods to be determined by the Contractor and explicitly described in the Contractor's Work Plan.

.7 Make provision for removal of debris in tender. Make no claims for delays attributed to debris.

.8 Do not dispose of debris in open lake.

.9 Dispose of the debris in accordance with Section 01 35 14 and Section 01 74 20.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 The objective of the dredging is to dredge and contain Priority 1 and 2 sediments above the Upper Silty Clay Layer within the Engineered Containment Facility (ECF), and then dredge and contain the largest possible quantity of Priority 3 sediments in the remaining space available, once Priority 1 and Priority 2 sediments have been placed in the ECF. The density/consistency of the Upper Silty Clay varies throughout the site and the Contractor shall not use relative density within subsurface materials as a basis for claims or dispute for dredging payment.

.2 Priority 1, Priority 2 and Priority 3 sediments shall be dredged using a hydraulic dredge and placed directly into the ECF using a hydraulic dredge pipeline.

.3 Achievement of required dredge grade and removal of priority sediment will be confirmed by the Departmental Representative based on a comparison of post-dredge sediment grades with the required dredge grades as shown on the Drawings. Final acceptance of work will only be approved upon review of pre-dredge and post-dredge. Second-pass dredging, thin-layer backfilling/capping, or isolation capping shall only commence at the direction of the Departmental Representative after dredging is completed and approved by the Departmental Representative.

.4 Second pass dredging applies only to dredging of contaminated sediment that Departmental Representative sampling indicates is located below the required dredge grade and after the Contractor has completed the required production dredging.

.5 The specific locations and thickness for second pass dredging, which shall apply within Priority 1, 2 and 3 Verification Zones, will be provided to the Contractor after the completion of production dredging.

.6 Complete second pass dredging to remove the required thickness of sediment in all or portions of a Verification Zones as determined by the Departmental Representative.

1.1 SECTION INCLUDES (Cont'd)

.7 If, upon completion of second pass dredging in Priority 1 and 2 Verification Zones, available space remains for placement of sediments in the ECF, dredging of Priority 3 Verification Zones will be authorized by the Departmental Representative

1.2 MEASUREMENT PROCEDURES

.1 Class B Dredging to be measured in cubic metres, in-place measurement (CMPM), determined from soundings taken by Departmental Representative before and after dredging. Only material excavated above the dredge grade will be measured. Dredging shall include all labour, equipment and material necessary to complete the work. The volume in the side slopes will not be measured for payment where the difference in required dredge grades between adjacent dredge units is less than or equal to 1.5 metres.

.1 The elevation of firm sub-soil including clay varies throughout the project. Dredging to specified grade depths will include dredging of softer surface sediments and firm sub-soil including clay. References throughout this specification that refer to dredging of sediments include other material including clay that is above the specified dredge plane.

.2 Class B Dredging on Slope will be measured by square metres horizontal projection as determined by multiplying horizontal length by horizontal width of rectangles defined on Drawings. Dredging within Dredge Areas P1-1, P1-2, P1-33 and P2-29 are considered as Class B Dredging on Slope. These specified areas do not have a specified grade depth. Dredge a minimum of 0.6 m thick to a maximum of 0.9 m thick in these areas.

.3 Second pass dredging where the averaged dredge thickness is less than 300 mm will be measured by square metres horizontal projection (SQM) as determined by multiplying horizontal length by horizontal width of rectangles defined on Drawings. Dredging of side slopes where required will be considered included and will not be measured separately for payment. Second Pass Dredging shall include all labour, equipment and material necessary to complete the work.

.4 Second pass dredging where the averaged dredge thickness is greater than 300 mm will be measured in cubic metres, in-place measurement

1.2 MEASUREMENT PROCEDURES (Cont'd)

.4 (Cont'd)
(CMPM), determined from soundings taken by Departmental Representative before and after dredging. Dredging of side slopes where required will be considered included and will not be measured separately for payment. Second Pass Dredging shall include all labour, equipment and material necessary to complete the work.

.5 Dredging at haul-out location will be measured in cubic metres, in-place measurement (CMPM), determined from soundings taken by Departmental Representative before and after dredging. Only material excavated above the dredge grade will be measured. Dredging shall include all labour, equipment and material necessary to complete the work. The volume in the side slopes will not be measured for payment where the difference in required dredge grades between adjacent dredge units is less than or equal to 1.5 metres.

.6 Include in the dredging payment item, all costs for transport and placement of Class B dredge material in the ECF at the seven different designated discharge locations.

.7 All operations in connection with field positioning of dredging equipment, Contractor's survey vessel, equipment and crew or diving services will not be measured separately for payment but shall be considered included in the dredging item.

.8 There will be no additional payment for delays caused by vessel traffic or downtime.

.9 Average overdredging thickness within a verification zone is not to exceed 150 mm.

.10 If the averaged overdredging thickness within a verification zone is less than 150 mm, no penalty will be apply.

.11 If the averaged overdredging thickness within a verification zone is greater than 150 mm, an amount for all volume below dredge grade will be deducted from measured payment quantities as follows:
.1 For all sediment removed between 0.15 metre and 0.3 metre below dredge grade the deduction shall be $10 per cubic metre.
.2 For all sediment removed between 0.3 metre and 0.6 metre below dredge grade the deduction shall be $50 per cubic metre.

1.2 MEASUREMENT PROCEDURES (Cont'd)

.11 (Cont'd)
.3 For all sediment removed greater than 0.6 metre below dredge grade the deduction shall be $250 per cubic metre.

1.3 RELATED REQUIREMENTS

.1 Departmental Representative reserves the right to adjust the dredge area and required dredge grade as necessary based on field observations and conditions encountered during dredging.

.2 Anchoring utilized during the work includes all mooring, spudding, and other means of securing work-related vessels that result in a disturbance of sediment.

.3 Sediment resuspended as a result of anchoring is subject to Section 35 20 35.

.4 Prior to dredging, remove all debris as defined and in accordance with Section 35 20 33.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Prepare and submit an Anchoring Plan to the Departmental Representative for review 4 weeks prior to commencement of dredging. The Anchoring Plan shall include:
.1 Locations and methods that will be used to secure the work-related vessels and equipment including, but not limited to, dredges, barges, floating pipelines, submerged pipelines, clamshell bucket, dragline, dipper or backhoe dredge, dump scows and other work boats and floating equipment during execution of the work.
.2 The procedure for how the system will work when a temporary movement is required for navigation or other purposes.
.3 The methods through which the Contractor will comply with navigation requirements within the harbour to minimize disturbance to other navigational uses of the harbour.
.4 The procedure and locations for securing all vessels during storm conditions, when ice is present or when work restrictions temporary halt operations (refer to Section 01 14 00).
.5 Anchoring for work-related vessels that are under the control of the Contractor, but are currently not being used in conduct of the work.

1.4 SUBMITTALS (Cont'd)

.2 (Cont'd)

.6 Anchoring for work-related vessels that are neither owned nor operated by the Contractor.

.7 Plans for securing vessels in areas where anchoring is not permitted, such as areas that have been capped.

.3 Document and report incidents as required by all federal, provincial and local laws, codes, regulations, and in Section 01 35 28.

.4 Qualifications of Dredging Personnel:

.1 Names and years of experience in both general and environmental dredging of the proposed dredge operators to be used on the project. All dredge operators shall be approved by the Departmental Representative prior to the start of work. Departmental Representative reserves the right to revoke approval of a previously-approved dredge operator at any point during the work based on performance.

.2 Qualifications and experience of positioning equipment technical support personnel used for positioning equipment at the Work Area whenever dredging activities take place.

.3 Organization chart of Key Persons proposed for the project including job management and field management, and resumes for the proposed Key Persons.

.4 Do not delegate, reassign, transfer or replace the Key Person to other duties or positions such that the Key Person is no longer available to provide the project with the Key Person's Services unless the Departmental Representative provides prior written consent to such delegation, re-assignment, transfer or replacement. In the event Contractor requests the Departmental Representative to consent to a delegation, re-assignment, transfer or other replacement of the Key Person, the Departmental Representative may interview and review the qualifications of the proposed substitute personnel before providing its consent or rejecting such replacement. Any such replacement shall have equivalent or better qualifications than the Key Person being replaced. Any replacement personnel approved by the Departmental Representative will thereafter be deemed a Key Person for purposes of this Contract.

1.4 SUBMITTALS (Cont'd)

.5 Prepare and submit a Dredge Work Plan to the Departmental Representative for review 4 weeks prior to commencement of dredging. The Dredge Work Plan shall include:

.1 A complete description of means and methods for the dredging work, including equipment details such as type, size, and number of dredges; manufacturer specifications for other equipment such as tug boats, barges, and other support vessels; and manufacturers specifications for transport equipment such as pipelines, booster pumps, clamshell and dump scows. The work plan shall include sufficient detail to demonstrate that the approach has been developed to achieve the required design grades on the Drawings. Details such as assumed production rate and schedule shall also be provided for the different work environments encountered during the work (e.g., shoreline areas, open water, near structures). Means and methods description shall include the dredge type the Contractor has identified for:

  .1 Priority 1, Priority 2 and Priority 3 dredging.

.2 Proposed approach for deployment of equipment and personnel, including mobilization of dredges and other ancillary equipment utilized in the execution of the work, to the Work Area and daily deployment of personnel and vessels refer to Section 01 14 00.

.3 Proposed procedures and equipment for debris removal prior to and during dredging including the segregation, stockpiling, and transport of debris that may be encountered during dredging.

.4 Proposed approach for providing complete coverage of the areas to be dredged including sufficient overlap to ensure no gaps between dredge cuts.

.5 Proposed procedures for dredging to remain within dredging limits and proposed overdredge.

.6 Proposed verification methods for RTK-DGPS and Contractor's means and methods for demonstrating the ability to achieve, monitor, and report these tolerances, and proposed methods to verify the RTK-DGPS error budget (i.e., quality control check of all positioning sensors to verify that individually and together they operate within an error range that satisfies the error budget requirement).

.7 Proposed means and methods for maintenance of all equipment used for activities associated with dredging for the duration of the work.

1.4 SUBMITTALS (Cont'd)

.5 (Cont'd)

.8 Proposed methods for avoiding, protecting, or removing and replacing public and private structures including setbacks.

.9 Identify any exceptions to the setback distances from adjacent structures as shown on the Drawings.

.10 Proposed lighting for work during non-daylight hours, including number and placement of lights, light colours, flashing patterns, and wattages.

.11 Description of logistics of the operation and schedule such as down-times assumptions, sequence of work, and scheduled weekly production rates.

.12 Schedule for all Work submittals during construction.

.13 Assumed work days and hours of operation.

.14 Any proposed changes to the dredge sequence within the VZ.

.15 Provide the Departmental Representative details regarding the location and times the Departmental Representative will be able to have access to the dredging equipment prior to mobilization. In general, Contractor shall facilitate Departmental Representative access to work vessels or equipment upon request.

.6 Prepare and submit a Dredged Sediment Transport Work Plan to Departmental Representative for review 4 weeks prior to commencement of dredging, including proposed means and methods for dredged sediment transport from the dredge to the ECF designated discharge locations including the following:

.1 The transport plan shall include means and methods on how sediments will be discharged at the seven (7) designated discharge locations indicated on the drawings.

.2 For hydraulic dredging:

.1 Technical specifications including but not limited to materials, size, manufacturer and vendor information, installation, verification, and construction methods for the pipe, booster pumps, flotation, anchors, aids to navigation, and instrumentation.

.2 Approximate pipeline location and approach to prevent interference with navigation and vessel movement within the Work Area.

.3 Operation and monitoring approach for the pipeline.

1.4 SUBMITTALS (Cont'd)

.6 (Cont'd)

.2 For hydraulic dredging:(Cont'd)

.4 Means and methods of raising the pipeline over the ECF double sheet pile walls at each discharge locations to attach to the hard-pipe manifold. ECF double sheet pile wall pipeline crossing shall have:

.1 No sharp bends to avoid settling of particles within the pipeline and/or inefficient energy loss.

.2 Sufficient structural support of the pipeline between the double sheet pile walls to protect the pipe, preventing any stress concentrations or strain on the pipeline. Any dredged sediments losses or spills from the pipeline between the walls shall be removed at the expense of the Contract, which shall include but not limited to the removal of constructed components between walls, disposal or decontamination to Section 01 35 13, and replacement within the affected area.

.3 Suitable temporary connection to the ECF to provide for a secure crossing system considering both the pipeline itself, and the external forces acting upon the pipeline during the course of the work.

.5 Means and methods for submerged diffusion of dredged sediments into ECF.

.6 Planned pipeline cleanout schedules, methods for pipeline cleanout, and volumes of water to be used during pipeline cleanout. All pipeline cleanout activities shall be approved by the Departmental Representative prior to the execution of the work.

.7 Means and methods for monitoring ponded water depth in the ECF to ensure minimum ponded water depth is maintained in accordance with Section 44 01 40.

.8 Proposed plan for removal of the pipeline after the dredging work is completed.

1.5 DEFINITIONS

.1 The following defines the terminology used in this specification.

.2 Dredging: excavating, transporting and disposing of underwater materials.

1.5 DEFINITIONS (Cont'd)

.3 Class A material: solid rock requiring drilling and blasting to loosen, and boulders or rock fragments of individual volumes of 1.5 cubic metres or more.

.4 Class B material: loose rock, silt, sand, quick sand, mud, sediments, shingle, gravel, clay and sand, gumbo, boulders, till, debris or and material not specified under Class A.

.5 Sediments:
.1 Sediments within Priority Areas 1, 2 and 3 shown on the Drawings; includes those sediments within the Verification Zones boundaries located between the sediment surface elevation and the required dredge grade.
.2 The following definitions of contaminated sediments' priority have been developed during the design.
.3 Priority 1, 2, 3 Areas: Areas that have been delineated during sediment characterization and design in the following manner:
  .1 Priority 1 (P1) sediments: Area containing sediments with highest concentrations of Total Polycyclic Aromatic Hydrocarbons (PAHs), which can include coal tar, also metals, and toxic based on Benthic Assessment of Sediment (BEAST) analysis.
  .2 Priority 2 (P2) sediments: Total PAHs greater than 100 milligrams per kilogram (mg/kg) and/or metals concentrations greater than the Severe Effects Levels (SELs); toxic based on BEAST analysis.
  .3 Priority 3 (P3) sediments: Total PAHs greater than 100 mg/kg and/or metals concentration greater than SELs; non-toxic based on BEAST analysis or no toxicity information.

.6 Verification Zones: a Verification Zone is a portion of the Work Area, as shown on the Drawings. Verification Zones are identified with numbers through 22. The Verification Zones are subdivisions of the Priority Areas. The Verification Zones are listed below with their associated Priority Area:
.1 Priority 1: Verification Zones VZ-1, VZ-2, VZ-3, VZ-4.
.2 Priority 2: Verification Zones VS-5, VZ-6, VZ-7, VZ-8, VZ-9, VZ-10, VZ-11, VZ-12, VZ-13, VZ-14.
.3 Priority 3: Verification Zones VZ-15,

1.5 DEFINITIONS (Cont'd)

.6 Verification Zones:(Cont'd)
.3 Priority 3:(Cont'd)
VZ-16, VZ-17, VZ-18, VZ-19, VZ-20, VZ-21 and VZ-22.

.7 Production Dredging: is defined as Class B dredging required to achieve the specified grade depths for each dredge area.

.8 Second Pass Dredging: Once the Departmental Representative has determined that required design dredge elevations were achieved in all Priority 1, Priority 2 and Priority 3 Verification Zones as confirmed by the post-dredge survey, second pass dredging will be conducted in Priority 1, Priority 2 and Priority 3 Verification Zones as needed to remove remaining sediments above the Silty Clay layer that was not captured in the dredging configuration provided by the design. Second pass required dredge grades will be provided in the field by the Departmental Representative in the form of a dredging plan with coordinates for second pass dredging units and required dredge grades.

.9 Side Slopes: is the dredging of sediments in locations where the difference in required dredge grades is greater than 1.5 metres between adjacent dredge units. When dredging on slopes is performed, a dredge cut of 3H:1V (horizontal to vertical) will be completed unless otherwise noted on the Drawings, or otherwise approved by the Departmental Representative.

.10 Obstructions: class of material greater than 1.5 cubic metres that is not included in this specification.

.11 Debris: pieces of wood, wood fibre, logs, wire rope, tires, scrap steel, pieces of concrete and other waste materials.

.12 Dredge Grade: plane above which all material is to be dredged.

.13 Estimated quantity:
.1 Volume of material calculated to be above dredge grade and inside specified dredge grade side slopes unless otherwise specified.
.2 Area in square metres of material calculated horizontally to exist above dredge grade and within dredge limits, unless otherwise specified.

1.5 DEFINITIONS (Cont'd)

.14 CMPM: cubic metres place measurement at dredging site.

.15 Cleared areas: areas of dredging accepted as complying with plans and specifications.

.16 Mechanical sweep: clearing all the dredged areas to the dredge grade depth using a mechanical device suspended from a barge.

.17 Chart datum: permanently established plane from which soundings or tide heights are referenced.

.18 Hydraulic dredging plant: equipment that uses the movement of water to excavate and transport underwater materials such as: cutter suction dredger, suction dredger or trailing suction hopper dredger.

1.6 LOCATION

.1 Work comprises dredging of areas as indicated on Drawings.

.2 Area measurements do not include side slopes.

1.7 NOTIFICATIONS

.1 Notifications in accordance with Section 01 11 02.

1.8 INTERFERENCE TO NAVIGATION

.1 Navigation in accordance with Section 01 11 02.

1.9 REQUIREMENTS OF REGULATORY AGENCIES

.1 Mark floating equipment with lights in accordance with the Collision Regulations with Canadian Modifications, 1983, and maintain a VHF marine radio watch on board.

1.10 SITE INFORMATION

.1 Material to be dredged consists of contaminated Class 'B' material.

.2 Results of most recent soundings are shown on drawings.

1.11 DREDGING SEQUENCE

.1 Sequence of dredging in accordance with PART 3 EXECUTION.

1.12 DREDGING PLANT

.1 Dredging plant used in the work to be of sufficient capacity and in good operating condition to satisfactorily complete the work, within the time schedule and in accordance with the specifications.

1.13 QUALITY ASSURANCE

.1 Comply with municipal, provincial and national codes and regulations relating to project.

1.14 SEDIMENT TO BE DREDGED

.1 Information regarding the characteristics of sediment is available to the Contractor, in Appendix B - Sediment Chemistry. The information is based on field investigation and laboratory testing of the sediment to be dredged. Although the results of such explorations are representative of subsurface conditions at their respective locations, local variations in the subsurface sediments are to be expected and, if encountered, shall not be considered materially different for this Contract and will not constitute the basis for a change order.

1.15 QUANTITIES

.1 Dredging shall proceed until the ECF is full, as defined on the Drawings.

.2 The estimated dredging volumes for each dredge area are provided in Appendix H - Dredge Volumes, the volumes are based on the dredge grades and the 2013 bathymetry data.

1.16 DREDGING EQUIPMENT

.1 Dredging Equipment:
.1 All dredges will be fitted with at least 2 marine very high frequency (VHF) radios and an Automatic Identification System (AIS transponder) with associated equipment to read the transponder signal.
.2 All dredging equipment shall be seaworthy and maintained to meet the requirements of the work, including the immediate repair of leaks within one hour of observation.

1.16 DREDGING EQUIPMENT (Cont'd)

.1 (Cont'd)
.3 Hydraulic dredging equipment: use equipment capable of dredging soft sediments and firm sub-soil including clay. Dredge equipment control panel to be capable of identifying to dredge operator soft versus firm dredge material.
.4 Provide immediate line of communication between Contractor's response manager or superintendent and the Departmental Representative and HPA representatives and shall facilitate immediate communications among in-water and land-based operations.

.2 Dredge Positioning Equipment:
.1 The dredge shall be equipped with Real-Time Kinematic - Differential Global Positioning System (RTK DGPS) and the necessary sensors or transducers, to enable accurate horizontal and vertical positioning of the dredge head or bucket. The dredge head/bucket shall have a positioning tolerance of plus or minus 4 centimetres vertically and plus or minus 8 centimetres horizontally.
.2 Dredge shall have qualified positioning equipment technical support personnel at the Work Area whenever dredging activities take place.
.3 The dredge positioning software shall be capable of:
- .1 Inputting a dredge prism file (an x, y, z file on a gridded interval of 30 centimetres by 30 centimetres);
- .2 Recording all dredge sensor information to a hard-disc so that the position and movements of the dredge head can be reviewed at a later date (playback capability), this playback data is to be provided as part of the daily progress report;
- .3 Capable of producing plots showing the location of each dredge cut location in the dredge unit;
- .4 Showing the dredge operator in real-time the elevation of sediment as the dredge head or bucket is operating; and
- .5 Using a true 3-dimensional computational system to calculate the position of the dredge head taking into account the tilt and list of the dredge platform as well as the standard positioning sensors.

.4 Show that dredge positioning system's error budget allows it to work within the stated

1.16 DREDGING EQUIPMENT (Cont'd)

.2 Dredge Positioning Equipment:(Cont'd)

.4 (Cont'd)
vertical and horizontal accuracies. The error budget should include all errors associated with measuring the positioning of the dredge head or bucket.

.5 Sediment Transfer Equipment: provide means and methods to transfer sediments from scows to ECF without spillage and satisfying air quality requirements.

.6 The RTK-DGPS for each dredge plant shall be verified in the field 30 days prior to the scheduled use of the equipment. The equipment verification can be completed on-land or on-water and shall demonstrate the ability to achieve, monitor, and report these tolerances. The Departmental Representative will be present for the operation and must approve the verification procedures. Procedures for verification shall be submitted to the Departmental Representative for written approval 30 days in advance of field verification. On-land verifications are considered necessary and shall be re-verified once the equipment is on the water, and before the equipment is used for dredging. The RTK-DGPS equipment must be re-verified weekly.

.7 Verify its error budget (i.e., quality control check of all positioning sensors to verify that individually and together they operate within an error range that satisfies the error budget requirement) at least one time per day against site benchmarks and include it in the Daily Report. If, during any verification activities, the Contractor determines that the RTK-DGPS system is out of the stated positioning tolerance, dredging shall be halted until the system is brought back into tolerance and is verified.

.8 If, at any time during the work, the Contractor determines that the RTK-DGPS system is malfunctioning or has failed, dredging shall be halted until the system has been restored to proper operating condition.

.3 Tow Boats: All tow boats used for propelling barges and other equipment shall be equipped with DGPS navigational equipment, radar, corrected compass, at least two marine VHF radios, an AIS transponder, and depth sounding equipment which is to be maintained in good operating condition during each tow. The number and size of tow boats to be used shall be specified in the Dredge Plan. Select tows that

1.16 DREDGING EQUIPMENT (Cont'd)

.3 Tow Boats:(Cont'd) minimize sediment resuspension and/or erosion from the propeller wash.

1.17 DREDGE PIPELINE FOR HYDRAULIC DREDGING

.1 Sediment transport pipeline shall be used to convey dredged sediments from its origin to final placement in the ECF at the seven discharge locations.

.2 Pipeline shall be of adequate length to transport dredged sediments from all dredge areas within the Work Area to the ECF discharge locations.

.3 Pipeline shall be of the appropriate material and sizing to deliver dredged sediment in a timely manner and avoid settlement of dredged sediments during transfer.

.4 Booster pumps shall be placed along the length of the pipeline as necessary to maintain the dredged sediments in suspension as sediment slurry, and shall be positioned prior to any point where the pressure head falls to zero and/or creates a negative pressure in the pipe. If the Contractor determines that booster pumps are necessary, the Contractor shall provide, at minimum, a number of spare booster pumps that will prevent downtime resulting from problems with pumps or from pump failures.

.5 Pipelines used to convey dredged sediments shall comply with requirements of Section 40 80 10.

.6 Provide all necessary propulsion for moving the pipeline around the Work Area, and for moving the pipeline to yield to navigation within the harbour. The pipeline shall be capable of both floating on the water surface and being submerged and resting on the harbour bottom.

.7 The dredge pipeline outlet shall be connected to a hard-pipe manifold fitted with flexible pipe and submerged diffusers to disperse the dredge sediments throughout the footprint of the ECF.

.8 Provide all necessary appurtenances, including but not limited to flotation, anchoring, aids to navigation, valves, metres, gauges, and

1.17 DREDGE PIPELINE FOR HYDRAULIC DREDGING (Cont'd)

.8 (Cont'd)
telemetric devices required for operation of the pipeline.

PART 2 - PRODUCTS

2.1 DREDGING EQUIPMENT

.1 Determine required equipment necessary to dredge material specified and to dispose of dredged material at locations specified and indicated.

PART 3 - EXECUTION

3.1 RESTRICTIONS

.1 Priority 1, 2 and 3 areas shall be dredged using hydraulic dredging techniques only.

.2 There can be no discharge of water from dredging operations at any location other than into the ECF by hydraulic dredge pipeline.

.3 Dewatering of the ECF is permitted prior to dredging activities provided that the final surface water within the ECF after dewatering is not less than 2.0 m below Chart Datum.

.4 Water must satisfy discharge criteria in Section 44 01 40.

.5 Discharge of dredge slurry to the ECF settling cells shall be directed in accordance with the water treatment needs with regular relocation and reorientation of the discharge ports in a manner that will promote a uniform distribution of the consolidating sediments while maximizing the effectiveness of the settling process.

3.2 ANCHORAGE

.1 Installation:
.1 No anchoring of work-related vessels is permitted to occur in the harbour without prior approval by the HPA Harbour Master's Office and the Departmental Representative.
.2 Coordinate vessel movement and anchoring daily with the HPA Harbour Master's Office.
.3 All anchoring shall accommodate on-going shipping and navigation activities within the Work Area, as specified in Section 01 14 00.

3.2 ANCHORAGE (Cont'd)

.1 Installation:(Cont'd)

.4 Spuds are the preferred methods of anchoring and shall be used for in-water anchoring when possible.

.5 No anchoring is permitted in areas where caps or backfill material have been placed.

.6 Remove sediment from all anchors before leaving the location of anchoring. If a vessel has been anchored in an area where it has come into contact with metal and/or PAH-containing materials, and will be maneuvering and anchoring in an area where it will come into contact with non-metal and/or non-PAH containing materials, the vessel and anchor must be decontaminated as specified in Section 01 35 14. The Departmental Representative will be contacted of said maneuvering and anchoring and the Contractor will await approval prior to doing so. The maneuvering and anchoring of contaminated spuds and other anchoring mechanisms will be avoided, to the extent possible.

.7 Decontamination of spuds is not required until the equipment is to be demobilized.

.2 Maintenance:

.1 All anchoring systems for work-related vessels must be kept in proper working order. All anchoring chains and winches shall be inspected prior to deployment each day to ensure proper working order. Repairs and preventative maintenance to equipment shall be made in a timely manner to minimize down time and loss of production. Repairs shall also be made to ensure the safety of the operation, as well as continuing the efficiency of all operating equipment. Inspections of equipment shall be allowed upon request of the Departmental Representative.

.2 Lost production or time due to malfunctioning anchoring systems does not constitute a basis for delay.

3.3 DEBRIS REMOVAL AND DISPOSAL

.1 To Section 35 20 33.

3.4 DREDGING SEQUENCE AND ACCEPTANCE

.1 Remove all materials above specified dredge grades, within limits indicated. Material removed from below dredge grade or outside specified area is not part of work.

.2 Department Representative will give final acceptance of production dredging upon completion of each Priority Area. Allow Departmental Representative 10 days to complete post-dredging surveys for each Priority Area.

.3 Production and second pass dredging shall be conducted as specified on the Drawings. Dredging on slopes shall proceed from highest to lowest elevation in all circumstances.

- .1 Dredge all Priority 1 Areas in the sequence and to the limits indicated on Drawings.
  - .1 Dredge as required up to the piles of the boat haul-out location to grade matching the adjacent Priority 1 Areas.
- .2 Priority 2 Areas dredging may commence while Departmental Representative confirms if dredging in Priority 1 Areas is completed as specified. If any Priority 1 Area is founded unacceptable, mobilize back to Priority 1 Areas and complete the dredging to the satisfaction of the Departmental Representative.
- .3 All Priority 2 Areas are to be dredged in the sequence and to the limits indicated on Drawings.
- .4 After completion and acceptance of Priority 2 Areas, post-dredge sampling will be performed by the Departmental Representative and may direct Contractor to perform second pass dredging. Post dredge sampling results will be utilized to identify the specific locations/areas, thickness and sequence of second pass dredging. Second pass dredging only applies within Priority 1 and 2 Areas. Allow Departmental Representative 15 days from the completion of Priority 2 production dredging to define the second passing dredging program.
- .5 Second pass dredging will be accepted in the following sequence Priority 1 Areas, followed by Priority 2 Areas.
- .6 Second pass dredging of Priority 2 Areas may commence while Departmental Representative confirms final acceptance of second pass dredging in Priority 1 Areas. If second pass dredging of Priority 1 Areas is found unacceptable, mobilize back to Priority 1 Areas to complete second pass dredging to the satisfaction of the Departmental Representative.

3.4 DREDGING SEQUENCE AND ACCEPTANCE (Cont'd)

.3 (Cont'd)

.7 Do not commence dredging of Priority 3 Areas until Departmental Representative gives final acceptance of second pass dredging. Allow Departmental Representative 15 days from the completion of second pass dredging to define dredging of Priority 3 Areas.

.8 Dredging of Priority 3 Areas can commence upon determination of remaining capacity of the ECF. Dredge Priority 3 Areas in the sequence and to the limits indicated on Drawings until ECF is filled to maximum permissible fill elevation of +1.1 to +1.5 metres.

.4 The dredge area sequence within a verification zone shall be in accordance with the Contractor's Dredge Work Plan. Dredging on slopes shall proceed from highest elevation to lowest elevation in all circumstances.

.5 Departmental Representative reserves the right to alter the sequence of the Contractor's work as necessary to maintain compliance with Project requirements, enable access to the property by others, or as otherwise deemed necessary by the Departmental Representative. The order that the work will be performed shall be provided in the Dredge Work Plan Submittal.

.6 Immediately notify Departmental Representative upon encountering an obstruction. By-pass the obstruction after clearly marking its location, move to another area and continue work. No related claim will be entertained if the foregoing procedure is not followed.

3.5 DREDGE APPROACH

.1 Dredge equipment shall be placed in manner as to provide complete horizontal coverage of each dredge area. Dredge head placement shall not allow for gaps or skipping of material scheduled for removal.

.2 Use procedures that minimize sediment resuspension during dredging.

3.6 SOUNDING SURVEYS

.1 Contract drawings are based on soundings taken by the Departmental Representative in 2013. Contract quantity shown on the Unit Price Table are based on this survey.

3.6 SOUNDING SURVEYS (Cont'd)

.2 A pre-dredging sounding survey will be taken by the Departmental Representative, as soon as possible after Contract award.

.3 Departmental Representative reserves the right to adjust the dredge depths as necessary based on field observations and conditions encountered during dredging.

.4 No area will be dredged prior to Departmental Representative's and Contractor's mutual acceptance of pre-dredge survey for that area.

.5 Departmental Representative will conduct one post dredging survey per Priority Area at no cost to the Contractor. Survey will confirm if dredging is completed as specified and whether area can be considered cleared area. If post dredge surveying indicates that dredging operations failed to achieve the required dredge grade, re-dredge the area to the required dredge grade. Any subsequent surveys as a result of finding high spots or incomplete dredging will be done at the Contractor's cost at a charge of $4000/day of survey fieldwork.

.6 Results of the pre and post dredging surveys will be distributed to the Contractor, by the Departmental Representative, prior to and upon completion of the work, respectively.

.7 The final pay quantity will be calculated on the basis of the pre and post dredging surveys and the design dredge elevations.

3.7 TRANSPORT

.1 Manage vessels in accordance with marine safety requirements and HPA Harbour Master's Office and CCG regulations as described in Section 01 35 28.

.2 Overflow from barges and scows is prohibited.

.3 Booster pumps shall be operated to minimize the risk of spills or releases in accordance with Section 01 35 43.

3.8 PIPELINE TRANSPORT

.1 Loss of dredged sediments during transport is prohibited. Environmental protection and monitoring, including procedures for spill prevention, emergency spill containment, and removal operations shall be in accordance with Section 01 35 28. Pipeline shall conform to the specifications presented in Section 40 80 10.

.2 All pipeline cleanout activities shall be reviewed by the Departmental Representative prior to the execution of the cleanout activities.

.3 Dredge pipeline shall be inspected on a weekly basis.

3.9 ECF FILLING

.1 Do not contaminate the existing fill materials between the ECF face wall and anchor wall.

.2 Dredged sediments shall be discharged at the designated discharge locations shown on the drawings.

.3 Set discharge elevation top of pipe at +0.2 m. When dredged sediments are deposited to this elevation raise discharge elevation as required to continue dredging.

.4 Discharge Priority 1 and 2 dredged sediments over the seven discharge locations equally to ensure uniform filling of the ECF.

.5 Priority 3 dredged sediments will be discharged from discharge locations "D6" and "D7".

.6 Dredged sediments shall be discharged in a manner that will provide equal pressure against the internal cell wall. Maximum sediment unbalance height on either sides of the internal cell wall is no more than 2 m.

.7 Provide means and methods to evenly distribute the dredged sediments within the ECF.

.8 The maximum dredged sediments fill elevation within the ECF is +1.1 metres at perimeter and +1.5 metres at D6 and D7 of the ECF. At the completion of dredging, grade any dredged sediment within the ECF that is outside of the required elevations to meet required elevations.

3.9 ECF FILLING (Cont'd)

.9 Remove pipelines after completion of dredging work.

3.10 CO-OPERATION AND ASSISTANCE TO DEPARTMENT REPRESENTATIVE

.1 Cooperate with Departmental Representative on inspection of work and provide assistance requested.

.2 Furnish use of such boats, equipment, labour and materials forming ordinary and usual part of dredging plant as may be reasonably necessary to inspect and supervise work.

3.11 MONITORING OF WORK

.1 Be responsible for monitoring effectiveness and productivity of Contractor's own work on an ongoing basis.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This section includes sheen control for in-water work.

1.2 MEASUREMENT PROCEDURES

.1 Supply of oil booms will be measured as part of the Lump Sum Arrangement. Unused oil booms will become the property of the Departmental Representative at the end of the Contract.

.2 Deployment, maintenance and removal of oil booms, if directed by the Departmental Representative, will be paid as extra to Contract price in accordance with General Conditions.

.3 Deployment of oil boom required to mitigate a spill related to Contractor's equipment will not be measured for payment.

1.3 SUBMITTALS

.1 Submit details of oil booms to Departmental Representative at least 2 weeks prior to the start of isolation capping and 4 weeks prior to commencement of dredging, details to include:
.1 Type of boom, manufacturer and vendor information, alignment, method of placement, and inspection plans.
.2 In addition to oil spill containment booms, have on-hand spill kits that include oil-absorbent pads and other necessary materials to immediately remove sheen on the water surface within the containment boom, as described in Section 01 35 43.
.3 Describe markings, marker buoys, lighting, and other features that will be used to provide containment boom perimeter visibility to vessels.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Oil Booms: minimum 15-cm harbour boom and minimum 100 m in length.

PART 3 - EXECUTION

3.1 GENERAL

.1 Departmental Representative may direct the use of oil booms during in-water work to minimize and control sheen in the vicinity of the Work if necessary. NAPL may be present within the limits of work. Be prepared to control, manage, and properly handle sediment and the contained NAPL, as well as any sheen produced during in-water work.

.2 Maintain oil boom on site and store in a fashion that will permit rapid deployment.

END

PART 1 - GENERAL

1.1 MEASUREMENT PROCEDURES

.1 Supply, deployment and maintenance of turbidity curtain will be measured as part of the Lump Sum Arrangement and shall include all labour, materials and equipment necessary to complete the work.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):
- .1 ASTM D751-06(2011), Standard Test Methods for Coated Fabrics.
- .2 ASTM D2261-13, Standard Test Methods for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine).
- .3 ASTM D5034-09(2013), Standard Test Methods for Breaking Strength and Elongation of Textile Fabric (Grab Test).

.2 US Army Corps of Engineers:
- .1 EP 1110-1-16 Appendix C, BMP 27 Type 1.

1.3 SUBMITTALS

.1 Submit details of the turbidity curtain system to the Departmental Representative prior to the start of the work to Section 01 33 00.

.2 Submit to Departmental Representative details of geotextile material and seam at least 2 weeks prior to commencing work.

1.4 DELIVERY AND STORAGE

.1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Turbidity Curtain:
- .1 Flotation Properties:
  - .1 Size: 200 mm x 200 mm.
  - .2 Length: 200 m.
  - .3 Curtain Depth: 10 m.
  - .4 Bouyancy: 13 Kg/m.
- .2 Curtain Body Properties:
  - .1 Nylon Vinyl Reinforced: 610 g/m^2.
  - .2 Grab Tensile: to ASTM D5034, 1765N x 1660N.
  - .3 Tear: to ASTM D2261, 427 N x 382 N.
  - .4 Adhesion: to ASTM D751, 67 N.
  - .5 Hydrostatic Resistance: to ASTM D751, 2654 kPa.
  - .6 Seam strength: Heat Sealed.
  - .7 Connections: 15.8 mm rope hem edge.
  - .8 Ballast Chain: 8 mm.

.2 Seams: sewn in accordance with manufacturer's recommendations.

.3 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

.4 Turbidity curtain shall consist of geosynthetic, load line, flotation, ballast, anchors, mooring buoys, mooring lines, adjustment lines, and tie-downs.

.5 Design to conform to US Army Corp of Engineers EP 1110-1-16 Appendix C, BMP 27 Type 1.

.6 Turbidity curtains shall be constructed as follows:
- .1 The flotation shall provide support along the length of the turbidity curtain.
- .2 A sleeve shall be formed and heat-sealed or sewn along the entire bottom edge of the turbidity curtain geosynthetic, to contain the ballast in the sleeve. Breaks may be made in the sleeve to facilitate pulling, provided they are a minimum 100 mm in size and spaced at minimum 3 m intervals.
- .3 Where turbidity curtain geosynthetic is joined to provide a continuous run, the sections shall be connected to provide a continuous seal and prevent the escape of turbid water between the sections.

2.1 MATERIAL (Cont'd)

.6 (Cont'd)

.4 The turbidity curtain, as prepared for installation, shall be of sufficient width to account for water depth and wave action.

.5 The turbidity curtain shall be of sufficient length to permit work inside the area enclosed by the curtain without restricting equipment operations, and personnel from working.

.6 Seal the ends of the turbidity curtain where it terminates at the existing structure face.

PART 3 - EXECUTION

3.1 GENERAL

.1 Deploy turbidity curtain as required to satisfy the turbidity requirements under Section 01 35 43.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Furnish all labour, equipment, test connections, vents, water, and materials necessary for carrying out the pressure and leakage tests for water treatment operations.

.2 All testing shall be witnessed by Departmental Representative.

1.2 MEASUREMENT PROCEDURES

.1 Hydrostatic pressure testing for leakage of pipeline will be measured as part of the Lump Sum Arrangement and shall include all labour, materials and equipment necessary to complete testing.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 A testing schedule, including proposed plans for water conveyance and control to shall be submitted to Departmental representative in writing at least 48 hours prior to start of testing. The submittal shall also include the Contractor's plan for the release of water from pipelines and structures after testing has been completed.

.3 Results of all tests shall be submitted to Departmental Representative within 48 hours of test completion.

PART 2 - PRODUCTS

2.1 PRODUCTS

.1 Provide materials and equipment necessary to conduct hydrostatic testing.

PART 3 - EXECUTION

3.1 GENERAL

.1 Furnish potable water for testing hydraulic structures and pipelines that will carry treated water. Furnish harbour water for testing of remaining hydraulic structures and pipelines. Make all necessary arrangements for conveying the water to points of use.

3.2 LEAKAGE TESTS FOR HYDRAULIC STRUCTURES

.1 Test tanks, vessels, and other fluid-containing structures by filling the structure with water to overflowing. An initial water level reading shall be made. Three (3) days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the three (3) day period as computed from the two (2) water level readings, does not exceed 0.1% of the total volume of water in the structure, after allowance is made for evaporation loss.

.2 The structure will not be accepted as completed until the water loss leakage test is passed and all visible leakage repaired.

3.3 TESTS ON EXPOSED PRESSURE PIPING

.1 Pipelines designed to transport dredged sediment, water, or polymer under pressure shall be tested hydrostatically and observed for leakage prior to being placed in service. When piping is to be insulated, tests shall be made before the pipe is covered.

.2 Equipment in or attached to the pipes that may be damaged by the test (e.g., pumps, flow metres) shall be isolated. Any damage to such equipment during the test shall be repaired at no extra cost to Departmental Representative.

.3 All fittings and appurtenances must be properly braced and harnessed before the pressure is applied. Thrust restraining devices which will become a part of the system must also be tested at the test pressure.

.4 Provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall

3.3 TESTS ON EXPOSED PRESSURE PIPING (Cont'd)

.4 (Cont'd)
be permanently plugged. Ensure all air vents are open during filling.

.5 Hydrostatic Testing
.1 The pipeline shall be filled at a rate that will not cause surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. The system shall be initially pressurized to 50% of the normal service conditions and inspected. During this period, valves and connections shall be examined for leaks. If leaks are found, repair and or replace all necessary components at no extra cost to Departmental Representative.
.2 The system shall then be pressurized to the test pressure. The test pressure shall be 133% of the working pressure rating of the lowest rated component of the Section being tested.
.3 Immediately following pressurization, an initial expansion of the pipeline will occur. Small amounts of water shall be added as required on an hourly basis for a maximum of 3 hours, in order to maintain test pressure. After 4 hours, the test pressure shall be lowered by 70 kPa. If the hydrostatic pressure remains steady for one 1 hour, then no leakage is indicated. Inspect for leaks, repair and retest if necessary. The piping system shall be allowed to relax for 8 hours before retesting.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This section includes the design and operation requirements for the water treatment facility.

1.2 MEASUREMENT PROCEDURES

.1 All items not in the unit prices will be in the Lump Sum Arrangement.

1.3 REFERENCES

.1 Provincial Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, and the Provincial Water Quality Objectives (PWQOs).

.2 Canadian Water Quality Guidelines (CWQGs).

1.4 SUBMITTALS

.1 Submit in accordance to Section 01 33 00.

.2 Submit schematic design of the proposed water treatment system to Departmental Representative as per the approved Construction Progress Schedule. Include procedures for field sampling and quality control for water quality monitoring. Allow Departmental Representative 25 working days for review.

.3 Submit detailed shop drawings and technical specifications to the Departmental Representative for all equipment, instrumentation, materials and products to be used in the water treatment system schematic. Working pressures and levels for all system elements shall be specified.

.4 Submit proposed test data for products designed to assist gravity settling.

.5 Project specific test performance data shall be submitted to the Departmental Representative for review of the treatment process.

.6 Within 15 calendar days of review by Departmental Representative of the shop drawing submittals for all of the water treatment system components, prepare and submit five copies of the Operations and Maintenance (O&M) Manual for the temporary water treatment system that

1.4 SUBMITTALS (Cont'd)

.6 (Cont'd)
includes a general narrative detailing the Contractor's O&M activities. The O&M Manual shall at a minimum include the following information (as applicable) for each major system component:
.1 Mobilization, installation, initial startup and testing, normal (daily) operations, troubleshooting, and shutdown procedures;
.2 Preventive or routine maintenance requirements;
.3 Lubrication schedules;
.4 Instrumentation monitoring frequency, including obtaining readings from pressure gauges, flow metres, and turbidity metres;
.5 Inspection schedules, including visual inspection of piping, fittings, pumps, equipment, and WTP containment area;
.6 Recommended spare parts list;
.7 Calibration and alignment information;
.8 Care and cleaning of surfaces;
.9 A daily operations log form;
.10 Corrective actions and contingency measures for process upsets, exceedances of discharge limits, and non-compliance with performance requirements;
.11 Winter shutdown procedures, including approach to drain pipelines and manage drained water. Drained water shall go back into the ECF;
.12 Spill prevention and spill clean-up plans for decant water management system;
.13 Emergency plans for decant water management system; and
.14 Manufacturer's product literature including O&M Manuals.

.7 Submit a list of trained staff and their responsibilities.

.8 Submit a Water Treatment Operations Training Plan to Departmental Representative. The Training Plan shall identify how the Contractor proposes to train the water treatment operations staff in the operation and maintenance of the individual pieces of equipment and the overall system operation.

.9 Submit a report on Initial Startup and Testing within 7 days of completion of the Initial Startup and Testing.

.10 Water Treatment System Monitoring Data:
.1 Monitoring data shall be provided to the Departmental Representative on USB flash drive

1.4 SUBMITTALS (Cont'd)

.10 (Cont'd)
.1 (Cont'd)
every quarter during the Work, and all of the monitoring data shall be submitted on USB flash drive at completion of the Work.
.2 Copies of field notes, including field observations, field metre inspections and calibration, and all records of maintenance and repair activities conducted, shall be provided upon the Departmental Representative's request.

1.5 DEFINITIONS

.1 Freeboard - Freeboard is the distance between the water level and the elevation at which a tank, vessel, or other liquid storage container will overflow.

.2 Winter Shutdown: Winter operations are defined as the period from November through February when dredging is not being performed. This period may be adjusted due to weather conditions which allow continued construction activities.

1.6 PROTECTION

.1 Protect existing ECF walls, structures, roads, landscaping and components not part of the Work from damages associated with Work activities. Make good of damages to match existing condition or better at no additional cost to Contract.

1.7 DESIGN REQUIREMENTS

.1 Water Treatment Facility:
.1 Design and Operating Criteria: design water filtering plant capable of filtering water generated from dewatering ECF and work area to meet discharge requirements of the discharge criteria, capable of removing oil, suspended solids, particulates, and filter water through 5-micron particulate filter prior to discharge.
.2 Treatability Studies have been undertaken to characterize the effluent and to provide indications of the effectiveness of some methods of water treatment. These studies are presented in Appendix I - Water Treatment Data and Follow-Up Study.
.3 Ensure that discharges from site are in compliance with Section 01 35 43 and discharge requirements of this specification section.
.4 Provide piping to transfer liquid/solid mixtures generated by dewatering operations

1.7 DESIGN REQUIREMENTS (Cont'd)

.1 (Cont'd)
.4 (Cont'd)
which require water filtering to water filtering plant.
.5 Design water filtering operations capable of receiving liquid/solid mixtures and not causing delay to dewatering operations.
.6 The existing ECF structure settling cells #1 and #2 shall be used as the main gravity settling area for the water treatment process and shall be the final destination for all contaminated sediments collected throughout the duration of the project.
.7 Contractor may use the final settling cell for Contractor's water treatment process. The northeast portion of the ECF is equipped with pumping platforms and is available for Contractor's use. The final settling cell shall be lined with geomembranes as indicated and specified in Section 31 32 19.02 prior to use and clean upon completion. The final settling cell shall be filled as specified in Section 31 23 11.
.8 Treatment facilities and storage/distribution facilities for water treatment shall be located within the Staging Area.

.2 Piping: suitable material type, of sufficient diameter and structural thickness for purpose intended; satisfactorily tested for leaks with potable water in presence of Departmental Representative before handling wastewater.

.3 Discharge Requirements:
.1 Maintain the treatment system at all times, do not exceed the following effluent discharge limits, which are based on PWQOs, CWQGs, and background water quality, as required for discharge to Hamilton Harbour:
  .1 pH discharge limit: 6.0 to 9.0.
  .2 Total suspended solids (TSS) discharge limit: 15 mg/L.
  .3 Polycyclic aromatic hydrocarbons (PAHs) discharge limits are as follows:
    .1 1-Methylnaphthalene: 2 µg/L.
    .2 2-Methylnaphthalene: 2 µg/L.
    .3 Acenaphthene: 5.8 µg/L.
    .4 Anthracene: 0.05 µg/L.
    .5 Benzo(a)anthracene: 0.05 µg/L.
    .6 Benzo(a)pyrene: 0.015 µg/L.
    .7 Benzo(ghi)perylene: 0.05 µg/L.
    .8 Benzo(k)fluoranthene: 0.05 µg/L.
    .9 Chrysene: 0.05 µg/L.

1.7 DESIGN REQUIREMENTS (Cont'd)

.3 Discharge Requirements:(Cont'd)
- .1 (Cont'd)
  - .3 (Cont'd)
    - .10 Dibenzo(a,h)anthracene: 0.05 µg/L.
    - .11 Fluoranthene: 0.05 µg/L.
    - .12 Fluorene: 0.2 µg/L.
    - .13 Naphthalene: 7 µg/L.
    - .14 Perylene: 0.05 µg/L.
    - .15 Phenanthrene: 0.03 µg/L.
    - .16 Pyrene: 0.05 µg/L.
  - .4 Total metals discharge limits are as follows:
    - .1 Aluminum: 75 µg/L.
    - .2 Arsenic: 100 µg/L.
    - .3 Beryllium: 1,100 µg/L.
    - .4 Boron: 200 µg/L.
    - .5 Cadmium: 0.3 µg/L.
    - .6 Chromium: 8.9 µg/L.
    - .7 Cobalt: 0.9 µg/L.
    - .8 Copper: 5 µg/L.
    - .9 Iron: 300 µg/L.
    - .10 Lead: 25 µg/L.
    - .11 Molybdenum: 40 µg/L.
    - .12 Nickel: 25 µg/L.
    - .13 Silver: 0.1 µg/L.
    - .14 Vanadium: 6 µg/L.
    - .15 Zinc: 30 µg/L.
- .2 Compliance with discharge limits will be at the pipe that discharges treated water to the harbour.

PART 2 - PRODUCTS

2.1 PRODUCTS

.1 Provide all supplies and/or equipment necessary for operation and maintenance of the water treatment system including, but not limited to, equipment, mechanical products, materials, and other items as required to achieve target water quality through the water treatment system.

.2 Flocculants or other additives designed to assist in settling, where employed, shall be in accordance with those recommended in Appendix I - Water Treatment Data, with respect to settling efficiencies, effluent quality and bed consolidation characteristics.

.3 Where flocculant or other additive products are proposed, testing results shall be provided to the Departmental Representative. Tests and

2.1 PRODUCTS (Cont'd)

.3 (Cont'd)
supporting documentation shall be developed at no additional cost to Contract, and shall be undertaken using water and sediments which are deemed representative of the dredge slurry for the various composite sediments.

PART 3 - EXECUTION

3.1 IMPLEMENTATION OF WATER TREATMENT SYSTEM

.1 Contractor may transport effluent from the ECF settling cells to the final settling cell by means of pumping and piping facilities. Installation of mechanical treatment plant and final discharge location if constructed shall be within the limits of the ECF face wall and within the Staging Area.

.2 Use of pumping platforms and designated facility areas shall respect space constraints and load limits. All surfaces shall be prepared as required to provide proper mounting of structures and to properly manage drainage and potential spills.

.3 Existing rock fill within the final settling cell shall not be contaminated by dredged sediments. If utilized, install geomembranes as shown on drawings and to Section 31 32 19.02 and shall be removed at the completion of the project. Ensure all contaminated sediments are transferred to the ECF settling cells prior to removal. Install new fill materials to details on drawings and as specified in Section 31 23 11.

3.2 PERFORMANCE REQUIREMENTS

.1 Maintain a minimum ponded depth of 1.0 m of water over the dredged material in the ECF, except during final filling. Final filling will begin when the placed sediment surface reaches 0.0 metre Chart Datum in elevation. During final filling, the minimum ponded depth shall be 0.6 m, and water treatment operations may need to be modified to maintain effluent quality. Based on the monitoring results, Departmental Representative may require the Contractor to modify the water treatment system operations. Ponded depth shall be monitored at the ECF and final settling cell effluent discharge locations.

3.2 PERFORMANCE REQUIREMENTS (Cont'd)

.2 If the final settling cell is utilized during the water treatment process, maintain a minimum ponded depth of 2 m above the crushed rock in the final settling cell.

.3 Minimum freeboard requirement at the ECF anchorwall is 1 metre, except during final filling, when the minimum freeboard requirement is 0.5 m.

.4 Maximum water levels within the final settling cell shall be no higher than Lake level.

.5 Placement of dredged material shall be conducted to promote settling as specified in Section 35 20 34.

3.3 INITIAL STARTUP AND TESTING

.1 After mobilization and setup of the water treatment system, perform system startup and testing activities and troubleshooting prior to initiating full-scale (normal) operations. Startup and testing activities shall be in accordance with the manufacturer's recommendations and as indicated in the Contractor-prepared O&M Manual that has been reviewed by Departmental Representative.

.2 Startup and testing of the water treatment system shall consist of three stages:
   .1 Hydrostatic Testing:
      .1 On required equipment for the decant water management system, hydrostatic testing will be performed in accordance with Section 40 80 10.
   .2 Mechanical Shakedown:
      .1 A clean water mechanical shakedown will be conducted following hydrostatic testing. The mechanical shakedown may be performed with harbour water or potable water. During the mechanical shakedown, verify the correct operation of the automated equipment and make any potential repairs noted during testing.
   .3 Initial Startup:
      .1 Prior to and during initial startup testing, isolate a small area of the ECF and agitate the sediment within the ECF to generate and maintain a TSS of 80 mg/l in water samples collected from the surface.
      .2 Initial startup of the decant water management system will include treating a minimum of 3,750 m3 of effluent measured at

3.3 INITIAL STARTUP AND TESTING (Cont'd)

.2 (Cont'd)

.3 Initial Startup:(Cont'd)

.2 (Cont'd)

the discharge location. During the startup test, the water treatment system shall be operated at the peak flow rate until the entire 3,750 m3 batch is treated. During this time, continuously monitor and record readings (every 30 minutes minimum) from all gauges, flow metres, and other indicators as necessary in order to demonstrate that the system is operating as designed.

.3 Startup testing samples:

.1 Collect four (4) samples of agitated water.

.2 Collect four (4) startup testing samples after each interval following treatment of approximately 1,250 m3, 2,500 m3, and 3,750 m3 of water. Measure turbidity, pH, temperature, electrical conductivity, and oxygen reducing potential in the samples collected during startup. The samples will be submitted by the Contractor to an independent laboratory with a CCIL certificate for testing based on the parameters with discharge limits listed for pH, TSS, PAHs and total metals.

.3 Repeat startup sample and procedure each day for a minimum of four (4) consecutive days.

.4 If any samples fail discharge procedure adjust treatment process and repeat startup testing. Start-up testing will be deemed complete when test results show four (4) consecutive days with no failure.

.4 Pump the startup and testing water back into the ECF. The Contractor may alternatively store the entire volume of treated water generated during startup and testing in temporary tanks at the Work Area until analytical results obtained indicate that the Contractor may discharge the water to Hamilton Harbour.

.5 Initial dredging and ECF filling activities following initial startup testing shall be coordinated with the dredging program and completed such that the ECF is brought to its design operating water level in a manner consistent with the limitations of the overall water treatment system.

3.4 OPERATION AND MAINTENANCE OF WATER TREATMENT SYSTEM

.1 Maintenance of the water treatment system shall be performed in accordance with the approved operation and maintenance manual such that target water quality parameters are met consistently and risk of system failure or

.2 The water treatment operations shall be maintained for 6 months after completion of thin layer backfill/capping. During the 6 months, maintain a constant water level in the ECF overflow structure at or below -2.0 m. If there is a winter shutdown within the 6 months period after the thin layer backfill/capping then the period of maintenance is extended by a time equal to the duration of the winter shutdown.

3.5 TRAINING

.1 Train the staff in the operation and maintenance of the selected/installed equipment and the operation of the water treatment system. Records of equipment and system training for the staff shall be documented and provided to Departmental Representative.

3.6 WATER QUALITY MONITORING

.1 Conduct water quality monitoring of the water treatment operations, including three different types of monitoring: startup monitoring, performance monitoring, and compliance monitoring.

.2 Startup monitoring shall be performed during initial treatment of decant water generated during initial dredging, during initial treatment of production dredging decant water, and when decant water treatment is initiated after a period of inactivity. Startup monitoring shall be conducted in accordance with the schedule set in Clause 3.3 of this section:
.1 Startup monitoring samples shall be analyzed for pH, temperature, electrical conductivity, oxygen reducing potential, TSS, turbidity, total metals, and PAHs.
.2 Startup monitoring samples shall be collected from ECF settling cell effluent and at the downstream end of each subsequent major treatment process.

3.6 WATER QUALITY MONITORING (Cont'd)

.3 Performance monitoring shall be performed during water treatment operations and shall include the following:
.1 At a minimum of every 5 hours of operation, the following water quality field data: turbidity, pH, temperature, electrical conductivity, and oxygen reducing potential within the treatment train to provide indications of system performance at the following locations:
.1 ECF settling cells outlet and downstream end of each subsequent major treatment process.
.2 Monitoring of individual water treatment process units and products/media shall be completed in accordance with the approved FSP and QAPP documents and shall address issues related to product replacement or maintenance as required to ensure adequate system performance.
.3 Turbidity shall be continuously measured in the ECF settling cells effluent and at the downstream end of all subsequent major water treatment process using in-line turbidity metres.
.1 Turbidity measurements shall be verified periodically, at a minimum once every 15 days of operations, with grab samples analyzed for TSS.
.4 The ECF and final settling cell (if utilized) shall be visually monitored for the presence of films, sheen, discolouration, and odour once every 2 hours during active water treatment operations.

.4 Compliance monitoring shall be performed during water treatment operations in accordance with the following:
.1 Compliance samples shall be analyzed for pH, TSS, turbidity, total metals (arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc), and PAHs.
.2 Compliance samples shall be collected from discharge point of the final water treatment process prior to discharge to Hamilton Harbour.
.3 Compliance sampling shall be performed at a minimum of 10 samples every 50,000 cubic metres of effluent, including a minimum of one (1) sample per day and 10 samples per week.

3.7 ECF BED LEVEL MONITORING

.1 Bed elevations within the ECF cells shall be monitored on a regular basis to ensure that sediments are evenly distributed throughout the ECF cells and to guide the relocation of dredge slurry. Do not short circuit the ECF flow.

.2 Bed levels between adjacent ECF cells should not differ by more than 0.6 m on average until the site is filled to Chart Datum, and should target a uniformity within a given cell of ±0.2 m.

.3 Maintain the elevation of sediment within the ECF overflow structure at or below -6.0 m.

3.8 COLD WEATHER OPERATIONS

.1 If water treatment operations are conducted during days with a temperature less than 0°C, then take additional measures to allow operation of the water treatment system during cold weather.

3.9 WINTER SHUTDOWN

.1 Prior to demobilization and/or winter shutdown, shut down the Water Treatment System to prevent damage, spills, or releases during the winter months when dredging is not being performed. At a minimum, winter shutdown shall include the following:
.1 Drain all liquid from all process equipment, piping, and systems not associated with the Stormwater Collection and Treatment System.
.2 Open tanks (excluding stormwater tanks) shall be covered to prevent water and snow from entering the tank. The covering shall be adequately weighted down to prevent it from being blown off the tank by high winds and shall be designed to withstand snow loads.
.3 All pumps not in operation during the winter shall be drained to ensure that the pump casing is protected.
.4 Water traps on air lines shall be drained.
.5 Equipment not rated for exposure to winter conditions shall be protected from damages and/or removed from the Work Area.

.2 During winter shutdown, be responsible for maintaining site security; providing access to the site when required, including snow plowing; and for any damage to or loss of materials, equipment, or other property at the Work Area.

3.9 WINTER SHUTDOWN (Cont'd)

.3 During winter shutdown, inspect the site on at least a weekly basis.

3.10 DECOMMISSIONING

.1 Restore site to original or better condition at location where structures are removed/deconstructed at no additional cost to Contract.

.2 Decontaminate and remove salvageable components of water filtering plant including water filtering system, pumps, piping, and electrical equipment.

.3 After completion of water treatment operations, the water treatment system shall be decommissioned in accordance with Section 01 77 00.

3.11 CORRECTIVE ACTIONS

.1 In the event of a non-compliant effluent water quality sample, shut down the WTP until corrective actions are implemented.

.2 If the effluent non-compliance is related to water treatment design, materials, installation, operations and/or maintenance of the water treatment operations that do not comply with contract specifications then take corrective actions as necessary to maintain specified treatment system performance. During Corrective Actions, the Contractor may be required to mobilize additional effluent storage tanks and/or repeat startup and testing procedures as specified herein. If the Contractor fails to make these corrections, or if the improved equipment fails to meet the guarantees or specified requirements, the Departmental Representative, notwithstanding having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

.3 Make no claims for delays associated with maintenance, repairs, delays, or documentation to correct performance of the water treatment system.

.4 Contact Departmental Representative within 4 hours of discovery of problems with water

3.11 CORRECTIVE ACTIONS (Cont'd)

.4 (Cont'd)
treatment system operations and provide immediate notification of major repairs necessary to keep the system in a normal operational state. Major repairs shall be considered as repair/replacement of pumps, motors, treatment units, and control devices.

.5 Where the final settling cell is utilized in the water treatment process, manage the final settling cell water level to maintain the water level equal to Lake Level or lower than Lake Level at all times. This includes preventing the release of untreated water from the final settling cell and avoiding work shutdowns during and following storm events or other upset condition. If the settling cell water level is found to be higher than Lake Level, the water in the final settling cell shall be pumped into the ECF.

.6 If weather conditions cause an upset in the ECF that adversely impacts the ECF effluent water quality, make appropriate adjustments in operations, including adjustment of flow rates, shutdown of the water treatment system, and other actions as necessary.

3.12 DOCUMENTATION

.1 Maintain a daily operations log (i.e., tabulated results) in which the process variables described above will be recorded at a minimum frequency of once per shift or more frequently if requested by the Departmental Representative. In addition, all activities related to O&M of the treatment system will be documented in the daily log. The daily log will be kept at the Work Area and will be made available to Departmental Representative on demand.

.2 After completion of water treatment operations, the daily log shall be submitted to Departmental Representative.

END

Appendix A
Geotechnical Investigations

Appendix A includes the following:

ITEM A1. Figure A1 - Compilation of Geotechnical Sampling Locations from 1999 and 2004.

ITEM A2. Excerpts from: Amec Earth & Environmental - Randle Reef Sediment Remediation Project, Hamilton, Ontario, RS-2 Phase 1 Geotechnical Investigation Report, March 2004.

ITEM A3. Excerpts from: Trow Consulting Engineers Ltd. - Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour Pier 16, Hamilton, Ontario, August 1999.

Appendix A
Geotechnical Investigations

ITEM A1

Figure A1 - Compilation of Geotechnical Sampling Locations from 1999 and 2004

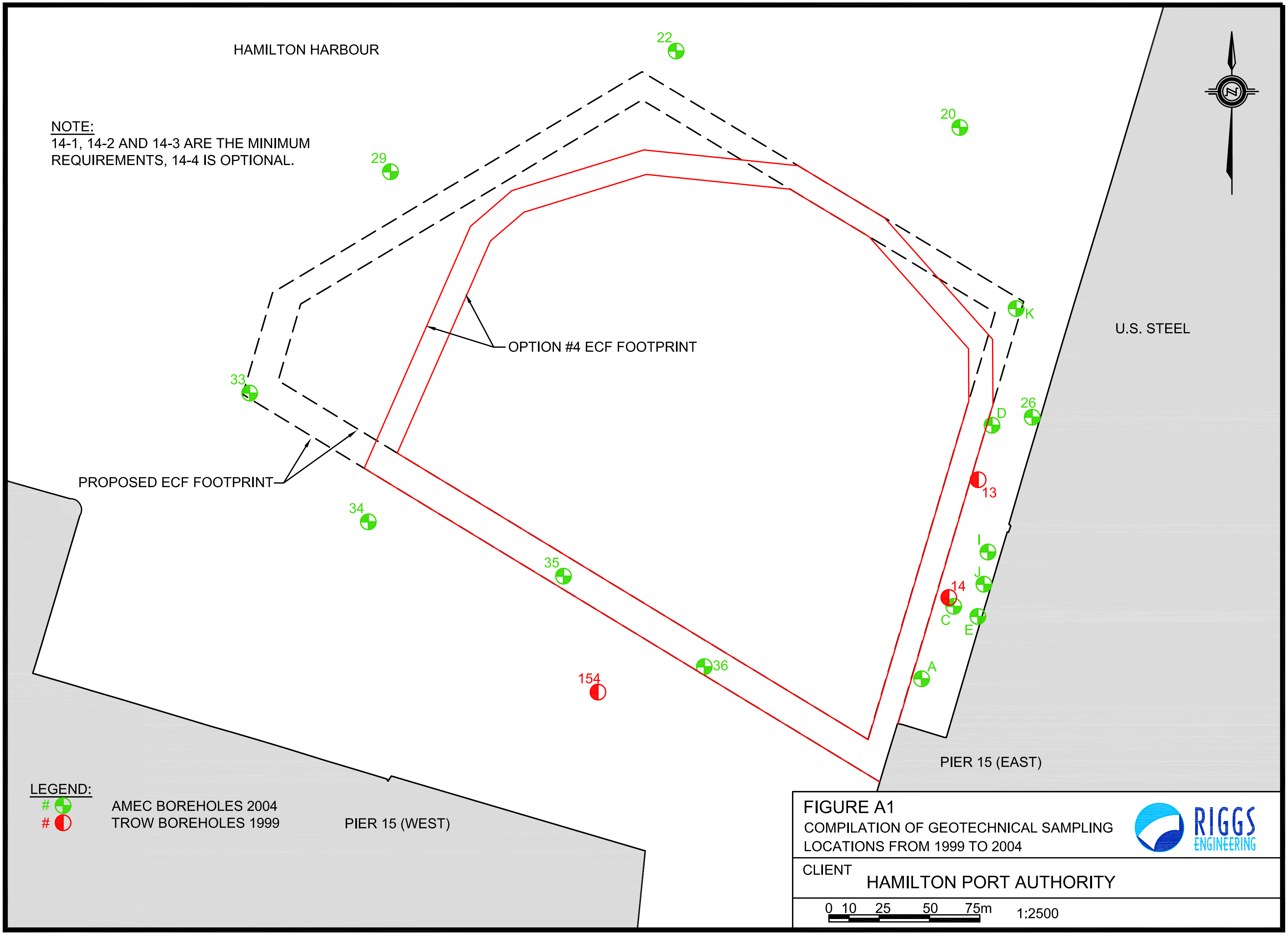

FIGURE A1
COMPILATION OF GEOTECHNICAL SAMPLING LOCATIONS FROM 1999 TO 2004

Appendix A
Geotechnical Investigations

ITEM A2
Excerpts from: Amec Earth & Environmental - Randle Reef Sediment Remediation Project, Hamilton, Ontario, RS-2 Phase 1 Geotechnical Investigation Report, March 2004.

RANDLE REEF SEDIMENT REMEDIATION PROJECT
HAMILTON, ONTARIO

RS-2 PHASE 1 GEOTECHNICAL INVESTIGATION REPORT

Submitted to:

AMEC E&C Services, a division of AMEC Americas Limited
Hamilton Port Authority
Environment Canada
Ministry of Environment of Ontario

Submitted by:

AMEC Earth & Environmental
A division of AMEC Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
L8H 6N6

March 2004
TC035071

4.0 FIELDWORK AND LABORATORY TESTING

The fieldwork for the investigation program outlined in Section 3.4.2 was carried out from October 6 to October 29, 2003, during which time 16 boreholes (numbered, 20, 22, 26, 28, 29, 31 to 36, 38, 39, and 41 to 43) and 3 monitoring wells (numbered, 40 MW, 40A MW, and 43A MW) were put down. The fieldwork also included two flat plate dilatometer test (DMT) profiles performed beside the locations of Boreholes 33 and 36. On encountering a thick deposit of slag fill, an additional investigation program to delineate the slag deposit was also executed. The slag delineation investigation carried out between December 16 and 23, 2003 involved 7 boreholes (numbered, A, C, D, E, I, J and K).

The land boreholes (Boreholes 38 and 43) were put down using a truck-mounted CME 75 drilling rig, supplied by Elite Drilling. The boreholes were advanced by driving 95 mm (inside diameter) hollow-stem augers. All excess soils from the land-based boreholes were removed from site for appropriate disposal as directed by AMEC environmental staff.

The water boreholes (all remaining boreholes) were put down using the same equipment mounted on a 500-ton spudding drill platform, supplied by McKeil Marine Limited. The barge was modified by the construction of a platform off the rear of the barge to allow the drilling crew to safely access the drill head and controls. The drilling platform was moved between borehole locations using a harbour tugboat, also supplied by McKeil Marine Limited.

Casing Setup: After setup at the borehole location, the depth from the drilling platform to the lake water surface was measured. NX–sized casing was lowered into the water and was allowed to settle under its own weight. Generally, the depth to which the casing settled provided "a reasonably good indication" of the interface between the soft, recent sediments and the underlying native soils. The casing was then hydraulically pushed an additional 0.15 m, to set the casing.

These boreholes were advanced by wash boring and tri-coning, with wash water from the drilling operations being discharged directly into the harbour. The casing was advanced when necessary to prevent caving. As well, Quick-Gel® was added where required to keep boreholes from caving across the deep saturated sand and gravel seams. Quick-Gel® is a finely ground bentonite that when mixed with fresh water, forms a low-solids drilling fluid. The product is ANSI/NSF Standard 60 certified. Upon completion, these boreholes were backfilled using Quik-Grout®, as per new Ontario Regulation 903 dated August 2003. The grout was applied through the water by a tremie process. The Quik-Grout® is ANSI/NSF Standard 60 certified, and was mixed to the manufacturer's specifications.

Prior to commencement of the drilling program, the site specific Health & Safety Plan, developed in the RS-1 stage, was reviewed and implemented. In addition to the standard safety equipment worn by the drill crew and field staff, Tyvek suits, Nitrile gloves, respirators and safety glasses were issued. PID readings were taken in the work area and at the borehole casing to ensure the field staff were not exposed to adverse air conditions.

The borehole locations developed in the proposal stage were translated into UTM (Universal Transverse Mercator) coordinates, based on 1983 North American Datum (NAD 83). A global positioning survey ("GPS") unit was used to locate the borehole coordinates in the field, as close as possible to the proposed coordinates. The survey was carried out using a Lowrance GlobalMap 100 with DGPS beacon receiver. The GPS unit was deployed until a minimum of 3 satellites was accounted for and the unit gave a "position acquired" signal. Following that, the DPGS signal was acquired, which, according to the Unit Manual, placed the borehole within 1 to 3 meters of the intended location. No daily calibration of the GPS unit was carried out. Subsequent comparison of borehole locations to actual coordinates indicates the GPS readings were out by 4 metres in one direction.

The elevations of the water boreholes were determined using data from the Lake Ontario Real-Time Water Level Gauging Station located in Burlington, Ontario. The elevations are referred to International Great Lakes Datum (IGLD) 1985. The elevations of the land boreholes were surveyed relative to lake level.

The location coordinates and elevations of the land boreholes were subsequently surveyed by Russell Technical Services Inc., as part of the total station survey of the project site.

All of the above-described fieldwork was directly supervised in the field by experienced AMEC geotechnical personnel, under the direction of the project engineer.

4.1 Geotechnical Sample Collection and Testing

Sampling and testing was performed using standard split spoons, Shelby tubes, NX-size casing, and side sampling equipment. A brief description of each type of equipment follows.

- Split Spoon: Split spoon sampling was carried out to recover samples in both cohesive and non-cohesive soil strata. Where necessary (in soft or loose soils), the split spoon sampler was equipped with a spring trap to reduce sample loss during retrieval of the equipment. The Standard Penetration Tests (SPT) were carried out in conjunction with the split spoon sampling, in accordance with ASTM D1586. The resulting standard penetration resistance ‘N-values’ provide a measure of the resistance of the soil to penetration of the sampler (or the state of relative density).

- Shelby Tube: Thin-walled Shelby tubes were used to recover relatively undisturbed soil samples (suitable for quantitative laboratory tests of engineering properties, such as strength, compressibility, permeability and unit weight) of cohesive soil strata.

Prior to starting the geotechnical sampling, two Shelby tube samples of the soft surficial deposits (i.e., the recent sediments and/or the silt layers) were taken at each borehole location for environmental testing. Geotechnical sampling and testing started immediately after the environmental sampling.

In the deep boreholes (i.e., Boreholes 26, 33 to 36, 39, 41 and 42, located around the perimeter of the proposed ECF and terminated on encountering practical refusal to further penetration), the typical sampling schedule was to sample at 1.5 m intervals to a depth of 17 m. Below that depth, the sampling interval was increased to every 3 m, until practical refusal to sampling was encountered. Refusal was defined as 100 blows for 30 cm penetration with the split spoon sampler. Shelby tube samples were taken within the relatively softer cohesive deposits in between split spoon sampling (generally between 11 and 15 m depth below lake water level). The sampling depths were generally staggered between boreholes, so that the interval between samples in one borehole would be sampled in an adjacent borehole.

The remaining deep boreholes (Boreholes 20, 22, and 29, which were not driven to refusal) within the anticipated berm areas were typically sampled every 1.5 m, and terminated at 12.5 to 27 m depths where Standard Penetration test results were greater than 15 blows for 30 cm penetration. Shelby Tube samples and field vanes were taken at about the 12 m depth.

The shallow boreholes inside the perimeter of the proposed ECF (i.e., Boreholes 28, 31 and 32) were sampled every 1.5 m, and terminated when the borehole had been advanced a minimum of 3 m into native soils.

Slag Delineation

Sampling and testing was performed in the slag delineation boreholes using a standard split spoon. Sampling was carried at 1.5 metres intervals through the slag fill. The boreholes were terminated approximately 3 metres into the deposit underlying the slag fill.

Preliminary identification of the split spoon samples was carried out upon retrieval from the borehole. The samples were then sealed in individual containers, and returned to an AMEC laboratory for detailed examination and testing.

4.2 Geotechnical Down Hole Testing

The down hole geotechnical testing included: standard penetration tests (SPT), conventional field vane tests (in between soil sampling) to determine in-situ undrained shear strength, and three flat plate dilatometer (DMT) probes. One in-situ consolidation test was also performed at the location of the softest soil layer using the DMT.

Standard Penetration Tests: Described earlier in Section 4.1.

Conventional Field Vane: Field vane tests (using a standard MTO vane) were carried out in the relatively soft clay deposit to determine the in-situ undrained shear strength. The vane was pushed into the soil to the desired depth, and the test carried out to determine in-situ as well as remoulded shear strengths. The ratio of the two strengths provides a measure of the soil sensitivity.

Flat Plate Dilatometer (DMT): This test is initiated by forcing the steel, flat plate, dilatometer blade, with its sharp cutting edge into the soil, stopping at 0.2 meter increments of vertical penetration and performing a test. Each test consists of applying pressure to the back of a flat, circular, metallic membrane, which causes its expansion into the surrounding soil. Correlation of the resulting pressures, expansion and the time that this expansion takes allows estimation of the soil's in-situ stratigraphy, stress, strength, compressibility, and pore-water pressure.

4.3 Environmental Sample Collection

The sediment sampling procedures used at the site are designed to maintain the integrity of the sample for laboratory analysis. Although the technologist completing these procedures wore Nitrile gloves, the Nitrile does not contact the sediment sample. The cleaning procedure is described below.

- Loose dirt was removed from the sampling equipment using a brush.
- The sampling equipment was washed with a brush in a dilute mix of potable water and Alconox soap.
- The sampling equipment was rinsed with distilled water.
- The sampling equipment was rinsed with methanol and allowed to air dry.

4.3.1 Collection of Environmental Samples at Geotechnical Borehole Locations

As part of the geotechnical fieldwork, samples of surface deposits (recent sediments and/or the shallow silt deposits) were collected for environmental assessment purposes (Boreholes 20, 22, 26, 28, 29, 31 to 36, 38, 39, and 41 to 43). The proscribed sampling schedule was to collect a Shelby tube straddling the interface between the recent, soft sediment and the underlying native soil. A second Shelby tube sample was taken immediately below the first, so that the potential downward migration of any contaminants could be assessed.

Where required, the upper recent, soft sediment was washed from the casing to a point where it was judged that the first Shelby tube interval would straddle the interface. After collection of the first Shelby tube within the casing, the borehole was washed out to the depth of the end of the Shelby tube sample. The second Shelby tube was then pushed into the underlying soil.

Samples for environmental assessment were also collected outside the borehole casing. After setting the borehole casing, an NX-sized length of casing was pushed into the recent, soft sediments next to the borehole casing. In the event of poor or no recovery, alternative sampling procedures were carried out using a side sampler or the split spoon. Stainless steel spring traps were used in the split spoon sampler as required.

<u>NX-size Casing Sampler</u>

NX sized casing was used to obtain bulk samples of the recent, soft sediment, from the ground adjacent the main borehole locations. The sampler was approximately 1 metre in length with a sharpened tip. In most cases, this technique allowed a relatively large sample of the entire stratum of sediment to be sampled. The base of the casing was pushed into the underlying clay and sheared, so that the clay would act as a plug to prevent the loss of the sediment during retrieval.

<u>Side Sampler</u>

Recovering samples of the saturated soft recent sediments was occasionally impossible with open-ended core samplers (e.g. Shelby tube, or split spoon, with or without a spring trap). A side sampler is a hollow tube similar in size to a split spoon but with a solid base to contain the sample during retrieval. The sampler is driven through the soil and rotated which allows a soil sample to be collected through a raised side port. Although the sample is disturbed during collection, it allows a bulk sample to be taken where no recovery can be obtained with conventional core samplers. Where required, the side sampler was used both inside and outside the borehole casing.

4.3.2 Collection of Environmental Samples at Other Locations

The sediment sampling program consisted of 28 cores collected manually by divers. These sediment sampling locations have been referred to as 'Sediment Sampling Holes', and are indicated on Figure 3-2 as BH-1 to 18, 20, 21, 23 to 25, 29, 30, and 44 to 46.

A Wildco sampler was used by divers in the sediment sampling holes. The Wildco sampler consists of a 1.5 m long stainless steel core tube equipped with a T-handle. A polycarbonate sample collection tube was inserted into the sampling device and driven into the soft sediments by hand. Prior to submerging the sampling device beneath the water, the ends of the Wildco sampler were sealed with plugs. As the sampler was positioned into place on the lakebed, the plugs were removed for sample collection. Upon retrieval, the ends of the sampler were again plugged and the sample brought to the surface. At the surface, the polycarbonate sample collection tube was removed from the sampler, sealed at each end and labelled. Diver notes pertaining to sediment depth were recorded at this time. Sample collection tubes were stored vertically in the field (on the barge) and kept on ice until they were delivered to AMEC's Hamilton laboratory.

The sediment thickness was measured on retrieving the sample to the barge (without correction for any changes that may have occurred during sampling). The sample tubes were stored vertically while they were prepared for freezing and transportation to the laboratory. The sample lengths were measured again prior to freezing. The changes noticed between the two measurements were: 8 samples showed no change, 13 samples showed a 2 to 10% increase and 5 samples showed a 2 to 7% reduction.

In the laboratory, each core sample was divided into two to three segments (referred to as sub-samples) and subjected to testing, or archived for future reference. Each core was visually assessed and logged to determine soil type, visual evidence of contamination and an estimate of sediment thickness

4.4 Sample Containment and Preservation

The NX-size casing samples taken outside the borehole casing through the recent sediments, were extruded in the field and divided into separate, sealed containers for environmental assessment as well geotechnical testing to be carried out by Hart Crowser. The samples were transported back to an AMEC laboratory, after which the environmental portions of the recent sediment samples and the geotechnical sediment samples were refrigerated.

All environmental Shelby tube samples were sealed on-site (with plastic sheets at tube ends) for transport back to AMEC's Hamilton laboratory. Generally, the soft sediments from the first (uppermost) Shelby tube were examined and the top and bottom portion of these samples used for environmental analysis. These samples were refrigerated and submitted to AMEC's Analytical Chemistry Laboratory in Mississauga. Sediment samples remaining within the tubes were placed in individual bags for geotechnical examination. The second Shelby tube (typically containing lower part of the sediment and the underlying soil deposit) from each borehole was opened, and the bottom 15 cm extruded and submitted for environmental assessment. The Shelby tube was then sealed with wax and preserved for subsequent geotechnical testing. Shelby tube samples obtained from the underlying silty clay stratum for detailed geotechnical laboratory testing (e.g., consolidation, triaxial testing) were immediately sealed with wax upon arrival in the Hamilton laboratory.

Preliminary identification of the split spoon samples was carried out upon retrieval from the borehole. The samples were then identified in the field and sealed in individual labelled containers. These samples were subsequently subjected to detailed examination in the laboratory.

4.5 Geotechnical Laboratory Testing

This section presents the results of the laboratory testing, which was carried out on selected representative soil samples. Interpretation of test results vis-à-vis the geotechnical design of the ECF components is presented in Section 6 of this report.

Routine laboratory testing (e.g., natural moisture content, grain size distribution and Atterberg limits) was carried out in the AMEC geotechnical laboratories in St. Catharines and Hamilton. More sophisticated testing (e.g., triaxial shear and one-dimensional consolidation) was carried out by the AMEC Scarborough laboratory. The minimum qualifications for each laboratory is certification according to the Canadian Council for Independent Laboratories (CCIL) as well as MTO approval by participation in a yearly Soils and Aggregates Correlation Program.

Table 4.1 on the following page summarizes the samples tested and type of tests carried out on each sample.

Index or Classification Tests: Grain size distribution curves (based on mechanical sieve and/or hydrometer analyses) are presented on Figures B-1 to B-8 in Appendix B. The natural moisture content, liquid limit, plastic limit and the plasticity index values are presented on the individual borehole logs. The results of the Atterberg limits tests are also plotted on the plasticity chart on Figures B-9A and B-9B in Appendix B.

Consolidation Testing: An important consideration for ECF design is the estimated settlement resulting from compression under future loading of the silty clay soils within and surrounding the ECF. One-dimensional consolidation (oedometer) testing was carried out to obtain consolidation characteristics for the upper silty clay stratum (the relatively softer deposit) that will permit estimating compression of the stratum. The tests were carried out on the following Shelby tube samples:

Table 4.1 Laboratory Test Program on Recovered Soil Samples

BH	Location	Sample Type	Depth (m)	Soil Type	Laboratory Tests Gradation	Atterberg Limits	Consolidation	Triaxial – c', phi'	Triaxial – (U-U)	Notes
20	Berm	SS5	11.9-12.3	Silty Clay	X	X				
20		SH6	13.4-13.55	Silty Clay	X	X		X		
22	Berm	SS5&6	7-8.6	Silt	X	X				
22		SH8	11.4-11.55	Silty Clay	X	X	X		X	
22		SS9	13-13.4	Silty Clay	X	X				
29	Berm	SS3,4,5	5.5-8.5	Silt	X	X				
29		SH8	12.8-13.15	Silty Clay	X	X			X	
29		SS9	14.5-14.9	Silty Clay	X	X				
29		SS13	22.1-22.5	Clayey Silt Till	X	X				
32	ECF	SS6	14.5-14.9	Silty Clay	X	X				
33	Dock	SH4	13.15-13.4	Silty Clay	X	X	X		X	
34	Dock	SS3	10.2-10.6	Silty Clay	X	X				
34		SH4	11.6-12	Silty Clay	X	X		X		
35	Dock	SS7	11.6-11.10	Silty Clay	X	X				
35		SH8	13-13.2	Silty Clay	X	X		X		
35		SS12	26.7-27.1	Silt Till	X	X				
36	Dock	SH6	13-13.4	Silty Clay	X	X		X	X	DMT Consolidation Test
36		SS11	20.4-20.8	Clayey Silt	X	X				
38	Dock (Land)	SS2	3-3.4	Alluvium	X	X				
38		SS5	7.6-8.2	Silty Clay	X	X				
38		SH8	12.2-12.4	Silty Clay	X	X			X	
39	Dock	SH4	10.8-11.2	Silty Clay	X	X	X		X	
42	Dock	SH1	8.1 – 8.5	Silt	X	X				
42		SH4	11.4-11.6	Silty Clay	X	X	X		X	
43	Dock (Land)	SS10	15.2-15.6	Silty Clay	X	X				
43		SH11	18.25-18.6	Silty Clay	X	X			X	

Sample	Location	Description of Soil	Depth of Sample below IGLD
BH 22 – Sa8	Berm Area	Silty Clay	11.4 to 11.5 m
BH 33 – Sa4	Berthing Area	Silty Clay	13.2 to 13.4 m
BH 39 – Sa4	Berthing Area	Silty Clay	10.8 to 11.2 m
BH 42 – Sa4	Berthing Area	Silty Clay	11.4 to 11.6 m

The test results are shown on Figures B-10 to B-13 (each with three sheets, A: Test Data, B: ‘v versus e and c_v, and C: Strain energy data).

Undrained Shear Strength

Triaxial “Quick” tests were carried out to determine undrained shear strength of the cohesive soils. Selected representative samples were subjected to confining cell pressures corresponding to approximately 50% of the effective in-situ vertical stress (existing overburden pressure) and then sheared at a strain rate of 0.5% per minute.

Sample	Location	Description of Soil	Depth of Sample below IGLD
BH 22 – Sa8	Berm Area	Upper Silty Clay	11.4 to 11.5 m
BH 29 – Sa8	Berm Area	Upper Silty Clay	12.8 to 13.2 m
BH 33 – Sa4	Dock Area	Upper Silty Clay	13.2 to 13.4 m
BH 38 – Sa8	Dock (Land)	Upper Silty Clay	12.2 to 12.4 m
BH 39 – Sa4	Berthing Area	Upper Silty Clay	10.8 to 11.2 m
BH 42 – Sa4	Berthing Area	Upper Silty Clay	11.4 to 11.6 m
BH 43 - Sa11	Dock (Land)	Upper Silty Clay	18.3 to 18.6 m

The test results for the above seven samples are summarized on Figures B-14 and B-15 in Appendix B.

Triaxial Testing to Obtain Effective Stress Strength Parameters

Isotropically Consolidated Undrained (CIU) Triaxial compression shear tests with pore pressure measurement were carried out to determine the effective shear strength parameters of the cohesive soils. Each test involved testing three specimens of the soil sample obtained from the same Shelby tube sample. The specimens were saturated by backpressure application (together with a small effective confining cell pressure), then consolidated under effective cell pressures of 30, 60 and 120 kPa, and finally sheared in compression (in undrained condition with pore pressure response measurement).

Sample	Location	Description of Soil	Depth of Sample below IGLD
BH 20 – Sa6	Berm Area	Silty Clay	13.4 to 13.6 m
BH 34 – Sa4	Berthing Area	Silty Clay	11.6 to 12.1 m
BH 35 – Sa8	Berthing Area	Silty Clay	16.0 to 16.4 m
BH 36 – Sa6	Berthing Area	Silty Clay	13.0 to 13.4 m

The test results for the above four samples are shown on Figures B-16 to B-19 in Appendix B. Each figure is a set of four sub-figures as follows: (A) Test Data, (B) Stress-Strain curves, (C) Stress Paths, and (D) Mohr’s envelopes.

APPENDIX A – BOREHOLE LOGS AND SOIL STRATIGRAPHIC PROFILES

General Borehole Log Notes

Borehole Logs

Boreholes 20, 22, 26, 28, 29, 31 to 36, 38, 39 and 41 to 43.
Monitoring Well Holes 40 (MW), 40A (MW) and 43A (MW).
Slag Delineation Boreholes A, C, D, E, I, J and K.

Stratigraphic Profiles

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GENERAL BOREHOLE LOG NOTES

DEFINITIONS OF PENETRATION RESISTANCE

Standard penetration resistance, SPT 'N'-value: -- The number of blows required to advance a standard split spoon sampler 30 cm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 70 cm (ASTM D1586).

Dynamic cone penetration resistance, DCPT: -- The number of blows required to advance a 50 mm, 60 degree cone, fitted to the end of drill rods, 30 cm into the subsoil, the driving energy being 475 Joules per blow.

SAMPLE TYPE ABBREVIATIONS USED IN BOREHOLE LOGS

S.S.	Split spoon	T.W.	Thinwall open	R.C.	Rock core
A.S.	Auger sample	T.P.	Thinwall piston	W.S.	Washed sample
P.H.	Sample pushed hydraulically			P.M.	Sample pushed manually

SOIL TEST SYMBOLS USED IN BOREHOLE LOGS

☐ Standard penetration resistance — ▼ Laboratory vane — ○ Unconfined compression

■ Dynamic penetration resistance — ▲ Field vane — ● Undrained triaxial

✕ Penetrometer — **S** Sensitivity

CONVENTIONAL SOIL DESCRIPTIONS

The terms used to describe size variation in a soil mass, and the corresponding percentage by weight, are as follows: "and" implies >35%, "adjectives (such as silty, sandy, etc)" imply 20-35%, "some" represents 10-20%, and "trace" indicates 1-10%, respectively.

COHESIVE SOILS		**GRANULAR SOILS (SANDS, ETC.)**	
Consistency	Shear Strength, kPa	Compactness	SPT 'N'-Value
Very Soft	0 - 12	Very Loose	0 - 4
Soft	12 – 25	Loose	4 - 10
Firm	25 – 50	Compact	10 - 30
Stiff	50 -100	Dense	30 - 50
Very Stiff	100 -200	Very Dense	>50
Hard	> 200		

ABBREVIATIONS FOR MOISTURE CONDITIONS

sdtpl - slightly drier than the plastic limit.
dtpl - drier than the plastic limit.
apl - about the plastic limit.
swtpl - slightly wetter than the plastic limit.
wtpl - wetter than the plastic limit.
mwtpl - much wetter than the plastic limit.

NOTE

The soil conditions, profiles, comments, conclusions and recommendations found in this report are based upon the samples recovered during the fieldwork. Soils are heterogeneous materials and, consequently, variations (possibly extreme) may be encountered at site locations away from boreholes. During construction, competent, qualified inspection personnel should verify that no significant variations exist from the conditions described in this report.

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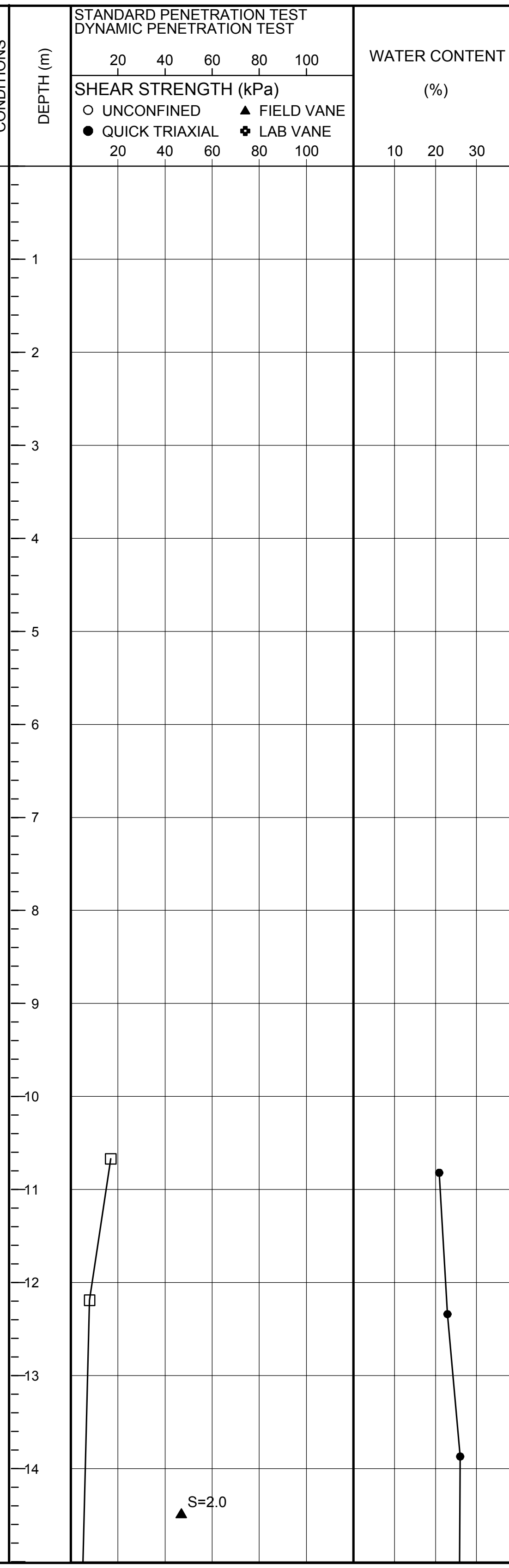
RECORD OF BOREHOLE No 20

PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791958N 594784E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 17.10.03
CHECKED BY: pmc

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.6 / 0.0	**WATER**					
65.9 / 8.7	Black **SOFT SEDIMENT (Recent)**	1	SIDE			
65.2 / 9.4	Brown to grey-brown **SILT**, marbled with recent sediment near top, frequent thin clay seams at depth, saturated/wtpl, very stiff/compact.	2	SH			
		3	SH			
		4	SS		17	
63.2 / 11.4	Grey **SILTY CLAY**, occasional silt and sand laminae, wtpl, firm to stiff.					**Gs/Hyd LL/PI**
		5	SS		8	
		6	SH	100		**'C-U'**
			VANE			



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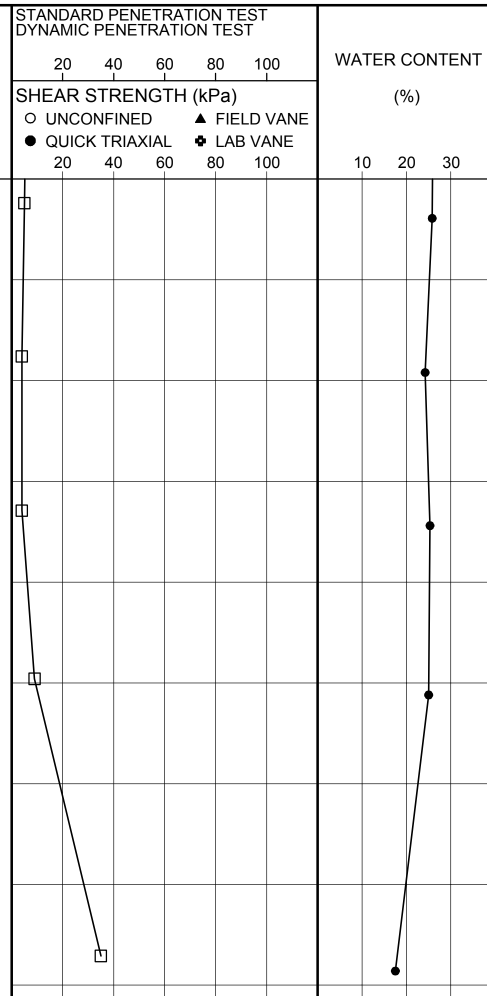
RECORD OF BOREHOLE No 20

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791958N 594784E
ORIGINATED BY rse
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 17.10.03
CHECKED BY pmc

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
		7	SS		5	
		8	SS		4	
		9	SS		4	
		10	SS		9	
53.3 / 21.3	Grey to grey-brown **CLAYEY SILT TILL**, wtpl to apl, hard.	11	SS		35	
51.4 / 23.2	Borehole Terminated.					Borehole backfilled completely with Grout.

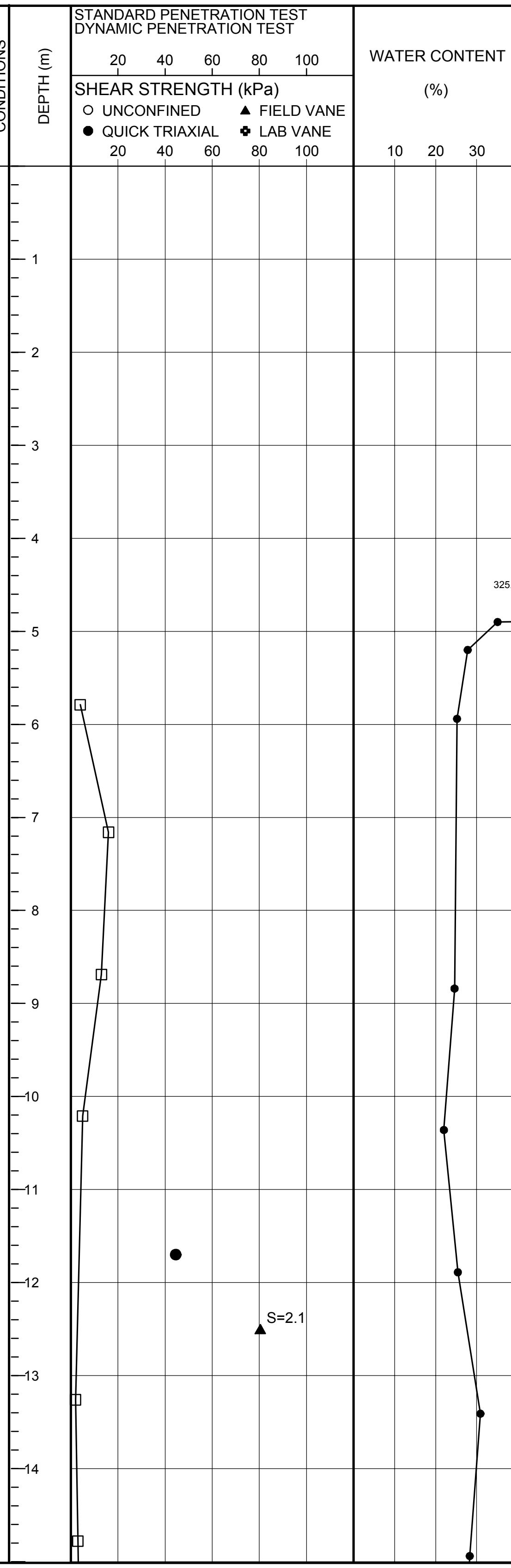
DEPTH (m): 16, 17, 18, 19, 20, 21, 22, 23



RECORD OF BOREHOLE No 22

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791996N 594643E	ORIGINATED BY	rse
CLIENT	Hamilton Port Authority			COMPILED BY	jdo
JOB NO.	TC035071 DATE 16.10.03			CHECKED BY	pmc

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.6 / 0.0	**WATER**					
70.5 / 4.1	**SOFT SEDIMENT (Recent)**, with zebra mussels.	1	SH			
70.2 / 4.4	3 cm brown Organic **ALLUVIUM**, over Grey, red-brown and brown **SILT**, some black staining in upper 0.4 m(±), layer of brown Organic **PEAT** and **ALLUVIUM** from 4.6 to 4.8 m(±), occasional grey clay seam and thin organic layers, wet to saturated, loose to compact.	2	SH			
		3	SH			
		4	SS		4	
		5	SS		16	**Gs/Hyd LL/PI**
		6	SS		13	**Gs/Hyd LL/PI**
65.2 / 9.4	Grey to grey-brown **SILTY CLAY**, wtpl, occasional siltier zones, traces of sand at depth, firm.	7	SS		5	
		8	SH			**Cons**
			VANE			
		9	SS		2	**Gs/Hyd LL/PI**
		10	SS		3	



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RECORD OF BOREHOLE No 22

PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791996N 594643E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 16.10.03
CHECKED BY: pmc

SOIL PROFILE

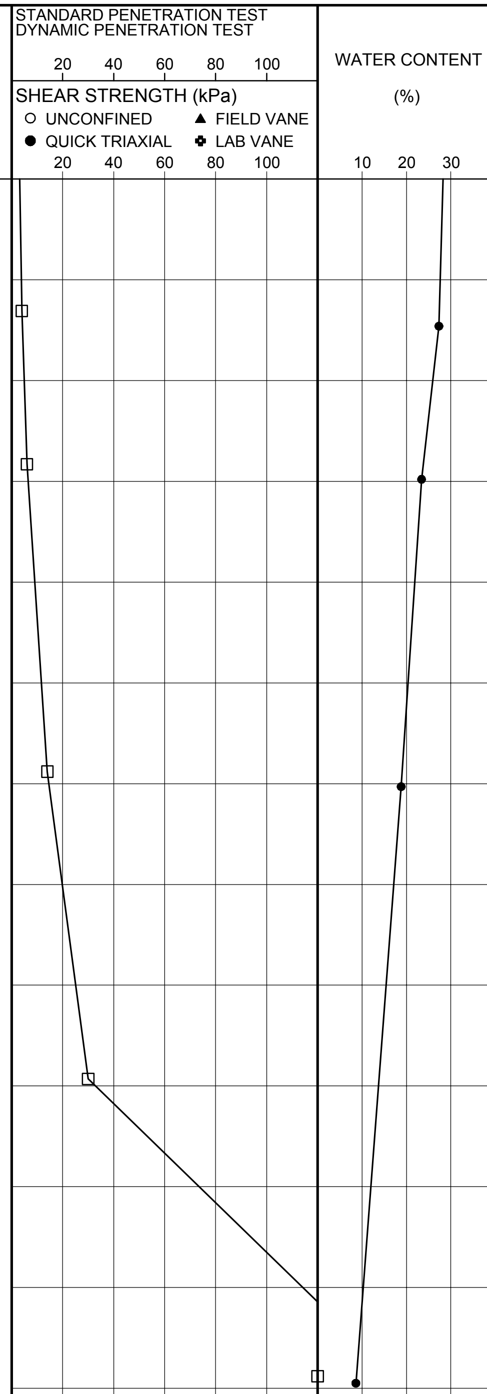
ELEV / DEPTH	DESCRIPTION
55.3 / 19.3	Grey **SILTY CLAY** to **CLAYEY SILT**, weakly laminated, occasional medium to coarse Sand layer, occasional small cobble below 21.0 m, wtpl, stiff.
52.3 / 22.3	Grey-brown **CLAYEY SILT TILL**, occasional small cobbles, apl, hard.
49.2 / 25.4	**SAND & GRAVEL**, saturated.
48.3 / 26.3	Reddish-brown and grey/green **SILT TILL** to **SHALE** at 26.8 m(±), very dense.
47.5 / 27.1	Borehole Terminated.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
11	SS		4
12	SS		6
13	SS		14
14	SS		30
15	SS		100/13cm

GROUND WATER CONDITIONS

DEPTH (m): 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27



OBSERVATIONS & REMARKS

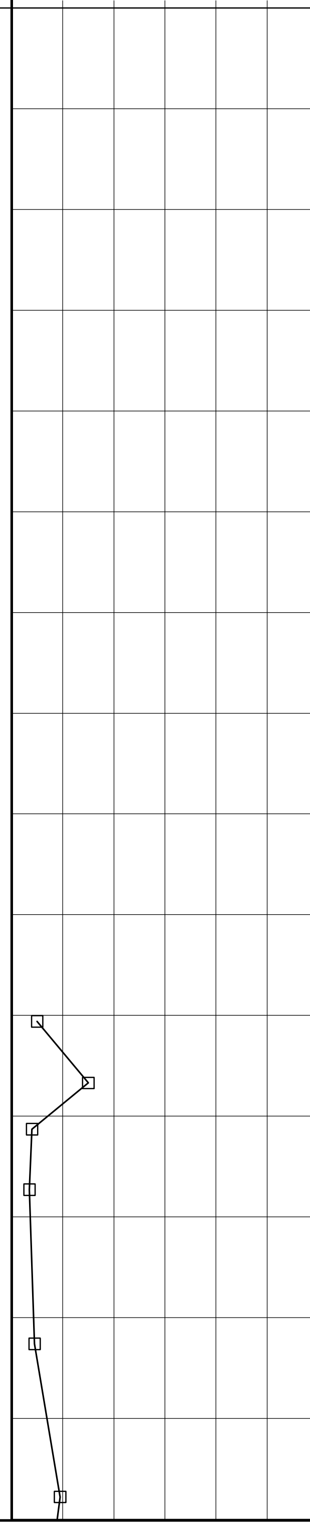
- Good wash return (at about 21 m)
- Quick-Gel added to displace sand & gravel. (at about 25.5–26 m)
- Borehole backfilled completely with Grout.

RECORD OF BOREHOLE No 26

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791814N 594805E	ORIGINATED BY	rse
CLIENT	Hamilton Port Authority			COMPILED BY	jdo
JOB NO.	TC035071 DATE 29.10.03			CHECKED BY	pmc

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.7 / 0.0	**WATER**					
65.8 / 8.9	**SOFT SEDIMENT (Recent)**, mixed with **SLAG Fill** and **Zebra Mussels**					Sampling outside casing: Nx casing pushed to 9.9 m.
64.9 / 9.8	Grey to black **SLAG**, minor recent sediment and shells in upper 0.4 m(±), little sample recovery, trace coal tar below 17.0 m(±), saturated, compact.	1	SS	15	10	
		2	SS	5	30	
		3	SS	5	8	
		4	SS	5	7	
		5	SS	5	9	
		6	SS	5	19	

Column headings: STRAT PLOT; GROUND WATER CONDITIONS; DEPTH (m) 1–14; STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE 20 40 60 80 100; WATER CONTENT (%) 10 20 30



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RECORD OF BOREHOLE No 26

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791814N 594805E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 29.10.03 CHECKED BY pmc

SOIL PROFILE

ELEV DEPTH	DESCRIPTION	OBSERVATIONS & REMARKS
53.1 21.6	Grey **SILTY CLAY**, traces of sand and gravel, wtpl, very stiff.	Good wash return.
49.3 25.4	Brown, Grey and Reddish-brown **SILT TILL** to **CLAYEY SILT TILL**, apl/moist to wet, hard/very dense.	
46.3 28.4	Borehole Terminated.	Borehole backfilled completely with Grout.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
7	SS	5	11
8	SS	5	15
9	SS	5	23
10	SS	10	17
11	SS	5	25
12	SS	70	19
13	SS	10	69
14	SS	60	50/3cm

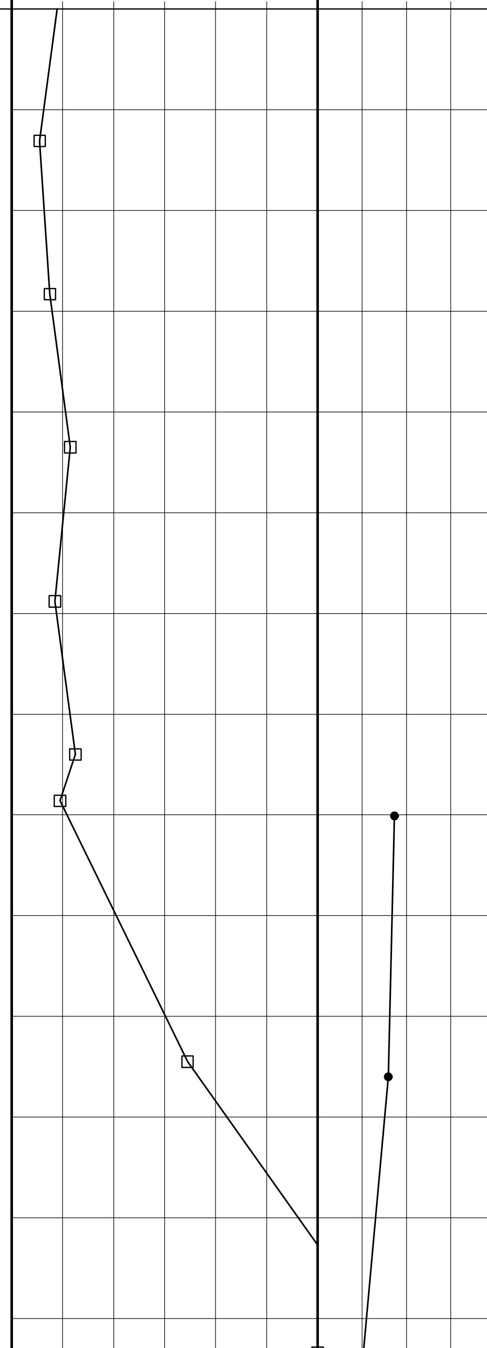
GROUND WATER CONDITIONS

DEPTH (m): 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28

STANDARD PENETRATION TEST
DYNAMIC PENETRATION TEST
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✚ LAB VANE
20 40 60 80 100

WATER CONTENT (%)
10 20 30



RECORD OF BOREHOLE No 28

PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791871N 594597E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 27.10.03
CHECKED BY: pmc

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
74.6 / 0.0	**WATER**
65.5 / 9.1	**SOFT SEDIMENT (Recent)**
64.8 / 9.8	Brown saturated **SILT**, occasional black Recent Sediment seams, loose.
64.2 / 10.4	Grey **SILTY CLAY**, occasional silt seams, wtpl, firm.
62.1 / 12.5	Borehole Terminated.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
1	SH		N/R
2	SH		
3	SS	100	8
4	SS	100	3

GROUND WATER CONDITIONS

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST: 20, 40, 60, 80, 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE — 20, 40, 60, 80, 100

WATER CONTENT (%): 10, 20, 30

OBSERVATIONS & REMARKS

Sampling outside casing: Nx sampler pushed to 9.5 m - no recovery. Split Spoon driven from 9.5 to 10.0 m(±).

No recovery from SH 1. Side Sampler used to obtain sample.

Borehole backfilled completely with Grout.

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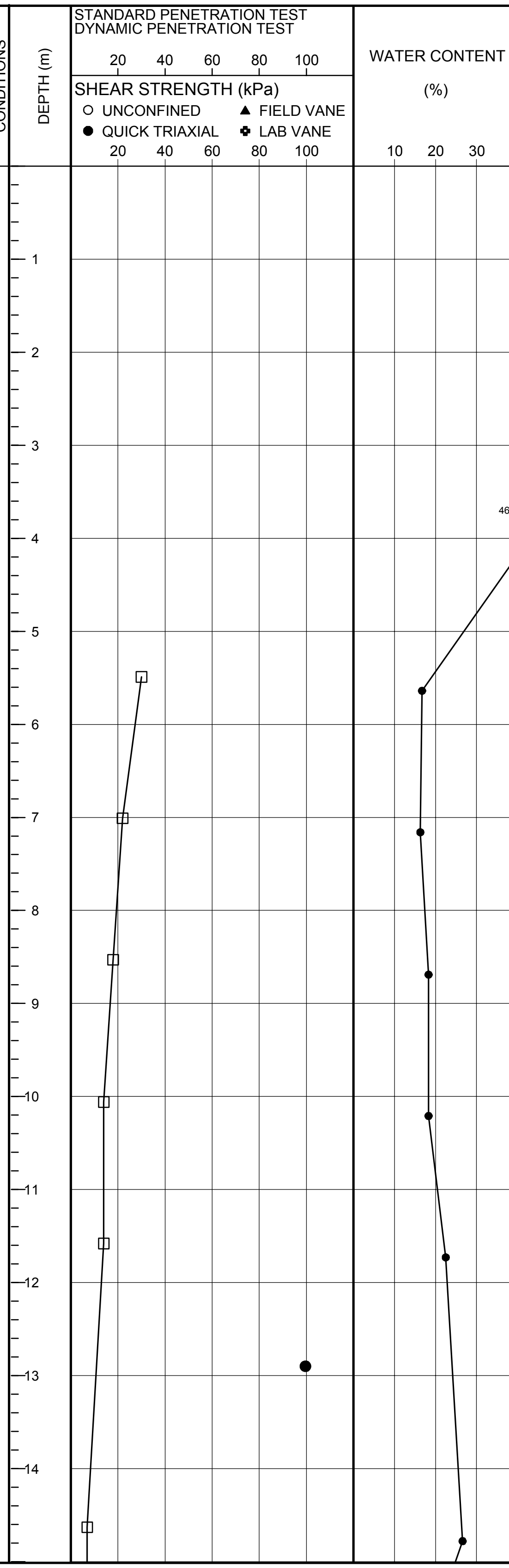
RECORD OF BOREHOLE No 29

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791936N 594501E
CLIENT	Hamilton Port Authority	ORIGINATED BY	rse
JOB NO.	TC035071	DATE	20.10.03
COMPILED BY	jdo	CHECKED BY	pmc

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.6 / 0.0	**WATER**					
70.9 / 3.8	**SOFT SEDIMENT (Recent)**	1	SH			Sampling outside casing: Nx sampler driven twice to 4.1 m - no recovery. Split Spoon driven from 3.7 to 4.0 m(±).
	Brown to reddish-brown **SILT**, wet to saturated, 10 cm thick black recent sediment layer at 4.1 m(±), trace clay increasing with depth, dense to compact (apl and very stiff near base of deposit).	2	SH			
		3	SS	45	30	**Gs/Hyd LL/PI**
		4	SS	40	22	**Gs/Hyd LL/PI**
		5	SS	45	18	**Gs/Hyd LL/PI**
64.8 / 9.8	Grey to grey-brown **SILTY CLAY** to **CLAYEY SILT**, trace of sand & gravel, occasional silt/sand seam, becoming siltier below 17.5 m(±), wtpl, firm to stiff.	6	SS	50	14	
		7	SS	100	14	
	(harder zone at 13.2 m, vane not attempted)	8	SH			
		9	SS	70	7	



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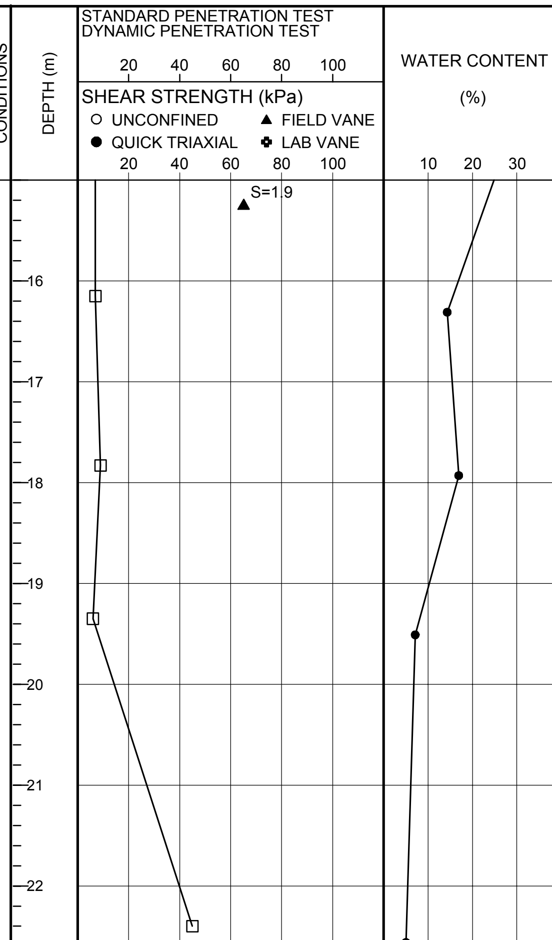
RECORD OF BOREHOLE No 29

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791936N 594501E	ORIGINATED BY	rse
CLIENT	Hamilton Port Authority			COMPILED BY	jdo
JOB NO.	TC035071 DATE 20.10.03			CHECKED BY	pmc

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
			VANE			
		10	SS	100	7	
		11	SS	100	9	
		12	SS	100	6	
54.5 / 20.1	Grey-brown **CLAYEY SILT TILL**, cobbles from 21.8 to 22.1 m(±), wtpl to sdtpl, hard.	13	SS	15	45	**Gs/Hyd LL/PI**
52.0 / 22.6	Borehole Terminated.					Borehole backfilled completely with Grout.



RECORD OF BOREHOLE No 31

PROJECT Randle Reef Sediment Remediation Project　LOCATION 4791830N 594534E　ORIGINATED BY rse

CLIENT Hamilton Port Authority　COMPILED BY jdo

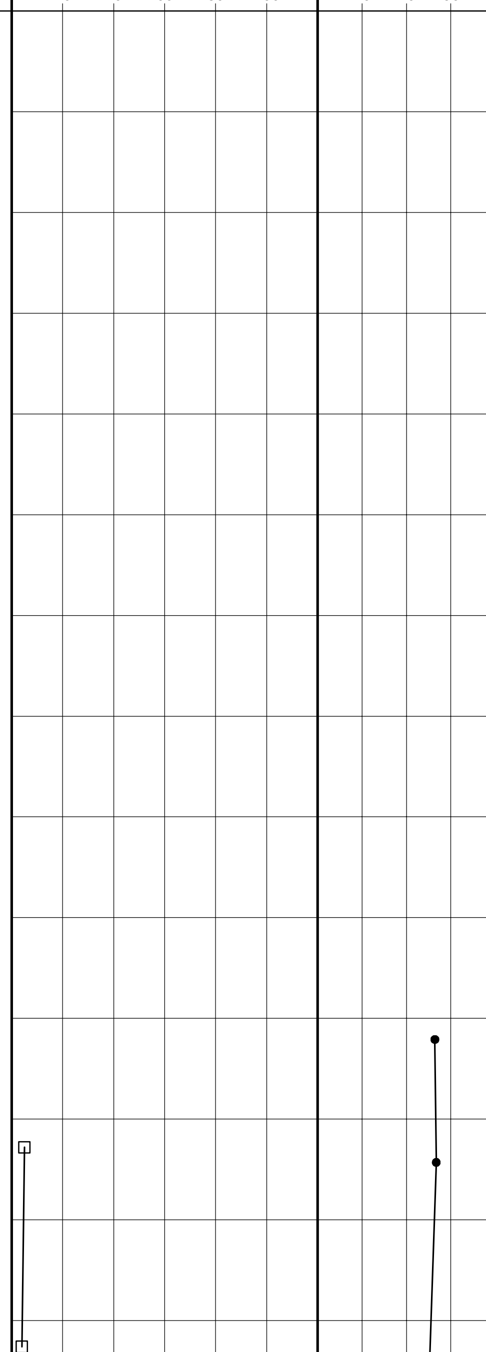
JOB NO. TC035071　DATE 24.10.03　CHECKED BY pmc

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	STRAT PLOT	SAMPLES – NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	OBSERVATIONS & REMARKS
74.6 / 0.0	**WATER**								
65.6 / 9.0	**SOFT SEDIMENT (Recent)**								Sampling outside casing: Nx sampler pushed to 10.0 m. Duplicate sample taken.
64.8 / 9.8	Brown **SILT**, minor staining, saturated.		1	SH					Bottom 65 cm of SH 1 saved as bag sample.
64.5 / 10.1	Grey **SILTY CLAY**, wtpl, firm.		2	SH					
			3	SS	100	5			
			4	SS	100	4			
61.2 / 13.4	Borehole Terminated.								Borehole backfilled completely with Grout.

STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE — 20 40 60 80 100

WATER CONTENT (%): 10 20 30



RECORD OF BOREHOLE No 32

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791783N 594619E
ORIGINATED BY rse

CLIENT Hamilton Port Authority
COMPILED BY jdo

JOB NO. TC035071 DATE 24.10.03
CHECKED BY pmc

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | DEPTH (m) | STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100) | SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100) | WATER CONTENT (%) (10 20 30) | OBSERVATIONS & REMARKS

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.6 0.0	**WATER**						
66.2 8.4	Brown **ORGANIC ALLUVIUM** Black **SOFT SEDIMENT (Recent)**, some shells, silt layers. Brown **ORGANICS**, saturated, very loose.		1	SH		N/R	Sampling outside casing: Nx sampler pushed to 10.2 m.
			2	SH			
			3	SH			
			4	SS	40	1/46cm	
	(wood in split spoon #5)		5	SS	20	2	
60.6 14.0	Brown to Grey **SILTY CLAY**, fissured, apl to wtpl, very stiff to firm.		6	SS	55	18	**Gs/Hyd** **LL/PI**

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

242.7

Continued Next Page

RECORD OF BOREHOLE No 32

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791783N 594619E	ORIGINATED BY	rse
CLIENT	Hamilton Port Authority			COMPILED BY	jdo
JOB NO.	TC035071	DATE	24.10.03	CHECKED BY	pmc

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100); SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
			7	SS	100	8		16			
58.1 16.5	Borehole Terminated.										Borehole backfilled completely with Grout.

amec

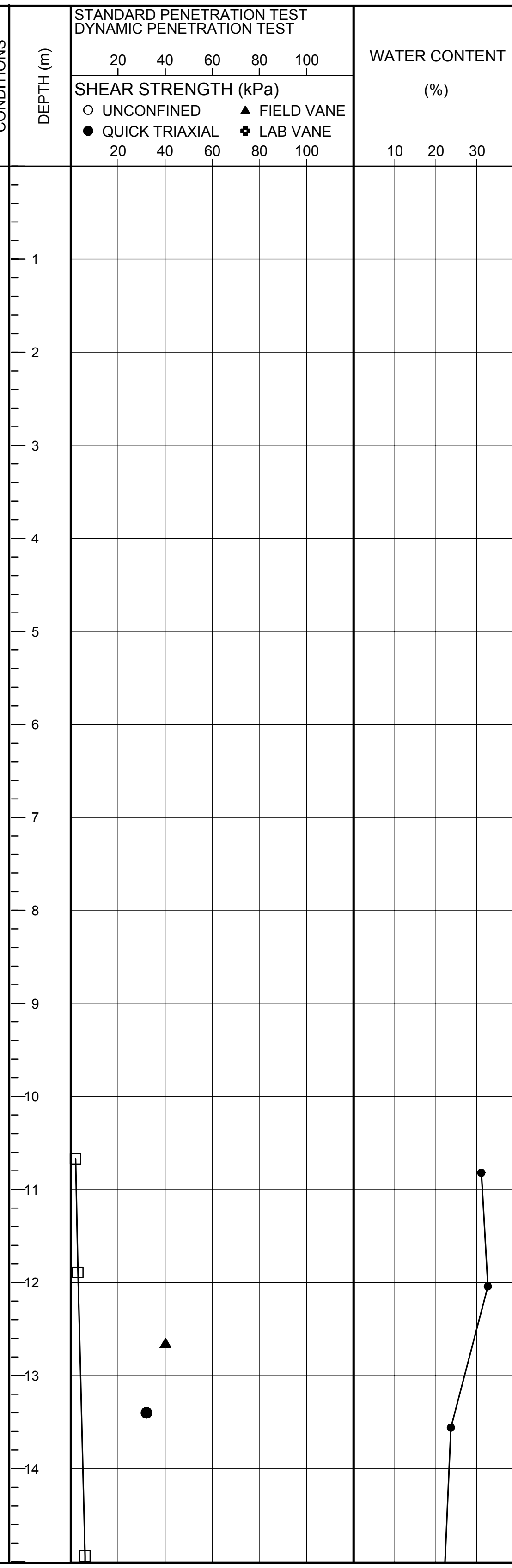
RECORD OF BOREHOLE No 33

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791826N 594431E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 10.10.03 CHECKED BY pmc

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.7 / 0.0	**WATER**					
65.7 / 9.0	**SOFT SEDIMENT (Recent)**					
65.4 / 9.3	Grey **SILTY CLAY** to **CLAYEY SILT**, trace to some sand, trace of gravel below 18.0 m (±), wtpl, firm to stiff.	1	SH			
		2	SS		2	
		3	SS		3	
			VANE			
		4	SH			Gs/Hyd LL/PI Cons
		5	SS		6	



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RECORD OF BOREHOLE No 33

PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791826N 594431E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 10.10.03
CHECKED BY: pmc

SOIL PROFILE

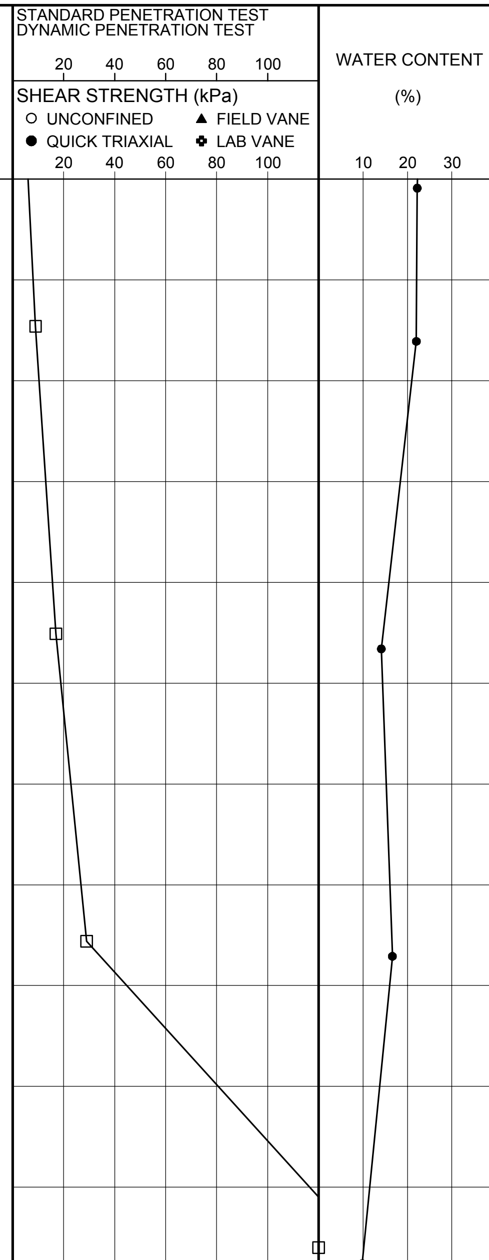
ELEV / DEPTH	DESCRIPTION
56.8 / 17.9	Grey, laminated **SILTY CLAY**, traces of sand & gravel, augers grinding occasionally below 21.6 m(±), wtpl, very stiff.
50.9 / 23.8	**SAND & GRAVEL**, saturated.
50.2 / 24.5	Grey **CLAYEY SILT**, traces of sand & gravel, wtpl.
49.2 / 49.1 / 25.5	Reddish-brown **SILT TILL**, wet to saturated, very dense.
48.9 / 25.6 / 25.8	Reddish-brown **SAND & GRAVEL**, saturated, very dense.
	Borehole Terminated.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
6	SS		9
7	SS		17
8	SS		29
9	SS		138

GROUND WATER CONDITIONS

DEPTH (m): 16, 17, 18, 19, 20, 21, 22, 23, 24, 25



OBSERVATIONS & REMARKS

SS 8 - Driving Stone.

Quick-Gel added to prevent water loss through sand & gravel layer.

Borehole backfilled completely with Grout.

RECORD OF BOREHOLE No 34

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791762N 594490E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 21.10.03 CHECKED BY pmc

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST; SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES					
74.7 0.0	**WATER**										
66.5 8.2	**SOFT SEDIMENT (Recent)**										Sampling outside casing: Three Nx samplers pushed to 9.7 m(±).
65.3 9.4	Grey **SILTY CLAY** to **CLAYEY SILT**, trace of sand & gravel, wtpl, stiff to firm.		1	SH						57.1	
			2	SH							Gs/Hyd LL/PI
			3	SS		4					
			4	SH							'C-U'
				VANE					S=1.7		
			5	SS	100	9					
			6	SS	100	12					

Continued Next Page

RECORD OF BOREHOLE No 34

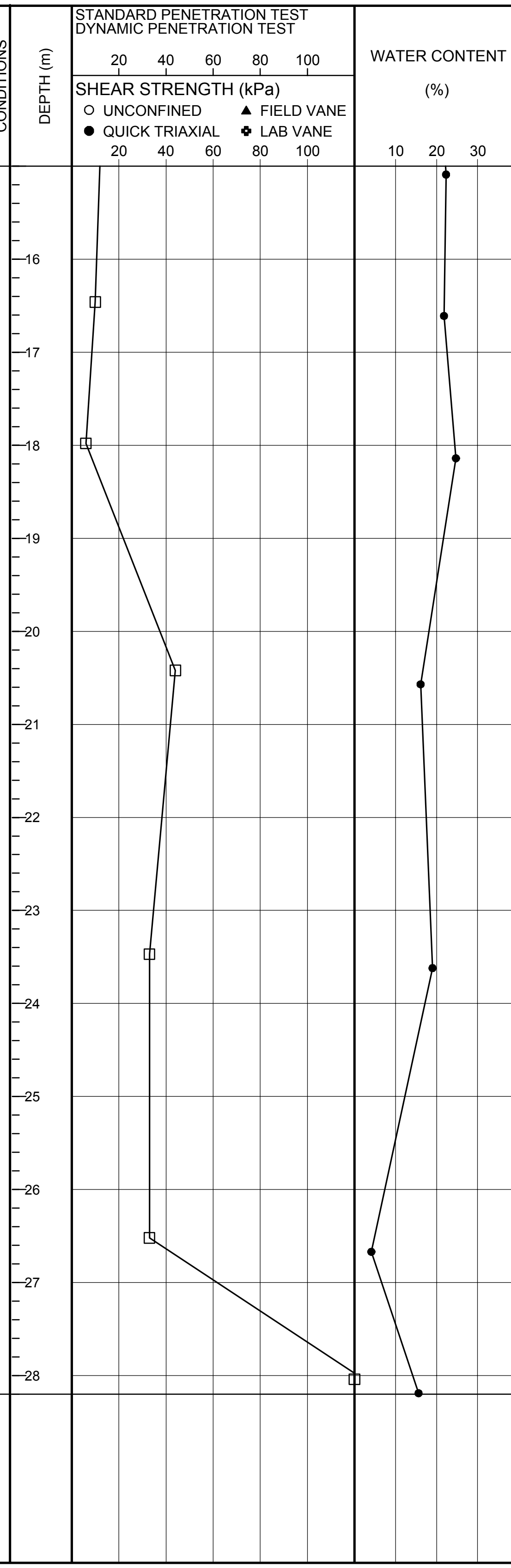
PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791762N 594490E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 21.10.03
CHECKED BY: pmc

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION	OBSERVATIONS & REMARKS
55.8 / 18.9	Grey-brown **CLAYEY SILT**, traces of sand & gravel, some till-like zones, cobbles below 24.6 m(±), sdtpl to apl, hard.	harder augering. Good wash return.
49.8 / 24.9	Reddish-brown **SAND & GRAVEL**, cobbles at 26.8 m±, saturated, dense.	Quick-Gel added to keep Hole open across sand & gravel layer.
47.5 / 27.2	Grey **CLAYEY SILT TILL**, damp, very dense.	
46.5 / 28.2	Borehole Terminated.	Borehole backfilled completely with Grout.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
7	SS	100	10
8	SS	100	6
9	SS	100	44
10	SS	100	33
11	SS	20	33
12	SS	100	124



RECORD OF BOREHOLE No 35

PROJECT Randle Reef Sediment Remediation Project | LOCATION 4791735N 594587E | ORIGINATED BY rse

CLIENT Hamilton Port Authority | COMPILED BY jdo

JOB NO. TC035071 | DATE 14.10.03 | CHECKED BY pmc

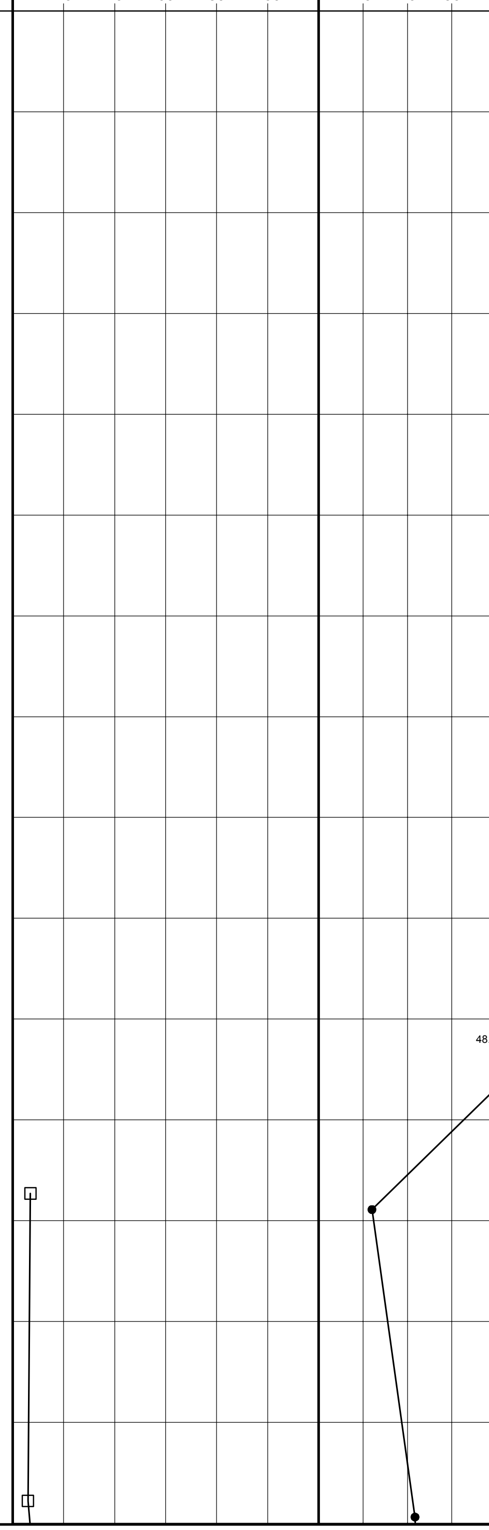
ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	OBSERVATIONS & REMARKS
74.7 / 0.0	**WATER**						
66.8 / 7.9	**SOFT SEDIMENT (Recent)**	1	SIDE				
		2	SIDE				
64.9 / 9.8	Grey **SILTY CLAY**, trace of sand and gravel, swtpl to wtpl, firm.	3	SH				
		4	SH				
		5	SS		7		
	(last 0.3 m of SH 6 hard to push (silt layers) - no vane attempted)	6	SH				
		7	SS		6		Gs/Hyd LL/PI

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE — 20 40 60 80 100

WATER CONTENT (%): 10 20 30



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RECORD OF BOREHOLE No 35

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791735N 594587E
ORIGINATED BY rse
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 14.10.03
CHECKED BY pmc

SOIL PROFILE

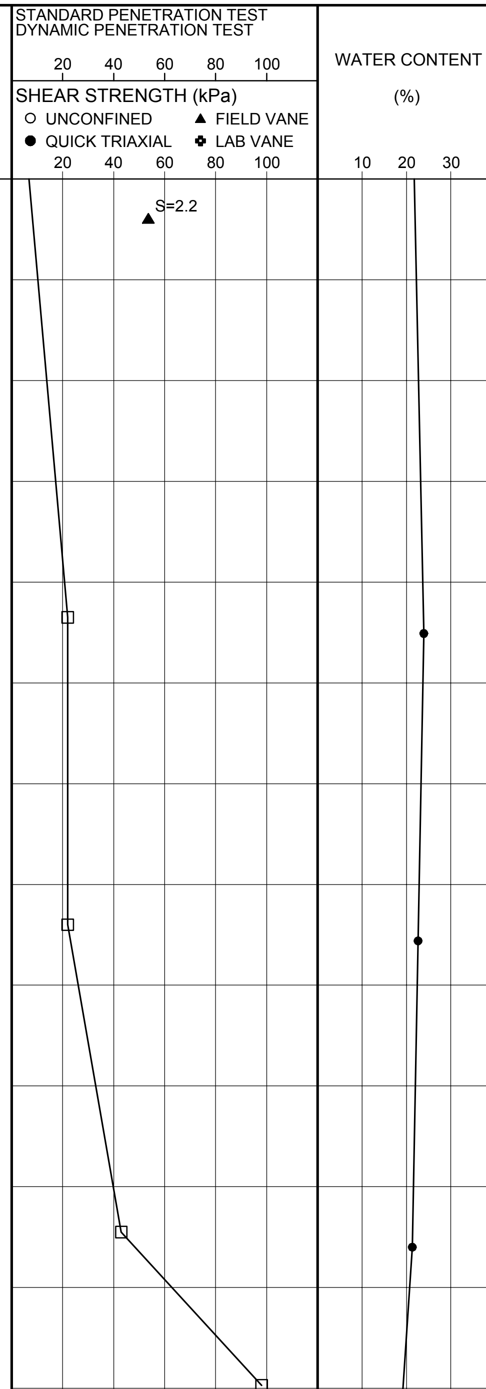
ELEV / DEPTH	DESCRIPTION
57.1 / 17.6	Grey **SILTY CLAY**, weakly laminated, occasional weathered shale piece, becoming siltier, cobble at 21 m, wtpl to swtpl, very stiff.
49.2 / 25.5	Reddish-brown **SAND & GRAVEL**, saturated.
48.6 / 26.1	Reddish-brown **SILT TILL**, minor cohesion, moist, very dense.
47.6 / 27.1	Borehole Terminated.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
	VANE		
8	SH		
9	SS		22
10	SS		22
11	SS		43
12	SS		98

GROUND WATER CONDITIONS

DEPTH (m): 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27



OBSERVATIONS & REMARKS

'C-U'

harder augering

Good wash return to 25 m. Quick-Gel added to displace sand & gravel 25.5 to 26.1m(±).

Gs/Hyd
LL/PI

Borehole backfilled completely with Grout.

RECORD OF BOREHOLE No 36

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791690N 594657E	ORIGINATED BY	rse
CLIENT	Hamilton Port Authority			COMPILED BY	jdo
JOB NO.	TC035071 DATE 21.10.03			CHECKED BY	pmc

SOIL PROFILE

ELEV DEPTH	DESCRIPTION
74.6 0.0	**WATER**
69.0 5.6	**SOFT SEDIMENT (Recent)**, with Silt layers.
67.7 6.9	Grey **SILTY CLAY**, traces of sand & gravel at depth, wtpl to apl, firm to stiff.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
1	SH		
2	SH		
3	SS	80	6
4	SS	100	5
	VANE		
5	SS	100	5
6	SH		
7	SS	100	13
8	SS	100	8

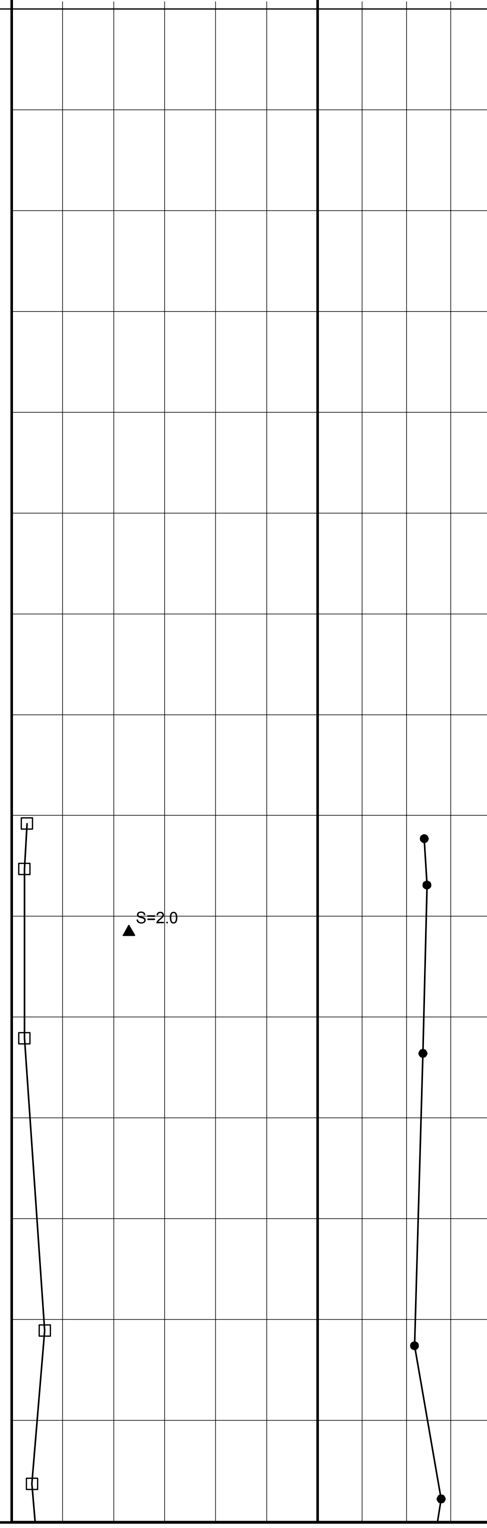
GROUND WATER CONDITIONS

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE — 20 40 60 80 100

WATER CONTENT (%): 10 20 30



OBSERVATIONS & REMARKS

Sampling outside casing: Nx sampler driven to 6.7m.

'C-U'

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RECORD OF BOREHOLE No 36

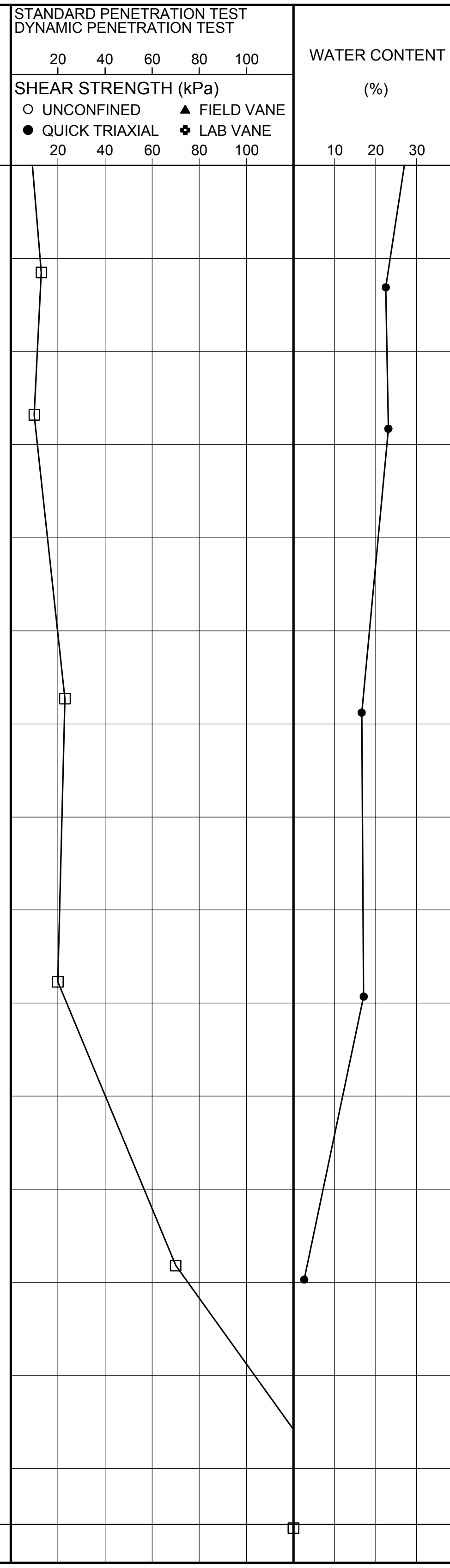
PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791690N 594657E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 21.10.03
CHECKED BY: pmc

SOIL PROFILE

ELEV DEPTH	DESCRIPTION
55.5 / 19.1	Grey-brown **CLAYEY SILT**, traces of sand & gravel, cobbles below 25 m, wtpl to apl, very stiff.
48.1 / 26.5	**SILT, SAND & GRAVEL**, some cobbles, saturated, very dense.
46.3 / 28.3	Possibly **Queenston SHALE**, very dense.
45.0 / 29.6	Borehole Terminated.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
9	SS	35	13
10	SS	100	10
11	SS	30	23
12	SS	100	20
13	SS	20	70
14	SS	0	100/8cm



DEPTH (m): 16 – 29

OBSERVATIONS & REMARKS

Good wash return. (at ~16 m)

Good wash return. (at ~19 m)

Gs/Hyd
LL/PI

Hole caving at 26.5 m. Quick-Gel added to displace sand & gravel.

Borehole backfilled completely with Grout.

RECORD OF BOREHOLE No 38

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791574N 594604E
CLIENT	Hamilton Port Authority	ORIGINATED BY	rse
JOB NO.	TC035071	DATE	6.10.03
COMPILED BY	jdo	CHECKED BY	pmc

SOIL PROFILE

ELEV DEPTH	DESCRIPTION
76.5 / 0.0	**FILL** - Grey and Black Granular (silt, sand & gravel).
74.8 / 1.7	**ALLUVIUM**- Black to brown Silt, some sand, few silty clay zones, trace of organics, augers grinding from 2.9 to 3.1 m(±), wet, very loose.
71.9 / 4.6	Brown to grey **SILTY CLAY** to **CLAYEY SILT**, occasional thin silt seams, becoming siltier below 15.0 m(±), traces of sand & gravel, wtpl, stiff to firm.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
1	SS		10
2	SS		3
3	SS		11
4	SS		12
5	SS		1
6	SS		3
	VANE		
7	SS		4
8	SH		
	VANE		
9	SS		7

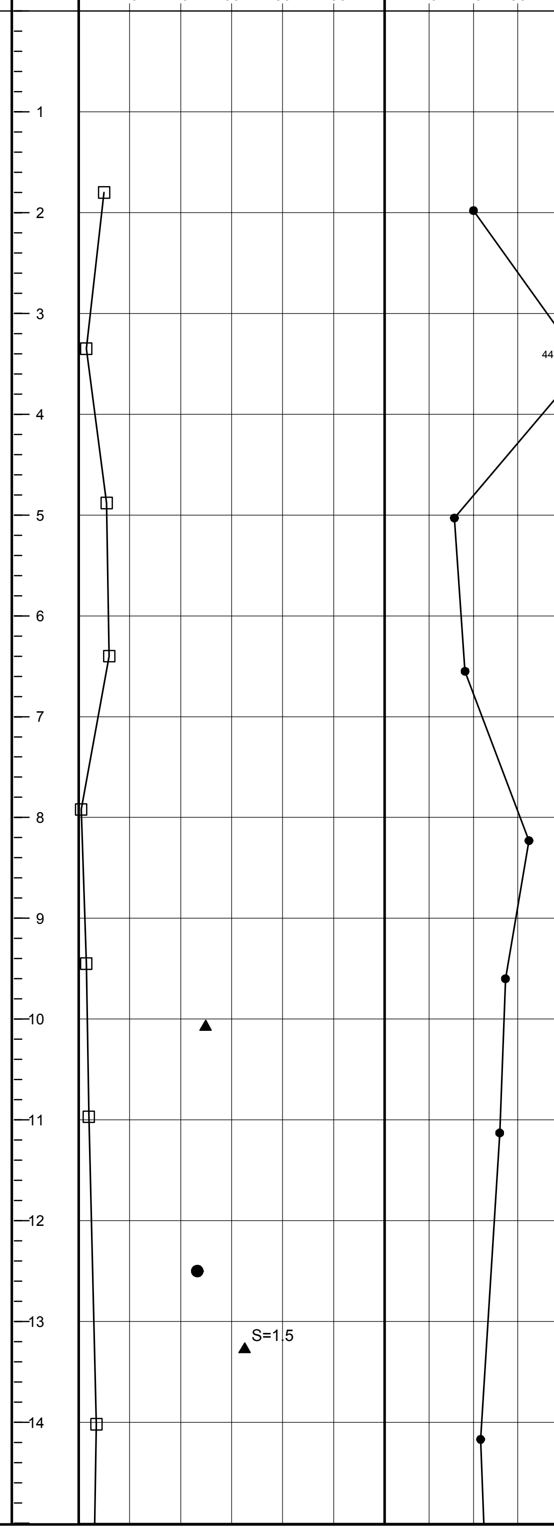
GROUND WATER CONDITIONS

DEPTH (m)

STANDARD PENETRATION TEST
DYNAMIC PENETRATION TEST
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✚ LAB VANE
20 40 60 80 100

WATER CONTENT (%)
10 20 30



OBSERVATIONS & REMARKS

Gs/Hyd
LL/PI

Gs/Hyd
LL/PI

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RECORD OF BOREHOLE No 38

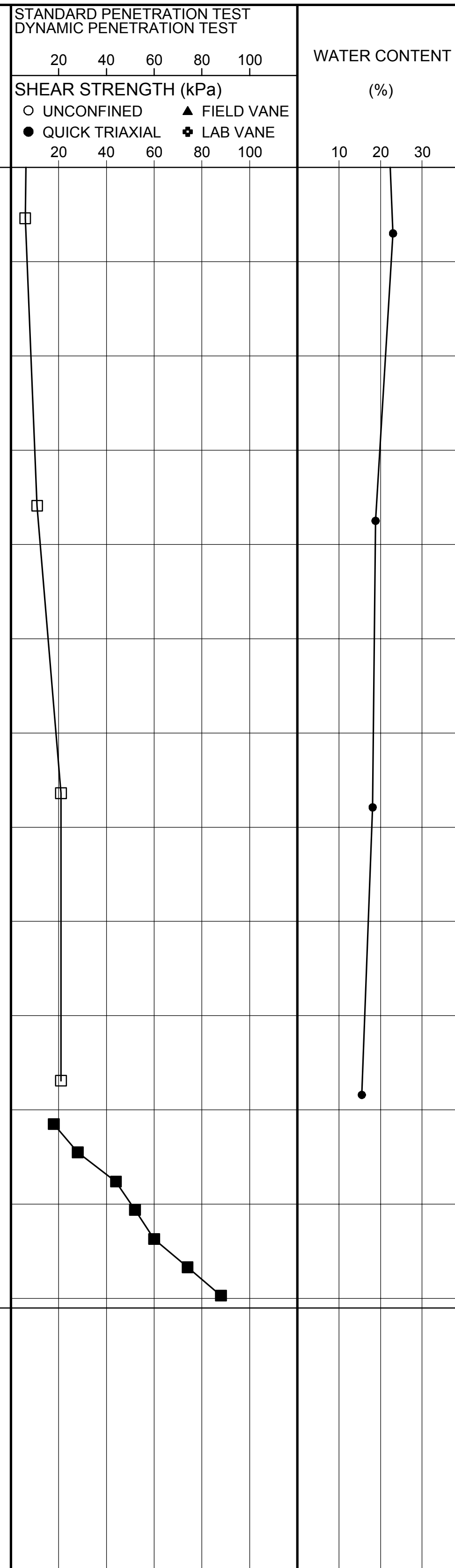
PROJECT Randle Reef Sediment Remediation Project — LOCATION 4791574N 594604E — ORIGINATED BY rse

CLIENT Hamilton Port Authority — COMPILED BY jdo

JOB NO. TC035071 — DATE 6.10.03 — CHECKED BY pmc

ELEV DEPTH	DESCRIPTION (SOIL PROFILE)	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	OBSERVATIONS & REMARKS
		10	SS		6			
		11	SS		11			
56.0 20.5	Grey **SILTY CLAY**, weakly laminated, traces of sand & gravel, occasional reddish-brown Silt Till layers, wtpl, very stiff.							harder augering
		12	SS		21			
		13	SS		21			Bearing gone in carriage. Deeper augering not possible. Dynamic Penetration testing carried out. Refusal depth correlates with Acres 1954 Borehole #'s 10 and 11.
51.5 25.0		14	DT		18			
		15	DT		28			
		16	DT		44			
		17	DT		52			
		18	DT		60			
		19	DT		74			
		20	DT		88			
49.4 27.1	Borehole Terminated.							Upon Completion: Borehole dry & open. Borehole backfilled with Quick Grout.

Depth (m) scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27



![amec logo]

RECORD OF BOREHOLE No 39

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791666N 594513E	ORIGINATED BY	rse
CLIENT	Hamilton Port Authority			COMPILED BY	jdo
JOB NO.	TC035071 DATE 27.10.03			CHECKED BY	pmc

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
74.6 / 0.0	**WATER**
66.8 / 7.8	Black **SOFT SEDIMENT (Recent)**
66.1 / 8.5	Grey **SILT**, layered with **Soft Recent Sediment**, saturated, very loose.
65.2 / 9.4	Grey **SILTY CLAY**, occasional weathered shale pieces below 17.0 m(±), wtpl, firm to stiff.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
1	SS		1
2	SH		
3	SH		
	VANE		
4	SH		
5	SS	100	9
6	SS	100	5

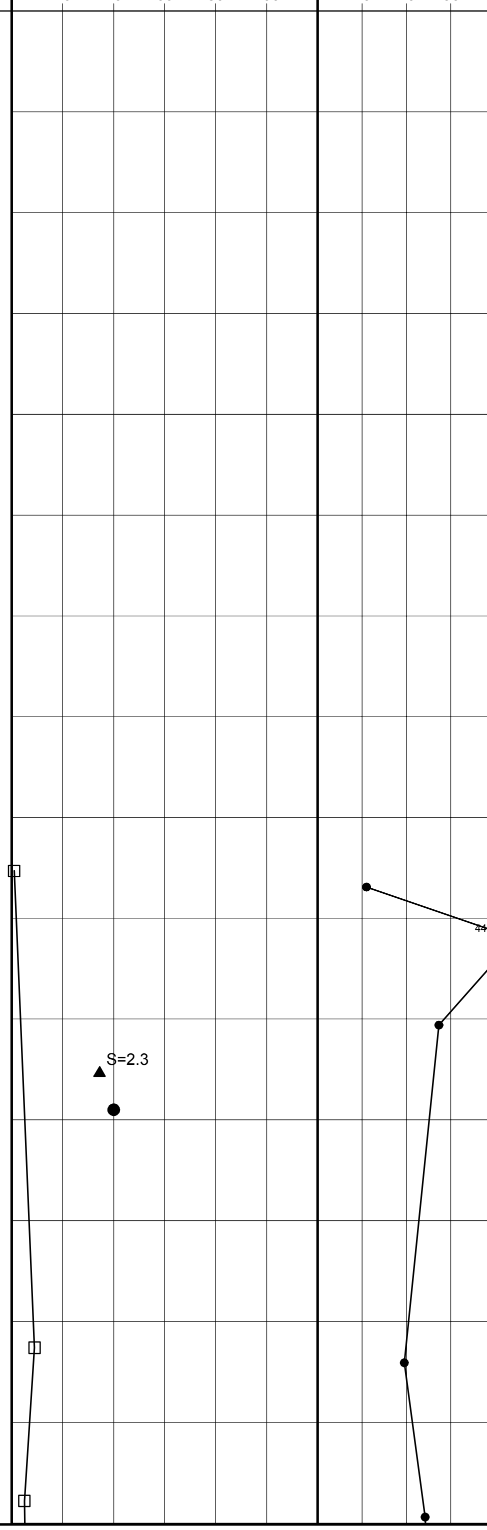
GROUND WATER CONDITIONS

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

STANDARD PENETRATION TEST
DYNAMIC PENETRATION TEST
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✚ LAB VANE
20 40 60 80 100

WATER CONTENT (%)
10 20 30



OBSERVATIONS & REMARKS

Sampling outside casing: Nx sampler pushed to 8.7 m.

Cons.

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RECORD OF BOREHOLE No 39

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791666N 594513E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 27.10.03 CHECKED BY pmc

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
55.3 / 19.3	**SAND & GRAVEL**, cobbles, saturated.
54.6 / 20.0	Grey **CLAYEY SILT TILL**, cobbles below 25.8 m(±), wtpl to apl, hard to stiff.
48.8 / 25.8	**SAND & GRAVEL**, saturated.
47.9 / 26.7	Reddish-brown to green-grey **SILT TILL**, possible **SHALE**, damp, very dense
47.5 / 27.1	Borehole Terminated.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
7	SS	100	6
8	SS	100	10
9	SS	100	45
10	SS	75	14
11	SS	10	100/28cm

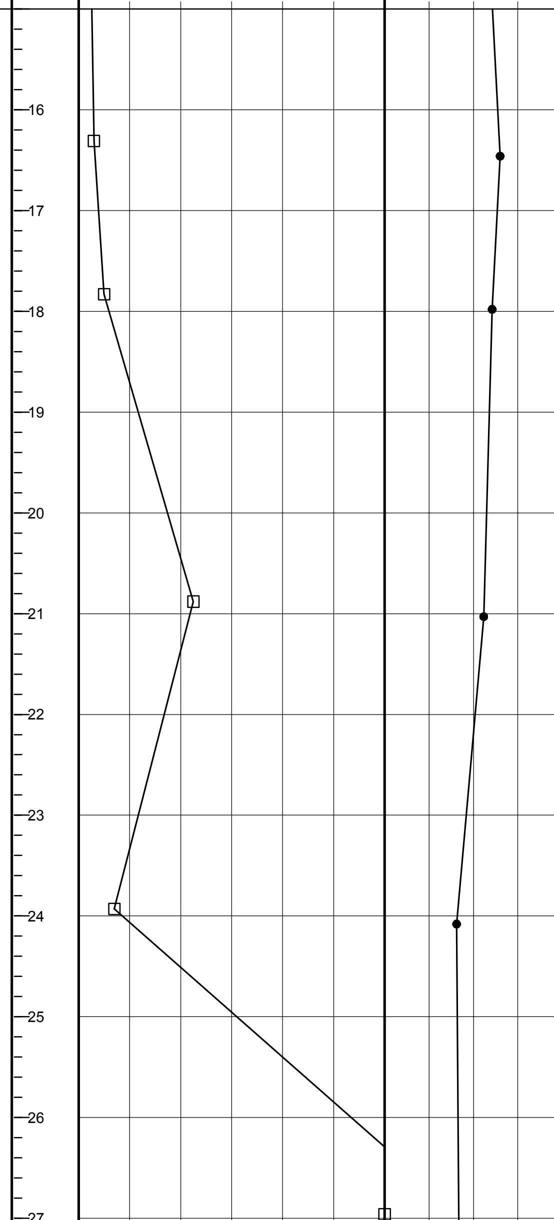
GROUND WATER CONDITIONS

DEPTH (m)

STANDARD PENETRATION TEST
DYNAMIC PENETRATION TEST
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✚ LAB VANE
20 40 60 80 100

WATER CONTENT (%)
10 20 30



OBSERVATIONS & REMARKS

Hole caving at 19.8 m. Casing advanced to 23.6 m(±).

Quick-Gel added to disperse sand & gravel 25.8 to 26.7m(±).

Borehole backfilled completely with Grout.

RECORD OF BOREHOLE No 41

PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791702N 594452E
ORIGINATED BY: rse

CLIENT: Hamilton Port Authority
COMPILED BY: jdo

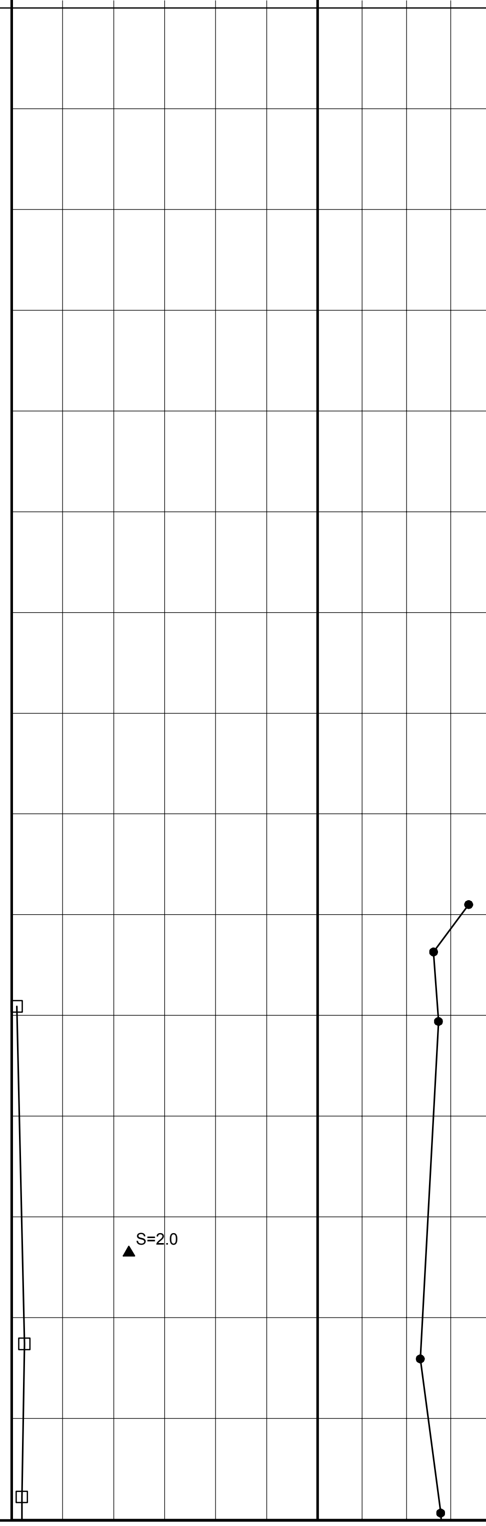
JOB NO.: TC035071
DATE: 28.10.03
CHECKED BY: pmc

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.7 / 0.0	**WATER**					
66.6 / 8.1	Black **SOFT SEDIMENT (Recent)**					
66.2 / 8.5	Grey **SILTY CLAY**, wtpl, firm.	1	SH			Sampling outside casing: Nx sampler pushed to 8.8 m.
		2	SH			
		3	SS	100	2	
		4	SH		N/R	
			VANE			
		5	SS	100	5	
		6	SS	100	4	

SOIL PROFILE · SAMPLES · GROUND WATER CONDITIONS · DEPTH (m)

STANDARD PENETRATION TEST
DYNAMIC PENETRATION TEST
20 40 60 80 100
SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✤ LAB VANE
20 40 60 80 100

WATER CONTENT (%)
10 20 30



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RECORD OF BOREHOLE No 41

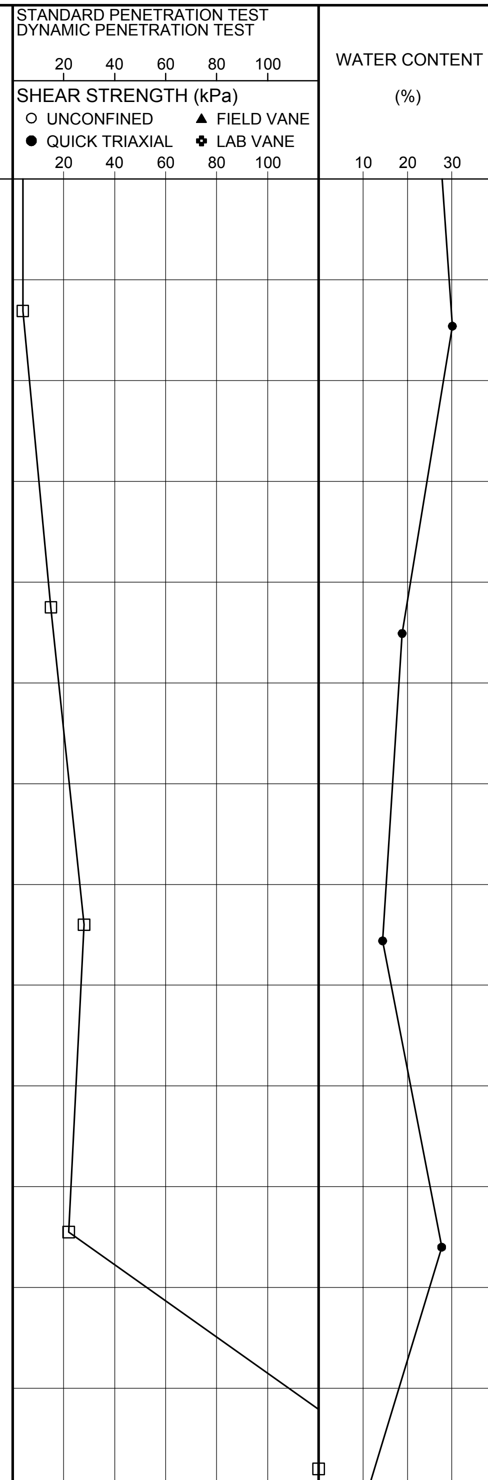
PROJECT Randle Reef Sediment Remediation Project LOCATION 4791702N 594452E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 28.10.03 CHECKED BY pmc

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	DEPTH (m)	OBSERVATIONS & REMARKS
		7	SS	100	4	16–17	
56.9 17.8	Grey **SILTY CLAY**, traces of sand & gravel, wtpl, very stiff.	8	SS	90	15	19	
		9	SS	20	28	22	
		10	SS	10	22	25	Quick-Gel used to clear cave through sand & gravel 25.1 to 27.2m(±).
47.9 26.8	Brown to Red-brown **CLAYEY SILT TILL** to **SILT TILL**, damp, very dense.	11	SS	65	153	27	
46.7 28.0	Borehole Terminated.					28	Borehole backfilled completely with Grout.

Column headings also include: SOIL PROFILE; STRAT PLOT; SAMPLES; GROUND WATER CONDITIONS.



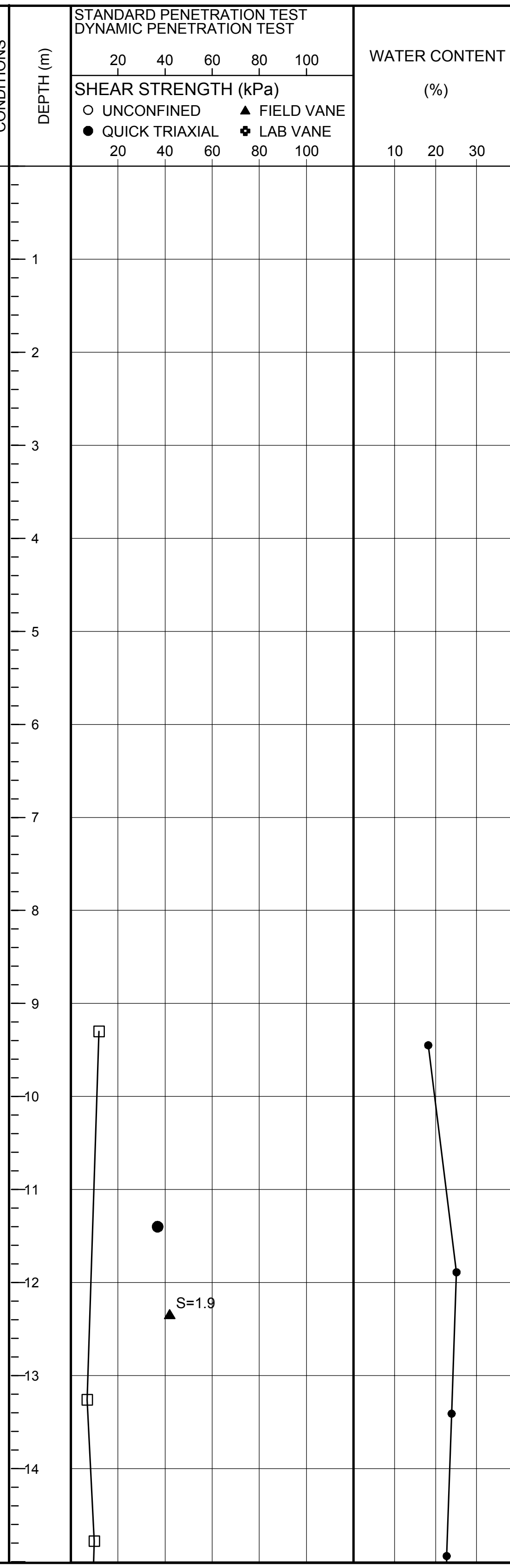
RECORD OF BOREHOLE No 42

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791741N 594395E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 29.10.03 CHECKED BY pmc

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.6 / 0.0	**WATER**					
67.0 / 7.6	**Black Oily Film** over Brown **SILT**, occasional clay seam, wood and organics in top 0.5 m(±), saturated.					Sampling outside casing: Nx sampler pushed to 8.2 m.
		1	SH			
		2	SH			
65.4 / 9.2	Grey **SILTY CLAY**, traces of sand & gravel, wtpl, firm to stiff.	3	SS	70	12	
		4	SH			'C-U'
			VANE			
		5	SS	100	7	
		6	SS	100	10	



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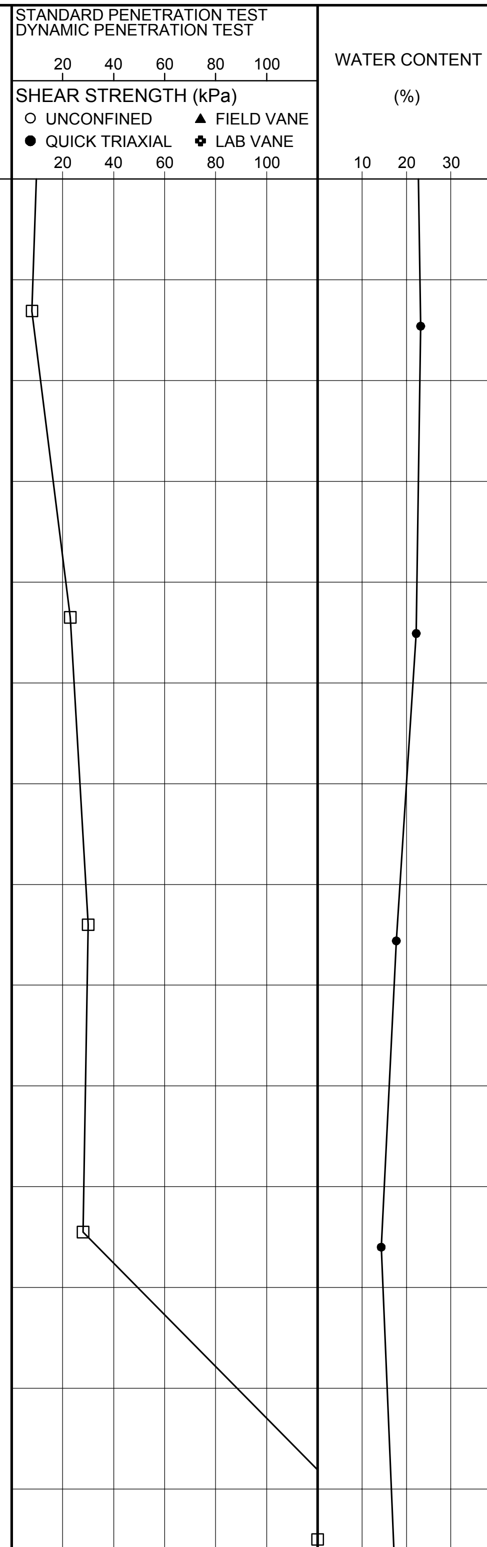
RECORD OF BOREHOLE No 42

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791741N 594395E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 29.10.03 CHECKED BY pmc

ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	DEPTH (m)	OBSERVATIONS & REMARKS
		7	SS	100	8	16	
56.8 17.8	Grey **CLAYEY SILT**, traces of sand & gravel, wtpl, very stiff to hard.	8	SS	5	23	19	SS 8 - Driving Stone
		9	SS	100	30	22	
50.8 23.8	Grey **CLAYEY SILT TILL**, cobbles from 25.7 to 26.2 m and 27.8 to 28.0 m, wtpl, very stiff.	10	SS	15	28	25	
48.1 26.5	Reddish-brown **SILT TILL**, wet, very dense.	11	SS	80	147	28	Reddish-brown wash water at 26.5 m.
45.9 28.7	Borehole Terminated.						Borehole backfilled completely with Grout.



RECORD OF BOREHOLE No 43

PROJECT: Randle Reef Sediment Remediation Project
LOCATION: 4791758N 594322E
ORIGINATED BY: rse
CLIENT: Hamilton Port Authority
COMPILED BY: jdo
JOB NO.: TC035071
DATE: 7.10.03
CHECKED BY: pmc

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION	STRAT PLOT
77.0 / 0.0	**FILL** - 15 cm black **Sand** over grey **Slag**, moist to saturated, loose to compact.	
	Black **ALLUVIUM** and **SLAG**, occasional clayey zones, more frequent below 9.5 m(±), saturated, compact.	
	Black **SILT**, some slag, coal tar odour, saturated, compact.	
62.3 / 14.7	Grey **SILTY CLAY**, traces	

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
1	SS		25
2	SS		6
3	SS		7
4	SS		19
5	SS		8
6	SS		12
7	SS		13
8	SS		16
9	SS		12

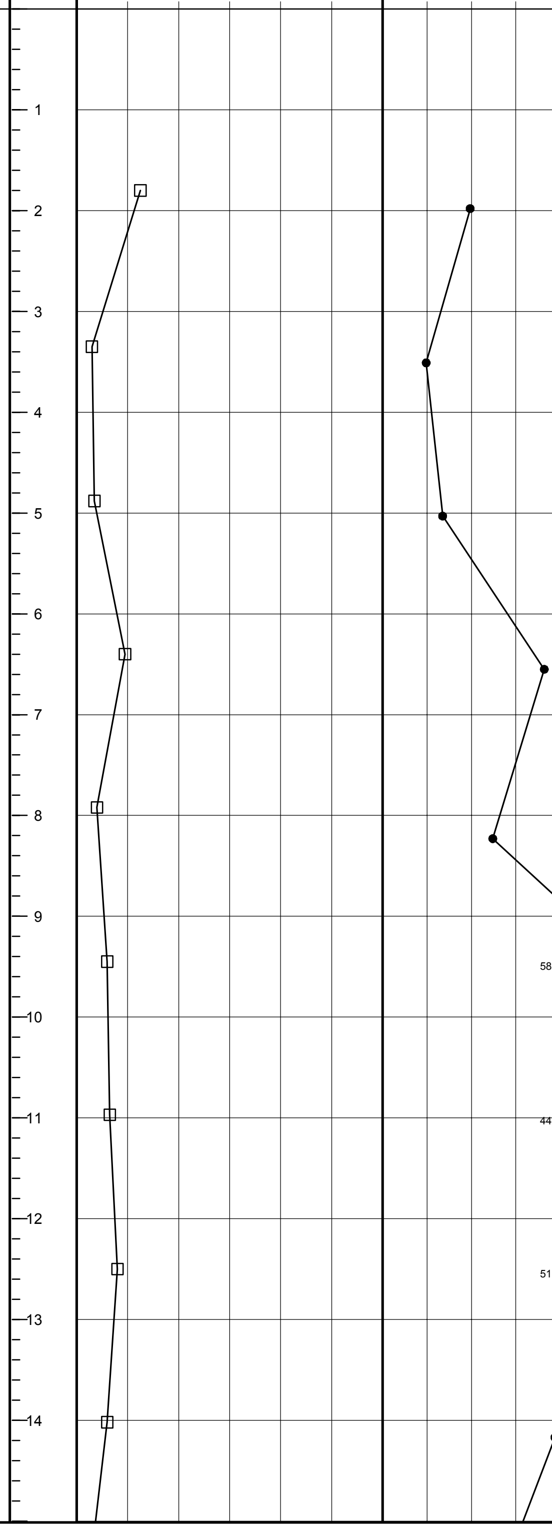
GROUND WATER CONDITIONS | DEPTH (m)

STANDARD PENETRATION TEST
DYNAMIC PENETRATION TEST
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✚ LAB VANE
20 40 60 80 100

WATER CONTENT (%)
10 20 30

OBSERVATIONS & REMARKS



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RECORD OF BOREHOLE No 43

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791758N 594322E
ORIGINATED BY rse

CLIENT Hamilton Port Authority
COMPILED BY jdo

JOB NO. TC035071
DATE 7.10.03
CHECKED BY pmc

SOIL PROFILE

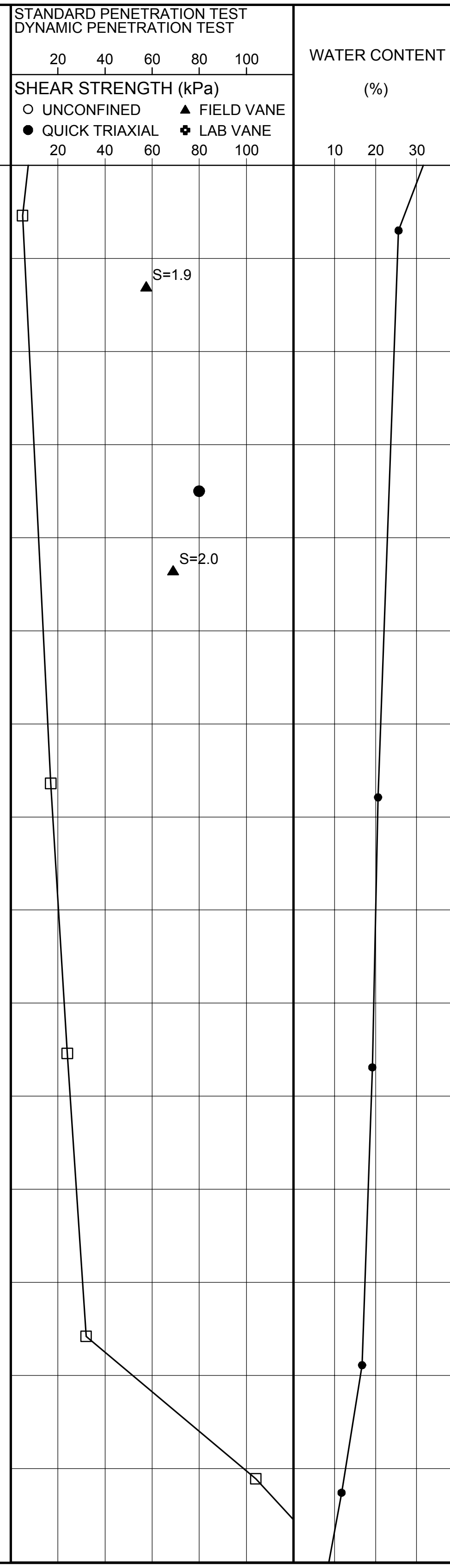
ELEV DEPTH	DESCRIPTION
	of sand & gravel, wtpl, firm.
56.7 20.3	Grey **SILTY CLAY**, traces of sand & gravel, occasional silt seam, scattered weathered shale pieces, becoming harder (augers grinding occasionally) below 23.2 m(±), cobble at 26.8 m(±), wtpl to apl, very stiff to hard.
48.8 28.2	Grey **SAND** & **GRAVEL**, numerous cobbles, saturated, very dense.
48.0 29.0	Reddish-brown **SILT TILL**, wet to moist, very dense.

SAMPLES

NUMBER	TYPE	RECOVERY (%)	"N" VALUES
10	SS		5
	VANE		
11	SH		
	VANE		
12	SS		17
13	SS		24
14	SS		32
15	SS		104

GROUND WATER CONDITIONS

DEPTH (m): 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29



OBSERVATIONS & REMARKS

Gs/Hyd
LL/PI

Sand & Gravel flowing into hole. Quick Grout added to keep Borehole open.

Continued Next Page

RECORD OF BOREHOLE No 43

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791758N 594322E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 7.10.03 CHECKED BY pmc

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE 20 40 60 80 100	WATER CONTENT (%) 10 20 30	OBSERVATIONS & REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES					
46.6 / 30.4	Borehole Terminated.		16	SS		70/8cm					Borehole backfilled with Grout.

RECORD OF BOREHOLE No 40 (MW)

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791600N 594520E
ORIGINATED BY rse

CLIENT Hamilton Port Authority
COMPILED BY jdo

JOB NO. TC035071
DATE 7.10.03
CHECKED BY pmc

ELEV DEPTH	DESCRIPTION (SOIL PROFILE)	OBSERVATIONS & REMARKS
77.0 0.0	¾" grey **GRANULAR**	
76.1 0.9	Black **SAND**.	
75.3 1.7	Brown **CLAY**.	
74.9 2.1	Grey/brown SILT, some organic zones, saturated.	
71.4 5.6	Grey **SILTY CLAY**, wtpl.	Borehole Upon Completion: Dry and open.

Column headings: SOIL PROFILE (ELEV DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, RECOVERY (%), "N" VALUES); GROUND WATER CONDITIONS; DEPTH (m); STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa) — ○ UNCONFINED, ▲ FIELD VANE, ● QUICK TRIAXIAL, ✚ LAB VANE (20, 40, 60, 80, 100); WATER CONTENT (%) (10, 20, 30); OBSERVATIONS & REMARKS

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

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RECORD OF BOREHOLE No 40 (MW)

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791600N 594520E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 7.10.03 CHECKED BY pmc

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE 20 40 60 80 100	WATER CONTENT (%) 10 20 30	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES					
61.8 15.2	Borehole Terminated.										

RECORD OF BOREHOLE No 40A (MW)

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791598N 594522E
ORIGINATED BY rse
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071
DATE 8.10.03
CHECKED BY pmc

ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100); SHEAR STRENGTH (kPa): O UNCONFINED, ▲ FIELD VANE, ● QUICK TRIAXIAL, ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
77.0 / 0.0	**GRANULAR FILL**							1			
75.3 / 1.7	**CLAY** with black to brown **SILT**, saturated							2, 3, 4			
72.4 / 4.6	Borehole Terminated										

RECORD OF BOREHOLE No 43A (MW)

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791758N 594322E ORIGINATED BY rse

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 7.10.03 CHECKED BY pmc

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST 20 40 60 80 100; SHEAR STRENGTH (kPa) O UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE 20 40 60 80 100	WATER CONTENT (%) 10 20 30	OBSERVATIONS & REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES					
77.0											
76.8 / 0.0	Black **SAND**										
0.2	Black granular **SLAG**							1			
								2			
								3			
								4			
72.3 / 4.7	Borehole Terminated										

RECORD OF BOREHOLE No A

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791684N 594765E
ORIGINATED BY kho
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 16.12.04
CHECKED BY nve

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	WATER CONTENT (%)
74.7 0.0	**WATER**					
67.3 7.4	Black, **SOFT SEDIMENT (Recent)**, loose to compact.	1	SS	100	10	43.6
67.0 7.7	Black to grey **SLAG**, compact.	2	SS	50	14	
63.8 11.0	Black, **SOFT SEDIMENT (Recent)**, trace to some slag, poor recovery, very loose.	3	SS	28	2	50.1
62.2 12.5	Grey to grey-brown **SILTY CLAY** to **CLAYEY SILT**, layered, some slag to 13.5 m(±), pebbles, wtpl, stiff to very stiff.	4	SS	83	10	
		5	SS	100	12	

Chart headings: STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, ▲ FIELD VANE, ● QUICK TRIAXIAL, ✚ LAB VANE (20, 40, 60, 80, 100); WATER CONTENT (%) (10, 20, 30); GROUND WATER CONDITIONS; DEPTH (m) 1–14; STRAT PLOT; OBSERVATIONS & REMARKS

Continued Next Page

RECORD OF BOREHOLE No A

PROJECT Randle Reef Sediment Remediation Project   LOCATION 4791684N 594765E   ORIGINATED BY kho

CLIENT Hamilton Port Authority   COMPILED BY jdo

JOB NO. TC035071   DATE 16.12.04   CHECKED BY nve

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST; SHEAR STRENGTH (kPa)	WATER CONTENT (%)	OBSERVATIONS & REMARKS
								16			
			6	SS	100	17					
58.1 16.6	Borehole Terminated										Borehole backfilled completely with Grout.

SHEAR STRENGTH legend: O UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE

RECORD OF BOREHOLE No C

PROJECT	Randle Reef Sediment Remediation Project	LOCATION	4791720N 594781E
CLIENT	Hamilton Port Authority	ORIGINATED BY	kho
JOB NO.	TC035071	DATE	17.12.04
COMPILED BY	jdo	CHECKED BY	nve

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	DEPTH (m)	WATER CONTENT (%)
74.7 / 0.0	**WATER**						
66.6 / 8.1	Black, **SOFT SEDIMENT (Recent)** very loose.	1	SS	100	0	~8.3	117.5
65.0 / 9.7	Grey **CLAY SEDIMENT** very soft to soft, leaves and twigs at 15.9 m(±), mwtpl.	2	SS	100	0	~11.0	89.5
		3	SS	100	2	~12.5	97.7
		4	SS	100	1	~14.5	99.3

Column headings: SOIL PROFILE (ELEV DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, RECOVERY (%), "N" VALUES); GROUND WATER CONDITIONS; DEPTH (m); STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, ▲ FIELD VANE, ● QUICK TRIAXIAL, ✤ LAB VANE (20 40 60 80 100); WATER CONTENT (%) (10 20 30); OBSERVATIONS & REMARKS

Continued Next Page

RECORD OF BOREHOLE No C

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791720N 594781E
ORIGINATED BY kho
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 17.12.04
CHECKED BY nve

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES					
58.9			5	SS	100	0				164.6	
15.9	Borehole Terminated										Borehole backfilled completely with Grout.

RECORD OF BOREHOLE No D

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791810N 594800E
ORIGINATED BY kho
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 23.12.04
CHECKED BY nve

SOIL PROFILE			SAMPLES						STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)			
74.8 0.0	**WATER**										
65.6 9.3	Black, soft **SEDIMENT (Recent)**, some slag, loose.		1	SS	31	7					
64.5 10.3	Grey **SLAG**, little recovery, some black, soft sediment, compact to very loose.		2	SS	34	15					
			3	SS	0	2					
			4	SS	11	0					
59.8											

Continued Next Page

RECORD OF BOREHOLE No D

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791810N 594800E ORIGINATED BY kho

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 23.12.04 CHECKED BY nve

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	DEPTH (m)	WATER CONTENT (%)	OBSERVATIONS & REMARKS
15.0	Brown to grey **ORGANIC SILT TO CLAYEY SILT** very soft.	5	SS	100	0	16	111.3	
		6	SS	100	2	17	51.8	
57.4 / 17.5	Borehole Terminated							Borehole backfilled completely with Grout.

Column headings: SOIL PROFILE (ELEV DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, RECOVERY (%), "N" VALUES); GROUND WATER CONDITIONS; DEPTH (m); STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20, 40, 60, 80, 100); WATER CONTENT (%) (10, 20, 30); OBSERVATIONS & REMARKS

amec

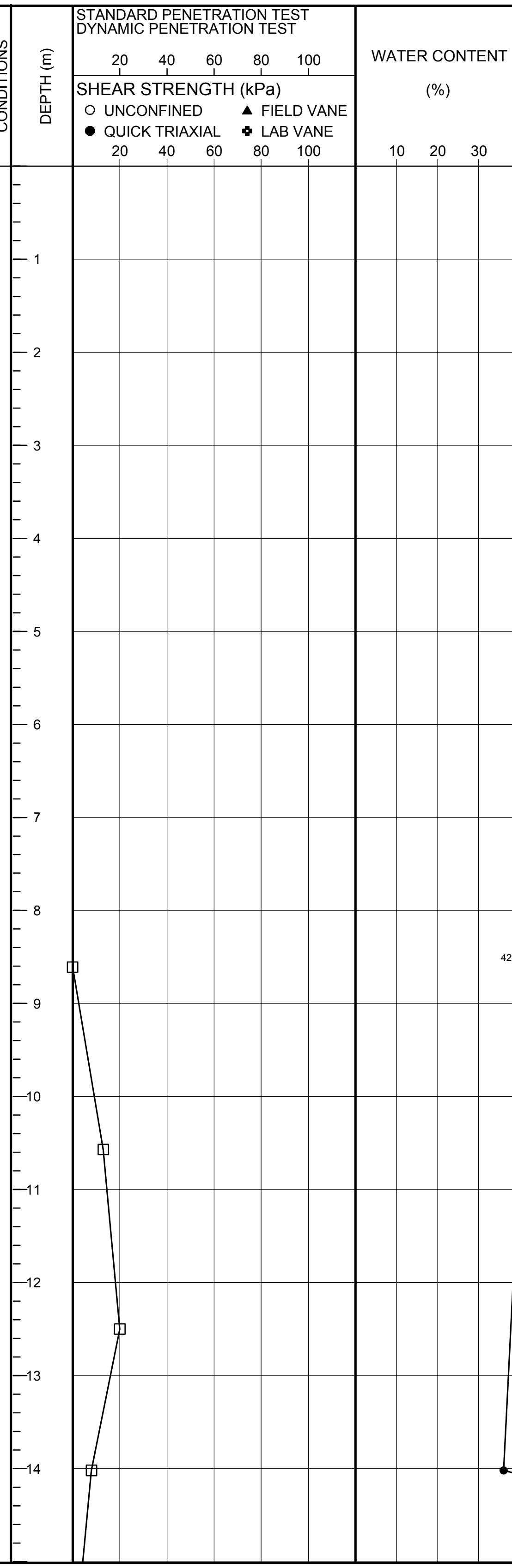
RECORD OF BOREHOLE No E

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791715N 594793E ORIGINATED BY kho

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 17.12.04 CHECKED BY nve

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY (%)	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	OBSERVATIONS & REMARKS
74.7 / 0.0	**WATER**						
66.3 / 8.4	Black, **SOFT SEDIMENT (Recent)**, very loose.	1	SS	44	0		
65.9 / 8.8	Brown **SILT**, black stain, organics.						
64.3 / 10.4	**SLAG**, some **SOFT SEDIMENT (Recent)** to 10.8 m(±), compact.	2	SS	72	13		
		3	SS	33	20		
61.4 / 13.3	Brown **SILT**, some organics, clayey silt layers, pebbles, wtpl, very loose to compact.	4	SS	100	8		



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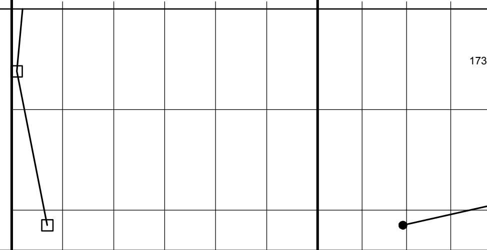
RECORD OF BOREHOLE No E

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791715N 594793E
ORIGINATED BY kho

CLIENT Hamilton Port Authority
COMPILED BY jdo

JOB NO. TC035071 DATE 17.12.04
CHECKED BY nve

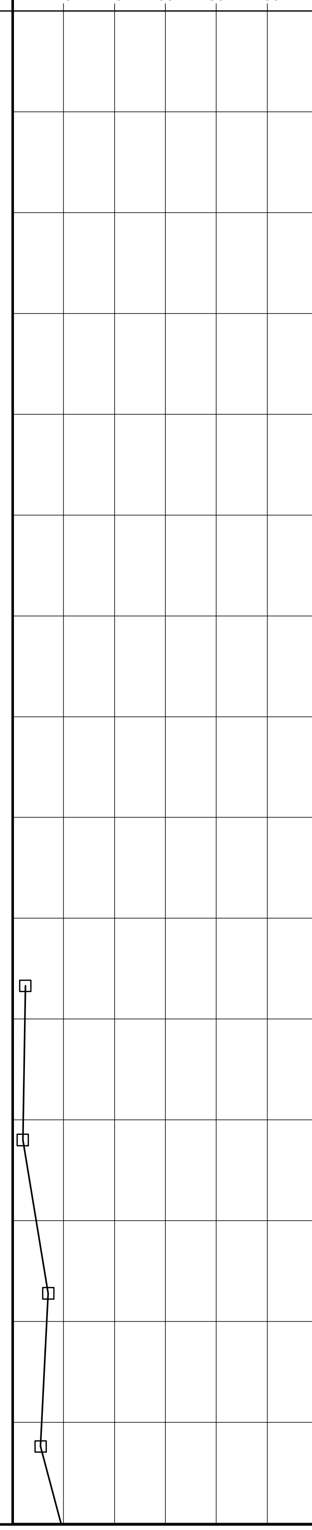
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST; SHEAR STRENGTH (kPa): ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
			5	SS	100	2		16		173.9	
			6	SS	100	14		17			
57.3 / 17.4	Borehole Terminated										Borehole backfilled completely with Grout.



RECORD OF BOREHOLE No I

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791747N 594798E
ORIGINATED BY kho
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 18.12.04
CHECKED BY nve

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES
74.7 / 0.0	**WATER**				
66.6 / 8.1	Grey **SLAG**, little recovery, saturated, loose to compact.	1	SS	17	5
		2	SS	6	4
		3	SS	11	14
		4	SS	6	11
59.8					



WATER CONTENT (%) 10 20 30

OBSERVATIONS & REMARKS

GROUND WATER CONDITIONS

DEPTH (m)

Continued Next Page

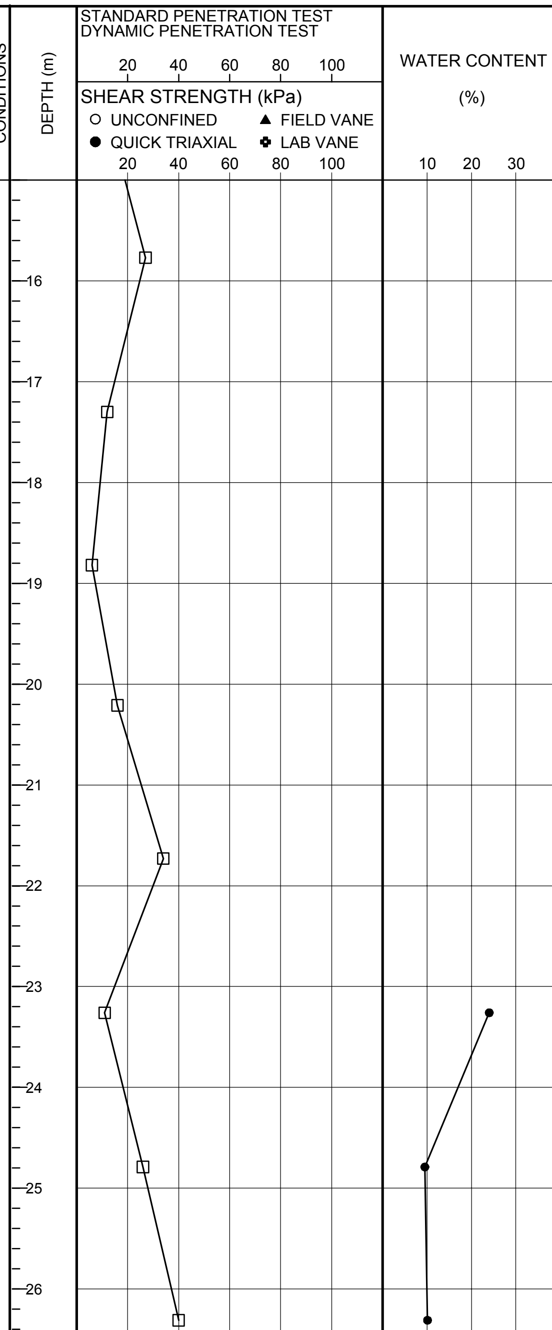
RECORD OF BOREHOLE No I

PROJECT Randle Reef Sediment Remediation Project LOCATION 4791747N 594798E ORIGINATED BY kho

CLIENT Hamilton Port Authority COMPILED BY jdo

JOB NO. TC035071 DATE 18.12.04 CHECKED BY nve

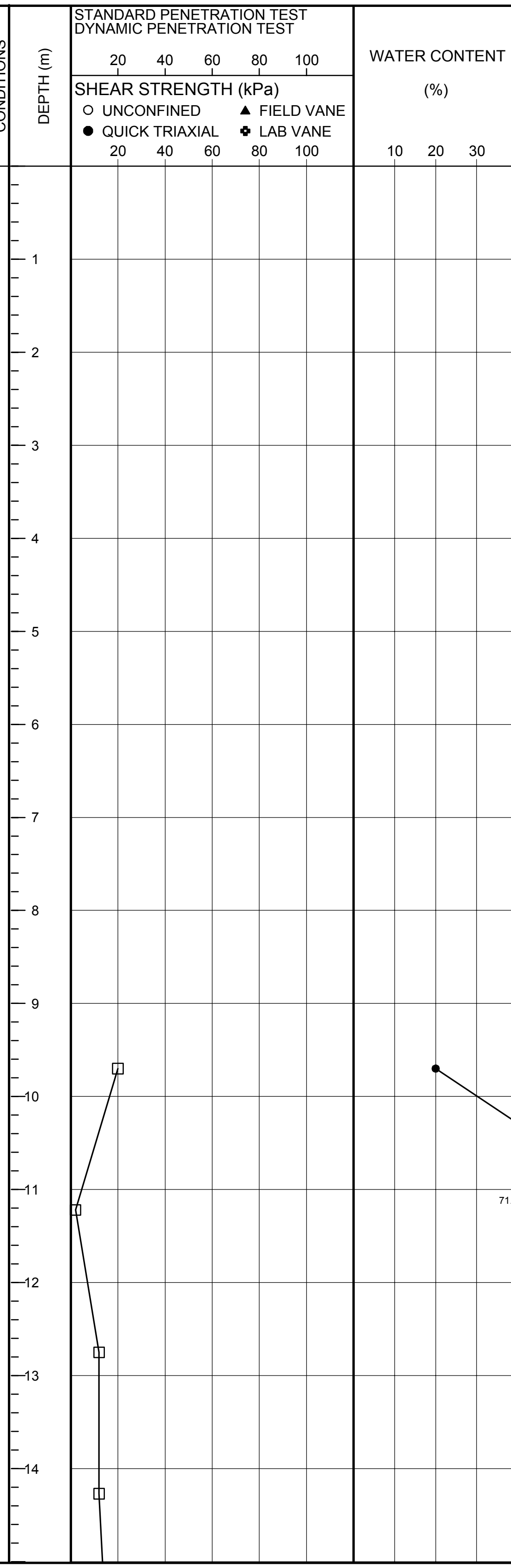
SOIL PROFILE: ELEV / DEPTH	DESCRIPTION	SAMPLES: NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
14.9	**SLAG** some **SOFT SEDIMENT (Recent)** loose to dense.	5	SS	17	27	
		6	SS	6	12	
		7	SS	6	6	
		8	SS	22	16	
		9	SS	6	34	
52.3 / 22.4	Grey **SILTY CLAY** to **CLAYEY SILT**, weakly laminated, occasional medium to coarse Sand layer, occasional small cobble below 21.0 m(±), wtpl, stiff to hard.	10	SS	61	11	
		11	SS	11	26	
		12	SS	11	40	
48.2 / 26.5	Borehole Terminated.					Borehole backfilled completely with Grout.



RECORD OF BOREHOLE No J

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791731N 594796E
ORIGINATED BY kho
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 18.12.04
CHECKED BY nve

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	DEPTH (m)
74.7 0.0	**WATER**					
66.6 8.1	Black, **SOFT SEDIMENT (Recent)**, some slag, compact to very loose.	1	SS	39	20	
		2	SS	67	2	
62.7 12.0	Grey **SLAG**, some **SOFT SEDIMENT (Recent)** layers, compact.	3	SS	3	12	
		4	SS	56	12	



OBSERVATIONS & REMARKS

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RECORD OF BOREHOLE No J

PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791731N 594796E
ORIGINATED BY kho
CLIENT Hamilton Port Authority
COMPILED BY jdo
JOB NO. TC035071 DATE 18.12.04
CHECKED BY nve

SOIL PROFILE			SAMPLES						STANDARD PENETRATION TEST / DYNAMIC PENETRATION TEST (20 40 60 80 100); SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✚ LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (10 20 30)	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	RECOVERY (%)	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)			
			5	SS	39	15					
58.7 16.0	Borehole Terminated							16			Borehole backfilled completely with Grout.

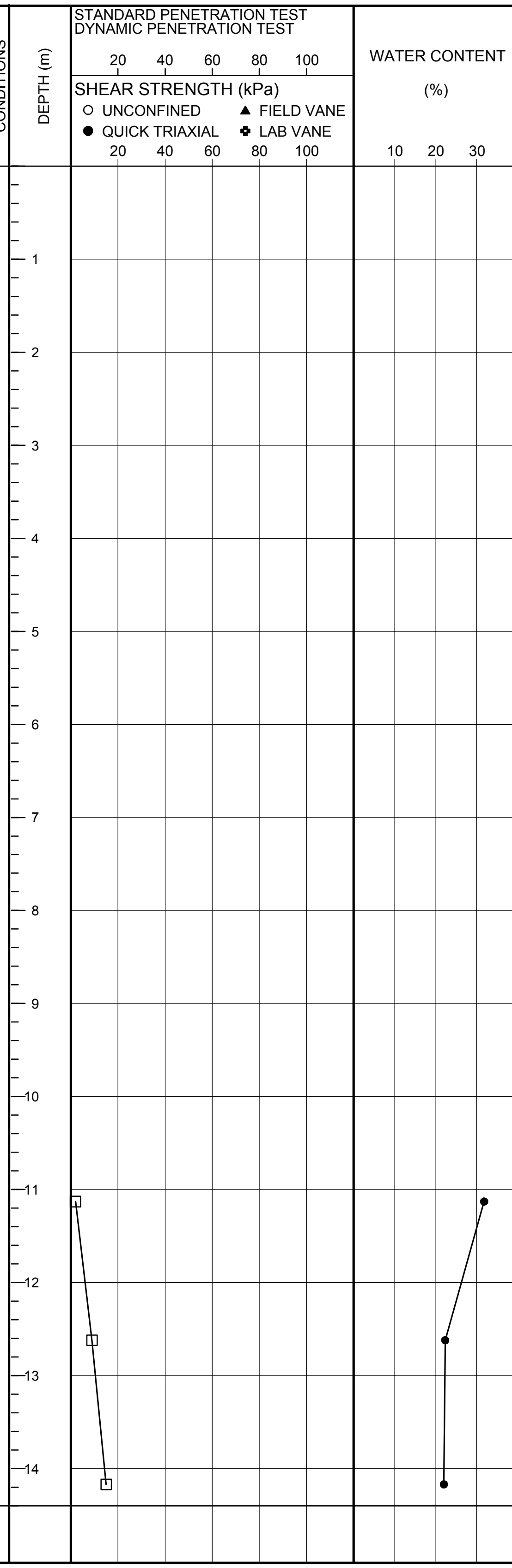
RECORD OF BOREHOLE No K

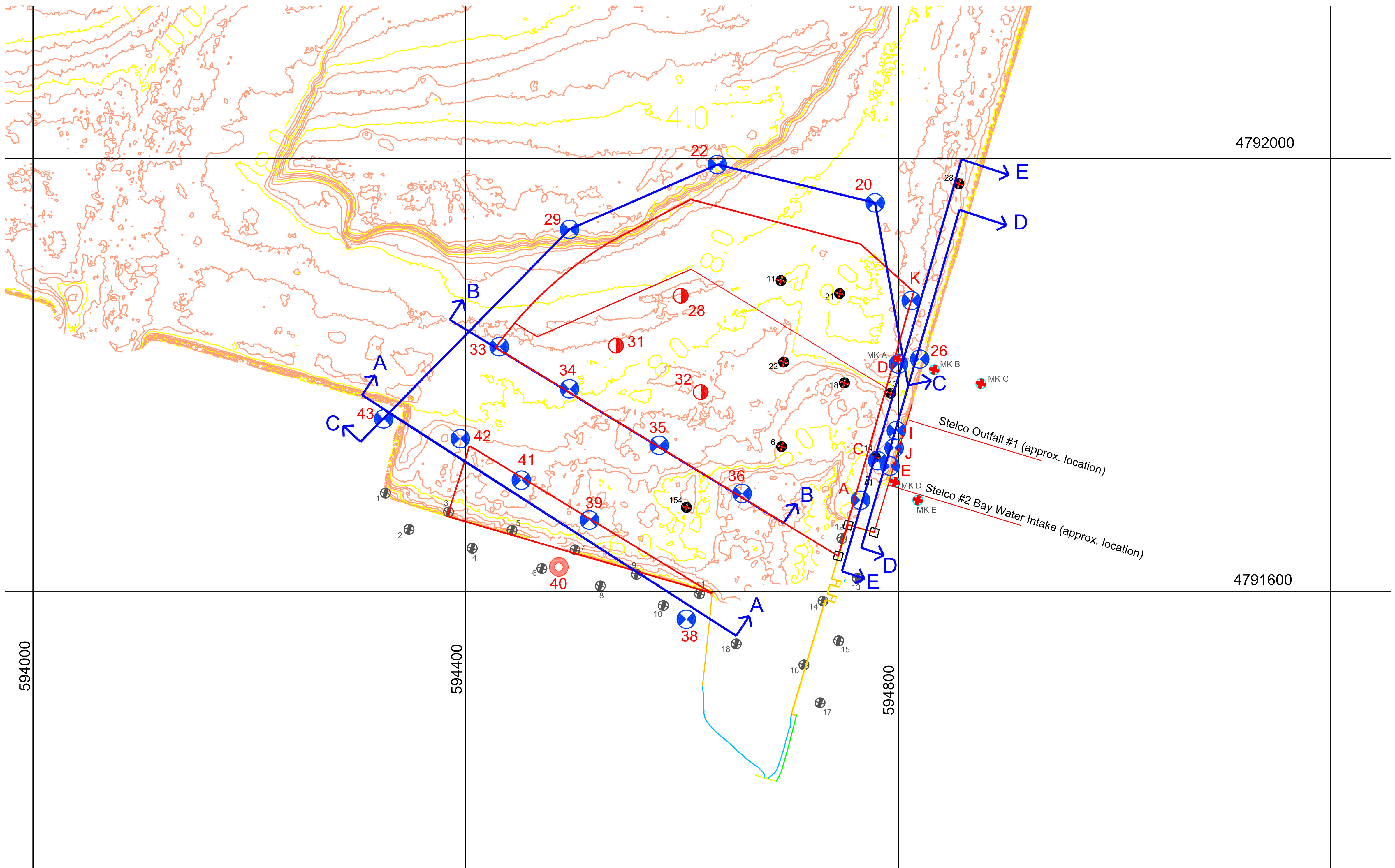
PROJECT Randle Reef Sediment Remediation Project
LOCATION 4791868N 594812E
ORIGINATED BY kho

CLIENT Hamilton Port Authority
COMPILED BY jdo

JOB NO. TC035071 DATE 23.12.04
CHECKED BY nve

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	RECOVERY (%)	"N" VALUES	OBSERVATIONS & REMARKS
74.8 / 0.0	**WATER**					
65.3 / 9.4	Brown, **SOFT SEDIMENT (Recent)** loose, silty, organics, very loose.	1	SS	94	2	
63.5 / 11.3	Reddish brown to grey **CLAYEY SILT**, layered, reddish silt seams, some pebbles, trace shale, wtpl, soft to stiff.	2	SS	100	9	
		3	SS	100	15	Borehole backfilled completely with Grout.
60.4 / 14.4	Borehole Terminated					





LEGEND:

GEOTECHNICAL INVESTIGATION

- DEEP BOREHOLE - THIS STUDY
- SHALLOW BOREHOLE - THIS STUDY
- GROUNDWATER MONITORING WELL - THIS STUDY
- ACRES BOREHOLE, 1954
- STELCO BOREHOLE, 1954 & 1976
- TROW BOREHOLE, 1999

1999 TROW BH's		
BH #	NORTHING	EASTING
6	4791733.6	594692.1
11	4791887.2	594691.6
13	4791783.1	594792.9
14	4791724.3	594778.6
18	4791792.3	594750.1
21	4791875.1	594745.7
22	4791811.8	594694
28	4791976.7	594856
154	4791677.5	594604.1

STELCO BH's		
BH #	NORTHING	EASTING
MK A	AS SHOWN ON STELCO DWG. 669880 DATED NOV. 3 OF 2003	
MK B		
MK C		
MK D		
MK E		

AMEC DEEP AND SHALLOW BH's		
BH #	NORTHING	EASTING
20	4791958	594784
22	4791996	594643
26	+/- 4791814	+/- 594820
28	4791871	594597
29	4791936	594501
31	4791830	594534
32	4791873	594619
33	4791826	594431
34	4791762	594490
35	4791735	594587
36	4791690	594657
38	4791574	594604
39	4791666	594513
41	4791702	594452
42	4791741	594395
43	4791758	594322
A	4791684	594765
C	4791720	594781
D	4791810	594800
E	4791715	594793
I	4791747	594798
J	4791731	594796
K	4791868	594812

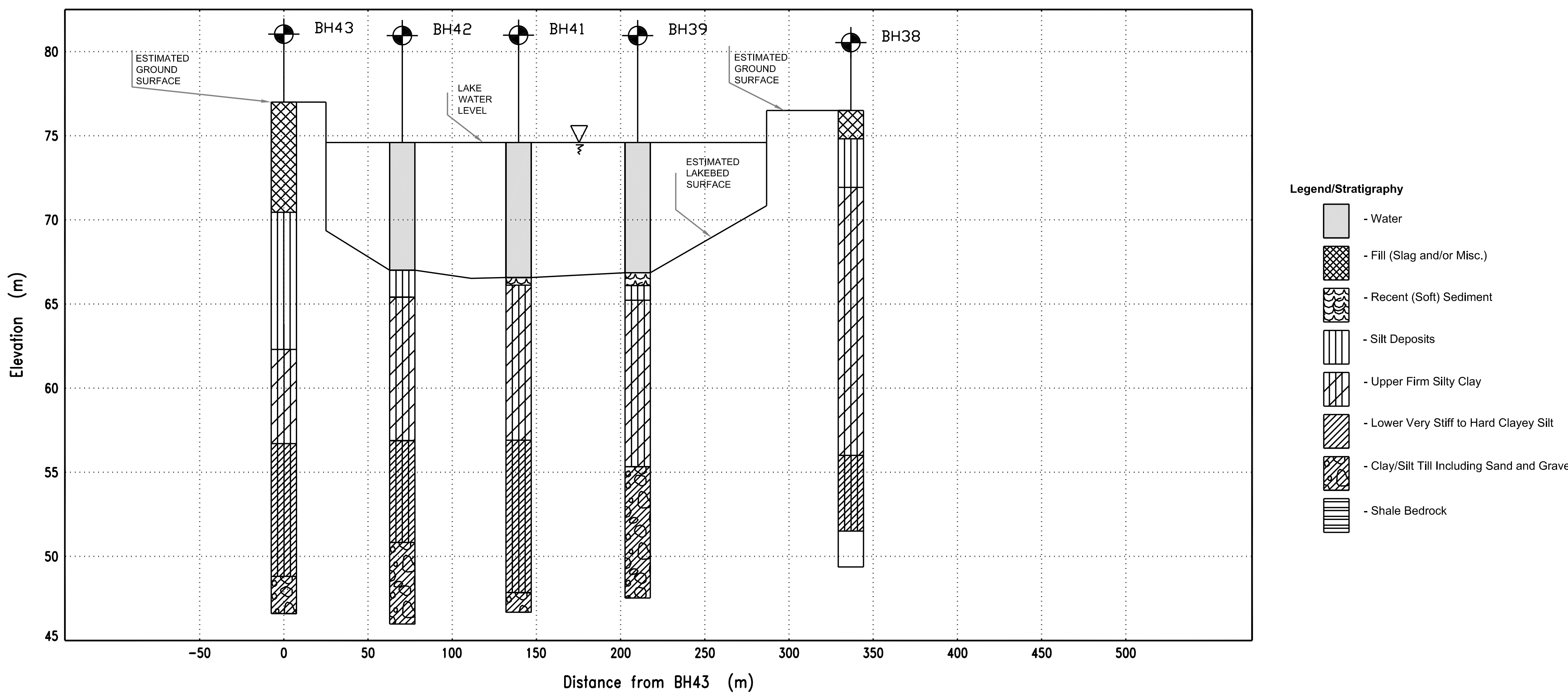
1954 ACRES BH's		
BH #	NORTHING	EASTING
1	AS SHOWN ON H.G. ACRES & COMPANY LTD. DWG. 597-1001, DATED MAY 12 OF 1954, FOR INTERNATIONAL HARVESTER COMPANY OF CANADA LTD. (PROVIDED TO AMEC BY HPA)	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		

NOTE: LOCATION COORDINATES FOR BH26 WERE ESTIMATED BASED ON PHOTOGRAPHIC EVIDENCE DURING DRILLING.

0 50 100 200m

SCALE

amec Earth & Environmental	Date: February 2004	Approximate Scale: 1 : 4000	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Phase 1 Geotechnical Investigation	Drawn by: RN / PN /KH	Approved by: IS / JD / NV	Figure A-1 Profile Location Plan



NOTES:

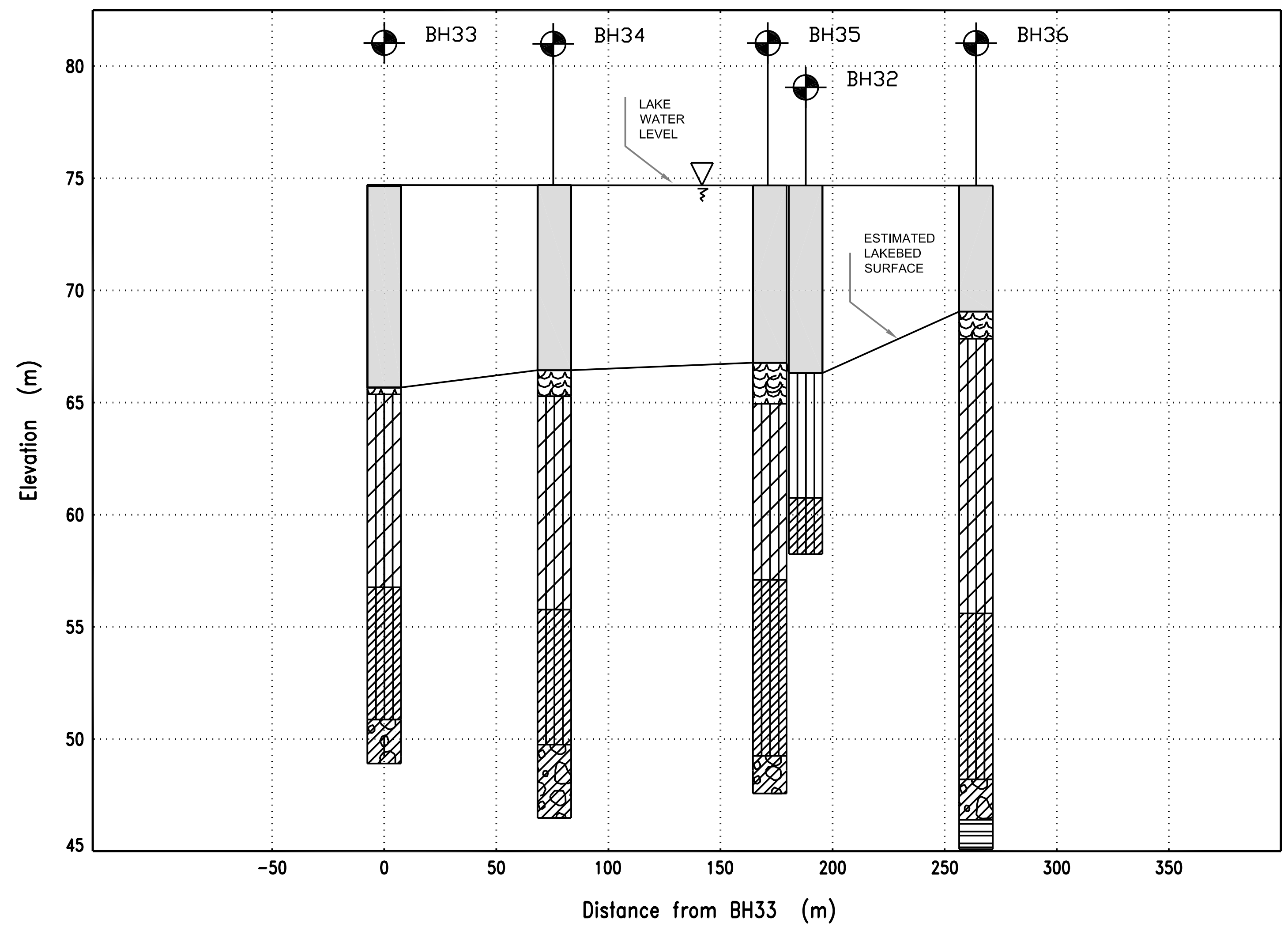
1. ALL ELEVATIONS SHOWN ON THIS DRAWING ARE IN METRES, AND ARE REFERED TO THE INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985.

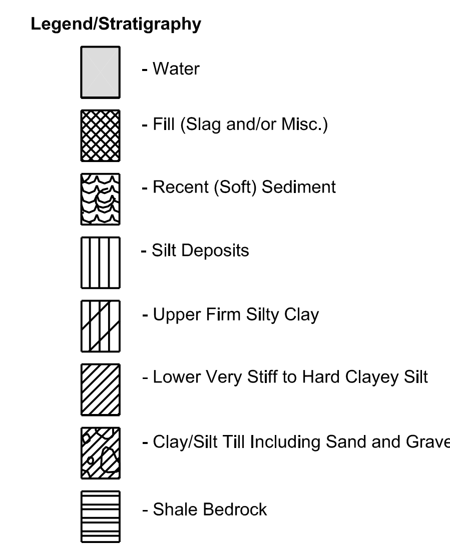
2. THE SOIL STRATIGRAPHY SHOWN AT BOREHOLE LOCATIONS HAS BEEN SIMPLIFIED. REFER TO BOREHOLE LOGS FOR DETAILS. THE SOIL CONDITIONS BEYOND THE BOREHOLE LOCATIONS COULD VARY SIGNIFICANTLY FROM THE SOIL CONDITIONS SHOWN ON THIS FIGURE.

3. PROFILE LOCATION IN PLAN VIEW IS SHOWN ON FIGURE A-1.

4. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH THE ACCOMPANYING INVESTIGATION REPORT.

amec Earth & Environmental	Date: February 2004	Scale: 1 : 300 V 1 : 3000 H	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Phase 1 Geotechnical Investigation	Drawn by: PN / KH	Approved by: IS / JD / NV	Figure A-2 Inferred Stratigraphic Profile A - A Along Secondary ECF Wall





NOTES:

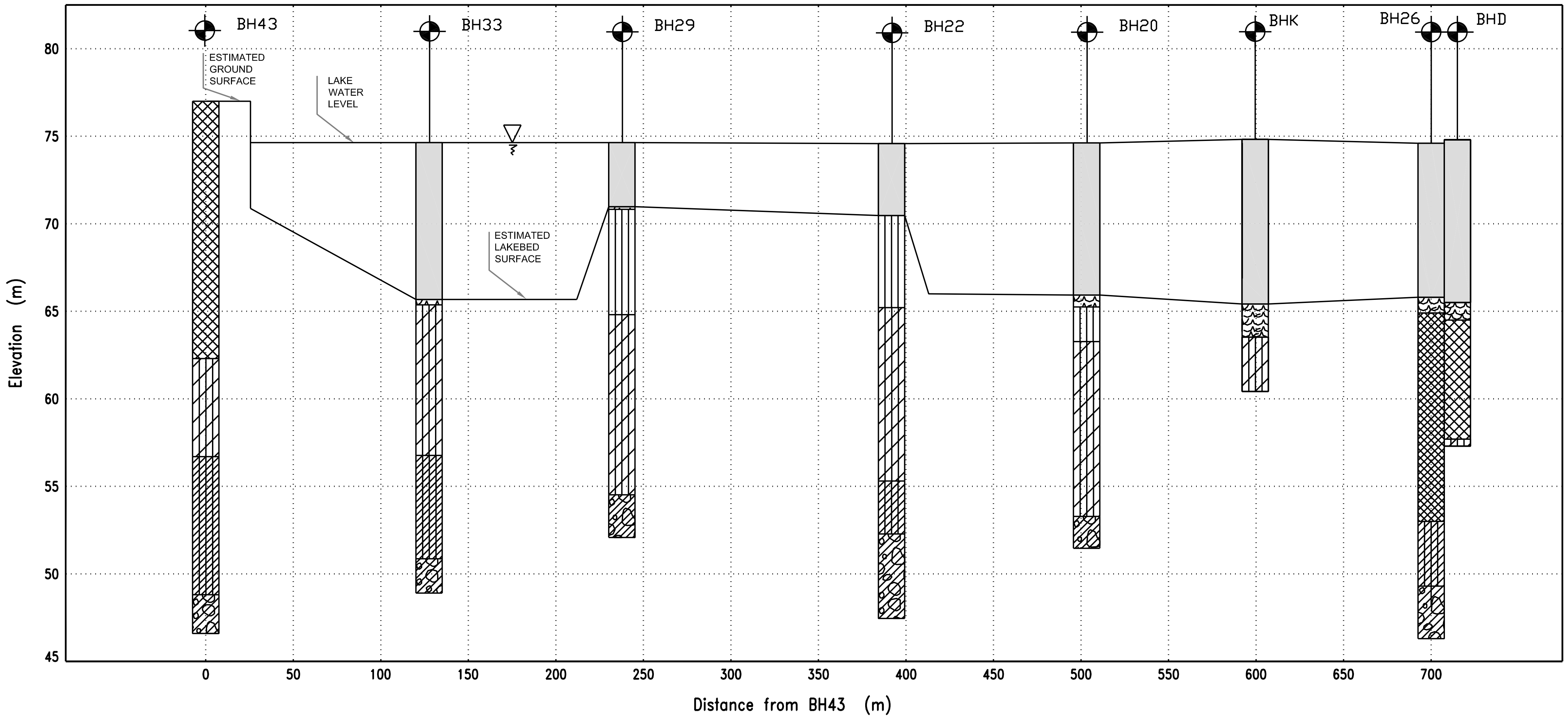
1. ALL ELEVATIONS SHOWN ON THIS DRAWING ARE IN METRES, AND ARE REFERED TO THE INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985.

2. THE SOIL STRATIGRAPHY SHOWN AT BOREHOLE LOCATIONS HAS BEEN SIMPLIFIED. REFER TO BOREHOLE LOGS FOR DETAILS. THE SOIL CONDITIONS BEYOND THE BOREHOLE LOCATIONS COULD VARY SIGNIFICANTLY FROM THE SOIL CONDITIONS SHOWN ON THIS FIGURE.

3. PROFILE LOCATION IN PLAN VIEW IS SHOWN ON FIGURE A-1.

4. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH THE ACCOMPANYING INVESTIGATION REPORT.

amec Earth & Environmental	Date: February 2004	Scale: 1 : 300 V 1 : 3000 H	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Phase 1 Geotechnical Investigation	Drawn by: PN / KH	Approved by: IS / JD / NV	Figure A-3 Inferred Stratigraphic Profile B - B Along Primary ECF Wall



NOTES:

1. ALL ELEVATIONS SHOWN ON THIS DRAWING ARE IN METRES, AND ARE REFERED TO THE INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985.

2. THE SOIL STRATIGRAPHY SHOWN AT BOREHOLE LOCATIONS HAS BEEN SIMPLIFIED. REFER TO BOREHOLE LOGS FOR DETAILS. THE SOIL CONDITIONS BEYOND THE BOREHOLE LOCATIONS COULD VARY SIGNIFICANTLY FROM THE SOIL CONDITIONS SHOWN ON THIS FIGURE.

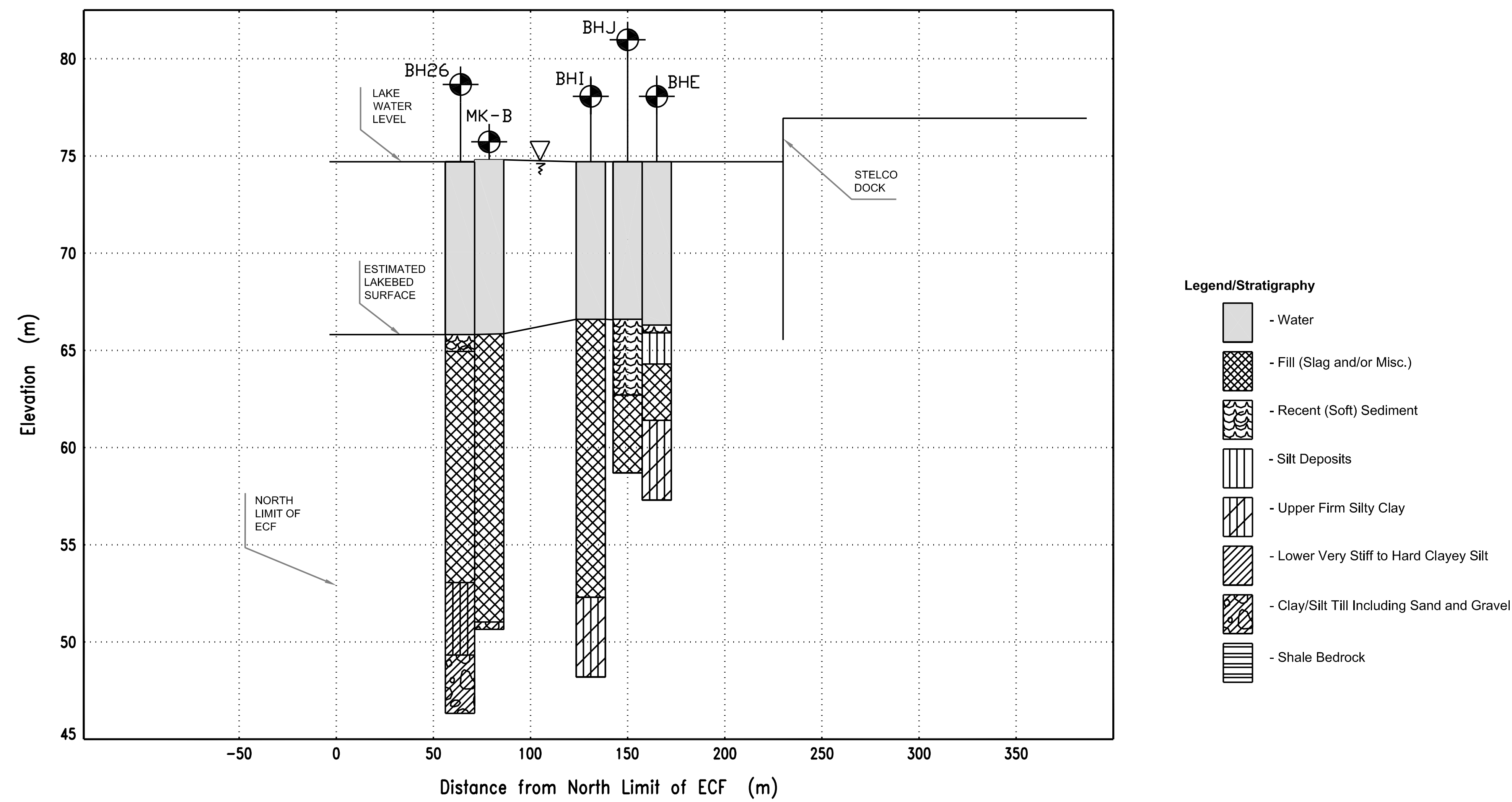
3. PROFILE LOCATION IN PLAN VIEW IS SHOWN ON FIGURE A-1.

4. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH THE ACCOMPANYING INVESTIGATION REPORT.

Legend/Stratigraphy

- Water
- Fill (Slag and/or Misc.)
- Recent (Soft) Sediment
- Silt Deposits
- Upper Firm Silty Clay
- Lower Very Stiff to Hard Clayey Silt
- Clay/Silt Till Including Sand and Gravel
- Shale Bedrock

amec Earth & Environmental	Date: February 2004	Scale: 1 : 300 V 1 : 3000 H	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Phase 1 Geotechnical Investigation	Drawn by: PN / KH	Approved by: IS / JD / NV	Figure A-4 Inferred Stratigraphic Profile C - C Along W. and N. Perimeter of ECF



NOTES:

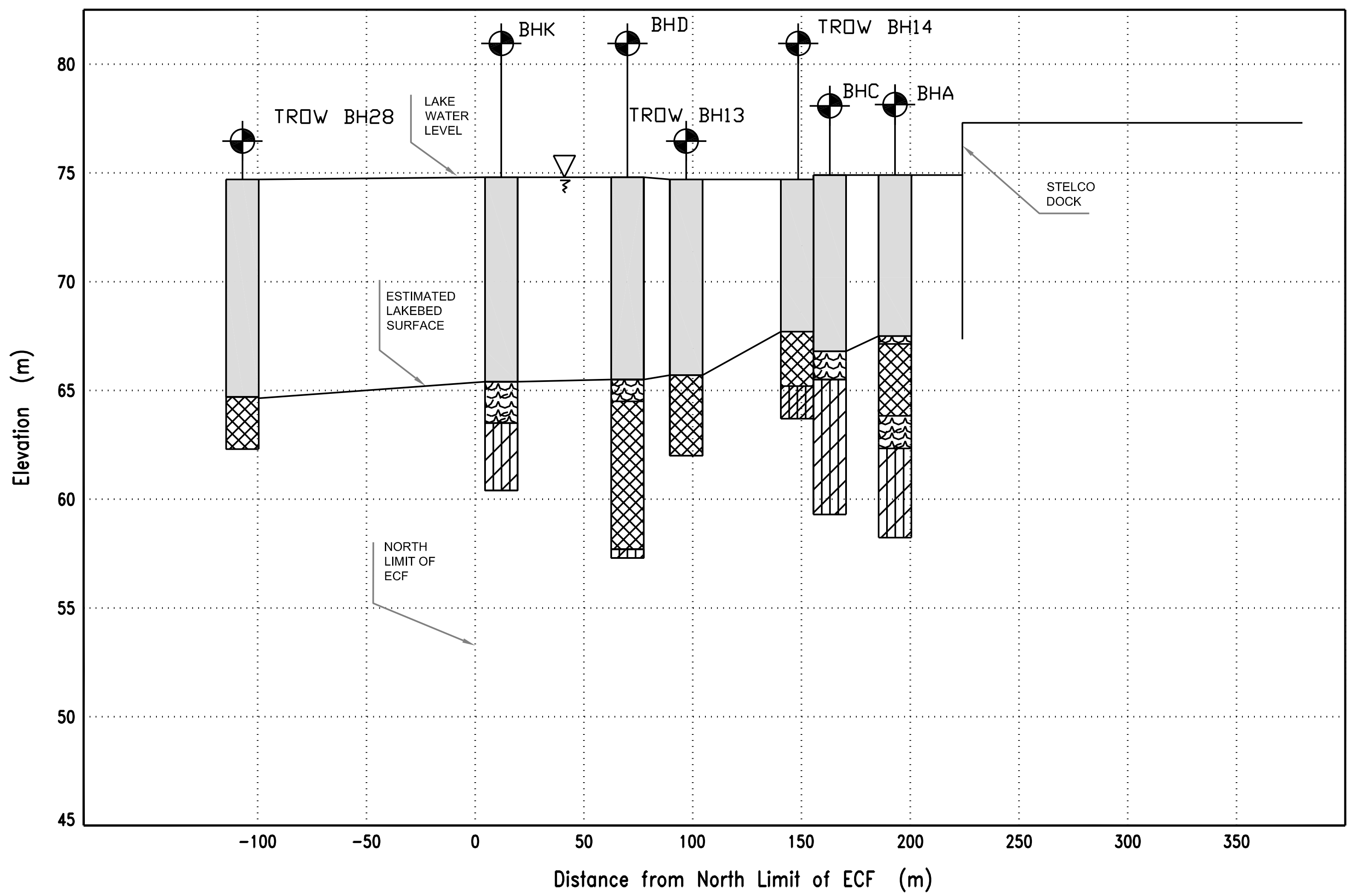
1. ALL ELEVATIONS SHOWN ON THIS DRAWING ARE IN METRES, AND ARE REFERED TO THE INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985.

2. THE SOIL STRATIGRAPHY SHOWN AT BOREHOLE LOCATIONS HAS BEEN SIMPLIFIED. REFER TO BOREHOLE LOGS FOR DETAILS. THE SOIL CONDITIONS BEYOND THE BOREHOLE LOCATIONS COULD VARY SIGNIFICANTLY FROM THE SOIL CONDITIONS SHOWN ON THIS FIGURE.

3. PROFILE LOCATION IN PLAN VIEW IS SHOWN ON FIGURE A-1.

4. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH THE ACCOMPANYING INVESTIGATION REPORT.

amec Earth & Environmental	Date: February 2004	Scale: 1 : 300 V 1 : 3000 H	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Pahse 1 Geotechnical Investigation	Drawn by: KH	Approved by: IS / JD / NV	Figure A-5 Inferred Stratigraphic Profile D - D Along East Perimeter of ECF



Legend/Stratigraphy

- Water
- Fill (Slag and/or Misc.)
- Recent (Soft) Sediment
- Silt Deposits
- Upper Firm Silty Clay
- Lower Very Stiff to Hard Clayey Silt
- Clay/Silt Till Including Sand and Gravel
- Shale Bedrock

NOTES:

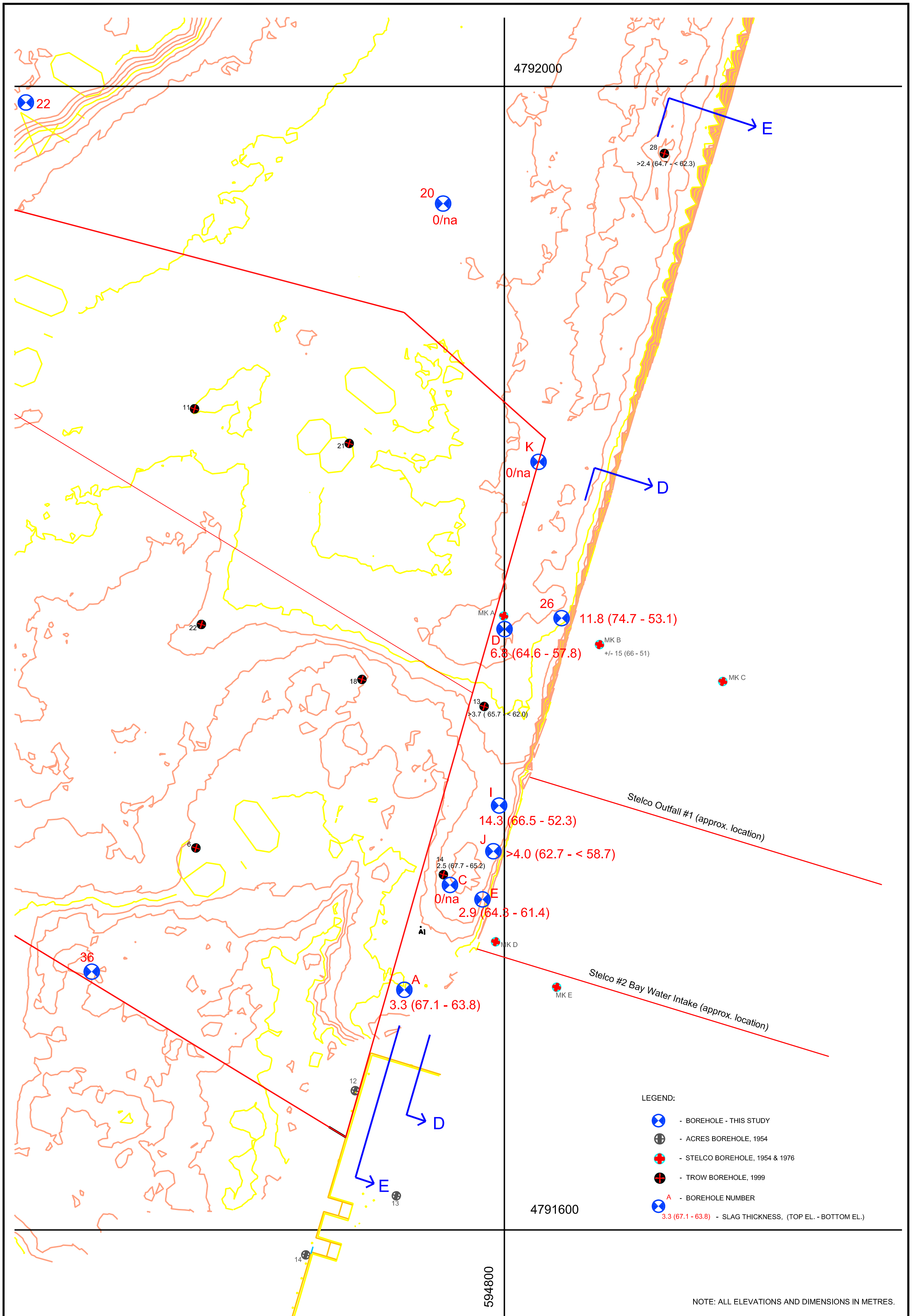
1. ALL ELEVATIONS SHOWN ON THIS DRAWING ARE IN METRES, AND ARE REFERED TO THE INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985.

2. THE SOIL STRATIGRAPHY SHOWN AT BOREHOLE LOCATIONS HAS BEEN SIMPLIFIED. REFER TO BOREHOLE LOGS FOR DETAILS. THE SOIL CONDITIONS BEYOND THE BOREHOLE LOCATIONS COULD VARY SIGNIFICANTLY FROM THE SOIL CONDITIONS SHOWN ON THIS FIGURE.

3. PROFILE LOCATION IN PLAN VIEW IS SHOWN ON FIGURE A-1.

4. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH THE ACCOMPANYING INVESTIGATION REPORT.

amec Earth & Environmental	Date: February 2004	Scale: 1 : 300 V 1 : 3000 H	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Phase 1 Geotechnical Investigation	Drawn by: KH	Approved by: IS / JD / NV	Figure A-6 Inferred Stratigraphic Profile E - E Along East Perimeter of ECF



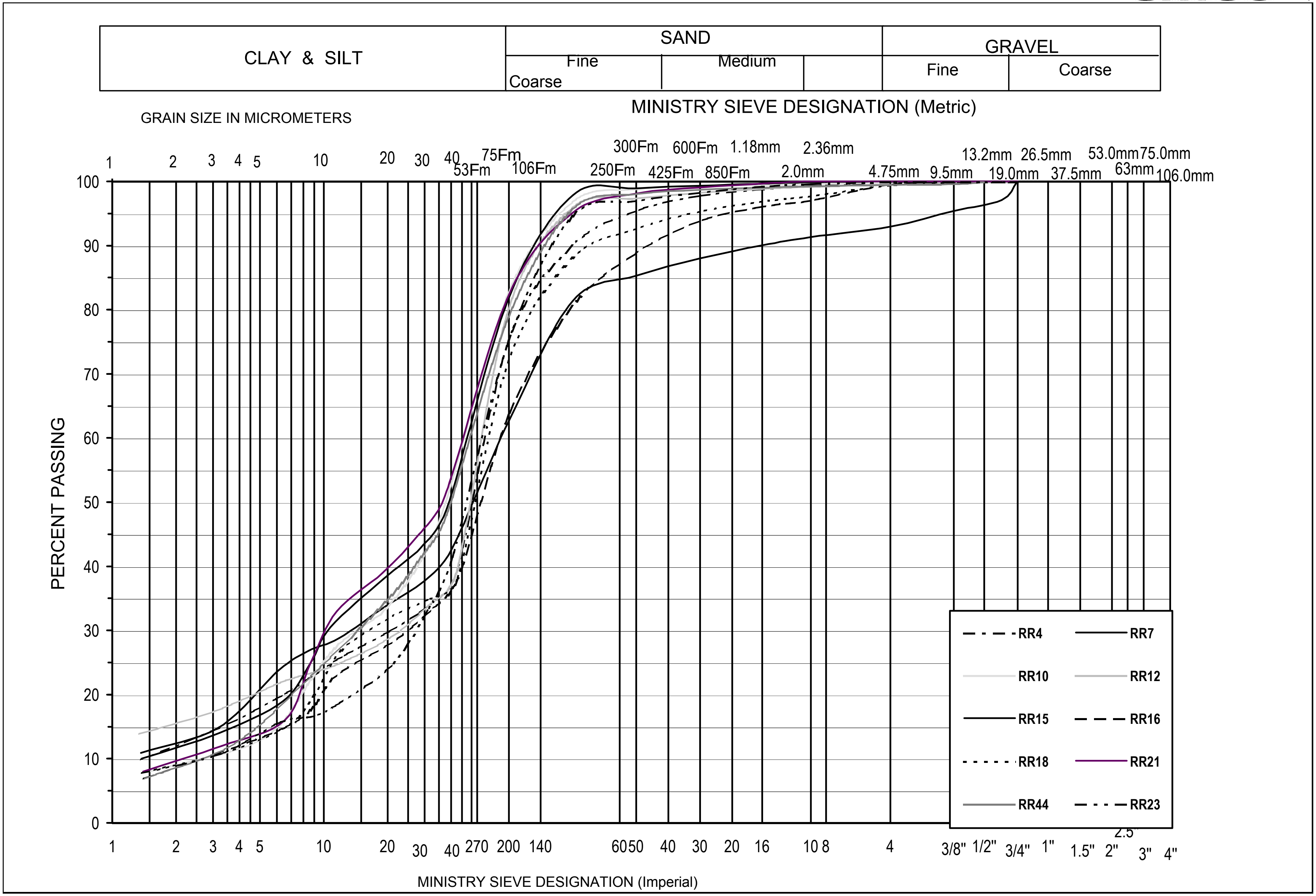
amec Earth & Environmental	Date: February 2004	Approximate Scale: 1 : 1250	Project No.: TC035071
Hamilton Port Authority Randle Reef Sediment Remediation Project RS 2 Phase 1 Geotechnical Investigation	Drawn by: PN/KH	Approved by: IS/JD/NV	Figure A-7 Slag Delineation Borehole Location Plan

APPENDIX B – FIGURES : LABORATORY TEST RESULTS

APPENDIX B FIGURES – LABORATORY TEST RESULTS

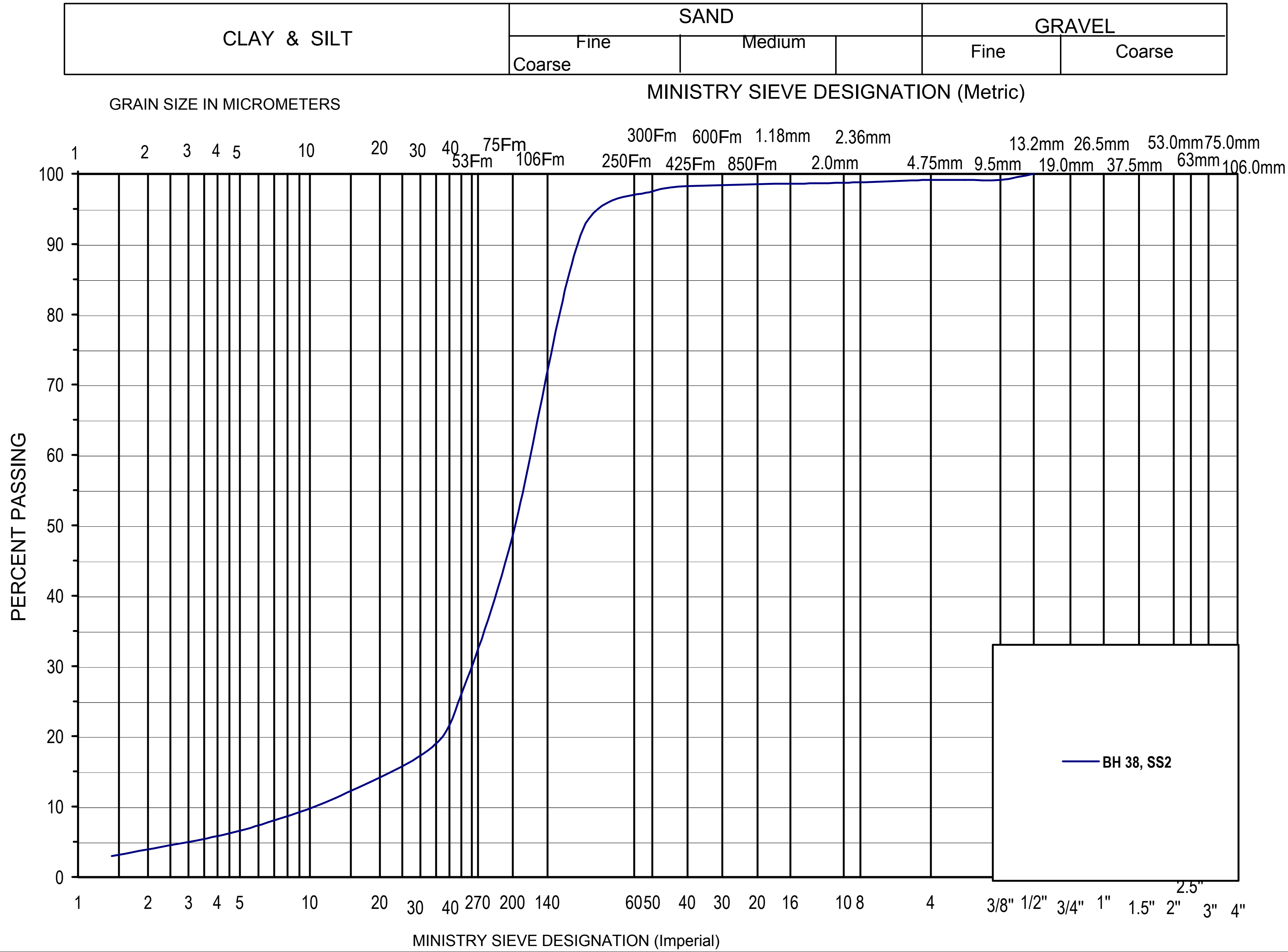
UNIFIED SOIL CLASSIFICATION SYSTEM

amec



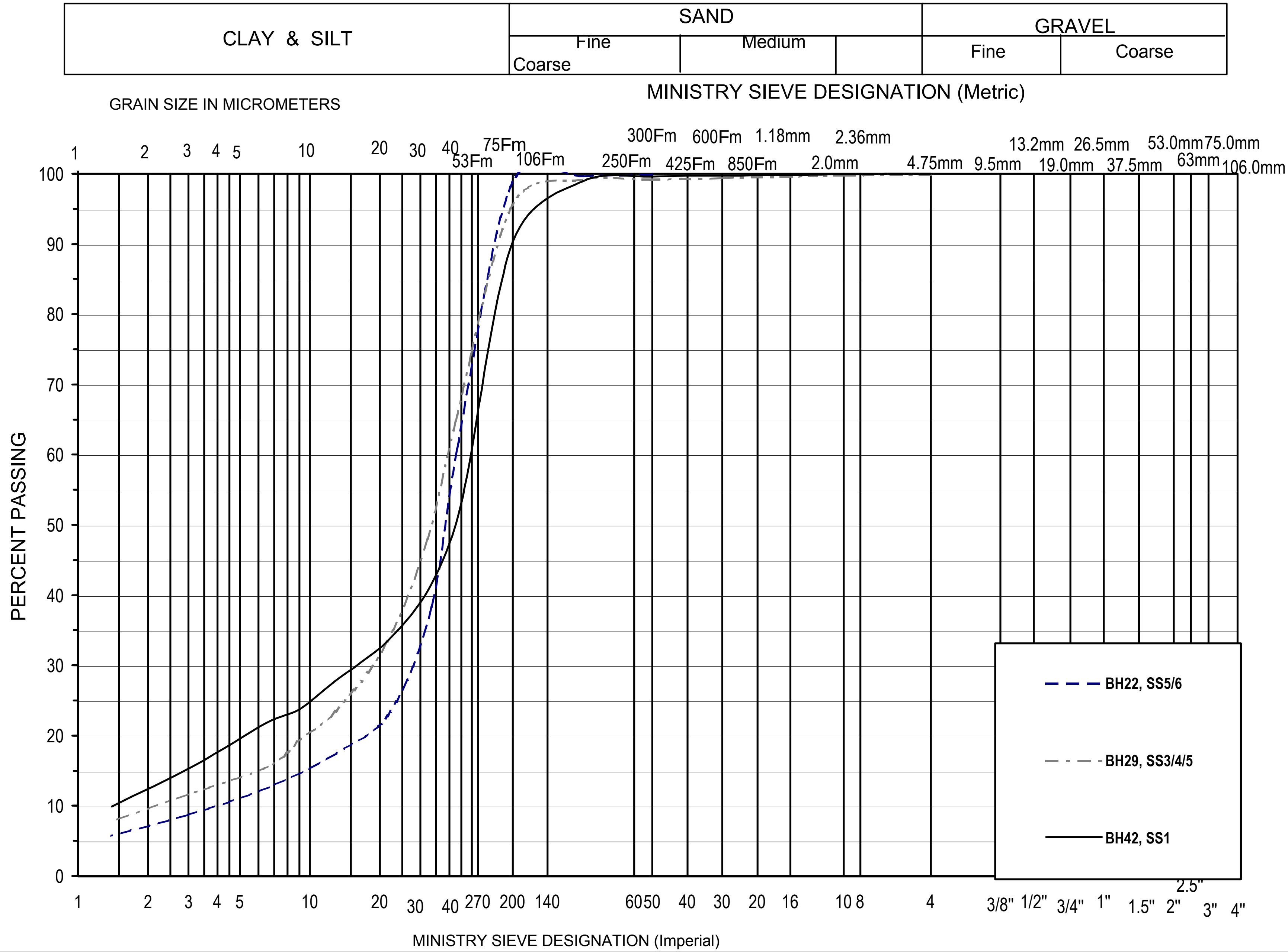
	GRAIN SIZE DISTRIBUTION RECENT SEDIMENT	FIGURE B-1	
		Prepared: GR	TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD	05-Feb-04

UNIFIED SOIL CLASSIFICATION SYSTEM



	GRAIN SIZE DISTRIBUTION ALLUVIUM (Grey - Black Silt Deposit)	**FIGURE B-2**	
		Prepared: GR	TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD	01-Dec-03

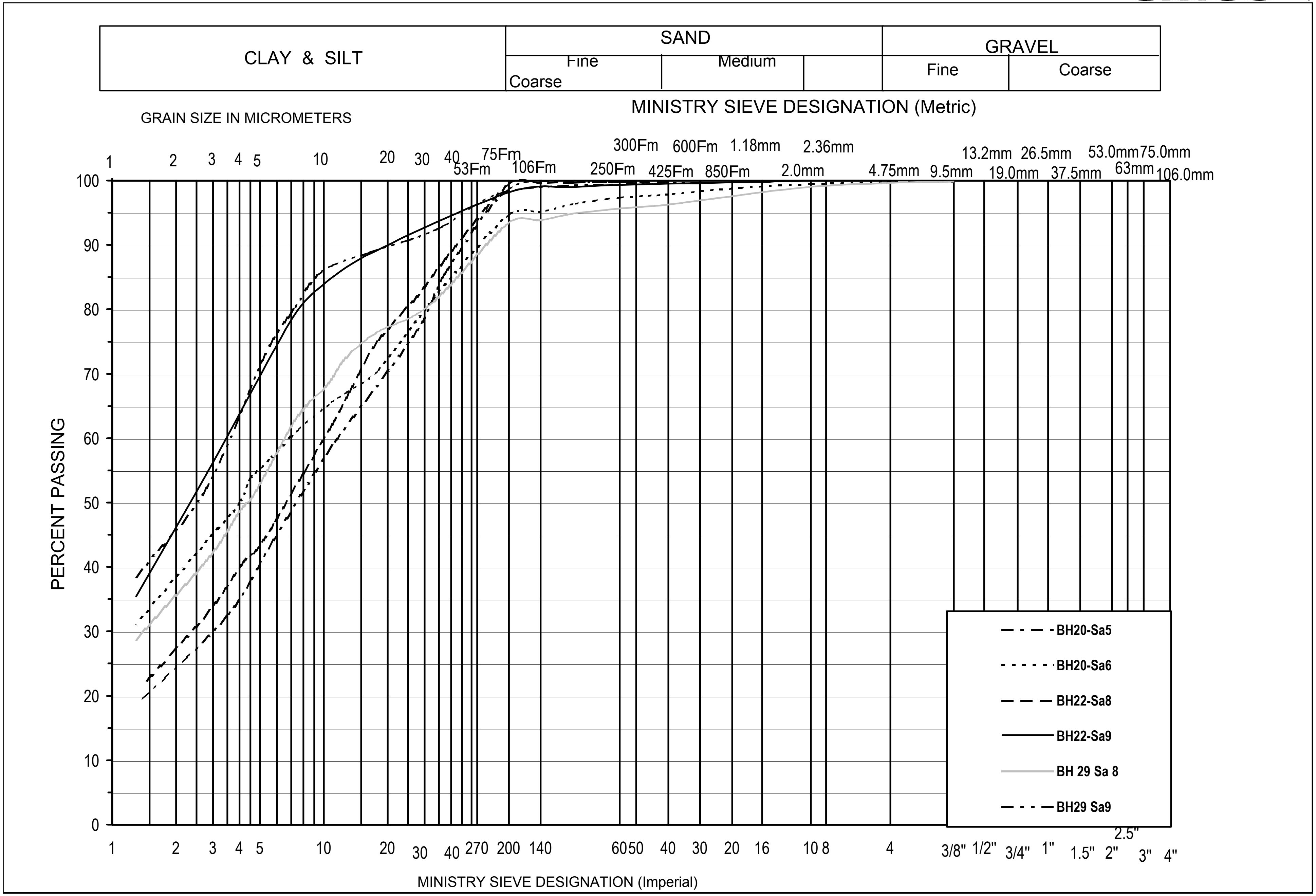
UNIFIED SOIL CLASSIFICATION SYSTEM



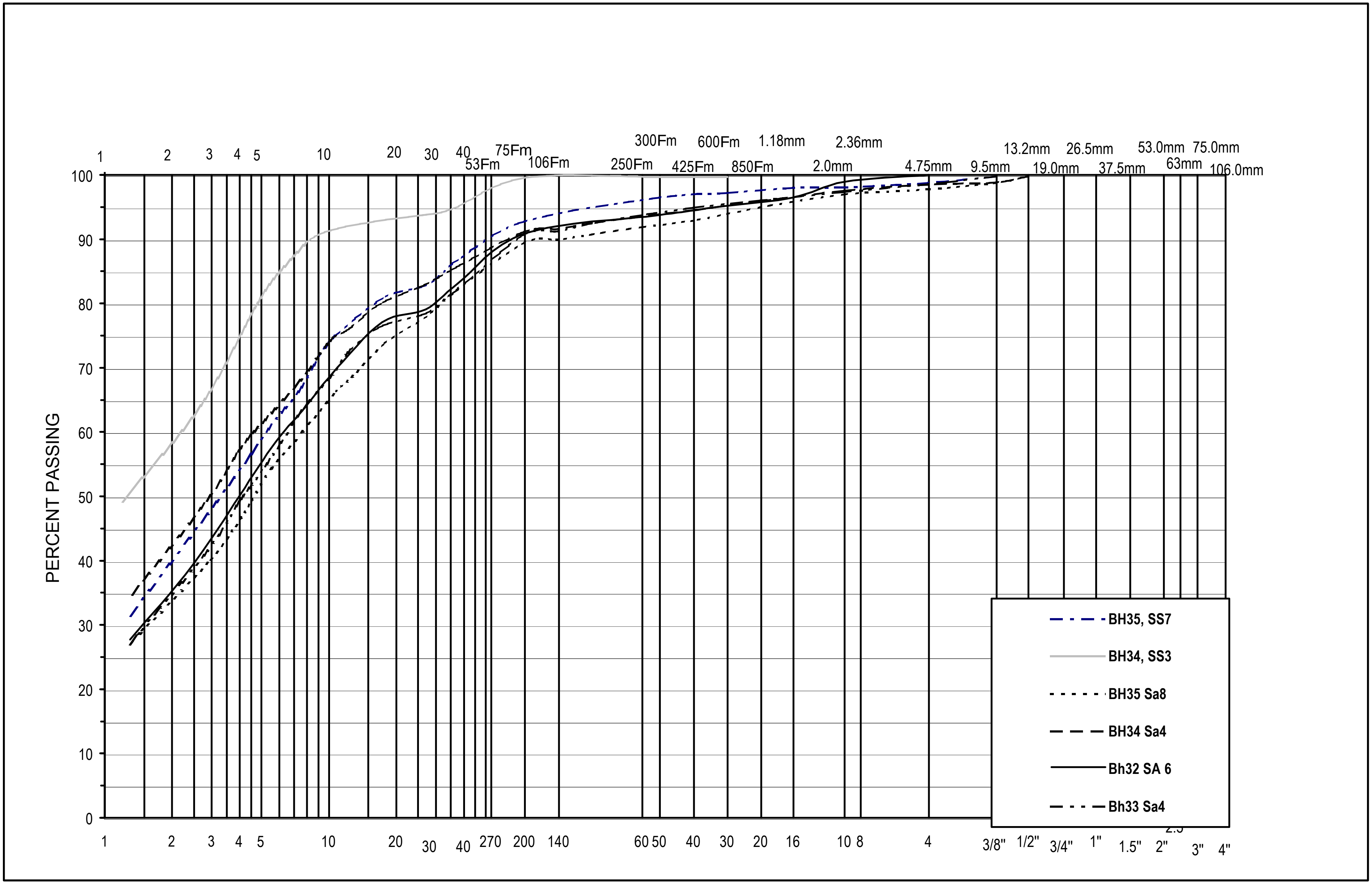
	GRAIN SIZE DISTRIBUTION BROWN SILT STRATUM	FIGURE B-3	
		Prepared: GR	TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD	01-Dec-03

UNIFIED SOIL CLASSIFICATION SYSTEM

amec

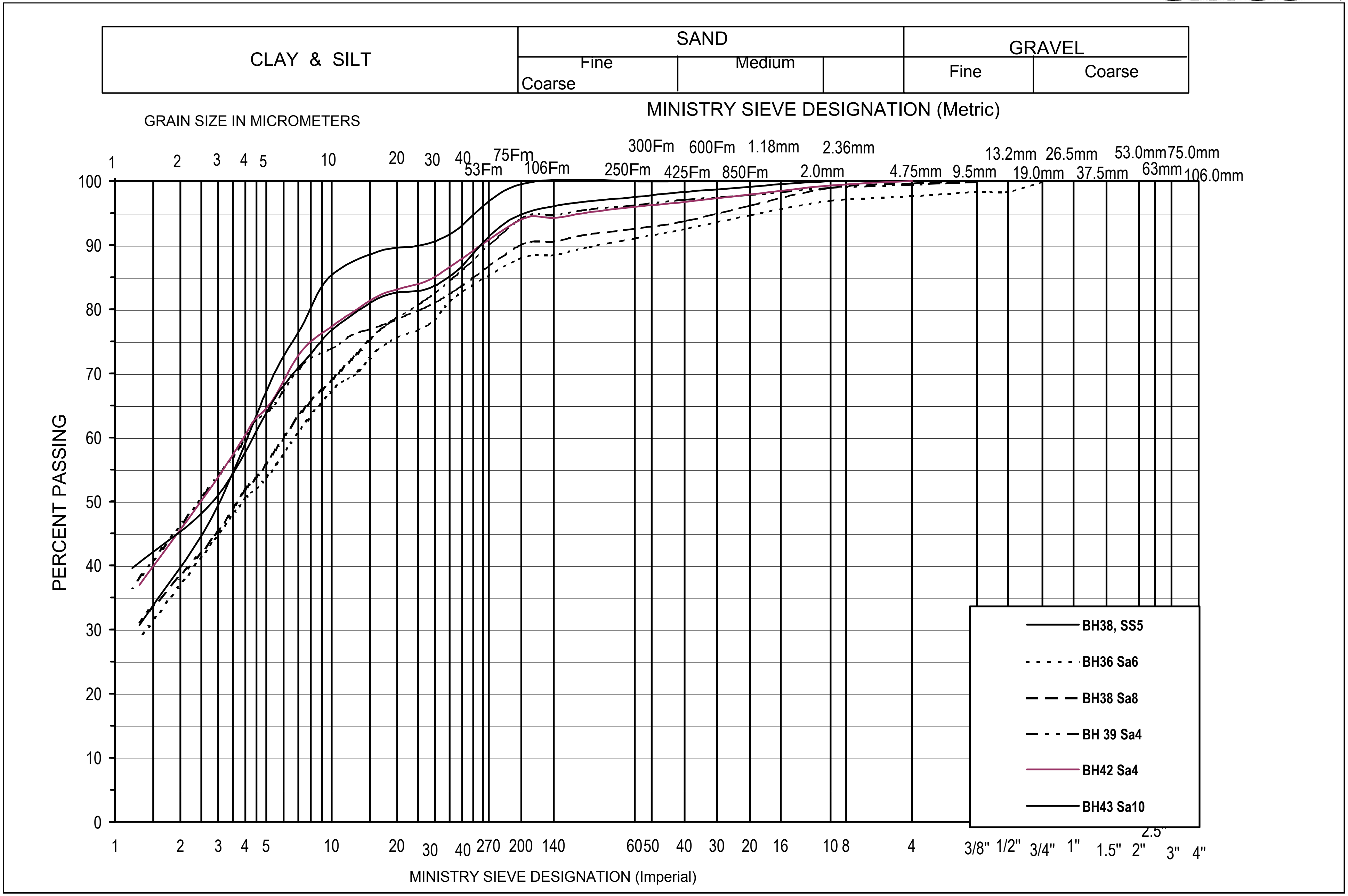


	GRAIN SIZE DISTRIBUTION UPPER SILTY CLAY STRATUM	FIGURE B-4	
		Prepared: GR	TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD	01-Dec-03


PERCENT PASSING
75Fm
106Fm
53Fm
250Fm
300Fm
425Fm
600Fm
850Fm
1.18mm
2.0mm
2.36mm
4.75mm
9.5mm
13.2mm
19.0mm
26.5mm
37.5mm
53.0mm
63mm
75.0mm
106.0mm
270
200
140
3/8"
1/2"
3/4"
1"
1.5"
2"
3"
4"
BH35, SS7
BH34, SS3
BH35 Sa8
BH34 Sa4
Bh32 SA 6
Bh33 Sa4

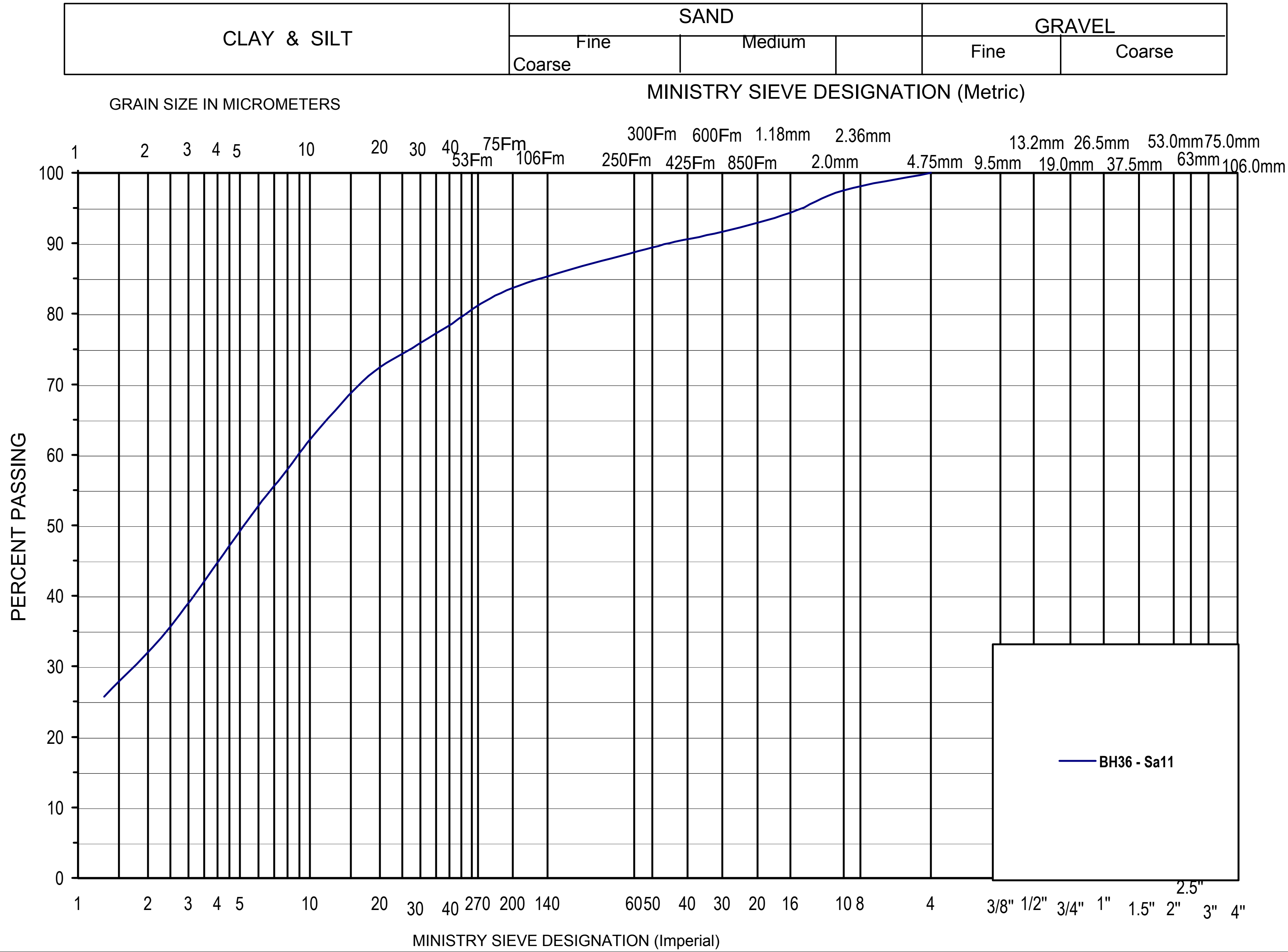
UNIFIED SOIL CLASSIFICATION SYSTEM

amec



	GRAIN SIZE DISTRIBUTION UPPER SILTY CLAY STRATUM	**FIGURE B-6**	
		Prepared: GR	TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD	01-Dec-03

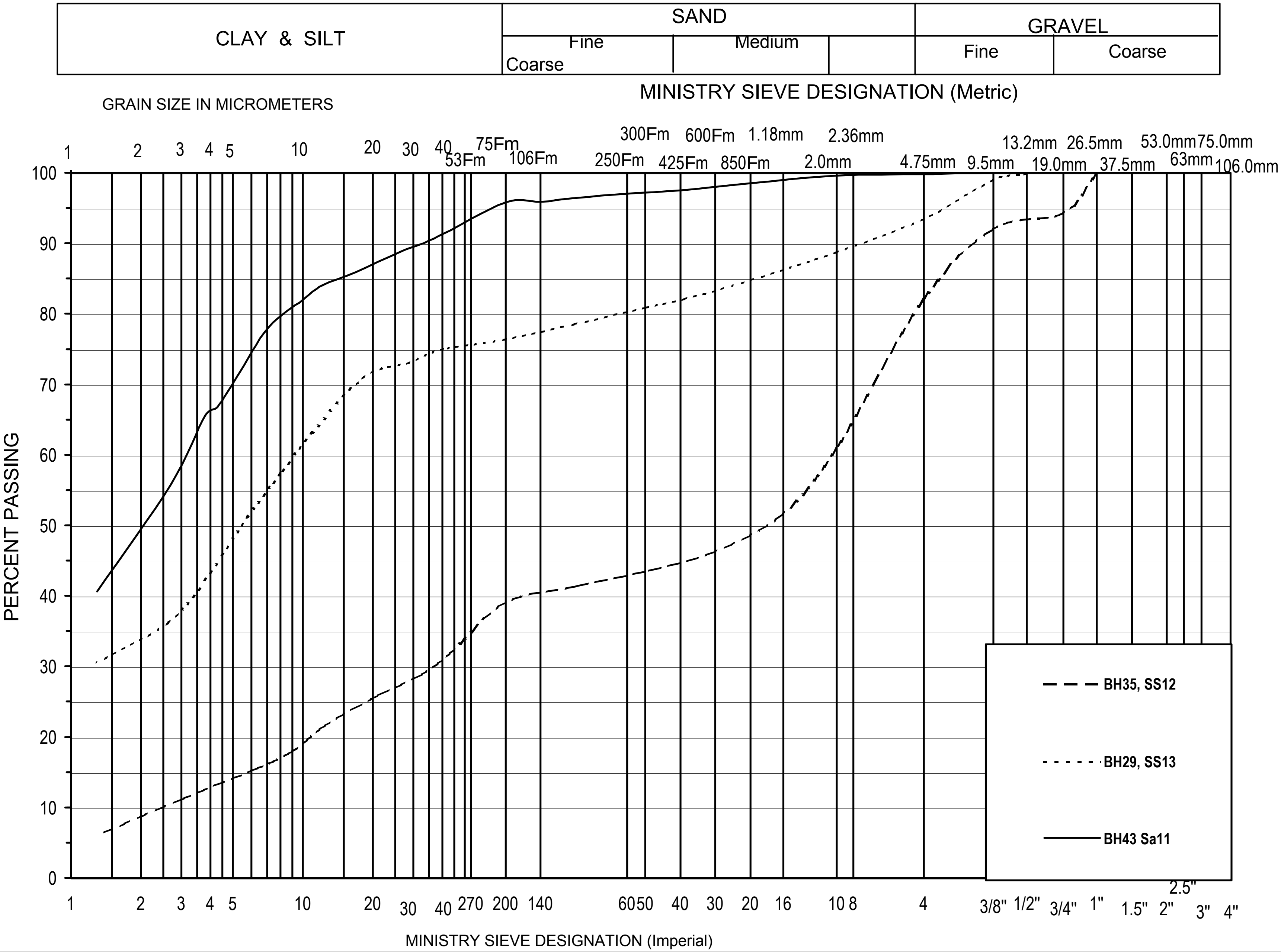
UNIFIED SOIL CLASSIFICATION SYSTEM



	GRAIN SIZE DISTRIBUTION LOWER CLAYEY SILT STRATUM	FIGURE B-7	
		Prepared: GR	TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD	01-Dec-03

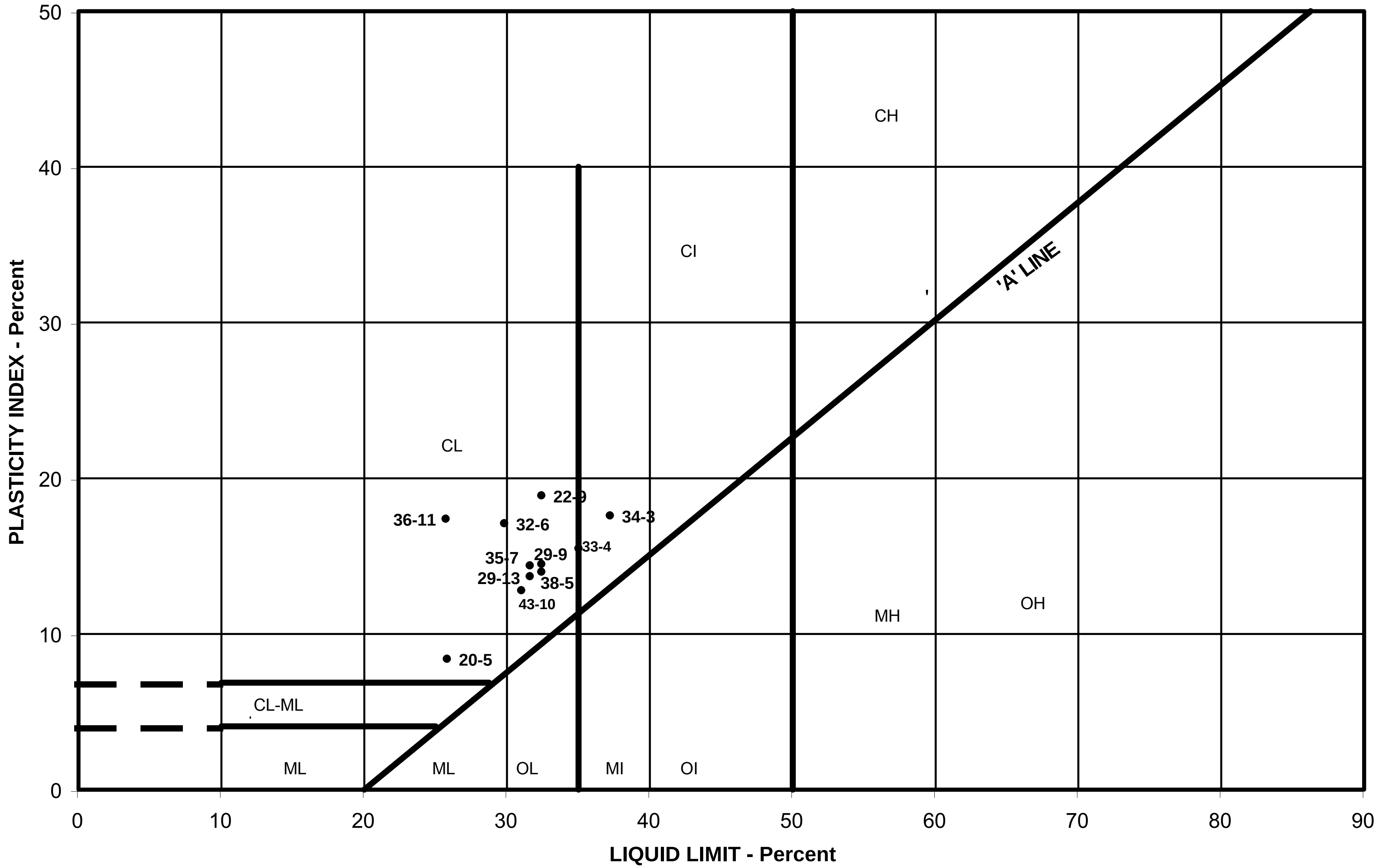
UNIFIED SOIL CLASSIFICATION SYSTEM

amec



	GRAIN SIZE DISTRIBUTION SILT TILL STRATUM	**FIGURE B-8**
		Prepared: GR / TC 030571
	RANDLE REEF SEDIMENT REMEDIATION PROJECT	Checked: JD / 01-Dec-03

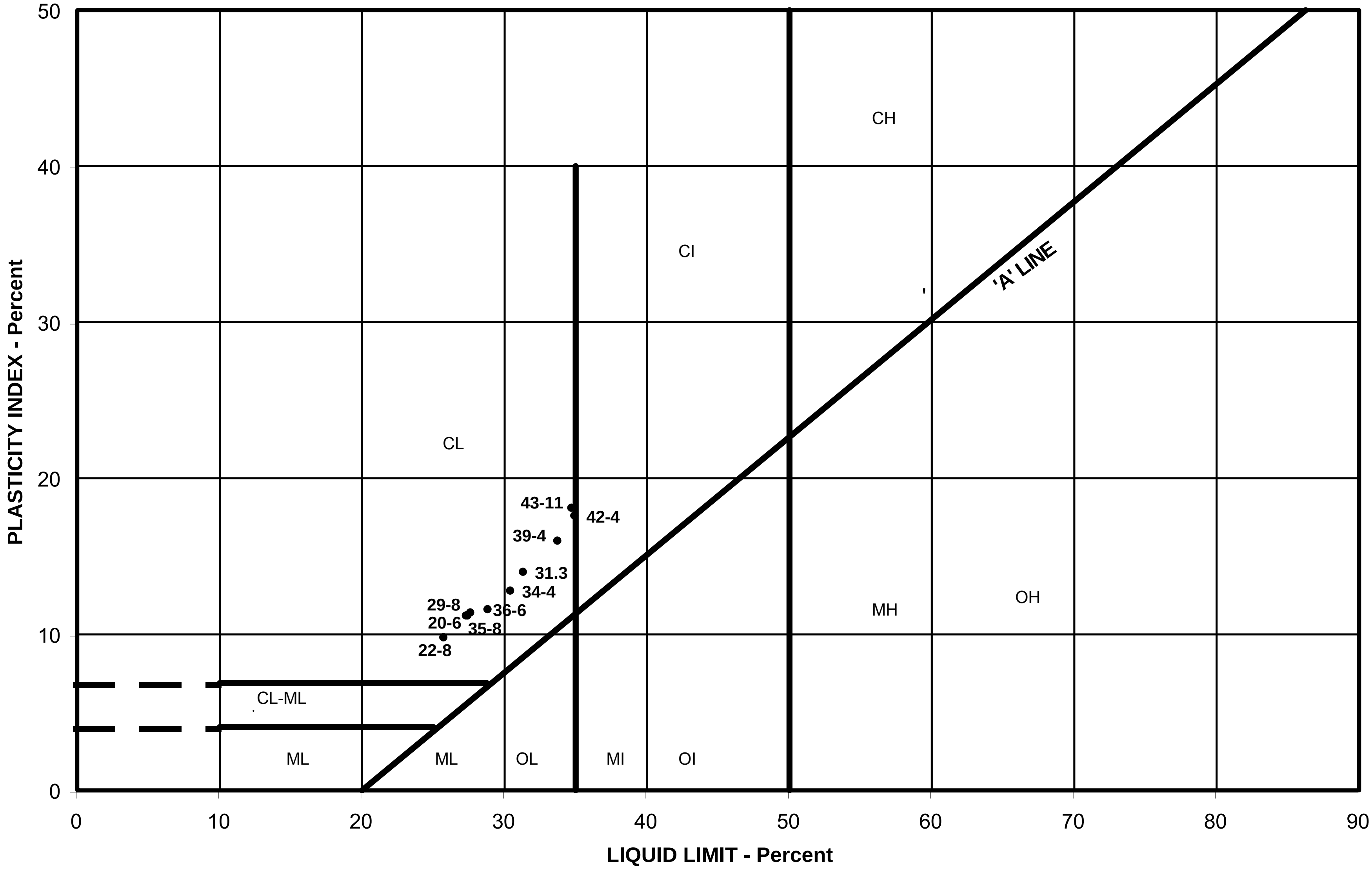
PLASTICITY CHART
Split Spoon Samples



Project Number: TC035071
Project Name: Randle Reef Sediment Remediation Project

FIGURE B-9A

PLASTICITY CHART
Shelby Tube Samples



Project Number: TC035071
Project Name: Randle Reef Sediment Remediation Project

FIGURE B-9B

amec

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 20 November 2003 **BH22-Sa8** **Depth(m):** 11.4

Test Data

Ring # :	A	Ring Height (in) =	0.753	Wt of dry filter paper (g)	0.64
Wet soil + Ring Wt (g)			199.61	Wt of ring (g)	76.61
Wet soil + Wet Paper + Ring (g)			198.31	Wet Paper (g)	1.72
Dry Soil + Dry Paper + Ring (g)			176.51	Ring Dia (in)	2.485
Initial moisture Content (%)			23.92	Final moisture Content (%)	20.87
Area of Ring (in^2)			4.85	Initial Volume (in^3)	3.6521
Initial Bulk Density (kg/m^3)			2055	Initial Dry Density (kg/m^3)	1659
Specific Gravity of Soil			2.72	Eqiv. Thick. of solids (mm)	11.663
Final Bulk Density (kg/m^3)			2131	Final Dry Density (kg/m^3)	1719
Initiall gauge reading for Load 1			0.2455	Gauge reading for last Loading	0.2010
Initial Voids Ratio			0.640	Final Void Ratio	0.543
Initial Degree of Saturation (%)			100.0	Final Degree of Saturation (%)	100.0

Trial #	1	2	3	4	5	6	7
Load (kpa)	0	20	30	45	70	100	150
Load (tsf)	0	0.208	0.312	0.468	0.728	1.04	1.56
Gauge Reading (in)	0.2455	0.2346	0.2318	0.2284	0.2253	0.2215	0.2165
(H-Hs) mm	7.464	7.185	7.116	7.029	6.951	6.854	6.727
Voids ratio	0.640	0.616	0.610	0.603	0.596	0.588	0.577
t90 (min)		0.64	3.61	1.96	4.00	4.00	2.10
Cv (ft^2/day)		1.851	0.322	0.588	0.286	0.283	0.532
k' (tsf)		14.304	28.320	33.674	62.222	59.776	75.816
Mv (ft^2 / ton)		0.0699	0.0353	0.0297	0.0161	0.0167	0.0132

Trial #	8	9	10	11	12	13	14
Load (kpa)	220	330	450	600	900	330	100
Load (tsf)	2.288	3.432	4.68	6.24	9.36	3.432	1.040
Gauge Reading (in)	0.2116	0.2047	0.1988	0.1921	0.1823	0.1864	0.1907
(H-Hs) mm	6.601	6.426	6.277	6.106	5.857	5.961	6.072
Voids ratio	0.566	0.551	0.538	0.524	0.502	0.511	0.521
t90 (min)	2.25	1.56	2.56	4.00	1.96		
Cv (ft^2/day)	0.491	0.695	0.417	0.262	0.522		
k' (tsf)	106.479	119.216	151.925	163.234	222.714		
Mv (ft^2 / ton)	0.0094	0.0084	0.0066	0.0061	0.0045		

Trial #	15	16
Load (kpa)	45	10
Load (tsf)	0.468	0.104
Gauge Reading (in)	0.1940	0.2010
(H-Hs) mm	6.154	6.333
Voids ratio	0.528	0.543
t90 (min)		
Cv (ft^2/day)		
k' (tsf)		
Mv (ft^2 / ton)		

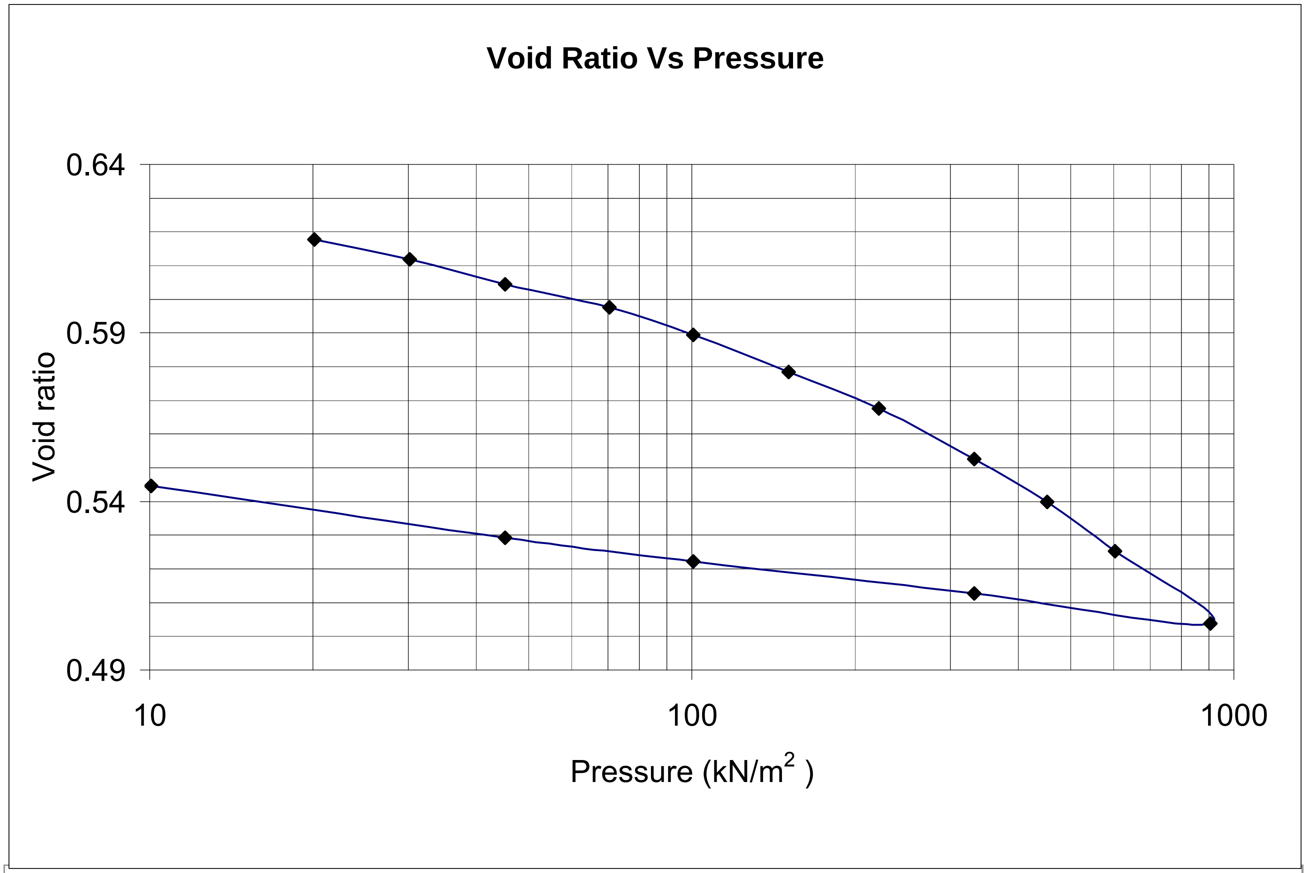
Figure B-10A

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 20 November 2003 **BH22-Sa8** **Depth(m):** 11.4

s'$_v$ versus e and c$_v$



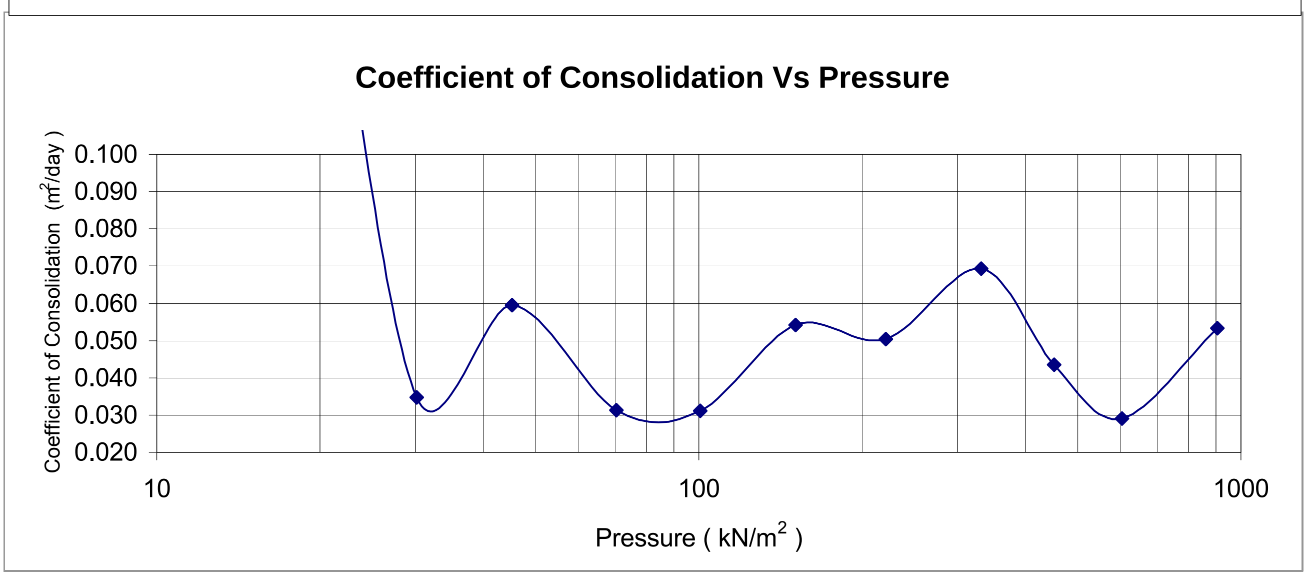


Figure B-10B

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 20 November 2003 **BH22-Sa8** **Depth(m):** 11.4

Strain Energy Data

Presssure (tsf)	c_v (ft^2/day)	Presssure (kN/m^2)	c_v (m^2/day)	Void ratio
0.2080	1.851	20	0.1720	0.616
0.3120	0.322	30	0.0299	0.610
0.4680	0.588	45	0.0547	0.603
0.7280	0.286	70	0.0266	0.596
1.0400	0.283	100	0.0263	0.588
1.5600	0.532	150	0.0494	0.577
2.2880	0.491	220	0.0456	0.566
3.4320	0.695	330	0.0645	0.551
4.6800	0.417	450	0.0387	0.538
6.2400	0.262	600	0.0243	0.524
9.3600	0.522	900	0.0485	0.502
3.4320		330		0.511
1.0400		100		0.521
0.4680		45		0.528
0.1040		10		0.543

Presssure (KN/m^2)	Height mm	Total Work (KJ/m^3)
0.0	19.126	0.000
20.0	18.848	0.145
30.0	18.779	0.237
45.0	18.692	0.411
70.0	18.614	0.651
100.0	18.517	1.095
150.0	18.390	1.952
220.0	18.264	3.217
330.0	18.089	5.856
450.0	17.940	9.060
600.0	17.769	14.077
900.0	17.520	24.584
330.0	17.624	20.928
100.0	17.734	19.580
45.0	17.817	19.243
10.0	17.996	18.966

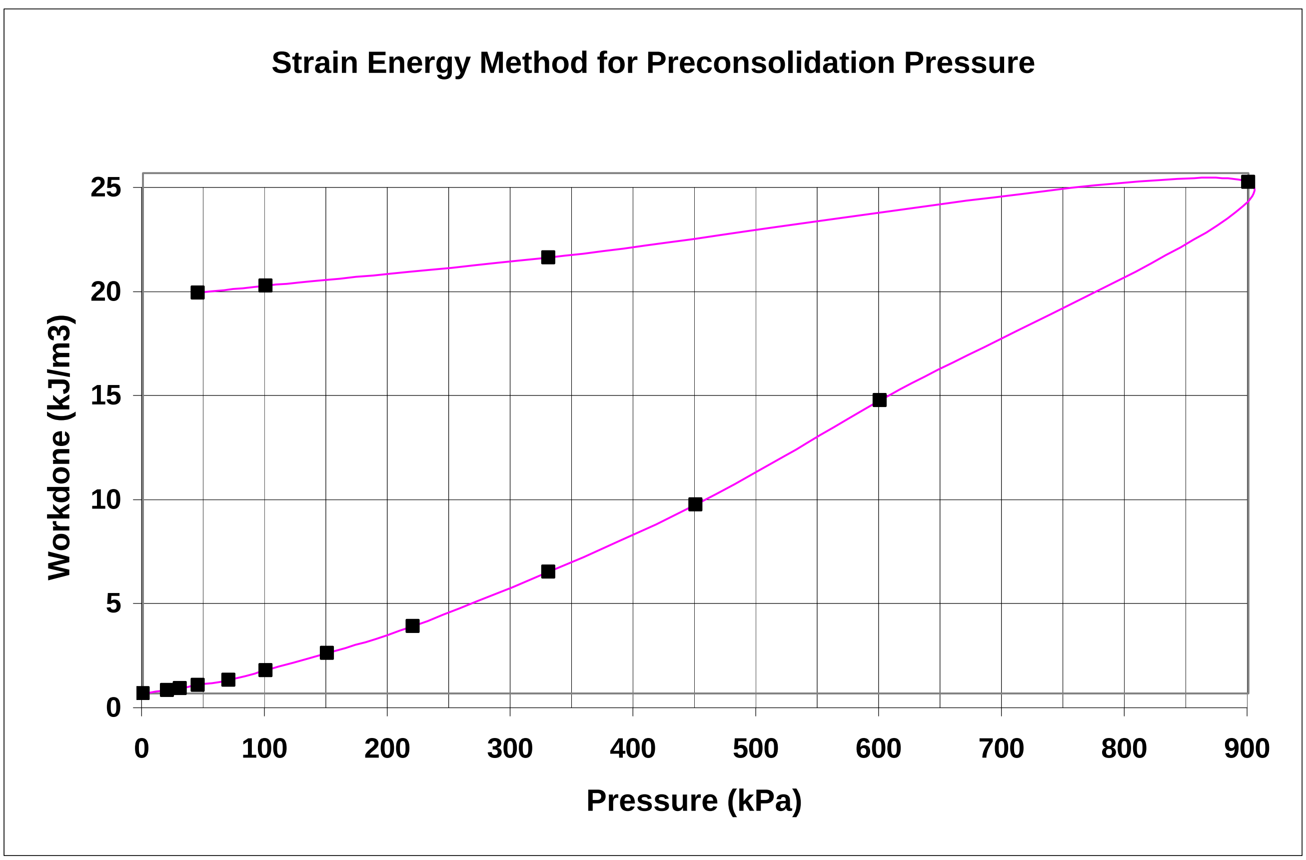


Figure B-10C

amec

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 12 November 2003 **BH33-Sa4** **Depth(m):** 13.1

Test Data

Ring # :	A	Ring Height (in) =	0.753	Wt of dry filter paper (g)	0.65
Wet soil + Ring Wt (g)			195.99	Wt of ring (g)	76.61
Wet soil + Wet Paper + Ring (g)			193.51	Wet Paper (g)	1.74
Dry Soil + Dry Paper + Ring (g)			169.85	Ring Dia (in)	2.485
Initial moisture Content (%)			28.93	Final moisture Content (%)	24.38
Area of Ring (in^2)			4.85	Initial Volume (in^3)	3.6521
Initial Bulk Density (kg/m^3)			1995	Initial Dry Density (kg/m^3)	1547
Specific Gravity of Soil			2.70	Eqiv. Thick. of solids (mm)	10.959
Final Bulk Density (kg/m^3)			2095	Final Dry Density (kg/m^3)	1625
Initiall gauge reading for Load 1			0.2537	Gauge reading for last Loading	0.1923
Initial Voids Ratio			0.745	Final Void Ratio	0.603
Initial Degree of Saturation (%)			100.0	Final Degree of Saturation (%)	100.0

Trial #	1	2	3	4	5	6	7
Load (kpa)	0	20	30	45	70	100	150
Load (tsf)	0	0.208	0.312	0.468	0.728	1.04	1.56
Gauge Reading (in)	0.2537	0.2455	0.2426	0.2394	0.2345	0.2299	0.2235
(H-Hs) mm	8.167	7.958	7.885	7.803	7.678	7.563	7.399
Voids ratio	0.745	0.726	0.720	0.712	0.701	0.690	0.675
t90 (min)		4.00	5.76	3.24	5.76	4.20	3.42
Cv (ft^2/day)		0.297	0.203	0.359	0.199	0.270	0.326
k' (tsf)		19.042	27.178	35.888	38.800	50.592	58.790
Mv (ft^2 / ton)		0.0525	0.0368	0.0279	0.0258	0.0198	0.0170

Trial #	8	9	10	11	12	13	14
Load (kpa)	220	330	450	600	220	100	45
Load (tsf)	2.288	3.432	4.68	6.24	2.288	1.040	0.468
Gauge Reading (in)	0.2152	0.1993	0.1860	0.1740	0.1778	0.1807	0.1848
(H-Hs) mm	7.189	6.784	6.446	6.141	6.238	6.312	6.415
Voids ratio	0.656	0.619	0.588	0.560	0.569	0.576	0.585
t90 (min)	4.00	4.41	7.56	5.29			
Cv (ft^2/day)	0.274	0.240	0.134	0.185			
k' (tsf)	63.779	51.168	65.548	89.083			
Mv (ft^2 / ton)	0.0157	0.0195	0.0153	0.0112			

Trial #	15
Load (kpa)	10
Load (tsf)	0.104
Gauge Reading (in)	0.1923
(H-Hs) mm	6.608
Voids ratio	0.603
t90 (min)	
Cv (ft^2/day)	
k' (tsf)	
Mv (ft^2 / ton)	

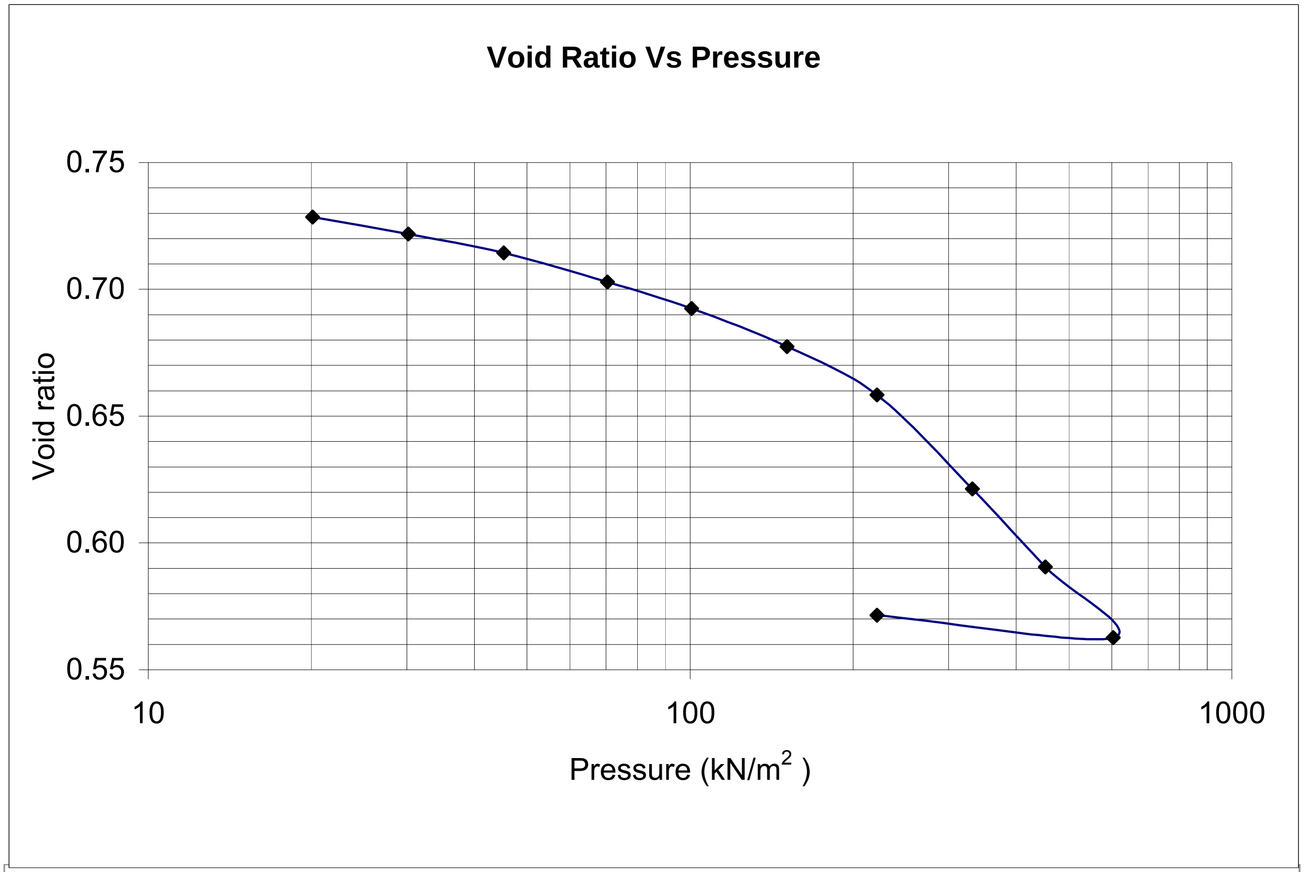
Figure B-11A

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 12 November 2003 **BH33-Sa4** **Depth(m):** 13.1

s'$_v$ versus e and c$_v$



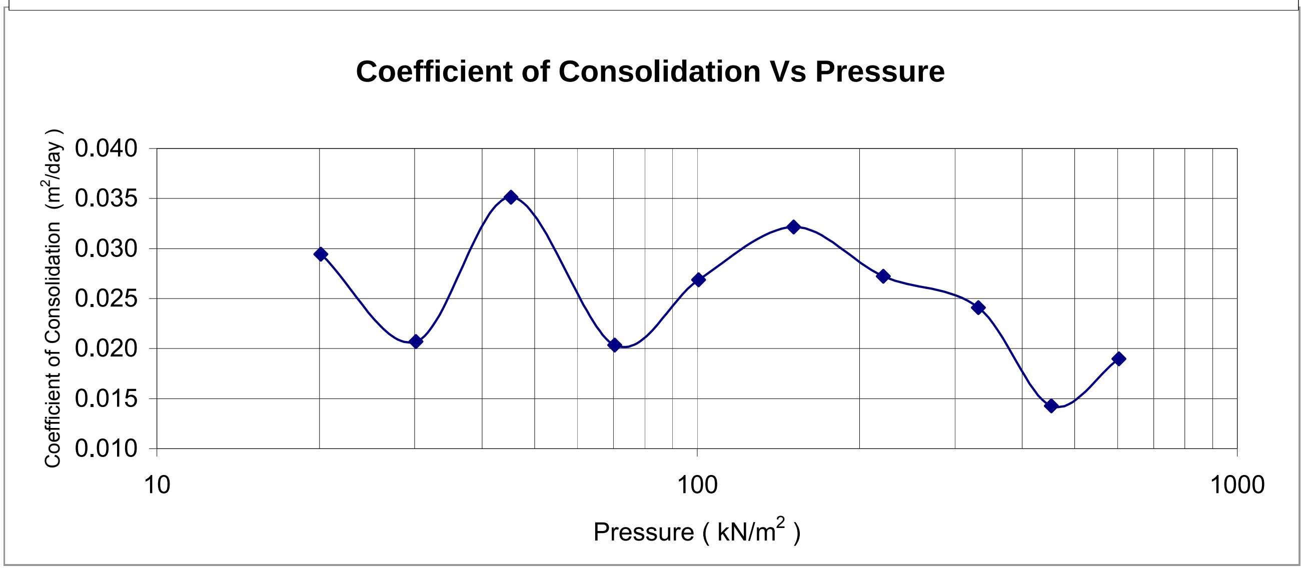


Figure B-11B

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 12 November 2003 **BH33-Sa4** **Depth(m):** 13.1

Strain Energy Data

Presssure (tsf)	Cv (ft^2/day)	Presssure (kN/m^2)	Cv (m^2/day)	Void ratio
0.2080	0.297	20	0.0276	0.726
0.3120	0.203	30	0.0189	0.720
0.4680	0.359	45	0.0333	0.712
0.7280	0.199	70	0.0185	0.701
1.0400	0.270	100	0.0251	0.690
1.5600	0.326	150	0.0303	0.675
2.2880	0.274	220	0.0254	0.656
3.4320	0.240	330	0.0223	0.619
4.6800	0.134	450	0.0125	0.588
6.2400	0.185	600	0.0172	0.560
2.2880		220		0.569
1.0400		100		0.576
0.4680		45		0.585
0.1040		10		0.603

Presssure (KN/m^2)	Height mm	Total Work (KJ/m^3)
0.0	19.126	0.000
20.0	18.917	0.109
30.0	18.845	0.205
45.0	18.763	0.368
70.0	18.637	0.753
100.0	18.522	1.277
150.0	18.358	2.383
220.0	18.149	4.495
330.0	17.743	10.643
450.0	17.405	18.068
600.0	17.101	27.262
220.0	17.197	24.948
100.0	17.271	24.257
45.0	17.375	23.822
10.0	17.567	23.518

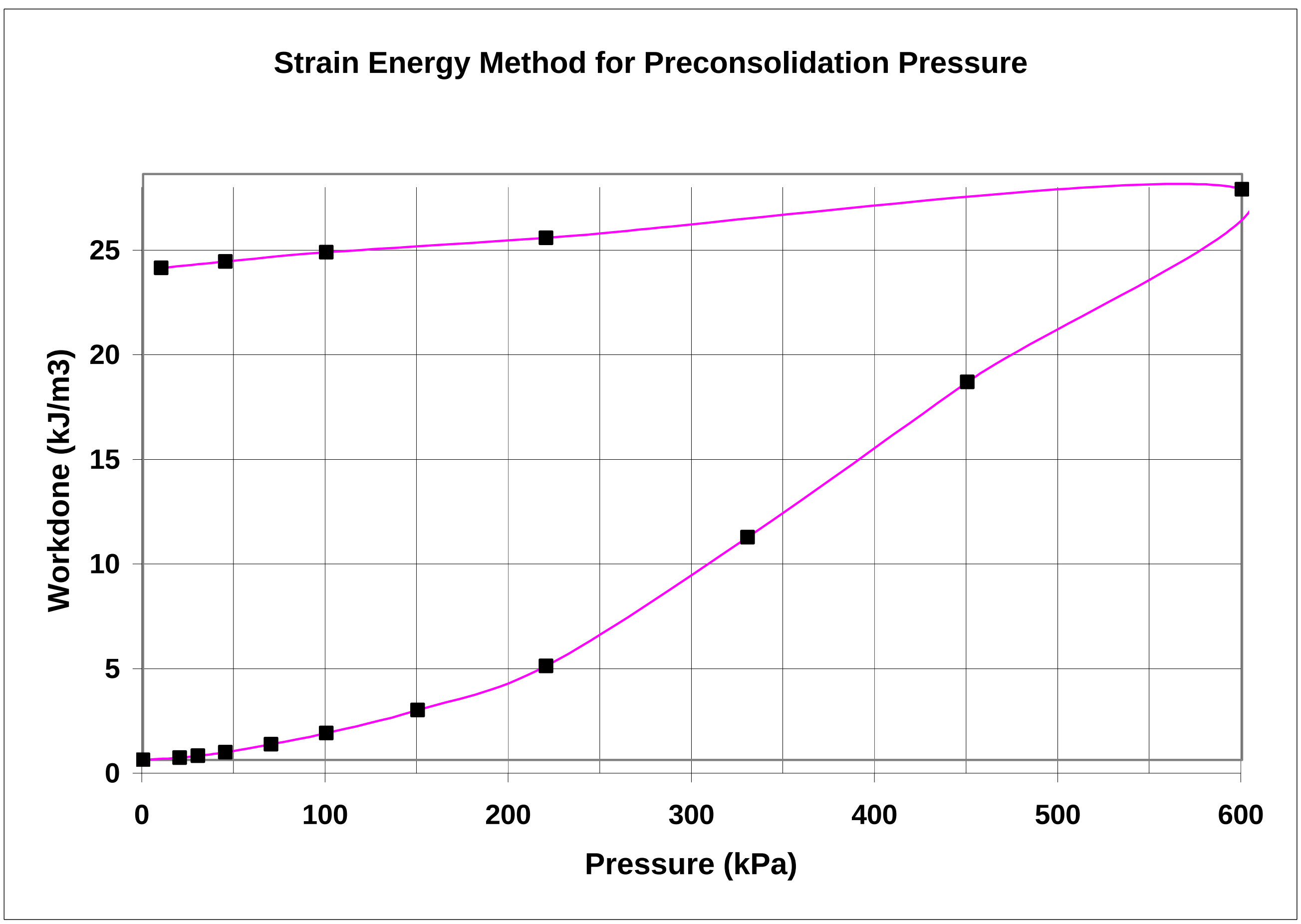


Figure B-11C

amec

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 12 November 2003 **BH39-Sa4** **Depth(m):** 10.8

Test Data

Ring # :	B	Ring Height (in) =	0.753	Wt of dry filter paper (g)	0.71
Wet soil + Ring Wt (g)			196.12	Wt of ring (g)	76.57
Wet soil + Wet Paper + Ring (g)			195.78	Wet Paper (g)	1.86
Dry Soil + Dry Paper + Ring (g)			171.09	Ring Dia (in)	2.485
Initial moisture Content (%)			27.44	Final moisture Content (%)	25.093
Area of Ring (in^2)			4.85	Initial Volume (in^3)	3.6521
Initial Bulk Density (kg/m^3)			1998	Initial Dry Density (kg/m^3)	1568
Specific Gravity of Soil			2.72	Eqiv. Thick. of solids (mm)	11.022
Final Bulk Density (kg/m^3)			2126	Final Dry Density (kg/m^3)	1668
Initiall gauge reading for Load 1			0.2599	Gauge reading for last Loading	0.2015
Initial Voids Ratio			0.735	Final Void Ratio	0.601
Initial Degree of Saturation (%)			100.0	Final Degree of Saturation (%)	100.0

Trial #	1	2	3	4	5	6	7
Load (kpa)	0	20	30	45	70	100	150
Load (tsf)	0	0.208	0.312	0.468	0.728	1.04	1.56
Gauge Reading (in)	0.2599	0.2561	0.25415	0.2515	0.2479	0.2446	0.2400
(H-Hs) mm	8.104	8.007	7.958	7.891	7.799	7.715	7.598
Voids ratio	0.735	0.726	0.722	0.716	0.708	0.700	0.689
t90 (min)		4.00	4.62	5.06	4.84	4.00	3.24
Cv (ft^2/day)		0.299	0.257	0.233	0.242	0.290	0.354
k' (tsf)		41.217	39.957	43.989	53.777	69.531	83.845
Mv (ft^2 / ton)		0.0243	0.0250	0.0227	0.0186	0.0144	0.0119

Trial #	8	9	10	11	12	13	14
Load (kpa)	220	330	450	600	220	100	45
Load (tsf)	2.288	3.432	4.68	6.24	2.288	1.04	0.468
Gauge Reading (in)	0.2338	0.2216	0.2049	0.1908	0.1967	0.2015	0.2081
(H-Hs) mm	7.440	7.130	6.707	6.348	6.497	6.621	6.789
Voids ratio	0.675	0.647	0.608	0.576	0.589	0.601	0.616
t90 (min)	3.24	6.76	13.32	12.96			
Cv (ft^2/day)	0.349	0.163	0.079	0.078			
k' (tsf)	85.391	68.157	53.567	76.953			
Mv (ft^2 / ton)	0.0117	0.0147	0.0187	0.0130			

Trial #	8
Load (kpa)	10
Load (tsf)	0.104
Gauge Reading (in)	0.2193
(H-Hs) mm	7.073
Voids ratio	0.642
t90 (min)	
Cv (ft^2/day)	
k' (tsf)	
Mv (ft^2 / ton)	

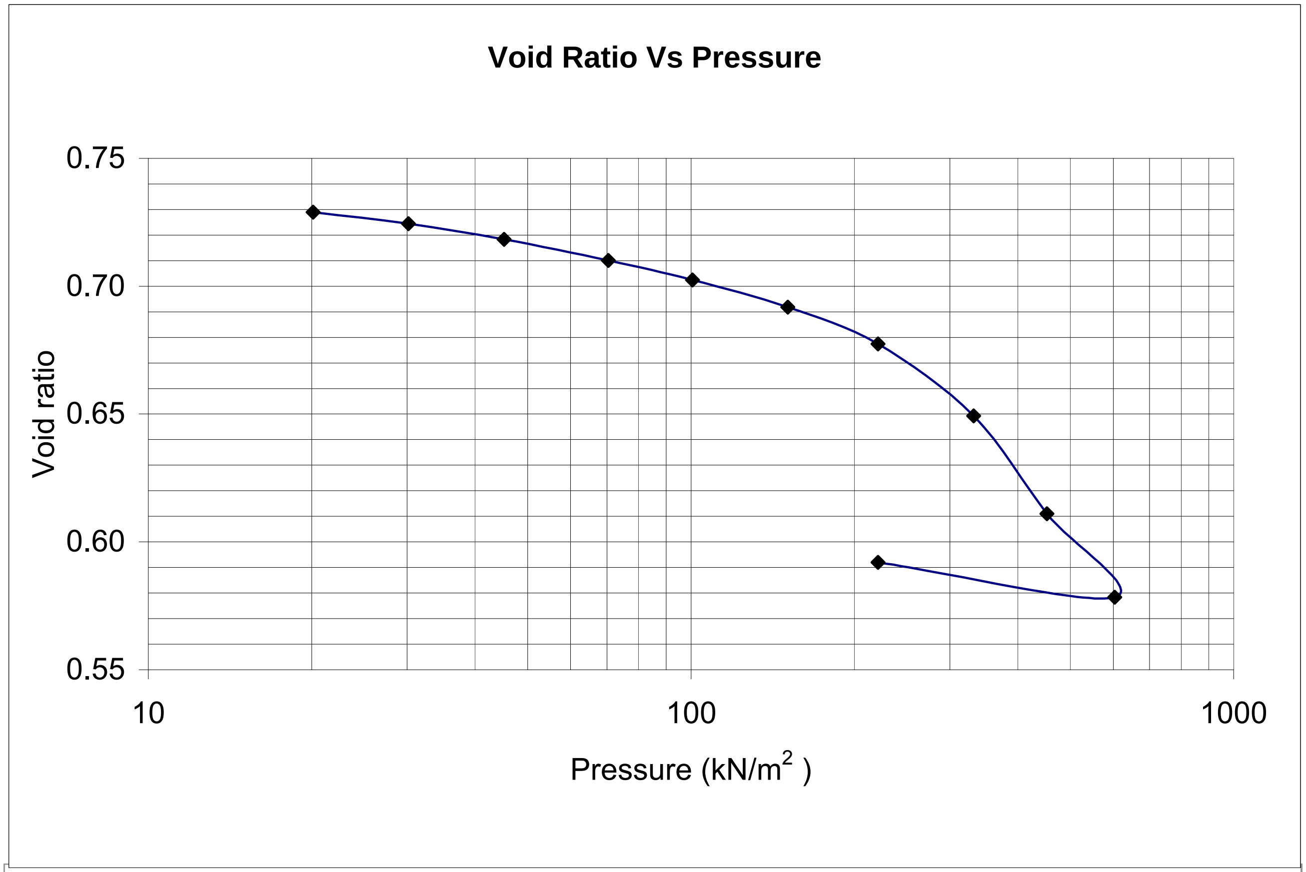
Figure B-12A

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 12 November 2003 **BH39-Sa4** **Depth(m):** 10.8

s'$_v$ versus e and c$_v$



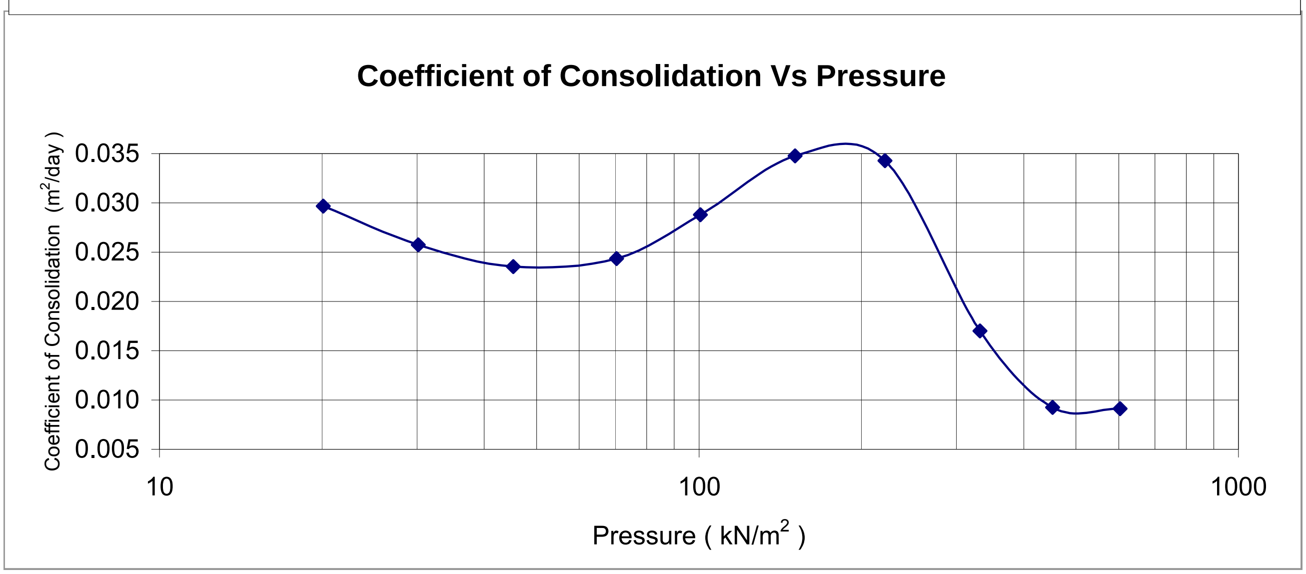


Figure B-12B

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 12 November 2003 **BH39-Sa4** **Depth(m):** 10.8

Strain Energy Data

Presssure (tsf)	Cv (ft^2/day)	Presssure (kN/m^2)	Cv (m^2/day)	Void ratio
0.2080	0.299	20	0.0278	0.726
0.3120	0.257	30	0.0239	0.722
0.4680	0.233	45	0.0216	0.716
0.7280	0.242	70	0.0225	0.708
1.0400	0.290	100	0.0269	0.700
1.5600	0.354	150	0.0329	0.689
2.2880	0.349	220	0.0324	0.675
3.4320	0.163	330	0.0151	0.647
4.6800	0.079	450	0.0074	0.608
6.2400	0.078	600	0.0073	0.576
2.2880		220		0.589
1.0400		100		0.601
0.4680		45		0.616
0.1040		10		0.642

Presssure (KN/m^2)	Height mm	Total Work (KJ/m^3)
0.0	19.126	0.000
20.0	19.030	0.050
30.0	18.980	0.116
45.0	18.913	0.249
70.0	18.821	0.527
100.0	18.737	0.908
150.0	18.621	1.683
220.0	18.462	3.260
330.0	18.152	7.876
450.0	17.729	16.962
600.0	17.370	27.605
220.0	17.520	24.068
100.0	17.643	22.937
45.0	17.811	22.248
10.0	18.095	21.810

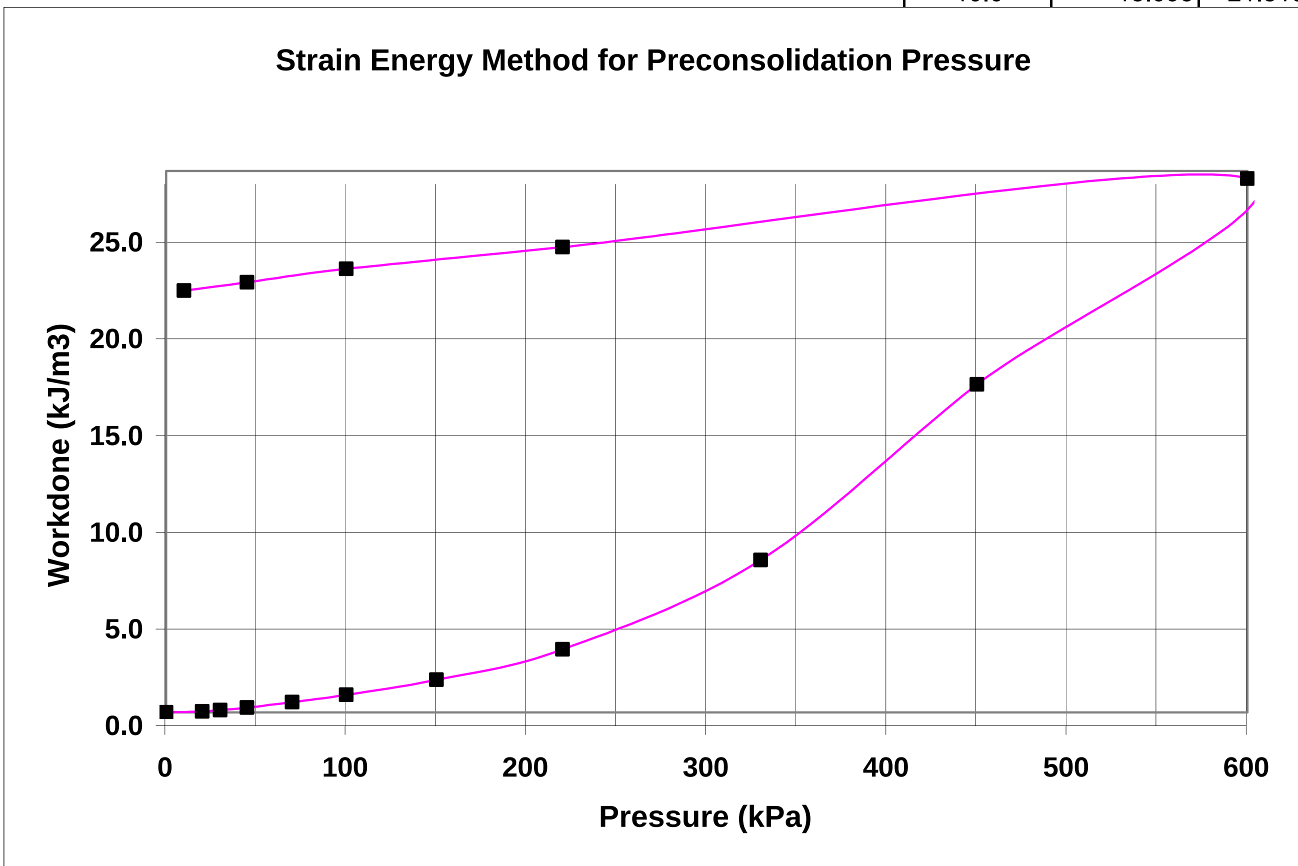


Figure B-12C

amec

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 20 November 2003 **BH42-Sa4** **Depth(m):** 11.4

Test Data

Ring # :	B	**Ring Height (in) =**	0.753	**Wt of dry filter paper (g)**	0.63
Wet soil + Ring Wt (g)			196.65	**Wt of ring (g)**	76.61
Wet soil + Wet Paper + Ring (g)			194.36	**Wet Paper (g)**	1.70
Dry Soil + Dry Paper + Ring (g)			170.98	**Ring Dia (in)**	2.485
Initial moisture Content (%)			28.06	**Final moisture Content (%)**	23.80
Area of Ring (in^2)			4.85	**Initial Volume (in^3)**	3.6521
Initial Bulk Density (kg/m^3)			2006	**Initial Dry Density (kg/m^3)**	1566
Specific Gravity of Soil			2.72	**Eqiv. Thick. of solids (mm)**	11.014
Final Bulk Density (kg/m^3)			2117	**Final Dry Density (kg/m^3)**	1653
Initiall gauge reading for Load 1			0.2436	**Gauge reading for last Loading**	0.1803
Initial Voids Ratio			0.737	**Final Void Ratio**	0.591
Initial Degree of Saturation (%)			100.0	**Final Degree of Saturation (%)**	100.0

Trial #	1	2	3	4	5	6	7
Load (kpa)	0	20	30	45	70	100	150
Load (tsf)	0	0.208	0.312	0.468	0.728	1.04	1.56
Gauge Reading (in)	0.2436	0.2324	0.2287	0.2246	0.2167	0.2126	0.2051
(H-Hs) mm	8.112	7.828	7.734	7.629	7.430	7.325	7.133
Voids ratio	0.737	0.711	0.702	0.693	0.675	0.665	0.648
t90 (min)		16.00	23.04	14.44	12.96	6.25	10.56
Cv (ft^2/day)		0.074	0.050	0.080	0.087	0.178	0.104
k' (tsf)		14.016	20.851	27.746	24.310	55.256	49.565
Mv (ft^2 / ton)		0.0713	0.0480	0.0360	0.0411	0.0181	0.0202

Trial #	8	9	10	11	12	13	14
Load (kpa)	220	330	450	600	900	300	100
Load (tsf)	2.288	3.432	4.68	6.24	9.36	3.120	1.040
Gauge Reading (in)	0.1957	0.1831	0.1725	0.1608	0.1447	0.1515	0.1600
(H-Hs) mm	6.895	6.575	6.306	6.008	5.600	5.773	5.989
Voids ratio	0.626	0.597	0.573	0.546	0.508	0.524	0.544
t90 (min)	10.89	9.00	11.56	6.76	6.76		
Cv (ft^2/day)	0.098	0.115	0.087	0.143	0.137		
k' (tsf)	55.479	64.016	81.529	90.917	130.074		
Mv (ft^2 / ton)	0.0180	0.0156	0.0123	0.0110	0.0077		

Trial #	15	16
Load (kpa)	45	10
Load (tsf)	0.468	0.104
Gauge Reading (in)	0.1669	0.1803
(H-Hs) mm	6.163	6.504
Voids ratio	0.560	0.591
t90 (min)		
Cv (ft^2/day)		
k' (tsf)		
Mv (ft^2 / ton)		

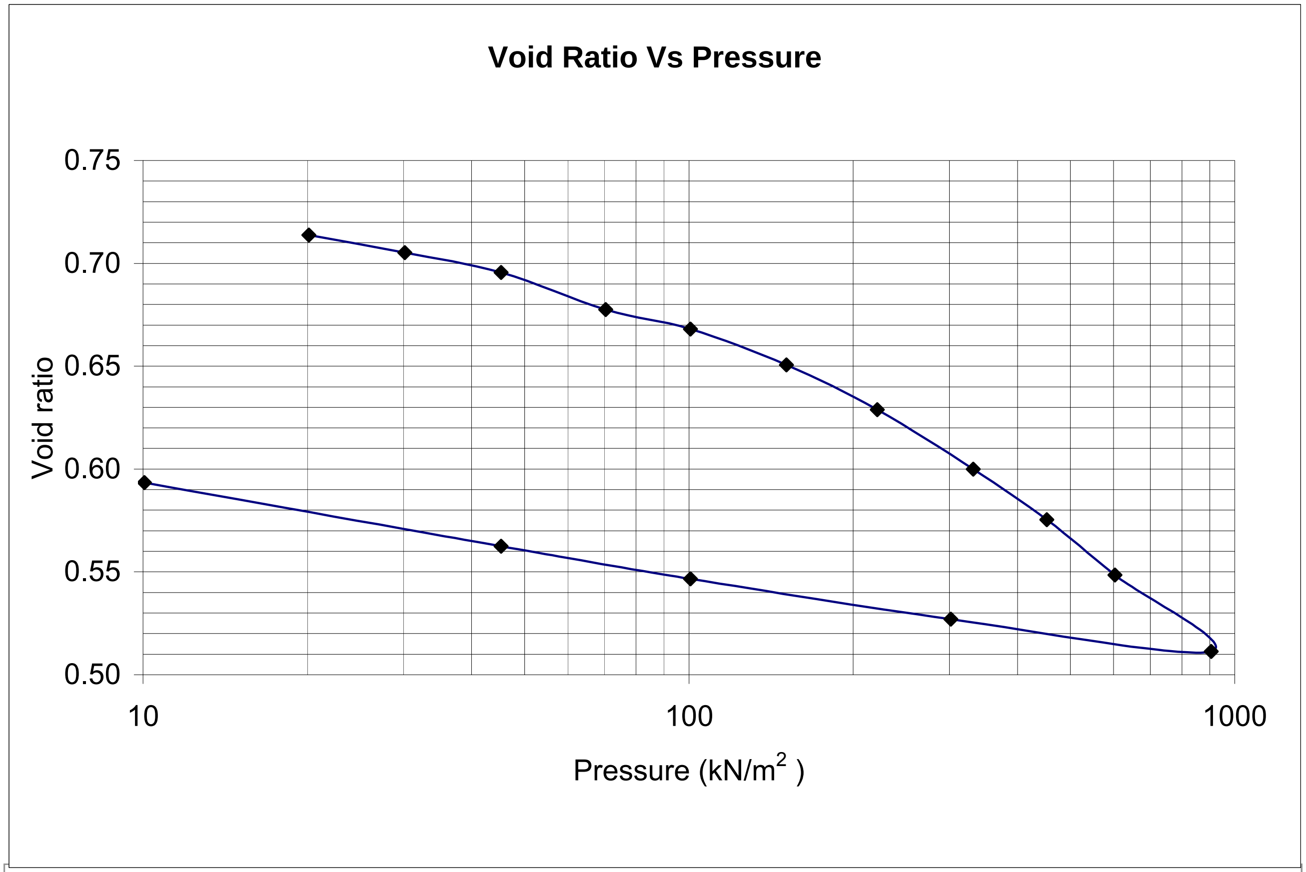
Figure B-13A

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 20 November 2003 BH42-Sa4 **Depth(m):** 11.4

s'$_v$ versus e and c$_v$



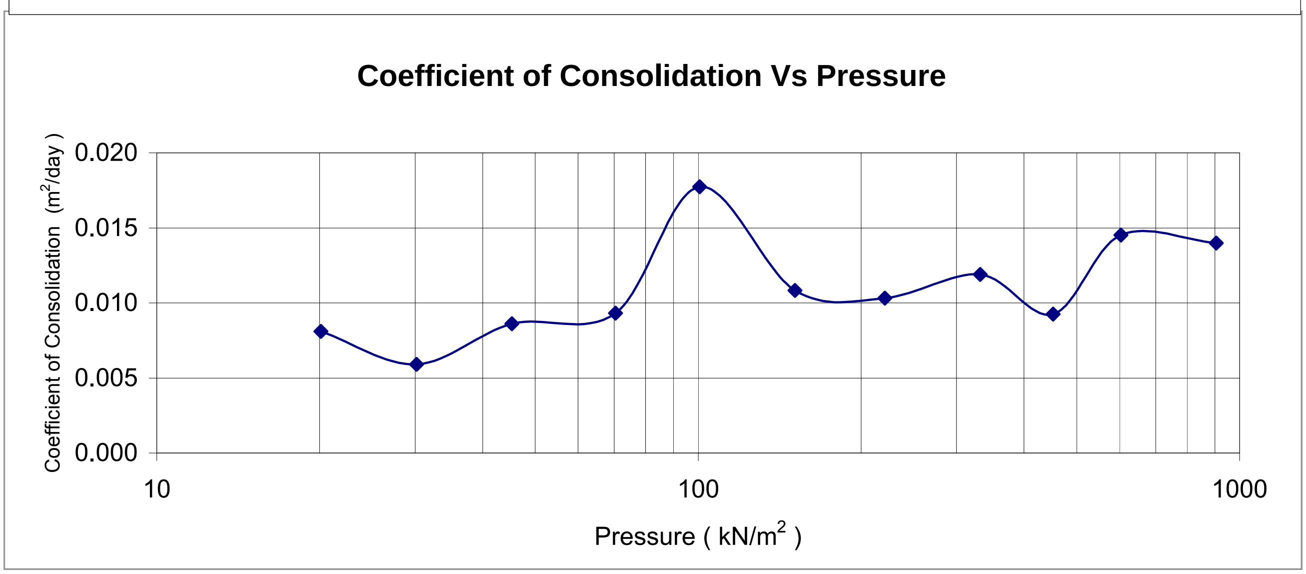


Figure B-13B

ONE DIMENSIONAL CONSOLIDATION TEST

Project: Randle Reef Remediation **Job#:** TC035071

Date: 20 November 2003 **BH42-Sa4** **Depth(m):** 11.4

Strain Energy Data

Presssure (tsf)	Cv (ft^2/day)	Presssure (kN/m^2)	Cv (m^2/day)	Void ratio
0.2080	0.074	20	0.0069	0.711
0.3120	0.050	30	0.0047	0.702
0.4680	0.080	45	0.0074	0.693
0.7280	0.087	70	0.0081	0.675
1.0400	0.178	100	0.0165	0.665
1.5600	0.104	150	0.0096	0.648
2.2880	0.098	220	0.0091	0.626
3.4320	0.115	330	0.0107	0.597
4.6800	0.087	450	0.0080	0.573
6.2400	0.143	600	0.0133	0.546
9.3600	0.137	900	0.0128	0.508
3.1200		300		0.524
1.0400		100		0.544
0.4680		45		0.560
0.1040		10		0.591

Presssure (KN/m^2)	Height mm	Total Work (KJ/m^3)
0.0	19.126	0.000
20.0	18.842	0.148
30.0	18.748	0.273
45.0	18.643	0.484
70.0	18.444	1.099
100.0	18.339	1.579
150.0	18.147	2.890
220.0	17.909	5.318
330.0	17.589	10.232
450.0	17.320	16.202
600.0	17.022	25.210
900.0	16.614	43.200
300.0	16.787	36.962
100.0	17.003	34.390
45.0	17.177	33.648
10.0	17.518	33.102

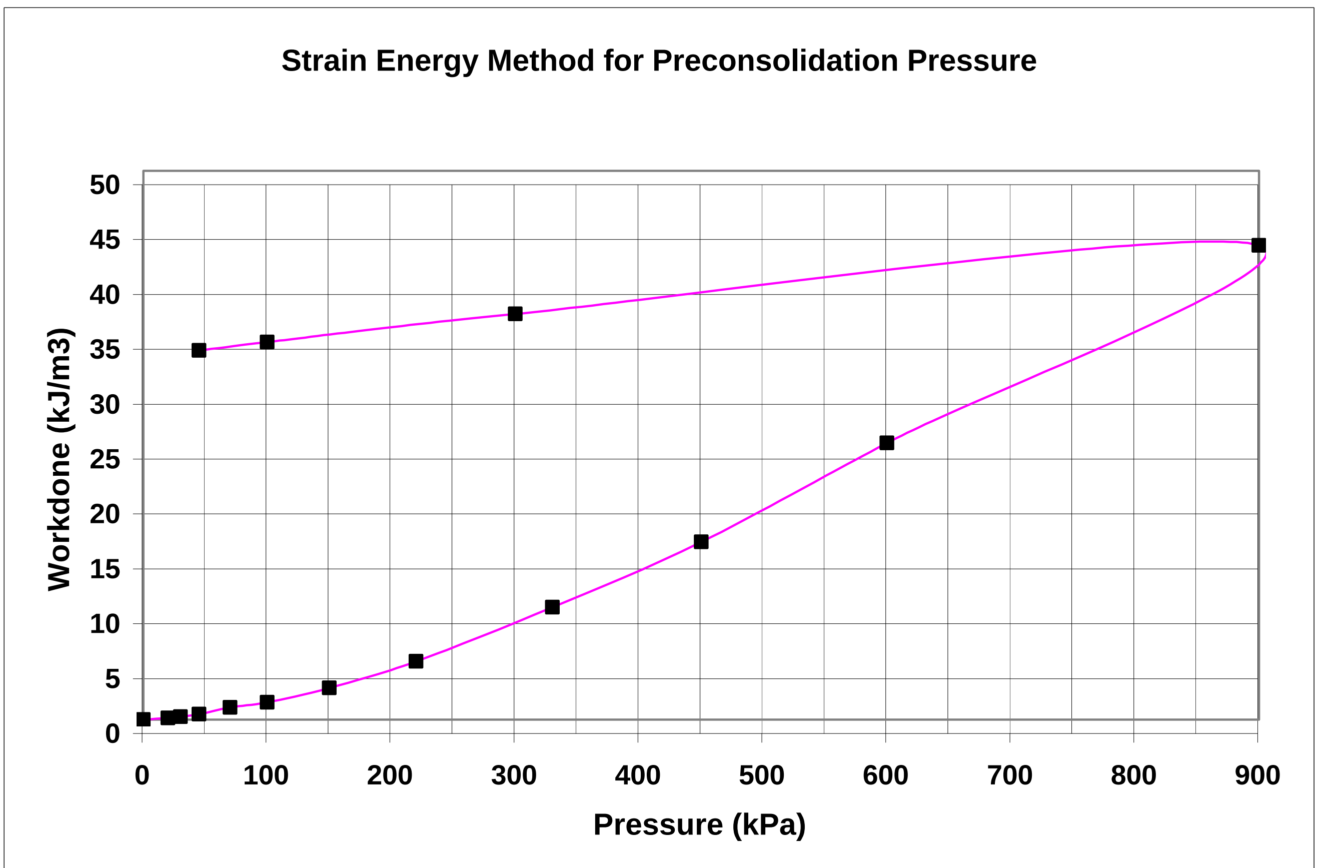


Figure B-13C

Triaxial Quick Shear Test – BH22-Sa8, BH29-Sa8, BH33-Sa4, BH38-Sa8

Project: Randle Reef Remediation **Job#:** TC035071

BH#	22	29	33	38
Sa#	8	8	4	8
Height (mm)	136.2	140.7	140.9	140.8
Diameter (mm)	69.7	69.4	69.4	69.4
Weight (g)	1060.3	1123.1	1095.8	1108.9
Unit Weight (kN/m3)	20.0	20.7	20.2	20.4
Natural Moisture Content (%)	24.0	21.0	25.0	22.0
s 3 (kPa)	37	50	22	80
Shear rate (mm / min)	0.7	0.7	0.7	0.7
Maximum Deviator Stress (kPa)	89.1	199.2	64.2	93.1
Shear Strength (kPa)	44.6	99.6	32.1	46.6
Strain (%)	14.4	14.1	13.4	14.1

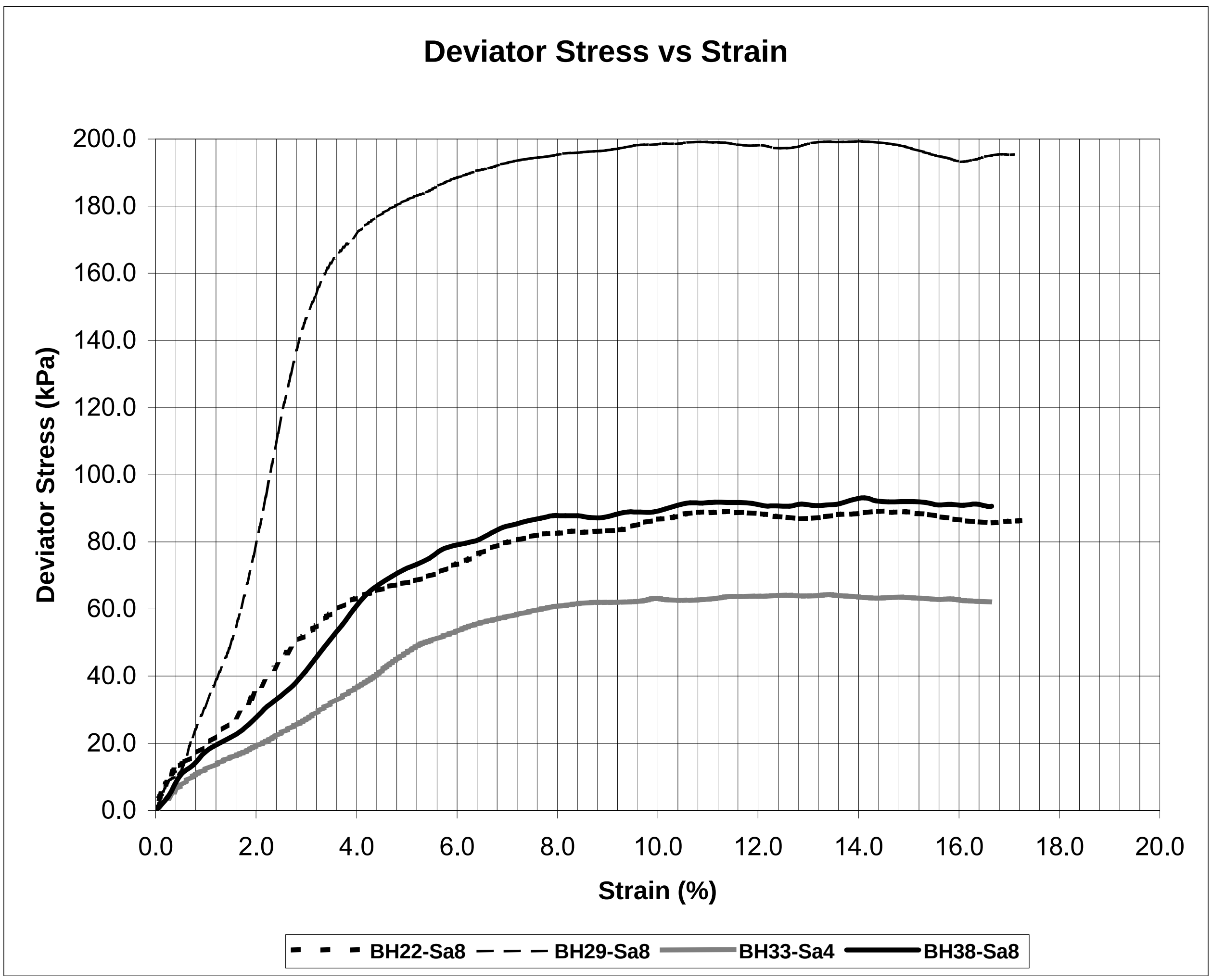


Figure B-14

Triaxial Quick Shear Test – BH39-Sa4, BH42-Sa4, BH43-Sa11

Project: Randle Reef Remediation **Job#:** TC035071

BH#	39	42	43
Sa#	4	4	11
Height (mm)	137.9	139.8	139.0
Diameter (mm)	69.5	69.6	69.5
Weight (g)	1049.9	1068.5	1075.1
Unit Weight (kN/m3)	19.7	19.7	20.0
Natural Moisture Content (%)	28.0	26.0	26.0
s 3 (kPa)	15	20	110
Shear rate (mm / min)	0.7	0.7	0.7
Maximum Deviator Stress (kPa)	80.1	73.7	159.8
Shear Strength (kPa)	40.0	36.8	79.9
Strain (%)	10.9	16.8	3.8

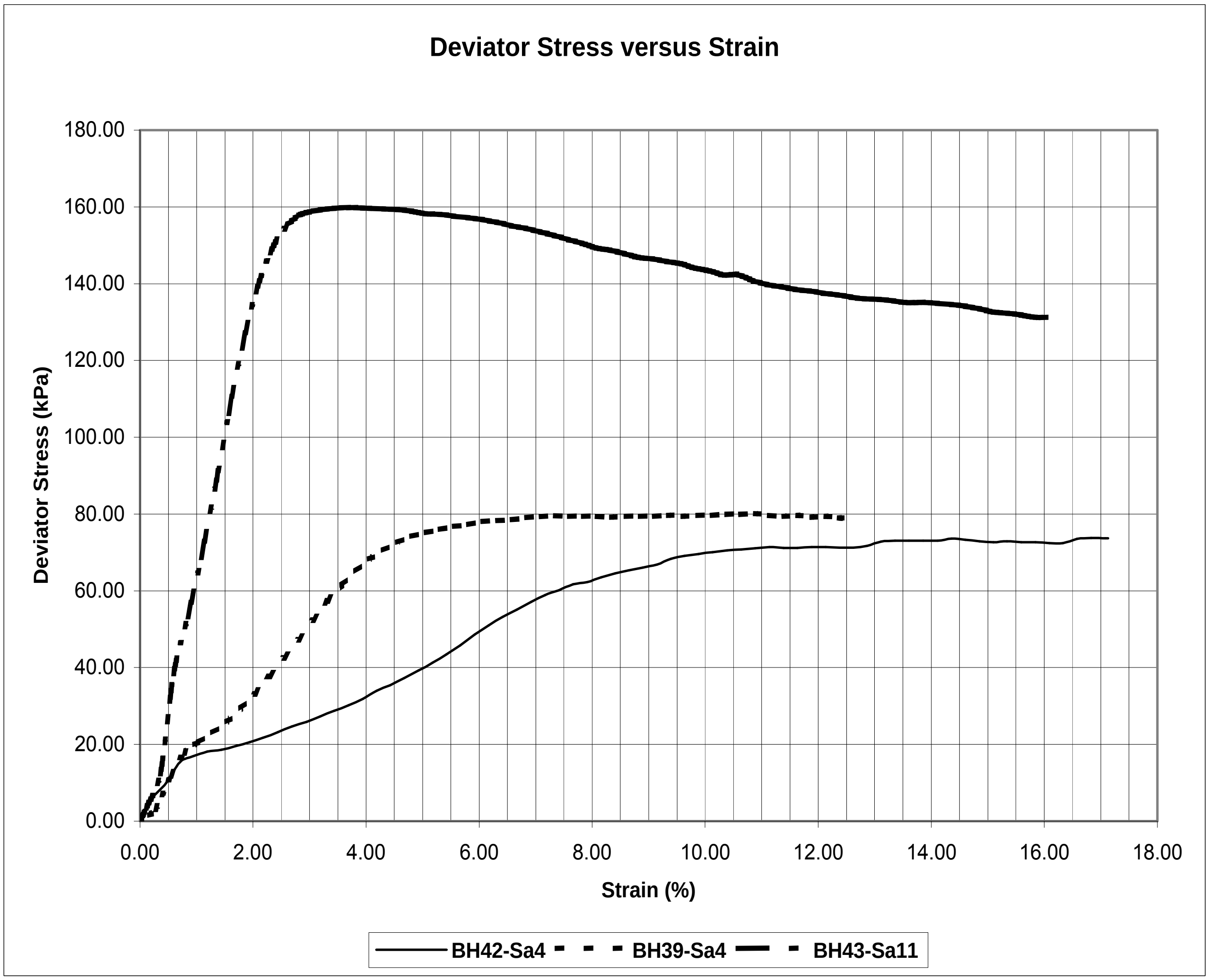


Figure B-15

Triaxial CU Compression Shear Test – BH20-Sa6 – Test Data

Consolidated Undrained

Sample details

Sketch showing specimen location in original Sample

Depth: 13.4 m
Description: Grey Silty Clay

	Specimen 1	Specimen 2	Specimen 3
Type	Grey Clay	Grey Clay	Grey Clay
Height H_0 (mm)	125.2	132.72	132.22
Diameter D_0 (mm)	69.63	69.75	69.72
Weight W_0 (gr)	967.49	1031.71	1035.63
Bulk Density ρ (Mg/m3)	2.03	2.03	2.05
Particle Density ρ_s	2.7 (assumed)	2.65 (assumed)	2.7 (assumed)

Initial Conditions

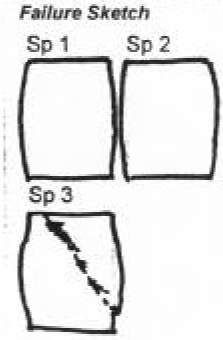
	Specimen 1	Specimen 2	Specimen 3
Cell Pressure σ_3 (kPa)	290.00	300.00	361.00
Pore Pressure u (kPa)	260.40	240.30	241.00
Machine Speed d_r(mm/min)	0.06	0.06	0.06
No. of Membranes	0	1	1
Total Thickness (mm)	0.2	0.2	0.2
Strain Channel	18	18	18
Load Channel	17	17	17
Pore P. Channel	19	23	19
Volume Channel	20	20	20
Moisture Content w_0%	26	26	26
Dry Density ρ_{d0} (Mg/m3)	1.61	1.61	1.63
Voids Ratio e_0	0.68	0.64	0.66
Deg of Saturation S_0%	100.00	100.00	100.00
Final B Value	0.99	0.99	1.00

Final Conditions

	Specimen 1	Specimen 2	Specimen 3
Moisture Content w_f%	25	24	22
Dry Density ρ_d (Mg/m3)	1.64	1.66	1.70
Voids Ratio e_f	0.65	0.59	0.59
Deg of Saturation S_f%	100.00	100.00	100.00
Failure Criteria	Mx Dev Stress	Mx Dev Stress	Mx Dev Stress
Axial Strain ε_f%	14.8	11.8	7.7
Corr Dev Stress $(\sigma_1 - \sigma_3)$f (kPa)	96.9	115.1	145.9
Minor Stress σ'_{3f} (kPa)	47.0	52.3	67.5
Major Stress σ'_{1f} (kPa)	143.9	167.4	213.4
Stress Ratio $(\sigma'_1/\sigma'_3)_f$	3.1	3.2	3.2

Notes:

Failure Sketch



Surface Inclination

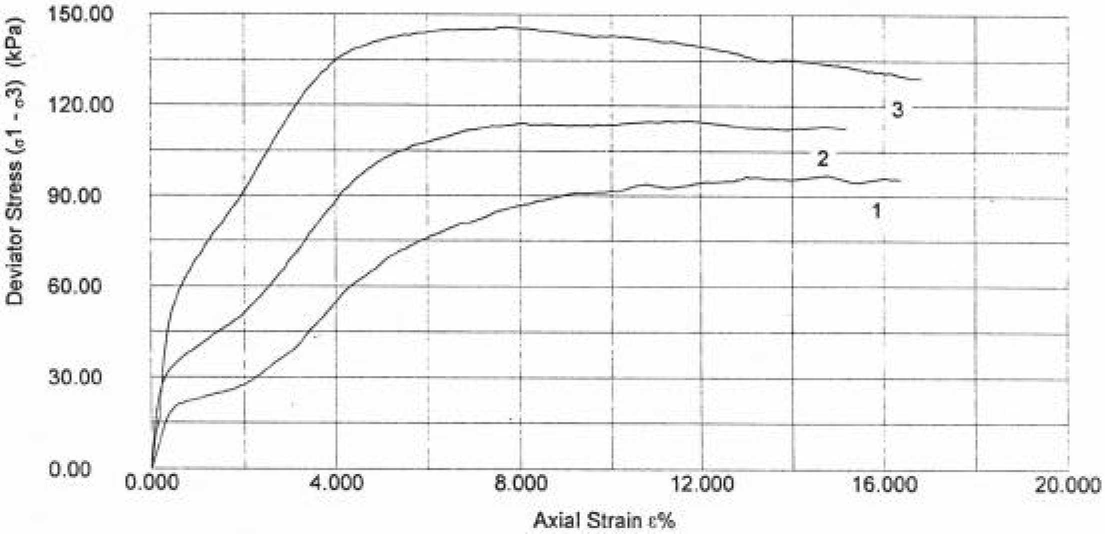
AMEC Earth & Environmental Limited

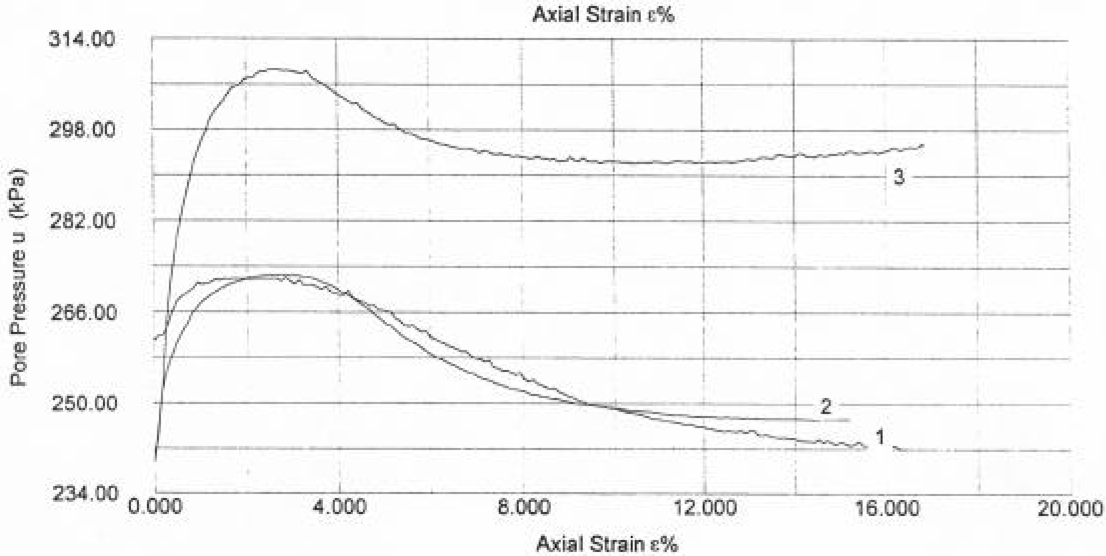
Test Method : BS1377 : Part 8 : 1990 : 8/~~9~~* (* delete as appropriate)		Test name	CU (SS, MS)
		Date of Test:	11/24/2003
Site Reference:	TC035071	Sample:	SH6
Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	20
Operator: SB	*Checked:* SB	*Approved:*	

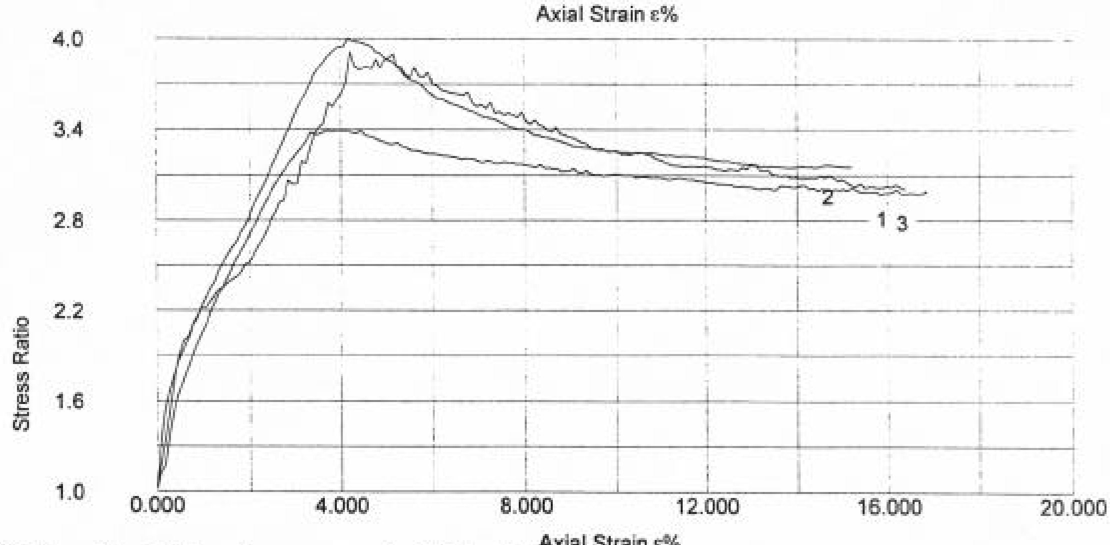
Figure B-16B

Triaxial CU Compression Shear Test – BH20-Sa6 – Stress Strain Curves

Consolidated Undrained







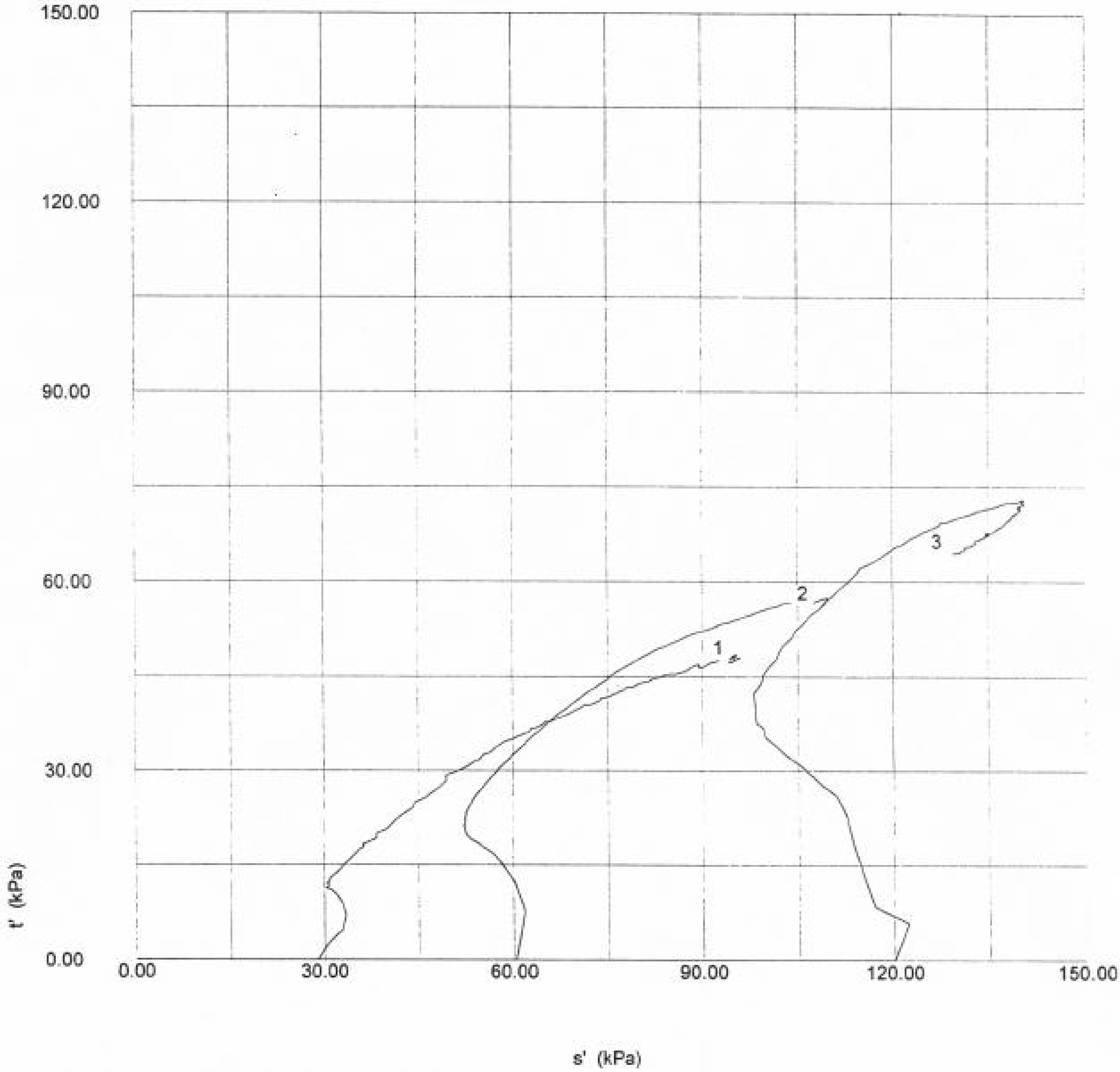
AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/8* (* delete as appropriate)	Test name	CU (SS, MS)
		Date of Test:	11/24/2003
	Site Reference: TC035071	Sample:	SH6
	Jobfile: C:\WINCLISP\RANDLE.JOB	Borehole:	20
	Operator: SB	Checked: SB	Approved:

Figure B-16C

Triaxial CU Compression Shear Test – BH20-Sa6 – Stress Paths

Consolidated Undrained



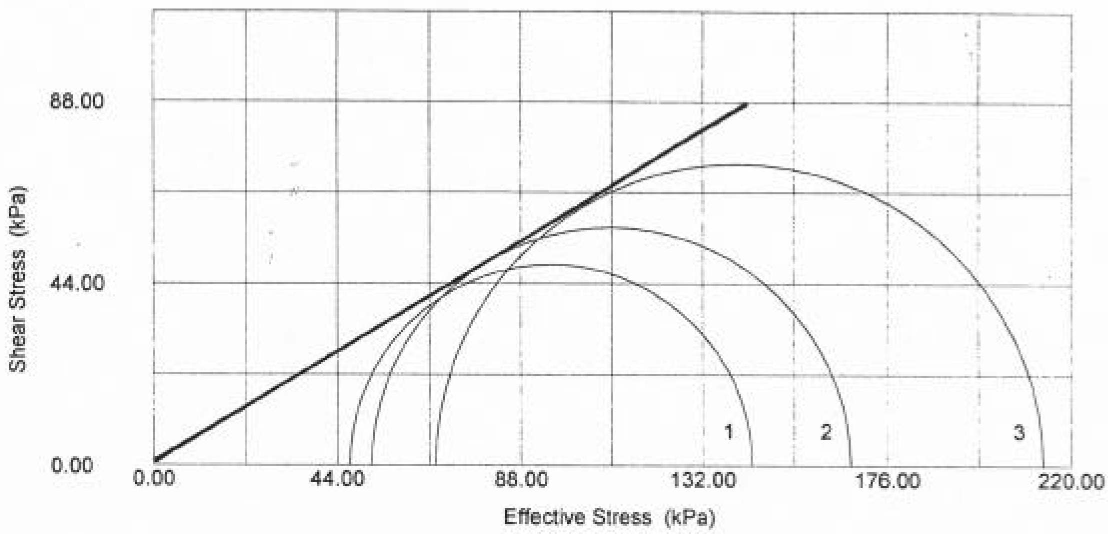
AMEC Earth & Environmental Limited

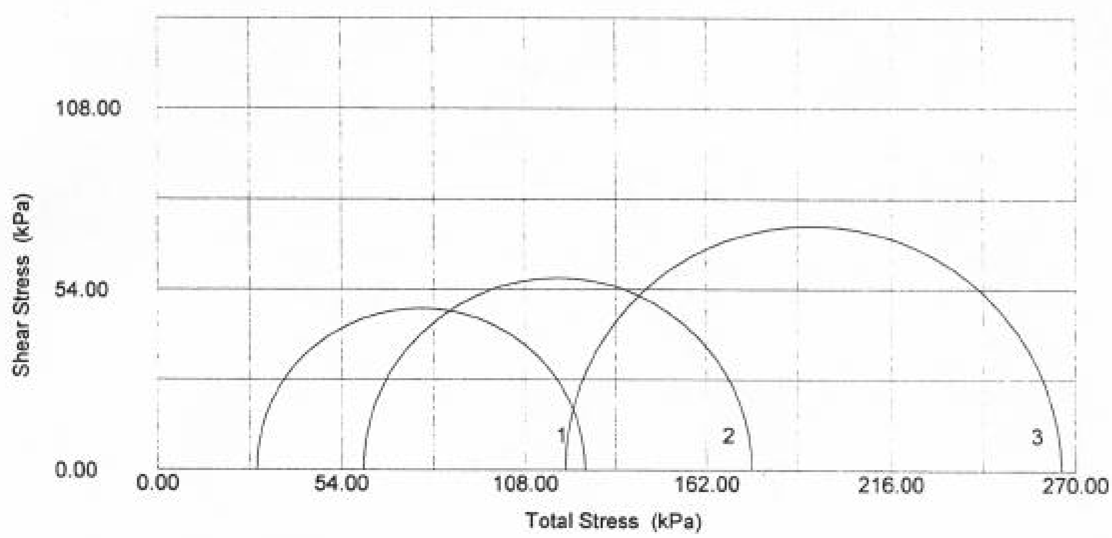
amec	Test Method : BS1377 : Part 8 : 1990 : 8/9* (* delete as appropriate)		Test name Date of Test:	CU (SS, MS) 11/24/2003
	Site Reference: Jobfile:	TC035071 C:\WINCLISP\RANDLE.JOB	Sample: Borehole:	SH6 20
	Operator: SB	Checked: SB	Approved:	

Figure B-16D

Triaxial CU Compression Shear Test – BH20-Sa6 – Mohr's Envelopes

Consolidated Undrained





AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/9* (* delete as appropriate)	Test name Date of Test:	CU (SS, MS) 11/24/2003
	Site Reference: TC035071 Jobfile: C:\WINCLISP\RANDLE.JOB	Sample: Borehole:	SH6 20
	Operator: SB	Checked: SB	Approved:

Figure B-17A

Triaxial CU Compression Shear Test – BH34-Sa4 – Test Data

Consolidated Undrained

Sample details

Sketch showing specimen location in original Sample

Depth	11.6 m			
Description:	Grey Silty Clay			
	Specimen 1	Specimen 2	Specimen 3	
Type	Shelby Tube	Shelby Tube	Shelby Tube(39/4)	
Height H_0 (mm)	133.35	133.55	131.7	
Diameter D_0 (mm)	69.47	69.47	69.2	
Weight W_0 (gr)	1052.61	1034.7	998.47	
Bulk Density ρ (Mg/m3)	2.08	2.04	2.02	
Particle Density ρ_s	2.7 (assumed)	2.7 (assumed)	2.7 (assumed)	

Initial Conditions

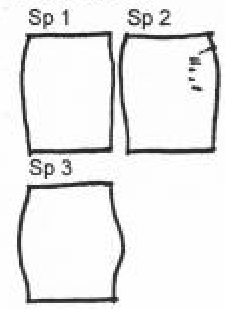
	Specimen 1	Specimen 2	Specimen 3
Cell Pressure σ_3 (kPa)	250.00	410.00	275.00
Pore Pressure u (kPa)	190.60	290.00	245.40
Machine Speed d_r(mm/min)	0.06	0.06	0.06
No. of Membranes	1	1	1
Total Thickness (mm)	0.2	0.2	0.2
Strain Channel	18	18	18
Load Channel	17	17	17
Pore P. Channel	23	23	23
Volume Channel			
Moisture Content w_0%	22	22	25
Dry Density ρ_{d0} (Mg/m3)	1.71	1.67	1.62
Voids Ratio e_0	0.58	0.62	0.67
Deg of Saturation S_0%	100.00	98.13	99.41
Final B Value	0.98	0.99	0.98

Final Conditions

	Specimen 1	Specimen 2	Specimen 3
Moisture Content w_f%	22	23	25
Dry Density ρ_d (Mg/m3)	1.74	1.70	1.66
Voids Ratio e_f	0.56	0.59	0.63
Deg of Saturation S_f%	100.00	100.00	100.00
Failure Criteria	Mx Dev Stress	Mx Dev Stress	Mx Dev Stress
Axial Strain ε_f%	11.6	3.1	15.7
Corr Dev Stress $(\sigma_1 - \sigma_3)$f (kPa)	93.2	126.7	56.2
Minor Stress σ'_{3f} (kPa)	44.5	59.9	23.3
Major Stress σ'_{1f} (kPa)	137.7	186.6	79.5
Stress Ratio $(\sigma'_1/\sigma'_3)_f$	3.1	3.1	3.4

Notes:

Failure Sketch



Surface Inclination

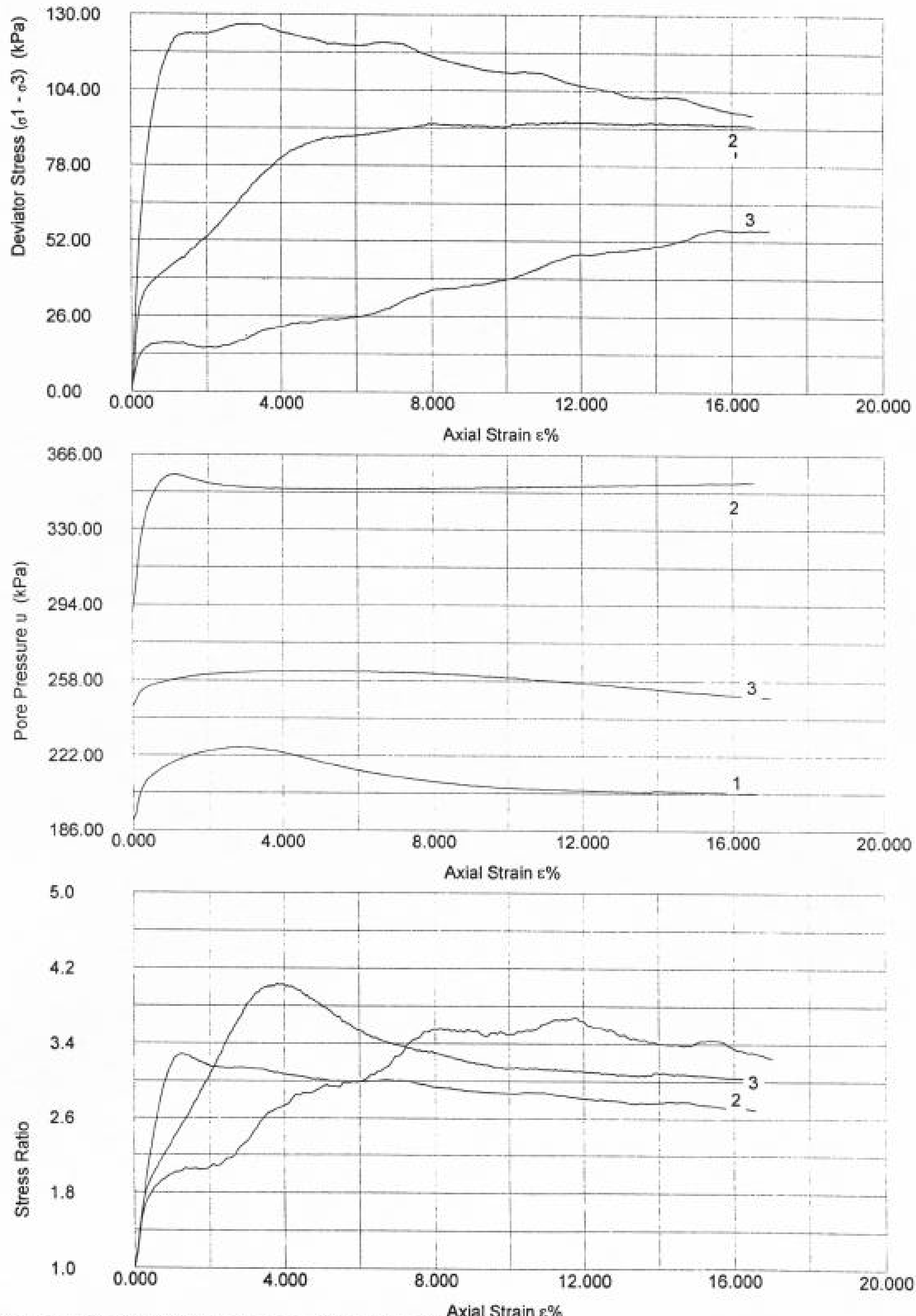
AMEC Earth & Environmental Limited

Test Method : BS1377 : Part 8 : 1990 : 8/8* (* delete as appropriate)		Test name	CU (SS, MS)
		Date of Test:	11/14/2003
Site Reference:	TC035071	Sample:	SH4
Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	34
Operator: SC/SB	Checked: SB	Approved:	

Figure B-17B

Triaxial CU Compression Shear Test – BH34-Sa4 – Stress Strain Curves

Consolidated Undrained



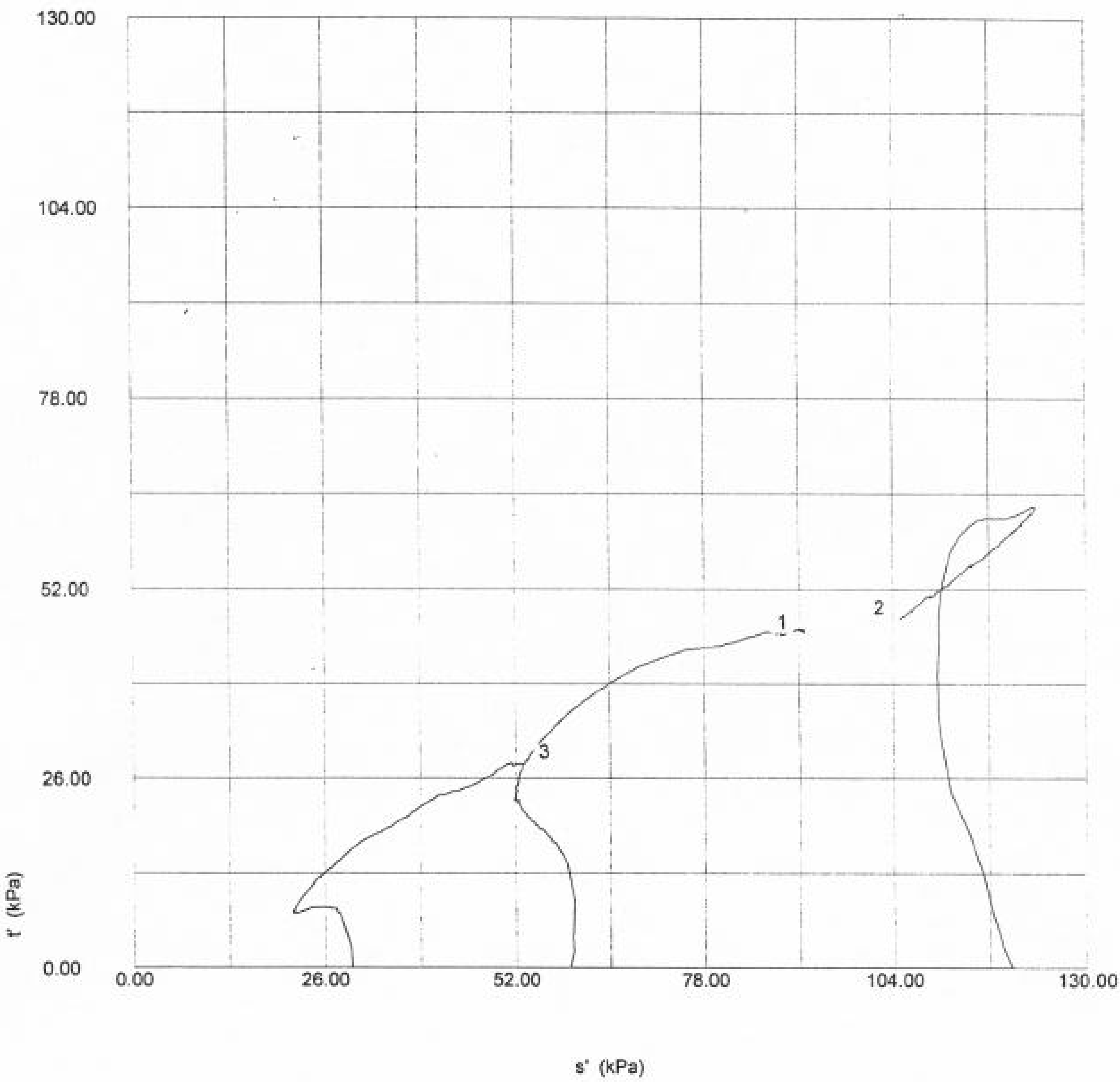
AMEC Earth & Environmental Limited

amec			
Test Method : BS1377 : Part 8 : 1990 : 8/9* (* delete as appropriate)		Test name / Date of Test:	CU (SS, MS) / 11/14/2003
Site Reference:	TC035071	Sample:	SH4
Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	34
Operator: SC/SB	Checked: SB	Approved:	

Figure B-17C

Triaxial CU Compression Shear Test – BH34-Sa4 – Stress Paths

Consolidated Undrained

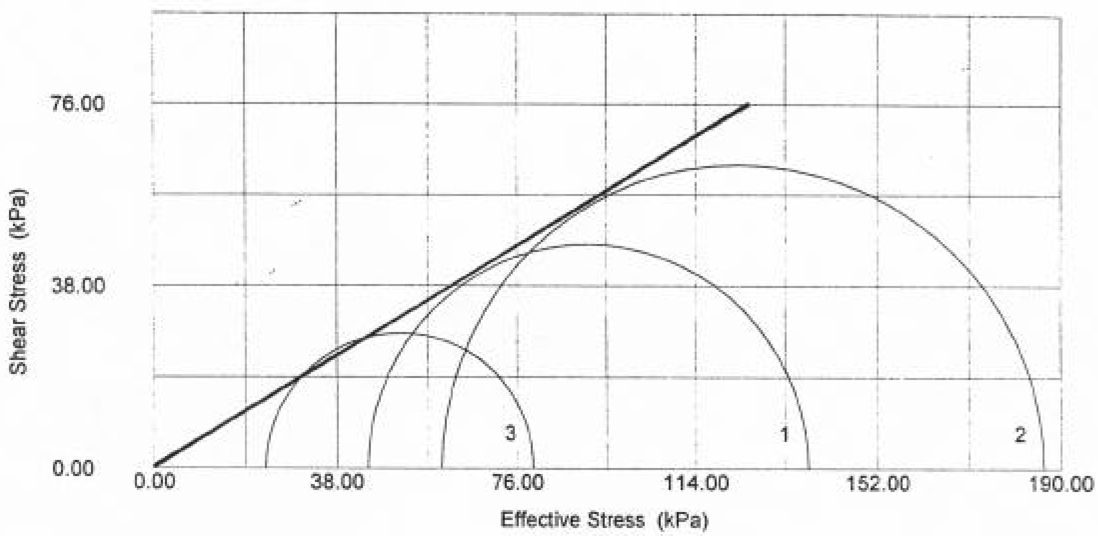


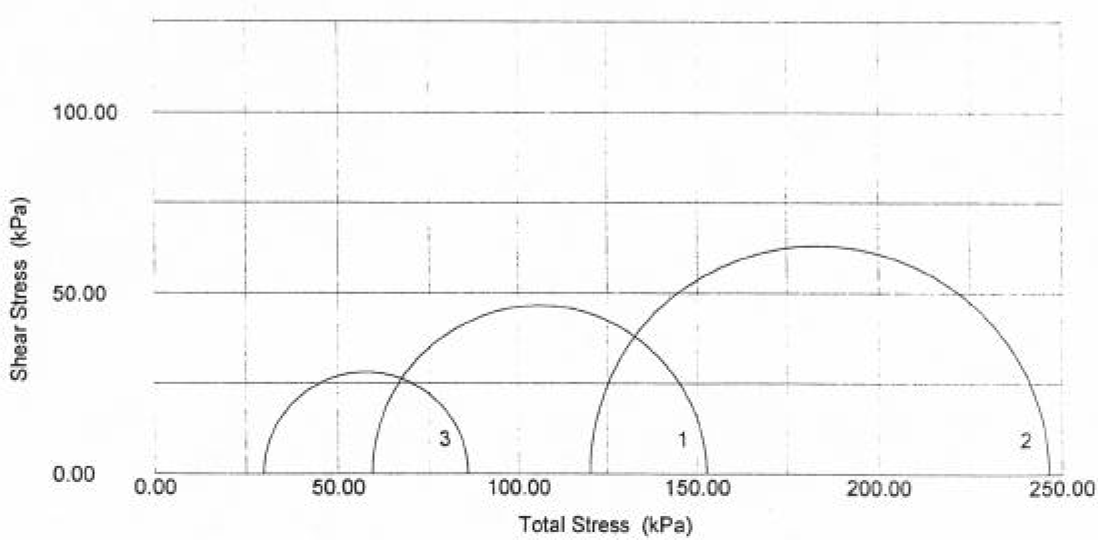
AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/9* (* delete as appropriate)		Test name Date of Test:	CU (SS, MS) 11/14/2003
	Site Reference: Jobfile:	TC035071 C:\WINCLISP\RANDLE.JOB	Sample: Borehole:	SH4 34
	Operator: Sc / cB	Checked: SM	Approved:	

Triaxial CU Compression Shear Test – BH34-Sa4 – Mohr's Envelopes

Consolidated Undrained





AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/9* (* delete as appropriate)	Test name	CU (SS, MS)
		Date of Test:	11/14/2003
	Site Reference: TC035071	Sample:	SH4
	Jobfile: C:\WINCLISP\RANDLE.JOB	Borehole:	34
	Operator: SC/SB	Checked: SB	Approved:

Figure B-18A

Triaxial CU Compression Shear Test – BH35-Sa8 – Test Data

Consolidated Undrained

Sample details

Sketch showing specimen location in original Sample

Depth 16.0 m
Description: Grey Silty Clay

	Specimen 1	Specimen 2	Specimen 3
Type	Shelby Tube	Shelby Tube	Shelby Tube
Height H_0 (mm)	127.7	135.29	137.16
Diameter D_0 (mm)	69.4	69.09	69.09
Weight W_0 (gr)	981.33	1073.89	1102.35
Bulk Density ρ (Mg/m3)	2.03	2.12	2.14
Particle Density ρ_s	2.7 (assumed)	2.7 (assumed)	2.7 (assumed)

Initial Conditions

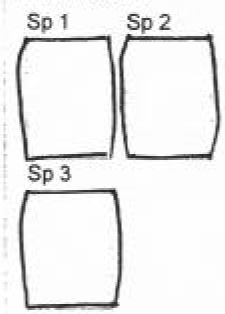
	Specimen 1	Specimen 2	Specimen 3
Cell Pressure σ_3 (kPa)	320.00	299.00	360.00
Pore Pressure u (kPa)	288.00	239.00	239.40
Machine Speed d_r(mm/min)	0.06	0.06	0.04
No. of Membranes	1	1	1
Total Thickness (mm)	0.2	0.2	0.2
Strain Channel	18	18	18
Load Channel	17	17	17
Pore P. Channel	19	23	19
Volume Channel	20	24	20
Moisture Content w_0%	24	23	20
Dry Density ρ_{d0} (Mg/m3)	1.64	1.72	1.78
Voids Ratio e_0	0.65	0.57	0.51
Deg of Saturation S_0%	100.00	100.00	100.00
Final B Value	0.98	0.98	0.98

Final Conditions

	Specimen 1	Specimen 2	Specimen 3
Moisture Content w_f%	24	22	19
Dry Density ρ_d (Mg/m3)	1.65	1.75	1.84
Voids Ratio e_f	0.64	0.54	0.47
Deg of Saturation S_f%	100.00	100.00	100.00
Failure Criteria	Mx Dev Stress	Mx Dev Stress	Mx Dev Stress
Axial Strain ε_f%	15.9	15.1	15.6
Corr Dev Stress $(\sigma_1 - \sigma_3)$f (kPa)	87.7	124.5	174.1
Minor Stress σ'_{3f} (kPa)	41.8	52.3	77.2
Major Stress σ'_{1f} (kPa)	129.5	176.8	251.3
Stress Ratio $(\sigma'_1/\sigma'_3)_f$	3.1	3.4	3.3

Notes:

Failure Sketch



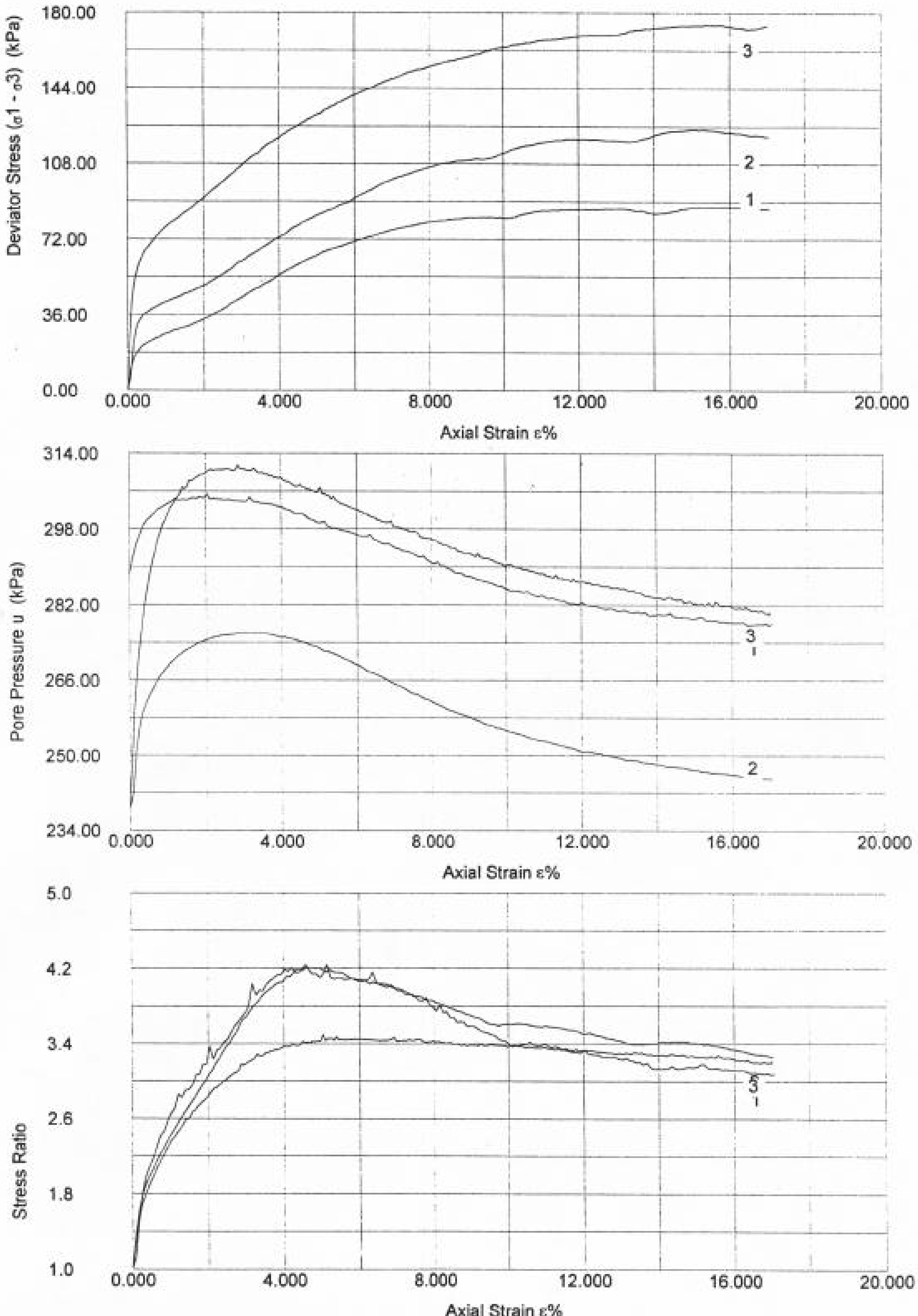
Surface Inclination

AMEC Earth & Environmental Limited

Test Method : BS1377 : Part 8 : 1990 : 8/8* (* delete as appropriate)		Test name	CU (SS, MS)
		Date of Test:	11/28/2003
Site Reference:	TC035071	Sample:	SH8
Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	35
Operator: SB	*Checked:* SB	*Approved:*	

Triaxial CU Compression Shear Test – BH35-Sa8 – Stress Strain Curves

Consolidated Undrained

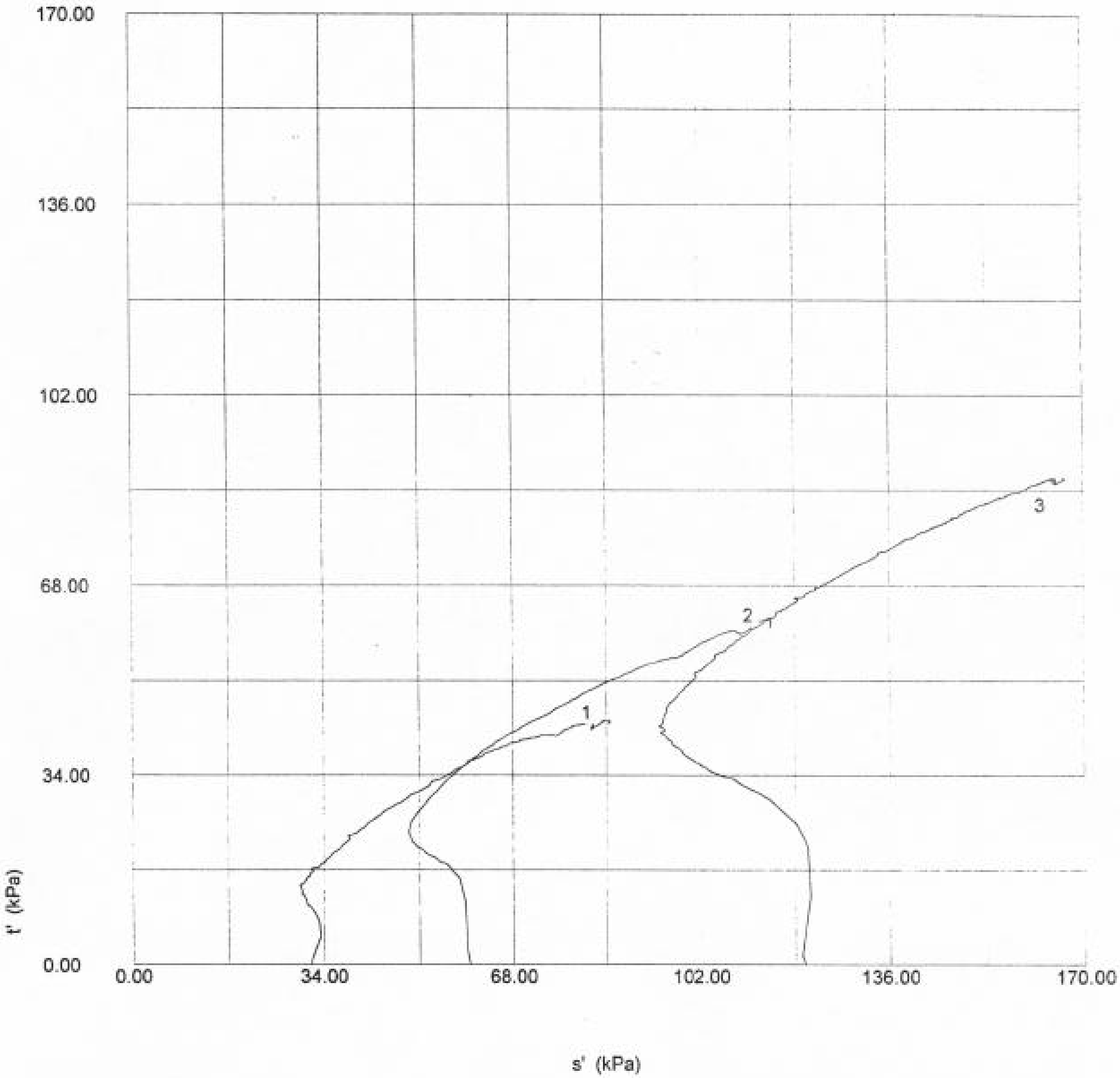


AMEC Earth & Environmental Limited

amec			
Test Method : BS1377 : Part 8 : 1990 : 8* (* delete as appropriate)		Test name	CU (SS, MS)
		Date of Test:	11/28/2003
Site Reference:	TC035071	Sample:	SH8
Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	35
Operator: SB	Checked: SB	Approved:	

Triaxial CU Compression Shear Test – BH35-Sa8 – Stress Paths

Consolidated Undrained

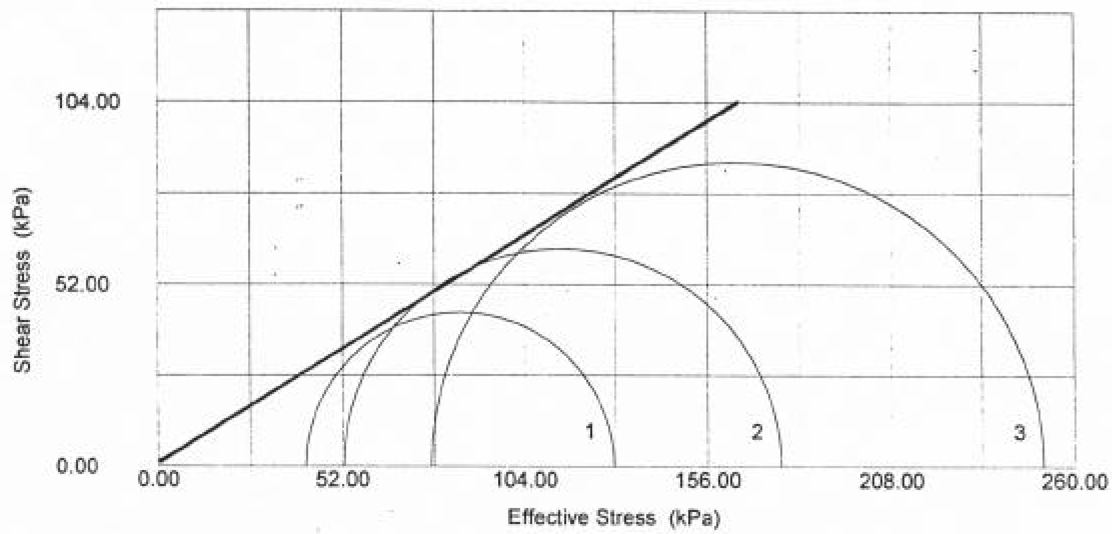


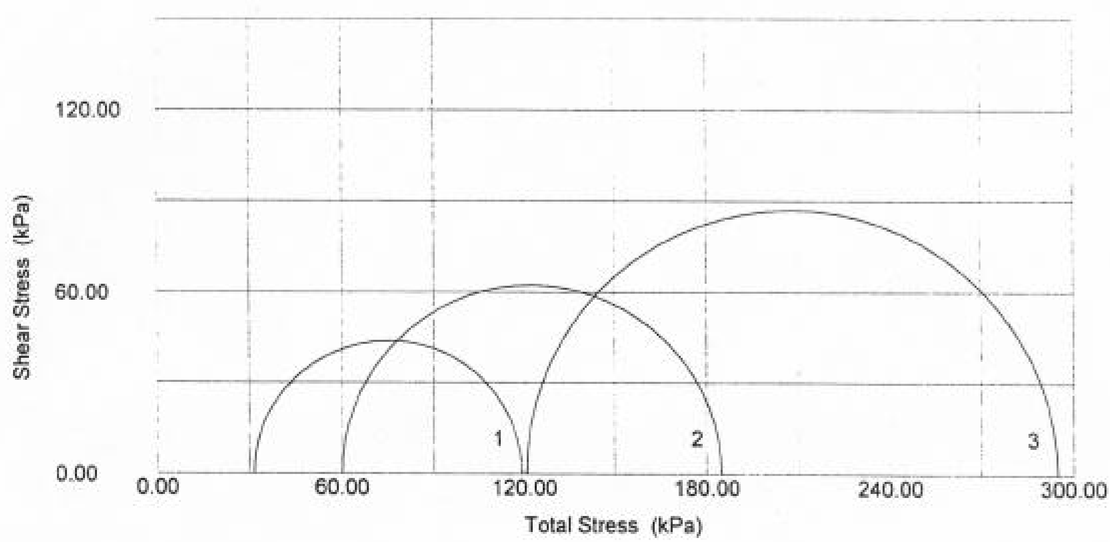
AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/9* (* delete as appropriate)	Test name / Date of Test:	CU (SS, MS) / 11/28/2005
	Site Reference: TC035071 / Jobfile: C:\WINCLISP\RANDLE.JOB	Sample: / Borehole:	SH8 / 35
	Operator: SB	Checked: SB	Approved:

Triaxial CU Compression Shear Test – BH35-Sa8 – Mohr's Envelopes

Consolidated Undrained





AMEC Earth & Environmental Limited

amec			
Test Method : BS1377 : Part 8 : 1990 : 8/~~9~~* (* delete as appropriate)		Test name / Date of Test:	CU (SS, MS) / 11/28/2003
Site Reference: TC035071		Sample:	SH8
Jobfile: C:\WINCLISP\RANDLE.JOB		Borehole:	35
Operator: SB	Checked: SB	Approved:	

Figure B-19A

Triaxial CU Compression Shear Test – BH36-Sa6 – Test Data

Consolidated Undrained

Sample details

Sketch showing specimen location in original Sample

Depth: 11.3 m
Description: Grey Silty Clay trace gravel

	Specimen 1	Specimen 2	Specimen 3
Type	Shelby Tube	Shelby Tube	Shelby Tube
Height H_0 (mm)	132.82	132.68	134.8
Diameter D_0 (mm)	69.62	69.6569	69.8
Weight W_0 (gr)	1058.77	1062.28	1072.38
Bulk Density ρ (Mg/m3)	2.09	2.10	2.08
Particle Density ρ_s	2.7 (assumed)	2.7 (assumed)	2.7 (assumed)

Initial Conditions

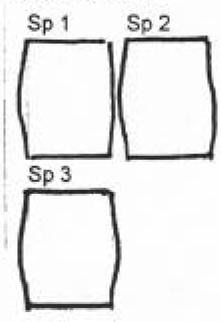
	Specimen 1	Specimen 2	Specimen 3
Cell Pressure σ_3 (kPa)	220.00	300.00	360.00
Pore Pressure u (kPa)	190.40	240.00	240.00
Machine Speed d_r(mm/min)	0.04	0.05	0.05
No. of Membranes	1	1	1
Total Thickness (mm)	0.2	0.2	0.2
Strain Channel	18	18	18
Load Channel	17	17	17
Pore P. Channel	23	19	23
Volume Channel		20	
Moisture Content w_0%	22	22	23
Dry Density ρ_{d0} (Mg/m3)	1.72	1.72	1.69
Voids Ratio e_0	0.57	0.57	0.59
Deg of Saturation S_0%	100.00	100.00	100.00
Final B Value	1.00	1.00	0.99

Final Conditions

	Specimen 1	Specimen 2	Specimen 3
Moisture Content w_f%	21	21	27
Dry Density ρ_d (Mg/m3)	1.74	1.77	1.67
Voids Ratio e_f	0.55	0.53	0.62
Deg of Saturation S_f%	100.00	100.00	100.00
Failure Criteria	Mx Dev Stress	Mx Dev Stress	Mx Dev Stress
Axial Strain ε_f%	15.3	10.6	7.7
Corr Dev Stress $(\sigma_1 - \sigma_3)f$ (kPa)	96.2	127.0	148.3
Minor Stress σ'_{3f} (kPa)	43.1	60.0	71.0
Major Stress σ'_{1f} (kPa)	139.3	187.0	219.3
Stress Ratio $(\sigma'_1/\sigma'_3)_f$	3.2	3.1	3.1

Notes:

Failure Sketch



Surface Inclination

AMEC Earth & Environmental Limited

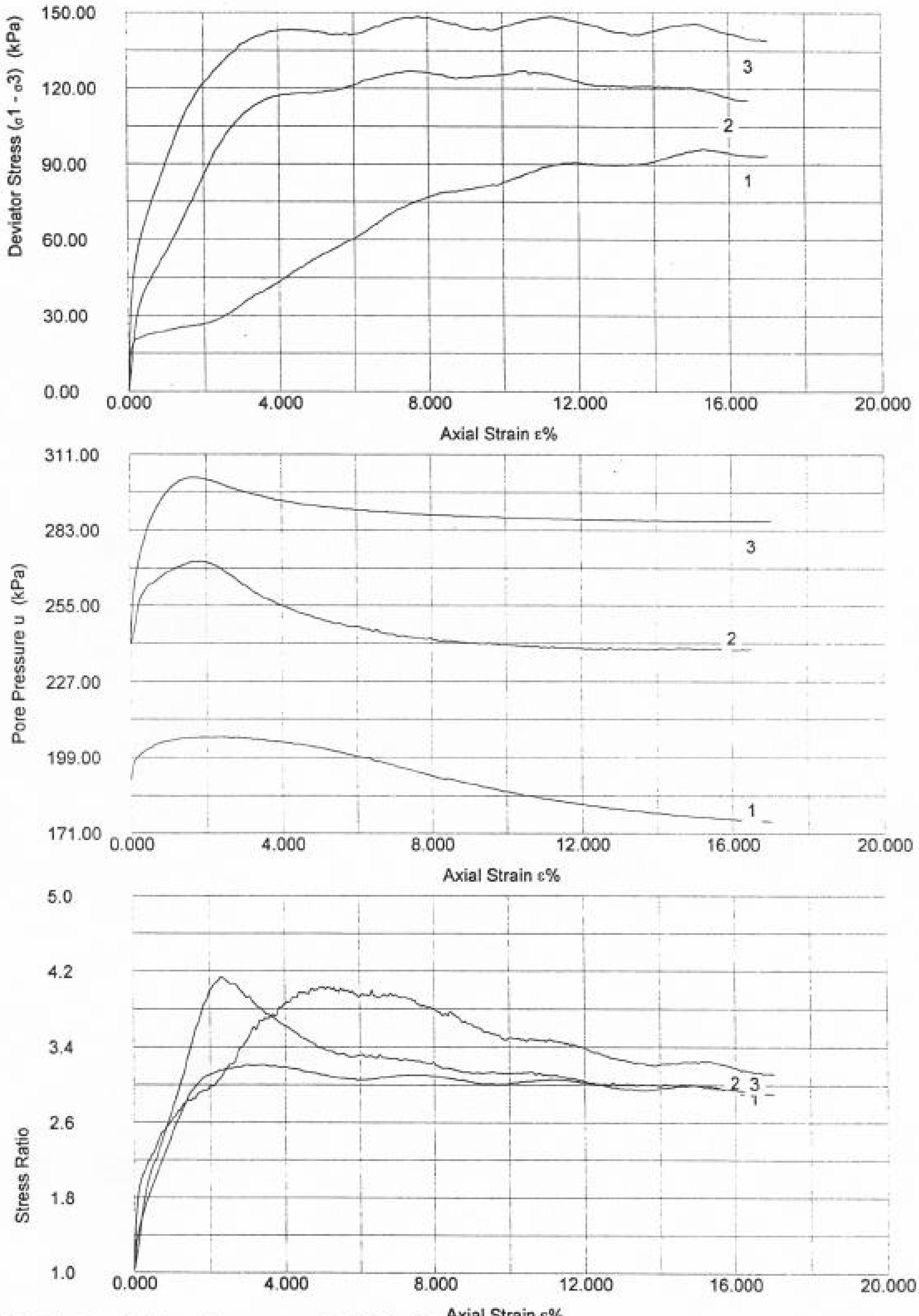
Test Method : BS1377 : Part 8 : 1990 : 8/8* (* delete as appropriate)		Test name	CU (SS, MS)
		Date of Test:	11/20/2003
Site Reference:	TC035071	Sample:	SH6
Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	36
Operator: SB	*Checked:* SB	*Approved:*	

amec

Figure B-19B

Triaxial CU Compression Shear Test – BH36-Sa6 – Stress Strain Curves

Consolidated Undrained



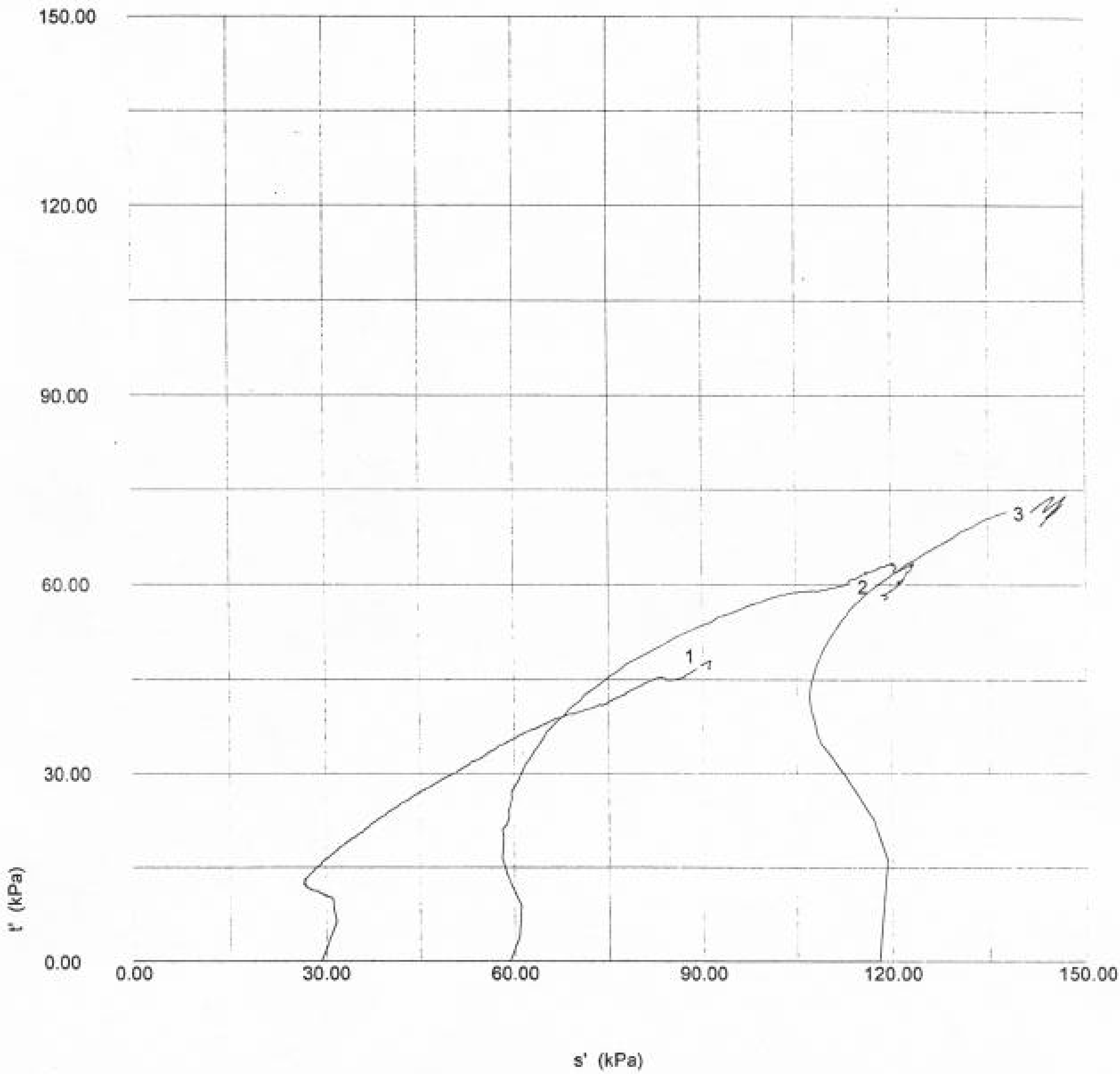
AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/~~9~~* (* delete as appropriate)		Test name / Date of Test:	CU (SS, MS) / 11/20/2003
	Site Reference:	TC035071	Sample:	SH6
	Jobfile:	C:\WINCLISP\RANDLE.JOB	Borehole:	36
	Operator: SB	Checked: SB	Approved:	

Figure B-19C

Triaxial CU Compression Shear Test – BH36-Sa6 – Stress Paths

Consolidated Undrained



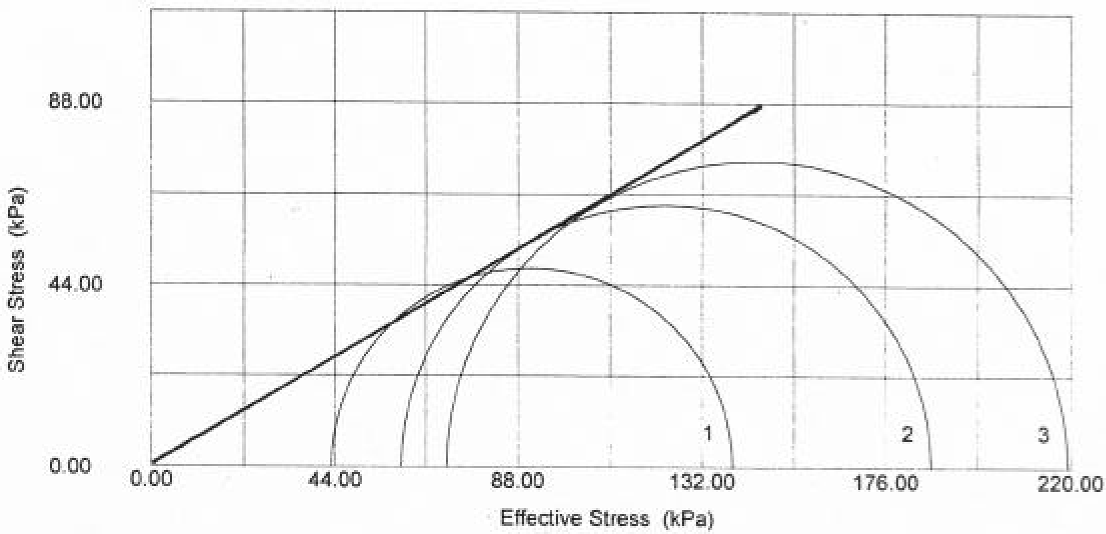
AMEC Earth & Environmental Limited

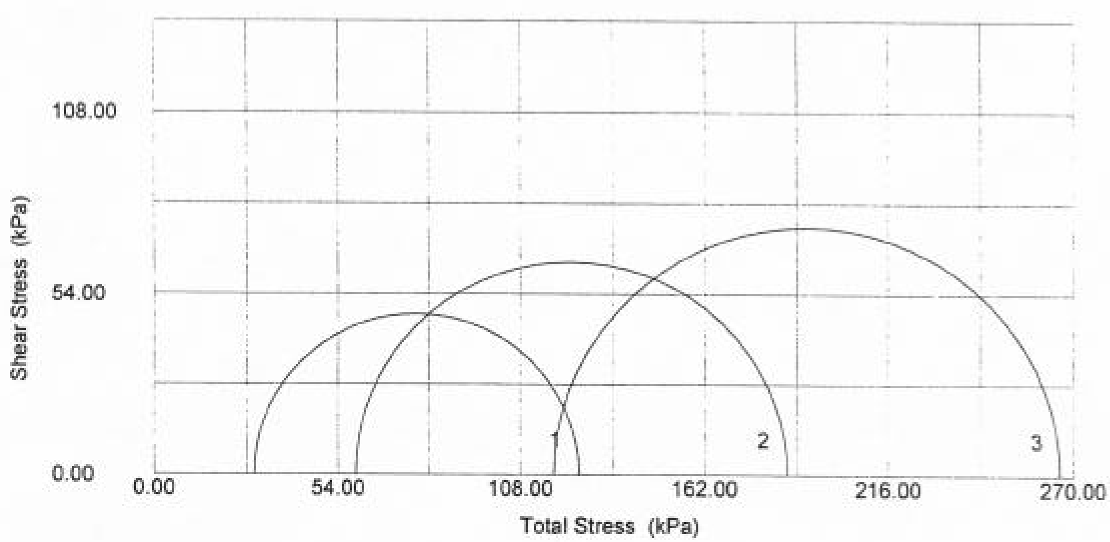
amec			
Test Method : BS1377 : Part 8 : 1990 : 8/~~9~~* (* delete as appropriate)		Test name / Date of Test:	CU (SS, MS) / 11/20/2003
Site Reference: TC035071	Jobfile: C:\WINCLISP\RANDLE.JOB	Sample: SH6	Borehole: 36
Operator: SB	Checked: SB	Approved:	

Figure B-19D

Triaxial CU Compression Shear Test – BH36-Sa6 – Mohr's Envelopes

Consolidated Undrained





AMEC Earth & Environmental Limited

amec	Test Method : BS1377 : Part 8 : 1990 : 8/~~9~~* (* delete as appropriate)	Test name CU (SS, MS) Date of Test: 11/20/2003
	Site Reference: TC035071 Jobfile: C:\WINCLISP\RANDLE.JOB	Sample: SH6 Borehole: 36
	Operator: SB / Checked: SA	Approved:

APPENDIX C – FLAT PLATE DILATOMETER TEST (DMT) RESULTS

DMT-1 Results Near Borehole 33

Project: TC035071 Randle Reef

DMT #33
Enclosure: 0

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	GW El.	74.6	m
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	Delta A	0.24	
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		Delta B	0.43	
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		Zero Gauge Reading	0.00	
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	Elevation	74.62	m
U -	Pore Pressure	kPa	q -	PC - PO	kPa			
Id -	Material Index		CU -	Undrained Cohesion	kPa			
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg			

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
64.0	3.0	3.8	16.8	11.6	103.8	0.4	16.5	2.7	8.0	2.5	26.9	35.6		Silty Clay	Firm
63.8	3.6	4.5	16.9	13.0	105.8	0.3	19.0	3.0	9.5	2.7	33.6	47.8		Silty Clay	Firm
63.6	3.8	4.6	16.9	14.4	107.7	0.3	18.4	2.7	8.3	2.7	32.0	50.9		Clay	Stiff
63.4	4.0	4.8	16.9	15.8	109.7	0.3	17.9	2.7	8.2	2.6	30.5	53.9		Clay	Stiff
63.2	4.2	5.0	16.9	17.2	111.6	0.2	17.5	2.7	8.2	2.6	29.4	56.9		Clay	Stiff
63.0	4.4	5.4	17.0	18.7	113.6	0.3	17.0	3.4	10.3	2.5	28.2	59.6		Silty Clay	Stiff
62.8	4.7	5.6	17.0	20.1	115.6	0.2	17.2	3.0	9.2	2.5	28.6	65.0		Clay	Stiff
62.6	4.7	5.6	17.0	21.5	117.5	0.2	15.9	3.0	9.0	2.4	25.5	63.5		Clay	Stiff
62.4	4.8	5.6	16.9	23.0	119.5	0.2	15.3	2.7	7.8	2.4	23.9	64.4		Clay	Stiff
62.2	4.9	5.6	16.8	24.4	121.4	0.2	14.8	2.3	6.6	2.3	22.6	65.3		Clay	Stiff
62.0	5.2	6.0	16.9	25.8	123.4	0.2	15.0	2.7	7.7	2.4	23.2	70.5		Clay	Stiff
61.8	5.3	6.1	16.9	27.2	125.4	0.2	14.5	2.7	7.7	2.3	22.0	71.3		Clay	Stiff
61.6	5.1	5.6	16.7	28.6	127.3	0.1	13.1	1.6	4.3	2.2	18.8	66.0		Clay	Stiff
61.4	5.1	5.5	16.6	29.9	129.3	0.1	12.5	1.2	3.3	2.1	17.4	64.9		Clay	Stiff
61.2	5.0	5.4	16.6	31.3	131.3	0.1	11.6	1.2	3.2	2.0	15.4	61.6		Clay	Stiff
61.0	5.4	6.4	17.1	32.7	133.2	0.2	12.1	3.4	9.1	2.1	16.6	68.3		Clay	Stiff
60.8	5.5	6.2	16.8	34.1	135.2	0.2	11.9	2.3	6.1	2.0	16.1	69.6		Clay	Stiff
60.6	6.0	7.0	17.1	35.6	137.1	0.2	12.7	3.4	9.3	2.1	17.8	78.7		Clay	Stiff
60.4	6.4	7.3	17.0	37.1	139.1	0.2	13.2	3.0	8.4	2.2	19.0	86.1		Clay	Stiff
60.2	6.5	7.6	17.2	38.5	141.1	0.2	12.9	3.7	10.3	2.1	18.2	86.8		Clay	Stiff
60.0	6.9	8.1	17.3	40.0	143.0	0.2	13.3	4.1	11.5	2.2	19.2	94.0		Clay	Stiff
59.8	7.2	8.6	17.5	41.6	145.0	0.2	13.4	4.8	13.6	2.2	19.5	99.0		Clay	Stiff
59.6	7.0	8.4	17.4	43.1	147.0	0.3	12.5	4.8	13.2	2.1	17.4	93.4		Clay	Stiff
59.4	6.8	7.9	17.2	44.6	148.9	0.2	11.6	3.7	9.9	2.0	15.5	88.3		Clay	Stiff
59.2	6.8	7.9	17.2	46.0	150.9	0.2	11.2	3.7	9.8	2.0	14.7	87.1		Clay	Stiff
59.0	6.6	7.6	17.1	47.5	152.8	0.2	10.4	3.4	8.6	1.9	13.1	82.1		Clay	Stiff
58.8	6.6	7.5	17.0	48.9	154.8	0.2	10.1	3.0	7.6	1.8	12.4	81.1		Clay	Stiff
58.6	6.3	7.1	16.9	50.4	156.8	0.2	9.2	2.7	6.4	1.7	10.7	74.3		Clay	Stiff

Project: TC035071 Randle Reef

DMT-1 Results Near Borehole 33

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	DMT	#33		
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	Enclosure:		0	
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		GW El.		74.6	m
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		Delta A		0.24	
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	Delta B		0.43	
U -	Pore Pressure	kPa	q -	PC - PO	kPa	Zero Gauge Reading		0.00	
Id -	Material Index		CU -	Undrained Cohesion	kPa	Elevation		74.62	m
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg				

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
58.4	6.9	8.4	17.5	51.9	158.7	0.3	9.9	5.2	13.0	1.8	12.2	84.6		Clay	Stiff
58.2	7.0	8.6	17.6	53.5	160.7	0.3	9.8	5.6	13.8	1.8	11.9	85.5		Silty Clay	Stiff
58.0	6.9	8.4	17.5	55.0	162.6	0.3	9.3	5.2	12.6	1.8	11.0	82.6		Clay	Stiff
57.8	6.9	8.4	17.5	56.5	164.6	0.3	9.0	5.2	12.4	1.7	10.5	81.6		Clay	Stiff
57.6	7.3	9.1	17.7	58.1	166.6	0.3	9.4	6.3	15.3	1.8	11.1	88.2		Silty Clay	Stiff
57.4	7.3	9.1	17.7	59.7	168.5	0.3	9.1	6.3	15.1	1.7	10.6	87.3		Silty Clay	Stiff
57.2	7.5	9.4	17.8	61.3	170.5	0.3	9.1	6.7	16.0	1.7	10.7	90.1		Silty Clay	Stiff
57.0	7.6	9.3	17.7	62.9	172.5	0.3	9.1	5.9	14.2	1.7	10.5	91.3		Clay	Stiff
56.8	7.7	9.6	17.8	64.5	174.4	0.3	8.9	6.7	15.9	1.7	10.3	92.1		Silty Clay	Stiff
56.6	8.0	9.9	17.8	66.1	176.4	0.3	9.1	6.7	16.0	1.7	10.7	97.1		Silty Clay	Stiff
56.4	7.4	8.3	17.1	67.5	178.3	0.2	8.1	3.0	6.9	1.6	8.9	85.4		Clay	Stiff
56.2	7.1	7.5	16.6	68.9	180.3	0.1	7.5	1.2	2.7	1.5	7.9	79.4		Clay	Stiff
56.0	8.2	11.6	18.6	70.6	182.3	0.5	8.8	11.8	27.8	1.7	10.1	98.8		Silty Clay	Stiff
55.8	6.9	9.6	18.1	72.3	184.2	0.5	6.8	9.2	19.4	1.4	6.8	73.9		Silty Clay	Stiff
55.6	7.5	10.1	18.1	74.0	186.2	0.5	7.5	8.8	19.4	1.5	7.8	84.3		Silty Clay	Stiff
55.4	7.8	10.6	18.3	75.6	188.2	0.5	7.6	9.6	21.3	1.5	8.1	88.9		Silty Clay	Stiff
55.2	8.4	11.3	18.4	77.4	190.1	0.4	8.2	9.9	22.8	1.6	9.0	99.3		Silty Clay	Stiff
55.0	9.2	12.9	18.9	79.2	192.1	0.5	8.9	12.8	30.6	1.7	10.3	113.1		Silty Clay	Very Stiff
54.8	10.1	14.1	19.1	81.0	194.0	0.5	9.8	13.9	34.5	1.8	11.9	129.6		Silty Clay	Very Stiff
54.6	10.0	14.6	19.4	83.0	196.0	0.6	9.5	15.8	38.5	1.8	11.4	128.0		Silty Clay	Very Stiff
54.4	10.0	14.6	19.4	84.9	198.0	0.6	9.3	15.8	38.1	1.8	10.9	126.8		Silty Clay	Very Stiff
54.2	10.0	15.1	19.6	86.8	199.9	0.6	9.0	17.6	42.0	1.7	10.5	125.3		Clayey Silt	Very Stiff
54.0	9.5	14.1	19.3	88.7	201.9	0.6	8.3	15.8	36.3	1.6	9.1	115.0		Clayey Silt	Very Stiff
53.8	10.0	15.1	19.6	90.7	203.9	0.6	8.6	17.6	41.2	1.7	9.7	123.1		Clayey Silt	Very Stiff
53.6	10.0	14.6	19.3	92.6	205.8	0.6	8.4	15.8	36.6	1.6	9.4	122.6		Silty Clay	Very Stiff
53.4	10.2	14.6	19.3	94.5	207.8	0.5	8.4	15.0	34.9	1.7	9.4	125.6		Silty Clay	Very Stiff
53.2	9.6	13.6	19.0	96.3	209.7	0.5	7.6	13.9	30.8	1.5	8.0	111.6		Silty Clay	Very Stiff
53.0	10.0	14.6	19.3	98.2	211.7	0.6	7.9	15.8	35.5	1.6	8.5	119.6		Silty Clay	Very Stiff
52.8	10.0	14.3	19.2	100.1	213.7	0.5	7.7	14.7	32.7	1.6	8.2	118.9		Silty Clay	Very Stiff
52.6	9.6	13.1	18.8	101.9	215.6	0.5	7.1	12.1	26.0	1.5	7.2	109.3		Silty Clay	Very Stiff
52.4	9.1	12.8	18.8	103.7	217.6	0.5	6.5	12.8	26.4	1.4	6.3	99.2		Silty Clay	Stiff
52.2	8.8	11.6	18.3	105.4	219.5	0.4	6.1	9.6	19.1	1.3	5.7	93.8		Silty Clay	Stiff
52.0	9.4	11.9	18.2	107.1	221.5	0.3	6.6	8.5	17.5	1.4	6.4	104.1		Silty Clay	Very Stiff
51.8	9.3	14.6	19.5	109.0	223.5	0.8	6.3	18.3	37.2	1.4	6.0	101.0		Clayey Silt	Very Stiff
51.6	9.1	14.1	19.3	110.9	225.4	0.7	6.0	17.2	34.2	1.3	5.6	96.9		Clayey Silt	Stiff
51.4	9.7	13.8	19.1	112.8	227.4	0.6	6.4	14.3	29.2	1.4	6.1	105.7		Silty Clay	Very Stiff
51.2	9.8	14.1	19.2	114.6	229.4	0.6	6.4	14.7	30.0	1.4	6.2	108.4		Silty Clay	Very Stiff
51.0	9.5	14.6	19.4	116.6	231.3	0.7	6.0	17.6	34.8	1.3	5.6	101.6		Clayey Silt	Very Stiff
50.8	10.5	15.1	19.4	118.5	233.3	0.6	6.8	15.8	33.0	1.4	6.7	119.2		Silty Clay	Very Stiff
50.6	10.5	15.1	19.4	120.4	235.2	0.6	6.6	15.8	32.7	1.4	6.5	118.4		Silty Clay	Very Stiff
50.4	10.6	14.4	19.0	122.2	237.2	0.5	6.5	13.2	27.3	1.4	6.3	118.2		Silty Clay	Very Stiff
50.2	7.9	11.6	18.6	124.0	239.2	0.7	4.3	12.8	21.0	1.0	3.3	71.0		Clayey Silt	Stiff
50.0	9.7	22.1	21.0	126.2	241.1	1.7	5.6	43.0	83.9	1.3	9.0		29	Sandy Silt	Dense
49.8	9.3	12.6	18.6	128.0	243.1	0.5	5.2	11.4	20.9	1.2	4.5	93.4		Silty Clay	Stiff
49.6	9.4	12.3	18.4	129.7	245.1	0.4	5.2	9.9	18.2	1.2	4.5	94.8		Silty Clay	Stiff
49.4	9.1	12.1	18.5	131.4	247.0	0.5	4.9	10.3	18.2	1.1	4.1	89.0		Silty Clay	Stiff
49.2	9.1	11.6	18.2	133.1	249.0	0.4	4.9	8.5	14.9	1.1	4.0	88.7		Silty Clay	Stiff
49.0	9.6	12.6	18.5	134.8	250.9	0.4	5.1	10.3	18.7	1.2	4.3	96.2		Silty Clay	Stiff
48.8	9.5	12.3	18.4	136.6	252.9	0.4	5.0	9.6	17.1	1.2	4.2	94.0		Silty Clay	Stiff
48.6	9.5	12.3	18.4	138.3	254.9	0.4	4.9	9.6	16.9	1.1	4.1	93.4		Silty Clay	Stiff
48.4	9.2	11.8	18.2	140.0	256.8	0.4	4.6	8.8	15.1	1.1	3.7	87.9		Silty Clay	Stiff
48.2	9.4	11.9	18.2	141.6	258.8	0.4	4.7	8.5	14.6	1.1	3.8	90.7		Silty Clay	Stiff
48.0	9.3	11.6	18.1	143.3	260.7	0.3	4.6	7.7	13.2	1.1	3.6	88.6		Silty Clay	Stiff
47.8	9.1	11.4	18.0	144.9	262.7	0.3	4.4	7.7	12.8	1.1	3.4	84.7		Silty Clay	Stiff
47.6	8.3	10.6	18.0	146.6	264.7	0.4	3.8	7.7	11.6	0.9	2.7	71.3		Silty Clay	Stiff
47.4	10.1	12.3	18.0	148.2	266.6	0.3	4.9	7.4	13.1	1.1	4.1	100.3		Clay	Very Stiff
47.2	9.3	11.6	18.1	149.9	268.6	0.3	4.3	7.7	12.7	1.0	3.3	86.3		Silty Clay	Stiff
47.0	9.2	11.6	18.1	151.5	270.6	0.4	4.2	8.1	13.0	1.0	3.2	84.0		Silty Clay	Stiff
46.8	9.2	11.6	18.1	153.2	272.5	0.4	4.1	8.1	12.9	1.0	3.1	83.5		Silty Clay	Stiff
46.6	9.3	11.6	18.0	154.8	274.5	0.3	4.1	7.7	12.4	1.0	3.1	84.6		Silty Clay	Stiff

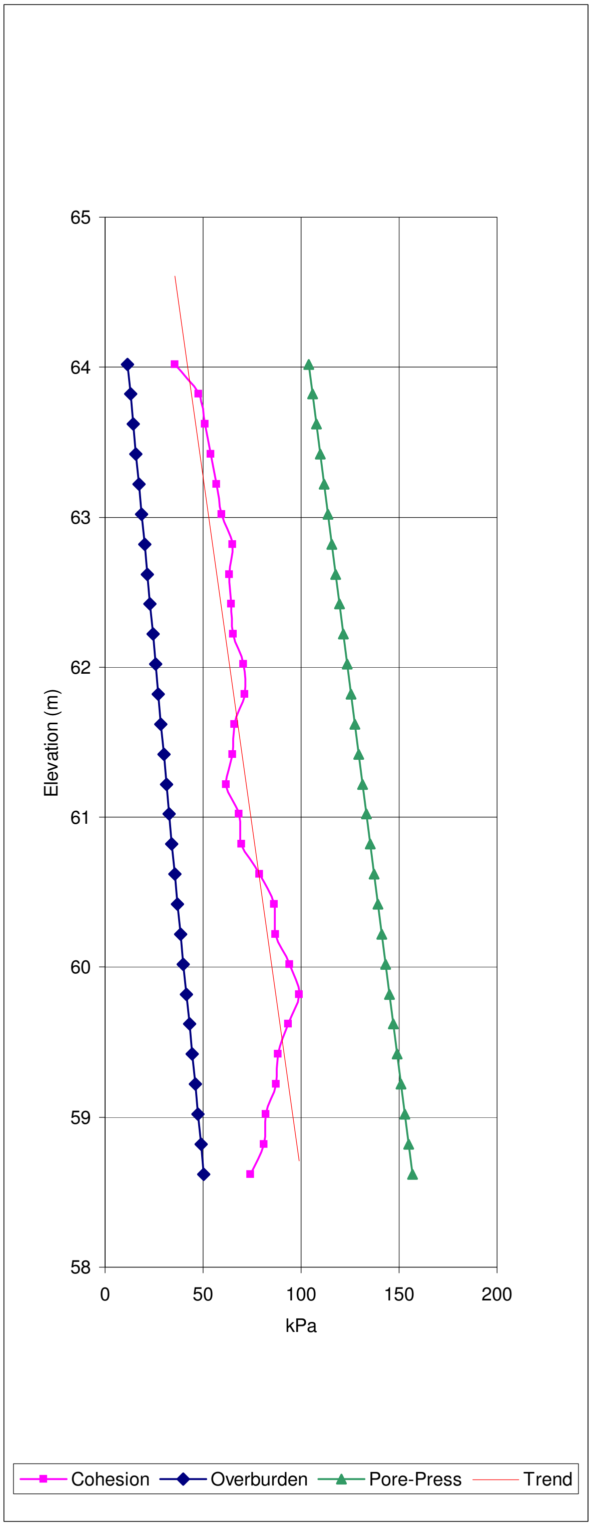
DMT-1 Results Near Borehole 33

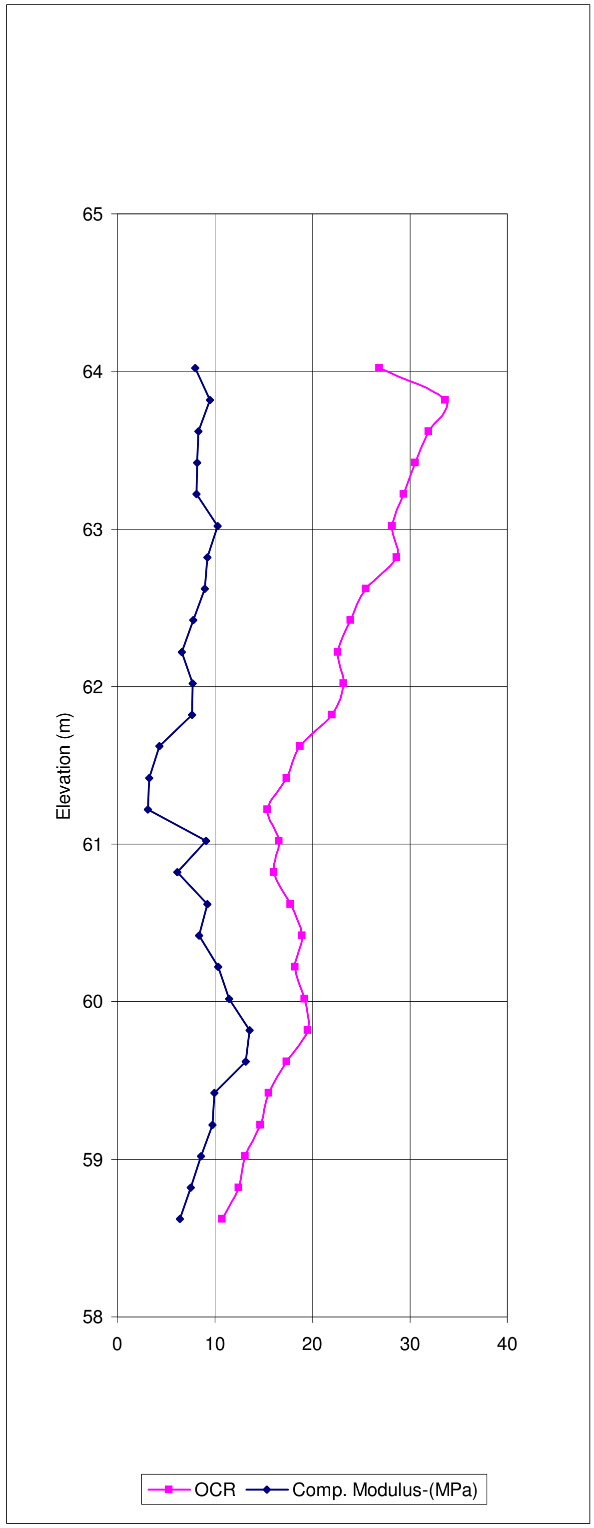
Project: TC035071 Randle Reef

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	DMT #33	
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	Enclosure:	0
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		GW El.	74.6 m
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		Delta A	0.24
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	Delta B	0.43
U -	Pore Pressure	kPa	q -	PC - PO	kPa	Zero Gauge Reading	0.00
Id -	Material Index		CU -	Undrained Cohesion	kPa	Elevation	74.62 m
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg		

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
46.4	9.6	12.1	18.2	156.5	276.4	0.4	4.3	8.5	13.8	1.0	3.3	88.8		Silty Clay	Stiff
46.2	9.8	12.8	18.5	158.2	278.4	0.4	4.3	10.3	16.9	1.0	3.3	91.1		Silty Clay	Stiff
46.0	10.6	13.3	18.4	160.0	280.4	0.3	4.8	9.2	16.0	1.1	3.9	104.0		Silty Clay	Very Stiff
45.8	10.6	13.6	18.6	161.7	282.3	0.4	4.7	10.3	17.7	1.1	3.8	103.1		Silty Clay	Very Stiff
45.6	9.8	12.4	18.3	163.4	284.3	0.4	4.2	8.8	14.1	1.0	3.1	89.7		Silty Clay	Stiff
45.4	9.8	12.6	18.4	165.1	286.3	0.4	4.1	9.6	15.2	1.0	3.1	89.0		Silty Clay	Stiff
45.2	9.1	11.6	18.1	166.8	288.2	0.4	3.6	8.5	12.4	0.9	2.5	77.6		Silty Clay	Stiff
45.0	10.1	12.9	18.4	168.5	290.2	0.4	4.2	9.6	15.3	1.0	3.1	92.7		Silty Clay	Stiff
44.8	10.1	12.8	18.3	170.2	292.1	0.4	4.1	9.2	14.6	1.0	3.1	92.2		Silty Clay	Stiff
44.6	10.1	12.8	18.3	171.9	294.1	0.4	4.1	9.2	14.5	1.0	3.0	91.7		Silty Clay	Stiff
44.4	10.6	13.3	18.4	173.6	296.1	0.3	4.3	9.2	15.0	1.0	3.3	99.2		Silty Clay	Stiff
44.2	10.1	13.1	18.5	175.4	298.0	0.4	4.0	10.3	15.9	1.0	2.9	90.4		Silty Clay	Stiff
44.0	10.6	13.4	18.4	177.1	300.0	0.4	4.2	9.6	15.4	1.0	3.2	98.0		Silty Clay	Stiff
43.8	10.1	12.9	18.4	178.8	302.0	0.4	3.9	9.6	14.6	1.0	2.8	89.5		Silty Clay	Stiff
43.6	10.6	13.1	18.3	180.5	303.9	0.3	4.1	8.5	13.4	1.0	3.1	97.1		Silty Clay	Stiff
43.4	10.6	13.3	18.4	182.2	305.9	0.4	4.0	9.2	14.5	1.0	3.0	96.4		Silty Clay	Stiff

DMT -1 Results Near Borehole 33





DMT-2 Results Near Borehole 33

Project: TC035071   Randle Reef

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	GW El.	74.6	m
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	Delta A	0.23	
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		Delta B	0.43	
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		Zero Gauge Reading	0.00	
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	Elevation	74.6	m
U -	Pore Pressure	kPa	q -	PC - PO	kPa			
Id -	Material Index		CU -	Undrained Cohesion	kPa			
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg			

DMT #33A
Enclosure: 0

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
65.4	1.0	1.0	16.2	4.0	90.1	0.0	2.3	0.0	0.0	0.6	1.2	1.0		Clay	Very Soft
65.2	1.0	1.0	16.2	5.3	92.0	0.0	1.3	0.0	0.0	0.3	0.5	0.7		Clay	Very Soft
65.0	1.0	1.3	17.2	6.8	94.0	4.2	0.9	0.9	0.3	0.2	0.4		29	Sand	Loose
64.8	1.2	1.4	16.3	8.0	95.9	0.6	3.0	0.5	0.6	0.8	1.9	2.9		Silty Clay	Very Soft
64.6	1.2	1.3	16.2	9.3	97.9	0.2	2.4	0.1	0.2	0.7	1.3	2.6		Clay	Very Soft
64.4	1.5	1.7	16.3	10.6	99.9	0.3	4.7	0.5	0.9	1.1	3.7	6.7		Clay	Very Soft
64.2	2.0	2.5	16.5	12.0	101.8	0.5	7.9	1.6	3.6	1.6	8.6	14.8		Silty Clay	Soft
64.0	2.7	3.7	16.9	13.4	103.8	0.6	11.9	3.4	9.2	2.0	16.2	27.4		Clayey Silt	Firm
63.8	2.3	3.3	16.8	14.8	105.8	0.8	8.0	3.4	7.8	1.6	8.7	18.4		Silty Sand	Soft
63.6	2.9	3.6	16.7	16.2	107.7	0.4	10.9	2.3	6.0	1.9	14.1	29.7		Silty Clay	Firm
63.4	3.1	4.0	16.9	17.6	109.7	0.4	11.0	3.1	7.9	2.0	14.3	32.6		Silty Clay	Firm
63.2	3.2	4.1	16.9	19.0	111.6	0.4	10.6	3.1	7.8	1.9	13.5	33.6		Silty Clay	Firm
63.0	3.3	4.2	16.9	20.4	113.6	0.4	10.2	3.1	7.7	1.9	12.8	34.6		Silty Clay	Firm
62.8	3.3	4.1	16.8	21.8	115.6	0.4	9.5	2.7	6.6	1.8	11.4	33.7		Silty Clay	Firm
62.6	3.4	4.1	16.8	23.2	117.5	0.3	9.3	2.3	5.6	1.8	11.0	34.9		Silty Clay	Firm
62.4	3.4	4.1	16.8	24.6	119.5	0.3	8.7	2.3	5.5	1.7	9.9	34.0		Silty Clay	Firm
62.2	3.4	4.0	16.7	26.0	121.4	0.3	8.2	2.0	4.5	1.6	9.0	33.2		Clay	Firm
62.0	3.6	4.3	16.8	27.4	123.4	0.3	8.4	2.3	5.4	1.6	9.4	36.1		Clay	Firm
61.8	3.7	4.4	16.8	28.8	125.4	0.3	8.3	2.3	5.4	1.6	9.1	37.2		Clay	Firm
61.6	3.7	4.4	16.8	30.2	127.3	0.3	7.8	2.3	5.2	1.6	8.4	36.4		Clay	Firm
61.4	3.4	4.2	16.8	31.6	129.3	0.4	6.4	2.7	5.5	1.4	6.2	30.0		Silty Clay	Firm
61.2	4.2	4.9	16.8	33.0	131.3	0.2	8.5	2.3	5.4	1.7	9.6	44.3		Clay	Firm
61.0	4.7	5.6	17.0	34.4	133.2	0.3	9.5	3.1	7.5	1.8	11.4	53.0		Clay	Stiff
60.8	5.2	6.2	17.1	35.9	135.2	0.3	10.4	3.4	8.7	1.9	13.1	62.0		Clay	Stiff
60.6	5.8	6.9	17.2	37.3	137.1	0.2	11.5	3.8	10.0	2.0	15.3	73.2		Clay	Stiff
60.4	6.1	7.2	17.2	38.8	139.1	0.2	11.8	3.8	10.1	2.0	15.9	78.3		Clay	Stiff
60.2	6.3	7.7	17.4	40.3	141.1	0.3	11.7	4.9	13.0	2.0	15.8	81.1		Clay	Stiff
60.0	6.4	7.9	17.5	41.9	143.0	0.3	11.5	5.2	13.8	2.0	15.3	81.9		Silty Clay	Stiff
59.8	6.5	7.9	17.4	43.4	145.0	0.3	11.3	4.9	12.8	2.0	14.8	82.9		Clay	Stiff
59.6	6.7	7.9	17.3	44.9	147.0	0.2	11.3	4.1	10.9	2.0	14.9	86.1		Clay	Stiff
59.4	6.9	8.1	17.3	46.4	148.9	0.2	11.3	4.1	10.9	2.0	15.0	89.2		Clay	Stiff
59.2	6.3	7.7	17.4	47.9	150.9	0.3	9.7	4.9	12.0	1.8	11.7	75.6		Clay	Stiff
59.0	6.9	8.6	17.6	49.5	152.8	0.3	10.5	6.0	15.2	1.9	13.3	86.4		Silty Clay	Stiff
58.8	7.6	10.1	18.1	51.1	154.8	0.4	11.6	8.5	22.6	2.0	15.5	101.1		Silty Clay	Very Stiff
58.6	8.3	10.6	18.1	52.8	156.8	0.3	12.5	7.8	21.2	2.1	17.4	114.8		Silty Clay	Very Stiff
58.4	8.5	10.9	18.1	54.4	158.7	0.3	12.4	8.1	22.2	2.1	17.3	117.6		Silty Clay	Very Stiff
58.2	8.1	10.6	18.2	56.1	160.7	0.4	11.3	8.5	22.4	2.0	14.9	107.8		Silty Clay	Very Stiff
58.0	8.3	9.6	17.4	57.6	162.6	0.2	11.2	4.5	11.8	2.0	14.8	109.8		Clay	Very Stiff
57.8	9.1	11.1	17.9	59.3	164.6	0.3	12.4	6.7	18.2	2.1	17.1	126.9		Clay	Very Stiff
57.6	8.4	9.4	17.2	60.7	166.6	0.1	10.8	3.4	8.8	1.9	13.9	109.9		Clay	Very Stiff
57.4	8.7	9.6	17.1	62.2	168.5	0.1	11.0	3.1	7.9	2.0	14.3	115.1		Clay	Very Stiff
57.2	8.6	9.6	17.2	63.7	170.5	0.1	10.5	3.4	8.7	1.9	13.4	111.9		Clay	Very Stiff
57.0	8.5	9.4	17.1	65.1	172.5	0.1	10.1	3.1	7.7	1.9	12.6	109.0		Clay	Very Stiff
56.8	9.0	10.4	17.5	66.7	174.4	0.2	10.6	4.9	12.5	1.9	13.4	117.6		Clay	Very Stiff
56.6	8.5	9.2	16.9	68.1	176.4	0.1	9.7	2.3	5.7	1.8	11.7	107.1		Clay	Very Stiff
56.4	7.8	8.8	17.2	69.5	178.3	0.2	8.4	3.4	7.9	1.6	9.4	92.2		Clay	Stiff
56.2	8.3	9.6	17.4	71.1	180.3	0.2	8.9	4.5	10.7	1.7	10.2	100.7		Clay	Very Stiff
56.0	8.4	9.6	17.3	72.6	182.3	0.2	8.8	4.1	9.8	1.7	10.1	101.8		Clay	Very Stiff
55.8	8.6	9.8	17.3	74.1	184.2	0.2	8.9	4.1	9.9	1.7	10.2	104.8		Clay	Very Stiff
55.6	8.6	9.6	17.2	75.6	186.2	0.1	8.7	3.4	8.1	1.7	9.9	104.1		Clay	Very Stiff

DMT-2 Results Near Borehole 33

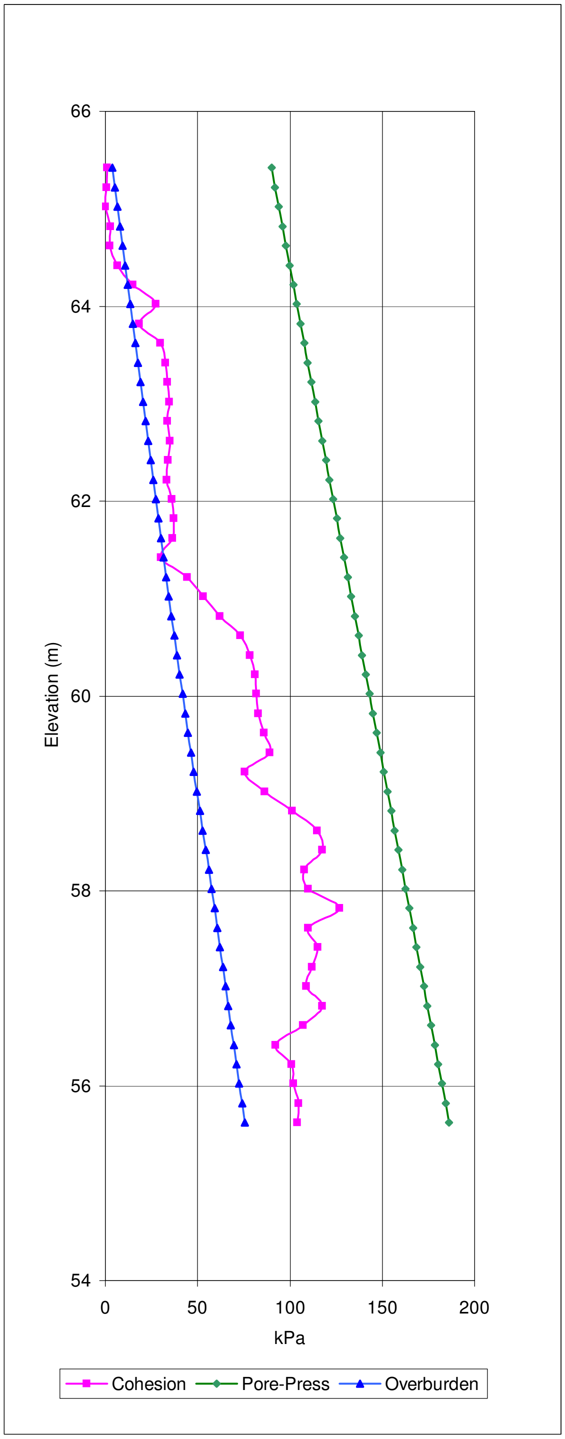
Project: TC035071 Randle Reef

DMT #33A
Enclosure: 0
GW El. 74.6 m
Delta A 0.23
Delta B 0.43
Zero Gauge Reading 0.00
Elevation 74.6 m

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure	
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio	
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa
U -	Pore Pressure	kPa	q -	PC - PO	kPa
Id -	Material Index		CU -	Undrained Cohesion	kPa
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
55.4	9.5	14.1	19.3	77.5	188.2	0.6	9.6	15.8	38.9	1.8	11.6	121.5		Silty Clay	Very Stiff
55.2	10.0	15.1	19.6	79.4	190.1	0.6	10.0	17.6	43.9	1.8	12.2	129.9		Clayey Silt	Very Stiff
55.0	10.0	14.6	19.4	81.3	192.1	0.6	9.7	15.8	39.0	1.8	11.8	129.2		Silty Clay	Very Stiff
54.8	10.2	14.6	19.3	83.2	194.0	0.5	9.7	15.1	37.2	1.8	11.8	132.2		Silty Clay	Very Stiff
54.6	9.5	13.6	19.1	85.1	196.0	0.5	8.7	14.0	32.9	1.7	9.9	117.6		Silty Clay	Very Stiff
54.4	10.0	14.6	19.4	87.0	198.0	0.6	9.0	15.8	37.8	1.7	10.5	125.9		Silty Clay	Very Stiff
54.2	10.0	14.3	19.2	88.9	199.9	0.5	8.8	14.7	34.9	1.7	10.1	125.1		Silty Clay	Very Stiff
54.0	9.6	13.1	18.8	90.7	201.9	0.5	8.1	12.2	27.8	1.6	8.9	115.0		Silty Clay	Very Stiff
53.8	9.1	12.8	18.9	92.5	203.9	0.5	7.4	12.9	28.2	1.5	7.7	104.5		Silty Clay	Very Stiff
53.6	8.8	11.6	18.4	94.2	205.8	0.4	7.0	9.6	20.5	1.5	7.0	98.9		Silty Clay	Stiff
53.4	9.4	11.9	18.2	95.9	207.8	0.3	7.5	8.5	18.7	1.5	7.8	109.5		Silty Clay	Very Stiff
53.2	9.3	14.6	19.5	97.8	209.7	0.7	7.2	18.3	39.6	1.5	7.3	106.2		Clayey Silt	Very Stiff
53.0	9.1	14.1	19.3	99.7	211.7	0.7	6.8	17.2	36.4	1.4	6.8	101.9		Clayey Silt	Very Stiff
52.8	9.6	13.8	19.1	101.6	213.7	0.6	7.2	14.3	31.0	1.5	7.4	110.9		Silty Clay	Very Stiff
52.6	9.8	14.1	19.2	103.4	215.6	0.6	7.2	14.7	31.9	1.5	7.4	113.7		Silty Clay	Very Stiff
52.4	9.5	14.6	19.4	105.4	217.6	0.7	6.8	17.6	37.0	1.4	6.7	106.6		Clayey Silt	Very Stiff
52.2	10.5	15.1	19.4	107.3	219.5	0.5	7.6	15.8	35.0	1.5	8.0	124.7		Silty Clay	Very Stiff
52.0	10.5	15.1	19.4	109.2	221.5	0.6	7.4	15.8	34.6	1.5	7.7	123.7		Silty Clay	Very Stiff
51.8	10.6	14.4	19.1	111.1	223.5	0.5	7.3	13.2	28.8	1.5	7.6	123.5		Silty Clay	Very Stiff
51.6	7.9	11.6	18.6	112.8	225.4	0.7	4.8	12.9	22.6	1.1	4.0	74.8		Clayey Silt	Stiff
51.4	9.7	22.1	21.0	115.1	227.4	1.7	6.3	43.1	88.4	1.4	10.6		29	Sandy Silt	Dense
51.2	9.3	12.6	18.7	116.8	229.4	0.5	5.8	11.4	22.2	1.3	5.3	97.8		Silty Clay	Stiff
51.0	9.4	12.3	18.5	118.6	231.3	0.4	5.8	10.0	19.4	1.3	5.3	99.2		Silty Clay	Stiff
50.8	9.1	12.1	18.5	120.3	233.3	0.4	5.5	10.3	19.4	1.2	4.8	93.2		Silty Clay	Stiff
50.6	9.1	11.6	18.2	122.0	235.2	0.4	5.4	8.5	15.9	1.2	4.7	92.9		Silty Clay	Stiff
50.4	9.6	12.6	18.5	123.7	237.2	0.4	5.7	10.3	19.9	1.3	5.1	100.5		Silty Clay	Very Stiff
50.2	9.5	12.3	18.4	125.4	239.2	0.4	5.5	9.6	18.2	1.2	4.9	98.3		Silty Clay	Stiff
50.0	9.5	12.3	18.4	127.2	241.1	0.4	5.4	9.6	18.0	1.2	4.8	97.6		Silty Clay	Stiff
49.8	9.2	11.8	18.3	128.8	243.1	0.4	5.1	8.9	16.1	1.2	4.3	91.9		Silty Clay	Stiff
49.6	9.4	11.9	18.2	130.5	245.1	0.4	5.2	8.5	15.6	1.2	4.4	94.8		Silty Clay	Stiff
49.4	9.3	11.6	18.1	132.2	247.0	0.3	5.1	7.8	14.0	1.2	4.2	92.6		Silty Clay	Stiff
49.2	9.1	11.4	18.1	133.8	249.0	0.3	4.8	7.8	13.7	1.1	4.0	88.6		Silty Clay	Stiff
49.0	8.3	10.6	18.0	135.5	250.9	0.4	4.2	7.8	12.5	1.0	3.2	74.8		Silty Clay	Stiff
48.8	10.1	12.3	18.1	137.1	252.9	0.3	5.4	7.4	13.9	1.2	4.7	104.5		Clay	Very Stiff
48.6	9.3	11.6	18.1	138.8	254.9	0.3	4.8	7.8	13.5	1.1	3.9	90.1		Silty Clay	Stiff
48.4	9.2	11.6	18.1	140.4	256.8	0.4	4.6	8.1	13.9	1.1	3.7	87.8		Silty Clay	Stiff
48.2	9.2	11.6	18.1	142.1	258.8	0.4	4.5	8.1	13.8	1.1	3.6	87.2		Silty Clay	Stiff
48.0	9.3	11.6	18.1	143.7	260.7	0.3	4.6	7.8	13.2	1.1	3.6	88.4		Silty Clay	Stiff
47.8	9.6	12.1	18.2	145.4	262.7	0.4	4.7	8.5	14.7	1.1	3.8	92.6		Silty Clay	Stiff
47.6	9.8	12.8	18.5	147.2	264.7	0.4	4.7	10.3	17.9	1.1	3.8	94.9		Silty Clay	Stiff
47.4	10.6	13.3	18.4	148.9	266.6	0.3	5.2	9.2	16.9	1.2	4.4	108.1		Silty Clay	Very Stiff
47.2	10.6	13.6	18.6	150.6	268.6	0.4	5.1	10.3	18.7	1.2	4.3	107.2		Silty Clay	Very Stiff
47.0	9.8	12.4	18.3	152.3	270.6	0.4	4.5	8.9	15.0	1.1	3.6	93.4		Silty Clay	Stiff
46.8	9.8	12.6	18.4	154.0	272.5	0.4	4.5	9.6	16.1	1.1	3.5	92.7		Silty Clay	Stiff
46.6	9.1	11.6	18.2	155.7	274.5	0.4	4.0	8.5	13.2	1.0	2.9	81.0		Silty Clay	Stiff
46.4	10.1	12.9	18.4	157.4	276.4	0.4	4.5	9.6	16.2	1.1	3.6	96.5		Silty Clay	Stiff
46.2	10.1	12.8	18.4	159.1	278.4	0.4	4.5	9.2	15.5	1.1	3.5	95.9		Silty Clay	Stiff
46.0	10.1	12.8	18.4	160.8	280.4	0.4	4.4	9.2	15.4	1.1	3.4	95.4		Silty Clay	Stiff
45.8	10.6	13.3	18.4	162.6	282.3	0.3	4.7	9.2	15.9	1.1	3.7	103.0		Silty Clay	Very Stiff
45.6	10.1	13.1	18.5	164.3	284.3	0.4	4.3	10.3	16.9	1.0	3.3	94.0		Silty Clay	Stiff
45.4	10.6	13.4	18.5	166.0	286.3	0.4	4.5	9.6	16.2	1.1	3.6	101.8		Silty Clay	Very Stiff
45.2	10.1	12.9	18.4	167.8	288.2	0.4	4.2	9.6	15.4	1.0	3.2	93.0		Silty Clay	Stiff
45.0	10.6	13.1	18.3	169.4	290.2	0.3	4.4	8.5	14.2	1.1	3.5	100.8		Silty Clay	Very Stiff
44.8	10.6	13.3	18.4	171.2	292.1	0.3	4.4	9.2	15.3	1.1	3.4	100.1		Silty Clay	Very Stiff

DMT - 2 Results Near Borehole 33



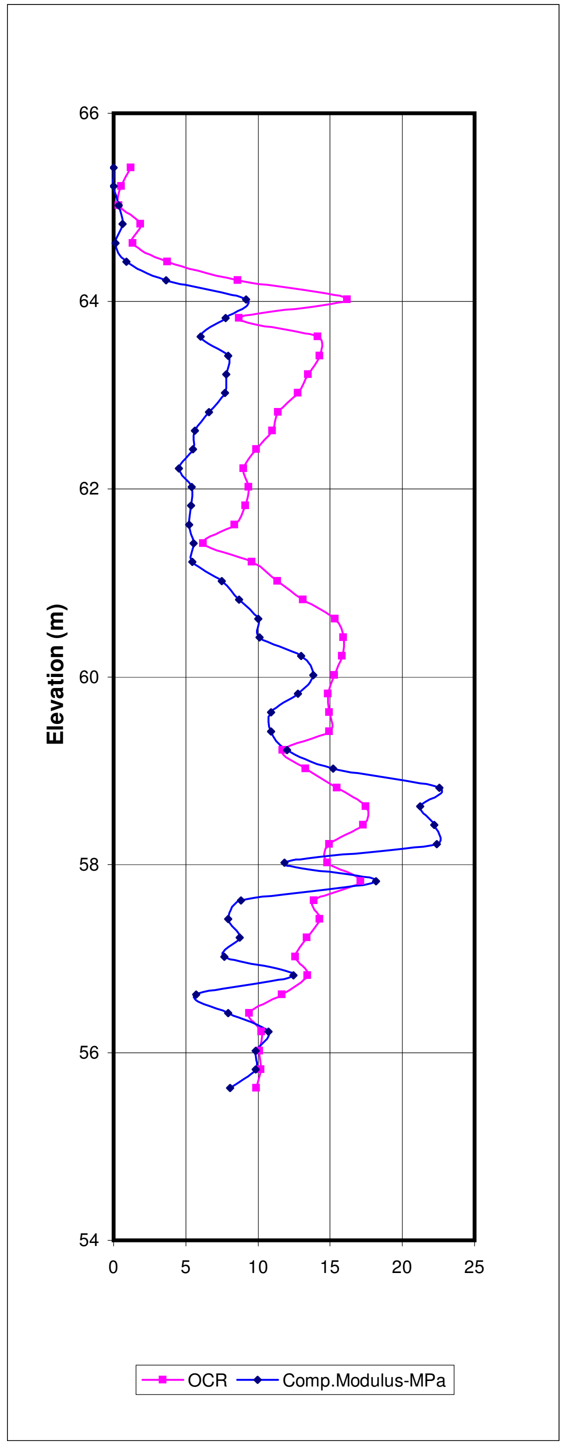


Figure C - 2B

DMT Results Near Borehole 36

Project: TC035071 Randle Reef

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	DMT	#36			
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	Enclosure:	0			
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		GW El.	74.6 m			
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		Delta A	0.22			
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	Delta B	0.43			
U -	Pore Pressure	kPa	q -	PC - PO	kPa	Zero Gauge Reading	0.00			
Id -	Material Index		CU -	Undrained Cohesion	kPa	Elevation	74.62 m			
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg					

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
67.8	1.2	1.5	16.4	11.3	66.7	0.5	4.6	0.9	1.5	1.1	3.6	7.0		Silty Clay	Very Soft
67.6	1.9	2.6	16.7	12.7	68.7	0.6	9.2	2.4	5.7	1.7	10.8	18.8		Silty Clay	Soft
67.4	2.4	3.2	16.8	14.1	70.6	0.5	11.6	2.7	7.2	2.0	15.5	27.8		Silty Clay	Firm
67.2	2.5	3.4	16.8	15.5	72.6	0.5	11.0	3.1	8.0	2.0	14.3	28.7		Silty Clay	Firm
67.0	2.8	3.6	16.8	16.9	74.6	0.4	11.7	2.7	7.3	2.0	15.8	34.0		Silty Clay	Firm
66.8	3.0	3.7	16.8	18.3	76.5	0.3	11.8	2.4	6.3	2.0	16.0	37.2		Silty Clay	Firm
66.6	3.2	4.1	16.9	19.7	78.5	0.4	11.8	3.1	8.3	2.0	16.0	40.0		Silty Clay	Firm
66.4	3.3	4.2	16.9	21.1	80.4	0.4	11.4	3.1	8.1	2.0	15.1	41.0		Silty Clay	Firm
66.2	3.4	4.2	16.9	22.5	82.4	0.3	11.1	2.7	7.1	2.0	14.4	42.1		Silty Clay	Firm
66.0	3.5	4.4	16.9	24.0	84.4	0.3	10.7	3.1	7.9	1.9	13.7	43.0		Silty Clay	Firm
65.8	3.5	4.3	16.9	25.4	86.3	0.3	10.1	2.7	6.8	1.8	12.4	42.1		Silty Clay	Firm
65.6	3.6	4.4	16.9	26.8	88.3	0.3	9.8	2.7	6.8	1.8	12.0	43.1		Clay	Firm
65.4	3.5	4.4	16.9	28.2	90.3	0.3	8.9	3.1	7.4	1.7	10.3	40.1		Silty Clay	Firm
65.2	3.8	4.6	16.9	29.6	92.2	0.3	9.4	2.7	6.7	1.8	11.2	45.2		Clay	Firm
65.0	3.9	4.9	17.0	31.1	94.2	0.3	9.2	3.5	8.3	1.7	10.8	46.0		Silty Clay	Firm
64.8	4.1	5.1	17.0	32.5	96.1	0.3	9.3	3.5	8.4	1.8	11.0	49.1		Silty Clay	Firm
64.6	4.4	5.3	17.0	34.0	98.1	0.3	9.8	3.1	7.7	1.8	11.9	54.2		Clay	Stiff
64.4	4.6	5.6	17.1	35.4	100.1	0.3	9.8	3.5	8.6	1.8	12.0	57.1		Clay	Stiff
64.2	4.7	5.9	17.2	36.9	102.0	0.3	9.6	4.2	10.3	1.8	11.6	57.9		Silty Clay	Stiff
64.0	5.0	6.1	17.2	38.4	104.0	0.3	10.0	3.8	9.5	1.8	12.3	63.1		Clay	Stiff
63.8	5.3	6.5	17.2	39.9	105.9	0.3	10.3	4.2	10.6	1.9	12.9	68.0		Clay	Stiff
63.6	5.6	6.9	17.3	41.4	107.9	0.3	10.6	4.5	11.6	1.9	13.4	73.0		Clay	Stiff
63.4	5.8	7.0	17.3	42.8	109.9	0.3	10.6	4.2	10.7	1.9	13.5	76.1		Clay	Stiff
63.2	6.0	7.3	17.4	44.4	111.8	0.3	10.7	4.5	11.7	1.9	13.6	79.0		Clay	Stiff
63.0	6.2	7.4	17.3	45.9	113.8	0.2	10.7	4.2	10.8	1.9	13.7	82.1		Clay	Stiff
62.8	6.3	7.6	17.4	47.4	115.8	0.3	10.5	4.5	11.6	1.9	13.3	83.0		Clay	Stiff
62.6	6.4	7.6	17.3	48.9	117.7	0.2	10.4	4.2	10.6	1.9	13.0	84.1		Clay	Stiff
62.4	6.6	7.7	17.2	50.3	119.7	0.2	10.4	3.8	9.7	1.9	13.1	87.2		Clay	Stiff
62.2	6.9	8.4	17.5	51.9	121.6	0.3	10.6	5.3	13.5	1.9	13.5	91.8		Clay	Stiff
62.0	6.9	8.6	17.6	53.4	123.6	0.3	10.4	5.6	14.3	1.9	13.2	92.7		Clay	Stiff
61.8	6.9	8.4	17.5	55.0	125.6	0.3	9.9	5.3	13.2	1.8	12.2	89.7		Clay	Stiff
61.6	6.9	8.4	17.5	56.5	127.5	0.3	9.6	5.3	13.0	1.8	11.6	88.7		Clay	Stiff
61.4	7.2	9.1	17.8	58.1	129.5	0.3	10.0	6.4	15.9	1.8	12.3	95.4		Silty Clay	Stiff
61.2	7.2	9.1	17.8	59.7	131.5	0.3	9.7	6.4	15.7	1.8	11.7	94.3		Silty Clay	Stiff
61.0	7.4	9.4	17.8	61.3	133.4	0.3	9.7	6.7	16.6	1.8	11.8	97.2		Silty Clay	Stiff
60.8	7.5	9.3	17.7	62.9	135.4	0.3	9.6	6.0	14.8	1.8	11.6	98.4		Clay	Stiff
60.6	7.6	9.6	17.8	64.5	137.3	0.3	9.5	6.7	16.5	1.8	11.3	99.2		Silty Clay	Stiff
60.4	7.9	9.9	17.9	66.1	139.3	0.3	9.7	6.7	16.6	1.8	11.7	104.1		Clay	Very Stiff
60.2	7.4	8.3	17.1	67.6	141.3	0.1	8.6	3.1	7.3	1.7	9.8	92.3		Clay	Stiff
60.0	7.1	7.5	16.6	68.9	143.2	0.1	8.0	1.3	2.9	1.6	8.7	86.2		Clay	Stiff

Project: TC035071 Randle Reef

DMT Results Near Borehole 36

DMT #36

Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	
U -	Pore Pressure	kPa	q -	PC - PO	kPa	
Id -	Material Index		CU -	Undrained Cohesion	kPa	
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg	

Enclosure:	0
GW El.	74.6 m
Delta A	0.22
Delta B	0.43
Zero Gauge Reading	0.00
Elevation	74.62 m

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
59.8	8.2	11.6	18.7	70.7	145.2	0.5	9.3	11.8	28.6	1.8	10.9	105.8		Silty Clay	Very Stiff
59.6	6.9	9.6	18.2	72.4	147.2	0.5	7.3	9.3	20.2	1.5	7.6	80.5		Silty Clay	Stiff
59.4	7.5	10.1	18.2	74.0	149.1	0.4	7.9	8.9	20.2	1.6	8.6	91.1		Silty Clay	Stiff
59.2	7.8	10.6	18.3	75.7	151.1	0.4	8.1	9.6	22.0	1.6	8.9	95.7		Silty Clay	Stiff
59.0	8.4	11.3	18.4	77.5	153.0	0.4	8.6	10.0	23.5	1.7	9.8	106.2		Silty Clay	Very Stiff
58.8	9.2	12.9	18.9	79.3	155.0	0.5	9.4	12.9	31.4	1.8	11.1	120.1		Silty Clay	Very Stiff
58.6	10.0	14.1	19.2	81.2	157.0	0.5	10.2	14.0	35.3	1.9	12.7	136.7		Silty Clay	Very Stiff
58.4	10.0	14.6	19.4	83.1	158.9	0.5	9.9	15.8	39.4	1.8	12.1	135.0		Silty Clay	Very Stiff
58.2	10.0	14.6	19.4	85.0	160.9	0.5	9.7	15.8	39.0	1.8	11.7	133.9		Silty Clay	Very Stiff
58.0	10.0	15.1	19.6	87.0	162.8	0.6	9.4	17.6	43.0	1.8	11.2	132.2		Clayey Silt	Very Stiff
57.8	9.5	14.1	19.3	88.9	164.8	0.6	8.6	15.8	37.2	1.7	9.8	121.8		Silty Clay	Very Stiff
57.6	10.0	15.1	19.6	90.9	166.8	0.6	8.9	17.6	42.1	1.7	10.4	130.0		Clayey Silt	Very Stiff
57.4	10.0	14.6	19.4	92.8	168.7	0.5	8.8	15.8	37.4	1.7	10.0	129.4		Silty Clay	Very Stiff
57.2	10.2	14.6	19.3	94.7	170.7	0.5	8.8	15.1	35.7	1.7	10.1	132.5		Silty Clay	Very Stiff
57.0	9.5	13.6	19.1	96.5	172.7	0.5	7.9	14.0	31.6	1.6	8.5	118.3		Silty Clay	Very Stiff
56.8	10.0	14.6	19.4	98.5	174.6	0.6	8.2	15.8	36.3	1.6	9.0	126.4		Silty Clay	Very Stiff
56.6	10.0	14.3	19.3	100.4	176.6	0.5	8.0	14.7	33.5	1.6	8.8	125.7		Silty Clay	Very Stiff
56.4	9.6	13.1	18.9	102.2	178.5	0.5	7.4	12.2	26.8	1.5	7.7	115.9		Silty Clay	Very Stiff
56.2	9.1	12.8	18.9	104.0	180.5	0.5	6.8	12.9	27.2	1.4	6.7	105.6		Silty Clay	Very Stiff
56.0	8.8	11.6	18.4	105.7	182.5	0.4	6.4	9.6	19.7	1.4	6.2	100.2		Silty Clay	Very Stiff
55.8	9.4	11.9	18.3	107.4	184.4	0.3	6.9	8.5	18.1	1.4	6.9	110.6		Silty Clay	Very Stiff
55.6	9.3	14.6	19.5	109.3	186.4	0.7	6.6	18.4	38.2	1.4	6.5	107.4		Clayey Silt	Very Stiff
55.4	9.1	14.1	19.4	111.2	188.4	0.7	6.3	17.3	35.1	1.4	6.0	103.2		Clayey Silt	Very Stiff
55.2	9.6	13.8	19.1	113.1	190.3	0.5	6.7	14.4	30.0	1.4	6.5	112.1		Silty Clay	Very Stiff
55.0	9.8	14.1	19.2	115.0	192.3	0.5	6.7	14.7	30.8	1.4	6.6	114.8		Silty Clay	Very Stiff
54.8	9.5	14.6	19.5	116.9	194.2	0.7	6.3	17.6	35.8	1.4	6.0	107.9		Clayey Silt	Very Stiff
54.6	10.5	15.1	19.4	118.9	196.2	0.5	7.0	15.8	33.8	1.5	7.1	125.7		Silty Clay	Very Stiff
54.4	10.5	15.1	19.4	120.8	198.2	0.5	6.9	15.8	33.5	1.4	6.9	124.8		Silty Clay	Very Stiff
54.2	10.5	14.4	19.1	122.6	200.1	0.4	6.8	13.3	27.9	1.4	6.7	124.6		Silty Clay	Very Stiff
54.0	7.9	11.6	18.7	124.4	202.1	0.6	4.6	12.9	21.9	1.1	3.6	76.8		Clayey Silt	Stiff
53.8	9.7	22.1	21.1	126.7	204.0	1.6	5.9	43.1	85.7	1.3	8.9		29	Sandy Silt	Dense
53.6	9.3	12.6	18.7	128.5	206.0	0.5	5.5	11.5	21.6	1.2	4.8	99.5		Silty Clay	Stiff
53.4	9.4	12.3	18.5	130.2	208.0	0.4	5.5	10.0	18.8	1.2	4.8	100.9		Silty Clay	Very Stiff
53.2	9.1	12.1	18.5	131.9	209.9	0.4	5.2	10.4	18.9	1.2	4.4	94.9		Silty Clay	Stiff
53.0	9.1	11.6	18.2	133.6	211.9	0.4	5.1	8.5	15.5	1.2	4.3	94.7		Silty Clay	Stiff
52.8	9.6	12.6	18.6	135.4	213.9	0.4	5.4	10.4	19.3	1.2	4.7	102.2		Silty Clay	Very Stiff
52.6	9.5	12.3	18.4	137.1	215.8	0.4	5.2	9.6	17.7	1.2	4.5	100.0		Silty Clay	Stiff
52.4	9.5	12.3	18.4	138.8	217.8	0.4	5.1	9.6	17.5	1.2	4.4	99.3		Silty Clay	Stiff
52.2	9.2	11.8	18.3	140.5	219.7	0.4	4.9	8.9	15.7	1.1	4.0	93.8		Silty Clay	Stiff
52.0	9.4	11.9	18.2	142.2	221.7	0.3	4.9	8.5	15.2	1.1	4.1	96.6		Silty Clay	Stiff
51.8	9.3	11.6	18.1	143.8	223.7	0.3	4.8	7.8	13.7	1.1	3.9	94.5		Silty Clay	Stiff
51.6	9.1	11.4	18.1	145.5	225.6	0.3	4.6	7.8	13.3	1.1	3.7	90.5		Silty Clay	Stiff
51.4	8.3	10.6	18.0	147.1	227.6	0.4	4.0	7.8	12.2	1.0	2.9	76.9		Silty Clay	Stiff
51.2	10.1	12.3	18.1	148.8	229.6	0.3	5.1	7.5	13.5	1.2	4.3	106.2		Clay	Very Stiff
51.0	9.3	11.6	18.1	150.4	231.5	0.3	4.5	7.8	13.2	1.1	3.6	92.1		Silty Clay	Stiff
50.8	9.2	11.6	18.1	152.1	233.5	0.3	4.4	8.2	13.6	1.1	3.4	89.8		Silty Clay	Stiff
50.6	9.2	11.6	18.1	153.8	235.4	0.3	4.3	8.2	13.5	1.0	3.4	89.2		Silty Clay	Stiff
50.4	9.3	11.6	18.1	155.4	237.4	0.3	4.4	7.8	12.9	1.0	3.4	90.4		Silty Clay	Stiff
50.2	9.6	12.1	18.2	157.1	239.4	0.3	4.5	8.5	14.3	1.1	3.5	94.6		Silty Clay	Stiff
50.0	9.8	12.8	18.5	158.9	241.3	0.4	4.5	10.4	17.5	1.1	3.6	96.9		Silty Clay	Stiff
49.8	10.6	13.3	18.4	160.6	243.3	0.3	5.0	9.3	16.5	1.2	4.1	109.9		Silty Clay	Very Stiff
49.6	10.6	13.6	18.6	162.3	245.3	0.4	4.9	10.4	18.3	1.1	4.0	109.0		Silty Clay	Very Stiff
49.4	9.8	12.4	18.3	164.0	247.2	0.4	4.4	8.9	14.7	1.1	3.4	95.4		Silty Clay	Stiff
49.2	9.8	12.6	18.4	165.8	249.2	0.4	4.3	9.6	15.7	1.0	3.3	94.7		Silty Clay	Stiff
49.0	9.1	11.6	18.2	167.4	251.1	0.4	3.8	8.5	13.0	1.0	2.8	83.1		Silty Clay	Stiff
48.8	10.1	12.9	18.4	169.2	253.1	0.4	4.4	9.6	15.9	1.1	3.4	98.5		Silty Clay	Stiff
48.6	10.1	12.8	18.4	170.9	255.1	0.4	4.3	9.3	15.2	1.0	3.3	98.0		Silty Clay	Stiff
48.4	10.1	12.8	18.4	172.6	257.0	0.4	4.2	9.3	15.1	1.0	3.2	97.4		Silty Clay	Stiff
48.2	10.6	13.3	18.4	174.3	259.0	0.3	4.5	9.3	15.5	1.1	3.5	105.0		Silty Clay	Very Stiff
48.0	10.1	13.1	18.6	176.1	260.9	0.4	4.1	10.4	16.5	1.0	3.1	96.0		Silty Clay	Stiff

DMT Results Near Borehole 36

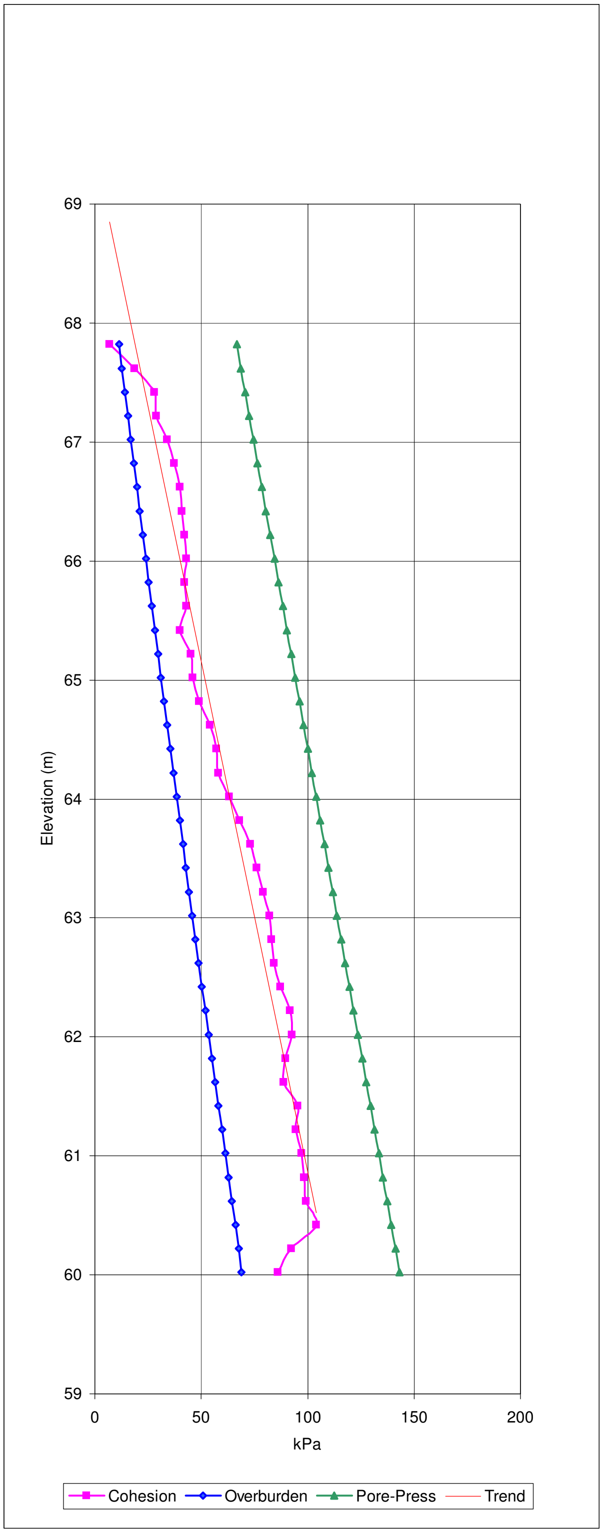
Project: TC035071 Randle Reef

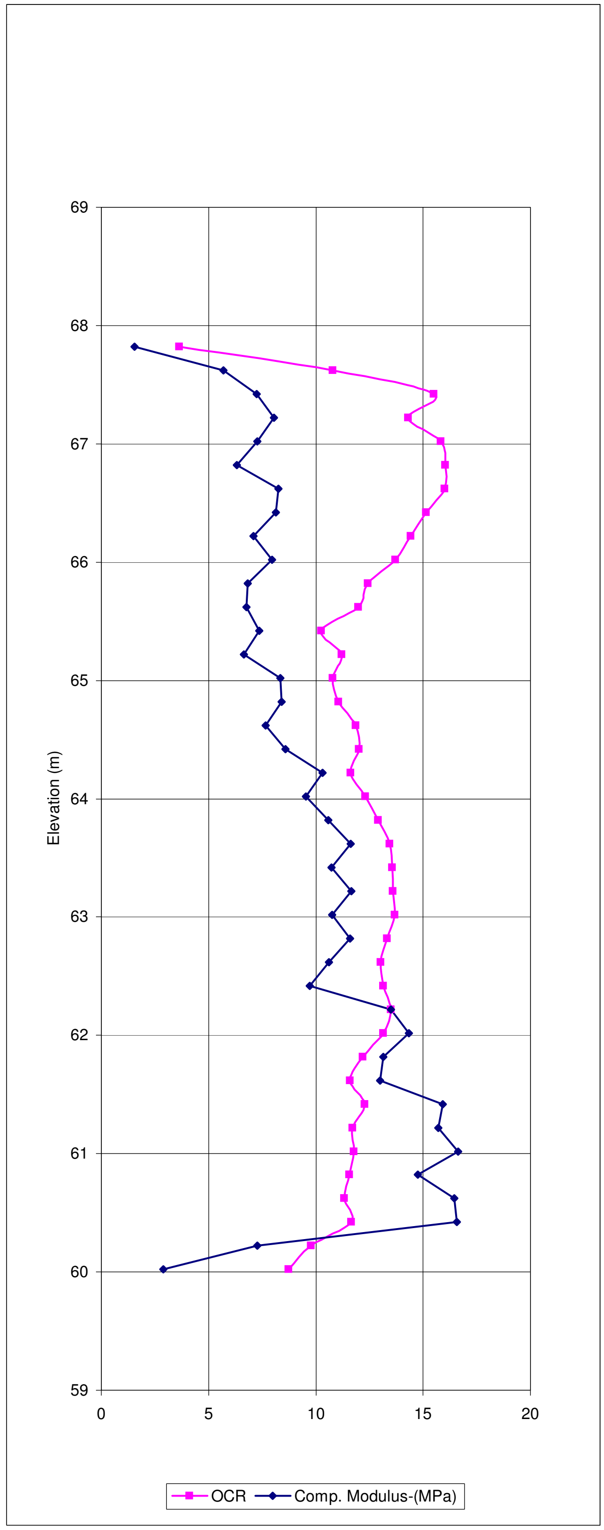
Z -	Elevation	m	Ed -	Dilatometer Modulus	MPa	DMT	#36		
						Enclosure:		0	
						GW El.		74.6	m
A' -	Corrected A Reading	kg/cm2	M -	Constrained (Oedometer) Modulus	MPa	Delta A		0.22	
B' -	Corrected B Reading	kg/cm2	KO -	Coefficient of Earth Pressure		Delta B		0.43	
G -	Bulk Unit Weight	kN/m3	OCR -	Overconsolidation Ratio		Zero Gauge Reading		0.00	
PO -	Effective Overburden Pressure	kPa	PC -	Preconsolidation Pressure	kPa	Elevation		74.62	m
U -	Pore Pressure	kPa	q -	PC - PO	kPa				
Id -	Material Index		CU -	Undrained Cohesion	kPa				
Kd -	Horizontal Stress Index		Phi -	Friction Angle	Deg				

Z	A'	B'	G	PO	U	Id	Kd	Ed	M	KO	OCR	CU	Phi	Description	
47.8	10.6	13.4	18.5	177.8	262.9	0.4	4.4	9.6	15.9	1.1	3.4	103.7		Silty Clay	Very Stiff
47.6	10.1	12.9	18.4	179.5	264.9	0.4	4.0	9.6	15.1	1.0	3.0	95.1		Silty Clay	Stiff
47.4	10.6	13.1	18.3	181.2	266.8	0.3	4.3	8.5	13.9	1.0	3.3	102.8		Silty Clay	Very Stiff
47.2	10.6	13.3	18.4	182.9	268.8	0.3	4.2	9.3	15.0	1.0	3.2	102.1		Silty Clay	Very Stiff

Ref.No. TC035071

DMT Results Near Borehole 36





11/02/2004

Figure C- 3B

APPENDIX D – RESULTS OF LABORATORY TESTS ON SEDIMENT SAMPLES

MEMORANDUM

DATE: February 18, 2004

TO: Ivan Severinsky, AMEC E&E Services Limited

FROM: Carsten Becker, P.E. and Garry E. Horvitz, P.E., Hart Crowser, Inc.

RE: **Randle Reef Sediment Remediation Project**
Consolidation Test Results
7979-01

This memorandum presents the results of geotechnical laboratory testing performed in January/February 2004 at Hart Crowser's laboratory in Seattle to estimate the consolidation behavior of dredged sediments sampled at the Randle Reef site.

INTRODUCTION

An Engineered Containment Facility (ECF) is proposed for the disposal of contaminated sediments at the Randle Reef site. The contaminated sediments will be dredged in areas surrounding the ECF. The test results presented herein will be used to model the consolidation settlement of the dredged material placed within the ECF using the computer model PSDDF (developed by the U.S. Army Corps of Engineers). At this time, it has not been determined whether the sediments will be dredged hydraulically or mechanically. The consolidation behavior of hydraulically dredged material is different than the behavior of mechanically dredged material. This difference in behavior demands the use of two sets of tests to simulate the corresponding conditions. The following tests were conducted:

- Index property tests and analyses including Atterberg limits, specific gravity, grain size, and organic content.
- One oedometer consolidation test on a remolded, composite sample at the as-received moisture content. This test represents the behavior of mechanically dredged sediment.
- One self-weight settlement test using a composite sample. The self-weight settlement test simulates the consolidation behavior of hydraulically dredged sediment at an early stage following deposition when the settled sediment is at its highest void ratio.

Anchorage
Denver
Edmonds
Philadelphia
Portland
Seattle

1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

- One oedometer consolidation test on the settled sediment from the self-weight settlement test. This test represents the behavior of hydraulically dredged sediment at higher stresses starting at a void ratio near the void ratio at the end of the self-weight settlement test.

The test results are summarized in the following section. Additional laboratory test results are presented in Attachment A to this memorandum. Test procedures are outlined at the end of this memorandum.

SUMMARY OF TEST RESULTS

The testing was performed on composite samples from the Randle Reef site. The sediment samples along with water from the site were sampled and provided to Hart Crowser by AMEC. Material from the following samples were combined to make up composite sample material for the various tests that were performed: RR-2, RR-4, RR-10, RR-12, RR-14, RR-20, RR-22, RR-23, RR-24, RR-25, RR-29, RR-30, RR-39, RR-44, and RR-46. The sampling procedures and locations are presented in AMEC's Environmental Studies Report dated December 2003.

Sediment Characterization

Index tests were performed to characterize the composite sediment sample material. Based on these tests, the composite material is characterized as sandy to very sandy SILT (ML) containing 30 percent sand with an organic matter content of 6 percent. The material is slightly plastic (PI = 8) and its initial moisture content is significantly higher than its liquid limit (w_n = 106 percent, LL = 42), which is typical for very soft, surficial sediments. The sediment solids have a specific gravity of 2.68.

Oedometer Test Results

As outlined above, two oedometer tests were conducted to simulate the two basic dredging conditions. The oedometer test results are summarized in Table 1. The test results plotted in terms of void ratio and coefficient of consolidation versus effective stress are presented on Figures 4 and 5.

Table 1 - Summary of Oedometer Consolidation Test Results

	"Mechanically Dredged"	"Hydraulically Dredged"
Initial Bulk Unit Weight in kN/m^3 (pcf)[1)]	15.7 (100)	14.1 (90)
Initial Dry Unit Weight in kN/m^3 (pcf)[1)]	7.5 (48)	6.6 (42)
Initial Moisture Content in Percent[1)]	106	113
Initial Void Ratio[1)]	2.45	2.98
Compression Index	0.43	0.42
Recompression Index	0.01	0.03
Secondary Compression Index	0.037	----

Note: [1)]Condition at beginning of test.

Self-Weight Settlement Test Results

A self-weight settlement test was conducted to obtain the initial void ratio at the time when the interface between supernatant and settled solids first develops and the hydraulically dredged sediment is at nearly zero effective stress. The average void ratio and corresponding average effective stress was also calculated at the end of the test after no further change in effective stress and void ratio is detected and the sediment is in an equilibrium state. The test results are summarized in Table 2, and the test data are presented in Attachment A.

Table 2 - Summary of Self-Weight Settlement Test Results

	"Hydraulically Dredged"
Initial Solids Content in Percent[1) 2)]	12.5
Initial Slurry Concentration in g/L[1)]	136
Average Void Ratio at Formation of Solids Interface	11.8
Average Void Ratio at Equilibrium	3.2
Average Effective Stress at Equilibrium in kPa (psf)	0.59 (12.4)

Notes: [1)]Condition at beginning of test.
[2)]Weight of solids as a percentage of the total weight

TEST PROCEDURES

The test procedures for the index, oedometer consolidation, and self-weight settlement tests on the composite samples from Randle Reef are outlined below.

Sediment Classification

A composite sediment sample was classified in a relatively controlled laboratory environment. The classification was based on laboratory tests such as Atterberg limits determination and grain size analyses and was made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure 1.

Moisture Content Determinations

Moisture contents were determined in general accordance with ASTM D 2216. Moisture contents were conducted for samples subjected to consolidation testing and are reported along with the consolidation test results.

Atterberg Limits

We determined Atterberg limits for the composite sample material. The liquid limit and plastic limit were determined in general accordance with ASTM D 4318. The results of the Atterberg limits analyses and the plasticity characteristics are summarized in the Liquid and Plastic Limits Test Report, Figure 2. This relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits tests are also shown on the consolidation test figures.

Specific Gravity

Hart Crowser's laboratory determined specific gravity for one composite sample. Specific gravity is a measure of the density of the sediment solids, and is expressed as a multiple of the density of water. Specific gravity was determined in general accordance with ASTM 854-91. The test data are presented in Attachment A.

Grain Size Analysis

Grain size distribution was analyzed on a composite sample in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method. The results of the tests are presented as a curve on Figure 3 plotting percent finer by weight versus grain size.

Organic Content

Organic content of the composite sample material was determined in general accordance with ASTM D 2974 - Method C. The moisture content of the sample was determined using Method A. The test data are presented in Attachment A.

Self-Weight Settlement Test

The self-weight settlement test is described as part of the settling column test procedure, which can be obtained via the World Wide Web on the U.S. Army Engineer Waterways Experiment Station web page (http://www.wes.army.mil). The self-weight settlement test simulates the consolidation behavior of hydraulically dredged material shortly after sediment deposition and the formation of an interface that develops between the water and the settled solids.

Before initiation of the test, a slurry was mixed using on-site water and composite sample material. Deionized as well as on-site water was added to achieve the required slurry volume for the test. The appropriate slurry concentration for the test was estimated based on the grain size distribution of the material. After thoroughly mixing the slurry in a drum, a 6-foot-high, 8-inch-diameter column was filled rapidly while compressed air was introduced at the bottom of the column to keep the solids in suspension until the start of the test. The test was then initiated by turning off the compressed air and the start time was recorded. After a solids interface developed, the interface height was recorded as a function of time. The test was carried out for 15 days. The equilibrium condition at which the column height no longer continued to change was reached a few days before the test was terminated.

The objective of the test is to obtain the initial void ratio at the time when the interface first occurs and the sediment is at nearly zero effective stress. The average void ratio and corresponding average effective stress is also calculated at the end of the test after no further change in effective stress and void ratio is detected, and the sediment is in an equilibrium state.

Consolidation Test

The one-dimensional consolidation test provides data for estimating the magnitude and time rate of settlement. The test was performed using the oedometer method described in U.S. Army Corps of Engineers (1987). In this method, a remolded sample of the material to be dredged is placed in the oedometer ring with porous stones placed on the top and bottom of the sample to allow drainage. Vertical loads were then applied incrementally to the sample in such a way that the sample was allowed to consolidate under each load increment. Measurements were made of the compression of the sample as a function of time under each load increment. Rebound was measured during the unloading phase. In general, each load was left in-place until the completion of 100 percent primary consolidation, as computed using Taylor's square root of time method. The next load increment was applied soon after attaining 100 percent primary consolidation. For a selected test, a load was left in-place for as long as 26 hours to record secondary consolidation characteristics.

Two oedometer tests were conducted, one for each method of dredging. A test to represent the behavior of mechanically dredged material was conducted at the *in situ* moisture content (i.e., the moisture content at which the material arrived at our laboratory, which should be close to the moisture content at the time of sampling). The results on the "mechanically dredged material" are shown on Figure 4. A second oedometer test was performed on the remolded, settled material from the self-weight settlement test. This test represents the behavior of hydraulically dredged material at stresses higher than simulated in the self-weight settlement test. The results on the "hydraulically dredged material" are shown on Figure 5. The test results are plotted in terms of void ratio and coefficient of consolidation versus effective stress.

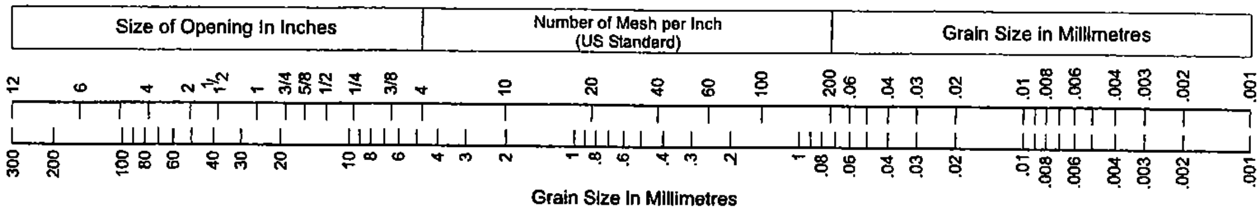
REFERENCES

U.S. Army Corps of Engineers 1987. Confined Disposal of Dredged Material, Engineer Manual EM 1110-2-5027.

Attachments:
Figure 1 - Unified Soil Classification (USC) System
Figure 2 - Liquid and Plastic Limit Test Report
Figure 3 - Particle Size Distribution Report
Figures 4 and 5 - Consolidation Test Results
Attachment A - Other Laboratory Test Results

F:\docs\jobs\797901\Consolidation Results Memo.doc

Unified Soil Classification (USC) System
Soil Grain Size



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines		* GRAVEL with >12% fines		Clean SAND <5% fines		* SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W $\quad \& \; 1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

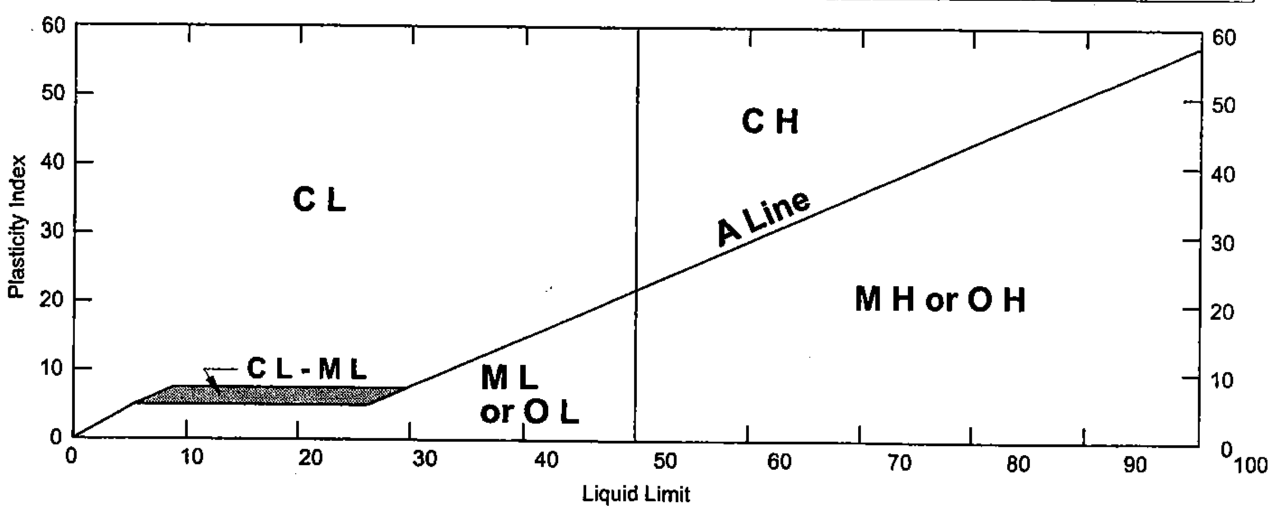
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

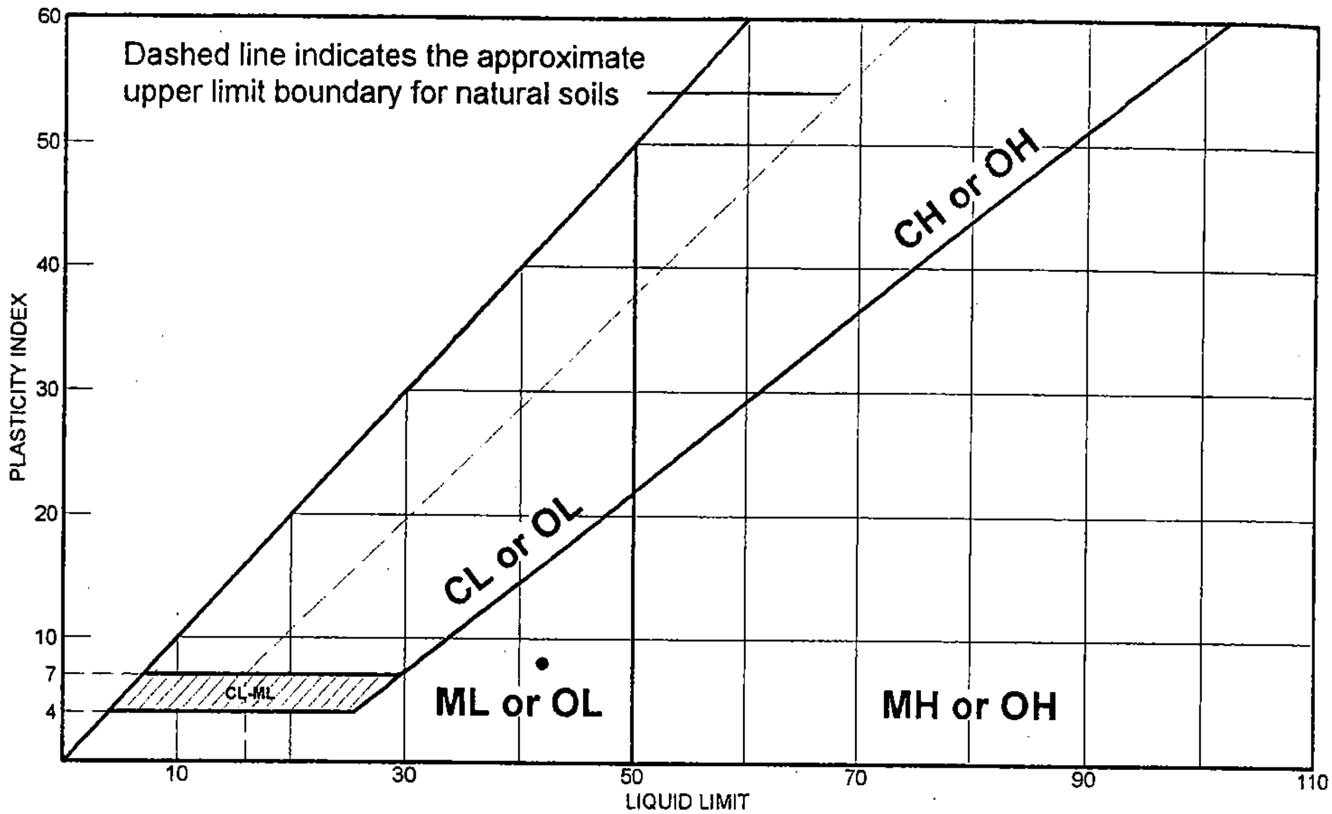
M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



HARTCROWSER
7979-01 *2/04*
Figure 1

Grain Size (B-1).cdr

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS
● Source: Sample No.: Composite Clayey, very sandy SILT	42	34	8	67.1	ML

Remarks:
●

Project: Randle Reef Geotechnical Lab Testing

Client: AMEC

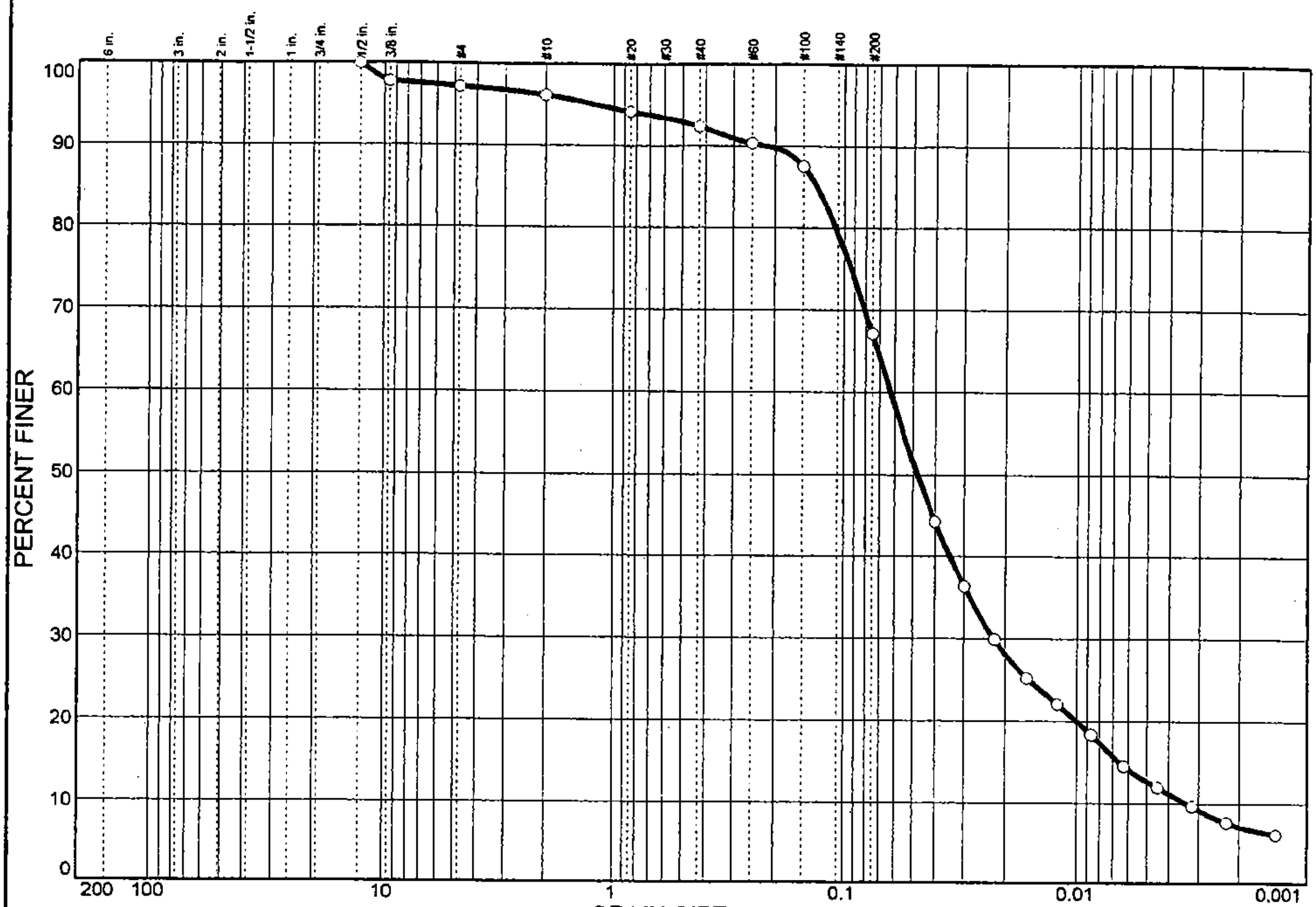
Location: Hamilton, Ontario, Canada

HARTCROWSER

797901 2/13/2004

Figure No. 2

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	2.8	30.1	54.4	12.7

☒	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	42	8	0.132	0.0624	0.0478	0.0223	0.0066	0.0034	2.34	18.35

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Clayey, very sandy SILT	ML	106%

Remarks:

○

Project: Randle Reef Geotechnical Lab Testing

Client: AMEC

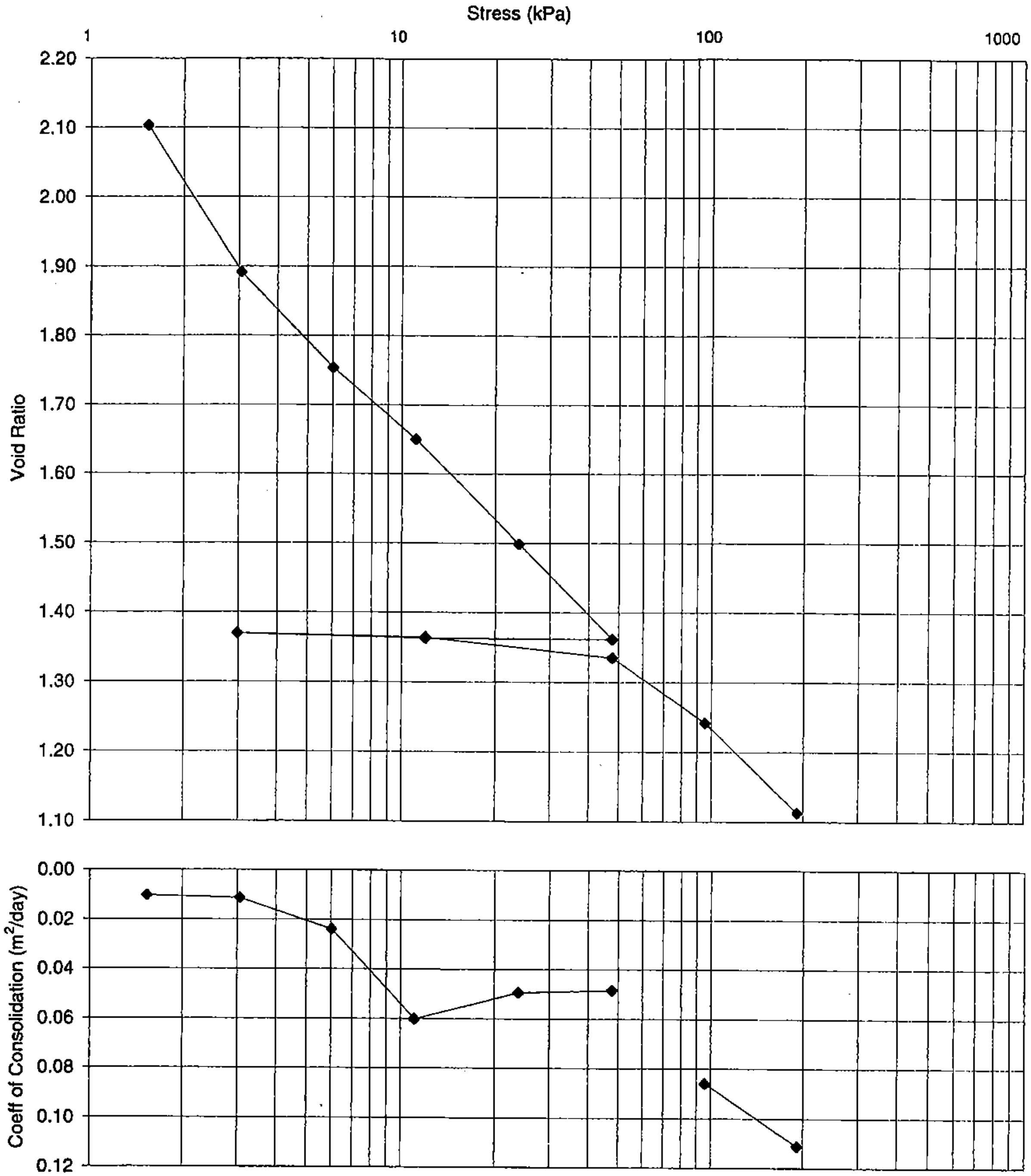
○ **Source:** **Sample No.:** Composite

HARTCROWSER

797901 2/13/2004

Figure No. 3

CONSOLIDATION TEST RESULTS



Expl. No.	Sample No.	Depth (ft)	W.C. %		Atterberg Limit			Wet Wt (pcf)	USCS	Description
			Before	After	LL	PL	PI			
AMEC	Comp.	-	106%	39%	42	34	8	15.7 KN/m^3	ML	Clayey, very sandy SILT

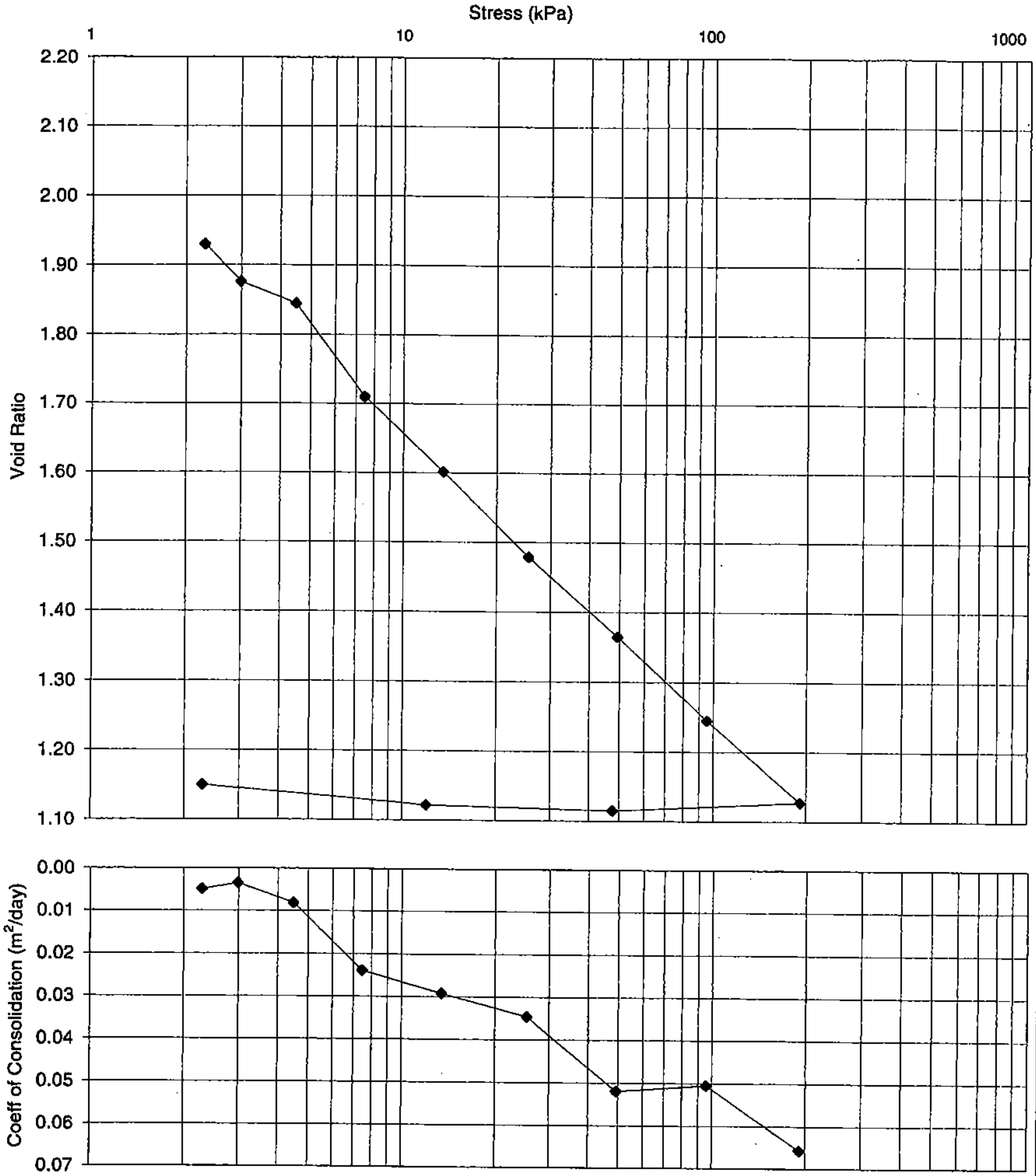
Remarks: Test to simulate behavior of "mechanically dredged material".

HARTCROWSER

J-7979-01 1/13/2004

Figure 4

CONSOLIDATION TEST RESULTS



Expl. No.	Sample No.	Depth (ft)	W.C. %		Atterberg Limit			Wet Wt (pcf)	USCS	Description
			Before	After	LL	PL	PI			
AMEC	Comp.	-	113%	39%	42	34	8	14.1 KN/m^3	ML	Clayey, very sandy SILT

Remarks: Test to simulate behavior of "hydraulically dredged material". Test was conducted on material from the self-weight settlement test column.

HARTCROWSER

J-7979-01 2/5/2004

Figure 5

ATTACHMENT A
OTHER LABORATORY TEST RESULTS

Randle Reef - Self-Weight Settlement Test Data - Composite Sediment Sample

Date and Time	Measured Soil Water Interface Height from Base in Feet	Height of Top of Water Column in Feet	Water/Zone Settling Interface Height in Feet
1/20/2004 10:37	4.950	4.950	
1/20/2004 11:37	3.020	4.930	
1/20/2004 12:37	2.260	4.930	
1/20/2004 13:37	1.820	4.920	
1/20/2004 14:37	1.660	4.920	
1/20/2004 15:37	1.590	4.920	
1/20/2004 16:37	1.550	4.920	
1/21/2004 6:14	1.230	4.910	
1/21/2004 17:21	1.150	4.910	
1/22/2004 6:23	1.100	4.910	
1/22/2004 15:32	1.065	4.910	
1/23/2004 8:25	1.035	4.910	
1/23/2004 14:05	1.030	4.910	4.790
1/26/2004 8:40	1.000	4.900	
1/28/2004 8:03	0.990	4.910	4.460
1/30/2004 8:34	0.995	4.910	4.210
2/2/2004 7:20	0.995	4.910	3.850
2/4/2004 10:40	0.995	4.910	0.995

Other Data:
Diameter of Column - 8.00 inches
Initial dry weight of sediment - 6250 grams
Initial weight of water - 43755 grams
Specific gravity of sediment - 2.68
Solids retained in water at end of test - 0.7 mg/L
Add base measuring point correction to height readings to get actual height
Distance of base measuring point from actual bottom of column - 0.012 feet

Specific Gravity

Date: 2/3/2004

Job Name: Randle Reef Geotechnical Testing

Job No: 7979-01

Boring Number	----	----	----	----	----	----	
Sample ID	Composite						
Depth (feet)	----						
Flask Number	B-2						
Tx (Centigrade)	21.1						
Tare ID	SA-27						
Tare Wt	377.29						
Wo + Tare	525.75						
Wo (gm)	148.46						
Wa (gm)	661.83						
Wo + Wa	810.29						-
Wb (gm)	754.92						-
Wo + Wa - Wb	55.37						
K	0.99977						-
Gs	2.68						-

Gs = Wo /(Wo+Wa-Wb) * K

Gs = Specific gravity of soil
Tx = Temperature of contents of Volumetric Flask when Wb was determined
Wo = Weight of oven dry sample
Wa = Weight of Volumetric Flask filled with water at Tx
Wb = Weight of Volumetric Flask filled with water and soil at Tx
K = Correction coefficient for density of water at Tx

Tested By: GWK

Organic Content

Job Name: Randle Reef

Job No: 797901

Sample Number	Geotech					
Boring Number	Composite					
Depth						
Tare ID	V					
Tare Wt	162.04					
Dry + Tare	200.69					
Dry + Tare, After Ashing	198.51					
% Organic Content	6 %	-	-	-	-	-

Tst By: GWK

Chk By: GWK

APPENDIX E – REPORT LIMITATIONS

REPORT LIMITATIONS

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. AMEC Earth & Environmental Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix A
Geotechnical Investigations

ITEM A3

Excerpts from: Trow Consulting Engineers Ltd. - Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour Pier 16, Hamilton, Ontario, August 1999.

Geotechnical Sampling of Sediment Dredging of Hamilton Harbour Pier 16 Hamilton, Ontario

Prepared for:

Mr. J. Shaw
Chief, Great Lakes 2000 Clean-up Fund
867 Lakeshore Road
Burlington, Ontario
L7R 4A6

Trow Consulting Engineers Ltd.

428 Millen Road
Stoney Creek, Ontario L8E 3N9
Telephone: (905) 664-3300
Facsimile: (905) 662-4144

HAGE-0053319-A
August 10, 1999

Table of Contents

1. Introduction

Trow Consulting Engineers Ltd. (Trow) was retained by the Great Lakes 2000 Clean-up Fund to conduct geotechnical sampling of sediment west of Pier 16 within the Hamilton Harbour for the purpose of assessing dredging operations in Hamilton, Ontario (Drawing No. 1). Authorization to proceed with the investigation was provided by Mr. John Shaw Chief of the Great Lakes 2000 Clean-up Fund.

The project will involve the dredging of an area immediately adjacent to Pier 16 on the west side and north of the mouth of the former Sherman Inlet. This area is also known as The Randel Reef. It is understood that the proposed area to be dredged was previously sampled and analytical testing was conducted by others. The previously sampled boreholes met refusal at depths of up to 2.1 m within or on an unknown material. The purpose of this investigation was to determine the geotechnical engineering properties of the unknown materials where refusal was met during the initial sampling program.

2. Terms of Reference

The geotechnical investigation was undertaken to:

a) establish the sediment and/or soil conditions at the site based on drilling eight (8) boreholes (each to 4 m (13 ft.) depth below harbour bottom) at locations specified by the Client, and

b) provide geotechnical engineering recommendations regarding dredging operations.

The following modifications to the terms of reference were made:

a) Nine (9) boreholes were drilled instead of eight (8). The boreholes extended to depths of 2.4 (~7' 10") to 4.9 (~16' 1") m below harbour bottom.

b) Based on subsequent discussions with the Client, geotechnical engineering recommendations regarding dredging operations are not required at this time. The report should be factual in nature.

c) The laboratory testing program was to consist of natural moisture content tests on all recovered soil and sediment samples. In addition, grain size analysis, Atterberg Limits and unit weights on selected soil samples was proposed.

   Based on subsequent meetings and correspondences with the Client, it was determined that additional laboratory testing was not required at this time and hence, grain size analysis, Atterberg Limit and unit weights were eliminated from the program. The samples will be retained for up to 3 months from the date of sample collection in Trow's laboratory. The samples will be discarded beyond this time period unless a longer retention time is requested by the Client.

   Environmental testing was not conducted as part of this sampling program, hence, this report does not reflect the environmental conditions at the site.

3. Investigation Program

3.1 Fieldwork

The fieldwork for this investigation was carried out from April 19 to 26, 1999. In accordance with the terms of reference (TOR), and subsequent modifications, nine (9) boreholes were located within the area to be investigated. The borehole locations are shown on Drawing No. 2. The boreholes were advanced by N-casing using equipment owned and operated by a specialized drilling subcontractor, under the full-time monitoring by Trow Consulting Engineers Ltd.

As requested, nine (9) boreholes were drilled at the proposed borehole locations shown on Drawing No. 2. Each borehole was advanced to depths ranging from 2.4 (~7' 10") to 4.9 (~16' 1") m below the harbour bottom, Elevation 61.3 to 65.0 m. The boreholes were advanced by means of a drill rig adapted for soil sampling mounted on the front of a spud barge.

The fieldwork was monitored by a member of Trow's engineering staff who directed the drilling and sampling operations, and documented the stratigraphy encountered at the boreholes.

Soil samples were retrieved on a continuous basis by using the split spoon sampler driven in accordance with the standard penetration test procedures. The undrained shear strength of the cohesive soils was measured using a field vane and pocket penetrometer. Poor sample recovery during the early stages of the fieldwork indicated other sampling equipment such as thin walled tubes (shelby tubes), piston samplers and side samplers were necessary to obtain sufficient sample recovery.

The borehole locations were established in the field by Trow Consulting Engineers Ltd. utilizing a Global Positioning System unit (GPS) supplied by the Canada Centre For Inland Waters (CCIW), Technical Operations Division. Antennae and receivers for the GPS unit were mounted on the top of the drill rig mast. Final borehole position co-ordinates (northing and eastings) were recorded once the spuds from the barge were set in the lake bottom and locations ranged from 0.2 to 5.7 m out of proposed layout centres. Final positions of each borehole are recorded on each borehole log.

The borehole elevations were determined from lake level elevations (on the days the fieldwork was conducted) provided by CCIW.

4. Summarized Subsurface Soil Conditions

Details of the fieldwork including soil descriptions, inferred stratigraphy, sampling methods, standard penetration 'N' values, shear strengths, and sampling method in the boreholes during and following completion of drilling are given on the Log of Borehole sheets, (Drawing Nos. 3 to 11). A summary of the borehole information is also presented in tabular form in Appendix A.

It must be noted that the boundaries of soil indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical assessment and should not be interpreted as exact planes of geological change. It should be noted that the "Notes on Sample Description", preceding the borehole logs, forms an integral part of the report and should be read in conjunction with it.

A brief description of the soils stratigraphy encountered at the borehole locations is summarized, in order of depth, in the following sections.

4.1 Water

The depth of water at each borehole location was determined by CCIW - Technical Operations Division prior to drilling. The lake level elevations were in the order of Elevation 74.7 m. The depth of water varied from approximately 6.0 to 11.0 m below the mean water level of the lake. At the borehole locations, the harbour bottom was contacted at Elevation 63.7 to 68.7 m.

4.2 Fill

A layer of fill was encountered at the surface of each borehole (ie. the harbour bottom) and ranges from approximately 0.8 to 3.4 m depth below harbour bottom, Elevation 62.5 to 66.5 m. The fill was not penetrated in Borehole Nos. 28 and 13. In general, the fill consists of a heterogeneous mixture of sandy silt to silt sediment, dark grey to black in colour with some fragments of coal tar, slag and trace organics (wood, rootlets). Numerous fragments of suspected slag were encountered in the fill within Borehole Nos. 28 and 13. The fill had significant coal tar (hydrocarbon) stains and odours. The compactness condition of the cohesionless portion of the fill based on SPT results of Borehole Nos. 28 and 13 is very loose to compact. The consistency of the cohesive portion based on shear strength measurements (from field vane tests) of 20 to greater than 115 kPa is soft to very stiff. The moisture content of the fill is 13 to 292 percent.

Sandy Silt to Silty Sand

A layer of sandy silt to silty sand was encountered beneath the fill in Borehole Nos. 11 and 18 and extended to 1.8 and 4.3 m depth below harbour bottom, Elevation 63.9 and 63.4 m. This layer was also encountered in Borehole No. 21 below the clay at 2.2 m depth below harbour bottom, Elevation 61.5 m. In general, this layer is described as a grey to brown sandy silt to silty sand with trace gravel, trace organics (shells, rootlets in Borehole No. 18) with no coal tar (hydrocarbons) stains or odours. Based on SPT N values from Borehole Nos. 11 and 18, the compactness condition of the sandy silt to silty sand is loose to dense and the natural moisture content ranges from 16 to 29 percent.

Clay

Beneath the fill in Borehole Nos. 154, 6, 22 and 21 and beneath a layer of sandy silt to silty sand in Borehole No. 11 exists a grey clay layer. The clay was penetrated in Borehole No. 21 at 2.2 m depth below harbour bottom, Elevation 61.5 m. In general, the clay is described as grey with trace silt and sand having no stains or odours and becoming till-like with trace to some sand and gravel in Boreholes No. 22 and 21. The undrained shear strength of the clay, based on field vane and pocket penetrometer tests was up to 115 kPa which indicates a very soft to very stiff consistency. The sensitivity of the clay was 1.0 to 9.2 indicating a low to highly sensitive clay. The natural moisture content of the clay ranges from 23 to 37 percent.

Organic Silt

Beneath the layer of fill within Borehole No. 14 and beneath a layer of silty sand within Borehole No. 18, a layer of organic silt was encountered at depths of 2.5 and 4.3 m below harbour bottom, Elevation 63.4 and 65.2 m. Both boreholes terminated within this layer. In general, this layer is described as a greeenish grey to grey organic silt with trace to some sand and gravel, trace organics (wood, rootlets). The silt has a spongy texture with organic stains, slight coal tar (hydrocarbon) stains and odours. Based on field vane tests from Borehole No. 14, the measured shear strength of the organic silt is 70 to 110 kPa indicating a consistency of stiff to very stiff. The natural moisture content of the silt is 69 to 87 percent.

5. Environmental Considerations

The disposal of any excess material is regulated by the current provincial government environmental regulations. If any of the excess material is disposed of off-site, the material should be tested so that the disposal of such material will be carried out in compliance with the environmental guidelines. Ontario Regulation 347 (O.Reg. 347) would apply. Trow will composite and retain the excess samples collected during this investigation and submit composite samples for O.Reg. 347 testing (leachate chemistry) to assess disposal options.

We trust this information is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

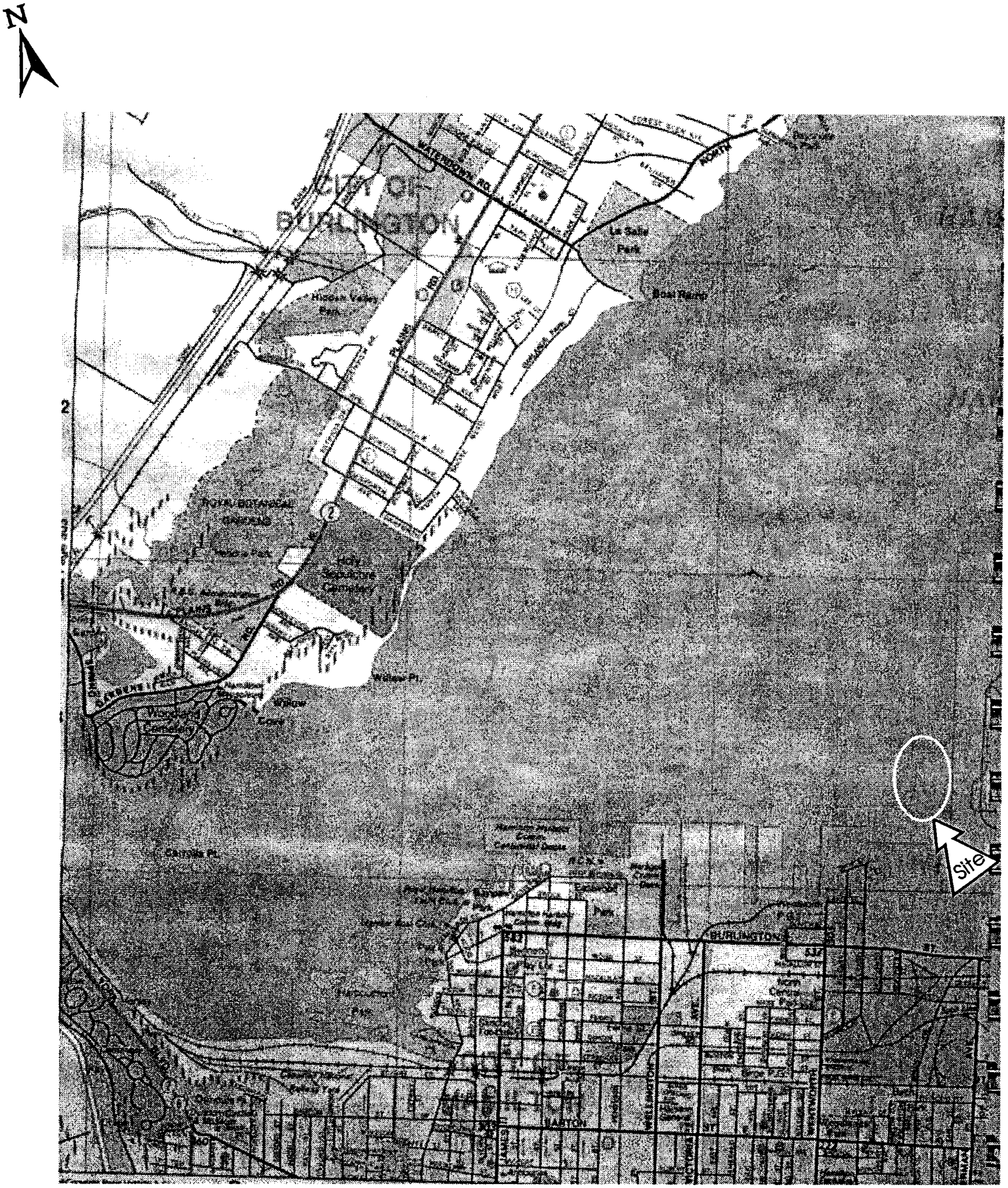
Yours very truly,

Trow Consulting Engineers Ltd.

Todd Barlow, P.Eng.
Field Engineer
Geotechnical Services Group

S. M. Potyondy, P.Eng.
Head, Geotechnical Services Group

Drawings:

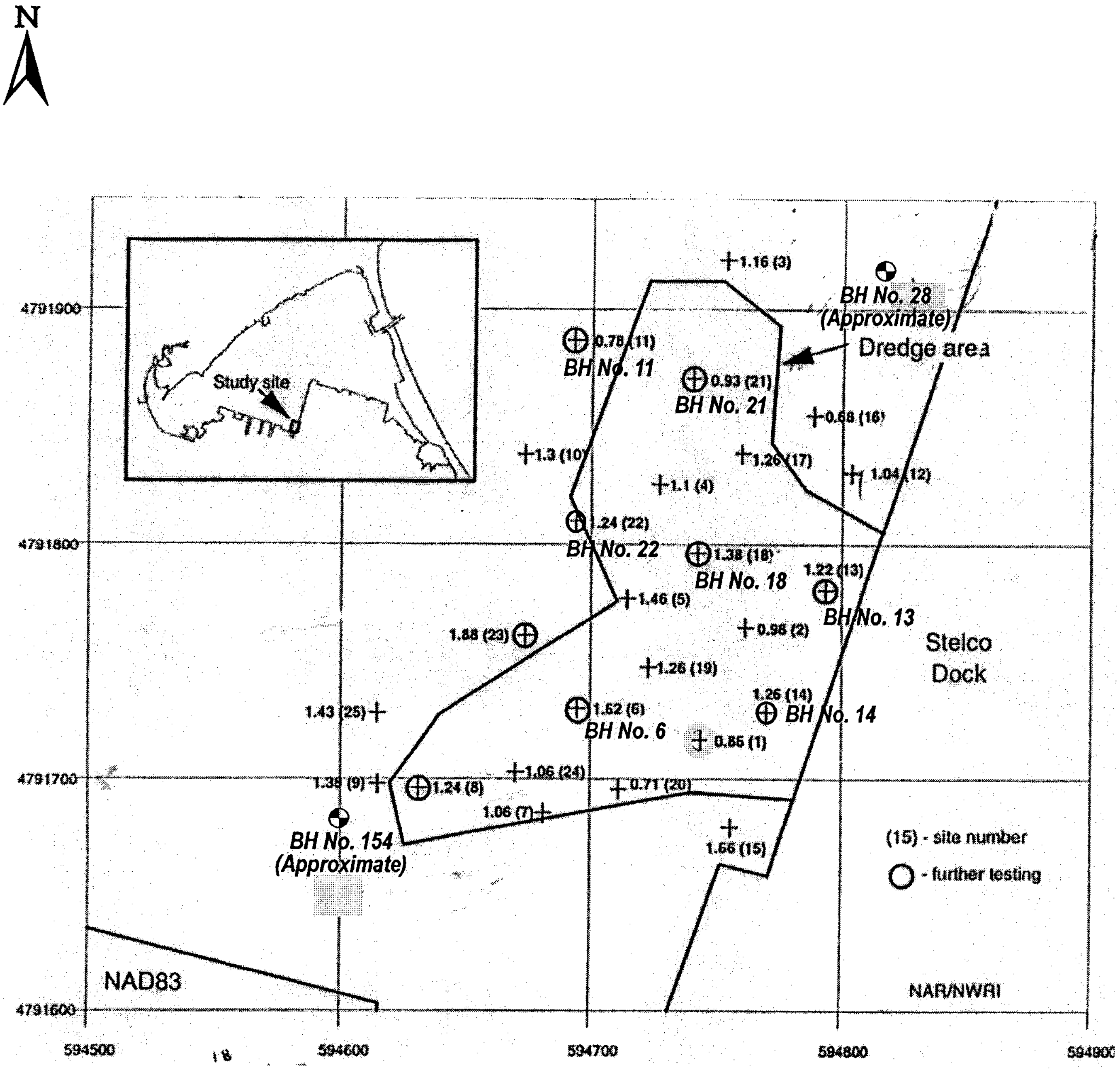


Geotechnical Sampling of Sediment
Derdging of Hamilton Harbour, Pier 16,
Hamilton, Ontario
HAGE-0053319-A/E

Location Plan

Drawing No. 1
August, 1999

TROW CONSULTING ENGINEERS LTD.



Note:

Site Plan Modified as supplied to Trow by CCIW via the Great Lakes 2000 Clean-Up Fund.

LEGEND

- Borehole Location Corresponding to CCIW Site No.

* All Dimensions are Approximate as Shown.

Notes:

1) Boundaries and soil types have been established only at Borehole locations.
Between Boreholes they are assumed and may be subject to considerable error.
2) Soil Samples will be retained in storage for 3 months and then destroyed unless the client advises otherwise.
3) Topsoil quantities should not be established from the information provided at the Borehole locations.
4) Borehole elevations should not be used to design building(s), or floor slab(s), or parking lot(s) grades.

Geotechnical Sampling of Sediment
Dredging of Hamilton Harbour, Pier 16,
Hamilton, Ontario
HAEN-0053319-A/E

Site Plan

Drawing No. 2
August, 1999
N.T.S.

TROW CONSULTING ENGINEERS LTD.

NOTES ON SAMPLE DESCRIPTIONS

1. All sample descriptions included in this report follow the Canadian Foundation Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Trow also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200	

EQUIVALENT GRAIN DIAMETER IN MILLIMTERES

CLAY (Plastic) to SILT (Non Plastic)	FINE	MEDIUM	COARSE	FINE	COARSE	
	SAND			GRAVEL		

UNIFIED SOIL CLASSIFICATION

2. **Fill:** Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstructions such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. **Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

LOG OF BOREHOLE 28

Trow

Legend	Symbol
Piston Sample	▥
Side Sampler	☒
SPT(N) Value	○○ ▩
Dynamic Cone Test	——
Shelby or BenthosTube	●● ■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——o
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 856.0 m
N 4 791 976.7 m

Dwg. No: 3

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Water Level	Elev. Scale (m) 74.66	Soil Description	Depth Scale m	Depth Scale ft	N Value	N Value 20 40 60 80 / Shear Strength kPa 100 200	Natural Moisture Content % Dry Weight 10 20 30	Sample
		Approximate Depth of Water = 10.0 m (as reported by CCIW - Tech Ops.)		32				
	~64.7 ~(10.0)	FILL: Sandy Silt to Silt Sediment and coal tar sludge, black, numerous fragments of slag, trace fragments of coal tar, (sand to cobble size), coal tar (hydrocarbon) stains and odours, very loose to compact, wet.	10	34	6	o	X = 130%	▩
		- limited sample recovery due to suspected presence of slag throughout, based on drilling and sampling observations in the field.	11	36	8	o	X	▩
				38	23	o	X	▩
		- heterogenous mixture of silty sand to clayey silt, dark brown to black, with oxidized and coal tar stains and odours and numerous fragments of slag from 11.7 to 12.4 m depth.	12	40	2	o	X	▩
	~62.3 ~(12.4)	*BOREHOLE TERMINATED*						
			13	42				
				44				
			14	46				

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 2.4 m below the Lake bottom or at 12.4 m depth from top of water level in lake on April 19, 1999.
2. Borehole advanced by means of wash-boring techniques (where applicable).

LOG OF BOREHOLE 13

Trow

Symbol	
Piston Sample	
Side Sampler	
SPT(N) Value	O O
Dynamic Cone Test	
Shelby or BenthosTube	● ● ■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 792.9 m
N 4 791 783.1 m

Dwg. No: 4

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Water Level	Elev. Scale (m) 74.66	Soil Description	Depth (m)	N Value	N Value (20 40 60 80) / Shear Strength kPa (100 200)	Natural Moisture Content % Dry Weight (10 20 30)	Sample
		Approximate Depth of Water = 9.0 m (as reported by CCIW - Tech Ops.)				Benthos Sample Retrieved from CCIW - Tech Ops. from 0 to 0.3 m depth below lake bottom or approx. 9.0 to 9.3 m depth from top of water level in lake	
	~65.7 ~(9.0)	FILL: Sandy Silt to Clayey Silt Sediment and coal tar sludge, black, numerous fragments of slag, trace fragments of coal tar, (sand to cobble size), coal tar (hydrocarbon) stains and odours, loose to compact, stiff to very stiff, wet.		-		X = 68%	
		- limited sample recovery due to suspected presence of slag throughout, based on drilling and sampling observations in the field.	10	23	O	X = 73%	
		-mixed with trace to some organics (wood) and organic silt from 9.6 to 11.4 m depth.			+ > 115 kPa		
				15	O + s = 2.2	X = 58%	
			11	5	O + s = 9.2	X = 51%	
		-heterogenous mixture of silty sand, dark brown to black, with coal tar stains and odours and numerous fragments of slag from 11.4 to 12.7 m depth.		13	O	X = 59%	
			12	8	O	X = No sample for Moisture Content Retained - Large Fragment of Slag	
	~62.0 ~(12.7)	*BOREHOLE TERMINATED*	13				

Depth scale (ft): 28, 30, 32, 34, 36, 38, 40, 42, 44

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 3.7 m below the Lake bottom or 12.7 m depth from top of water level in lake on April 19 and 20, 1999.
2. Borehole advanced by means of wash-boring techniques (where applicable).

LOG OF BOREHOLE 14

Trow

Legend	Symbol
Piston Sample	
Side Sampler	☒
SPT(N) Value	O O
Dynamic Cone Test	——
Shelby or BenthosTube	● ● ■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——o
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Dwg. No: 5

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Borehole Location : E 594 778.6 m
N 4 791 724.3 m

Elev. Scale (m) 74.66	Soil Description	Depth (m)	Depth (ft)	N Value	Shear Strength (kPa)	Natural Moisture Content % Dry Weight
	Approximate Depth of Water = 7.0 m (as reported by CCIW - Tech Ops.)		22			
~67.7 ~(7.0)	FILL: Sandy Silt to Clayey Silt Sediment and coal tar sludge, black, trace fragments of slag, and coal tar (sand size), trace organics (wood pieces), coal tar (hydrocarbon) stains and odours, firm to stiff, wet.	7	24	-		*Benthos Sample Retrieved from CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottomor approx. 7.0 to 7.6 m depth from top of water level in lake.* X = No Sample for Moisture Content Retained
		8	26	-		X = 90%
	-heavy coal tar sludge (thick) from 7.6 to 9.5 m depth below lake bottom.		28	-		X = 63.5%
					s = 2.5	
		9	30	-	s = 9.4	X = 56%
~65.2 ~(9.5)					s = 3.0	
	ORGANIC CLAYEY SILT: Greenish-grey to grey, trace to some sand, trace gravel, trace organics (wood, rootlets), spongy texture, organic stains, slight coal tar odour, stiff to very stiff, moist to wet.		32	5	s = 3.1	X = 98%
		10			s = 1.8	
			34	pushed spoon	s = 1.5	X = 69%
~64.0 ~(10.7)	- soil type from 10.7 to 11.0 m depth assumed to be organic clayey silt.				s = 1.7	
~63.7 ~(11.0)	*BOREHOLE TERMINATED*	11	36		s = 1.9	

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 4.0 m below the Lake bottom or 11.0 depth from top of water level in lake on April 20 and 21, 1999
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).
3. Vane Profile Hole conducted approximately 0.3 m to the south of existing hole.

LOG OF BOREHOLE 154

Trow

Legend	Symbol
Piston Sample	
Side Sampler	⊠
SPT(N) Value	O O
Dynamic Cone Test	——
Shelby or BenthosTube	● ● ■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——o
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 604.1 m
N 4 791 677.5 m

Dwg. No: 6

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Water Level	Elev. Scale (m) 74.66	Soil Description	Depth Scale (m)	Depth Scale (ft)	N Value	N Value (20, 40, 60, 80) / Shear Strength (100, 200 kPa)	Natural Moisture Content % Dry Weight (10, 20, 30)	Sample
		Approximate Depth of Water = 6.0 m (as reported by CCIW - Tech Ops.)						
	~68.7 ~(6.0)	FILL: Sandy Silt to Silt Sediment and coal tar sludge, black, trace fragments of coal tar (sand size), trace organics (wood pieces), coal tar (hydrocarbon) stains and odours, wet.	6	20	-		*Benthos Sample Retrived from CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottom or approx. 6.0 to 6.6 m depth from top of water level in lake.* X = 135%	⊠
			7	22	-		X = 129%	⊠
		-heavy coal tar sludge (thick) from 6.6 to 8.2 m depth.		24	-		X = 123%	⊠
	~66.5 ~(8.2)	CLAY: Grey, trace silt and sand, no stains or odours, firm, moist to wet.	8	26	-		X	■
				28	-	+ s = 1.5	X	■
			9	30	-	+ s = 1.5	X	■
	~65.0 ~(9.7)	*BOREHOLE TERMINATED*		32				
			10	34				

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 3.7 m below the Lake bottom or 9.7 m from top of water level in lake on April 22, 1999.
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).

LOG OF BOREHOLE 6

Trow

Legend	Symbol
Piston Sample	▥
Side Sampler	⊠
SPT(N) Value	○○▩
Dynamic Cone Test	——
Shelby or BenthosTube	●●■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——o
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 692.1 m N 4 791 733.6 m

Dwg. No: 7

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Water Level	Elev. Scale (m) 74.67	Soil Description	Depth Scale m	Depth Scale ft	N Value	N Value 20 40 60 80 / Shear Strength 100 200 kPa	Natural Moisture Content % Dry Weight 10 20 30	Sample
		Approximate Depth of Water = 7.0 m (as reported by CCIW - Tech Ops.)		22			Benthos Sample Retrived from CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottom o approx. 7.0 to 7.6 m depth from top of water level in lake.	
	~67.7 ~(7.0)	FILL: Sandy Silt to Clayey Silt Sediment and coal tar sludge, black, trace fragments of coal tar (sand size), trace organics (wood pieces), coal tar (hydrocarbon) stains and odours, soft to firm, wet.	7	24	-		X = No Sample for Moisture Content Retained	Benthos Tube
			8	26	-		X = 129%	Side Sampler
						+s = 1.0		
				28	-	+s = 1.2	X = 88%	Side Sampler
						+s = 1.6		
			9	30	-	+s = 9.2	X = 156%	Side Sampler
						+s = 9.2		
		-becoming coal tar sludge mixed with dark grey to grey clay from 9.4 to 10.2 m depth.		32	-	+s = 0.8	X = 135%	Side Sampler
			10			+s = 3.2		
	~64.5 ~(10.2)	CLAY: Grey, trace silt and sand, no stains or odours, stiff, moist to wet.		34	-	+s = 1.6	X	Shelby Tube
						+s = 1.7		
			11	36	-	+s = 1.6	X	Shelby Tube
						+s = 1.3		
	~63.1 ~(11.6)	*BOREHOLE TERMINATED*		38		+ s = 1.3		

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 4.3 m below the Lake bottom or 11.6 m depth from top of water level in lake on April 22 and 23, 1999.
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).
3. Vane Profile Hole conducted approximately 0.3 m south of the existing hole.

LOG OF BOREHOLE 18

Piston Sample
Side Sampler
SPT(N) Value
Dynamic Cone Test
Shelby or BenthosTube
Field Vane Test + S
Natural Moisture X
Plastic and Liquid Limit
Penetrometer

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 750.1 m
N 4 791 792.3 m

Trow

Dwg. No: 8

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Water Level	Elev. Scale (m) 74.67	Soil Description	Depth Scale m	Depth Scale ft	N Value	N Value 20 40 60 80 / Shear Strength kPa 100 200	Natural Moisture Content % Dry Weight 10 20 30	Sample
		Approximate Depth of Water = 7.0 m (as reported by CCIW - Tech Ops.)	7	22			*Benthos Sample Retrieved from CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottom or approx. 7.0 to 7.6 m depth from top of water level in lake.*	
	~67.7 ~(7.0)	FILL: Sandy Silt to Silt Sediment and coal tar sludge, black, trace fragments of coal tar (sand size), trace organics (wood pieces), coal tar (hydrocarbon) stains and odours, wet.	8	24 26	- -		X = 88%	
	~66.5 ~(8.2)	FILL: Sand mixed with coal tar sludge, black, trace fragments of coal tar (sand size), trace organics (wood pieces), coal tar (hydrocarbon) stains and odours, wet. -becoming thicker coal tar sludge from 9.9 to 10.4 m depth.	9 10	28 30 32 34	- - - -		X = 227% X = 292% X = 85% X	
	~64.3 ~(10.4)	SILTY SAND: Grey to brown, trace gravel, trace organics (shells, rootlets), no stains or odours, loose, moist to wet.	11	36	4	o	X	
	~63.4 ~(11.3)	ORGANIC SILT: Grey, trace sand and gravel, spongy texture, no stains or odours, wet.		38	-		X = 87%	
	~62.8 ~(11.9)	*BOREHOLE TERMINATED*	12					

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 4.9 m below the Lake bottom or 11.9 m depth from top pf water level in lake on April 23, 1999.
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).

LOG OF BOREHOLE 11

Trow

Legend	Symbol
Piston Sample	
Side Sampler	☒
SPT(N) Value	○ ○ ▩
Dynamic Cone Test	——
Shelby or BenthosTube	● ● ■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——○
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 691.6 m
N 4 791 887.2 m

Dwg. No: 9

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Elev. Scale (m) 74.67	Soil Description	Depth (m)	N Value	N Value / Shear Strength	Natural Moisture Content % Dry Weight
	Approximate Depth of Water = 9.0 m (as reported by CCIW - Tech Ops.)				Benthos Sample Retrieved by CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottom or approx. 9.0 to 9.6 m depth from top of water level in lake.
~65.7 ~(9.0)	FILL: Sandy Silt to Silt Sediment and coal tar sludge, black, trace fragments of coal tar (sand size), coal tar (hydrocarbon) stains and odours, wet.	9	-		X = 128%
~64.9 ~(9.8)	SANDY SILT to SILTY SAND: Brown, no stains or odours, dilatent, compact to dense, moist to wet.	10	39	○	X
	-increasing silt content from 10.4 to 10.8 m depth.		16	○	X
~63.9 ~(10.8)	CLAY: Grey, trace to some silt and sand, no stains or odours, stiff, moist.	11	-	+s=1.6	X
~63.3 ~(11.4)	*BOREHOLE TERMINATED*	12–14			

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 2.4 m below the Lake bottomor 11.4 m from top of water level in lake on April 26, 1999.
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).

LOG OF BOREHOLE 22

Trow

Legend	Symbol
Piston Sample	
Side Sampler	☒
SPT(N) Value	○○
Dynamic Cone Test	——
Shelby or BenthosTube	●●■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——o
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 694.0 m
N 4 791 811.8 m

Dwg. No: 10

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Elev. Scale (m) 74.67	Soil Description	Depth (m)	Depth (ft)	N Value	Shear Strength (kPa)	Natural Moisture Content % Dry Weight	Sample
	Approximate Depth of Water = 9.0 m (as reported by CCIW - Tech Ops.)		28			Benthos Sample Retrieved from CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottomor approx. 9.0 to 9.6 m depth from top of water level in lake.	
~65.7 ~(9.0)	FILL: Sandy Silt to Silt Sediment and coal tar sludge, black, trace fragments of coal tar (sand size), trace organics (wood pieces), coal tar (hydrocarbon) stains and odours, wet.	9	30	-		X = 102%	Shelby/Benthos Tube
		10	32	-		X = 183%	Side Sampler
			34	-		X = 119%	Side Sampler
~63.9 ~(10.8)	CLAY: Grey, trace to some silt and sand, trace gravel (Till-Like), no stains or odours, stiff to very stiff, wet.	11	36	-	s = 2.8; ▲	X	Shelby/Benthos Tube
			38	-	>115 kPa; ▲	X	
~62.6 ~(12.1)	*BOREHOLE TERMINATED*	12	40				
		13	42, 44				
		14					

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 3.1 m below the Lake bottom or 12.1 m depth from top of water level in lake on April 26, 1999.
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).

LOG OF BOREHOLE 21

Trow

Legend	Symbol
Piston Sample	
Side Sampler	☒
SPT(N) Value	○○
Dynamic Cone Test	——
Shelby or BenthosTube	●● ■
Field Vane Test	+ s
Natural Moisture	X
Plastic and Liquid Limit	——○
Penetrometer	▲

Project: Geotechnical Sampling of Sediment, Dredging of Hamilton Harbour, Pier 16, Hamilton, Ontario

Borehole Location : E 594 745.7 m N 4 791 875.1 m

Dwg. No: 11

Project No: HAGE0053319-A

Ground Elevation : N/A

Supervised By: T.B.

Water Level	Elev. Scale (m) 74.67	Soil Description	Depth Scale m	ft	N Value	N Value 20 40 60 80 / Shear Strength kPa 100 200	Natural Moisture Content % Dry Weight 10 20 30	Sample
		Approximate Depth of Water = 11.0 m (as reported by CCIW - Tech Ops.)	11	36			*Benthos Sample Retrieved from CCIW - Tech Ops. from 0 to 0.6 m depth below lake bottom or approx. 11.0 to 11.6 m depth from top of water level in lake*	
	~63.7 ~(11.0)	FILL: Sandy Silt to Silt Sediment and coal tar sludge, black, trace fragments of coal tar (sand size), coal tar (hydrocarbon) stains and odours, wet.	12	38, 40	- / -		X = 167% / X = 46%	
	~62.5 ~(12.2)	CLAY: Grey, trace to some silt and sand, trace gravel (Till-Like), no stains or odours, very stiff, moist to wet.	13	42	- / -	+ >115 kPa / ▲ / +s = 3.6	X / X	
	~61.5 ~(13.2)	SILTY SAND: Brown, trace gravel, no stains or odours, moist to wet.		44				
	~61.3 ~(13.4)	*BOREHOLE TERMINATED*	14, 15, 16	46, 48, 50, 52				

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.

1. Borehole advanced using N-Casing to a termination depth of 2.4 m below the Lake bottom or 13.4 m depth from top of water level in lake on April 26, 1999.
2. Borehole advanced by means of tricone and wash-boring techniques (where applicable).

Appendix A:

Summary Table of Sampling Parameters

Table No. 1
Summary of Sampling Parameters

Borehole No. (Site No.)	Sample No. *	Sampler Type	Shear Strength (kPa)	SPT N-Value	% Moisture Content
28	1	Split Spoon	--	6	130.0
28	2	Split Spoon	--	8	20.0
28	3	Split Spoon	--	23	14.1
28	4	Split Spoon	--	2	23.4
13	1	Side Sampler	--	--	68.0
13	2	Split Spoon	>115	23	73.0
13	3	Side Sampler	50	15	58.0
13	4	Side Sampler	78	5	51.0
13	5	Side Sampler	--	13	59.0
13	6	Side Sampler	--	8	--
14	1	Piston Sampler	--	--	--
14	2	Piston Sampler	--	--	90.0
14	3	Side Sampler	23	--	63.5
14	4	Side Sampler	65	--	56.0
14	5	Side Sampler	65	5	98.0
14	6	Split Spoon	78	push	69.0
154	1	Side Sampler	--	--	135.0
154	2	Side Sampler	--	--	129.0
154	3	Side Sampler	--	--	123.0
154	4	Shelby Tube	--	--	38.0
154	5	Shelby Tube	41	--	26.1
154	6	Shelby Tube	46	--	28.9
6	1	Benthos Tube	--	--	--
6	2	Side Sampler	--	--	129.0
6	3	Side Sampler	14	--	88.0
6	4	Side Sampler	9	--	156.0
6	5	Side Sampler	9	--	135.0
6	6	Shelby Tube	55	--	27.0
6	7	Shelby Tube	65	--	28.0

Table No. 1 (cont'd)
Summary of Sampling Parameters

Borehole No. (Site No.)	Sample No. *	Sampler Type	Shear Strength (kPa)	SPT N-Value	% Moisture Content
18	1	Benthos Tube	--	--	--
18	2	Side Sampler	--	--	88.0
18	3	Side Sampler	--	--	227.0
18	4	Side Sampler	--	--	292.0
18	5	Side Sampler	--	--	85.0
18	6	Shelby Tube	--	--	26.4
18	7	Split Spoon	--	4	29.3
18	8	Shelby Tube	--	--	87.0
11	1	Benthos Tube	--	--	128.0
11	2	Split Spoon	--	39	17.6
11	3	Split Spoon	--	16	18.3
11	4	Shelby Tube	83	--	23.4
22	1	Benthos Tube	--	--	102.0
22	2	Side Sampler	--	--	183.0
22	3	Side Sampler	--	--	119.0
22	4	Shelby Tube	97	--	36.0
22	5	Shelby Tube	>115	--	36.0
21	1	Benthos Tube	--	--	167.0
21	2	Side Sampler	--	--	46.0
21	3	Shelby Tube	>115	--	21.0
21	4	Shelby Tube	115	--	27.7

* Samples attempted at 0.6 m (2 ft.) depth intervals, therefore Sample No. 1 = 0' to 2', Sample No. 2 = 2' to 4', Sample No. 3 = 4' to 6' .....etc.

Appendix B
Sediment Chemistry

Table 1 - Sediment Chemistry - Metals and Nutrients

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
16 (14-1) (25-50)	9	2.2	20	29	42600	80	996	0.19	16	489	-	-	-
16 (14-1) (50-75)	5	<0.5	7	12	12300	5	872	<0.10	8	53	-	-	-
16 (14-1) (75-100)	2	<0.5	7	11	9040	4	1310	<0.10	4	61	-	-	-
16 (14-10) (25-50)	10	3.3	28	40	50000	119	1080	0.21	20	670	-	-	-
16 (14-10) (50-75)	2	<0.5	7	7	11100	3	550	<0.10	7	39	-	-	-
16 (14-10) (75-100)	3	<0.5	6	7	10200	3	585	<0.10	6	32	-	-	-
16-1 (0-25)	4	1.2	16	26	29300	69	764	0.10	14	326	-	-	-
16-1 (25-45)	2	<0.5	9	18	15800	6	623	<0.10	12	31	-	-	-
16-2 (50-75)	5	1.1	12	16	18100	27	658	<0.10	10	180	-	-	-
16-2 (75-100)	3	<0.5	7	10	12200	4	837	<0.10	10	43	-	-	-
16-5 (0-25)	7	2.9	48	40	43700	198	1110	0.29	23	1290	-	-	-
16-5 (25-50)	2	<0.5	9	16	15700	11	673	<0.10	12	54	-	-	-
16-5 (50-75)	2	<0.5	9	17	16000	6	691	<0.10	12	31	-	-	-
16-5 (75-97)	3	<0.5	9	17	16100	6	597	<0.10	12	31	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
16-7 (50-75)	2	<0.5	7	9	10900	4	462	<0.10	8	21	-	-	-
16-7 (75-100)	1	<0.5	7	9	11300	4	529	<0.10	8	44	-	-	-
16- 9 (0-25)	14	5.0	49	76	60200	213	1200	0.68	25	1090	-	-	-
16-9 (25-50)	3	<0.5	7	6	9790	3	515	<0.10	5	31	-	-	-
16-10 (50-75)	2	<0.5	8	6	9630	3	414	<0.10	6	23	-	-	-
16-10 (75-100)	2	<0.5	11	17	15100	6	763	<0.10	13	33	-	-	-
16-11 (0-25)	4	0.8	19	21	19100	41	566	0.44	13	258	-	-	-
16-11 (25-40)	3	<0.5	14	24	13900	8	466	<0.10	15	66	-	-	-
16-12 (50-75)	3	<0.5	17	24	16000	8	139	<0.10	19	37	-	-	-
16-12 (75-100)	3	<0.5	18	24	15600	7	133	<0.10	18	38	-	-	-
16-13 (50-75)	2	<0.5	10	15	12900	5	642	<0.10	11	30	-	-	-
16-13 (75-100)	2	<0.5	12	17	13100	5	452	<0.10	13	34	-	-	-
16-15 (0-25)	11	5.1	76	56	60400	351	1230	0.46	27	1560	-	-	-
16-15 (25-50)	10	2.9	35	37	57900	143	1150	0.24	19	680	-	-	-
16-15 (50-75)	2	<0.5	6	5	8950	6	405	<0.10	5	47	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
16-15 (75-100)	1	<0.5	7	5	9060	2	468	<0.10	5	25	-	-	-
14-1 (70-92)	5	<0.5	4.9	12	12800	6	877	<0.10	8	57	-	-	-
14-1 (92-100)	2	<0.5	3.9	12	7850	4	1150	<0.10	6	63	-	-	-
14-2 (10-35)	4	<0.5	11.0	27	24700	15	581	<0.10	23	66	-	-	-
14-2 (35-50)	9	0.9	8.8	29	50500	125	1070	0.14	18	614	-	-	-
14-3 (50-75)	4	<0.5	4.4	6	10300	3	535	<0.10	6	44	-	-	-
14-4 (50-75)	2	<0.5	3.8	5	8680	2	519	<0.10	5	27	-	-	-
14-5 (25-50)	6	0.9	13.0	37	37600	47	938	<0.10	27	252	-	-	-
14-6 (25-45)	3	<0.5	4.1	7	9580	3	388	<0.10	6	23	-	-	-
14-7 (28-96)	3	<0.5	3.6	8	9140	12	370	<0.10	5	88	-	-	-
14-8 (25-50)	3	<0.5	3.9	7	10000	6	477	<0.10	5	52	-	-	-
14-9 (40-50)	3	<0.5	3.2	4	7730	3	323	<0.10	4	25	-	-	-
14-10 (66-90)	10	1.1	7.7	26	59900	127	1260	0.18	17	755	-	-	-
14-11 (24-50)	2	<0.5	7.1	19	14500	6	679	<0.10	12	36	-	-	-
14-11A (24-50)	2	<0.5	7.1	19	14100	6	685	<0.10	12	35	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
14-12 (25-45)	2	<0.5	7.5	20	14000	6	669	<0.10	12	34	-	-	-
14-13 (25-50)	2	<0.5	4.8	8	9900	4	414	<0.10	7	27	-	-	-
14-13 (50-75)	2	<0.5	5.1	11	11000	4	499	<0.10	8	25	-	-	-
14-14 (14-25)	3	<0.5	8.3	22	17900	9	258	<0.10	15	48	-	-	-
14-15 (13-25)	3	<0.5	4.7	9	11300	7	396	<0.10	7	44	-	-	-
14-16 (11-25)	4	<0.5	3.0	5	9050	2	240	<0.10	4	21	-	-	-
14-17 (10-25)	2	<0.5	4.3	7	9540	3	370	<0.10	7	31	-	-	-
14-19 (11-25)	2	<0.5	9.6	24	16900	8	787	<0.10	15	49	-	-	-
14-21 (25-50)	3	<0.5	8.7	27	21200	10	239	<0.10	17	47	-	-	-
14-22 (25-50)	2	<0.5	7.1	19	14900	6	626	<0.10	12	32	-	-	-
14-23 (10-25)	4	<0.5	7.8	22	28300	37	814	0.11	14	248	-	-	-
14-25 (25-50)	4	0.7	8.3	22	23300	56	762	<0.10	15	270	-	-	-
14-27 (120-139)	4	0.5	11.1	28	28300	50	654	<0.10	23	219	-	-	-
14-34 (100-128)	3	<0.5	8.4	18	16600	12	653	<0.10	14	59	-	-	-
14-34 (78-100)	6	1.1	14.1	37	37000	98	1270	0.13	23	438	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
14-40 (44-70)	3	<0.5	7.1	18	19700	36	651	<0.10	11	165	-	-	-
14-43 (70-95)	4	0.7	7.0	20	22300	71	697	0.10	11	309	-	-	-
14-53 (31-50)	3	<0.5	8.2	28	18000	19	555	<0.10	15	71	-	-	-
14-70	4	<0.5	23	35	17100	27	1040	-	7	196	-	-	-
14-72	5	<0.5	25	36	19500	38	1300	-	6	241	-	-	-
14-73	5	1.0	37	52	27800	86	1370	-	12	490	-	-	-
14-74	9	1.9	56	87	42800	144	1500	-	22	902	-	-	-
14-75	6	0.8	40	44	26800	59	1190	-	14	401	-	-	-
14-76	5	1.0	37	32	27400	69	1080	-	13	426	-	-	-
14-77	6	1.2	43	47	31400	76	1140	-	15	484	-	-	-
10-9	3	0.8	30	24	24000	56	920	-	12	340	24000	-	-
10-8	2	0.4	10	15	13000	27	530	-	9.9	140	12000	-	-
10-7X	5	2	50	30	41000	130	1500	-	18	1000	39000	-	-
10-7	4	1.7	45	48	36000	110	1400	-	16	810	40000	-	-
10-6X	-	-	-	-	-	-	-	-	-	-	-	-	-
10-6	2	ND	14	20	19000	8	690	-	18	41	1600	-	-
10-5X	3	1.4	39	29	33000	85	1200	-	16	580	41000	-	-
10-5	3	1	26	21	27000	66	930	-	14	460	22000	-	-
10-4	2	ND	13	19	17000	8	630	-	16	38	7800	-	-
10-3	3	0.4	17	22	22000	18	790	-	18	100	8600	-	-
10-2	5	1.7	48	55	36000	90	1300	-	20	540	42000	-	-
10-17	ND	ND	6.8	7.4	8800	3	470	-	7.9	24	8600	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
10-16	2	0.7	42	38	25000	36	1200	-	14	250	18000	-	-
10-15	ND	ND	8.1	7.3	11000	3	440	-	8.5	24	5500	-	-
10-14	ND	ND	8	8	11000	4	380	-	8.3	23	7500	-	-
10-13	3	ND	14	19	19000	10	710	-	16	60	540000	-	-
10-12A,B	4	ND	8.4	12	11000	5	160	-	9.8	25	32000	-	-
10-12A,B	ND	ND	13	2.8	11000	26	1000	-	7.3	80	11000	-	-
10-11	2	ND	16	25	22000	9	510	-	18	42	870	-	-
10-10	2	ND	5	17	7700	4	420	-	6.4	49	33000	-	-
10-1	5	1.8	47	63	37000	110	1400	-	20	600	37000	-	-
06-9	-	-	-	-	-	-	-	-	-	-	7700	-	-
06-8	-	-	-	-	-	-	-	-	-	-	4600	-	-
06-7	-	-	-	-	-	-	-	-	-	-	1200	-	-
06-6	10	4	59	55	58000	240	1300	-	27	1400	27000	-	1600
06-5	-	-	-	-	-	-	-	-	-	-	45000	-	-
06-46	-	-	-	-	-	-	-	-	-	-	3700	-	-
06-45	-	-	-	-	-	-	-	-	-	-	3700	-	-
06-44	-	-	-	-	-	-	-	-	-	-	5300	-	-
06-43	-	-	-	-	-	-	-	-	-	-	1700	-	-
06-42	-	-	-	-	-	-	-	-	-	-	7600	-	-
06-41	-	-	-	-	-	-	-	-	-	-	4300	-	-
06-40	-	-	-	-	-	-	-	-	-	-	23000	-	-
06-4	-	-	-	-	-	-	-	-	-	-	31000	-	-
06-39	-	-	-	-	-	-	-	-	-	-	44000	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
06-38	-	-	-	-	-	-	-	-	-	-	32000	-	-
06-37	-	-	-	-	-	-	-	-	-	-	37000	-	-
06-36	-	-	-	-	-	-	-	-	-	-	52000	-	-
06-35	21	7.8	90	130	150000	640	2900	-	36	3100	77000	-	2000
06-34	38	10	79	110	250000	740	4200	-	36	3400	84000	-	2000
06-33	26	11	78	100	240000	840	4500	-	32	4000	86000	-	1800
06-32	38	8.9	78	87	350000	710	6200	-	36	3700	69000	-	1700
06-31	-	-	-	-	-	-	-	-	-	-	100000	-	-
06-30	-	-	-	-	-	-	-	-	-	-	72000	-	-
06-3	-	-	-	-	-	-	-	-	-	-	28000	-	-
06-29	-	-	-	-	-	-	-	-	-	-	2200	-	-
06-28	3	0.3	22	23	26000	16	570	-	27	68	4600	-	690
06-27	-	-	-	-	-	-	-	-	-	-	3400	-	-
06-26	-	-	-	-	-	-	-	-	-	-	23000	-	-
06-25	-	-	-	-	-	-	-	-	-	-	36000	-	-
06-24	-	-	-	-	-	-	-	-	-	-	3700	-	-
06-23	21	8.6	73	110	140000	600	2900	-	34	3300	67000	-	1800
06-22	-	-	-	-	-	-	-	-	-	-	120000	-	-
06-21	25	8.7	63	99	200000	670	3700	-	30	3300	58000	-	1600
06-20	-	-	-	-	-	-	-	-	-	-	120000	-	-
06-2	-	-	-	-	-	-	-	-	-	-	25000	-	-
06-19	-	-	-	-	-	-	-	-	-	-	95000	-	-
06-18	21	11	92	97	150000	1000	3700	-	33	5000	110000	-	1800
06-17	-	-	-	-	-	-	-	-	-	-	6600	-	-

Sample Name	Metals											Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc		Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
06-16	-	-	-	-	-	-	-	-	-	-		4000	-	-
06-15	-	-	-	-	-	-	-	-	-	-		28000	-	-
06-14	-	-	-	-	-	-	-	-	-	-		16000	-	-
06-13	-	-	-	-	-	-	-	-	-	-		27000	-	-
06-12	2	0.3	6.4	10	9300	4	810	-	7.7	42		10000	-	530
06-11	-	-	-	-	-	-	-	-	-	-		4400	-	-
06-10	-	-	-	-	-	-	-	-	-	-		2900	-	-
06-1	-	-	-	-	-	-	-	-	-	-		32000	-	-
05-9	4	1	16	23	24000	100	750	-	13	440		11000	-	750
05-8	6	1.6	24	38	38000	160	960	-	16	740		26000	-	1200
05-7	5	1.5	23	29	29000	140	710	-	13	680		16000	-	990
05-6	10	2.6	63	94	48000	200	1600	-	36	1100		52000	-	1700
05-5	8	1.9	42	51	48000	200	1400	-	21	1100		71000	-	1100
05-4	14	6.4	70	86	72000	540	1600	-	29	3100		57000	-	1800
05-3	16	5.8	85	86	95000	570	2400	-	30	3900		110000	-	1300
05-21	14	4.1	79	90	90000	410	2200	-	33	2300		57000	-	1300
05-20	8	2.2	38	36	48000	210	1200	-	17	1200		31000	-	900
05-2	7	1.6	53	47	41000	140	1400	-	22	1100		130000	-	1200
05-19	10	3.6	56	52	62000	350	1500	-	23	1900		42000	-	1200
05-18	-	-	-	-	-	-	-	-	-	-		-	-	-
05-17	10	3.1	65	58	52000	320	1400	-	25	1900		57000	-	1300
05-16	2	0.3	8.8	17	14000	7	550	-	11	32		1800	-	740
05-15	2	0.3	7.8	11	10000	5	360	-	9.9	32		11000	-	530

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
05-14	11	3.2	71	80	63000	270	1800	-	29	1700	38000	-	1200
05-13	10	3.1	47	50	57000	240	1200	-	22	1200	35000	-	1400
05-12	13	4.3	52	62	75000	330	1400	-	24	1500	40000	-	1200
05-11	11	4.5	49	59	60000	330	1100	-	23	1500	38000	-	1200
05-10	13	5.5	72	120	66000	330	1700	-	37	1900	55000	-	2100
05-1	11	2.8	65	77	65000	280	2100	-	28	1600	62000	-	1300
04-99	1.3	0.25	6.5	6.5	9100	3.1	-	0.04	6.9	19	-	-	-
04-98	1.5	0.25	7.6	12	12000	4.6	-	0.04	10	22	-	-	-
04-97	1.3	0.25	4.7	11	6400	2.3	-	0.04	5.3	18	-	-	-
04-9	7.6	2.8	57	39	34000	190	1200	0.32	22	1500	-	-	-
04-8	8.2	3.1	60	46	36000	270	1500	0.54	22	2000	-	-	-
04-7	10	1.9	25	34	65000	210	1600	0.19	19	1100	-	-	-
04-61	1.2	0.1	5	7.6	7100	2.5	630	0.04	1.6	26	-	-	-
04-60	0.8	0.1	5.6	7	7000	2.8	430	0.04	5.5	21	-	-	-
04-6	16	6.2	120	72	78000	860	3800	3.5	21	4900	-	-	-
04-59	1.2	0.1	6.6	10	8800	4.3	360	0.04	8.3	23	-	-	-
04-58	1.9	0.1	8.8	21	11000	16	420	0.1	9.2	58	-	-	-
04-57	1.5	0.1	7.5	10	7500	4	110	0.04	8.3	22	-	-	-
04-56	5	1	21	23	25000	13	700	0.04	19	57	-	-	-
04-55	2.6	0.1	22	20	21000	12	510	0.04	21	58	-	-	-
04-54	2.7	0.1	19	21	19000	11	510	0.04	18	54	-	-	-
04-53	2.6	0.1	19	20	19000	11	500	0.04	18	57	-	-	-
04-52	1.1	0.1	5.1	9.4	6400	3	330	0.04	5.3	21	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
04-51	3.3	0.4	16	35	11000	38	610	0.07	12	220	-	-	-
04-50	1.4	0.1	6	8.2	7200	3.8	380	0.04	5.8	25	-	-	-
04-5	6.3	2.1	39	41	29000	67	0	0.15	20	440	-	-	-
04-49	2.1	0.4	13	17	9300	26	660	0.06	8.5	150	-	-	-
04-48	2	0.1	9.7	15	12000	7.3	540	0.04	13	45	-	-	-
04-47	4.9	3.5	41	43	18000	96	710	0.21	20	750	-	-	-
04-46	1.6	0.1	11	8.5	8900	5.4	190	0.04	9.9	32	-	-	-
04-45	4.9	0.8	9.4	18	13000	30	540	0.11	8.3	190	-	-	-
04-44	1.7	0.1	7.4	10	10000	4	480	0.04	7.7	24	-	-	-
04-43	1.1	0.1	10	8.6	9600	5	170	0.04	9.4	25	-	-	-
04-42	0.9	0.1	5.9	5.4	5000	2.7	130	0.04	5.5	14	-	-	-
04-41	2.1	0.1	6.3	7.3	8600	5.5	570	0.04	5.2	47	-	-	-
04-40	1.8	0.1	5.2	6.9	8000	5.4	-	-	5	35	-	-	-
04-4	12	5.7	93	65	53000	230	-	0.4	33	1800	-	-	-
04-39	2	0.1	5.9	9.5	8800	3.6	400	0.04	6.8	22	-	-	-
04-38	1	0.1	7.1	11	8000	4.2	240	0.04	8.5	26	-	-	-
04-37	2.1	0.1	6.7	8.7	9000	3.6	670	0.04	5.5	35	-	-	-
04-36	1.3	0.1	7.7	11	7700	4	240	0.04	8.6	28	-	-	-
04-35	3.2	0.2	9	23	12000	22	510	0.09	10	130	-	-	-
04-34	5.5	3.3	32	51	22000	160	640	0.39	18	670	-	-	-
04-33	5	1	24	23	28000	14	620	0.04	24	61	-	-	-
04-32	2	0.1	7.8	17	12000	5.8	640	0.04	10	32	-	-	-
04-31	2.5	0.1	4	6.8	5500	2	770	0.04	0.5	21	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
04-30	4.5	0.1	7.2	11	10000	4.5	820	0.04	5.3	48	-	-	-
04-3	14	6.2	100	90	54000	230	-	0.47	38	1700	-	-	-
04-29	1.5	0.1	8.9	14	8800	5	290	0.04	10	33	-	-	-
04-28	5	1	5	11	6900	3.2	980	0.04	0.5	40	-	-	-
04-27	8.4	3.6	34	45	40000	170	920	0.34	19	890	-	-	-
04-26	4.7	2.1	32	45	19000	110	800	0.26	18	690	-	-	-
04-25	3.9	3.4	37	38	16000	89	540	0.18	15	530	-	-	-
04-24	4	0.9	35	29	18000	54	1100	0.14	12	340	-	-	-
04-23	6.9	2.6	60	61	29000	160	1200	0.37	29	1300	-	-	-
04-22	8.2	3	57	58	27000	170	1200	0.44	27	1400	-	-	-
04-21	23	12	62	91	130000	650	2800	1.4	32	3300	-	-	-
04-20	27	11	77	110	120000	680	2700	1.1	33	3300	-	-	-
04-2	9	3.4	59	53	39000	120	-	0.25	26	800	-	-	-
04-19	6.6	1.9	27	41	47000	160	1200	0.24	25	940	-	-	-
04-18	8.9	3.2	57	52	42000	250	1300	0.51	24	1600	-	-	-
04-17	5.5	1.5	17	25	35000	150	1100	0.15	13	650	-	-	-
04-16	14	7	95	78	55000	400	1500	0.6	34	2400	-	-	-
04-15	8.5	2.1	18	82	31000	300	620	0.98	16	1100	-	-	-
04-14	16	8.3	130	100	100000	570	-	-	51	3300	-	-	-
04-130	6.9	2.7	35	36	44000	200	-	0.45	18	1000	4.3	-	-
04-13	9.4	2	24	33	52000	130	1300	0.72	18	810	-	-	-
04-129	6.9	2.7	34	37	43000	200	-	0.37	18	1000	4.1	-	-
04-128	6.8	2.7	33	40	44000	200	-	0.5	18	1000	4.2	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
04-127	5	1.1	17	28	26000	55	-	0.15	14	270	-	-	-
04-126	4.5	1.3	23	31	26000	100	-	0.2	17	540	-	-	-
04-125	2.7	0.25	5.7	6	9900	2.5	-	0.04	5.9	22	-	-	-
04-124	1.9	0.36	6.6	7.9	9600	3.2	-	0.04	7.3	19	-	-	-
04-123	8.9	3.2	55	47	50000	220	-	0.65	23	1300	-	-	-
04-122	7.7	2.2	62	42	42000	140	-	0.18	24	750	-	-	-
04-121	11	4.1	70	98	52000	330	-	0.66	31	2000	-	-	-
04-120	9.3	0.88	24	30	55000	84	-	0.14	17	500	-	-	-
04-12	6	2.6	47	43	42000	240	1200	0.35	21	1600	-	-	-
04-119	12	4.8	90	67	62000	330	-	0.53	33	2100	-	-	-
04-118	9.6	3.5	33	39	56000	200	-	0.33	18	980	2.8	-	-
04-117	9.5	3.5	33	40	55000	200	-	0.33	19	960	2.8	-	-
04-116	9.2	3.4	31	39	54000	200	-	0.33	17	970	3.3	-	-
04-115	1	0.5	6.6	8.5	8800	3.1	-	0.04	7.3	22	-	-	-
04-114	1.6	0.25	7.1	6.9	8200	5.4	-	0.04	6.5	39	-	-	-
04-113	2.6	0.25	16	18	15000	20	-	0.05	13	130	-	-	-
04-112	6.5	1	22	30	36000	71	-	0.13	15	390	-	-	-
04-111	12	6.4	51	56	62000	280	-	0.6	23	1300	-	-	-
04-110	4.4	1.2	15	20	23000	29	-	0.07	15	160	-	-	-
04-11	2.2	0.2	14	18	13000	15	630	0.04	11	100	-	-	-
04-109	12	1.1	26	36	62000	140	-	0.16	18	780	-	-	-
04-108	11	3.7	22	25	58000	110	-	0.11	17	580	-	-	-
04-107	8.6	0.9	34	31	53000	110	-	0.19	19	720	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
04-106	6.3	0.65	24	25	37000	83	-	0.2	17	550	-	-	-
04-105	5.7	1.2	20	29	30000	55	-	0.12	17	300	-	-	-
04-104	2.8	0.56	14	20	16000	16	-	0.04	14	76	0.9	-	-
04-103	3.1	0.55	14	20	16000	15	-	0.04	14	76	0.9	-	-
04-102	3.1	0.5	14	20	16000	15	-	0.04	14	76	0.9	-	-
04-101	6.5	2.8	23	28	36000	99	-	0.18	15	440	-	-	-
04-100	1.5	0.25	7.6	10	11000	4.3	-	0.04	9.7	21	-	-	-
04-10	10	4.9	44	76	67000	500	1600	0.85	25	2700	-	-	-
04-1	5.6	1.9	39	32	29000	64	-	0.27	19	450	-	-	-
02-9	2.5	1.56	109.82	34.29	26200	66.80	1468	0.09	3.97	358.37	76000	2070	986
02-84	31.66	1.42	143.85	708.14	157000	335.61	2250	0.45	609	1590	46000	3160	1760
02-83	2.5	1.04	66.89	63.55	31100	111.22	1662	0.29	25.77	586.33	34000	1930	1490
02-82	2.5	1	33	31.08	16500	45.63	1149	0.11	9.83	229.49	21000	1980	1120
02-81	2.5	2.12	64.21	58.89	27000	115.08	1312	0.11	18.16	606.7	30000	1760	1240
02-80	2.5	1.51	39.65	17.72	15800	32.74	869	0.05	4.53	198.12	14000	1015	771
02-8	2.5	2.03	72.81	48.66	34200	109.67	1502	0.11	7.67	652.18	71000	1990	1310
02-79	2.5	0.51	30.4	21.47	15300	18.28	993	0.04	11.31	83.16	17000	2050	1050
02-78	2.5	1.57	23.16	16.64	14100	31.51	960	0.03	1.85	133.93	14000	2130	1070
02-77	2.5	1.41	21.61	18.15	11800	16.96	827	0.05	7	67.2	51000	1300	684
02-76	2.5	1.25	35.11	29.26	16300	34.74	1139	0.04	10.33	197.95	21000	2030	1210
02-75	2.5	1.55	48.16	39.73	21400	45.47	941	0.13	17.61	202.01	27000	2310	1510
02-74	2.5	1.34	50.53	31.94	18200	49.11	1171	0.1	13	265.71	23000	1790	992
02-73	2.5	1.15	48.03	30.54	16700	52.74	992	0.22	15.09	260.55	22000	1830	1220

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
02-72	2.5	1.63	76.77	47.36	17300	68.04	789	0.19	12.22	266.55	17000	1050	1230
02-71	2.5	1.07	38.91	31.24	17600	49.07	772	0.11	13.25	222.49	33000	1074	934
02-70	2.5	1.37	20.26	28.47	17000	45.39	1395	0.08	12.55	242.73	22000	1570	1300
02-7	2.5	2.43	67.29	58.99	42600	172.98	1565	0.26	13.88	979.79	51000	2180	1370
02-69	2.5	1.05	45.77	37.14	19300	59.76	1257	0.08	17.14	343.14	33000	1530	1240
02-68	2.5	1.84	48.87	64.87	21900	69.87	1787	0.24	22.37	340.42	25000	1870	1050
02-67	2.5	1.32	53.37	58.47	19800	69.63	1519	0.1	15.91	329.82	24000	1970	1470
02-66	2.5	1.32	29.11	46.13	20100	70.25	1757	0.23	19.67	351.51	22000	1760	1190
02-65	5	2.86	61.38	48.92	22900	103.21	885	0.1	18.41	532.73	29000	1660	1380
02-64	2.5	2.4	43.16	47.4	24100	62.10	926	0.25	12.43	255.07	23000	1500	866
02-63	2.5	1	68.59	31.49	15200	49.51	1069	0.05	7.76	230.81	33000	1930	885
02-62	2.5	1.53	55.94	41.37	15900	85.06	11019	0.06	18.22	287.72	21000	1140	1160
02-61	2.5	1.11	56.65	35.44	16300	46.85	1548	0.12	16.77	234.71	47000	1330	1200
02-60	2.5	2.21	82.71	61.9	30700	125.94	1375	0.17	20.65	711.6	32000	2201	1560
02-6	2.5	1.54	56.38	33.21	31900	113.01	1356	0.18	9.03	872.07	71000	1210	1012
02-59	2.5	1.7	97.97	44.29	21000	67.13	1022	0.19	15.57	356.14	31000	1990	1100
02-58	2.5	2.01	73.56	55.76	26800	108.56	1341	0.12	18.2	593.01	30000	2120	1490
02-57	2.5	4	71.66	66.97	33100	190.80	956	0.27	21.14	948.39	52000	1910	1330
02-56	2.5	1.43	32.84	70.34	26700	101.15	1483	0.49	29.86	494.43	35000	1903	1670
02-55	2.5	2.89	86.37	49.55	28900	146.02	1070	0.12	16.4	766.03	28000	1250	1110
02-54	2.5	1.08	35.35	61.76	31700	111.79	1774	0.44	25.44	608.86	31000	1740	1170
02-53	2.5	2.08	73.8	64.95	35600	154.69	1642	0.17	22.87	797.91	35000	2170	1540
02-52	2.5	1	90.69	56.25	30800	126.49	1347	0.14	24.73	775.49	33000	2480	2360

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
02-51	2.5	2.45	46.6	101.09	45700	200.11	1740	0.52	42.24	978.05	42000	2170	1530
02-50	2.5	1.86	37.97	32.41	17000	53.11	742	0.07	7.63	181.9	22000	784	931
02-5	5	3.35	92.3	80.01	68600	284.74	2030	0.35	39	1790	68000	2490	1390
02-49	5	1.76	42.92	48.36	31500	103.22	1309	0.13	21.06	698.53	31000	2050	2220
02-48	2.5	1.88	87.6	76.09	44400	168.76	1667	0.34	28.44	900.92	41000	2080	1560
02-47	22.95	1.4	111.47	608.49	88500	611.03	1710	0.34	303	1560	44000	1980	1590
02-46	2.5	3.91	84.71	71.32	42500	215.68	1575	0.31	29.81	1602.36	47000	2180	2640
02-45	5	2.89	80.99	68.9	43500	178.94	1631	0.15	28.93	1261.9	49000	2750	3610
02-44	2.5	1.77	65.83	30.66	22000	51.48	1122	0.04	6.43	297.23	25000	1420	1055
02-43	2.5	2.02	52.85	38.15	26200	70.33	1222	0.09	13.21	424.52	45000	1850	1090
02-42	8.53	3.91	98.56	66.89	66100	313.85	1615	0.31	42	2430	67000	1830	2630
02-41	30.33	1.58	141	703	150000	327.29	2200	0.66	572	1580	48000	2540	1290
02-40	2.5	0.5	37.31	26.06	23200	27.04	971	0.27	16.85	153.18	20000	577	858
02-4	2.5	2.19	67.04	46.6	31600	146.87	1548	0.26	7.33	575.7	117000	2560	1220
02-39	7.52	3.67	104.37	59.76	60100	284.55	1590	0.4	42	2160	72000	1900	2680
02-38	2.5	2.67	73.87	57.99	51400	227.10	1460	0.39	29.18	1765.23	69000	2140	2550
02-37	12.2	3.31	104.86	68.25	45500	208.57	1660	0.13	33.27	1514.92	48000	2440	2550
02-36	2.5	2.28	72.13	49.47	46600	172.06	1412	0.24	21.47	1163.54	64000	1740	1740
02-35	7.59	2.61	72.39	61.39	45100	192.23	1615	0.19	31.25	1498.51	56000	2240	2510
02-34	2.5	2.12	82.32	58.63	25300	70.23	1378	0.12	6.01	363.94	51000	1570	850
02-33	2.5	1	48.77	25.23	18700	47.96	1146	0.06	8	277.29	42000	1450	818
02-32	9.05	2.27	59.61	52.61	38500	134.69	1455	0.18	25.11	1014.92	52000	2170	2370
02-31	9.95	4.45	82.45	98.89	78600	446.86	2040	0.66	44	2480	64000	2090	1840

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
02-30	2.5	3.53	143.46	69.65	47800	217.60	1616	0.25	32.83	1709.62	52000	2047	2072
02-3	2.5	1.54	80.18	36.66	27000	86.37	1434	0.09	9.3	430.62	63000	1070	856
02-29	30	2	90	131.06	107000	438.01	2740	0.79	72	2350	71000	3220	1830
02-28	7.91	3.24	94.28	55.05	50800	223.17	1543	0.42	29.59	1838.33	65000	2210	2850
02-27	17	5	57.83	75.67	81800	566.10	1613	0.66	36	2520	68000	2180	3030
02-26	2.5	1.63	77.29	38.08	27800	75.36	1375	0.1	6.27	432.57	78000	1650	1021
02-25	2.5	1.89	59.56	35.4	24800	68.88	1150	0.12	6.71	392.67	57000	1480	999
02-24	2.5	2.11	78.03	55.78	36800	128.80	1404	0.38	28.23	954.88	46000	1870	1870
02-23	2.5	1.65	63.64	37.59	30600	90.65	1445	0.2	16.97	604.7	39000	1530	1430
02-22	2.5	3	88	29.12	19200	39.45	1780	0.05	8	182	53000	1540	706
02-21	2.5	2.08	80.79	68.57	52600	200.28	1713	0.43	20.55	1157.81	64000	2530	1650
02-20	2.5	1.42	76.42	43.77	32500	88.77	1229	0.13	17.86	568.15	48000	1560	1120
02-2	2.5	2.49	87.82	44.64	33300	137.59	2084	0.2	1.93	586.36	103000	2280	1330
02-19	2.5	1.22	58.88	33.75	33800	97.72	1210	0.33	13.12	697.93	60000	1440	1410
02-18	2.5	1.48	55.7	38.49	32500	94.43	1221	0.19	14.3	677.54	61000	1540	1210
02-17	2.5	2.53	82.12	46.82	38700	135.76	1325	0.14	20.52	1029.03	54000	1590	1310
02-16	2.5	1.76	43.27	38.87	15200	51.63	944	0.05	7.49	259.48	67000	1910	1060
02-15	2.5	1.87	54.82	37.44	25300	70.89	1361	0.06	5.03	378.6	56000	1720	1080
02-14	2.5	1.85	53.24	38.99	43700	149.65	1685	0.12	11.73	726.7	40000	1160	926
02-13	2.5	1.32	65.27	35.76	28400	76.19	1108	0.1	13.31	494.08	51000	1504	1110
02-12	2.5	2.03	77.22	28.67	22200	42.04	2041	0.05	3	185.95	105000	2050	1160
02-11	2.5	1.27	72.23	41.18	36800	122.20	1234	0.24	20.12	986.74	55000	1570	1750
02-10	2.5	2.14	73.64	43.6	36500	132.85	1319	0.17	16.94	1058.24	48000	1710	1380

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
02-1	2.5	2.46	82.19	62.32	30800	106.14	2040	0.1	8	477.05	90000	2440	1033
01-9	-	20	116	33.6	154000	601	3330	-	5	4500	-	-	-
01-8	-	20	109	51.2	150000	998	2960	-	5	5930	-	-	-
01-7	-	20	112	42.4	136000	754	2890	-	5	5290	-	-	-
01-6	-	20	107	42.2	120000	511	2620	-	5	3820	-	-	-
01-5	-	20	70	37.8	73300	269	1800	-	5	2250	-	-	-
01-48	-	40	87	25.2	270000	872	4470	-	10	4810	-	-	-
01-47	-	20	89	78.2	92200	359	2300	-	19	2190	-	-	-
01-46	-	20	74	61	72300	236	1870	-	12.5	1600	-	-	-
01-45	-	20	67.5	58	72900	235	1900	-	17	1580	-	-	-
01-44	-	20	65.5	48.6	71300	202	1860	-	5	1360	-	-	-
01-43	-	20	89.5	65.6	104000	399	2250	-	12	2330	-	-	-
01-42	-	20	85.5	70.8	82200	319	2010	-	19.5	2060	-	-	-
01-41	-	20	73	49	146000	573	2550	-	5	2240	-	-	-
01-40	-	20	75.5	33.8	80000	347	1900	-	5	2630	-	-	-
01-4	-	20	71	36.6	92200	317	2070	-	7.5	1990	-	-	-
01-39	-	20	69.5	48.2	58900	155	1670	-	12	1270	-	-	-
01-38	-	20	82.5	67.2	88700	330	2120	-	13	2180	-	-	-
01-37	-	20	87	68.6	131000	506	2460	-	6	3000	-	-	-
01-36	-	20	85	59	129000	516	2480	-	5	2740	-	-	-
01-35	-	20	69.5	58	71500	227	1880	-	15	1510	-	-	-
01-34	-	20	88.5	51	85900	349	2080	-	18	3160	-	-	-
01-33	-	20	91.5	78.8	107000	428	2270	-	25.5	2620	-	-	-

Sample Name	Metals										Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc	Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
01-32	-	20	87.5	60	138000	487	2630	-	7.5	2790	-	-	-
01-31	-	20	88	67.2	141000	549	2560	-	5.5	3050	-	-	-
01-30	-	20	85.5	60.6	111000	388	2270	-	7	2240	-	-	-
01-3	-	20	69	29.2	133000	562	2710	-	5	3130	-	-	-
01-29	-	20	79.5	55.4	78600	253	2110	-	18	1850	-	-	-
01-28	-	20	87.5	56	150000	560	2610	-	5	3070	-	-	-
01-27	-	20	76.5	65.2	108000	367	2270	-	16.5	2230	-	-	-
01-26	-	20	73	51.4	72800	227	1830	-	14	1730	-	-	-
01-25	-	20	85	14.4	162000	611	2650	-	5	3450	-	-	-
01-24	-	20	86.5	54.4	139000	506	2580	-	9.5	2770	-	-	-
01-23	-	40	92	14.6	256000	861	4780	-	10	4360	-	-	-
01-22	-	20	95.5	47.8	136000	641	2650	-	5	4490	-	-	-
01-21	-	20	67.5	51	67100	221	1790	-	11.5	1430	-	-	-
01-20	-	20	75	53.2	71200	241	1810	-	19.5	1890	-	-	-
01-2	-	20	103	72	127000	594	2690	-	13	3610	-	-	-
01-19	-	20	81.5	64.8	101000	381	2210	-	11	2200	-	-	-
01-18	-	20	105	39.8	178000	738	3460	-	5	4450	-	-	-
01-17	-	20	75	65.6	78000	219	2040	-	18.5	1600	-	-	-
01-16	-	20	73	65.4	92000	287	1990	-	10.5	1870	-	-	-
01-15	-	20	94.5	46.8	153000	566	2820	-	5	3090	-	-	-
01-14	-	20	89	78.2	92200	359	2300	-	19	2190	-	-	-
01-13	-	20	75.5	40.2	76000	323	1900	-	8	3050	-	-	-
01-12	-	20	83	45.2	83200	388	2100	-	9.5	3580	-	-	-

Sample Name	Metals											Nutrients		
	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc		Total Orgainc Carbon	Total Kjeldahl Nitrogen	Total Phosphorus
01-11	-	20	77	52.2	81500	280	1890	-	10.5	1940		-	-	-
01-10	-	20	49.5	13.8	148000	495	2770	-	5	2460		-	-	-
01-1	-	20	119	32.6	156000	819	3060	-	15.5	4790		-	-	-
00-9	17	0.5	9	13.9	10000	0.50	739	0.03	0.5	31		7000	765	436
00-8	13.3	2.4	56.4	70	39000	143.10	1506	0.3	21.9	808		33000	1460	1620
00-7	8.7	6	92.5	197.5	29000	240.70	909	4.42	23.4	821		54000	2570	679
00-6	11.3	2.8	50.2	52.1	50000	280.20	1110	0.39	23.2	1247		51000	1340	1530
00-5	9.6	2.2	54	53.9	48000	181.60	1460	0.25	18.9	854		47000	1580	1210
00-4	15.1	0.9	47.7	262.5	24000	78.90	1225	0.16	39	411		47000	1620	556
00-3	15.3	1.5	49.6	51.3	33000	98.70	1254	0.21	20	621		39000	1370	1220
00-2	57	0.5	93	129.5	147000	666.00	3150	2.18	67	3030		84000	2210	1780
00-13	12.8	1.2	29.2	42	19000	67.30	805	0.42	13.4	354		30000	1370	1010
00-12	15.5	1	55.1	113.1	24000	146.30	2517	2.38	23	507		47000	2510	1770
00-11	14	0.5	27.2	38.8	20000	55.70	992	0.13	13.9	313		30000	969	961
00-10	16.5	0.5	49.3	50.4	21000	68.00	1436	1.6	49.6	352		27000	1210	1280
00-1	14.4	0.5	35.2	25.3	22000	17.30	1251	0.11	3.7	166		26000	642	845

Note(s):
1. - Not tested.
2. ND = Not Detected
3. Unit of measure: mg/kg

Table 2 - Sediment Chemistry - Polycyclic Aromatic Hydrocarbons

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo(a)anthracene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Benzo(g,h,i)perylene**	**Chrysene**	**Dibenzo(a,h)anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3 cd)pyrene**	**Naphthalene**	**Phenanthrene**	**Pyrene**	***Total PAH***
16-1 (0-25)	<0.5	0.20	0.08	0.56	0.67	0.34	0.70	0.28	0.60	0.07	1.6	2.8	0.30	0.52	1.0	1.3	11.0
16-1 (25-45)	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
16-5 (0-25)	0.5	1.4	1.4	4.9	10	3.5	11	5.9	9.9	1.4	26	7.1	5.2	2.7	15	21	140.0
16-5 (25-50)	<0.5	0.09	<0.05	0.19	0.19	0.09	0.15	0.05	0.16	<0.05	0.43	0.98	0.05	0.12	0.47	0.32	3.5
16-9 (0-25)	1.2	1.2	0.97	3.4	9.4	3.2	4.7	2.6	8.2	0.61	16	3.7	2.4	4.3	11	13	92.0
16-9 (25-50)	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
16-11 (0-25)	<0.5	0.12	0.26	0.39	0.96	0.58	0.91	0.66	0.99	0.11	1.7	1.3	0.62	0.74	0.64	1.4	13.0
16-11 (25-40)	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.05	<0.05	<0.05	<0.05	0.05	0.4
16-15 (0-25)	1.8	2.8	0.82	5.1	6.4	1.9	4.5	2.1	5.7	0.47	14	13	2.2	2.5	12	11	91.0
16-15 (25-50)	1.1	1.4	0.07	1.0	0.61	0.18	0.28	0.11	0.53	<0.05	1.6	1.7	0.12	0.91	2.5	1.3	13.0
14-1 (70-92)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	<0.05	<0.05	33.2
14-1 (92-100)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	39.9

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
14-2 (10-35)	1.8	0.60	0.06	0.10	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.14	0.32	<0.05	8.7	0.37	0.09	20.9
14-2 (35-50)	3.5	4.5	0.41	5.1	3.8	1.0	2.1	0.82	2.1	0.27	9.1	4.9	0.90	6.3	16	6.3	29.4
14-3 (50-75)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-4 (50-75)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-5 (25-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-6 (25-45)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-7 (28-96)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-8 (25-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-9 (40-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-10 (66-90)	0.25	0.79	0.11	1.6	0.93	0.27	0.42	0.16	0.73	<0.05	3.3	0.49	0.14	0.20	4.0	2.5	17.0
14-11 (24-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-11A (24-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-12 (25-45)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
14-13 (25-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	23.4
14-13 (50-75)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	24.9
14-14 (14-25)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-15 (13-25)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.3
14-16 (11-25)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	19.5
14-17 (10-25)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-19 (11-25)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-21 (25-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-22 (25-50)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-23 (10-25)	<0.05	0.05	<0.05	0.11	0.08	<0.05	0.05	<0.05	0.09	<0.05	0.25	0.36	<0.05	0.05	0.36	0.20	1.8
14-25 (25-50)	0.13	0.10	<0.05	0.27	0.19	0.07	0.13	0.06	0.19	<0.05	0.56	0.13	0.05	0.10	0.61	0.41	3.1
14-27 (120-139)	0.11	0.05	<0.05	0.13	0.09	<0.05	0.05	<0.05	0.09	<0.05	0.26	0.52	<0.05	0.14	0.31	0.18	23.4
14-34 (100-128)	<0.05	<0.05	<0.05	0.09	0.08	<0.05	0.05	<0.05	0.08	<0.05	0.23	0.52	<0.05	0.06	0.19	0.17	17.5

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
14-34 (78-100)	0.14	0.15	0.09	0.63	0.56	0.20	0.34	0.15	0.53	<0.05	1.3	5.0	0.15	0.11	1.2	0.94	20.9
14-40 (44-70)	0.18	0.15	0.06	0.22	0.45	0.16	0.29	0.15	0.29	<0.05	0.80	<0.05	0.15	0.20	0.77	0.67	21.4
14-43 (70-95)	1.4	1.1	0.32	3.2	2.0	0.67	1.4	0.57	1.7	<0.05	2.6	6.0	0.57	0.54	2.8	1.9	18.8
14-45 (100-125)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.3
14-45 (75-100)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.14	<0.05	<0.05	0.4
14-45 (0-50)	2.4	0.17	0.37	0.79	0.95	0.39	0.55	0.23	0.99	0.07	2.3	0.39	0.24	39	2.4	1.8	53.0
14-46 (100-125)	0.45	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	5.7	0.10	0.06	6.4
14-46 (125-150)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.97	<0.05	<0.05	1.0
14-46 (0-50)	41	1.7	9.7	10	7.3	4.2	5.5	1.7	6.3	0.60	22	6.8	2.0	870	27	15	1000.0
14-47 (100-125)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.14	<0.05	<0.05	<0.3
14-47 (75-100)	0.22	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.8	0.06	<0.05	2.2
14-47 (0-50)	6.9	0.60	1.3	2.0	2.9	1.1	1.5	0.55	3.1	0.16	7.7	1.7	0.53	84	8.4	6.0	130.0
14-48 (128-150)	0.17	0.11	<0.05	0.33	0.40	0.16	0.28	0.09	0.35	<0.05	0.95	0.19	0.08	0.31	1.1	0.85	5.7

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo(a)anthracene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Benzo(g,h,i)perylene**	**Chrysene**	**Dibenzo(a,h)anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3 cd)pyrene**	**Naphthalene**	**Phenanthrene**	**Pyrene**	***Total PAH***
14-48 (0-50)	3.6	0.25	0.36	0.73	0.88	0.53	0.57	0.21	1.1	0.07	2.7	0.71	0.21	44	3.2	2.1	61.0
14-49 (0-25)	6.7	3.6	1.4	4.7	5.7	1.8	1.0	1.7	3.6	0.42	12	25	1.5	46	17	9.7	52.0
14-49 (100-120)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.16	<0.05	<0.05	29.7
14-49 (150-175)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	27.8
14-49 (75-100)	<0.05	0.11	0.05	0.63	1.1	0.29	0.50	0.21	0.68	0.08	1.8	0.18	0.23	<0.05	1.8	1.4	29.9
14-50 (0-25)	0.57	0.72	0.64	2.0	3.3	1.4	2.9	2.0	3.8	0.49	6.6	<0.05	1.8	3.6	4.6	5.2	46.7
14-50 (275-295)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	26.3
14-50 (75-100)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	0.05	<0.05	26.1
14-52 (0-25)	6.4	14	0.68	10	8.9	3.5	4.3	2.9	5.6	1.0	34	10	2.5	1.7	40	23	32.7
14-52 (200-225)	0.14	0.18	0.36	1.4	4.0	0.98	2.4	1.2	2.9	0.40	6.9	0.41	1.1	0.15	3.5	5.4	37.5
14-52 (300-318)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	27.9
14-53 (31-50)	<0.05	0.33	<0.05	0.17	0.09	0.05	0.08	0.07	0.13	<0.05	0.28	0.24	0.05	0.06	0.58	0.22	2.5
14-54 (35-50)	0.05	0.07	0.07	0.34	0.57	0.24	0.39	0.12	0.54	0.05	1.3	0.11	0.12	0.31	0.87	1.2	6.8

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
14-54 (35-50A)	0.05	0.08	0.09	0.40	0.76	0.32	0.52	0.16	0.72	0.05	1.5	0.12	0.15	0.68	0.88	1.4	8.6
14-54 (50-75)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	0.44	<0.05	0.06	0.8
14-54 (0-35)	7.1	4.7	1.5	12	9.8	5.9	8.1	2.3	8.0	0.79	31	5.1	2.6	6.3	32	23	170.0
14-54 (0-35A)	7.4	4.5	1.6	13	9.5	5.9	7.4	2.1	8.1	0.76	30	5.3	2.4	6.5	31	23	170.0
14-55 (0-50)	65	48	7.2	66	49	17	29	23	35	5.8	140	45	23	2400	150	100	45.7
14-55 (150-196)	16	0.84	2.4	4.2	2.4	0.50	1.2	0.53	1.8	0.16	7.0	2.3	0.49	360	13	5.6	36.5
14-56 (200-226)	51	1.8	28	32	18	12	15	3.6	15	1.4	48	22	4.5	890	74	34	1300.0
14-56 (0-50)	1000	15	200	150	140	71	98	39	120	12	540	100	43	22000	620	480	25000.0
14-57 (0-44)	4.0	2.1	0.72	3.9	6.1	2.7	5.3	4.2	4.6	0.72	15	1.3	3.4	35	12	12	110.0
14-57 (44-75)	0.77	0.29	<0.05	0.37	0.30	0.10	0.16	0.08	0.22	<0.05	0.81	0.18	0.08	4.3	1.1	0.60	9.5
14-57 (75-100)	0.33	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	4.2	0.09	<0.05	4.7
14-58 (50-75)	0.53	0.15	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	2.3	0.27	<0.05	3.3
14-58 (0-50)	5.1	1.7	0.90	5.3	4.8	2.3	3.1	0.80	4.2	0.27	13	2.4	0.97	81	13	8.7	150.0

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
14-59 (0-25)	0.26	1.1	0.95	3.0	3.1	1.9	4.3	2.6	4.2	0.45	9.2	1.3	2.4	2.6	6.6	7.1	46.4
14-59 (100-125)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.38	<0.05	<0.05	19.3
14-59 (225-250)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	22.5
14-59 (250-274)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	20.5
14-59 (83-100)	0.35	0.10	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	2.7	0.26	<0.05	19.9
14-60 (0-22)	1.2	5.4	0.55	9.0	6.8	2.4	4.7	4.2	4.8	0.68	25	2.4	3.4	0.66	29	19	39.5
14-60 (177-217)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	24.1
14-60 (22-50)	0.17	0.18	0.05	0.27	0.38	0.13	0.21	0.19	0.27	<0.05	0.82	0.35	0.16	0.08	0.75	0.61	64.5
14-61 (0-50)	40	6.7	8.1	25	13	7.6	12	3.4	12	1.2	52	13	4.0	870	63	37	1200.0
14-61 (100-128)	0.31	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	3.9	0.14	0.06	4.6
14-61 (75-100)	2.0	0.32	0.33	1.1	1.8	0.83	1.1	0.28	1.6	0.10	2.9	0.51	0.31	8.7	2.9	2.3	28.0
14-62 (142-160)	0.30	0.15	0.08	0.48	0.60	0.39	0.48	0.12	0.56	0.05	1.4	0.22	0.14	2.3	1.1	1.0	10.0
14-62 (160-200)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.3

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo(a)anthracene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Benzo(g,h,i)perylene**	**Chrysene**	**Dibenzo(a,h)anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3 cd)pyrene**	**Naphthalene**	**Phenanthrene**	**Pyrene**	***Total PAH***
14-62 (0-50)	17	3.2	5.8	14	9.3	6.7	7.9	2.3	7.7	0.72	32	8.6	2.6	270	37	22	550.0
14-63 (204-250)	0.97	0.16	0.34	1.1	1.6	1.2	1.4	0.48	1.5	0.16	3.3	0.36	0.51	7.5	2.6	2.8	28.0
14-63 (250-280)	5.5	0.14	0.67	1.0	2.1	1.7	1.5	0.71	2.5	0.23	5.8	0.34	0.77	39	5.3	3.8	73.0
14-63 (0-50)	68	12	7.2	16	9.3	5.6	8.7	3.0	7.9	0.94	26	11	3.4	3300	43	20	3600.0
14-63 (0-50A)	47	10	7.7	18	13	7.6	11	3.4	11	1.2	34	12	4.0	1800	44	23	2100.0
14-64 (0-50)	13	0.98	4.8	8.7	8.3	2.9	4.2	2.1	5.8	0.56	21	6.4	2.0	160	30	15	290.0
14-64 (122-150)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.23	0.05	<0.05	0.4
14-65 (0-50)	2.7	0.28	0.35	1.0	2.7	1.1	1.8	1.2	2.5	0.29	4.8	0.87	1.0	14	1.2	4.0	45.0
14-65 (66-85)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
14-66 (0-25)	200	170	86	230	190	84	180	98	180	17	950	300	91	2400	1300	690	7000.0
14-66 (100-135)	3.2	0.14	1.2	1.4	0.89	0.32	0.60	0.23	0.83	0.06	2.7	1.2	0.23	61	4.0	2.0	78.0
14-66 (70-100)	15	1.4	13	16	18	8.3	19	13	18	1.9	83	14	12	250	90	60	640.0
14-67 (0-25)	59	9.1	10	16	14	5.4	11	5.7	13	1.4	64	16	5.3	1400	72	45	1700.0

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
14-67 (140-165)	320	4.8	94	45	20	6.3	12	4.8	17	1.4	68	52	4.9	10000	120	46	11000.0
14-67 (265-295)	10	0.57	3.2	3.1	2.0	0.74	1.4	0.54	1.8	0.16	5.3	3.0	0.56	230	8.7	3.7	270.0
14-67 (295-320)	24	2.2	8.5	15	9.6	2.8	5.9	2.8	8.7	0.78	26	12	2.7	380	39	18	540.0
14-67 (320-348)	1.5	0.52	0.06	0.27	0.25	0.08	0.15	0.06	0.24	<0.05	0.60	0.46	0.06	20	0.92	0.45	24.0
14-68 (0-25)	6.6	1.9	0.77	3.9	4.0	1.8	3.4	1.8	3.8	0.46	10	2.3	1.9	61	9.6	7.7	240.0
14-68 (50-75)	0.10	0.07	<0.05	0.10	0.22	0.08	0.15	0.08	0.24	<0.05	0.42	0.09	0.07	1.2	0.32	0.41	3.8
14-68 (75-100)	<0.05	<0.05	<0.05	0.05	0.14	0.06	0.11	0.06	0.15	<0.05	0.29	<0.05	0.05	0.09	0.18	0.26	1.7
14-69 (0-25)	3.7	5.8	1.1	7.2	7.1	2.7	5.5	3.1	6.7	0.58	28	7.1	2.8	46	33	21	180.0
14-69 (73-100)	0.37	<0.05	<0.05	0.05	0.10	0.06	0.12	0.09	0.12	<0.05	0.21	0.05	0.07	15	0.12	0.16	16.0
14-70	0.14	0.16	0.51	1.5	2.1	0.98	2.0	1.5	2.1	0.27	6.4	0.58	1.3	0.52	3.9	4.8	31.0
14-72	2.7	0.65	6.8	16	18	5.9	13	8.5	17	1.8	62	12	8.0	3.8	70	42	300.0
14-73	<0.50	<0.50	1.3	5.1	6.6	2.3	5.1	3.1	6.1	0.63	18	2.7	2.8	1.0	16	13	92.0
14-74	2.1	4.8	2.0	9.7	15	5.4	11	7.1	14	1.6	44	5.9	6.8	9.7	36	30	220.0
14-75	0.75	4.2	1.7	5.1	6.8	2.4	5.6	3.6	6.3	0.64	25	4.5	3.2	2.3	26	16	120.0
14-76	<0.50	1.4	1.3	3.7	7.5	3.0	7.1	5.2	7.5	0.85	19	1.6	4.4	1.1	10	15	97.0
14-77	<0.50	1.2	0.71	3.1	4.8	2.0	4.6	3.4	4.8	0.50	14	1.1	2.8	0.96	7.9	11	68.0
13-9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.39	<0.05	<0.05	0.4

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo(a)anthracene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Benzo(g,h,i)perylene**	**Chrysene**	**Dibenzo(a,h)anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3 cd)pyrene**	**Naphthalene**	**Phenanthrene**	**Pyrene**	***Total PAH***
13-8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-7X	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-7	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-6	-	-	-	<0.05	0.10	0.08	-	0.06	0.16	<0.05	0.21	<0.05	0.05	-	0.07	0.19	<0.3
13-51	0.11	0.31	0.30	0.90	2.2	0.75	2.2	0.89	2.2	<0.05	5.5	0.32	0.96	0.96	2.3	4.5	27.0
13-50	0.06	0.12	0.25	0.46	1.1	0.49	1.1	0.56	1.1	<0.05	3.0	0.15	0.54	0.47	1.0	2.5	14.0
13-5	-	-	-	0.12	0.29	0.20	-	0.11	0.37	<0.05	0.47	0.09	0.12	-	0.36	0.44	<0.3
13-49	0.05	0.16	0.20	0.60	1.1	0.43	0.98	0.54	1.2	<0.05	2.4	0.18	0.49	0.38	1.3	2.4	14.0
13-48	0.17	1.4	0.99	4.9	7.0	2.8	7.7	4.0	7.1	0.73	21	1.5	3.6	0.97	13	16	100.0
13-47	0.08	0.42	0.29	1.2	2.2	0.84	2.1	1.1	2.2	0.18	6.4	0.43	1.0	0.60	3.6	5.1	30.0
13-46	0.07	0.37	0.24	0.82	1.4	0.49	1.4	0.65	1.3	0.08	3.9	0.31	0.68	0.35	2.3	3.0	19.0
13-45	0.25	2.7	1.5	3.6	7.8	3.5	8.3	4.0	7.5	1.2	20	2.5	4.1	1.6	9.4	16	100.0
13-44	0.89	2.4	1.8	6.5	9.3	2.9	6.3	2.2	8.2	0.97	19	2.4	2.5	2.6	15	14	100.0
13-43	0.08	0.40	0.22	0.93	2.1	0.73	1.8	0.86	2.1	0.14	3.1	0.33	0.90	0.54	2.3	2.5	21.0
13-42	0.14	1.0	0.58	3.1	5.7	1.8	5.0	1.8	5.5	0.37	17	1.0	1.8	0.60	8.8	13	73.0
13-41	0.18	1.1	0.64	2.9	4.5	1.7	4.7	2.0	4.6	0.34	15	1.3	2.0	0.90	9.0	12	69.0
13-40	0.22	2.7	2.0	11	19	8.5	21	9.8	19	1.9	62	3.2	9.7	0.78	28	49	270.0
13-4	-	-	-	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.3
13-39	0.10	0.23	0.28	0.85	1.9	0.78	1.8	1.0	2.0	0.16	4.8	0.28	0.93	0.70	2.0	3.9	24.0

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
13-38	0.15	0.53	0.78	2.3	4.3	1.8	4.5	2.4	4.7	0.37	11	0.68	2.2	0.93	5.8	9.0	57.0
13-37	0.07	0.10	0.13	0.34	0.98	0.45	0.94	0.46	1.1	0.08	2.1	0.12	0.49	0.51	0.88	1.7	12.0
13-36	0.08	0.15	0.12	0.44	0.89	0.38	0.74	0.27	0.97	0.06	1.8	0.18	0.35	0.36	0.72	1.5	10.0
13-35	0.08	0.12	0.16	0.51	1.6	0.70	1.4	0.44	1.7	0.07	3.1	0.13	0.51	0.51	1.4	2.7	17.0
13-34	0.10	0.12	0.26	0.57	1.7	0.74	1.7	1.0	1.9	0.16	3.2	0.17	0.90	0.67	1.2	2.8	19.0
13-33X	0.07	0.06	0.16	0.27	0.69	0.28	0.66	0.36	0.69	0.05	1.4	0.09	0.35	0.50	0.55	1.2	8.3
13-33	0.08	0.08	0.21	0.35	1.1	0.51	1.2	0.71	1.2	0.11	2.3	0.10	0.62	0.58	0.75	1.9	13.0
13-32	0.10	0.13	0.26	0.46	1.6	0.74	1.6	0.86	1.8	0.15	3.9	0.13	0.77	0.84	0.95	2.7	19.0
13-31X	0.13	0.18	0.27	0.46	2.4	0.85	1.7	0.69	2.5	0.16	5.4	0.08	0.68	0.76	<0.05	4.3	23.0
13-31	0.12	0.17	0.21	0.44	2.4	0.71	1.5	0.64	2.5	0.13	5.0	0.07	0.65	0.73	<0.05	3.9	21.0
13-30	-	-	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.3
13-3	-	-	-	0.73	1.8	1.3	-	0.52	1.6	0.15	2.9	0.29	0.59	-	2.0	2.2	<0.3
13-29	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-28	<0.05	0.83	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.17	<0.05	<0.05	<0.05	<0.05	1.1
13-27	-	-	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	0.05	<0.05	<0.3
13-26	-	-	-	0.07	0.18	0.16	-	0.10	0.24	<0.05	0.28	<0.05	0.10	-	0.14	0.27	<0.3
13-25	-	-	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.3
13-24	-	-	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.3
13-23	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-22	-	-	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.3

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
13-21	-	-	-	0.89	1.4	0.70	0.96	0.46	1.5	<0.05	2.5	0.71	0.49	7.5	2.9	2.2	25.0
13-20	0.30	0.19	<0.05	0.11	0.11	<0.05	0.06	<0.05	0.10	<0.05	0.24	0.17	<0.05	1.3	0.41	0.19	3.0
13-2	-	-	-	2.7	6.5	3.7	-	1.9	6.5	0.58	9.8	1.2	2.0	-	4.1	9.0	<0.3
13-19	330	22	190	210	160	51	64	15	130	6.5	650	180	20	2600	1000	260	5600.0
13-18X	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-18	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-17	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-16X	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.25	<0.05	<0.05	0.3
13-16	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-15	-	-	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.3
13-14A,B,C	-	-	-	6.5	5.7	5.7	-	3.3	5.9	0.69	20	2.5	2.8	-	21	16	<0.3
13-14A,B,C	0.59	0.20	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.56	<0.05	<0.05	0.9
13-14A,B,C	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-13	0.12	0.13	<0.05	0.24	0.37	0.19	0.25	0.10	0.35	<0.05	0.92	0.99	0.11	0.59	0.94	0.71	6.1
13-12A,B,C	3.2	9.2	1.1	7.7	7.1	2.5	4.8	2.2	6.7	<0.05	22	6.8	2.3	3.5	31	17	130.0
13-12A,B,C	1.5	6.7	1.4	8.6	11	4.4	9.3	3.6	11	1.5	28	5.0	4.1	1.7	27	22	140.0
13-12A,B,C	0.09	0.15	<0.05	0.10	0.08	<0.05	0.06	<0.05	0.09	<0.05	0.29	0.12	<0.05	0.08	0.40	0.21	1.6

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
13-11	5.2	3.4	0.12	1.0	0.70	0.27	0.33	0.12	0.70	<0.05	1.7	1.8	0.13	24	3.8	1.3	40.0
13-10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
13-1	-	-	-	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.3
10-9	-	75	22	85	76	29	73	48	58	7	250	61	50	200	290	190	*1600.0*
10-8	-	0.61	0.2	0.68	0.71	0.23	0.51	0.27	0.63	0.07	1.6	0.47	0.28	0.32	1.7	1.3	*10.2*
10-7X	-	89	14	87	81	26	79	49	54	6.6	250	62	51	43	300	190	*1468.6*
10-7	-	180	57	260	230	72	220	170	180	32	740	180	160	120	900	560	*4311.0*
10-6X	-	0.2	0.045	0.012	ND	ND	ND	ND	ND	ND	0.012	0.067	ND	1.4	0.058	0.016	*1.8*
10-6	-	0.21	0.049	0.017	ND	ND	ND	ND	ND	ND	0.017	0.086	ND	1.3	0.084	0.018	*1.8*
10-5X	-	26	9.3	38	41	15	41	30	32	4	110	23	29	12	120	83	*660.3*
10-5	-	78	13	95	74	26	70	46	52	7.6	240	55	48	100	290	180	*1453.6*
10-4	-	0.15	0.097	ND	ND	ND	ND	ND	ND	ND	ND	0.094	ND	0.98	0.041	0.006	*1.4*
10-3	-	0.21	0.03	0.17	0.07	0.01	0.031	ND	0.05	ND	0.33	0.19	ND	0.85	0.6	0.24	*2.8*
10-2	-	2.8	4.6	8.5	11	3.8	11	6.8	7.2	1.3	34	6.8	7.1	5.4	37	25	*184.3*
10-17	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*0.0*
10-16	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	*256.9*
10-15	-	ND	0.011	0.02	0.03	0.01	0.026	ND	0.02	ND	0.091	0.01	ND	0.022	0.061	0.073	*0.0*
10-14	-	28	20	38	36	14	38	25	28	3.1	140	30	25	49	170	110	*0.4*
10-13	-	700	11000	6500	5800	2800	6100	4000	4800	490	22000	5700	3900	43000	26000	16000	*797.1*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
10-12A	-	12	4.2	13	16	5.7	16	11	11	1.4	44	9	11	8.6	44	32	*142.9*
10-12B	-	1	10	7.4	5.6	2.1	5.5	4.1	4.5	ND	20	5.8	3.8	25	27	15	*166390.0*
10-11	-	0.48	0.14	0.33	0.39	0.15	0.4	0.24	0.31	0.03	0.95	0.32	0.24	0.63	1.2	0.73	*7.0*
10-10	-	4.2	0.3	0.36	0.25	0.09	0.24	0.16	0.12	ND	0.84	1.5	0.15	1	1.7	0.64	*11.8*
10-1	-	0.73	1.3	1.8	3	1.3	3.4	2.7	2.4	0.39	7.4	0.98	2.5	3.5	5.4	5.9	*46.7*
06-9	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-8	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-7	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-6	0.043	0.22	0.21	0.55	0.87	0.39	0.89	0.59	0.66	0.12	2.4	0.19	0.56	0.35	1.3	1.6	*12.2*
06-5	0.04	0.2	0.1	0.44	0.45	0.17	0.33	0.15	0.31	0.04	1.3	0.16	0.16	0.23	0.97	0.82	*6.4*
06-46	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-45	0.005	0.01	0.008	0.011	0.03	0.01	0.023	0.02	0.02	0.02	0.077	0.005	0.02	0.02	0.033	0.057	*0.3*
06-44	0.005	0.01	0.005	0.005	0.01	0.01	0.008	0.02	0.01	0.02	0.02	0.005	0.02	0.009	0.009	0.023	*0.1*
06-43	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.1	0.005	0.005	*0.1*
06-42	0.026	0.07	0.012	0.056	0.05	0.02	0.036	0.03	0.04	0.02	0.14	0.057	0.02	0.24	0.22	0.11	*1.2*
06-41	0.01	0.02	0.02	0.04	0.12	0.05	0.1	0.06	0.08	0.04	0.18	0.01	0.05	0.06	0.09	0.14	*1.1*
06-40	0.024	0.05	0.035	0.11	0.17	0.06	0.13	0.07	0.12	0.02	0.44	0.042	0.07	0.2	0.29	0.31	*2.3*
06-4	0.66	1	0.21	1.1	0.97	0.38	0.82	0.46	0.67	0.11	3.1	0.68	0.49	2	2.6	1.9	*18.6*
06-39	0.029	0.24	0.2	0.52	1.1	0.44	1	0.74	0.83	0.02	3	0.18	0.52	0.27	1.1	2.1	*13.6*
06-38	0.027	0.07	0.11	0.32	0.82	0.23	0.58	0.31	0.68	0.1	1.3	0.11	0.31	0.063	0.83	1.4	*8.0*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
06-37	0.027	0.06	0.092	0.36	0.65	0.17	0.5	0.28	0.62	0.07	1.1	0.099	0.2	0.087	1	1.5	*7.4*
06-36	0.22	0.89	0.48	1.5	1.6	0.68	1.5	0.75	1.2	0.22	5.6	0.89	0.81	2.5	5.8	3.5	*30.3*
06-35	0.43	0.5	0.22	0.96	1.1	0.4	0.77	0.4	0.8	0.2	3	0.38	0.4	2	2.2	1.9	*16.7*
06-34	1.1	0.57	0.32	1.1	1	0.35	0.75	0.34	0.69	0.1	3.1	0.53	0.39	11	3	2	*27.8*
06-33	2.8	0.7	1.1	1.7	1.3	0.54	1.3	0.56	1.1	0.16	4.4	1	0.54	100	4.5	2.6	*126.9*
06-32	2.5	0.31	0.82	1.2	1.4	0.46	0.99	0.46	0.98	0.14	3.7	0.77	0.51	29	3.7	2.5	*52.1*
06-31	6.6	3.6	1.6	5.4	6.5	2.8	6.1	3.5	4.6	0.88	20	2.6	3.7	150	16	12	*255.4*
06-30	7.2	1.6	2.6	4.9	4.9	2	3.9	2	3.8	0.56	15	32	2.2	230	13	10	*344.1*
06-3	0.92	1.4	0.24	1.4	1.3	0.48	1	0.5	0.93	0.16	3.9	0.99	0.63	3.3	3.8	2.2	*24.9*
06-29	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-28	0.006	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.009	0.005	0.02	0.11	0.011	0.017	*0.2*
06-27	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.007	0.005	0.02	0.005	0.007	0.005	*0.0*
06-26	0.044	0.13	0.097	0.29	0.4	0.15	0.32	0.17	0.31	0.06	0.93	0.12	0.2	0.28	0.65	0.61	*5.3*
06-25	0.05	0.24	0.21	0.67	0.86	0.34	0.72	0.36	0.6	0.1	2.3	0.44	0.38	0.42	1.4	1.5	*11.7*
06-24	0.49	0.23	0.009	0.13	0.01	0.01	0.005	0.02	0.02	0.02	0.17	0.12	0.02	1.2	0.38	0.095	*3.1*
06-23	1.3	0.52	0.36	0.89	1.2	0.5	1.1	0.6	0.88	0.15	3.4	0.41	0.63	45	2.3	2.2	*63.2*
06-22	1.8	3.5	2	5.7	7.6	3.5	7.4	4.5	5.4	1	22	2.5	4.5	12	14	13	*120.9*
06-21	7.2	1.3	3.3	4.7	3.7	1.4	3	1.4	2.8	0.43	11	2.6	1.5	350	11	7.3	*418.7*
06-20	18	5	2	6.7	6.6	2.7	5.7	3.1	4.5	0.83	19	3.5	3.3	1100	16	11	*1218.4*
06-2	1.2	1.6	0.29	1.7	1.3	0.5	1.1	0.48	0.92	0.15	4	0.99	0.56	5.3	4.5	2.3	*28.9*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
06-19	16	6.3	2.6	8.1	7.5	3.1	6.7	3.7	5.3	0.96	23	3.9	4	1100	21	14	*1238.2*
06-18	42	8.2	7.4	19	8.3	2.8	6.7	3.1	6.2	0.97	47	13	3.3	3500	49	27	*3762.5*
06-17	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-16	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-15	0.005	0.04	0.016	0.064	0.1	0.04	0.07	0.04	0.07	0.02	0.24	0.028	0.05	0.046	0.16	0.15	*1.2*
06-14	0.049	0.06	0.031	0.13	0.14	0.05	0.11	0.06	0.1	0.02	0.42	0.048	0.06	0.38	0.32	0.28	*2.4*
06-13	0.27	0.42	0.16	0.62	0.74	0.31	0.67	0.4	0.52	0.08	2.3	0.29	0.38	0.91	1.6	1.4	*12.1*
06-12	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-11	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-10	0.005	0.01	0.005	0.005	0.01	0.01	0.005	0.02	0.01	0.02	0.005	0.005	0.02	0.005	0.005	0.005	*0.0*
06-1	4.7	5.2	0.74	4.8	3.1	1.1	2.4	1.1	2.1	0.33	11	3.3	1.2	18	13	6.3	*83.8*
05-9	0.095	0.594	0.169	1.02	0.7	0.251	0.517	0.275	0.652	0.09	1.71	8.4	0.314	0.38	2.29	1.2	*18.6*
05-8	0.059	0.161	0.114	0.656	0.58	0.229	0.448	0.232	0.574	0.076	1.34	2.46	0.27	0.437	1.32	1.01	*9.9*
05-7	0.041	0.223	0.221	0.756	0.906	0.341	0.717	0.368	0.87	0.118	1.96	3.72	0.429	0.423	1.49	1.49	*14.0*
05-6	0.275	0.224	0.364	0.831	1.43	0.621	1.49	1.08	1.39	0.266	2.88	1.45	1.14	3.29	1.76	2.24	*20.5*
05-5	29.8	58	15.5	62.3	35.8	15.4	31.8	17.2	35	3.77	139	66.5	20	778	214	103	*1595.3*
05-4	0.286	1.48	0.618	2.66	2.46	0.837	1.89	1.12	2.31	0.297	6.61	14.2	1.25	3.18	6.25	4.9	*50.1*
05-3	102	168	29.9	124	80.6	32.7	65.4	30.9	74.1	9.15	237	153	38.8	2790	355	172	*4360.6*
05-21	0.273	3.94	0.951	6.68	6.28	2.87	6.41	4.43	6.39	0.846	17.8	2.87	4.81	1.64	17	13.9	*96.8*
05-20	1.96	8.62	1.23	8.49	6.45	2.76	5.12	2.64	6.32	0.619	19.3	24	3.12	4.9	23.4	14.7	*131.7*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
05-2	350	634	383	831	590	251	579	415	579	100	2140	929	415	8310	3140	1610	*20806.0*
05-19	3.97	3.95	0.774	5.15	3.59	1.02	2.6	1.27	3.4	0.321	10.5	18.5	1.49	5.97	13.8	7.78	*80.1*
05-18	0.131	0.079	0.014	0.124	0.083	0.029	0.057	0.033	0.074	0.02	0.181	0.507	0.036	0.093	0.281	0.141	*1.7*
05-17	5.12	9.91	2.18	13.1	11.4	5.03	11.7	5	11.3	1.22	34.5	24.8	6.2	8.69	34.1	26.6	*205.7*
05-16	0.005	0.025	0.005	0.01	0.013	0.01	0.008	0.02	0.01	0.02	0.025	0.025	0.02	0.008	0.018	0.023	*0.2*
05-15	0.005	0.01	0.005	0.009	0.01	0.01	0.006	0.02	0.01	0.02	0.015	0.032	0.02	0.005	0.018	0.012	*0.1*
05-14	5.43	14.4	2.64	14.5	10.3	4.58	10.1	4.51	9.96	1.05	35	31	5.46	6.11	44.3	26.7	*220.6*
05-13	0.175	1.3	0.519	2.24	1.98	0.75	1.54	0.833	1.86	0.221	5.6	8.4	0.962	1.42	4.96	4.13	*36.7*
05-12	0.54	1.83	1.17	5.76	5.88	2.34	4.66	2.73	5.94	0.774	13.9	17.2	2.97	5.11	11.6	10.5	*92.4*
05-11	0.111	0.488	0.461	1.64	1.87	0.585	1.4	0.727	1.81	0.215	4.29	12.4	0.807	1.12	3.17	3.34	*34.3*
05-10	1.25	2.2	2.22	5.54	7.35	3.59	7.28	5.12	7.48	1.28	15.8	21	5.39	14.1	12.2	12.2	*122.8*
05-1	6.39	2.44	2.52	3.9	5.38	1.57	3.75	1.68	5.34	0.515	9.88	7.72	1.95	281	11.3	7.66	*346.6*
04-99	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-98	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-97	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-9	-	13	3.4	26	29	15	32	21	30	4.9	91	11	19	12	88	76	*509.0*
04-8	-	14	4.3	26	27	18	29	18	27	4.6	64	13	17	34	74	58	*458.0*
04-7	-	19	1.7	18	13	8.9	8.7	3	12	1.5	29	14	4.5	54	53	25	*280.0*
04-61	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-60	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
04-6	-	120	150	290	380	190	350	120	330	37	1100	290	150	1600	1300	750	*7637.0*
04-59	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.04	0.03	*0.0*
04-58	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.04	0.03	0.06	0.09	0.03	0.05	*0.2*
04-57	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-56	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.04	0.06	0.25	0.1	0.03	*0.4*
04-55	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-54	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-53	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.04	0.04	0.02	0.05	0.06	0.09	0.04	0.03	*0.1*
04-52	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-51	-	0.07	0.04	0.07	0.13	0.1	0.12	0.08	0.2	0.04	0.26	0.04	0.09	0.3	0.43	0.3	*2.3*
04-50	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.04	0.03	*0.0*
04-5	-	0.71	0.48	2.2	2.9	1.6	3.1	2.5	3.5	0.66	9.6	1.1	1.8	2.4	5.8	7.2	-
04-49	-	0.07	0.04	0.09	0.17	0.16	0.17	0.13	0.23	0.04	0.31	0.05	0.13	0.48	0.34	0.43	*2.9*
04-48	-	0.07	0.04	0.06	0.04	0.04	0.05	0.04	0.04	0.04	0.05	0.03	0.06	0.09	0.05	0.06	*0.2*
04-47	-	0.07	0.04	0.24	0.5	0.34	0.49	0.26	0.55	0.04	0.89	0.18	0.28	1	0.88	1.3	*8.0*
04-46	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-45	-	0.07	0.04	0.06	0.09	0.04	0.07	0.05	0.08	0.04	0.12	0.03	0.06	0.17	0.1	0.03	*0.8*
04-44	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-43	-	0.07	0.04	0.06	0.02	0.04	0.05	0.06	0.03	0.04	0.02	0.03	0.09	0.09	0.03	0.03	*0.2*
04-42	-	0.07	0.06	0.06	0.02	0.05	0.08	0.07	0.03	0.04	0.02	0.03	0.08	0.09	0.03	0.03	*0.4*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2- Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
04-41	-	0.07	0.04	0.06	0.05	0.04	0.05	0.04	0.05	0.04	0.08	0.03	0.06	0.09	0.07	0.07	*0.4*
04-40	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-4	-	0.71	0.56	2.3	4	2.1	4.7	3.5	4.2	0.8	11	1	3.3	2.4	6.9	8.7	-
04-39	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-38	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.02	0.03	0.06	0.09	0.03	0.03	-
04-37	-	0.07	0.04	0.06	0.03	0.04	0.05	0.04	0.03	0.04	0.1	0.03	0.06	0.09	0.09	0.08	*0.3*
04-36	-	0.07	0.04	0.06	0.02	0.04	0.05	0.04	0.03	0.04	0.03	0.03	0.06	0.09	0.07	0.03	*0.1*
04-35	-	0.1	0.05	0.29	0.39	0.3	0.35	0.14	0.45	0.05	0.76	0.13	0.15	0.64	0.75	0.77	*5.7*
04-34	-	0.12	0.04	0.54	0.67	0.46	0.67	0.23	0.81	0.04	0.87	0.57	0.31	0.43	1.1	1.7	*6.9*
04-33	-	0.14	0.08	0.12	0.04	0.08	0.1	0.08	0.06	0.08	0.04	0.06	0.12	0.18	0.06	0.06	-
04-32	-	0.14	0.08	0.12	0.04	0.08	0.1	0.08	0.06	0.08	0.04	0.06	0.12	0.18	0.06	0.03	-
04-31	-	0.14	0.08	0.12	0.04	0.08	0.1	0.08	0.06	0.08	0.04	0.06	0.12	0.18	0.06	0.06	-
04-30	-	0.14	0.08	0.12	0.04	0.08	0.1	0.08	0.06	0.08	0.04	0.06	0.12	0.18	0.06	0.06	-
04-3	-	0.94	0.83	2.8	5.3	2.4	6.3	4.6	5.7	1.2	15	1.3	4.4	3	8.5	11	-
04-29	-	0.14	0.04	0.12	0.04	0.04	0.05	0.04	0.06	0.04	0.04	0.06	0.06	0.18	0.06	0.06	-
04-28	-	0.14	0.08	0.12	0.04	0.08	0.1	0.08	0.06	0.08	0.04	0.06	0.12	0.18	0.06	0.06	-
04-27	-	0.2	0.17	0.68	1.3	0.97	1.3	0.5	1.5	0.17	2.6	0.3	0.5	2.3	1.6	2.6	*18.1*
04-26	-	0.22	0.06	0.54	0.94	0.6	0.98	0.51	1.1	0.04	1.6	0.52	0.51	0.83	1.6	2.5	*13.8*
04-25	-	0.26	0.04	1.6	0.52	0.29	0.5	0.23	0.61	0.04	1.5	0.94	0.25	0.57	4.2	2.2	*14.4*
04-24	-	0.28	0.36	1.1	1.5	1	1.6	1.1	1.6	0.18	4.3	0.55	0.98	2.7	3.5	3.8	*26.0*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
04-23	-	0.3	0.39	1.1	2.9	1.7	3.3	1.9	3.2	0.37	6.5	0.39	1.8	2.3	3.2	6.1	*40.0*
04-22	-	0.34	0.35	0.87	2.2	1.8	2.6	1.2	2.3	0.34	4.7	0.34	1.4	1.6	0.03	4.1	*26.6*
04-21	-	0.53	0.59	2.7	3.8	2.8	3.1	1.5	4.6	0.52	8.4	4.9	1.7	38	8.2	6.4	*92.0*
04-20	-	0.57	0.91	2.3	3.9	2.3	3.4	1.6	4	0.51	9.7	1.5	1.9	80	12	8.4	*137.0*
04-2	-	1.1	0.89	3.7	5.3	2.1	5.9	3.9	5.3	1	16	1.7	3.9	2	11	12	-
04-19	-	0.77	0.06	1.4	0.92	0.73	0.71	0.34	0.99	0.04	1.7	1.1	0.39	3.4	3.5	2.3	*19.0*
04-18	-	0.81	0.92	2.2	5.1	4.2	6.2	2.6	5	0.71	10	0.92	3	4.3	6.6	8.6	*68.0*
04-17	-	1.2	0.25	3	2.2	1.2	1.7	0.61	2.1	0.18	5.6	1.6	0.73	9	7.1	5.2	*44.0*
04-16	-	1.2	0.8	3.6	5.8	5.4	5.6	3	5.5	0.89	13	1.5	3.1	4.7	8	9.7	*77.0*
04-15	-	1.4	0.59	7.6	13	7	8.4	3.1	13	1.1	24	3.9	3.3	2.8	18	24	*139.0*
04-14	-	1.8	1.5	5.6	11	3.5	12	7.4	11	1.2	27	2.8	7.8	8.1	14	24	*153.0*
04-130	130	130	37	170	150	120	150	110	150	19	580	210	110	8100	750	420	-
04-13	-	2	0.14	1.2	1.1	0.63	0.68	0.29	1	0.08	2.9	1.2	0.34	11	4.2	2.3	*30.0*
04-129	84	83	26	100	100	73	100	74	97	17	350	130	77	4800	490	260	-
04-128	92	86	21	110	110	88	110	70	110	16	380	130	72	4900	510	280	-
04-127	-	0.07	0.046	0.17	0.31	0.12	0.34	0.19	0.29	0.052	0.58	0.41	0.21	0.5	0.37	0.49	-
04-126	-	0.19	0.24	0.87	1	0.47	1	0.65	1	0.15	2.9	0.29	0.67	1.7	1.8	2.3	-
04-125	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-124	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-123	-	0.93	0.6	2.1	4.6	1.8	4.7	3	4.3	0.6	9.1	4.5	3.2	5	5.9	7.5	-

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
04-122	-	0.98	1.4	5.7	8.7	3.3	8.4	4.9	7.9	0.97	20	2.3	5.4	3.6	12	15	-
04-121	-	1.4	0.95	3.9	6	2.3	5.9	3.7	5.3	0.78	11	8.3	4	13	8.7	8.7	-
04-120	-	1.2	0.26	1.5	1.2	0.52	1	0.5	1.2	0.15	2.9	1.6	0.6	4.2	4	2	-
04-12	-	3.1	1.7	10	16	11	16	7.8	16	1.3	44	3.7	7.7	6.4	31	34	*226.0*
04-119	-	4.9	1.9	5.9	12	4.9	12	7.7	11	1.5	24	9.9	8	7.7	17	18	-
04-118	6.6	11	1.6	13	13	8.3	11	6.9	12	1.5	40	25	7.2	110	47	33	-
04-117	10	25	5.2	25	20	15	19	13	19	2.7	62	37	14	160	65	50	-
04-116	6.1	10	1.7	9.9	11	8.9	11	8.4	10	2	31	22	8.7	110	37	25	-
04-115	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-114	-	0.007	0.027	0.071	0.1	0.044	0.13	0.091	0.11	0.016	0.28	0.022	0.091	0.092	0.16	0.22	-
04-113	-	0.31	0.2	0.6	1	0.43	1.2	0.88	0.94	0.2	2.6	0.34	0.91	0.67	2	2	-
04-112	-	0.45	0.13	0.72	1	0.2	0.85	0.55	0.91	0.2	2.3	3.6	0.34	1.5	2.3	1.7	-
04-111	-	2.1	0.87	4.2	7	2.5	6.1	3.4	5.8	0.79	13	13	3.8	8	11	10	-
04-110	-	0.57	0.13	1.1	1.3	0.45	1	0.48	1.2	0.13	3.1	0.69	0.56	1.2	2.6	2.3	-
04-11	-	6.6	40	54	63	72	74	41	59	5.7	200	28	40	57	170	160	*1163.0*
04-109	-	1.2	0.48	2.8	2.8	0.85	2	0.92	2.3	0.26	7.2	5.6	1.1	14	7.7	5.2	-
04-108	-	3.3	0.8	5.7	3.6	1.1	2.4	1.1	3.1	0.33	9.9	4	1.4	5.5	15	7	-
04-107	-	5.7	1.9	12	15	6.4	16	11	14	1.9	46	7.8	11	9.2	37	32	-
04-106	-	2.8	1.2	5.2	6.9	2.4	5.1	2.2	6.5	0.71	16	3.6	2.8	5	16	11	-
04-105	-	0.12	0.047	0.15	0.22	0.097	0.21	0.11	0.23	0.03	0.39	0.43	0.12	0.88	0.45	0.35	-

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
04-104	0.68	0.14	0.08	0.12	0.1	0.08	0.1	0.1	0.12	0.12	0.17	0.16	0.12	0.18	0.13	0.16	-
04-103	0.68	0.14	0.08	0.12	0.12	0.08	0.1	0.1	0.12	0.12	0.19	0.19	0.12	0.18	0.15	0.18	-
04-102	0.68	0.14	0.08	0.12	0.1	0.09	0.1	0.1	0.12	0.12	0.2	0.17	0.12	0.18	0.14	0.17	-
04-101	-	0.94	1.1	2.5	2.2	0.45	1.5	0.67	1.9	0.19	6.1	2.4	0.71	4	7.4	4.4	-
04-100	-	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01	-
04-10	-	8.3	1.2	15	11	6.7	7.6	2.7	11	0.08	31	14	3.1	220	41	23	*404.0*
04-1	-	3.7	2.6	12	18	2.3	17	11	17	2.8	48	4.4	10	2.6	36	35	-
02-9	-	17	7.4	35	38	24	38	23	38	3.8	100	17	23	33	100	79	*612.2*
02-80	-	0.01	0.02	0.05	0.17	0.08	0.19	0.09	0.18	0.03	0.28	0.07	0.11	0.28	0.12	0.24	*2.1*
02-8	-	17	7.1	33	41	31	44	29	40	5.8	110	16	31	27	98	81	*648.9*
02-79	-	0.01	0.01	0.03	0.07	0.03	0.07	0.04	0.07	0.01	0.13	0.03	0.05	0.12	0.1	0.11	*1.0*
02-78	-	0.02	0.02	0.07	0.14	0.07	0.15	0.07	0.15	0.02	0.29	0.31	0.09	0.18	0.15	0.25	*2.2*
02-77	-	0.02	0.06	0.09	0.11	0.05	0.13	0.08	0.11	0.02	0.27	0.09	0.09	0.79	0.32	0.21	*2.6*
02-76	-	0.03	0.05	0.12	0.34	0.32	0.44	0.29	0.39	0.08	0.58	0.08	0.34	0.8	0.37	0.49	*5.2*
02-75	-	0.03	0.05	0.1	0.37	0.32	0.37	0.21	0.44	0.05	0.63	0.06	0.24	0.24	0.36	0.55	*4.4*
02-74	-	0.03	0.07	0.16	0.46	0.22	0.5	0.31	0.48	0.09	0.65	0.11	0.36	0.7	0.36	0.57	*5.6*
02-73	-	0.04	0.08	0.15	0.41	0.23	0.53	0.3	0.4	0.09	0.79	0.15	0.35	0.58	0.45	0.71	*5.8*
02-72	-	0.04	0.05	0.12	0.48	0.46	0.54	0.32	0.55	0.08	0.81	0.08	0.36	0.5	0.52	0.67	*6.2*
02-71	-	0.04	0.04	0.11	0.3	0.24	0.36	0.23	0.36	0.06	0.59	0.09	0.25	0.6	0.5	0.5	*4.7*
02-70	-	0.05	0.07	0.17	0.52	0.46	0.6	0.37	0.58	0.1	0.93	0.21	0.44	0.99	0.66	0.75	*7.5*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo(a)anthracene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Benzo(g,h,i)perylene**	**Chrysene**	**Dibenzo(a,h)anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3 cd)pyrene**	**Naphthalene**	**Phenanthrene**	**Pyrene**	***Total PAH***
02-7	-	17	12	50	68	50	70	48	68	7.7	170	22	50	36	150	130	*1010.7*
02-69	-	0.05	0.11	0.21	0.65	0.59	0.74	0.46	0.76	0.13	1.1	0.2	0.52	1.1	0.72	0.91	*9.2*
02-68	-	0.05	0.11	0.22	0.56	0.34	0.76	0.44	0.61	0.13	1.1	0.21	0.52	2.3	0.64	0.95	*9.8*
02-67	-	0.05	0.12	0.26	0.65	0.37	0.85	0.47	0.67	0.14	1.2	0.28	0.56	1.5	0.75	1.1	*9.9*
02-66	-	0.06	0.14	0.27	0.75	0.44	0.94	0.49	0.78	0.15	1.4	0.22	0.6	1.4	0.88	1.2	*10.8*
02-65	-	0.07	0.09	0.18	0.88	0.73	0.93	0.61	1	0.18	1	1	0.71	0.85	1.2	0.96	*11.3*
02-64	-	0.07	0.05	0.12	0.42	0.3	0.36	0.18	0.49	0.05	0.68	0.23	0.21	0.34	0.56	0.58	*5.0*
02-63	-	0.07	0.09	0.23	0.52	0.27	0.52	0.28	0.53	0.07	1.2	0.59	0.32	0.51	0.7	1	*7.5*
02-62	-	0.07	0.07	0.2	0.53	0.3	0.53	0.31	0.63	0.08	1.4	0.14	0.36	0.64	0.84	1.2	*8.0*
02-61	-	0.08	0.1	0.25	0.5	0.27	0.6	0.34	0.51	0.1	1	0.26	0.41	1.3	0.89	0.87	*8.2*
02-60	-	0.1	0.26	0.49	1.3	0.75	1.7	0.8	1.3	0.23	2.8	0.34	1	4.4	1.2	2	*20.9*
02-6	-	22	7.6	38	58	42	59	39	57	6.9	180	21	40	15	130	120	*888.5*
02-59	-	0.1	0.11	0.25	0.94	0.74	1	0.54	1.1	0.15	1.4	0.18	0.64	1.8	1.1	1.2	*12.5*
02-58	-	0.11	0.25	0.48	1.3	0.67	1.6	0.75	1.3	0.22	2.2	0.38	0.96	3.6	1.2	1.9	*18.8*
02-57	-	0.11	0.14	0.41	1.2	0.53	0.92	0.39	1.2	0.12	1.9	2.4	0.48	0.75	1.1	1.6	*14.5*
02-56	-	0.13	0.28	0.48	1.4	0.9	1.9	0.97	1.5	0.27	2.3	0.55	1.2	5	1.4	1.9	*22.0*
02-55	-	0.16	0.18	0.57	1.7	0.74	1.7	0.82	1.5	0.25	3.2	2.5	1.1	2.9	1.9	2.7	*24.1*
02-54	-	0.17	0.31	0.56	1.3	1.4	1.7	1	1.5	0.3	2.7	1.3	1.2	6.1	2.2	2	*25.1*
02-53	-	0.21	0.31	0.77	1.9	0.95	2.1	1	2.2	0.32	3.9	2.7	1.3	10	3.3	3.1	*36.6*
02-52	-	0.21	0.4	0.8	1.7	1.2	2.1	1.2	1.9	0.3	3.6	0.42	1.5	1.8	1.9	3	*24.6*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
02-51	-	0.22	0.44	1	3.1	1.4	3.5	1.6	2.9	0.5	5.4	3.9	2	15	4	4.5	*53.4*
02-50	-	0.24	0.08	0.52	1.3	0.64	1.4	0.68	1.5	0.19	4	0.32	0.88	0.58	3.6	3.2	*20.8*
02-5	-	24	14	50	58	29	65	41	57	7.1	170	33	46	100	150	130	*1047.1*
02-49	-	0.24	0.52	0.89	2.7	2.6	3.7	3	3	0.69	5.5	0.41	3	4.1	2.3	4.5	*40.6*
02-48	-	0.29	0.54	0.84	2.4	2.8	3.1	2.1	2.7	0.49	4.3	1.9	2.3	13	3.4	3.2	*46.4*
02-47	-	0.34	0.39	0.78	2	2	2.5	1.8	2.3	0.45	4.1	1.2	1.9	5.4	3.3	3.2	*34.4*
02-46	-	0.41	0.91	1.8	5.3	4.7	6.2	3.9	5.8	1.1	9.7	0.73	4.3	4.2	5	7.7	*67.7*
02-45	-	0.49	1.3	2.5	6.7	6	9.1	7.1	7.2	1.4	15	0.83	7.6	6.6	5.8	12	*98.0*
02-44	-	0.53	0.76	2.3	3.5	2.6	3.3	2	3.6	0.65	7.5	1.1	2.2	3.8	5.6	5.4	*48.4*
02-43	-	0.65	0.76	1.8	3.3	1.5	3.8	2.5	3.6	0.54	8.1	0.99	2.6	3.8	5.8	6.3	*50.4*
02-42	-	0.68	1.4	3.5	11	6	12	8.1	11	1.5	22	3	8.4	11	7.2	18	*138.8*
02-41	-	0.77	0.75	1.1	1.9	1.7	2.1	1.3	2	0.76	4	3.6	1.4	15	4.6	2.9	*45.7*
02-40	-	0.78	1.2	2.5	3.8	1.8	3.9	2.6	3.5	0.43	12	1.8	2.7	2.2	11	8.8	*63.5*
02-4	-	26	11	45	58	45	68	42	58	8.7	220	26	48	28	200	160	*1104.7*
02-39	-	0.85	1.5	2.9	8.9	6.3	12	8.1	9.6	1.9	21	1.9	9.3	7.2	8.1	17	*128.6*
02-38	-	0.93	1.9	3.5	12	6.7	15	10	12	1.7	25	1.8	10	12	7	21	*157.5*
02-37	-	0.98	1.5	4.2	8.9	7.8	11	8.6	9.2	1.9	22	1.5	8.9	5.1	12	18	*133.6*
02-36	-	1.1	1.6	3.5	8.9	5.4	12	8	9.6	1.3	20	2.4	8.7	13	7.8	16	*132.3*
02-35	-	1.2	2.1	4.7	11	7.3	15	11	12	2.1	28	1.7	12	6.7	13	23	*166.8*
02-34	-	1.2	1.9	5.7	6.9	3.3	8.1	4.1	6.2	1	20	2.6	4.8	6.8	16	15	*111.8*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
02-33	-	1.2	1.1	3.5	4.8	2.5	5.4	3.6	5	0.68	12	1.9	3.8	3.3	9.6	9.5	*73.9*
02-32	-	1.5	2.2	6.3	12	9.3	14	11	12	2	30	2.1	12	4.2	15	25	*171.6*
02-31	-	1.5	1	3.6	5.9	4.7	6.6	3.9	5.9	1.2	14	19	4.5	32	16	10	*135.8*
02-30	-	1.7	2.8	8.1	15	8.5	18	12	15	1.8	37	2.9	13	6	22	30	*213.8*
02-3	-	29	4	25	24	12	26	17	25	2.6	86	19	18	66	93	66	*541.6*
02-29	-	1.7	1.2	5.3	7.1	5.6	7.6	4.3	7.2	1.3	17	22	5.2	83	21	12	*208.8*
02-28	-	2	2.9	6.6	17	13	22	16	18	2.9	45	2.4	17	8.7	19	37	*249.5*
02-27	-	2.1	1.4	5.5	9.6	6.9	8.2	4	8.7	1.4	21	43	5.1	9.8	33	16	*182.7*
02-26	-	2.4	1.5	5.4	7.3	6.4	7.8	5.1	7.6	0.94	20	3.1	5.3	7.6	18	14	*120.0*
02-25	-	2.5	1.4	4.8	8.7	6.9	9.3	5.8	8.7	1.1	20	2.8	6.3	5.2	15	15	*122.5*
02-24	-	2.7	3.2	11	19	8.7	22	11	18	2.3	47	3.7	13	5.2	28	37	*254.8*
02-23	-	2.9	3.1	10	17	8.1	19	12	17	1.8	41	4	12	3.9	26	32	*230.8*
02-22	-	2.9	5.5	14	13	9.8	13	8.7	14	1.4	44	6.8	9	5.6	43	34	*237.7*
02-21	-	3.5	1.8	5.3	8.9	9.2	12	8.4	9.4	1.8	22	5.8	9.2	26	19	17	*170.3*
02-20	-	3.8	3.9	11	18	7.9	19	9.7	16	2.1	44	5.7	11	6.7	35	34	*247.8*
02-2	-	68	34	110	120	54	120	81	120	15	450	90	82	150	500	350	*2474.0*
02-19	-	4.2	4	11	22	18	29	21	24	3.8	57	4.4	23	7.8	32	45	*332.2*
02-18	-	4.7	2.9	10	20	16	23	15	20	2.7	50	4.7	16	6.2	29	40	*281.2*
02-17	-	5.1	4.2	13	25	14	30	20	26	3	70	5.9	21	7.3	39	56	*372.5*
02-16	-	5.5	0.25	2.9	8.3	5.1	8.6	5.5	9	1.2	21	2.6	5.8	1.5	16	16	*120.3*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
02-15	-	5.6	1.5	7.4	6.5	5.7	6.8	5.4	6.3	0.98	22	4.6	5.6	7.5	25	17	*134.6*
02-14	-	5.7	11	36	39	17	42	22	35	4.7	110	19	26	34	98	84	*626.4*
02-13	-	6.2	2.8	12	21	16	22	14	21	2.5	52	5.8	15	6.3	35	39	*289.6*
02-12	-	6.2	3.5	17	16	12	17	13	16	1.9	63	8.2	14	6.3	68	46	*324.1*
02-11	-	7.6	4.7	19	35	26	39	25	36	4.3	87	8.1	26	7.2	58	69	*487.9*
02-10	-	13	5.3	34	45	30	47	30	45	5.3	140	15	31	7.4	110	100	*704.0*
02-1	-	120	270	500	500	320	470	290	480	48	1500	320	300	390	2000	1100	*9048.0*
01-9	-	20	4	17	31	14	26	18	29	5.3	86	20	21	530	86	61	*1005.3*
01-8	-	23	98	110	110	44	89	46	97	16	310	110	59	8300	360	210	*10102.0*
01-7	-	27	32	36	39	19	32	20	34	5.7	120	49	29	1900	150	78	*2615.7*
01-6	-	27	54	67	80	32	61	36	69	11	220	79	45	3700	270	150	*4985.0*
01-5	-	27	28	57	74	31	60	36	67	11	210	49	43	1400	220	140	*2534.0*
01-48	-	0.26	0.52	1.6	2.1	0.8	1.4	0.88	2.7	0.32	6.9	1.6	1.1	150	8.3	5	*186.0*
01-47	-	1.1	6.3	15	11	5.2	8.9	4.4	10	1.4	40	13	5.5	460	57	28	*677.8*
01-46	-	1.2	1.8	3.6	8.4	4.3	9	6	8.2	1.6	20	1.9	6.9	81	12	15	*192.9*
01-45	-	1.3	1.7	3.8	9.2	4.6	9.8	6.7	9	1.9	21	1.9	7.9	130	12	16	*249.8*
01-44	-	1.4	1.2	3.2	8	3.6	7.6	5	7.9	1.2	15	1.9	5.5	18	12	11	*112.3*
01-43	-	1.6	1.5	3.6	7.8	3.9	7.9	5.2	7.5	1.5	20	2.3	6	57	13	14	*163.8*
01-42	-	1.8	1.2	2.8	5.4	3.2	6.9	4.3	5.2	1.2	15	2.6	5.8	17	12	12	*105.0*
01-41	-	1.8	1.8	3.8	7	4.2	9.2	5.6	6.9	1.6	18	2.5	7.7	92	12	13	*198.1*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
01-40	-	2	0.52	2.2	4.1	1.8	3.3	2.3	4	0.64	12	2.5	2.7	43	12	8.6	*106.6*
01-4	-	31	4.5	24	34	15	31	21	31	4.6	140	39	27	490	180	100	*1212.1*
01-39	-	2	2.3	6.2	13	6.1	14	9.2	13	2.3	32	2.8	11	50	19	24	*223.9*
01-38	-	2.2	1	3	5.7	3.3	6.7	4.2	5.7	1	16	2.8	7.2	52	13	12	*144.1*
01-37	-	2.4	1.9	5.7	9.6	5	10	6.8	9.3	1.9	24	3	7.6	89	16	18	*224.2*
01-36	-	2.5	2	5	11	5.2	11	6.8	10	2	26	3.6	8.2	130	19	20	*276.3*
01-35	-	2.5	1.7	5.7	9.2	5.3	12	8.2	9.3	1.7	28	3.3	13	74	18	22	*227.9*
01-34	-	2.5	1.7	5.5	8.9	5.5	12	7.2	9.1	1.5	29	3.9	10	52	23	22	*207.8*
01-33	-	3.3	2.5	5.1	9.5	5.2	11	7	8.7	2	27	4.4	9.8	57	20	20	*206.5*
01-32	-	3.3	2.1	5.5	8.8	4.8	9.9	5.9	8.4	1.7	26	4.2	8.2	210	20	19	*350.8*
01-31	-	3.5	1.9	4.9	10	5.1	10	6.1	9.6	1.8	24	4.2	8.3	220	20	17	*359.4*
01-30	-	3.6	2	5.7	9.4	5.2	11	6.8	9	1.9	25	4.4	9.3	240	20	18	*385.3*
01-3	-	33	3.4	20	26	11	20	13	23	3.4	85	28	18	1400	110	59	*1881.8*
01-29	-	3.7	3.6	14	20	11	25	16	20	2.8	70	6.3	23	88	52	52	*435.4*
01-28	-	4.2	2.7	7.1	11	6.2	12	7.5	10	1.8	30	5.6	11	540	25	22	*711.1*
01-27	-	4.3	1.8	6	11	5.4	12	8.4	11	2	31	5.1	9	25	28	23	*198.0*
01-26	-	4.3	1.8	6	11	5.4	12	8.4	11	2	31	5.1	9	25	28	23	*198.0*
01-25	-	5.6	2.7	12	28	14	30	21	28	4.3	75	6.1	27	140	50	58	*538.7*
01-24	-	5.7	3.8	11	23	11	23	15	22	4.2	64	8.8	18	230	52	46	*567.5*
01-23	-	7.3	3.7	11	14	5.8	10	6.6	13	2	42	12	7.5	1000	49	28	*1226.9*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
01-22	-	8.2	3.2	13	22	10	21	14	21	3.6	64	10	16	440	54	47	*775.0*
01-21	-	9	3.7	45	52	23	52	32	49	7.5	160	14	44	27	120	110	*811.2*
01-20	-	9.5	4.3	16	24	13	29	18	23	3.6	83	13	27	240	71	62	*669.4*
01-2	-	38	2.6	18	16	6.8	14	9.4	15	2.4	78	46	11	260	160	55	*751.2*
01-19	-	9.9	4	16	29	13	31	19	27	4.2	100	16	26	160	96	73	*661.1*
01-18	-	11	3.3	12	18	10	18	11	16	2.8	51	9.8	16	800	42	36	*1079.9*
01-17	-	11	6	24	44	20	45	30	43	7.3	130	18	35	130	110	91	*800.3*
01-16	-	13	3.3	16	22	12	25	15	20	3	78	15	21	380	75	58	*785.3*
01-15	-	13	5.9	18	30	14	28	18	28	5.2	80	16	22	1500	76	57	*1948.1*
01-14	-	17	1.4	7.9	8.4	5	10	6.4	8.6	1	39	18	9.2	140	66	29	*378.9*
01-13	-	18	4.4	18	28	13	25	17	27	3.8	90	16	23	1300	81	65	*1762.2*
01-12	-	18	6.8	30	54	24	53	36	51	8.5	170	24	41	240	160	130	*1113.3*
01-11	-	19	5.9	30	37	19	44	27	36	5.2	150	27	40	100	150	110	*850.1*
01-10	-	20	4.1	18	35	16	32	22	34	5.1	96	18	29	460	84	70	*985.2*
01-1	-	48	78	190	140	56	110	67	150	21	370	110	81	3800	410	250	*6031.0*
00-9	-	0.14	0.08	0.18	0.24	0.17	0.3	0.08	0.23	0.08	0.55	0.06	0.12	0.56	0.46	0.44	*3.4*
00-8	-	0.19	0.34	0.84	2.3	1.6	3	2.5	2.8	0.5	4.2	0.61	2.5	4.7	2.3	3.9	*35.7*
00-7	-	0.35	0.2	0.6	3	2.1	2.9	2.3	3.7	0.2	5.4	0.39	2.3	0.95	3.3	6.1	*36.8*
00-6	-	0.7	0.89	2.3	6.2	4.6	6.4	4.4	6	1.1	10	21	4.9	19	5.9	8.9	*108.7*
00-5	-	1.1	0.96	3.3	8	5.8	9.9	7.4	9.5	1.6	15	1.7	7.6	12	9.2	16	*120.1*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
00-4	-	1.4	0.2	2.1	5.1	3.3	4.7	2.9	6	0.8	13	1.6	3.3	2.4	14	11	*77.0*
00-3	-	1.8	1.2	6.9	11	6.2	12	9.6	12	1.6	25	2.3	9.5	3.4	18	23	*155.5*
00-2	-	2.7	5.1	13	20	8.6	17	7.9	18	2.1	40	38	9.3	230	38	31	*498.7*
00-13	-	0.07	0.04	0.22	0.59	0.61	0.78	0.57	0.71	0.04	1.2	0.03	0.58	1.2	0.76	0.96	*9.0*
00-12	-	0.08	0.06	0.26	0.62	0.45	0.78	0.7	0.76	0.16	1	0.21	0.68	1.8	0.82	0.94	*10.2*
00-11	-	0.1	0.08	0.28	0.72	0.37	0.93	0.67	0.83	0.17	1.4	0.19	0.71	2.2	1.1	1	*12.1*
00-10	-	0.12	0.1	0.36	0.94	0.59	1	0.73	1.1	0.21	2	0.21	0.76	2.5	1.4	1.4	*14.7*
00-1	-	3.8	8.9	22	21	11	23	17	23	2.9	70	11	18	17	76	59	*407.6*
99-9	-	3.74	1.53	4.41	4.86	2.58	3.67	4.05	4.75	0.57	21	6.01	3.36	131	29.4	15.2	*242.3*
99-8	-	3.75	2.02	8.5	8.86	3.96	6.63	3.67	8.64	0.86	17.1	4.68	3.82	88.5	16	12.3	*198.4*
99-7	-	5.17	67.2	45.7	22.5	8.15	14.5	7.16	19.6	1.91	63.4	63.1	7.61	3040	175	48.1	*3604.7*
99-6	-	7.79	3.81	14.3	9.49	2.49	8.25	6.71	8.55	1.08	38.3	3.24	5.67	68.5	55.3	27.3	*271.5*
99-5	-	19.8	127	78.6	44.6	23.5	30.3	26.1	36.1	34.5	84.5	179	18.5	62600	303	43.7	*63692.1*
99-4	-	64.9	939	352	127	45	89.7	50.6	109	19.6	348	485	60.5	52100	1150	230	*56284.3*
99-30	-	0	0.01	0.05	0.04	0.02	0.02	0.03	0.08	0	0.1	0.02	0.02	0.07	0.02	0.08	-
99-3	-	68.8	1740	1000	449	168	297	124	385	39.8	1260	1250	155	38100	2130	855	*48338.6*
99-29	-	0	1.63	2.29	0.98	0.34	0.48	0.26	1.1	0.06	3.31	1.08	0.28	353	0.18	2.21	*367.9*
99-28	-	0.01	0.01	0.05	0.07	0.04	0.04	0.29	0.06	0.01	0.1	0.04	0.02	1.33	0.14	0.08	*1.7*
99-27	-	0.02	0.18	0.17	0.04	0.01	0.01	0.01	0.02	0.01	0.14	0.27	0.01	15.2	0.61	0.09	*16.6*
99-26	-	0.06	0.09	0.21	0.36	0.24	0.37	0.5	0.47	0.06	0.74	0.15	0.36	2.37	0.7	0.59	*7.6*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
99-25	-	0.1	0.21	0.24	0.03	0.01	0.01	0.01	0.1	0	0.19	0.17	0.01	101	1.39	0.11	*103.2*
99-24	-	0.115	0.118	0.133	0.225	0.146	0.121	0.175	0.1	0.15	0.052	0.139	0.175	0.086	0.073	0.12	*2.2*
99-23	-	0.13	0.18	0.42	0.3	0.14	0.14	0.11	0.25	0.04	0.78	0.28	0.09	36.1	1.16	0.53	*40.3*
99-22	-	0.14	0.46	0.83	0.15	0.05	0.07	0.05	0.19	0.01	0.87	0.72	0.04	27.7	2.82	0.7	*34.4*
99-21	-	0.33	0.29	0.29	0.11	0.06	0.06	0.05	0.12	0.01	0.35	0.24	0.05	20.1	1.07	0.24	*23.0*
99-20	-	0.34	0.03	0.31	0.08	0.05	0.06	0.04	0.09	0.01	0.34	0.33	0.03	1.69	1.06	0.22	*4.3*
99-2	-	154	107	301	292	88	264	182	287	29.3	1160	330	178	2290	1250	855	*8070.3*
99-19	-	0.36	0.11	0.71	0.83	0.42	0.58	0.38	0.77	0.08	1.78	0.68	0.43	2.73	0.64	1.25	*12.4*
99-18	-	0.38	0.1	0.26	0.02	0.01	0.01	0.01	0.11	0.01	0.28	0.65	0.01	32.5	1.07	0.17	*35.4*
99-17	-	0.43	0.18	0.93	0.71	0.36	0.56	0.54	0.72	0.08	2.45	0.86	0.49	11.8	1.81	1.82	*24.3*
99-16	-	0.47	0.05	0.18	0.08	0.03	0.03	0.04	0.12	0.01	0.12	0.5	0.02	20.6	0.91	0.09	*22.9*
99-15	-	0.57	0.12	0.33	0.16	0.19	0.08	0.09	0.2	0.02	0.43	0.15	0.07	21.3	0.94	0.31	*24.5*
99-14	-	0.67	0.16	0.8	0.34	0.15	0.21	0.15	0.33	0.03	0.89	1.06	0.15	21.4	2.43	0.62	*29.4*
99-13	-	0.69	1.38	5.19	4.5	2.42	2.42	2.08	4.85	0.35	11.1	4.85	1.73	40.9	18.4	7.96	*113.7*
99-12	-	0.7	0.14	0.28	0.09	0.05	0.05	0.08	0.13	0.01	0.23	0.87	0.05	56.6	1.42	0.16	*60.5*
99-11	-	1.34	0.1	0.27	0.21	0.08	0.09	0.09	0.22	0.01	0.43	1.09	0.06	9.06	1.12	0.31	*13.8*
99-10	-	2.33	2.88	4.15	1.15	0.4	0.51	0.36	1.07	0.08	4.03	6.28	0.24	1110	16.4	2.73	*1153.4*
99-1	-	198	901	1030	230	77.5	168	103	221	24.5	675	675	111	66800	1880	458	*73755.0*
96-99	-	7.67	1.44	8.74	27.2	9.25	23.7	18.1	22.9	2.75	65.9	6.63	20.7	161	44.8	50	*503.5*
96-98	-	8.38	4.77	14.8	38	5.83	18.4	12.8	27.9	4	64.4	10.2	14.6	780	57.6	48.5	*1137.2*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-97	-	8.68	1.4	10.4	22.5	7.96	20.3	17	18.5	3.07	48.2	8.23	17.1	169	35.5	36.1	*450.7*
96-96	-	9.23	1.221	12.5	23.1	6.94	20.3	15.3	19.5	2.87	51	8.76	15.1	268	38.6	37	*555.6*
96-95	-	9.8	1.73	10.7	23.1	5.29	12	8.87	15.8	1.94	41.2	9.4	15.4	209	39.2	31.2	*452.6*
96-94	-	9.83	4.2	11.9	56.2	19	47.6	32.9	46.6	6.04	108	9.75	39.6	384	64.7	83.1	*981.5*
96-93	-	10.2	1.85	10.6	33.8	7.2	19.1	14.7	24	3.76	58.1	8.94	16.1	357	46.3	42.8	*682.3*
96-92	-	10.2	6.92	14.8	29.4	8.27	17.3	9	23.9	2.31	65	11.8	12.1	690	63.5	47.2	*1034.6*
96-91	-	10.6	10.1	16.8	38.5	6.29	19.9	13.1	28.6	4.01	73.2	15.1	14.8	3920	65.9	53.5	*4320.6*
96-90	-	10.6	2.14	10.5	36	9.86	26.2	18.6	28.7	3.68	71	10.4	22.6	2030	56.2	51.2	*2422.2*
96-9	-	38.7	159	146	143	39.6	113	62.1	332	15.2	127	156	72.5	46200	482	217	*48444.1*
96-89	-	11.1	2.03	11.4	38	6.9	22.8	16.9	28.9	4.06	70.9	8.42	19.2	2330	47.7	52	*2703.4*
96-88	-	12.7	4.87	16	28.7	6.63	22.1	14.2	24.1	3.66	59	13.9	14.4	5430	45.4	41.3	*5764.7*
96-87	-	12.9	1.63	14.2	26.1	9.47	18.4	12.7	21.5	3.04	47.3	78.2	12.2	1280	38.3	34.2	*1633.3*
96-86	-	13.6	1.2	14.4	27.3	8.6	17.9	23.9	18.6	3.29	54.5	12.1	27.7	329	51.6	38.8	*666.2*
96-85	-	13.9	2.02	17.6	40.8	10.7	31.7	22.4	31.5	4.03	88.7	13.1	30.5	193	74.4	67	*684.8*
96-84	-	14.2	1.52	19.4	29.8	8.66	20.3	13.8	17.4	3.22	58.3	13.9	15.7	144	45.5	37.2	*461.3*
96-83	-	15.5	1.89	10.2	28.2	9.33	22.8	18.6	21.3	2.94	68	15.3	26	108	69.1	51.4	*500.3*
96-82	-	15.7	22.9	25.1	30.5	7.15	18.6	10.8	22.4	2.49	84.9	31.5	17.3	1810	29.7	61.4	*2215.4*
96-81	-	15.8	1.61	16.9	30.1	9.47	26.4	18.1	24.2	3.34	68.3	12.3	18.8	5170	54.2	49.4	*5551.1*
96-80	-	16.2	47.9	36.5	36.2	8.37	24.6	13.1	29.1	3.57	81.3	39.4	13.6	19200	103	56.8	*19738.7*
96-8	-	39.6	2.57	65.1	60.6	16.4	45.9	30.8	49.3	5.64	135	34	42	2970	128	94.8	*3779.9*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-79	-	16.5	2.1	23.2	37.7	13.9	36.1	24.7	31.8	4.41	95.6	16.5	27.4	364	80.5	70.8	*889.7*
96-78	-	17.2	1.98	34	69.5	29.9	76.7	50.5	62.5	7.56	196	16.7	59.6	71.4	134	145	*1066.4*
96-77	-	18.5	3.85	20.5	30	5.72	16.7	10.7	22.5	2.83	50.2	15.4	13	290	63.4	37.3	*626.8*
96-76	-	19.7	1.81	19.8	50.7	9.69	38.1	25.1	38.6	4.45	100	17.7	34	2830	70.7	71.8	*3382.4*
96-75	-	19.7	16	26	37.9	10.3	21.6	25.3	25.3	4.38	84.9	26.8	30.7	10800	87.3	56.9	*11304.7*
96-74	-	20.3	1.65	24.3	36.5	12.6	31.5	28.9	28.5	3.97	105	20.7	31.6	503	97	76.8	*1359.9*
96-73	-	22.3	1.86	21.6	37.6	12.6	32.4	22.9	31.89	4.3	91.2	21	24.5	3530	76.8	64	*4034.2*
96-72	-	22.6	2.18	25	47.7	19.2	45.5	29.4	39.4	4.37	138	20.2	33.8	1230	126	104	*1944.6*
96-71	-	23.6	25.6	41.9	74.1	27	63	38.1	64.9	6.93	189	32.2	46.7	12400	174	137	*13420.0*
96-70	-	25.1	3.5	19.3	53.2	9.11	41.2	27.3	40.2	6.92	112	19.1	32	7970	86.3	80.9	*8581.2*
96-7	-	47.4	8.18	49.5	38.4	11.5	30.9	17.1	30.8	5.24	94.8	103	21	14100	155	69.2	*14821.6*
96-69	-	27.7	3.31	36.3	53.1	22.6	55.7	39.2	48.7	6.93	141	25.9	45.1	2170	38.2	101	*2883.7*
96-68	-	28.8	3.69	28.5	62.3	16.9	52.6	38.5	50.4	6.43	142	30	48.5	412	134	106	*1227.1*
96-67	-	30.3	3.98	43.5	96.6	27	79.6	51.7	80.8	8.21	257	40.5	66.9	725	219	192	*2018.7*
96-66	-	32.9	1.84	22.8	53.4	12.7	42.2	29.8	46.5	4.67	121	27	39.1	3050	98.2	87.6	*3724.9*
96-65	-	39.5	3.16	26.4	35.3	11.3	33.2	21.2	30.5	4.42	85.1	26.6	22.7	18700	82.7	59.6	*19223.7*
96-64	-	43	1.39	27.4	40.9	14.2	35.2	32.3	29.3	5.29	102	28.4	36.9	5070	92.8	69	*5671.6*
96-63	-	55.5	2.31	30.4	35.1	13.5	23.7	26.8	23.5	3.37	133	58.2	32.2	1070	203	95.2	*1838.5*
96-62	-	70.5	209	87.9	70.5	14.4	49.8	38.6	57	7.48	182	124	43.4	54500	284	124	*55924.3*
96-61	-	166	25.5	148	369	122	260	313	261	45.1	781	126	358	2580	516	567	*6985.6*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-60	-	441	45.1	424	757	259	724	524	673	67.9	3240	576	538	10300	4060	2370	*25838.0*
96-6	-	47.7	186	173	142	44	112	61	123	13.5	337	175	74.2	39400	534	225	*41783.4*
96-59	-	0.4	0.4	0.66	1.2	0.44	0.86	0.4	0.97	0.4	1.96	1.76	0.49	2.37	1.34	1.82	*16.6*
96-58	-	0.51	1.51	0.93	3.61	0.68	1.34	1.39	2.14	0.5	4.65	22.6	1.45	197	7.59	3.92	*254.1*
96-57	-	0.56	0.71	0.98	3.92	1.03	2.68	1.58	4.03	0.52	5.6	16.2	1.89	23.7	5.73	5.03	*78.5*
96-56	-	0.6	0.4	1.03	1.83	0.53	1.23	0.64	1.54	0.4	2.88	4.56	0.79	3.84	2.16	2.43	*26.5*
96-55	-	0.83	1.78	3.03	8.34	2.28	4.92	2.83	7.09	0.97	10.3	1.8	4	22	9.07	8.05	*94.2*
96-54	-	0.97	2.27	1.57	3.95	0.76	2.07	1.25	4.55	0.4	7.59	20.5	1.35	653	10.4	6.45	*720.7*
96-53	-	1.06	34	53.7	33.6	9.2	25	12.2	27.1	4.37	86	247	16.1	9200	160	63.1	*10002.9*
96-52	-	1.56	1.84	3.44	5.6	1.17	2.95	1.72	5.21	0.51	7.79	2.8	2.14	249	10.6	6.11	*305.9*
96-51	-	1.76	0.98	2.34	7.09	2.16	5.54	3.46	6.34	1	14.2	14.5	4.52	11.7	11.9	10.9	*105.4*
96-50	-	1.78	1.98	2.92	13.5	4.76	12.8	9.35	12.3	2.14	27.6	8	10.4	26.1	15.4	21.5	*186.7*
96-5	-	48.9	8.26	41.2	76.2	15	55.8	38.2	57.6	13.8	164	59.7	46.9	13600	190	114	*14615.0*
96-49	-	1.97	6.19	6.02	7.97	2.18	4.88	2.95	7.51	0.86	14.7	23.8	3.32	555	18.4	11	*673.2*
96-48	-	2	0.85	3.09	7.09	2	4.52	2.31	5.88	0.77	13.4	26.5	2.91	6.88	13.4	10.3	*108.1*
96-47	-	2.04	1.12	3.29	5	2.01	3.42	3.83	4.17	1.04	9.24	15.7	5.55	8.25	7.72	7.01	*84.2*
96-46	-	2.69	0.24	3.02	5.89	1.16	2.99	1.78	4.11	0.42	8.46	2.49	2.52	4.72	10.9	5.41	*61.6*
96-45	-	3.15	1.03	3.25	4.39	1.43	2.83	1.4	3.62	0.42	8.34	17.2	1.72	400	6.84	5.8	*465.0*
96-44	-	4.02	13.2	16.2	16.8	4.22	9.44	5.38	15.1	1.75	40.4	75.2	5.1	1340	47.9	29.8	*1636.8*
96-43	-	4.1	22.9	21	33	4.9	15.9	10.1	23.5	6.14	79	110	8.6	2690	105	53.9	*3214.0*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-42	-	4.43	11.7	14.6	29.9	4.27	15.9	8.32	21	5.46	65.2	125	9.76	1420	77.4	44.9	*1885.2*
96-41	-	4.73	20.2	19.2	15	3.95	8.97	4.73	13.1	1.42	43.2	42.5	5.89	1260	67.2	30.8	*1553.1*
96-40	-	4.88	2.81	5.86	8.78	3.31	7.23	5.51	7.79	1.7	18.3	56.2	7.72	1230	19	13.7	*1402.2*
96-4	-	60	17.7	53.7	30.9	10	22.8	9.52	24.4	3.9	75	309	13.7	21500	167	55.2	*22381.6*
96-39	-	4.89	1.23	7.8	7.04	1.72	5.1	2.15	6.42	0.85	18	5.1	3.48	10.4	21.6	13.3	*115.6*
96-38	-	5.38	3.47	10.6	18.7	6.1	17.7	12.9	17.5	3.77	41.2	20.9	15.8	55.7	32.9	31.1	*316.6*
96-37	-	5.52	3.8	14.7	22.5	8.8	22.3	17.5	20.1	4.42	57.2	19.7	19.8	52.3	50.2	43.7	*390.0*
96-36	-	5.66	3.05	10.7	24.5	7.07	21.3	13.8	21.1	2.77	53.1	19.9	15.8	78.4	44.6	40.7	*389.3*
96-35	-	5.67	13.5	19	28.4	6.42	16	10.6	19.1	2.41	54.9	16	17.4	1080	60.5	38.4	*1410.8*
96-34	-	5.73	19.7	28.7	31.1	8.2	17.9	7.5	27.3	2.69	66.1	113	9.22	1470	87.8	48.4	*1964.6*
96-33	-	5.76	1.35	8.06	26.8	8.36	21.9	16.3	19.5	2.75	48.7	5.79	23.3	102	32.2	36.4	*389.3*
96-32	-	5.8	20.9	36.4	36.5	8.7	21.8	8.95	31.3	3.17	77.3	119	10.7	1870	109	57.1	*2440.3*
96-31	-	5.83	3.35	9.24	23.2	6.87	21.4	14.1	19.6	3.29	49.6	29.8	16.4	89.4	39.2	37.8	*396.5*
96-30	-	5.88	1.22	7.46	25.9	7.31	19.9	15.5	17.8	2.71	48.7	5.28	22.8	58.1	31.7	36.7	*335.9*
96-3	-	62.3	204	198	95.6	26.7	74.8	42.1	77.8	11.2	289	247	50.6	31800	625	190	*34085.0*
96-29	-	6.3	1.32	8.29	24.9	9.35	18.1	15.2	16.4	2.47	47.9	6.4	22.4	93	35.6	35.8	*370.1*
96-28	-	6.63	3.47	15.1	18.3	4.77	13.7	8.56	15.8	2.93	42.5	62.4	11.8	167	49.3	31.5	*472.9*
96-27	-	6.99	26.9	5.01	17	2.42	7.61	4.69	9.55	2.2	30	178	5.16	16500	36	20.6	*16868.1*
96-26	-	7.98	3.27	15.5	17.1	4	11.8	7.75	14.7	2.75	41.3	85.2	10.7	52.2	52.9	31	*374.0*
96-25	-	8.77	2.88	17.7	24.8	6.75	18.3	10.9	22.4	2.93	47	88.5	13.4	83.1	48	35.5	*454.0*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-24	-	9.13	2.4	12.8	25.5	9.29	22.6	14.5	21.9	3.14	57.3	25.7	16.5	91.7	52.8	42.8	*437.0*
96-23	-	10.1	11.8	18.6	36.1	5.03	17.5	9.7	24.6	6.41	73.3	176	9.79	1980	95.2	51.5	*2555.0*
96-22	-	10.3	5.7	8.81	21.7	6.29	18.2	11.3	18	3.02	41.5	69.4	13.9	3830	40.5	31.3	*4152.2*
96-21	-	10.4	3.89	8.35	30	5.27	14.9	11.6	18.5	8.2	47.8	122	9.8	3630	45.2	34	*4029.6*
96-20	-	11.1	3.88	8.3	29	4.53	19.8	15.1	21.6	6.66	60.2	67.9	13.8	3820	53.2	44.5	*4211.7*
96-2	-	478	74.7	519	494	207	493	309	483	82.4	2490	683	315	8880	3200	1800	*21091.1*
96-19	-	13.6	31.1	31.2	64.7	10.4	42.7	24.7	50.2	10.6	123	199	31.7	7790	146	85	*8720.5*
96-18	-	14.6	6.52	34	42.1	15.9	43	32.6	39	7.31	121	54.8	34.6	61.7	113	90.2	*759.8*
96-17	-	15.3	12.6	20.7	44.3	7.27	26.2	15.7	31.8	8.09	93.7	156	20.1	5470	107	64.6	*6138.0*
96-16	-	15.6	15.3	30.8	35.5	13.3	33.2	21.3	29.6	4.62	96.2	87.8	23.6	55300	122	73.3	*55940.1*
96-15	-	17.2	4.76	26.8	46.6	11.3	35.9	21.9	39.6	5.55	98.6	33.1	25.3	799	106	72.2	*1389.0*
96-14	-	18.1	3.97	15.2	24.5	6.21	19	12.5	20.2	2.83	54.4	53.8	14.7	2320	66.5	39.6	*2694.2*
96-13	-	25	5.39	26	69	16.5	55.6	44.2	51.8	13.8	145	41	43.1	3570	132	105	*4422.3*
96-129	-	0.01	0	0.01	0.08	0.01	0.01	0.02	0.05	-	0.1	0.03	0.03	0.09	0.04	0.12	*0.7*
96-128	-	0.52	0.35	1.16	6.36	1.26	3.04	2.59	3.91	0.59	6.35	0.67	2.66	12	4	5.31	*56.5*
96-127	-	0.96	0.89	2.14	11.9	2.37	6.83	6.19	8.32	1.38	11.4	1.14	6.26	24.6	7.46	8.81	*111.7*
96-126	-	1.08	1.13	2.44	14	2.94	9.4	7.71	10.5	1.44	16.6	1.34	9.39	18.1	10.4	13.5	*135.5*
96-125	-	1.34	1.17	3.28	17.1	3.32	10.4	9.16	12.2	1.95	18.4	1.65	9.16	32.8	11.6	14.2	*164.0*
96-124	-	1.64	0.57	3.53	10	3.63	6.02	5.05	8.44	1	17.4	2.03	6.55	25.9	8.71	13.3	*123.6*
96-123	-	1.78	1.31	3.78	18.2	4.18	11.1	10.9	12.7	2.43	24.4	2.23	11	37.6	12.5	18.7	*193.0*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)															
	1- and 2- Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-122	-	2.12	1.79	4.73	18.5	5.26	15.6	12.4	15.3	2.16	28.6	2.62	14.1	28	16.3	22.9	*213.0*
96-121	-	2.37	1.12	4.97	13.4	5.86	11.6	9.01	11.2	1.67	24.4	3.12	7.97	21	14.7	18.5	*166.6*
96-120	-	2.48	0.59	3.71	9.52	1.66	5.23	3.67	6.92	0.88	12.5	2.43	4.34	43.3	12	9.71	*127.7*
96-12	-	28.6	6.11	26.2	27.9	8.45	25.1	17.4	24.4	4.89	71.2	75.8	20.4	9410	67.5	51.1	*9896.0*
96-119	-	2.59	1.48	4.92	18.3	3.61	10.5	9.56	13.3	2.11	28.3	2.7	9.98	29	18.2	22.5	*194.8*
96-118	-	2.67	1.35	4.52	17.4	3.88	12.1	10.1	13.4	1.76	23.8	2.6	11.6	52.5	16.1	18.8	*212.1*
96-117	-	2.87	1.19	4.08	15.8	5.62	14.8	11.6	13.3	1.85	32.5	3.09	13.8	51.6	17.5	24.7	*236.4*
96-116	-	2.93	9.26	8.7	18.1	6.15	8.29	6.44	14.8	1.56	40.1	0.74	8.77	6760	46.3	28.8	*6976.7*
96-115	-	3.08	1.17	5.17	17.8	4.95	15.7	11.9	13.7	2.21	29.4	2.94	13.3	46.4	19.2	23	*234.3*
96-114	-	4.08	1.68	6.72	18.4	6.72	15.4	12.6	15	2.25	33.9	4.36	12.4	43	20.5	25.7	*242.9*
96-113	-	4.09	1.76	7.15	20.4	6.23	18	13.5	16.2	2.56	38.1	5.33	15.2	58.3	24	29.6	*286.3*
96-112	-	4.3	1.16	6.04	20.2	4.33	10.1	9.83	13.9	2.18	29.3	4.11	9.84	74.7	20	22.3	*249.9*
96-111	-	5.05	0.96	8.4	17.3	5.21	9.46	5.8	13.4	1.38	36	6.18	8.21	79.6	33.4	27.2	*272.5*
96-110	-	5.28	6.95	18.5	28.4	9.08	20.1	15.2	21.3	2.93	65.5	11.9	18.9	482	46.9	45.9	*822.1*
96-11	-	32	56	35.6	39.3	9.96	26.2	13.5	33.5	4.26	80.2	88.6	17.3	56700	81.9	56.5	*57309.0*
96-109	-	5.73	1.58	8.74	22.7	4.55	15.2	12.6	17.9	2.59	34.2	5.75	14.2	91.1	28.5	27	*316.7*
96-108	-	5.97	1.23	8.56	21	5.35	18.5	13.6	17.8	2.7	42.9	5.29	14.3	941	25.4	31.7	*1178.5*
96-107	-	6.03	1.24	6.35	28.6	9.04	23.8	17.6	21.6	2.72	55.8	5.94	24.5	73	34	42.6	*383.9*
96-106	-	6.11	1.48	8.22	21.9	4.18	12.6	10.7	15.2	2.59	34.8	5.97	10.8	661	30.2	26.3	*872.6*
96-105	-	6.224	1.42	6.51	20.9	9.08	16	13.4	16.6	2.16	45.7	5.58	16	267	34.4	34.7	*520.6*

Sample Name	Polycyclic Aromatic Hydrocarbons (PAHs)																
	1- and 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3 cd)pyrene	Naphthalene	Phenanthrene	Pyrene	*Total PAH*
96-104	-	6.3	6.65	13.2	20.9	7.33	16.3	12.7	13.1	2.42	38	9.79	14	568	33.3	26.4	*803.7*
96-103	-	6.84	0.68	9.59	10.8	3.27	6.29	4.23	8.7	0.9	23.9	7.85	4.02	39.4	29.7	16.6	*181.9*
96-102	-	7.4	14.1	20.6	25.9	6.37	12.5	11.1	16.6	2.39	59.2	113	12.9	2390	67.6	40.2	*2817.4*
96-101	-	7.58	2.02	9.01	30	8.07	22.5	16.9	23.1	3.65	54	6.83	18.7	148	36.2	41.6	*458.4*
96-100	-	7.62	1.46	8.05	29.5	6.59	21.1	16	22.2	3.46	55.1	6.99	17.7	82	39.6	42.4	*391.5*
96-10	-	37	36.7	32.5	43.9	11.5	33.1	15.3	35.5	4.87	93.2	378	20.4	48400	172	66.1	*49424.3*
96-1	-	569	159	755	853	237	790	469	794	90.2	3300	949	511	9920	4540	2340	*27224.2*

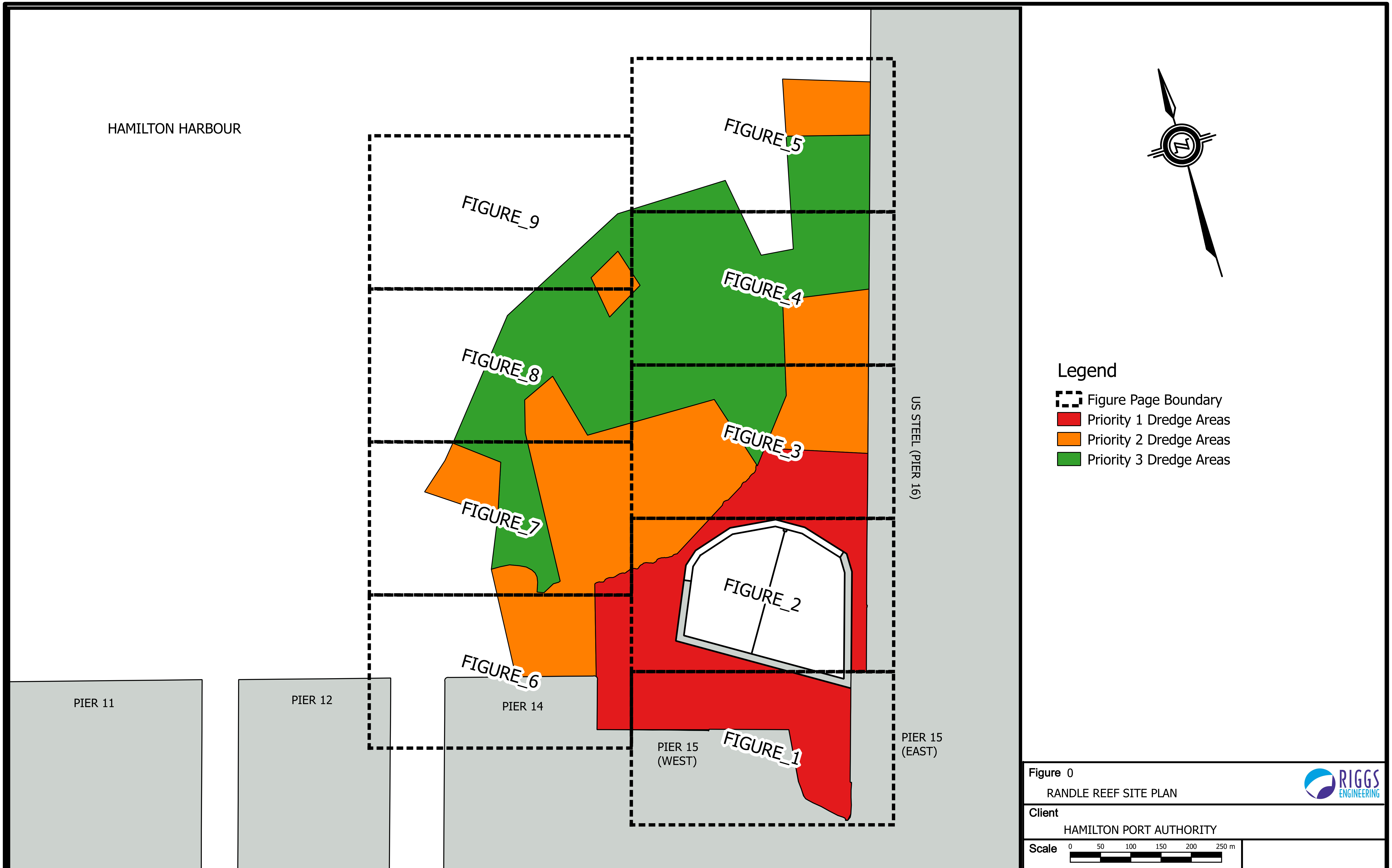
Note(s):
1. - Not tested.
2. ND = Not Detected.
2. Unit of measure: mg/kg

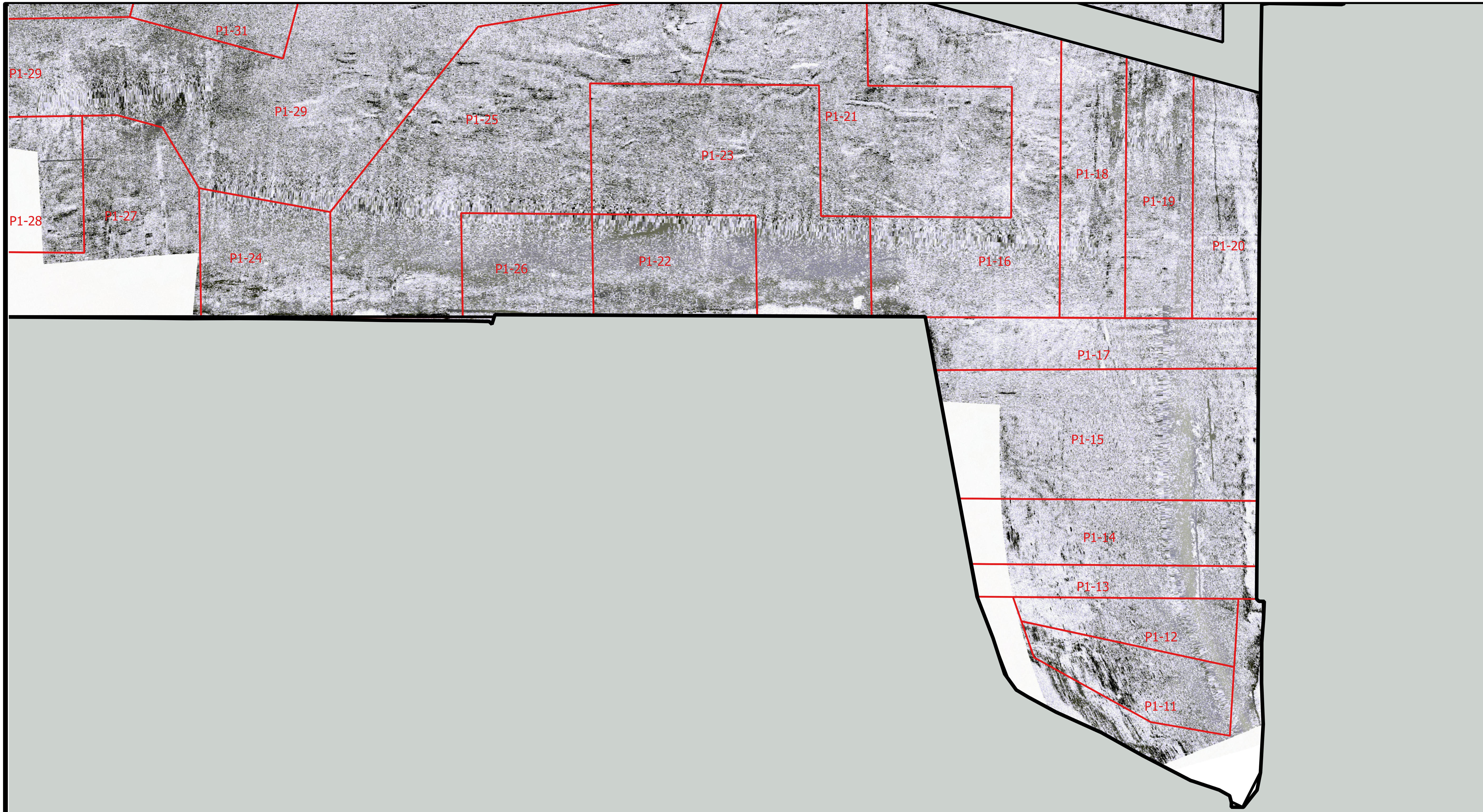
Appendix C
Side Scan Survey

Debris surveys were conducted for the driving lines and dredge areas of the Randle Reef Engineered Containment Facility (ECF) on August 1st, 2013 and October 2nd, 2013. The surveys were conducted with an Imagenex Yellowfin sidescan sonar. The dual channel sidescan was set to medium frequency (330 kHz) with a range of 50 metres per side. Survey lines were run in an east – west direction with 40 metre spacing. The range was sampled 1000 times along each ping giving an across track ground resolution of 0.05 metres for each pixel.

The sidescan data was geo-rectified and mosaiced using Chesapeake's Sonar Web software. The resolution of the image data was reduced to a pixel size of 0.1 metres for the mosaic in Figures 1 to 9. The mosaic should be viewed as if the illumination is coming from the south. A protrusion will be brightly illuminated and have a shadow directly to the north and a depression will have a shadow to the south with brighter illumination on the north side.

Debris that is totally buried is not detected in a sidescan survey.


HAMILTON HARBOUR
FIGURE_1
FIGURE_2
FIGURE_3
FIGURE_4
FIGURE_5
FIGURE_6
FIGURE_7
FIGURE_8
FIGURE_9
PIER 11
PIER 12
PIER 14
PIER 15 (WEST)
PIER 15 (EAST)
US STEEL (PIER 16)
Legend
Figure Page Boundary
Priority 1 Dredge Areas
Priority 2 Dredge Areas
Priority 3 Dredge Areas
N
Figure 0
RANDLE REEF SITE PLAN
Client
HAMILTON PORT AUTHORITY
Scale
0 50 100 150 200 250 m
RIGGS ENGINEERING



Legend

Priority 1 - Dredge Areas

Priority 2 - Dredge Areas

Priority 3 - Dredge Areas

Figure 1

2013 SIDE SCAN SURVEY

RIGGS ENGINEERING

Client

HAMILTON PORT AUTHORITY

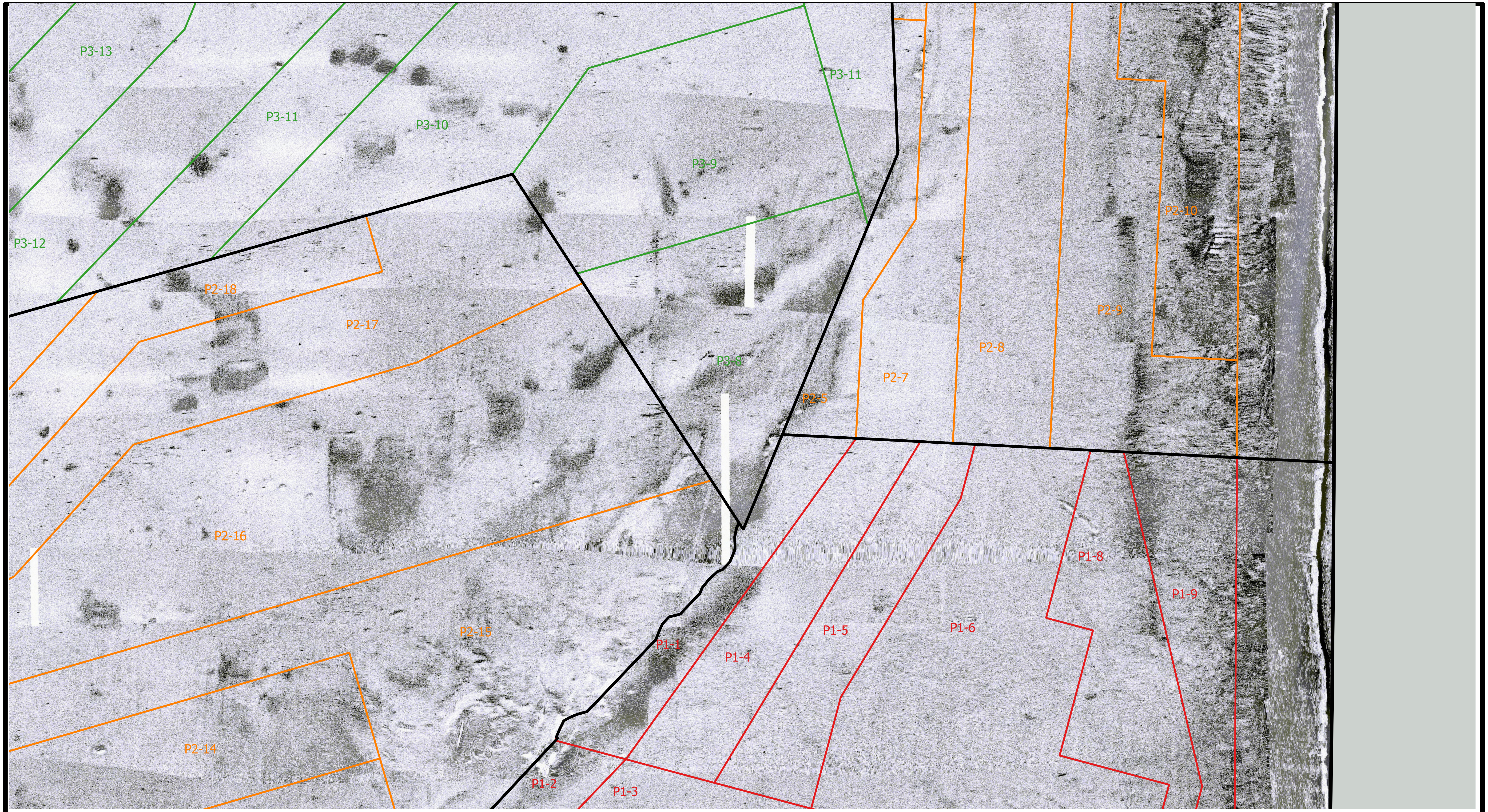
Scale 0 20 40 60 80 m

Legend

- Priority 1 - Dredge Areas
- Priority 2 - Dredge Areas
- Priority 3 - Dredge Areas

Figure 2	2013 SIDE SCAN SURVEY
Client	HAMILTON PORT AUTHORITY
Scale	0 20 40 60 80 m

RIGGS ENGINEERING



Legend

Priority 1 - Dredge Areas

Priority 2 - Dredge Areas

Priority 3 - Dredge Areas

Figure 3

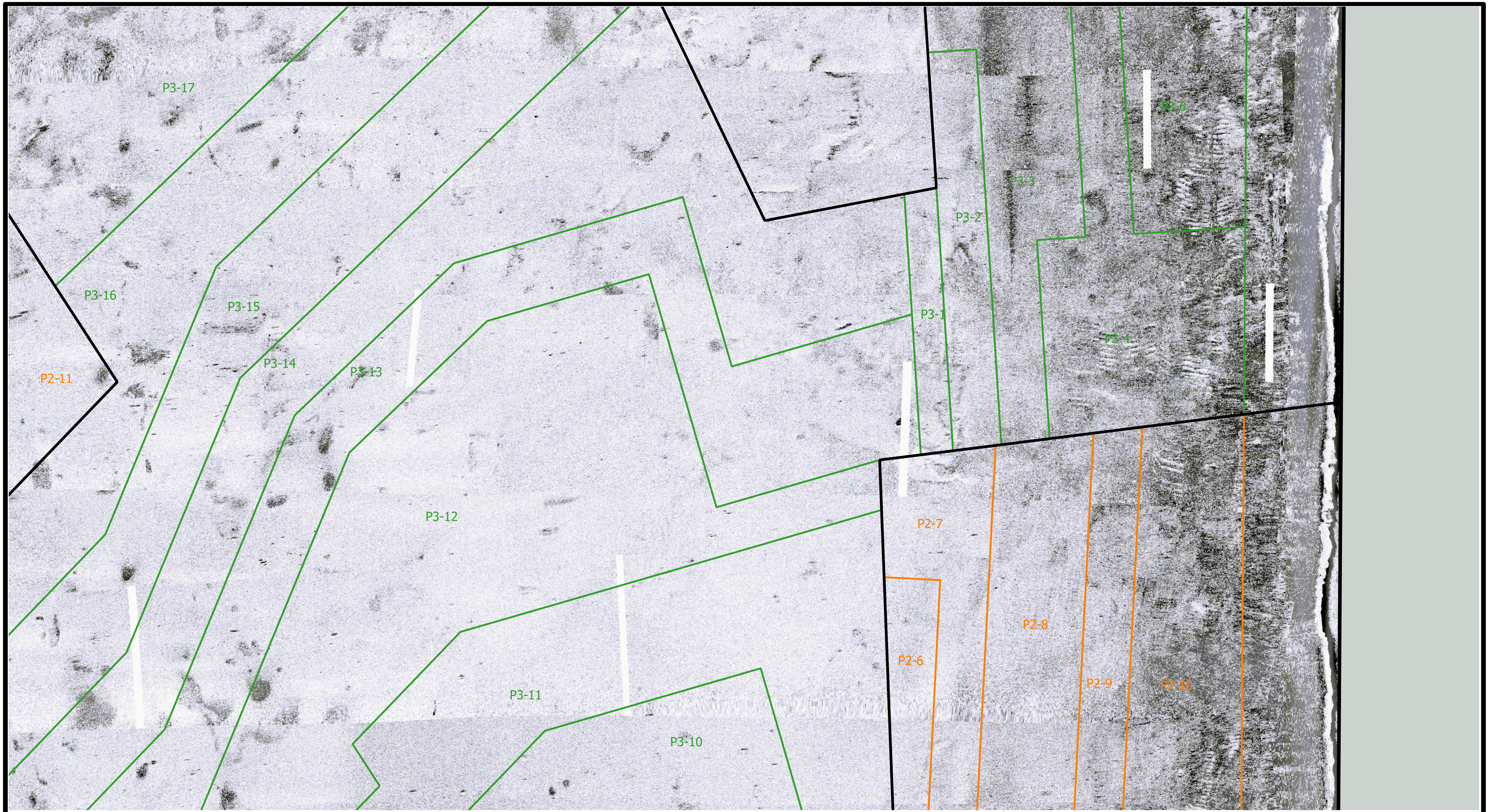
2013 SIDE SCAN SURVEY

Client

HAMILTON PORT AUTHORITY

Scale 0 20 40 60 80 m

RIGGS ENGINEERING

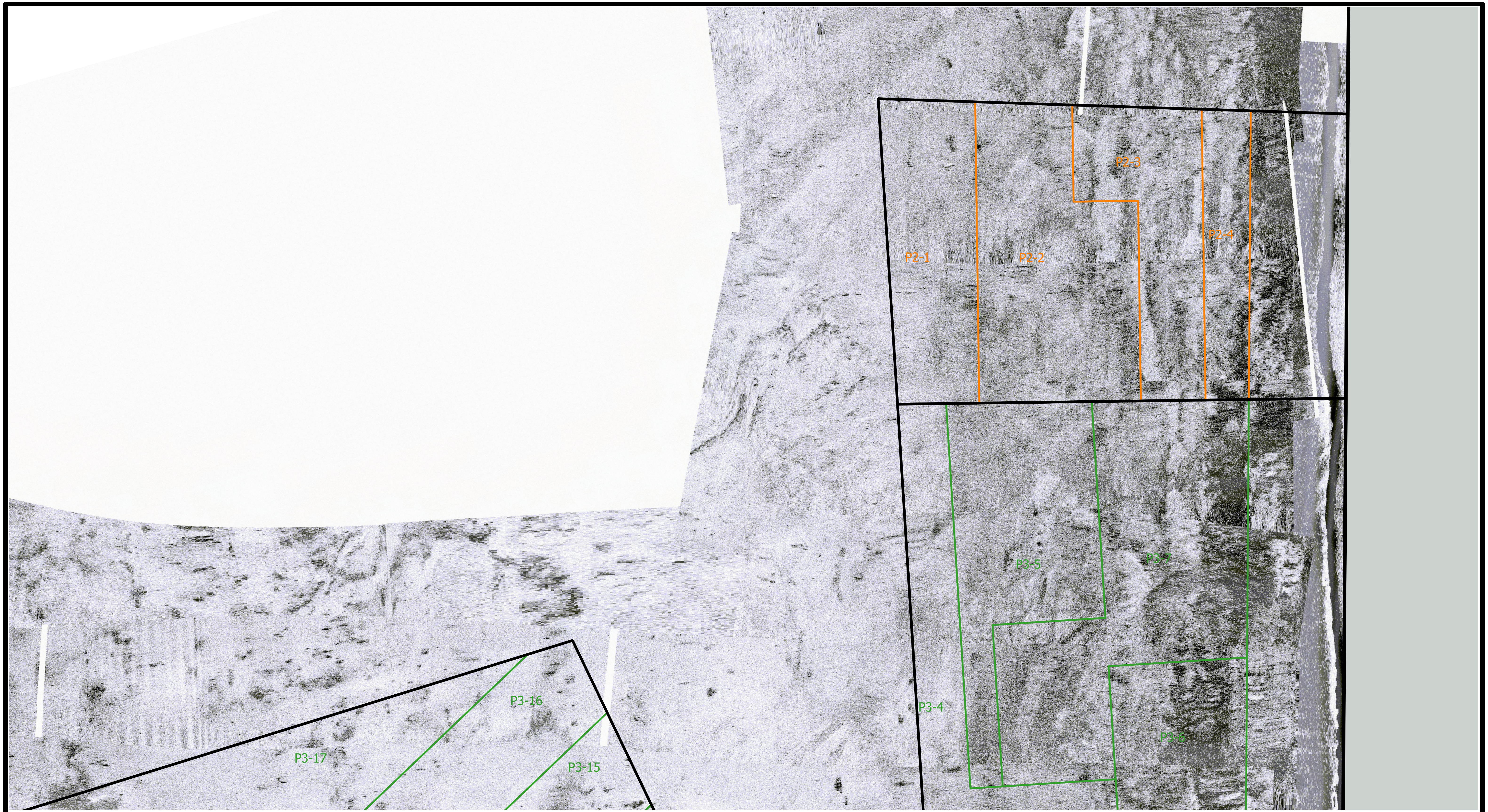


Legend

- Priority 1 - Dredge Areas
- Priority 2 - Dredge Areas
- Priority 3 - Dredge Areas

Figure 4	2013 SIDE SCAN SURVEY
Client	HAMILTON PORT AUTHORITY
Scale	0 20 40 60 80 m

RIGGS ENGINEERING



Legend

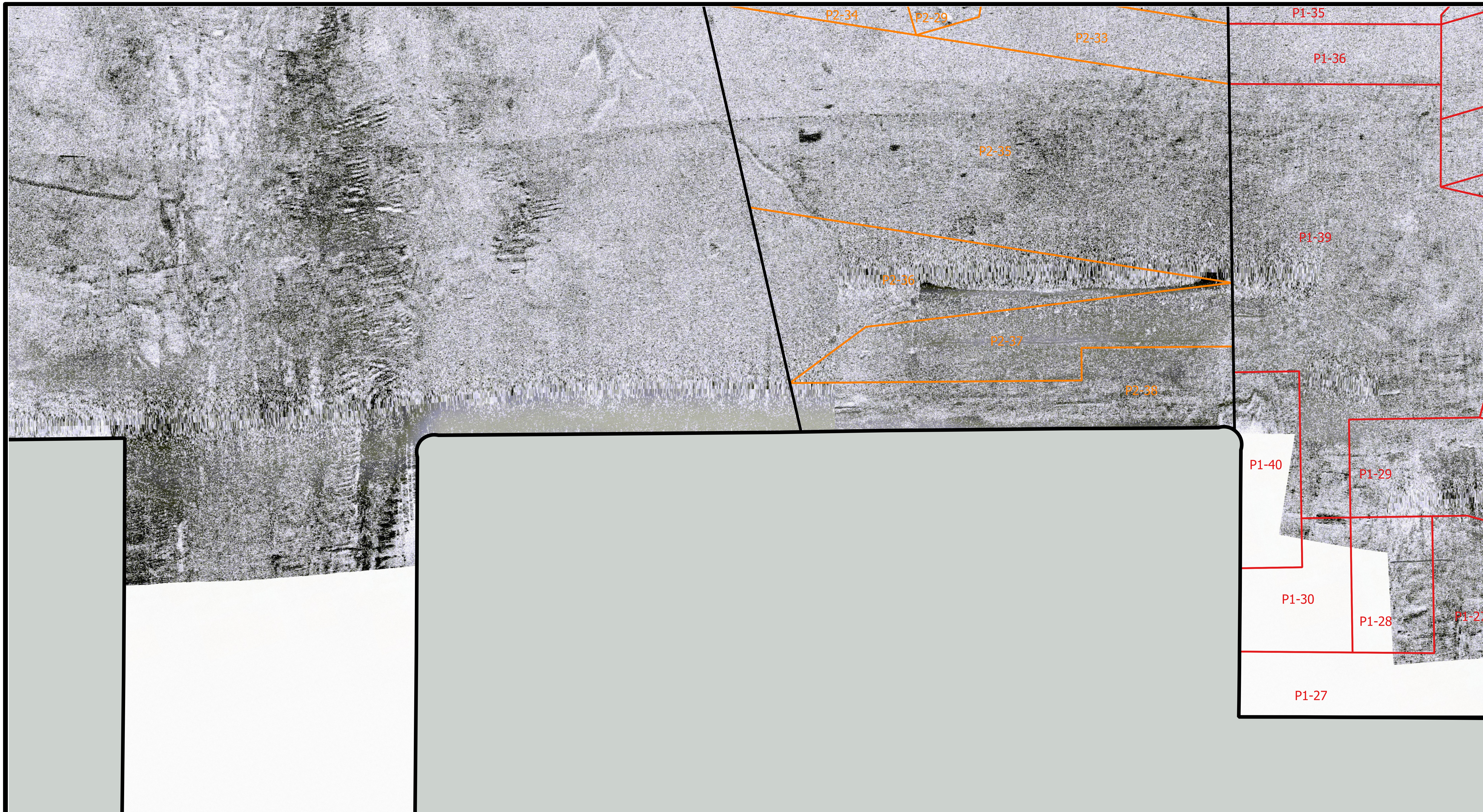
- Priority 1 - Dredge Areas
- Priority 2 - Dredge Areas
- Priority 3 - Dredge Areas

Figure 5
2013 SIDE SCAN SURVEY

RIGGS ENGINEERING

Client
HAMILTON PORT AUTHORITY

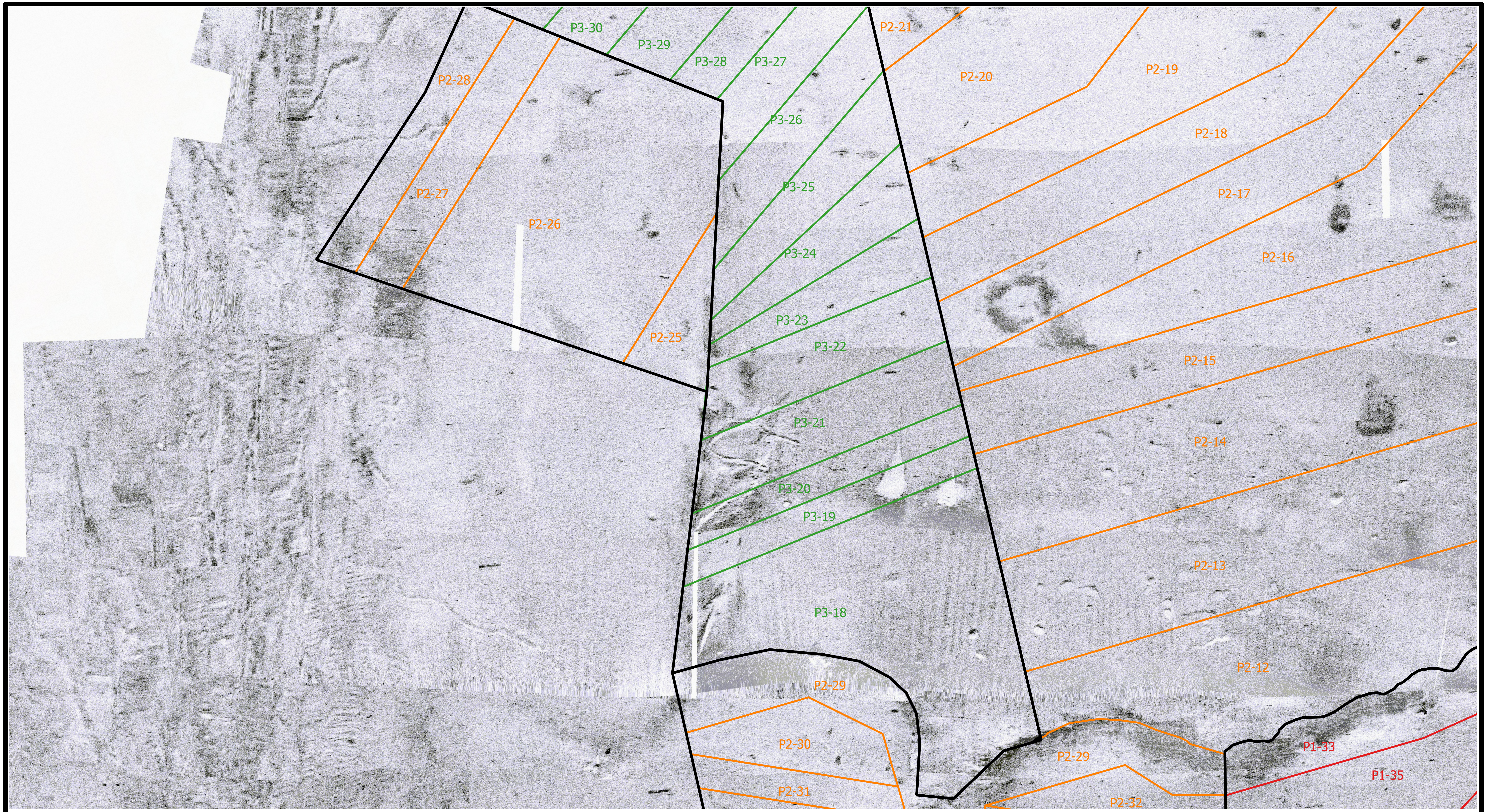
Scale 0 20 40 60 80 m



Legend

- Priority 1 - Dredge Areas
- Priority 2 - Dredge Areas
- Priority 3 - Dredge Areas

Figure	6 2013 SIDE SCAN SURVEY
Client	HAMILTON PORT AUTHORITY
Scale	0 20 40 60 80 m



Legend

Priority 1 - Dredge Areas

Priority 2 - Dredge Areas

Priority 3 - Dredge Areas

Figure 7

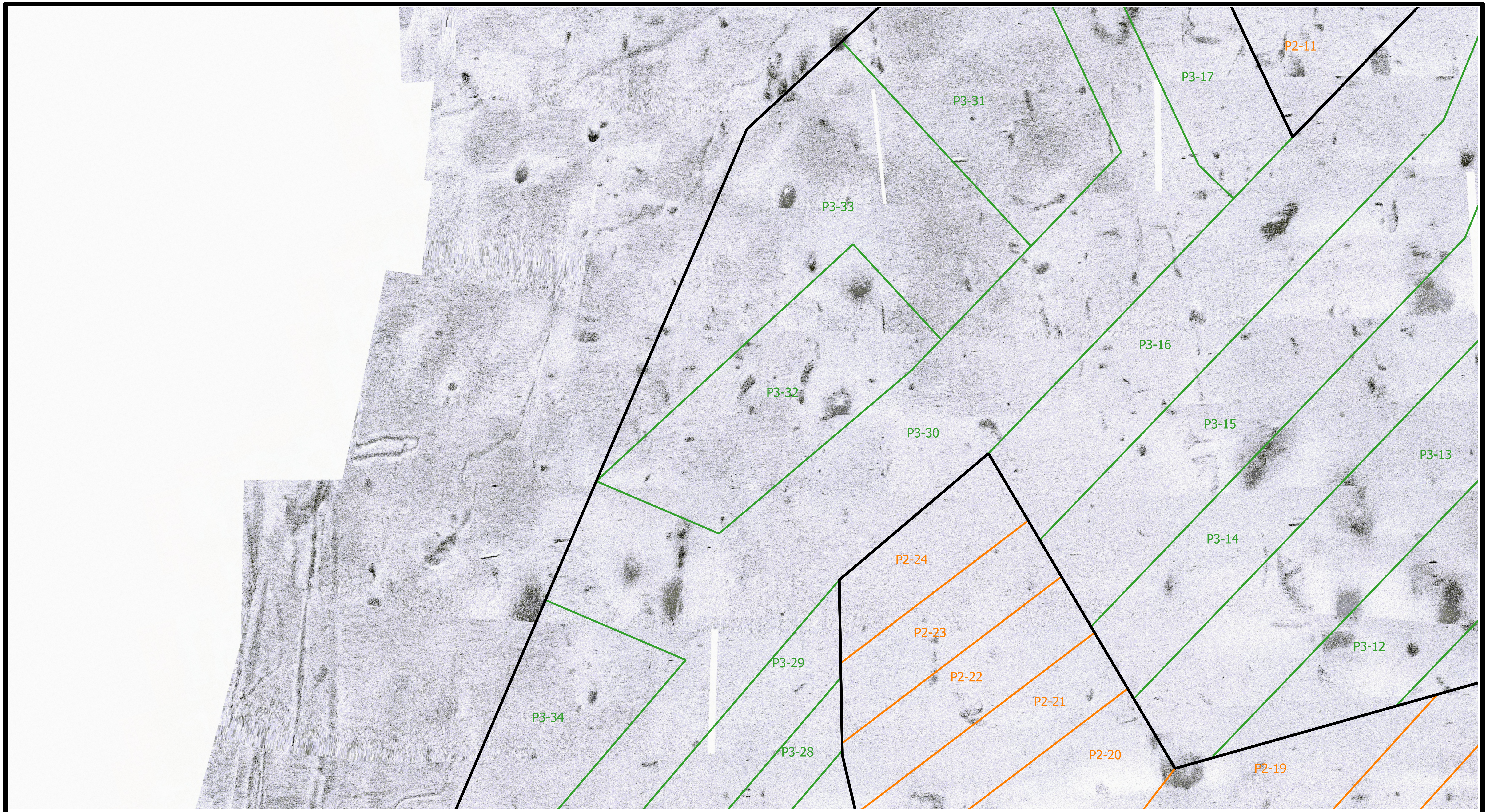
2013 SIDE SCAN SURVEY

RIGGS ENGINEERING

Client

HAMILTON PORT AUTHORITY

Scale 0 20 40 60 80 m

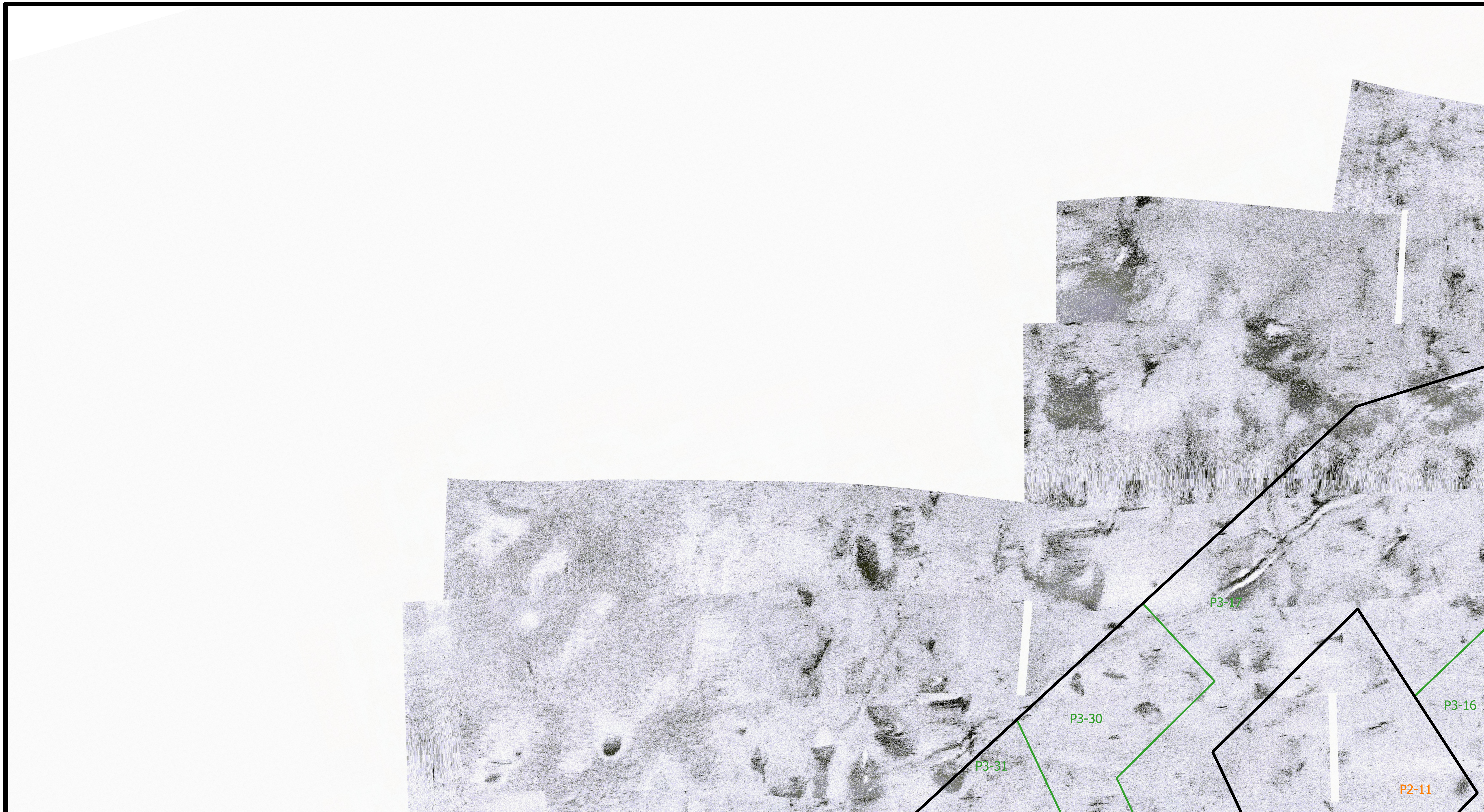


Legend

- Priority 1 - Dredge Areas
- Priority 2 - Dredge Areas
- Priority 3 - Dredge Areas

Figure	8
	2013 SIDE SCAN SURVEY
Client	HAMILTON PORT AUTHORITY
Scale	0 20 40 60 80 m

RIGGS ENGINEERING



Legend

Priority 1 - Dredge Areas
Priority 2 - Dredge Areas
Priority 3 - Dredge Areas

Figure 9 2013 SIDE SCAN SURVEY	RIGGS ENGINEERING
Client HAMILTON PORT AUTHORITY	
Scale 0 20 40 60 80 m	

Appendix D
Water Quality Monitoring Data

Figure 1 - Map of Water Monitoring Stations

Table 1 - Water Chemistry - Metals

Metals	2008 to 2014 - R2, R3 and 7061 Statistics			
	Min (ug/L)	Max (ug/L)	Average (ug/L)	75 Percentile (ug/L)
Silver	0.001	0.007	0.002	0.003
Aluminum	9.7	326	30.324	34.500
Arsenic	0.66	1.15	0.914	0.990
Boron	43.5	77.7	59.658	63.900
Barium	26	40.2	31.518	33.700
Beryllium	0.001	36.4	3.019	0.008
Bismuth	0.001	0.007	0.002	0.003
Cadmium	0.002	0.023	0.012	0.015
Cobalt	0.054	0.34	0.083	0.090
Chromium	0.101	0.6	0.201	0.230
Copper	1.19	3.11	1.910	2.253
Iron	16.1	511	63.347	77.250
Galium	0.014	0.126	0.027	0.029
Lanthanum	0.006	0.291	0.026	0.029
Lithiom	4.12	12	6.463	7.250
Manganese	6.69	120	22.089	26.850
Molibdonum	2.98	4.77	3.841	4.183
Nickel	1.13	2.16	1.473	1.590
Lead	0.096	0.908	0.288	0.354
Rubidium	5.91	11.3	7.991	8.963
Antinomy	0.316	0.505	0.396	0.427
Selenium	0.23	1.36	0.512	0.563
Strontium	337	618	471.464	531.000
Tha,ium	0.003	0.043	0.015	0.018
Uranium	0.437	0.85	0.599	0.677
Vanadium	0.477	1.14	0.698	0.746
Zinc	1.8	9.34	4.315	5.193

Table 1 - Water Chemistry - Polycyclic Aromatic Hydrocarbons

(Typical 16 Priority PAHS)	Avg (ug/L)	Min (ug/L)	Max (ug/L)	75th Percentile (ug/L)
Naphthalene	0.0302	0.00113	2.2500	0.0124
Acenaphthylene	0.0030	0.00004	0.0906	0.0023
Acenaphthene	0.0013	0.00002	0.0122	0.0018
Fluorene	0.0015	0.00005	0.0368	0.0017
Phenanthrene	0.0051	0.00052	0.1090	0.0052
Anthracene	0.0010	0.00007	0.0169	0.0010
Fluoranthene	0.0083	0.00113	0.0812	0.0095
Pyrene	0.0099	0.00130	0.1010	0.0121
Chrysene	0.0032	0.00044	0.0343	0.0039
Benzo[b]fluoranthene	0.0036	0.00022	0.0540	0.0039
Benzo[b,j,k]fluoranthene	0.0043	0.00025	0.0267	0.0056
Benzo[a]pyrene	0.0023	0.00008	0.0335	0.0029
Benzo(a)anthracene	0.0022	0.00013	0.0291	0.0027
Dibenz[a,h]anthracene	0.0004	0.00003	0.0049	0.0005
Indeno[1,2,3-cd]pyrene	0.0020	0.00010	0.0240	0.0025
Benzo[ghi]perylene	0.0021	0.00010	0.0232	0.0026
2-methylnapthalene	0.003	0.0002	0.074	0.003

Appendix E
Air Quality Monitoring Data

Appendix E includes the following:

ITEM E1. 2014 Environmental Canada Background Air Monitoring Program Summary Randle Reef Sediment Remediation Project Hamilton Harbour/Lake Ontario, March 12, 2015.

ITEM E2. 2015 Environmental Canada Background Air Monitoring Program Summary Randle Reef Sediment Remediation Project Hamilton Harbour/Lake Ontario, May 19, 2015.

Appendix E
Air Quality Monitoring Data

ITEM E1
2014 Environmental Canada Background Air Monitoring Program Summary
Randle Reef Sediment Remediation Project Hamilton Harbour/Lake
Ontario, March 12, 2015.

Environment Canada Environnement Canada

2014 ENVIRONMENT CANADA BACKGROUND AIR MONITORING PROGRAM SUMMARY RANDLE REEF SEDIMENT REMEDIATION PROJECT HAMILTON HARBOUR / LAKE ONTARIO

R. Joyner, M. Graham and E. Hartman

Ontario Region

March 12, 2015

Great Lakes Division
Great Lakes Areas of Concern
Sediment Remediation Unit

Canada

Contents

INTRODUCTION

Randle Reef refers to a highly contaminated section of Hamilton Harbour, located adjacent to the U.S. Steel (USS) dock wall and the Hamilton Port Authority (HPA) Pier 15.

Contaminated sediment at the Randle Reef Sediment Remediation Project (the project) site has been assessed and various sub-areas of the site classified in terms of the priority for remediation. The planned remediation consists of the dredging of contaminated sediment and its placement within an Engineered Containment Facility (ECF). Past assessments have divided the contaminated sediment into separate areas with assigned priorities (from Priority one to Priority 4) which relate to the level of impact and importance of remediation. Areas of the highest priority are designated as Priority One areas, followed by Priority One and then Priority Three all of which require management (Figure 1).

The project has been designed to account for and minimize the possible air emissions from dredged sediment as it is removed and placed into the ECF. The primary air quality concern related to the emission of volatile organic compounds (VOCs) from dredged sediments exposed to the air. Particulate related contaminants are not considered a concern because the dredged sediment will only be exposed for a short period of time before placement back below the water. Because the dredged sediment will not dry, airborne particulate is not anticipated from the sediment itself.

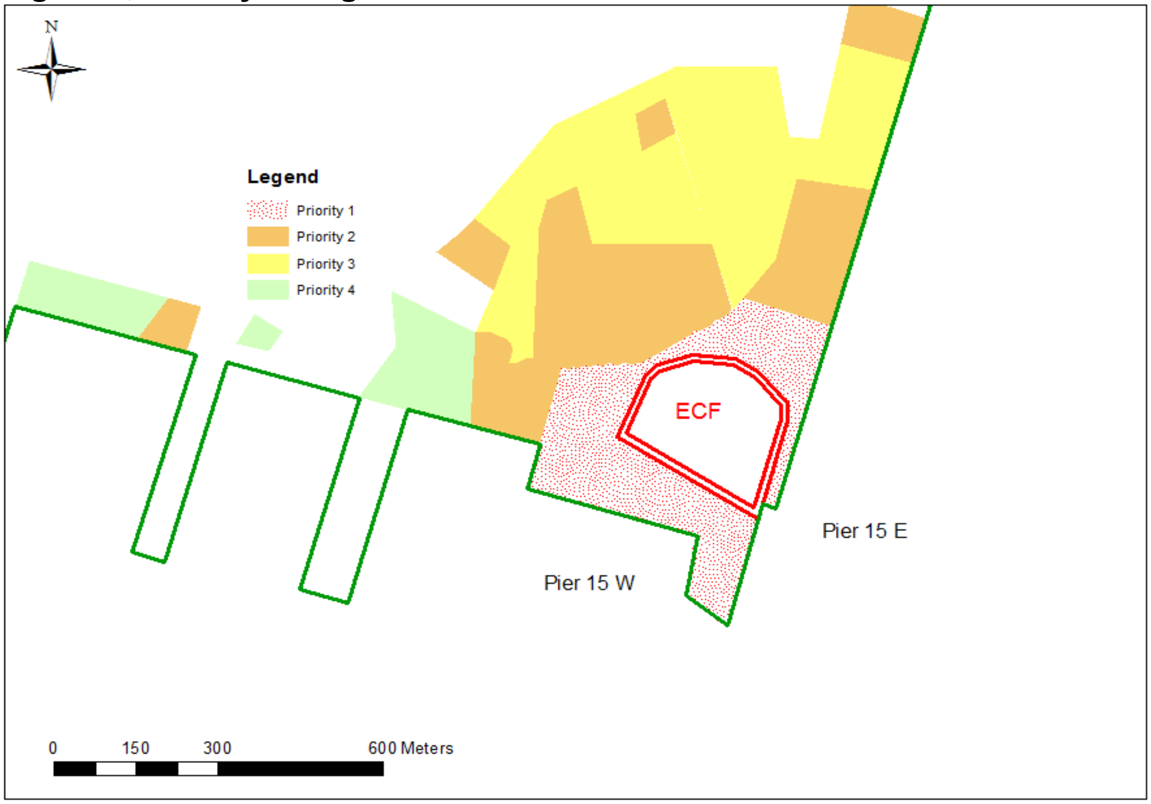
The majority of the sediment to be dredged and placed within the ECF is anticipated to be hydraulically dredged and piped into the ECF with a discharge located below the water surface. This set-up would minimize air emissions.

A small amount of mechanical dredging is anticipated between the double sheet pile walls. This activity represents a higher risk of air emissions based on the exposure of the dredged sediment to the air. Contaminated sediment to be mechanically dredged from between the walls is all Priority One sediment.

Many heavy industrial activities and operations exist within Hamilton Harbour and the neighborhoods adjacent to the project area. In addition to considering potential emissions from the project, potential VOC emissions from the surrounding properties will also need to be considered.

The risk of air emissions also relates to the degree of contamination, with Priority One sediments therefor representing the greatest risk.

Figure 1; Priority Dredge Areas



Sediment related VOC concerns focus on naphthalene along with benzene, toluene, ethyl benzene and xylenes (BTEX). Ontario has developed **24 hour Ambient Air Quality Criteria** (AAQC) for these compounds based upon health effects.

24 hour Ambient Air Quality Criteria (ug/m^3)

Naphthalene	22.5
Benzene	2.3
Toluene	2,000*
Ethyl benzene	1,000
Xylene	730

*odour related criteria scheduled to be updated.

Within the Hamilton Harbour area it is not uncommon for benzene to exceed the AAQC. The Hamilton Air Monitoring Network (HAMN) uses the upper risk threshold (URT) values for benzene, of 100 ug/m^3, as an alternative reference while reporting their benzene measurements.

OBJECTIVE

Environment Canada (EC) designed and implemented the background air sampling program, with advice and input from the Ministry of Environment and Climate Change (MOECC) and the HAMN, in order to increase the available data set for background air quality levels prior to the onset of project activities.

EC's background monitoring is also anticipated to continue on during the project activities which represent an air quality risk. The establishment of this data set will provide an opportunity to compare any future perceived project emissions to the pre-existing or existing air quality levels in the neighborhoods surrounding the Randle Reef area.

It should be specifically noted that the air sampling associated with this program was not completed for regulatory purposes and the results should not be used in any regulatory application.

SCOPE OF WORK

The background air sampling program consisted of the collection of "grab samples" from three different locations surrounding the Randle Reef project area. These locations were selected to represent possible receptor sites, dependent on wind direction, for any air emissions generated by the project. The sampling locations were also selected to augment existing data available from the HAMN (http://www.hamnair.ca/).

The three EC stations were;

- EC Station 1; DND property at the HMCS Star
- EC Station 2; City of Hamilton property at 235 Birch
- EC Station 3: USS property along the dockwall

The EC sample locations where selected to fill in the gaps between the existing HAMN stations and provide more comprehensive coverage (Figure 2).

Figure 2; Background Air Monitoring Locations

In general, in order to establish consistency with the HAMN sampling, the air samples were collected on the same 12 day cycle as the HAMN VOC collection.

METHODS

Sampling;

Samples were collected using a 6 liter suma canister outfitted with a flow regulators calibrated for 24 hour collection and electronic timer.

Ambient air sampling involves collecting a representative sample of ambient air for analysis. To obtain a more representative sample requires time-integrated sampling. A flow controller was used to spread the sample collection flow over a 24 hour time period and achieve a time-weighted average sample (TWA). This TWA sample accurately reflects the mean conditions of the ambient air in the environment for those 24 hours.

The samples were collected using a passive sampling technique, where the vacuum pressure of the suma canister itself is used to collect the sample. The passive canister sampling system was set up with six basic components:

1. An electronic timer with opening and closing valve to control the sampling period;
2. an in-line Swagelok™ filter with 2 µm stainless-steel sintered filter to eliminate particulate;
3. a restrictor;
4. a Veriflow SC423XL back-pressure flow regulator;
5. a vacuum gauge, and
6. the 6 L suma canister

A picture of the initial set-up is presented in Figure 3. It should be noted that the samplers were removed from the plastic enclosures part way through the program due to elevated styrene readings determined to be related to the enclosure composition.

Figure 3 – EC Air Monitoring station set up (timer, controller and canister)

The back-pressure regulator maintained approximately a 0.5 to 1 psi pressure drop across the restrictor until the canister was within 1to 2 psi of reaching atmospheric pressure, after which the regulator can no longer maintain a 1 psi differential across the orifice, resulting in a drop in flow rate.

The vacuum gauge enabled sampling personnel to visually monitor changes in the vacuum in the canister during sampling.

The flow controllers/electronic timer assembly was assembled in the Environment Canada's Air Quality and Analysis (AQA) laboratory and leak tested. The flow rates were set according to the canister size, 3.5 mL/min for 6-liter canisters.

The assembled flow controllers were purged with humidified clean air for at least three days. US EPA Compendium Method TO-15 requires that the flow controllers be certified clean prior to use. The flow controllers were certified by passing a humidified high-purity air through the flow controller to evacuated canisters, and analyzed the air by GC-MS. The flow controllers were certified clean when no target VOC concentration is greater than 0.2 ppbv. The certified flow controllers were capped with Swagelok fittings and shipped to the site for sampling.

The AQA laboratory also supplied purged and voided the 6 liter suma canisters used in the collection of the samples.

Samples were set-up before the sampling date with the electronic timers programmed with pre-set opening and closing times. The suma canisters were attached to the controller/timer assembly and leak tested in the field prior to sampling. Samples were collected from 0:01 to 23:59 on the date of sampling.

The date, time, technician, pre-sampling canister pressure and post sampling canister pressure were recorded for each sample. Weather conditions and any other notes of significance were also recorded. A second duplicate sample was collected from some stations on occasion and submitted to the AQA laboratory as a blind duplicate. The completed samples were collected the next working day after sampling.

Analysis:

The completed samples were sent to the AQA Laboratory at 335 River Road, Ottawa, Ontario for analysis. The air samples were analyzed using a cryogenic preconcentration technique with high resolution gas chromatograph and quadrupole mass-selective detector (GC-MSD) as described in US EPA TO-15. A total of 150 non-polar VOCs were in the target list. To achieve the detection limits desired, air samples must be concentrated before injection into a GC-MS for analysis. EnTech Model 7100 preconcentrators with auto-sampler (EnTech Instruments, Inc., Simi Valley, CA) was used for sample preconcentration, The instruments used for species identification and quantification was Agilent 7890 gas chromatograph and Agilent 5975 MSD. VOCs were separated on a 60 metre, 0.32 I.D. fused silica capillary column with a 1.0 µm film thickness of J&W DB-1 bonded liquid phase.

The presence of water vapour and CO2 at levels 4-8 orders of magnitude higher than the target volatile compounds requires water and CO2 to be removed prior to GC injection in order to avoid chromatography problems and attenuation of response in the mass spectrometer. The EnTech 7100 utilizes three stages to manage the water and CO2 without losses of desired analytes. Air from the sample canister was drawn through the preconcentrator's multi-stage trapping system. Sample volume was measured by a mass flow controller. For non-polar operation, 500 mL of outdoor or 200 mL indoor/personal sample air was passed through a glass bead trap maintained at -170°C. In the same manner, 50 mL of a gaseous mixture of internal standard was added directly to the first stage cryogenic trap under mass flow control. A three-stage concentration technique call "Microscale Purge and Trap" was used to separate water from organic sample components. The air sample was first concentrated to about a 0.5 cc in a cryogenic glass bead trap. This trap was then heated to roughly 10°C and held there, while slowly passing helium through it to transfer the organics to a secondary Tenax™ trap at -60°C. Sweeping the VOC's from the first to the second trap with only 40 to 50 cc of helium results in the transfer all the VOCs and less than 1 µl of water. After transfer to the second trap, the VOC's were back-flushed while heating to 180°C to be further focused on an open-tubular focusing trap at -180°C. This cryofocusing trap was ballistically heated to 100°C, resulting in rapid injection of VOCs onto the analytical column. Heating of the focusing trap occurs extremely fast, producing the narrow peaks and reducing peak tailing.

Optimum results were obtained by temperature programming the GC oven as listed below.

Table of EnTech Operation Mode and GC Parameters
Non-Polar VOCs
GCMS inlet System: 7100 Preconcentrator and 7016 16 Position Autosampler (EnTech Instruments, Inc.)
7100 Mode of Operation: Microscale Purge and Trap
GCMS: Agilent 6890 GC/5973 MSD (Palo Alto, CA)
Column: DB-1, 0.32 mm ID, 60 M, 1 um
Temperature: -60°C (3 min) to 164 at 7°C/min, to 220°C at 14°C /min

The GC-MSDs were operated in the selected ion monitoring mode (SIM). Identification of target analytes by SIM analysis is based on a combination of chromatographic retention time and relative abundance of selected monitored ions. Two or three characteristic ions were monitored for each of approximately 188 hydrocarbons which are either frequently or occasionally found in urban air samples. The MSD acquires data for target ions only, and ignores all others. This detection technique is highly specific and sensitive.

Instrument calibration standards were prepared using stock gas standards prepared in house from multi-component liquid mixtures and gas mixture cylinders purchased from Scott Environmental Technology Inc. The accuracy of the calibration standards were verified against two certified reference standards, the Scotty TO-14 calibration mix (39 compounds) and the Spectra Gases Inc. Certified 62 compounds standard. Quantification was based on a daily 6-point linear regression calibration curves obtained from analysis of these external standard mixtures. Precision, as determined from replicate analyses of samples, is within 15% for the compounds at concentrations above 0.1 µg/m3.

Maintenance:

The flow regulators, timers and associated components were also periodically shipped to the AQA laboratory for purging/cleaning and calibration as described above.

Meteorological data:

Wind rose plots were used to visually identify the predominant wind direction and intensity over each of the 24 hour sampling periods. Wind rose plots were created in Microsoft excel based on hourly wind speed and direction from data from the Environment Canada weather station located at the Hamilton Airport. The hourly data collected was for the same 24 hour time period in which the suma canisters were open. The wind direction and intensity data was read and summarized by a computer program written in MATLAB^{TM} to produce a frequency matrix of compass directions vs wind speeds as shown in figure 4.

Figure 4; 24 hour sampling date wind data frequency matrix

Direction	0<wind speed<5	5<wind speed<10	10<wind speed<15	wind speed>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	0	0	0	0
SW	0	1	1	0
WSW	0	2	3	13
W	0	0	0	4
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0

The MATLAB code utilized in creating the wind rose charts for each sampling period is attached in Appendix I.

RESULTS:

The sampling analytical results are presented below by sample date with the associated wind rose for that 24 hour period.

While the AAQCs do not necessarily represent the best comparison for certain parameters during project air monitoring, they are used here as an easy reference.

AAQC exceedances are noted with as:
Exceedances of 50% of the AAQC are noted as:

The frequency of occurrence in the wind rose is represented by the number of concentric circles emanating from the centre. These circles are numbered on the plots. For example, data points plotted on a concentric line labelled as “3” indicate that there were 3 hours in the 24 hour period for this wind direction. Wind speed is represented by the colour of the plotted point / line.

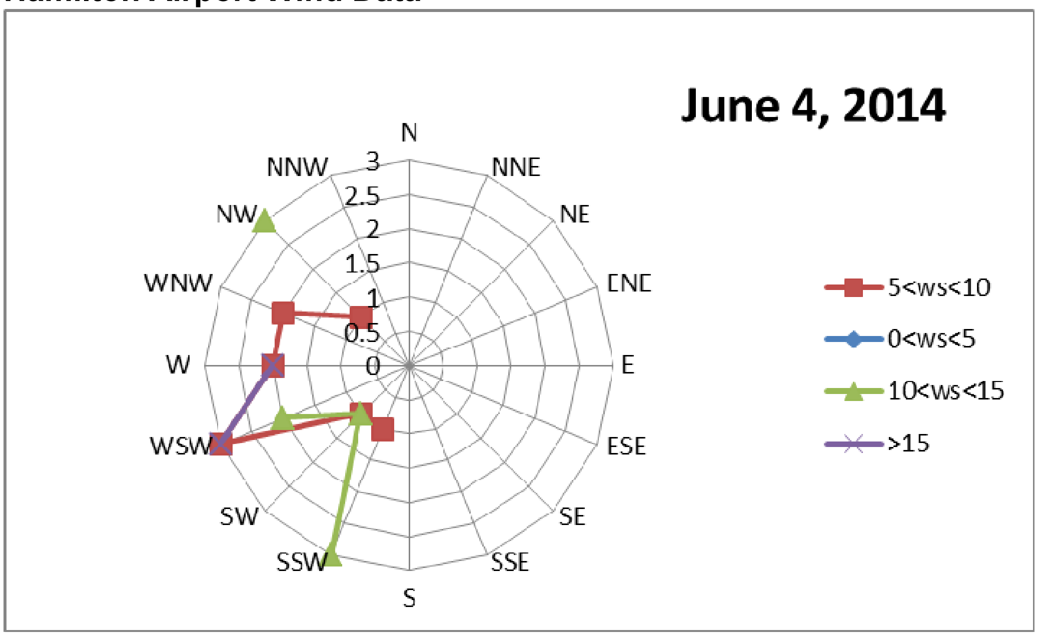
It should be noted that in some instances mechanical issues with the timer valves prevented the collection of samples from all stations.

June 4, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham		EC 3, USS	AAQC
Canister ID	EPS 800	EPS 805	EPS 561	EPS 764	
Sample Volume (mL)	500	500	500	500	
Benzene	1.59	0.30	0.46	0.37	2.3
Toluene	4.57	1.02	1.45	1.63	2,000*
Ethyl benzene	2.07	0.32	0.66	0.22	1,000
m,p-Xylene	3.52	1.14	1.58	0.61	730
o-Xylene	2.70	0.40	0.90	0.26	
Naphthalene	0.46	0.17	0.21	0.16	22.5

Hamilton Airport Wind Data

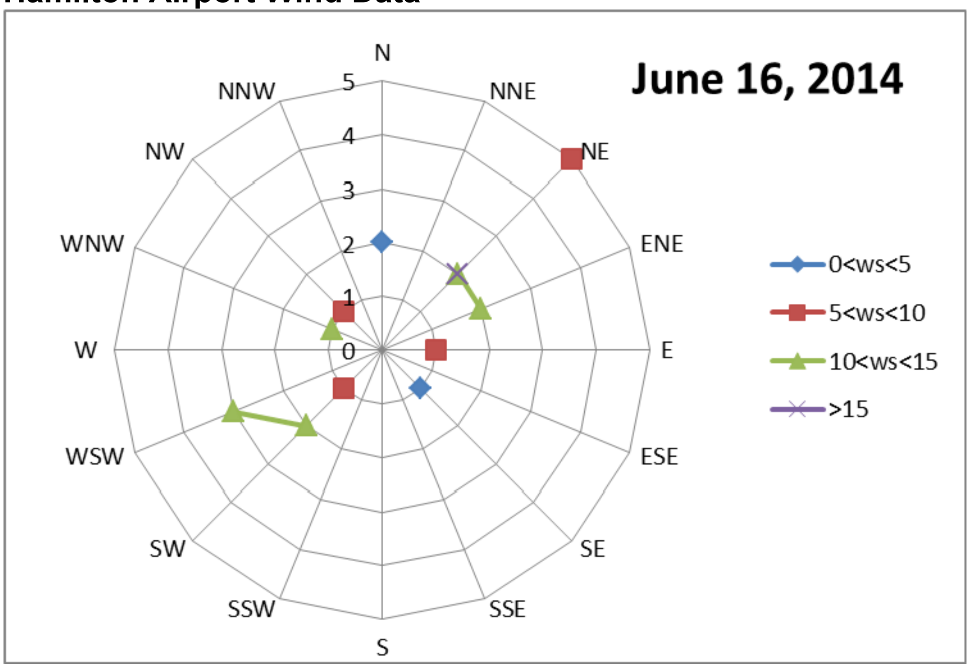


June 16, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 893	EPS 107	EPS 056	
Sample Volume (mL)	500	500	500	
Benzene	0.47	7.07	8.26	2.3
Toluene	1.09	6.75	2.68	2,000*
Ethyl benzene	0.15	3.16	0.17	1,000
m,p-Xylene	0.35	4.06	0.58	730
o-Xylene	0.16	4.41	0.26	
Naphthalene	0.25	7.20	11.42	22.5

Hamilton Airport Wind Data

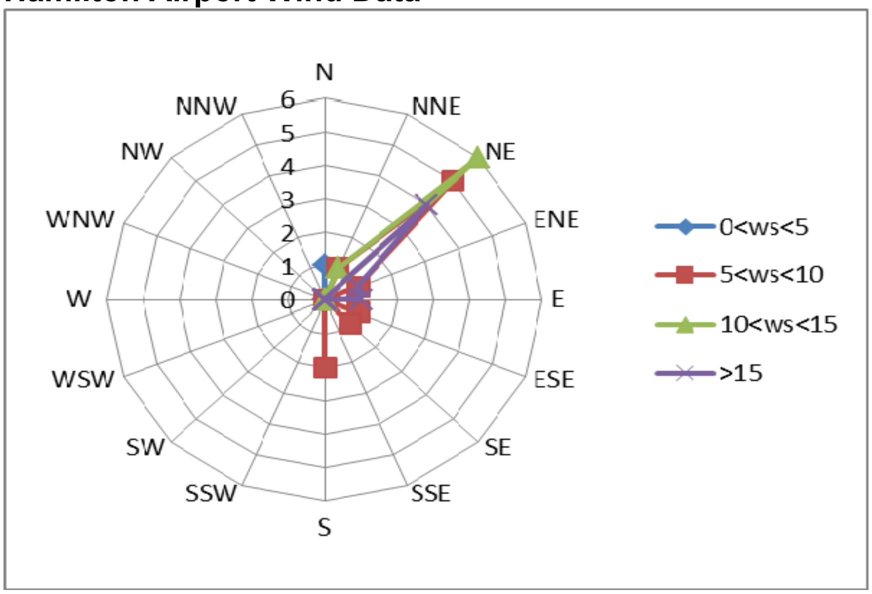


June 28, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 053	EPS 772	EPS 1000	
Sample Volume (mL)	500	500	500	
Benzene	0.50	4.14	4.62	2.3
Toluene	2.03	3.48	3.57	2,000*
Ethylbenzene	0.29	0.98	0.34	1,000
m,p-Xylene	0.71	2.29	0.84	730
o-Xylene	0.34	1.28	0.44	
Naphthalene	0.24	5.62	7.08	22.5

Hamilton Airport Wind Data

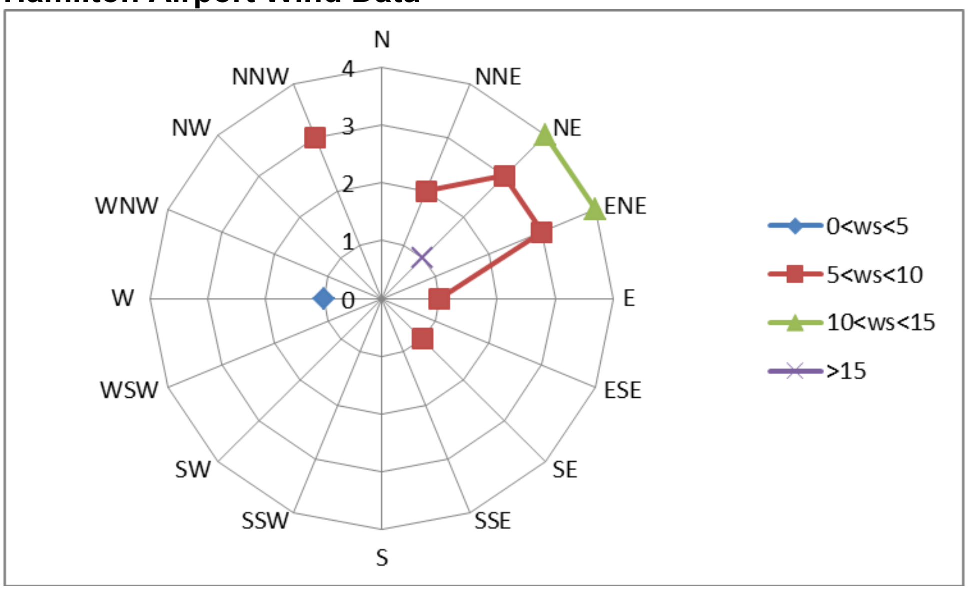


July 10, 2014

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 960	EPS 709	
Sample Volume (mL)	500	500	
Benzene	2.46	4.66	2.3
Toluene	3.62	4.29	2,000*
Ethylbenzene	0.95	0.60	1,000
m,p-Xylene	3.53	1.15	730
o-Xylene	1.15	0.77	
Naphthalene	2.76	7.30	22.5

Hamilton Airport Wind Data

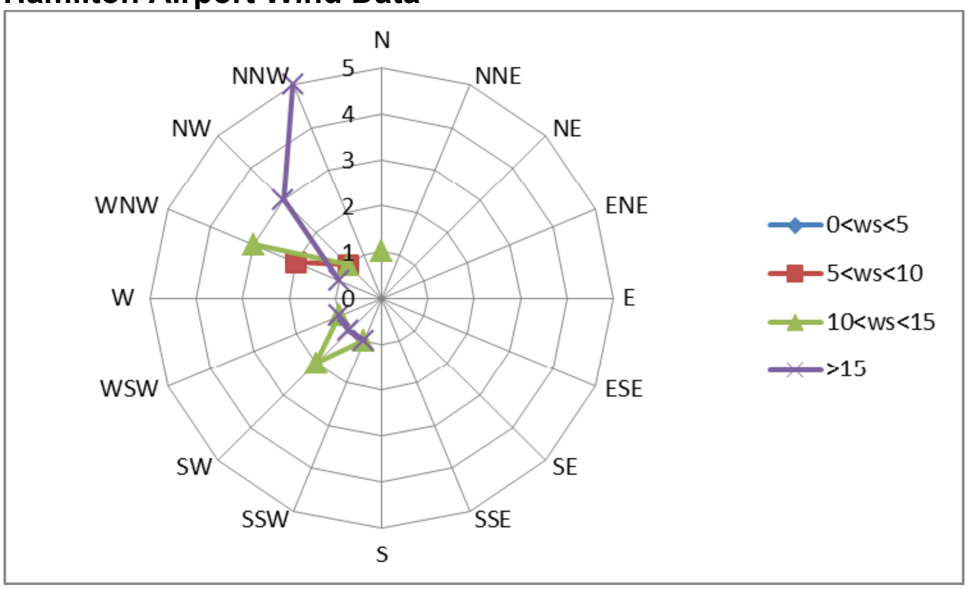


July 23, 2014:

Randle Reef Study 2014 Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	**EPS 040**	**EPS 977**	**EPS 942**	
Sample Volume (mL)	**500**	**500**	**500**	
Benzene	1.04	0.75	0.74	2.3
Toluene	4.64	3.63	2.17	2,000*
Ethylbenzene	1.15	0.62	0.41	1,000
m,p-Xylene	1.32	1.46	0.67	730
o-Xylene	1.36	0.76	0.52	
Naphthalene	0.32	0.28	0.56	22.5

Hamilton Airport Wind Data

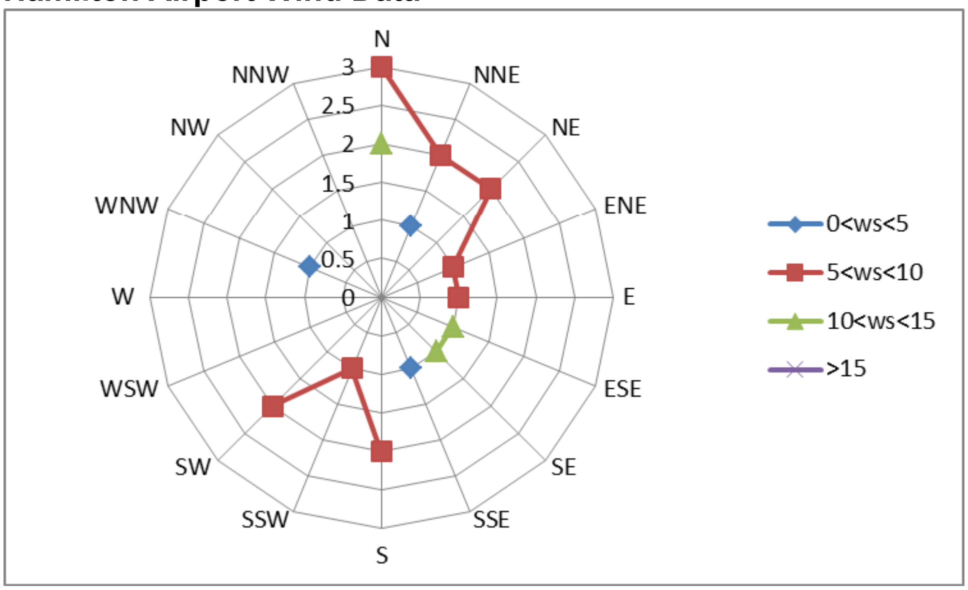


August 3, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 391	EPS 309	EPS 775	
Sample Volume (mL)	500	500	500	
Benzene	2.20	2.70	3.53	2.3
Toluene	7.44	3.68	6.89	2,000*
Ethylbenzene	3.86	1.65	2.57	1,000
m,p-Xylene	3.82	2.45	2.89	730
o-Xylene	4.46	2.13	2.70	
Naphthalene	0.73	2.84	3.52	22.5

Hamilton Airport Wind Data

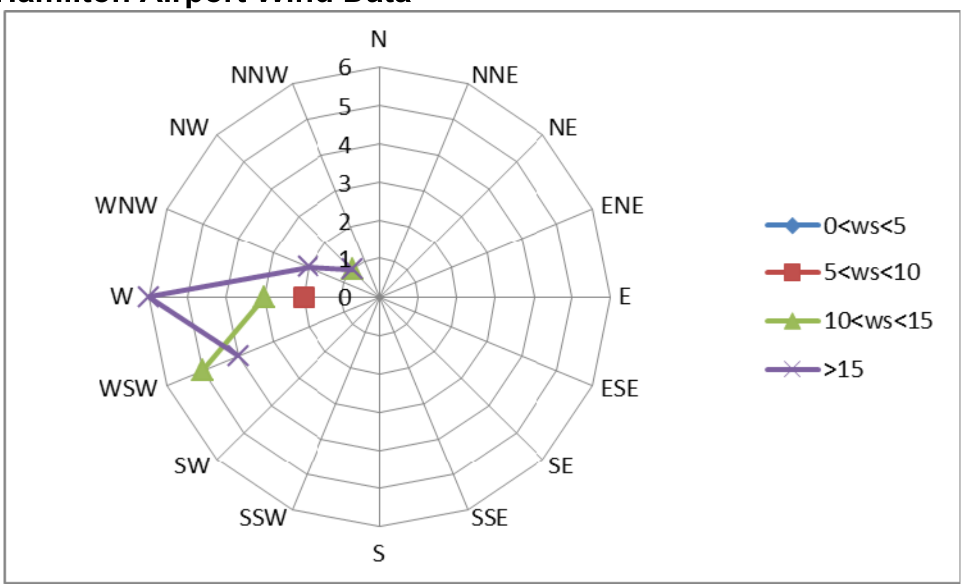


August 13, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 600	EPS 055	EPS 626	
Sample Volume (mL)	500	500	500	
Benzene	0.27	0.27	0.60	2.3
Toluene	0.78	0.65	1.43	2,000*
Ethylbenzene	0.37	0.29	0.57	1,000
m,p-Xylene	0.45	0.55	0.73	730
o-Xylene	0.56	0.47	0.87	
Naphthalene	0.07	0.10	0.18	22.5

Hamilton Airport Wind Data

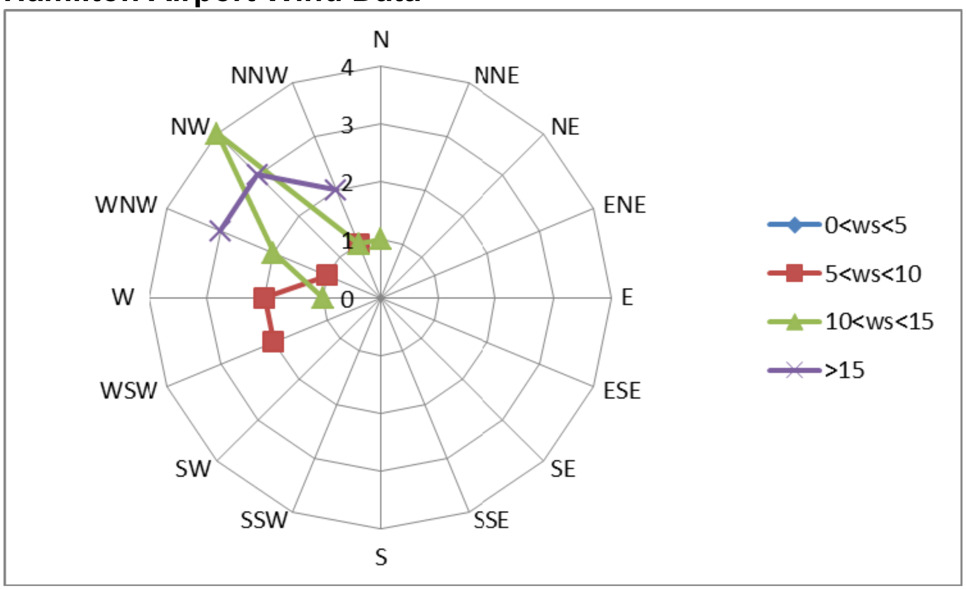


August 27, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 721	EPS 301	
Sample Volume (mL)	500	500	
Benzene	0.67	0.31	2.3
Toluene	1.56	0.87	2,000*
Ethylbenzene	1.04	0.14	1,000
m,p-Xylene	1.47	0.27	730
o-Xylene	1.38	0.19	
Naphthalene	0.23	0.27	22.5

Hamilton Airport Wind Data

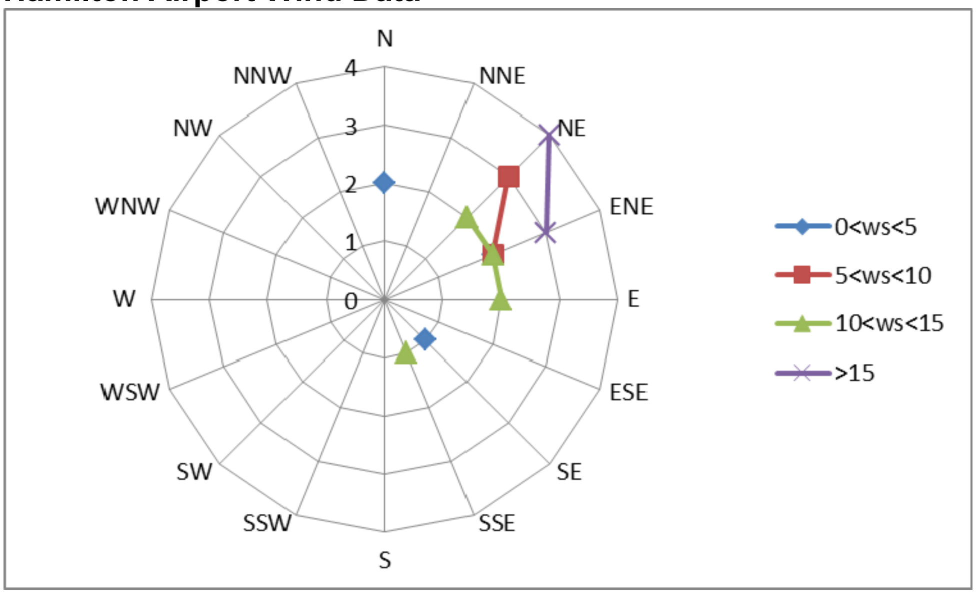


September 8, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 3, USS	AAQC
Canister ID	EPS 031	EPS 564	
Sample Volume (mL)	500	500	
Benzene	1.54	3.75	2.3
Toluene	8.14	4.79	2,000*
Ethylbenzene	3.29	0.55	1,000
m,p-Xylene	3.17	1.64	730
o-Xylene	4.02	0.61	
Naphthalene	0.27	3.24	22.5

Hamilton Airport Wind Data

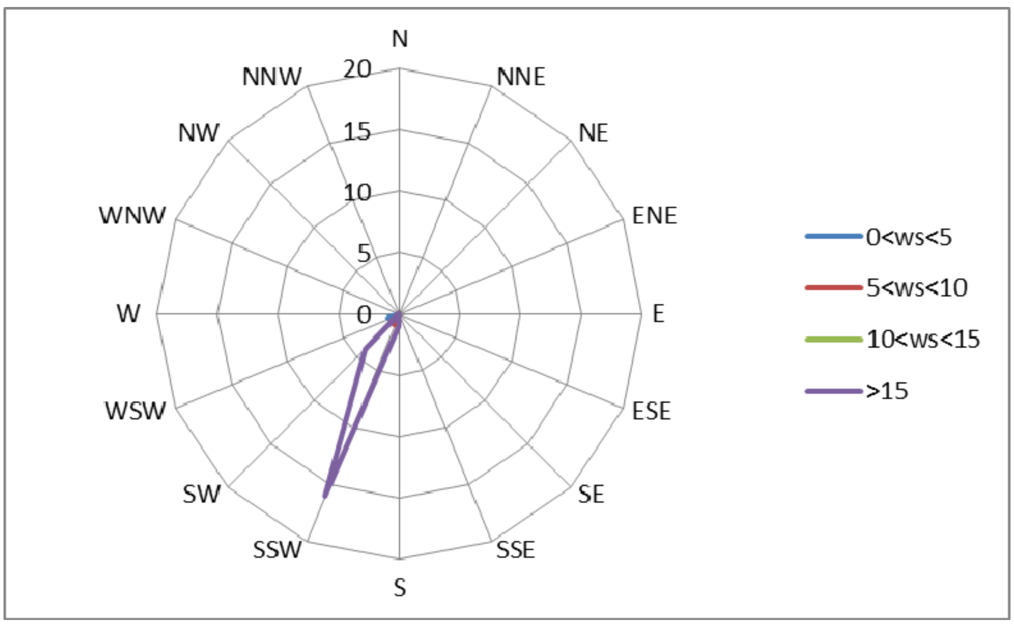


September 20, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 3, USS	AAQC
Canister ID	EPS 070	
Sample Volume (mL)	500	
Benzene	1.27	2.3
Toluene	2.37	2,000*
Ethylbenzene	1.03	1,000
m,p-Xylene	1.37	730
o-Xylene	1.35	
Naphthalene	0.93	22.5

Hamilton Airport Wind Data

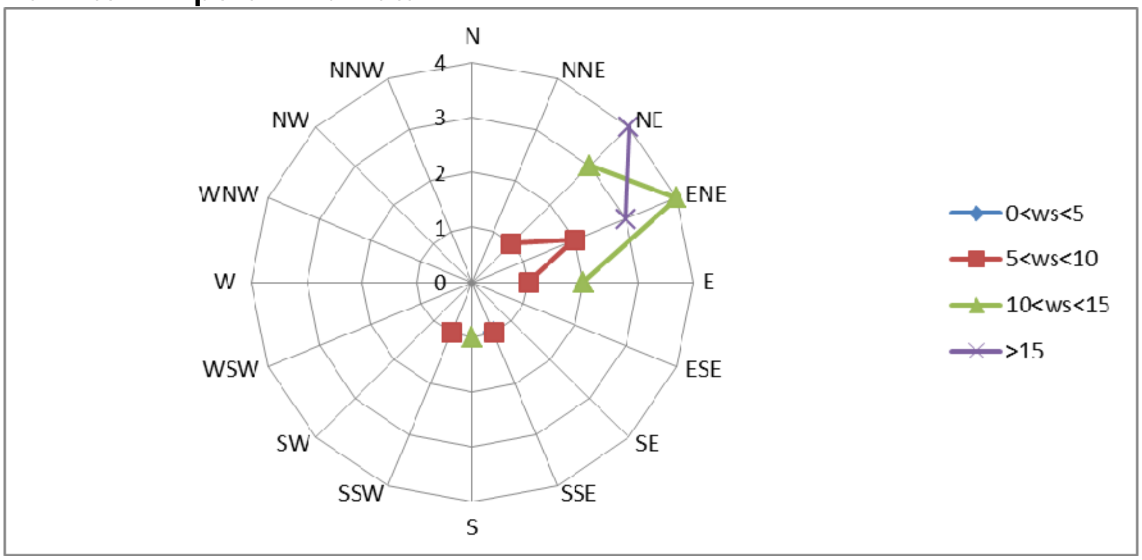


October 2, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 3, USS	AAQC
Canister ID	EPS 156	
Sample Volume (mL)	500	
Benzene	7.18	2.3
Toluene	1.24	2,000*
Ethylbenzene	0.08	1,000
m,p-Xylene	0.29	730
o-Xylene	0.11	
Naphthalene	8.04	22.5

Hamilton Airport Wind Data

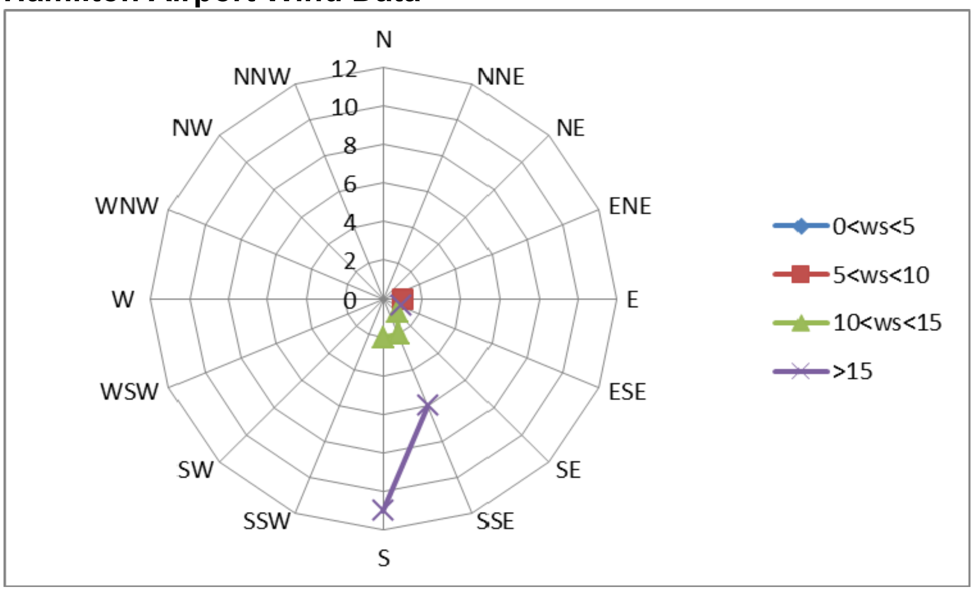


October 14, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 390	EPS 882	
Sample Volume (mL)	500	500	
Benzene	1.43	4.07	2.3
Toluene	6.86	3.00	2,000*
Ethylbenzene	1.09	0.44	1,000
m,p-Xylene	3.86	1.56	730
o-Xylene	1.41	0.65	
Naphthalene	1.04	4.86	22.5

Hamilton Airport Wind Data

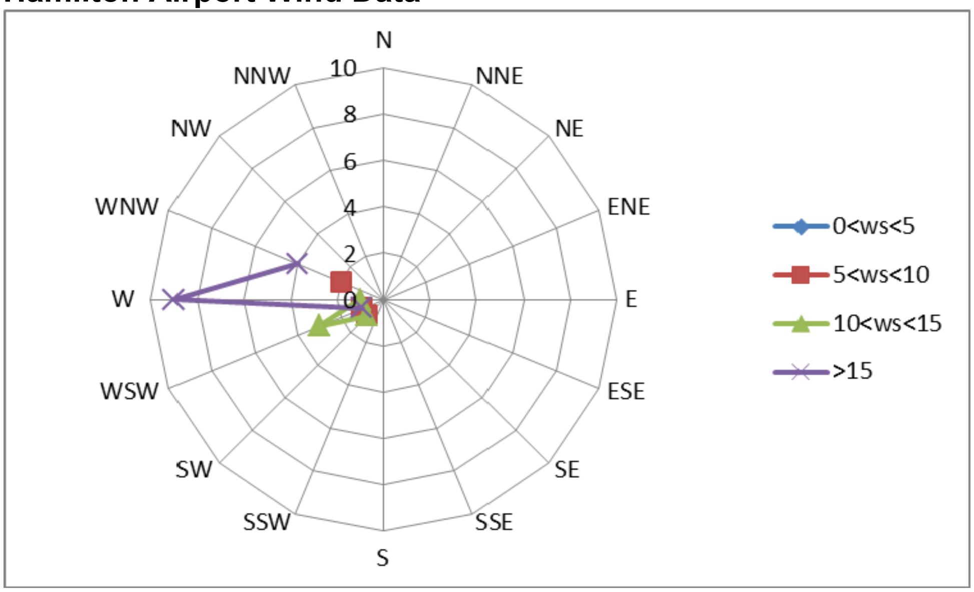


October 26, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 466	EPS 890	
Sample Volume (mL)	500	500	
Benzene	0.39	0.69	2.3
Toluene	0.76	0.80	2,000*
Ethylbenzene	0.27	0.13	1,000
m,p-Xylene	0.88	0.40	730
o-Xylene	0.32	0.14	
Naphthalene	0.16	0.08	22.5

Hamilton Airport Wind Data

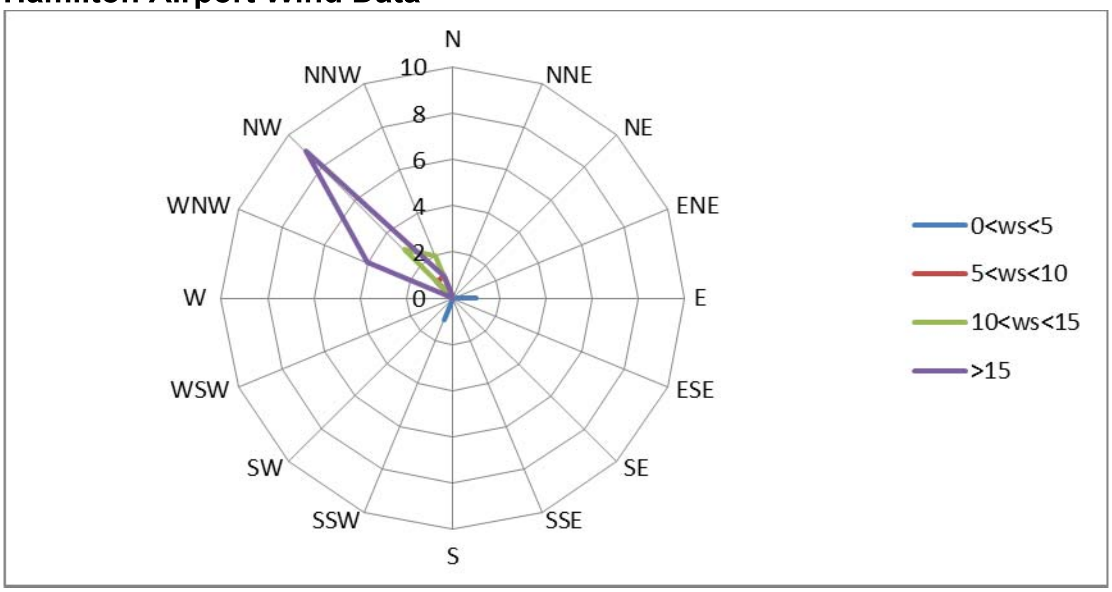


November 7, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 2, Ham	EC 3, USS	AAQC
Canister ID	EPS 998	EPS 777	
Sample Volume (mL)	500	500	
Benzene	0.37	0.69	2.3
Toluene	1.47	0.39	2,000*
Ethylbenzene	0.40	0.24	1,000
m,p-Xylene	1.39	0.54	730
o-Xylene	0.40	0.25	
Naphthalene	0.02	0.47	22.5

Hamilton Airport Wind Data

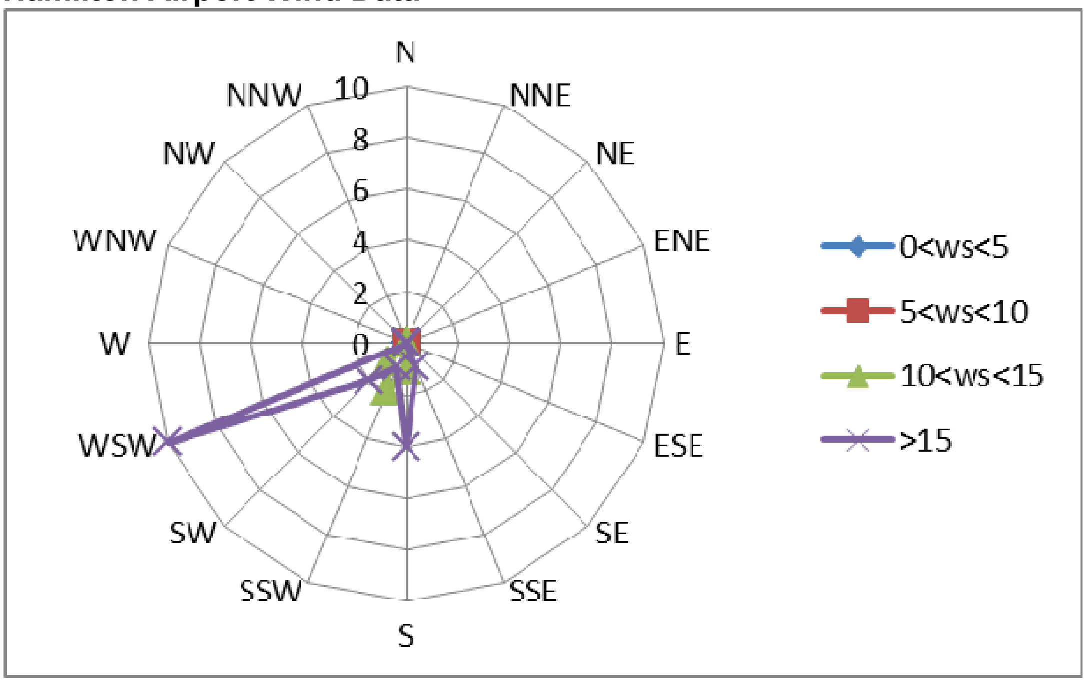


November 19, 2014:

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 2, Ham	AAQC
Canister ID	EPS 084	
Sample Volume (mL)	500	
Benzene	0.50	2.3
Toluene	0.73	2,000*
Ethylbenzene	0.18	1,000
m,p-Xylene	0.53	730
o-Xylene	0.16	
Naphthalene	0.02	22.5

Hamilton Airport Wind Data

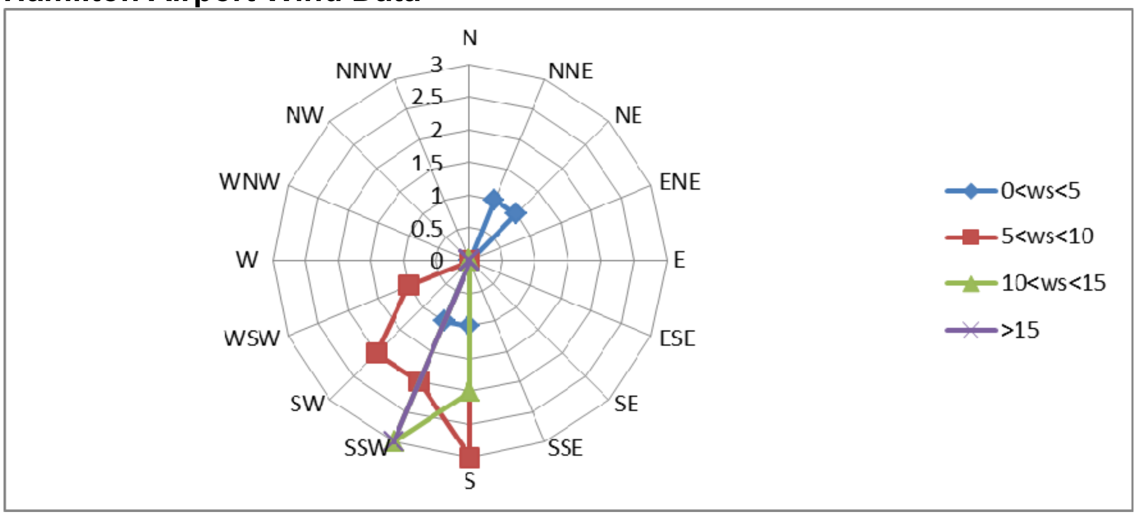


December 1, 2014;

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 3, USS		AAQC
Canister ID	**EPS 943**	**EPS 569**	**EPS 980**	
Sample Volume (mL)	**500**	**500**	**500**	
Benzene	0.32	1.04	0.86	2.3
Toluene	0.22	0.94	0.27	2,000
Ethylbenzene	0.04	0.18	0.04	1,000
m,p-Xylene	0.07	0.56	0.11	730
o-Xylene	0.03	0.19	0.04	
Naphthalene	0.00	0.30	0.01	22.5

Hamilton Airport Wind Data

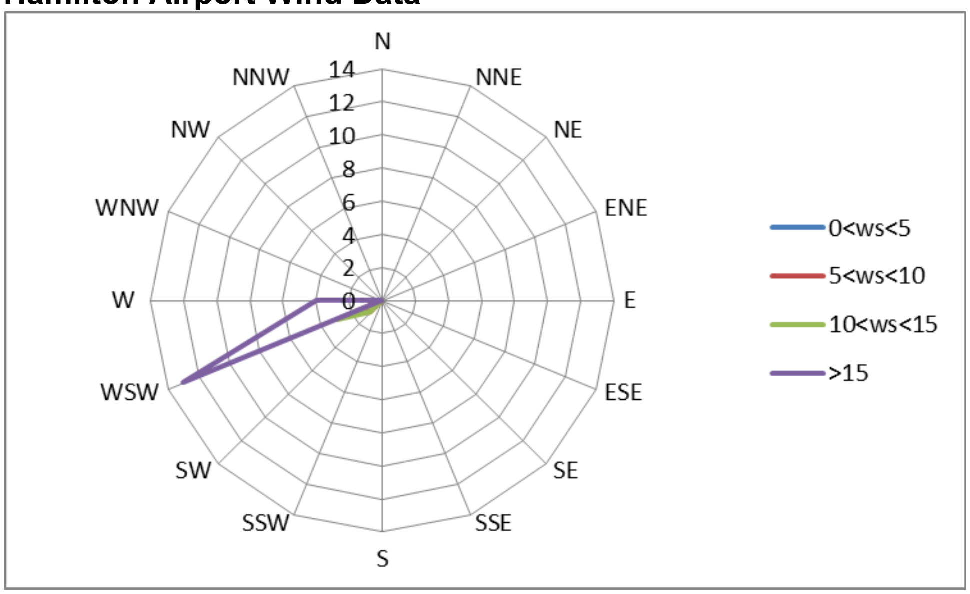


<u>December 13, 2014:</u>

Randle Reef Study Sample Data (ug/m3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS		AAQC
Canister ID	**EPS 1017**	**EPS 214**	**EPS 1018**	**EPS 859**	
Sample Volume (mL)	**500**	**500**	**500**	**500**	
Benzene	0.61	0.66	1.02	1.05	2.3
Toluene	0.68	0.89	0.75	1.15	2,000
Ethylbenzene	0.15	0.20	0.13	0.17	1,000
m,p-Xylene	0.36	0.54	0.38	0.48	730
o-Xylene	0.13	0.18	0.12	0.18	
Naphthalene	0.09	0.09	0.07	0.06	22.5

Hamilton Airport Wind Data



The full analytical results for the EC background air samples is included in Appendix II. Corresponding VOC results for HAMN starions; 2962 located at Niagara and Land Streets and 29180 located at Gage street are included in Appendix III.

The meteorological data used to populate the wind rose charts is included in Appendix IV.

DISCUSSION/CONCLUSION

AAQC Exceedances:

Benzene concentrations exceeded either the AAQC or 50% of the AAQC on certain dates at certain locations. Naphthalene exceeded 50% of the AAQC on one date at one location. In all other instances the BTEX and naphthalene concentrations were below both the AAQC and 50% of the AAQC.

The noted exceedances are listed below with the associated times, locations, predominant wind directions and approximate relationship with the RR site at the time;

- June 4, 2014; EC station 1 DND HCMS Star exceeded 50% of the benzene AAQC. Wind was predominantly from the WNW-SSW, RR site would be down gradient.
- June 16, 2014; EC Station 2 Hamilton Birch St. property exceeded benzene AAQC. Wind was variable.
- June 16, 2014; EC Station 3 USS dock wall exceeded benzene AAQC and 50% naphthalene AAQC. Wind was variable however 5 of the 24 hour wind directions were from the NE, which brings wind from the USS property to the RR site.
- June 28, 2014; EC Station 2 Hamilton Birch St. property exceeded benzene AAQC. Wind was predominantly from the NE, RR site would have been up gradient.
- June 28, 2014; EC Station 3 USS dock wall exceeded benzene AAQC. Wind was from the NE, RR site would be down gradient.
- July 10, 2014; EC Station 2 Hamilton Birch St. property exceeded benzene AAQC. Wind was predominantly from the NE-ENE, the RR site would be up gradient.
- July 10, 2014; EC Station 3 USS dock wall exceeded benzene AAQC. Wind was predominantly from the NE-ENE, the RR site would be down gradient.
- August 3, 2014; EC station 1 DND HCMS Star exceeded 50% of the benzene AAQC. Wind was variable.
- August 3, 2014; EC Station 2 Hamilton Birch St. property exceeded benzene AAQC. Wind was variable.
- August 3, 2014; EC Station 3 USS dock wall exceeded benzene AAQC. Wind was variable.
- September 8, 2014; EC station 1 DND HCMS Star exceeded 50% of the benzene AAQC. Wind was predominantly from the NE-ENE, RR site would be up gradient.
- September 8, 2014; EC station 3 USS dock wall exceeded benzene AAQC. Wind was predominantly from the NE-ENE, RR site would be down gradient.

- September 20, 2014; EC station 3 USS dock wall exceeded 50% of the benzene AAQC. Wind was from the south south west. The site would be trans gradient.
- October 2, 2014; EC station 3 USS dock wall exceeded benzene AAQC. Wind was predominantly from the NE-ENE, RR site would be down gradient.
- October 14, 2014; EC Station 2 Hamilton Birch St. property exceeded 50% of the benzene AAQC. Wind was predominantly from the S-SSE, RR site would have been down gradient.
- October 14, 2014; EC Station 3 USS dock wall exceeded benzene AAQC. Wind was predominantly from the S-SSE, RR site would have been trans gradient to slightly down gradient.

For ease this report compares the reported benzene concentrations to the AAQC, **2.3 ug/m^3**, in order to give a frame of reference. However, as noted above, HAMN compares benzene to the URT of **100 ug/m^3** as their frame of reference.

Considering benzene exceedances of the AAQC are currently common within the Randle Reef area of the harbour, the AAQC may be of limited use as a reference point during the Randle Reef project air monitoring. The use of the benzene URT as an alternative reference in combination with the establishment of specific assessment values (established in order to ensure critical daily and annual levels are not exceeded) is also a possible approach when monitoring the effects of the project on local air quality related to existing background air quality.

<u>Air Quality at the Randle Reef site related to wind direction:</u>

EC station 3, based upon the fact that it is adjacent to the Randle Reef project site represents to best source of information related to either current contributions from the Randle Reef contaminants themselves OR the immediately adjacent industrial activity.

In general EC station 3 would be affected by the RR site during times when the prevailing wind blew from the west or south west. This occurred on the following dates and corresponded with the following BTEX and naphthalene concentrations;

EC Station 3 USS Dock wall Sample Data (ug/m3)

Canister ID	EPS 764	EPS 626	EPS 890	EPS 1018	EPS 859
Date	June 4, 2014	Aug 13, 2014	Oct 26, 2014	Dec 13, 2014	Dec 13, 2014
Wind direction	WNW-SSW	W-WSW	W	WSW	WSW
Benzene	0.37	0.60	0.69	1.02	1.05
Toluene	1.63	1.43	0.80	0.75	1.15
Ethyl benzene	0.22	0.57	0.13	0.13	0.17
m,p-Xylene	0.61	0.73	0.40	0.38	0.48
o-Xylene	0.26	0.87	0.14	0.12	0.18
Naphthalene	0.16	0.18	0.08	0.07	0.06

In general EC station 3 would be affected by the closest industrial activities during times when the prevailing wind blew from the east, north east or south east. This occurred on following dates and corresponded with the following BTEX and naphthalene concentrations;

EC Station 3 USS Dock wall Sample Data (ug/m3)

Canister ID	EPS 1000	EPS 709	EPS 564	EPS 156
Date	June 28, 2014	July 10, 2014	Sept 8, 2014	Oct 2, 2014
Wind direction	NE	NE-ENE	NE-ENE	NE-ENE
Benzene	4.62	4.66	3.75	7.18
Toluene	3.57	4.29	4.79	1.24
Ethyl benzene	0.34	0.60	0.55	0.08
m,p-Xylene	0.84	1.15	1.64	0.29
o-Xylene	0.44	0.77	0.61	0.11
Naphthalene	7.08	7.30	3.24	8.04

These results suggest that during remediation, in addition to any contributions from the project itself, air quality at the Randle Reef site will also be greatly affected by the industrial activities to the northeast.

<u>Elevated Styrene results related to enclosure usage:</u>

EC notes that the air samples collected from June 2nd, 2014 through September 20th, 2014 utilized an air sampling station step up which included a prefabricated enclosure to contain and protect the timer, controller and canister. Results from some initial samples collected under this set-up showed elevated styrene readings. A number of potential explanations for these readings were investigated. Although these enclosures are commonly used and had been recommended and supplied by professionals within the air monitoring community, the investigations determined they were source of the elevated styrene readings. The enclosures were therefore removed from the air monitoring stations and the elevated styrene reading corresponding dropped.

The potential contribution of these enclosures to all other VOC parameters was not established, however, the relationship between levels of styrene and BTEX was examined. Benzene is particularly of interest since it was a VOC that was noted to exceed the AAQC on a number of occasions as discussed in the previous section. The relationship was examined by regression analysis of the corresponding concentrations of styrene and benzene. The data was first log-transformed to account for non-normality. The results indicated that the relationship between styrene and benzene is poor with and R2 value of 0.045. In addition, the resulting p-value of 0.157 (>0.05 / 95%confidence level) is insignificant and meaning that changes in the predictor (benzene) are not associated with changes in the response (Styrene).This indicates that the high levels of styrene observed from June to September are unlikely to have influenced the levels of benzene, and caused the exceedances. The relationship between styrene and toluene, ethyl benzene and xylene is greater with R2 values of 0.24, 0.54 and 0.37 respectively.

In addition it is noted that from a non-statistical perspective, there were two significant exceedances of benzene for the sample periods after September 20, where the plastic enclosures were not in use.

When considering the results for BTEX and naphthalene during enclosure use, comparing the results from the EC stations to the corresponding results from the HAMN stations is also a useful reference;

- Benzene; from June to September 20th 2014;
    - The EC results ranged from 0.27 to 8.26 ug/m^3, with an average of 2.10 ug/m^3.
    - The HAMN results ranged from 0.35 to 7.25 ug/m^3, with an average of 1.74 ug/ m^3
- Toluene; from June to September 20th 2014;
    - The EC results ranged from 0.78 to 8.14 ug/m^3, with an average of 3.28 ug/ m^3.
    - The HAMN results ranged from 1.48 to 9.11 ug/m^3, with an average of 4.10 ug/m^3.
- Ethyl Benzene; from June to September 20th 2014;
    - The EC results ranged from 0.15 to 3.86 ug/m^3, with an average of 1.06 ug/m^3.
    - The HAMN results ranged from 0.22 to 4.36 ug/m^3, with an average of 0.91 ug/m^3.
- Xylenes; from June to September 20th 2014;
    - The EC results ranged from 0.46 to 8.47 ug/m^3, with an average of 2.96 ug/m^3.
    - The HAMN results ranged from 0.75 to 17.00 ug/m^3, with an average of 4.04 ug/m^3.
- Naphthalene; from June to September 20th 2014;
    - The EC results ranged from 0.07 to 11.42 ug/m^3, with an average of 2.17 ug/m^3.

- The HAMN results ranged from 0.09 to 10.46 ug/m^3, with an average of 1.98 ug/m^3.

While this comparison is of limited use due to the different geographic locations of the stations in question, it does show that the BTEX and naphthalene results over that period of time were comparable.

While caution should be exercised in the use of the EC air sampling data from June 4, 2014-September 20, 2014, it appears that the interference from the former enclosures was primarily elevated styrene levels with an insignificant effect on BTEX and naphthalene levels.

Background Air Sampling Data;

The results of this round and future rounds of EC background air monitoring will be supplied to the project engineer as a reference in their development of a project specific air monitoring plan.

In addition the results from this round and future rounds of EC background air monitoring may be utilized as a reference in the event air quality concerns are raised for any of the receptors covered by these three stations. If specific monitoring is required based upon air quality concerns, these results will provide a more specific background air quality reference for comparison.

Future background air sampling:

Background air sampling is expected to resume from April through December 2015 and continue on until the project activities which represent a potential or perceived risk of air emissions are concluded.

APPENDIX I
MATLAB Code

MATLAB Code:

```
clear
clc
%This Program reads in compass bearing data and wind speed data for weather
stations
% available from Environment Canada and produces and output frequency
% matrix used for plotting wind roses in excel.

% Get the full filename, with path prepended.
% File must have not titles on the first row, just data
folder = 'C:\Users\MattG\Documents\MATLAB';
% User can change data file
baseFileName = 'Dec132014.xlsx';
fullFileName = fullfile(folder, baseFileName);
% Check if file exists.
if ~exist(fullFileName, 'file')
                % File doesn't exist -- didn't find it there.  Check the
search path for it.
                fullFileNameOnSearchPath = baseFileName; % No path this time.
                if ~exist(fullFileNameOnSearchPath, 'file')
                                % Still didn't find it.  Alert user.
                                errorMessage = sprintf('Error: %s does not
exist in the search path folders.', fullFileName);
                                uiwait(warndlg(errorMessage));
                                return;
end
end
%Read in excel file
num = xlsread(fullFileName);
%Assign a variable to 6th column which is the compass bearings/10 and multiply
these by 10.
bear= num(:,6);
bear=bear*10
%Assign a variable to the 7th column (wind speed)Note
%the bearings are actually in column 8 but MATLAB does not recognize the
%first column due to it containing dates and a number and is ignoring it.
windsp= num(:,7)
%Define the size of the output matrix that will follow (number of rows equals
the size of the
%input rows and the number if columns equals the size of the input columns.
[row,col]=size(bear)

%Using boolean operators to identify matches to the different bearing
%increments (1=true and 0=false, therefore the output matrix multiplies
%the bearing by 1 where there is a match and zero where not)
%find is used to id where they occur in the vector
    a=bear.*(bear>=350 | bear<=11)
    aa=find(a>0,row);
    b=bear.*(bear>=12 & bear<=34)
    bb=find(b>0,row);
    c=bear.*(bear>=35 & bear<=57)
    cc=find(c>0,row);
    d=bear.*(bear>=58 & bear<=79)
    dd=find(d>0,row);
    e=bear.*(bear>=80 & bear<=101)
    ee=find(e>0,row);
    f=bear.*(bear>=102 & bear<=123)
    ff=find(f>0,row);
    g=bear.*(bear>=124 & bear<=146)
```

```
    gg=find(g>0,row);
    h=bear.*(bear>=147 & bear<=169)
    hh=find(h>0,row);
    i=bear.*(bear>=170 & bear<=191)
    ii=find(i>0,row);
    j=bear.*(bear>=192 & bear<=214)
    jj=find(j>0,row);
    k=bear.*(bear>=215 & bear<=236)
    kk=find(k>0,row);
    l=bear.*(bear>=237 & bear<=258)
    ll=find(l>0,row);
    m=bear.*(bear>=259 & bear<=281)
    mm=find(m>0,row);
    n=bear.*(bear>=282 & bear<=304)
    nn=find(n>0,row);
    o=bear.*(bear>=305 & bear<=326)
    oo=find(o>0,row);
    p=bear.*(bear>=327 & bear<=349)
    pp=find(p>0,row);
  %converting the previous vectors into ones and zeros by dividing by the
original windspeed matrix
    aaa=a./bear
    bbb=b./bear
    ccc=c./bear
    ddd=d./bear
    eee=e./bear
    fff=f./bear
    ggg=g./bear
    hhh=h./bear
    iii=i./bear
    jjj=j./bear
    kkk=k./bear
    lll=l./bear
    mmm=m./bear
    nnn=n./bear
    ooo=o./bear
    ppp=p./bear
  %Converting the windspeeds(km/hr)that fit into the categories 0 to 5, 6 to
10, 11 to 15 and greater than 15
  % and using boolean operators to identify matches to the different
  %increments (1=true and 0=false, therefore the output matrix multiplies
  %the windspeed by 1 where there is a match and zero where not)
    wsp1=windsp.*(windsp>=0 & windsp<=5)
    wsp2=windsp.*(windsp>=6 & windsp<=10)
    wsp3=windsp.*(windsp>=11 & windsp<=15)
    wsp4=windsp.*(windsp>=16)
  %converting the previous vectors into ones and zeros by dividing by the
original windspeed matrix
    wsp11=wsp1./windsp
    wsp22=wsp2./windsp
    wsp33=wsp3./windsp
    wsp44=wsp4./windsp

%displaying a matrix with the 4 columns representing wind speeds 0 to 5, 6 to
10, 11 to 15 and greater than 15
finalwsp=[wsp11 wsp22 wsp33 wsp44]
%multiplying the windspeed vectors by the vectors representing N
%bearing.
n0to5=aaa.*wsp11
n6to10=aaa.*wsp22
n11to15=aaa.*wsp33
n16on=aaa.*wsp44

north=[n0to5 n6to10 n11to15 n16on]
```

```
%Tallying the counts for each windspeed increment for the N bearing
northtally=sum(north,1)

%multiplying the windspeed vectors by the vectors representing NNE
%bearing.
nne0to5=bbb.*wsp11;
nne6to10=bbb.*wsp22;
nne11to15=bbb.*wsp33;
nne16on=bbb.*wsp44;

northNE=[nne0to5 nne6to10 nne11to15 nne16on]
%Tallying the counts for each windspeed increment for the NNE bearing
northNEtally=sum(northNE,1)

%multiplying the windspeed vectors by the vectors representing NE
%bearing.
ne0to5=ccc.*wsp11;
ne6to10=ccc.*wsp22;
ne11to15=ccc.*wsp33;
ne16on=ccc.*wsp44;

northE=[ne0to5 ne6to10 ne11to15 ne16on]
%Tallying the counts for each windspeed increment for the NE bearing
northEtally=sum(northE,1)

%multiplying the windspeed vectors by the vectors representing ENE
%bearing.
ene0to5=ddd.*wsp11;
ene6to10=ddd.*wsp22;
ene11to15=ddd.*wsp33;
ene16on=ddd.*wsp44;

eastNE=[ene0to5 ene6to10 ene11to15 ene16on]
%Tallying the counts for each windspeed increment for the ENE bearing
eastNEtally=sum(eastNE,1)

%multiplying the windspeed vectors by the vectors representing E
%bearing.
e0to5=eee.*wsp11;
e6to10=eee.*wsp22;
e11to15=eee.*wsp33;
e16on=eee.*wsp44;

east=[e0to5 e6to10 e11to15 e16on]
%Tallying the counts for each windspeed increment for the E bearing
easttally=sum(east,1)

%multiplying the windspeed vectors by the vectors representing ESE
%bearing.
ese0to5=fff.*wsp11;
ese6to10=fff.*wsp22;
ese11to15=fff.*wsp33;
ese16on=fff.*wsp44;

eastSE=[ese0to5 ese6to10 ese11to15 ese16on]
%Tallying the counts for each windspeed increment for the ESE bearing
eastSEtally=sum(eastSE,1)

%multiplying the windspeed vectors by the vectors representing SE
%bearing.
se0to5=ggg.*wsp11;
se6to10=ggg.*wsp22;
```

```
se11to15=ggg.*wsp33;
se16on=ggg.*wsp44;

southE=[se0to5 se6to10 se11to15 se16on]
%Tallying the counts for each windspeed increment for the SE bearing
southEtally=sum(southE,1)

%multiplying the windspeed vectors by the vectors representing SSE
%bearing.
sse0to5=hhh.*wsp11;
sse6to10=hhh.*wsp22;
sse11to15=hhh.*wsp33;
sse16on=hhh.*wsp44;

southSE=[sse0to5 sse6to10 sse11to15 sse16on]
%Tallying the counts for each windspeed increment for the SSE bearing
southSEtally=sum(southSE,1)

%multiplying the windspeed vectors by the vectors representing S
%bearing.
s0to5=iii.*wsp11;
s6to10=iii.*wsp22;
s11to15=iii.*wsp33;
s16on=iii.*wsp44;

south=[s0to5 s6to10 s11to15 s16on]
%Tallying the counts for each windspeed increment for the S bearing
southtally=sum(south,1)

%multiplying the windspeed vectors by the vectors representing SSW
%bearing.
ssw0to5=jjj.*wsp11;
ssw6to10=jjj.*wsp22;
ssw11to15=jjj.*wsp33;
ssw16on=jjj.*wsp44;

southSW=[ssw0to5 ssw6to10 ssw11to15 ssw16on]
%Tallying the counts for each windspeed increment for the SSW bearing
southSWtally=sum(southSW,1)

%multiplying the windspeed vectors by the vectors representing SW
%bearing.
sw0to5=kkk.*wsp11;
sw6to10=kkk.*wsp22;
sw11to15=kkk.*wsp33;
sw16on=kkk.*wsp44;

southW=[sw0to5 sw6to10 sw11to15 sw16on]
%Tallying the counts for each windspeed increment for the SW bearing
southWtally=sum(southW,1)

%multiplying the windspeed vectors by the vectors representing WSW
%bearing.
wsw0to5=lll.*wsp11;
wsw6to10=lll.*wsp22;
wsw11to15=lll.*wsp33;
wsw16on=lll.*wsp44;

westSW=[wsw0to5 wsw6to10 wsw11to15 wsw16on]
%Tallying the counts for each windspeed increment for the WSW bearing
westSWtally=sum(westSW,1)
```

```
%multiplying the windspeed vectors by the vectors representing W
%bearing.
w0to5=mmm.*wsp11;
w6to10=mmm.*wsp22;
w11to15=mmm.*wsp33;
w16on=mmm.*wsp44;

west=[w0to5 w6to10 w11to15 w16on]
%Tallying the counts for each windspeed increment for the W bearing
westtally=sum(west,1)

%multiplying the windspeed vectors by the vectors representing WNW
%bearing.
wnw0to5=nnn.*wsp11;
wnw6to10=nnn.*wsp22;
wnw11to15=nnn.*wsp33;
wnw16on=nnn.*wsp44;

westNW=[wnw0to5 wnw6to10 wnw11to15 wnw16on]
%Tallying the counts for each windspeed increment for the WNW bearing
westNWtally=sum(westNW,1)

%multiplying the windspeed vectors by the vectors representing NW
%bearing.
nw0to5=ooo.*wsp11;
nw6to10=ooo.*wsp22;
nw11to15=ooo.*wsp33;
nw16on=ooo.*wsp44;

northW=[nw0to5 nw6to10 nw11to15 nw16on]
%Tallying the counts for each windspeed increment for the NW bearing
northWtally=sum(northW,1)

%multiplying the windspeed vectors by the vectors representing NNW
%bearing.
nnw0to5=ppp.*wsp11;
nnw6to10=ppp.*wsp22;
nnw11to15=ppp.*wsp33;
nnw16on=ppp.*wsp44;

northNW=[nnw0to5 nnw6to10 nnw11to15 nnw16on]
%Tallying the counts for each windspeed increment for the NNW bearing
northNWtally=sum(northNW,1)

%displaying summary matrix of counts.  The 4 Columns are windspeed increments,
%0-5, 6-10,11-15,>15.  The rows are bearings from top
%(N,NNE,NE,ENE,E,ESE,SE,SSE,S,SSW,SW,WSW,W,WNW,NW,NNW)
%rows are the compass bearings

summary=[northtally;northNEtally;northEtally;eastNEtally;easttally;eastSEtally
;southEtally;southSEtally;southtally;southSWtally;southWtally;westSWtally;west
tally;westNWtally;northWtally;northNWtally]

%Write results into a txt tile using.  NOTE - open in wordpad not notepad
    dlmwrite('windrose_out.txt', summary, 'delimiter','\t')
```

APPENDIX II
RR 2014 Sample Results

Randle Reef Study 2014 Sample Data
Concentration (µg/m^3)
NR= Data not reported

FID Analysis Date	**14JUN16-19**	**14JUN16-20**	**14JUN16-21**	**14JUN16-22**	**14JUL02-12.**	**14JUL02-13.**	**14JUL02-14.**	**14JUL15-15.**	**14JUL15-16.**	**14JUL15-17.**	**14JUL22-14.**	**14JUL22-15.D**
FID Analysis Location	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**
Non-Polar Analysis Date	**9-Jun-14**	**9-Jun-14**	**9-Jun-14**	**9-Jun-14**	**23-Jun-14**	**23-Jun-14**	**25-Jun-14**	**14-Jul-14**	**14-Jul-14**	**14-Jul-14**	**16-Jul-14**	**16-Jul-14**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**RR01.D**	**RR02.D**	**RR03.D**	**RR04.D**	**RR05.D**	**RR06.D**	**RR07.D**	**RR08.D**	**RR09.D**	**RR10.D**	**RR11.D**	**RR12.D**
Sample location	**EC STATION**	**EC STATION**	**EC STATION**	**DUPLICATE**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION 3, USS Doc**
Sampling Date	**4-Jun-14**	**4-Jun-14**	**4-Jun-14**	**4-Jun-14**	**16-Jun-14**	**16-Jun-14**	**16-Jun-14**	**28-Jun-14**	**28-Jun-14**	**28-Jun-14**	**10-Jul-14**	**10-Jul-14**
Canister ID	**EPS 800**	**EPS 561**	**EPS 764**	**EPS 805**	**EPS 893**	**EPS 107**	**EPS 056**	**EPS 053**	**EPS 772**	**EPS 1000**	**EPS 960**	**EPS 709**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**
Comments	**Initial Pressure = -27**					**Styrene peak corrupted**						
Ethylene	**14.00**	**2.40**	**0.84**	**0.57**	**1.17**	**19.54**	**2.43**	**1.87**	**3.28**	**2.35**	**1.72**	**2.54**
Acetylene	**0.37**	**0.23**	**0.18**	**0.23**	**0.19**	**0.59**	**0.28**	**0.24**	**0.51**	**0.33**	**0.61**	**0.22**
Ethane	**58.03**	**9.62**	**4.65**	**2.48**	**4.21**	**74.54**	**8.06**	**5.98**	**9.28**	**8.15**	**5.14**	**10.05**
Freon 134A	0.62	2.48	0.48	2.57	0.51	2.14	0.53	0.69	2.87	0.71	3.08	0.59
Propene	1.04	0.38	0.18	0.24	0.19	1.72	0.42	0.27	0.66	0.50	0.40	0.51
Propane	**1.46**	**1.96**	**1.37**	**1.92**	**1.39**	**3.01**	**1.34**	**1.56**	**2.24**	**1.79**	**2.14**	**1.82**
Freon 22 (Chlorodifluoromethane)	0.93	0.98	0.86	0.99	0.88	0.97	0.90	1.07	1.06	1.09	1.21	0.98
Freon 12 (Dichlorodifluoromethane)	2.86	2.74	2.72	2.74	2.89	2.87	2.81	3.07	3.05	3.12	2.99	3.26
Propyne	0.05	0.03	0.02	0.03	0.02	0.07	0.03	0.03	0.05	0.05	0.04	0.03
Chloromethane	2.69	1.50	1.44	1.44	1.36	1.95	1.42	1.52	1.71	1.58	1.35	1.57
Isobutane (2-Methylpropane)	0.55	0.61	1.54	0.58	0.55	1.21	0.39	0.49	0.79	0.58	0.92	1.83
Freon 114 (1,2-Dichlorotetrafluoroethane	0.14	0.14	0.13	0.13	0.14	0.13	0.13	0.14	0.14	0.22	0.14	0.15
Vinylchloride (Chloroethene)	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.02	0.00	0.00
1-Butene/2-Methylpropene	7.40	1.15	0.57	0.26	0.35	9.50	0.85	0.49	1.13	0.91	0.46	1.28
1,3-Butadiene	0.07	0.03	0.02	0.03	0.02	0.10	0.03	0.02	0.06	0.05	0.06	0.04
Butane	1.07	0.83	4.31	0.80	1.71	2.62	1.27	1.02	1.73	1.27	1.67	3.80
t-2-Butene	0.07	0.05	0.16	0.04	0.04	0.10	0.03	0.02	0.06	0.05	0.09	0.19
2,2-Dimethylpropane	0.01	0.01	0.02	0.01	0.02	0.04	0.02	0.01	0.02	0.03	0.02	0.02
Bromomethane	0.14	0.08	0.06	0.06	0.06	0.13	0.06	0.07	0.10	0.13	0.06	0.14
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
c-2-Butene	0.06	0.05	0.12	0.04	0.04	0.09	0.03	0.02	0.05	0.05	0.08	0.14
Chloroethane	0.49	0.14	0.04	0.02	0.03	1.00	0.07	0.04	0.14	0.10	0.02	0.10
3-Methyl-1-Butene	0.04	0.03	0.05	0.02	0.02	0.07	0.02	0.02	0.04	0.03	0.04	0.06
2-Methylbutane	NR	NR	5.68	1.02	2.34	0.00	0.00	3.10	7.06	0.00	3.36	10.07
Freon 11 (Trichlorofluoromethane)	1.45	1.39	1.42	1.50	1.63	1.50	1.49	1.59	1.58	1.55	1.73	1.61
1-Pentene	0.21	0.09	0.11	0.06	0.10	0.21	0.08	0.12	0.10	0.11	0.11	0.16
2-Methyl-1-Butene	1.33	0.22	0.23	0.06	0.09	2.01	0.11	0.10	0.26	0.16	0.14	0.38
Pentane	0.90	0.61	1.78	0.65	0.65	1.23	0.47	0.87	1.41	1.19	1.21	2.75
Isoprene (2-Methyl-1,3-Butadiene)	0.55	0.12	0.10	0.12	0.04	0.17	0.05	0.10	0.18	0.13	0.17	0.14
t-2-Pentene	0.09	0.07	0.24	0.07	0.07	0.11	0.03	0.05	0.09	0.04	0.17	0.40
Ethylbromide	0.01	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.03	0.00	0.01
1,1-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
c-2-Pentene	0.05	0.04	0.11	0.03	0.04	0.06	0.02	0.02	0.04	0.03	0.08	0.17
Dichloromethane	3.97	1.13	0.59	0.42	0.53	7.64	1.22	0.75	1.62	1.52	0.61	7.12
2-Methyl-2-Butene	1.93	0.32	0.35	0.07	0.11	2.84	0.13	0.19	0.33	0.22	0.22	0.68
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.63	0.60	0.61	0.63	0.67	0.63	0.63	0.67	0.67	0.69	0.69	0.71
2,2-Dimethylbutane	0.04	0.04	0.13	0.03	0.05	0.07	0.02	0.05	0.07	0.07	0.07	0.20
Cyclopentene	0.02	0.02	0.03	0.01	0.01	0.04	0.01	0.01	0.01	0.03	0.02	0.04
t-1,2-Dichloroethene	0.33	0.31	0.03	0.07	0.03	2.32	0.07	0.07	0.12	0.10	0.08	0.04
4-Methyl-1-Pentene	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02
1,1-Dichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Cyclopentane	0.11	0.10	0.18	0.07	0.08	0.26	0.06	0.10	0.23	0.11	0.22	0.38
2,3-Dimethylbutane	0.09	0.08	0.25	0.08	0.07	0.13	0.04	0.09	0.14	0.09	0.16	0.41
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	0.37	0.35	1.22	0.32	0.26	0.57	0.14	0.35	0.59	0.37	0.74	2.57
c-4-Methyl-2-Pentene	0.01	0.01	0.02	0.01	0.01	0.02	0.00	0.01	0.01	0.02	0.02	0.04
3-Methylpentane	0.26	0.32	1.32	0.30	0.20	0.31	0.12	0.24	0.37	0.24	0.60	3.04
1-Hexene/2-Methyl-1-Pentene	0.15	0.07	0.07	0.05	0.06	0.18	0.06	0.09	0.09	0.11	0.10	0.13
c-1,2-Dichloroethene	0.01	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.02	0.01	0.01
Hexane	0.38	0.60	2.98	0.57	0.20	0.46	0.16	0.27	0.46	0.28	0.99	8.79
Chloroform	0.16	0.12	0.13	0.11	0.17	0.23	0.18	0.23	0.22	0.27	0.17	0.19
t-2-Hexene	0.03	0.02	0.03	0.02	0.01	0.03	0.01	0.01	0.03	0.02	0.04	0.06
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.03	0.03	0.03	0.00	0.00	0.13	0.00	0.00	0.00	0.06	0.03	0.04
c-2-Hexene	0.02	0.01	0.02	0.01	0.01	0.28	0.01	0.01	0.02	0.02	0.02	0.03
c-3-Methyl-2-Pentene	0.11	0.04	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.12
2,2-Dimethylpentane	0.01	0.02	0.03	0.01	0.01	0.02	0.01	0.01	0.02	0.04	0.02	0.08
1,2-Dichloroethane	0.09	0.08	0.08	0.08	0.07	0.08	0.07	0.07	0.08	0.10	0.07	0.09
Methylcyclopentane	0.74	0.36	1.13	0.27	0.13	1.92	0.08	0.16	0.53	0.15	0.51	3.47
2,4-Dimethylpentane	0.12	0.12	0.13	0.07	0.05	0.16	0.04	0.08	0.12	0.08	0.12	0.24
1,1,1-Trichloroethane	0.03	0.03	0.03	0.03	0.03	0.05	0.02	0.03	0.04	0.05	0.03	0.03
2,2,3-Trimethylbutane	0.03	0.00	0.02	0.01	0.01	0.00	0.02	0.02	0.04	0.05	0.01	0.03
1-Methylcyclopentene	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.03	0.03	0.04
Benzene	1.59	0.46	0.37	0.30	0.47	7.07	8.26	0.50	4.14	4.62	2.46	4.66
Carbontretrachloride	0.40	0.45	0.44	0.44	0.49	0.47	0.46	0.46	0.47	0.49	0.48	0.47
Cyclohexane	0.09	0.10	0.13	0.09	0.06	0.16	0.07	0.06	0.12	0.09	0.14	0.32
2-Methylhexane	0.18	0.90	0.22	0.86	0.16	0.26	0.09	0.17	0.26	0.14	0.47	0.37
2,3-Dimethylpentane	0.09	0.34	0.14	0.33	0.07	0.12	0.04	0.09	0.14	0.10	0.21	0.21
Cyclohexene	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.04	0.02	0.01
3-Methylhexane	0.22	1.45	0.25	1.41	0.20	0.32	0.12	0.21	0.34	0.18	0.59	0.41
Dibromomethane	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.08	0.03	0.03
1,2-Dichloropropane	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.01	0.01
Bromodichloromethane	0.02	0.00	0.02	0.00	0.02	0.01	0.02	0.02	0.02	0.07	0.00	0.02
1-Heptene	0.20	0.00	0.00	0.00	0.08	0.19	0.00	0.12	0.00	0.00	0.00	0.17
Trichloroethene	0.21	0.02	0.02	0.02	0.31	0.35	0.03	0.26	0.11	0.20	0.08	0.11
2,2,4-Trimethylpentane	0.24	0.17	0.25	0.15	0.13	0.23	0.11	0.24	0.31	0.24	0.32	0.38
t-3-Heptene	0.07	0.02	0.01	0.00	0.00	0.12	0.00	0.01	0.02	0.02	0.00	0.03
Heptane	0.30	1.41	0.16	1.31	0.13	0.46	0.13	0.18	0.31	0.22	0.36	0.37
c-3-Heptene	0.03	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.10	0.02	0.01	0.01	0.00	0.16	0.01	0.01	0.03	0.02	0.01	0.03
c-2-Heptene	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.09	0.20	0.11	0.19	0.10	0.19	0.12	0.11	0.22	0.17	0.21	0.24
2,5-Dimethylhexane	0.05	0.11	0.03	0.05	0.02	0.09	0.01	0.03	0.06	0.04	0.05	0.04
2,4-Dimethylhexane	0.04	0.08	0.03	0.06	0.02	0.05	0.00	0.04	0.06	0.05	0.06	0.06
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1,1,2-Trichloroethane	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.00
Bromotrichloromethane	0.00	0.00	0.00	0.00	NR	NR	NR	0.00	0.00	0.00	0.00	0.00
2,3,4-Trimethylpentane	0.08	0.05	0.07	0.05	0.04	0.07	0.03	0.07	0.11	0.07	0.11	0.09
Toluene	4.57	1.45	1.63	1.02	1.09	6.75	2.68	2.03	3.48	3.57	3.62	4.29
2-Methylheptane	0.06	0.05	0.06	0.06	0.04	0.00	0.04	0.07	0.12	0.07	0.14	0.09
4-Methylheptane	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04	0.03	0.04	0.03

1-Methylcyclohexene	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.02	0.01	0.01
3-Methylheptane	0.06	0.05	0.05	0.04	0.03	0.08	0.04	0.05	0.10	0.06	0.11	0.08
Dibromochloromethane	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.04	0.01	0.01
c-1,3-Dimethylcyclohexane	0.05	0.04	0.05	0.04	0.04	0.10	0.06	0.05	0.11	0.07	0.11	0.06
t-1,4-Dimethylcyclohexane	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.03	0.03	0.03	0.02
2,2,5-Trimethylhexane	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.02	0.03	0.02	0.03	0.02
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
1-Octene	0.54	0.18	0.09	0.12	0.16	0.42	0.09	0.20	0.12	0.13	0.15	0.34
Octane	0.28	0.12	0.10	0.09	0.08	0.32	0.13	0.12	0.22	0.14	0.20	0.13
t-2-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
t-1,2-Dimethylcyclohexane	0.03	0.02	0.03	0.02	0.02	0.06	0.03	0.02	0.07	0.05	0.06	0.03
Tetrachloroethene	0.11	0.05	0.21	0.04	0.05	0.14	0.04	0.07	0.27	0.10	2.43	0.08
c-1,4/t-1,3-Dimethylcyclohexane	0.02	0.02	0.02	0.02	0.01	0.03	0.02	0.02	0.04	0.03	0.04	0.02
c-1,2-Dimethylcyclohexane	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.03	0.02	0.01
Chlorobenzene	0.01	0.01	0.01	0.00	0.01	0.04	0.01	0.01	0.05	0.04	0.00	0.01
Ethylbenzene	2.07	0.66	0.22	0.32	0.15	3.16	0.17	0.29	0.98	0.34	0.95	0.60
m,p-Xylene	3.52	1.58	0.61	1.14	0.35	4.06	0.58	0.71	2.29	0.84	3.53	1.15
Bromoform	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.05	0.01	0.01
1,4-Dichlorobutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.58	0.52	0.34	0.00
Styrene	274.82	100.81	12.42	0.85	13.01 NR		17.82	35.40	128.21	40.99	29.18	102.39
1,1,2,2-Tetrachloroethane	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
1-Nonene	0.26	0.11	0.07	0.11	0.06	0.18	0.09	0.12	0.10	0.09	0.12	0.11
o-Xylene	2.70	0.90	0.26	0.40	0.16	4.41	0.26	0.34	1.28	0.44	1.15	0.77
Nonane	0.37	0.19	0.15	0.15	0.08	0.45	0.13	0.11	0.40	0.16	0.30	0.13
iso-Propylbenzene	1.34	0.34	0.05	0.02	0.03	2.99	0.06	0.09	0.60	0.18	0.11	0.43
a-Pinene	0.49	0.13	0.08	0.12	0.04	0.14	0.03	0.08	0.10	0.09	0.41	0.13
3,6-Dimethyloctane	0.03	0.00	0.01	0.01	0.00	0.04	0.00	0.01	0.04	0.00	0.04	0.02
n-Propylbenzene	6.94	1.82	0.19	0.07	0.15	13.73	0.27	0.43	2.95	0.75	0.47	2.10
3-Ethyltoluene	15.85	4.37	0.42	0.16	0.31	31.10	0.59	0.99	7.37	1.72	1.24	4.43
Camphene	0.16	0.07	0.03	0.03	0.02	0.25	0.01	0.04	0.07	0.09	0.07	0.08
4-Ethyltoluene	10.72	2.86	0.27	0.09	0.20	21.06	0.40	0.66	4.76	1.14	0.78	2.91
1,3,5-Trimethylbenzene	3.96	1.03	0.13	0.09	0.09	8.58	0.17	0.25	2.09	0.46	0.42	0.87
2-Ethyltoluene	4.10	1.10	0.12	0.07	0.09	8.92	0.15	0.26	2.03	0.45	0.37	1.20
b-Pinene	0.13	0.00	0.06	0.06	0.00	0.05	0.00	0.03	0.00	0.06	0.12	0.06
1-Decene	0.13	0.04	0.01	0.02	0.03	0.00	0.02	0.11	0.05	0.04	0.03	0.03
tert-Butylbenzene	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
1,2,4-Trimethylbenzene	16.39	4.64	0.51	0.32	0.41	33.18	0.68	1.22	8.97	1.92	1.72	4.45
Decane	0.45	0.32	0.21	0.26	0.10	0.62	0.14	0.19	0.87	0.21	0.57	0.21
Benzyl Chloride	0.00	0.01	0.00	0.00	0.00	0.00 NR		0.00	0.00	0.03	0.00	0.00
1,3-Dichlorobenzene	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
1,4-Dichlorobenzene	7.10	1.26	0.12	0.10	0.11	6.17	0.20	0.24	1.01	0.29	0.20	0.61
iso-Butylbenzene	0.13	0.04	0.01	0.01	0.01	0.29	0.01	0.01	0.08	0.04	0.02	0.05
sec-Butylbenzene	0.15	0.05	0.01	0.01	0.01	0.33	0.01	0.02	0.10	0.04	0.03	0.06
1,2,3-Trimethylbenzene	2.23	0.62	0.09	0.08	0.06	5.04	0.10	0.15	1.33	0.27	0.30	0.57
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.21	0.05	0.02	0.03	0.01	0.26	0.03	0.05	0.09	0.05	0.06	0.05
1,2-Dichlorobenzene	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Limonene	0.96	0.08	0.06	0.13	0.02	0.24	0.03	0.05	0.10	0.10	0.26	0.04
Indan (2,3-Dihydroindene)	0.93	0.25	0.04	0.04	0.03	1.81	0.04	0.08	0.50	0.13	0.23	0.20
1,3-Diethylbenzene	0.25	0.08	0.01	0.01	0.01	0.56	0.02	0.03	0.16	0.05	0.05	0.07
1,4-Diethylbenzene	0.87	0.26	0.06	0.07	0.05	1.80	0.06	0.11	0.54	0.16	0.17	0.24
n-Butylbenzene	0.24	0.08	0.02	0.03	0.02	0.49	0.02	0.03	0.16	0.00	0.05	0.07
1,2-Diethylbenzene	0.03	0.01	0.00	0.01	0.00	0.05	0.01	0.01	0.02	0.02	0.01	0.01
1-Undecene	0.16	0.05	0.00	0.12	0.07	0.00	0.07	0.26	0.00	0.05	0.05	0.03
Undecane	0.54	0.34	0.17	0.30	0.17	0.78	0.19	0.41	0.93	0.27	0.58	0.18
1,2,4-Trichlorobenzene	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.04	0.02	0.01
Naphthalene	0.46	0.21	0.16	0.17	0.25	7.20	11.42	0.24	5.62	7.08	2.76	7.30
Dodecane	1.28	0.50	0.27	0.46	0.27	1.41	0.45	0.62	0.87	0.49	0.58	0.29
Hexachlorobutadiene	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.01
Hexylbenzene	0.05	0.03	0.02	0.03	0.02	0.05	0.02	0.03	0.05	0.04	0.03	0.02

Randle Reef Study 2014 Sample Data
Concentration (µg/m^3)
NR= Data not reported

Non-Polar Analysis Date	**9-Jun-14**	**23-Jun-14**	**25-Jun-14**	**14-Jul-14**	**16-Jul-14**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**
Freon 134A	0.00	0.00	0.00	0.00	0.00
Propene	0.00	0.00	0.00	0.00	0.00
Propane	NR	NR	NR	NR	NR
Freon 22 (Chlorodifluoromethane)	0.00	0.00	0.00	0.00	0.00
Freon 12 (Dichlorodifluoromethane)	0.00	0.00	0.00	0.00	0.00
Propyne	0.00	0.00	0.00	0.00	0.00
Chloromethane	0.00	0.00	0.00	0.00	0.00
Isobutane (2-Methylpropane)	0.00	0.00	0.00	0.00	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00	0.00	0.00	0.00	0.00
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.01	0.01	0.01	0.01	0.01
1,3-Butadiene	0.00	0.00	0.00	0.00	0.00
Butane	0.00	0.00	0.00	0.00	0.00
t-2-Butene	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylpropane	0.00	0.00	0.00	0.00	0.00
Bromomethane	0.00	0.00	0.00	0.00	0.00
1-Butyne	0.00	0.00	0.00	0.00	0.00
c-2-Butene	0.00	0.00	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Butene	0.00	0.00	0.00	0.00	0.00
2-Methylbutane	0.00	0.00	0.00	0.00	0.00
Freon 11 (Trichlorofluoromethane)	0.00	0.00	0.00	0.00	0.00
1-Pentene	0.00	0.00	0.00	0.00	0.00
2-Methyl-1-Butene	0.00	0.00	0.00	0.00	0.00
Pentane	0.00	0.00	0.00	0.00	0.00
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.00	0.00	0.00	0.00
t-2-Pentene	0.00	0.00	0.00	0.00	0.00
Ethylbromide	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00	0.00
c-2-Pentene	0.00	0.00	0.00	0.00	0.00
Dichloromethane	0.02	0.02	0.02	0.02	0.02
2-Methyl-2-Butene	0.00	0.00	0.00	0.00	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylbutane	0.00	0.00	0.00	0.00	0.00
Cyclopentene	0.00	0.00	0.00	0.00	0.00
t-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00
4-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.00	0.00	0.00
2,3-Dimethylbutane	0.00	0.00	0.00	0.00	0.00
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	0.00	0.00	0.00	0.00	0.00
c-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00
3-Methylpentane	0.00	0.00	0.00	0.00	0.00
1-Hexene/2-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00
c-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00
Hexane	0.00	0.00	0.00	0.00	0.00
Chloroform	0.00	0.00	0.00	0.00	0.00
t-2-Hexene	0.00	0.00	0.00	0.00	0.00
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00
c-2-Hexene	0.00	0.00	0.00	0.00	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylpentane	0.00	0.00	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.00	0.00	0.00
Methylcyclopentane	0.00	0.00	0.00	0.00	0.00
2,4-Dimethylpentane	0.00	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.00	0.00	0.00	0.00	0.00
2,2,3-Trimethylbutane	0.00	0.00	0.00	0.00	0.00
1-Methylcyclopentene	0.00	0.00	0.00	0.00	0.00
Benzene	0.00	0.00	0.00	0.00	0.00
Carbontretrachloride	0.00	0.00	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.00	0.00	0.00
2-Methylhexane	0.00	0.00	0.00	0.00	0.00
2,3-Dimethylpentane	0.00	0.00	0.00	0.00	0.00
Cyclohexene	0.00	0.00	0.00	0.00	0.00
3-Methylhexane	0.00	0.00	0.00	0.00	0.00
Dibromomethane	0.02	0.02	0.02	0.02	0.02
1,2-Dichloropropane	0.00	0.00	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.00	0.00	0.00
1-Heptene	0.00	0.00	0.00	0.00	0.00

Trichloroethene	0.00	0.00	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00	0.00	0.00	0.00
t-3-Heptene	0.00	0.00	0.00	0.00	0.00
Heptane	0.00	0.00	0.00	0.00	0.00
c-3-Heptene	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.00	0.00	0.00
c-2-Heptene	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.00	0.00	0.00	0.00	0.00
2,5-Dimethylhexane	0.00	0.00	0.00	0.00	0.00
2,4-Dimethylhexane	0.00	0.00	0.00	0.00	0.00
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.00	0.00	0.00
Bromotrichloromethane	0.00	NR	NR	0.00	0.00
2,3,4-Trimethylpentane	0.00	0.00	0.00	0.00	0.00
Toluene	0.00	0.00	0.00	0.00	0.00
2-Methylheptane	0.00	0.00	0.00	0.00	0.01
4-Methylheptane	0.00	0.00	0.00	0.00	0.00
1-Methylcyclohexene	0.00	0.00	0.00	0.00	0.00
3-Methylheptane	0.00	0.00	0.00	0.00	0.00
Dibromochloromethane	0.00	0.00	0.00	0.00	0.00
c-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00
t-1,4-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00
2,2,5-Trimethylhexane	0.00	0.00	0.00	0.00	0.00
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.00	0.00
1-Octene	0.00	0.00	0.00	0.00	0.00
Octane	0.00	0.00	0.00	0.00	0.00
t-2-Octene	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00
Tetrachloroethene	0.00	0.00	0.00	0.00	0.00
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00
c-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00
Chlorobenzene	0.00	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00	0.00
m,p-Xylene	0.00	0.00	0.00	0.00	0.00
Bromoform	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobutane	0.00	0.00	0.00	0.00	0.00
Styrene	0.00	0.00	0.00	0.00	0.00
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.00	0.00
1-Nonene	0.00	0.00	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.00	0.00	0.00
Nonane	0.00	0.00	0.00	0.00	0.00
iso-Propylbenzene	0.00	0.00	0.00	0.00	0.00
a-Pinene	0.00	0.00	0.00	0.00	0.00
3,6-Dimethyloctane	0.00	0.00	0.00	0.00	0.00
n-Propylbenzene	0.00	0.00	0.00	0.00	0.00
3-Ethyltoluene	0.00	0.00	0.00	0.00	0.00
Camphene	0.00	0.00	0.00	0.00	0.00
4-Ethyltoluene	0.00	0.00	0.00	0.00	0.00
1,3,5-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00
2-Ethyltoluene	0.00	0.00	0.00	0.00	0.00
b-Pinene	0.00	0.00	0.00	0.00	0.00
1-Decene	0.00	0.00	0.00	0.00	0.00
tert-Butylbenzene	0.00	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00
Decane	0.00	0.00	0.00	0.00	0.00
Benzyl Chloride	0.00	0.00	NR	0.00	0.00
1,3-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00
iso-Butylbenzene	0.00	0.00	0.00	0.00	0.00
sec-Butylbenzene	0.00	0.00	0.00	0.00	0.00
1,2,3-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00
Limonene	0.00	0.00	0.00	0.00	0.00
Indan (2,3-Dihydroindene)	0.00	0.00	0.00	0.00	0.00
1,3-Diethylbenzene	0.00	0.00	0.00	0.00	0.00
1,4-Diethylbenzene	0.00	0.00	0.00	0.00	0.00
n-Butylbenzene	0.00	0.00	0.00	0.00	0.00
1,2-Diethylbenzene	0.00	0.00	0.00	0.00	0.00
1-Undecene	0.00	0.00	0.00	0.00	0.00
Undecane	0.00	0.00	0.00	0.00	0.00
1,2,4-Trichlorobenzene	0.00	0.00	0.00	0.01	0.00
Naphthalene	0.00	0.00	0.00	0.01	0.00
Dodecane	0.00	0.00	0.00	0.00	0.00
Hexachlorobutadiene	0.00	0.00	0.00	0.00	0.00
Hexylbenzene	0.00	0.00	0.00	0.00	0.00

Method Detection Limit
Concentration ($\mu g/m^3$)

Non-Polar Analysis Location	**Lab176ML**
Date of MDL analysis	**28-Jan-14**
Compound Name	
Freon 134A	0.03
Propene	0.02
Propane	0.16
Freon 22 (Chlorodifluoromethane)	0.03
Freon 12 (Dichlorodifluoromethane)	0.03
Propyne	0.01
Chloromethane	0.02
Isobutane (2-Methylpropane)	0.01
Freon 114 (1,2-Dichlorotetrafluoroethan	0.04
Vinylchloride (Chloroethene)	0.01
1-Butene/2-Methylpropene	0.01
1,3-Butadiene	0.00
Butane	0.02
t-2-Butene	0.00
2,2-Dimethylpropane	0.02
Bromomethane	0.03
1-Butyne	0.00
c-2-Butene	0.02
Chloroethane	0.03
3-Methyl-1-Butene	0.02
2-Methylbutane	0.05
Freon 11 (Trichlorofluoromethane)	0.02
1-Pentene	0.04
2-Methyl-1-Butene	0.01
Pentane	0.09
Isoprene (2-Methyl-1,3-Butadiene)	0.02
t-2-Pentene	0.02
Ethylbromide	0.02
1,1-Dichloroethene	0.00
c-2-Pentene	0.02
Dichloromethane	0.01
2-Methyl-2-Butene	0.02
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.01
2,2-Dimethylbutane	0.02
Cyclopentene	0.03
t-1,2-Dichloroethene	0.01
4-Methyl-1-Pentene	0.01
3-Methyl-1-Pentene	0.02
1,1-Dichloroethane	0.01
Cyclopentane	0.02
2,3-Dimethylbutane	0.00
t-4-Methyl-2-Pentene	0.02
Methyl-t-Butyl Ether (MTBE)	0.06
2-Methylpentane	0.05
c-4-Methyl-2-Pentene	0.02
3-Methylpentane	0.04
1-Hexene/2-Methyl-1-Pentene	0.03
c-1,2-Dichloroethene	0.02
Hexane	0.03
Chloroform	0.02
t-2-Hexene	0.01
2-Ethyl-1-Butene	0.00
t-3-Methyl-2-Pentene	0.01
c-2-Hexene	0.01
c-3-Methyl-2-Pentene	0.02
2,2-Dimethylpentane	0.03
1,2-Dichloroethane	0.01
Methylcyclopentane	0.02
2,4-Dimethylpentane	0.01
1,1,1-Trichloroethane	0.02
2,2,3-Trimethylbutane	0.01
1-Methylcyclopentene	0.02
Benzene	0.00
Carbontretrachloride	0.01
Cyclohexane	0.02
2-Methylhexane	0.01
2,3-Dimethylpentane	0.02
Cyclohexene	0.02
3-Methylhexane	0.02
Dibromomethane	0.04
1,2-Dichloropropane	0.11
Bromodichloromethane	0.02
1-Heptene	0.00
Trichloroethene	0.02

2,2,4-Trimethylpentane	0.02
t-3-Heptene	0.01
Heptane	0.02
c-3-Heptene	0.02
t-2-Heptene	0.00
c-2-Heptene	0.00
c-1,3-Dichloropropene	0.02
2,2-Dimethylhexane	0.02
Methylcyclohexane	0.01
2,5-Dimethylhexane	0.01
2,4-Dimethylhexane	0.02
t-1,3-Dichloropropene	0.00
1,1,2-Trichloroethane	0.02
Bromotrichloromethane	0.01
2,3,4-Trimethylpentane	0.00
Toluene	0.01
2-Methylheptane	0.01
4-Methylheptane	0.01
1-Methylcyclohexene	0.01
3-Methylheptane	0.02
Dibromochloromethane	0.03
c-1,3-Dimethylcyclohexane	0.01
t-1,4-Dimethylcyclohexane	0.02
2,2,5-Trimethylhexane	0.01
1,2-Dibromoethane (EDB)	0.02
1-Octene	0.02
Octane	0.01
t-2-Octene	0.01
t-1,2-Dimethylcyclohexane	0.01
Tetrachloroethene	0.02
c-1,4/t-1,3-Dimethylcyclohexane	0.02
c-1,2-Dimethylcyclohexane	0.02
Chlorobenzene	0.02
Ethylbenzene	0.01
m,p-Xylene	0.02
Bromoform	0.04
1,4-Dichlorobutane	0.01
Styrene	0.01
1,1,2,2-Tetrachloroethane	0.02
1-Nonene	0.01
o-Xylene	0.01
Nonane	0.01
iso-Propylbenzene	0.01
a-Pinene	0.03
3,6-Dimethyloctane	0.02
n-Propylbenzene	0.01
3-Ethyltoluene	0.02
Camphene	0.04
4-Ethyltoluene	0.02
1,3,5-Trimethylbenzene	0.01
2-Ethyltoluene	0.01
b-Pinene	0.03
1-Decene	0.00
tert-Butylbenzene	0.01
1,2,4-Trimethylbenzene	0.03
Decane	0.02
Benzyl Chloride	0.02
1,3-Dichlorobenzene	0.03
1,4-Dichlorobenzene	0.01
iso-Butylbenzene	0.02
sec-Butylbenzene	0.01
1,2,3-Trimethylbenzene	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02
1,2-Dichlorobenzene	0.03
Limonene	0.05
Indan (2,3-Dihydroindene)	0.02
1,3-Diethylbenzene	0.01
1,4-Diethylbenzene	0.02
n-Butylbenzene	0.02
1,2-Diethylbenzene	0.01
1-Undecene	0.02
Undecane	0.01
1,2,4-Trichlorobenzene	0.04
Naphthalene	0.00
Dodecane	0.00
Hexachlorobutadiene	0.04
Hexylbenzene	0.02

Randle Reef Study 2014 Sample Data
Concentration (µg/m^3)
NR= Data not reported

FID Analysis Date	**14AUG05-07**	**14AUG06-13**	**14AUG06-14**	**14AUG18-17**	**14AUG26-11**	**14AUG26-12**	**14AUG26-13**	**14AUG26-14**	**14AUG26-15**	**14SEP04-16**	**14SEP04-17**	**14SEP16-17**	**14SEP17-16.**
FID Analysis Location	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**
Non-Polar Analysis Date	**29-Jul-14**	**5-Aug-14**	**5-Aug-14**	**7-Aug-14**	**7-Aug-14**	**7-Aug-14**	**2-Sep-14**	**2-Sep-14**	**2-Sep-14**	**3-Sep-14**	**3-Sep-14**	**25-Sep-14**	**25-Sep-14**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176DW**	**Lab176DW**	**Lab176DW**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**RR13.D**	**RR14.D**	**RR15.D**	**RR16.D**	**RR17.D**	**RR18.D**	**RR19.D**	**RR20.D**	**RR21.D**	**RR22.D**	**RR23.D**	**RR24.D**	**RR25.D**
Sample location	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**
Sampling Date	**23-Jul-14**	**23-Jul-14**	**23-Jul-14**	**3-Aug-14**	**3-Aug-14**	**3-Aug-14**	**13-Aug-14**	**13-Aug-14**	**13-Aug-14**	**27-Aug-14**	**27-Aug-14**	**8-Sep-14**	**8-Sep-14**
Canister ID	**EPS 040**	**EPS 977**	**EPS 942**	**EPS 391**	**EPS 309**	**EPS 775**	**EPS 600**	**EPS 055**	**EPS 626**	**EPS 721**	**EPS 301**	**EPS 031**	**EPS 564**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**
Comments													
Ethylene	**8.20**	**1.34**	**1.25**	**41.32**	**6.59**	**9.46**	**5.78**	**1.89**	**4.54**	**6.10**	**0.78**	**42.97**	**2.47**
Acetylene	**0.32**	**0.24**	**0.18**	**0.51**	**0.60**	**0.54**	**0.19**	**0.21**	**0.21**	**0.20**	**0.16**	**0.34**	**0.41**
Ethane	**24.19**	**6.45**	**7.86**	**118.40**	**28.85**	**51.02**	**16.72**	**8.15**	**25.78**	**31.35**	**5.02**	**130.06**	**8.85**
Freon 134A	0.55	1.02	0.53	0.85	1.61	0.74	0.37	0.53	0.37	0.77	0.44	0.77	0.90
Propene	0.44	0.30	0.28	1.19	0.78	1.58	0.27	0.29	0.54	0.60	0.18	1.24	0.60
Propane	**1.43**	**2.02**	**1.42**	**1.95**	**2.53**	**2.91**	**0.96**	**1.17**	**1.41**	**1.88**	**1.26**	**2.06**	**4.60**
Freon 22 (Chlorodifluoromethane)	1.49	0.98	0.94	1.01	1.09	1.03	0.70	0.71	0.71	1.03	0.87	3.55	1.55
Freon 12 (Dichlorodifluoromethane)	2.92	3.34	3.21	3.10	3.13	3.19	2.10	2.14	2.07	2.68	2.79	2.99	3.12
Propyne	0.03	0.03	0.02	0.06	0.06	0.06	0.02	0.02	0.02	0.02	0.02	0.04	0.05
Chloromethane	1.50	1.51	1.54	1.58	1.64	2.27	1.00	1.01	1.09	1.29	1.27	1.64	1.39
Isobutane (2-Methylpropane)	0.34	2.74	1.08	0.74	1.12	1.60	0.18	0.28	0.91	0.75	0.36	0.73	5.16
Freon 114 (1,2-Dichlorotetrafluoroethane	0.14	0.17	0.16	0.16	0.15	0.16	0.09	0.09	0.09	0.13	0.15	0.14	0.14
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
1-Butene/2-Methylpropene	2.13	0.89	1.00	7.73	3.62	6.18	0.91	0.75	2.15	3.52	0.48	10.09	1.09
1,3-Butadiene	0.04	0.03	0.02	0.08	0.07	0.08	0.02	0.03	0.03	0.03	0.02	0.06	0.06
Butane	0.79	2.92	2.46	1.28	2.13	3.91	0.34	0.50	2.02	1.31	0.85	1.41	11.52
t-2-Butene	0.03	0.13	0.11	0.05	0.06	0.13	0.02	0.03	0.13	0.06	0.02	0.07	0.57
2,2-Dimethylpropane	0.01	0.03	0.02	0.02	0.02	0.04	0.00	0.01	0.01	0.02	0.01	0.02	0.06
Bromomethane	0.07	0.11	0.11	0.10	0.10	0.32	0.04	0.04	0.07	0.07	0.07	0.08	0.06
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Butene	0.03	0.09	0.07	0.04	0.05	0.10	0.02	0.03	0.09	0.05	0.02	0.06	0.41
Chloroethane	0.37	0.07	0.07	1.07	0.33	0.80	0.13	0.09	0.23	0.44	0.05	1.90	0.08
3-Methyl-1-Butene	0.03	NR	NR	0.03	0.04	0.10	0.01	0.01	0.04	0.03	0.02	0.04	0.15
2-Methylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.18
Freon 11 (Trichlorofluoromethane)	1.50	1.77	1.60	1.59	1.55	1.51	1.29	1.21	1.20	1.32	1.40	1.50	1.60
1-Pentene	0.13	0.11	0.09	0.16	0.13	0.18	0.05	0.04	0.18	0.10	0.06	0.16	0.32
2-Methyl-1-Butene	0.50	0.24	0.23	2.26	0.77	1.35	0.18	0.13	0.39	0.71	0.07	2.47	0.79
Pentane	0.63	2.17	1.72	1.23	1.35	3.10	0.34	0.55	1.96	1.27	0.82	1.27	9.69
Isoprene (2-Methyl-1,3-Butadiene)	2.01	0.31	0.28	1.17	0.90	0.74	0.63	0.14	0.21	0.25	0.18	0.62	0.26
t-2-Pentene	0.07	0.23	0.19	0.10	0.11	0.31	0.03	0.04	0.20	0.10	0.05	0.09	1.25
Ethylbromide	0.01	0.01	0.01	0.02	0.01	0.03	0.00	0.00	0.01	0.01	0.01	0.03	0.01
1,1-Dichloroethene	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Pentene	0.03	0.10	0.08	0.05	0.06	0.14	0.01	0.02	0.09	0.05	0.02	0.05	0.51
Dichloromethane	2.76	7.22	24.32	10.38	8.52	73.57	2.13	1.49	8.54	4.43	1.08	12.90	1.52
2-Methyl-2-Butene	1.40	0.45	0.40	6.60	1.10	2.04	0.48	0.21	0.67	0.99	0.08	6.58	1.71
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.68	0.79	0.72	0.73	0.71	0.70	0.45	0.45	0.44	0.57	0.62	0.65	0.67
2,2-Dimethylbutane	0.04	0.15	0.08	0.08	0.08	0.19	0.02	0.03	0.09	0.06	0.04	0.07	0.56
Cyclopentene	0.01	0.03	0.02	0.02	0.02	0.04	0.01	0.01	0.03	0.02	0.01	0.02	0.14
t-1,2-Dichloroethene	0.04	0.11	0.04	0.05	0.07	0.06	0.02	0.03	0.31	0.04	0.03	0.06	0.07
4-Methyl-1-Pentene	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.01	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.01	0.01	0.01	0.01	0.03
1,1-Dichloroethane	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclopentane	0.10	0.25	0.17	0.17	0.18	0.43	0.03	0.05	0.17	0.11	0.08	0.13	0.84
2,3-Dimethylbutane	0.08	0.35	0.18	0.00	0.17	0.33	0.03	0.05	0.26	0.25	0.05	0.12	1.11
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	NR	NR	NR	NR	NR	NR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	0.32	2.57	0.93	0.68	0.77	1.73	0.16	0.22	2.01	2.18	0.26	0.53	6.82
c-4-Methyl-2-Pentene	0.01	0.02	0.02	0.02	0.01	0.03	0.00	0.00	0.02	0.01	0.01	0.01	0.10
3-Methylpentane	0.22	3.28	0.93	0.43	0.65	1.30	0.10	0.15	2.78	2.79	0.26	0.38	6.90
1-Hexene/2-Methyl-1-Pentene	0.11	0.10	0.09	0.12	0.12	0.16	0.04	0.03	0.12	0.08	0.04	0.09	0.21
c-1,2-Dichloroethene	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01
Hexane	0.28	8.06	1.99	0.56	1.17	2.83	0.14	0.19	7.56	5.76	0.47	0.43	14.30
Chloroform	0.14	0.14	0.18	0.24	0.20	0.31	0.09	0.08	0.14	0.11	0.15	0.24	0.24
t-2-Hexene	0.02	0.04	0.03	0.00	0.03	0.05	0.01	0.01	0.03	0.02	0.01	0.02	0.14
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.01	0.02	0.02	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.02	0.08
c-2-Hexene	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.00	0.06
c-3-Methyl-2-Pentene	0.05	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.05	0.00	0.01	0.00	0.27
2,2-Dimethylpentane	0.01	0.05	0.03	0.02	0.02	0.06	0.01	0.01	0.06	0.03	0.01	0.02	0.17
1,2-Dichloroethane	0.06	0.08	0.07	0.07	0.06	0.08	0.04	0.04	0.06	0.05	0.05	0.06	0.09
Methylcyclopentane	0.16	2.90	1.20	0.00	1.11	0.00	0.00	0.09	2.23	1.65	0.16	1.11	4.91
2,4-Dimethylpentane	0.08	0.21	0.15	0.16	0.15	0.25	0.03	0.03	0.10	0.09	0.04	0.13	0.47
1,1,1-Trichloroethane	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03
2,2,3-Trimethylbutane	0.02	0.04	0.03	0.02	0.02	0.00	0.01	0.01	0.02	0.01	0.01	0.02	0.04
1-Methylcyclopentene	0.02	0.03	0.02	0.01	0.02	0.03	0.01	0.01	0.02	0.02	0.01	0.02	0.13
Benzene	1.04	0.75	0.74	2.20	2.70	3.53	0.27	0.27	0.60	0.67	0.31	1.54	3.75
Carbontretrachloride	0.51	0.61	0.55	0.47	0.48	0.54	0.32	0.33	0.32	0.36	0.41	0.47	0.46
Cyclohexane	0.07	0.26	0.13	0.11	0.14	0.44	0.04	0.04	0.16	0.10	0.05	0.07	0.47
2-Methylhexane	0.16	1.10	0.15	0.27	0.35	0.43	0.06	0.12	0.17	0.23	0.07	0.21	0.83
2,3-Dimethylpentane	0.09	0.38	0.10	0.14	0.17	0.22	0.03	0.06	0.10	0.10	0.04	0.11	0.47
Cyclohexene	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
3-Methylhexane	0.19	1.24	0.18	0.30	0.43	0.46	0.06	0.16	0.19	0.32	0.09	0.26	0.91
Dibromomethane	0.03	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02
1,2-Dichloropropane	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bromodichloromethane	0.01	0.00	0.05	0.02	0.01	0.04	0.01	0.00	0.03	0.01	0.04	0.02	0.00
1-Heptene	0.11	0.00	0.09	0.00	0.00	0.00	0.06	0.00	0.12	0.07	0.00	0.00	0.00
Trichloroethene	0.28	0.06	0.16	0.29	0.08	0.24	0.11	0.03	0.07	0.06	0.04	0.22	0.23
2,2,4-Trimethylpentane	0.20	0.22	0.18	0.39	0.32	0.43	0.08	0.08	0.17	0.11	0.07	0.28	0.92
t-3-Heptene	0.03	0.01	0.01	0.11	0.04	0.07	0.01	0.01	0.02	0.04	0.00	0.10	0.00
Heptane	0.18	0.46	0.16	0.40	0.38	0.81	0.08	0.18	0.28	0.39	0.10	0.42	0.64
c-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.04	0.02	0.01	0.15	0.07	0.10	0.02	0.01	0.03	0.06	0.00	0.13	0.02
c-2-Heptene	0.37	0.00	0.00	0.51	0.00	0.00	0.12	0.21	0.00	0.28	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.08	0.22	0.11	0.13	0.18	0.52	0.03	0.04	0.12	0.09	0.04	0.09	0.37
2,5-Dimethylhexane	0.03	0.04	0.02	0.06	0.06	0.10	0.02	0.02	0.03	0.02	0.01	0.04	0.10
2,4-Dimethylhexane	0.04	0.00	0.00	0.00	0.06	0.00	0.01	0.02	0.03	0.03	0.00	0.04	0.00
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00
Bromotrichloromethane	0.00	NR	NR	NR	NR	NR	NR	NR	NR	0.00	0.00	0.00	0.00
2,3,4-Trimethylpentane	0.06	0.06	0.04	0.14	0.11	0.13	0.03	0.03	0.04	0.03	0.02	0.09	0.22
Toluene	4.64	3.63	2.17	7.44	3.68	6.89	0.78	0.65	1.43	1.56	0.87	8.14	4.79
2-Methylheptane	0.05	0.06	0.04	0.00	0.08	0.14	0.02	0.02	0.05	0.04	0.02	0.05	0.17
4-Methylheptane	0.02	0.03	0.02	0.03	0.04	0.09	0.01	0.01	0.02	0.01	0.01	0.02	0.06

1-Methylcyclohexene	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01
3-Methylheptane	0.05	0.06	0.03	0.07	0.08	0.16	0.02	0.02	0.05	0.03	0.02	0.06	0.15
Dibromochloromethane	0.01	0.01	0.03	0.01	0.01	0.02	0.00	0.00	0.01	0.00	0.02	0.01	0.02
c-1,3-Dimethylcyclohexane	0.04	0.07	0.04	0.05	0.07	0.18	0.01	0.02	0.03	0.05	0.01	0.03	0.09
t-1,4-Dimethylcyclohexane	0.01	0.02	0.01	0.02	0.02	0.07	0.00	0.01	0.01	0.01	0.01	0.01	0.03
2,2,5-Trimethylhexane	0.01	0.01	0.01	0.03	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.04
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Octene	0.23	0.09	0.18	0.37	0.13	0.20	0.11	0.03	0.15	0.14	0.04	0.35	0.07
Octane	0.13	0.14	0.10	0.18	0.16	0.42	0.03	0.04	0.12	0.08	0.04	0.14	0.17
t-2-Octene	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.02	0.04	0.02	0.03	0.04	0.11	0.01	0.01	0.02	0.03	0.01	0.02	0.04
Tetrachloroethene	0.06	0.06	0.07	0.12	0.10	0.16	0.02	0.02	0.03	0.12	0.04	0.11	0.29
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.03	0.01	0.02	0.02	0.05	0.00	0.01	0.01	0.02	0.01	0.01	0.03
c-1,2-Dimethylcyclohexane	0.01	0.02	0.01	0.01	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chlorobenzene	0.01	0.03	0.02	0.01	0.03	0.03	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Ethylbenzene	1.15	0.62	0.41	3.86	1.65	2.57	0.37	0.29	0.57	1.04	0.14	3.29	0.55
m,p-Xylene	1.32	1.46	0.67	3.82	2.45	2.89	0.45	0.55	0.73	1.47	0.27	3.17	1.64
Bromoform	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02
1,4-Dichlorobutane	0.28	0.44	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.22	0.26	0.21	0.18
Styrene	247.30	76.75	79.41	458.63	232.26	285.30	105.85	59.10	116.84	130.01	28.35	399.92	21.51
1,1,2,2-Tetrachloroethane	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1-Nonene	0.12	0.05	0.08	0.11	0.11	0.00	0.05	0.03	0.07	0.08	0.03	0.09	0.05
o-Xylene	1.36	0.76	0.52	4.46	2.13	2.70	0.56	0.47	0.87	1.38	0.19	4.02	0.61
Nonane	0.16	0.18	0.11	0.30	0.32	0.57	0.05	0.07	0.13	0.14	0.04	0.23	0.15
iso-Propylbenzene	1.65	0.36	0.34	3.29	1.56	2.32	0.30	0.24	0.54	1.03	0.10	2.61	0.09
a-Pinene	0.17	0.12	0.08	0.27	0.25	0.17	0.05	0.05	0.04	0.11	0.06	0.25	0.24
3,6-Dimethyloctane	0.02	0.00	0.00	0.05	0.04	0.05	0.01	0.00	0.01	0.00	0.01	0.04	0.01
n-Propylbenzene	5.14	1.71	1.48	16.87	7.27	9.50	1.49	1.11	2.33	4.87	0.45	13.53	0.41
3-Ethyltoluene	11.55	4.33	3.74	36.09	17.40	22.14	3.44	2.85	5.89	10.73	1.03	28.76	0.85
Camphene	0.14	0.06	0.06	0.32	0.20	0.20	0.04	0.04	0.06	0.12	0.04	0.30	0.06
4-Ethyltoluene	7.60	2.76	2.35	24.38	11.16	14.18	2.17	1.73	3.57	6.86	0.63	19.20	0.54
1,3,5-Trimethylbenzene	2.75	1.16	1.04	9.44	5.12	6.57	0.74	0.80	1.66	2.69	0.33	7.47	0.23
2-Ethyltoluene	2.94	1.18	1.01	10.02	5.11	6.74	0.87	0.81	1.65	3.22	0.33	8.07	0.27
b-Pinene	0.10	0.07	0.08	0.19	0.15	0.15	0.02	0.02	0.02	0.06	0.06	0.12	0.07
1-Decene	0.12	0.03	0.07	0.00	0.11	0.00	0.06	0.00	0.00	0.00	0.02	0.00	0.02
tert-Butylbenzene	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	12.32	5.18	4.33	38.69	20.07	25.31	3.69	3.48	6.73	11.83	1.62	31.33	1.07
Decane	0.28	0.27	0.27	0.59	0.61	0.69	0.07	0.09	0.14	0.22	0.08	0.42	0.19
Benzyl Chloride	0.00	0.00	0.00	0.00	0.00	0.00	NR	NR	NR	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
1,4-Dichlorobenzene	0.54	0.46	0.33	1.39	1.40	1.80	0.21	0.33	0.54	1.30	0.23	1.36	0.24
iso-Butylbenzene	0.12	0.05	0.05	0.40	0.18	0.25	0.04	0.03	0.07	0.12	0.02	0.31	0.02
sec-Butylbenzene	0.14	0.05	0.06	0.46	0.21	0.29	0.04	0.04	0.08	0.14	0.02	0.36	0.02
1,2,3-Trimethylbenzene	1.24	0.69	0.58	4.50	3.06	3.83	0.33	0.42	0.75	1.73	0.23	3.76	0.16
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.17	0.06	0.09	0.34	0.17	0.20	0.03	0.03	0.05	0.09	0.02	0.20	0.03
1,2-Dichlorobenzene	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Limonene	0.44	0.06	0.03	0.30	0.17	0.07	0.02	0.03	0.01	0.05	0.03	0.12	0.07
Indan (2,3-Dihydroindene)	0.63	0.24	0.17	2.22	1.06	1.24	0.18	0.16	0.28	0.53	0.05	1.85	0.07
1,3-Diethylbenzene	0.20	0.08	0.07	0.70	0.34	0.44	0.06	0.06	0.10	0.18	0.02	0.54	0.02
1,4-Diethylbenzene	0.64	0.27	0.25	2.06	1.06	1.33	0.18	0.19	0.30	0.60	0.09	1.64	0.09
n-Butylbenzene	0.18	0.08	0.08	0.59	0.29	0.36	0.05	0.05	0.08	0.17	0.03	0.49	0.03
1,2-Diethylbenzene	0.02	0.01	0.02	0.06	0.03	0.04	0.01	0.01	0.01	0.02	0.01	0.04	0.01
1-Undecene	0.25	0.05	0.11	0.16	0.16	0.00	0.02	0.03	0.02	0.04	0.03	0.00	0.02
Undecane	0.28	0.29	0.45	0.59	0.54	0.48	0.09	0.11	0.09	0.18	0.08	0.42	0.12
1,2,4-Trichlorobenzene	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Naphthalene	0.32	0.28	0.56	0.73	2.84	3.52	0.07	0.10	0.18	0.23	0.27	0.27	3.24
Dodecane	0.38	0.43	0.77	0.53	0.44	0.47	0.11	0.18	0.15	0.24	0.15	0.54	0.12
Hexachlorobutadiene	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Hexylbenzene	0.03	0.03	0.04	0.04	0.08	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01

Randle Reef Study 2014 Sample Data
Concentration (µg/m^3)
NR= Data not reported

Non-Polar Analysis Date	**29-Jul-14**	**5-Aug-14**	**7-Aug-14**	**2-Sep-14**	**3-Sep-14**	**25-Sep-14**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176DW**	**Lab176ML**	**Lab176ML**
Filename	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**	**500**
Freon 134A	0.00	0.00	0.04	0.00	0.00	0.00
Propene	0.00	0.00	0.03	0.01	0.00	0.00
Propane	NR	NR	NR	NR	NR	NR
Freon 22 (Chlorodifluoromethane)	0.00	0.00	0.07	0.00	0.00	0.00
Freon 12 (Dichlorodifluoromethane)	0.00	0.00	0.09	0.02	0.00	0.00
Propyne	0.00	0.00	0.02	0.00	0.00	0.00
Chloromethane	0.00	0.00	0.05	0.00	0.00	0.00
Isobutane (2-Methylpropane)	0.00	0.00	0.07	0.00	0.00	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00	0.00	0.13	0.00	0.00	0.00
Vinylchloride (Chloroethene)	0.00	0.00	0.02	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.01	0.01	0.12	0.01	0.01	0.00
1,3-Butadiene	0.00	0.00	0.03	0.00	0.00	0.00
Butane	0.00	0.00	0.13	0.00	0.00	0.00
t-2-Butene	0.00	0.00	0.03	0.00	0.00	0.00
2,2-Dimethylpropane	0.00	0.00	0.03	0.00	0.00	0.00
Bromomethane	0.00	0.00	0.15	0.00	0.00	0.00
1-Butyne	0.00	0.00	0.04	0.00	0.00	0.00
c-2-Butene	0.00	0.00	0.04	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.08	0.00	0.00	0.00
3-Methyl-1-Butene	0.00	NR	0.02	0.00	0.00	0.00
2-Methylbutane	0.00	0.00	0.16	0.00	0.00	0.00
Freon 11 (Trichlorofluoromethane)	0.00	0.00	0.05	0.00	0.00	0.00
1-Pentene	0.00	0.00	0.06	0.00	0.00	0.00
2-Methyl-1-Butene	0.00	0.00	0.02	0.00	0.00	0.00
Pentane	0.00	0.00	0.13	0.00	0.00	0.00
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.00	0.03	0.00	0.00	0.00
t-2-Pentene	0.00	0.00	0.01	0.00	0.00	0.00
Ethylbromide	0.00	0.00	0.06	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.04	0.00	0.00	0.00
c-2-Pentene	0.00	0.00	0.02	0.00	0.00	0.00
Dichloromethane	0.02	0.02	0.09	0.02	0.01	0.01
2-Methyl-2-Butene	0.00	0.00	0.02	0.00	0.00	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00	0.00	0.09	0.00	0.00	0.00
2,2-Dimethylbutane	0.00	0.00	0.05	0.00	0.00	0.00
Cyclopentene	0.00	0.00	0.03	0.00	0.00	0.00
t-1,2-Dichloroethene	0.00	0.00	0.05	0.00	0.00	0.00
4-Methyl-1-Pentene	0.00	0.00	0.02	0.00	0.00	0.00
3-Methyl-1-Pentene	0.00	0.00	0.02	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.05	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.02	0.00	0.00	0.00
2,3-Dimethylbutane	0.00	0.00	0.01	0.00	0.00	0.00
t-4-Methyl-2-Pentene	0.00	0.00	0.02	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	NR	NR	NR	0.00	0.00	0.00
2-Methylpentane	0.00	0.00	0.06	0.00	0.00	0.00
c-4-Methyl-2-Pentene	0.00	0.00	0.02	0.00	0.00	0.00
3-Methylpentane	0.00	0.00	0.06	0.00	0.00	0.00
1-Hexene/2-Methyl-1-Pentene	0.00	0.00	0.07	0.00	0.00	0.00
c-1,2-Dichloroethene	0.00	0.00	0.04	0.00	0.00	0.00
Hexane	0.00	0.00	0.05	0.00	0.00	0.00
Chloroform	0.00	0.00	0.08	0.00	0.00	0.00
t-2-Hexene	0.00	0.00	0.02	0.00	0.00	0.00
2-Ethyl-1-Butene	0.00	0.00	0.03	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.00	0.02	0.00	0.00	0.00
c-2-Hexene	0.00	0.00	0.02	0.00	0.00	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.03	0.00	0.00	0.00
2,2-Dimethylpentane	0.00	0.00	0.05	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.06	0.00	0.00	0.00
Methylcyclopentane	0.00	0.00	0.02	0.00	0.00	0.00
2,4-Dimethylpentane	0.00	0.00	0.02	0.00	0.00	0.00
1,1,1-Trichloroethane	0.00	0.00	0.06	0.00	0.00	0.00
2,2,3-Trimethylbutane	0.00	0.00	0.02	0.00	0.00	0.00
1-Methylcyclopentene	0.00	0.00	0.04	0.00	0.00	0.00
Benzene	0.00	0.00	0.05	0.00	0.00	0.00
Carbontretrachloride	0.00	0.00	0.07	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.03	0.00	0.00	0.00
2-Methylhexane	0.00	0.00	0.03	0.00	0.00	0.00
2,3-Dimethylpentane	0.00	0.00	0.04	0.00	0.00	0.00
Cyclohexene	0.00	0.00	0.04	0.00	0.00	0.00
3-Methylhexane	0.00	0.00	0.03	0.00	0.00	0.00
Dibromomethane	0.02	0.02	0.14	0.01	0.01	0.01
1,2-Dichloropropane	0.00	0.00	0.05	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.08	0.00	0.00	0.00
1-Heptene	0.00	0.00	0.02	0.00	0.00	0.00

Trichloroethene	0.00	0.00	0.08	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00	0.02	0.00	0.00	0.00
t-3-Heptene	0.00	0.00	0.02	0.00	0.00	0.00
Heptane	0.00	0.00	0.06	0.00	0.00	0.00
c-3-Heptene	0.00	0.00	0.04	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.01	0.00	0.00	0.00
c-2-Heptene	0.00	0.00	0.03	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.02	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.02	0.00	0.00	0.00
Methylcyclohexane	0.00	0.00	0.02	0.00	0.00	0.00
2,5-Dimethylhexane	0.00	0.00	0.02	0.00	0.00	0.00
2,4-Dimethylhexane	0.00	0.00	0.02	0.00	0.00	0.00
t-1,3-Dichloropropene	0.00	0.00	0.02	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.07	0.00	0.00	0.00
Bromotrichloromethane	0.00	NR	NR	NR	0.00	0.00
2,3,4-Trimethylpentane	0.00	0.00	0.02	0.00	0.00	0.00
Toluene	0.00	0.00	0.10	0.00	0.00	0.00
2-Methylheptane	0.00	0.00	0.02	0.00	0.00	0.00
4-Methylheptane	0.00	0.00	0.02	0.00	0.00	0.00
1-Methylcyclohexene	0.00	0.00	0.03	0.00	0.00	0.00
3-Methylheptane	0.00	0.00	0.02	0.00	0.00	0.00
Dibromochloromethane	0.00	0.00	0.09	0.00	0.00	0.00
c-1,3-Dimethylcyclohexane	0.00	0.00	0.02	0.00	0.00	0.00
t-1,4-Dimethylcyclohexane	0.00	0.00	0.02	0.00	0.00	0.00
2,2,5-Trimethylhexane	0.00	0.00	0.01	0.00	0.00	0.00
1,2-Dibromoethane (EDB)	0.00	0.00	0.04	0.00	0.00	0.00
1-Octene	0.00	0.00	0.02	0.00	0.00	0.00
Octane	0.00	0.00	0.02	0.00	0.00	0.00
t-2-Octene	0.00	0.00	0.02	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.00	0.00	0.01	0.00	0.00	0.00
Tetrachloroethene	0.00	0.00	0.08	0.00	0.00	0.00
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.00	0.02	0.00	0.00	0.00
c-1,2-Dimethylcyclohexane	0.00	0.00	0.04	0.00	0.00	0.00
Chlorobenzene	0.00	0.00	0.06	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.03	0.00	0.00	0.00
m,p-Xylene	0.00	0.00	0.05	0.00	0.00	0.00
Bromoform	0.00	0.00	0.12	0.00	0.00	0.00
1,4-Dichlorobutane	0.00	0.00	0.03	0.00	0.00	0.00
Styrene	0.00	0.00	0.03	0.00	0.00	0.00
1,1,2,2-Tetrachloroethane	0.00	0.00	0.05	0.00	0.00	0.00
1-Nonene	0.00	0.00	0.02	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.02	0.00	0.00	0.00
Nonane	0.00	0.00	0.02	0.00	0.00	0.00
iso-Propylbenzene	0.00	0.00	0.03	0.00	0.00	0.00
a-Pinene	0.00	0.00	0.08	0.00	0.00	0.00
3,6-Dimethyloctane	0.00	0.00	0.01	0.00	0.00	0.00
n-Propylbenzene	0.00	0.00	0.02	0.00	0.00	0.00
3-Ethyltoluene	0.00	0.00	0.01	0.00	0.00	0.00
Camphene	0.00	0.00	0.10	0.00	0.00	0.00
4-Ethyltoluene	0.00	0.00	0.01	0.00	0.00	0.00
1,3,5-Trimethylbenzene	0.00	0.00	0.01	0.00	0.00	0.00
2-Ethyltoluene	0.00	0.00	0.01	0.00	0.00	0.00
b-Pinene	0.00	0.00	0.06	0.00	0.00	0.00
1-Decene	0.00	0.00	0.02	0.00	0.00	0.00
tert-Butylbenzene	0.00	0.00	0.02	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.00	0.00	0.03	0.00	0.00	0.00
Decane	0.00	0.00	0.02	0.00	0.00	0.00
Benzyl Chloride	0.00	0.00	0.02	NR	0.00	0.00
1,3-Dichlorobenzene	0.00	0.00	0.05	0.00	0.00	0.00
1,4-Dichlorobenzene	0.00	0.00	0.02	0.00	0.00	0.00
iso-Butylbenzene	0.00	0.00	0.01	0.00	0.00	0.00
sec-Butylbenzene	0.00	0.00	0.02	0.00	0.00	0.00
1,2,3-Trimethylbenzene	0.00	0.00	0.01	0.00	0.00	0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.00	0.00	0.01	0.00	0.00	0.00
1,2-Dichlorobenzene	0.00	0.00	0.05	0.00	0.00	0.00
Limonene	0.00	0.00	0.10	0.00	0.00	0.00
Indan (2,3-Dihydroindene)	0.00	0.00	0.02	0.00	0.00	0.00
1,3-Diethylbenzene	0.00	0.00	0.01	0.00	0.00	0.00
1,4-Diethylbenzene	0.00	0.00	0.03	0.00	0.00	0.00
n-Butylbenzene	0.00	0.00	0.01	0.00	0.00	0.00
1,2-Diethylbenzene	0.00	0.00	0.01	0.00	0.00	0.00
1-Undecene	0.00	0.00	0.01	0.00	0.00	0.00
Undecane	0.00	0.00	0.02	0.00	0.00	0.00
1,2,4-Trichlorobenzene	0.00	0.00	0.04	0.00	0.00	0.00
Naphthalene	0.00	0.00	0.02	0.00	0.00	0.00
Dodecane	0.00	0.00	0.02	0.00	0.00	0.00
Hexachlorobutadiene	0.00	0.00	0.06	0.00	0.00	0.00
Hexylbenzene	0.00	0.00	0.02	0.00	0.00	0.00

Method Detection Limit
Concentration ($\mu g/m^3$)

Non-Polar Analysis Location	Lab176DW	Lab176ML
Date of MDL analysis	**22-Jan-14**	**28-Jan-14**
Compound Name		
Freon 134A	0.02	0.03
Propene	0.02	0.02
Propane	0.02	0.16
Freon 22 (Chlorodifluoromethane)	0.03	0.03
Freon 12 (Dichlorodifluoromethane)	0.03	0.03
Propyne	0.01	0.01
Chloromethane	0.02	0.02
Isobutane (2-Methylpropane)	0.02	0.01
Freon 114 (1,2-Dichlorotetrafluoroethan	0.04	0.04
Vinylchloride (Chloroethene)	0.00	0.01
1-Butene/2-Methylpropene	0.02	0.01
1,3-Butadiene	0.00	0.00
Butane	0.03	0.02
t-2-Butene	0.02	0.00
2,2-Dimethylpropane	0.00	0.02
Bromomethane	0.04	0.03
1-Butyne	0.02	0.00
c-2-Butene	0.02	0.02
Chloroethane	0.02	0.03
3-Methyl-1-Butene	0.02	0.02
2-Methylbutane	0.01	0.05
Freon 11 (Trichlorofluoromethane)	0.02	0.02
1-Pentene	0.02	0.04
2-Methyl-1-Butene	0.02	0.01
Pentane	0.05	0.09
Isoprene (2-Methyl-1,3-Butadiene)	0.02	0.02
t-2-Pentene	0.02	0.02
Ethylbromide	0.02	0.02
1,1-Dichloroethene	0.01	0.00
c-2-Pentene	0.00	0.02
Dichloromethane	0.02	0.01
2-Methyl-2-Butene	0.00	0.02
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.02	0.01
2,2-Dimethylbutane	0.02	0.02
Cyclopentene	0.02	0.03
t-1,2-Dichloroethene	0.02	0.01
4-Methyl-1-Pentene	0.01	0.01
3-Methyl-1-Pentene	0.01	0.02
1,1-Dichloroethane	0.02	0.01
Cyclopentane	0.00	0.02
2,3-Dimethylbutane	0.00	0.00
t-4-Methyl-2-Pentene	0.01	0.02
Methyl-t-Butyl Ether (MTBE)	0.04	0.06
2-Methylpentane	0.03	0.05
c-4-Methyl-2-Pentene	0.02	0.02
3-Methylpentane	0.02	0.04
1-Hexene/2-Methyl-1-Pentene	0.03	0.03
c-1,2-Dichloroethene	0.02	0.02
Hexane	0.02	0.03
Chloroform	0.02	0.02
t-2-Hexene	0.02	0.01
2-Ethyl-1-Butene	0.01	0.00
t-3-Methyl-2-Pentene	0.02	0.01
c-2-Hexene	0.02	0.01
c-3-Methyl-2-Pentene	0.01	0.02
2,2-Dimethylpentane	0.02	0.03
1,2-Dichloroethane	0.02	0.01
Methylcyclopentane	0.00	0.02
2,4-Dimethylpentane	0.00	0.01
1,1,1-Trichloroethane	0.03	0.02
2,2,3-Trimethylbutane	0.00	0.01
1-Methylcyclopentene	0.03	0.02
Benzene	0.02	0.00
Carbontretrachloride	0.02	0.01
Cyclohexane	0.00	0.02
2-Methylhexane	0.00	0.01
2,3-Dimethylpentane	0.01	0.02
Cyclohexene	0.02	0.02
3-Methylhexane	0.02	0.02
Dibromomethane	0.02	0.04
1,2-Dichloropropane	0.01	0.11
Bromodichloromethane	0.02	0.02
1-Heptene	0.01	0.00
Trichloroethene	0.01	0.02

2,2,4-Trimethylpentane	0.02	0.02
t-3-Heptene	0.02	0.01
Heptane	0.02	0.02
c-3-Heptene	0.01	0.02
t-2-Heptene	0.00	0.00
c-2-Heptene	0.02	0.00
c-1,3-Dichloropropene	0.02	0.02
2,2-Dimethylhexane	0.00	0.02
Methylcyclohexane	0.00	0.01
2,5-Dimethylhexane	0.01	0.01
2,4-Dimethylhexane	0.02	0.02
t-1,3-Dichloropropene	0.02	0.00
1,1,2-Trichloroethane	0.02	0.02
Bromotrichloromethane	0.05	0.01
2,3,4-Trimethylpentane	0.02	0.00
Toluene	0.03	0.01
2-Methylheptane	0.01	0.01
4-Methylheptane	0.00	0.01
1-Methylcyclohexene	0.02	0.01
3-Methylheptane	0.02	0.02
Dibromochloromethane	0.03	0.03
c-1,3-Dimethylcyclohexane	0.02	0.01
t-1,4-Dimethylcyclohexane	0.01	0.02
2,2,5-Trimethylhexane	0.00	0.01
1,2-Dibromoethane (EDB)	0.03	0.02
1-Octene	0.01	0.02
Octane	0.01	0.01
t-2-Octene	0.03	0.01
t-1,2-Dimethylcyclohexane	0.00	0.01
Tetrachloroethene	0.01	0.02
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.02
c-1,2-Dimethylcyclohexane	0.00	0.02
Chlorobenzene	0.02	0.02
Ethylbenzene	0.02	0.01
m,p-Xylene	0.04	0.02
Bromoform	0.05	0.04
1,4-Dichlorobutane	0.03	0.01
Styrene	0.04	0.01
1,1,2,2-Tetrachloroethane	0.03	0.02
1-Nonene	0.02	0.01
o-Xylene	0.03	0.01
Nonane	0.01	0.01
iso-Propylbenzene	0.03	0.01
a-Pinene	0.04	0.03
3,6-Dimethyloctane	0.01	0.02
n-Propylbenzene	0.02	0.01
3-Ethyltoluene	0.03	0.02
Camphene	0.03	0.04
4-Ethyltoluene	0.02	0.02
1,3,5-Trimethylbenzene	0.03	0.01
2-Ethyltoluene	0.02	0.01
b-Pinene	0.04	0.03
1-Decene	0.02	0.00
tert-Butylbenzene	0.02	0.01
1,2,4-Trimethylbenzene	0.06	0.03
Decane	0.02	0.02
Benzyl Chloride	0.05	0.02
1,3-Dichlorobenzene	0.08	0.03
1,4-Dichlorobenzene	0.04	0.01
iso-Butylbenzene	0.02	0.02
sec-Butylbenzene	0.03	0.01
1,2,3-Trimethylbenzene	0.04	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.03	0.02
1,2-Dichlorobenzene	0.06	0.03
Limonene	0.07	0.05
Indan (2,3-Dihydroindene)	0.04	0.02
1,3-Diethylbenzene	0.02	0.01
1,4-Diethylbenzene	0.06	0.02
n-Butylbenzene	0.02	0.02
1,2-Diethylbenzene	0.03	0.01
1-Undecene	0.02	0.02
Undecane	0.02	0.01
1,2,4-Trichlorobenzene	0.18	0.04
Naphthalene	0.16	0.00
Dodecane	0.02	0.00
Hexachlorobutadiene	0.04	0.04
Hexylbenzene	0.07	0.02

Method Detection Limit
Concentration ($\mu g/m^3$)

FID Analysis Location	**Lab177N**
Date of MDL analysis	**5-May-14**
Compound Name	
Ethylene	0.02
Acetylene	0.01
Ethane	0.01
Propane	0.02

Duplicate-VOC Analysis

Concentration ($\mu g/m^3$)

Non-Polar Analysis Date	**29-Jul-14**	**29-Jul-14**		**7-Aug-14**	**7-Aug-14**	
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**		**Lab176ML**	**Lab176ML**	
Filename	**RR13.D**	**RRDUP.D**		**RR16.D**	**RRDUP.D**	
Sample location	**EC STATI(**	**EC STATION 1, DND HMSC Star**		**EC STATI(**	**EC STATION 1, DND HMSC Star**	
Sampling Date	**23-Jul-14**	**23-Jul-14**		**3-Aug-14**	**3-Aug-14**	
Canister ID	**EPS 040**	**EPS 040**		**EPS 391**	**EPS 391**	
Sample Volume (mL)	**500**	**500**		**500**	**500**	
			% difference			**% difference**
Freon 134A	0.55	0.60	-9.03%	0.85	0.92	-7.89%
Propene	0.44	0.48	-6.96%	1.19	1.41	-17.40%
Propane	FID DATA	FID DATA	#VALUE!	FID DATA	FID DATA	#VALUE!
Freon 22 (Chlorodifluoromethane)	1.49	1.58	-5.99%	1.01	1.08	-6.33%
Freon 12 (Dichlorodifluoromethane)	2.92	3.07	-5.14%	3.10	3.28	-5.77%
Propyne	0.03	0.04	-11.76%	0.06	0.07	-12.90%
Chloromethane	1.50	1.56	-3.80%	1.58	1.71	-8.27%
Isobutane (2-Methylpropane)	0.34	0.38	-10.06%	0.74	0.82	-9.48%
Freon 114 (1,2-Dichlorotetrafluoroethane	0.14	0.15	-2.78%	0.16	0.15	6.62%
Vinylchloride (Chloroethene)	0.00	0.00	0.00%	0.01	0.00	40.00%
1-Butene/2-Methylpropene	2.13	2.01	5.60%	7.73	7.97	-3.03%
1,3-Butadiene	0.04	0.04	0.00%	0.08	0.08	2.60%
Butane	0.79	0.83	-5.93%	1.28	1.31	-2.32%
t-2-Butene	0.03	0.04	-5.71%	0.05	0.05	3.77%
2,2-Dimethylpropane	0.01	0.01	-18.18%	0.02	0.01	13.33%
Bromomethane	0.07	0.07	-2.99%	0.10	0.10	2.06%
1-Butyne	0.00	0.00	0.00%	0.00	0.00	0.00%
c-2-Butene	0.03	0.03	0.00%	0.04	0.04	0.00%
Chloroethane	0.37	0.35	5.04%	1.07	1.10	-2.57%
3-Methyl-1-Butene	0.03	0.03	0.00%	0.03	0.04	-5.71%
2-Methylbutane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Freon 11 (Trichlorofluoromethane)	1.50	1.54	-2.64%	1.59	1.62	-1.99%
1-Pentene	0.13	0.12	1.60%	0.16	0.16	-2.50%
2-Methyl-1-Butene	0.50	0.48	4.90%	2.26	2.35	-3.99%
Pentane	0.63	0.66	-4.62%	1.23	1.21	1.15%
Isoprene (2-Methyl-1,3-Butadiene)	2.01	1.98	1.20%	1.17	1.22	-4.34%
t-2-Pentene	0.07	0.07	-5.88%	0.10	0.11	-5.83%
Ethylbromide	0.01	0.01	0.00%	0.02	0.02	11.76%
1,1-Dichloroethene	0.00	0.00	200.00%	0.00	0.00	66.67%
c-2-Pentene	0.03	0.03	0.00%	0.05	0.05	-3.77%
Dichloromethane	2.76	2.64	4.59%	10.38	10.62	-2.32%
2-Methyl-2-Butene	1.40	1.33	4.69%	6.60	6.83	-3.39%
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.68	0.69	-1.76%	0.73	0.75	-2.98%
2,2-Dimethylbutane	0.04	0.04	-9.52%	0.08	0.08	-2.53%
Cyclopentene	0.01	0.01	0.00%	0.02	0.02	0.00%
t-1,2-Dichloroethene	0.04	0.03	5.71%	0.05	0.05	0.00%
4-Methyl-1-Pentene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
3-Methyl-1-Pentene	0.01	0.01	0.00%	0.00	0.01	-200.00%
1,1-Dichloroethane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Cyclopentane	0.10	0.11	-5.83%	0.17	0.18	-3.39%
2,3-Dimethylbutane	0.08	0.08	-10.00%	0.00	0.17	-200.00%
t-4-Methyl-2-Pentene	0.00	0.00	0.00%	0.00	0.00	#DIV/0!
Methyl-t-Butyl Ether (MTBE)	NR	NR	#VALUE!	NR	NR	#VALUE!
2-Methylpentane	0.32	0.35	-6.57%	0.68	0.71	-4.30%
c-4-Methyl-2-Pentene	0.01	0.01	0.00%	0.02	0.02	0.00%
3-Methylpentane	0.22	0.25	-11.06%	0.43	0.44	-2.29%
1-Hexene/2-Methyl-1-Pentene	0.11	0.10	3.77%	0.12	0.13	-1.60%
c-1,2-Dichloroethene	0.00	0.00	66.67%	0.01	0.00	40.00%
Hexane	0.28	0.31	-11.53%	0.56	0.59	-3.83%
Chloroform	0.14	0.14	-2.82%	0.24	0.24	-1.67%
t-2-Hexene	0.02	0.02	0.00%	0.00	0.03	-200.00%
2-Ethyl-1-Butene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-3-Methyl-2-Pentene	0.01	0.01	18.18%	0.00	0.00	#DIV/0!
c-2-Hexene	0.01	0.00	200.00%	0.00	0.11	-200.00%
c-3-Methyl-2-Pentene	0.05	0.00	200.00%	0.00	0.00	#DIV/0!
2,2-Dimethylpentane	0.01	0.01	0.00%	0.02	0.02	0.00%
1,2-Dichloroethane	0.06	0.06	-3.51%	0.07	0.06	3.08%
Methylcyclopentane	0.16	0.17	-8.48%	0.00	0.94	-200.00%
2,4-Dimethylpentane	0.08	0.09	-16.09%	0.16	0.18	-13.95%
1,1,1-Trichloroethane	0.03	0.03	0.00%	0.03	0.03	0.00%
2,2,3-Trimethylbutane	0.02	0.02	0.00%	0.02	0.00	200.00%
1-Methylcyclopentene	0.02	0.02	0.00%	0.01	0.01	0.00%
Benzene	1.04	1.04	-0.77%	2.20	2.24	-2.07%
Carbontretrachloride	0.51	0.52	-1.17%	0.47	0.46	0.86%
Cyclohexane	0.07	0.08	-8.22%	0.11	0.12	-8.40%
2-Methylhexane	0.16	0.18	-9.30%	0.27	0.26	3.01%
2,3-Dimethylpentane	0.09	0.09	-2.15%	0.14	0.14	1.46%

Cyclohexene	0.01	0.02	-13.33%	0.01	0.01	0.00%
3-Methylhexane	0.19	0.22	-11.65%	0.30	0.29	3.34%
Dibromomethane	0.03	0.03	-6.90%	0.03	0.03	14.29%
1,2-Dichloropropane	0.01	0.01	0.00%	0.01	0.01	18.18%
Bromodichloromethane	0.01	0.01	0.00%	0.02	0.01	40.00%
1-Heptene	0.11	0.12	-1.74%	0.00	0.00	#DIV/0!
Trichloroethene	0.28	0.28	0.00%	0.29	0.27	5.71%
2,2,4-Trimethylpentane	0.20	0.22	-9.62%	0.39	0.39	-2.05%
t-3-Heptene	0.03	0.03	0.00%	0.11	0.10	13.08%
Heptane	0.18	0.20	-7.33%	0.40	0.40	2.00%
c-3-Heptene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-2-Heptene	0.04	0.04	0.00%	0.15	0.14	4.08%
c-2-Heptene	0.37	0.00	200.00%	0.51	0.00	200.00%
c-1,3-Dichloropropene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
2,2-Dimethylhexane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Methylcyclohexane	0.08	0.10	-22.73%	0.13	0.13	0.00%
2,5-Dimethylhexane	0.03	0.03	-13.33%	0.06	0.06	-6.67%
2,4-Dimethylhexane	0.04	0.04	-10.53%	0.00	0.06	-200.00%
t-1,3-Dichloropropene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1,1,2-Trichloroethane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Bromotrichloromethane	0.00	0.00	#DIV/0!	NR	NR	#VALUE!
2,3,4-Trimethylpentane	0.06	0.07	-14.93%	0.14	0.13	1.48%
Toluene	4.64	4.71	-1.46%	7.44	7.02	5.84%
2-Methylheptane	0.05	0.07	-41.38%	0.00	0.05	-200.00%
4-Methylheptane	0.02	0.03	-24.00%	0.03	0.03	0.00%
1-Methylcyclohexene	0.00	0.00	0.00%	0.01	0.00	40.00%
3-Methylheptane	0.05	0.07	-22.95%	0.07	0.07	2.74%
Dibromochloromethane	0.01	0.01	0.00%	0.01	0.01	18.18%
c-1,3-Dimethylcyclohexane	0.04	0.07	-61.54%	0.05	0.05	0.00%
t-1,4-Dimethylcyclohexane	0.01	0.02	-50.00%	0.02	0.02	0.00%
2,2,5-Trimethylhexane	0.01	0.02	-13.33%	0.03	0.03	0.00%
1,2-Dibromoethane (EDB)	0.00	0.00	200.00%	0.00	0.00	200.00%
1-Octene	0.23	0.22	1.79%	0.37	0.36	2.74%
Octane	0.13	0.15	-14.49%	0.18	0.18	4.44%
t-2-Octene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-1,2-Dimethylcyclohexane	0.02	0.04	-66.67%	0.03	0.03	13.33%
Tetrachloroethene	0.06	0.08	-20.29%	0.12	0.11	7.14%
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.03	-60.00%	0.02	0.02	0.00%
c-1,2-Dimethylcyclohexane	0.01	0.01	-33.33%	0.01	0.01	0.00%
Chlorobenzene	0.01	0.01	0.00%	0.01	0.01	15.38%
Ethylbenzene	1.15	1.21	-5.76%	3.86	3.81	1.46%
m,p-Xylene	1.32	1.44	-8.97%	3.82	3.79	0.84%
Bromoform	0.01	0.01	-15.38%	0.02	0.01	25.00%
1,4-Dichlorobutane	0.28	0.00	200.00%	0.00	0.00	#DIV/0!
Styrene	247.30	269.28	-8.51%	458.63	449.96	1.91%
1,1,2,2-Tetrachloroethane	0.01	0.00	40.00%	0.00	0.00	#DIV/0!
1-Nonene	0.12	0.14	-14.17%	0.11	0.11	-1.87%
o-Xylene	1.36	1.43	-5.17%	4.46	4.36	2.22%
Nonane	0.16	0.19	-13.79%	0.30	0.30	0.00%
iso-Propylbenzene	1.65	1.79	-7.67%	3.29	3.42	-3.81%
a-Pinene	0.17	0.20	-16.39%	0.27	0.29	-6.45%
3,6-Dimethyloctane	0.02	0.02	-8.70%	0.05	0.05	-3.92%
n-Propylbenzene	5.14	5.52	-7.13%	16.87	17.16	-1.75%
3-Ethyltoluene	11.55	12.48	-7.77%	36.09	36.80	-1.95%
Camphene	0.14	0.15	-11.11%	0.32	0.33	-2.48%
4-Ethyltoluene	7.60	8.20	-7.64%	24.38	24.91	-2.15%
1,3,5-Trimethylbenzene	2.75	2.98	-8.23%	9.44	9.73	-3.05%
2-Ethyltoluene	2.94	3.17	-7.72%	10.02	10.33	-2.99%
b-Pinene	0.10	0.11	-13.33%	0.19	0.19	-3.17%
1-Decene	0.12	0.11	10.17%	0.00	0.00	#DIV/0!
tert-Butylbenzene	0.00	0.00	#DIV/0!	0.02	0.02	11.76%
1,2,4-Trimethylbenzene	12.32	13.49	-9.06%	38.69	39.77	-2.75%
Decane	0.28	0.32	-14.77%	0.59	0.62	-4.62%
Benzyl Chloride	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1,3-Dichlorobenzene	0.00	0.00	66.67%	0.01	0.00	40.00%
1,4-Dichlorobenzene	0.54	0.58	-7.89%	1.39	1.42	-2.00%
iso-Butylbenzene	0.12	0.13	-9.52%	0.40	0.41	-3.94%
sec-Butylbenzene	0.14	0.15	-11.11%	0.46	0.48	-5.11%
1,2,3-Trimethylbenzene	1.24	1.37	-10.09%	4.50	4.71	-4.47%
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.17	0.19	-11.24%	0.34	0.35	-4.03%
1,2-Dichlorobenzene	0.00	0.00	0.00%	0.01	0.01	28.57%
Limonene	0.44	0.49	-11.26%	0.30	0.33	-8.20%
Indan (2,3-Dihydroindene)	0.63	0.69	-9.98%	2.22	2.30	-3.36%
1,3-Diethylbenzene	0.20	0.22	-9.52%	0.70	0.74	-5.86%
1,4-Diethylbenzene	0.64	0.70	-9.21%	2.06	2.15	-4.27%
n-Butylbenzene	0.18	0.20	-8.33%	0.59	0.61	-3.31%
1,2-Diethylbenzene	0.02	0.03	-15.38%	0.06	0.06	0.00%
1-Undecene	0.25	0.25	0.00%	0.16	0.12	28.99%
Undecane	0.28	0.33	-16.18%	0.59	0.64	-7.46%
1,2,4-Trichlorobenzene	0.01	0.01	0.00%	0.02	0.01	85.71%
Naphthalene	0.32	0.49	-40.79%	0.73	0.80	-9.65%
Dodecane	0.38	0.45	-18.27%	0.53	0.58	-10.45%
Hexachlorobutadiene	0.00	0.00	0.00%	0.01	0.00	66.67%
Hexylbenzene	0.03	0.03	-7.41%	0.04	0.04	-15.38%

Randle Reef Study 2014 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

FID Analysis Date	**14OCT02-16.D**
FID Analysis Location	**Lab177N**
Non-Polar Analysis Date	**1-Oct-14**
Non-Polar Analysis Location	**Lab176ML**
Filename	**RR26.D**
Sample location	**EC STATION 3, USS Dockwall**
Sampling Date	**20-Sep-14**
Canister ID	**EPS 070**
Sample Volume (mL)	**500**
Comments	
Ethylene	**5.94**
Acetylene	**0.35**
Ethane	**32.93**
Freon 134A	0.56
Propene	0.79
Propane	**4.56**
Freon 22 (Chlorodifluoromethane)	1.02
Freon 12 (Dichlorodifluoromethane)	2.85
Propyne	0.04
Chloromethane	1.49
Isobutane (2-Methylpropane)	3.35
Freon 114 (1,2-Dichlorotetrafluoroethane	0.14
Vinylchloride (Chloroethene)	0.00
1-Butene/2-Methylpropene	4.25
1,3-Butadiene	0.05
Butane	4.88
t-2-Butene	0.32
2,2-Dimethylpropane	0.04
Bromomethane	0.08
1-Butyne	0.00
c-2-Butene	0.22
Chloroethane	0.56
3-Methyl-1-Butene	0.07
2-Methylbutane	0.00
Freon 11 (Trichlorofluoromethane)	1.42
1-Pentene	0.24
2-Methyl-1-Butene	0.86
Pentane	2.76
Isoprene (2-Methyl-1,3-Butadiene)	0.21
t-2-Pentene	0.32
Ethylbromide	0.01
1,1-Dichloroethene	0.00
c-2-Pentene	0.14
Dichloromethane	3.87
2-Methyl-2-Butene	1.35
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.66
2,2-Dimethylbutane	0.18
Cyclopentene	0.05
t-1,2-Dichloroethene	0.06
4-Methyl-1-Pentene	0.00
3-Methyl-1-Pentene	0.01
1,1-Dichloroethane	0.00
Cyclopentane	0.28
2,3-Dimethylbutane	0.39
t-4-Methyl-2-Pentene	0.00
Methyl-t-Butyl Ether (MTBE)	0.00
2-Methylpentane	2.91
c-4-Methyl-2-Pentene	0.02
3-Methylpentane	3.55
1-Hexene/2-Methyl-1-Pentene	0.19
c-1,2-Dichloroethene	0.00
Hexane	8.09
Chloroform	0.17
t-2-Hexene	0.04
2-Ethyl-1-Butene	0.00
t-3-Methyl-2-Pentene	0.03
c-2-Hexene	0.02
c-3-Methyl-2-Pentene	0.00
2,2-Dimethylpentane	0.10
1,2-Dichloroethane	0.05
Methylcyclopentane	2.66
2,4-Dimethylpentane	0.22
1,1,1-Trichloroethane	0.02
2,2,3-Trimethylbutane	0.04
1-Methylcyclopentene	0.04
Benzene	1.27
Carbontetrachloride	0.44
Cyclohexane	0.22

2-Methylhexane		0.30
2,3-Dimethylpentane		0.14
Cyclohexene		0.02
3-Methylhexane		0.33
Dibromomethane		0.02
1,2-Dichloropropane		0.01
Bromodichloromethane		0.03
1-Heptene		0.16
Trichloroethene		0.05
2,2,4-Trimethylpentane		0.28
t-3-Heptene		0.05
Heptane		0.38
c-3-Heptene		0.00
t-2-Heptene		0.06
c-2-Heptene		0.00
c-1,3-Dichloropropene		0.00
2,2-Dimethylhexane		0.00
Methylcyclohexane		0.18
2,5-Dimethylhexane		0.04
2,4-Dimethylhexane		0.00
t-1,3-Dichloropropene		0.00
1,1,2-Trichloroethane		0.00
Bromotrichloromethane	NR	
2,3,4-Trimethylpentane		0.09
Toluene		2.37
2-Methylheptane		0.08
4-Methylheptane		0.03
1-Methylcyclohexene		0.01
3-Methylheptane		0.07
Dibromochloromethane		0.02
c-1,3-Dimethylcyclohexane		0.06
t-1,4-Dimethylcyclohexane		0.02
2,2,5-Trimethylhexane		0.02
1,2-Dibromoethane (EDB)		0.00
1-Octene		0.17
Octane		0.13
t-2-Octene		0.00
t-1,2-Dimethylcyclohexane		0.03
Tetrachloroethene		0.08
c-1,4/t-1,3-Dimethylcyclohexane		0.02
c-1,2-Dimethylcyclohexane		0.01
Chlorobenzene		0.02
Ethylbenzene		1.03
m,p-Xylene		1.37
Bromoform		0.01
1,4-Dichlorobutane		0.00
Styrene		148.49
1,1,2,2-Tetrachloroethane		0.00
1-Nonene		0.12
o-Xylene		1.35
Nonane		0.17
iso-Propylbenzene		1.04
a-Pinene		0.11
3,6-Dimethyloctane		0.00
n-Propylbenzene		4.66
3-Ethyltoluene		10.96
Camphene		0.11
4-Ethyltoluene		6.95
1,3,5-Trimethylbenzene		3.17
2-Ethyltoluene		3.20
b-Pinene		0.06
1-Decene		0.12
tert-Butylbenzene		0.01
1,2,4-Trimethylbenzene		12.65
Decane		0.28
Benzyl Chloride		0.00
1,3-Dichlorobenzene		0.01
1,4-Dichlorobenzene		1.02
iso-Butylbenzene		0.12
sec-Butylbenzene		0.13
1,2,3-Trimethylbenzene		1.91
p-Cymene (1-Methyl-4-Isopropylbenzene)		0.09
1,2-Dichlorobenzene		0.01
Limonene		0.07
Indan (2,3-Dihydroindene)		0.62
1,3-Diethylbenzene		0.22
1,4-Diethylbenzene		0.68
n-Butylbenzene		0.19
1,2-Diethylbenzene		0.02
1-Undecene		0.17
Undecane		0.23
1,2,4-Trichlorobenzene		0.01
Naphthalene		0.93
Dodecane	NR	
Hexachlorobutadiene		0.01
Hexylbenzene		0.04

Randle Reef Study 2014 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

Non-Polar Analysis Date	**1-Oct-14**
Non-Polar Analysis Location	**Lab176ML**
Filename	**BLK02.D**
Sample Volume (mL)	**500**
Freon 134A	0.00
Propene	0.00
Propane	NR
Freon 22 (Chlorodifluoromethane)	0.00
Freon 12 (Dichlorodifluoromethane)	0.00
Propyne	0.00
Chloromethane	0.00
Isobutane (2-Methylpropane)	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00
Vinylchloride (Chloroethene)	0.00
1-Butene/2-Methylpropene	0.00
1,3-Butadiene	0.00
Butane	0.00
t-2-Butene	0.00
2,2-Dimethylpropane	0.00
Bromomethane	0.00
1-Butyne	0.00
c-2-Butene	0.00
Chloroethane	0.00
3-Methyl-1-Butene	0.00
2-Methylbutane	0.00
Freon 11 (Trichlorofluoromethane)	0.00
1-Pentene	0.00
2-Methyl-1-Butene	0.00
Pentane	0.00
Isoprene (2-Methyl-1,3-Butadiene)	0.00
t-2-Pentene	0.00
Ethylbromide	0.00
1,1-Dichloroethene	0.00
c-2-Pentene	0.00
Dichloromethane	0.01
2-Methyl-2-Butene	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00
2,2-Dimethylbutane	0.00
Cyclopentene	0.00
t-1,2-Dichloroethene	0.00
4-Methyl-1-Pentene	0.00
3-Methyl-1-Pentene	0.00
1,1-Dichloroethane	0.00
Cyclopentane	0.00
2,3-Dimethylbutane	0.00
t-4-Methyl-2-Pentene	0.00
Methyl-t-Butyl Ether (MTBE)	0.00
2-Methylpentane	0.00
c-4-Methyl-2-Pentene	0.00
3-Methylpentane	0.00
1-Hexene/2-Methyl-1-Pentene	0.00
c-1,2-Dichloroethene	0.00
Hexane	0.00
Chloroform	0.00
t-2-Hexene	0.00
2-Ethyl-1-Butene	0.00
t-3-Methyl-2-Pentene	0.00
c-2-Hexene	0.00
c-3-Methyl-2-Pentene	0.00
2,2-Dimethylpentane	0.00
1,2-Dichloroethane	0.00
Methylcyclopentane	0.00
2,4-Dimethylpentane	0.00
1,1,1-Trichloroethane	0.00
2,2,3-Trimethylbutane	0.00
1-Methylcyclopentene	0.00
Benzene	0.00
Carbontretrachloride	0.00
Cyclohexane	0.00
2-Methylhexane	0.00
2,3-Dimethylpentane	0.00
Cyclohexene	0.00
3-Methylhexane	0.00
Dibromomethane	0.01
1,2-Dichloropropane	0.00
Bromodichloromethane	0.00
1-Heptene	0.00

Trichloroethene		0.00
2,2,4-Trimethylpentane		0.00
t-3-Heptene		0.00
Heptane		0.00
c-3-Heptene		0.00
t-2-Heptene		0.00
c-2-Heptene		0.00
c-1,3-Dichloropropene		0.00
2,2-Dimethylhexane		0.00
Methylcyclohexane		0.00
2,5-Dimethylhexane		0.00
2,4-Dimethylhexane		0.00
t-1,3-Dichloropropene		0.00
1,1,2-Trichloroethane		0.00
Bromotrichloromethane	NR	
2,3,4-Trimethylpentane		0.00
Toluene		0.00
2-Methylheptane		0.00
4-Methylheptane		0.00
1-Methylcyclohexene		0.00
3-Methylheptane		0.00
Dibromochloromethane		0.00
c-1,3-Dimethylcyclohexane		0.00
t-1,4-Dimethylcyclohexane		0.00
2,2,5-Trimethylhexane		0.00
1,2-Dibromoethane (EDB)		0.00
1-Octene		0.00
Octane		0.00
t-2-Octene		0.00
t-1,2-Dimethylcyclohexane		0.00
Tetrachloroethene		0.00
c-1,4/t-1,3-Dimethylcyclohexane		0.00
c-1,2-Dimethylcyclohexane		0.00
Chlorobenzene		0.00
Ethylbenzene		0.00
m,p-Xylene		0.00
Bromoform		0.00
1,4-Dichlorobutane		0.00
Styrene		0.00
1,1,2,2-Tetrachloroethane		0.00
1-Nonene		0.00
o-Xylene		0.00
Nonane		0.00
iso-Propylbenzene		0.00
a-Pinene		0.00
3,6-Dimethyloctane		0.00
n-Propylbenzene		0.00
3-Ethyltoluene		0.00
Camphene		0.00
4-Ethyltoluene		0.00
1,3,5-Trimethylbenzene		0.00
2-Ethyltoluene		0.00
b-Pinene		0.00
1-Decene		0.00
tert-Butylbenzene		0.00
1,2,4-Trimethylbenzene		0.00
Decane		0.00
Benzyl Chloride		0.00
1,3-Dichlorobenzene		0.00
1,4-Dichlorobenzene		0.00
iso-Butylbenzene		0.00
sec-Butylbenzene		0.00
1,2,3-Trimethylbenzene		0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)		0.00
1,2-Dichlorobenzene		0.00
Limonene		0.00
Indan (2,3-Dihydroindene)		0.00
1,3-Diethylbenzene		0.00
1,4-Diethylbenzene		0.00
n-Butylbenzene		0.00
1,2-Diethylbenzene		0.00
1-Undecene		0.00
Undecane		0.00
1,2,4-Trichlorobenzene		0.00
Naphthalene		0.00
Dodecane	NR	
Hexachlorobutadiene		0.00
Hexylbenzene		0.00

Method Detection Limit
Concentration ($\mu g/m^3$)

Non-Polar Analysis Location	**Lab176ML**
Date of MDL analysis	**28-Jan-14**
Compound Name	
Freon 134A	0.03
Propene	0.02
Propane	0.16
Freon 22 (Chlorodifluoromethane)	0.03
Freon 12 (Dichlorodifluoromethane)	0.03
Propyne	0.01
Chloromethane	0.02
Isobutane (2-Methylpropane)	0.01
Freon 114 (1,2-Dichlorotetrafluoroethan	0.04
Vinylchloride (Chloroethene)	0.01
1-Butene/2-Methylpropene	0.01
1,3-Butadiene	0.00
Butane	0.02
t-2-Butene	0.00
2,2-Dimethylpropane	0.02
Bromomethane	0.03
1-Butyne	0.00
c-2-Butene	0.02
Chloroethane	0.03
3-Methyl-1-Butene	0.02
2-Methylbutane	0.05
Freon 11 (Trichlorofluoromethane)	0.02
1-Pentene	0.04
2-Methyl-1-Butene	0.01
Pentane	0.09
Isoprene (2-Methyl-1,3-Butadiene)	0.02
t-2-Pentene	0.02
Ethylbromide	0.02
1,1-Dichloroethene	0.00
c-2-Pentene	0.02
Dichloromethane	0.01
2-Methyl-2-Butene	0.02
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.01
2,2-Dimethylbutane	0.02
Cyclopentene	0.03
t-1,2-Dichloroethene	0.01
4-Methyl-1-Pentene	0.01
3-Methyl-1-Pentene	0.02
1,1-Dichloroethane	0.01
Cyclopentane	0.02
2,3-Dimethylbutane	0.00
t-4-Methyl-2-Pentene	0.02
Methyl-t-Butyl Ether (MTBE)	0.06
2-Methylpentane	0.05
c-4-Methyl-2-Pentene	0.02
3-Methylpentane	0.04
1-Hexene/2-Methyl-1-Pentene	0.03
c-1,2-Dichloroethene	0.02
Hexane	0.03
Chloroform	0.02
t-2-Hexene	0.01
2-Ethyl-1-Butene	0.00
t-3-Methyl-2-Pentene	0.01
c-2-Hexene	0.01
c-3-Methyl-2-Pentene	0.02
2,2-Dimethylpentane	0.03
1,2-Dichloroethane	0.01
Methylcyclopentane	0.02
2,4-Dimethylpentane	0.01
1,1,1-Trichloroethane	0.02
2,2,3-Trimethylbutane	0.01
1-Methylcyclopentene	0.02
Benzene	0.00
Carbontretrachloride	0.01
Cyclohexane	0.02
2-Methylhexane	0.01
2,3-Dimethylpentane	0.02
Cyclohexene	0.02
3-Methylhexane	0.02
Dibromomethane	0.04
1,2-Dichloropropane	0.11
Bromodichloromethane	0.02
1-Heptene	0.00
Trichloroethene	0.02

2,2,4-Trimethylpentane	0.02
t-3-Heptene	0.01
Heptane	0.02
c-3-Heptene	0.02
t-2-Heptene	0.00
c-2-Heptene	0.00
c-1,3-Dichloropropene	0.02
2,2-Dimethylhexane	0.02
Methylcyclohexane	0.01
2,5-Dimethylhexane	0.01
2,4-Dimethylhexane	0.02
t-1,3-Dichloropropene	0.00
1,1,2-Trichloroethane	0.02
Bromotrichloromethane	0.01
2,3,4-Trimethylpentane	0.00
Toluene	0.01
2-Methylheptane	0.01
4-Methylheptane	0.01
1-Methylcyclohexene	0.01
3-Methylheptane	0.02
Dibromochloromethane	0.03
c-1,3-Dimethylcyclohexane	0.01
t-1,4-Dimethylcyclohexane	0.02
2,2,5-Trimethylhexane	0.01
1,2-Dibromoethane (EDB)	0.02
1-Octene	0.02
Octane	0.01
t-2-Octene	0.01
t-1,2-Dimethylcyclohexane	0.01
Tetrachloroethene	0.02
c-1,4/t-1,3-Dimethylcyclohexane	0.02
c-1,2-Dimethylcyclohexane	0.02
Chlorobenzene	0.02
Ethylbenzene	0.01
m,p-Xylene	0.02
Bromoform	0.04
1,4-Dichlorobutane	0.01
Styrene	0.01
1,1,2,2-Tetrachloroethane	0.02
1-Nonene	0.01
o-Xylene	0.01
Nonane	0.01
iso-Propylbenzene	0.01
a-Pinene	0.03
3,6-Dimethyloctane	0.02
n-Propylbenzene	0.01
3-Ethyltoluene	0.02
Camphene	0.04
4-Ethyltoluene	0.02
1,3,5-Trimethylbenzene	0.01
2-Ethyltoluene	0.01
b-Pinene	0.03
1-Decene	0.00
tert-Butylbenzene	0.01
1,2,4-Trimethylbenzene	0.03
Decane	0.02
Benzyl Chloride	0.02
1,3-Dichlorobenzene	0.03
1,4-Dichlorobenzene	0.01
iso-Butylbenzene	0.02
sec-Butylbenzene	0.01
1,2,3-Trimethylbenzene	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02
1,2-Dichlorobenzene	0.03
Limonene	0.05
Indan (2,3-Dihydroindene)	0.02
1,3-Diethylbenzene	0.01
1,4-Diethylbenzene	0.02
n-Butylbenzene	0.02
1,2-Diethylbenzene	0.01
1-Undecene	0.02
Undecane	0.01
1,2,4-Trichlorobenzene	0.04
Naphthalene	0.00
Dodecane	0.00
Hexachlorobutadiene	0.04
Hexylbenzene	0.02

Method Detection Limit
Concentration ($\mu g/m^3$)

FID Analysis Location	**Lab177N**
Date of MDL analysis	**5-May-14**
Compound Name	
Ethylene	0.02
Acetylene	0.01
Ethane	0.01
Propane	0.02

Randle Reef Study 2014 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

FID Analysis Date	**14OCT27-10**	**14OCT27-11**	**14NOV03-08**	**14NOV03-09**	**14NOV03-10.D**
FID Analysis Location	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**
Non-Polar Analysis Date	**23-Oct-14**	**23-Oct-14**	**30-Oct-14**	**30-Oct-14**	**5-Nov-14**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**RR27.D**	**RR28.D**	**RR29.D**	**RR30.D**	**RR31.D**
Sample location	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION**	**EC STATION 3, USS Dockwall**
Sampling Date	**14-Oct-14**	**14-Oct-14**	**2-Oct-14**	**26-Oct-14**	**26-Oct-14**
Canister ID	**EPS 390**	**EPS 882**	**EPS 156**	**EPS 466**	**EPS 890**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**
Comments					
Ethylene	**1.52**	**1.55**	**0.93**	**0.76**	**0.53**
Acetylene	**0.63**	**0.53**	**0.40**	**0.36**	**0.24**
Ethane	**5.87**	**5.20**	**3.41**	**3.21**	**2.74**
Freon 134A	2.10	1.29	0.55	0.92	0.46
Propene	0.68	0.59	0.13	0.39	0.28
Propane	**13.81**	**3.83**	**2.00**	**1.90**	**2.49**
Freon 22 (Chlorodifluoromethane)	0.96	1.07	0.89	1.08	0.89
Freon 12 (Dichlorodifluoromethane)	3.09	2.83	2.70	2.96	3.20
Propyne	0.06	0.05	0.03	0.08	0.02
Chloromethane	1.35	1.46	1.23	1.44	1.45
Isobutane (2-Methylpropane)	13.13	2.95	0.65	1.15	4.22
Freon 114 (1,2-Dichlorotetrafluoroethane	0.12	0.13	0.14	0.41	0.15
Vinylchloride (Chloroethene)	0.02	0.00	0.00	0.05	0.00
1-Butene/2-Methylpropene	1.71	0.72	0.21	0.52	0.70
1,3-Butadiene	0.10	0.06	0.02	0.09	0.03
Butane	21.63	6.18	1.68	2.70	17.76
t-2-Butene	0.90	0.22	0.02	0.11	0.37
2,2-Dimethylpropane	0.09	0.03	0.02	0.09	0.05
Bromomethane	0.06	0.07	0.07	0.26	0.06
1-Butyne	0.00	0.00	0.00	0.06	0.00
c-2-Butene	0.61	0.17	0.02	0.10	0.24
Chloroethane	0.03	0.04	0.02	0.14	0.02
3-Methyl-1-Butene	0.14	0.05	0.01	0.05	0.06
2-Methylbutane	11.69	3.51	1.03	1.23	5.26
Freon 11 (Trichlorofluoromethane)	1.45	1.56	1.49	1.52	1.69
1-Pentene	0.31	0.16	0.03	0.22	0.13
2-Methyl-1-Butene	0.58	0.18	0.04	0.07	0.24
Pentane	6.13	2.14	5.31	0.81	3.44
Isoprene (2-Methyl-1,3-Butadiene)	0.16	0.10	0.03	0.09	0.04
t-2-Pentene	0.85	0.22	0.02	0.08	0.33
Ethylbromide	0.00	0.00	0.00	0.09	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.06	0.00
c-2-Pentene	0.36	0.10	0.01	0.06	0.15
Dichloromethane	7.22	0.70	0.57	0.47	0.32
2-Methyl-2-Butene	1.11	0.26	0.02	0.10	0.41
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.57	0.61	0.61	0.73	0.73
2,2-Dimethylbutane	0.42	0.11	0.04	0.13	0.15
Cyclopentene	0.14	0.04	0.00	0.06	0.06
t-1,2-Dichloroethene	0.06	0.06	0.02	0.09	0.01
4-Methyl-1-Pentene	0.03	0.02	0.00	0.04	0.00
3-Methyl-1-Pentene	0.03	0.01	0.00	0.04	0.01
1,1-Dichloroethane	0.00	0.00	0.00	0.08	0.00
Cyclopentane	0.63	0.22	0.06	0.07	0.29
2,3-Dimethylbutane	0.68	0.20	0.04	0.07	0.31
t-4-Methyl-2-Pentene	0.01	0.01	0.00	0.03	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	3.14	0.89	0.18	0.33	1.99
c-4-Methyl-2-Pentene	0.08	0.02	0.00	0.05	0.03
3-Methylpentane	2.23	0.68	0.13	0.27	2.24
1-Hexene/2-Methyl-1-Pentene	0.22	0.11	0.03	0.22	0.11
c-1,2-Dichloroethene	0.01	0.00	0.00	0.07	0.00
Hexane	3.09	0.95	0.17	0.30	4.72
Chloroform	0.15	0.16	0.13	0.20	0.11
t-2-Hexene	0.10	0.04	0.00	0.05	0.04
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.08	0.03	0.00	0.04	0.03
c-2-Hexene	0.05	0.02	0.00	0.05	0.02
c-3-Methyl-2-Pentene	0.20	0.05	0.00	0.06	0.11
2,2-Dimethylpentane	0.13	0.03	0.01	0.09	0.07
1,2-Dichloroethane	0.07	0.07	0.05	0.15	0.08
Methylcyclopentane	1.41	0.40	0.07	0.13	1.53
2,4-Dimethylpentane	0.35	0.10	0.02	0.06	0.12
1,1,1-Trichloroethane	0.39	0.03	0.02	0.10	0.02
2,2,3-Trimethylbutane	0.03	0.02	0.01	0.03	0.02
1-Methylcyclopentene	0.10	0.03	0.01	0.08	0.04
Benzene	1.43	4.07	7.18	0.39	0.69
Carbontretrachloride	0.36	0.39	0.43	0.49	0.48
Cyclohexane	0.45	0.13	0.05	0.07	0.23

2-Methylhexane	1.16	0.32	0.07	0.19	0.20
2,3-Dimethylpentane	0.58	0.17	0.04	0.15	0.11
Cyclohexene	0.03	0.02	0.01	0.08	0.02
3-Methylhexane	1.51	0.43	0.10	0.31	0.23
Dibromomethane	0.02	0.02	0.02	0.20	0.03
1,2-Dichloropropane	0.02	0.02	0.01	0.11	0.02
Bromodichloromethane	0.00	0.02	0.02	0.12	0.01
1-Heptene	0.00	0.00	0.00	0.13	0.00
Trichloroethene	0.11	0.04	0.02	0.12	0.01
2,2,4-Trimethylpentane	0.83	0.35	0.10	0.14	0.18
t-3-Heptene	0.00	0.00	0.00	0.04	0.01
Heptane	1.38	0.45	0.11	0.43	0.19
c-3-Heptene	0.00	0.00	0.00	0.05	0.00
t-2-Heptene	0.02	0.01	0.00	0.02	0.01
c-2-Heptene	0.00	0.00	0.00	0.05	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.03	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.05	0.00
Methylcyclohexane	0.50	0.22	0.07	0.10	0.15
2,5-Dimethylhexane	0.11	0.05	0.01	0.05	0.02
2,4-Dimethylhexane	0.13	0.06	0.01	0.05	0.00
t-1,3-Dichloropropene	0.00	0.00	0.00	0.03	0.00
1,1,2-Trichloroethane	0.00	0.01	0.00	0.11	0.01
Bromotrichloromethane	NR	NR	0.00	0.00	0.00
2,3,4-Trimethylpentane	0.24	0.11	0.02	0.06	0.04
Toluene	6.86	3.00	1.24	0.76	0.80
2-Methylheptane	0.21	0.13	0.06	0.07	0.06
4-Methylheptane	0.07	0.04	0.01	0.04	0.02
1-Methylcyclohexene	0.01	0.01	0.00	0.06	0.01
3-Methylheptane	0.18	0.11	0.02	0.06	0.04
Dibromochloromethane	0.01	0.01	0.01	0.11	0.01
c-1,3-Dimethylcyclohexane	0.16	0.14	0.03	0.05	0.04
t-1,4-Dimethylcyclohexane	0.05	0.04	0.01	0.04	0.01
2,2,5-Trimethylhexane	0.06	0.03	0.01	0.03	0.01
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.07	0.00
1-Octene	0.17	0.19	0.07	0.17	0.14
Octane	0.31	0.25	0.07	0.09	0.08
t-2-Octene	0.00	0.00	0.00	0.04	0.00
t-1,2-Dimethylcyclohexane	0.10	0.08	0.01	0.03	0.02
Tetrachloroethene	0.37	2.52	0.11	0.18	0.03
c-1,4/t-1,3-Dimethylcyclohexane	0.05	0.05	0.01	0.04	0.01
c-1,2-Dimethylcyclohexane	0.03	0.03	0.01	0.05	0.01
Chlorobenzene	0.01	0.01	0.01	0.09	0.01
Ethylbenzene	1.09	0.44	0.08	0.27	0.13
m,p-Xylene	3.86	1.56	0.29	0.88	0.40
Bromoform	0.01	0.02	0.02	0.15	0.02
1,4-Dichlorobutane	0.00	0.00	0.00	0.21	0.00
Styrene	3.94	2.87	0.30	0.29	0.10
1,1,2,2-Tetrachloroethane	0.00	0.01	0.01	0.12	0.00
1-Nonene	0.20	0.30	0.03	0.13	0.07
o-Xylene	1.41	0.65	0.11	0.32	0.14
Nonane	0.56	0.31	0.04	0.11	0.07
iso-Propylbenzene	0.06	0.03	0.01	0.06	0.01
a-Pinene	0.47	0.40	0.04	0.17	0.03
3,6-Dimethyloctane	0.05	0.03	0.00	0.03	0.01
n-Propylbenzene	0.19	0.11	0.02	0.08	0.03
3-Ethyltoluene	0.49	0.28	0.03	0.12	0.05
Camphene	0.08	0.07	0.02	0.20	0.05
4-Ethyltoluene	0.27	0.15	0.02	0.07	0.03
1,3,5-Trimethylbenzene	0.25	0.14	0.02	0.08	0.03
2-Ethyltoluene	0.20	0.10	0.01	0.07	0.02
b-Pinene	0.13	0.14	0.03	0.16	0.02
1-Decene	0.05	0.08	0.03	0.09	0.03
tert-Butylbenzene	0.00	0.00	0.00	0.05	0.00
1,2,4-Trimethylbenzene	0.90	0.52	0.06	0.23	0.08
Decane	0.94	0.33	0.04	0.13	0.05
Benzyl Chloride	0.01	0.02	0.01	0.06	0.00
1,3-Dichlorobenzene	0.00	0.00	0.00	0.09	0.00
1,4-Dichlorobenzene	0.15	0.10	0.02	0.08	0.10
iso-Butylbenzene	0.02	0.01	0.00	0.04	0.00
sec-Butylbenzene	0.03	0.01	0.00	0.05	0.00
1,2,3-Trimethylbenzene	0.21	0.11	0.02	0.07	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.07	0.04	0.02	0.06	0.02
1,2-Dichlorobenzene	0.00	0.00	0.00	0.08	0.00
Limonene	0.42	0.26	0.10	0.30	0.02
Indan (2,3-Dihydroindene)	0.12	0.08	0.01	0.08	0.01
1,3-Diethylbenzene	0.04	0.02	0.00	0.04	0.00
1,4-Diethylbenzene	0.17	0.09	0.03	0.10	0.02
n-Butylbenzene	0.06	0.03	0.01	0.05	0.01
1,2-Diethylbenzene	0.02	0.01	0.00	0.04	0.00
1-Undecene	0.06	0.17	0.00	0.09	0.03
Undecane	0.80	0.30	0.08	0.12	0.04
1,2,4-Trichlorobenzene	0.01	0.00	0.01	0.09	0.01
Naphthalene	1.04	4.86	8.04	0.16	0.08
Dodecane	0.55	0.27	0.28	0.12	0.05
Hexachlorobutadiene	0.01	0.00	0.01	0.12	0.01
Hexylbenzene	0.04	0.04	0.02	0.03	0.01

Randle Reef Study 2014 Sample Data
Concentration (µg/m^3)
NR= Data not reported

Non-Polar Analysis Date	**23-Oct-14**	**30-Oct-14**	**5-Nov-14**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**BLK02.D**	**BLK02.D**	**BLK02.D**
Sample Volume (mL)	**500**	**500**	**500**
Freon 134A	0.00	0.00	0.00
Propene	0.00	0.00	0.00
Propane	NR	NR	NR
Freon 22 (Chlorodifluoromethane)	0.00	0.00	0.00
Freon 12 (Dichlorodifluoromethane)	0.00	0.00	0.00
Propyne	0.00	0.00	0.00
Chloromethane	0.00	0.00	0.00
Isobutane (2-Methylpropane)	0.00	0.00	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00	0.00	0.00
Vinylchloride (Chloroethene)	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.01	0.01	0.01
1,3-Butadiene	0.00	0.00	0.00
Butane	0.00	0.00	0.00
t-2-Butene	0.00	0.00	0.00
2,2-Dimethylpropane	0.00	0.00	0.00
Bromomethane	0.00	0.00	0.00
1-Butyne	0.00	0.00	0.00
c-2-Butene	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00
3-Methyl-1-Butene	0.00	0.00	0.00
2-Methylbutane	0.00	0.00	0.00
Freon 11 (Trichlorofluoromethane)	0.00	0.00	0.00
1-Pentene	0.00	0.00	0.00
2-Methyl-1-Butene	0.00	0.00	0.00
Pentane	0.00	0.00	0.00
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.00	0.00
t-2-Pentene	0.00	0.00	0.00
Ethylbromide	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00
c-2-Pentene	0.00	0.00	0.00
Dichloromethane	0.01	0.01	0.01
2-Methyl-2-Butene	0.00	0.00	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00	0.00	0.00
2,2-Dimethylbutane	0.00	0.00	0.00
Cyclopentene	0.00	0.00	0.00
t-1,2-Dichloroethene	0.00	0.00	0.00
4-Methyl-1-Pentene	0.00	0.00	0.00
3-Methyl-1-Pentene	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.00
2,3-Dimethylbutane	0.00	0.00	0.00
t-4-Methyl-2-Pentene	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00
2-Methylpentane	0.00	0.00	0.00
c-4-Methyl-2-Pentene	0.00	0.00	0.00
3-Methylpentane	0.00	0.00	0.00
1-Hexene/2-Methyl-1-Pentene	0.00	0.00	0.00
c-1,2-Dichloroethene	0.00	0.00	0.00
Hexane	0.00	0.00	0.00
Chloroform	0.00	0.00	0.00
t-2-Hexene	0.00	0.00	0.00
2-Ethyl-1-Butene	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.00	0.00
c-2-Hexene	0.00	0.00	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.00
2,2-Dimethylpentane	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.00
Methylcyclopentane	0.00	0.00	0.00
2,4-Dimethylpentane	0.00	0.00	0.00
1,1,1-Trichloroethane	0.00	0.00	0.00
2,2,3-Trimethylbutane	0.00	0.00	0.00
1-Methylcyclopentene	0.00	0.00	0.00
Benzene	0.00	0.00	0.00
Carbontretrachloride	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.00
2-Methylhexane	0.00	0.00	0.00
2,3-Dimethylpentane	0.00	0.00	0.00
Cyclohexene	0.00	0.00	0.00
3-Methylhexane	0.00	0.00	0.00
Dibromomethane	0.01	0.01	0.01
1,2-Dichloropropane	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.00
1-Heptene	0.00	0.00	0.00

Trichloroethene		0.00	0.00	0.00
2,2,4-Trimethylpentane		0.00	0.00	0.00
t-3-Heptene		0.00	0.00	0.00
Heptane		0.00	0.00	0.00
c-3-Heptene		0.00	0.00	0.00
t-2-Heptene		0.00	0.00	0.00
c-2-Heptene		0.00	0.00	0.00
c-1,3-Dichloropropene		0.00	0.00	0.00
2,2-Dimethylhexane		0.00	0.00	0.00
Methylcyclohexane		0.00	0.00	0.00
2,5-Dimethylhexane		0.00	0.00	0.00
2,4-Dimethylhexane		0.00	0.00	0.00
t-1,3-Dichloropropene		0.00	0.00	0.00
1,1,2-Trichloroethane		0.00	0.00	0.00
Bromotrichloromethane	NR		0.00	0.00
2,3,4-Trimethylpentane		0.00	0.00	0.00
Toluene		0.00	0.00	0.00
2-Methylheptane		0.00	0.00	0.00
4-Methylheptane		0.00	0.00	0.00
1-Methylcyclohexene		0.00	0.00	0.00
3-Methylheptane		0.00	0.00	0.00
Dibromochloromethane		0.00	0.00	0.00
c-1,3-Dimethylcyclohexane		0.00	0.00	0.00
t-1,4-Dimethylcyclohexane		0.00	0.00	0.00
2,2,5-Trimethylhexane		0.00	0.00	0.00
1,2-Dibromoethane (EDB)		0.00	0.00	0.00
1-Octene		0.00	0.00	0.00
Octane		0.00	0.00	0.00
t-2-Octene		0.00	0.00	0.00
t-1,2-Dimethylcyclohexane		0.00	0.00	0.00
Tetrachloroethene		0.00	0.00	0.00
c-1,4/t-1,3-Dimethylcyclohexane		0.00	0.00	0.00
c-1,2-Dimethylcyclohexane		0.00	0.00	0.00
Chlorobenzene		0.00	0.00	0.00
Ethylbenzene		0.00	0.00	0.00
m,p-Xylene		0.00	0.00	0.00
Bromoform		0.00	0.00	0.00
1,4-Dichlorobutane		0.00	0.00	0.00
Styrene		0.00	0.00	0.00
1,1,2,2-Tetrachloroethane		0.00	0.00	0.00
1-Nonene		0.00	0.00	0.00
o-Xylene		0.00	0.00	0.00
Nonane		0.00	0.00	0.00
iso-Propylbenzene		0.00	0.00	0.00
a-Pinene		0.00	0.00	0.00
3,6-Dimethyloctane		0.00	0.00	0.00
n-Propylbenzene		0.00	0.00	0.00
3-Ethyltoluene		0.00	0.00	0.00
Camphene		0.00	0.00	0.00
4-Ethyltoluene		0.00	0.00	0.00
1,3,5-Trimethylbenzene		0.00	0.00	0.00
2-Ethyltoluene		0.00	0.00	0.00
b-Pinene		0.00	0.00	0.00
1-Decene		0.00	0.00	0.00
tert-Butylbenzene		0.00	0.00	0.00
1,2,4-Trimethylbenzene		0.00	0.00	0.00
Decane		0.00	0.00	0.00
Benzyl Chloride		0.00	0.00	0.00
1,3-Dichlorobenzene		0.00	0.00	0.00
1,4-Dichlorobenzene		0.00	0.00	0.00
iso-Butylbenzene		0.00	0.00	0.00
sec-Butylbenzene		0.00	0.00	0.00
1,2,3-Trimethylbenzene		0.00	0.00	0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)		0.00	0.00	0.00
1,2-Dichlorobenzene		0.00	0.00	0.00
Limonene		0.00	0.00	0.00
Indan (2,3-Dihydroindene)		0.00	0.00	0.00
1,3-Diethylbenzene		0.00	0.00	0.00
1,4-Diethylbenzene		0.00	0.00	0.00
n-Butylbenzene		0.00	0.00	0.00
1,2-Diethylbenzene		0.00	0.00	0.00
1-Undecene		0.00	0.00	0.00
Undecane		0.00	0.00	0.00
1,2,4-Trichlorobenzene		0.00	0.00	0.00
Naphthalene		0.00	0.00	0.00
Dodecane		0.00	0.00	0.00
Hexachlorobutadiene		0.00	0.00	0.00
Hexylbenzene		0.00	0.00	0.00

Method Detection Limit
Concentration ($\mu g/m^3$)

Non-Polar Analysis Location	**Lab176ML**
Date of MDL analysis	**28-Jan-14**
Compound Name	
Freon 134A	0.03
Propene	0.02
Propane	0.16
Freon 22 (Chlorodifluoromethane)	0.03
Freon 12 (Dichlorodifluoromethane)	0.03
Propyne	0.01
Chloromethane	0.02
Isobutane (2-Methylpropane)	0.01
Freon 114 (1,2-Dichlorotetrafluoroethan	0.04
Vinylchloride (Chloroethene)	0.01
1-Butene/2-Methylpropene	0.01
1,3-Butadiene	0.00
Butane	0.02
t-2-Butene	0.00
2,2-Dimethylpropane	0.02
Bromomethane	0.03
1-Butyne	0.00
c-2-Butene	0.02
Chloroethane	0.03
3-Methyl-1-Butene	0.02
2-Methylbutane	0.05
Freon 11 (Trichlorofluoromethane)	0.02
1-Pentene	0.04
2-Methyl-1-Butene	0.01
Pentane	0.09
Isoprene (2-Methyl-1,3-Butadiene)	0.02
t-2-Pentene	0.02
Ethylbromide	0.02
1,1-Dichloroethene	0.00
c-2-Pentene	0.02
Dichloromethane	0.01
2-Methyl-2-Butene	0.02
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.01
2,2-Dimethylbutane	0.02
Cyclopentene	0.03
t-1,2-Dichloroethene	0.01
4-Methyl-1-Pentene	0.01
3-Methyl-1-Pentene	0.02
1,1-Dichloroethane	0.01
Cyclopentane	0.02
2,3-Dimethylbutane	0.00
t-4-Methyl-2-Pentene	0.02
Methyl-t-Butyl Ether (MTBE)	0.06
2-Methylpentane	0.05
c-4-Methyl-2-Pentene	0.02
3-Methylpentane	0.04
1-Hexene/2-Methyl-1-Pentene	0.03
c-1,2-Dichloroethene	0.02
Hexane	0.03
Chloroform	0.02
t-2-Hexene	0.01
2-Ethyl-1-Butene	0.00
t-3-Methyl-2-Pentene	0.01
c-2-Hexene	0.01
c-3-Methyl-2-Pentene	0.02
2,2-Dimethylpentane	0.03
1,2-Dichloroethane	0.01
Methylcyclopentane	0.02
2,4-Dimethylpentane	0.01
1,1,1-Trichloroethane	0.02
2,2,3-Trimethylbutane	0.01
1-Methylcyclopentene	0.02
Benzene	0.00
Carbontretrachloride	0.01
Cyclohexane	0.02
2-Methylhexane	0.01
2,3-Dimethylpentane	0.02
Cyclohexene	0.02
3-Methylhexane	0.02
Dibromomethane	0.04
1,2-Dichloropropane	0.11
Bromodichloromethane	0.02
1-Heptene	0.00
Trichloroethene	0.02

2,2,4-Trimethylpentane	0.02
t-3-Heptene	0.01
Heptane	0.02
c-3-Heptene	0.02
t-2-Heptene	0.00
c-2-Heptene	0.00
c-1,3-Dichloropropene	0.02
2,2-Dimethylhexane	0.02
Methylcyclohexane	0.01
2,5-Dimethylhexane	0.01
2,4-Dimethylhexane	0.02
t-1,3-Dichloropropene	0.00
1,1,2-Trichloroethane	0.02
Bromotrichloromethane	0.01
2,3,4-Trimethylpentane	0.00
Toluene	0.01
2-Methylheptane	0.01
4-Methylheptane	0.01
1-Methylcyclohexene	0.01
3-Methylheptane	0.02
Dibromochloromethane	0.03
c-1,3-Dimethylcyclohexane	0.01
t-1,4-Dimethylcyclohexane	0.02
2,2,5-Trimethylhexane	0.01
1,2-Dibromoethane (EDB)	0.02
1-Octene	0.02
Octane	0.01
t-2-Octene	0.01
t-1,2-Dimethylcyclohexane	0.01
Tetrachloroethene	0.02
c-1,4/t-1,3-Dimethylcyclohexane	0.02
c-1,2-Dimethylcyclohexane	0.02
Chlorobenzene	0.02
Ethylbenzene	0.01
m,p-Xylene	0.02
Bromoform	0.04
1,4-Dichlorobutane	0.01
Styrene	0.01
1,1,2,2-Tetrachloroethane	0.02
1-Nonene	0.01
o-Xylene	0.01
Nonane	0.01
iso-Propylbenzene	0.01
a-Pinene	0.03
3,6-Dimethyloctane	0.02
n-Propylbenzene	0.01
3-Ethyltoluene	0.02
Camphene	0.04
4-Ethyltoluene	0.02
1,3,5-Trimethylbenzene	0.01
2-Ethyltoluene	0.01
b-Pinene	0.03
1-Decene	0.00
tert-Butylbenzene	0.01
1,2,4-Trimethylbenzene	0.03
Decane	0.02
Benzyl Chloride	0.02
1,3-Dichlorobenzene	0.03
1,4-Dichlorobenzene	0.01
iso-Butylbenzene	0.02
sec-Butylbenzene	0.01
1,2,3-Trimethylbenzene	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02
1,2-Dichlorobenzene	0.03
Limonene	0.05
Indan (2,3-Dihydroindene)	0.02
1,3-Diethylbenzene	0.01
1,4-Diethylbenzene	0.02
n-Butylbenzene	0.02
1,2-Diethylbenzene	0.01
1-Undecene	0.02
Undecane	0.01
1,2,4-Trichlorobenzene	0.04
Naphthalene	0.00
Dodecane	0.00
Hexachlorobutadiene	0.04
Hexylbenzene	0.02

Method Detection Limit
Concentration ($\mu g/m^3$)

FID Analysis Location	**Lab177N**
Date of MDL analysis	**5-May-14**
Compound Name	
Ethylene	0.02
Acetylene	0.01
Ethane	0.01
Propane	0.02

Duplicate-VOC Analysis

Concentration ($\mu g/m^3$)

Non-Polar Analysis Date	**23-Oct-14**	**23-Oct-14**	
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	
Filename	**RR27.D**	**RRDUP.D**	
Sample location	**EC STATI(**	**EC STATION 2, Hamilton, 235 Birch**	
Sampling Date	**14-Oct-14**	**14-Oct-14**	
Canister ID	**EPS 390**	**EPS 390**	
Sample Volume (mL)	**500**	**500**	
			% difference
Freon 134A	2.10	2.54	-18.79%
Propene	0.68	0.89	-26.02%
Propane	FID DATA	FID DATA	#VALUE!
Freon 22 (Chlorodifluoromethane)	0.96	1.12	-15.56%
Freon 12 (Dichlorodifluoromethane)	3.09	3.58	-14.88%
Propyne	0.06	0.08	-30.99%
Chloromethane	1.35	1.62	-18.33%
Isobutane (2-Methylpropane)	13.13	15.28	-15.15%
Freon 114 (1,2-Dichlorotetrafluoroethane	0.12	0.15	-20.90%
Vinylchloride (Chloroethene)	0.02	0.02	-22.22%
1-Butene/2-Methylpropene	1.71	1.99	-15.25%
1,3-Butadiene	0.10	0.11	-15.09%
Butane	21.63	25.07	-14.73%
t-2-Butene	0.90	1.05	-15.61%
2,2-Dimethylpropane	0.09	0.10	-18.95%
Bromomethane	0.06	0.08	-26.87%
1-Butyne	0.00	0.01	-40.00%
c-2-Butene	0.61	0.72	-16.59%
Chloroethane	0.03	0.04	-32.26%
3-Methyl-1-Butene	0.14	0.16	-14.38%
2-Methylbutane	11.69	13.43	-13.86%
Freon 11 (Trichlorofluoromethane)	1.45	1.63	-11.81%
1-Pentene	0.31	0.37	-19.35%
2-Methyl-1-Butene	0.58	0.80	-32.22%
Pentane	6.13	8.11	-27.84%
Isoprene (2-Methyl-1,3-Butadiene)	0.16	0.19	-20.69%
t-2-Pentene	0.85	1.03	-20.00%
Ethylbromide	0.00	0.01	-120.00%
1,1-Dichloroethene	0.00	0.00	-66.67%
c-2-Pentene	0.36	0.45	-21.13%
Dichloromethane	7.22	8.41	-15.23%
2-Methyl-2-Butene	1.11	1.36	-20.39%
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.57	0.66	-13.33%
2,2-Dimethylbutane	0.42	0.51	-18.49%
Cyclopentene	0.14	0.17	-20.78%
t-1,2-Dichloroethene	0.06	0.07	-14.49%
4-Methyl-1-Pentene	0.03	0.04	-18.18%
3-Methyl-1-Pentene	0.03	0.04	-37.50%
1,1-Dichloroethane	0.00	0.00	#DIV/0!
Cyclopentane	0.63	0.75	-17.92%
2,3-Dimethylbutane	0.68	0.81	-17.36%
t-4-Methyl-2-Pentene	0.01	0.02	-50.00%
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	#DIV/0!
2-Methylpentane	3.14	3.64	-14.81%
c-4-Methyl-2-Pentene	0.08	0.09	-18.60%
3-Methylpentane	2.23	2.60	-15.32%
1-Hexene/2-Methyl-1-Pentene	0.22	0.27	-21.49%
c-1,2-Dichloroethene	0.01	0.01	-50.00%
Hexane	3.09	3.68	-17.32%
Chloroform	0.15	0.18	-14.63%
t-2-Hexene	0.10	0.13	-20.69%
2-Ethyl-1-Butene	0.00	0.00	#DIV/0!
t-3-Methyl-2-Pentene	0.08	0.09	-16.87%
c-2-Hexene	0.05	0.06	-22.22%
c-3-Methyl-2-Pentene	0.20	0.25	-21.24%
2,2-Dimethylpentane	0.13	0.16	-17.69%
1,2-Dichloroethane	0.07	0.09	-21.69%
Methylcyclopentane	1.41	1.65	-15.83%
2,4-Dimethylpentane	0.35	0.43	-19.02%
1,1,1-Trichloroethane	0.39	0.43	-10.73%
2,2,3-Trimethylbutane	0.03	0.04	-27.03%
1-Methylcyclopentene	0.10	0.13	-25.21%
Benzene	1.43	1.72	-18.55%
Carbontretrachloride	0.36	0.38	-5.93%
Cyclohexane	0.45	0.52	-14.94%
2-Methylhexane	1.16	1.39	-18.32%
2,3-Dimethylpentane	0.58	0.71	-19.94%

Cyclohexene	0.03	0.03	-19.35%
3-Methylhexane	1.51	1.81	-18.31%
Dibromomethane	0.02	0.03	-33.33%
1,2-Dichloropropane	0.02	0.02	-31.58%
Bromodichloromethane	0.00	0.00	#DIV/0!
1-Heptene	0.00	0.00	#DIV/0!
Trichloroethene	0.11	0.14	-19.05%
2,2,4-Trimethylpentane	0.83	1.00	-18.50%
t-3-Heptene	0.00	0.00	#DIV/0!
Heptane	1.38	1.73	-22.54%
c-3-Heptene	0.00	0.00	#DIV/0!
t-2-Heptene	0.02	0.02	-31.58%
c-2-Heptene	0.00	0.00	#DIV/0!
c-1,3-Dichloropropene	0.00	0.00	#DIV/0!
2,2-Dimethylhexane	0.00	0.00	#DIV/0!
Methylcyclohexane	0.50	0.61	-19.75%
2,5-Dimethylhexane	0.11	0.15	-24.62%
2,4-Dimethylhexane	0.13	0.17	-22.52%
t-1,3-Dichloropropene	0.00	0.00	#DIV/0!
1,1,2-Trichloroethane	0.00	0.00	#DIV/0!
Bromotrichloromethane	NR	NR	#VALUE!
2,3,4-Trimethylpentane	0.24	0.30	-24.54%
Toluene	6.86	8.69	-23.54%
2-Methylheptane	0.21	0.26	-23.93%
4-Methylheptane	0.07	0.09	-21.69%
1-Methylcyclohexene	0.01	0.02	-40.00%
3-Methylheptane	0.18	0.23	-23.92%
Dibromochloromethane	0.01	0.01	-40.00%
c-1,3-Dimethylcyclohexane	0.16	0.20	-20.99%
t-1,4-Dimethylcyclohexane	0.05	0.06	-22.22%
2,2,5-Trimethylhexane	0.06	0.07	-24.24%
1,2-Dibromoethane (EDB)	0.00	0.00	-66.67%
1-Octene	0.17	0.24	-35.29%
Octane	0.31	0.41	-27.78%
t-2-Octene	0.00	0.00	#DIV/0!
t-1,2-Dimethylcyclohexane	0.10	0.11	-17.14%
Tetrachloroethene	0.37	0.45	-20.15%
c-1,4/t-1,3-Dimethylcyclohexane	0.05	0.07	-25.81%
c-1,2-Dimethylcyclohexane	0.03	0.04	-32.26%
Chlorobenzene	0.01	0.01	-40.00%
Ethylbenzene	1.09	1.34	-20.61%
m,p-Xylene	3.86	4.64	-18.49%
Bromoform	0.01	0.02	-25.00%
1,4-Dichlorobutane	0.00	0.00	#DIV/0!
Styrene	3.94	4.71	-17.76%
1,1,2,2-Tetrachloroethane	0.00	0.00	#DIV/0!
1-Nonene	0.20	0.24	-18.83%
o-Xylene	1.41	1.70	-18.25%
Nonane	0.56	0.69	-20.67%
iso-Propylbenzene	0.06	0.07	-18.75%
a-Pinene	0.47	0.54	-13.92%
3,6-Dimethyloctane	0.05	0.06	-15.38%
n-Propylbenzene	0.19	0.23	-20.75%
3-Ethyltoluene	0.49	0.60	-19.45%
Camphene	0.08	0.10	-25.29%
4-Ethyltoluene	0.27	0.32	-17.81%
1,3,5-Trimethylbenzene	0.25	0.30	-17.27%
2-Ethyltoluene	0.20	0.23	-16.82%
b-Pinene	0.13	0.15	-12.59%
1-Decene	0.05	0.07	-41.38%
tert-Butylbenzene	0.00	0.00	#DIV/0!
1,2,4-Trimethylbenzene	0.90	1.07	-17.04%
Decane	0.94	1.14	-18.46%
Benzyl Chloride	0.01	0.00	200.00%
1,3-Dichlorobenzene	0.00	0.00	0.00%
1,4-Dichlorobenzene	0.15	0.18	-15.95%
iso-Butylbenzene	0.02	0.02	-20.00%
sec-Butylbenzene	0.03	0.03	-20.69%
1,2,3-Trimethylbenzene	0.21	0.25	-18.50%
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.07	0.08	-15.79%
1,2-Dichlorobenzene	0.00	0.00	0.00%
Limonene	0.42	0.51	-20.13%
Indan (2,3-Dihydroindene)	0.12	0.15	-20.29%
1,3-Diethylbenzene	0.04	0.05	-13.33%
1,4-Diethylbenzene	0.17	0.20	-18.18%
n-Butylbenzene	0.06	0.07	-15.87%
1,2-Diethylbenzene	0.02	0.02	-22.22%
1-Undecene	0.06	0.07	-21.54%
Undecane	0.80	0.98	-19.57%
1,2,4-Trichlorobenzene	0.01	0.01	0.00%
Naphthalene	1.04	1.29	-21.96%
Dodecane	0.55	0.70	-23.08%
Hexachlorobutadiene	0.01	0.01	0.00%
Hexylbenzene	0.04	0.04	-20.00%

Randle Reef Study 2014 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

FID Analysis Date	**14NOV20-12**	**14NOV20-13**	**14DEC29-10**	**14DEC29-11**	**14DEC29-12**	**14DEC29-13**	**14DEC29-14**	**14DEC29-15**	**14DEC29-16**	**14DEC29-17.D**
FID Analysis Location	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**	**Lab177N**
Non-Polar Analysis Date	**24-Nov-14**	**24-Nov-14**	**23-Dec-14**	**23-Dec-14**	**23-Dec-14**	**23-Dec-14**	**29-Dec-14**	**23-Dec-14**	**29-Dec-14**	**6-Jan-15**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**RR32.D**	**RR33.D**	**RR34.D**	**RR35.D**	**RR36.D**	**RR37.D**	**RR38.D**	**RR39.D**	**RR40.D**	**RR41.D**
Sample location	**EC STATIO**	**EC STATIO**	**EC STATIO**	**DUPLICATE**	**EC STATIO**	**EC STATIO**	**EC STATIO**	**EC STATIO**	**EC STATIO**	**DUPLICATE, Blind Dupli**
Sampling Date	**7-Nov-14**	**7-Nov-14**	**1-Dec-14**	**1-Dec-14**	**19-Nov-14**	**1-Dec-14**	**13-Dec-14**	**13-Dec-14**	**13-Dec-14**	**13-Dec-14**
Canister ID	**EPS 998**	**EPS 777**	**EPS 569**	**EPS 980**	**EPS 084**	**EPS 943**	**EPS 1017**	**EPS 214**	**EPS 1018**	**EPS 859**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**
Comments										
Ethylene	**0.73**	**0.32**	**1.11**	**0.53**	**1.02**	**0.49**	**1.22**	**1.32**	**1.20**	**1.10**
Acetylene	**0.50**	**0.24**	**0.60**	**0.29**	**0.54**	**0.25**	**0.57**	**0.63**	**0.58**	**0.51**
Ethane	**3.11**	**2.38**	**9.34**	**3.09**	**4.68**	**2.96**	**9.46**	**10.12**	**9.42**	**8.46**
Freon 134A	0.71	0.36	0.60	0.44	0.62	0.46	0.51	0.67	0.53	0.49
Propene	0.21	0.19	0.26	0.14	0.41	0.16	0.32	0.40	0.36	0.35
Propane	**2.73**	**1.47**	**5.50**	**2.36**	**3.41**	**2.01**	**8.11**	**8.55**	**8.65**	**7.43**
Freon 22 (Chlorodifluoromethane)	0.82	0.71	1.31	0.86	1.01	0.88	0.99	0.96	0.93	2.35
Freon 12 (Dichlorodifluoromethane)	2.70	2.88	2.78	3.02	3.17	3.10	2.90	3.10	2.96	2.93
Propyne	0.03	0.02	0.06	0.03	0.06	0.02	0.06	0.07	0.06	0.05
Chloromethane	1.29	1.31	1.36	1.45	1.51	1.47	1.35	1.52	1.42	1.59
Isobutane (2-Methylpropane)	1.81	0.77	1.72	0.85	1.09	0.57	1.88	2.31	8.00	7.21
Freon 114 (1,2-Dichlorotetrafluoroethane	0.12	0.45	0.13	0.14	0.15	0.14	0.14	0.14	0.15	0.16
Vinylchloride (Chloroethene)	0.02	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.32	0.24	0.23	0.24	0.38	0.17	0.29	0.24	0.78	0.78
1,3-Butadiene	0.03	0.11	0.04	0.03	0.06	0.01	0.05	0.06	0.06	0.07
Butane	3.86	2.13	4.19	2.11	3.01	1.44	5.34	6.42	18.57	15.25
t-2-Butene	0.09	0.04	0.05	0.02	0.06	0.01	0.05	0.04	0.53	0.45
2,2-Dimethylpropane	0.02	0.01	0.03	0.02	0.02	0.01	0.03	0.03	0.07	0.06
Bromomethane	0.06	0.38	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
c-2-Butene	0.06	0.03	0.04	0.10	0.05	0.01	0.04	0.03	0.36	0.33
Chloroethane	0.07	0.15	0.03	0.02	0.04	0.02	0.02	0.02	0.02	0.03
3-Methyl-1-Butene	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.05	0.04
2-Methylbutane	1.75	0.84	1.72	0.84	1.23	0.55	1.87	2.09	6.78	5.63
Freon 11 (Trichlorofluoromethane)	1.66	1.95	1.72	1.79	1.87	1.80	1.77	1.83	1.93	1.70
1-Pentene	0.05	0.07	0.05	0.03	0.11	0.05	0.05	0.04	0.11	0.11
2-Methyl-1-Butene	0.06	0.03	0.04	0.04	0.05	0.02	0.05	0.05	0.19	0.16
Pentane	3.03	0.83	1.33	0.92	1.07	0.80	3.77	2.14	6.88	9.27
Isoprene (2-Methyl-1,3-Butadiene)	0.03	0.02	0.03	0.00	0.04	0.01	0.04	0.05	0.04	0.04
t-2-Pentene	0.09	0.04	0.04	0.02	0.04	0.01	0.03	0.03	0.27	0.22
Ethylbromide	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
1,1-Dichloroethene	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Pentene	0.04	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.11	0.09
Dichloromethane	0.78	0.50	0.32	0.30	0.33	0.33	0.39	0.40	0.45	0.74
2-Methyl-2-Butene	0.09	0.03	0.04	0.01	0.04	0.01	0.04	0.04	0.29	0.25
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.58	0.95	0.57	0.63	0.65	0.64	0.65	0.66	0.65	0.63
2,2-Dimethylbutane	0.05	0.02	0.08	0.04	0.06	0.03	0.05	0.05	0.13	0.12
Cyclopentene	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.02
t-1,2-Dichloroethene	0.01	0.20	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.01
4-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
3-Methyl-1-Pentene	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01
1,1-Dichloroethane	0.02	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Cyclopentane	0.08	0.04	0.10	0.04	0.07	0.03	0.10	0.12	0.23	0.24
2,3-Dimethylbutane	0.13	0.03	0.08	0.03	0.05	0.02	0.06	0.07	0.28	0.31
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	1.11	0.20	0.40	0.19	0.27	0.11	0.39	0.40	2.49	2.42
c-4-Methyl-2-Pentene	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02
3-Methylpentane	1.75	0.20	0.29	0.21	0.21	0.08	0.30	0.30	3.29	3.12
1-Hexene/2-Methyl-1-Pentene	0.05	0.05	0.04	0.03	0.09	0.03	0.04	0.03	0.06	0.10
c-1,2-Dichloroethene	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexane	4.71	0.66	0.43	0.44	0.34	0.16	0.56	0.55	8.27	7.31
Chloroform	0.12	0.38	0.10	0.10	0.11	0.10	0.10	0.11	0.11	0.10
t-2-Hexene	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.03	0.03
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
c-2-Hexene	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
2,2-Dimethylpentane	0.03	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.06	0.06
1,2-Dichloroethane	0.07	0.25	0.07	0.07	0.07	0.07	0.09	0.09	0.11	0.12
Methylcyclopentane	1.27	0.14	0.14	0.13	0.13	0.06	0.20	0.21	2.73	2.50
2,4-Dimethylpentane	0.06	0.02	0.04	0.02	0.05	0.01	0.04	0.05	0.12	0.11
1,1,1-Trichloroethane	0.02	0.27	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
2,2,3-Trimethylbutane	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.02	0.02	0.02
1-Methylcyclopentene	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.02
Benzene	0.37	0.69	1.04	0.86	0.50	0.32	0.61	0.66	1.02	1.05
Carbontretrachloride	0.43	0.66	0.41	0.45	0.13	0.43	0.45	0.49	0.45	0.43
Cyclohexane	0.14	0.19	0.10	0.05	0.09	0.04	0.17	0.17	0.32	0.35
2-Methylhexane	0.45	0.05	0.18	0.05	0.58	0.05	0.17	0.19	0.24	0.25
2,3-Dimethylpentane	0.19	0.03	0.09	0.03	0.22	0.03	0.08	0.10	0.12	0.15
Cyclohexene	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.02
3-Methylhexane	0.62	0.06	0.21	0.00	0.63	0.00	0.20	0.23	0.26	0.33
Dibromomethane	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
1,2-Dichloropropane	0.02	0.23	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.03
Bromodichloromethane	0.00	0.25	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
1-Heptene	0.00	0.08	0.00	0.03	0.10	0.03	0.00	0.00	0.00	0.15
Trichloroethene	0.15	0.26	0.04	0.02	0.02	0.01	0.02	0.07	0.06	0.04
2,2,4-Trimethylpentane	0.13	0.04	0.12	0.03	0.11	0.03	0.11	0.12	0.13	0.18

t-3-Heptene	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01
Heptane	0.54	0.27	0.20	0.07	0.28	0.07	0.21	0.25	0.25	0.34
c-3-Heptene	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
c-2-Heptene	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.13	0.04	0.10	0.04	0.09	0.04	0.12	0.13	0.15	0.20
2,5-Dimethylhexane	0.02	0.00	0.02	0.00	0.02	0.01	0.02	0.02	0.02	0.02
2,4-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
t-1,3-Dichloropropene	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.01	0.23	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
Bromotrichloromethane	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
2,3,4-Trimethylpentane	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.04	0.03	0.04
Toluene	1.47	0.39	0.94	0.27	0.73	0.22	0.68	0.89	0.75	1.15
2-Methylheptane	0.07	0.03	0.07	0.03	0.05	0.02	0.07	0.07	0.06	0.10
4-Methylheptane	0.02	0.01	0.02	0.00	0.02	0.00	0.01	0.02	0.02	0.03
1-Methylcyclohexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
3-Methylheptane	0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.04	0.04	0.06
Dibromochloromethane	0.00	0.23	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
c-1,3-Dimethylcyclohexane	0.04	0.01	0.04	0.01	0.03	0.01	0.03	0.03	0.03	0.04
t-1,4-Dimethylcyclohexane	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01
2,2,5-Trimethylhexane	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01
1,2-Dibromoethane (EDB)	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Octene	0.06	0.13	0.05	0.03	0.10	0.04	0.06	0.03	0.04	0.22
Octane	0.09	0.05	0.07	0.02	0.08	0.03	0.06	0.07	0.07	0.10
t-2-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02
Tetrachloroethene	0.06	0.31	0.15	0.02	0.05	0.03	0.06	0.08	0.07	0.09
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01
c-1,2-Dimethylcyclohexane	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chlorobenzene	0.01	0.25	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ethylbenzene	0.40	0.24	0.18	0.04	0.18	0.04	0.15	0.20	0.13	0.17
m,p-Xylene	1.39	0.54	0.56	0.11	0.53	0.07	0.36	0.54	0.38	0.48
Bromoform	0.02	0.33	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01
1,4-Dichlorobutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Styrene	0.04	0.19	0.44	0.00	0.07	0.00	0.05	0.17	0.04	0.04
1,1,2,2-Tetrachloroethane	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Nonene	0.07	0.09	0.03	0.01	0.05	0.01	0.04	0.03	0.03	0.11
o-Xylene	0.40	0.25	0.19	0.04	0.16	0.03	0.13	0.18	0.12	0.18
Nonane	0.09	0.04	0.07	0.01	0.06	0.02	0.04	0.05	0.04	0.06
iso-Propylbenzene	0.02	0.01	0.02	0.00	0.01	0.01	0.01	0.02	0.01	0.01
a-Pinene	0.01	0.02	0.02	0.00	0.01	0.00	0.03	0.02	0.01	0.01
3,6-Dimethyloctane	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00
n-Propylbenzene	0.03	0.02	0.03	0.01	0.02	0.01	0.03	0.04	0.02	0.04
3-Ethyltoluene	0.06	0.02	0.08	0.00	0.05	0.01	0.07	0.09	0.06	0.08
Camphene	0.06	0.08	0.01	0.00	0.01	0.01	0.02	0.03	0.02	0.03
4-Ethyltoluene	0.03	0.18	0.04	0.00	0.03	0.01	0.04	0.05	0.03	0.04
1,3,5-Trimethylbenzene	0.02	0.21	0.04	0.00	0.02	0.00	0.03	0.04	0.03	0.03
2-Ethyltoluene	0.03	0.01	0.03	0.00	0.02	0.01	0.03	0.04	0.03	0.03
b-Pinene	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
1-Decene	0.01	0.03	0.01	0.00	0.02	0.00	0.01	0.01	0.00	0.03
tert-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.07	0.23	0.12	0.00	0.06	0.01	0.10	0.13	0.08	0.11
Decane	0.09	0.02	0.09	0.01	0.04	0.01	0.04	0.05	0.03	0.05
Benzyl Chloride	0.00	0.13	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
1,3-Dichlorobenzene	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	0.02	0.30	0.04	0.01	0.03	0.01	0.02	0.04	0.03	0.03
iso-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sec-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1,2,3-Trimethylbenzene	0.02	0.02	0.03	0.00	0.01	0.00	0.02	0.03	0.02	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.02	0.01	0.01
1,2-Dichlorobenzene	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Limonene	0.01	0.02	0.01	0.00	0.00	0.00	0.03	0.04	0.00	0.02
Indan (2,3-Dihydroindene)	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.02	0.01	0.01
1,3-Diethylbenzene	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01
1,4-Diethylbenzene	0.02	0.02	0.03	0.00	0.01	0.00	0.02	0.03	0.01	0.02
n-Butylbenzene	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
1,2-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Undecene	0.00	0.04	0.01	0.00	0.01	0.00	0.02	0.02	0.00	0.04
Undecane	0.07	0.03	0.11	0.00	0.03	0.01	0.04	0.07	0.03	0.05
1,2,4-Trichlorobenzene	0.01	0.51	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Naphthalene	0.02	0.47	0.30	0.01	0.02	0.00	0.09	0.09	0.07	0.06
Dodecane	0.07	0.06	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	0.05
Hexachlorobutadiene	0.01	0.89	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Hexylbenzene	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01

Randle Reef Study 2014 Sample Data

Concentration (µg/m^3)

NR= Data not reported

Non-Polar Analysis Date	**24-Nov-14**	**23-Dec-14**	**29-Dec-14**	**6-Jan-15**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**
Sample Volume (mL)	**500**	**500**	**500**	**500**
Freon 134A	0.00	0.00	0.00	0.00
Propene	0.00	0.00	0.00	0.00
Propane	NR	NR	NR	NR
Freon 22 (Chlorodifluoromethane)	0.00	0.00	0.00	0.00
Freon 12 (Dichlorodifluoromethane)	0.00	0.00	0.00	0.00
Propyne	0.00	0.00	0.00	0.00
Chloromethane	0.00	0.00	0.00	0.00
Isobutane (2-Methylpropane)	0.00	0.00	0.00	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00	0.00	0.00	0.00
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.00	0.00	0.00	0.00
1,3-Butadiene	0.00	0.00	0.00	0.00
Butane	0.00	0.00	0.00	0.00
t-2-Butene	0.00	0.00	0.00	0.00
2,2-Dimethylpropane	0.00	0.00	0.00	0.00
Bromomethane	0.00	0.00	0.00	0.00
1-Butyne	0.00	0.00	0.00	0.00
c-2-Butene	0.00	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00	0.00
3-Methyl-1-Butene	0.00	0.00	0.00	0.00
2-Methylbutane	0.00	0.00	0.00	0.00
Freon 11 (Trichlorofluoromethane)	0.00	0.00	0.00	0.00
1-Pentene	0.00	0.00	0.00	0.00
2-Methyl-1-Butene	0.00	0.00	0.00	0.00
Pentane	0.00	0.00	0.00	0.00
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.00	0.00	0.00
t-2-Pentene	0.00	0.00	0.00	0.00
Ethylbromide	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00
c-2-Pentene	0.00	0.00	0.00	0.00
Dichloromethane	0.02	0.02	0.02	0.02
2-Methyl-2-Butene	0.00	0.00	0.00	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00	0.00	0.00	0.00
2,2-Dimethylbutane	0.00	0.00	0.00	0.00
Cyclopentene	0.00	0.00	0.00	0.00
t-1,2-Dichloroethene	0.00	0.00	0.00	0.00
4-Methyl-1-Pentene	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.00	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.00	0.00
2,3-Dimethylbutane	0.00	0.00	0.00	0.00
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00
2-Methylpentane	0.00	0.00	0.00	0.00
c-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00
3-Methylpentane	0.00	0.00	0.00	0.00
1-Hexene/2-Methyl-1-Pentene	0.00	0.00	0.00	0.00
c-1,2-Dichloroethene	0.00	0.00	0.00	0.00
Hexane	0.00	0.00	0.00	0.00
Chloroform	0.00	0.00	0.00	0.00
t-2-Hexene	0.00	0.00	0.00	0.00
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00
c-2-Hexene	0.00	0.00	0.00	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00
2,2-Dimethylpentane	0.00	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.00	0.00
Methylcyclopentane	0.00	0.00	0.00	0.00
2,4-Dimethylpentane	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.00	0.00	0.00	0.00
2,2,3-Trimethylbutane	0.00	0.00	0.00	0.00
1-Methylcyclopentene	0.00	0.00	0.00	0.00
Benzene	0.00	0.00	0.00	0.00
Carbontretrachloride	0.00	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.00	0.00
2-Methylhexane	0.00	0.00	0.00	0.00
2,3-Dimethylpentane	0.00	0.00	0.00	0.00
Cyclohexene	0.00	0.00	0.00	0.00
3-Methylhexane	0.00	0.00	0.00	0.00
Dibromomethane	0.02	0.02	0.02	0.02
1,2-Dichloropropane	0.00	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.00	0.00
1-Heptene	0.00	0.00	0.00	0.00

Trichloroethene	0.00	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00	0.00	0.00
t-3-Heptene	0.00	0.00	0.00	0.00
Heptane	0.00	0.00	0.00	0.00
c-3-Heptene	0.00	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.00	0.00
c-2-Heptene	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00
Methylcyclohexane	0.00	0.00	0.00	0.00
2,5-Dimethylhexane	0.00	0.00	0.00	0.00
2,4-Dimethylhexane	0.00	0.00	0.00	0.00
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.00	0.00
Bromotrichloromethane	NR	NR	NR	NR
2,3,4-Trimethylpentane	0.00	0.00	0.00	0.00
Toluene	0.00	0.00	0.00	0.00
2-Methylheptane	0.00	0.00	0.00	0.00
4-Methylheptane	0.00	0.00	0.00	0.00
1-Methylcyclohexene	0.00	0.00	0.00	0.00
3-Methylheptane	0.00	0.00	0.00	0.00
Dibromochloromethane	0.00	0.00	0.00	0.00
c-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00
t-1,4-Dimethylcyclohexane	0.00	0.00	0.00	0.00
2,2,5-Trimethylhexane	0.00	0.00	0.00	0.00
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.00
1-Octene	0.00	0.00	0.00	0.00
Octane	0.00	0.00	0.00	0.00
t-2-Octene	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00
Tetrachloroethene	0.00	0.00	0.00	0.00
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00
c-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00
Chlorobenzene	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00
m,p-Xylene	0.00	0.00	0.00	0.00
Bromoform	0.00	0.00	0.00	0.00
1,4-Dichlorobutane	0.00	0.00	0.00	0.00
Styrene	0.00	0.00	0.00	0.00
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.00
1-Nonene	0.00	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.00	0.00
Nonane	0.00	0.00	0.00	0.00
iso-Propylbenzene	0.00	0.00	0.00	0.00
a-Pinene	0.00	0.00	0.00	0.00
3,6-Dimethyloctane	0.00	0.00	0.00	0.00
n-Propylbenzene	0.00	0.00	0.00	0.00
3-Ethyltoluene	0.00	0.00	0.00	0.00
Camphene	0.00	0.00	0.00	0.00
4-Ethyltoluene	0.00	0.00	0.00	0.00
1,3,5-Trimethylbenzene	0.00	0.00	0.00	0.00
2-Ethyltoluene	0.00	0.00	0.00	0.00
b-Pinene	0.00	0.00	0.00	0.00
1-Decene	0.00	0.00	0.00	0.00
tert-Butylbenzene	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.00	0.00	0.00	0.00
Decane	0.00	0.00	0.00	0.00
Benzyl Chloride	0.00	NR	NR	NR
1,3-Dichlorobenzene	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	0.00	0.00	0.00	0.00
iso-Butylbenzene	0.00	0.00	0.00	0.00
sec-Butylbenzene	0.00	0.00	0.00	0.00
1,2,3-Trimethylbenzene	0.00	0.00	0.00	0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00
Limonene	0.00	0.00	0.00	0.00
Indan (2,3-Dihydroindene)	0.00	0.00	0.00	0.00
1,3-Diethylbenzene	0.00	0.00	0.00	0.00
1,4-Diethylbenzene	0.00	0.00	0.00	0.00
n-Butylbenzene	0.00	0.00	0.00	0.00
1,2-Diethylbenzene	0.00	0.00	0.00	0.00
1-Undecene	0.00	0.00	0.00	0.00
Undecane	0.00	0.00	0.00	0.00
1,2,4-Trichlorobenzene	0.00	0.00	0.00	0.01
Naphthalene	0.00	0.00	0.00	0.00
Dodecane	0.00	NR	NR	0.00
Hexachlorobutadiene	0.00	0.00	0.00	0.00
Hexylbenzene	0.00	0.00	0.00	0.00

Method Detection Limit
Concentration (μg/m^3)

Non-Polar Analysis Location	**Lab176ML**
Date of MDL analysis	**28-Jan-14**
Compound Name	
Freon 134A	0.03
Propene	0.02
Propane	0.16
Freon 22 (Chlorodifluoromethane)	0.03
Freon 12 (Dichlorodifluoromethane)	0.03
Propyne	0.01
Chloromethane	0.02
Isobutane (2-Methylpropane)	0.01
Freon 114 (1,2-Dichlorotetrafluoroethan	0.04
Vinylchloride (Chloroethene)	0.01
1-Butene/2-Methylpropene	0.01
1,3-Butadiene	0.00
Butane	0.02
t-2-Butene	0.00
2,2-Dimethylpropane	0.02
Bromomethane	0.03
1-Butyne	0.00
c-2-Butene	0.02
Chloroethane	0.03
3-Methyl-1-Butene	0.02
2-Methylbutane	0.05
Freon 11 (Trichlorofluoromethane)	0.02
1-Pentene	0.04
2-Methyl-1-Butene	0.01
Pentane	0.09
Isoprene (2-Methyl-1,3-Butadiene)	0.02
t-2-Pentene	0.02
Ethylbromide	0.02
1,1-Dichloroethene	0.00
c-2-Pentene	0.02
Dichloromethane	0.01
2-Methyl-2-Butene	0.02
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.01
2,2-Dimethylbutane	0.02
Cyclopentene	0.03
t-1,2-Dichloroethene	0.01
4-Methyl-1-Pentene	0.01
3-Methyl-1-Pentene	0.02
1,1-Dichloroethane	0.01
Cyclopentane	0.02
2,3-Dimethylbutane	0.00
t-4-Methyl-2-Pentene	0.02
Methyl-t-Butyl Ether (MTBE)	0.06
2-Methylpentane	0.05
c-4-Methyl-2-Pentene	0.02
3-Methylpentane	0.04
1-Hexene/2-Methyl-1-Pentene	0.03
c-1,2-Dichloroethene	0.02
Hexane	0.03
Chloroform	0.02
t-2-Hexene	0.01
2-Ethyl-1-Butene	0.00
t-3-Methyl-2-Pentene	0.01
c-2-Hexene	0.01
c-3-Methyl-2-Pentene	0.02
2,2-Dimethylpentane	0.03
1,2-Dichloroethane	0.01
Methylcyclopentane	0.02
2,4-Dimethylpentane	0.01
1,1,1-Trichloroethane	0.02
2,2,3-Trimethylbutane	0.01
1-Methylcyclopentene	0.02
Benzene	0.00
Carbontretrachloride	0.01
Cyclohexane	0.02
2-Methylhexane	0.01
2,3-Dimethylpentane	0.02
Cyclohexene	0.02
3-Methylhexane	0.02
Dibromomethane	0.04
1,2-Dichloropropane	0.11
Bromodichloromethane	0.02
1-Heptene	0.00
Trichloroethene	0.02

2,2,4-Trimethylpentane	0.02
t-3-Heptene	0.01
Heptane	0.02
c-3-Heptene	0.02
t-2-Heptene	0.00
c-2-Heptene	0.00
c-1,3-Dichloropropene	0.02
2,2-Dimethylhexane	0.02
Methylcyclohexane	0.01
2,5-Dimethylhexane	0.01
2,4-Dimethylhexane	0.02
t-1,3-Dichloropropene	0.00
1,1,2-Trichloroethane	0.02
Bromotrichloromethane	0.01
2,3,4-Trimethylpentane	0.00
Toluene	0.01
2-Methylheptane	0.01
4-Methylheptane	0.01
1-Methylcyclohexene	0.01
3-Methylheptane	0.02
Dibromochloromethane	0.03
c-1,3-Dimethylcyclohexane	0.01
t-1,4-Dimethylcyclohexane	0.02
2,2,5-Trimethylhexane	0.01
1,2-Dibromoethane (EDB)	0.02
1-Octene	0.02
Octane	0.01
t-2-Octene	0.01
t-1,2-Dimethylcyclohexane	0.01
Tetrachloroethene	0.02
c-1,4/t-1,3-Dimethylcyclohexane	0.02
c-1,2-Dimethylcyclohexane	0.02
Chlorobenzene	0.02
Ethylbenzene	0.01
m,p-Xylene	0.02
Bromoform	0.04
1,4-Dichlorobutane	0.01
Styrene	0.01
1,1,2,2-Tetrachloroethane	0.02
1-Nonene	0.01
o-Xylene	0.01
Nonane	0.01
iso-Propylbenzene	0.01
a-Pinene	0.03
3,6-Dimethyloctane	0.02
n-Propylbenzene	0.01
3-Ethyltoluene	0.02
Camphene	0.04
4-Ethyltoluene	0.02
1,3,5-Trimethylbenzene	0.01
2-Ethyltoluene	0.01
b-Pinene	0.03
1-Decene	0.00
tert-Butylbenzene	0.01
1,2,4-Trimethylbenzene	0.03
Decane	0.02
Benzyl Chloride	0.02
1,3-Dichlorobenzene	0.03
1,4-Dichlorobenzene	0.01
iso-Butylbenzene	0.02
sec-Butylbenzene	0.01
1,2,3-Trimethylbenzene	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02
1,2-Dichlorobenzene	0.03
Limonene	0.05
Indan (2,3-Dihydroindene)	0.02
1,3-Diethylbenzene	0.01
1,4-Diethylbenzene	0.02
n-Butylbenzene	0.02
1,2-Diethylbenzene	0.01
1-Undecene	0.02
Undecane	0.01
1,2,4-Trichlorobenzene	0.04
Naphthalene	0.00
Dodecane	0.00
Hexachlorobutadiene	0.04
Hexylbenzene	0.02

Method Detection Limit
Concentration ($\mu g/m^3$)

FID Analysis Location	**Lab177N**
Date of MDL analysis	**5-May-14**
Compound Name	
Ethylene	0.02
Acetylene	0.01
Ethane	0.01
Propane	0.02

Duplicate-VOC Analysis
Concentration (µg/m³)

Non-Polar Analysis Date	**24-Nov-14**	**24-Nov-14**	
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	
Filename	**RR33.D**	**RRDUP.D**	
Sample location	**EC STATIC**	**EC STATION 3, USS Dockwall**	
Sampling Date	**7-Nov-14**	**7-Nov-14**	
Canister ID	**EPS 777**	**EPS 777**	
Sample Volume (mL)	**500**	**500**	
			% difference
Freon 134A	0.36	0.37	-2.21%
Propene	0.19	0.19	-4.21%
Propane	FID DATA	FID DATA	#VALUE!
Freon 22 (Chlorodifluoromethane)	0.71	0.72	-0.84%
Freon 12 (Dichlorodifluoromethane)	2.88	2.93	-1.79%
Propyne	0.02	0.02	-11.76%
Chloromethane	1.31	1.34	-1.81%
Isobutane (2-Methylpropane)	0.77	0.77	-0.52%
Freon 114 (1,2-Dichlorotetrafluoroethane	0.45	0.48	-6.40%
Vinylchloride (Chloroethene)	0.13	0.14	-8.82%
1-Butene/2-Methylpropene	0.24	0.24	-0.82%
1,3-Butadiene	0.11	0.12	-8.55%
Butane	2.13	2.14	-0.47%
t-2-Butene	0.04	0.04	0.00%
2,2-Dimethylpropane	0.01	0.01	0.00%
Bromomethane	0.38	0.41	-7.52%
1-Butyne	0.00	0.00	200.00%
c-2-Butene	0.03	0.03	0.00%
Chloroethane	0.15	0.17	-9.88%
3-Methyl-1-Butene	0.01	0.01	0.00%
2-Methylbutane	0.84	0.85	-0.71%
Freon 11 (Trichlorofluoromethane)	1.95	2.01	-3.14%
1-Pentene	0.07	0.07	0.00%
2-Methyl-1-Butene	0.03	0.03	0.00%
Pentane	0.83	0.94	-12.67%
Isoprene (2-Methyl-1,3-Butadiene)	0.02	0.02	-10.53%
t-2-Pentene	0.04	0.04	0.00%
Ethylbromide	0.00	0.00	0.00%
1,1-Dichloroethene	0.19	0.21	-11.17%
c-2-Pentene	0.02	0.02	0.00%
Dichloromethane	0.50	0.53	-5.03%
2-Methyl-2-Butene	0.03	0.03	6.06%
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.95	0.99	-4.74%
2,2-Dimethylbutane	0.02	0.02	0.00%
Cyclopentene	0.01	0.01	0.00%
t-1,2-Dichloroethene	0.20	0.22	-8.53%
4-Methyl-1-Pentene	0.00	0.01	-200.00%
3-Methyl-1-Pentene	0.00	0.00	200.00%
1,1-Dichloroethane	0.20	0.22	-8.70%
Cyclopentane	0.04	0.04	4.88%
2,3-Dimethylbutane	0.03	0.03	0.00%
t-4-Methyl-2-Pentene	0.00	0.00	200.00%
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	#DIV/0!
2-Methylpentane	0.20	0.20	0.00%
c-4-Methyl-2-Pentene	0.00	0.00	0.00%
3-Methylpentane	0.20	0.20	0.00%
1-Hexene/2-Methyl-1-Pentene	0.05	0.05	0.00%
c-1,2-Dichloroethene	0.20	0.21	-8.78%
Hexane	0.66	0.69	-3.84%
Chloroform	0.38	0.41	-7.14%
t-2-Hexene	0.01	0.01	0.00%
2-Ethyl-1-Butene	0.00	0.02	-200.00%
t-3-Methyl-2-Pentene	0.00	0.00	#DIV/0!
c-2-Hexene	0.00	0.00	200.00%
c-3-Methyl-2-Pentene	0.00	0.00	#DIV/0!
2,2-Dimethylpentane	0.01	0.01	0.00%
1,2-Dichloroethane	0.25	0.27	-6.90%
Methylcyclopentane	0.14	0.15	-2.74%
2,4-Dimethylpentane	0.02	0.02	0.00%
1,1,1-Trichloroethane	0.27	0.29	-9.32%
2,2,3-Trimethylbutane	0.01	0.01	0.00%
1-Methylcyclopentene	0.00	0.00	0.00%
Benzene	0.69	0.71	-3.15%
Carbontretrachloride	0.66	0.69	-4.76%
Cyclohexane	0.19	0.21	-9.05%
2-Methylhexane	0.05	0.05	-4.08%
2,3-Dimethylpentane	0.03	0.03	7.41%

Cyclohexene	0.01	0.01	28.57%
3-Methylhexane	0.06	0.06	-6.45%
Dibromomethane	0.03	0.03	-6.45%
1,2-Dichloropropane	0.23	0.26	-11.38%
Bromodichloromethane	0.25	0.29	-11.85%
1-Heptene	0.08	0.08	-2.53%
Trichloroethene	0.26	0.29	-11.68%
2,2,4-Trimethylpentane	0.04	0.04	-9.52%
t-3-Heptene	0.00	0.00	#DIV/0!
Heptane	0.27	0.30	-9.86%
c-3-Heptene	0.03	0.03	-12.50%
t-2-Heptene	0.00	0.00	66.67%
c-2-Heptene	0.04	0.00	200.00%
c-1,3-Dichloropropene	0.15	0.16	-10.26%
2,2-Dimethylhexane	0.00	0.00	#DIV/0!
Methylcyclohexane	0.04	0.04	5.13%
2,5-Dimethylhexane	0.00	0.00	0.00%
2,4-Dimethylhexane	0.00	0.01	-200.00%
t-1,3-Dichloropropene	0.14	0.15	-9.79%
1,1,2-Trichloroethane	0.23	0.25	-11.67%
Bromotrichloromethane	0.00	0.00	#DIV/0!
2,3,4-Trimethylpentane	0.01	0.01	0.00%
Toluene	0.39	0.41	-5.05%
2-Methylheptane	0.03	0.03	0.00%
4-Methylheptane	0.01	0.01	0.00%
1-Methylcyclohexene	0.00	0.00	0.00%
3-Methylheptane	0.01	0.01	0.00%
Dibromochloromethane	0.23	0.26	-11.29%
c-1,3-Dimethylcyclohexane	0.01	0.01	0.00%
t-1,4-Dimethylcyclohexane	0.00	0.00	0.00%
2,2,5-Trimethylhexane	0.00	0.00	0.00%
1,2-Dibromoethane (EDB)	0.28	0.31	-10.81%
1-Octene	0.13	0.13	-1.53%
Octane	0.05	0.05	0.00%
t-2-Octene	0.00	0.00	#DIV/0!
t-1,2-Dimethylcyclohexane	0.01	0.01	0.00%
Tetrachloroethene	0.31	0.34	-10.40%
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.00	0.00%
c-1,2-Dimethylcyclohexane	0.01	0.01	0.00%
Chlorobenzene	0.25	0.27	-8.56%
Ethylbenzene	0.24	0.26	-7.17%
m,p-Xylene	0.54	0.58	-7.14%
Bromoform	0.33	0.36	-9.25%
1,4-Dichlorobutane	0.00	0.00	#DIV/0!
Styrene	0.19	0.21	-8.08%
1,1,2,2-Tetrachloroethane	0.32	0.35	-9.06%
1-Nonene	0.09	0.09	-4.55%
o-Xylene	0.25	0.27	-7.69%
Nonane	0.04	0.04	0.00%
iso-Propylbenzene	0.01	0.01	0.00%
a-Pinene	0.02	0.02	0.00%
3,6-Dimethyloctane	0.00	0.00	0.00%
n-Propylbenzene	0.02	0.02	0.00%
3-Ethyltoluene	0.02	0.02	0.00%
Camphene	0.08	0.08	0.00%
4-Ethyltoluene	0.18	0.19	-5.35%
1,3,5-Trimethylbenzene	0.21	0.22	-4.74%
2-Ethyltoluene	0.01	0.01	0.00%
b-Pinene	0.04	0.04	0.00%
1-Decene	0.03	0.03	6.45%
tert-Butylbenzene	0.00	0.00	0.00%
1,2,4-Trimethylbenzene	0.23	0.24	-4.22%
Decane	0.02	0.02	0.00%
Benzyl Chloride	0.13	0.14	-6.06%
1,3-Dichlorobenzene	0.31	0.34	-8.05%
1,4-Dichlorobenzene	0.30	0.32	-7.07%
iso-Butylbenzene	0.00	0.00	0.00%
sec-Butylbenzene	0.00	0.00	0.00%
1,2,3-Trimethylbenzene	0.02	0.02	0.00%
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.01	0.01	0.00%
1,2-Dichlorobenzene	0.32	0.34	-7.27%
Limonene	0.02	0.02	-9.52%
Indan (2,3-Dihydroindene)	0.01	0.01	0.00%
1,3-Diethylbenzene	0.00	0.00	0.00%
1,4-Diethylbenzene	0.02	0.02	0.00%
n-Butylbenzene	0.01	0.01	0.00%
1,2-Diethylbenzene	0.00	0.00	0.00%
1-Undecene	0.04	0.04	5.13%
Undecane	0.03	0.02	8.00%
1,2,4-Trichlorobenzene	0.51	0.55	-8.27%
Naphthalene	0.47	0.48	-2.10%
Dodecane	0.06	0.06	3.39%
Hexachlorobutadiene	0.89	0.94	-5.46%
Hexylbenzene	0.01	0.01	22.22%

APPENDIX III
HAMN 2014 VOC Readings

Hamilton Air Monitoring Network - VOC Report

HAMN
HAMILTON AIR MONITORING NETWORK

Station	: STN29180	**Sample Matrix**	: SUMMA Canisters
Location	: Burlington / Gage, Hamilton	**Method**	: Cryofocus GC/MS (TO15)

VOC Parameter	Guideline 24 Hr ug/m³	11-Jan-14	23-Jan-14	04-Feb-14	16-Feb-14	28-Feb-14	12-Mar-14	24-Mar-14	05-Apr-14	17-Apr-14	29-Apr-14	11-May-14	23-May-14	04-Jun-14	16-Jun-14	25-Jun-14	10-Jul-14	22-Jul-14	03-Aug-14	15-Aug-14	27-Aug-14	08-Sep-14	20-Sep-14	02-Oct-14	14-Oct-14	26-Oct-14	07-Nov-14	19-Nov-14	01-Dec-14	13-Dec-14	25-Dec-14		Ave ug/m³	Max ug/m³	Min ug/m³	No. Samples > AAQC	No. Valid Samples
Vinyl Chloride	1	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	0	22
1,1-Dichloroethene	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	0	
Dichloromethane	220	0.80	0.37	0.61	0.38	0.36	0.31	0.50	0.37	0.43	0.81	0.59	0.93	1.96	0.48	0.75	2.31	0.76	0.41	1.86	0.95	2.06	0.93										0.9	2.3	0.3	0	
Chloroform	1	0.09	0.08	0.10	0.08	0.08	0.07	0.08	0.09	0.10	0.10	0.09	0.09	0.11	0.15	0.14	0.16	0.18	0.13	0.08	0.12	0.23	0.16										0.1	0.2	0.1	0	
Carbon Tetrachloride	2.4	0.41	0.45	0.44	0.46	0.44	0.45	0.44	0.49	0.56	0.40	0.47	0.39	0.45	0.48	0.61	0.51	0.51	0.40	0.36	0.44	0.47	0.49										0.5	0.6	0.4	0	
1,1-Dichloroethane	165	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	0	
1,2-Dichloroethane	2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.09	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.08	0.07	0.05	0.04	0.05	0.07	0.06										0.1	0.1	0.0	0	
1,2-Dibromoethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,1,1-Trichloroethane	115000	0.05	0.03	0.03	0.03	0.02	0.02	0.03	0.04	0.03	0.02	0.03	0.03	0.09	0.03	0.09	0.11	0.12	0.02	0.10	0.02	0.07	0.04										0.0	0.1	0.0	0	
1,1,2-Trichloroethane		0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,1,2,2-Tetrachloroethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
cis-1,3-Dichloropropene		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,2-Dichloropropane	2400	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01										0.0	0.0	0.0	0	
Bromodichloromethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
Trichloroethylene	12	0.06	0.02	0.09	0.03	0.02	0.03	0.01	0.02	0.11	0.16	0.02	0.53	0.06	0.11	0.21	0.27	0.11	0.02	0.02	0.06	0.36	0.03										0.1	0.5	0.0	0	
Tetrachloroethylene	360	0.43	0.61	2.64	0.53	0.13	0.06	0.14	0.05	0.11	0.16	0.19	1.37	1.85	0.11	2.05	1.20	0.90	0.13	0.17	10.23	1.91	0.45										1.2	10.2	0.1	0	
Benzene	100 (URT)	2.03	0.72	2.98	0.74	0.93	2.09	0.77	0.67	1.68	5.10	0.86	0.56	0.77	7.25	2.06	2.85	0.98	1.26	0.53	0.35	1.67	0.48										1.7	7.2	0.4	0	
Toluene	2000	3.86	1.57	6.99	1.58	1.38	1.00	1.93	1.63	1.60	2.05	2.65	3.92	4.34	2.90	3.48	7.80	6.63	1.76	3.66	2.21	6.60	2.26										3.3	7.8	1.0	0	
Ethylbenzene	1000	0.98	0.23	0.91	0.28	0.26	0.21	0.28	0.29	0.57	0.45	0.49	0.64	0.80	0.55	0.66	1.55	1.22	0.31	1.46	0.38	0.99	0.35										0.6	1.6	0.2	0	
m / p-Xylene	730	3.28	0.68	2.97	0.88	0.68	0.67	0.82	0.97	2.17	1.63	1.64	2.14	2.70	1.76	2.13	5.07	4.21	0.91	5.19	1.24	3.58	1.17										2.1	5.2	0.7	0	
o-Xylene	730	1.18	0.23	0.89	0.28	0.23	0.24	0.28	0.36	0.66	0.52	0.58	0.74	0.88	0.62	0.70	1.61	1.32	0.36	1.66	0.41	1.17	0.39										0.7	1.7	0.2	0	
Styrene	400	0.62	0.16	1.22	0.02	0.00	0.06	0.01	0.02	0.13	0.21	0.13	0.38	0.62	0.78	0.32	1.07	1.04	0.25	0.14	0.68	0.60	0.14										0.4	1.2	0.0	0	
1,3,5-Trimethylbenzene	220	0.25	0.04	0.16	0.06	0.01	0.04	0.03	0.09	0.07	0.09	0.14	0.23	0.25	0.14	0.14	0.46	0.35	0.09	0.21	0.10	0.27	0.08										0.1	0.5	0.0	0	
1,2,4-Trimethylbenzene	220	0.85	0.14	0.47	0.20	0.04	0.14	0.13	0.32	0.23	0.33	0.52	0.79	0.86	0.42	0.49	1.57	1.21	0.32	0.74	0.36	0.96	0.29										0.5	1.6	0.0	0	
Chlorobenzene		0.01	0.00	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01										0.0	0.0	0.0	x	
1,3-Dichlorobenzene		0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,4-Dichlorobenzene	95	2.02	0.63	0.48	0.34	0.24	0.33	0.25	0.32	0.31	0.36	0.65	0.29	0.47	0.41	0.55	0.54	0.69	0.46	0.30	0.37	0.47	0.28										0.5	2.0	0.2	0	
1,2-Dichlorobenzene		0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01										0.0	0.0	0.0	x	
n-Hexane	2500	1.45	1.31	2.20	1.62	0.43	0.26	0.65	0.58	0.26	0.33	1.05	1.54	1.83	0.55	1.54	3.47	1.93	1.20	1.88	1.59	2.50	1.36										1.3	3.5	0.3	0	
Cyclohexane	6100	0.23	0.10	0.22	0.09	0.09	0.08	0.12	0.12	0.07	0.09	0.14	0.18	0.23	0.16	0.23	0.39	0.30	0.12	0.23	0.09	0.28	0.11										0.2	0.4	0.1	0	
Isoprene		0.07	0.03	0.05	0.01	0.03	0.02	0.03	0.02	0.02	0.05	0.06	0.05	0.11	0.08	0.14	0.18	0.60	0.40	0.16	0.21	0.23	0.12										0.1	0.6	0.0	x	
Alpha-Pinene		0.30	0.07	0.25	0.00	0.00	0.21	0.01	0.04	0.05	0.10	0.31	0.24	0.52	0.87	0.40	2.02	1.00	1.75	0.27	3.02	1.20	0.87										0.6	3.0	0.0	x	
Naphthalene	22.5	0.50	0.04	0.34	0.04	0.02	0.62	0.02	0.10	0.69	3.17	0.78	0.28	0.40	10.46	2.22	3.74	0.92	1.34	0.23	0.28	0.99	0.25										1.2	10.5	0.0	0	
1,3-Butadiene	300 (URT)	0.10	0.05	0.11	0.03	0.05	0.05	0.04	0.02	0.04	0.08	0.04	0.03	0.03	0.07	0.04	0.06	0.05	0.05	0.03	0.03	0.08	0.03										0.1	0.1	0.0	0	

HAMILTON AIR MONITORING NETWORK

Hamilton Air Monitoring Network - VOC Report

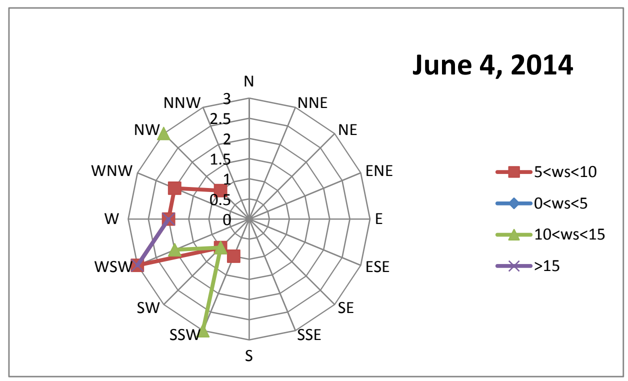
Station : STN29567
Location : Niagara / Land, Hamilton
Sample Matrix : SUMMA Canisters
Method : Cryofocus GC/MS (TO15)

VOC Parameter	Guideline 24 Hr ug/m³	11-Jan-14	23-Jan-14	04-Feb-14	16-Feb-14	28-Feb-14	12-Mar-14	24-Mar-14	05-Apr-14	17-Apr-14	29-Apr-14	11-May-14	23-May-14	04-Jun-14	16-Jun-14	25-Jun-14	10-Jul-14	22-Jul-14	03-Aug-14	15-Aug-14	27-Aug-14	08-Sep-14	20-Sep-14	02-Oct-14	14-Oct-14	26-Oct-14	07-Nov-14	19-Nov-14	01-Dec-14	13-Dec-14	25-Dec-14		Ave ug/m³	Max ug/m³	Min ug/m³	No. Samples > AAQC	No. Valid Samples
Vinyl Chloride	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	0	22
1,1-Dichloroethene	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	0	
Dichloromethane	220	0.37	0.31	0.50	0.31	0.33	0.31	0.30	0.32	0.33	0.36	0.37	0.32	0.36	0.44	0.44	0.44	0.57	0.36	0.39	0.32	0.50	0.42										0.4	0.6	0.3	0	
Chloroform	1	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.18	0.14	0.14	0.16	0.15	0.07	0.11	0.21	0.15										0.1	0.2	0.1	0	
Carbon Tetrachloride	2.4	0.42	0.37	0.42	0.44	0.40	0.47	0.46	0.49	0.56	0.41	0.46	0.40	0.44	0.54	0.62	0.50	0.52	0.38	0.33	0.44	0.48	0.49										0.5	0.6	0.3	0	
1,1-Dichloroethane	165	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	0	
1,2-Dichloroethane	2	0.07	0.06	0.09	0.08	0.08	0.07	0.09	0.11	0.08	0.07	0.09	0.09	0.10	0.08	0.07	0.08	0.08	0.06	0.05	0.06	0.09	0.07										0.1	0.1	0.1	0	
1,2-Dibromoethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,1,1-Trichloroethane	115000	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.01	0.02	0.03	0.02										0.0	0.0	0.0	0	
1,1,2-Trichloroethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,1,2,2-Tetrachloroethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
cis-1,3-Dichloropropene		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,2-Dichloropropane	2400	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01										0.0	0.0	0.0	0	
Bromodichloromethane		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
Trichloroethylene	12	0.04	0.03	0.02	0.01	0.04	0.01	0.01	0.01	0.04	0.02	0.01	0.00	0.01	0.01	0.07	0.02	0.10	0.02	0.01	0.01	0.04	0.02										0.0	0.1	0.0	0	
Tetrachloroethylene	360	0.10	0.06	0.07	0.03	0.08	0.06	0.03	0.03	0.05	0.08	0.08	0.04	0.08	0.06	0.14	0.23	0.10	0.09	0.03	0.06	0.42	0.11										0.1	0.4	0.0	0	
Benzene	100 (URT)	1.62	0.54	2.36	0.82	0.93	1.34	0.99	0.65	2.46	3.12	0.99	0.47	0.76	4.28	2.14	3.18	1.04	1.13	0.67	0.46	2.12	0.80										1.5	4.3	0.5	0	
Toluene	2000	2.28	0.70	2.66	1.20	1.63	0.60	2.37	0.85	0.59	1.02	3.32	2.15	5.26	1.48	2.77	5.45	4.87	2.91	2.68	2.52	9.11	3.21										2.7	9.1	0.6	0	
Ethylbenzene	1000	0.52	0.11	0.42	0.14	0.19	0.10	0.39	0.11	0.10	0.12	0.35	0.33	0.60	0.22	1.26	0.57	0.77	0.48	0.32	4.36	0.88	0.37										0.6	4.4	0.1	0	
m / p-Xylene	730	1.79	0.25	1.23	0.31	0.48	0.27	1.19	0.27	0.34	0.47	0.89	1.20	1.89	0.76	4.66	1.76	2.42	1.38	0.92	15.76	2.86	1.12										1.9	15.8	0.2	0	
o-Xylene	730	0.68	0.08	0.39	0.11	0.16	0.10	0.39	0.10	0.12	0.17	0.34	0.43	0.64	0.27	1.39	0.58	0.79	0.49	0.30	4.55	0.85	0.36										0.6	4.6	0.1	0	
Styrene	400	0.08	0.01	0.08	0.00	0.03	0.03	0.01	0.02	0.05	0.33	0.07	0.06	0.17	0.16	0.20	0.35	0.10	0.15	0.06	0.03	0.13	0.02										0.1	0.3	0.0	0	
1,3,5-Trimethylbenzene	220	0.15	0.01	0.08	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.09	0.13	0.13	0.11	0.14	0.16	0.20	0.13	0.07	0.20	0.16	0.07										0.1	0.2	0.0	0	
1,2,4-Trimethylbenzene	220	0.47	0.02	0.26	0.04	0.03	0.06	0.06	0.10	0.09	0.11	0.33	0.40	0.43	0.27	0.47	0.50	0.68	0.42	0.27	0.70	0.56	0.24										0.3	0.7	0.0	0	
Chlorobenzene		0.01	0.01	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,3-Dichlorobenzene		0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
1,4-Dichlorobenzene	95	0.05	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.03	0.05	0.01	0.05	0.04	0.05	0.05	0.08	0.08	0.06	0.02	0.10	0.04										0.0	0.1	0.0	0	
1,2-Dichlorobenzene		0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00										0.0	0.0	0.0	x	
n-Hexane	2500	1.77	1.49	13.95	6.65	5.35	0.22	6.21	18.71	0.08	0.11	11.32	13.42	9.20	0.32	3.32	8.02	7.04	5.54	7.80	5.94	11.78	7.00										6.6	18.7	0.1	0	
Cyclohexane	6100	0.23	0.08	0.31	0.15	0.16	0.06	0.33	0.24	0.03	0.04	0.30	0.23	0.49	0.12	0.22	0.51	0.62	0.52	0.46	0.27	0.77	0.48										0.3	0.8	0.0	0	
Isoprene		0.04	0.02	0.03	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.06	0.05	0.12	0.04	0.11	0.12	0.65	0.34	0.15	0.19	0.18	0.15										0.1	0.6	0.0	x	
Alpha-Pinene		0.10	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.13	0.06	0.11	0.17	0.25	0.26	0.23	0.24	0.06	0.10	0.26	0.10										0.1	0.3	0.0	x	
Naphthalene	22.5	0.35	0.00	0.52	0.01	0.01	0.14	0.01	0.03	1.64	4.80	0.51	0.10	0.16	6.96	3.64	5.48	0.47	0.59	0.09	0.11	1.18	0.10										1.2	7.0	0.0	0	
1,3-Butadiene	300 (URT)	0.08	0.04	0.09	0.03	0.06	0.02	0.04	0.02	0.02	0.02	0.04	0.03	0.03	0.04	0.03	0.05	0.05	0.04	0.03	0.03	0.05	0.04										0.0	0.1	0.0	0	

APPENDIX IV
Meteorological Data

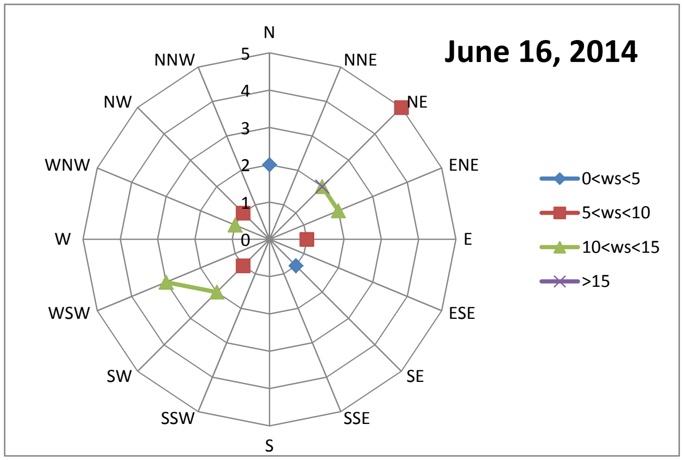
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (Deg)	Compass	Wind Spd (km/h)	Stn Press	Weather
04/06/2014 22:00	2014	6	4	22:00	13.6	31	310	NW	9	98.11	Mainly Clear
04/06/2014 18:00	2014	6	4	18:00	19.6	32	320	NW	12	98.08	NA
04/06/2014 23:00	2014	6	4	23:00	13.1	32	320	NW	14	98.1	NA
04/06/2014 19:00	2014	6	4	19:00	18	32	320	NW	15	98.13	Mostly Cloudy
04/06/2014 1:00	2014	6	4	1:00	11	21	210	SSW	8	98.43	Clear
04/06/2014 2:00	2014	6	4	2:00	11.3	21	210	SSW	10	98.42	NA
04/06/2014 3:00	2014	6	4	3:00	11.2	20	200	SSW	11	98.41	NA
04/06/2014 4:00	2014	6	4	4:00	11.7	21	210	SSW	11	98.38	Clear
04/06/2014 10:00	2014	6	4	10:00	19.7	23	230	SW	8	98.38	Mostly Cloudy
04/06/2014 9:00	2014	6	4	9:00	18.5	23	230	SW	10	98.43	NA
04/06/2014 21:00	2014	6	4	21:00	15.7	28	280	W	8	98.15	NA
04/06/2014 16:00	2014	6	4	16:00	20.2	26	260	W	16	98.14	Cloudy
04/06/2014 17:00	2014	6	4	17:00	20.3	26	260	W	16	98.07	NA
04/06/2014 6:00	2014	6	4	6:00	13.3	26	260	W	9	98.5	NA
04/06/2014 8:00	2014	6	4	8:00	17.8	30	300	WNW	5	98.5	NA
04/06/2014 20:00	2014	6	4	20:00	16.5	30	300	WNW	8	98.13	NA
04/06/2014 0:00	2014	6	4	0:00	12.2	24	240	WSW	8	98.41	NA
04/06/2014 5:00	2014	6	4	5:00	11.8	24	240	WSW	9	98.41	NA
04/06/2014 7:00	2014	6	4	7:00	15.6	25	250	WSW	9	98.48	Mainly Clear
04/06/2014 12:00	2014	6	4	12:00	20.3	25	250	WSW	11	98.35	NA
04/06/2014 15:00	2014	6	4	15:00	19.7	25	250	WSW	14	98.17	NA
04/06/2014 11:00	2014	6	4	11:00	19.9	25	250	WSW	17	98.41	NA
04/06/2014 14:00	2014	6	4	14:00	20	24	240	WSW	17	98.22	NA
04/06/2014 13:00	2014	6	4	13:00	20.4	24	240	WSW	19	98.29	Cloudy

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)	Number of Events
N						
NNE						
NE						
ENE						
E						
ESE						
SE						
SSE						
S						
SSW		1	3		10	4
SW		1	1		9	2
WSW		3	2	3	13	8
W		2		2	12.25	4
WNW		2			6.5	2
NW		1	3		12.5	4



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (Deg)	Compass	Wind Spd (	Weather
16/06/2014 7:00	2014	6	16	7:00	15.6	9	90	E	5	Mostly Cloudy
16/06/2014 16:00	2014	6	16	16:00	24.2	6	60	ENE	12	Mostly Cloudy
16/06/2014 15:00	2014	6	16	15:00	25.6	7	70	ENE	14	NA
16/06/2014 17:00	2014	6	16	17:00	26.5	36	360	N	4	NA
16/06/2014 14:00	2014	6	16	14:00	25.8	36	360	N	1	Thunderstorms,Rain S
16/06/2014 6:00	2014	6	16	6:00	13.9	5	50	NE	6	NA
16/06/2014 3:00	2014	6	16	3:00	11.1	4	40	NE	8	NA
16/06/2014 2:00	2014	6	16	2:00	10.7	5	50	NE	9	NA
16/06/2014 4:00	2014	6	16	4:00	12.2	5	50	NE	9	Cloudy
16/06/2014 5:00	2014	6	16	5:00	13.2	5	50	NE	9	NA
16/06/2014 23:00	2014	6	16	23:00	16.9	4	40	NE	11	NA
16/06/2014 22:00	2014	6	16	22:00	17	4	40	NE	13	Mainly Clear
16/06/2014 0:00	2014	6	16	0:00	11.2	4	40	NE	16	NA
16/06/2014 1:00	2014	6	16	1:00	10.9	5	50	NE	16	Mainly Clear
16/06/2014 19:00	2014	6	16	19:00	27.1	32	320	NW	6	Mainly Clear
16/06/2014 8:00	2014	6	16	8:00	19.1	12	120	SE	4	NA
16/06/2014 20:00	2014	6	16	20:00	24	22	220	SW	6	NA
16/06/2014 9:00	2014	6	16	9:00	23	22	220	SW	12	NA
16/06/2014 12:00	2014	6	16	12:00	27.5	22	220	SW	14	NA
16/06/2014 21:00	2014	6	16	21:00	22.6	26	260	W	7	NA
16/06/2014 18:00	2014	6	16	18:00	28.5	29	290	WNW	14	NA
16/06/2014 13:00	2014	6	16	13:00	28.6	24	240	WSW	10	Mostly Cloudy
16/06/2014 11:00	2014	6	16	11:00	26.1	25	250	WSW	11	NA
16/06/2014 10:00	2014	6	16	10:00	24.9	25	250	WSW	12	Mostly Cloudy

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)	Number of Events
N	2				2.5	
NNE						
NE		5	2	2	10.77777778	
ENE			2		9.739130435	
E		1			5	
ESE						
SE	1				4	
SSE						
S						
SSW						
SW		1	2		10.66666667	
WSW			3		11	
W						
WNW			1		14	
NW		1			6	
NNW						



Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (deg	Wind Spd (km/h)	Compass	Weather
2014	6	28	7:00	20.7	6	60	8	ENE	Mainly Clear
2014	6	28	17:00	26.4	6	60	19	ENE	NA
2014	6	28	10:00	26.3	36	360	2	N	Mostly Cloudy
2014	6	28	23:00	17.8	5	50	7	NE	NA
2014	6	28	4:00	17.2	4	40	8	NE	Mainly Clear
2014	6	28	22:00	19.7	5	50	8	NE	Clear
2014	6	28	3:00	16.9	5	50	9	NE	NA
2014	6	28	5:00	16.1	4	40	9	NE	NA
2014	6	28	21:00	20	4	40	10	NE	NA
2014	6	28	0:00	18.5	5	50	11	NE	NA
2014	6	28	1:00	18.4	4	40	12	NE	Clear
2014	6	28	15:00	28.1	4	40	12	NE	NA
2014	6	28	2:00	17.6	5	50	13	NE	NA
2014	6	28	13:00	27.5	4	40	13	NE	Mostly Cloudy
2014	6	28	18:00	25.7	5	50	15	NE	NA
2014	6	28	20:00	21.2	5	50	16	NE	NA
2014	6	28	14:00	27.1	4	40	17	NE	NA
2014	6	28	16:00	27.7	4	40	17	NE	Mostly Cloudy
2014	6	28	6:00	18.7	2	20	8	NNE	NA
2014	6	28	19:00	23.9	3	30	13	NNE	Mainly Clear
2014	6	28	12:00	28.6	17	170	6	S	NA
2014	6	28	11:00	27.7	19	190	7	S	NA
2014	6	28	8:00	23.1	14	140	6	SE	NA
2014	6	28	9:00	24.9	12	120	8	ESE	NA

0<ws<5	5<ws<10	10<ws<15	>15
1	0	0	0
0	1	1	0
0	5	6	4
0	1	0	1
0	0	0	1
0	1	0	0
0	1	0	0
0	0	0	0
0	2	0	0
0	0	0	0
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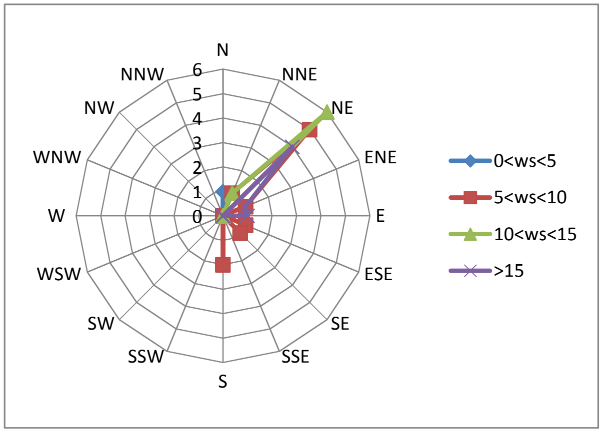
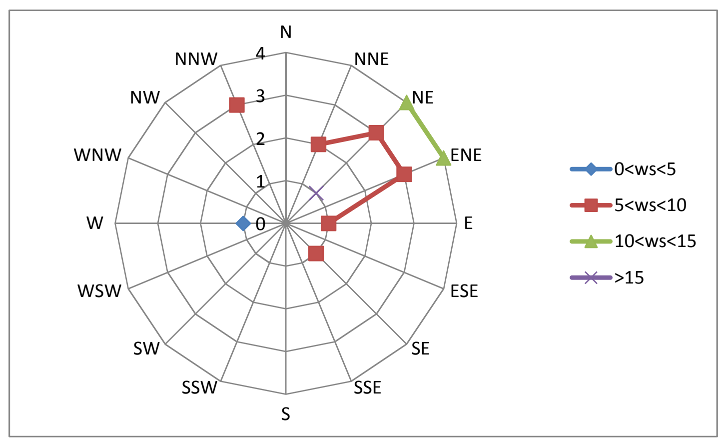
0	0	0	0
0	0	0	0



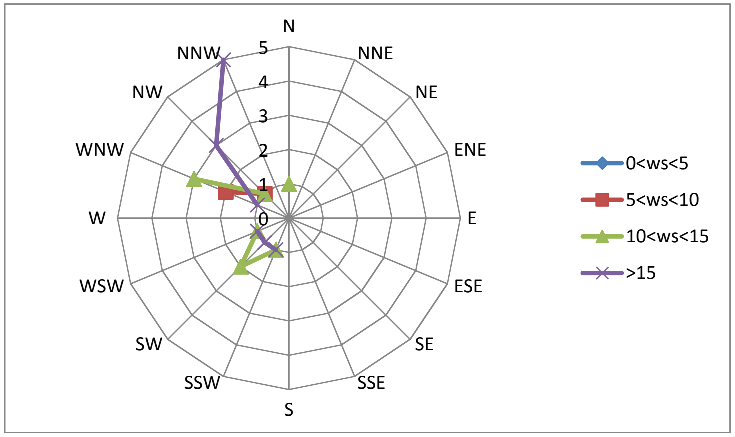
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Dir (Deg)	Compass	Wind Spd	Weather
10/07/2014 15:00	2014	7	10	15:00	22.1	8	80	E	9	NA
10/07/2014 10:00	2014	7	10	10:00	18.8	7	70	ENE	9	Mainly Clear
10/07/2014 13:00	2014	7	10	13:00	20.6	7	70	ENE	9	Mostly Cloudy
10/07/2014 22:00	2014	7	10	22:00	15.8	6	60	ENE	9	Mainly Clear
10/07/2014 7:00	2014	7	10	7:00	15.9	6	60	ENE	11	Clear
10/07/2014 9:00	2014	7	10	9:00	17.8	6	60	ENE	12	NA
10/07/2014 17:00	2014	7	10	17:00	20.5	6	60	ENE	12	NA
10/07/2014 19:00	2014	7	10	19:00	18.9	7	70	ENE	13	Mainly Clear
10/07/2014 8:00	2014	7	10	8:00	17.2	6	60	ENE	14	NA
10/07/2014 23:00	2014	7	10	23:00	14.8	5	50	NE	5	NA
10/07/2014 6:00	2014	7	10	6:00	13.4	4	40	NE	9	NA
10/07/2014 11:00	2014	7	10	11:00	19.5	4	40	NE	9	NA
10/07/2014 5:00	2014	7	10	5:00	10.7	5	50	NE	10	NA
10/07/2014 20:00	2014	7	10	20:00	15.8	5	50	NE	10	NA
10/07/2014 12:00	2014	7	10	12:00	20.3	5	50	NE	11	NA
10/07/2014 21:00	2014	7	10	21:00	15.1	4	40	NE	12	NA
10/07/2014 18:00	2014	7	10	18:00	19.9	5	50	NE	18	NA
10/07/2014 3:00	2014	7	10	3:00	13.1	3	30	NNE	7	NA
10/07/2014 4:00	2014	7	10	4:00	11.1	3	30	NNE	8	Clear
10/07/2014 2:00	2014	7	10	2:00	12.2	35	350	NNW	5	NA
10/07/2014 0:00	2014	7	10	0:00	14	34	340	NNW	7	NA
10/07/2014 1:00	2014	7	10	1:00	13.7	35	350	NNW	7	Clear
10/07/2014 14:00	2014	7	10	14:00	21.1	12	120	SE	5	NA
10/07/2014 16:00	2014	7	10	16:00	22.3	26	260	W	4	Mainly Clear

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N					
NNE		2			7.5
NE		3	4	1	10.5
ENE		3	4		11.125
E		1			9
ESE					
SE		1			5
SSE					
S					
SSW					
SW					
WSW					
W	1				4
WNW					
NW					
NNW		3			6.333333



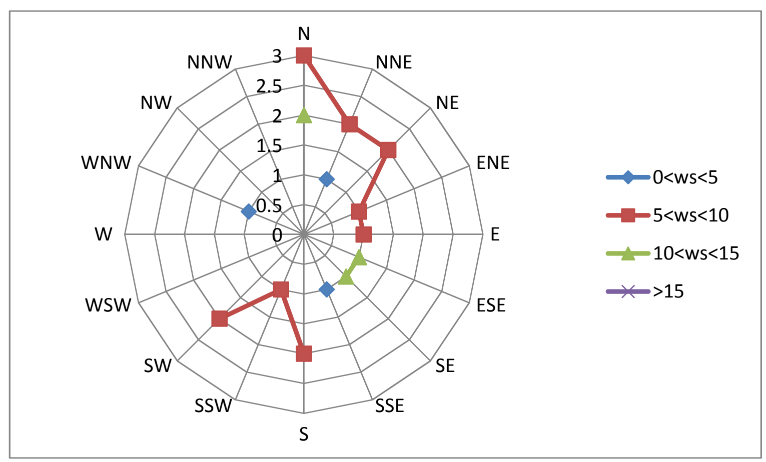
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Dir (deg)	Compass	Wind Spd (	Weather
23/07/2014 20:00	2014	7	23	20:00	16.9	36	360	N	10	NA
23/07/2014 9:00	2014	7	23	9:00	19.8	33	330	NNW	17	NA
23/07/2014 19:00	2014	7	23	19:00	18.2	34	340	NNW	19	Mostly Cloudy
23/07/2014 18:00	2014	7	23	18:00	18.1	33	330	NNW	21	NA
23/07/2014 16:00	2014	7	23	16:00	19.9	33	330	NNW	25	Mostly Cloudy
23/07/2014 17:00	2014	7	23	17:00	18.6	34	340	NNW	26	NA
23/07/2014 22:00	2014	7	23	22:00	14.6	32	320	NW	7	Clear
23/07/2014 10:00	2014	7	23	10:00	20.8	32	320	NW	13	Mostly Cloudy
23/07/2014 13:00	2014	7	23	13:00	22	32	320	NW	17	Mostly Cloudy
23/07/2014 14:00	2014	7	23	14:00	22.2	31	310	NW	19	NA
23/07/2014 15:00	2014	7	23	15:00	22.5	32	320	NW	21	NA
23/07/2014 0:00	2014	7	23	0:00	22.2	20	200	SSW	12	NA
23/07/2014 4:00	2014	7	23	4:00	21.6	21	210	SSW	18	Thunderstorms,Rain Showers
23/07/2014 2:00	2014	7	23	2:00	23.3	22	220	SW	13	NA
23/07/2014 5:00	2014	7	23	5:00	21.6	22	220	SW	14	Fog
23/07/2014 1:00	2014	7	23	1:00	23.5	22	220	SW	16	Mostly Cloudy
23/07/2014 21:00	2014	7	23	21:00	15.9	30	300	WNW	7	NA
23/07/2014 23:00	2014	7	23	23:00	14.1	30	300	WNW	8	NA
23/07/2014 11:00	2014	7	23	11:00	20.7	30	300	WNW	10	NA
23/07/2014 7:00	2014	7	23	7:00	22	30	300	WNW	12	Cloudy
23/07/2014 8:00	2014	7	23	8:00	20.6	29	290	WNW	13	NA
23/07/2014 12:00	2014	7	23	12:00	21.5	34	340	WNW	15	NA
23/07/2014 3:00	2014	7	23	3:00	22.4	25	250	WSW	13	Thunderstorms,Rain Showers
23/07/2014 6:00	2014	7	23	6:00	21.5	25	250	WSW	23	NA

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N			1		10
NNE					
NE					
ENE					
E					
ESE					
SE					
SSE					
S					
SSW			1	1	15
SW			2	1	14.33333
WSW			1	1	18
W					
WNW		2	3	1	10.83333
NW		1	1	3	15.4
NNW				5	21.6



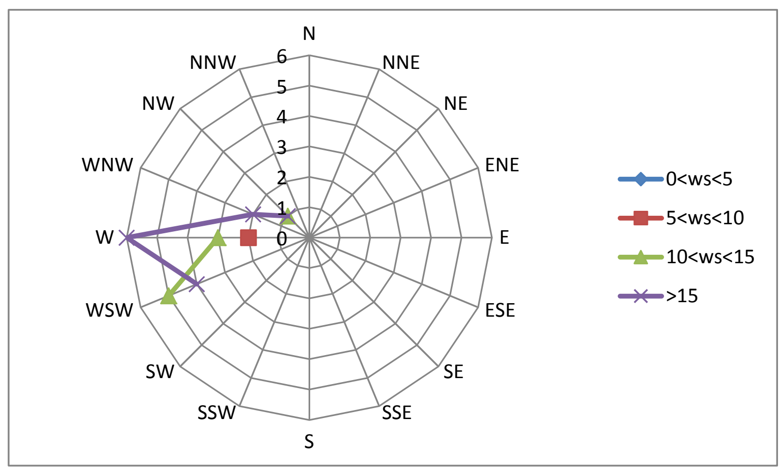
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Dir (deg)	Compass	Wind Spd (km	Weather
03/08/2014 8:00	2014	8	3	8:00	19.9	10	100	E	8	NA
03/08/2014 6:00	2014	8	3	6:00	17.8	7	70	ENE	8	NA
03/08/2014 17:00	2014	8	3	17:00	25	11	110	ESE	13	NA
03/08/2014 5:00	2014	8	3	5:00	17.2	1	10	N	6	NA
03/08/2014 3:00	2014	8	3	3:00	17.7	36	360	N	7	NA
03/08/2014 4:00	2014	8	3	4:00	17.8	36	360	N	7	Cloudy
03/08/2014 14:00	2014	8	3	14:00	24.6	1	10	N	10	NA
03/08/2014 15:00	2014	8	3	15:00	24.1	36	360	N	10	NA
03/08/2014 10:00	2014	8	3	10:00	22.2	4	40	NE	5	Mostly Cloudy
03/08/2014 9:00	2014	8	3	9:00	20.8	4	40	NE	8	NA
03/08/2014 1:00	2014	8	3	1:00	18	2	20	NNE	4	Cloudy
03/08/2014 13:00	2014	8	3	13:00	24.4	3	30	NNE	8	Cloudy
03/08/2014 16:00	2014	8	3	16:00	24.2	2	20	NNE	9	Cloudy
03/08/2014 11:00	2014	8	3	11:00	23.2	34	340	NNW	7	NA
03/08/2014 12:00	2014	8	3	12:00	24	32	320	NW	4	NA
03/08/2014 2:00	2014	8	3	2:00	17.4	31	310	NW	7	NA
03/08/2014 21:00	2014	8	3	21:00	18.9	19	190	S	7	NA
03/08/2014 19:00	2014	8	3	19:00	21.7	19	190	S	9	Mostly Cloudy
03/08/2014 18:00	2014	8	3	18:00	22.9	13	130	SE	14	NA
03/08/2014 0:00	2014	8	3	0:00	19	15	150	SSE	4	NA
03/08/2014 20:00	2014	8	3	20:00	19.9	20	200	SSW	9	NA
03/08/2014 22:00	2014	8	3	22:00	18.7	22	220	SW	5	Mostly Cloudy
03/08/2014 23:00	2014	8	3	23:00	18.3	22	220	SW	7	NA
03/08/2014 7:00	2014	8	3	7:00	18.7	29	290	WNW	4	Cloudy

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N		3	2		8
NNE	1	2			7
NE		2			6.5
ENE		1			8
E		1			8
ESE			1		13
SE			1		14
SSE	1				4
S		2			8
SSW		1			9
SW		2			6
WSW					
W					
WNW	1				4
NW					
NNW					



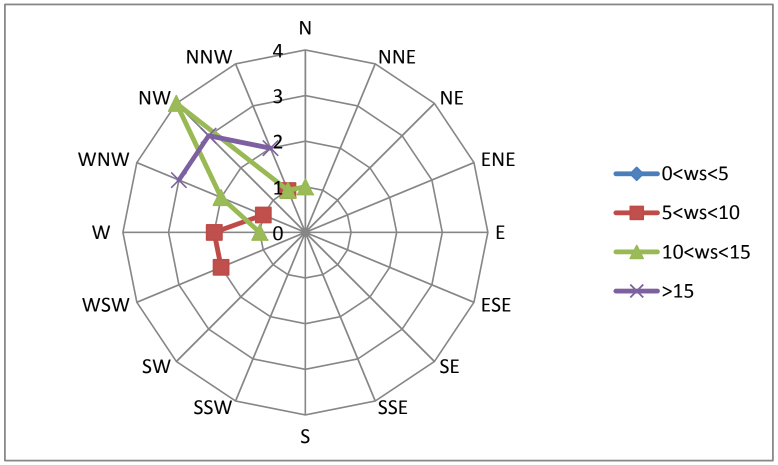
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Dir (deg)	Compass	Wind Spd (	Weather
13/08/2014 19:00	2014	8	13	19:00	15.7	31	310	NW	10	Mainly Clear
13/08/2014 18:00	2014	8	13	18:00	17.3	32	320	NW	22	NA
13/08/2014 0:00	2014	8	13	0:00	16.2	26	260	W	9	NA
13/08/2014 20:00	2014	8	13	20:00	13.6	26	260	W	9	NA
13/08/2014 1:00	2014	8	13	1:00	15.6	26	260	W	11	Mainly Clear
13/08/2014 6:00	2014	8	13	6:00	16	26	260	W	12	NA
13/08/2014 4:00	2014	8	13	4:00	15.8	27	270	W	13	Mostly Cloudy
13/08/2014 2:00	2014	8	13	2:00	15.8	26	260	W	15	NA
13/08/2014 10:00	2014	8	13	10:00	17.7	26	260	W	19	Mostly Cloudy
13/08/2014 12:00	2014	8	13	12:00	19.5	26	260	W	21	NA
13/08/2014 15:00	2014	8	13	15:00	17.4	27	270	W	24	NA
13/08/2014 13:00	2014	8	13	13:00	18.8	27	270	W	25	Mostly Cloudy
13/08/2014 14:00	2014	8	13	14:00	17.1	27	270	W	27	NA
13/08/2014 16:00	2014	8	13	16:00	18.4	29	290	WNW	28	Mostly Cloudy
13/08/2014 17:00	2014	8	13	17:00	17.5	29	290	WNW	31	NA
13/08/2014 21:00	2014	8	13	21:00	12.2	25	250	WSW	10	NA
13/08/2014 7:00	2014	8	13	7:00	16.1	25	250	WSW	11	Mostly Cloudy
13/08/2014 22:00	2014	8	13	22:00	11.2	25	250	WSW	11	Mainly Clear
13/08/2014 23:00	2014	8	13	23:00	11.8	25	250	WSW	13	NA
13/08/2014 3:00	2014	8	13	3:00	15.8	25	250	WSW	14	NA
13/08/2014 5:00	2014	8	13	5:00	16.3	25	250	WSW	16	NA
13/08/2014 9:00	2014	8	13	9:00	17.9	25	250	WSW	21	NA
13/08/2014 8:00	2014	8	13	8:00	17.1	25	250	WSW	22	NA
13/08/2014 11:00	2014	8	13	11:00	19.2	25	250	WSW	26	NA

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N					
NNE					
NE					
ENE					
E					
ESE					
SE					
SSE					
S					
SSW					
SW					
WSW			5	4	16
W		2	3	6	16.81818
WNW				2	29.5
NW			1	1	16
NNW					



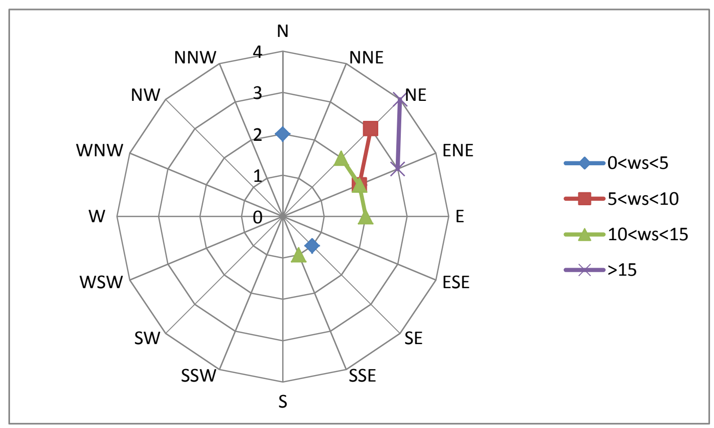
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Dir (Deg)	Compass	Wind Spd	Weather
27/08/2014 10:00	2014	8	27	10:00	21.2	36	360	N	14	Mainly Clear
27/08/2014 4:00	2014	8	27	4:00	18.7	34	340	NNW	7	Mainly Clear
27/08/2014 21:00	2014	8	27	21:00	15.1	33	330	NNW	12	NA
27/08/2014 3:00	2014	8	27	3:00	20.3	33	330	NNW	19	NA
27/08/2014 20:00	2014	8	27	20:00	16.9	33	330	NNW	25	NA
27/08/2014 8:00	2014	8	27	8:00	18.9	31	310	NW	11	NA
27/08/2014 9:00	2014	8	27	9:00	20	31	310	NW	12	NA
27/08/2014 11:00	2014	8	27	11:00	21.9	32	320	NW	12	NA
27/08/2014 2:00	2014	8	27	2:00	22.3	32	320	NW	14	NA
27/08/2014 19:00	2014	8	27	19:00	18.6	32	320	NW	16	Clear
27/08/2014 18:00	2014	8	27	18:00	20.6	32	320	NW	18	NA
27/08/2014 17:00	2014	8	27	17:00	21.9	32	320	NW	20	NA
27/08/2014 22:00	2014	8	27	22:00	14.3	27	270	W	5	Clear
27/08/2014 5:00	2014	8	27	5:00	17.8	27	270	W	7	NA
27/08/2014 13:00	2014	8	27	13:00	22.7	27	270	W	14	Mostly Cloudy
27/08/2014 6:00	2014	8	27	6:00	16.9	29	290	WNW	8	NA
27/08/2014 12:00	2014	8	27	12:00	23.2	30	300	WNW	10	NA
27/08/2014 7:00	2014	8	27	7:00	18.1	30	300	WNW	11	Mainly Clear
27/08/2014 14:00	2014	8	27	14:00	23.7	29	290	WNW	15	NA
27/08/2014 15:00	2014	8	27	15:00	23.2	29	290	WNW	20	NA
27/08/2014 16:00	2014	8	27	16:00	23	30	300	WNW	20	Mainly Clear
27/08/2014 1:00	2014	8	27	1:00	22	25	250	WSW	8	Cloudy
27/08/2014 0:00	2014	8	27	0:00	21.8	25	250	WSW	9	NA

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N			1		14
NNE					
NE					
ENE					
E					
ESE					
SE					
SSE					
S					
SSW					
SW					
WSW		2			8.5
W		2	1		8.666667
WNW		1	2	3	14
NW			4	3	14.71429
NNW		1	1	2	15.75



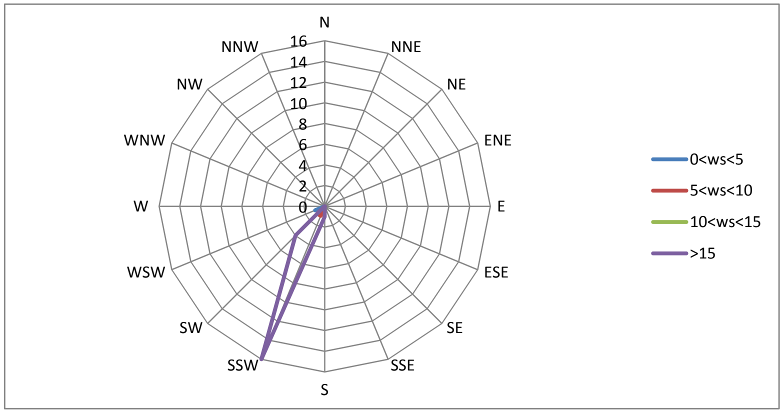
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (deg)	Compass	Wind Spd (km/h)	Weather
08/09/2014 9:00	2014	9	8	9:00	18.1	8	80	E	13	NA
08/09/2014 11:00	2014	9	8	11:00	21.5	9	90	E	13	NA
08/09/2014 3:00	2014	9	8	3:00	10.3	6	60	ENE	4	NA
08/09/2014 4:00	2014	9	8	4:00	10.3	6	60	ENE	10	Clear
08/09/2014 6:00	2014	9	8	6:00	10.6	6	60	ENE	11	NA
08/09/2014 8:00	2014	9	8	8:00	16.1	7	70	ENE	12	NA
08/09/2014 10:00	2014	9	8	10:00	19.8	7	70	ENE	9	Clear
08/09/2014 13:00	2014	9	8	13:00	22	6	60	ENE	21	Mainly Clear
08/09/2014 15:00	2014	9	8	15:00	21.5	7	70	ENE	21	NA
08/09/2014 17:00	2014	9	8	17:00	20.2	7	70	ENE	22	NA
08/09/2014 22:00	2014	9	8	22:00	15.9	7	70	ENE	5	Mainly Clear
08/09/2014 1:00	2014	9	8	1:00	12.4	36	360	N	3	Clear
08/09/2014 2:00	2014	9	8	2:00	12.8	0	0	N	1	NA
08/09/2014 5:00	2014	9	8	5:00	11.2	5	50	NE	10	NA
08/09/2014 7:00	2014	9	8	7:00	13.2	5	50	NE	9	Clear
08/09/2014 12:00	2014	9	8	12:00	21.1	4	40	NE	16	NA
08/09/2014 14:00	2014	9	8	14:00	22	4	40	NE	19	NA
08/09/2014 16:00	2014	9	8	16:00	21.3	4	40	NE	21	Mainly Clear
08/09/2014 18:00	2014	9	8	18:00	18.6	5	50	NE	19	NA
08/09/2014 19:00	2014	9	8	19:00	17.1	4	40	NE	15	Mainly Clear
08/09/2014 20:00	2014	9	8	20:00	16.9	5	50	NE	13	NA
08/09/2014 21:00	2014	9	8	21:00	16.2	5	50	NE	8	NA
08/09/2014 0:00	2014	9	8	0:00	12.7	13	130	SE	3	NA
08/09/2014 23:00	2014	9	8	23:00	17.4	15	150	SSE	13	NA

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N	2				8.5
NNE					
NE		3	2	4	14.4
ENE	2	2	2	3	12.8
E			2		13
ESE					
SE	1				3
SSE			1		13
S					
SSW					
SW					
WSW					
W					
WNW					
NW					
NNW					



Date/Time	Year	Month	Day	Time	Data Quali	Temp (°C)	Dew Point	Rel Hum (%	Wind Dir (1	Wind Spd (	Visibility (k	Stn Press (	Hmdx	Weather
20/09/2014 0:00	2014	9	20	0:00	**	7.9	7.5	97	25	4	24.1	98.98		NA
20/09/2014 1:00	2014	9	20	1:00	**	7.6	7.2	97	21	9	24.1	98.95		Mainly Clear
20/09/2014 2:00	2014	9	20	2:00	**	8.3	7.9	97	22	8	24.1	98.91		NA
20/09/2014 3:00	2014	9	20	3:00	**	11.8	11.5	98	19	16	24.1	98.84		NA
20/09/2014 4:00	2014	9	20	4:00	**	14.7	14.1	96	20	18	24.1	98.81		Mainly Clear
20/09/2014 5:00	2014	9	20	5:00	**	15	14.4	96	20	16	16.1	98.82		NA
20/09/2014 6:00	2014	9	20	6:00	**	15.3	14.7	96	21	21	12.9	98.87		NA
20/09/2014 7:00	2014	9	20	7:00	**	16.3	15.4	94	21	26	24.1	98.79		Mostly Cloudy
20/09/2014 8:00	2014	9	20	8:00	**	17.4	15.9	91	20	27	19.3	98.81		NA
20/09/2014 9:00	2014	9	20	9:00	**	18.7	16.2	85	21	23	24.1	98.77		NA
20/09/2014 10:00	2014	9	20	10:00	**	20	15.9	77	21	33	24.1	98.71	25	Mostly Cloudy
20/09/2014 11:00	2014	9	20	11:00	**	20.8	15.9	73	22	36	24.1	98.63	25	NA
20/09/2014 12:00	2014	9	20	12:00	**	21.6	16.4	72	21	29	24.1	98.51	26	NA
20/09/2014 13:00	2014	9	20	13:00	**	22.6	17.2	71	20	30	24.1	98.4	28	Mostly Cloudy
20/09/2014 14:00	2014	9	20	14:00	**	23.2	16.1	64	21	36	24.1	98.31	28	NA
20/09/2014 15:00	2014	9	20	15:00	**	23	16.2	65	21	32	24.1	98.32	28	NA
20/09/2014 16:00	2014	9	20	16:00	**	23.4	15.6	61	22	38	24.1	98.29	28	Mostly Cloudy
20/09/2014 17:00	2014	9	20	17:00	**	23	15.9	64	22	31	24.1	98.24	28	NA
20/09/2014 18:00	2014	9	20	18:00	**	21.3	16.1	72	20	23	24.1	98.15	26	NA
20/09/2014 19:00	2014	9	20	19:00	**	20.6	16.7	78	21	25	24.1	98.13	26	Rain Showers
20/09/2014 20:00	2014	9	20	20:00	**	20.9	17.2	79	21	25	24.1	98.14	26	NA
20/09/2014 21:00	2014	9	20	21:00	**	21.4	17.1	76	21	29	24.1	98.12	27	NA
20/09/2014 22:00	2014	9	20	22:00	**	21	17.1	78	20	29	24.1	98.02	26	Mostly Cloudy
20/09/2014 23:00	2014	9	20	23:00	**	20.7	17	79	22	28	24.1	98	26	NA

Direction	0<ws<5	5<ws<10	10<ws<15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	1
SSW	0	1	0	16
SW	0	1	0	4
WSW	1	0	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (deg)	Compass	Wind Spd (km/h)	Weather
02/10/2014 2:00	2014	10	2	2:00	14.6	8	80	E	7	Fog
02/10/2014 9:00	2014	10	2	9:00	16.1	10	100	E	11	Fog
02/10/2014 23:00	2014	10	2	23:00	14.4	8	80	E	12	NA
02/10/2014 0:00	2014	10	2	0:00	14.7	6	60	ENE	16	Fog
02/10/2014 1:00	2014	10	2	1:00	14.7	6	60	ENE	12	Fog
02/10/2014 3:00	2014	10	2	3:00	14.5	7	70	ENE	9	Fog
02/10/2014 6:00	2014	10	2	6:00	14.7	6	60	ENE	10	Fog
02/10/2014 7:00	2014	10	2	7:00	14.8	7	70	ENE	14	Fog
02/10/2014 8:00	2014	10	2	8:00	15.5	6	60	ENE	11	Fog
02/10/2014 15:00	2014	10	2	15:00	18.6	7	70	ENE	17	NA
02/10/2014 16:00	2014	10	2	16:00	18.6	7	70	ENE	18	Mostly Cloudy
02/10/2014 22:00	2014	10	2	22:00	14	7	70	ENE	9	Fog
02/10/2014 4:00	2014	10	2	4:00	14.5	4	40	NE	7	Fog
02/10/2014 5:00	2014	10	2	5:00	14.4	5	50	NE	12	Fog
02/10/2014 14:00	2014	10	2	14:00	18.7	4	40	NE	19	NA
02/10/2014 17:00	2014	10	2	17:00	17.8	4	40	NE	10	NA
02/10/2014 18:00	2014	10	2	18:00	15.4	5	50	NE	14	Fog
02/10/2014 19:00	2014	10	2	19:00	14.8	5	50	NE	18	Fog
02/10/2014 20:00	2014	10	2	20:00	14.7	5	50	NE	17	Fog
02/10/2014 21:00	2014	10	2	21:00	14.6	5	50	NE	16	Fog
02/10/2014 10:00	2014	10	2	10:00	16.6	19	190	S	13	Fog
02/10/2014 12:00	2014	10	2	12:00	18.5	15	150	SSE	4	NA
02/10/2014 13:00	2014	10	2	13:00	20.5	15	150	SSE	5	Mostly Cloudy
02/10/2014 11:00	2014	10	2	11:00	16.2	20	200	SSW	9	Fog

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
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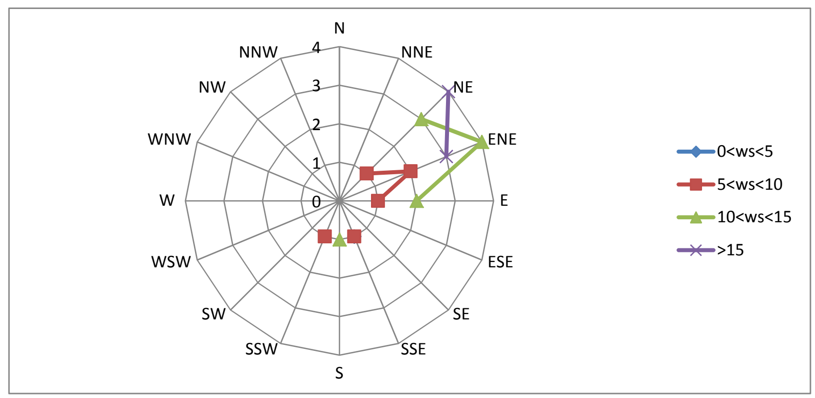
NE		1	3	4	14.125
ENE		2	4	3	12.88889
E		1	2		10
ESE					
SE					
SSE	1	1			4.5
S			1		13
SSW		1			9
SW					
WSW					
W					
WNW					



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14/10/2014 17:00	2014	10	14	17:00	22.1	12	120	ESE	19	NA
14/10/2014 0:00	2014	10	14	0:00	16.5	17	170	S	14	NA
14/10/2014 1:00	2014	10	14	1:00	16.4	17	170	S	22	Mainly Clear
14/10/2014 2:00	2014	10	14	2:00	16.3	18	180	S	21	NA
14/10/2014 4:00	2014	10	14	4:00	16	17	170	S	16	Mainly Clear
14/10/2014 5:00	2014	10	14	5:00	15.9	17	170	S	13	NA
14/10/2014 9:00	2014	10	14	9:00	20.5	17	170	S	25	NA
14/10/2014 10:00	2014	10	14	10:00	22.4	18	180	S	39	Mostly Cloudy
14/10/2014 11:00	2014	10	14	11:00	21.9	18	180	S	30	NA
14/10/2014 12:00	2014	10	14	12:00	20.5	17	170	S	23	Rain Showers
14/10/2014 13:00	2014	10	14	13:00	21.6	19	190	S	23	Rain Showers
14/10/2014 14:00	2014	10	14	14:00	22.2	17	170	S	17	NA
14/10/2014 15:00	2014	10	14	15:00	22.3	17	170	S	17	Rain Showers
14/10/2014 19:00	2014	10	14	19:00	20.1	17	170	S	19	Rain Showers
14/10/2014 23:00	2014	10	14	23:00	20.7	14	140	SE	14	NA
14/10/2014 3:00	2014	10	14	3:00	16.7	16	160	SSE	19	NA
14/10/2014 6:00	2014	10	14	6:00	15.4	15	150	SSE	13	NA
14/10/2014 7:00	2014	10	14	7:00	16.4	16	160	SSE	17	Mostly Cloudy
14/10/2014 8:00	2014	10	14	8:00	18.2	16	160	SSE	23	NA
14/10/2014 18:00	2014	10	14	18:00	21.7	16	160	SSE	25	Rain Showers
14/10/2014 20:00	2014	10	14	20:00	19.8	15	150	SSE	16	Rain Showers
14/10/2014 21:00	2014	10	14	21:00	20.2	15	150	SSE	12	Rain Showers
14/10/2014 22:00	2014	10	14	22:00	20.7	15	150	SSE	17	Rain Showers

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
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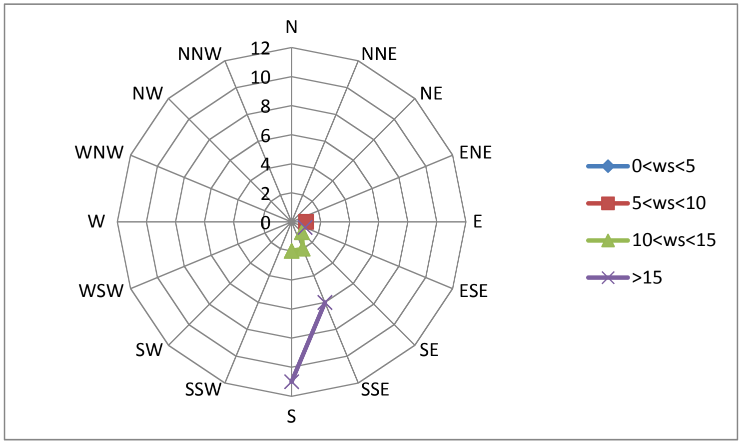
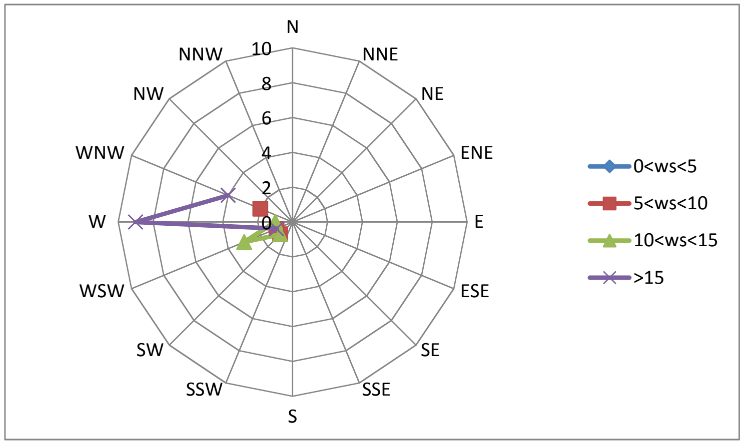
NNE					
NE					
ENE					
E		1			9
ESE				1	19
SE			1		14
SSE			2	6	17.75
S			2	11	21.46153846
SSW					
SW					
WSW					
W					
WNW					
NW					
NNW					



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (deg)	Compass	Wind Spd (km/h)	Weather
26/10/2014 5:00	2014	10	26	5:00	6.8	22	220	SW	11	NA
26/10/2014 21:00	2014	10	26	21:00	3.9	22	220	SW	8	NA
26/10/2014 0:00	2014	10	26	0:00	6.9	26	260	W	15	NA
26/10/2014 6:00	2014	10	26	6:00	9.1	28	280	W	23	NA
26/10/2014 7:00	2014	10	26	7:00	8.9	28	280	W	23	Mostly Cloudy
26/10/2014 8:00	2014	10	26	8:00	9.1	28	280	W	21	NA
26/10/2014 11:00	2014	10	26	11:00	9.5	28	280	W	23	NA
26/10/2014 12:00	2014	10	26	12:00	9.5	28	280	W	25	NA
26/10/2014 14:00	2014	10	26	14:00	10.2	28	280	W	22	NA
26/10/2014 15:00	2014	10	26	15:00	10.8	27	270	W	24	NA
26/10/2014 16:00	2014	10	26	16:00	9.6	28	280	W	27	Mostly Cloudy
26/10/2014 18:00	2014	10	26	18:00	7.2	28	280	W	13	NA
26/10/2014 9:00	2014	10	26	9:00	9.3	29	290	WNW	23	NA
26/10/2014 10:00	2014	10	26	10:00	9.8	30	300	WNW	33	Mostly Cloudy
26/10/2014 13:00	2014	10	26	13:00	9.9	29	290	WNW	19	Mostly Cloudy
26/10/2014 17:00	2014	10	26	17:00	8.9	30	300	WNW	18	NA
26/10/2014 22:00	2014	10	26	22:00	4.7	30	300	WNW	9	Clear
26/10/2014 23:00	2014	10	26	23:00	5.1	29	290	WNW	9	NA
26/10/2014 1:00	2014	10	26	1:00	6.7	25	250	WSW	13	Clear
26/10/2014 2:00	2014	10	26	2:00	6.5	24	240	WSW	13	NA
26/10/2014 3:00	2014	10	26	3:00	6.3	24	240	WSW	17	NA
26/10/2014 4:00	2014	10	26	4:00	6.1	24	240	WSW	13	Clear
26/10/2014 19:00	2014	10	26	19:00	5.3	24	240	WSW	7	Clear
26/10/2014 20:00	2014	10	26	20:00	5.2	24	240	WSW	4	NA

Direction	0<ws<5	5<ws<10	10<ws<15	>15	Avg ws (km/hr)
N					
NNE					
NE					
ENE					
E					
ESE					
SE					
SSE					
S					
SSW					
SW		1	1		9.5
WSW	1	1	3	1	11.16667
W			1	9	21.6
WNW		2		4	18.5
NW					
NNW					



Date/Time	Year	Month	Day	Time	Wind Dir (10s deg)	Wind Spd	Visibility (k	Stn Press	Weather
07/11/2014 0:00	2014	11	7	0:00	33	13	9.7	98.09	Rain Showers,Fog
07/11/2014 1:00	2014	11	7	1:00	32	21	24.1	98.11	Cloudy
07/11/2014 2:00	2014	11	7	2:00	33	23	24.1	98.15	Rain Showers
07/11/2014 3:00	2014	11	7	3:00	31	21	24.1	98.18	NA
07/11/2014 4:00	2014	11	7	4:00	31	19	24.1	98.21	Mostly Cloudy
07/11/2014 5:00	2014	11	7	5:00	31	20	24.1	98.3	NA
07/11/2014 6:00	2014	11	7	6:00	31	18	24.1	98.37	NA
07/11/2014 7:00	2014	11	7	7:00	30	16	24.1	98.44	Mainly Clear
07/11/2014 8:00	2014	11	7	8:00	30	21	24.1	98.5	NA
07/11/2014 9:00	2014	11	7	9:00	30	25	24.1	98.56	NA
07/11/2014 10:00	2014	11	7	10:00	30	17	24.1	98.59	Mostly Cloudy
07/11/2014 11:00	2014	11	7	11:00	32	22	24.1	98.66	Snow Showers
07/11/2014 12:00	2014	11	7	12:00	32	19	24.1	98.66	NA
07/11/2014 13:00	2014	11	7	13:00	31	20	24.1	98.63	Mostly Cloudy
07/11/2014 14:00	2014	11	7	14:00	31	15	24.1	98.64	NA
07/11/2014 15:00	2014	11	7	15:00	31	18	24.1	98.69	NA
07/11/2014 16:00	2014	11	7	16:00	33	13	24.1	98.72	Mostly Cloudy
07/11/2014 17:00	2014	11	7	17:00	31	12	24.1	98.77	NA
07/11/2014 18:00	2014	11	7	18:00	31	11	24.1	98.8	NA
07/11/2014 19:00	2014	11	7	19:00	32	8	24.1	98.81	Mostly Cloudy
07/11/2014 20:00	2014	11	7	20:00	34	6	24.1	98.8	NA
07/11/2014 21:00	2014	11	7	21:00	32	4	24.1	98.79	NA
07/11/2014 22:00	2014	11	7	22:00	8	5	24.1	98.73	Mainly Clear
07/11/2014 23:00	2014	11	7	23:00	21	4	24.1	98.71	NA

Data below copied in from a MATLAB program

Direction	0<ws<5	5<ws<10	10<ws<15	>15
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ENE	0	0	0	0
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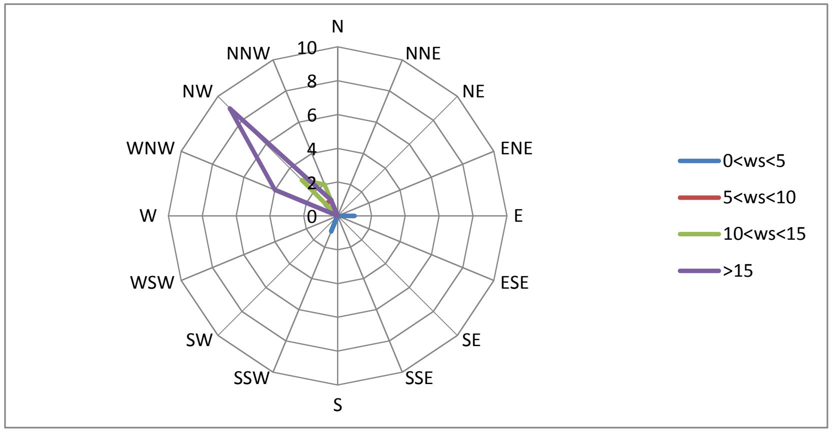
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	1	0	0	0
SW	0	0	0	0
WSW	0	0	0	0
W	0	0	0	0
WNW	0	0	0	4
NW	1	1	3	9
NNW	0	1	2	1



Date/Time	Year									
19/11/2014 15:00	2014	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Direc	Wind Spd	Compass	Weather
19/11/2014 16:00	2014	11	19	15:00	-5	18	180	19	S	Moderate Snow,Blowing Snow
19/11/2014 17:00	2014	11	19	16:00	-4.4	18	180	26	S	Snow,Blowing Snow
19/11/2014 18:00	2014	11	19	17:00	-3.8	19	190	24	S	Snow,Blowing Snow
19/11/2014 14:00	2014	11	19	18:00	-3.1	18	180	29	S	Snow,Blowing Snow
19/11/2014 9:00	2014	11	19	14:00	-5.4	16	160	16	SSE	Snow
19/11/2014 13:00	2014	11	19	9:00	-9.9	21	210	14	SSW	NA
19/11/2014 19:00	2014	11	19	13:00	-6.3	20	200	13	SSW	Snow
19/11/2014 6:00	2014	11	19	19:00	-2.1	20	200	30	SSW	Snow,Blowing Snow
19/11/2014 8:00	2014	11	19	6:00	-13	22	220	14	SW	NA
19/11/2014 10:00	2014	11	19	8:00	-11.6	19	190	13	S	NA
19/11/2014 20:00	2014	11	19	10:00	-8	23	230	17	SW	Snow Showers
19/11/2014 5:00	2014	11	19	20:00	-1.6	23	230	27	SW	Snow,Blowing Snow
19/11/2014 7:00	2014	11	19	5:00	-11.2	27	270	19	W	NA
19/11/2014 0:00	2014	11	19	7:00	-12.2	26	260	13	W	Mainly Clear
19/11/2014 1:00	2014	11	19	0:00	-9.9	24	240	31	WSW	NA
19/11/2014 2:00	2014	11	19	1:00	-10.2	24	240	25	WSW	Mainly Clear
19/11/2014 3:00	2014	11	19	2:00	-10.6	24	240	22	WSW	NA
19/11/2014 4:00	2014	11	19	3:00	-10.8	24	240	21	WSW	Blowing Snow
19/11/2014 11:00	2014	11	19	4:00	-10.9	25	250	25	WSW	Blowing Snow
19/11/2014 12:00	2014	11	19	11:00	-7.3	24	240	23	WSW	Snow Showers
19/11/2014 21:00	2014	11	19	12:00	-7.1	24	240	22	WSW	Snow
19/11/2014 22:00	2014	11	19	21:00	-1.2	24	240	30	WSW	Snow,Blowing Snow
19/11/2014 23:00	2014	11	19	22:00	-1.5	24	240	28	WSW	Snow,Blowing Snow
		11	19	23:00	-2.4	25	250	32	WSW	Snow Showers,Blowing Snow

Direction	0<ws<5	5<ws<10	10<ws<15	>15
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ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	1
S	0	0	1	4
SSW	0	0	2	1
SW	0	0	1	2
WSW	0	0	0	10
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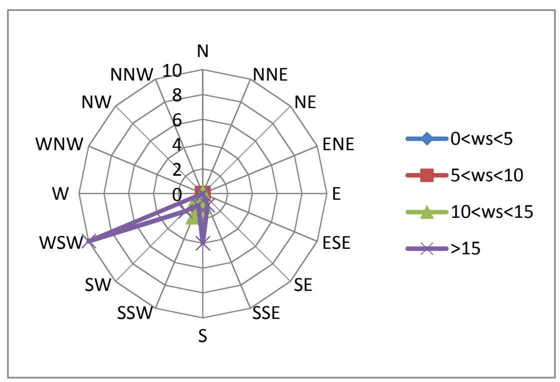
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s deg)	Wind Direction (deg)	Wind Spd (km/h)	Compass	
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01/12/2013 18:00	2013	12	1	18:00	1.8	3	30	3	NNE	Mostly Cloudy
01/12/2013 6:00	2013	12	1	6:00	1.4	18	180	9	S	NA
01/12/2013 7:00	2013	12	1	7:00	1.5	19	190	9	S	NA
01/12/2013 8:00	2013	12	1	8:00	1.6	18	180	8	S	Cloudy
01/12/2013 9:00	2013	12	1	9:00	2.2	18	180	10	S	NA
01/12/2013 10:00	2013	12	1	10:00	2.8	18	180	13	S	NA
01/12/2013 19:00	2013	12	1	19:00	1.5	17	170	4	S	Cloudy
01/12/2013 0:00	2013	12	1	0:00	1.5	21	210	23	SSW	NA
01/12/2013 1:00	2013	12	1	1:00	1	21	210	16	SSW	NA
01/12/2013 2:00	2013	12	1	2:00	1.7	21	210	14	SSW	Cloudy
01/12/2013 3:00	2013	12	1	3:00	1.7	20	200	12	SSW	Rain Showers
01/12/2013 4:00	2013	12	1	4:00	1.4	21	210	10	SSW	Rain Showers
01/12/2013 5:00	2013	12	1	5:00	1.1	20	200	8	SSW	Rain Showers
01/12/2013 11:00	2013	12	1	11:00	2.9	21	210	15	SSW	Rain Showers,Fog
01/12/2013 20:00	2013	12	1	20:00	1.4	20	200	3	SSW	Fog
01/12/2013 23:00	2013	12	1	23:00	0.6	21	210	6	SSW	Fog
01/12/2013 12:00	2013	12	1	12:00	2.8	23	230	9	SW	Fog
01/12/2013 13:00	2013	12	1	13:00	2.7	22	220	7	SW	NA
01/12/2013 14:00	2013	12	1	14:00	2.6	27	270	2	W	Cloudy
01/12/2013 16:00	2013	12	1	16:00	2.3	27	270	4	W	Fog
01/12/2013 21:00	2013	12	1	21:00	0.7	26	260	8	W	Fog
01/12/2013 22:00	2013	12	1	22:00	1	28	280	7	W	Fog
01/12/2013 15:00	2013	12	1	15:00	2.5	25	250	5	WSW	Fog

Direction	0<ws<5	5<ws<10	10<ws<15	>15
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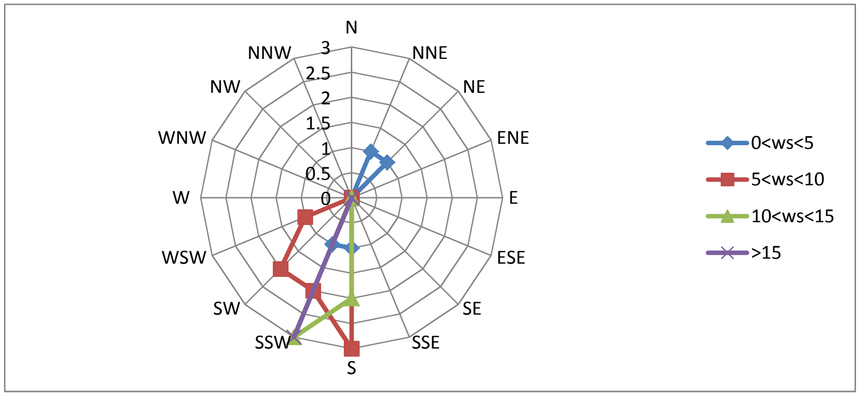
NE	1	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	1	3	2	0
SSW	1	2	3	3
SW	0	2	0	0
WSW	0	1	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



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13/12/2014 2:00	2014	12	13	2:00	-0.5	25	13	6.4	99.15
13/12/2014 3:00	2014	12	13	3:00	-0.4	24	13	4.8	99.12
13/12/2014 4:00	2014	12	13	4:00	-0.4	24	13	4	99.07
13/12/2014 5:00	2014	12	13	5:00	-0.3	27	16	9.7	99.07
13/12/2014 6:00	2014	12	13	6:00	-0.5	27	20	9.7	99.06
13/12/2014 7:00	2014	12	13	7:00	-0.6	25	18	4.8	99.08
13/12/2014 8:00	2014	12	13	8:00	-0.7	26	20	1.2	99.1
13/12/2014 9:00	2014	12	13	9:00	-0.6	26	17	1.6	99.08
13/12/2014 10:00	2014	12	13	10:00	-0.6	25	23	1.6	99.08
13/12/2014 11:00	2014	12	13	11:00	-0.4	25	26	2	99.02
13/12/2014 12:00	2014	12	13	12:00	0.1	24	23	4.8	98.93
13/12/2014 13:00	2014	12	13	13:00	0.4	24	25	3.2	98.83
13/12/2014 14:00	2014	12	13	14:00	0.6	24	26	2.4	98.76
13/12/2014 15:00	2014	12	13	15:00	0.6	25	31	4.8	98.74
13/12/2014 16:00	2014	12	13	16:00	0.7	24	27	4.8	98.74
13/12/2014 17:00	2014	12	13	17:00	0.8	24	22	6.4	98.73
13/12/2014 18:00	2014	12	13	18:00	0.9	24	21	8.1	98.68
13/12/2014 19:00	2014	12	13	19:00	1	24	28	9.7	98.66
13/12/2014 20:00	2014	12	13	20:00	1.1	24	21	9.7	98.64
13/12/2014 21:00	2014	12	13	21:00	1.3	24	19	9.7	98.59
13/12/2014 22:00	2014	12	13	22:00	1	23	9	3.2	98.6
13/12/2014 23:00	2014	12	13	23:00	1.3	23	11	2	98.57

Data below supplied by an external MATLAB program

Direction	0<ws<5	5<ws<10	10<ws<15	>15
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ENE	0	0	0	0
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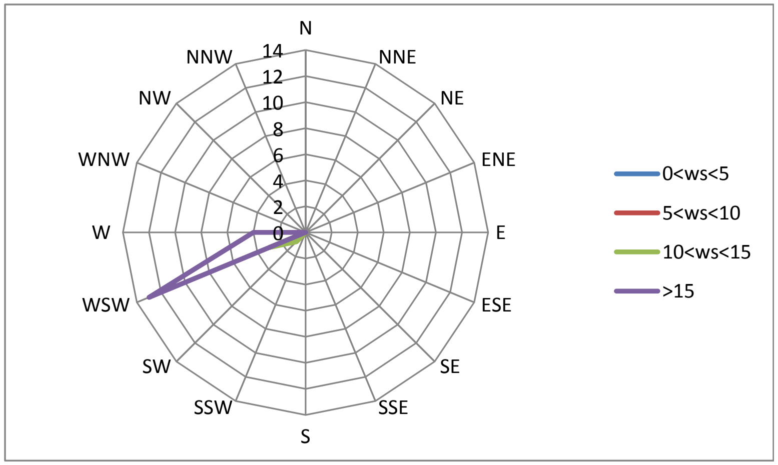
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	0	0	0	0
SW	0	1	1	0
WSW	0	2	3	13
W	0	0	0	4
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Appendix E
Air Quality Monitoring Data

ITEM E2
2015 Environmental Canada Background Air Monitoring Program Summary Randle Reef Sediment Remediation Project Hamilton Harbour/Lake Ontario, May 19, 2015.

Environment Canada Environnement Canada

2015 ENVIRONMENT CANADA BACKGROUND AIR MONITORING PROGRAM SUMMARY RANDLE REEF SEDIMENT REMEDIATION PROJECT HAMILTON HARBOUR / LAKE ONTARIO

R. Joyner, M. Graham and E. Hartman

Ontario Region

May 19, 2015

Great Lakes Division
Great Lakes Areas of Concern
Sediment Remediation Unit

Canada

Contents

Appendices

INTRODUCTION

Randle Reef refers to a highly contaminated section of Hamilton Harbour, located adjacent to the U.S. Steel Canada (USSC) dock wall and the Hamilton Port Authority (HPA) Pier 15.

Contaminated sediment at the Randle Reef Sediment Remediation Project (the project) site has been assessed and various sub-areas of the site classified in terms of the priority for remediation. The planned remediation consists of the dredging of contaminated sediment and its placement within a double walled Engineered Containment Facility (ECF). Past assessments have divided the contaminated sediment into separate areas with assigned priorities (from Priority 1 to Priority 4) which relate to the level of potential impact to the environment.. Areas of the highest priority are designated as Priority One areas, followed by Priority Two and then Priority Three, all of which require management (Figure 1).

The project has been designed to account for and minimize the possible air emissions from dredged sediment as it is removed and placed into the ECF. The primary air quality concern is related to the emission of volatile organic compounds (VOCs) from dredged sediments exposed to the air. Particulate-related contaminants are not considered a concern because the dredged sediment will only be exposed for a short period of time before placement back below the water. Because the dredged sediment will not dry, airborne particulate matter is not anticipated from the sediment itself.

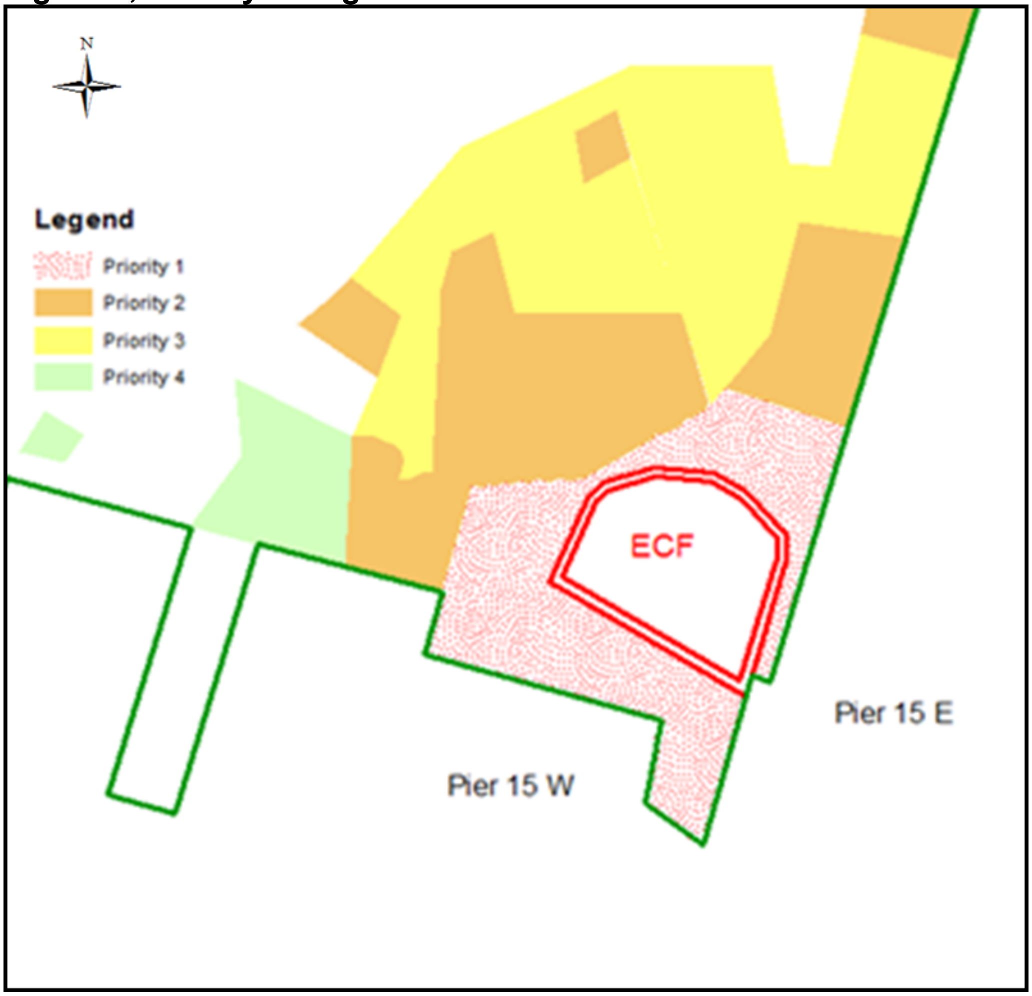
The majority of the sediment to be dredged and placed within the ECF is anticipated to be hydraulically dredged and piped into the ECF with a discharge located below the water surface. This set-up will minimize air emissions.

A small amount of mechanical dredging is anticipated between the double sheet pile walls. This activity represents a higher risk of air emissions based on the exposure of the dredged sediment to the air. Contaminated sediment to be mechanically dredged from between the walls is all Priority One sediment.

Many heavy industrial activities and operations exist within Hamilton Harbour and the neighborhoods adjacent to the project area. In addition to considering potential emissions from the project, potential VOC emissions from the surrounding properties will also need to be considered.

The risk of air emissions also relates to the degree of contamination, with Priority One sediments therefore representing the greatest risk.

Figure 1; Priority Dredge Areas



Sediment related VOC concerns focus on naphthalene along with benzene, toluene, ethyl benzene and xylenes (BTEX). Ontario has **24 hour Ambient Air Quality Criteria** (AAQC) for these compounds based upon health effects.

Table 1: 24 hour Ambient Air Quality Criteria

Compound	24 hour Ambient Air Quality Criteria (ug/m^3)
Naphthalene	22.5
Benzene	2.3
Toluene	2,000
Ethyl benzene	1,000
Xylene	730

Within the Hamilton Harbour area it is not uncommon for benzene to exceed the AAQC. The Hamilton Air Monitoring Network (HAMN) has traditionally used the upper risk threshold (URT) value for benzene of 100 ug/m^3 as their reference when reporting benzene measurements. As of July 1st, 2016 the new provincial benzene criteria will come into effect.

This report represents the summary of the second year of background air monitoring; an initial background air sampling program was completed from June 4th to December 13th, 2014. Whenever possible the sampling was conducted on a twelve day cycle to align with the HAMN sampling events.

OBJECTIVE

Environment and Climate Change Canada (ECCC) designed and implemented this background air sampling program, with advice and input from the Ministry of Environment and Climate Change (MOECC) and the HAMN, in order to increase the available data set for background air quality levels prior to the onset of project activities.

ECCC's background monitoring began in 2014 and is also anticipated to continue on during the project activities which represent a potential air quality risk. The establishment of this data set will provide an opportunity to compare any future perceived project emissions to the pre-existing or existing air quality levels in the neighborhoods surrounding the Randle Reef area.

It should be specifically noted that the air sampling associated with this program was not completed for regulatory purposes and the results should not be used in any regulatory application.

SCOPE OF WORK

The 2015 background air sampling program consisted of the collection of "grab samples" from three different locations surrounding the Randle Reef project area. These locations were selected to represent possible receptor sites, dependent on wind direction, for any air emissions generated by the project. The sampling locations were also selected to augment existing data available from the HAMN (http://www.hamnair.ca/).

The three ECCC stations were;

- EC Station 1; Department of National Defense (DND) property at the HMCS Star
- EC Station 2; City of Hamilton property at 235 Birch Ave.
- EC Station 3: USSC property along the dock wall

The EC sample locations where selected to fill in the gaps between the existing HAMN stations and provide more comprehensive coverage (Figure 2).

Figure 2; Background Air Monitoring Locations

In general, in order to establish consistency with the HAMN sampling, the air samples were collected on the same 12 day cycle as the HAMN VOC collection.

METHODS

Sampling;

Samples were collected using 6 liter suma canisters outfitted with flow regulators calibrated for 24 hour collection. The regulators were controlled by electronic timed valves which were programmed to open for 24 hour collection.

Ambient air sampling involves collecting a representative sample of ambient air for analysis. To obtain a more representative sample requires time-integrated sampling. A flow controller was used to spread the sample collection flow over a 24 hour time period and achieve a time-weighted average sample (TWA). This TWA sample accurately reflects the mean conditions of the ambient air in the environment for those 24 hours.

The samples were collected using a passive sampling technique, where the vacuum pressure of the suma canister itself is used to collect the sample. The passive canister sampling system was set up with six basic components:

1. An electronic timer with opening and closing valve to control the sampling period;
2. an in-line Swagelok™ filter with 2 µm stainless-steel sintered filter to eliminate particulate;
3. a restrictor;
4. a Veriflow SC423XL back-pressure flow regulator;
5. a vacuum gauge, and
6. the 6 L suma canister

A picture of the initial set-up is presented in Figure 3.

Figure 3 – EC Air Monitoring Station Set Up (timer, controller and canister)

The back-pressure regulator maintained approximately a 0.5 to 1 psi pressure drop across the restrictor until the canister was within 1 to 2 psi of reaching atmospheric pressure, after which the regulator can no longer maintain a 1 psi differential across the orifice, resulting in a drop in flow rate.

The vacuum gauge enabled sampling personnel to visually monitor changes in the vacuum in the canister during sampling.

The flow controllers/electronic timer assembly was assembled in the Environment Canada's Air Quality and Analysis (AQA) laboratory and leak tested. The flow rates were set according to the canister size, 3.5 mL/min for 6-liter canisters.

The assembled flow controllers were purged with humidified clean air for at least three days. US EPA Compendium Method TO-15 requires that the flow controllers be certified clean prior to use. The flow controllers were certified by passing a humidified high-purity air through the flow controller to evacuated canisters, and analyzed the air by GC-MS. The flow controllers were certified clean when no target VOC concentration is greater than 0.2 parts per billion volume (ppbv). The certified flow controllers were capped with Swagelok fittings and shipped to the site for sampling.

The AQA laboratory also supplied purged and voided 6 liter suma canisters used in the collection of the samples.

Samples were set-up before the sampling date with the electronic timers programmed with pre-set opening and closing times. The suma canisters were attached to the controller/timer assembly and leak tested in the field prior to sampling. Samples were collected from 0:01 to 23:59 on the date of sampling.

The date, time, technician, pre-sampling canister pressure and post sampling canister pressure were recorded for each sample. Weather conditions and any other notes of significance were also recorded. A second duplicate sample was collected from some stations on occasion and submitted to the AQA laboratory as a blind duplicate. The completed samples were collected the next working day after sampling.

Analysis:

The completed samples were sent to the AQA Laboratory at 335 River Road, Ottawa, Ontario for analysis. They were analyzed using a cryogenic preconcentration technique with high resolution gas chromatograph and quadrupole mass-selective detector (GC-MSD) as described in US EPA TO-15. A total of 150 non-polar VOCs were in the target list. To achieve the detection limits desired, air samples must be concentrated before injection into a GC-MS for analysis. EnTech Model 7100 preconcentrators with auto-sampler (EnTech Instruments, Inc., Simi Valley, CA) was used for sample preconcentration, The instruments used for species identification and quantification was Agilent 7890 gas chromatograph and Agilent 5975 MSD. VOCs were separated on a 60 metre, 0.32 I.D. fused silica capillary column with a 1.0 µm film thickness of J&W DB-1 bonded liquid phase.

The presence of water vapour and CO_2 at levels 4-8 orders of magnitude higher than the target volatile compounds requires water and CO_2 to be removed prior to GC injection in order to avoid chromatography problems and attenuation of response in the mass spectrometer. The EnTech 7100 utilizes three stages to manage the water and CO_2 without losses of desired analytes. Air from the sample canister was drawn through the preconcentrator's multi-stage trapping system. Sample volume was measured by a mass flow controller. For non-polar operation, 500 mL of outdoor or 200 mL indoor/personal sample air was passed through a glass bead trap maintained at -170°C. In the same manner, 50 mL of a gaseous mixture of internal standard was added directly to the first stage cryogenic trap under mass flow control. A three-stage concentration technique called "Microscale Purge and Trap" was used to separate water from organic sample components. The air sample was first concentrated to about a 0.5 cc in a cryogenic glass bead trap. This trap was then heated to roughly 10°C and held there, while slowly passing helium through it to transfer the organics to a secondary Tenax™ trap at -60°C. Sweeping the VOCs from the first to the second trap with only 40 to 50 cc of helium results in the transfer all the VOCs and less than 1 µL of water. After transfer to the second trap, the VOCs were back-flushed while heating to 180°C to be further focused on an open-tubular focusing trap at -180°C. This cryofocusing trap was ballistically heated to 100°C, resulting in rapid injection of VOCs onto the analytical column. Heating of the focusing trap occurs extremely fast, producing the narrow peaks and reducing peak tailing.

Optimum results were obtained by temperature programming the GC oven as listed below.

Table of EnTech Operation Mode and GC Parameters
Non-Polar VOCs
GCMS inlet System: 7100 Preconcentrator and 7016 16 Position Autosampler (EnTech Instruments, Inc.)
7100 Mode of Operation: Microscale Purge and Trap
GCMS: Agilent 6890 GC/5973 MSD (Palo Alto, CA)
Column: DB-1, 0.32 mm ID, 60 M, 1 um
Temperature: -60°C (3 min) to 164 at 7°C/min, to 220°C at 14°C /min

The GC-MSDs were operated in the selected ion monitoring mode (SIM). Identification of target analytes by SIM analysis is based on a combination of chromatographic retention time and relative abundance of selected monitored ions. Two or three characteristic ions were monitored for each of approximately 188 hydrocarbons which are either frequently or occasionally found in urban air samples. The MSD acquires data for target ions only, and ignores all others. This detection technique is highly specific and sensitive.

Instrument calibration standards were prepared using stock gas standards prepared in house from multi-component liquid mixtures and gas mixture cylinders purchased from Scott Environmental Technology Inc. The accuracy of the calibration standards were verified against two certified reference standards, the Scotty TO-14 calibration mix (39 compounds) and the Spectra Gases Inc. Certified 62 compounds standard. Quantification was based on a daily 6-point linear regression calibration curves obtained from analysis of these external standard mixtures. Precision, as determined from replicate analyses of samples, is within 15% for the compounds at concentrations above 0.1 µg/m^3.

Maintenance:

The flow regulators, timers and associated components were also periodically shipped to the AQA laboratory for purging/cleaning and calibration as described above.

Meteorological data:

Wind rose plots were used to visually identify the predominant wind direction and intensity over each of the 24 hour sampling periods. Wind rose plots were created in Microsoft excel based on hourly wind speed and direction from data from the Environment Canada weather station located at the Hamilton Airport. The hourly data collected was for the same 24 hour time period in which the suma canisters were open. The wind direction and intensity data was read and summarized by a computer program written in MATLAB™ to produce a frequency matrix of compass directions vs wind speeds as shown by the example in Table 4 below.

Table 2; 24 Hour Sampling Date Wind Data Frequency Matrix

Direction	0<wind speed<5	5<wind speed<10	10<wind speed<15	wind speed>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	0	0	0	0
SW	0	1	1	0
WSW	0	2	3	13
W	0	0	0	4
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0

RESULTS:

The sampling analytical results are presented below by sample date with the associated wind rose for that 24 hour period.

While the AAQCs do not necessarily represent the best comparison for certain parameters during project air monitoring, they are used here as an easy reference.

AAQC exceedances are noted as:
Exceedances of 50% of the AAQC are noted as:

The frequency of occurrence in the wind rose is represented by the number of concentric circles emanating from the centre. These circles are numbered on the plots. For example, data points plotted on a concentric line labelled as “3” indicate that there were 3 hours in the 24 hour period for this wind direction. Wind speed is represented by the colour of the plotted point / line.

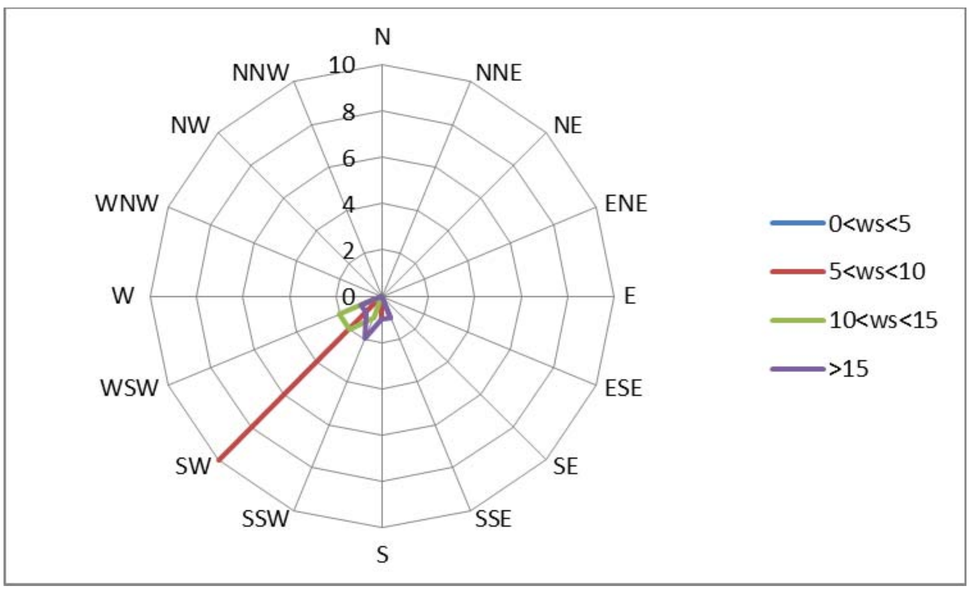
Samples were collected from April-December 2015 to coincide with the expected months of construction work for the Randle Reef Sediment Remediation Project. It should be noted that in some instances mechanical issues with the timer valves prevented the collection of samples from all stations. This was particularly prevalent in the late fall and winter months of 2015.

April 12, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 3, USS		AAQC
Canister ID	EPS 423	EPS 975	EPS 780	
Sample Volume (mL)	500	500	500	
Benzene	0.35	1.08	0.91	2.3
Toluene	0.65	0.60	0.50	2,000
Ethylbenzene	0.12	0.13	0.13	1,000
m,p-Xylene	0.35	0.46	0.42	730
o-Xylene	0.13	0.16	0.15	
Naphthalene	0.02	0.08	0.08	22.5

Hamilton Airport Wind Data

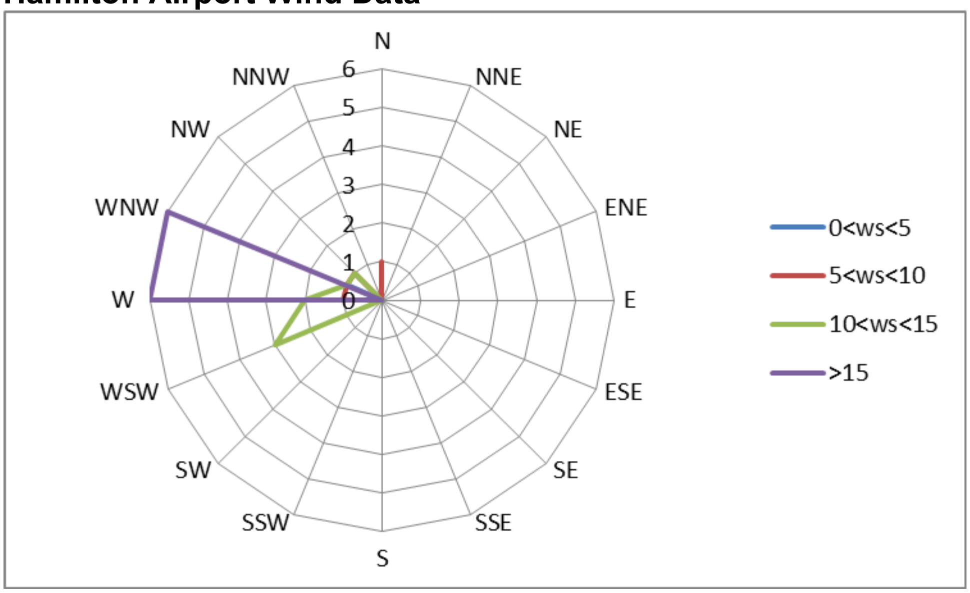


April 24, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS		AAQC
Canister ID	EPS 321	EPS 842	EPS 163	EPS 071	
Sample Volume (mL)	500	500	500	500	
Benzene	0.22	0.20	0.71	0.63	2.3
Toluene	0.17	0.37	0.29	0.25	2,000
Ethylbenzene	0.04	0.16	0.06	0.05	1,000
m,p-Xylene	0.09	0.52	0.22	0.20	730
o-Xylene	0.03	0.16	0.09	0.07	
Naphthalene	0.01	0.01	0.09	0.09	22.5

Hamilton Airport Wind Data

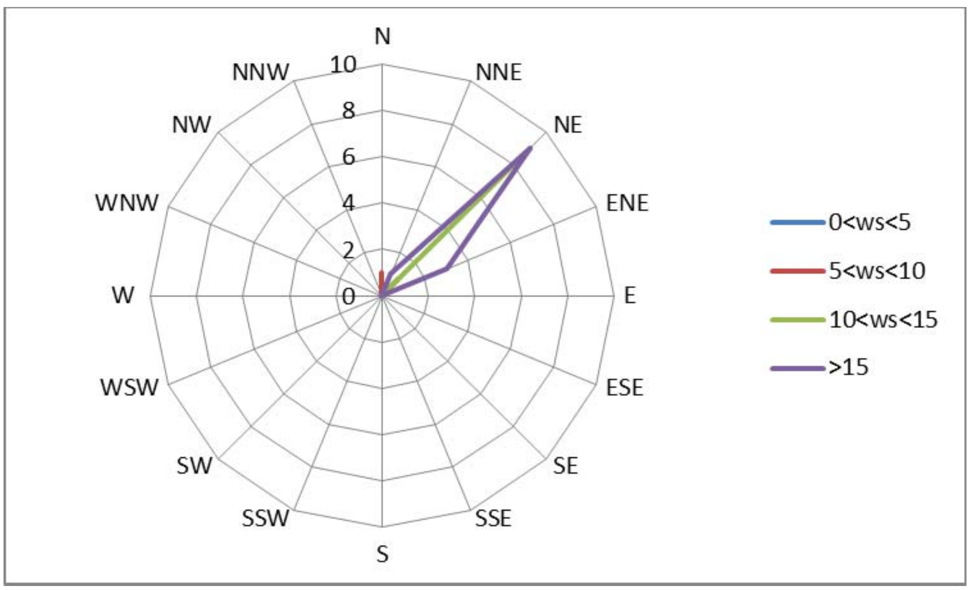


May 6, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS		AAQC
Canister ID	**EPS 395**	**EPS 114**	**EPS 191**	**EPS 125**	
Sample Volume (mL)	**500**	**500**	**500**	**500**	
Benzene	0.43	3.47	3.09	2.94	2.3
Toluene	2.54	6.06	1.84	1.79	2,000
Ethylbenzene	0.96	0.81	0.21	0.21	1,000
m,p-Xylene	3.31	2.74	0.71	0.72	730
o-Xylene	1.13	0.96	0.28	0.28	
Naphthalene	0.21	2.32	8.88	9.71	22.5

Hamilton Airport Wind Data

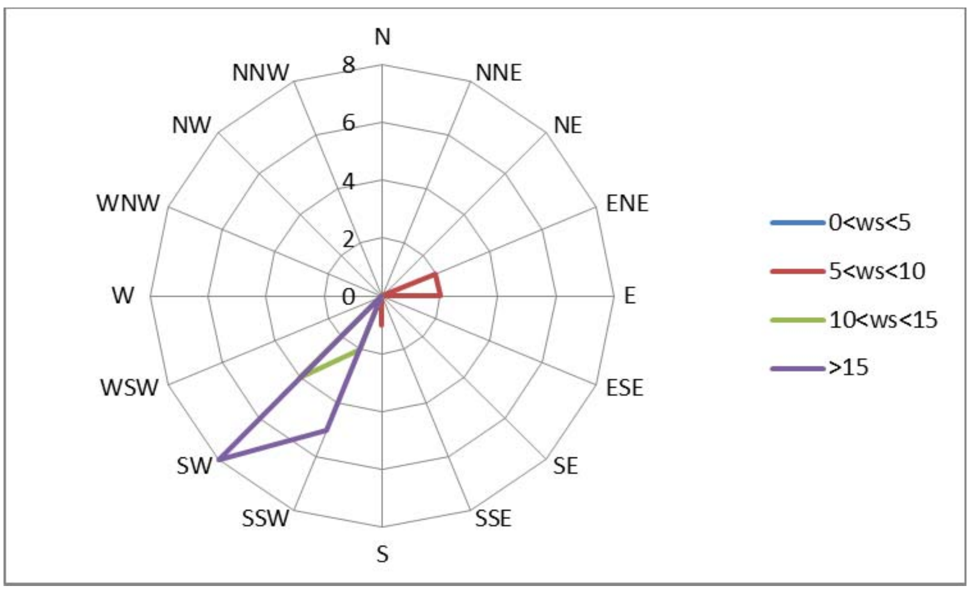


May 18, 2015

Randle Reef Study Sample Data (ug/m³)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	**EPS 896**	**EPS 568**	**EPS 238**	
Sample Volume (mL)	**500**	**500**	**500**	
Benzene	0.75	3.50	6.80	2.3
Toluene	0.74	1.79	1.55	2,000
Ethylbenzene	0.11	0.31	0.14	1,000
m,p-Xylene	0.26	0.88	0.58	730
o-Xylene	0.11	0.34	0.23	
Naphthalene	0.52	4.44	15.36	22.5

Hamilton Airport Wind Data

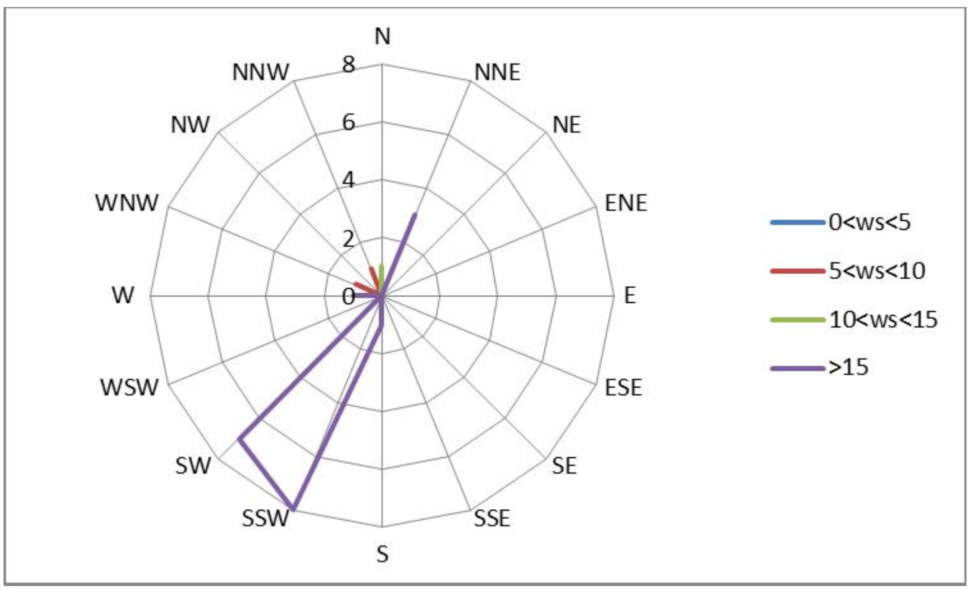


May 30, 2015:

Randle Reef Study 2014 Sample Data (ug/m)

Sample location	EC 1, DND	EC 3, USS	AAQC
Canister ID	EPS 152	EPS 293	
Sample Volume (mL)	500	500	
Benzene	0.51	6.59	2.3
Toluene	0.87	1.67	2,000
Ethylbenzene	0.16	0.10	1,000
m,p-Xylene	0.47	0.49	730
o-Xylene	0.18	0.17	
Naphthalene	0.64	10.96	22.5

Hamilton Airport Wind Data

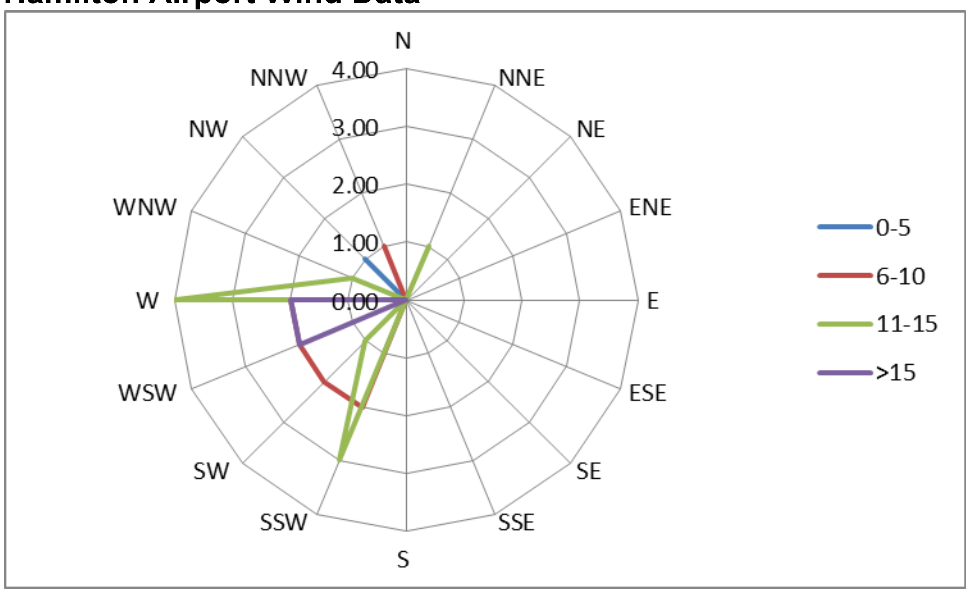


June 11, 2015:

Randle Reef Study Sample Data (ug/m)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS	AAQC
Canister ID	**EPS 351**	**EPS 573**	**EPS 512**	
Sample Volume (mL)	**500**	**500**	**500**	
Benzene	0.55	0.53	0.60	2.3
Toluene	1.06	1.09	1.15	2,000
Ethylbenzene	0.17	0.22	0.17	1,000
m,p-Xylene	0.37	0.58	0.38	730
o-Xylene	0.18	0.25	0.18	
Naphthalene	0.11	0.05	0.07	22.5

Hamilton Airport Wind Data

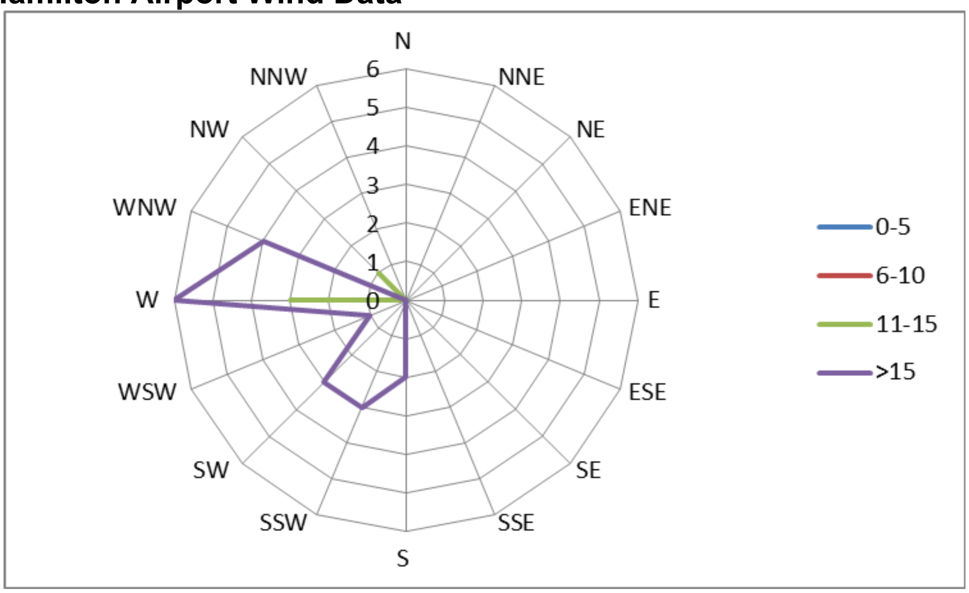


June 23, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 3, USS	AAQC
Canister ID	EPS 675	EPS 911	
Sample Volume (mL)	500	500	
Benzene	0.20	0.31	2.3
Toluene	0.49	0.55	2,000
Ethylbenzene	0.12	0.11	1,000
m,p-Xylene	0.27	0.25	730
o-Xylene	0.14	0.14	
Naphthalene	0.05	0.09	22.5

Hamilton Airport Wind Data

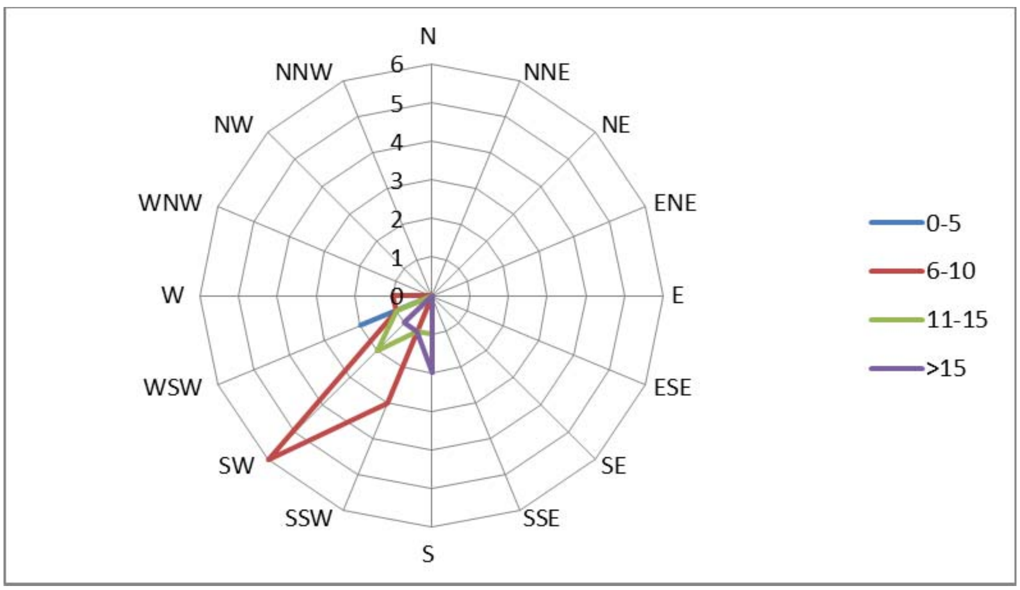


July 5, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 3, USS		AAQC
Canister ID	**EPS 153**	**EPS 346**	**EPS 301**	
Sample Volume (mL)	**500**	**500**	**500**	
Benzene	0.69	0.77	0.77	2.3
Toluene	1.23	1.65	1.99	2,000
Ethylbenzene	0.23	0.27	0.31	1,000
m,p-Xylene	0.53	0.64	0.70	730
o-Xylene	0.23	0.29	0.36	
Naphthalene	0.18	0.14	0.28	22.5

Hamilton Airport Wind Data

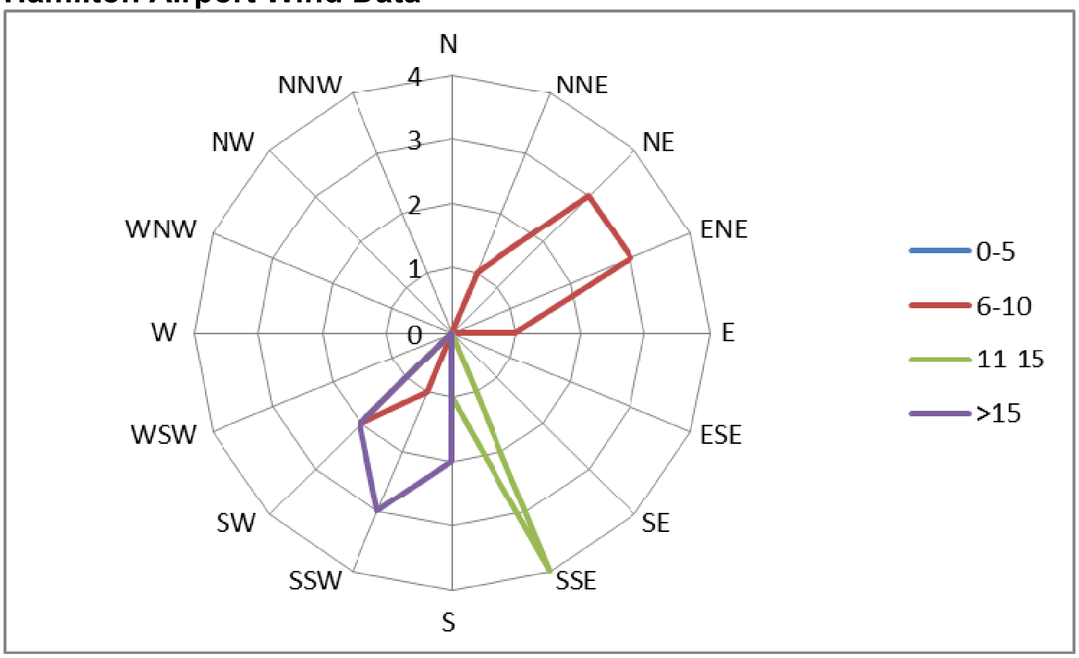


July 17, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 2, Ham	AAQC
Canister ID	EPS 323	EPS 599	
Sample Volume (mL)	500	500	
Benzene	0.57	0.57	2.3
Toluene	1.73	1.79	2,000
Ethylbenzene	0.33	0.35	1,000
m,p-Xylene	0.84	1.00	730
o-Xylene	0.36	0.40	
Naphthalene	0.16	0.04	22.5

Hamilton Airport Wind Data

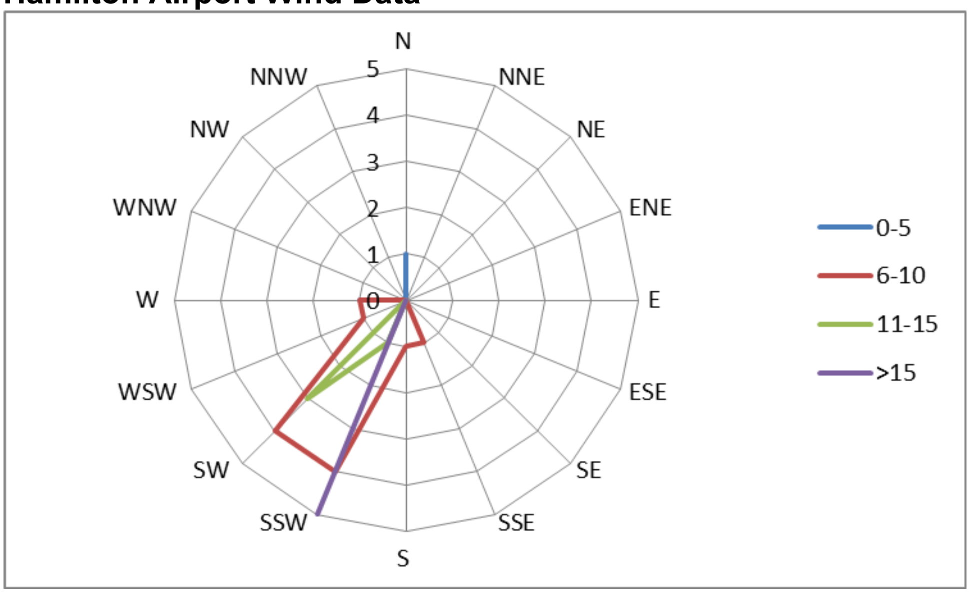


July 29, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	**EC 1, DND**	**EC 2, Ham**	**AAQC**
Canister ID	**EPS 901**	**EPS 461**	
Sample Volume (mL)	**500**	**500**	
Benzene	0.53	0.87	2.3
Toluene	1.71	2.99	2,000
Ethylbenzene	0.28	0.68	1,000
m,p-Xylene	0.76	2.42	730
o-Xylene	0.31	0.79	
Naphthalene	0.23	0.37	22.5

Hamilton Airport Wind Data

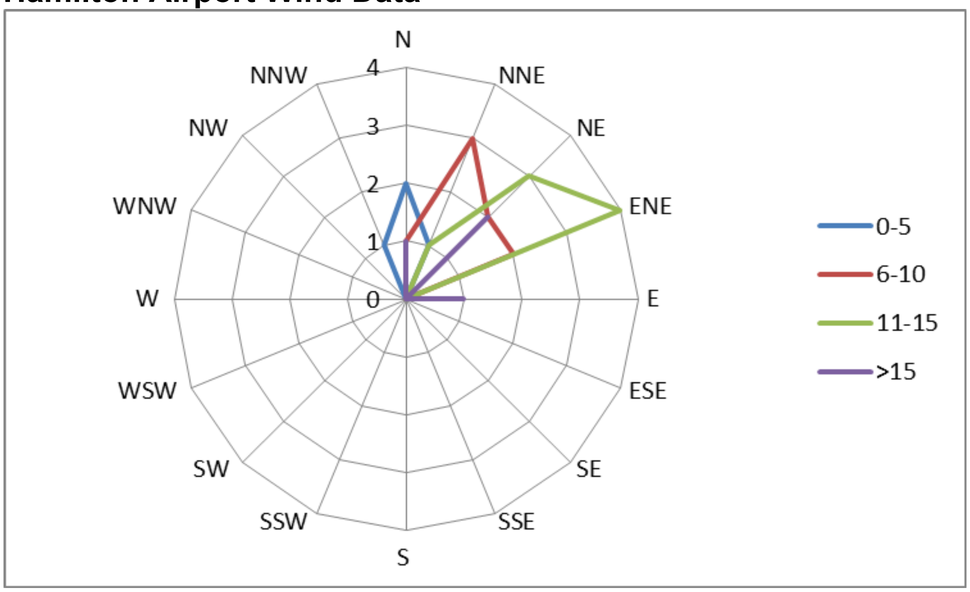


August 10, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	**EC 2, Ham**	**EC 3, USS**	**AAQC**
Canister ID	**EPS 595**	**EPS 1016**	
Sample Volume (mL)	**500**	**500**	
Benzene	0.94	1.53	2.3
Toluene	3.13	3.28	2,000
Ethylbenzene	0.64	0.45	1,000
m,p-Xylene	2.02	1.13	730
o-Xylene	0.67	0.42	
Naphthalene	0.41	1.31	22.5

Hamilton Airport Wind Data

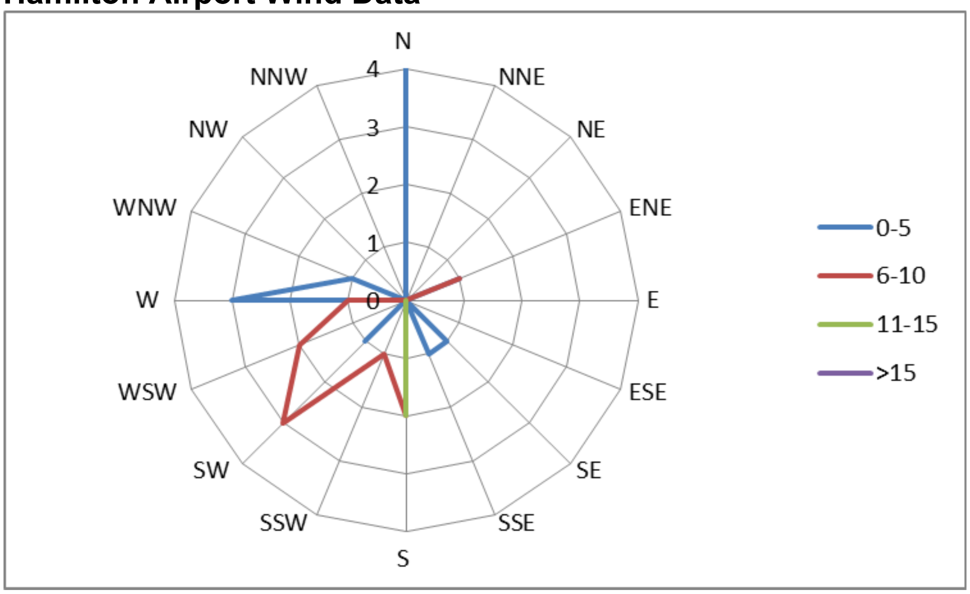


August 21, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS		AAQC
Canister ID	EPS 113	EPS 332	EPS 758	EPS 669	
Sample Volume (mL)	500	500	500	500	
Benzene	0.81	0.86	1.82	2.00	2.3
Toluene	1.09	2.98	2.15	2.22	2,000
Ethylbenzene	0.18	0.62	0.29	0.29	1,000
m,p-Xylene	0.47	2.11	0.81	0.86	730
o-Xylene	0.21	0.74	0.34	0.37	
Naphthalene	0.22	0.19	0.18	0.60	22.5

Hamilton Airport Wind Data

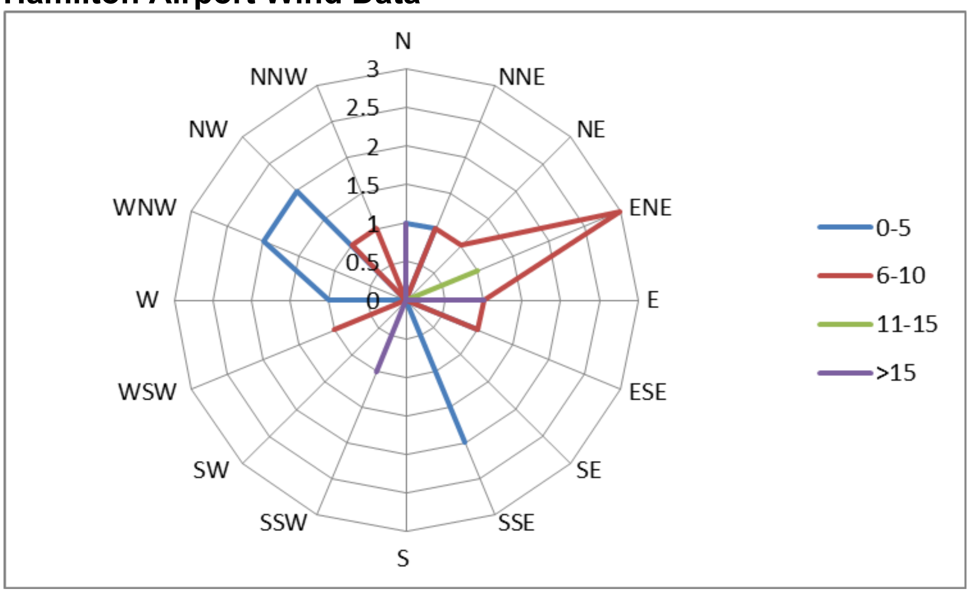


September 3, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 3, USS	AAQC
Canister ID	EPS 613	EPS 1020	
Sample Volume (mL)	500	500	
Benzene	0.69	2.19	2.3
Toluene	2.38	2.88	2,000
Ethylbenzene	0.34	0.49	1,000
m,p-Xylene	0.93	1.30	730
o-Xylene	0.36	0.51	
Naphthalene	0.37	1.40	22.5

Hamilton Airport Wind Data

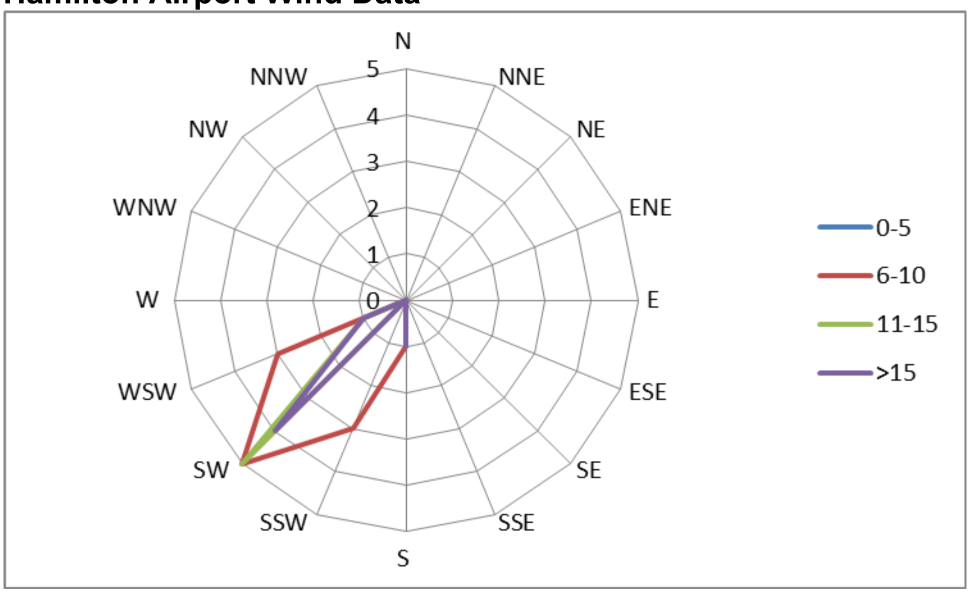


September 15, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS		AAQC
Canister ID	**EPS 624**	**EPS 126**	**EPS 980**	**EPS 084**	
Sample Volume (mL)	**500**	**500**	**500**	**500**	
Benzene	0.33	0.35	0.37	0.50	2.3
Toluene	1.42	1.92	1.62	3.18	2,000
Ethylbenzene	0.25	0.48	0.28	0.49	1,000
m,p-Xylene	0.54	1.47	0.68	0.99	730
o-Xylene	0.29	0.54	0.32	0.53	
Naphthalene	0.09	0.09	0.09	0.09	22.5

Hamilton Airport Wind Data

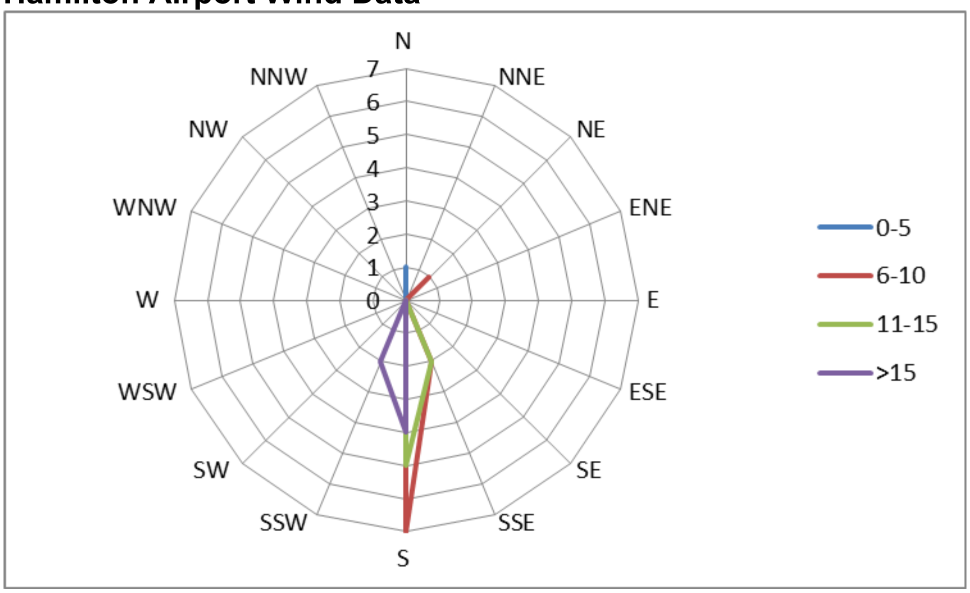


September 27, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND		EC 2, Ham	EC 3, USS		AAQC
Canister ID	EPS 513	EPS 513	EPS 590	EPS 072	EPS 245	
Sample Volume (mL)	500	500	500	500	500	
Benzene	0.39	0.41	0.78	0.72	0.67	2.3
Toluene	1.48	1.54	3.75	2.78	2.37	2,000
Ethylbenzene	0.22	0.22	0.62	0.37	0.32	1,000
m,p-Xylene	0.57	0.57	2.04	1.00	0.89	730
o-Xylene	0.27	0.27	0.71	0.42	0.36	
Naphthalene	0.08	0.06	0.24	0.38	0.40	22.5

Hamilton Airport Wind Data

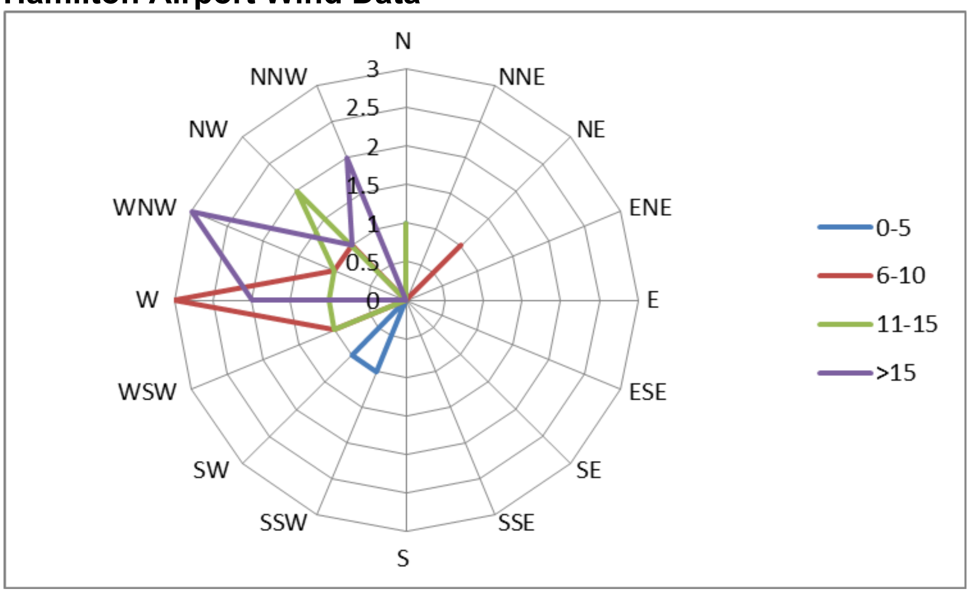


October 9, 2015;

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS			AAQC
Canister ID	**EPS 260**	**EPS 673**	**EPS 458**	**EPS 259**	**EPS 259**	
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**	
Benzene	0.22	0.36	0.65	0.60	0.55	2.3
Toluene	0.51	1.30	0.70	0.69	0.61	2,000
Ethylbenzene	0.09	0.31	0.12	0.11	0.10	1,000
m,p-Xylene	0.22	1.09	0.33	0.31	0.28	730
o-Xylene	0.11	0.40	0.15	0.14	0.13	
Naphthalene	0.05	0.09	1.48	1.40	1.14	22.5

Hamilton Airport Wind Data

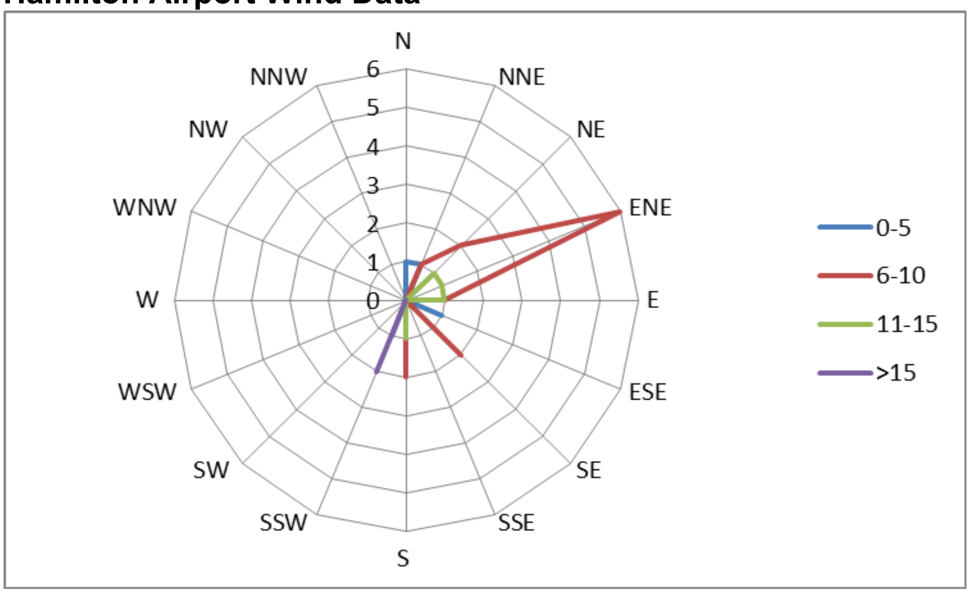


October 21, 2015:

Randle Reef Study Sample Data (ug/m³)

Sample location	EC 1, DND	EC 3, USS	AAQC
Canister ID	EPS 522	EPS 521	
Sample Volume (mL)	500	500	
Benzene	0.53	2.16	2.3
Toluene	3.20	2.41	2,000
Ethylbenzene	0.34	0.26	1,000
m,p-Xylene	1.18	0.96	730
o-Xylene	0.45	0.32	
Naphthalene	0.06	2.52	22.5

Hamilton Airport Wind Data

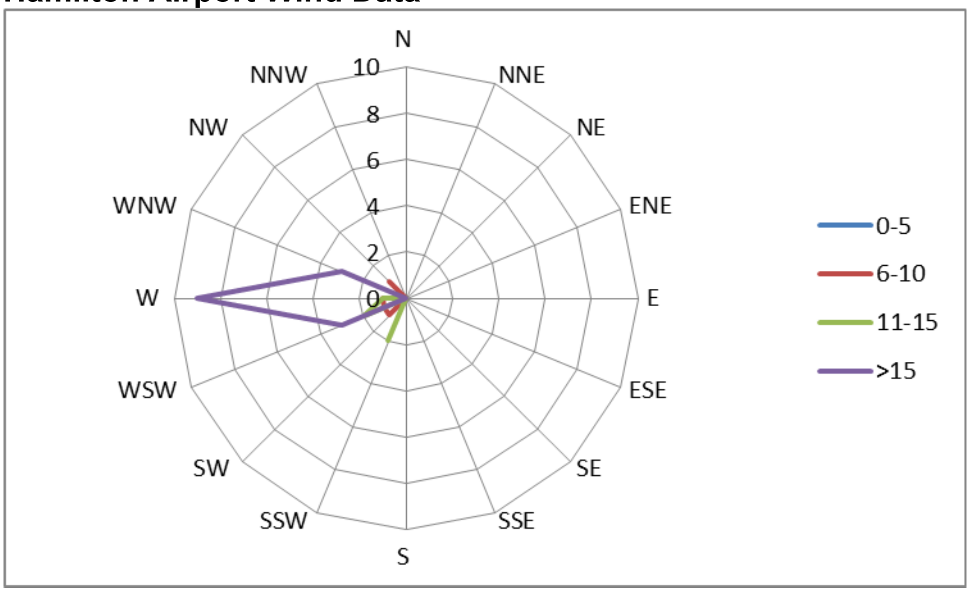


November 14, 2015:

Randle Reef Study Sample Data (ug/m³)

Sample location	EC 1, DND	EC 2, Ham	EC 3, USS		AAQC
Canister ID	**EPS 238**	**EPS 161**	**EPS 200**	**EPS 690**	
Sample Volume (mL)	**500**	**500**	**500**	**500**	
Benzene	0.27	0.29	0.96	0.40	2.3
Toluene	0.40	0.49	0.97	0.52	2,000
Ethylbenzene	0.09	0.10	0.17	0.08	1,000
m,p-Xylene	0.20	0.27	0.46	0.19	730
o-Xylene	0.09	0.11	0.19	0.08	
Naphthalene	0.04	0.02	0.10	0.01	22.5

Hamilton Airport Wind Data

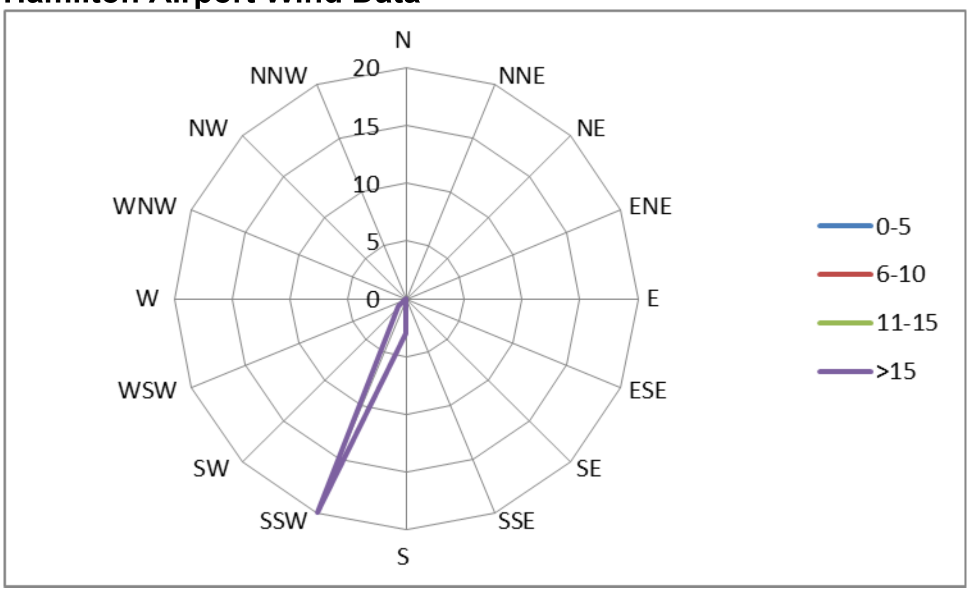


November 26, 2015:

Randle Reef Study Sample Data (ug/m^3)

Sample location	EC 1, DND	AAQC
Canister ID	**EPS 568**	
Sample Volume (mL)	**500**	
Benzene	0.42	2.3
Toluene	0.68	2,000
Ethylbenzene	0.10	1,000
m,p-Xylene	0.23	730
o-Xylene	0.11	
Naphthalene	0.04	22.5

Hamilton Airport Wind Data

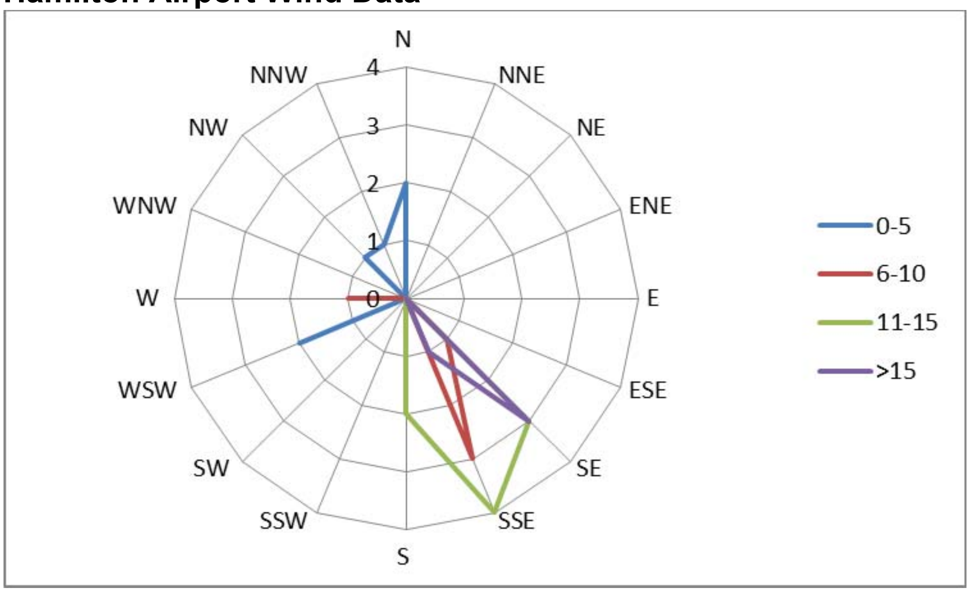


December 8, 2015:

Randle Reef Study Sample Data (ug/m)

Sample location	EC 1, DND	EC 3, USS		AAQC
Canister ID	EPS 098	EPS 913	EPS 916	
Sample Volume (mL)	500	500	500	
Benzene	0.68	1.10	1.09	2.3
Toluene	1.53	2.05	1.97	2,000
Ethylbenzene	0.24	0.28	0.28	1,000
m,p-Xylene	0.67	0.85	0.84	730
o-Xylene	0.26	0.32	0.32	
Naphthalene	0.03	0.10	0.11	22.5

Hamilton Airport Wind Data



The full analytical results for the EC background air samples are included in Appendix I. Corresponding VOC results for HAMN stations; 2962 located at Niagara and Land Streets and 29180 located at Gage Street are included in Appendix II.

The meteorological data used to populate the wind rose charts is included in Appendix III.

DISCUSSION/CONCLUSION

AAQC Exceedances:

Benzene concentrations exceeded either the AAQC or 50% of the AAQC on multiple dates at the USS and 235 Birch Street locations. Naphthalene exceeded 50% of the AAQC on one date at the USS location. In all other instances, the BTEX and naphthalene concentrations were below both the AAQC and 50% of the AAQC.

The noted exceedances are listed below with the associated times, locations, predominant wind directions and approximate relationship with the RR site to the sample location at the time;

- May 6, 2015; EC stations 2 (Birch St. Hamilton) and 3 (USS) exceeded the benzene AAQC. Wind was predominantly from the NE and the RR site would be down gradient.
- May 18, 2015; EC stations 2 (Birch St. Hamilton) and 3 (USS) exceeded the benzene AAQC. EC station 3 (USS) also exceeded 50% of the Naphthalene AAQC. Wind was predominantly from the SW, the RR site would be up gradient from USS and trans gradient to the Birch street Hamilton location.
- May 30, 2015; EC station 3 (USS) exceeded the benzene AAQC. Wind was predominantly from the SW and the RR site would be up gradient.
- August 10, 2015; EC station 3 (USS) exceeded 50% of the Benzene AAQC. Wind was predominantly from the NE and the RR site would be down gradient.
- August 21, 2015; EC station 3 (USS) exceeded 50% of the Benzene AAQC. Wind varied from the N to the SW and the RR site would be partially up gradient and partially trans gradient.
- September 3, 2015; EC station 3 (USS) exceeded 50% of the Benzene AAQC. Wind was predominantly from the ENE and the RR site would be down gradient.
- October 21, 2015; EC station 3 (USS) exceeded 50% of the Benzene AAQC. Wind was predominantly from the ENE and the RR site would be down gradient.

For ease, this report compares the reported benzene concentrations to the pre 2016 AAQC, **2.3 ug/m^3**, in order to give a frame of reference. However, as noted above, HAMN compares benzene to the URT of **100 ug/m^3**. A new provincial benzene criterion will come into effect in July 2016.

Air Quality at the Randle Reef Site Related to Wind Direction:

EC station 3, based upon the fact that it is adjacent to the Randle Reef project site, represents the best source of information to indicate whether exceedances are caused by contributions from the Randle Reef site OR caused by the immediately adjacent industrial activity.

In general, EC station 3 would be affected by the RR site during times when the prevailing wind blew from the west or south west. This occurred on the following dates and corresponded with the following BTEX and naphthalene concentrations;

EC Station 3 USS Dock wall Sample Data (ug/m^3)

Canister ID	EPS 975	EPS 780	EPS 163	EPS 238	EPS 293	EPS 512	EPS 911	EPS 346	EPS 301
Date	April 12	April 12	April 24	May 18	May 30	June 11	June 23	July 5	July 5
Wind direction	SW	SW	W	SW	SSW	W-SSW	W	SW	SW
Benzene	1.08	0.91	0.71	6.80	6.59	0.60	0.31	0.77	0.77
Naphthalene	0.08	0.08	0.09	15.36	10.96	0.07	0.09	0.14	0.28

Canister ID	EPS 758	EPS 669	EPS 980	EPS 084	EPS 458	EPS 259	EPS 259	EPS 200	EPS 690
Date	Aug 21	Aug 21	Sept 15	Sept 15	Oct 9	Oct 9	Oct 9	Nov 14	Nov 14
Wind direction	SW-N	SW-N	SW	SW	NNW-W	NNW-W	NNW-W	W	W
Benzene	1.82	2.00	0.37	0.50	0.65	0.60	0.55	0.96	0.40
Naphthalene	0.18	0.60	0.09	0.09	1.48	1.40	1.14	0.10	0.01

In general, EC station 3 would be affected by the closest industrial activities during times when the prevailing wind blew from the east, north east or south east. This occurred on the following dates and corresponded with the following BTEX and naphthalene concentrations;

EC Station 3 USS Dock wall Sample Data (ug/m^3)

Canister ID	EPS 191	EPS 125	EPS 599	EPS 1016	EPS 1020	EPS 521
Date	May 6	May 6	July 17	Aug 10	Sept 3	Oct 21
Wind direction	NE	NE	ENE-SSE	NNE-ENE	ENE	ENE
Benzene	3.09	2.94	0.57	1.53	2.19	2.16
Naphthalene	8.88	9.71	0.04	1.31	1.40	2.52

<u>Background Air Sampling Data;</u>

The results of the previous round of EC background air monitoring was supplied to the project engineer as a reference in their development of a project specific air monitoring plan.

The results from this round and future rounds of EC background air monitoring may be utilized as a reference in the event air quality concerns are raised for any of the receptors covered by these three stations. If specific monitoring is required based upon air quality concerns, these results will provide a more specific background air quality reference for comparison.

<u>Future Background Air Sampling:</u>

Background air sampling is expected to resume from April through December 2016 and continue on until the project activities which represent a potential or perceived risk of air emissions are concluded. Background air sampling is not conducted from January through to the end of March as these months do not correspond to the anticipated project work schedule.

APPENDIX I
RR 2015 Sample Results

Randle Reef Study 2015 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

FID Analysis Date	15APR27-05	15APR27-06	15APR27-07	15MAY04-08	15MAY04-09	15MAY05-05	15MAY05-06	15MAY19-05	15MAY19-06	15MAY19-07	15MAY19-08	15JUN11-15	15JUN11-16	15JUN11-17	15JUN17-14	15JUN17-06	15JUL13-12	15JUL13-13	15JUL13-14	15JUL13-15	15JUL13-16	15JUL16-15	15JUL16-16	15JUL16-17.
FID Analysis Location	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N
Non-Polar Analysis Date	21-Apr-15	21-Apr-15	21-Apr-15	30-Apr-15	30-Apr-15	4-May-15	4-May-15	14-May-15	14-May-15	14-May-15	14-May-15	26-May-15	26-May-15	26-May-15	10-Jun-15	10-Jun-15	2-Jul-15	2-Jul-15	2-Jul-15	2-Jul-15	2-Jul-15	15-Jul-15	20-Jul-15	15-Jul-15
Non-Polar Analysis Location	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176 Urb	Lab176 Urb	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML
Filename	RR42.D	RR43.D	RR44.D	RR45.D	RR46.D	RR47.D	RR48.D	RR49.D	RR50.D	RR51.D	RR52.D	RR53.D	RR54.D	RR55.D	RR56.D	RR57.D	RR58.D	RR59.D	RR60.D	RR61.D	RR62.D	RR63.D	RR64.D	RR65.D
Sample location	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	DUPLICATE	EC STATIOI	EC STATIOI	EC STATIOI	DUPLICATE	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	EC STATIOI	DUPLICATE
Sampling Date	12-Apr-15	12-Apr-15	12-Apr-15	24-Apr-15	24-Apr-15	24-Apr-15	24-Apr-15	6-May-15	6-May-15	6-May-15	6-May-15	18-May-15	18-May-15	18-May-15	30-May-15	30-May-15	11-Jun-15	11-Jun-15	11-Jun-15	23-Jun-15	23-Jun-15	5-Jul-15	5-Jul-15	5-Jul-15
Canister ID	EPS 975	EPS 780	EPS 423	EPS 321	EPS 842	EPS 163	EPS 071	EPS 395	EPS 114	EPS 191	EPS 125	EPS 896	EPS 568	EPS 238	EPS 152	EPS 293	EPS 351	EPS 573	EPS 512	EPS 675	EPS 911	EPS 153	EPS 346	EPS 301
Sample Volume (mL)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Comments																	Ethane Value corrected for Blank	Ethane Value corrected for Blank	Ethane Value corrected for Blank	Final Pressure = - 15"Hg. Ethane	Ethane Value corrected for Blank	Ethane Value corrected for Blank	Ethane Value corrected for Blank	Final Pressure = - 17"Hg. Ethane
Ethylene (FID)	0.71	0.61	0.72	0.38	0.53	0.24	0.30	0.80	2.12	1.09	1.03	0.79	2.11	1.98	0.56	6.00	0.52	0.98	0.62	0.28	0.39	1.23	1.20	0.80
Acetylene (FID)	0.46	0.46	0.57	0.29	0.37	0.25	0.28	0.45	0.75	0.50	0.46	0.24	0.69	0.44	0.29	0.34	0.31	0.42	0.43	0.09	0.16	0.53	0.50	0.35
Ethane (FID) / Ethane (FID corrected for blank)	4.57	4.61	4.57	2.52	3.12	2.65	2.45	3.70	5.74	2.29	3.90	2.74	4.74	3.55	3.75	5.20	2.05	2.95	2.74	1.42	2.60	3.87	3.85	2.83
Freon 134A	0.54	0.49	0.55	0.46	0.60	0.35	0.36	0.70	3.43	0.69	0.68	0.42	1.07	0.43	0.48	0.59	0.47	1.28	0.42	0.42	0.39	0.56	0.64	0.57
Propene	0.20	0.16	0.22	0.19	0.13	0.08	0.08	0.23	0.58	0.26	0.23	0.30	0.33	0.29	0.19	0.63	0.25	0.24	0.19	0.14	0.12	0.32	0.37	0.41
Propane / **Propane (FID)**	2.77	2.77	2.47	1.06	1.47	1.20	1.15	2.06	7.48	2.15	2.13	1.38	2.57	1.72	2.14	1.54	0.81	1.80	1.37	0.76	1.51	2.42	2.98	2.11
Freon 22 (Chlorodifluoromethane)	0.92	0.83	0.90	0.99	0.90	0.72	0.73	0.89	1.16	0.92	0.90	0.75	0.82	0.75	0.84	0.99	0.80	0.80	0.77	0.79	0.72	0.87	1.01	0.93
Freon 12 (Dichlorodifluoromethane)	2.94	2.64	2.82	3.05	2.61	2.45	2.43	2.56	2.99	2.68	2.63	2.33	2.36	2.27	2.39	2.77	2.32	2.17	2.20	2.29	1.97	2.30	2.69	2.44
Propyne	0.02	0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.05	0.02	0.03	0.02	0.04	0.03	0.02	0.05	0.05	0.04	0.04	0.02	0.01	0.05	0.05	0.05
Chloromethane	1.56	1.42	1.50	1.79	1.52	1.32	1.41	1.28	1.40	1.38	1.35	1.35	1.44	1.32	1.37	1.46	1.41	1.28	1.33	1.37	1.18	1.25	1.42	1.37
Isobutane (2-Methylpropane)	2.53	2.27	0.69	0.22	0.90	1.48	1.42	0.97	4.20	1.43	1.44	0.34	1.31	0.50	0.50	0.37	0.29	0.80	1.06	0.29	0.45	0.49	1.31	1.24
Freon 114 (1,2-Dichlorotetrafluoroethane	0.13	0.12	0.12	0.13	0.12	0.12	0.12	0.11	0.12	0.12	0.12	0.11	0.11	0.11	0.13	0.14	0.10	0.10	0.10	0.10	0.09	0.11	0.16	0.12
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.45	0.36	0.24	0.27	0.17	0.24	0.23	0.21	0.42	0.28	0.22	0.37	0.29	0.22	0.18	0.29	0.29	0.29	0.29	0.20	0.21	0.28	0.44	0.42
1,3-Butadiene	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.03	0.08	0.03	0.03	0.02	0.05	0.05	0.02	0.10	0.03	0.03	0.02	0.02	0.01	0.04	0.04	0.04
Butane	5.34	4.79	1.67	0.73	2.04	3.65	3.61	1.96	6.66	3.27	3.35	0.88	2.78	1.12	1.41	0.91	0.67	0.84	2.50	0.68	1.18	1.03	3.15	2.98
t-2-Butene	0.15	0.14	0.03	0.02	0.07	0.15	0.15	0.04	0.16	0.11	0.11	0.03	0.10	0.03	0.04	0.04	0.04	0.04	0.16	0.02	0.06	0.04	0.14	0.14
2,2-Dimethylpropane	0.04	0.03	0.01	0.01	0.01	0.02	0.02	0.01	0.03	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.03	0.03
Bromomethane	0.06	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.07	0.07	0.06	0.06	0.06	0.05	0.04	0.06	0.08	0.06
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Butene	0.21	0.19	0.03	0.02	0.05	0.12	0.12	0.04	0.13	0.09	0.09	0.02	0.08	0.03	0.04	0.04	0.04	0.04	0.12	0.02	0.05	0.04	0.12	0.11
Chloroethane	0.02	0.03	0.02	0.04	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.03	0.05	0.03	0.03	0.02	0.02	0.03	0.08	0.05
3-Methyl-1-Butene	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.03	0.01	0.02	0.02	0.05	0.05
2-Methylbutane	4.22	3.80	1.03	0.21	1.03	2.81	2.65	1.72	5.08	3.40	3.41	0.66	3.09	0.99	1.61	1.12	0.82	1.13	4.38	0.61	1.84	1.42	5.83	5.75
Freon 11 (Trichlorofluoromethane)	1.82	1.63	1.78	1.80	1.60	1.48	1.49	1.65	2.02	1.68	1.66	1.46	1.52	1.41	1.56	1.79	1.35	1.26	1.25	1.34	1.14	1.38	1.55	1.42
1-Pentene	0.08	0.06	0.07	0.09	0.05	0.07	0.06	0.05	0.10	0.08	0.07	0.08	0.07	0.04	0.09	0.14	0.10	0.06	0.13	0.06	0.06	0.06	0.14	0.16
2-Methyl-1-Butene	0.08	0.08	0.04	0.02	0.03	0.09	0.08	0.05	0.14	0.09	0.09	0.04	0.08	0.03	0.08	0.06	0.04	0.05	0.15	0.02	0.08	0.06	0.22	0.19
Pentane	2.09	1.87	0.69	0.72	0.85	1.39	1.36	1.54	3.03	2.04	2.04	0.48	1.54	0.61	0.94	0.68	0.57	0.70	2.39	0.48	1.02	0.86	3.26	2.39
Isoprene (2-Methyl-1,3-Butadiene)	0.02	0.02	0.03	0.01	0.02	0.01	0.01	0.03	0.05	0.02	0.02	0.04	0.05	0.04	0.46	0.20	0.46	0.12	0.13	0.43	0.11	0.87	0.38	0.32
t-2-Pentene	0.10	0.09	0.04	0.02	0.04	0.10	0.10	0.05	0.17	0.10	0.10	0.03	0.10	0.03	0.08	0.06	0.04	0.05	0.20	0.02	0.10	0.06	0.26	0.21
Ethylbromide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
c-2-Pentene	0.04	0.04	0.02	0.01	0.02	0.05	0.04	0.02	0.08	0.04	0.04	0.02	0.05	0.01	0.04	0.03	0.02	0.03	0.09	0.01	0.04	0.03	0.11	0.12
Dichloromethane	0.38	0.34	0.37	0.53	0.41	0.34	0.27	0.56	3.14	0.66	0.70	0.33	0.86	0.31	0.36	0.38	0.37	0.35	0.50	0.34	0.31	0.67	0.64	0.48
2-Methyl-2-Butene	0.09	0.08	0.03	0.01	0.04	0.11	0.11	0.05	0.16	0.10	0.10	0.04	0.09	0.03	0.07	0.07	0.04	0.05	0.21	0.02	0.12	0.05	0.29	0.31
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.66	0.60	0.62	0.60	0.52	0.53	0.52	0.55	0.61	0.58	0.57	0.51	0.50	0.49	0.55	0.64	0.48	0.44	0.44	0.47	0.40	0.57	0.68	0.59
2,2-Dimethylbutane	0.10	0.09	0.04	0.01	0.02	0.06	0.06	0.05	0.13	0.07	0.07	0.03	0.07	0.03	0.07	0.05	0.02	0.03	0.09	0.02	0.06	0.05	0.23	0.23
Cyclopentene	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.04	0.04
t-1,2-Dichloroethene	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.03	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03
4-Methyl-1-Pentene	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.00	0.02	0.01	0.00	0.01	0.01	0.01	0.00	0.02	0.02
3-Methyl-1-Pentene	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.02
1,1-Dichloroethane	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.00	0.01	0.00
Cyclopentane	0.09	0.08	0.04	0.02	0.04	0.07	0.07	0.12	0.24	0.13	0.14	0.05	0.15	0.05	0.09	0.06	0.05	0.07	0.15	0.04	0.08	0.09	0.25	0.25
2,3-Dimethylbutane	0.15	0.14	0.05	0.02	0.04	0.09	0.09	0.09	0.24	0.13	0.13	0.07	0.16	0.07	0.13	0.09	0.06	0.08	0.30	0.04	0.08	0.11	1.44	1.41
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
Methyl-t-Butyl Ether (MTBE)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.00
2-Methylpentane	1.14	1.03	0.21	0.05	0.20	0.44	0.42	0.42	1.16	0.60	0.59	0.26	0.68	0.34	0.43	0.36	0.22	0.30	1.69	0.14	0.29	0.48	14.03	12.72
c-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00
3-Methylpentane	1.60	1.43	0.19	0.06	0.25	0.51	0.50	0.45	1.03	0.61	0.59	0.28	0.69	0.44	0.33	0.34	0.18	0.30	2.42	0.12	0.24	0.38	19.74	18.27
1-Hexene/2-Methyl-1-Pentene	0.07	0.04	0.06	0.07	0.03	0.05	0.04	0.04	0.07	0.05	0.04	0.08	0.06	0.03	0.06	0.12	0.09	0.05	0.10	0.07	0.03	0.06	0.11	0.12
c-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Hexane	3.00	2.70	0.22	0.09	0.43	0.84	0.80	0.71	1.40	0.89	0.86	0.39	1.10	0.86	0.53	0.62	0.22	0.47	4.96	0.15	0.32	0.49	42.46	39.29
Chloroform	0.12	0.10	0.11	0.11	0.09	0.09	0.09	0.14	0.17	0.15	0.15	0.11	0.11	0.11	0.11	0.13	0.11	0.10	0.11	0.10	0.14	0.18	0.19	0.18
t-2-Hexene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.01	0.02	0.03	0.03
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.06	0.00	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.02	0.01	0.01	0.00	0.02	0.03
c-2-Hexene	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
c-3-Methyl-2-Pentene	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.08	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
2,2-Dimethylpentane	0.03	0.03	0.01	0.00	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.03	0.01	0.01	0.01	0.11	0.11
1,2-Dichloroethane	0.09	0.08	0.07	0.08	0.06	0.07	0.06	0.07	0.09	0.08	0.08	0.07	0.08	0.07	0.07	0.08	0.07	0.07	0.08	0.06	0.06	0.06	0.16	0.15
Methylcyclopentane	0.90	0.82	0.08	0.02	0.15	0.32	0.30	0.29	0.56	0.35	0.34	0.18	0.58	0.36	0.26	0.31	0.09	0.22	1.92	0.06	0.14	0.21	16.86	15.67
2,4-Dimethylpentane	0.06	0.05	0.03	0.01	0.02	0.04	0.04	0.06	0.13	0.06	0.06	0.04	0.08	0.04	0.07	0.05	0.04	0.04	0.09	0.02	0.05	0.06	0.19	0.19
1,1,1-Trichloroethane	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.26	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
2,2,3-Trimethylbutane	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.00	0.01	0.01	0.02	0.02	0.02	0.01	0.03	0.04	0.03
1-Methylcyclopentene	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Benzene	1.08	0.91	0.35	0.22	0.20	0.71	0.63	0.43	3.47	3.09	2.94	0.75	3.50	6.80	0.51	6.59	0.55	0.53	0.60	0.20	0.31	0.69	0.77	0.77
Carbontetrachloride	0.60	0.55	0.45	0.20	0.39	0.43	0.43	0.45	0.54	0.54	0.55	0.45	0.44	0.42	0.51	0.55	0.36	0.37	0.33	0.34	0.32	0.49	0.54	0.48
Cyclohexane	0.09	0.09	0.03	0.02	0.03	0.06	0.05	0.11	0.22	0.10	0.09	0.05	0.12	0.10	0.10	0.07	0.03	0.05	0.12	0.03	0.04	0.06	0.62	0.57
2-Methylhexane	0.14	0.12	0.14	0.04	0.22	0.07	0.07	0.33	0.60	0.22	0.22	0.13	0.20	0.10	0.16	0.09	0.11	0.21	0.18	0.07	0.11	0.17	0.31	0.33
2,3-Dimethylpentane	0.08	0.07	0.07	0.02	0.11	0.07	0.06	0.17	0.31	0.13	0.13	0.07	0.13	0.06	0.10	0.06	0.07	0.12	0.12	0.04	0.07	0.09	0.19	0.20
Cyclohexene	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02
3-Methylhexane	0.18	0.14	0.18	0.06	0.34	0.08	0.07	0.43	0.77	0.28	0.28	0.18	0.26	0.13	0.19	0.11	0.16	0.35	0.23	0.10	0.14	0.20	0.37	0.36
Dibromomethane	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
1,2-Dichloropropane	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Bromodichloromethane	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.00	0.02	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.01	0.04	0.02
1-Heptene	0.06	0.00	0.07	0.11	0.07	0.04	0.04	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.14	0.12	0.00	0.10	0.11	0.00	0.00	0.00	0.08
Trichloroethene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.22	0.04	0.04	0.12	0.04	0.01	0.04	0.02	0.01	0.01	0.05	0.01	0.03	0.05	0.02	0.02
2,2,4-Trimethylpentane	0.15	0.12	0.17	0.05	0.08	0.10	0.09	0.22	0.41	0.18	0.18	0.18	0.28	0.11	0.21	0.13	0.20	0.21	0.30	0.11	0.11	0.25	0.38	0.38
t-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01
Heptane	0.12	0.09	0.12	0.04	0.23	0.06	0.05	0.41	0.62	0.21	0.21	0.15	0.22	0.15	0.21	0.14	0.14	0.34	0.18	0.09	0.11	0.16	0.26	0.29
c-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01
c-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.07	0.05	0.05	0.01	0.06	0.04	0.04	0.29	0.25	0.10	0.10	0.09	0.19	0.22	0.17	0.09	0.05	0.10	0.08	0.05	0.06	0.07	0.12	0.12
2,5-Dimethylhexane	0.02	0.01	0.02	0.00	0.01	0.01	0.01	0.03	0.05	0.02	0.02	0.02	0.04	0.02	0.03	0.02	0.03	0.03	0.03	0.01	0.01	0.04	0.05	0.07
2,4-Dimethylhexane	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.04	0.06	0.02	0.02	0.02	0.04	0.02	0.04	0.02	0.03	0.03	0.03	0.01	0.02	0.04	0.06	0.06
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
Bromotrichloromethane	0.00	0.00	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3,4-Trimethylpentane	0.03	0.03	0.04	0.01	0.02	0.02	0.02	0.05	0.09	0.04	0.04	0.06	0.07	0.03	0.07	0.04	0.08	0.07	0.09	0.04	0.03	0.09	0.11	0.12
Toluene	0.60	0.50	0.65	0.17	0.37	0.29	0.25	2.54	6.06	1.84	1.79	0.74	1.79	1.55	0.87	1.67	1.06	1.09	1.15	0.49	0.55	1.23	1.65	1.99
2-Methylheptane	0.05	0.04	0.04	0.01	0.03	0.02	0.02	0.10	0.14	0.06	0.06	0.00	0.12	0.11	0.09	0.05	0.06	0.09	0.07	0.00	0.05	0.04	0.11	0.00
4-Methylheptane	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.04	0.05	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.03	0.00
1-Methylcyclohexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01
3-Methylheptane	0.03	0.02	0.03	0.01	0.02	0.01	0.01	0.07	0.11	0.04	0.04	0.05	0.08	0.08	0.06	0.03	0.03	0.04	0.04	0.02	0.03	0.05	0.07	0.07
Dibromochloromethane	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.01
c-1,3-Dimethylcyclohexane	0.02	0.02	0.01	0.00	0.02	0.01	0.01	0.07	0.11	0.05	0.05	0.02	0.06	0.08	0.05	0.03	0.01	0.03	0.02	0.01	0.01	0.02	0.04	0.03
t-1,4-Dimethylcyclohexane	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.02	0.02	0.01	0.02	0.03	0.02	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01
2,2,5-Trimethylhexane	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.03	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02
1,2-Dibromoethane (EDB)	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
1-Octene	0.24	0.07	0.12	0.14	0.09	0.08	0.05	0.06	0.04	0.04	0.06	0.08	0.11	0.10	0.06	0.17	0.13	0.06	0.12	0.17	0.03	0.04	0.08	0.09
Octane	0.08	0.05	0.04	0.02	0.04	0.03	0.02	0.12	0.20	0.08	0.09	0.06	0.16	0.20	0.12	0.09	0.06	0.08	0.08	0.04	0.05	0.07	0.11	0.14
t-2-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.04	0.09	0.03	0.03	0.01	0.05	0.07	0.03	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.03
Tetrachloroethene	0.08	0.07	0.06	0.03	0.04	0.03	0.02	0.17	0.27	0.12	0.12	0.06	0.21	0.06	0.06	0.05	0.05	0.09	0.04	0.05	0.11	0.08	0.07	0.06
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.07	0.02	0.02	0.01	0.04	0.05	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02
c-1,2-Dimethylcyclohexane	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chlorobenzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02
Ethylbenzene	0.13	0.13	0.12	0.04	0.16	0.06	0.05	0.96	0.81	0.21	0.21	0.11	0.31	0.14	0.16	0.10	0.17	0.22	0.17	0.12	0.11	0.23	0.27	0.31
m,p-Xylene	0.46	0.42	0.35	0.09	0.52	0.22	0.20	3.31	2.74	0.71	0.72	0.26	0.88	0.58	0.47	0.49	0.37	0.58	0.38	0.27	0.25	0.53	0.64	0.70
Bromoform	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02
1,4-Dichlorobutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.18	0.31	0.19	0.33	0.00	0.34	0.00
Styrene	0.03	0.06	0.08	0.06	0.05	0.05	0.04	2.96	7.22	2.34	2.35	0.70	1.81	1.45	5.28	6.85	14.18	8.70	7.83	21.23	17.04	21.73	28.88	54.72
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
1-Nonene	0.07	0.04	0.10	0.08	0.07	0.04	0.04	0.07	0.00	0.07	0.06	0.06	0.06	0.00	0.06	0.16	0.11	0.06	0.11	0.12	0.03	0.05	0.11	0.14
o-Xylene	0.16	0.15	0.13	0.03	0.16	0.09	0.07	1.13	0.96	0.28	0.28	0.11	0.34	0.23	0.18	0.17	0.18	0.25	0.18	0.14	0.14	0.23	0.29	0.36
Nonane	0.07	0.05	0.06	0.03	0.04	0.02	0.02	0.20	0.48	0.19	0.19	0.05	0.24	0.35	0.10	0.09	0.07	0.15	0.09	0.05	0.06	0.14	0.16	0.23
iso-Propylbenzene	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.04	0.06	0.03	0.03	0.01	0.04	0.03	0.10	0.12	0.17	0.09	0.10	0.27	0.22	0.36	0.48	1.23
a-Pinene	0.02	0.02	0.05	0.12	0.02	0.02	0.02	0.15	0.32	0.08	0.08	0.05	0.11	0.06	0.13	0.10	0.13	0.07	0.08	0.11	0.06	0.34	0.20	0.19
3,6-Dimethyloctane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.01	0.00	0.02	0.02	0.02	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01
n-Propylbenzene	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.08	0.13	0.05	0.05	0.03	0.06	0.04	0.08	0.07	0.14	0.09	0.08	0.16	0.13	0.22	0.28	0.56
3-Ethyltoluene	0.04	0.04	0.06	0.02	0.04	0.03	0.02	0.18	0.33	0.12	0.12	0.07	0.16	0.10	0.19	0.20	0.30	0.18	0.19	0.33	0.33	0.57	0.65	1.20
Camphene	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.03	0.05	0.03	0.03	0.01	0.03	0.02	0.04	0.08	0.06	0.04	0.03	0.04	0.02	0.09	0.09	0.11
4-Ethyltoluene	0.02	0.02	0.03	0.01	0.02	0.01	0.01	0.09	0.17	0.07	0.06	0.03	0.08	0.04	0.10	0.10	0.17	0.10	0.10	0.19	0.19	0.33	0.38	0.63
1,3,5-Trimethylbenzene	0.03	0.02	0.03	0.01	0.02	0.02	0.02	0.08	0.18	0.07	0.08	0.03	0.09	0.09	0.07	0.11	0.12	0.07	0.08	0.09	0.13	0.21	0.32	0.47
2-Ethyltoluene	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.07	0.13	0.05	0.05	0.03	0.06	0.04	0.07	0.07	0.10	0.07	0.07	0.12	0.11	0.20	0.25	0.48
b-Pinene	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.04	0.02	0.03	0.03	0.03	0.05	0.00	0.07	0.11	0.05	0.01	0.04	0.03	0.04	0.18	0.08	0.09
1-Decene	0.01	0.01	0.03	0.03	0.02	0.02	0.01	0.01	0.00	0.02	0.00	0.04	0.02	0.02	0.03	0.16	0.07	0.02	0.07	0.07	0.01	0.02	0.04	0.09
tert-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
1,2,4-Trimethylbenzene	0.07	0.07	0.09	0.02	0.05	0.05	0.04	0.25	0.52	0.21	0.22	0.12	0.28	0.22	0.34	0.38	0.51	0.27	0.31	0.52	0.59	0.95	1.08	2.07
Decane	0.06	0.05	0.06	0.02	0.04	0.02	0.01	0.25	0.67	0.23	0.26	0.06	0.32	0.34	0.12	0.11	0.09	0.17	0.11	0.06	0.06	0.22	0.19	0.28
Benzyl Chloride	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00
1,4-Dichlorobenzene	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.07	0.11	0.06	0.06	0.02	0.05	0.03	0.05	0.05	0.08	0.07	0.05	0.11	0.09	0.16	0.29	0.39
iso-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03
sec-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
1,2,3-Trimethylbenzene	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.05	0.12	0.04	0.04	0.02	0.07	0.06	0.06	0.07	0.07	0.05	0.05	0.07	0.07	0.13	0.15	0.28
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.04	0.01	0.02	0.01	0.03	0.02	0.02	0.04	0.03	0.02	0.02	0.02	0.02	0.04	0.04	0.05
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Limonene	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.06	0.20	0.04	0.04	0.03	0.14	0.08	0.29	0.33	0.20	0.03	0.12	0.06	0.10	0.18	0.09	0.10
Indan (2,3-Dihydroindene)	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.08	0.02	0.02	0.02	0.13	0.05	0.03	0.04	0.02	0.02	0.02	0.02	0.03	0.05	0.05	0.05
1,3-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
1,4-Diethylbenzene	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.06	0.03	0.03	0.02	0.05	0.05	0.05	0.05	0.04	0.03	0.03	0.04	0.04	0.06	0.06	0.09
n-Butylbenzene	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.03	0.04
1,2-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01
1-Undecene	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.00	0.04	0.00	0.00	0.08	0.23	NR	NR	NR	NR	NR	0.06	0.04	0.07
Undecane	0.03	0.03	0.02	0.02	0.03	0.02	0.02	0.14	0.49	0.12	0.18	0.07	0.29	0.26	0.17	0.15	0.06	0.11	0.09	0.05	0.05	0.11	0.10	0.19
1,2,4-Trichlorobenzene	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Naphthalene	0.08	0.08	0.02	0.01	0.01	0.09	0.09	0.21	2.32	8.88	9.71	0.52	4.44	15.36	0.64	10.96	0.11	0.05	0.07	0.05	0.09	0.18	0.14	0.28
Dodecane	0.03	0.02	0.01	0.01	0.02	0.03	0.04	0.08	0.21	0.10	0.18	0.09	0.27	0.23	NR	NR	0.04	0.04	0.08	0.05	0.05	0.22	0.06	0.17
Hexachlorobutadiene	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
Hexylbenzene	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	NR	NR	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01

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, Blind Duplicate

Randle Reef Study 2015 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

Non-Polar Analysis Date	**21-Apr-15**	**30-Apr-15**	**4-May-15**	**14-May-15**	**26-May-15**	**10-Jun-15**	**2-Jul-15**	**15-Jul-15**	**20-Jul-15**
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176ML**	**Lab176 Urba**	**Lab176ML**	**Lab176ML**	**Lab176ML**
Filename	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**	**MS96AF.D**	**BLK02.D**	**BLK02.D**	**BLK02.D**
Sample Volume (mL)	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**
Freon 134A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propene	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Propane	NR	NR	NR	NR	NR	0.02	NR	NR	NR
Freon 22 (Chlorodifluoromethane)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 12 (Dichlorodifluoromethane)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloromethane	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Isobutane (2-Methylpropane)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01
1,3-Butadiene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Butane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylpropane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromomethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 11 (Trichlorofluoromethane)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pentane	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethylbromide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dichloromethane	0.01	0.01	0.01	0.01	0.02	0.03	0.01	0.01	0.01
2-Methyl-2-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclopentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3-Dimethylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Hexene/2-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloroform	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Hexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Hexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclopentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,4-Dimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2,3-Trimethylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Methylcyclopentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzene	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Carbontretrachloride	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3-Dimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclohexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibromomethane	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.01	0.02
1,2-Dichloropropane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,5-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,4-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromotrichloromethane	0.00	0.00	NR	0.00	0.00	0.00	0.00	0.00	0.00
2,3,4-Trimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylheptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Methylheptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Methylcyclohexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylheptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibromochloromethane	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
c-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,4-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2,5-Trimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Octane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tetrachloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m,p-Xylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromoform	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Styrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Nonene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iso-Propylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
a-Pinene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3,6-Dimethyloctane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Propylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Ethyltoluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Camphene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Ethyltoluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3,5-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Ethyltoluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b-Pinene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Decene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
tert-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Decane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzyl Chloride	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iso-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sec-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,3-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limonene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indan (2,3-Dihydroindene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Undecene	0.00	0.00	0.00	0.00	0.00	0.00	NR	0.00	0.00
Undecane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trichlorobenzene	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Naphthalene	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Dodecane	0.00	0.00	0.00	0.00	0.00	NR	0.00	0.00	0.00
Hexachlorobutadiene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexylbenzene	0.00	0.00	0.00	0.00	0.00	NR	0.00	0.00	0.00

Method Detection Limit
Concentration ($\mu g/m^3$)

Non-Polar Analysis Location	**Lab176 Ur**	**Lab176ML**
Date of MDL analysis	**1-Apr-14**	**9-Feb-15**
Compound Name		
Freon 134A	0.02	0.03
Propene	0.03	0.03
Propane	0.04	0.16
Freon 22 (Chlorodifluoromethane)	0.03	0.05
Freon 12 (Dichlorodifluoromethane)	0.05	0.04
Propyne	0.00	0.01
Chloromethane	0.03	0.03
Isobutane (2-Methylpropane)	0.03	0.03
Freon 114 (1,2-Dichlorotetrafluoroethan	0.04	0.05
Vinylchloride (Chloroethene)	0.00	0.01
1-Butene/2-Methylpropene	0.03	0.03
1,3-Butadiene	0.00	0.02
Butane	0.03	0.05
t-2-Butene	0.01	0.02
2,2-Dimethylpropane	0.02	0.01
Bromomethane	0.03	0.03
1-Butyne	0.02	0.01
c-2-Butene	0.01	0.02
Chloroethane	0.02	0.03
3-Methyl-1-Butene	0.02	0.00
2-Methylbutane	0.02	0.04
Freon 11 (Trichlorofluoromethane)	0.00	0.01
1-Pentene	0.02	0.05
2-Methyl-1-Butene	0.01	0.01
Pentane	0.03	0.01
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.02
t-2-Pentene	0.01	0.01
Ethylbromide	0.01	0.02
1,1-Dichloroethene	0.02	0.02
c-2-Pentene	0.00	0.01
Dichloromethane	0.02	0.01
2-Methyl-2-Butene	0.00	0.01
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.01	0.02
2,2-Dimethylbutane	0.02	0.04
Cyclopentene	0.01	0.02
t-1,2-Dichloroethene	0.02	0.01
4-Methyl-1-Pentene	0.01	0.01
3-Methyl-1-Pentene	0.02	0.01
1,1-Dichloroethane	0.02	0.00
Cyclopentane	0.01	0.02
2,3-Dimethylbutane	0.01	0.01
t-4-Methyl-2-Pentene	0.02	0.02
Methyl-t-Butyl Ether (MTBE)	0.03	0.04
2-Methylpentane	0.03	0.04
c-4-Methyl-2-Pentene	0.01	0.02
3-Methylpentane	0.02	0.04
1-Hexene/2-Methyl-1-Pentene	0.04	0.04
c-1,2-Dichloroethene	0.02	0.01
Hexane	0.02	0.02
Chloroform	0.01	0.02
t-2-Hexene	0.02	0.01
2-Ethyl-1-Butene	0.02	0.01
t-3-Methyl-2-Pentene	0.00	0.01
c-2-Hexene	0.02	0.02
c-3-Methyl-2-Pentene	0.01	0.00
2,2-Dimethylpentane	0.02	0.02
1,2-Dichloroethane	0.02	0.01
Methylcyclopentane	0.00	0.00
2,4-Dimethylpentane	0.01	0.00
1,1,1-Trichloroethane	0.02	0.01
2,2,3-Trimethylbutane	0.00	0.00
1-Methylcyclopentene	0.02	0.02
Benzene	0.02	0.01
Carbontretrachloride	0.00	0.02
Cyclohexane	0.02	0.02
2-Methylhexane	0.01	0.02
2,3-Dimethylpentane	0.02	0.03
Cyclohexene	0.03	0.02
3-Methylhexane	0.01	0.01
Dibromomethane	0.02	0.08
1,2-Dichloropropane	0.02	0.03
Bromodichloromethane	0.02	0.05
1-Heptene	0.01	0.02
Trichloroethene	0.03	0.04
2,2,4-Trimethylpentane	0.00	0.01
t-3-Heptene	0.01	0.02
Heptane	0.03	0.03
c-3-Heptene	0.02	0.01
t-2-Heptene	0.00	0.00
c-2-Heptene	0.01	0.02
c-1,3-Dichloropropene	0.01	0.02
2,2-Dimethylhexane	0.02	0.00
Methylcyclohexane	0.01	0.00
2,5-Dimethylhexane	0.00	0.02
2,4-Dimethylhexane	0.02	0.00
t-1,3-Dichloropropene	0.00	0.02
1,1,2-Trichloroethane	0.03	0.04
Bromotrichloromethane	0.02	0.01
2,3,4-Trimethylpentane	0.01	0.02
Toluene	0.02	0.04
2-Methylheptane	0.02	0.01
4-Methylheptane	0.02	0.01
1-Methylcyclohexene	0.01	0.02
3-Methylheptane	0.01	0.00
Dibromochloromethane	0.02	0.03
c-1,3-Dimethylcyclohexane	0.02	0.02
t-1,4-Dimethylcyclohexane	0.01	0.02
2,2,5-Trimethylhexane	0.01	0.01
1,2-Dibromoethane (EDB)	0.02	0.02
1-Octene	0.02	0.02
Octane	0.02	0.02
t-2-Octene	0.03	0.02
t-1,2-Dimethylcyclohexane	0.00	0.01
Tetrachloroethene	0.03	0.03
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.01
c-1,2-Dimethylcyclohexane	0.02	0.02
Chlorobenzene	0.02	0.04
Ethylbenzene	0.01	0.02
m,p-Xylene	0.03	0.04
Bromoform	0.03	0.04
1,4-Dichlorobutane	0.06	0.05
Styrene	0.02	0.02
1,1,2,2-Tetrachloroethane	0.04	0.04
1-Nonene	0.01	0.02
o-Xylene	0.02	0.02
Nonane	0.01	0.02
iso-Propylbenzene	0.02	0.02
a-Pinene	0.03	0.05
3,6-Dimethyloctane	0.00	0.02
n-Propylbenzene	0.02	0.02
3-Ethyltoluene	0.02	0.02
Camphene	0.03	0.07
4-Ethyltoluene	0.01	0.01
1,3,5-Trimethylbenzene	0.02	0.02
2-Ethyltoluene	0.02	0.02
b-Pinene	0.02	0.03
1-Decene	0.02	0.02
tert-Butylbenzene	0.04	0.01
1,2,4-Trimethylbenzene	0.05	0.02
Decane	0.02	0.02
Benzyl Chloride	0.02	0.02
1,3-Dichlorobenzene	0.05	0.03
1,4-Dichlorobenzene	0.02	0.02
iso-Butylbenzene	0.02	0.02
sec-Butylbenzene	0.03	0.02
1,2,3-Trimethylbenzene	0.02	0.02
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02	0.01
1,2-Dichlorobenzene	0.05	0.03
Limonene	0.08	0.07
Indan (2,3-Dihydroindene)	0.03	0.02
1,3-Diethylbenzene	0.02	0.02
1,4-Diethylbenzene	0.04	0.03
n-Butylbenzene	0.02	0.02
1,2-Diethylbenzene	0.03	0.02
1-Undecene	0.04	0.02
Undecane	0.03	0.01
1,2,4-Trichlorobenzene	0.08	0.03
Naphthalene	0.03	0.00
Dodecane	0.07	0.01
Hexachlorobutadiene	0.10	0.04
Hexylbenzene	0.04	0.02

Method Detection Limit
Concentration ($\mu g/m^3$)

FID Analysis Location	Lab177N	Lab177N
Date of MDL analysis	5-May-14	11-Jun-15
Compound Name		
Ethylene	0.02	0.01
Acetylene	0.01	0.01
Ethane	0.01	0.01
Propane	0.02	0.01

Duplicate-VOC Analysis
Concentration (µg/m^3)

Non-Polar Analysis Date	**4-May-15**	**4-May-15**		**14-May-15**	**14-May-15**	
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**		**Lab176ML**	**Lab176ML**	
Filename	**RR47.D**	**RRDUP.D**		**RR49.D**	**RRDUP.D**	
Sample location	**EC STATIC**	**EC STATION 3, USS Dockwall**		**EC STATIC**	**EC STATION 1, DND HMSC Star**	
Sampling Date	**24-Apr-15**	**24-Apr-15**		**6-May-15**	**6-May-15**	
Canister ID	**EPS 163**	**EPS 163**		**EPS 395**	**EPS 395**	
Sample Volume (mL)	**500**	**500**		**500**	**500**	
			% difference			**% difference**
Freon 134A	0.35	0.37	-6.13%	0.70	0.76	-8.46%
Propene	0.08	0.08	0.00%	0.23	0.27	-15.87%
Propane	FID DATA	FID DATA	#VALUE!	FID DATA	FID DATA	#VALUE!
Freon 22 (Chlorodifluoromethane)	0.72	0.74	-3.03%	0.89	0.93	-4.60%
Freon 12 (Dichlorodifluoromethane)	2.45	2.49	-1.70%	2.56	2.65	-3.61%
Propyne	0.01	0.01	0.00%	0.02	0.02	0.00%
Chloromethane	1.32	1.36	-3.58%	1.28	1.36	-5.75%
Isobutane (2-Methylpropane)	1.48	1.45	2.59%	0.97	1.01	-3.83%
Freon 114 (1,2-Dichlorotetrafluoroethane	0.12	0.11	3.45%	0.11	0.11	0.00%
Vinylchloride (Chloroethene)	0.00	0.00	0.00%	0.00	0.00	0.00%
1-Butene/2-Methylpropene	0.24	0.24	1.67%	0.21	0.24	-10.62%
1,3-Butadiene	0.01	0.01	0.00%	0.03	0.03	0.00%
Butane	3.65	3.62	0.88%	1.96	1.99	-1.52%
t-2-Butene	0.15	0.15	2.67%	0.04	0.04	0.00%
2,2-Dimethylpropane	0.02	0.02	10.53%	0.01	0.01	0.00%
Bromomethane	0.05	0.05	8.00%	0.05	0.05	0.00%
1-Butyne	0.00	0.00	0.00%	0.00	0.00	0.00%
c-2-Butene	0.12	0.12	5.04%	0.04	0.04	0.00%
Chloroethane	0.02	0.02	0.00%	0.02	0.02	0.00%
3-Methyl-1-Butene	0.02	0.01	13.33%	0.01	0.01	0.00%
2-Methylbutane	2.81	2.74	2.81%	1.72	1.74	-1.39%
Freon 11 (Trichlorofluoromethane)	1.48	1.51	-1.74%	1.65	1.69	-2.28%
1-Pentene	0.07	0.07	11.43%	0.05	0.06	-3.64%
2-Methyl-1-Butene	0.09	0.08	12.35%	0.05	0.05	0.00%
Pentane	1.39	1.37	1.30%	1.54	1.58	-2.31%
Isoprene (2-Methyl-1,3-Butadiene)	0.01	0.01	15.38%	0.03	0.03	0.00%
t-2-Pentene	0.10	0.09	10.53%	0.05	0.05	-3.92%
Ethylbromide	0.00	0.00	66.67%	0.00	0.00	0.00%
1,1-Dichloroethene	0.00	0.00	200.00%	0.00	0.00	#DIV/0!
c-2-Pentene	0.05	0.04	13.95%	0.02	0.02	0.00%
Dichloromethane	0.34	0.34	-1.18%	0.56	0.58	-3.17%
2-Methyl-2-Butene	0.11	0.10	13.08%	0.05	0.05	0.00%
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.53	0.53	0.38%	0.55	0.56	-1.81%
2,2-Dimethylbutane	0.06	0.05	10.91%	0.05	0.05	0.00%
Cyclopentene	0.01	0.01	18.18%	0.01	0.01	0.00%
t-1,2-Dichloroethene	0.00	0.00	0.00%	0.02	0.02	0.00%
4-Methyl-1-Pentene	0.01	0.01	0.00%	0.01	0.00	200.00%
3-Methyl-1-Pentene	0.00	0.00	0.00%	0.00	0.00	0.00%
1,1-Dichloroethane	0.00	0.00	#DIV/0!	0.01	0.00	200.00%
Cyclopentane	0.07	0.06	9.23%	0.12	0.11	5.22%
2,3-Dimethylbutane	0.09	0.08	9.52%	0.09	0.09	-2.15%
t-4-Methyl-2-Pentene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Methyl-t-Butyl Ether (MTBE)	0.01	0.01	18.18%	0.00	0.00	0.00%
2-Methylpentane	0.44	0.40	10.93%	0.42	0.41	0.48%
c-4-Methyl-2-Pentene	0.01	0.01	22.22%	0.01	0.01	0.00%
3-Methylpentane	0.51	0.48	7.29%	0.45	0.46	-1.75%
1-Hexene/2-Methyl-1-Pentene	0.05	0.04	13.33%	0.04	0.04	0.00%
c-1,2-Dichloroethene	0.00	0.00	66.67%	0.00	0.00	0.00%
Hexane	0.84	0.77	8.91%	0.71	0.71	0.00%
Chloroform	0.09	0.09	2.20%	0.14	0.15	-2.74%
t-2-Hexene	0.01	0.01	33.33%	0.01	0.01	0.00%
2-Ethyl-1-Butene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-3-Methyl-2-Pentene	0.01	0.01	-15.38%	0.00	0.00	#DIV/0!
c-2-Hexene	0.01	0.01	28.57%	0.01	0.01	-28.57%
c-3-Methyl-2-Pentene	0.00	0.00	#DIV/0!	0.04	0.00	200.00%
2,2-Dimethylpentane	0.01	0.01	0.00%	0.01	0.01	0.00%
1,2-Dichloroethane	0.07	0.06	6.25%	0.07	0.07	-2.74%
Methylcyclopentane	0.32	0.29	9.84%	0.29	0.29	0.00%
2,4-Dimethylpentane	0.04	0.04	10.00%	0.06	0.06	-3.39%
1,1,1-Trichloroethane	0.02	0.02	0.00%	0.02	0.02	0.00%
2,2,3-Trimethylbutane	0.01	0.00	40.00%	0.01	0.01	0.00%
1-Methylcyclopentene	0.01	0.01	28.57%	0.00	0.00	0.00%
Benzene	0.71	0.65	8.52%	0.43	0.44	-2.29%
Carbontretrachloride	0.43	0.42	2.38%	0.45	0.46	-1.77%
Cyclohexane	0.06	0.05	11.32%	0.11	0.11	-1.80%
2-Methylhexane	0.07	0.06	6.06%	0.33	0.32	2.48%
2,3-Dimethylpentane	0.07	0.06	3.08%	0.17	0.16	2.44%
Cyclohexene	0.01	0.01	-18.18%	0.01	0.01	0.00%
3-Methylhexane	0.08	0.08	5.00%	0.43	0.43	1.40%
Dibromomethane	0.03	0.03	13.33%	0.03	0.03	14.29%
1,2-Dichloropropane	0.02	0.02	-18.18%	0.03	0.03	0.00%
Bromodichloromethane	0.01	0.01	22.22%	0.02	0.02	-10.53%
1-Heptene	0.04	0.05	-13.33%	0.00	0.00	#DIV/0!
Trichloroethene	0.01	0.01	28.57%	0.05	0.05	0.00%
2,2,4-Trimethylpentane	0.10	0.09	6.19%	0.22	0.22	1.82%
t-3-Heptene	0.00	0.00	66.67%	0.00	0.00	#DIV/0!
Heptane	0.06	0.05	14.29%	0.41	0.39	3.51%
c-3-Heptene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-2-Heptene	0.00	0.00	0.00%	0.00	0.00	0.00%
c-2-Heptene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
c-1,3-Dichloropropene	0.00	0.00	200.00%	0.00	0.00	#DIV/0!
2,2-Dimethylhexane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Methylcyclohexane	0.04	0.03	11.11%	0.29	0.28	3.53%
2,5-Dimethylhexane	0.01	0.01	28.57%	0.03	0.03	6.06%
2,4-Dimethylhexane	0.01	0.01	22.22%	0.04	0.04	0.00%
t-1,3-Dichloropropene	0.00	0.00	200.00%	0.00	0.00	#DIV/0!
1,1,2-Trichloroethane	0.01	0.00	40.00%	0.00	0.01	-40.00%
Bromotrichloromethane	NR	NR	#VALUE!	0.00	0.00	#DIV/0!
2,3,4-Trimethylpentane	0.02	0.02	11.76%	0.05	0.05	3.92%
Toluene	0.29	0.26	10.99%	2.54	2.57	-1.17%
2-Methylheptane	0.02	0.02	9.52%	0.10	0.10	3.92%
4-Methylheptane	0.01	0.00	40.00%	0.04	0.03	5.71%
1-Methylcyclohexene	0.00	0.00	66.67%	0.00	0.00	66.67%
3-Methylheptane	0.01	0.01	18.18%	0.07	0.07	0.00%
Dibromochloromethane	0.01	0.01	28.57%	0.01	0.01	22.22%
c-1,3-Dimethylcyclohexane	0.01	0.01	18.18%	0.07	0.07	5.71%
t-1,4-Dimethylcyclohexane	0.00	0.00	0.00%	0.02	0.02	8.70%
2,2,5-Trimethylhexane	0.00	0.00	0.00%	0.02	0.02	0.00%
1,2-Dibromoethane (EDB)	0.01	0.00	85.71%	0.00	0.00	200.00%
1-Octene	0.08	0.07	11.11%	0.06	0.06	-6.90%
Octane	0.03	0.03	14.29%	0.12	0.11	5.31%
t-2-Octene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-1,2-Dimethylcyclohexane	0.01	0.01	0.00%	0.04	0.04	0.00%
Tetrachloroethene	0.03	0.03	14.29%	0.17	0.17	4.71%
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.01	0.00%	0.03	0.03	6.06%
c-1,2-Dimethylcyclohexane	0.01	0.01	28.57%	0.02	0.02	11.76%
Chlorobenzene	0.01	0.01	22.22%	0.01	0.01	0.00%
Ethylbenzene	0.06	0.05	11.32%	0.96	0.99	-3.07%
m,p-Xylene	0.22	0.20	10.33%	3.31	3.45	-4.14%
Bromoform	0.02	0.01	35.29%	0.02	0.02	20.00%
1,4-Dichlorobutane	0.00	0.00	#DIV/0!	0.18	0.00	200.00%
Styrene	0.05	0.05	12.24%	2.96	3.03	-2.40%
1,1,2,2-Tetrachloroethane	0.01	0.00	100.00%	0.00	0.00	#DIV/0!
1-Nonene	0.04	0.04	4.65%	0.07	0.06	12.90%
o-Xylene	0.09	0.08	11.24%	1.13	1.19	-4.84%
Nonane	0.02	0.02	9.52%	0.20	0.21	-2.96%
iso-Propylbenzene	0.01	0.01	28.57%	0.04	0.05	-8.70%
a-Pinene	0.02	0.01	28.57%	0.15	0.15	-4.03%
3,6-Dimethyloctane	0.00	0.00	66.67%	0.01	0.01	0.00%
n-Propylbenzene	0.01	0.01	33.33%	0.08	0.08	-7.41%
3-Ethyltoluene	0.03	0.02	16.67%	0.18	0.19	-6.45%
Camphene	0.01	0.01	18.18%	0.03	0.04	-18.18%
4-Ethyltoluene	0.01	0.01	15.38%	0.09	0.10	-6.19%
1,3,5-Trimethylbenzene	0.02	0.02	20.00%	0.08	0.09	-7.06%
2-Ethyltoluene	0.01	0.01	22.22%	0.07	0.07	-5.71%
b-Pinene	0.01	0.01	18.18%	0.04	0.04	10.53%
1-Decene	0.02	0.01	13.33%	0.01	0.01	-15.38%
tert-Butylbenzene	0.00	0.00	0.00%	0.00	0.00	#DIV/0!
1,2,4-Trimethylbenzene	0.05	0.04	20.41%	0.25	0.26	-3.10%
Decane	0.02	0.02	9.52%	0.25	0.26	-5.53%
Benzyl Chloride	0.00	0.00	66.67%	0.00	0.00	200.00%
1,3-Dichlorobenzene	0.01	0.00	100.00%	0.01	0.00	100.00%
1,4-Dichlorobenzene	0.01	0.01	50.00%	0.07	0.07	-2.74%
iso-Butylbenzene	0.00	0.00	200.00%	0.01	0.01	0.00%
sec-Butylbenzene	0.00	0.00	0.00%	0.01	0.01	0.00%
1,2,3-Trimethylbenzene	0.01	0.01	18.18%	0.05	0.05	0.00%
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.01	0.00	40.00%	0.02	0.02	0.00%
1,2-Dichlorobenzene	0.01	0.00	100.00%	0.00	0.00	66.67%
Limonene	0.02	0.02	28.57%	0.06	0.06	3.39%
Indan (2,3-Dihydroindene)	0.01	0.01	28.57%	0.02	0.02	0.00%
1,3-Diethylbenzene	0.00	0.00	0.00%	0.01	0.01	0.00%
1,4-Diethylbenzene	0.01	0.01	0.00%	0.03	0.03	0.00%
n-Butylbenzene	0.00	0.00	0.00%	0.02	0.02	0.00%
1,2-Diethylbenzene	0.00	0.00	200.00%	0.00	0.00	0.00%
1-Undecene	0.02	0.02	0.00%	0.01	0.01	0.00%
Undecane	0.02	0.02	9.52%	0.14	0.14	-4.26%
1,2,4-Trichlorobenzene	0.02	0.01	120.00%	0.01	0.00	142.86%
Naphthalene	0.09	0.07	30.77%	0.21	0.20	3.96%
Dodecane	0.03	0.03	13.33%	0.08	0.08	2.41%
Hexachlorobutadiene	0.01	0.00	120.00%	0.01	0.00	100.00%
Hexylbenzene	0.01	0.00	66.67%	0.01	0.00	66.67%

Randle Reef Study 2015 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

Part A

FID Analysis Date	15JUL23-05.	15JUL23-06.D		15AUG06-12	15AUG06-14.D		15AUG24-16	15AUG24-17	15SEP08-5.D	15SEP08-6.D	15SEP30-07	15SEP30-08	15SEP22-15.D	
FID Analysis Location	Lab177N	Lab177N		Lab176	Lab176		Lab176	Lab176	Lab176	Lab176	Lab177N	Lab177N	Lab176	
Non-Polar Analysis Date	5-Aug-15	7-Oct-15		5-Aug-15	5-Aug-15		19-Aug-15	19-Aug-15	6-Oct-15	6-Oct-15	6-Oct-15	6-Oct-15	17-Sep-15	
Non-Polar Analysis Location	Lab176ML	Lab176ML	VOID	Lab176ML	Lab176ML	VOID	Lab176 Urba	Lab176 Urba	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176 Urba	VOID
Filename	RR66.D	RR67.D	RR68.D	RR69.D	RR70.D	RR71.D	RR72.D	RR73.D	RR74.D	RR75.D	RR76.D	RR77.D	RR78.D	RR79.D
Sample location	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION
Sampling Date	17-Jul-15	17-Jul-15	17-Jul-15	29-Jul-15	29-Jul-15	29-Jul-15	10-Aug-15	10-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	2-Sep-15	2-Sep-15
Canister ID	EPS 323	EPS 599	EPS 685	EPS 901	EPS 461	EPS 145	EPS 595	EPS 1016	EPS 113	EPS 332	EPS 758	EPS 669	EPS 613	EPS 967
Sample Volume (mL)	500	500	VOID	500	500	VOID	500	500	500	500	500	500	500	VOID
Comments			Final Pressure = -17"Hg			Final Pressure = -17"Hg								Valve Leaking
Ethylene (FID)	1.04	1.16		0.72	0.75		1.30	0.84	0.92	1.18	1.70	1.53	0.57	
Acetylene (FID)	0.38	0.47		0.29	0.31		0.52	0.31	0.41	0.67	0.55	0.54	0.26	
Ethane (FID) / Ethane (FID corrected for blank)	5.67	6.84		2.17	2.69		3.21	1.90	2.03	3.40	3.13	3.01	2.90	
Freon 134A	0.67	2.05		0.74	4.27		1.55	0.74	0.86	1.39	0.63	0.72	0.74	
Propene	0.39	0.57		0.27	0.36		0.50	0.49	0.31	0.45	0.49	0.40	0.24	
Propane (FID)	3.39	5.69		1.97	2.21		3.63	2.18	1.39	2.83	2.39	2.36	1.94	
Freon 22 (Chlorodifluoromethane)	1.02	1.23		1.13	1.06		2.26	2.06	0.96	1.23	0.97	1.07	0.98	
Freon 12 (Dichlorodifluoromethane)	2.63	2.19		2.30	2.53		2.55	2.52	2.32	2.28	2.35	2.63	2.36	
Propyne	0.03	0.03		0.03	0.04		0.05	0.03	0.03	0.04	0.03	0.04	0.02	
Chloromethane	1.41	0.92		1.20	1.33		1.15	1.19	0.94	1.01	0.98	1.08	1.18	
Isobutane (2-Methylpropane)	0.82	0.96		0.70	1.03		1.59	2.47	0.52	0.84	1.50	1.67	0.87	
Freon 114 (1,2-Dichlorotetrafluoroethane)	0.12	0.10		0.11	0.11		0.12	0.13	0.11	0.10	0.11	0.12	0.11	
Vinylchloride (Chloroethene)	0.01	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1-Butene/2-Methylpropene	0.39	0.36		0.47	0.31		0.56	0.98	0.27	0.45	0.52	0.51	0.33	
1,3-Butadiene	0.03	0.03		0.02	0.04		0.08	0.06	0.04	0.05	0.06	0.05	0.02	
Butane	1.76	1.64		1.35	1.85		2.65	6.20	3.13	3.26	6.75	7.68	1.87	
t-2-Butene	0.05	0.06		0.03	0.07		0.11	0.32	0.05	0.08	0.23	0.27	0.05	
2,2-Dimethylpropane	0.03	0.02		0.01	0.02		0.02	0.07	0.05	0.05	0.10	0.11	0.02	
Bromomethane	0.07	0.03		0.06	0.06		0.05	0.06	0.03	0.03	0.03	0.03	0.06	
1-Butyne	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
c-2-Butene	0.05	0.05		0.03	0.06		0.10	0.25	0.05	0.07	0.21	0.24	0.04	
Chloroethane	0.11	0.03		0.05	0.03		0.04	0.02	0.02	0.10	0.02	0.02	0.04	
3-Methyl-1-Butene	0.02	0.03		0.02	0.03		0.04	0.10	0.02	0.03	0.06	0.05	0.02	
2-Methylbutane	2.27	1.88		1.89	2.72		3.41	12.54	1.95	2.37	9.10	10.25	2.03	
Freon 11 (Trichlorofluoromethane)	1.58	1.44		1.38	1.55		1.42	1.42	1.44	1.45	1.42	1.55	1.36	
1-Pentene	0.10	0.13		0.11	0.14		0.13	0.90	0.08	0.13	0.32	0.17	0.10	
2-Methyl-1-Butene	0.07	0.06		0.05	0.10		0.15	0.48	0.06	0.09	0.23	0.27	0.07	
Pentane	2.14	1.97		1.79	2.07		2.16	8.47	1.85	1.97	5.28	6.58	1.66	
Isoprene (2-Methyl-1,3-Butadiene)	0.29	0.16		1.35	0.64		0.18	0.26	0.23	0.18	0.12	0.15	0.14	
t-2-Pentene	0.07	0.06		0.05	0.07		0.17	0.65	0.07	0.10	0.33	0.38	0.07	
Ethylbromide	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1,1-Dichloroethene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
c-2-Pentene	0.04	0.03		0.02	0.05		0.09	0.29	0.03	0.05	0.14	0.16	0.04	
Dichloromethane	0.47	1.19		0.37	0.45		0.89	3.19	0.70	0.52	0.80	0.58	0.45	
2-Methyl-2-Butene	0.07	0.06		0.04	0.07		0.18	0.79	0.06	0.09	0.34	0.43	0.07	
Freon 113 (1,1,2-Trichlorotrifluoroethane)	0.65	0.47		0.57	0.62		0.59	0.58	0.50	0.49	0.50	0.55	0.54	
2,2-Dimethylbutane	0.09	0.06		0.06	0.08		0.11	0.46	0.05	0.07	0.22	0.25	0.07	
Cyclopentene	0.02	0.02		0.01	0.01		0.03	0.08	0.01	0.02	0.04	0.04	0.01	
t-1,2-Dichloroethene	0.07	0.03		0.04	0.05		0.06	0.05	0.03	0.04	0.03	0.02	0.03	
4-Methyl-1-Pentene	0.00	0.00		0.00	0.01		0.02	0.00	0.00	0.00	0.00	0.00	0.00	
3-Methyl-1-Pentene	0.01	0.01		0.01	0.01		0.01	0.03	0.00	0.01	0.02	0.02	0.01	
1,1-Dichloroethane	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	
Cyclopentane	0.11	0.12		0.10	0.15		0.20	0.58	0.09	0.16	0.33	0.38	0.10	
2,3-Dimethylbutane	0.26	0.11		0.13	0.18		0.26	0.80	0.11	0.16	0.47	0.55	0.13	
t-4-Methyl-2-Pentene	0.00	0.00		0.00	0.00		0.00	0.01	0.00	0.00	0.00	0.00	0.00	
Methyl-t-Butyl Ether (MTBE)	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2-Methylpentane	2.05	0.00		0.71	0.86		1.11	4.15	0.61	0.96	3.38	3.82	0.47	
c-4-Methyl-2-Pentene	0.00	0.01		0.01	0.01		0.02	0.05	0.00	0.01	0.03	0.03	0.01	
3-Methylpentane	2.98	0.41		0.65	0.79		1.03	4.98	0.86	0.96	4.67	5.28	0.43	
1-Hexene/2-Methyl-1-Pentene	0.10	0.12		0.07	0.10		0.08	0.19	0.07	0.08	0.24	0.14	0.07	
c-1,2-Dichloroethene	0.00	0.00		0.00	0.00		0.01	0.00	0.00	0.00	0.00	0.00	0.00	
Hexane	6.73	0.46		1.10	1.27		1.72	10.45	1.76	1.58	10.37	11.55	0.55	
Chloroform	0.16	0.13		0.19	0.20		0.30	0.24	0.17	0.18	0.17	0.17	0.16	
t-2-Hexene	0.02	0.03		0.01	0.02		0.03	0.07	0.01	0.02	0.04	0.05	0.02	
2-Ethyl-1-Butene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
t-3-Methyl-2-Pentene	0.02	0.00		0.00	0.00		0.00	0.10	0.00	0.03	0.00	0.00	0.00	
c-2-Hexene	0.01	0.01		0.01	0.01		0.02	0.03	0.01	0.01	0.02	0.02	0.01	
c-3-Methyl-2-Pentene	0.00	0.02		0.00	0.00		0.02	0.06	0.00	0.07	0.00	0.00	0.01	
2,2-Dimethylpentane	0.06	0.02		0.02	0.03		0.04	0.17	0.02	0.03	0.11	0.13	0.02	
1,2-Dichloroethane	0.07	0.04		0.05	0.06		0.05	0.10	0.05	0.05	0.07	0.07	0.05	
Methylcyclopentane	2.14	0.19		0.39	0.54		0.75	3.67	0.56	0.59	3.68	4.17	0.23	
2,4-Dimethylpentane	0.12	0.09		0.07	0.11		0.13	0.31	0.06	0.10	0.23	0.26	0.08	
1,1,1-Trichloroethane	0.03	0.04		0.02	0.03		0.06	0.02	0.02	0.02	0.02	0.02	0.02	
2,2,3-Trimethylbutane	0.03	0.05		0.02	0.03		0.01	0.02	0.02	0.02	0.04	0.08	0.01	
1-Methylcyclopentene	0.02	0.01		0.01	0.01		0.02	0.05	0.01	0.01	0.02	0.03	0.01	
Benzene	0.57	0.57		0.53	0.87		0.94	1.53	0.81	0.86	1.82	2.00	0.69	
Carbontretrachloride	0.56	0.29		0.48	0.48		0.47	0.45	0.38	0.41	0.32	0.45	0.45	
Cyclohexane	0.20	0.10		0.07	0.12		0.18	0.50	0.09	0.12	0.35	0.41	0.11	
2-Methylhexane	0.59	0.33		0.21	0.48		0.47	0.64	0.16	0.35	0.52	0.51	0.26	
2,3-Dimethylpentane	0.25	0.15		0.11	0.22		0.22	0.36	0.10	0.18	0.31	0.31	0.13	
Cyclohexene	0.02	0.03		0.01	0.01		0.01	0.02	0.02	0.02	0.02	0.02	0.02	
3-Methylhexane	0.94	0.43		0.27	0.61		0.59	0.73	0.23	0.49	0.62	0.61	0.34	
Dibromomethane	0.04	0.04		0.03	0.03		0.04	0.04	0.04	0.03	0.04	0.03	0.04	
1,2-Dichloropropane	0.01	0.01		0.01	0.01		0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Bromodichloromethane	0.00	0.00		0.01	0.00		0.02	0.03	0.02	0.02	0.02	0.03	0.02	
1-Heptene	0.00	0.11		0.00	0.10		0.00	0.12	0.00	0.00	0.18	0.00	0.00	
Trichloroethene	0.03	0.08		0.02	0.25		0.12	0.09	0.03	0.06	0.05	0.02	0.03	
2,2,4-Trimethylpentane	0.27	0.28		0.25	0.37		0.38	0.49	0.18	0.31	0.45	0.44	0.26	
t-3-Heptene	0.00	0.00		0.00	0.00		0.00	0.02	0.00	0.00	0.01	0.00	0.01	
Heptane	0.91	0.29		0.20	0.38		0.49	0.54	0.16	0.33	0.38	0.37	0.21	
c-3-Heptene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
t-2-Heptene	0.01	0.01		0.00	0.01		0.01	0.01	0.00	0.01	0.01	0.01	0.01	
c-2-Heptene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
c-1,3-Dichloropropene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2,2-Dimethylhexane	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Methylcyclohexane	0.25	0.16		0.08	0.15		0.23	0.26	0.09	0.17	0.27	0.27	0.13	
2,5-Dimethylhexane	0.06	0.04		0.04	0.06		0.06	0.06	0.02	0.05	0.06	0.06	0.03	
2,4-Dimethylhexane	0.07	0.05		0.04	0.06		0.07	0.09	0.03	0.05	0.00	0.06	0.04	
t-1,3-Dichloropropene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1,1,2-Trichloroethane	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	
Bromotrichloromethane	NR	0.00		NR	NR		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2,3,4-Trimethylpentane	0.11	0.10		0.09	0.13		0.13	0.20	0.06	0.11	0.11	0.12	0.08	
Toluene	1.73	1.79		1.71	2.99		3.13	3.28	1.09	2.98	2.15	2.22	2.38	
2-Methylheptane	0.00	0.07		0.06	0.10		0.14	0.17	0.07	0.13	0.15	0.17	0.09	
4-Methylheptane	0.04	0.03		0.02	0.04		0.04	0.05	0.02	0.04	0.04	0.04	0.03	
1-Methylcyclohexene	0.01	0.01		0.00	0.01		0.01	0.01	0.00	0.01	0.01	0.01	0.00	
3-Methylheptane	0.08	0.07		0.05	0.08		0.11	0.12	0.04	0.08	0.10	0.10	0.06	
Dibromochloromethane	0.02	0.01		0.02	0.02		0.02	0.02	0.02	0.01	0.02	0.02	0.02	
c-1,3-Dimethylcyclohexane	0.05	0.05		0.03	0.11		0.09	0.07	0.03	0.06	0.06	0.07	0.04	
t-1,4-Dimethylcyclohexane	0.02	0.02		0.01	0.03		0.02	0.02	0.01	0.02	0.02	0.02	0.01	
2,2,5-Trimethylhexane	0.02	0.02		0.02	0.03		0.03	0.03	0.01	0.03	0.02	0.03	0.02	
1,2-Dibromoethane (EDB)	0.01	0.00		0.00	0.00		0.00	0.01	0.00	0.00	0.00	0.00	0.00	
1-Octene	0.09	0.10		0.05	0.10		0.05	0.06	0.08	0.06	0.14	0.21	0.09	
Octane	0.16	0.12		0.09	0.18		0.18	0.21	0.07	0.13	0.15	0.17	0.10	
t-2-Octene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
t-1,2-Dimethylcyclohexane	0.05	0.03		0.02	0.09		0.08	0.06	0.02	0.04	0.04	0.05	0.03	
Tetrachloroethene	0.10	0.11		0.16	0.21		0.14	0.13	0.06	0.41	0.06	0.06	0.13	
c-1,4/t-1,3-Dimethylcyclohexane	0.03	0.03		0.02	0.06		0.05	0.04	0.02	0.03	0.03	0.04	0.02	
c-1,2-Dimethylcyclohexane	0.02	0.01		0.01	0.03		0.02	0.02	0.01	0.02	0.02	0.02	0.01	
Chlorobenzene	0.02	0.01		0.01	0.02		0.01	0.08	0.01	0.01	0.01	0.01	0.01	
Ethylbenzene	0.33	0.35		0.28	0.68		0.64	0.45	0.18	0.62	0.29	0.29	0.34	
m,p-Xylene	0.84	1.00		0.76	2.42		2.02	1.13	0.47	2.11	0.81	0.86	0.93	
Bromoform	0.02	0.01		0.02	0.02		0.03	0.02	0.02	0.02	0.01	0.01	0.02	
1,4-Dichlorobutane	0.00	0.10		0.00	0.32		0.00	0.00	0.00	0.00	0.00	0.00	0.44	
Styrene	35.58	8.13		16.48	14.08		4.04	1.53	1.04	1.87	0.66	1.45	8.79	
1,1,2,2-Tetrachloroethane	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1-Nonene	0.11	0.13		0.07	0.15		0.06	0.09	0.09	0.12	0.15	0.10	0.12	
o-Xylene	0.36	0.40		0.31	0.79		0.67	0.42	0.21	0.74	0.34	0.37	0.36	
Nonane	0.18	0.22		0.12	0.25		0.26	0.23	0.08	0.19	0.13	0.13	0.15	
iso-Propylbenzene	0.70	0.33		0.31	0.23		0.06	0.07	0.03	0.07	0.04	0.04	0.11	
a-Pinene	0.11	0.03		0.24	0.36		0.44	0.17	0.18	0.16	0.03	0.08	0.15	
3,6-Dimethyloctane	0.02	0.01		0.00	0.02		0.02	0.02	0.01	0.02	0.01	0.01	0.01	
n-Propylbenzene	0.40	0.21		0.21	0.22		0.11	0.10	0.05	0.14	0.07	0.07	0.11	
3-Ethyltoluene	1.14	0.56		0.61	0.65		0.31	0.22	0.11	0.38	0.16	0.15	0.28	
Camphene	0.04	0.03		0.06	0.07		0.05	0.06	0.04	0.04	0.03	0.03	0.04	
4-Ethyltoluene	0.66	0.32		0.35	0.36		0.16	0.12	0.06	0.20	0.09	0.08	0.16	
1,3,5-Trimethylbenzene	0.44	0.18		0.28	0.31		0.15	0.10	0.05	0.17	0.06	0.07	0.12	
2-Ethyltoluene	0.40	0.19		0.23	0.26		0.13	0.09	0.04	0.14	0.07	0.06	0.10	
b-Pinene	0.00	0.01		0.14	0.13		0.10	0.05	0.06	0.00	0.02	0.02	0.04	
1-Decene	0.05	0.04		0.04	0.06		0.02	0.05	0.05	0.03	0.07	0.02	0.05	
tert-Butylbenzene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1,2,4-Trimethylbenzene	2.10	0.86		1.32	1.31		0.53	0.35	0.19	0.62	0.24	0.24	0.50	
Decane	0.19	0.32		0.20	0.36		0.36	0.25	0.11	0.28	0.14	0.14	0.20	
Benzyl Chloride	0.02	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1,3-Dichlorobenzene	0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1,4-Dichlorobenzene	0.20	0.10		0.15	0.20		0.12	0.14	0.04	0.11	0.08	0.05	0.07	
iso-Butylbenzene	0.02	0.01		0.01	0.02		0.01	0.01	0.00	0.01	0.01	0.01	0.01	
sec-Butylbenzene	0.03	0.02		0.02	0.02		0.01	0.01	0.01	0.02	0.01	0.01	0.01	
1,2,3-Trimethylbenzene	0.25	0.11		0.18	0.20		0.12	0.08	0.04	0.11	0.05	0.06	0.08	
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.04	0.02		0.04	0.05		0.04	0.19	0.02	0.03	0.02	0.02	0.03	
1,2-Dichlorobenzene	0.01	0.00		0.00	0.01		0.00	0.00	0.01	0.02	0.01	0.01	0.00	
Limonene	0.05	0.00		0.07	0.14		0.15	0.06	0.04	0.01	0.00	0.01	0.04	
Indan (2,3-Dihydroindene)	0.07	0.04		0.05	0.08		0.08	0.03	0.03	0.10	0.03	0.03	0.03	
1,3-Diethylbenzene	0.04	0.02		0.02	0.03		0.02	0.01	0.01	0.02	0.01	0.01	0.01	
1,4-Diethylbenzene	0.12	0.05		0.08	0.09		0.07	0.05	0.03	0.06	0.03	0.04	0.05	
n-Butylbenzene	0.04	0.02		0.03	0.04		0.03	0.02	0.01	0.02	0.01	0.02	0.02	
1,2-Diethylbenzene	0.01	0.00		0.01	0.01		0.01	0.01	0.00	0.01	0.00	0.00	0.01	
1-Undecene	0.05	0.03		0.05	0.05		0.01	0.05	0.04	0.02	0.04	0.02	0.07	
Undecane	0.16	0.16		0.15	0.28		0.27	0.26	0.08	0.17	0.10	0.11	0.11	
1,2,4-Trichlorobenzene	0.01	0.01		0.01	0.01		0.00	0.01	0.01	0.01	0.01	0.01	0.00	
Naphthalene	0.16	0.04		0.23	0.37		0.41	1.31	0.22	0.19	0.18	0.60	0.37	
Dodecane	0.10	0.06		0.09	0.10		0.16	0.20	0.06	0.06	0.05	0.07	0.10	
Hexachlorobutadiene	0.01	0.00		0.00	0.00		0.00	0.00	0.01	0.00	0.01	0.01	0.00	
Hexylbenzene	0.02	0.00		0.01	0.01		0.01	0.01	0.01	0.01	0.00	0.01	0.01	

Part B

FID Analysis Date	15SEP22-16	15OCT01-14	15OCT01-15	15OCT01-16	15OCT01-17	15OCT05-07	15OCT05-07	15OCT05-08	15OCT05-09	15OCT05-10	15OCT15-16	15OCT26-05	15OCT27-10	16JAN14-16	16JAN14-16	15NOV02-09	15NOV02-10	15DEC08-09	15DEC08-05	15DEC08-06	15DEC08-07	15DEC08-08	16JAN07-09	16JAN07-10	16JAN11-14.D
FID Analysis Location	Lab176	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab176	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N	Lab177N
Non-Polar Analysis Date	17-Sep-15	16-Dec-15	22-Sep-15	22-Sep-15	22-Sep-15	14-Oct-15	14-Oct-15	7-Oct-15	7-Oct-15	7-Oct-15	14-Oct-15	14-Oct-15	26-Oct-15	26-Oct-15	26-Oct-15	29-Oct-15	29-Oct-15	10-Dec-15	6-Jan-16	6-Jan-16	10-Dec-15	10-Dec-15	5-Jan-16	5-Jan-16	5-Jan-16
Non-Polar Analysis Location	Lab176 Urba	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176DW	Lab176DW	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML
Filename	RR80.D	RR81.D	RR82.D	RR83.D	RR84.D	RR85.D	RRDUP.D	RR86.D	RR87.D	RR88.D	RR89.D	RR90.D	RR91.D	RR92.D	RRDUP.D	RR93.D	RR94.D	RR95.D	RR96.D	RR97.D	RR98.D	RR99.D	RR01A.D	RR02A.D	RR03A.D
Sample location	DUPLICATE	EC STATION	EC STATION	EC STATION	DUPLICATE	EC STATION	EC STATION	EC STATION	EC STATION	DUPLICATE	EC STATION	EC STATION	EC STATION	DUPLICATE	DUPLICATE	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION	EC STATION 3, USS Dockwall
Sampling Date	2-Sep-15	14-Sep-15	14-Sep-15	14-Sep-15	14-Sep-15	25-Sep-15	25-Sep-15	25-Sep-15	25-Sep-15	25-Sep-15	9-Oct-15	9-Oct-15	9-Oct-15	9-Oct-15	9-Oct-15	21-Oct-15	21-Oct-15	14-Nov-15	14-Nov-15	14-Nov-15	14-Nov-15	26-Nov-15	8-Dec-15	8-Dec-15	8-Dec-15
Canister ID	EPS 1020	EPS 624	EPS 126	EPS 980	EPS 084	EPS 513	EPS 513	EPS 590	EPS 072	EPS 245	EPS 260	EPS 673	EPS 458	EPS 259	EPS 259	EPS 522	EPS 521	EPS 200	EPS 238	EPS 161	EPS 690	EPS 568	EPS 098	EPS 913	EPS 916
Sample Volume (mL)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Ethylene (FID)	0.83	0.55	0.78	0.70	0.69	0.73	0.73	1.19	0.73	0.70	0.34	0.81	0.47	0.46	0.46	1.19	1.29	0.48	0.48	0.64	0.52	0.65	1.47	1.34	1.30
Acetylene (FID)	0.33	0.23	0.32	0.38	0.37	0.31	0.31	0.45	0.29	0.30	0.15	0.30	0.37	0.34	0.34	0.50	0.47	0.32	0.32	0.35	0.30	0.50	0.78	0.75	0.75
Ethane (FID) / Ethane (FID corrected for blank)	3.32	2.60	3.23	2.79	2.85	3.43	3.43	5.30	3.44	3.50	1.64	3.47	2.59	2.48	2.48	5.50	5.64	3.67	2.77	3.25	2.57	6.77	9.73	9.93	9.48
Freon 134A	0.78	0.49	0.79	0.49	0.57	0.68	0.72	1.68	0.70	0.66	0.43	0.81	0.45	0.45	0.43	0.66	0.61	0.39	0.40	0.61	0.38	0.46	0.81	1.05	1.07
Propene	0.26	0.20	0.25	0.20	0.27	0.27	0.26	0.38	0.27	0.24	0.15	0.22	0.16	0.14	0.12	0.29	0.31	0.24	0.15	0.18	0.18	0.15	0.34	0.29	0.28
Propane (FID)	3.06	1.68	3.71	2.32	2.36	2.56	2.56	5.06	2.91	2.99	1.03	2.64	2.12	2.06	2.06	4.65	4.50	3.18	1.33	1.63	1.56	4.14	6.89	6.81	6.67
Freon 22 (Chlorodifluoromethane)	1.06	0.88	1.06	0.89	1.05	1.03	1.10	1.95	1.09	1.01	0.85	1.28	0.90	0.90	0.86	0.98	1.14	0.90	0.86	0.91	0.81	0.93	1.15	0.91	0.89
Freon 12 (Dichlorodifluoromethane)	2.52	2.17	2.27	2.25	2.55	2.54	2.71	2.39	2.58	2.44	2.28	2.76	2.42	2.42	2.32	2.34	2.33	2.31	2.30	2.30	2.22	2.38	2.16	2.20	2.17
Propyne	0.03	0.02	0.03	0.02	0.02	0.03	0.03	0.04	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.03	0.03	0.02	0.02	0.02	0.01	0.03	0.05	0.04	0.04
Chloromethane	1.27	0.86	0.92	0.93	1.06	0.87	0.98	0.91	1.01	0.95	0.84	0.99	0.95	0.94	0.89	0.92	0.93	1.00	1.02	1.01	0.96	1.04	0.92	0.94	0.93
Isobutane (2-Methylpropane)	2.77	0.33	0.76	1.23	1.42	0.69	0.71	2.20	3.92	3.81	0.39	1.67	2.00	1.93	1.75	2.12	3.35	6.11	0.37	0.61	2.51	0.95	2.84	3.25	3.24
Freon 114 (1,2-Dichlorotetrafluoroethane)	0.12	0.11	0.10	0.10	0.12	0.11	0.12	0.11	0.12	0.11	0.10	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.10	0.10
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.35	0.22	0.20	0.25	0.46	0.19	0.22	0.38	0.81	0.63	0.35	0.25	0.29	0.28	0.28	0.25	0.39	0.65	0.16	0.16	0.40	0.13	0.33	0.33	0.28
1,3-Butadiene	0.03	0.02	0.03	0.02	0.03	0.03	0.04	0.06	0.03	0.03	0.01	0.03	0.02	0.02	0.02	0.02	0.04	0.04	0.02	0.02	0.02	0.02	0.05	0.04	0.03
Butane	6.17	0.69	1.29	2.79	3.25	1.22	1.47	4.74	9.27	9.02	0.98	4.52	5.96	5.74	5.42	3.66	7.63	22.41	0.84	1.56	7.76	2.79	7.43	8.97	8.96
t-2-Butene	0.34	0.07	0.05	0.14	0.16	0.05	0.06	0.18	0.50	0.48	0.02	0.16	0.24	0.23	0.22	0.12	0.20	0.59	0.02	0.04	0.25	0.04	0.13	0.14	0.13
2,2-Dimethylpropane	0.04	0.01	0.01	0.06	0.07	0.01	0.01	0.02	0.04	0.04	0.01	0.02	0.03	0.03	0.03	0.02	0.03	0.07	0.01	0.01	0.03	0.02	0.04	0.05	0.05
Bromomethane	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.02
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Butene	0.24	0.02	0.04	0.11	0.12	0.04	0.05	0.14	0.32	0.32	0.02	0.10	0.14	0.14	0.13	0.08	0.13	0.38	0.02	0.03	0.16	0.03	0.10	0.10	0.10
Chloroethane	0.03	0.02	0.01	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
3-Methyl-1-Butene	0.07	0.01	0.02	0.04	0.04	0.02	0.02	0.03	0.07	0.06	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.01	0.01	0.02	0.01	0.02	0.02	0.02
2-Methylbutane	12.75	0.85	1.73	7.67	10.11	1.44	1.75	6.15	8.72	8.54	0.69	2.91	4.00	3.85	4.04	2.45	4.18	8.33	0.40	0.62	3.45	1.00	3.04	3.81	3.80
Freon 11 (Trichlorofluoromethane)	1.44	1.41	1.38	1.34	1.51	1.51	1.68	1.42	1.50	1.38	1.33	1.60	1.48	1.48	1.38	1.43	1.44	1.43	1.25	1.26	1.41	1.52	1.41	1.50	1.50
1-Pentene	0.20	0.06	0.06	0.08	0.13	0.08	0.08	0.10	0.15	0.14	0.04	0.06	0.05	0.04	0.04	0.05	0.06	0.13	0.04	0.05	0.06	0.03	0.05	0.07	0.06
2-Methyl-1-Butene	0.31	0.04	0.06	0.16	0.19	0.06	0.06	0.16	0.25	0.25	0.02	0.07	0.08	0.07	0.07	0.07	0.08	0.25	0.02	0.03	0.11	0.02	0.08	0.10	0.10
Pentane	5.76	0.71	1.05	5.60	6.41	1.30	1.39	2.87	7.95	4.64	0.51	1.57	2.05	2.01	1.86	2.17	4.15	1.45	0.48	0.83	1.75	0.83	1.83	2.50	2.37
Isoprene (2-Methyl-1,3-Butadiene)	0.13	0.55	0.20	0.20	0.23	0.20	0.20	0.14	0.10	0.10	0.04	0.03	0.03	0.03	0.04	0.03	0.02	0.03	0.02	0.03	0.02	0.01	0.03	0.02	0.02
t-2-Pentene	0.44	0.03	0.07	0.21	0.24	0.06	0.06	0.21	0.39	0.38	0.03	0.11	0.15	0.14	0.13	0.09	0.11	0.37	0.02	0.03	0.13	0.02	0.09	0.11	0.11
Ethylbromide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Pentene	0.21	0.01	0.03	0.10	0.11	0.03	0.03	0.10	0.17	0.16	0.01	0.05	0.06	0.06	0.05	0.04	0.05	0.16	0.01	0.02	0.06	0.01	0.04	0.05	0.05
Dichloromethane	0.54	0.50	0.37	0.32	0.44	0.43	0.44	0.72	0.48	0.43	0.25	0.70	0.27	0.30	0.28	0.63	0.42	0.38	0.27	0.39	0.28	0.41	0.57	0.53	0.52
2-Methyl-2-Butene	0.45	0.03	0.05	0.21	0.26	0.05	0.05	0.20	0.37	0.36	0.03	0.11	0.15	0.14	0.13	0.09	0.09	0.47	0.02	0.03	0.14	0.02	0.11	0.13	0.13
Freon 113 (1,1,2-Trichlorotrifluoroethane)	0.57	0.48	0.49	0.47	0.54	0.58	0.60	0.51	0.56	0.53	0.51	0.61	0.54	0.54	0.52	0.51	0.48	0.46	0.45	0.45	0.46	0.50	0.46	0.46	0.46
2,2-Dimethylbutane	0.28	0.03	0.05	0.15	0.18	0.04	0.05	0.12	0.20	0.19	0.02	0.07	0.09	0.08	0.08	0.05	0.08	0.13	0.02	0.03	0.07	0.04	0.08	0.09	0.09
Cyclopentene	0.03	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.03	0.03	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
t-1,2-Dichloroethene	0.03	0.02	0.01	0.02	0.03	0.04	0.04	0.04	0.03	0.03	0.01	0.00	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.01	0.00	0.00	0.02	0.02	0.02
4-Methyl-1-Pentene	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01
1,1-Dichloroethane	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Cyclopentane	0.40	0.06	0.10	0.26	0.30	0.07	0.07	0.21	0.28	0.27	0.03	0.09	0.11	0.10	0.09	0.09	0.11	0.28	0.03	0.04	0.10	0.04	0.13	0.18	0.18
2,3-Dimethylbutane	0.68	0.06	0.10	0.45	0.52	0.09	0.09	0.28	0.40	0.40	0.03	0.17	0.29	0.28	0.25	0.10	0.14	0.37	0.03	0.03	0.16	0.05	0.17	0.19	0.19
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.00
2-Methylpentane	3.08	0.22	0.42	3.61	4.08	0.37	0.38	1.33	2.00	1.96	0.14	1.25	2.48	2.37	2.23	0.47	0.73	2.01	0.12	0.15	0.84	0.20	0.95	0.86	0.86
c-4-Methyl-2-Pentene	0.03	0.01	0.00	0.00	0.02	0.01	0.01	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.01	0.01
3-Methylpentane	3.27	0.19	0.35	5.65	6.35	0.37	0.38	1.14	2.05	2.00	0.13	1.91	3.79	3.65	3.43	0.41	0.76	2.41	0.09	0.12	1.24	0.16	1.17	0.80	0.80
1-Hexene/2-Methyl-1-Pentene	0.13	0.07	0.04	0.06	0.09	0.06	0.06	0.07	0.08	0.08	0.02	0.04	0.04	0.03	0.03	0.04	0.04	0.07	0.04	0.05	0.05	0.02	0.04	0.06	0.05
c-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexane	6.02	0.23	0.46	13.56	15.22	0.49	0.53	1.63	3.67	3.63	0.17	4.54	8.10	7.92	7.46	0.67	1.34	5.51	0.15	0.19	2.86	0.24	2.51	1.51	1.49
Chloroform	0.17	0.12	0.13	0.13	0.14	0.18	0.18	0.16	0.18	0.17	0.10	0.12	0.12	0.12	0.11	0.13	0.13	0.10	0.08	0.08	0.09	0.10	0.11	0.10	0.10
t-2-Hexene	0.04	0.01	0.00	0.03	0.03	0.01	0.01	0.04	0.04	0.04	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.03	0.01	0.01	0.02	0.00	0.02	0.02	0.02
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.03	0.02	0.00	0.00	0.03	0.02	0.02	0.04	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03
c-2-Hexene	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.00	0.01	0.01	0.01
c-3-Methyl-2-Pentene	0.04	0.00	0.00	0.00	0.00	0.01	0.01	0.11	0.00	0.00	0.01	0.00	0.02	0.02	0.01	0.01	0.02	0.00	0.01	0.01	0.00	0.01	0.02	0.01	0.01
2,2-Dimethylpentane	0.08	0.01	0.01	0.11	0.13	0.01	0.01	0.04	0.06	0.06	0.01	0.04	0.05	0.05	0.04	0.02	0.02	0.06	0.00	0.01	0.03	0.01	0.05	0.03	0.03
1,2-Dichloroethane	0.07	0.04	0.04	0.07	0.08	0.05	0.05	0.06	0.06	0.06	0.04	0.06	0.06	0.06	0.06	0.05	0.05	0.07	0.05	0.05	0.06	0.07	0.08	0.08	0.08
Methylcyclopentane	2.27	0.08	0.19	4.48	5.10	0.18	0.19	0.80	1.53	1.51	0.06	1.35	2.29	2.20	2.06	0.25	0.49	1.93	0.05	0.08	0.92	0.08	0.75	0.51	0.51
2,4-Dimethylpentane	0.32	0.04	0.06	0.16	0.18	0.05	0.05	0.15	0.17	0.17	0.02	0.11	0.09	0.08	0.08	0.07	0.08	0.14	0.02	0.02	0.07	0.03	0.10	0.10	0.10
1,1,1-Trichloroethane	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02
2,2,3-Trimethylbutane	0.02	0.03	0.01	0.03	0.03	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
1-Methylcyclopentene	0.03	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Benzene	2.19	0.33	0.35	0.37	0.50	0.39	0.41	0.78	0.72	0.67	0.22	0.36	0.65	0.60	0.55	0.53	2.16	0.96	0.27	0.29	0.40	0.42	0.68	1.10	1.09
Carbontretrachloride	0.47	0.45	0.46	0.43	0.47	0.47	0.50	0.45	0.47	0.43	0.46	0.55	0.47	0.47	0.45	0.46	0.45	0.38	0.28	0.31	0.39	0.42	0.40	0.37	0.35
Cyclohexane	0.29	0.04	0.07	0.31	0.37	0.05	0.06	0.16	0.19	0.18	0.03	0.12	0.15	0.14	0.13	0.15	0.15	0.22	0.03	0.04	0.09	0.04	0.14	0.13	0.13
2-Methylhexane	0.52	0.11	0.26	0.28	0.32	0.15	0.17	0.44	0.33	0.32	0.07	0.84	0.20	0.20	0.18	0.44	0.28	0.24	0.06	0.13	0.12	0.13	0.35	0.30	0.29
2,3-Dimethylpentane	0.38	0.06	0.12	0.16	0.18	0.09	0.10	0.24	0.20	0.19	0.04	0.32	0.10	0.10	0.09	0.18	0.14	0.18	0.04	0.07	0.09	0.07	0.18	0.17	0.17
Cyclohexene	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
3-Methylhexane	0.65	0.15	0.34	0.33	0.39	0.21	0.22	0.57	0.41	0.39	0.09	1.02	0.24	0.23	0.21	0.58	0.35	0.29	0.08	0.19	0.15	0.17	0.47	0.39	0.37
Dibromomethane	0.04	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03
1,2-Dichloropropane	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02
Bromodichloromethane	0.04	0.01	0.01	0.03	0.03	0.02	0.01	0.03	0.03	0.03	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
1-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.05	0.00	0.00	0.00	0.00	0.00
Trichloroethene	0.04	0.02	0.03	0.02	0.01	0.03	0.03	0.06	0.02	0.03	0.01	0.03	0.02	0.02	0.02	0.46	0.04	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.04
2,2,4-Trimethylpentane	0.61	0.24	0.18	0.23	0.26	0.24	0.26	0.53	0.50	0.47	0.07	0.18	0.16	0.15	0.13	0.21	0.19	0.27	0.07	0.08	0.16	0.12	0.27	0.28	0.28
t-3-Heptene	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heptane	0.40	0.10	0.23	0.22	0.28	0.14	0.15	0.38	0.25	0.24	0.06	0.31	0.13	0.13	0.12	0.56	0.25	0.20	0.09	0.19	0.10	0.13	0.39	0.29	0.28
c-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.33	0.04	0.10	0.15	0.17	0.06	0.07	0.20	0.13	0.13	0.03	0.09	0.08	0.08	0.07	0.31	0.13	0.16	0.04	0.06	0.06	0.06	0.15	0.15	0.14
2,5-Dimethylhexane	0.06	0.02	0.03	0.03	0.04	0.03	0.03	0.07	0.06	0.05	0.01	0.02	0.02	0.02	0.02	0.04	0.03	0.02	0.01	0.02	0.01	0.01	0.03	0.04	0.03
2,4-Dimethylhexane	0.08	0.03	0.03	0.04	0.04	0.03	0.03	0.08	0.06	0.06	0.01	0.02	0.02	0.02	0.02	0.04	0.03	0.03	0.01	0.02	0.02	0.02	0.04	0.05	0.04
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Bromotrichloromethane	0.00	#VALUE!	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3,4-Trimethylpentane	0.18	0.05	0.06	0.07	0.08	0.07	0.08	0.15	0.13	0.12	0.02	0.05	0.04	0.04	0.03	0.06	0.05	0.06	0.03	0.03	0.04	0.03	0.07	0.08	0.07
Toluene	2.88	1.42	1.92	1.62	3.18	1.48	1.54	3.75	2.78	2.37	0.51	1.30	0.70	0.69	0.61	3.20	2.41	0.97	0.40	0.49	0.52	0.68	1.53	2.05	1.97
2-Methylheptane	0.26	0.00	0.07	0.10	0.10	0.06	0.06	0.14	0.09	0.09	0.02	0.05	0.05	0.05	0.04	0.09	0.07	0.07	0.03	0.04	0.00	0.04	0.09	0.09	0.09
4-Methylheptane	0.06	0.00	0.02	0.02	0.03	0.02	0.02	0.05	0.03	0.03	0.01	0.01	0.02	0.02	0.01	0.03	0.02	0.02	0.01	0.01	0.00	0.01	0.03	0.03	0.03
1-Methylcyclohexene	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylheptane	0.18	0.03	0.05	0.06	0.07	0.03	0.04	0.11	0.07	0.07	0.02	0.03	0.03	0.03	0.03	0.07	0.05	0.04	0.03	0.02	0.02	0.03	0.06	0.08	0.07
Dibromochloromethane	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
c-1,3-Dimethylcyclohexane	0.13	0.02	0.03	0.03	0.04	0.02	0.02	0.07	0.04	0.04	0.01	0.03	0.03	0.02	0.02	0.06	0.04	0.03	0.01	0.01	0.01	0.02	0.04	0.06	0.06
t-1,4-Dimethylcyclohexane	0.04	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.02
2,2,5-Trimethylhexane	0.03	0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
1,2-Dibromoethane (EDB)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Octene	0.16	0.14	0.04	0.02	0.07	0.04	0.05	0.05	0.05	0.05	0.01	0.05	0.02	0.02	0.02	0.04	0.03	0.06	0.11	0.08	0.02	0.07	0.03	0.05	0.02
Octane	0.34	0.06	0.09	0.10	0.14	0.05	0.05	0.14	0.09	0.09	0.03	0.07	0.06	0.06	0.05	0.10	0.08	0.08	0.06	0.05	0.04	0.05	0.09	0.11	0.10
t-2-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.12	0.01	0.02	0.02	0.03	0.01	0.01	0.04	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.03	0.04	0.04
Tetrachloroethene	0.12	0.05	0.06	0.05	0.06	0.07	0.08	0.12	0.17	0.17	0.04	0.07	0.04	0.04	0.03	0.59	0.11	0.03	0.02	0.03	0.03	0.06	0.15	1.86	1.75
c-1,4/t-1,3-Dimethylcyclohexane	0.07	0.01	0.02	0.02	0.02	0.01	0.01	0.04	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.04	0.04
c-1,2-Dimethylcyclohexane	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	NR	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03
Chlorobenzene	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Ethylbenzene	0.49	0.25	0.48	0.28	0.49	0.22	0.22	0.62	0.37	0.32	0.09	0.31	0.12	0.11	0.10	0.34	0.26	0.17	0.09	0.10	0.08	0.10	0.24	0.28	0.28
m,p-Xylene	1.30	0.54	1.47	0.68	0.99	0.57	0.57	2.04	1.00	0.89	0.22	1.09	0.33	0.31	0.28	1.18	0.96	0.46	0.20	0.27	0.19	0.23	0.67	0.85	0.84
Bromoform	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,4-Dichlorobutane	0.00	0.49	0.38	0.00	0.37	0.12	0.11	0.27	0.25	0.00	0.13	0.24	0.16	0.24	0.21	0.15	0.00	0.00	0.06	0.02	0.00	0.00	0.00	0.03	0.00
Styrene	7.17	52.47	37.65	35.90	103.81	29.55	29.31	20.26	44.97	27.51	9.00	6.74	4.63	4.81	4.34	10.63	0.44	4.55	2.63	1.57	0.71	3.09	0.60	3.81	2.82
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Nonene	0.10	0.08	0.05	0.05	0.11	0.07	0.08	0.05	0.08	0.05	0.02	0.03	0.02	0.02	0.02	0.00	0.04	0.07	0.05	0.06	0.02	0.02	0.00	0.04	0.03
o-Xylene	0.51	0.29	0.54	0.32	0.53	0.27	0.27	0.71	0.42	0.36	0.11	0.40	0.15	0.14	0.13	0.45	0.32	0.19	0.09	0.11	0.08	0.11	0.26	0.32	0.32
Nonane	0.43	0.18	0.21	0.22	0.32	0.17	0.18	0.21	0.16	0.16	0.04	0.08	0.06	0.06	0.06	0.18	0.12	0.08	0.06	0.07	0.04	0.04	0.10	0.12	0.12
iso-Propylbenzene	0.15	1.53	0.78	0.88	3.01	0.65	0.64	0.57	1.07	0.63	0.18	0.10	0.07	0.08	0.07	0.18	0.02	0.07	0.05	0.05	0.03	0.04	0.02	0.04	0.04
a-Pinene	0.09	0.09	0.14	0.04	0.06	0.25	0.25	0.36	0.19	0.18	0.09	0.13	0.07	0.07	0.06	0.27	0.15	0.03	0.03	0.02	0.01	0.03	0.03	0.08	0.07
3,6-Dimethyloctane	0.03	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01
n-Propylbenzene	0.18	0.61	0.36	0.40	1.14	0.31	0.30	0.36	0.49	0.31	0.09	0.08	0.06	0.06	0.05	0.15	0.05	0.07	0.06	0.04	0.03	0.04	0.04	0.06	0.06
3-Ethyltoluene	0.37	1.72	1.02	1.11	3.19	0.91	0.88	0.97	1.50	0.91	0.26	0.21	0.16	0.16	0.14	0.39	0.12	0.14	0.10	0.09	0.05	0.08	0.11	0.15	0.14
Camphene	0.04	0.05	0.03	0.02	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.09	0.06	0.04	0.04	0.03	0.02	0.01	0.01	0.01	0.02
4-Ethyltoluene	0.22	0.94	0.55	0.60	1.65	0.52	0.50	0.54	0.82	0.51	0.14	0.11	0.08	0.08	0.07	0.22	0.06	0.08	0.05	0.05	0.03	0.05	0.05	0.08	0.07
1,3,5-Trimethylbenzene	0.19	0.65	0.41	0.40	1.20	0.38	0.37	0.36	0.62	0.38	0.12	0.09	0.08	0.08	0.07	0.17	0.07	0.06	0.04	0.04	0.02	0.03	0.05	0.07	0.07
2-Ethyltoluene	0.17	0.55	0.35	0.38	1.02	0.31	0.31	0.36	0.52	0.31	0.09	0.08	0.06	0.06	0.05	0.16	0.05	0.05	0.04	0.04	0.02	0.03	0.05	0.06	0.06
b-Pinene	0.05	0.02	0.05	0.01	0.04	0.06	0.06	0.04	0.06	0.07	0.06	0.07	0.05	0.06	0.06	0.10	0.07	0.02	0.01	0.00	0.00	0.01	0.01	0.02	0.02
1-Decene	0.02	0.05	0.00	0.00	0.06	0.05	0.04	0.00	0.04	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.01
tert-Butylbenzene	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.60	2.64	1.69	1.81	4.68	1.66	1.58	1.65	2.74	1.70	0.54	0.42	0.30	0.29	0.27	0.76	0.21	0.23	0.14	0.14	0.07	0.14	0.17	0.23	0.23
Decane	0.38	0.34	0.33	0.35	0.48	0.31	0.31	0.33	0.28	0.28	0.08	0.13	0.06	0.07	0.06	0.32	0.19	0.07	0.06	0.08	0.04	0.05	0.12	0.15	0.15
Benzyl Chloride	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	0.06	0.11	0.07	0.06	0.10	0.09	0.09	0.18	0.13	0.09	0.03	0.04	0.02	0.03	0.02	0.06	0.04	0.02	0.02	0.02	0.01	0.03	0.03	0.03	0.03
iso-Butylbenzene	0.01	0.03	0.02	0.02	0.05	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sec-Butylbenzene	0.02	0.03	0.02	0.03	0.06	0.02	0.02	0.03	0.03	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01
1,2,3-Trimethylbenzene	0.13	0.27	0.20	0.20	0.51	0.18	0.17	0.22	0.30	0.19	0.07	0.06	0.05	0.05	0.04	0.12	0.05	0.04	0.02	0.02	0.02	0.03	0.04	0.05	0.05
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.03	0.04	0.02	0.02	0.04	0.02	0.02	0.05	0.05	0.02	0.02	0.02	0.02	0.02	0.01	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2-Dichlorobenzene	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limonene	0.04	0.04	0.06	0.01	0.05	0.07	0.06	0.08	0.10	0.09	0.06	0.10	0.03	0.03	0.03	0.09	0.06	0.03	0.02	0.01	0.00	0.02	0.01	0.03	0.03
Indan (2,3-Dihydroindene)	0.04	0.06	0.05	0.05	0.11	0.05	0.05	0.09	0.08	0.06	0.02	0.03	0.02	0.02	0.01	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02
1,3-Diethylbenzene	0.05	0.04	0.03	0.03	0.07	0.03	0.02	0.04	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
1,4-Diethylbenzene	0.10	0.13	0.09	0.09	0.20	0.07	0.07	0.11	0.13	0.08	0.03	0.03	0.02	0.02	0.02	0.06	0.02	0.03	0.02	0.02	0.01	0.02	0.03	0.02	0.03
n-Butylbenzene	0.03	0.04	0.03	0.02	0.06	0.02	0.02	0.04	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
1,2-Diethylbenzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Undecene	0.00	0.03	0.00	0.00	0.05	0.02	0.02	0.00	0.04	0.00	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01
Undecane	0.24	0.09	0.15	0.08	0.14	0.08	0.07	0.18	0.12	0.11	0.04	0.09	0.03	0.04	0.03	0.11	0.08	0.04	0.04	0.05	0.02	0.04	0.05	0.07	0.09
1,2,4-Trichlorobenzene	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Naphthalene	1.40	0.09	0.09	0.09	0.09	0.08	0.06	0.24	0.38	0.40	0.05	0.09	1.48	1.40	1.14	0.06	2.52	0.10	0.04	0.02	0.01	0.04	0.03	0.10	0.11
Dodecane	0.20	0.05	0.07	0.05	0.09	0.04	0.03	0.06	0.07	0.06	0.03	0.04	0.03	0.03	0.03	0.05	0.05	0.02	0.02	0.02	0.01	0.03	0.02	0.03	0.03
Hexachlorobutadiene	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexylbenzene	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00

Randle Reef Study 2015 Sample Data
Concentration ($\mu g/m^3$)
NR= Data not reported

Non-Polar Analysis Date	15-Jul-15	20-Jul-15	5-Aug-15	19-Aug-15	17-Sep-15	22-Sep-15	6-Oct-15	7-Oct-15	14-Oct-15	26-Oct-15	29-Oct-15	10-Dec-15	16-Dec-15	5-Jan-16	6-Jan-16
Non-Polar Analysis Location	Lab176ML	Lab176ML	Lab176ML	Lab176Urba	Lab176Urba	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176ML	Lab176DW
Filename	BLK02.D	BLK02.D	BLK02.D	MS50AH.D	MS10AH.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D	BLK02.D
Sample Volume (mL)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Freon 134A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Propene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Propane	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Freon 22 (Chlorodifluoromethane)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 12 (Dichlorodifluoromethane)	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.02
Propyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloromethane	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Isobutane (2-Methylpropane)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 114 (1,2-Dichlorotetrafluoroethane	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Vinylchloride (Chloroethene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Butene/2-Methylpropene	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.02
1,3-Butadiene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Butane	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
t-2-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylpropane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromomethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1-Butyne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylbutane	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 11 (Trichlorofluoromethane)	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pentane	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Isoprene (2-Methyl-1,3-Butadiene)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethylbromide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dichloromethane	0.01	0.01	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
2-Methyl-2-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
2,2-Dimethylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclopentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3-Dimethylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-4-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Hexene/2-Methyl-1-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,2-Dichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloroform	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
t-2-Hexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Ethyl-1-Butene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Hexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-3-Methyl-2-Pentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclopentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,4-Dimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2,3-Trimethylbutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Methylcyclopentene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carbontetrachloride	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3-Dimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclohexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibromomethane	0.01	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.03
1,2-Dichloropropane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trichloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
c-3-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-2-Heptene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,5-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,4-Dimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,3-Dichloropropene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromotrichloromethane	0.00	0.00	NR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NR	0.00	0.00
2,3,4-Trimethylpentane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Methylheptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Methylheptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Methylcyclohexene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Methylheptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibromochloromethane	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
c-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,4-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,2,5-Trimethylhexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dibromoethane (EDB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Octane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-2-Octene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tetrachloroethene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-1,2-Dimethylcyclohexane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m,p-Xylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromoform	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1,4-Dichlorobutane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Styrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1-Nonene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iso-Propylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
a-Pinene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3,6-Dimethyloctane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Propylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-Ethyltoluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Camphene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Ethyltoluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3,5-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-Ethyltoluene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b-Pinene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Decene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
tert-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Decane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzyl Chloride	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iso-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sec-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,3-Trimethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limonene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Indan (2,3-Dihydroindene)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,3-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,4-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Butylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Diethylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Undecene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Undecane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2,4-Trichlorobenzene	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Naphthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Dodecane	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hexachlorobutadiene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Hexylbenzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Method Detection Limit
Concentration ($\mu g/m^3$)

Non-Polar Analysis Location	**Lab176ML**	**Lab176Urt**	**Lab176DW**
Date of MDL analysis	**26-Aug-15**	**23-Jul-15**	**4-Jan-16**
Compound Name			
Freon 134A	0.02	0.13	0.02
Propene	0.02	0.16	0.02
Propane	0.09	0.34	0.03
Freon 22 (Chlorodifluoromethane)	0.03	0.34	0.02
Freon 12 (Dichlorodifluoromethane)	0.04	0.07	0.02
Propyne	0.01	0.21	0.02
Chloromethane	0.02	0.19	0.01
Isobutane (2-Methylpropane)	0.03	0.51	0.02
Freon 114 (1,2-Dichlorotetrafluoroethan	0.05	0.08	0.02
Vinylchloride (Chloroethene)	0.00	0.31	0.00
1-Butene/2-Methylpropene	0.04	0.10	0.03
1,3-Butadiene	0.00	0.29	0.01
Butane	0.09	0.11	0.03
t-2-Butene	0.02	0.12	0.01
2,2-Dimethylpropane	0.02	0.36	0.01
Bromomethane	0.04	0.09	0.01
1-Butyne	0.02	0.11	0.04
c-2-Butene	0.00	0.21	0.02
Chloroethane	0.02	0.11	0.03
3-Methyl-1-Butene	0.02	0.13	0.02
2-Methylbutane	0.04	0.15	0.02
Freon 11 (Trichlorofluoromethane)	0.01	0.13	0.02
1-Pentene	0.04	0.05	0.03
2-Methyl-1-Butene	0.02	0.31	0.01
Pentane	0.05	0.06	0.06
Isoprene (2-Methyl-1,3-Butadiene)	0.02	0.06	0.02
t-2-Pentene	0.02	0.19	0.02
Ethylbromide	0.03	0.08	0.02
1,1-Dichloroethene	0.02	0.05	0.00
c-2-Pentene	0.02	0.12	0.02
Dichloromethane	0.01	0.06	0.02
2-Methyl-2-Butene	0.02	0.21	0.02
Freon 113 (1,1,2-Trichlorotrifluoroetha	0.03	0.17	0.03
2,2-Dimethylbutane	0.04	0.09	0.02
Cyclopentene	0.03	0.16	0.02
t-1,2-Dichloroethene	0.02	0.04	0.01
4-Methyl-1-Pentene	0.02	0.07	0.02
3-Methyl-1-Pentene	0.02	0.15	0.01
1,1-Dichloroethane	0.02	0.04	0.02
Cyclopentane	0.01	0.05	0.02
2,3-Dimethylbutane	0.00	0.04	0.02
t-4-Methyl-2-Pentene	0.02	0.12	0.02
Methyl-t-Butyl Ether (MTBE)	0.04	0.15	0.06
2-Methylpentane	0.05	0.05	0.04
c-4-Methyl-2-Pentene	0.02	0.20	0.02
3-Methylpentane	0.05	0.25	0.03
1-Hexene/2-Methyl-1-Pentene	0.07	0.15	0.05
c-1,2-Dichloroethene	0.03	0.17	0.02
Hexane	0.04	0.20	0.02
Chloroform	0.01	0.06	0.02
t-2-Hexene	0.02	0.05	0.02
2-Ethyl-1-Butene	0.02	0.06	0.02
t-3-Methyl-2-Pentene	0.01	0.05	0.01
c-2-Hexene	0.02	0.06	0.02
c-3-Methyl-2-Pentene	0.02	0.04	0.01
2,2-Dimethylpentane	0.02	0.15	0.01
1,2-Dichloroethane	0.02	0.05	0.01
Methylcyclopentane	0.01	0.04	0.01
2,4-Dimethylpentane	0.01	0.17	0.02
1,1,1-Trichloroethane	0.02	0.04	0.04
2,2,3-Trimethylbutane	0.02	0.11	0.00
1-Methylcyclopentene	0.04	0.11	0.04
Benzene	0.03	0.21	0.02
Carbontretrachloride	0.02	0.04	0.04
Cyclohexane	0.02	0.05	0.02
2-Methylhexane	0.02	0.10	0.00
2,3-Dimethylpentane	0.02	0.17	0.02
Cyclohexene	0.01	0.08	0.02
3-Methylhexane	0.01	0.34	0.02
Dibromomethane	0.03	0.15	0.04
1,2-Dichloropropane	0.04	0.26	0.01
Bromodichloromethane	0.07	0.07	0.03
1-Heptene	0.01	0.18	0.02
Trichloroethene	0.02	0.09	0.02
2,2,4-Trimethylpentane	0.00	0.06	0.02
t-3-Heptene	0.01	0.23	0.00
Heptane	0.04	0.07	0.04
c-3-Heptene	0.03	0.07	0.02
t-2-Heptene	0.01	0.07	0.02
c-2-Heptene	0.00	0.07	0.02
c-1,3-Dichloropropene	0.01	0.04	0.02
2,2-Dimethylhexane	0.02	0.04	0.02
Methylcyclohexane	0.02	0.04	0.00
2,5-Dimethylhexane	0.00	0.08	0.01
2,4-Dimethylhexane	0.02	0.07	0.02
t-1,3-Dichloropropene	0.00	0.21	0.02
1,1,2-Trichloroethane	0.02	0.25	0.03
Bromotrichloromethane	0.07	0.08	0.10
2,3,4-Trimethylpentane	0.02	0.20	0.02
Toluene	0.03	0.08	0.02
2-Methylheptane	0.02	0.04	0.02
4-Methylheptane	0.01	0.13	0.02
1-Methylcyclohexene	0.02	0.05	0.03
3-Methylheptane	0.00	0.33	0.01
Dibromochloromethane	0.02	0.05	0.05
c-1,3-Dimethylcyclohexane	0.02	0.02	0.02
t-1,4-Dimethylcyclohexane	0.02	0.05	0.00
2,2,5-Trimethylhexane	0.00	0.54	0.00
1,2-Dibromoethane (EDB)	0.03	0.09	0.03
1-Octene	0.02	0.09	0.00
Octane	0.01	0.07	0.02
t-2-Octene	0.01	0.03	0.02
t-1,2-Dimethylcyclohexane	0.02	0.23	0.01
Tetrachloroethene	0.02	0.05	0.02
c-1,4/t-1,3-Dimethylcyclohexane	0.00	0.09	0.01
c-1,2-Dimethylcyclohexane	0.00	0.15	0.02
Chlorobenzene	0.01	0.10	0.01
Ethylbenzene	0.02	0.19	0.02
m,p-Xylene	0.03	0.36	0.04
Bromoform	0.03	0.79	0.07
1,4-Dichlorobutane	0.04	0.15	0.02
Styrene	0.01	0.23	0.02
1,1,2,2-Tetrachloroethane	0.03	0.08	0.02
1-Nonene	0.01	0.10	0.02
o-Xylene	0.03	0.04	0.02
Nonane	0.00	0.09	0.02
iso-Propylbenzene	0.02	0.20	0.02
a-Pinene	0.04	0.18	0.06
3,6-Dimethyloctane	0.04	0.10	0.04
n-Propylbenzene	0.02	0.09	0.02
3-Ethyltoluene	0.03	0.24	0.02
Camphene	0.05	0.09	0.06
4-Ethyltoluene	0.03	0.09	0.02
1,3,5-Trimethylbenzene	0.02	0.09	0.02
2-Ethyltoluene	0.02	0.23	0.03
b-Pinene	0.05	0.11	0.06
1-Decene	0.02	0.10	0.02
tert-Butylbenzene	0.03	0.22	0.03
1,2,4-Trimethylbenzene	0.05	0.07	0.05
Decane	0.02	0.11	0.02
Benzyl Chloride	0.01	0.17	0.03
1,3-Dichlorobenzene	0.03	0.08	0.02
1,4-Dichlorobenzene	0.02	0.09	0.01
iso-Butylbenzene	0.02	0.09	0.02
sec-Butylbenzene	0.02	0.10	0.03
1,2,3-Trimethylbenzene	0.03	0.07	0.03
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02	0.15	0.03
1,2-Dichlorobenzene	0.02	0.31	0.02
Limonene	0.06	0.11	0.09
Indan (2,3-Dihydroindene)	0.03	0.07	0.02
1,3-Diethylbenzene	0.02	0.06	0.02
1,4-Diethylbenzene	0.02	0.10	0.02
n-Butylbenzene	0.03	0.08	0.02
1,2-Diethylbenzene	0.03	0.10	0.02
1-Undecene	0.02	0.05	0.02
Undecane	0.01	0.21	0.02
1,2,4-Trichlorobenzene	0.04	0.12	0.07
Naphthalene	0.02	0.08	0.04
Dodecane	0.02	0.21	0.01
Hexachlorobutadiene	0.03	0.08	0.09
Hexylbenzene	0.01	0.21	0.05

Method Detection Limit
Concentration ($\mu g/m^3$)

FID Analysis Location	Lab177N	Lab176
Date of MDL analysis	**11-Jun-15**	**15-Jun-15**
Compound Name		
Ethylene	0.01	0.02
Acetylene	0.01	0.03
Ethane	0.01	0.02
Propane	0.01	0.05

Duplicate-VOC Analysis

Concentration (μg/m³)

Non-Polar Analysis Date	**14-Oct-15**	**14-Oct-15**		**26-Oct-15**	**26-Oct-15**	
Non-Polar Analysis Location	**Lab176ML**	**Lab176ML**		**Lab176ML**	**Lab176ML**	
Filename	**RR85.D**	**RRDUP.D**		**RR92.D**	**RRDUP.D**	
Sample location	**EC STATIC**	**EC STATION 1, DND HMSC Star**		**DUPLICAT**	**DUPLICATE, Blind Duplicate**	
Sampling Date	**25-Sep-15**	**25-Sep-15**		**9-Oct-15**	**9-Oct-15**	
Canister ID	**EPS 513**	**EPS 513**		**EPS 259**	**EPS 259**	
Sample Volume (mL)	**500**	**500**		**500**	**500**	
			% difference			**% difference**
Freon 134A	0.68	0.72	-5.73%	0.45	0.43	4.06%
Propene	0.27	0.26	3.05%	0.14	0.12	12.12%
Propane	FID DATA	FID DATA	#VALUE!	FID DATA	FID DATA	#VALUE!
Freon 22 (Chlorodifluoromethane)	1.03	1.10	-6.77%	0.90	0.86	4.77%
Freon 12 (Dichlorodifluoromethane)	2.54	2.71	-6.70%	2.42	2.32	4.21%
Propyne	0.03	0.03	20.69%	0.02	0.01	13.33%
Chloromethane	0.87	0.98	-11.23%	0.94	0.89	5.91%
Isobutane (2-Methylpropane)	0.69	0.71	-3.16%	1.93	1.75	9.80%
Freon 114 (1,2-Dichlorotetrafluoroethane	0.11	0.12	-13.79%	0.11	0.11	3.70%
Vinylchloride (Chloroethene)	0.00	0.00	0.00%	0.00	0.00	#DIV/0!
1-Butene/2-Methylpropene	0.19	0.22	-15.38%	0.28	0.28	2.14%
1,3-Butadiene	0.03	0.04	-11.11%	0.02	0.02	11.76%
Butane	1.22	1.47	-18.56%	5.74	5.42	5.73%
t-2-Butene	0.05	0.05	-4.26%	0.23	0.22	7.08%
2,2-Dimethylpropane	0.01	0.01	-15.38%	0.03	0.03	6.90%
Bromomethane	0.03	0.03	-13.33%	0.03	0.03	0.00%
1-Butyne	0.00	0.00	0.00%	0.00	0.00	-200.00%
c-2-Butene	0.04	0.05	-13.95%	0.14	0.13	4.51%
Chloroethane	0.02	0.02	-22.22%	0.01	0.01	0.00%
3-Methyl-1-Butene	0.02	0.02	22.22%	0.02	0.01	44.44%
2-Methylbutane	1.44	1.75	-19.39%	3.85	4.04	-4.76%
Freon 11 (Trichlorofluoromethane)	1.51	1.68	-10.78%	1.48	1.38	7.14%
1-Pentene	0.08	0.08	2.60%	0.04	0.04	4.65%
2-Methyl-1-Butene	0.06	0.06	-3.39%	0.07	0.07	5.56%
Pentane	1.30	1.39	-6.56%	2.01	1.86	7.77%
Isoprene (2-Methyl-1,3-Butadiene)	0.20	0.20	-2.00%	0.03	0.03	7.41%
t-2-Pentene	0.06	0.06	-6.67%	0.14	0.13	8.82%
Ethylbromide	0.00	0.00	0.00%	0.00	0.00	0.00%
1,1-Dichloroethene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
c-2-Pentene	0.03	0.03	-6.90%	0.06	0.05	7.14%
Dichloromethane	0.43	0.44	-1.37%	0.30	0.28	7.51%
2-Methyl-2-Butene	0.05	0.05	-3.92%	0.14	0.13	7.63%
Freon 113 (1,1,2-Trichlorotrifluoroethane	0.58	0.60	-3.06%	0.54	0.52	4.17%
2,2-Dimethylbutane	0.04	0.05	-9.09%	0.08	0.08	7.41%
Cyclopentene	0.01	0.01	-22.22%	0.01	0.01	15.38%
t-1,2-Dichloroethene	0.04	0.04	0.00%	0.01	0.01	0.00%
4-Methyl-1-Pentene	0.01	0.00	200.00%	0.00	0.00	#DIV/0!
3-Methyl-1-Pentene	0.01	0.01	-28.57%	0.00	0.00	0.00%
1,1-Dichloroethane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Cyclopentane	0.07	0.07	5.56%	0.10	0.09	8.16%
2,3-Dimethylbutane	0.09	0.09	-2.30%	0.28	0.25	9.09%
t-4-Methyl-2-Pentene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Methyl-t-Butyl Ether (MTBE)	0.00	0.00	-200.00%	0.01	0.00	200.00%
2-Methylpentane	0.37	0.38	-4.26%	2.37	2.23	6.08%
c-4-Methyl-2-Pentene	0.01	0.01	0.00%	0.00	0.00	#DIV/0!
3-Methylpentane	0.37	0.38	-4.26%	3.65	3.43	6.21%
1-Hexene/2-Methyl-1-Pentene	0.06	0.06	-6.90%	0.03	0.03	0.00%
c-1,2-Dichloroethene	0.00	0.00	0.00%	0.00	0.00	0.00%
Hexane	0.49	0.53	-6.65%	7.92	7.46	5.88%
Chloroform	0.18	0.18	-1.13%	0.12	0.11	7.02%
t-2-Hexene	0.01	0.01	0.00%	0.02	0.01	13.33%
2-Ethyl-1-Butene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-3-Methyl-2-Pentene	0.02	0.02	-10.53%	0.02	0.02	0.00%
c-2-Hexene	0.01	0.01	-28.57%	0.01	0.01	28.57%
c-3-Methyl-2-Pentene	0.01	0.01	0.00%	0.02	0.01	13.33%
2,2-Dimethylpentane	0.01	0.01	-15.38%	0.05	0.04	4.44%
1,2-Dichloroethane	0.05	0.05	-3.92%	0.06	0.06	3.28%
Methylcyclopentane	0.18	0.19	-6.52%	2.20	2.06	6.47%
2,4-Dimethylpentane	0.05	0.05	-3.92%	0.08	0.08	7.59%
1,1,1-Trichloroethane	0.02	0.02	0.00%	0.02	0.02	11.76%
2,2,3-Trimethylbutane	0.01	0.01	15.38%	0.01	0.01	54.55%
1-Methylcyclopentene	0.01	0.01	0.00%	0.01	0.01	0.00%
Benzene	0.39	0.41	-3.98%	0.60	0.55	8.64%
Carbontretrachloride	0.47	0.50	-6.64%	0.47	0.45	3.90%
Cyclohexane	0.05	0.06	-7.41%	0.14	0.13	7.41%
2-Methylhexane	0.15	0.17	-10.13%	0.20	0.18	8.51%
2,3-Dimethylpentane	0.09	0.10	-8.70%	0.10	0.09	8.70%
Cyclohexene	0.01	0.01	0.00%	0.01	0.01	-22.22%
3-Methylhexane	0.21	0.22	-6.57%	0.23	0.21	8.22%
Dibromomethane	0.04	0.04	-4.88%	0.04	0.03	5.71%
1,2-Dichloropropane	0.01	0.01	0.00%	0.01	0.01	0.00%
Bromodichloromethane	0.02	0.01	13.33%	0.01	0.01	15.38%
1-Heptene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Trichloroethene	0.03	0.03	-6.06%	0.02	0.02	9.52%
2,2,4-Trimethylpentane	0.24	0.26	-8.13%	0.15	0.13	10.07%
t-3-Heptene	0.00	0.01	-200.00%	0.00	0.00	0.00%
Heptane	0.14	0.15	-8.22%	0.13	0.12	11.38%
c-3-Heptene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-2-Heptene	0.00	0.00	0.00%	0.00	0.00	0.00%
c-2-Heptene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
c-1,3-Dichloropropene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
2,2-Dimethylhexane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
Methylcyclohexane	0.06	0.07	-8.96%	0.08	0.07	10.53%
2,5-Dimethylhexane	0.03	0.03	-14.29%	0.02	0.02	11.76%
2,4-Dimethylhexane	0.03	0.03	-6.45%	0.02	0.02	20.00%
t-1,3-Dichloropropene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1,1,2-Trichloroethane	0.00	0.00	#DIV/0!	0.00	0.00	-66.67%
Bromotrichloromethane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
2,3,4-Trimethylpentane	0.07	0.08	-5.26%	0.04	0.03	17.14%
Toluene	1.48	1.54	-4.37%	0.69	0.61	11.40%
2-Methylheptane	0.06	0.06	-6.90%	0.05	0.04	13.95%
4-Methylheptane	0.02	0.02	-11.76%	0.02	0.01	13.33%
1-Methylcyclohexene	0.01	0.01	0.00%	0.00	0.00	0.00%
3-Methylheptane	0.03	0.04	-11.11%	0.03	0.03	12.50%
Dibromochloromethane	0.02	0.02	-11.76%	0.02	0.02	0.00%
c-1,3-Dimethylcyclohexane	0.02	0.02	-9.52%	0.02	0.02	8.70%
t-1,4-Dimethylcyclohexane	0.01	0.01	0.00%	0.01	0.01	28.57%
2,2,5-Trimethylhexane	0.02	0.02	-8.70%	0.01	0.01	0.00%
1,2-Dibromoethane (EDB)	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1-Octene	0.04	0.05	-4.44%	0.02	0.02	0.00%
Octane	0.05	0.05	-7.69%	0.06	0.05	13.79%
t-2-Octene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
t-1,2-Dimethylcyclohexane	0.01	0.01	-15.38%	0.02	0.01	13.33%
Tetrachloroethene	0.07	0.08	-7.79%	0.04	0.03	11.11%
c-1,4/t-1,3-Dimethylcyclohexane	0.01	0.01	-18.18%	0.01	0.01	18.18%
c-1,2-Dimethylcyclohexane	0.01	0.01	0.00%	0.01	0.01	22.22%
Chlorobenzene	0.01	0.01	18.18%	0.00	0.01	-40.00%
Ethylbenzene	0.22	0.22	-0.90%	0.11	0.10	11.32%
m,p-Xylene	0.57	0.57	-0.35%	0.31	0.28	10.96%
Bromoform	0.02	0.02	-8.70%	0.02	0.02	0.00%
1,4-Dichlorobutane	0.12	0.11	10.53%	0.24	0.21	14.98%
Styrene	29.55	29.31	0.80%	4.81	4.34	10.28%
1,1,2,2-Tetrachloroethane	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1-Nonene	0.07	0.08	-7.79%	0.02	0.02	10.53%
o-Xylene	0.27	0.27	0.00%	0.14	0.13	7.19%
Nonane	0.17	0.18	-2.27%	0.06	0.06	10.17%
iso-Propylbenzene	0.65	0.64	1.55%	0.08	0.07	7.79%
a-Pinene	0.25	0.25	-1.60%	0.07	0.06	6.25%
3,6-Dimethyloctane	0.01	0.01	0.00%	0.00	0.00	0.00%
n-Propylbenzene	0.31	0.30	3.32%	0.06	0.05	10.53%
3-Ethyltoluene	0.91	0.88	3.57%	0.16	0.14	11.92%
Camphene	0.03	0.03	0.00%	0.03	0.02	8.00%
4-Ethyltoluene	0.52	0.50	2.75%	0.08	0.07	10.26%
1,3,5-Trimethylbenzene	0.38	0.37	3.21%	0.08	0.07	11.11%
2-Ethyltoluene	0.31	0.31	2.58%	0.06	0.05	13.79%
b-Pinene	0.06	0.06	0.00%	0.06	0.06	13.33%
1-Decene	0.05	0.04	28.57%	0.01	0.00	40.00%
tert-Butylbenzene	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1,2,4-Trimethylbenzene	1.66	1.58	4.69%	0.29	0.27	10.00%
Decane	0.31	0.31	2.58%	0.07	0.06	12.90%
Benzyl Chloride	0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!
1,3-Dichlorobenzene	0.00	0.00	0.00%	0.00	0.00	#DIV/0!
1,4-Dichlorobenzene	0.09	0.09	0.00%	0.03	0.02	8.00%
iso-Butylbenzene	0.02	0.02	0.00%	0.00	0.00	0.00%
sec-Butylbenzene	0.02	0.02	-18.18%	0.01	0.00	40.00%
1,2,3-Trimethylbenzene	0.18	0.17	3.39%	0.05	0.04	13.95%
p-Cymene (1-Methyl-4-Isopropylbenzene)	0.02	0.02	8.70%	0.02	0.01	13.33%
1,2-Dichlorobenzene	0.00	0.00	66.67%	0.00	0.00	200.00%
Limonene	0.07	0.06	6.06%	0.03	0.03	12.50%
Indan (2,3-Dihydroindene)	0.05	0.05	3.92%	0.02	0.01	13.33%
1,3-Diethylbenzene	0.03	0.02	8.00%	0.01	0.01	0.00%
1,4-Diethylbenzene	0.07	0.07	5.56%	0.02	0.02	20.00%
n-Butylbenzene	0.02	0.02	0.00%	0.01	0.01	28.57%
1,2-Diethylbenzene	0.01	0.01	0.00%	0.00	0.00	0.00%
1-Undecene	0.02	0.02	9.52%	0.02	0.01	50.00%
Undecane	0.08	0.07	8.00%	0.04	0.03	16.22%
1,2,4-Trichlorobenzene	0.00	0.00	66.67%	0.00	0.00	0.00%
Naphthalene	0.08	0.06	17.14%	1.40	1.14	20.27%
Dodecane	0.04	0.03	11.76%	0.03	0.03	19.35%
Hexachlorobutadiene	0.00	0.00	0.00%	0.00	0.00	0.00%
Hexylbenzene	0.00	0.00	0.00%	0.00	0.00	0.00%

APPENDIX II
HAMN 2015 VOC Readings

HAMN - VOC Report

Station	: 29567	Sample Matrix	: SUMMA Canisters
Location	: Niagara St / Land St, Hamilton	Method	: GC/MS (TO15A)
Reporting Period	: 01 January, 2015 to 31 December, 2015	Valid Samples - No. / %	: 30 / 100%

VOC Parameter	AAQC 24 Hr µg/m³	RDL µg/m³	06-Jan-15	18-Jan-15	30-Jan-15	11-Feb-15	23-Feb-15	07-Mar-15	19-Mar-15	31-Mar-15	12-Apr-15	24-Apr-15	06-May-15	18-May-15	30-May-15	11-Jun-15	23-Jun-15	05-Jul-15	Ave µg/m³	Max µg/m³	Min µg/m³	Samples > AAQC No.
2,2,4-Trimethylpentane	x	0.934	0.467	0.467	0.467	0.467	0.467	0.467	0.467	0.467	0.467	0.467	1.020	0.467	0.467	0.467	0.467	1.440	0.562	1.440	0.467	x
Carbon Disulfide	330	1.56	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	4.07	0.78	0.78	0.78	0.78	0.99	4.07	0.78	0
Propene	4000	0.516	2.670	2.670	2.325	2.670	0.431	2.670	3.270	1.265	1.120	0.600	0.945	0.600	0.775	0.775	1.720	1.30	1.613	3.270	0.431	0
Vinyl Acetate	x	0.704	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.35	0.352	0.352	0.352	x
Dichlorodifluoromethane	500000	0.989	3.60	3.81	3.48	3.07	3.11	3.95	3.94	2.97	2.98	2.56	3.37	3.80	3.80	3.50	3.44	3.58	3.44	3.95	2.56	0
Vinyl Chloride	1	0.0511	0.0255	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0255	0.0256	0.0255	0
1,2-Dichlorotetrafluoroethane	700000	1.19	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0
1,3-Butadiene	10	0.11	0.055	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.524	0.555	0.055	0
Chloromethane	320	0.620	1.520	1.420	1.100	1.110	1.130	1.400	1.210	1.250	1.250	1.000	1.150	1.320	1.390	1.220	1.160	0.993	1.226	1.520	0.993	0
Trichlorotrifluoroethane	800000	0.38	0.900	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.595	0.900	0.575	0
Vinyl Bromide	x	0.22	0.1100	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4170	0.4375	0.1100	x
Chloroethane	5600	0.792	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0
Chloroform	1	0.195	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.11	0.20	0.10	0
1,2-Dichloroethane	2	0.20	0.100	0.103	0.095	0.094	0.098	0.107	0.083	0.073	0.070	0.087	0.112	0.081	0.074	0.086	0.062	0.074	0.087	0.112	0.062	0
Carbon Tetrachloride	2.4	0.31	0.800	0.669	0.641	0.577	0.507	0.715	0.517	0.458	0.458	0.764	0.495	0.690	0.700	0.622	0.558	0.568	0.609	0.800	0.458	0
Trichlorofluoromethane	6000	1.12	1.81	1.92	1.85	1.69	1.59	2.00	2.14	1.54	1.46	1.21	1.92	1.82	1.79	1.67	1.48	1.57	1.72	2.14	1.21	0
Benzene	2.3	0.16	1.10	0.82	0.98	1.15	0.97	0.86	1.34	1.98	0.78	0.57	3.29	4.13	3.46	1.05	0.41	1.34	1.51	4.13	0.41	3
Ethanol	19000	1.88	7.170	6.410	8.360	15.300	5.330	4.830	8.230	7.760	13.4	5.690	9.720	5.890	5.950	9.87	8.85	15.500	8.641	15.500	4.830	0
Trichloroethylene	12	0.269	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0
2-propanol	7300	2.46	3.685	3.685	3.685	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.23	1.690	3.685	1.230	0
Bromodichloromethane	x	0.34	0.170	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.639	0.670	0.170	x
2-Propanone	11880	0.475	11.600	5.050	4.390	7.780	7.650	8.760	3.710	4.570	5.400	5.190	13.000	8.650	10.300	8.310	19.400	8.840	8.288	19.400	3.710	0
cis-1,3-Dichloropropene	x	0.227	0.1150	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1136	0.1150	0.1135	x
Methyl Ethyl Ketone	1000	0.295	4.425	3.610	6.200	2.770	0.148	3.710	5.600	3.620	4.380	3.170	5.050	3.080	3.740	5.220	2.890	0.148	3.610	6.200	0.148	0
trans-1,3-Dichloropropene	x	0.227	0.1150	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1136	0.1150	0.1135	x
1,1,2-Trichloroethane	x	0.0655	0.11	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.11	0.03	x
Methyl Isobutyl Ketone	1200	0.410	6.550	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.602	6.550	0.205	0
Dibromochloromethane	x	0.43	0.215	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.85	0.810	0.850	0.215	x
Methyl Butyl Ketone	x	4.10	4.095	4.095	4.095	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.05	2.433	4.095	2.050	x
Ethylene Dibromide	3	0.0768	0.190	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.048	0.190	0.038	0
Methyl t-butyl ether (MTBE)	7000	0.361	0.3605	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.18	0.1918	0.3605	0.1805	0
1,1,2,2-Tetrachloroethane	x	0.0185	0.17	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.17	0.01	x
Ethyl Acetate	x	3.60	3.965	3.965	3.965	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	2.206	3.965	1.800	x
1,1-Dichloroethylene	10	0.198	0.4955	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.1238	0.4955	0.0990	0
Benzyl chloride	x	0.26	0.130	2.590	2.590	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.384	2.590	0.130	x
cis-1,2-Dichloroethylene	105	0.198	0.3765	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.1163	0.3765	0.0990	0
Hexachlorobutadiene	x	0.0501	0.2650	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0400	0.2650	0.0251	x
trans-1,2-Dichloroethylene	105	0.396	0.3965	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.2104	0.3965	0.1980	0
Methylene Chloride	220	2.78	1.390	0.795	0.482	0.610	0.414	0.516	0.478	0.422	0.344	0.441	1.040	0.446	0.446	0.637	0.400	0.464	0.583	1.390	0.344	0
1,1-Dichloroethane	165	0.202	0.4045	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1200	0.4045	0.1010	0
1,1,1-Trichloroethane	115000	0.273	0.8200	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1792	0.8200	0.1365	0
1,2-Dichloropropane	2400	0.231	0.9250	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1661	0.9250	0.1155	0
Bromomethane	1350	0.194	0.3495	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.1128	0.3495	0.0970	0
Bromoform	55	1.03	1.035	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.548	1.035	0.515	0
Heptane	11000	1.23	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0
Tetrachloroethylene	360	0.339	0.6800	0.1950	0.1695	0.7170	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.2372	0.7170	0.1695	0
Toluene	2000	0.188	1.7000	0.9240	1.3600	2.0600	1.4000	0.7960	1.3800	1.6600	1.5100	1.3400	4.4100	1.3500	1.5100	3.1900	8.3100	4.0000	2.3063	8.3100	0.7960	0
Ethylbenzene	1000	0.217	0.4340	0.2400	0.1085	0.7270	0.2360	0.1085	0.3160	0.2690	0.2330	0.1085	0.5600	0.1085	0.1085	0.3700	0.1085	0.3440	0.2738	0.7270	0.1085	0
p+m-Xylene	730	0.434	0.8050	0.7280	0.5100	2.5500	0.6880	0.2170	0.9290	0.8940	0.7430	0.4550	1.8800	0.6510	0.5730	1.0600	0.5850	0.9710	0.8899	2.5500	0.2170	0
o-Xylene	730	0.217	0.4340	0.2820	0.1085	0.9570	0.2340	0.1085	0.2810	0.3440	0.3350	0.1085	0.8060	0.2930	0.2500	0.4100	0.2280	0.3690	0.3468	0.9570	0.1085	0
Styrene	400	0.213	0.4260	0.1065	0.1065	0.5020	0.1065	0.1065	0.1065	0.1065	0.1065	0.1065	0.2620	0.1065	0.1065	0.1065	0.1065	0.1065	0.1609	0.5020	0.1065	0
1,3,5-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	0
1,2,4-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	0
4-ethyltoluene	x	2.46	5.40	5.40	5.40	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	2.01	5.40	1.23	x
Chlorobenzene	x	0.230	0.4605	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1366	0.4605	0.1150	x
1,3-Dichlorobenzene	x	2.40	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	x
1,4-Dichlorobenzene	95	0.301	1.2000	0.1505	2.0900	0.5260	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.3608	2.0900	0.1505	0
1,2-Dichlorobenzene	x	0.301	1.2000	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.2161	1.2000	0.1505	x
1,2,4-Trichlorobenzene	400	0.742	7.400	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.810	7.400	0.371	0
Hexane	2500	0.352	1.630	2.860	8.880	0.423	21.300	2.150	4.740	2.910	4.810	2.800	2.870	1.520	2.360	4.780	1.740	54.300	7.505	54.300	0.423	0
Cyclohexane	6100	0.688	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.993	0.385	0.993	0.344	0
Tetrahydrofuran	93000	1.18	37.10	32.70	0.59	20.10	6.84	35.90	0.59	0.59	5.98	5.90	0.59	13.50	19.60	25.40	12.20	7.40	14.06	37.10	0.59	0
1,4-Dioxane	3500	3.60	3.605	3.605	3.605	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	2.138	3.605	1.800	0
Xylene (Total)	730	0.662	1.305	1.010	0.331	3.510	0.922	0.331	1.210	1.240	1.080	0.331	2.690	0.944	0.824	1.470	0.813	1.340	1.209	3.510	0.331	0
Naphthalene	x	0.524	0.262	0.262	0.262	0.262	0.262	0.262	0.262	0.262	0.262	0.262	4.310	4.080	2.220	0.262	0.262	0.262	0.876	4.310	0.262	0
1,1,1,2-Tetrachloroethane	x	0.144	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0

Note 1: All non detectable results are reported as ½ the detection limit.

Note 2: Due to ambient air quality sampling methodology and laboratory analytics a Reportable Detection Limit (RDL) can fluctuate from sample to sample. Therefore the reported ½ RDL values, for example the reported value may be above or below RDL indicated in the RDL column. Note all data presented is actual data as reported from the laboratory and modified to meet the MOECC ½ detection limit reporting requirement.

HAMN
HAMILTON AIR MONITORING NETWORK

HAMN - VOC Report

Station	: 29567	**Sample Matrix**	: SUMMA Canisters
Location	: Niagara St / Land St, Hamilton	**Method**	: GC/MS (TO15A)
Reporting Period	: 01 January, 2015 to 31 December, 2015	**Valid Samples - No. / %**	: 30 / 100%

Parameter	AAQC 24 Hr µg/m³	RDL µg/m³	17-Jul-15	29-Jul-15	10-Aug-15	22-Aug-15	03-Sep-15	15-Sep-15	27-Sep-15	09-Oct-15	21-Oct-15	02-Nov-15	14-Nov-15	26-Nov-15	08-Dec-15	20-Dec-15			Ave µg/m³	Max µg/m³	Min µg/m³	Samples > AAQC No.
2,2,4-Trimethylpentane	x	0.934	0.467	2.290	2.260	1.980	2.050	1.580	1.770	1.060	0.467	2.000	0.956	0.467	0.467	0.467			1.306	2.290	0.467	x
Carbon Disulfide	330	1.56	0.78	0.78	0.78	0.78	0.78	0.78	0.78	2.24	0.78	0.78	0.78	0.78	0.78	0.78			0.88	2.24	0.78	0
Propene	4000	0.516	0.790	1.730	2.410	1.805	1.695	2.580	1.205	1.065	1.720	2.580	1.125	0.955	2.600	1.465			1.695	2.600	0.790	0
Vinyl Acetate	x	0.704	0.352	0.352	0.352	0.352	0.352	6.040	0.352	0.352	0.352	1.270	0.352	0.352	0.352	0.352			0.824	6.040	0.352	x
Dichlorodifluoromethane	500000	0.989	3.73	3.81	3.42	3.60	2.89	3.47	3.66	3.19	3.54	3.33	3.93	3.47	3.23	3.31			3.47	3.93	2.89	0
Vinyl Chloride	1	0.0511	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256			0.0256	0.0256	0.0256	0
1,2-Dichlorotetrafluoroethane	700000	1.19	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595			0.595	0.595	0.595	0
1,3-Butadiene	10	0.11	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555			0.555	0.555	0.555	0
Chloromethane	320	0.620	1.070	1.030	1.010	1.010	1.020	1.030	1.140	1.000	1.070	1.050	1.160	0.990	0.987	1.040			1.043	1.160	0.987	0
Trichlorotrifluoroethane	800000	1.15	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575			0.575	0.575	0.575	0
Vinyl Bromide	x	0.875	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375			0.4375	0.4375	0.4375	x
Chloroethane	5600	0.792	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396			0.396	0.396	0.396	0
Chloroform	1	0.195	0.0975	0.0975	0.4230	0.2630	0.0975	0.0975	0.1980	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975			0.1398	0.4230	0.0975	0
1,2-Dichloroethane	2	0.20	0.063	0.067	0.055	0.059	0.056	0.053	0.065	0.055	0.067	0.068	0.074	0.080	0.0757	0.0708			0.065	0.080	0.053	0
Carbon Tetrachloride	2.4	0.31	0.473	0.480	0.506	0.534	0.508	0.881	0.343	0.609	0.716	0.757	0.601	0.631	0.620	0.618			0.591	0.881	0.343	0
Trichlorofluoromethane	6000	1.12	1.73	1.78	1.67	1.75	1.44	1.62	1.89	1.65	1.91	1.82	1.76	1.56	1.48	1.48			1.68	1.91	1.44	0
Benzene	2.3	0.16	1.88	1.64	2.44	3.51	2.47	1.68	1.05	0.82	1.96	1.56	0.71	0.71	1.24	0.76			1.60	3.51	0.71	3
Ethanol	19000	1.88	27.100	16.700	17.400	16.800	14.700	21.100	13.000	9.580	10.100	21.500	16.300	6.650	41.800	6.720			17.104	41.800	6.650	0
Trichloroethylene	12	0.269	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135			0.135	0.135	0.135	0
2-propanol	7300	2.46	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230			1.230	1.230	1.230	0
Bromodichloromethane	x	1.34	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670			0.670	0.670	0.670	x
2-Propanone	11880	0.475	12.800	15.200	10.900	8.240	11.200	9.170	6.750	8.100	7.680	11.500	4.920	5.510	9.650	2.460			8.863	15.200	2.460	0
cis-1,3-Dichloropropene	x	0.227	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135			0.1135	0.1135	0.1135	x
Methyl Ethyl Ketone	1000	0.295	4.120	20.700	14.400	17.400	8.160	0.148	0.148	9.320	4.780	7.380	7.940	2.410	5.080	1.400			7.385	20.700	0.148	0
trans-1,3-Dichloropropene	x	0.227	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135			0.1135	0.1135	0.1135	x
1,1,2-Trichloroethane	x	0.0655	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328			0.0328	0.0328	0.0328	x
Methyl Isobutyl Ketone	1200	0.410	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205			0.205	0.205	0.205	0
Dibromochloromethane	x	1.70	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850			0.850	0.850	0.850	x
Methyl Butyl Ketone	x	4.10	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050			2.050	2.050	2.050	x
Ethylene Dibromide	3	0.0768	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038			0.038	0.038	0.038	0
Methyl t-butyl ether (MTBE)	7000	0.361	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805			0.1805	0.1805	0.1805	0
1,1,2,2-Tetrachloroethane	x	0.0185	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093			0.0093	0.0093	0.0093	x
Ethyl Acetate	x	3.60	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800			1.800	1.800	1.800	x
1,1-Dichloroethylene	10	0.198	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990			0.0990	0.0990	0.0990	0
Benzyl chloride	x	2.59	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295			1.295	1.295	1.295	x
cis-1,2-Dichloroethylene	105	0.198	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990			0.0990	0.0990	0.0990	0
Hexachlorobutadiene	x	0.0501	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251			0.0251	0.0251	0.0251	x
trans-1,2-Dichloroethylene	105	0.396	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980			0.1980	0.1980	0.1980	0
Methylene Chloride	220	0.174	0.508	0.680	0.755	0.660	0.621	1.170	0.692	0.415	0.842	0.832	0.418	0.415	0.904	0.392			0.665	1.170	0.392	0
1,1-Dichloroethane	165	0.202	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010			0.1010	0.1010	0.1010	0
1,1,1-Trichloroethane	115000	0.273	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365			0.1365	0.1365	0.1365	0
1,2-Dichloropropane	2400	0.231	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155			0.1155	0.1155	0.1155	0
Bromomethane	1350	0.194	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970			0.0970	0.0970	0.0970	0
Bromoform	55	1.03	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515			0.515	0.515	0.515	0
Heptane	11000	1.23	0.615	0.695	0.615	1.420	1.270	1.290	0.692	0.615	0.615	0.615	0.615	0.615	0.615	0.615			0.773	1.420	0.615	0
Tetrachloroethylene	360	0.339	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695	2.4700	0.1695			0.3338	2.4700	0.1695	0
Toluene	2000	0.188	2.0300	5.9300	7.7200	7.4300	5.9200	5.7900	4.3100	1.7900	3.4700	5.4800	1.9600	1.3500	3.4300	0.9600			4.1121	7.7200	0.9600	0
Ethylbenzene	1000	0.217	0.366	1.120	0.763	0.612	0.960	0.525	0.544	0.240	0.419	0.512	0.272	0.314	0.369	0.109			0.509	1.120	0.109	0
p+m-Xylene	730	0.434	1.340	3.820	2.580	2.010	3.220	1.560	1.860	0.679	1.340	1.760	0.745	1.030	1.130	0.217			1.664	3.820	0.217	0
o-Xylene	730	0.217	0.528	1.370	0.841	0.694	1.180	0.531	0.630	0.288	0.550	0.670	0.270	0.415	0.533	0.109			0.615	1.370	0.109	0
Styrene	400	0.213	3.3800	0.1065	0.4290	0.1065	0.1065	0.1065	0.1065	0.1065	0.1065	0.1065	0.1065	0.1065	1.4000	0.1065			0.4558	3.3800	0.1065	0
1,3,5-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23			1.23	1.23	1.23	0
1,2,4-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23			1.23	1.23	1.23	0
4-ethyltoluene	x	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23			1.23	1.23	1.23	x
Chlorobenzene	x	0.230	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150			0.1150	0.1150	0.1150	x
1,3-Dichlorobenzene	x	2.40	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20			1.20	1.20	1.20	x
1,4-Dichlorobenzene	95	0.301	0.1505	0.3140	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505			0.1622	0.3140	0.1505	0
1,2-Dichlorobenzene	x	0.301	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505			0.1505	0.1505	0.1505	x
1,2,4-Trichlorobenzene	400	0.742	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371			0.371	0.371	0.371	0
Hexane	2500	0.352	0.530	21.300	19.500	26.100	7.460	49.300	5.020	10.600	1.500	7.740	9.420	0.353	4.240	1.030			11.721	49.300	0.353	0
Cyclohexane	6100	0.688	0.344	0.991	1.010	1.460	0.770	1.410	0.344	0.344	0.344	0.852	0.344	0.344	0.344	0.344			0.660	1.460	0.344	0
Tetrahydrofuran	93000	1.18	24.30	13.90	0.59	1.88	4.23	14.90	6.70	2.36	0.59	13.80	20.70	0.59	0.59	13.00			8.44	24.30	0.59	0
1,4-Dioxane	3500	3.60	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800			1.800	1.800	1.800	0
Xylene (Total)	730	0.662	1.870	5.200	3.420	2.700	4.400	2.090	2.490	0.967	1.890	2.430	1.010	1.450	1.670	0.331			2.280	5.200	0.331	0

Station : 29567

Location : Niagara St / Land St, Hamilton

Reporting Period : 01 January, 2015 to 31 December, 2015

Sample Matrix : SUMMA Canisters

Method : GC/MS (TO15A)

Valid Samples - No. / % : 30 / 100%

Naphthalene		0.524	1.380	0.262	0.780	1.090	1.880	0.262	0.262	0.262	1.180	0.262	0.262	0.262	0.262	0.262			0.619	1.880	0.262	0
1,1,1,2-Tetrachloroethane		0.144	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072			0.072	0.072	0.072	0

Note 1: All non detectable results are reported as ½ the detection limit.

Note 2: Due to ambient air quality sampling methodology and laboratory analytics a Reportable Detection Limit (RDL) can fluctuate from sample to sample. Therefore the reported ½ RDL values, for example the reported value may be above or below RDL indicated in the RDL column. Note all data presented is actual data as reported from the laboratory and modified to meet the MOECC ½ detection limit reporting requirement.

HAMN - VOC Report

Station	: 29180	**Sample Matrix**	: SUMMA Canisters
Location	: Burlington St / Gage Ave, Hamilton	**Method**	: GC/MS (TO15A)
Reporting Period	: 01 January, 2015 to 31 December, 2015	**Valid Samples - No. / %**	: 30 / 100%

VOC Parameter	AAQC 24 Hr µg/m³	RDL µg/m³	06-Jan-15	18-Jan-15	30-Jan-15	11-Feb-15	23-Feb-15	07-Mar-15	19-Mar-15	31-Mar-15	12-Apr-15	24-Apr-15	06-May-15	18-May-15	30-May-15	11-Jun-15	23-Jun-15	05-Jul-15	Ave µg/m³	Max µg/m³	Min µg/m³	Samples > AAQC No.
2,2,4-Trimethylpentane	x	0.934	0.467	0.467	0.467	0.467	0.467	0.467	0.467	0.467	0.467	0.467	1.170	0.467	0.467	0.467	0.467	0.467	0.511	1.170	0.467	x
Carbon Disulfide	330	1.56	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0
Propene	4000	0.516	2.840	2.670	2.150	2.755	0.431	2.670	3.010	1.465	0.670	0.431	1.205	0.775	0.775	1.895	0.945	1.205	1.618	3.010	0.431	0
Vinyl Acetate	x	0.704	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	x
Dichlorodifluoromethane	500000	0.989	3.87	3.60	3.54	3.18	3.16	3.98	4.25	3.59	3.16	2.66	3.51	3.84	4.19	4.16	3.60	3.77	3.63	4.25	2.66	0
Vinyl Chloride	1	0.0511	0.0255	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0255	0.0256	0.0255	0
1,2-Dichlorotetrafluoroethane	700000	1.19	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0
1,3-Butadiene	10	0.11	0.055	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.524	0.555	0.055	0
Chloromethane	320	0.620	1.400	1.400	1.030	1.090	1.200	1.290	1.310	1.550	1.300	1.000	1.290	1.370	1.290	1.120	1.070	1.010	1.233	1.550	1.000	0
Trichlorotrifluoroethane	800000	0.38	0.990	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.601	0.990	0.575	0
Vinyl Bromide	x	0.22	0.1100	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4170	0.4375	0.1100	x
Chloroethane	5600	0.792	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0
Chloroform	1	0.195	0.1200	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.2280	0.0975	0.0975	0.0975	0.0975	0.2360	0.1157	0.2360	0.0975	0
1,2-Dichloroethane	2	0.20	0.100	0.100	0.102	0.092	0.101	0.113	0.089	0.071	0.0722	0.099	0.115	0.078	0.078	0.0912	0.0659	0.076	0.090	0.115	0.066	0
Carbon Tetrachloride	2.4	0.31	0.770	0.643	0.664	0.639	0.563	0.660	0.566	0.488	0.458	0.741	0.496	0.695	0.707	0.625	0.535	0.576	0.614	0.770	0.458	0
Trichlorofluoromethane	6000	1.12	1.72	1.84	2.11	1.53	1.62	2.15	2.95	2.09	1.54	1.32	2.45	2.14	2.09	2.06	1.53	1.61	1.92	2.95	1.32	0
Benzene	2.3	0.16	0.94	0.80	0.99	1.30	0.95	0.91	0.93	2.15	0.61	0.61	6.14	6.00	2.80	1.01	0.52	1.03	1.73	6.14	0.52	3
Ethanol	19000	1.88	10.200	11.700	14.900	6.060	12.800	9.580	10.600	17.500	22.200	18.600	17.500	4.100	10.900	29.100	42.400	30.800	16.809	42.400	4.100	0
Trichloroethylene	12	0.269	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.300	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.145	0.300	0.135	0
2-propanol	7300	2.46	3.685	3.685	3.685	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.690	3.685	1.230	0
Bromodichloromethane	x	0.34	0.170	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.639	0.670	0.170	x
2-Propanone	11880	0.475	6.900	4.400	6.620	5.490	3.660	5.780	3.610	6.710	4.860	5.680	13.300	7.680	9.550	9.980	8.470	11.500	7.137	13.300	3.610	0
cis-1,3-Dichloropropene	x	0.227	0.1150	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1136	0.1150	0.1135	x
Methyl Ethyl Ketone	1000	0.295	4.425	1.770	3.830	2.650	2.110	2.620	3.200	2.920	2.020	3.260	5.520	2.880	3.230	3.750	3.170	6.560	3.370	6.560	1.770	0
trans-1,3-Dichloropropene	x	0.227	0.1150	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1136	0.1150	0.1135	x
1,1,2-Trichloroethane	x	0.0655	0.1100	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0376	0.1100	0.0328	x
Methyl Isobutyl Ketone	1200	0.410	6.550	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.602	6.550	0.205	0
Dibromochloromethane	x	0.43	0.215	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.810	0.850	0.215	x
Methyl Butyl Ketone	x	4.10	4.095	4.095	4.095	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.433	4.095	2.050	x
Ethylene Dibromide	3	0.0768	0.190	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.048	0.190	0.038	0
Methyl t-butyl ether (MTBE)	7000	0.361	0.3605	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1918	0.3605	0.1805	0
1,1,2,2-Tetrachloroethane	x	0.0185	0.1700	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0193	0.1700	0.0093	x
Ethyl Acetate	x	3.60	3.965	3.965	3.965	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.80	2.206	3.965	1.800	x
1,1-Dichloroethylene	10	0.198	0.4955	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.1238	0.4955	0.0990	0
Benzyl chloride	x	0.26	0.130	2.590	2.590	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.384	2.590	0.130	x
cis-1,2-Dichloroethylene	105	0.198	0.3765	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.1163	0.3765	0.0990	0
Hexachlorobutadiene	x	0.0501	0.2650	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0400	0.2650	0.0251	x
trans-1,2-Dichloroethylene	105	0.396	0.3965	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.198	0.2104	0.3965	0.1980	0
Methylene Chloride	220	2.78	1.390	0.500	3.930	0.685	0.713	0.666	0.893	1.530	0.462	1.520	3.140	0.592	0.494	1.410	1.190	0.715	1.239	3.930	0.462	0
1,1-Dichloroethane	165	0.202	0.4045	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1200	0.4045	0.1010	0
1,1,1-Trichloroethane	115000	0.273	0.8200	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1792	0.8200	0.1365	0
1,2-Dichloropropane	2400	0.231	0.9250	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1661	0.9250	0.1155	0
Bromomethane	1350	0.194	0.3495	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.1128	0.3495	0.0970	0
Bromoform	55	1.03	1.035	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.548	1.035	0.515	0
Heptane	11000	1.23	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	1.280	0.615	0.615	0.615	0.615	0.615	0.657	1.280	0.615	0
Tetrachloroethylene	360	0.339	0.6800	0.1695	5.5200	0.1695	0.1695	0.1695	0.1695	0.1695	0.3940	0.8290	0.4680	0.1695	0.1695	0.1695	7.0800	1.0100	1.0942	7.0800	0.1695	0
Toluene	2000	0.188	1.1300	1.0500	4.5900	2.1400	1.4500	1.2300	1.7500	2.8500	2.0000	3.4500	6.9200	1.6300	1.9200	3.0300	6.7500	4.0600	2.8719	6.9200	1.0500	0
Ethylbenzene	1000	0.217	0.4340	0.2240	0.7760	0.3540	0.1085	0.1085	0.3390	0.4790	0.3030	0.6040	1.2800	0.3900	0.2550	0.4770	0.5300	0.4910	0.4471	1.2800	0.1085	0
p+m-Xylene	730	0.434	0.8050	0.6820	2.4400	1.0000	0.5960	0.5290	1.0700	1.4800	1.0100	2.1000	4.4600	1.2200	0.8230	1.5400	1.7700	1.6700	1.4497	4.4600	0.5290	0
o-Xylene	730	0.217	0.4340	0.2890	0.9310	0.4130	0.1085	0.1085	0.3740	0.5890	0.3920	0.7720	1.7600	0.5290	0.3390	0.5930	0.6510	0.7210	0.5628	1.7600	0.1085	0
Styrene	400	0.213	0.4260	0.1065	1.5300	0.1065	0.1065	0.1065	0.1065	1.8600	0.1065	0.6730	2.8100	0.1065	0.1065	0.4980	0.2820	0.1065	0.5648	2.8100	0.1065	0
1,3,5-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	0
1,2,4-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	0
4-ethyltoluene	x	2.46	5.40	5.40	5.40	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	2.01	5.40	1.23	x
Chlorobenzene	x	0.230	0.4605	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1366	0.4605	0.1150	x
1,3-Dichlorobenzene	x	2.40	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	x
1,4-Dichlorobenzene	95	0.301	1.2000	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.2161	1.2000	0.1505	0
1,2-Dichlorobenzene	x	0.301	1.2000	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.2161	1.2000	0.1505	x
1,2,4-Trichlorobenzene	400	0.742	7.400	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.810	7.400	0.371	0
Hexane	2500	0.352	0.530	0.712	3.930	0.494	1.370	0.406	1.340	1.200	0.881	1.940	2.970	0.247	1.440	0.705	1.460	5.350	1.561	5.350	0.247	0
Cyclohexane	6100	0.688	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.764	0.344	0.344	0.344	0.344	0.344	0.370	0.764	0.344	0
Tetrahydrofuran	93000	1.18	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	1.24	0.59	0.59	0.59	0.59	0.59	0.59	0.63	1.24	0.59	0
1,4-Dioxane	3500	3.60	3.605	3.605	3.605	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	2.138	3.605	1.800	0
Xylene (Total)	730	0.662	1.305	0.971	3.370	1.420	0.331	0.331	1.450	2.070	1.410	2.870	6.220	1.750	1.160	2.140	2.420	2.390	1.976	6.220	0.331	0
Naphthalene	x	0.524	0.262	0.262	0.262	0.262	0.262	0.262	0.262	0.262	0.262	0.262	2.110	3.100	0.967	0.262	0.262	0.26	0.599	3.100	0.262	0
1,1,1,2-Tetrachloroethane	x	0.144	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0

Note 1: All non detectable results are reported as ½ the detection limit.

Note 2: Due to ambient air quality sampling methodology and laboratory analytics a Reportable Detection Limit (RDL) can fluctuate from sample to sample. Therefore the reported ½ RDL values, for example the reported value may be above or below RDL indicated in the RDL column. Note all data presented is actual data as reported from the laboratory and modified to meet the MOECC ½ detection limit reporting requirement.

HAMN - VOC Report

Station	: 29180		**Sample Matrix**	: SUMMA Canisters
Location	: Burlington St / Gage Ave, Hamilton		**Method**	: GC/MS (TO15A)
Reporting Period	: 01 January, 2015 to 31 December, 2015		**Valid Samples - No. / %**	: 30 / 100%

Parameter	AAQC 24 Hr µg/m³	RDL µg/m³	17-Jul-15	29-Jul-15	10-Aug-15	22-Aug-15	03-Sep-15	15-Sep-15	27-Sep-15	09-Oct-15	21-Oct-15	02-Nov-15	14-Nov-15	26-Nov-15	08-Dec-15	20-Dec-15			Ave µg/m³	Max µg/m³	Min µg/m³	Samples > AAQC No.
2,2,4-Trimethylpentane	x	0.934	0.976	1.450	1.230	1.080	1.440	0.467	1.160	1.170	1.010	0.467	0.467	0.467	0.968	0.467			0.916	1.450	0.467	x
Carbon Disulfide	330	1.56	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78			0.78	0.78	0.78	0
Propene	4000	0.516	1.215	2.890	2.065	1.805	1.720	2.265	1.480	0.930	2.670	2.755	0.595	1.255	2.265	1.315			1.802	2.890	0.595	0
Vinyl Acetate	x	0.704	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352	0.352			0.352	0.352	0.352	x
Dichlorodifluoromethane	500000	0.989	3.19	3.83	3.42	3.66	3.05	3.89	3.44	3.09	4.35	3.69	3.96	3.39	3.26	3.31			3.54	4.35	3.05	0
Vinyl Chloride	1	0.0511	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256			0.0256	0.0256	0.0256	0
1,2-Dichlorotetrafluoroethane	700000	1.19	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595			0.595	0.595	0.595	0
1,3-Butadiene	10	0.11	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555			0.555	0.555	0.555	0
Chloromethane	320	0.620	0.901	1.030	0.934	1.100	0.980	0.954	1.030	0.893	1.150	1.100	1.070	0.937	1.010	1.030			1.009	1.150	0.893	0
Trichlorotrifluoroethane	800000	1.15	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575			0.575	0.575	0.575	0
Vinyl Bromide	x	0.875	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375			0.4375	0.4375	0.4375	x
Chloroethane	5600	0.792	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396	0.396			0.396	0.396	0.396	0
Chloroform	1	0.195	0.0975	0.2250	0.3630	0.2790	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975	0.0975			0.1385	0.3630	0.0975	0
1,2-Dichloroethane	2	0.20	0.060	0.071	0.057	0.066	0.064	0.052	0.076	0.054	0.072	0.080	0.075	0.079	0.0825	0.0771			0.069	0.083	0.052	0
Carbon Tetrachloride	2.4	0.31	0.488	0.565	0.514	0.568	0.506	0.943	0.348	0.591	0.744	0.735	0.632	0.640	0.624	0.646			0.610	0.943	0.348	0
Trichlorofluoromethane	6000	1.12	1.73	1.80	1.73	2.07	1.86	1.69	1.79	1.75	2.72	1.98	1.79	1.51	1.50	1.52			1.82	2.72	1.50	0
Benzene	2.3	0.16	1.20	0.82	1.83	1.73	1.69	0.76	1.26	0.89	1.89	0.975	0.566	0.655	1.350	0.736			1.17	1.89	0.57	0
Ethanol	19000	1.88	8.390	24.900	31.800	31.700	34.600	30.400	18.200	26.700	33.900	44.800	25.200	4.060	18.500	6.280			24.245	44.800	4.060	0
Trichloroethylene	12	0.269	0.135	0.135	0.756	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135			0.179	0.756	0.135	0
2-propanol	7300	2.46	1.230	1.230	1.230	1.230	1.230	1.535	1.230	2.550	1.230	2.690	1.230	1.230	1.230	1.230			1.450	2.690	1.230	0
Bromodichloromethane	x	1.34	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670	0.670			0.670	0.670	0.670	x
2-Propanone	11880	0.475	13.40	19.10	14.90	15.10	16.50	13.50	9.02	7.58	11.6	9.57	4.58	5.86	5.31	3.29			10.67	19.10	3.29	0
cis-1,3-Dichloropropene	x	0.227	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135			0.1135	0.1135	0.1135	x
Methyl Ethyl Ketone	1000	0.295	8.530	9.590	7.820	8.300	8.900	4.720	3.130	5.440	7.360	3.830	2.340	2.670	2.920	1.420			5.498	9.590	1.420	0
trans-1,3-Dichloropropene	x	0.227	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135	0.1135			0.1135	0.1135	0.1135	x
1,1,2-Trichloroethane	x	0.0655	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328			0.0328	0.0328	0.0328	x
Methyl Isobutyl Ketone	1200	0.410	0.205	0.442	0.205	0.205	0.519	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205			0.244	0.519	0.205	0
Dibromochloromethane	x	1.70	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850			0.850	0.850	0.850	x
Methyl Butyl Ketone	x	4.10	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050	2.050			2.050	2.050	2.050	x
Ethylene Dibromide	3	0.0768	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038			0.038	0.038	0.038	0
Methyl t-butyl ether (MTBE)	7000	0.361	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805	0.1805			0.1805	0.1805	0.1805	0
1,1,2,2-Tetrachloroethane	x	0.0185	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093			0.0093	0.0093	0.0093	x
Ethyl Acetate	x	3.60	1.800	1.800	4.490	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800			1.992	4.490	1.800	x
1,1-Dichloroethylene	10	0.198	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990			0.0990	0.0990	0.0990	0
Benzyl chloride	x	2.59	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295			1.295	1.295	1.295	x
cis-1,2-Dichloroethylene	105	0.198	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990			0.0990	0.0990	0.0990	0
Hexachlorobutadiene	x	0.0501	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251			0.0251	0.0251	0.0251	x
trans-1,2-Dichloroethylene	105	0.396	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980	0.1980			0.1980	0.1980	0.1980	0
Methylene Chloride	220	0.174	1.040	1.100	2.150	1.320	3.210	3.790	2.090	1.540	2.460	2.020	0.512	0.428	1.580	0.450			1.692	3.790	0.428	0
1,1-Dichloroethane	165	0.202	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010	0.1010			0.1010	0.1010	0.1010	0
1,1,1-Trichloroethane	115000	0.273	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365	0.1365			0.1365	0.1365	0.1365	0
1,2-Dichloropropane	2400	0.231	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155	0.1155			0.1155	0.1155	0.1155	0
Bromomethane	1350	0.194	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970	0.0970			0.0970	0.0970	0.0970	0
Bromoform	55	1.03	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515	0.515			0.515	0.515	0.515	0
Heptane	11000	1.23	0.615	0.615	0.615	0.615	1.330	0.615	0.615	0.615	2.530	0.615	0.615	0.615	0.615	0.615			0.803	2.530	0.615	0
Tetrachloroethylene	360	0.339	0.1695	7.0800	0.6030	2.2800	1.3800	5.0800	0.5920	0.6300	2.8700	0.9910	0.1695	0.1695	0.1695	0.1695			1.5967	7.0800	0.1695	0
Toluene	2000	0.188	3.2300	7.3000	7.9300	7.2600	6.5100	7.1100	6.0400	6.0100	6.1300	3.9000	2.1700	1.3300	3.7200	1.2500			4.9921	7.9300	1.2500	0
Ethylbenzene	1000	0.217	0.722	1.060	0.848	1.050	1.400	0.740	1.060	0.814	0.793	0.491	0.323	0.373	0.512	0.218			0.743	1.400	0.218	0
p+m-Xylene	730	0.434	2.600	3.750	3.020	3.790	4.730	2.600	3.860	2.640	2.750	1.560	1.060	1.210	1.710	0.630			2.565	4.730	0.630	0
o-Xylene	730	0.217	0.982	1.390	1.090	1.440	1.740	0.915	1.380	1.100	1.160	0.744	0.392	0.404	0.558	0.109			0.957	1.740	0.109	0
Styrene	400	0.213	0.1065	0.3620	0.5970	0.2760	1.2400	0.5380	0.1065	1.1400	1.2400	0.3620	0.1065	0.1065	0.1065	0.1065			0.4567	1.2400	0.1065	0
1,3,5-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23			1.23	1.23	1.23	0
1,2,4-Trimethylbenzene	220	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23			1.23	1.23	1.23	0
4-ethyltoluene	x	2.46	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23			1.23	1.23	1.23	x
Chlorobenzene	x	0.230	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150			0.1150	0.1150	0.1150	x
1,3-Dichlorobenzene	x	2.40	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20			1.20	1.20	1.20	x
1,4-Dichlorobenzene	95	0.301	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505			0.1505	0.1505	0.1505	0
1,2-Dichlorobenzene	x	0.301	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505	0.1505			0.1505	0.1505	0.1505	x
1,2,4-Trichlorobenzene	400	0.742	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371			0.371	0.371	0.371	0
Hexane	2500	0.352	0.985	1.180	3.820	3.940	1.550	0.900	1.850	3.900	1.585	1.055	0.530	0.317	0.775	0.317			1.622	3.940	0.317	0
Cyclohexane	6100	0.688	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344			0.344	0.344	0.344	0
Tetrahydrofuran	93000	1.18	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59			0.59	0.59	0.59	0
1,4-Dioxane	3500	3.60	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800			1.800	1.800	1.800	0
Xylene (Total)	730	0.662	3.580	5.140	4.120	5.230	6.470	3.520	5.240	3.750	3.910	2.300	1.450	1.610	2.270	0.331			3.494	6.470	0.331	0
Naphthalene		0.524	0.262	0.653	0.624	0.864	2.140	0.262	0.804	0.262	0.562	0.262	0.262	0.262	0.262	0.262			0.553	2.140	0.262	0
1,1,1,2-Tetrachloroethane		0.144	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072			0.072	0.072	0.072	0

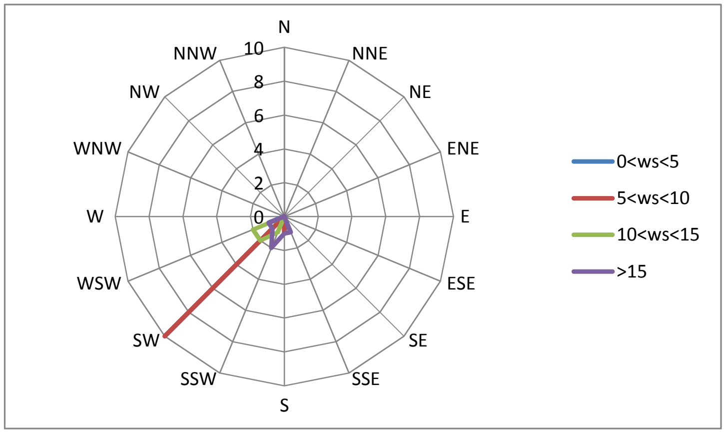
Note 1: All non detectable results are reported as ½ the detection limit.

APPENDIX III
Meteorological Data

Date/Time	Year	Month	Day	Time	Wind Dir (10s deg)	Wind Spd (km/h)	Weather
4/12/2015 0:00	2015	4	12	0:00	22	8	NA
4/12/2015 1:00	2015	4	12	1:00	22	9	Clear
4/12/2015 2:00	2015	4	12	2:00	21	11	NA
4/12/2015 3:00	2015	4	12	3:00	22	8	NA
4/12/2015 4:00	2015	4	12	4:00	22	10	Clear
4/12/2015 5:00	2015	4	12	5:00	22	9	NA
4/12/2015 6:00	2015	4	12	6:00	22	8	NA
4/12/2015 7:00	2015	4	12	7:00	22	9	Clear
4/12/2015 8:00	2015	4	12	8:00	22	10	NA
4/12/2015 9:00	2015	4	12	9:00	24	11	NA
4/12/2015 10:00	2015	4	12	10:00	23	10	Clear
4/12/2015 11:00	2015	4	12	11:00	23	14	NA
4/12/2015 12:00	2015	4	12	12:00	24	16	NA
4/12/2015 13:00	2015	4	12	13:00	24	13	Mainly Clear
4/12/2015 14:00	2015	4	12	14:00	20	24	NA
4/12/2015 15:00	2015	4	12	15:00	19	22	NA
4/12/2015 16:00	2015	4	12	16:00	20	21	Mainly Clear
4/12/2015 17:00	2015	4	12	17:00	22	17	NA
4/12/2015 18:00	2015	4	12	18:00	23	13	NA
4/12/2015 19:00	2015	4	12	19:00	25	5	Mainly Clear
4/12/2015 20:00	2015	4	12	20:00	15	3	NA
4/12/2015 21:00	2015	4	12	21:00	16	16	NA
4/12/2015 22:00	2015	4	12	22:00	19	10	Mainly Clear
4/12/2015 23:00	2015	4	12	23:00	23	7	NA

Data below copied in from a MATLAB program

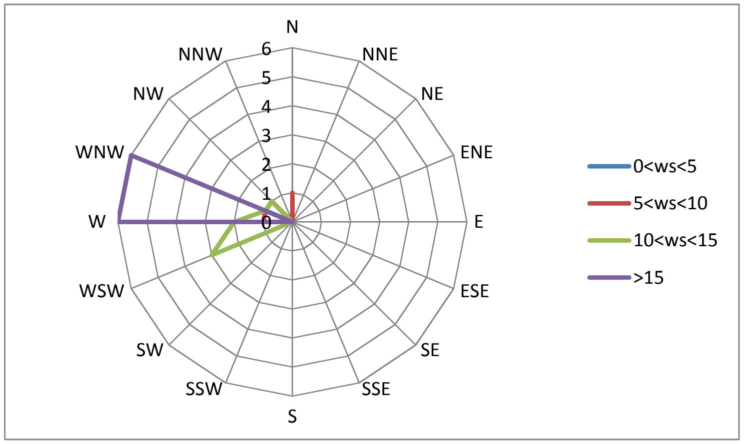
Direction	0<ws<5	5<ws<10	10<ws<15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	1	0	0	1
S	0	1	0	1
SSW	0	0	1	2
SW	0	10	2	1
WSW	1	0	2	1
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Wind Dir (10s deg)	Wind Spd (km/h)	Weather
4/24/2015 0:00	2015	4	24	0:00	25	14	NA
4/24/2015 1:00	2015	4	24	1:00	25	15	Mainly Clear
4/24/2015 2:00	2015	4	24	2:00	26	10	NA
4/24/2015 3:00	2015	4	24	3:00	25	12	NA
4/24/2015 4:00	2015	4	24	4:00	26	11	Mainly Clear
4/24/2015 5:00	2015	4	24	5:00	28	13	NA
4/24/2015 6:00	2015	4	24	6:00	31	15	NA
4/24/2015 7:00	2015	4	24	7:00	28	24	Mainly Clear
4/24/2015 8:00	2015	4	24	8:00	28	19	NA
4/24/2015 9:00	2015	4	24	9:00	29	23	NA
4/24/2015 10:00	2015	4	24	10:00	29	24	Mostly Cloudy
4/24/2015 11:00	2015	4	24	11:00	28	23	NA
4/24/2015 12:00	2015	4	24	12:00	30	23	NA
4/24/2015 13:00	2015	4	24	13:00	27	28	Mostly Cloudy
4/24/2015 14:00	2015	4	24	14:00	30	32	NA
4/24/2015 15:00	2015	4	24	15:00	28	30	NA
4/24/2015 16:00	2015	4	24	16:00	30	19	Mainly Clear
4/24/2015 17:00	2015	4	24	17:00	28	24	NA
4/24/2015 18:00	2015	4	24	18:00	29	23	NA
4/24/2015 19:00	2015	4	24	19:00	30	15	Clear
4/24/2015 20:00	2015	4	24	20:00	32	9	NA
4/24/2015 21:00	2015	4	24	21:00	30	4	NA
4/24/2015 22:00	2015	4	24	22:00	29	10	Clear
4/24/2015 23:00	2015	4	24	23:00	35	8	NA

Data below copied in from a MATLAB program

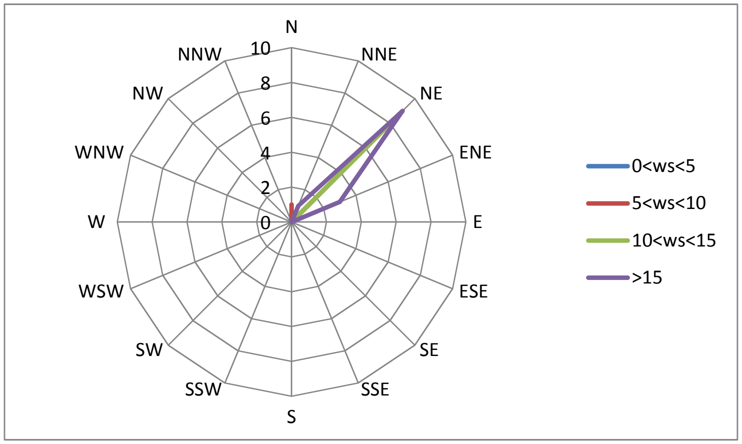
Direction	0<ws<5	5<ws<10	10<ws<15	>15
N	0	1	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	0	0	0	0
SW	0	0	0	0
WSW	0	0	3	0
W	0	1	2	6
WNW	1	1	1	6
NW	0	1	1	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time		Wind Dir (10s d	Wind Spd (km/h)
5/6/2015 0:00	2015	5	6	0:00	fill	36	9
5/6/2015 1:00	2015	5	6	1:00	fill	4	9
5/6/2015 2:00	2015	5	6	2:00	fill	4	13
5/6/2015 3:00	2015	5	6	3:00	fill	4	14
5/6/2015 4:00	2015	5	6	4:00	fill	4	16
5/6/2015 5:00	2015	5	6	5:00	fill	5	14
5/6/2015 6:00	2015	5	6	6:00	fill	5	12
5/6/2015 7:00	2015	5	6	7:00	fill	5	15
5/6/2015 8:00	2015	5	6	8:00	fill	5	23
5/6/2015 9:00	2015	5	6	9:00	fill	6	23
5/6/2015 10:00	2015	5	6	10:00	fill	5	22
5/6/2015 11:00	2015	5	6	11:00	fill	4	20
5/6/2015 12:00	2015	5	6	12:00	fill	5	22
5/6/2015 13:00	2015	5	6	13:00	fill	3	21
5/6/2015 14:00	2015	5	6	14:00	fill	5	23
5/6/2015 15:00	2015	5	6	15:00	fill	5	24
5/6/2015 16:00	2015	5	6	16:00	fill	6	22
5/6/2015 17:00	2015	5	6	17:00	fill	6	20
5/6/2015 18:00	2015	5	6	18:00	fill	5	17
5/6/2015 19:00	2015	5	6	19:00	fill	5	16
5/6/2015 20:00	2015	5	6	20:00	fill	5	12
5/6/2015 21:00	2015	5	6	21:00	fill	5	14
5/6/2015 22:00	2015	5	6	22:00	fill	5	14
5/6/2015 23:00	2015	5	6	23:00	fill	4	12

Data below copied in from a MATLAB program

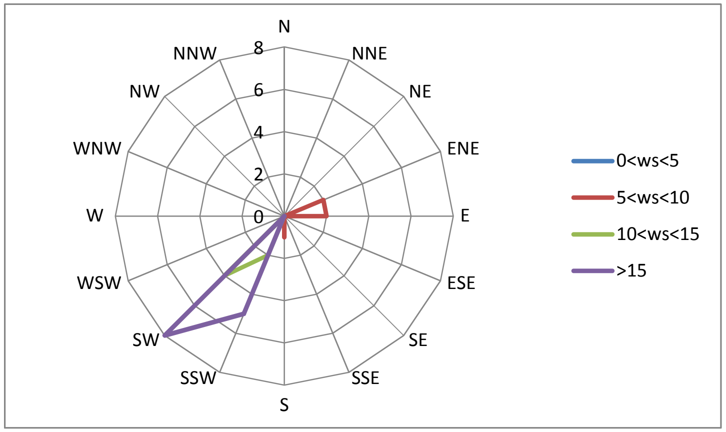
Direction	0<ws<5	5<ws<10	10<ws<15	>15
N	0	1	0	0
NNE	0	0	0	1
NE	0	1	9	9
ENE	0	0	0	3
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	0	0	0	0
SW	0	0	0	0
WSW	0	0	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time		Wind Dir (1	Wind Spd (km/h)
5/18/2015 0:00	2015	5	18	0:00	fill	6	10
5/18/2015 1:00	2015	5	18	1:00	fill	7	9
5/18/2015 2:00	2015	5	18	2:00	fill	8	8
5/18/2015 3:00	2015	5	18	3:00	fill	9	8
5/18/2015 4:00	2015	5	18	4:00	fill	18	9
5/18/2015 5:00	2015	5	18	5:00	fill	20	13
5/18/2015 6:00	2015	5	18	6:00	fill	21	12
5/18/2015 7:00	2015	5	18	7:00	fill	22	13
5/18/2015 8:00	2015	5	18	8:00	fill	23	14
5/18/2015 9:00	2015	5	18	9:00	fill	22	14
5/18/2015 10:00	2015	5	18	10:00	fill	23	23
5/18/2015 11:00	2015	5	18	11:00	fill	23	19
5/18/2015 12:00	2015	5	18	12:00	fill	22	23
5/18/2015 13:00	2015	5	18	13:00	fill	22	23
5/18/2015 14:00	2015	5	18	14:00	fill	21	27
5/18/2015 15:00	2015	5	18	15:00	fill	21	31
5/18/2015 16:00	2015	5	18	16:00	fill	23	25
5/18/2015 17:00	2015	5	18	17:00	fill	23	26
5/18/2015 18:00	2015	5	18	18:00	fill	21	28
5/18/2015 19:00	2015	5	18	19:00	fill	20	18
5/18/2015 20:00	2015	5	18	20:00	fill	20	16
5/18/2015 21:00	2015	5	18	21:00	fill	22	21
5/18/2015 22:00	2015	5	18	22:00	fill	22	16
5/18/2015 23:00	2015	5	18	23:00	fill	22	13

Data below copied in from a MATLAB program

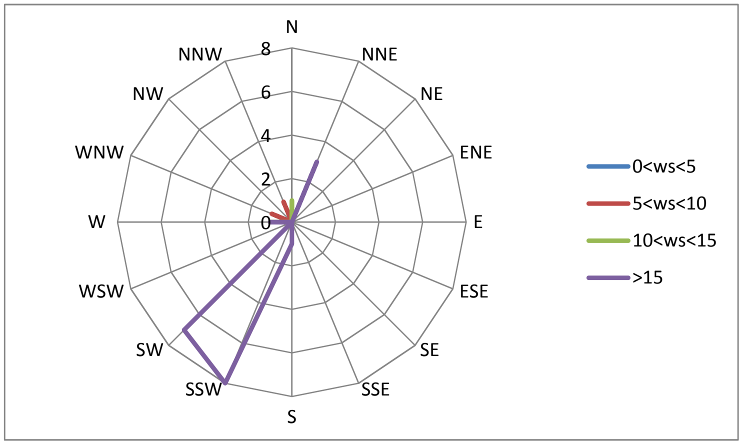
Direction	0<ws<5	5<ws<10	10<ws<15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	2	0	0
E	0	2	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	1	0	0
SSW	0	0	2	5
SW	0	0	4	8
WSW	0	0	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time		Wind Dir (1	Wind Spd (km/h)
5/30/2015 0:00	2015	5	30	0:00	fill	19	16
5/30/2015 1:00	2015	5	30	1:00	fill	20	23
5/30/2015 2:00	2015	5	30	2:00	fill	20	22
5/30/2015 3:00	2015	5	30	3:00	fill	20	23
5/30/2015 4:00	2015	5	30	4:00	fill	21	19
5/30/2015 5:00	2015	5	30	5:00	fill	20	17
5/30/2015 6:00	2015	5	30	6:00	fill	21	20
5/30/2015 7:00	2015	5	30	7:00	fill	21	26
5/30/2015 8:00	2015	5	30	8:00	fill	22	34
5/30/2015 9:00	2015	5	30	9:00	fill	22	32
5/30/2015 10:00	2015	5	30	10:00	fill	23	29
5/30/2015 11:00	2015	5	30	11:00	fill	22	35
5/30/2015 12:00	2015	5	30	12:00	fill	23	28
5/30/2015 13:00	2015	5	30	13:00	fill	21	39
5/30/2015 14:00	2015	5	30	14:00	fill	23	26
5/30/2015 15:00	2015	5	30	15:00	fill	22	39
5/30/2015 16:00	2015	5	30	16:00	fill	26	16
5/30/2015 17:00	2015	5	30	17:00	fill	27	15
5/30/2015 18:00	2015	5	30	18:00	fill	30	7
5/30/2015 19:00	2015	5	30	19:00	fill	33	8
5/30/2015 20:00	2015	5	30	20:00	fill	1	13
5/30/2015 21:00	2015	5	30	21:00	fill	3	27
5/30/2015 22:00	2015	5	30	22:00	fill	3	22
5/30/2015 23:00	2015	5	30	23:00	fill	2	25

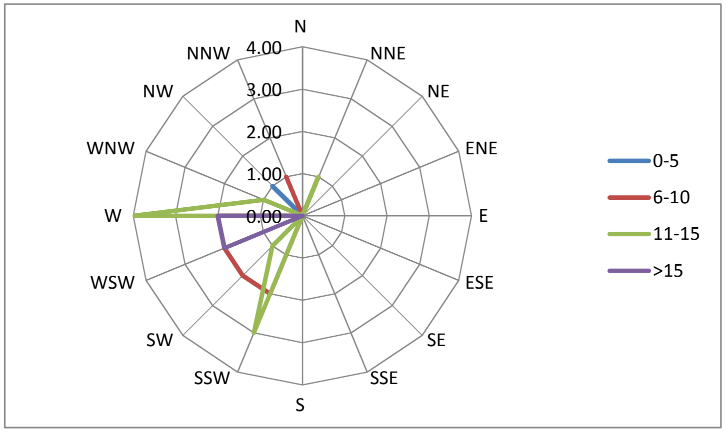
Data below copied in from a MATLAB program

Direction	0<ws<5	5<ws<10	10<ws<15	>15
N	0	0	1	0
NNE	0	0	0	3
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	1
SSW	0	0	0	8
SW	0	0	0	7
WSW	0	0	0	0
W	0	0	1	1
WNW	0	1	0	0
NW	0	0	0	0
NNW	0	1	0	0



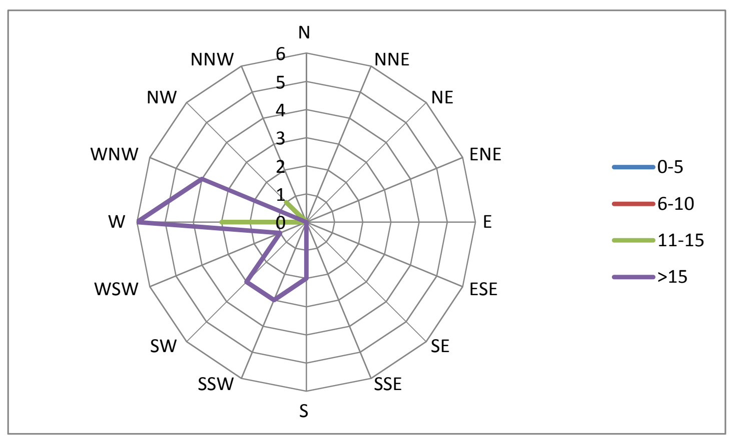
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (:	Wind Spd	Weather
6/11/2015 0:00	2015	6	11	0:00	14.6	24	8	NA
6/11/2015 1:00	2015	6	11	1:00	14.6	27	9	Mostly Cloudy
6/11/2015 2:00	2015	6	11	2:00	13.1	23	8	NA
6/11/2015 3:00	2015	6	11	3:00	13.1	26	9	NA
6/11/2015 4:00	2015	6	11	4:00	11.7	22	12	Mainly Clear
6/11/2015 5:00	2015	6	11	5:00	12.1	25	10	NA
6/11/2015 6:00	2015	6	11	6:00	13.4	26	15	NA
6/11/2015 7:00	2015	6	11	7:00	15.3	25	16	Mostly Cloudy
6/11/2015 8:00	2015	6	11	8:00	17.3	27	15	NA
6/11/2015 9:00	2015	6	11	9:00	18.1	25	17	NA
6/11/2015 10:00	2015	6	11	10:00	19.3	27	11	Mostly Cloudy
6/11/2015 11:00	2015	6	11	11:00	20.4	26	11	NA
6/11/2015 12:00	2015	6	11	12:00	21.8	29	15	NA
6/11/2015 13:00	2015	6	11	13:00	22.9	28	19	Mostly Cloudy
6/11/2015 14:00	2015	6	11	14:00	22.9	26	18	NA
6/11/2015 15:00	2015	6	11	15:00	22.1	21	14	NA
6/11/2015 16:00	2015	6	11	16:00	20.7	20	11	Cloudy
6/11/2015 17:00	2015	6	11	17:00	20.6	20	14	NA
6/11/2015 18:00	2015	6	11	18:00	20.7	21	7	NA
6/11/2015 19:00	2015	6	11	19:00	19.4	20	9	Cloudy
6/11/2015 20:00	2015	6	11	20:00	18.5	23	7	NA
6/11/2015 21:00	2015	6	11	21:00	17.7	32	3	NA
6/11/2015 22:00	2015	6	11	22:00	17.6	34	7	Mostly Cloudy
6/11/2015 23:00	2015	6	11	23:00	17.3	2	13	NA

DIR	0-5	6-10	11-15	>15
N	0.00	0.00	0.00	0.00
NNE	0.00	0.00	1.00	0.00
NE	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00
SSW	0.00	2.00	3.00	0.00
SW	0.00	2.00	1.00	0.00
WSW	0.00	2.00	0.00	2.00
W	0.00	2.00	4.00	2.00
WNW	0.00	0.00	1.00	0.00
NW	1.00	0.00	0.00	0.00
NNW	0.00	1.00	0.00	0.00



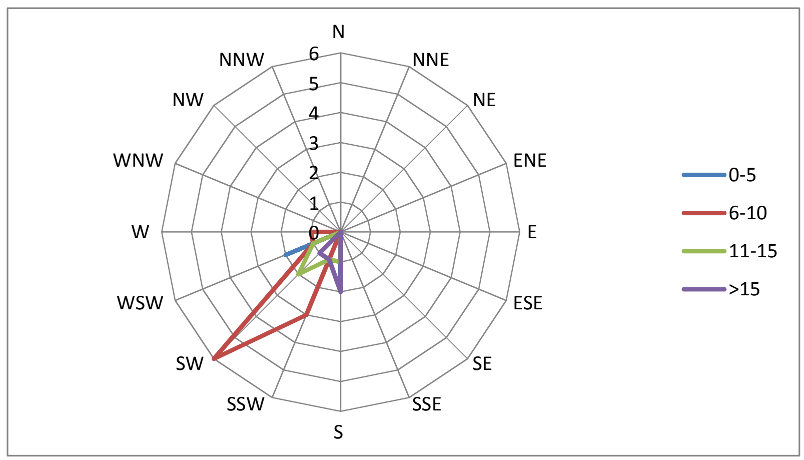
Date/Time	Year	Month	Day	Time		Wind Dir (10s deg)	Wind Spd (km/h)	Weather
6/23/2015 0:00	2015	6	23	0:00	fill	21	36	NA
6/23/2015 1:00	2015	6	23	1:00	fill	22	30	Mostly Cloudy
6/23/2015 2:00	2015	6	23	2:00	fill	22	46	Thunderstorms,Rain Showers
6/23/2015 3:00	2015	6	23	3:00	fill	19	16	Thunderstorms,Rain Showers
6/23/2015 4:00	2015	6	23	4:00	fill	19	22	Thunderstorms,Rain Showers
6/23/2015 5:00	2015	6	23	5:00	fill	20	20	NA
6/23/2015 6:00	2015	6	23	6:00	fill	21	30	NA
6/23/2015 7:00	2015	6	23	7:00	fill	22	23	Cloudy
6/23/2015 8:00	2015	6	23	8:00	fill	25	22	NA
6/23/2015 9:00	2015	6	23	9:00	fill	27	34	NA
6/23/2015 10:00	2015	6	23	10:00	fill	27	33	Mainly Clear
6/23/2015 11:00	2015	6	23	11:00	fill	29	44	NA
6/23/2015 12:00	2015	6	23	12:00	fill	29	33	NA
6/23/2015 13:00	2015	6	23	13:00	fill	29	35	Mostly Cloudy
6/23/2015 14:00	2015	6	23	14:00	fill	30	23	NA
6/23/2015 15:00	2015	6	23	15:00	fill	27	25	NA
6/23/2015 16:00	2015	6	23	16:00	fill	28	25	Mostly Cloudy
6/23/2015 17:00	2015	6	23	17:00	fill	27	25	NA
6/23/2015 18:00	2015	6	23	18:00	fill	28	22	NA
6/23/2015 19:00	2015	6	23	19:00	fill	31	14	Mostly Cloudy
6/23/2015 20:00	2015	6	23	20:00	fill	28	11	NA
6/23/2015 21:00	2015	6	23	21:00	fill	27	5	NA
6/23/2015 22:00	2015	6	23	22:00	fill	27	12	Clear
6/23/2015 23:00	2015	6	23	23:00	fill	26	13	NA

DIR	0-5	6-10	11-15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	2
SSW	0	0	0	3
SW	0	0	0	3
WSW	0	0	0	1
W	1	0	3	6
WNW	0	0	0	4
NW	0	0	1	0
NNW	0	0	0	0



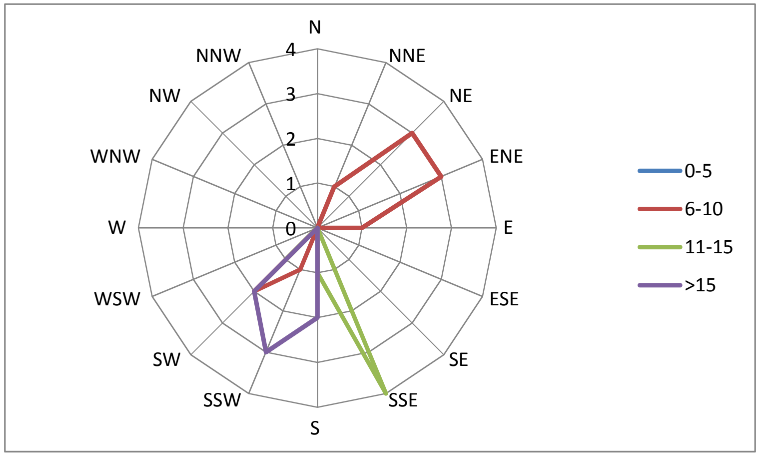
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (10s	Wind Spd (	Weather
7/5/2015 0:00	2015	7	5	0:00	15.4	23	7	NA
7/5/2015 1:00	2015	7	5	1:00	14.4	22	8	Mainly Clear
7/5/2015 2:00	2015	7	5	2:00	14	24	5	NA
7/5/2015 3:00	2015	7	5	3:00	14.2	25	7	NA
7/5/2015 4:00	2015	7	5	4:00	13.4	23	7	Mainly Clear
7/5/2015 5:00	2015	7	5	5:00	14	27	6	NA
7/5/2015 6:00	2015	7	5	6:00	14.5	24	5	NA
7/5/2015 7:00	2015	7	5	7:00	16.7	22	7	Mainly Clear
7/5/2015 8:00	2015	7	5	8:00	19.1	23	7	NA
7/5/2015 9:00	2015	7	5	9:00	21.6	22	9	NA
7/5/2015 10:00	2015	7	5	10:00	23.7	23	12	Mainly Clear
7/5/2015 11:00	2015	7	5	11:00	24.8	23	16	NA
7/5/2015 12:00	2015	7	5	12:00	25.7	23	12	NA
7/5/2015 13:00	2015	7	5	13:00	26	24	12	Mostly Cloudy
7/5/2015 14:00	2015	7	5	14:00	26.7	21	14	NA
7/5/2015 15:00	2015	7	5	15:00	26.5	19	20	NA
7/5/2015 16:00	2015	7	5	16:00	26.2	20	17	Mostly Cloudy
7/5/2015 17:00	2015	7	5	17:00	25.6	19	16	NA
7/5/2015 18:00	2015	7	5	18:00	24.6	19	13	NA
7/5/2015 19:00	2015	7	5	19:00	22.5	20	10	Mostly Cloudy
7/5/2015 20:00	2015	7	5	20:00	21.4	20	8	NA
7/5/2015 21:00	2015	7	5	21:00	20.8	21	6	NA
7/5/2015 22:00	2015	7	5	22:00	20	17	4	Mainly Clear
7/5/2015 23:00	2015	7	5	23:00	19.1	18	4	NA

DIR	0-5	6-10	11-15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	2	0	1	2
SSW	0	3	1	1
SW	0	6	2	1
WSW	2	1	1	0
W	0	1	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



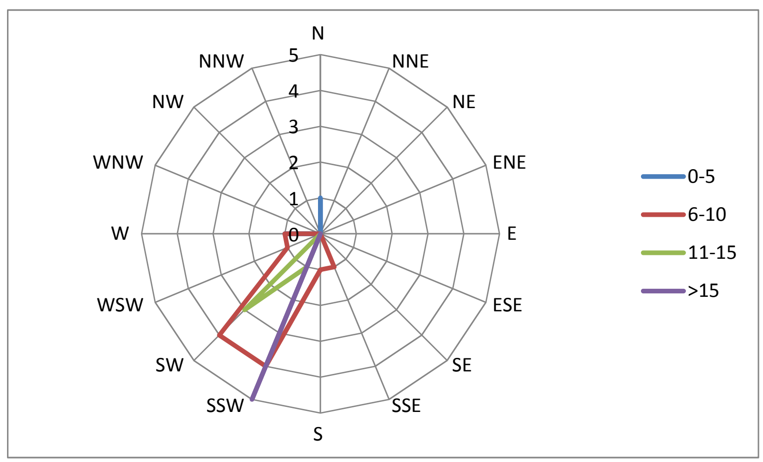
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
7/17/2015 0:00	2015	7	17	0:00	15.7	4	9	NA
7/17/2015 1:00	2015	7	17	1:00	14.9	3	9	Mostly Cloudy
7/17/2015 2:00	2015	7	17	2:00	15.4	6	8	NA
7/17/2015 3:00	2015	7	17	3:00	16	6	9	NA
7/17/2015 4:00	2015	7	17	4:00	15.8	5	10	Mostly Cloudy
7/17/2015 5:00	2015	7	17	5:00	15.9	4	9	NA
7/17/2015 6:00	2015	7	17	6:00	16.4	7	7	NA
7/17/2015 7:00	2015	7	17	7:00	16.9	9	7	Cloudy
7/17/2015 8:00	2015	7	17	8:00	19	16	13	NA
7/17/2015 9:00	2015	7	17	9:00	19.8	17	15	Rain
7/17/2015 10:00	2015	7	17	10:00	19.2	18	16	Rain
7/17/2015 11:00	2015	7	17	11:00	19	16	15	Rain
7/17/2015 12:00	2015	7	17	12:00	18.8	16	14	Rain,Fog
7/17/2015 13:00	2015	7	17	13:00	19.3	16	12	Rain
7/17/2015 14:00	2015	7	17	14:00	21.4	18	20	NA
7/17/2015 15:00	2015	7	17	15:00	23.5	20	22	NA
7/17/2015 16:00	2015	7	17	16:00	24	20	24	Cloudy
7/17/2015 17:00	2015	7	17	17:00	24.2	21	22	NA
7/17/2015 18:00	2015	7	17	18:00	23.8	22	21	NA
7/17/2015 19:00	2015	7	17	19:00	23.2	22	17	Mostly Cloudy
7/17/2015 20:00	2015	7	17	20:00	22.1	22	12	NA
7/17/2015 21:00	2015	7	17	21:00	21	22	9	NA
7/17/2015 22:00	2015	7	17	22:00	21.2	21	10	Mostly Cloudy
7/17/2015 23:00	2015	7	17	23:00	21.5	22	9	NA

DIR	0-5	6-10	11-15	>15
N	0	0	0	0
NNE	0	1	0	0
NE	0	3	0	0
ENE	0	3	0	0
E	0	1	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	4	0
S	0	0	1	2
SSW	0	1	0	3
SW	0	2	1	2
WSW	0	0	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
7/29/2015 0:00	2015	7	29	0:00	20.6	23	8	NA
7/29/2015 1:00	2015	7	29	1:00	20.6	27	5	Clear
7/29/2015 2:00	2015	7	29	2:00	18.4	23	8	NA
7/29/2015 3:00	2015	7	29	3:00	18.4	22	7	NA
7/29/2015 4:00	2015	7	29	4:00	17.3	25	8	Mostly Cloudy
7/29/2015 5:00	2015	7	29	5:00	17.8	28	7	NA
7/29/2015 6:00	2015	7	29	6:00	18.7	21	5	NA
7/29/2015 7:00	2015	7	29	7:00	21.1	36	1	Mostly Cloudy
7/29/2015 8:00	2015	7	29	8:00	25.1	18	7	NA
7/29/2015 9:00	2015	7	29	9:00	27	15	9	NA
7/29/2015 10:00	2015	7	29	10:00	27.9	22	8	Mostly Cloudy
7/29/2015 11:00	2015	7	29	11:00	29.6	20	10	NA
7/29/2015 12:00	2015	7	29	12:00	29.8	20	15	NA
7/29/2015 13:00	2015	7	29	13:00	31	21	21	Mostly Cloudy
7/29/2015 14:00	2015	7	29	14:00	31.4	21	23	NA
7/29/2015 15:00	2015	7	29	15:00	31.4	20	18	NA
7/29/2015 16:00	2015	7	29	16:00	30.9	20	22	Mainly Clear
7/29/2015 17:00	2015	7	29	17:00	28.9	21	22	NA
7/29/2015 18:00	2015	7	29	18:00	27.2	22	12	NA
7/29/2015 19:00	2015	7	29	19:00	26	22	11	Mostly Cloudy
7/29/2015 20:00	2015	7	29	20:00	24.8	21	10	NA
7/29/2015 21:00	2015	7	29	21:00	24	21	9	NA
7/29/2015 22:00	2015	7	29	22:00	23.2	22	13	Mostly Cloudy
7/29/2015 23:00	2015	7	29	23:00	23.1	21	10	NA

DIR	0-5	6-10	11-15	>15
N	1	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	1	0	0
S	0	1	0	0
SSW	1	4	1	5
SW	0	4	3	0
WSW	0	1	0	0
W	1	1	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



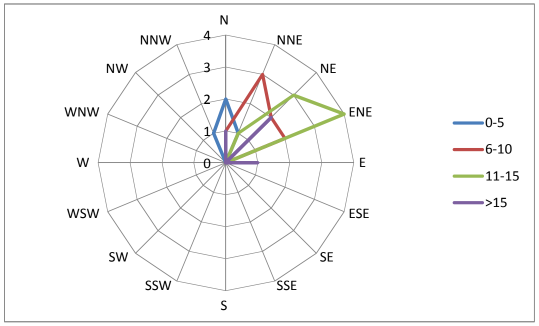
Station Name	HAMILTON A
Province	ONTARIO
Latitude	43.17
Longitude	-79.94
Elevation	237.7
Climate Identifier	6153193
WMO Identifier	71263
TC Identifier	YHM

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

Legend	
E	Estimated
M	Missing
NA	Not Available
‡	Partner data that is not subject to review by the National Climate Archives

Date/Time	Year	Month	Day	Time	Wind Dir (1	Wind Spd (	Weather
8/10/2015 0:00	2015	8	10	0:00	3	6	NA
8/10/2015 1:00	2015	8	10	1:00	1	5	Mainly Clear
8/10/2015 2:00	2015	8	10	2:00	3	7	NA
8/10/2015 3:00	2015	8	10	3:00	1	5	NA
8/10/2015 4:00	2015	8	10	4:00	3	9	Mostly Cloudy
8/10/2015 5:00	2015	8	10	5:00	4	12	NA
8/10/2015 6:00	2015	8	10	6:00	4	10	NA
8/10/2015 7:00	2015	8	10	7:00	5	12	Mostly Cloudy
8/10/2015 8:00	2015	8	10	8:00	7	13	NA
8/10/2015 9:00	2015	8	10	9:00	7	12	NA
8/10/2015 10:00	2015	8	10	10:00	6	12	Mostly Cloudy
8/10/2015 11:00	2015	8	10	11:00	7	9	NA
8/10/2015 12:00	2015	8	10	12:00	5	8	NA
8/10/2015 13:00	2015	8	10	13:00	1	17	Cloudy
8/10/2015 14:00	2015	8	10	14:00	4	16	NA
8/10/2015 15:00	2015	8	10	15:00	4	19	Rain Showers
8/10/2015 16:00	2015	8	10	16:00	3	15	Rain Showers
8/10/2015 17:00	2015	8	10	17:00	5	11	Thunderstorms,Rain Showers,Fog
8/10/2015 18:00	2015	8	10	18:00	6	15	Rain Showers,Fog
8/10/2015 19:00	2015	8	10	19:00	9	16	Cloudy
8/10/2015 20:00	2015	8	10	20:00	7	10	NA
8/10/2015 21:00	2015	8	10	21:00	1	7	NA
8/10/2015 22:00	2015	8	10	22:00	2	4	Mostly Cloudy
8/10/2015 23:00	2015	8	10	23:00	34	3	NA

DIR	0-5	6-10	11-15	>15
N	2	1	0	1
NNE	1	3	1	0
NE	0	2	3	2
ENE	0	2	4	0
E	0	0	0	1
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	0	0	0	0
SW	0	0	0	0
WSW	0	0	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	1	0	0	0



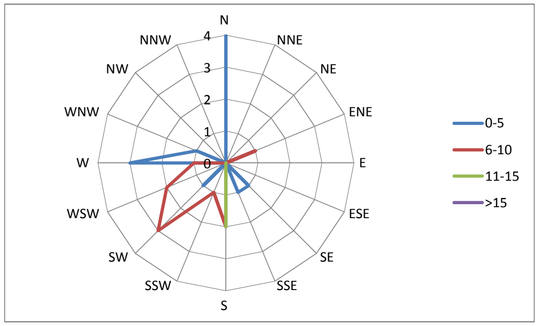
Station Name	HAMILTON A
Province	ONTARIO
Latitude	43.17
Longitude	-79.94
Elevation	237.7
Climate Identifier	6153193
WMO Identifier	71263
TC Identifier	YHM

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

Legend	
E	Estimated
M	Missing
NA	Not Available
‡	Partner data that is not subject to review by the National Climate Archives

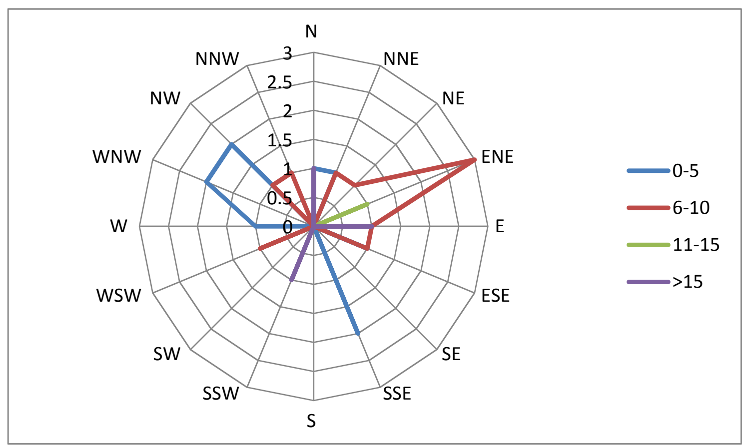
Date/Time	Year	Month	Day	Time	Wind Dir (10s deg)	Wind Spd (	Weather
8/22/2015 0:00	2015	8	22	0:00	27	4	NA
8/22/2015 1:00	2015	8	22	1:00	25	6	Clear
8/22/2015 2:00	2015	8	22	2:00	22	6	NA
8/22/2015 3:00	2015	8	22	3:00	22	4	NA
8/22/2015 4:00	2015	8	22	4:00	28	6	Clear
8/22/2015 5:00	2015	8	22	5:00	28	5	NA
8/22/2015 6:00	2015	8	22	6:00	36	3	NA
8/22/2015 7:00	2015	8	22	7:00	29	3	Clear
8/22/2015 8:00	2015	8	22	8:00	36	2	NA
8/22/2015 9:00	2015	8	22	9:00	22	7	NA
8/22/2015 10:00	2015	8	22	10:00	28	3	Clear
8/22/2015 11:00	2015	8	22	11:00	20	8	NA
8/22/2015 12:00	2015	8	22	12:00	22	8	NA
8/22/2015 13:00	2015	8	22	13:00	24	8	Mainly Clear
8/22/2015 14:00	2015	8	22	14:00	14	4	NA
8/22/2015 15:00	2015	8	22	15:00	6	5	NA
8/22/2015 16:00	2015	8	22	16:00	16	4	Mostly Cloudy
8/22/2015 17:00	2015	8	22	17:00	17	13	NA
8/22/2015 18:00	2015	8	22	18:00	17	14	NA
8/22/2015 19:00	2015	8	22	19:00	19	9	Mostly Cloudy
8/22/2015 20:00	2015	8	22	20:00	18	7	NA
8/22/2015 21:00	2015	8	22	21:00	6	8	NA
8/22/2015 22:00	2015	8	22	22:00	36	1	Mostly Cloudy
8/22/2015 23:00	2015	8	22	23:00	36	2	NA

DIR	0-5	6-10	11-15	>15
N	4	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	1	1	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	1	0	0	0
SSE	1	0	0	0
S	0	2	2	0
SSW	0	1	0	0
SW	1	3	0	0
WSW	0	2	0	0
W	3	1	0	0
WNW	1	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



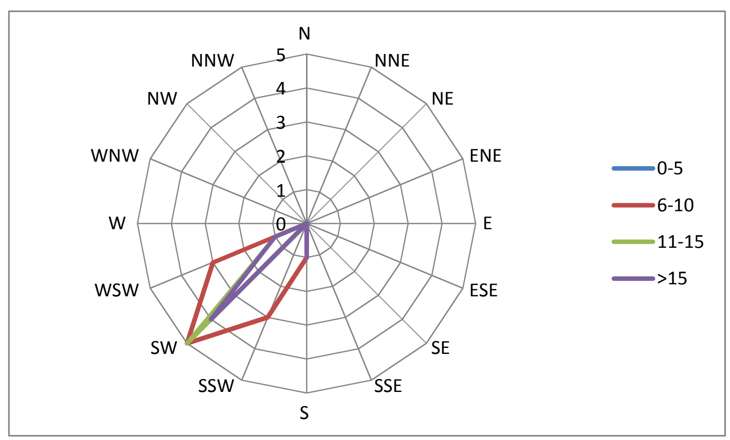
Date/Time	Year	Month	Day	Time		Wind Dir (10s deg)	Wind Spd (km/h)	Weather
9/3/2015 0:00	2015	9	3	0:00	Filler	31	5	NA
9/3/2015 1:00	2015	9	3	1:00	Filler	24	7	Fog
9/3/2015 2:00	2015	9	3	2:00	Filler	31	6	Fog
9/3/2015 3:00	2015	9	3	3:00	Filler	29	5	Fog
9/3/2015 4:00	2015	9	3	4:00	Filler	32	3	Fog
9/3/2015 5:00	2015	9	3	5:00	Filler	34	7	Fog
9/3/2015 6:00	2015	9	3	6:00	Filler	36	2	Fog
9/3/2015 7:00	2015	9	3	7:00	Filler	2	3	Fog
9/3/2015 8:00	2015	9	3	8:00	Filler	6	8	Fog
9/3/2015 9:00	2015	9	3	9:00	Filler	9	7	Fog
9/3/2015 10:00	2015	9	3	10:00	Filler	15	4	Mainly Clear
9/3/2015 11:00	2015	9	3	11:00	Filler	27	4	NA
9/3/2015 12:00	2015	9	3	12:00	Filler	15	3	NA
9/3/2015 13:00	2015	9	3	13:00	Filler	7	7	Mostly Cloudy
9/3/2015 14:00	2015	9	3	14:00	Filler	11	4	NA
9/3/2015 15:00	2015	9	3	15:00	Filler	8	19	NA
9/3/2015 16:00	2015	9	3	16:00	Filler	21	21	Thunderstorms,Rain Showers
9/3/2015 17:00	2015	9	3	17:00	Filler	30	5	Thunderstorms,Rain Showers
9/3/2015 18:00	2015	9	3	18:00	Filler	1	22	NA
9/3/2015 19:00	2015	9	3	19:00	Filler	2	6	Cloudy
9/3/2015 20:00	2015	9	3	20:00	Filler	4	10	NA
9/3/2015 21:00	2015	9	3	21:00	Filler	7	13	NA
9/3/2015 22:00	2015	9	3	22:00	Filler	12	7	Mainly Clear
9/3/2015 23:00	2015	9	3	23:00	Filler	6	9	NA

DIR	0-5	6-10	11-15	>15
N	1	0	0	1
NNE	1	1	0	0
NE	0	1	0	0
ENE	0	3	1	0
E	0	1	0	1
ESE	1	1	0	0
SE	0	0	0	0
SSE	2	0	0	0
S	0	0	0	0
SSW	0	0	0	1
SW	0	0	0	0
WSW	0	1	0	0
W	1	0	0	0
WNW	2	0	0	0
NW	2	1	0	0
NNW	0	1	0	0



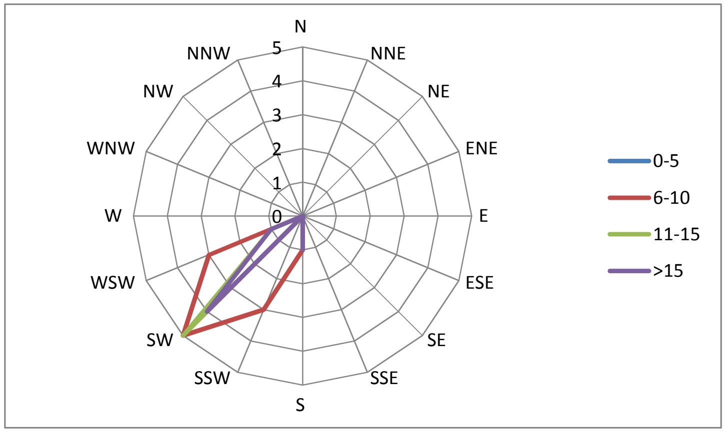
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (	Wind Spd	Weather
9/15/2015 0:00	2015	9	15	0:00	13	19	8	NA
9/15/2015 1:00	2015	9	15	1:00	12.4	20	8	Clear
9/15/2015 2:00	2015	9	15	2:00	12.4	22	8	NA
9/15/2015 3:00	2015	9	15	3:00	12.7	23	8	NA
9/15/2015 4:00	2015	9	15	4:00	12.5	23	8	Clear
9/15/2015 5:00	2015	9	15	5:00	11.5	24	9	NA
9/15/2015 6:00	2015	9	15	6:00	11.9	22	8	Fog
9/15/2015 7:00	2015	9	15	7:00	13.5	23	12	Clear
9/15/2015 8:00	2015	9	15	8:00	16.7	23	15	NA
9/15/2015 9:00	2015	9	15	9:00	19.7	23	14	NA
9/15/2015 10:00	2015	9	15	10:00	22.5	24	13	Clear
9/15/2015 11:00	2015	9	15	11:00	24.2	23	16	NA
9/15/2015 12:00	2015	9	15	12:00	25.2	24	16	NA
9/15/2015 13:00	2015	9	15	13:00	26	23	12	Mainly Clear
9/15/2015 14:00	2015	9	15	14:00	26.5	23	15	NA
9/15/2015 15:00	2015	9	15	15:00	26.1	19	20	NA
9/15/2015 16:00	2015	9	15	16:00	25.4	22	26	Mainly Clear
9/15/2015 17:00	2015	9	15	17:00	24.3	22	19	NA
9/15/2015 18:00	2015	9	15	18:00	21.8	22	16	NA
9/15/2015 19:00	2015	9	15	19:00	18.8	21	9	Mostly Cloudy
9/15/2015 20:00	2015	9	15	20:00	17.9	22	10	NA
9/15/2015 21:00	2015	9	15	21:00	18.2	25	10	NA
9/15/2015 22:00	2015	9	15	22:00	17.6	25	10	Mainly Clear
9/15/2015 23:00	2015	9	15	23:00	15.5	21	8	NA

DIR	0-5	6-10	11-15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	1	0	1
SSW	0	3	0	0
SW	0	5	5	4
WSW	0	3	1	1
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



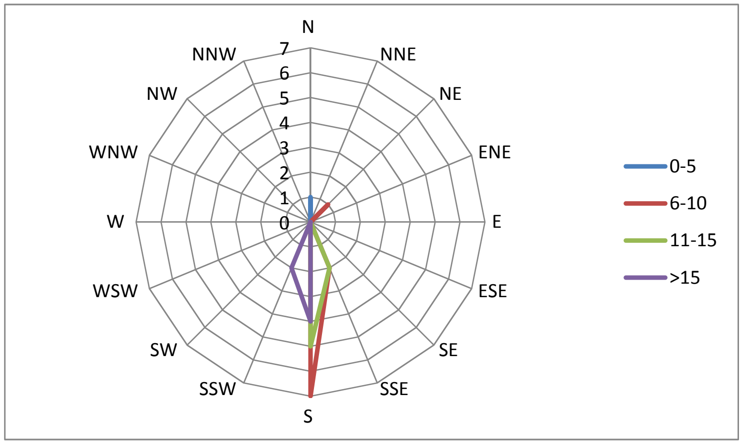
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (:	Wind Spd	Weather
9/15/2015 0:00	2015	9	15	0:00	13	19	8	NA
9/15/2015 1:00	2015	9	15	1:00	12.4	20	8	Clear
9/15/2015 2:00	2015	9	15	2:00	12.4	22	8	NA
9/15/2015 3:00	2015	9	15	3:00	12.7	23	8	NA
9/15/2015 4:00	2015	9	15	4:00	12.5	23	8	Clear
9/15/2015 5:00	2015	9	15	5:00	11.5	24	9	NA
9/15/2015 6:00	2015	9	15	6:00	11.9	22	8	Fog
9/15/2015 7:00	2015	9	15	7:00	13.5	23	12	Clear
9/15/2015 8:00	2015	9	15	8:00	16.7	23	15	NA
9/15/2015 9:00	2015	9	15	9:00	19.7	23	14	NA
9/15/2015 10:00	2015	9	15	10:00	22.5	24	13	Clear
9/15/2015 11:00	2015	9	15	11:00	24.2	23	16	NA
9/15/2015 12:00	2015	9	15	12:00	25.2	24	16	NA
9/15/2015 13:00	2015	9	15	13:00	26	23	12	Mainly Clear
9/15/2015 14:00	2015	9	15	14:00	26.5	23	15	NA
9/15/2015 15:00	2015	9	15	15:00	26.1	19	20	NA
9/15/2015 16:00	2015	9	15	16:00	25.4	22	26	Mainly Clear
9/15/2015 17:00	2015	9	15	17:00	24.3	22	19	NA
9/15/2015 18:00	2015	9	15	18:00	21.8	22	16	NA
9/15/2015 19:00	2015	9	15	19:00	18.8	21	9	Mostly Cloudy
9/15/2015 20:00	2015	9	15	20:00	17.9	22	10	NA
9/15/2015 21:00	2015	9	15	21:00	18.2	25	10	NA
9/15/2015 22:00	2015	9	15	22:00	17.6	25	10	Mainly Clear
9/15/2015 23:00	2015	9	15	23:00	15.5	21	8	NA

DIR	0-5	6-10	11-15	>15
N	0	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	1	0	1
SSW	0	3	0	0
SW	0	5	5	4
WSW	0	3	1	1
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



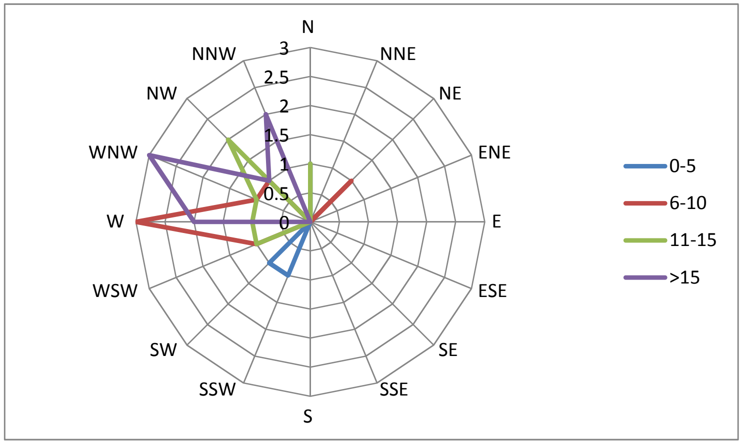
Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
9/27/2015 0:00	2015	9	27	0:00	13.5	5	9	NA
9/27/2015 1:00	2015	9	27	1:00	13.4	36	3	Fog
9/27/2015 2:00	2015	9	27	2:00	14	18	9	NA
9/27/2015 3:00	2015	9	27	3:00	12.8	18	8	NA
9/27/2015 4:00	2015	9	27	4:00	12.6	19	8	Clear
9/27/2015 5:00	2015	9	27	5:00	12.7	17	14	NA
9/27/2015 6:00	2015	9	27	6:00	13.5	17	16	NA
9/27/2015 7:00	2015	9	27	7:00	14.1	17	10	Clear
9/27/2015 8:00	2015	9	27	8:00	16.1	15	8	NA
9/27/2015 9:00	2015	9	27	9:00	17.6	16	15	NA
9/27/2015 10:00	2015	9	27	10:00	19.4	15	13	Mostly Cloudy
9/27/2015 11:00	2015	9	27	11:00	20.9	17	19	NA
9/27/2015 12:00	2015	9	27	12:00	20.5	19	16	NA
9/27/2015 13:00	2015	9	27	13:00	21.2	17	15	Mostly Cloudy
9/27/2015 14:00	2015	9	27	14:00	21.8	21	19	NA
9/27/2015 15:00	2015	9	27	15:00	22.2	17	13	NA
9/27/2015 16:00	2015	9	27	16:00	20.8	20	20	Mostly Cloudy
9/27/2015 17:00	2015	9	27	17:00	20.8	17	18	NA
9/27/2015 18:00	2015	9	27	18:00	19	18	10	NA
9/27/2015 19:00	2015	9	27	19:00	18.5	18	7	Mostly Cloudy
9/27/2015 20:00	2015	9	27	20:00	18.5	15	10	NA
9/27/2015 21:00	2015	9	27	21:00	18.5	17	10	NA
9/27/2015 22:00	2015	9	27	22:00	17	19	12	Mostly Cloudy
9/27/2015 23:00	2015	9	27	23:00	17.2	19	13	NA

DIR	0-5	6-10	11-15	>15
N	1	0	0	0
NNE	0	0	0	0
NE	0	1	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	2	2	0
S	0	7	5	4
SSW	0	0	0	2
SW	0	0	0	0
WSW	0	0	0	0
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
10/9/2015 0:00	2015	10	9	0:00	11.8	5	10	Rain
10/9/2015 1:00	2015	10	9	1:00	11.8	36	15	Rain
10/9/2015 2:00	2015	10	9	2:00	11.5	35	3	Rain
10/9/2015 3:00	2015	10	9	3:00	11.4	21	4	Rain,Fog
10/9/2015 4:00	2015	10	9	4:00	11.4	22	5	Rain,Fog
10/9/2015 5:00	2015	10	9	5:00	12	24	7	Rain,Fog
10/9/2015 6:00	2015	10	9	6:00	13	25	11	Fog
10/9/2015 7:00	2015	10	9	7:00	13.5	26	11	Fog
10/9/2015 8:00	2015	10	9	8:00	14.6	26	9	Fog
10/9/2015 9:00	2015	10	9	9:00	15.7	27	10	Fog
10/9/2015 10:00	2015	10	9	10:00	16	26	20	Cloudy
10/9/2015 11:00	2015	10	9	11:00	15.9	29	22	NA
10/9/2015 12:00	2015	10	9	12:00	15.3	29	21	NA
10/9/2015 13:00	2015	10	9	13:00	14.1	28	25	Mostly Cloudy
10/9/2015 14:00	2015	10	9	14:00	14.1	29	23	NA
10/9/2015 15:00	2015	10	9	15:00	12.8	32	31	NA
10/9/2015 16:00	2015	10	9	16:00	12.4	33	19	Mostly Cloudy
10/9/2015 17:00	2015	10	9	17:00	11.9	34	19	NA
10/9/2015 18:00	2015	10	9	18:00	11.4	32	11	NA
10/9/2015 19:00	2015	10	9	19:00	11.2	32	10	Cloudy
10/9/2015 20:00	2015	10	9	20:00	9.9	31	11	NA
10/9/2015 21:00	2015	10	9	21:00	8.4	30	9	NA
10/9/2015 22:00	2015	10	9	22:00	7	26	7	Clear
10/9/2015 23:00	2015	10	9	23:00	7	29	11	NA

DIR	0-5	6-10	11-15	>15
N	1	0	1	0
NNE	0	0	0	0
NE	0	1	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
SSW	1	0	0	0
SW	1	0	0	0
WSW	0	1	1	0
W	0	3	1	2
WNW	0	1	1	3
NW	0	1	2	1
NNW	0	0	0	2



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
10/21/2015 0:00	2015	10	21	0:00	11.3	1	4	Rain Showers
10/21/2015 1:00	2015	10	21	1:00	12.2	12	4	Rain Showers
10/21/2015 2:00	2015	10	21	2:00	12.1	13	7	Rain Showers
10/21/2015 3:00	2015	10	21	3:00	12.1	18	8	Rain Showers
10/21/2015 4:00	2015	10	21	4:00	11.7	20	4	Rain Showers
10/21/2015 5:00	2015	10	21	5:00	10.9	4	8	Rain Showers
10/21/2015 6:00	2015	10	21	6:00	11.5	6	8	NA
10/21/2015 7:00	2015	10	21	7:00	11.5	3	7	Rain,Fog
10/21/2015 8:00	2015	10	21	8:00	11.6	3	5	Rain,Fog
10/21/2015 9:00	2015	10	21	9:00	12	6	9	Rain,Fog
10/21/2015 10:00	2015	10	21	10:00	11.4	7	10	Fog
10/21/2015 11:00	2015	10	21	11:00	12.2	6	13	Fog
10/21/2015 12:00	2015	10	21	12:00	12.7	4	13	Fog
10/21/2015 13:00	2015	10	21	13:00	14.1	5	10	Mostly Cloudy
10/21/2015 14:00	2015	10	21	14:00	13.6	8	11	NA
10/21/2015 15:00	2015	10	21	15:00	12.3	6	10	NA
10/21/2015 16:00	2015	10	21	16:00	11.8	6	7	Cloudy
10/21/2015 17:00	2015	10	21	17:00	11.3	8	7	NA
10/21/2015 18:00	2015	10	21	18:00	10.8	7	9	NA
10/21/2015 19:00	2015	10	21	19:00	11.1	14	8	Mostly Cloudy
10/21/2015 20:00	2015	10	21	20:00	13.6	17	10	NA
10/21/2015 21:00	2015	10	21	21:00	14.3	19	14	NA
10/21/2015 22:00	2015	10	21	22:00	15.6	21	30	Rain Showers
10/21/2015 23:00	2015	10	21	23:00	16	21	24	NA

DIR	0-5	6-10	11-15	>15
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ENE	0	6	1	0
E	0	1	1	0
ESE	1	0	0	0
SE	0	2	0	0
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SSW	1	0	0	2
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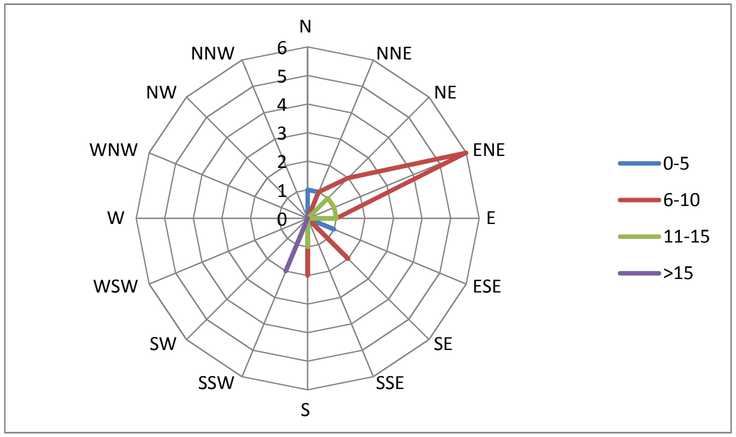

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11/2/2015 4:00	2015	11	2	4:00	4.2	19	7	Clear
11/2/2015 5:00	2015	11	2	5:00	4.5	22	7	NA
11/2/2015 6:00	2015	11	2	6:00	4.3	25	7	NA
11/2/2015 7:00	2015	11	2	7:00	3.3	25	8	Mainly Clear
11/2/2015 8:00	2015	11	2	8:00	5.2	27	8	NA
11/2/2015 9:00	2015	11	2	9:00	9.1	25	5	NA
11/2/2015 10:00	2015	11	2	10:00	11.4	20	7	Clear
11/2/2015 11:00	2015	11	2	11:00	13	18	10	NA
11/2/2015 12:00	2015	11	2	12:00	13.6	20	8	NA
11/2/2015 13:00	2015	11	2	13:00	15	20	19	Mainly Clear
11/2/2015 14:00	2015	11	2	14:00	15.1	18	15	NA
11/2/2015 15:00	2015	11	2	15:00	14.9	19	17	NA
11/2/2015 16:00	2015	11	2	16:00	13.8	19	20	Mainly Clear
11/2/2015 17:00	2015	11	2	17:00	11.8	18	16	NA
11/2/2015 18:00	2015	11	2	18:00	10.1	20	13	NA
11/2/2015 19:00	2015	11	2	19:00	8.7	18	10	Mostly Cloudy
11/2/2015 20:00	2015	11	2	20:00	8.5	21	11	NA
11/2/2015 21:00	2015	11	2	21:00	8	22	13	NA
11/2/2015 22:00	2015	11	2	22:00	8.3	22	14	Mostly Cloudy
11/2/2015 23:00	2015	11	2	23:00	7.5	22	12	NA

DIR	0-5	6-10	11-15	>15
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NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	1	4	1	3
SSW	0	2	2	1
SW	0	1	3	0
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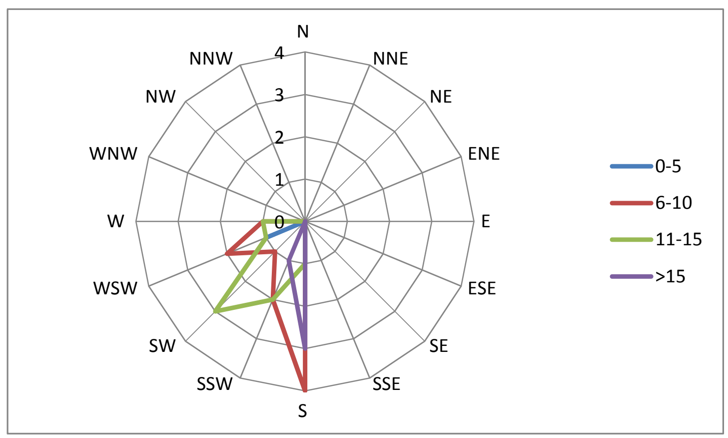
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
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11/14/2015 1:00	2015	11	14	1:00	1	28	16	Mainly Clear
11/14/2015 2:00	2015	11	14	2:00	1.5	28	17	NA
11/14/2015 3:00	2015	11	14	3:00	1.7	29	19	NA
11/14/2015 4:00	2015	11	14	4:00	1.6	27	14	Mostly Cloudy
11/14/2015 5:00	2015	11	14	5:00	0.6	28	23	Snow
11/14/2015 6:00	2015	11	14	6:00	0.4	26	10	Snow
11/14/2015 7:00	2015	11	14	7:00	1.1	31	10	Snow
11/14/2015 8:00	2015	11	14	8:00	1.4	24	8	NA
11/14/2015 9:00	2015	11	14	9:00	2.6	27	19	NA
11/14/2015 10:00	2015	11	14	10:00	3.5	27	19	Mostly Cloudy
11/14/2015 11:00	2015	11	14	11:00	3.8	27	25	NA
11/14/2015 12:00	2015	11	14	12:00	4.2	29	21	NA
11/14/2015 13:00	2015	11	14	13:00	4.7	27	23	Cloudy
11/14/2015 14:00	2015	11	14	14:00	4.9	27	25	NA
11/14/2015 15:00	2015	11	14	15:00	4.6	24	23	NA
11/14/2015 16:00	2015	11	14	16:00	4.5	26	32	Cloudy
11/14/2015 17:00	2015	11	14	17:00	4.2	24	27	NA
11/14/2015 18:00	2015	11	14	18:00	1.5	22	10	NA
11/14/2015 19:00	2015	11	14	19:00	0.8	20	12	Clear
11/14/2015 20:00	2015	11	14	20:00	0.7	21	15	NA
11/14/2015 21:00	2015	11	14	21:00	1.2	24	15	NA
11/14/2015 22:00	2015	11	14	22:00	1.8	24	14	Mostly Cloudy
11/14/2015 23:00	2015	11	14	23:00	2.7	24	18	NA

DIR	0-5	6-10	11-15	>15
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NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	0
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SW	0	1	0	0
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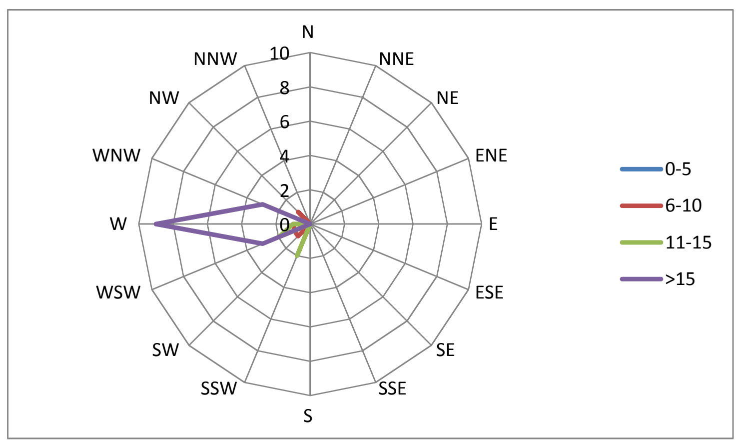
WNW	0	0	0	3
NW	0	1	0	0
NNW	0	0	0	0



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11/26/2015 3:00	2015	11	26	3:00	7.2	20	21	NA
11/26/2015 4:00	2015	11	26	4:00	8.1	20	27	Mostly Cloudy
11/26/2015 5:00	2015	11	26	5:00	8.3	20	26	NA
11/26/2015 6:00	2015	11	26	6:00	8.1	20	28	NA
11/26/2015 7:00	2015	11	26	7:00	8.4	20	24	Mostly Cloudy
11/26/2015 8:00	2015	11	26	8:00	8.8	20	28	NA
11/26/2015 9:00	2015	11	26	9:00	9.5	20	33	NA
11/26/2015 10:00	2015	11	26	10:00	10.1	21	39	Cloudy
11/26/2015 11:00	2015	11	26	11:00	11.6	21	29	NA
11/26/2015 12:00	2015	11	26	12:00	12.9	21	28	NA
11/26/2015 13:00	2015	11	26	13:00	12.9	22	37	Mostly Cloudy
11/26/2015 14:00	2015	11	26	14:00	13.2	20	28	NA
11/26/2015 15:00	2015	11	26	15:00	13.7	21	31	NA
11/26/2015 16:00	2015	11	26	16:00	13.6	21	22	Mostly Cloudy
11/26/2015 17:00	2015	11	26	17:00	12.7	21	23	NA
11/26/2015 18:00	2015	11	26	18:00	13.2	20	25	NA
11/26/2015 19:00	2015	11	26	19:00	13.8	20	26	Mostly Cloudy
11/26/2015 20:00	2015	11	26	20:00	13.7	21	28	NA
11/26/2015 21:00	2015	11	26	21:00	14.1	21	36	NA
11/26/2015 22:00	2015	11	26	22:00	13.9	21	36	Mostly Cloudy
11/26/2015 23:00	2015	11	26	23:00	13.2	21	32	NA

DIR	0-5	6-10	11-15	>15
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NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	0	0	0
SSE	0	0	0	0
S	0	0	0	3
SSW	0	0	0	20
SW	0	0	0	1
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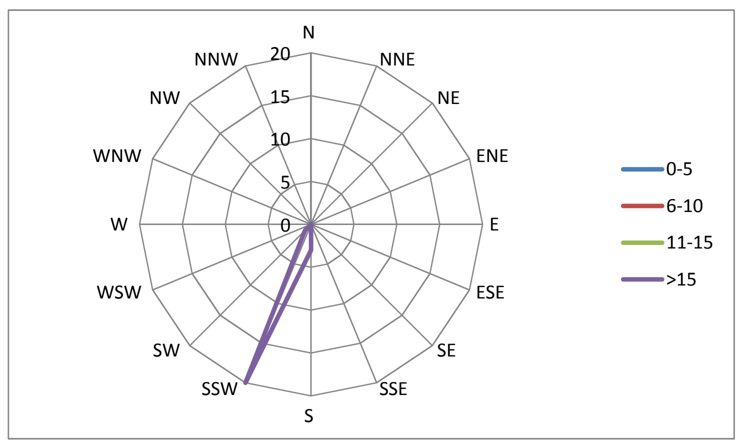
W	0	0	0	0
WNW	0	0	0	0
NW	0	0	0	0
NNW	0	0	0	0



Date/Time	Year	Month	Day	Time	Temp (°C)	Wind Dir (1	Wind Spd (	Weather
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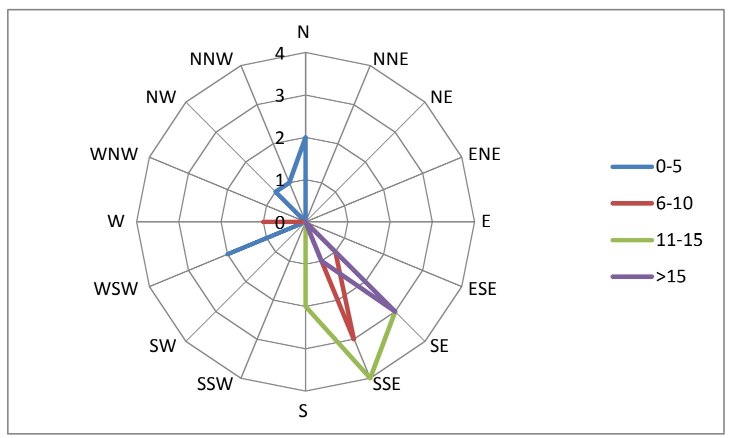
12/8/2015 1:00	2015	12	8	1:00	1.4	31	3	Fog
12/8/2015 2:00	2015	12	8	2:00	1.2	34	3	Fog
12/8/2015 3:00	2015	12	8	3:00	-0.1	25	4	Fog
12/8/2015 4:00	2015	12	8	4:00	0	35	3	Fog
12/8/2015 5:00	2015	12	8	5:00	0.2	25	4	Fog
12/8/2015 6:00	2015	12	8	6:00	0.8	14	9	Fog
12/8/2015 7:00	2015	12	8	7:00	0.6	16	10	Fog
12/8/2015 8:00	2015	12	8	8:00	1	15	13	Fog
12/8/2015 9:00	2015	12	8	9:00	1.8	15	13	Fog
12/8/2015 10:00	2015	12	8	10:00	2.6	15	14	Cloudy
12/8/2015 11:00	2015	12	8	11:00	3.5	13	18	NA
12/8/2015 12:00	2015	12	8	12:00	4.2	14	17	NA
12/8/2015 13:00	2015	12	8	13:00	4.4	14	18	Mostly Cloudy
12/8/2015 14:00	2015	12	8	14:00	4.1	16	16	NA
12/8/2015 15:00	2015	12	8	15:00	4.1	13	14	NA
12/8/2015 16:00	2015	12	8	16:00	4.2	15	11	Cloudy
12/8/2015 17:00	2015	12	8	17:00	4	13	12	Haze
12/8/2015 18:00	2015	12	8	18:00	3.7	14	12	Fog
12/8/2015 19:00	2015	12	8	19:00	2.6	15	8	Mainly Clear
12/8/2015 20:00	2015	12	8	20:00	2.2	36	3	NA
12/8/2015 21:00	2015	12	8	21:00	2	16	6	NA
12/8/2015 22:00	2015	12	8	22:00	3	17	11	Mostly Cloudy
12/8/2015 23:00	2015	12	8	23:00	3.6	17	12	NA

DIR	0-5	6-10	11-15	>15
N	2	0	0	0
NNE	0	0	0	0
NE	0	0	0	0
ENE	0	0	0	0
E	0	0	0	0
ESE	0	0	0	0
SE	0	1	3	3
SSE	0	3	4	1
S	0	0	2	0
SSW	0	0	0	0
SW	0	0	0	0
WSW	2	0	0	0
W	0	1	0	0
WNW	0	0	0	0
NW	1	0	0	0
NNW	1	0	0	0



Appendix F
Environmental Mitigation Measures

APPENDIX F
ENVIRONMENTAL MITIGATION MEASURES

Responsible Authority: Environment Canada

Hamilton, Ontario
Randle Reef Sediment Remediation Project (Stage 2)

PWGSC Project No. R.050927.202

The purpose of this record is to monitor the implementation of mitigation measures. It is the responsibility of the PWGSC Project Manager to ensure that this record is completed over the duration of the project. This Environmental Mitigation Measures report form must be completed in full. Specify in the table below whether the mitigation measures have been applied. If a mitigation measure has not been applied, specify the reason(s) why this was not done.

Environmental Mitigation Measure	**Implementation Schedule/Date**	**Person/Title/ Firm Responsible**	**Compliance (Task Complete – Yes or No/Date) If No, provide reason**
Trucking routes shall be selected to minimize the effect on local residences.			
Designate and enforce haul route so that all truck traffic uses the designated truck routes. (via QEW and Burlington Street not through the city).			
Appropriate methods and approved Municipal and Provincial haul routes must be adhered to during construction.			
Designated haul routes will be identified and adhered to by truck drivers hauling material.			
Standard construction procedures and street cleaning will be employed to keep the trucks clean and minimize the accumulation of soils on public roadways.			
Perform housekeeping on roads including watering/sweeping and / or vacuuming to minimize track-out onto local roads.			
Truck cleaning / washing stations set up at the exit to prevent track out of dust as well as contaminated material.			
Implement a "no idle" policy on site to minimize unnecessary combustion emissions.			
Traffic management, which includes limiting traffic in and around the site will be implemented.			
Delineate the limits of work zones.			

Construction contractor may determine or acquire the various construction materials and use one or more methods, including rail, barge or truck.			
Transport of materials will be in an environmentally sound manner and in accordance with all applicable legislation.			
Contractor to provide a flag person for any railroad crossings at the internal access road in accordance with contract specifications.			
Follow standard operating regulations and local protocols as sought out by the HPA.			
Trucks carrying loose material either entering or leaving the project site will have boxes covered.			
A Traffic Management Plan shall be produced.			
Proper site security and site access will be established by the contractors and will likely involve some combination of temporary barriers, flag persons, and other measures.			
Ensure contractor identifies the existing utility services and proposed tie-in locations to the HPA for approval prior to excavations for staging and water treatment areas.			
Manage any stockpiles to eliminate dust and erosion.			
Cease all dust-generating activities in the event of extremely high winds.			
Dust suppressants will be used, when necessary.			
Development of a dust management plan.			
All internal combustion engines will be fitted with appropriate muffler systems.			
Noise-muffling equipment will be in good working order.			

Intensive construction activities will be limited to the hours between 07:00 and 19:00 to reduce the potential impact on receptors.			
The public will have contact numbers for appropriate construction and government personnel in the case of any noise issues.			
Noise complaints from members of the public will be investigated and appropriate responses will be initiated.			
Strategic placement of material storage piles to reduce noise associated with loading/unloading will be undertaken.			
Develop and implement a communications protocol for real-time air monitoring exceedances.			
Use of real-time air monitoring program for implementing the appropriate mitigation measures.			
The contractor will be required to develop a Health and Safety Plan for the project.			
The Health and Safety Plan for the project will also include measures to ensure the safety of the public in the event of a spill.			
Follow developed health and safety plan(s).			

Refueling areas shall employ standard mitigations (e.g., a gently sloping area with compacted soils and three-sided containment berm) operator training, emergency response planning and equipment maintenance. A refueling station will be set up within the project area so that any accidental leaks of petroleum products during equipment fuelling and maintenance will be contained and managed within the refueling area. This station should have a liner/spill containment control features (e.g., collection systems, berms).			
Application of best management practices to prevent spillage of gasoline, diesel fuel and other oil products in to the water.			
Contactor will have emergency spill response equipment available onsite to facilitate prompt response to any accidental oil, fuel leaks or spills.			
Use of a cleanup crew with containment/sorbent booms, sorbent pads and skimmers as required primarily for removal of spilled non-aqueous phase liquids (NAPLs) including hydrocarbon fuels, oils and lubricants, and aromatic solvents.			
A Spill Control Plan will be developed and implemented by the contractor during construction.			
Water Treatment Plant Operators shall be trained in spill containment / prevention and shall have a site specific emergency response plan.			
Any rainwater or snow melt coming into contact with the debris storage pile shall be directed to the on-site water treatment plant.			
The effluent from the water treatment facility shall be monitored regularly.			

Should observations indicate that suspended sediments are being transported away from debris removal work areas (i.e. in excess of specified CCME criteria), Fisheries and Oceans Canada, will be contacted to discuss additional mitigation measures.			
Removed debris shall be stored on a paved or low permeability geo-textile barrier and a stormwater collection system used to prevent infiltration to the underlying soil.			
Soil stockpiles shall be shaped to avoid steep faces.			
If contaminated soils are encountered in any of the construction activities, the soil shall be stored on a paved or low permeability geo-textile barrier and a stormwater collection system used to prevent infiltration to the underlying soil.			
Contaminated stockpiled materials will be covered to reduce stormwater-induced runoff from the stockpiles. A stormwater collection and management system will be used to prevent direct discharge of any contaminated water to the Harbour. The stormwater management system will consist of sand filter berms (or a similar system) that filters surface runoff before discharging into the Harbour. Discharge water quality is expected to meet or exceed background values.			
To protect against turbid stormwater discharges from storage piles, install a storm management system surrounding the site and staging area.			
Perform monitoring during dredging and other in-water operations to verify compliance with specifications as well as verify that mitigations are working.			

Turbidity curtains or other appropriate containment means shall be used to control total suspended solids during in-water work when required based on the results of the monitoring programs and when required to meet specified turbidity requirement.			
Engineering controls (such as hoods or shrouds on the dredgeheads) or operational controls (such as dredging from higher to lower elevations, or reduced production rates) shall be considered for reducing the total suspended solids during in-water work when required based on the results of the monitoring programs.			
Capping material shall be released in a controlled manner.			
Equipment configurations should be appropriate for the Harbour location.			
Contact Canadian Coast Guard Radio Station, U.S. Steel, shipping companies (e.g. notice to mariners) prior to in-water work activities (e.g., dredging, construction and obstruction).			
Communicate in-water work activities (e.g., dredging, construction and obstruction) to, Hamilton Harbour recreational facilities and users (e.g., notices to mariners).			
In-water works area (e.g., dredging construction and/or obstruction) area will be marked with cautionary/navigation buoys in compliance with the Private Buoy Regulations of the Canada Shipping Act.			
Placement of additional structures/beacons in coordination with the Harbour Master and HPA.			
Shipping and navigation to be accommodated at all times.			

All vessels (e.g., dredging float) will have proper lighting;			
Provide advance notifications to Heddle Marine prior to dredging along Pier 14, Pier 15 and U.S. Steel (intake protection structure).			
Follow specific navigation protocols for area.			
Provide proper navigation lighting on and around ECF. Update port facilities marine chart mapping to reflect ECF.			
Follow specific navigation protocols for area around U.S. Steel Intake/Outfall channel (e.g., vessel restrictions, maintain low speed, no wake zone).			

NOTES: ____

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Completed by:

Name: ______________________ Title: ______________________

Firm: ______________________ Telephone No.: ______________________

Signature: ______________________ Date: ______________________

Appendix G
Air Dispersion Modelling - Excerpts from Randle Reef Sediment Remediation Project, Comprehensive Study Report, October 30, 2012

Construction

Effects Analysis

The construction activities involved in the ECF phase of the Randle Reef Sediment Remediation Project, which have the potential to affect air quality and contribute to regional air pollution include:

- ECF and Turbidity Structure Construction, and Pier 15 stabilization;
- dredging and capping;
- backfilling and capping of the ECF; and
- sub-aqueous capping of the U.S. Steel channel.

These construction activities will require the use of a number of pieces of heavy construction equipment and vehicles including: pile drivers, dump trucks, concrete trucks, excavators, backhoes, front end loaders and miscellaneous smaller contractor equipment.

The large diesel powered equipment will generate combustion gases including: CO_2, CO, NO_x, N_2O, SO_2, VOCs, PAHs, and PM. The use of construction equipment and trucks will also generate airborne PM from road dust as they travel to and from, as well as on, the construction site. PM will also be generated from the delivery, movement and erosion of material stockpiles, which will be required for aggregate and sand requirements for the ECF.

Dredging operations during the construction of the ECF as well as during production dredging will require the use of large barge operated and or land-based mechanical and hydraulic dredging equipment. Dredging activities during construction (e.g., between the ECF walls) will include mechanical and hydraulic dredging. Production dredging activities will occur outside of the ECF and will only include hydraulic dredging. These large diesel powered units will generate combustion gasses, as well as airborne PM.

Furthermore, dredging activities may potentially release VOCs and PAHs from the disturbed contaminated sediments.

An air dispersion modelling assessment was conducted to determine the potential effects on air quality from the volatilization of contaminated sediment due to dredging operations and the placement of sediment into the ECF. Volatilization is the movement or gaseous emission from a liquid surface to the atmospheric environment.

The modelling assessment focused on assessing scenarios that would represent a maximum emissions scenario from volatilization sources during normal operating conditions. For the remediation activities, five volatilization sources were identified:

- the dredging area during hydraulic dredging operations;
- exposed sediment during mechanical dredging operations for the transport and placement of contaminated sediment in the ECF;
- the ECF during active placement of the dredged material;
- the quiescent, ponded ECF; and
- the dewatered capped ECF due to minor vapour migration through the cap.

It is expected that dredging operations will emit more volatile emissions than quiescent ponded conditions or the capped ECF. Therefore, to capture the effect of maximum emitting operation conditions, the following two scenarios were assessed:

1) mechanical dredging operations for 2 mechanical dredges operating simultaneously; and
2) production dredging operations for 2 hydraulic dredges operating simultaneously.

Mechanical dredging between the ECF walls is scheduled to occur before production dredging outside of the ECF. Currently, it is expected that mechanical dredging and production dredging will not occur simultaneously, therefore, the scenarios assessed do not account for this. In addition, both modelling scenarios assumed operations consist of two (2) ten-hour (10) shifts, seven (7) days a week throughout the year.

During the construction phase, mechanical dredging will remove the sediment in between the ECF walls before backfilling activities occur. The dredged material may be exposed to the air as the mechanical dredge bucket moves through the air and over the sheetpile wall for placement of contaminated sediment into the ECF. The exposure of the dredged material to the air may result in the volatilization of chemicals from the sediment. During mechanical dredging, the ECF itself may also be a volatilization source. This is because mechanical dredging causes increased suspended solids in the near-surface water and increased water turbulence as the mechanical dredge bucket breaks the surface of the water.

Hydraulic dredging will be used during production dredging. Volatilization may occur due to increased suspended solids in the water column and increased water turbulence. The volatile sediment emissions from hydraulic dredging will be lower than mechanical dredging. In hydraulic dredging, the increased suspended solids are limited to the water near the mudline (ARCADIS BBL, 2007).

A modelling exercise was previously completed for Hamilton Port Authority (HPA) by ARCADIS BBL. The modelling exercise was a screening analysis, which assessed the potential for volatilization from dredged material by calculating the maximum flux for PAHs and specified VOCs (benzene, toluene, ethylbenzene and xylene (BTEX)). Based on the maximum flux rates, naphthalene (a PAH) and benzene were screened as the parameters of concern for air dispersion modelling. These compounds are deemed to be reasonable indicators of overall air quality due to their high volatility potential. Emission rates for hydraulic dredging activities and ECF emissions rates previously developed by ARCADIS BBL were used in the modelling assessment. The calculation methodology outlined by ARCADIS BBL for mechanical dredging emission rates was used to predict emission rates from mechanical dredging activities. The emission rates of the identified substances of concern are given below in Table 9.4:

Table 9.4: Source Emission Rates

Parameter		**ECF**	**Production Dredge #1**	**Production Dredge #2**	**Mechanical Dredge #1**	**Mechanical Dredge #2**
Source Type		Area	Area	Area	Volume	Volume
Emission Rates (g/s)	Benzene	2.31E-5	2.12E-6	2.12E-6	1.55E-4	1.55E-4
	Naphthalene	3.17E-3	5.63E-4	5.63E-4	8.13E-3	8.13E-3

The ADMGO was used as a guide for this assessment. As per Section 6.6 in the ADMGO, the modelling results were screened to remove meteorological anomalies. Thus the highest eight (8) 1-hr concentration values and the highest one (1) 24-hr concentration values were removed from each year to determine compliance to the ambient air quality criteria. A conversion factor of 1.2 was used to convert AERMOD 1-hour results to 30-minute results for comparison to 30-minute Point of Impingement (POI) guidelines, outlined in Ontario Regulation 419. With respect to the discharge of air contaminants, Ontario's Reg. 419 defines a POI as any that is not located on the same property as the source of the contaminant. However, the regulation further defines POI as a point located on the same property as the source if that point is located on the following:

- a child care facility; or
- a structure, if the primary purpose of the structure is to serve as a
  - o health care facility;
  - o a senior citizen's residence or long-term care facility; or
  - o and educational facility.

As previously stated, the area of modelling coverage focused on a 5 km by 5 km domain surrounding the project Site.

A tiered receptor grid with variable receptor spacing was used for the dispersion modelling assessment, as outlined in the ADMGO. All receptors situated on water were removed from the assessment. Furthermore, the site plan provided by HPA was used to input the dimensions and location of the project.

Isopleths depicting the maximum point of impingement (POI) location for naphthalene and benzene modelling results are shown in **Figure 9.2, Figure 9.3** and **Figure 9.4**. An isopleth is a contour line on a map representing points of equal value. In this context an isopleth represents points of equal air contaminant concentration on ground level. All areas inside the contour lines represent areas with equal or less air contaminant concentrations.

The maximum predicted ground-level concentrations for naphthalene and benzene for the proposed remediation project are presented in Table 9.5 below:

Table 9.5: Maximum Predicted Ground-Level Concentrations

Contaminant	**Averaging Period**	**Ambient Background Concentration (μg/m³)[1]**	**Maximum Predicted Ground Level Concentration (μg/m³)**		**Location of Maximum POI**	**Ambient Air Quality Criteria (μg/m³)[2]**
			Before Ambient Background Added	After Ambient Background Added		
Naphthalene	½ hour	NA	332.45	NA	East of ECF, on Pier 15	36.5
	Daily	1.26	137.70	138.96	East of ECF, on Pier 15	22.5
Benzene	Daily	1.56	2.63	4.19	Southeast of ECF, on Pier 15	NA

Notes:
1. Ambient background concentration was determined to be an average of five years of data (2003 – 2007) obtained from the Hillyard air monitoring station
2. Air Quality Guidelines from Ontario Regulation 419/05 (MOE, 2005)

Figure 9.2: Maximum Point of Impingement (POI) Modelling Results (Naphthalene)

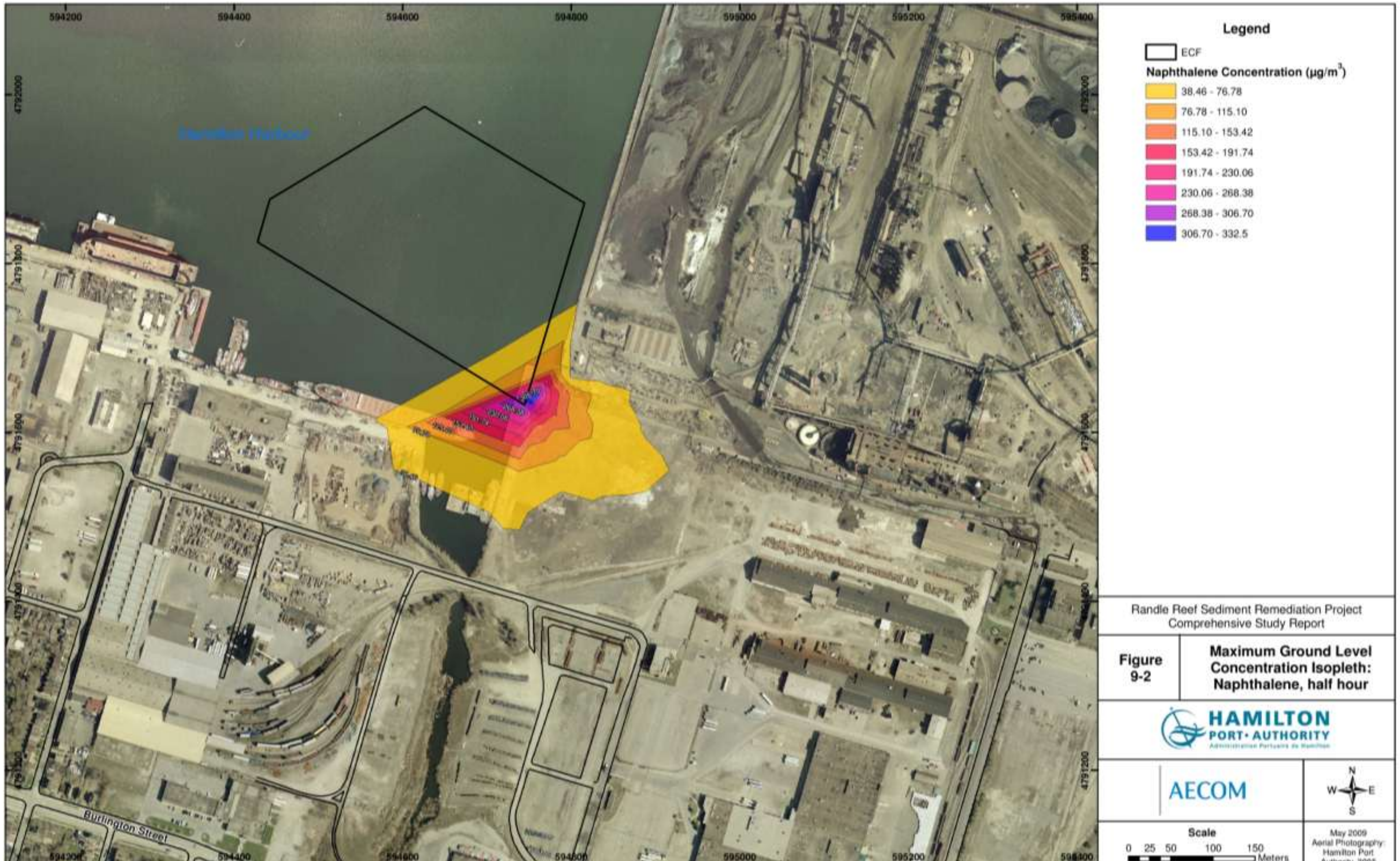


Figure 9.3: Maximum Point of Impingement (POI) Modelling Results (Naphthalene)

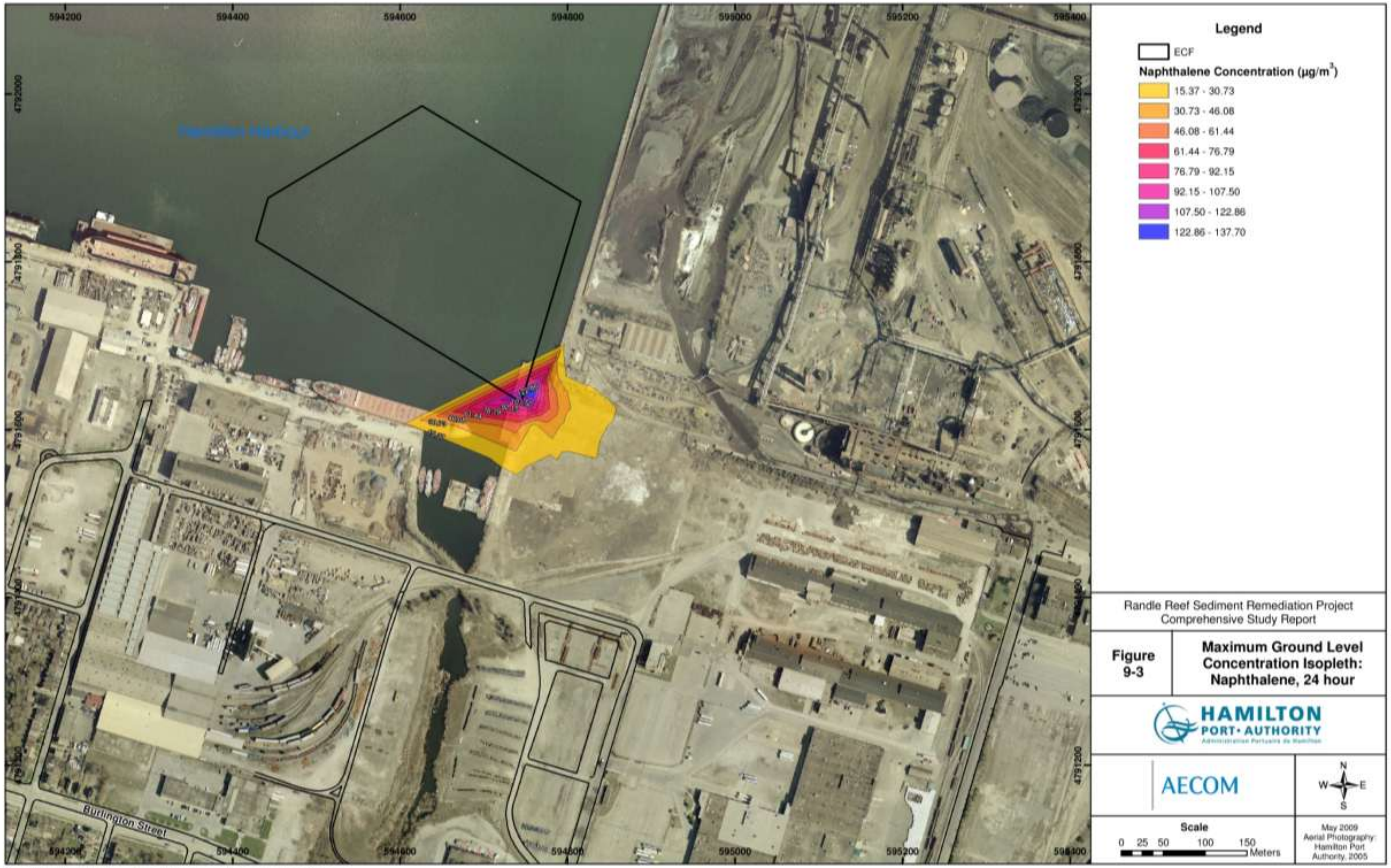
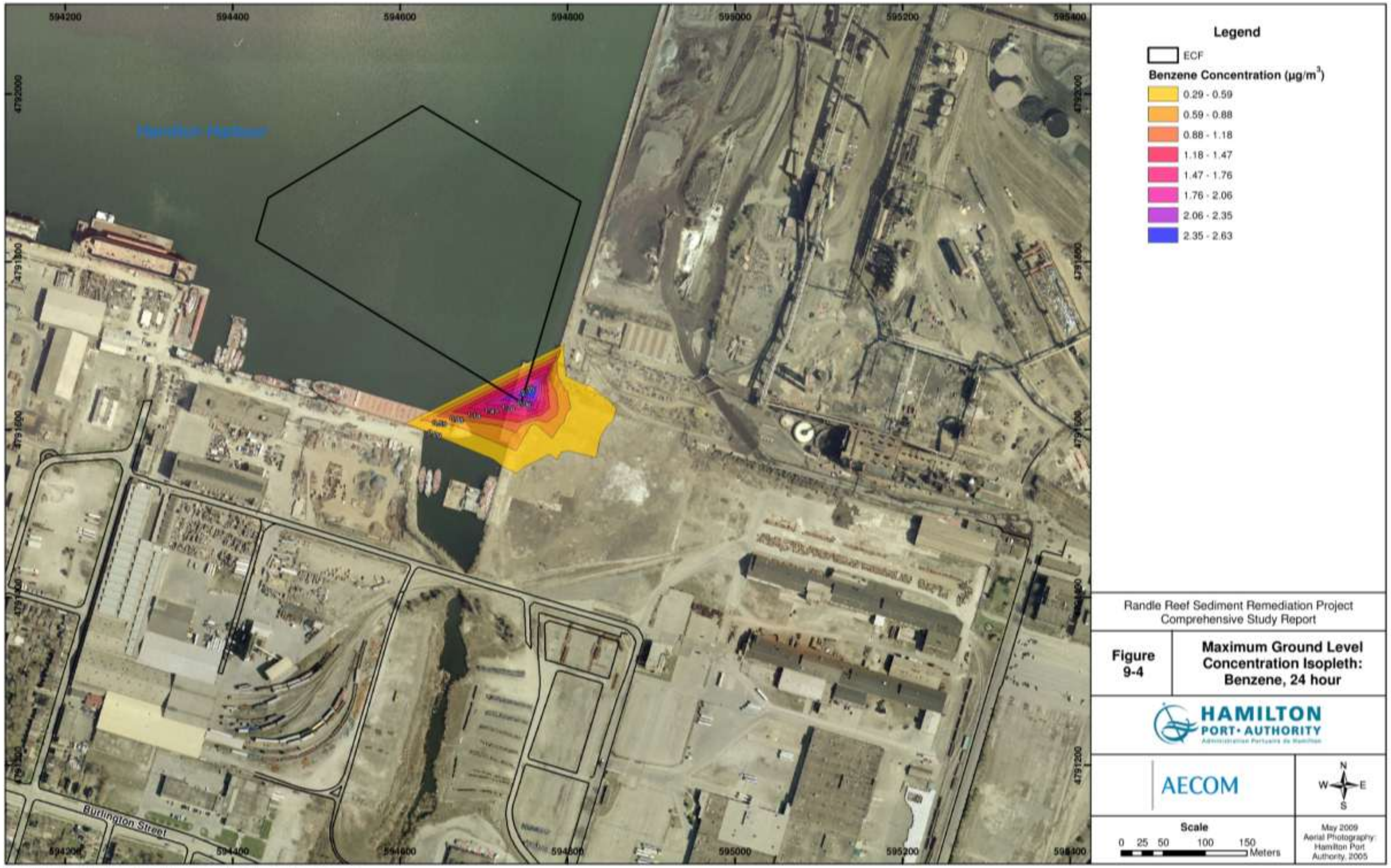


Figure 9.4: Maximum Point of Impingement (POI) Modelling Results (Benzene)



Appendix H
Dredge Volumes

Table 1: Priority 1 - Dredge Volumes

Dredge Sequence	Dredge Volume (m3)	Dredge Area (m2)	Dredge Grade (m)
P1-1	*	1,803	*
P1-2	*	2,614	*
P1-3	1,972	1,850	8.7
P1-4	3,135	2,689	8.7
P1-5	3,062	2,623	9
P1-6	8,754	8,169	9.2
P1-7	1,151	1,087	9.3
P1-8	3,404	3,149	9.5
P1-9	4,055	2,891	10.1
P1-10	1,698	2,942	7.4
P1-11	1,479	1,142	3.1
P1-12	1,260	942	3.7
P1-13	1,106	778	4.1
P1-14	3,083	1,649	5
P1-15	5,977	3,599	5.6
P1-16	4,699	3,701	6.5
P1-17	3,949	1,531	7
P1-18	3,613	1,650	7
P1-19	4,357	1,584	7
P1-20	4,074	1,299	7
P1-21	5,384	4,000	7.1
P1-22	2,465	1,530	7.1
P1-23	6,133	3,870	7.6
P1-24	1,125	1,396	7.1
P1-25	8,731	5,816	8
P1-26	2,971	1,250	8.2
P1-27	5,867	3,057	8
P1-28	1,505	1,040	8.3
P1-29	10,679	9,626	8.5
P1-30	2,503	1,104	9.1
P1-31	2,991	2,427	9.2
P1-32	1,312	1,308	9.3
P1-33	*	2,147	*
P1-34	2,238	2,406	8.7
P1-35	3,173	2,415	8.8
P1-36	1,591	1,196	9.2
P1-37	2,421	2,259	9.3
P1-38	1,681	1,551	9.6
P1-39	12,009	8,945	9.6
P1-40	3,613	1,181	10.8

Note(s):
1. * Sloping Surfaces

Table 2: Priority 2 - Dredge Volumes

Dredge Sequence	Dredge Volume (m3)	Dredge Area (m2)	Dredge Grade (m)
P2-1	3,324	2,591	10.6
P2-2	4,975	4,009	10.8
P2-3	2,718	2,395	11.1
P2-4	1,461	1,280	11.6
P2-5	*	1,478	*
P2-6	1,683	1,103	7.8
P2-7	6,210	5,320	8.6
P2-8	8,123	7,653	9.1
P2-9	7,793	6,430	9.6
P2-10	6,986	7,206	10.1
P2-11	6,919	4,483	10.1
P2-12	4,140	7,232	3.7
P2-13	5,838	8,270	3.9
P2-14	7,591	7,989	4.5
P2-15	9,597	11,994	4.8
P2-16	13,193	14,773	5.4
P2-17	7,672	8,867	5.9
P2-18	4,762	5,579	6.4
P2-19	3,320	4,653	6.8
P2-20	2,506	3,714	7.2
P2-21	1,727	1,917	8
P2-22	1,235	1,784	8.4
P2-23	1,117	1,579	8.9
P2-24	953	1,476	9.3
P2-25	1,090	735	9.4
P2-26	7,403	6,026	10
P2-27	1,831	1,387	10.6
P2-28	1,461	1,154	11.1
P2-29	*	2,997	*
P2-30	1,307	1,038	8.3
P2-31	709	651	8.8
P2-32	922	879	8.8
P2-33	1,674	1,486	9.2
P2-34	620	657	9.2
P2-35	12,288	9,373	9.8
P2-36	5,178	3,020	10.1
P2-37	5,571	2,344	10.8
P2-38	7,270	2,432	11.3

Note(s):
1. * Sloping Surfaces

Table 3: Priority 3 - Dredge Volumes

Dredge Sequence	Dredge Volume (m3)	Dredge Area (m2)	Dredge Grade (m)
P3-1	807	811	8.5
P3-2	1,667	1,840	9.3
P3-3	2,324	3,402	9.5
P3-4	5,796	7,236	10
P3-5	3,638	3,563	10.5
P3-6	3,857	4,641	10.5
P3-7	5,754	5,444	11
P3-8	3,941	4,423	5.5
P3-9	4,648	5,484	5.7
P3-10	5,771	7,910	6
P3-11	9,379	12,468	6.5
P3-12	13,163	17,447	7
P3-13	9,658	13,183	7.5
P3-14	12,840	14,346	8.2
P3-15	12,441	12,161	8.8
P3-16	9,745	12,990	9
P3-17	13,824	14,197	9.7
P3-18	3,999	5,499	4
P3-19	750	961	4.5
P3-20	641	921	5
P3-21	1,209	1,723	5.5
P3-22	1,120	1,568	6
P3-23	627	911	6.5
P3-24	797	1,067	7
P3-25	974	1,193	7.5
P3-26	1,072	1,272	8
P3-27	860	1,114	8.5
P3-28	800	1,140	9
P3-29	1,464	2,034	9.5
P3-30	12,369	13,715	10.2
P3-31	3,264	4,523	10.5
P3-32	2,795	3,917	10.5
P3-33	4,874	6,110	11
P3-34	2,798	2,548	11

Note(s):
1. * Sloping Surfaces

Appendix I
Water Treatment Data and Follow-Up Study

Appendix I includes the following:

ITEM I1. Water Treatment Data.

ITEM I2. Chemical Loading Associated with Water Treament, Randle Reef Sediment Remediation Project, Hamilton Harbour, Lake Ontario, July 18, 2016.

Appendix I
Water Treatment Data and Follow-Up Study

ITEM I1
Water Treatment Data.

These appendices provide basic data obtained during the design stages of this project as may be relevant to the water quality treatment component of this contract. The data presented herein has been obtained from two sources:

- *Randle Reef Sediment Remediation Project Basis of Design Report (and supporting appendices), Submitted by Blasland Bouck and Lee Inc., Hart Crowser Inc., Riggs Engineering, and Ocean and Coastal Consultants Ltd., Project 34305-009, February 2, 2006.*
- *Randle Reef Sediment Remediation Project, Basis of Design Addendum (and supporting appendices), ARCADIS BBL, Issued December 2007, Revised May 2008*

While the information from these sources has been cut and pasted into the appropriate specification appendix sections, it remains unadjusted. Where additional discussion is provided as may be required to assist in the interpretation of the specifications, that information is presented in italicized font.

Table of Contents

Part A Sediment Composite Characterization

The information presented in Appendix A depicts the characteristics of the site sediments as defined through the sampling and testing programs of the Design process.

A.1
Sediment Composite Definition

While a large number of sediment samples were collected throughout the design stage of this project for evaluation of both physical and chemical characteristics, much of the evaluation of sediment treatability, including the ability to treat the waste water resulting from the dredging process is based on an evaluation of "composite" sediments. Sediments from selected sampling locations were mixed together to represent 3 typical types of sediments to be expected during the dredging work. These are defined in the design documentation as:

- *Composite I*
- *Composite II*
- *Composite III*

A discussion of the composite makeup is presented in Appendix H of the Basis of Design Report, with relevant excerpt and table presented below.

Sediment for the treatability studies was collected using a vibracore sampler. Three composite samples were then generated from the individual samples, as follows: Composite I consisted of sediment samples collected from within the proposed ECF footprint; Composite II consisted of current Priority 1, 2, and 3 sediments from the dredging area; and Composite III consisted of the current Priority 2 and 4 sediments, as well as 40% non-priority sediments. The samples included in each of the three composites are listed in Table H-1.

TABLE H-1
SEDIMENT COMPOSITE ORIGIN

Composite	Station / Exploration Identification	Final Sediment Sub Area	Final Sediment Priority Classification
Composite I	A13	1A	Priority 1, ECF Footprint
	A14	1A	Priority 1, ECF Footprint
	A15	1B	Priority 1, ECF Footprint
Composite II	A1	3	Priority 1, Dredging Area
	A2	4	Priority 1, Dredging Area
	A3	9	Priority 2
	A4	12	Priority 2
	A5	17	Priority 3
	A6	9	Priority 2
	A7	16	Priority 3
Composite III	A8	NA	Non-Priority
	A9	12	Priority 2
	A10	11	Priority 2
	A11	NA	Non-Priority
	A12	22	Priority 4

A.2
Sediment Composite Chemistry

A brief discussion of the composite chemistry is presented in Appendix H of the Basis of Design Report, with relevant excerpt and table presented below.

Three subsamples were collected from each of the composites and submitted for analytical testing; the samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, moisture content, and total organic carbon (TOC). Analytical results for the three composite subsamples are shown in Table H-2, along with calculated average concentrations and standard deviations for each of the composites. Low standard deviations indicate that the composites were well mixed. Detected concentrations tended to be highest in Composite I samples, followed by Composite II concentrations. The lowest concentrations were in Composite III.

TABLE H-2
SEDIMENT DATA

Lab ID Sample ID Sampling Date	087214 04 HH2004-COMP I-1 12/2/2004	087215 04 HH2004-COMP I-2 12/2/2004	087216 04 HH2004-COMP I-3 12/2/2004	COMP I Average	COMP I Standard Deviation	COMP I Percent RSD
Conventionals in %						
Moisture	42	47	40	43	4	8
TOC (Solid)	4.2	4.1	4.3	4.2	0.1	2
Metals in mg/kg						
Aluminum	7800	7600	8100	7833	252	3
Arsenic	6.8	6.9	6.9	6.9	0.1	1
Beryllium	0.59	0.57	0.58	0.58	0.01	2
Boron	9	9	9.9	9.3	1	6
Cadmium	2.7	2.7	2.7	2.7	0.0	0
Chromium	33	34	35	34	1	3
Cobalt	7.2	7.1	7.2	7.2	0.1	1
Copper	40	37	36	38	2	6
Iron	44000	43000	44000	43667	577	1
Lead	200	200	200	200	0	0
Mercury	0.5	0.37	0.45	0.44	0.07	15
Molybdenum	0.88	0.81	0.84	0.84	0.04	4
Nickel	18	18	18	18	0	0
Silver	0.53	0.51	0.51	0.52	0.01	2
Vanadium	26	26	27	26	1	2
Zinc	1000	1000	1000	1000	0	0
Volatiles in mg/kg						
1,2,4-Trimethylbenzene	10	10	10	10	0	0
1,3,5-Trimethylbenzene	10 U	10 U	9 U	9.7 U	0.6	6
Benzene	11	11	10	10.7	0.6	5
Ethylbenzene	3.3	3.6	3.4	3.4	0.2	4
Toluene	2 U	2 U	1.8 U	1.9 U	0.1	6
m,p-Xylenes	5.1	5.3	5.3	5.2	0.1	2
o-Xylene	2.5	2.5	2.6	2.5	0.1	2
Semivolatiles in mg/kg						
1-Methylnaphthalene	18	20	23	20	3	12
2,4-Dimethylphenol	1.7 U	1.7 U	1.7 U	1.7 U	0.0	0
2-Methylnaphthalene	92	84	130	102	25	24
2-Methylphenol	5 U	5 U	5 U	5 U	0	0
3&4-Methylphenol	5 U	5 U	5 U	5 U	0	0
Acenaphthene	86	83	130	100	26	26
Acenaphthylene	21	26	37	28	8	29
Anthracene	110	100	170	127	38	30
Benzidine	5 U	5 U	5 U	5 U	0	0
Benzo(a)anthracene	110	100	150	120	26	22
Benzo(a)pyrene	110	100	150	120	26	22
Benzo(b)fluoranthene	81	75	120	92	24	27
Benzo(ghi)perylene	70	74	110	85	22	26
Benzo(k)fluoranthene	88	73	120	94	24	26
Biphenyl	14	13	17	15	2	14
Chrysene	110	97	150	119	28	23
Dibenzo(a,h)anthracene	16	17	19	17	2	9
Dibenzofuran	85	80	130	98	28	28
Dimethylnaphthalenes	17	20	20	19	2	9
Fluoranthene	380	350	580	437	125	29
Fluorene	130	130	210	157	46	29
Indeno(1,2,3-cd)pyrene	72	77	110	86	21	24
Naphthalene	4900	4800	8100	5933	1877	32
Perylene	36	39	44	40	4	10
Phenanthrene	510	490	750	583	145	25
Phenol	2.7 U	2.7 U	2.7 U	2.7 U	0.0	0
Pyrene	280	260	420	320	87	27

TABLE H-2
SEDIMENT DATA

Lab ID Sample ID Sampling Date	087211 04 HH2004-COMP II-1 12/1/2004	087212 04 HH2004-COMP II-2 12/1/2004	087213 04 HH2004-COMP II-3 12/1/2004	COMP II Average	COMP II Standard Deviation	COMP II Percent RSD
Conventionals in %						
Moisture	35	34	35	35	1	2
TOC (Solid)	2.8	2.8	3.3	3.0	0.3	10
Metals in mg/kg						
Aluminum	8000	7800	7400	7733	306	4
Arsenic	9.5	9.6	9.2	9.4	0.2	2
Beryllium	0.63	0.63	0.61	0.62	0.01	2
Boron	13	12	11	12	1	8
Cadmium	3.5	3.5	3.4	3.5	0.1	2
Chromium	33	33	31	32	1	4
Cobalt	7.2	7.3	7.1	7.2	0.1	1
Copper	40	39	39	39	1	1
Iron	55000	56000	54000	55000	1000	2
Lead	200	200	200	200	0	0
Mercury	0.33	0.33	0.33	0.33	0.00	0
Molybdenum	0.91	0.88	0.85	0.88	0.03	3
Nickel	19	18	17	18	1	6
Silver	0.63	0.57	0.56	0.59	0.04	6
Vanadium	30	30	29	30	1	2
Zinc	960	980	970	970	10	1
Volatiles in mg/kg						
1,2,4-Trimethylbenzene	2.1	2.1	2.2	2.1	0.1	3
1,3,5-Trimethylbenzene	0.94	0.92	0.99	1.0	0.04	4
Benzene	0.092	0.088	0.098	0.1	0.01	5
Ethylbenzene	0.16 U	0.16 U	0.16 U	0.2 U	0.00	0
Toluene	0.16 U	0.16 U	0.16 U	0.2 U	0.00	0
m,p-Xylenes	0.49	0.47	0.5	0.5	0.02	3
o-Xylene	0.25	0.25	0.27	0.3	0.01	4
Semivolatiles in mg/kg						
1-Methylnaphthalene	2.9	1.8	1.9	2	1	28
2,4-Dimethylphenol	1.7 U	1.7 U	1.7 U	1.7 U	0.0	0
2-Methylnaphthalene	10	6.6	6.1	7.6	2	28
2-Methylphenol	5 U	5 U	5 U	5 U	0	0
3&4-Methylphenol	5 U	5 U	5 U	5 U	0	0
Acenaphthene	25	11	10	15	8	55
Acenaphthylene	5.2	1.6	1.7	2.8	2	72
Anthracene	25	13	9.9	16.0	8	50
Benzidine	5 U	5 U	5 U	5 U	0	0
Benzo(a)anthracene	20	13	11	15	5	32
Benzo(a)pyrene	19	11	11	14	5	34
Benzo(b)fluoranthene	16	9.3	8.9	11.4	4	35
Benzo(ghi)perylene	13	6.9	8.4	9.4	3	34
Benzo(k)fluoranthene	15	8.3	8.9	10.7	4	35
Biphenyl	2.09	0.72	0.87	1.23	1	61
Chrysene	19	12	10	14	5	35
Dibenzo(a,h)anthracene	2.7	1.5	2	2	1	29
Dibenzofuran	12	6.7	5.8	8.2	3	41
Dimethylnaphthalenes	5.7	3.6	5.3	4.9	1	23
Fluoranthene	62	40	31	44	16	36
Fluorene	37	25	22	28	8	28
Indeno(1,2,3-cd)pyrene	14	7.2	8.7	10.0	4	36
Naphthalene	160	110	110	127	29	23
Perylene	6.5	3.8	3.8	4.7	2	33
Phenanthrene	65	47	37	50	14	29
Phenol	2.7 U	2.7 U	2.7 U	2.70 U	0.0	0
Pyrene	50	33	25	36	13	35

TABLE H-2
SEDIMENT DATA

Lab ID Sample ID Sampling Date	087208 04 HH2004-COMP III-1 11/30/2004	087209 04 HH2004-COMP III-2 11/30/2004	087210 04 HH2004-COMP III-3 11/30/2004	COMP III Average	COMP III Standard Deviation	COMP III Percent RSD
Conventionals in %						
Moisture	31	25	25	27	3	13
TOC (Solid)	0.9	0.9	0.9	0.9	0.0	0
Metals in mg/kg						
Aluminum	7400	7600	7700	7567	153	2
Arsenic	3.1	3.1	2.8	3.0	0.2	6
Beryllium	0.5 U	0.5 U	0.5 U	0.50	0.00	0
Boron	6.4	6.7	6.8	6.6	0	3
Cadmium	0.5	0.55	0.56	0.54	0.0	6
Chromium	14	14	14	14	0	0
Cobalt	6.8	6.5	6.8	6.7	0.2	3
Copper	20	20	20	20	0	0
Iron	16000	16000	16000	16000	0	0
Lead	15	15	16	15	1	4
Mercury	0.04 U	0.04 U	0.04 U	0.04	0.00	0
Molybdenum	0.5 U	0.5 U	0.5 U	0.50	0.00	0
Nickel	14	14	14	14	0	0
Silver	0.25 U	0.25 U	0.25 U	0.25	0.00	0
Vanadium	20	20	21	20	1	3
Zinc	76	76	76	76	0	0
Volatiles in mg/kg						
1,2,4-Trimethylbenzene	0.01 U	0.01 U	0.01 U	0.01	0.00	0
1,3,5-Trimethylbenzene	0.01 U	0.01 U	0.01 U	0.01	0.00	0
Benzene	0.005	0.003	0.002	0.003	0.002	46
Ethylbenzene	0.002 U	0.002 U	0.002 U	0.002	0.000	0
Toluene	0.01	0.008	0.005	0.008	0.003	33
m,p-Xylenes	0.011	0.009	0.006	0.009	0.003	29
o-Xylene	0.004	0.003	0.002	0.003	0.001	33
Semivolatiles in mg/kg						
1-Methylnaphthalene	0.05	0.1	0.05	0.07	0.03	43
2,4-Dimethylphenol	0.34 U	0.34 U	0.34 U	0.34	0.00	0
2-Methylnaphthalene	0.68 U	0.68 U	0.68 U	0.68	0.00	0
2-Methylphenol	1 U	1 U	1 U	1	0.00	0
3&4-Methylphenol	1 U	1 U	1 U	1	0.00	0
Acenaphthene	0.14 U	0.14 U	0.14 U	0.14	0.00	0
Acenaphthylene	0.08 U	0.08 U	0.08 U	0.08	0.00	0
Anthracene	0.12 U	0.12 U	0.12 U	0.12	0.00	0
Benzidine	1 U	1 U	1 U	1	0.00	0
Benzo(a)anthracene	0.1 U	0.12	0.1	0.11	0.01	11
Benzo(a)pyrene	0.1 U	0.1	0.1 U	0.1	0.00	0
Benzo(b)fluoranthene	0.09	0.08 U	0.09	0.09	0.01	7
Benzo(ghi)perylene	0.1 U	0.1 U	0.1 U	0.1	0.00	0
Benzo(k)fluoranthene	0.09	0.08	0.08 U	0.08	0.01	7
Biphenyl	0.8	0.11	0.12	0.34	0.40	115
Chrysene	0.12 U	0.12 U	0.12 U	0.12	0.00	0
Dibenzo(a,h)anthracene	0.12 U	0.12 U	0.12 U	0.12	0.00	0
Dibenzofuran	1 U	1 U	1 U	1.0	0.00	0
Dimethylnaphthalenes	0.4 U	0.4 U	0.4 U	0.4	0.00	0
Fluoranthene	0.2	0.19	0.17	0.19	0.02	8
Fluorene	0.17	0.19	0.16	0.17	0.02	9
Indeno(1,2,3-cd)pyrene	0.12 U	0.12 U	0.12 U	0.12	0.00	0
Naphthalene	0.18 U	0.18 U	0.18 U	0.18	0.00	0
Perylene	0.18 U	0.18 U	0.18 U	0.18	0.00	0
Phenanthrene	0.14	0.15	0.13	0.14	0.01	7
Phenol	0.54 U	0.54 U	0.54 U	0.54	0.00	0
Pyrene	0.17	0.18	0.16	0.17	0.01	6

Notes:
mg/kg = milligrams per kilogram
RSD = relative standard deviation
TOC = total organic carbon
U = Not detected at detection limit indicated.

A.3
Sediment Composite Physical Properties

A brief discussion of the composite sediment physical properties is presented in Appendix H and Appendix F of the Basis of Design Report, with relevant excerpts, tables and figures presented below.

Grain size analysis were also conducted on one subsample from each composite (Table H-3).

TABLE H-3
GRAIN SIZE ANALYSIS

Lab ID Sample ID Sampling Date	087214 04 HH2004-COMP I-1 12/2/2004	087211 04 HH2004-COMP II-1 12/1/2004	087208 04 HH2004-COMP III-1 11/30/2004
Grain Size in %			
Clay (<0.002 mm)	3.3	1.3	7.3
Silt (0.002 to 0.050 mm)	62	61	62
Very Fine Sand (0.050 to 0.10 mm)	20	28	24
Fine Sand (0.10 to 0.25 mm)	7.8	8.1	5.8
Medium Sand (0.25 to 0.50 mm)	2.1	<0.1	0.6
Coarse Sand (0.50 to 1.0 mm)	3.6	0.9	0.4
Very Coarse Sand (1.0 to 2.0 mm)	0.9	0.9	0.3
Fine Gravel (2.0 to 4.8 mm)	0.2	0.1	<0.1
Coarse Gravel (>4.8 mm)	<0.1	<0.1	<0.1

Water content was determined for most samples recovered in the explorations by PSC Analytical Services, Inc. (PSC Analytical) in general accordance with ASTM D 2216. Water content was also determined for the three composite samples. The results of these tests are presented in Tables F-1 and F-2. *(Table F2 is not included in this appendix)*

TABLE F-1
COMPOSITE SAMPLE WATER CONTENT

Sample ID	Water Content (%)
Composite I	43
Composite II	35
Composite III	27

Specific gravities were determined by Hart Crowser for the three composite sediment samples and the Composite II with Polymer Additive sample. Specific gravity is a measure of the density of the soil solids and is expressed as a multiple of the density of water (1 gm/cm^3 [62.4 pcf]). The specific gravity was determined in general accordance with ASTM D 854. Table F-3 lists the results of the specific gravity tests.

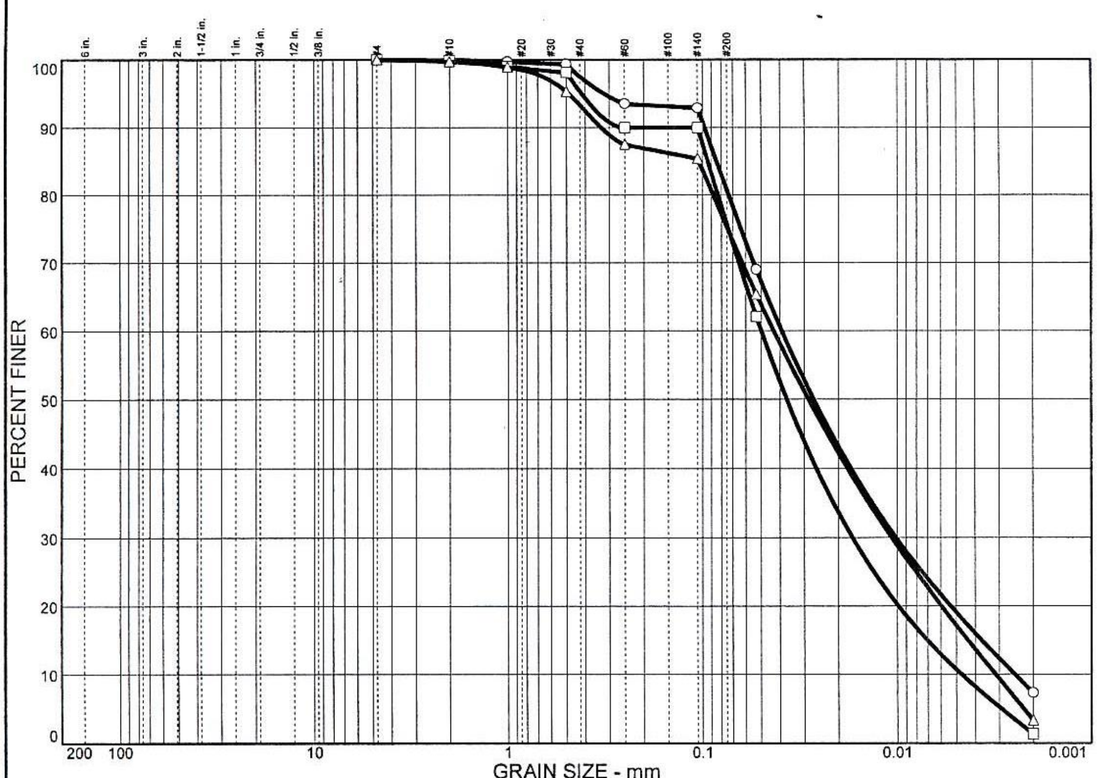
TABLE F-3
SPECIFIC GRAVITY – COMPOSITE SAMPLES

Sample ID	Specific Gravity
Composite I	2.65
Composite II	2.72
Composite II with Polymer Additive	2.74
Composite III	2.74

Grain size distributions were analyzed for 37 discrete and the three composite samples by PSC Analytical. Samples were analyzed in general accordance with Walton (1978). This method is suitable for the measurement of particle size in solid samples ranging from 2 mm to 2 µm.

Sand and gravel fractions of each sample were determined using sieve analyses. Silt and clay fractions (particles passing through a 63-micron mesh sieve) were determined using pipette analysis. The results of the tests are presented as curves on Figures F-10 through F-24, plotting percent finer by weight versus grain size. *(Figures F-11 through F-23 are not included in this appendix)*

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	19.4	61.5	19.1
□	0.0	0.0	24.4	64.8	10.8
△	0.0	0.0	24.8	58.0	17.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	47	14	0.0850	0.0393	0.0269	0.0102	0.0037	0.0025	1.06	15.79
□	33	6	0.0941	0.0500	0.0370	0.0170	0.0070	0.0047	1.23	10.66
△	24	3	0.105	0.0432	0.0286	0.0107	0.0043	0.0031	0.84	13.79

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Clayey, sandy SILT	ML	
□ Slightly clayey, sandy SILT	ML	
△ Clayey, sandy SILT	ML	

Remarks:

Grain size data replotted from PSC Analytical Services Inc.

Material description in general accordance with ASTM 2487

Project: Additional Laboratory Testing for Randle Reef Sediment Remediation Project

Client: Blasland, Bouck & Lee, Inc.

○ **Source:** HH2004-Comp **Sample No.:** I

□ **Source:** HH2004-Comp **Sample No.:** II

△ **Source:** HH2004-Comp **Sample No.:** III

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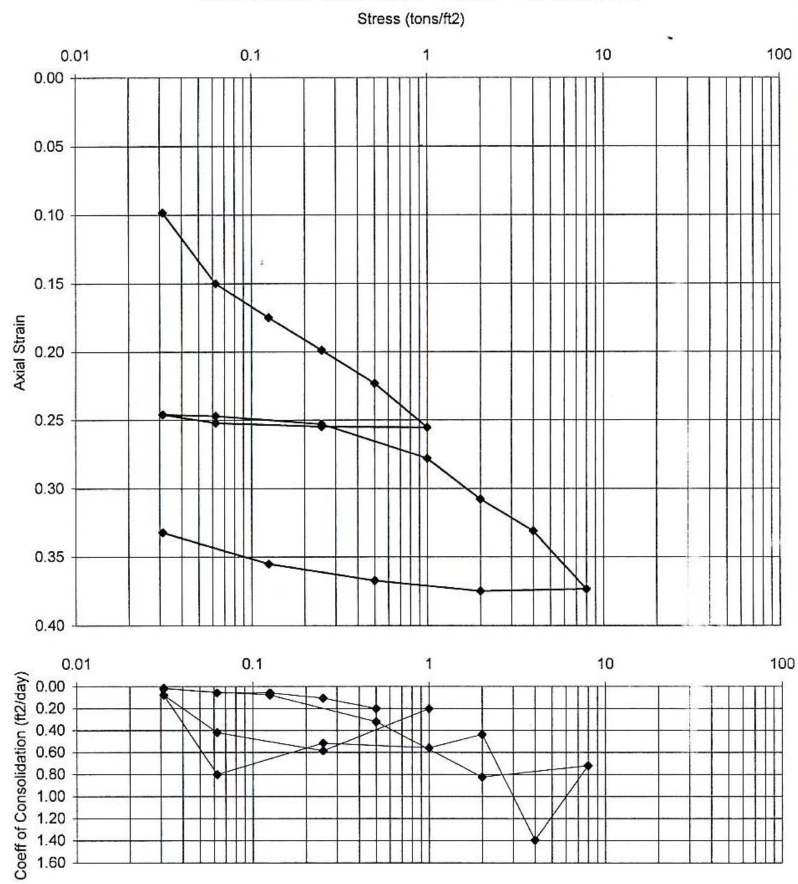
Figure No. ***F-10***

The one-dimensional consolidation test provides data for estimating settlement as soils are subjected to vertical loads. Hart Crowser performed one-dimensional consolidation tests on remixed samples of Composite II, Composite II with Polymer Additive, and Composite III. Each sample was collected from the bottom of the settling column immediately after completion of the CST. A one-dimensional consolidation test was also conducted on a Composite I sample to determine settlement characteristics of the sediment underlying the proposed engineered containment facility (ECF). The tests were performed in general accordance with ASTM D 2435. Porous stones were placed on the top and bottom of the sample to allow drainage. Vertical loads were then applied incrementally to the sample in such a way that the sample was allowed to consolidate under each load increment. Measurements were made of the compression of the sample (with time) under each load increment. Rebound was measured during the unloading phase. In general, each load was left in place until completion of 100% primary consolidation, as computed using Taylor's square root of time method. The next load increment was applied soon after attaining 100% primary consolidation. The test results plotted in terms of axial strain versus applied load (stress) are presented on Figures F-26 through F-29.

CONSOLIDATION TEST RESULTS



Sample No.		W.C. % Before	W.C. % After	Atterberg Limit LL	Atterberg Limit PL	Atterberg Limit PI	Wet Wt (pcf)	USC	Description
Composite I		69%	34%	47	33	14	97 pcf	ML	SILT

Remarks: As received moisture

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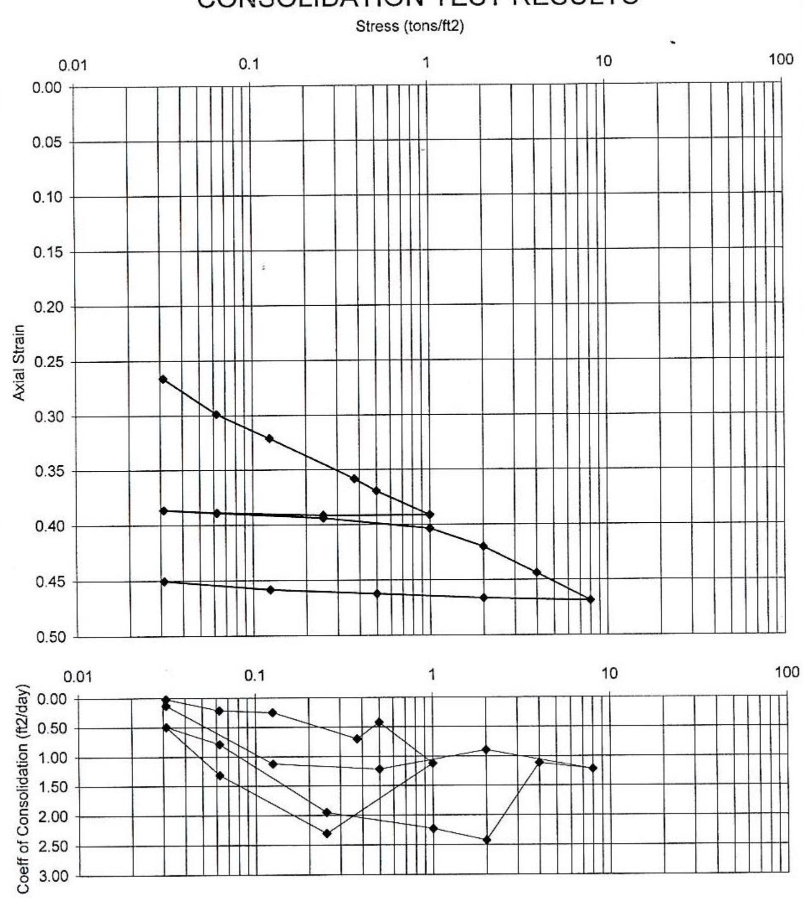
Figure No. F-26

CONSOLIDATION TEST RESULTS

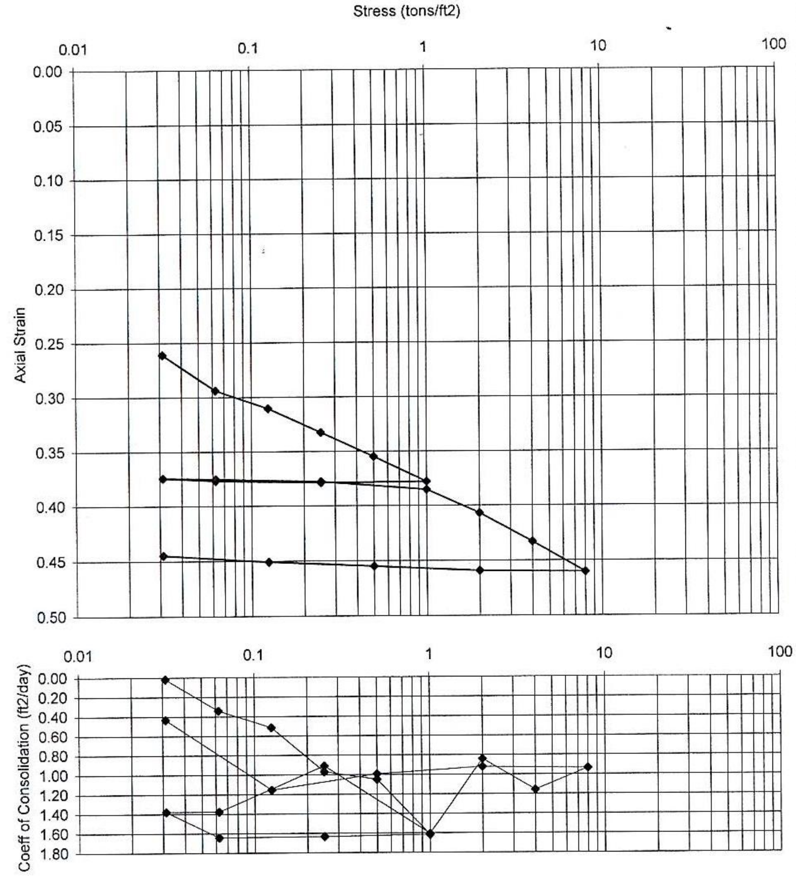


Sample No.		W.C. % Before	W.C. % After	Atterberg Limit LL	Atterberg Limit PL	Atterberg Limit PI	Wet Wt (pcf)	USC	Description
Composite II		78%	29%	33	27	6	99 pcf	ML	SILT

Remarks: Slurry from column settling test

HARTCROWSER 17099-06 1/10/2005
Figure No. F-27

CONSOLIDATION TEST RESULTS

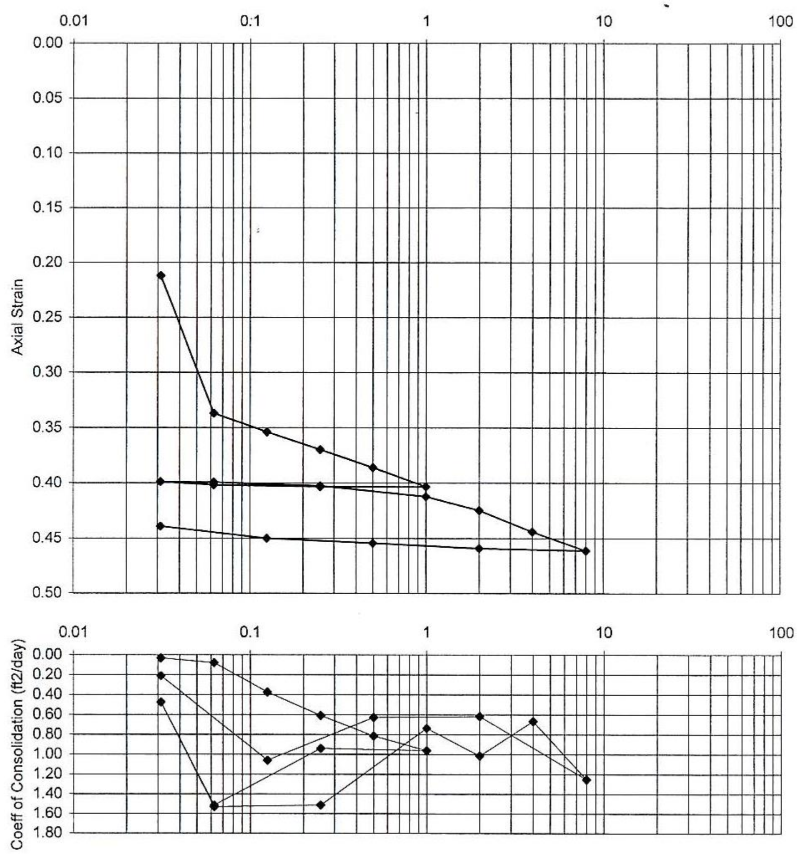


Sample No.	W.C. %		Atterberg Limit			Wet Wt (pcf)	USC	Description
	Before	After	LL	PL	PI			
Composite II w polymer	88%	38%	30	28	2	97 pcf	ML	SILT

Remarks: Slurry from column settling test

HARTCROWSER 17099-06 1/3/2005
Figure No. F-28

CONSOLIDATION TEST RESULTS



Sample No.		W.C. % Before	W.C. % After	Atterberg Limit LL	Atterberg Limit PL	Atterberg Limit PI	Wet Wt (pcf)	USC	Description
Composite III		76%	25%	24	21	3	98 pcf	ML	SILT

Remarks: Slurry from column settling test

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Figure No. F-29

The permeabilities of the Composite I, Composite II, Composite II with Polymer Additive, and Composite III samples were determined by Hart Crowser using falling-head, constant tail-water permeability tests in general accordance with ASTM D 5856. The falling-head, constant tail-water permeability test involves measuring the volume of inflow and outflow through a soil sample with time under a gradient imposed by the difference in elevation of the head and tail-waters.

Samples from Composite II, Composite II with Polymer Additive, and Composite III were collected from the bottom of the settling columns and remixed immediately following completion of the CST. Each sample was placed in a 10-centimetre (4-inch)-diameter rigid wall permeameter, and subjected to a range of one-dimensional consolidation pressures to determine the change in permeability with applied load (stress). Permeability tests were also performed on Composite I to determine the permeability characteristics of the sediments underlying the proposed ECF. The results of the test are presented on Figures F-30 through F-33, plotting permeability versus void ratio and applied pressure.

Permeability Relationships - Composite I

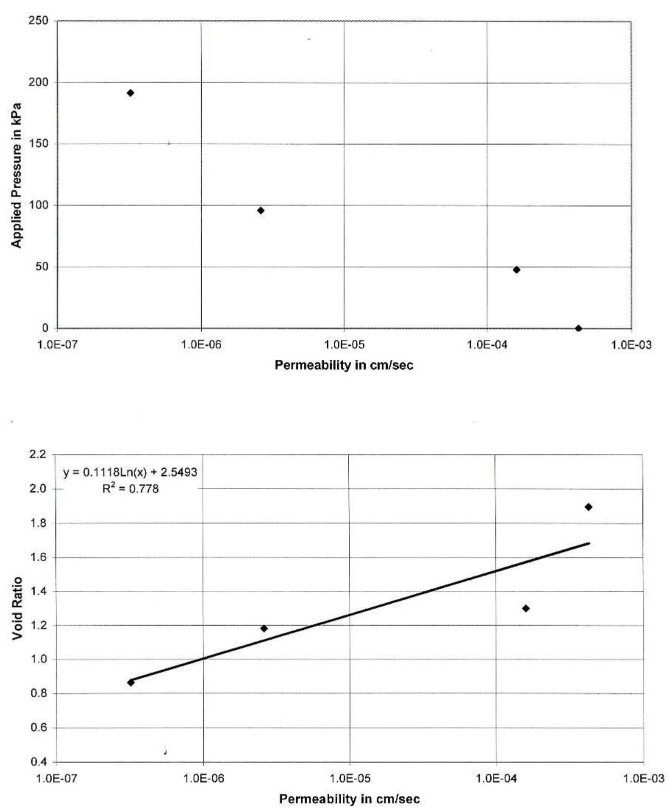

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Figure F-30

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Permeability Relationships - Composite II

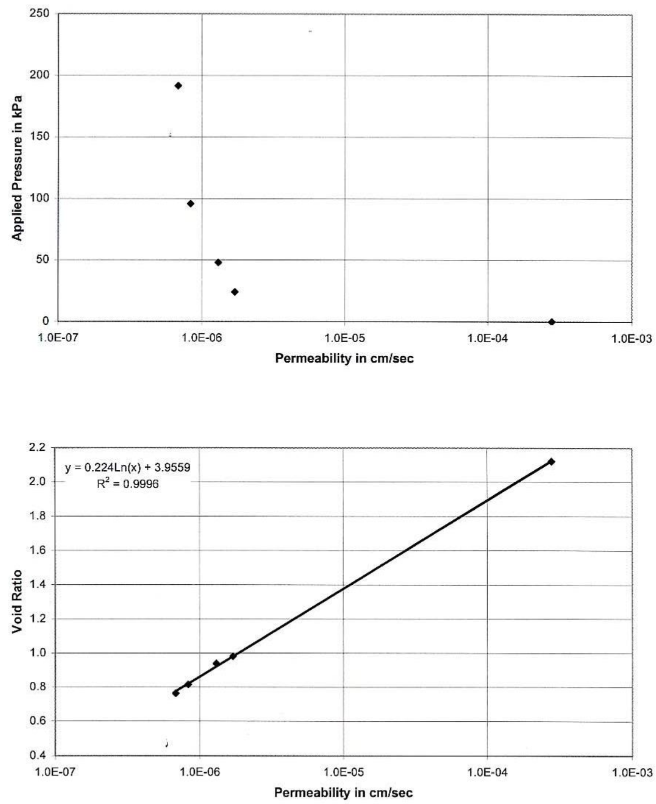

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Figure F-31

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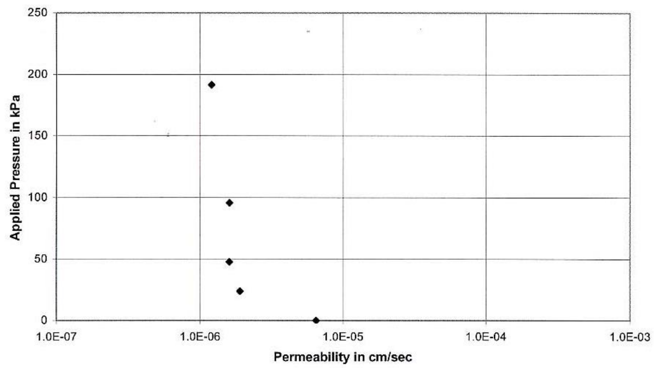
Permeability Relationships - Composite II with Polymer Additive



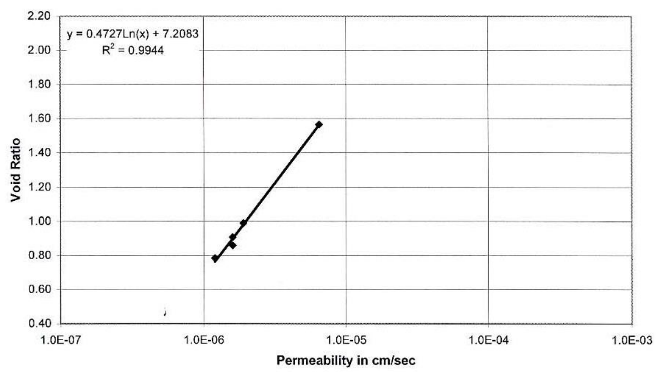


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Figure F-32

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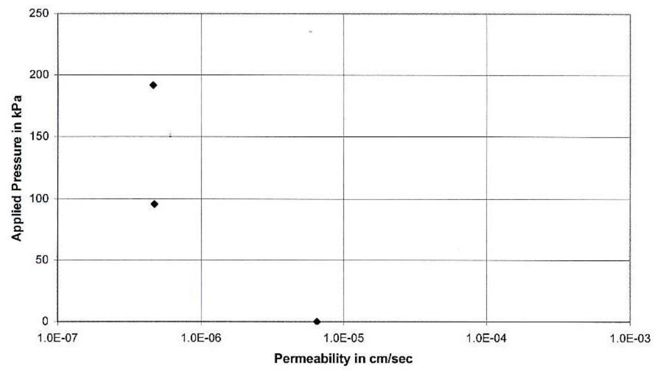
Permeability Relationships - Composite III



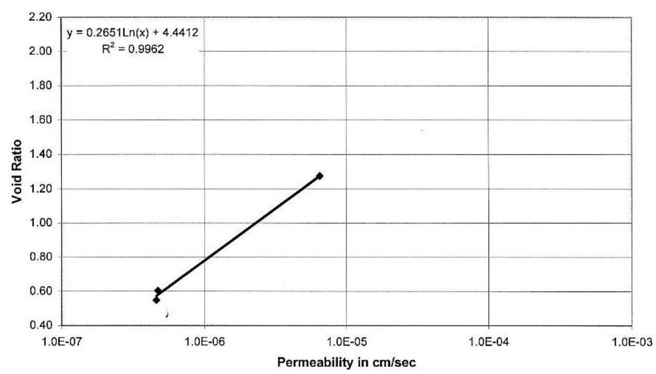


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Figure F-33

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Part B Sediment Treatability

The information presented in Appendix B provides background on the testing for removal of contaminants from expected dredge slurry samples as defined through the treatability testing programs of the Design process.

B.1
Column Settling Tests

A brief discussion of the column settling tests is presented in Appendix H and Appendix F of the Basis of Design Report, with relevant excerpts, tables and figures presented below.

H.3 Column Settling Tests

H.3.1 Method

The procedures used for the column settling tests (CST) were in general accordance with the USACE Waterways Experiment Station (WES)-recommended procedures (Palermo and Thackston, 1988). A schematic of the column is shown on Figure H-1, and photographs H-4 through H-6 illustrate the test setup and the columns during settling. The test was conducted using the following specific procedures:

- The initial slurry concentration was 150 gm/L.
- The columns were vigorously aerated to keep the TSS suspended until the column was completely filled.
- Samples for TSS and turbidity were collected at 0, 1, 2, 4, 8, 12, 24, 48, 72, and 96 hours.
- The polymer was added to Composite II one hour after aeration was stopped. The polymer was poured in from the top and mixed with an air stone placed just above the sediment interface.
- Once the sediment interface was established, samples were collected only from ports above the interface.

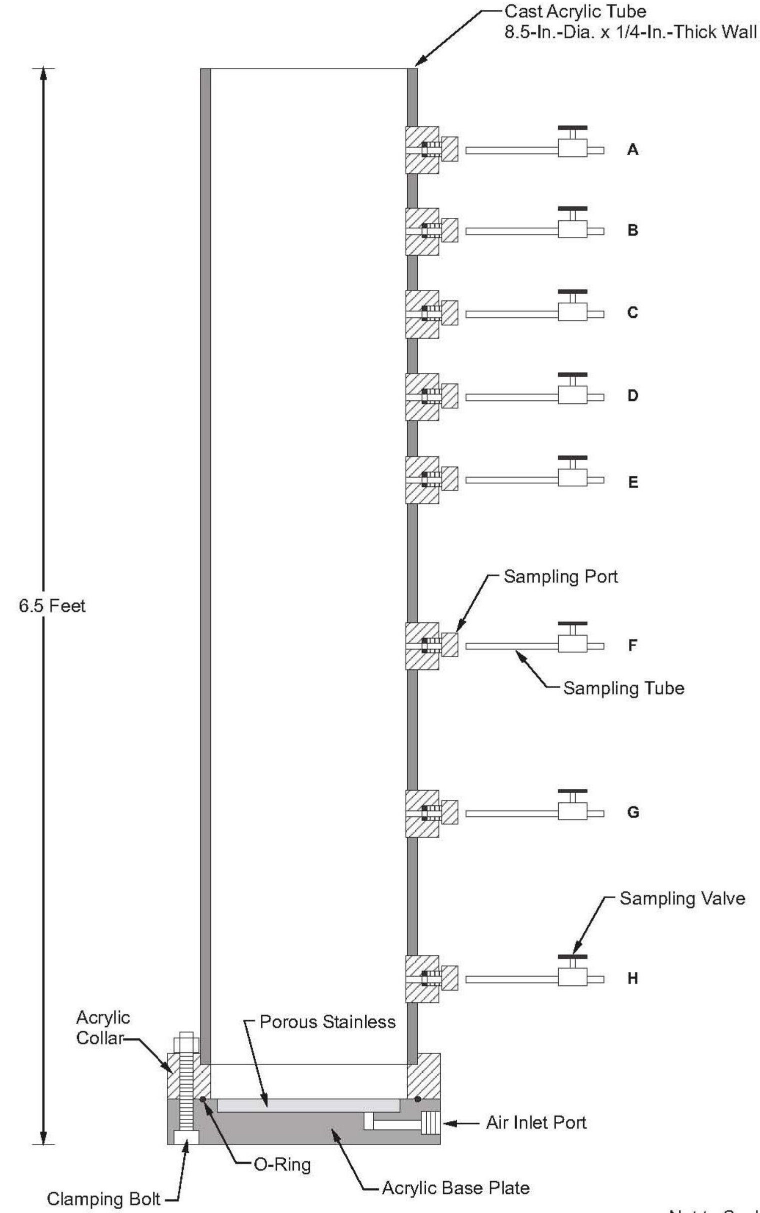
H.3.2 Results

Turbidity and TSS data are presented in Tables H-6 (Composite II), H-7 (Composite II with polymer), and H-8 (Composite III). Settling curves and TSS versus turbidity are presented on Figures H-2 through H-7. Settling curves were obtained by the following method:

- Depth of sample was plotted versus the percent of initial flocculant zone TSS for each sampling interval. The initial flocculant zone TSS is the TSS value measured at the top port during the time interval when a sediment zone first forms.
- Best-fit lines were hand-drawn to determine the percent of initial flocculant zone TSS at 0.15-metre (0.5-foot) depth intervals, and the TSS was calculated at each depth based on these percentages.
- TSS was plotted against retention time in hours for each depth to obtain the settling curves discussed below.

The curves indicate that Composite II sediment with polymer settles slightly faster than does Composite II alone. The use of the polymer, including type and amount, may need to be refined to produce more noticeable results. The Composite III sediment appears to have a great deal of stratification in the first 10 hours of settling and appears to settle faster and more completely than do Composite II and Composite II with polymer. *(Note - Photographs H-4 through H-6 are not included in this appendix. Additional discussion in the Basis of Design Addendumin support of Figure 3-1 identifies the Polymer as Krysalis CF2406D.)*

Column Settling Test (CST) Apparatus Diagram



Not to Scale

After Trautwein Soil Testing Equipment

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Figure H-1

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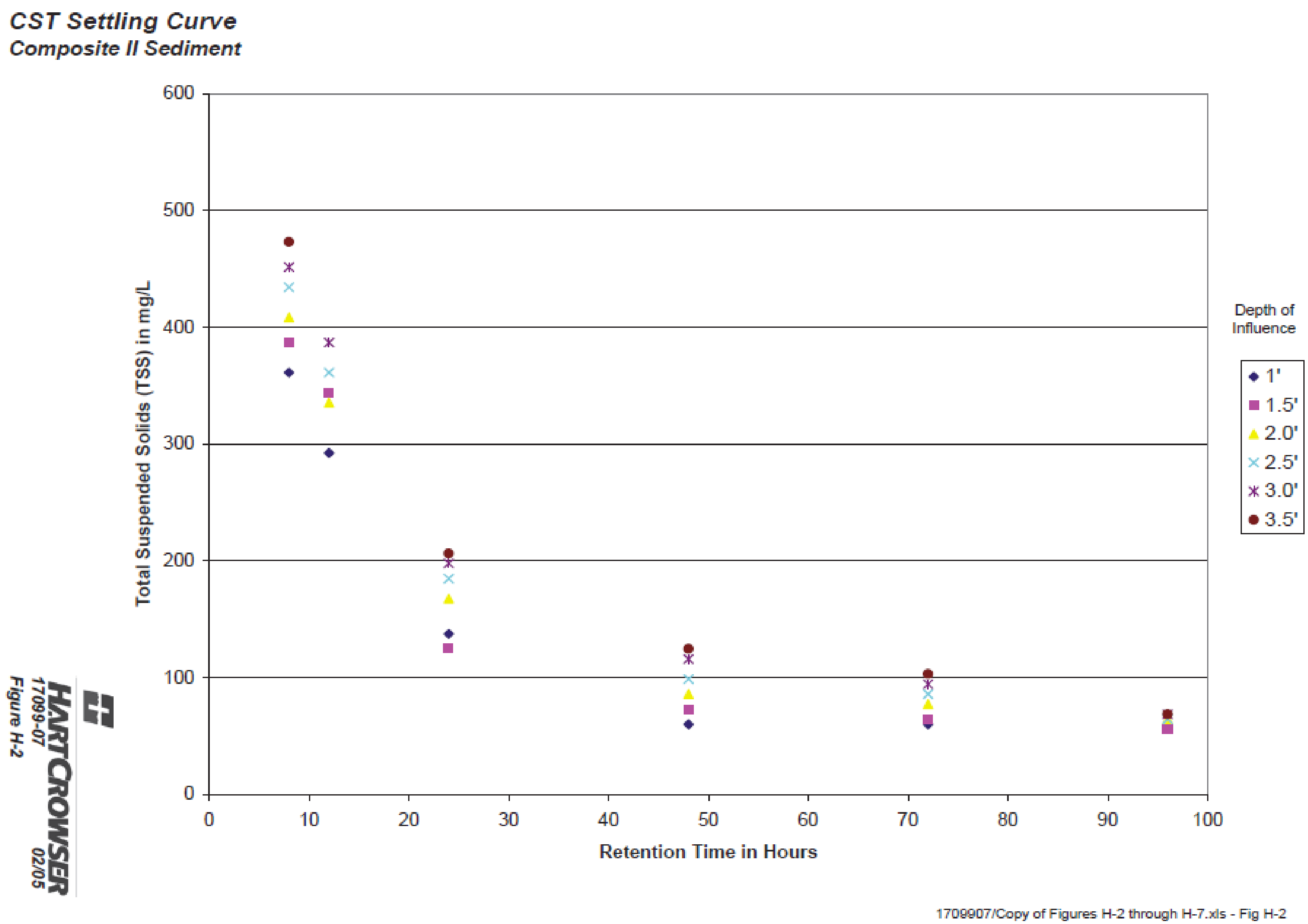
CST Settling Curve
Composite II Sediment
Total Suspended Solids (TSS) in mg/L
Retention Time in Hours
0
100
200
300
400
500
600
0
10
20
30
40
50
60
70
80
90
100
Depth of Influence
1'
1.5'
2.0'
2.5'
3.0'
3.5'
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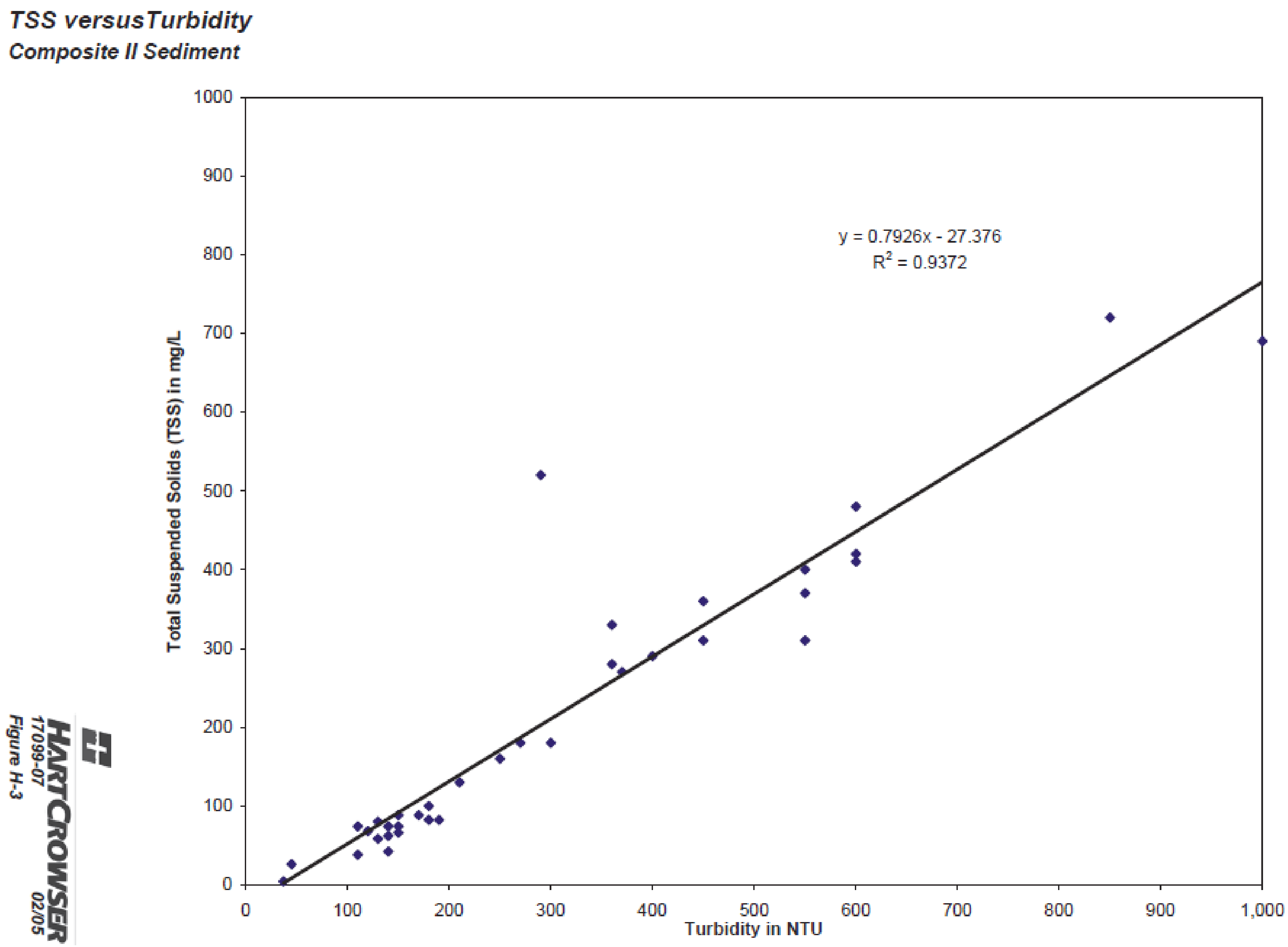
Figure H-2
1709907/Copy of Figures H-2 through H-7.xls - Fig H-2



1709907/Copy of Figures H-2 through H-7.xls - Fig H-3

CST Settling Curve

Composite II Sediment With Polymer

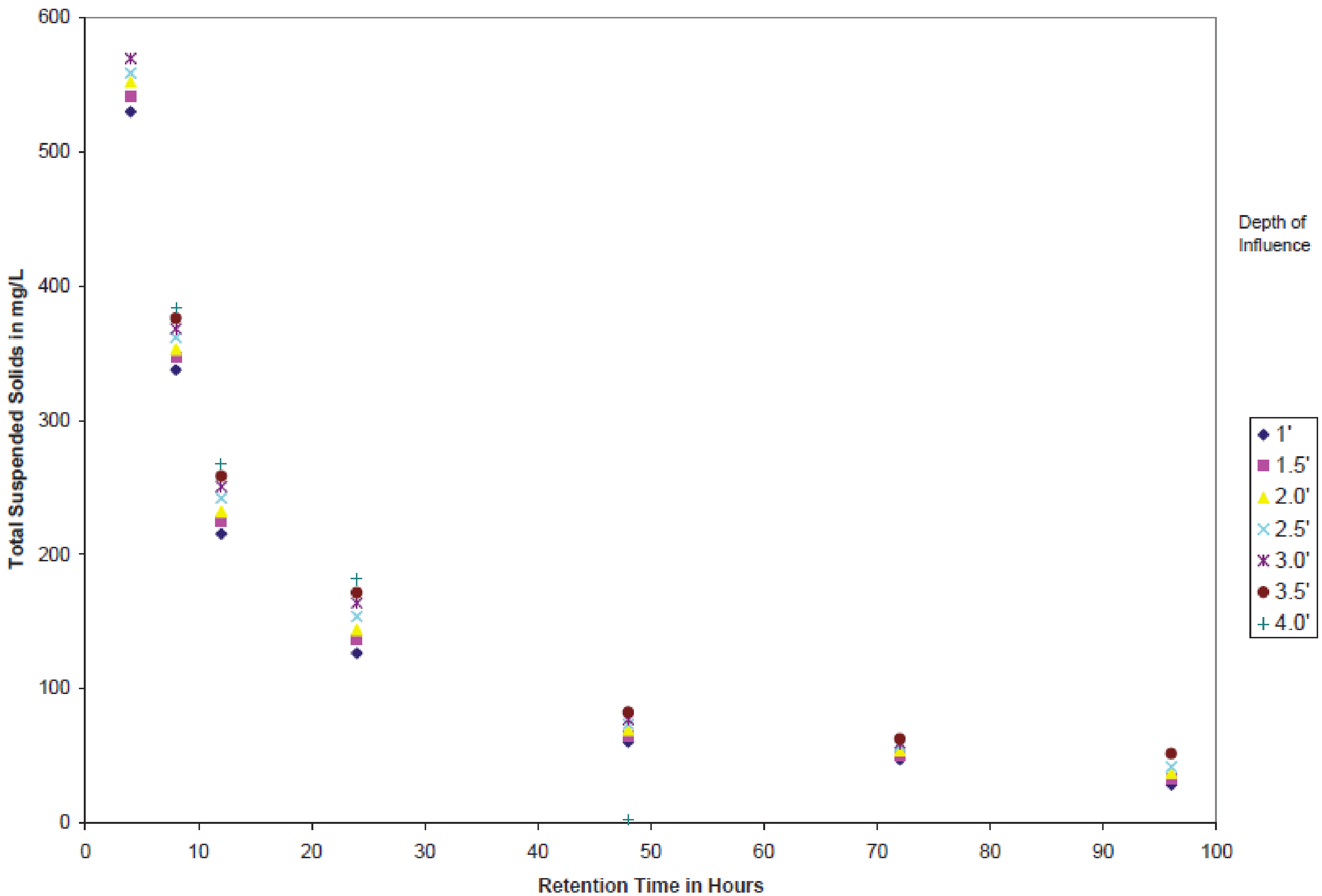


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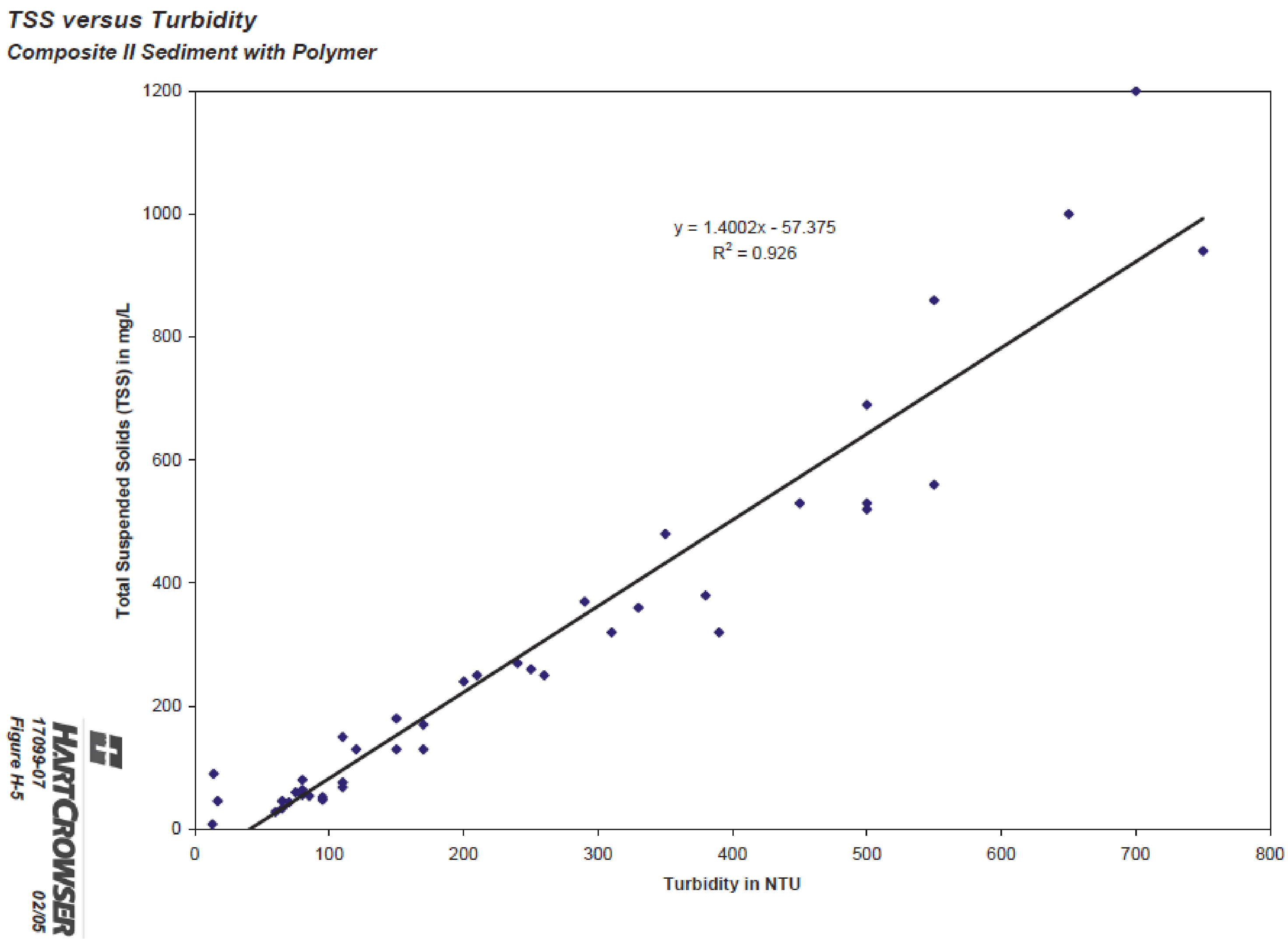
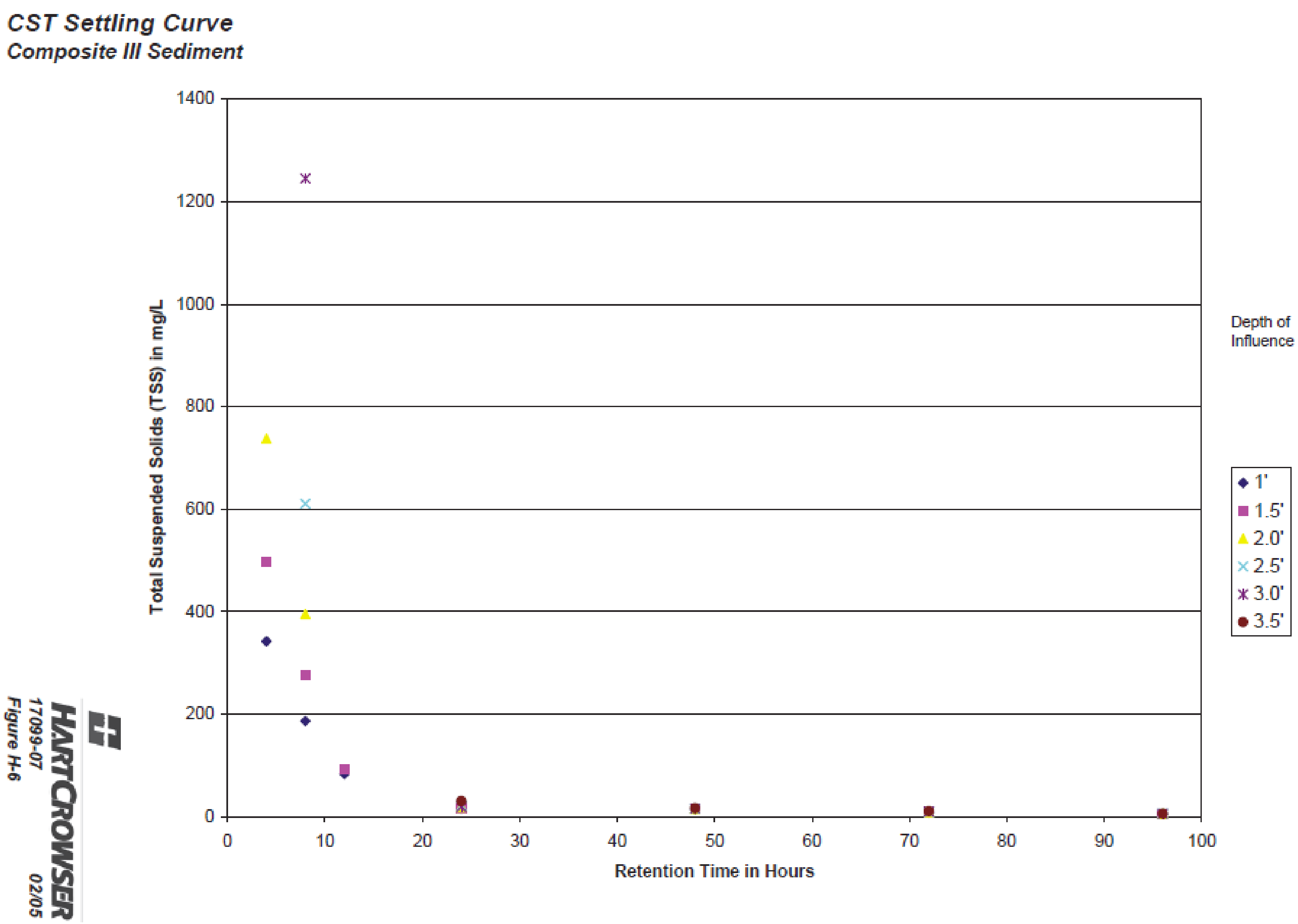
Figure H-4

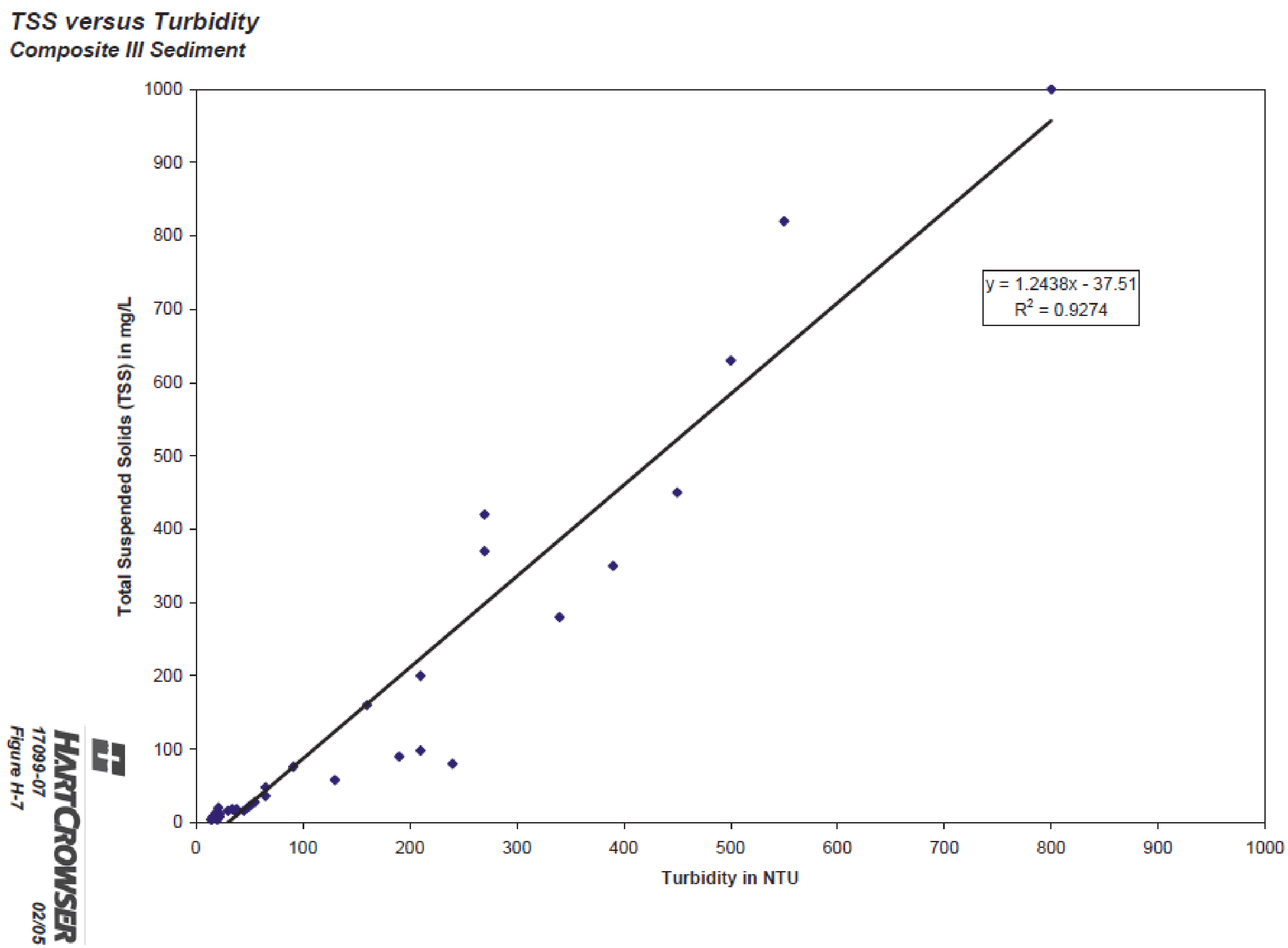
1709907/Copy of Figures H-2 through H-7.xls - Fig H-4



1709907/Copy of Figures H-2 through H-7.xls - Fig H-5



1709907/Copy of Figures H-2 through H-7.xls - Fig H-6



1709907/Copy of Figures H-2 through H-7.xls - Fig H-7

TABLE H-6
ANALYTICAL RESULTS FOR CST COMPOSITE II

Lab ID	Sample ID		Sampling Date	TSS in mg/L	Turbidity in NTU
Time: 0 Hours					
091690 04	CST	COMPII-A-00	12/20/2004	71,000	17,500
091691 04	CST	COMPII-B-00	12/20/2004	78,000	
091692 04	CST	COMPII-C-00	12/20/2004	75,000	
091693 04	CST	COMPII-D-00	12/20/2004	70,000	
091694 04	CST	COMPII-E-00	12/20/2004	71,000	
091695 04	CST	COMPII-F-00	12/20/2004	78,000	
091696 04	CST	COMPII-G-00	12/20/2004	86,000	
091697 04	CST	COMPII-H-00	12/20/2004	77,000	22,500
Time: 1 Hour					
091714 04	CST	COMPII-A-01	12/20/2004	2,400	2,400
091715 04	CST	COMPII-B-01	12/20/2004	12,000	4,000
091716 04	CST	COMPII-C-01	12/20/2004	12,000	4,250
091717 04	CST	COMPII-D-01	12/20/2004	6,500	3,250
091718 04	CST	COMPII-E-01	12/20/2004	40,000	22,500
091719 04	CST	COMPII-F-01	12/20/2004	50,000	25,000
091720 04	CST	COMPII-G-01	12/20/2004	57,000	32,500
091721 04	CST	COMPII-H-01	12/20/2004	91,000	33,000
Time: 2 Hours					
091730 04	CST	COMPII-B-02	12/20/2004	4,300	2,000
091731 04	CST	COMPII-C-02	12/20/2004	1,900	2,100
091732 04	CST	COMPII-D-02	12/20/2004	5,500	2,600
091733 04	CST	COMPII-E-02	12/20/2004	4,600	3,300
Time: 4 Hours					
091743 04	CST	COMPII-B-03	12/20/2004	720	850
091744 04	CST	COMPII-C-03	12/20/2004	690	1,000
091745 04	CST	COMPII-D-03	12/20/2004	940	1,300
091746 04	CST	COMPII-E-03	12/20/2004	930	1,300
091747 04	CST	COMPII-F-03	12/20/2004	1,100	1,200
Time: 8 Hours					
091758 04	CST	COMPII-B-04	12/20/2004	310	550
091759 04	CST	COMPII-C-04	12/20/2004	400	550
091760 04	CST	COMPII-D-04	12/20/2004	370	550
091761 04	CST	COMPII-E-04	12/20/2004	420	600
091762 04	CST	COMPII-F-04	12/20/2004	410	600
091763 04	CST	COMPII-G-04	12/20/2004	480	600
Time: 12 Hours					
091775 04	CST	COMPII-B-05	12/20/2004	280	360
091776 04	CST	COMPII-C-05	12/20/2004	270	370
091777 04	CST	COMPII-D-05	12/20/2004	310	450
091778 04	CST	COMPII-E-05	12/20/2004	360	450
091779 04	CST	COMPII-F-05	12/20/2004	330	360
091780 04	CST	COMPII-G-05	12/20/2004	290	400
Time: 24 Hours					
091814 04	CST	COMPII-B-06	12/21/2004	74	110
091815 04	CST	COMPII-C-06	12/21/2004	160	250
091816 04	CST	COMPII-D-06	12/21/2004	130	210
091817 04	CST	COMPII-E-06	12/21/2004	180	270
091818 04	CST	COMPII-F-06	12/21/2004	520	290
091819 04	CST	COMPII-G-06	12/21/2004	180	300

TABLE H-6
ANALYTICAL RESULTS FOR CST COMPOSITE II

Lab ID	Sample ID		Sampling Date	TSS in mg/L	Turbidity in NTU
Time: 48 Hours					
091838 04	CST	COMPIIB-07	12/22/2004	26	110
091839 04	CST	COMPIIC-07	12/22/2004	88	250
091840 04	CST	COMPIID-07	12/22/2004	66	210
091841 04	CST	COMPIIE-07	12/22/2004	82	270
091842 04	CST	COMPIIF-07	12/22/2004	100	290
091843 04	CST	COMPIIG-07	12/22/2004	82	300
Time: 72 Hours					
092297 04	CST	COMPII-C-08	12/23/2004	38	110
092298 04	CST	COMPII-D-08	12/23/2004	74	150
092299 04	CST	COMPII-E-08	12/23/2004	80	130
092300 04	CST	COMPII-F-08	12/23/2004	68	120
092301 04	CST	COMPII-G-08	12/23/2004	88	150
Time: 96 Hours					
092307 04	CST	COMPII-C-09	12/24/2004	4	37
092308 04	CST	COMPII-D-09	12/24/2004	58	130
092309 04	CST	COMPII-E-09	12/24/2004	74	140
092310 04	CST	COMPII-F-09	12/24/2004	62	140
092311 04	CST	COMPII-G-09	12/24/2004	42	140

Notes:
Turbidity was measured in-house.
CST = column settling test
mg/L = milligrams per litre
NTU = Nephelometer turbidity units
TSS = total suspended solids

TABLE H-7
ANALYTICAL RESULTS FOR CST COMPOSITE II WITH POLYMER

Lab ID	Sample ID		Sampling Date	TSS in mg/L	Turbidity in NTU
Time: -1 Hour					
091698 04	CST	COMPIIF-A-00	12/20/2004	100,000	9,500
091699 04	CST	COMPIIF-B-00	12/20/2004	93,000	
091700 04	CST	COMPIIF-C-00	12/20/2004	88,000	
091701 04	CST	COMPIIF-D-00	12/20/2004	100,000	
091702 04	CST	COMPIIF-E-00	12/20/2004	61,000	
091703 04	CST	COMPIIF-F-00	12/20/2004	78,000	
091704 04	CST	COMPIIF-G-00	12/20/2004	68,000	
091705 04	CST	COMPIIF-H-00	12/20/2004	110,000	22,500
Time: 0 Hour, Flocculant Added					
091722 04	CST	COMPIIF-B-01	12/20/2004	29,000	16,500
091723 04	CST	COMPIIF-C-01	12/20/2004	31,000	19,000
091724 04	CST	COMPIIF-D-01	12/20/2004	31,000	20,000
091725 04	CST	COMPIIF-E-01	12/20/2004	28,000	19,000
091726 04	CST	COMPIIF-F-01	12/20/2004	36,000	18,000
091727 04	CST	COMPIIF-G-01	12/20/2004	65,000	40,000
Time: 1 Hour					
091734 04	CST	COMPIIF-A-02	12/20/2004	1,100	700
091735 04	CST	COMPIIF-B-02	12/20/2004	2,800	1,300
091736 04	CST	COMPIIF-C-02	12/20/2004	940	6,500
091737 04	CST	COMPIIF-D-02	12/20/2004	860	7,000
091738 04	CST	COMPIIF-E-02	12/20/2004	1,200	5,500
091739 04	CST	COMPIIF-F-02	12/20/2004	1,000	6,500
Time: 2 Hours					
091748 04	CST	COMPIIF-B-03	12/20/2004	530	700
091749 04	CST	COMPIIF-C-03	12/20/2004	690	750
091750 04	CST	COMPIIF-D-03	12/20/2004	520	550
091751 04	CST	COMPIIF-E-03	12/20/2004	560	700
091752 04	CST	COMPIIF-F-03	12/20/2004	530	650
Time: 4 Hours					
091764 04	CST	COMPIIF-B-04	12/20/2004		450
091765 04	CST	COMPIIF-C-04	12/20/2004	320	500
091766 04	CST	COMPIIF-D-04	12/20/2004	360	500
091767 04	CST	COMPIIF-E-04	12/20/2004	480	550
091768 04	CST	COMPIIF-F-04	12/20/2004	320	500
091769 04	CST	COMPIIF-G-04	12/20/2004	370	450
Time: 8 Hours					
091781 04	CST	COMPIIF-B-05	12/20/2004	380	310
091782 04	CST	COMPIIF-C-05	12/20/2004	180	330
091783 04	CST	COMPIIF-D-05	12/20/2004	250	350
091784 04	CST	COMPIIF-E-05	12/20/2004	270	390
091785 04	CST	COMPIIF-F-05	12/20/2004	240	290
091786 04	CST	COMPIIF-G-05	12/20/2004	260	380
Time: 12 Hours					
091820 04	CST	COMPIIF-B-06	12/20/2004	90	150
091821 04	CST	COMPIIF-C-06	12/20/2004	130	210
091822 04	CST	COMPIIF-D-06	12/20/2004	150	240
091823 04	CST	COMPIIF-E-06	12/20/2004	130	200
091824 04	CST	COMPIIF-F-06	12/20/2004	130	250
091825 04	CST	COMPIIF-G-06	12/20/2004	170	260

TABLE H-7
ANALYTICAL RESULTS FOR CST COMPOSITE II WITH POLYMER

Lab ID	Sample ID		Sampling Date	TSS in mg/L	Turbidity in NTU
Time: 24 Hours					
091832 04	CST	COMPIIF-B-07	12/21/2004	2 U	14
091833 04	CST	COMPIIF-C-07	12/21/2004	80	120
091834 04	CST	COMPIIF-D-07	12/21/2004	56	110
091835 04	CST	COMPIIF-E-07	12/21/2004	64	150
091836 04	CST	COMPIIF-F-07	12/21/2004	68	170
091837 04	CST	COMPIIF-G-07	12/21/2004	76	170
Time: 48 Hours					
091850 04	CST	COMPIIF-C-08	12/22/2004	46	80
091851 04	CST	COMPIIF-D-08	12/22/2004	46	80
091852 04	CST	COMPIIF-E-08	12/22/2004	44	80
091853 04	CST	COMPIIF-F-08	12/22/2004	54	110
091854 04	CST	COMPIIF-G-08	12/22/2004	60	110
Time: 72 Hours					
092312 04	CST	COMPIIF-C-09	12/23/2004	8	17
092313 04	CST	COMPIIF-D-09	12/23/2004	28	65
092314 04	CST	COMPIIF-E-09	12/23/2004	34	70
092315 04	CST	COMPIIF-F-09	12/23/2004	52	85
092316 04	CST	COMPIIF-G-09	12/23/2004	48	75
Time: 96 Hours					
092317 04	CST	COMPIIF-C-10	12/24/2004	4	13
092318 04	CST	COMPIIF-D-10	12/24/2004	31	60
092319 04	CST	COMPIIF-E-10	12/24/2004	29	65
092320 04	CST	COMPIIF-F-10	12/24/2004	30	95
092321 04	CST	COMPIIF-G-10	12/24/2004	34	95

Notes:
Turbidity was measured in-house.
CST = column settling test
mg/L = milligrams per litre
NTU = Nephelometer turbidity units
TSS = total suspended solids
U = Not detected at detection limit indicated

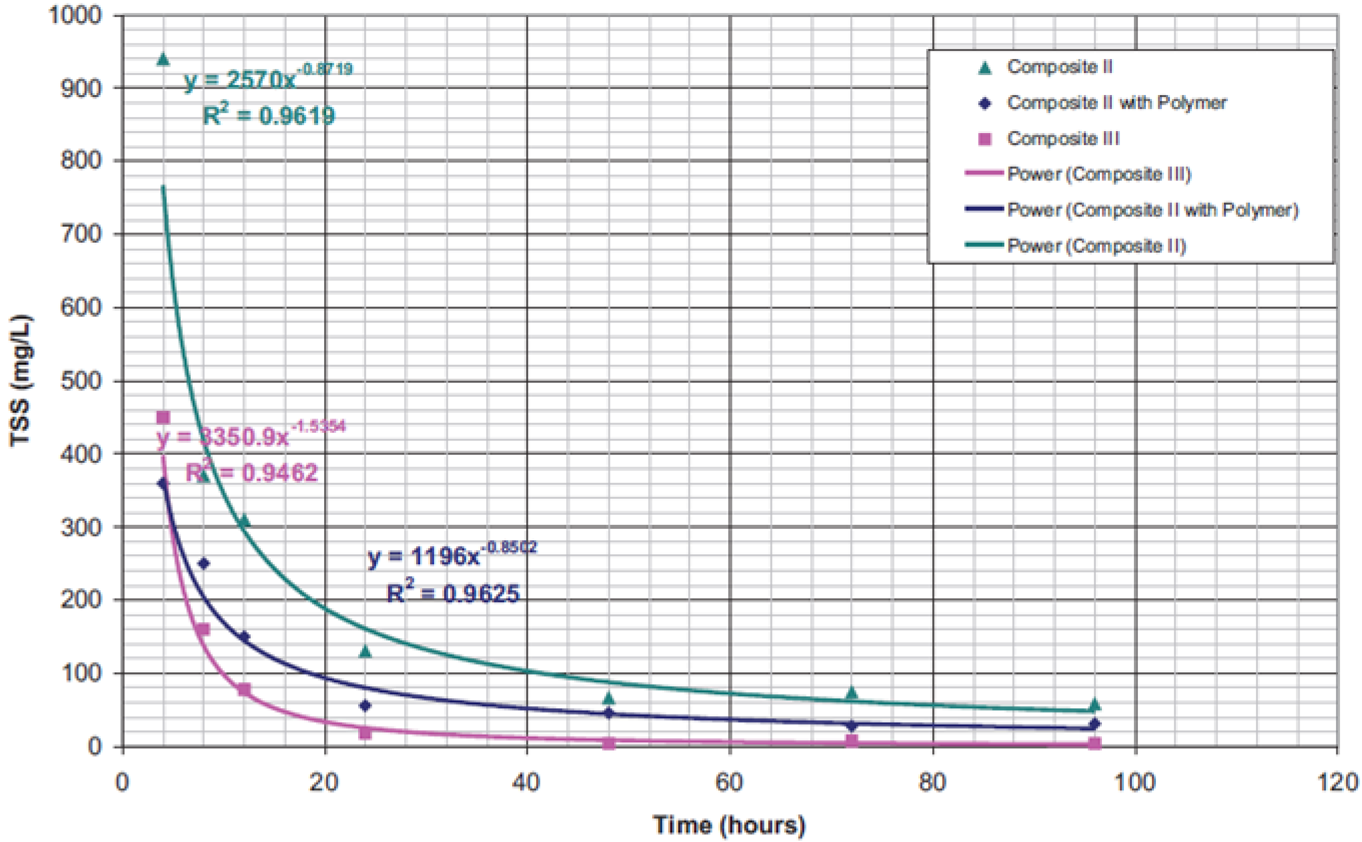
TABLE H-8
ANALYTICAL RESULTS FOR CST COMPOSITE III

Lab ID	Sample ID		Sampling Date	TSS in mg/L	Turbidity in NTU
Time: 0 Hours					
091706 04	CST	COMPIII-A-00	12/20/2004	100,000	32,500
091707 04	CST	COMPIII-B-00	12/20/2004	91,000	
091708 04	CST	COMPIII-C-00	12/20/2004	86,000	
091709 04	CST	COMPIII-D-00	12/20/2004	97,000	
091710 04	CST	COMPIII-E-00	12/20/2004	94,000	
091711 04	CST	COMPIII-F-00	12/20/2004	81,000	
091712 04	CST	COMPIII-G-00	12/20/2004	110,000	
091713 04	CST	COMPIII-H-00	12/20/2004	89,000	30,000
Time: 1 Hour					
091728 04	CST	COMPIII-A-01	12/20/2004	710	700
091729 04	CST	COMPIII-B-01	12/20/2004	4,000	2,000
Time: 2 Hours					
091740 04	CST	COMPIII-A-02	12/20/2004	370	270
091741 04	CST	COMPIII-B-02	12/20/2004	630	500
091742 04	CST	COMPIII-C-02	12/20/2004	1,000	800
Time: 4 Hours					
091753 04	CST	COMPIII-A-03	12/20/2004	90	190
091754 04	CST	COMPIII-B-03	12/20/2004	280	340
091755 04	CST	COMPIII-C-03	12/20/2004	350	390
091756 04	CST	COMPIII-D-03	12/20/2004	450	450
091757 04	CST	COMPIII-E-03	12/20/2004	820	550
Time: 8 Hours					
091770 04	CST	COMPIII-B-04	12/20/2004	80	240
091771 04	CST	COMPIII-C-04	12/20/2004	200	210
091772 04	CST	COMPIII-D-04	12/20/2004	160	160
091773 04	CST	COMPIII-E-04	12/20/2004	420	270
091774 04	CST	COMPIII-F-04	12/20/2004	1,200	350
Time: 12 Hours					
091808 04	CST	COMPIII-B-05	12/20/2004	58	130
091809 04	CST	COMPIII-C-05	12/20/2004	98	210
091810 04	CST	COMPIII-D-05	12/20/2004	76	91
091811 04	CST	COMPIII-E-05	12/20/2004	1,900	130
091812 04	CST	COMPIII-F-05	12/20/2004	2,400	240
091813 04	CST	COMPIII-G-05	12/20/2004	7,100	2,000
Time: 24 Hours					
091826 04	CST	COMPIII-B-06	12/21/2004	16	30
091827 04	CST	COMPIII-C-06	12/21/2004	48	65
091828 04	CST	COMPIII-D-06	12/21/2004	18	34
091829 04	CST	COMPIII-E-06	12/21/2004	16	45
091830 04	CST	COMPIII-F-06	12/21/2004	22	50
091831 04	CST	COMPIII-G-06	12/21/2004	36	65

TABLE H-8
ANALYTICAL RESULTS FOR CST COMPOSITE III

Lab ID	Sample ID		Sampling Date	TSS in mg/L	Turbidity in NTU
Time: 48 Hours					
091844 04	CST	COMPIII-B-07	12/22/2004	12	18
091845 04	CST	COMPIII-C-07	12/22/2004	28	55
091846 04	CST	COMPIII-D-07	12/22/2004	4	20
091847 04	CST	COMPIII-E-07	12/22/2004	12	22
091848 04	CST	COMPIII-F-07	12/22/2004	18	38
091849 04	CST	COMPIII-G-07	12/22/2004	14	38
Time: 72 Hours					
092292 04	CST	COMPIII-C-08	12/23/2004	20	21
092293 04	CST	COMPIII-D-08	12/23/2004	8	16
092294 04	CST	COMPIII-E-08	12/23/2004	6	20
092295 04	CST	COMPIII-F-08	12/23/2004	12	22
092296 04	CST	COMPIII-G-08	12/23/2004	8	22
Time: 96 Hours					
092302 04	CST	COMPIII-C-09	12/24/2004	8	17
092303 04	CST	COMPIII-D-09	12/24/2004	4	14
092304 04	CST	COMPIII-E-09	12/24/2004	6	16
092305 04	CST	COMPIII-F-09	12/24/2004	4	15
092306 04	CST	COMPIII-G-09	12/24/2004	5	19

Notes:
Turbidity was measured in-house.
CST = column settling test
mg/L = milligrams per litre
NTU = Nephelometer turbidity units
TSS = total suspended solids



Note: CST results shown are at the 0.6 metre (2 foot) depth

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SEDIMENT MANAGEMENT MEMO

CST POWER CURVES

ARCADIS BBL

FIGURE
3-1

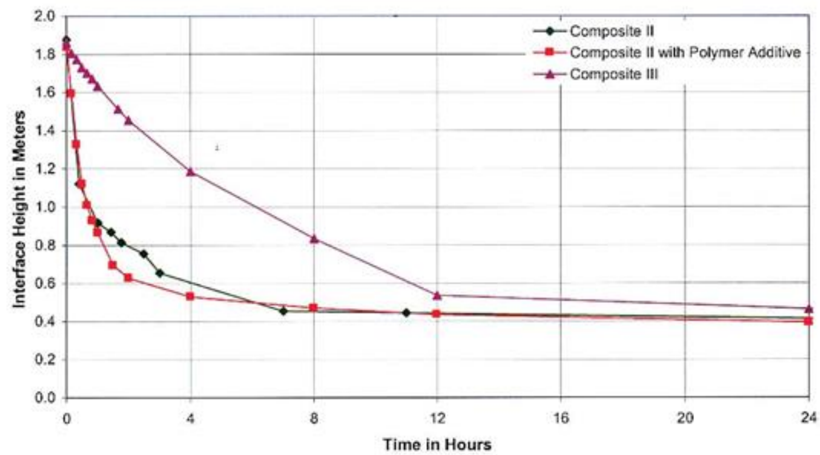
F.6 Column Settling Test

The column settling test (CST) is conducted in a water column to simulate and evaluate gravity settling behavior of dredged sediments in a large-scale, continuous flow, dredged material containment area. The test provides quantitative data on the settling characteristics of the sediment that are used to model the settlement and consolidation behavior of the dredged sediments.

Hart Crowser conducted three CSTs following the procedures outlined in Appendix H, Section H.3.1. Results from the CSTs are presented on Figure F-25 (CST Results).

CST Results

Zone Settling Interface vs Time



Sediment Height vs Time

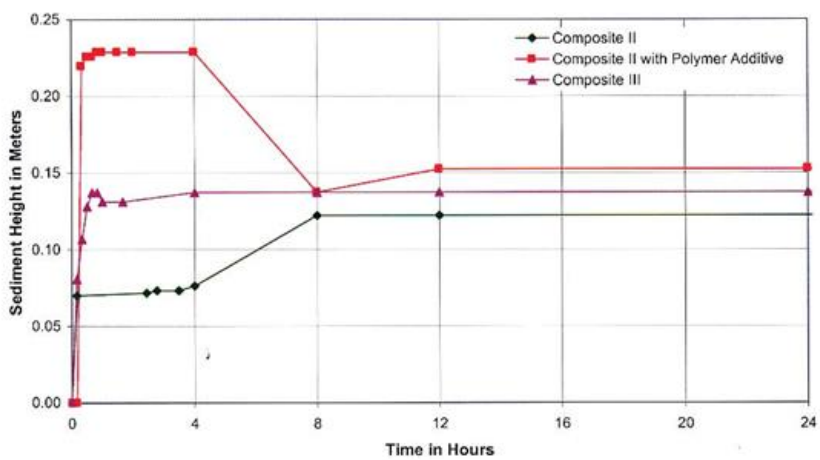


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Figure F-25

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B.2
Polymer Assisted Settling

A brief discussion of the polymer assisted settling tests is presented in Appendix H of the Basis of Design Report and in Appendix D of the Basis of Design Addendum Report , with relevant excerpts and tables presented below.

H.2 Flocculation Jar Tests

H.2.1 Method
Jar tests were performed in general accordance with the guidelines set forth in Appendix E of the U.S. Army Corps of Engineers' (USACE) Engineer Manual (USACE, 1987). Lake Ontario water and sediment (Composite II) were thoroughly mixed to form a slurry (150 gm/L) and allowed the slurry to settle for one hour, at which time the supernatant was transferred to numerous 2 litre glass cylinders. Flocculants and/or coagulants were added to the supernatant and allowed to react/settle for one hour. The performance of each polymer was evaluated based on sample clarity, turbidity, and TSS. Samples showing poor performance based on visual clarity were not sampled for turbidity or TSS analysis. A second round of jar tests was performed using those polymers that performed well in the first round, as well as polymers received after the first round of testing. A third round of testing was performed on the Ciba Chemicals polymers, because the initial tests with these polymers failed. Untreated supernatant and neat Lake Ontario water was also submitted for TSS analysis. Several of the tests are shown in Photographs H-1 through H-3. *(Note - Photographs H-1 through H-3 are not presented in this appendix.)*

H.2.2 Results
Polymers used in the jar tests were selected after researching water treatment, wastewater treatment, and sediment polymer manufacturers, as well as on the basis of performance in jar tests results conducted on Randle Reef sediments in 2003 (i.e., the best-performing polymer in those tests). The Cetco, Nalco, and Transfloc polymers were selected as potentially suitable for settling suspended sediments. to the original work plan had anticipated using Ciba's polymer Zetag 7867, which was specifically designed for sediments. However, the Ciba vendor recommended two other polymers, Krysalis CF2106D and CF2406D, which had just been introduced and theoretically would perform better than the Zetag 7867 polymer.

Krysalis CF2406D (Ciba Chemicals) was the best polymer for removing TSS based on the TSS results shown in Table H-5, water clarity after flocculant addition, and the designated uses of the polymer. Although Krysalis CF2406D performed well in bench-scale studies, further tests will be needed to determine the appropriate polymer and dosage for full-scale operation.

TABLE H-5
ANALYTICAL RESULTS FOR JAR TESTS

Polymer Used	Polymer in ppm	Finish Water Quality/ Description	Turbidity in NTU	TSS in mg/L	Sample ID	Sample Date	Lab ID
Round 1							
Dober DWT665	20	poor settling	--	--	--	--	--
Dober DWT680	20	poor settling	--	--	--	--	--
Dober DWT681	20	poor settling	--	--	--	--	--
Cetco CA101	20	poor settling	--	--	--	--	--
Cetco CA103	20	poor settling	--	--	--	--	--
Cetco CA101 /F970	20/4	poor settling	--	--	--	--	--
Cetco CA103/970	*20/4*	*good*	*65.8*	*52*	*JT-1209-01*	*12/9/04*	*089233 04*
Cetco F970C	*4*	*good*	*45.2*	*30*	*JT-1209-02*	*12/9/04*	*089234 04*
Cetco B203	20	poor settling	--	--	--	--	--
Cetco B303	20	poor settling	--	--	--	--	--
Tramfloc 873	25	good	--	--	--	--	--
Tramfloc 875	25	poor settling	--	--	--	--	--
Tramfloc 872	25	poor settling	--	--	--	--	--
Tramfloc 871	25	good	--	--	--	--	--
Tramfloc 623	*25*	*good*	*40.8*	*22*	*JT-1209-03*	*12/9/04*	*089235 04*
Tramfloc 622	*25*	*good*	*35.5*	*6*	*JT-1209-04*	*12/9/04*	*089236 04*
Tramfloc 552	25	good	--	--	--	--	--
Tramfloc 554	25	good	--	--	--	--	--
Round 2							
Cetco CA103/F970	*20/40*	*3/8" bed, cloudy, floaters, pin floc*	*72.5*	*74*	*JT-1215-01*	*12/15/04*	*090034 04*
Cetco CA103/F970	*20/20*	*1/4" bed, more cloudy*	*120*	*92*	*JT-1215-02*	*12/15/04*	*090035 04*
Cetco CA103/F970	*10/40*	*clear, pin floc, no floaters*	*45*	*46*	*JT-1215-03*	*12/15/04*	*090036 04*
Cetco F970	4	poor settling	--	--	--	--	--
Cetco F970	2	poor settling	--	--	--	--	--
Cetco F970	1	poor settling	--	--	--	--	--
Nalco 7191+	40	mounding, pin floc	40	6	JT-1215-04	12/15/04	090037 04
Nalco 7191+	20	poor settling	--	--	--	--	--
Nalco 7191+	10	poor settling	--	--	--	--	--
Tramfloc 623	10	3/8" bed, floaters, slightly cloudy	--	--	--	--	--
Tramfloc 623	*5*	*3/8" bed, slightly cloudy, pin floc*	*36.5*	*2*	*JT-1215-05*	*12/15/04*	*090038 04*
Tramfloc 622	10	1/4" bed, floater, slightly cloudy					
Tramfloc 622	*5*	*1/2" bed, lots of floaters, clear*	*33*	*6*	*JT-1215-06*	*12/15/04*	*090039 04*
Ciba CF2106D	100	error - test run incorrectly	--	--	--	--	--
Ciba CF2106D	60	error - test run incorrectly	--	--	--	--	--
Ciba CF2406D	30	error - test run incorrectly	--	--	--	--	--
Ciba CF2406D	60	error - test run incorrectly	--	--	--	--	--
Ciba CF2406D	*40*	*clear, few floaters*	*32.5*	*2*	*JT-1215-07*	*12/15/04*	*090040 04*
Round 3							
Ciba CF2106D	25	poor settling	--	--	--	--	--
Supernatant, no polymer	N/A			1600	JT-1217-01	12/17/04	091787 04
Ciba CF2406D	*25*	*good*	*23*	*2*	*JT-1217-02*	*12/17/04*	*091788 04*
Lake Ontario Water	N/A			3.3	JT-1217-04	12/17/04	091789 04

Notes:
-- Samples not collected or analyzed
Samples in italics had samples collected and submitted for TSS and turbidity analysis.
For other jar tests, samples were not collected because of poor performance of polymer
mg/L = milligrams per litre
NTU = Nephelometer turbidity units
ppm = parts per million
TSS = total suspended solids

(Supplementary information from Section 3.4, Appendix D of Basis of Design Addendum Report is provided below)

Confirmation tests were conducted in June 2007 to confirm the appropriate polymer and dosage for fullscale operation. The confirmation tests were conducted using Lake Ontario surface water and Priority 1 and 2 sediment. After the slurry was allowed to settle for 24 hours, the supernatant was collected for use in the confirmation jar tests.

Table 3-2 summarizes the confirmation polymer test results. For the confirmation test, 50 parts per million (ppm) of Krysalis Cl2471H polymer, a coagulant, was added to the 24-hour supernatant and allowed to settle for one hour. Tests were also conducted with 50 ppm of Krysalis Cl2471H and 1 ppm of Krysalis FC2406D, a flocculant. The aliquots were allowed to settle for one hour. TSS concentrations and removal efficiencies for the coagulant polymer alone ranged from 4 to 8 mg/L and 91.5 to 97.8 percent, respectively. TSS concentrations and removal efficiencies for the coagulant polymer with the flocculant polymer ranged from nondetect to 4 mg/L and 95.7 to 98.4 percent, respectively.

TABLE 3-2
POLYMER CONFIRMATION RESULTS

TASK 2.1.4 SEDIMENT MANAGEMENT
RANDLE REEF SEDIMENT REMEDIATION PROJECT
HAMILTON HARBOUR

Sample Area	EET Supernatant TSS[1] (mg/L)	Krysalis CI2471H (ppm)	Krysalis FC2406D (ppm)	Turbidity (NTU)	Polymer-Assisted Supernatant TSS[2] (mg/L)	TSS Removal Efficiency (%)
S01	181	50	1	3	<4	>97.8 %
S01	181	50	0	6	4	97.8%
S02	94	50	1	3	<4	95.7%
S02	94	50	0	3	8	91.5%
S03	257	50	1	3	4	98.4%
S03	257	50	0	4	8	96.9%

Notes:
1. Effluent elutriate test results are for supernatant samples collected after 24 hours of settling.
2. Polymer-assisted supernatant TSS results are for samples collected one hour after addition of indicated polymer doses.
Testing conducted by CIBA Chemicals
mg/L = milligrams per litre
ppm = parts per million
TSS = total suspended solids
NTU = nephelometric turbidity units

H.4 Effluent Elutriate Test

H.4.1 Method

The effluent elutriate test (EET), formerly called the modified elutriate test (MET), was performed in general accordance with the USACE WES-recommended procedure (Palermo, 1986) (Figure H-8). Photographs H-7 through H-9 illustrate the experiment. *(Note: Photographs H-7 through H-9 are not presented in this appendix.)* The test was run using the following specific procedures:

- The EET was performed to obtain water for the column media filtration test and the batch media adsorption test.
- A 150 gm/L slurry was prepared using sediment from Composite II and Lake Ontario water.
- The slurry was aerated for one hour and then allowed to settle for 24 hours.
- Krysalis CF2406D polymer was added to the supernatant and allowed to react and settle residual TSS for one hour. This water was used in the batch media adsorption test and the column media filtration tests.
- Four separate batches of water were created from the EET: one for use in the batch media adsorption test and three for use in the column media filtration tests (one per medium tested: sand, carbon, and organoclay).
- Water prepared for the carbon media test was also used in the glass fiber filtration test.
- The Krysalis CF2406D polymer at 25 milligrams per litre (mg/L) was used to reduce TSS in the supernatant from the EET prior to its use in the batch media adsorption test and the column media filtration tests.
- Samples were collected for analysis of SVOCs, total and dissolved metals, TOC, and TSS.

H.4.2 Results

Results for the EET/MET are presented on Table H-9.

Effluent Elutriate Test (EET) Apparatus Diagram

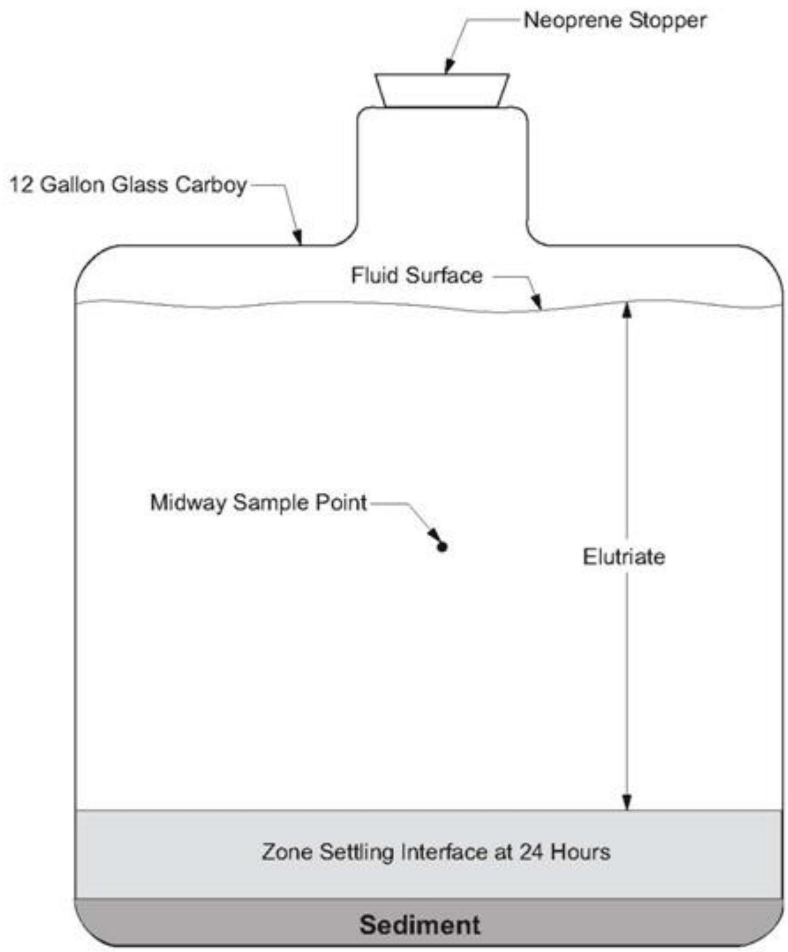

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Figure H-8

TABLE H-9
MET RESULTS COMPARED TO PWQOs

Lab ID Location Sample ID Sampling Date	Ontario Prov. Water Quality Objectives (PWQOs)	001410 05 MF C2-METS-1 (1) 1/07/2005	001412 05 MF C2-METS-2 (1) 1/07/2005	002097 05 MF C-MET1 (1) 1/11/2005	002098 05 MF C-MET2 (1) 1/11/2005	002931 05 MF CL-MET1 (1) 1/13/2005	002932 05 MF CL-MET2 (1) 1/13/2005	001414 05 BAT C1-EET1 (1) 1/05/2005
Conventionals in mg/L								
TOC (uv/persulf)		7.3	7.3	8.6	8.1	8.7	8.4	14
TSS		16	18	18	20	42	38	2
Total Metals in mg/L								
Aluminum	0.075 (filtered)	0.35	0.37	0.65	0.62	1.8	1.1	0.11
Arsenic	0.1	0.002	0.002	0.002	0.002	0.003	0.003	0.002 U
Beryllium	1.1 (hardness > 100)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.2	0.18	0.17	0.19	0.19	0.22	0.2	0.17
Cadmium	0.0002	0.00031	0.00027	0.00036	0.00043	0.00053	0.00056	0.00015
Chromium	0.0089 (Cr+3)	0.002	0.002	0.003	0.003	0.007	0.007	0.002
Cobalt	0.0009	0.0005	0.0005	0.0007	0.0007	0.0013	0.0012	0.0005
Copper	0.005	0.005	0.004	0.005	0.006	0.014	0.016	0.002
Iron	0.3	1.1	1.1	1.9	1.9	3.9	3.5	0.23
Lead	0.025 (Alk > 80)	0.021	0.022	0.029	0.029	0.047	0.046	0.011
Molybdenum	0.04	0.011	0.011	0.012	0.011	0.013	0.013	0.012
Nickel	0.025	0.004	0.004	0.004	0.004	0.006	0.006	0.004
Silver	0.0001	0.0001 U	0.0001	0.0001	0.0001	0.0002	0.0002	0.0001 U
Vanadium	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.004	0.002	0.002 U
Zinc	0.03	0.098	0.1	0.14	0.14	0.24	0.24	0.051
Dissolved Metals in mg/L								
Aluminum	0.075 (filtered)	0.018	0.014	0.019	0.013	0.02	0.04	0.01 U
Arsenic	0.1	0.002	0.002 U	0.002	0.002	0.002 U	0.002 U	0.002 U
Beryllium	1.1 (hardness > 100)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.2	0.19	0.17	0.18	0.18	0.21	0.22	0.17
Cadmium	0.0002	0.00007 U	0.00007 U	0.00016	0.00011	0.00007	0.00007	0.00009
Chromium	0.0089 (Cr+3)	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002	0.002 U
Cobalt	0.0009	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Copper	0.005	0.002 U	0.002 U	0.007	0.006	0.002 U	0.005	0.004
Iron	0.3	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.046	0.02 U
Lead	0.025 (Alk > 80)	0.0005 U	0.0005 U	0.0006	0.0005	0.0005 U	0.0005 U	0.0013
Mercury	0.0002 (filtered)	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U
Molybdenum	0.04	0.01	0.012	0.011	0.011	0.014	0.014	0.012
Nickel	0.025	0.002	0.002	0.005	0.004	0.003	0.003	0.002
Silver	0.0001	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Vanadium	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	0.03	0.006	0.005	0.042	0.025	0.016	0.088	0.02

TABLE H-9
MET RESULTS COMPARED TO PWQOs

Lab ID Location Sample ID Sampling Date	Ontario Prov. Water Quality Objectives (PWQOs)	001410 05 MF C2-METS-1 (1) 1/07/2005	001412 05 MF C2-METS-2 (1) 1/07/2005	002097 05 MF C-MET1 (1) 1/11/2005	002098 05 MF C-MET2 (1) 1/11/2005	002931 05 MF CL-MET1 (1) 1/13/2005	002932 05 MF CL-MET2 (1) 1/13/2005	001414 05 BAT C1-EET1 (1) 1/05/2005
Semivolatiles in ug/L								
1-Methylnaphthalene	2.0	11	9.8	13	14	2 U	2 U	80
2,4-Dimethylphenol		3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	34
2-Methylnaphthalene	2.0	5.7	4	8.4	11	1.9 U	1.9 U	170
2-Methylphenol		3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	33
3&4-Methylphenol		3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	60
Acenaphthene		18	17	23	24	9.3	9.4	87
Acenaphthylene		4	3.6	4.7	5	0.4 U	0.4 U	20
Anthracene	0.0008	3.1	2.8	3.9	3.7	2.4	2.1	9
Benzidine		10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	0.0004	0.7	0.9	0.9	0.9	1.1	1.1	1.2
Benzo(a)pyrene	0.015	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzo(b)fluoranthene		0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.8	0.4 U
Benzo(ghi)perylene	0.00002	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(k)fluoranthene	0.0002	0.4 U	0.4 U	0.4 U	0.6	0.4 U	0.8	0.4 U
Biphenyl		2.9	2.7	4.3	4.3	0.4 U	0.42	30
Chrysene	0.0001	0.5	0.6	0.9	0.8	1	1.1	0.7
Dibenzo(a,h)anthracene	0.002	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Dibenzofuran		9.3	8.8	12	13	5 U	5 U	78
Dimethylnaphthalenes		8.5	8.2	8.9	9.2	6.7	6.8	18
Fluoranthene	0.0008	3.9	4	4.9	4.9	5.3	5.3	12
Fluorene	0.2	13	12	20	21	12	13	67
Indeno(1,2,3-cd)pyrene		0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Naphthalene	7.0	7	3.4	21	37	1.7	3.1	8400
Perylene	0.00007	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.5
Phenanthrene	0.03	15	15	19	19	2.6	2.7	85
Phenol	5	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	24
Pyrene		2.6	2.5	3.5	3.4	3.8	3.9	7

1 Data are from the METs performed to obtain water for the media filtration tests and represent polymer-assisted ECF effluent characteristics.
Box indicates concentration is above PWQO.

BAT = batch adsorption test
C = carbon
C2 = sand
CL = clay
MF = media filtration
mg/L = milligrams per litre

TSS = total suspended solids
TOC = total organic carbon
U = Not detected at the detection limit indicated
ug/L = micrograms per litre
uv/persulf = uv with persulfite method

(Supplementary table referenced from Section 3.2, Appendix D of Basis of Design Addendum Report is provided below)

TABLE 3-1
EET RESULTS COMPARED TO PWQOs

TASK 2.1.4 SEDIMENT MANAGEMENT
RANDLE REEF SEDIMENT REMEDIATION PROJECT
HAMILTON HARBOUR

	Ontario Prov. Water Quality Objectives (PWQOs)	Minimum EET		Average EET		Maximum EET	
Conventionals in mg/L							
TOC (uv/persulf)	NA	7.3		8.9		14	
TSS	NA	2		22		42	
Total Metals in µg/L							
Aluminum	NA	110		714		1800	
Arsenic	100	2.0	U	2.3		3.0	
Beryllium	1,100	1.0	U	1.0	U	1.0	U
Boron	200	170		189		220	
Cadmium	0.2	0.15		0.37		0.56	
Chromium	8.9	2.0		3.7		7.0	
Cobalt	0.9	0.5		0.8		1.3	
Copper	5	2.0		7.4		16	
Iron	300	230		1947		3900	
Lead	25	11		29		47	
Molybdenum	40	11		12		13	
Nickel	25	4.0		4.6		6.0	
Silver	0.1	0.1	U	0.13		0.20	
Vanadium	6	2.0	U	2.3		4.0	
Zinc	30	51		144		240	
Semivolatiles in µg/L							
1-Methylnaphthalene	2.0	2	U	**19**		**80**	
2-Methylnaphthalene	2.0	1.9	U	**29**		**170**	
Acenaphthene	NA	9.3		27		87	
Acenaphthylene	NA	0.4	U	5.4		20	
Anthracene	0.0008	**2.1**		**3.9**		**9**	
Benz(a)anthracene	0.0004	**0.7**		**1.0**		**1.2**	
Benzo(a)pyrene	NA	0.5	U	0.5	U	0.5	U
Benzo(b)fluoranthene	NA	0.4	U	0.5		0.8	
Benzo(ghi)perylene	0.00002	0.4	U	0.4	U	0.4	U
Benzo(k)fluoranthene	0.0002	0.4	U	**0.5**		**0.8**	
Chrysene	0.0001	0.5		**0.8**		**1.1**	
Dibenz(a,h)anthracene	0.002	0.4	U	0.4	U	0.4	U
Fluoranthene	0.0008	**3.9**		**5.8**		**12**	
Fluorene	0.2	**12**		**22.6**		**67**	
Indeno(1,2,3-cd)pyrene	NA	0.6	U	0.6	U	0.6	U
Naphthalene	7.0	1.7		**1210**		**8400**	
Perylene	0.00007	0.3	U	**0.3**		**0.5**	
Phenanthrene	0.03	**2.6**		**23**		**85**	
Pyrene	NA	2.5		3.8		7	

Notes:

1. Data are from the January 2005 effluent elutriate tests (EETs) performed to obtain water for the media filtration tests and represent polymer-assisted ECF effluent characteristics.

mg/L = milligrams per litre
µg/L = micrograms per litre
TSS = total suspended solids
TOC = total organic carbon
uv/persulf = uv with persulfite method
U = Not detected at detection limit indicated
Bold indicates detected concentration is greater than or equal to PWQO

B.3
Column Media Filtration

A brief discussion of the column media filtration tests is presented in Appendix H of the Basis of Design Report and in Appendix D of the Basis of Design Addendum Report , with relevant excerpts and tables presented below.

H.5 Column Media Filtration Tests

H.5.1 Method

The general procedure used for the column media filtration tests is described below. Photographs H-10 through H-12 were taken during the experiment. *(Note: Photographs H-10 through H-12 are not presented in this appendix.)*

- We contracted Advanced Chemical Technologies (Redmond, Washington) to construct a column device (Figure H-9) for testing several media in series or parallel.
- The columns were made of clear Schedule 40 polyvinyl chloride. All fittings were made of high-density polyethylene (HDPE) plastic and were either threaded or glued together. For glued joints, the glue was used sparingly and placed only on outside joints to minimize the potential for contaminating the water used in the test. The device was also configured with three pre-filters for possible use prior to the column.
- Polyethylene tubing connected to a two-head peristaltic pump was used for flow onto the column and also for backwashing the media prior to startup. Flow rates were monitored with a flow meter. The columns, pre-filters, flow meter, and pump were secured to a fiberglass support structure.
- The columns were cleaned with Alconox and rinsed three times with deionized (DI) water. After the columns were installed on the fiberglass support structure, DI water was pumped through the tubing and column for 30 minutes prior to loading the media.
- The column was filled with about 45 centimetres (cm) (18 inches) of DI water prior to loading the media. Approximately 33 cm (13 inches) of media were added through the top of the column. During backwashing, entrained air and fines were removed and the bed became stratified. After backwashing, the final bed height was about 30 cm (12 inches).
- Three glass fiber pre-filters (50, 20, and 5 µm) connected in series were evaluated independently of the media to determine the percent reduction of contaminants based solely on TSS removal as accomplished by the pre-filters.
- Once the column was filled with the prepared water, residual air was removed through a vent located at the top of the column.
- The sand medium and pre-filters had a loading rate of 1.0 gallons per minute per square foot (gpm/ft^2) and the carbon and organoclay media had a loading rate of 0.5 gpm/ft^2. Flow was adjusted at the peristaltic pump and was passed (down flow) through the media bed.
- During startup, residual DI water in the bed column (~ 200 ml) was wasted prior to collecting treated water. The treated water was collected in a 20-litre (5-gallon) bucket, which was placed on a scale. Because of the large amount of sample volume required (1.1 L), several pore volumes were collected (30 to 36, 63 to 69, and 93 to 99) for each sample event. We estimated when a pore volume was coming off the column by

weighing the effluent from the column and estimating one pore volume at 200 ml and that 1 ml of water weighed 1 gram.

- Water samples were collected before being loaded onto the column. Polyethylene tubing attached to a peristaltic pump was placed in the feed reservoir for the water. The tubing inlet was placed near the tubing inlet used to feed the column. Samples of the feed water were collected over the same time period and approximate pore volume as the samples coming off the column.
- Each medium was tested separately using a new batch of supernatant water from an EET test with added polymer. The supernatant was obtained from Composite II sediment and Lake Ontario water.
- New tubing was installed for each test.
- Following collection, samples were submitted for analysis of SVOCs, total and dissolved metals, mercury, TOC, and TSS.

H.5.2 Media Selection

Three media (sand, carbon, and organoclay) were evaluated for their ability to remove dissolved or suspended SVOCs (i.e., naphthalene and phenanthrene) and VOCs (i.e., benzene, toluene, ethylbenzene, and xylenes [BTEX]) in the water column.

Sand was selected as one of the media proposed for possible application because it is relatively inexpensive and readily available, and it is used regularly in water treatment processes to remove TSS. Sand has not been demonstrated to be very effective at removing dissolved contaminants. However, with the exception of naphthalene, which is very soluble in water, most of the other contaminants of concern are likely to be sorbed to TSS and potentially could be removed with sand filtration.

Granular activated carbon has been used to purify water for many years, and the process by which contaminant removal occurs is well understood. The adsorption of contaminants by carbon is a physical process in which the contaminant molecule is held at the surface of the carbon. Carbon, which is activated with heating, can adsorb large quantities of contaminants because it has very large surface area available for the sorption of organic molecules.

Typically, clay is used as a barrier to water flow because of its low permeability and tendency to swell after being wetted. However, there has been extensive research in the past 20 years on the use of modified clays for removing organic contaminants from water. Clays can be modified with a variety of compounds to reduce the tendency for swelling and increase their ability to sorb compounds such as most SVOCs and VOCs. The compounds used to modify clay's chemically bonded organic compounds, containing a large number of alkyl chains (Boyd et al., 1988; Lo et al., 1997; Lo and Yang, 2001), demonstrated that organoclays are capable of effectively removing dissolved organic contaminants. Wolfe et al. (1986) also described the ability of organoclays to remove organic compounds, which became sorbed to the interlamellar areas of the organoclay. Wolfe et al. reported that an area up 800 m^2 per gram was available for the sorption of organic contaminants. ET-1, the organoclay we used in these experiments, is produced by combining sodium montmorillonite clay with a cationic quaternary amine salt, which replaces adsorbed sodium by an ion exchange process. The final product is clay that is organophilic and readily adsorbs organic compounds such as SVOCs and VOCs.

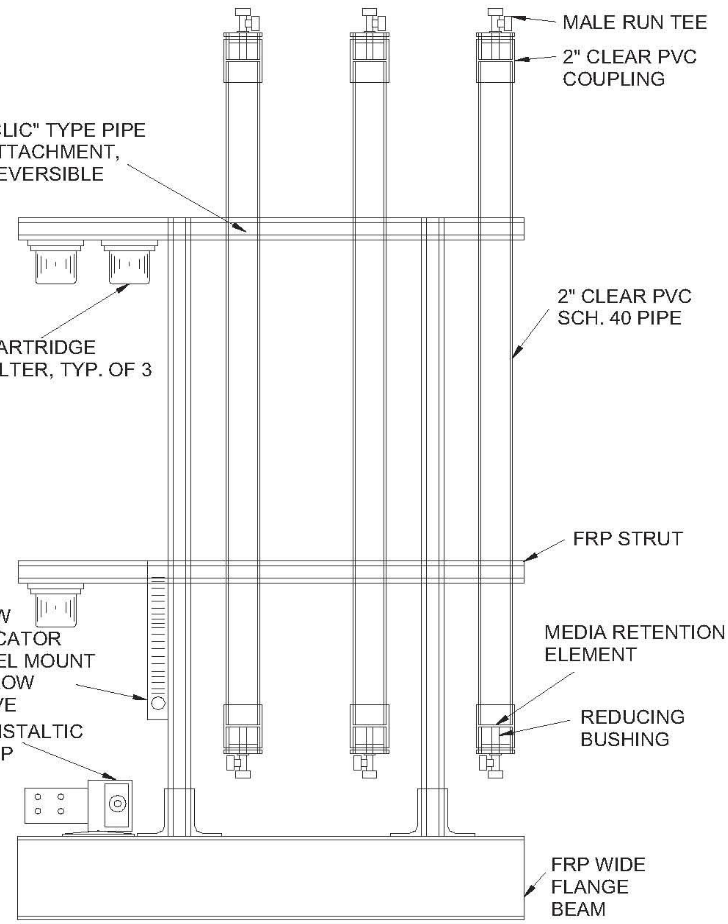
The sand, carbon, organoclay, and glass fiber filters used in these experiments were obtained from the following sources:

- The No. 30 silica sand is the same sand used by Rain for Rent in its sand filter systems, which are typically used at construction sites to treat stormwater runoff.
- The granular activated carbon (DSR-A, 8 to 40 mesh) was obtained from Calgon Carbon Corporation (Pittsburgh, Pennsylvania).
- The organoclay (ET-1) was obtained from Aqua Technologies (Casper, Wyoming).
- The glass fiber filters were manufactured by Osmonics, Inc. (Minnetonka, Minnesota).

H.5.3 Results

The results of the column media filtration tests are shown in Tables H-10, H-11, and H-12. The No. 30 sand removed 50% of the phenanthrene, 70% of the acenaphthene, and 60% of the fluorene, but only 25% of the naphthalene. The organoclay removed 100% of the phenanthrene, fluorene, and acenaphthene. For the naphthalene, there was some indication of breakthrough at 66 pore volumes (PVs). The naphthalene concentration increased between PV 33 and PV 100 from 0.3 to 2.8 micrograms per litre (µg/L), respectively. The activated carbon removed 100% of the phenanthrene, acenaphthene, fluorene, and naphthalene. There was no sign of breakthrough after passing 100 PVs through the media column.

Media Filtration Column Diagram



Source: By Advanced Chemical Technologies.

HARTCROWSER
17099-07 *2/05*
Figure H-9

TABLE H-10
MEDIA FILTRATION TEST DATA FOR NO. 30 SAND

	Starting Conditions		After Settling with Polymer			Effluent After Filtration		
Lab ID	**001410 05**	**001412 05**	**002100 05**	**002102 05**	**002104 05**	**002099 05**	**002101 05**	**002103 05**
Location	**MF**	**MF**	**MFS**	**MFS**	**MFS**	**MFS**	**MFS**	**MFS**
Sample ID	**C2-METS-1 (1)**	**C2-METS-2 (1)**	**AP-33 (2)**	**AP-66 (2)**	**AP-99 (2)**	**PV-33 (3)**	**PV-66 (3)**	**PV-99 (3)**
Sampling Date	**1/07/2005**	**1/07/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**
Conventionals in mg/L								
TOC (uv/persulf)	7.3	7.3	8	8.1	8.4	7.6	7.3	7.8
TSS	16	18	2 U	2 U	2 U	2 U	2 U	2 U
Total Metals in mg/L								
Aluminum	0.35	0.37	0.021	0.023	0.022	0.013	0.016	0.015
Arsenic	0.002	0.002	0.002	0.002 U	0.002	0.002 U	0.002 U	0.002
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.18	0.17	0.16	0.16	0.16	0.16	0.17	0.16
Cadmium	0.00031	0.00027	0.00007 U	0.00007 U	0.00007 U	0.00014	0.00009	0.00007 U
Chromium	0.002	0.002	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.0005	0.0005	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Copper	0.005	0.004	0.002 U	0.002	0.002	0.003	0.012	0.002 U
Iron	1.1	1.1	0.033	0.059	0.039	0.02 U	0.02 U	0.02
Lead	0.021	0.022	0.0011	0.0011	0.0011	0.0005	0.0006	0.0005 U
Molybdenum	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Nickel	0.004	0.004	0.003	0.003	0.003	0.006	0.005	0.004
Silver	0.0001 U	0.0001	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	0.098	0.1	0.009	0.028	0.012	0.03	0.015	0.007
Dissolved Metals in mg/L								
Aluminum	0.018	0.014	0.01	0.012	0.014	0.012	0.015	0.012
Arsenic	0.002	0.002 U	0.002	0.002 U	0.002 U	0.002	0.002 U	0.002 U
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.19	0.17	0.15	0.18	0.18	0.16	0.19	0.19
Cadmium	0.00007 U	0.00007 U	0.00017	0.00019	0.00015	0.00007 U	0.00007	0.00015
Chromium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Copper	0.002 U	0.002 U	0.008	0.002 U	0.002	0.002 U	0.002 U	0.002
Iron	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Lead	0.0005 U	0.0005 U	0.0006	0.0005 U	0.0005	0.0005 U	0.0005 U	0.0013
Mercury	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U	0.00005 U
Molybdenum	0.01	0.012	0.01	0.011	0.011	0.01	0.011	0.011
Nickel	0.002	0.002	0.006	0.003	0.004	0.003	0.003	0.004
Silver	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	0.006	0.005	0.027	0.007	0.02	0.004	0.017	0.015

TABLE H-10
MEDIA FILTRATION TEST DATA FOR NO. 30 SAND

	Starting Conditions		After Settling with Polymer			Effluent After Filtration		
Lab ID	**001410 05**	**001412 05**	**002100 05**	**002102 05**	**002104 05**	**002099 05**	**002101 05**	**002103 05**
Location	**MF**	**MF**	**MFS**	**MFS**	**MFS**	**MFS**	**MFS**	**MFS**
Sample ID	**C2-METS-1 (1)**	**C2-METS-2 (1)**	**AP-33 (2)**	**AP-66 (2)**	**AP-99 (2)**	**PV-33 (3)**	**PV-66 (3)**	**PV-99 (3)**
Sampling Date	**1/07/2005**	**1/07/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**	**1/11/2005**
Semivolatiles in ug/L								
1-Methylnaphthalene	11	9.8	9.1	8.5	5.9	5.7	5.8	6.1
2,4-Dimethylphenol	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U
2-Methylnaphthalene	5.7	4	14	13	8.7	8.1	8.7	8.8
2-Methylphenol	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
3&4-Methylphenol	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Acenaphthene	18	17	13	13	8.9	8	8.3	8.8
Acenaphthylene	4	3.6	4.1	4.2	3.1	2.9	3.2	3.1
Anthracene	3.1	2.8	1.6	1.6	1.1	0.7	0.8	0.8
Benzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	0.7	0.9	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Benzo(a)pyrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzo(b)fluoranthene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(ghi)perylene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(k)fluoranthene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Biphenyl	2.9	2.7	2.3	2.3	1.6	1.4	1.5	1.6
Chrysene	0.5	0.6	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Dibenzo(a,h)anthracene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Dibenzofuran	9.3	8.8	6.7	5 U	5 U	5 U	5 U	5 U
Dimethylnaphthalenes	8.5	8.2	4.9	4.7	3	2.4	2.7	3
Fluoranthene	3.9	4	1.2	1.2	0.8	0.2 U	0.2 U	0.3
Fluorene	13	12	10	9.8	6.6	5	5.6	6.1
Indeno(1,2,3-cd)pyrene	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Naphthalene	7	3.4	430	420	310	310	310	300
Perylene	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Phenanthrene	15	15	8.2	8.3	5.4	3.2	3.8	4.4
Phenol	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Pyrene	2.6	2.5	0.7	0.7	0.5	0.3 U	0.3 U	0.3 U

Notes:
1. Data are from the METs performed to obtain water for the media filtration tests and represent polymer-assisted ECF effluent characteristics.
2. AP = after polymer. Water represents influent water prior to being passed through column. Number after AP is approximate pore volume when sample was taken.
3. PV = pore volume. Represents water after passing through column. Number after PV is approximate PV when sample was taken.
mg/L = milligrams per litre
TOC = total organic carbon
TSS = total suspended solids
ug/L = micrograms per litre
uv/persulf = uv with persulfite method
U = Not detected at detection limit indicated.

TABLE H-11
MEDIA FILTRATION TEST DATA FOR GAC (DSR-A)

	Starting Conditions		After Settling with Polymer			Effluent After Filtration		
Location	002097 05	002098 05	002096 05	002927 05	002929 05	002095 05	002928 05	002930 05
Sample ID	MF	MF	MF	MF	MF	MF	MF	MF
	C-MET1 (1)	C-MET2 (1)	C-AP1 (2)	MF-C-AP2 (2)	MF-C-AP3 (2)	C-PV1 (3)	MF-C-PV2 (3)	MF-C-PV3 (3)
Sampling Date	1/11/2005	1/11/2005	1/12/2005	1/12/2005	1/12/2005	1/12/2005	1/12/2005	1/12/2005
Conventionals in mg/L								
TOC (uv/persulf)	8.6	8.1	13	10	8.9	1.3	1.4	1.4
TSS	18	20	2 U	2 U	2 U	2 U	2 U	2 U
Total Metals in mg/L								
Aluminum	0.65	0.62	0.16	0.18	0.12	0.43	0.33	0.31
Arsenic	0.002	0.002	0.002	0.002	0.002 U	0.013	0.006	0.004
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.19	0.19	0.18	0.17	0.18	0.012	0.011	0.026
Cadmium	0.00036	0.00043	0.00029	0.00017	0.00011	0.00013	0.00007	0.00008
Chromium	0.003	0.003	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.0007	0.0007	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Copper	0.005	0.006	0.006	0.003	0.002	0.002 U	0.002 U	0.002 U
Iron	1.9	1.9	0.49	0.61	0.46	0.02 U	0.038	0.027
Lead	0.029	0.029	0.011	0.011	0.008	0.0005 U	0.0005 U	0.0005 U
Molybdenum	0.012	0.011	0.012	0.011	0.012	0.054	0.032	0.023
Nickel	0.004	0.004	0.006	0.003	0.003	0.002 U	0.002 U	0.002 U
Silver	0.0001	0.0001	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.009	0.006	0.005
Zinc	0.14	0.14	0.074	0.056	0.043	0.007	0.003	0.009
Dissolved Metals in mg/L								
Aluminum	0.019	0.013	0.026	0.012	0.028	0.47	0.31	0.27
Arsenic	0.002	0.002	0.002 U	0.002 U	0.002 U	0.014	0.006	0.004
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.18	0.18	0.18	0.18	0.17	0.036	0.007	0.022
Cadmium	0.00016	0.00011	0.00007 U	0.00007 U	0.00007	0.00015	0.00009	0.00007 U
Chromium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0015	0.0005 U	0.0005 U	0.0005 U
Copper	0.007	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Iron	0.02 U	0.02 U	0.02 U	0.021	0.032	0.02 U	0.023	0.02 U
Lead	0.0006	0.0005	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Mercury	0.00005 U	0.00005 U	0.00005 U	0.0002 U	0.0001 U	0.00005 U	0.0001 U	0.00005 U
Molybdenum	0.011	0.011	0.011	0.012	0.011	0.056	0.034	0.024
Nickel	0.005	0.004	0.002	0.002	0.003	0.002 U	0.002 U	0.002
Silver	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.009	0.006	0.005
Zinc	0.042	0.025	0.003	0.015	0.062	0.013	0.006	0.011

TABLE H-11
MEDIA FILTRATION TEST DATA FOR GAC (DSR-A)

Location Sample ID Sampling Date	002097 05 MF C-MET1 (1) 1/11/2005	002098 05 MF C-MET2 (1) 1/11/2005	002096 05 MF C-AP1 (2) 1/12/2005	002927 05 MF MF-C-AP2 (2) 1/12/2005	002929 05 MF MF-C-AP3 (2) 1/12/2005	002095 05 MF C-PV1 (3) 1/12/2005	002928 05 MF MF-C-PV2 (3) 1/12/2005	002930 05 MF MF-C-PV3 (3) 1/12/2005
Semivolatiles in ug/L								
1-Methylnaphthalene	13	14	14	8.7	9.6	2 U	2 U	2 U
2,4-Dimethylphenol	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U
2-Methylnaphthalene	8.4	11	24	12	14	1.9 U	1.9 U	1.9 U
2-Methylphenol	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
3&4-Methylphenol	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Acenaphthene	23	24	20	17	17	0.7 U	0.7 U	0.7 U
Acenaphthylene	4.7	5	5.1	3.2	3.7	0.4 U	0.4 U	0.4 U
Anthracene	3.9	3.7	2.6	2.5	2.4	0.2 U	0.2 U	0.2 U
Benzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	0.9	0.9	0.6	0.6	0.6	0.2 U	0.2 U	0.2 U
Benzo(a)pyrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzo(b)fluoranthene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(ghi)perylene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(k)fluoranthene	0.4 U	0.6	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Biphenyl	4.3	4.3	3.5	3.1	3.04	0.4 U	0.4 U	0.4 U
Chrysene	0.9	0.8	0.5	0.5	0.4	0.3 U	0.3 U	0.3 U
Dibenzo(a,h)anthracene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Dibenzofuran	12	13	10	8.7	9	5 U	5 U	5 U
Dimethylnaphthalenes	8.9	9.2	7.6	6.5	6.2	0.02 U	0.02 U	0.02 U
Fluoranthene	4.9	4.9	3.2	2.9	2.5	0.2 U	0.2 U	0.2 U
Fluorene	20	21	16	14	14	0.3 U	0.3 U	0.3 U
Indeno(1,2,3-cd)pyrene	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Naphthalene	21	37	960	350	390	0.3 U	0.3 U	0.3 U
Perylene	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Phenanthrene	19	19	14	13	13	0.3 U	0.3 U	0.3 U
Phenol	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Pyrene	3.5	3.4	2.3	2.1	1.9	0.3 U	0.3 U	0.3 U

Notes:
1. Data are from the METs performed to obtain water for the media filtration tests and represent polymer-assisted ECF effluent characteristics
2. AP - after polymer. Water represents influent water prior to being passed through column. Number after AP is 1 = 33 pore volume (PV), 2 = 66 PV, and 3 = 99 PV.
3. PV - pore volume. Represents water after passing through column. Number after PV is 1 = 33 PV, 2 = 66 PV, and 3 = 99 PV
GAC = granular activated carbon
mg/L = milligrams per litre
TOC = total organic carbon
TSS = total suspended solids
U = Not detected at detection limit indicated.
ug/L = micrograms per litre
uv/persulf = uv with persulfite method

TABLE H-12
MEDIA FILTRATION TEST DATA FOR ORGANOCLAY (ET-1)

	Starting Conditions		After Settling with Polymer			Effluent After Filtration		
Lab ID	**002931 05**	**002932 05**	**002933 05**	**002935 05**	**002937 05**	**002934 05**	**002936 05**	**002938 05**
Location	**MF**	**MF**	**MF**	**MF**	**MF**	**MF**	**MF**	**MF**
Sample ID	**CL-MET1 (1)**	**CL-MET2 (1)**	**CL-AP1 (2)**	**CL-AP2 (2)**	**CL-AP3 (2)**	**CL-PV1 (3)**	**CL-PV2 (3)**	**CL-PV3 (3)**
Sampling Date	**1/13/2005**	**1/13/2005**	**1/13/2005**	**1/13/2005**	**1/13/2005**	**1/13/2005**	**1/13/2005**	**1/13/2005**
Conventionals in mg/L								
TOC (uv/persulf)	8.7	8.4	12	12	13	34	22	18
TSS	42	38	2	2 U	2	2 U	2 U	2 U
Metals in mg/L								
Aluminum	1.8	1.1	0.47	0.4	0.37	0.34	0.3	0.28
Arsenic	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.22	0.2	0.19	0.19	0.2	0.17	0.18	0.19
Cadmium	0.00053	0.00056	0.00046	0.00039	0.00034	0.00038	0.00036	0.00032
Chromium	0.007	0.007	0.003	0.003	0.003	0.002	0.002	0.002
Cobalt	0.0013	0.0012	0.0006	0.0006	0.0005	0.0005	0.0005	0.0006
Copper	0.014	0.016	0.005	0.004	0.004	0.004	0.004	0.004
Iron	3.9	3.5	1.7	1.5	1.3	0.97	1.1	1
Lead	0.047	0.046	0.025	0.023	0.02	0.018	0.017	0.017
Molybdenum	0.013	0.013	0.011	0.011	0.011	0.012	0.012	0.012
Nickel	0.006	0.006	0.004	0.003	0.003	0.003	0.003	0.003
Silver	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Vanadium	0.004	0.002	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	0.24	0.24	0.13	0.12	0.1	0.09	0.087	0.09
Dissolved Metals in mg/L								
Aluminum	0.02	0.04	0.012	0.01 U	0.011	0.01 U	0.01 U	0.01 U
Arsenic	0.002 U	0.002 U	0.002 U	0.002	0.002 U	0.002	0.002	0.002
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	0.21	0.22	0.18	0.18	0.19	0.16	0.18	0.18
Cadmium	0.00007	0.00007	0.00007 U	0.00009	0.00009	0.00007	0.00009	0.00007 U
Chromium	0.002 U	0.002	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Copper	0.002 U	0.005	0.002 U	0.002	0.003	0.002 U	0.002	0.003
Iron	0.02 U	0.046	0.02	0.025	0.022	0.035	0.037	0.025
Lead	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0006	0.0005 U	0.0005 U	0.0005 U
Mercury	0.00005 U	0.00005 U	0.0001 U	0.0001 U	0.00005 U	0.0001 U	0.0001 U	0.00005 U
Molybdenum	0.014	0.014	0.011	0.011	0.011	0.012	0.011	0.012
Nickel	0.003	0.003	0.002	0.003	0.003	0.002	0.002	0.002
Silver	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	0.016	0.088	0.02	0.017	0.018	0.008	0.009	0.006

TABLE H-12
MEDIA FILTRATION TEST DATA FOR ORGANOCLAY (ET-1)

Lab ID Location Sample ID Sampling Date	002931 05 MF CL-MET1 (1) 1/13/2005	002932 05 MF CL-MET2 (1) 1/13/2005	002933 05 MF CL-AP1 (2) 1/13/2005	002935 05 MF CL-AP2 (2) 1/13/2005	002937 05 MF CL-AP3 (2) 1/13/2005	002934 05 MF CL-PV1 (3) 1/13/2005	002936 05 MF CL-PV2 (3) 1/13/2005	002938 05 MF CL-PV3 (3) 1/13/2005
Semivolatiles in ug/L								
1-Methylnaphthalene	2 U	2 U	11	11	21	2 U	2 U	2 U
2,4-Dimethylphenol	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U
2-Methylnaphthalene	1.9 U	1.9 U	19	20	19	1.9 U	1.9 U	1.9 U
2-Methylphenol	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
3&4-Methylphenol	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Acenaphthene	9.3	9.4	15	16	14	0.7 U	0.7 U	0.7 U
Acenaphthylene	0.4 U	0.4 U	4.4	4.7	4.5	0.4 U	0.4 U	0.4 U
Anthracene	2.4	2.1	2.6	2.6	2.7	0.2 U	0.2 U	0.2 U
Benzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	1.1	1.1	0.7	0.7	0.7	0.2 U	0.2 U	0.2 U
Benzo(a)pyrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzo(b)fluoranthene	0.4 U	0.8	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(ghi)perylene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(k)fluoranthene	0.4 U	0.8	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Biphenyl	0.4 U	0.42	1.2	1	1.4	0.4 U	0.4 U	0.4 U
Chrysene	1	1.1	0.6	0.5	0.5	0.3 U	0.3 U	0.3 U
Dibenzo(a,h)anthracene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Dibenzofuran	5 U	5 U	7.3	8	7.2	5 U	5 U	5 U
Dimethylnaphthalenes	6.7	6.8	7.5	7.3	7.2	0.02 U	0.02 U	0.02 U
Fluoranthene	5.3	5.3	3.3	3.1	3.2	0.2 U	0.2 U	0.2 U
Fluorene	12	13	12	13	12	0.3 U	0.3 U	0.3 U
Indeno(1,2,3-cd)pyrene	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Naphthalene	1.7	3.1	930	870	880	0.3 U	0.8	2.8
Perylene	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Phenanthrene	2.6	2.7	11	12	10	0.3 U	0.3 U	0.3 U
Phenol	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Pyrene	3.8	3.9	2.5	2.3	2.3	0.3 U	0.3 U	0.3 U

Notes:
1. Data are from the METs performed to obtain water for the media filtration tests and represent polymer-assisted ECF effluent characteristics
2. AP - after polymer. Water represents influent water prior to being passed through column. Number after AP is 1 = 33 pore volume (PV), 2 = 66 PV, and 3 = 99 PV.
3. PV - pore volume. Represents water after passing through column. Number after PV is 1 = 33 PV, 2 = 66 PV, and 3 = 99 PV

mg/L = milligrams per litre
TOC = total organic carbon
TSS = total suspended solids
U = Not detected at detection limit indicated.
ug/L = milligrams per litre
uv/persulf = uv with persulfite method

(Supplementary information from Section 3.5, Appendix D of Basis of Design Addendum Report is provided below)

Metals and PAH concentrations in the bench-scale GAC effluent were less than PWQOs, with the exception of PAHs that have analytical detection limits greater than PWQOs. All GAC effluent concentrations for the PAHs were below the practical quantitation limits. There was no sign of breakthrough after passing 100 pore volumes through the media column. Table 3-3 summarizes the results of the GAC filtration tests in comparison with PWQOs.

GAC had the highest removal rate for both metals and PAHs. The average metals removal efficiencies for the GAC ranged from 51 percent for cadmium to 95 percent for iron and lead. PAH removal efficiencies also varied for individual PAHs, primarily due to the range (four orders of magnitude) of influent concentrations and the adsorbability of the individual PAHs. The removal efficiency for total PAHs was calculated to be 99 percent. Table 3-4 summarizes the removal efficiencies for the GAC bench-scale tests.

TABLE 3-4
BENCH-SCALE GAC REMOVAL EFFICENCIES

TASK 2.1.4 SEDIMENT MANAGEMENT
RANDLE REEF SEDIMENT REMEDIATION PROJECT
HAMILTON HARBOUR

Contaminants	Average Percent Removal	Number of Non-Detects
Cadmium	47%	0
Copper	67%	3[1]
Iron	95%	1
Lead	95%	3[1]
Zinc	88%	0
Total PAHs	99%	3[1]

Notes:
1. For removal percentages where contaminant was non-detect after the GAC, the percent removal is based on largest calculated percent removal using the influent concentration and the level of detection.
PAHs = polycyclic aromatic hydrocarbons

TABLE 3-3
GAC FILTRATION TEST RESULTS COMPARED TO PWQOs

TASK 2.1.4 SEDIMENT MANAGEMENT
RANDLE REEF SEDIMENT REMEDIATION PROJECT
HAMILTON HARBOUR

	Ontario Prov. Water Quality Objectives (PWQOs)	Average Starting Concentrations		Average Concentrations After Settling with Polymer		Average Effluent Concentrations After GAC Filtration	
Conventionals in mg/L							
TOC (uv/persulf)	NA	8.35		10.6		1.4	
TSS	NA	19		2.0	U	2.0	U
Total Metals in µg/L							
Aluminum	NA	635		153		357	
Arsenic	100	2.0		2.0		7.7	
Beryllium	1,100	1.0	U	1.0	U	1.0	U
Boron	200	190		177		16	
Cadmium	0.2	**0.40**		0.19		0.09	
Chromium	8.9	3.0		2.0	U	2.0	U
Cobalt	0.9	0.7		0.5	U	0.5	U
Copper	5	**5.5**		3.7		2.0	U
Iron	300	**1900**		**520**		28	U
Lead	25	**29**		10		0.5	U
Molybdenum	40	12		12		36	
Nickel	25	4.0		4.0		2.0	U
Silver	0.1	0.1		0.1	U	0.1	U
Vanadium	6	2.0	U	2.0	U	**6.7**	
Zinc	30	**140**		**58**		6.3	
Semivolatiles in µg/L							
1-Methylnaphthalene	2.0	**14**		**11**		2.0	U
2-Methylnaphthalene	2.0	**9.7**		**17**		1.9	U
Acenaphthene	NA	24		18		0.7	U
Acenaphthylene	NA	4.9		4.0		0.4	U
Anthracene	0.0008	**3.8**		**2.5**		0.2	U
Benz(a)anthracene	0.0004	**0.9**		**0.6**		0.2	U
Benzo(a)pyrene	NA	0.5	U	0.5	U	0.5	U
Benzo(b)fluoranthene	NA	0.4	U	0.4	U	0.4	U
Benzo(ghi)perylene	0.00002	0.4	U	0.4	U	0.4	U
Benzo(k)fluoranthene	0.0002	**0.5**		0.4	U	0.4	U
Chrysene	0.0001	**0.9**		**0.5**		0.3	U
Dibenz(a,h)anthracene	0.002	0.4	U	0.4	U	0.4	U
Fluoranthene	0.0008	**4.9**		**2.9**		0.2	U
Fluorene	0.2	**21**		**15**		0.3	U
Indeno(1,2,3-cd)pyrene	NA	0.6	U	0.6	U	0.6	U
Naphthalene	7.0	**29**		**567**		0.3	U
Perylene	0.00007	0.3	U	0.3	U	0.3	U
Phenanthrene	0.03	**19**		**13**		0.3	U
Pyrene	NA	3.5		2.1		0.3	U

Notes:
1. Data are from the EETs performed to obtain water for the media filtration tests and represent polymer-assisted
2. Water represents influent water prior to being passed through column.
3. Represents water after passing through column. Average of effluent from pore volume 33, 66, and 99.

mg/L = milligrams per litre
µg/L = micrograms per litre
GAC = granular activated carbon
TOC = total organic carbon
TSS = total suspended solids
uv/persulf = uv with persulfite method
U = Not detected at detection limit indicated
Bold indicates concentration is detected and is greater than or equal to PWQO.

B.4
Batch Media Adsorption

A brief discussion of the batch media adsorption tests is presented in Appendix H of the Basis of Design Repor , with relevant excerpts and tables presented below.

H.6 Batch Media Adsorption Tests

H.6.1 Method
The general procedure for this test is similar to the batch equilibrium test (BET) as described by the USACE (Myers et al., 1996; Brannon et al., 1994). Photographs H-13 through H-21 were taken during the experiment. *(Note: Photographs H-13 through H-21 are not presented in this appendix.)* We ran the test using the following specific procedures:

- This test was performed to determine the amount of transfer of dissolved contaminants from prepared water to a select medium.
- EET supernatant treated with Krysalis CF4206D polymer at 25 mg/L was used as the source of water containing VOC and SVOC contaminants.
- The source water was not spiked with contaminants.
- Samples were prepared on the lab bench under oxic conditions. Tubes were filled with 400 ml of EET supernatant water.
- The amount of adsorbent added to each centrifuge tube was based on the TOC concentration of the water used. Samples collected for TOC analysis were submitted to Analytical Resources, Inc. (Seattle, Washington). The results indicated that the TOC averaged 20 mg/L.
- Water in the centrifuge tubes was carefully decanted directly into sample bottles.
- Samples were collected for SVOC, TOC, and TSS analysis.

H.6.2 Results
The results of the batch media adsorption tests are presented in Table H-13. There was almost linear removal of phenanthrene compared to the amount of sorbent added. The granular activated carbon was twice as effective at removing SVOCs given equal amounts of media. Results for phenanthrene removal are presented graphically on Figure H-10. Results for naphthalene removal are not presented graphically because the analytical results might have been overestimated (because the laboratory appeared to experience significant losses of naphthalene during sample extraction and preparation).

Adsorption media/water partition coefficients for a number of contaminants were calculated in the following two ways:

- Single point estimates were calculated by dividing the equilibrium water concentration into the calculated adsorption media concentration. It was assumed that the difference between the initial water concentration and the equilibrated water concentration was due solely to adsorption onto the media.
- Partition coefficients were determined as the slope of the best-fit line to the adsorption isotherm.

The adsorption isotherm for phenanthrene is presented on Figure H-11. Calculated and isotherm-derived partition coefficients are summarized in Table H-14. Naphthalene and methylnaphthalene partition coefficients may be overestimated for the reason stated above.

TABLE H-13
MEDIA ADSORPTION BATCH TEST DATA -
GAC (DSR-A) AND ORGANOCLAY (ET-1)

Lab ID	001414 05	001416 05	001404 05	001406 05	001408 05	001405 05	001407 05	001409 05
Sample ID	C1-EET1 (a)	C1-SPIN (b)	C1-C02 (c)	C1-C04 (c)	C1-C08 (c)	C1-CL02 (c)	C1-CL04 (c)	C1-CL08 (c)
Sampling Date	1/05/2005	1/05/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005
Conventionals in mg/L								
TOC (uv/persulf)	14	14	13	14	12	14	14	14
TSS	2	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Semivolatiles in µg/L								
1-Methylnaphthalene	80	73	60	46	33	67	68	66
2,4-Dimethylphenol	34	43	43	29	21	44	42	44
2-Methylnaphthalene	170	160	120	92	59	150	140	150
2-Methylphenol	33	30	30	25	22	32	32	33
3&4-Methylphenol	60	56	54	20	28	57	58	59
Acenaphthene	87	81	62	50	34	72	70	67
Acenaphthylene	20	20	15	12	8	18	17	17
Anthracene	9	7.6	4.4	3.7	1.9	6	4.9	4.4
Benzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	1.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Benzo(a)pyrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzo(b)fluoranthene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(ghi)perylene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzo(k)fluoranthene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Biphenyl	30	27	21	16	11	25	24	22
Chrysene	0.7	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Dibenzo(a,h)anthracene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Dibenzofuran	78	70	50	38	23	61	58	52
Dimethylnaphthalenes	18	16	12	9.5	6.5	13	13	12
Fluoranthene	12	6.7	3.3	3	1.8	3.7	2.9	2.4
Fluorene	67	60	42	33	21	49	48	43
Indeno(1,2,3-cd)pyrene	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Naphthalene	8400	10000	5900	3000	2700	7700	8300	8300
Perylene	0.5	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Phenanthrene	85	71	38	32	18	48	40	35
Phenol	24	14	20	7.3	11	21	21	22
Pyrene	7	3.7	1.8	1.5	1	2.2	1.7	1.3

Notes:
a. MET results; MET data represent polymer-assisted settled ECP effluent characteristics.
b. Influent water for filtration test before loading onto column.
c. Effluent water from filtration test. Number in sample ID indicates approximate pore volume (eg PV-3) is pore volume 33.
C = carbon
CL = clay
GAC = granular activated carbon
SPIN = After polymer addition
TOC = total organic carbon
TSS = total suspended solids
U = Not detected at detection limit indicated.
ug/L = micrograms per litre
uv/persulf = uv with persulfite method

Batch Media Adsorption Test - Phenanthrene Removal

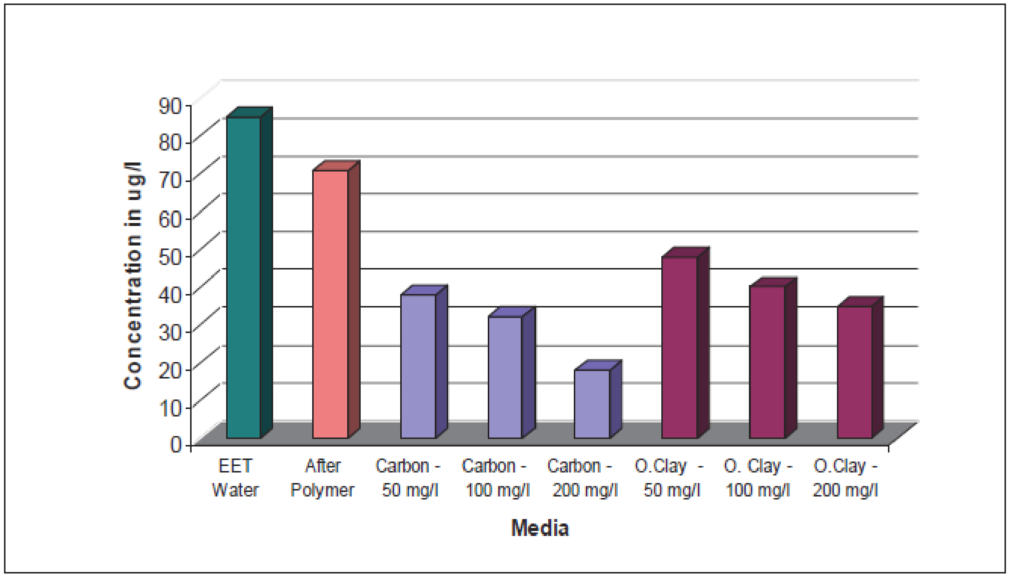


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Figure H-10

1709907/Figure H-10.xls

TABLE H-14

BATCH MEDIA ADSORPTION PARTITION COEFFICIENTS (K_d)

Activated Carbon Adsorption Media	Single-Point Calculated K_d				Isotherm Slope-Derived K_d
Adsorbent Mass	50 mg	100 mg	200 mg	Average	
Naphthalene	13,898	23,333	13,519	16,917	10,163
2-Methylnaphthalene	6,667	7,391	8,559	7,539	4,850
Biphenyl	5,714	6,875	7,273	6,621	4,000
Phenanthrene	17,368	12,188	14,722	14,759	17,832
Anthracene	14,545	10,541	15,000	13,362	12,540
Fluorene	8,571	8,182	9,286	8,680	7,770
Fluoranthene	20,606	12,333	13,611	15,517	23,690
Pyrene	21,111	14,667	13,500	16,426	29,235
Phenol	4,000	22,877	5,909	10,929	negative slope
3 & 4-methylphenol	2,222	20,000	5,714	9,312	negative slope
Dibenzofuran	8,000	8,421	10,217	8,879	6,093
Organoclay Adsorption Media	**Single-Point Calculated K_d**				**Isotherm Slope-Derived K_d**
Adsorbent Mass	50 mg	100 mg	200 mg	Average	
Naphthalene	5,974	2,048	1,024	3,015	negative slope
2-Methylnaphthalene	1,333	1,429	333	1,032	negative slope
Biphenyl	1,600	1,250	1,136	1,329	4,643
Phenanthrene	9,583	7,750	5,143	7,492	21,279
Anthracene	5,333	5,510	3,636	4,827	9,104
Fluorene	4,490	2,500	1,977	2,989	17,500
Fluoranthene	16,216	13,103	8,958	12,759	29,419
Pyrene	13,636	11,765	9,231	11,544	20,000
Phenol	2,857	1,429	455	1,580	negative slope
3 & 4-methylphenol	1,053	345	85	494	negative slope
Dibenzofuran	2,951	2,069	1,731	2,250	9,286

Notes:
Naphthalene and 2-methylnaphthalene K_ds may be biased high due to laboratory sample extraction errors.
Phenol and methylphenol analytical results are questionable.

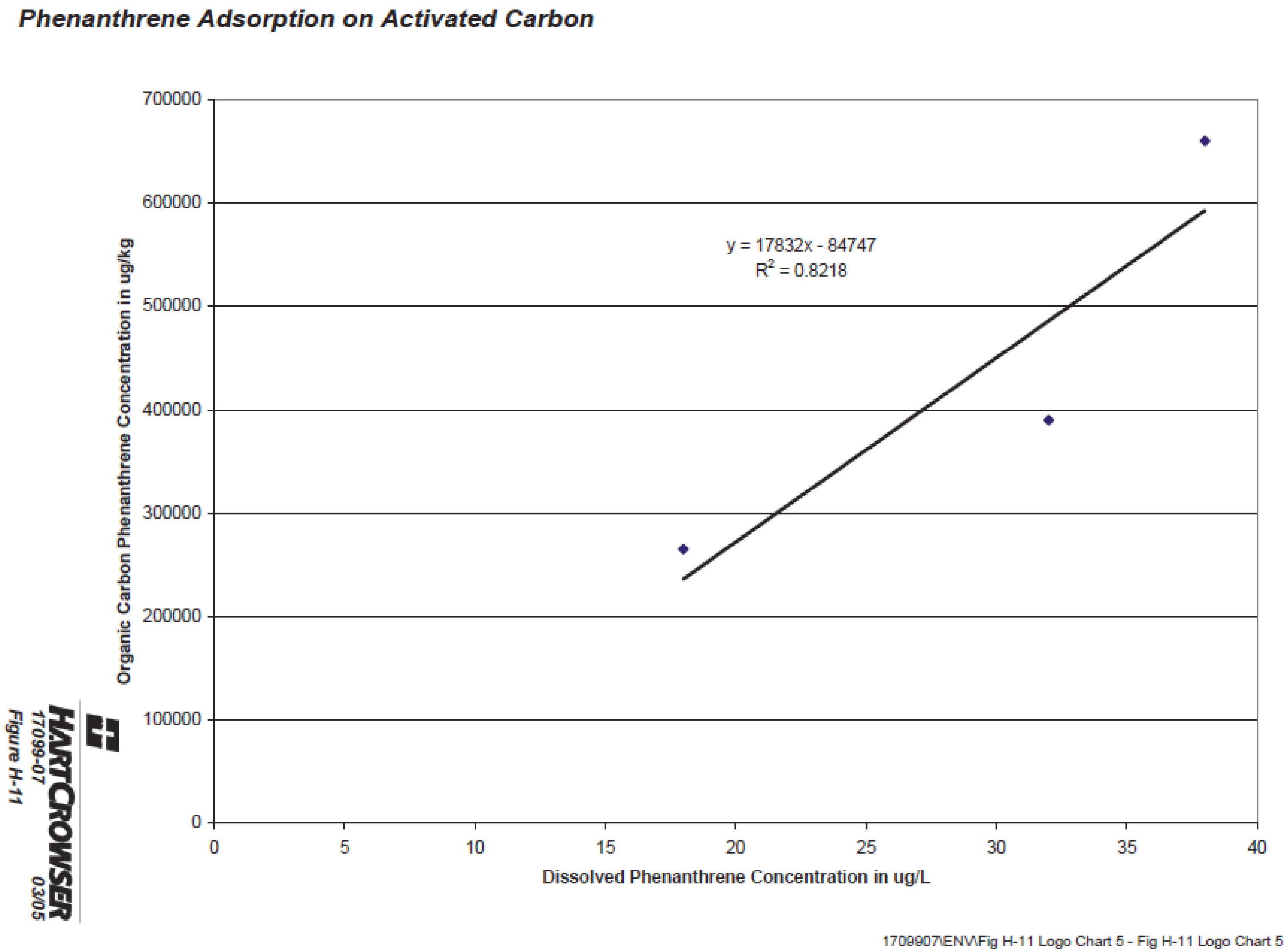
Phenanthrene Adsorption on Activated Carbon
700000
600000
500000
400000
300000
200000
100000
0
Organic Carbon Phenanthrene Concentration in ug/kg
y = 17832x - 84747
R2 = 0.8218
0
5
10
15
20
25
30
35
40
Dissolved Phenanthrene Concentration in ug/L
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Figure H-11
1709907\ENV\Fig H-11 Logo Chart 5 - Fig H-11 Logo Chart 5

Appendix I
Water Treatment Data and Follow-Up Study

ITEM I2
Chemical Loading Associated with Water Treament, Randle Reef Sediment Remediation Project, Hamilton Harbour, Lake Ontario, July 18, 2016.

CHEMICAL LOADING ASSOCIATED WITH WATER TREATMENT
RANDLE REEF SEDIMENT REMEDIATION PROJECT
HAMILTON HARBOUR, LAKE ONTARIO

FINAL REPORT

Prepared by:
M. Graham, A. Busef, E. Hartman and R. Joyner

Department of the Environment
Sediment Remediation Unit
Great Lakes Areas of Concern
Canada Centre for Inland Waters
867 Lakeshore Road
Burlington, ON Canada
L7S 1A1

Date: July 18, 2016

1 BACKGROUND

Randle Reef is a zone of contaminated sediment located within the Hamilton Harbour Area of Concern at the western end of Lake Ontario. The sediments present are contaminated with heavy metals and polycyclic aromatic hydrocarbons (PAHs) with total PAH (tPAH) concentrations reaching as high as 70,000 ppm. Randle Reef is the largest PAH contaminated sediment site in Canada. This contaminated site has been described as “a spill in slow motion” due to the continuing spread of contaminants across the harbour floor and uptake into the food chain.

The contaminated sediment at Randle Reef has been prioritized (Figure 1) based on contaminant levels and toxicity as follows;

Priority 1	Severely contaminated area identified in early studies.
Priority 2	Total PAH$\geq$100 mg/kg, Metals$\geq$SELs, Toxic
Priority 3	Total PAH$\geq$100 mg/kg, Metals$\geq$SELs, Non-toxic

Proposed remediation for this site involves constructing a 6.2 hectare engineered containment facility (ECF) that will manage PAH and heavy metal contaminated sediments in three ways:

(1) the ECF will be constructed on top of the most contaminated sediments (140,000 m^3 *in-situ*) isolating over approximately 50% of the Priority 1 sediments in place;
(2) the majority of contaminated sediments (445,000 m^3) outside the ECF will be dredged and placed inside the ECF, and
(3) marginally contaminated sediments will be capped with a thin layer of clean sand (105,000 m^3).

It is the dredging associated with filling the ECF that prompted this study; in particular, the need to treat the decant water from the ECF that will be displaced by incoming contaminated sediment before it is released back to the harbour.

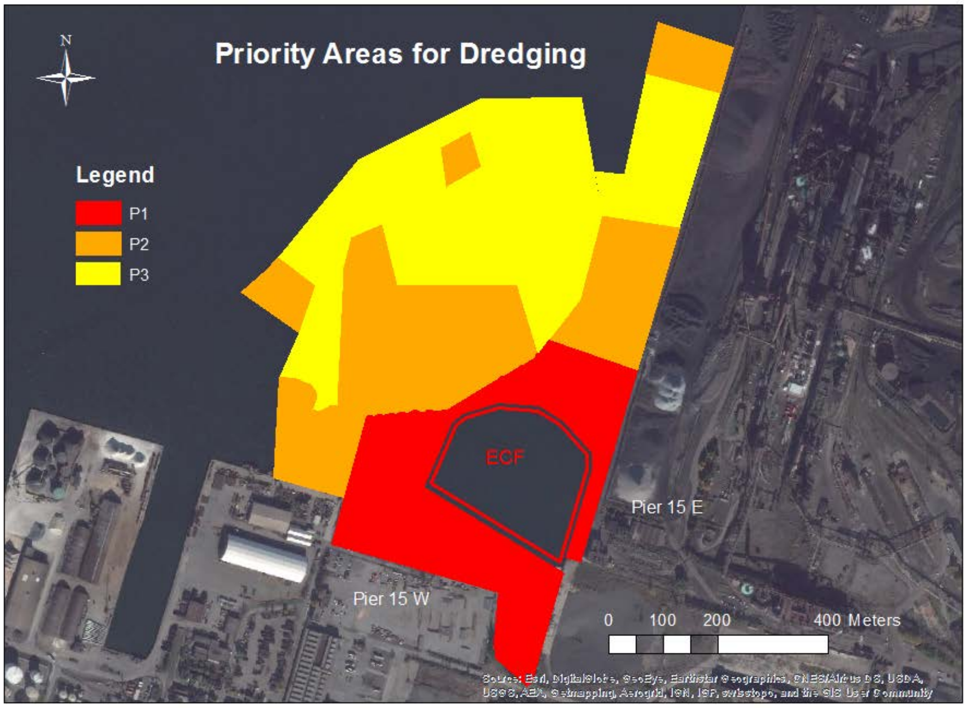

Figure 1 – Priority Areas for Dredging

OBJECTIVES

The details of how to treat decant water displaced from the ECF as it is filled with contaminated sediment is not being specified to the bidding contractors, rather the final effluent concentrations they are required to meet will be specified. Previous treatability study data will be provided and the contractor will be expected to design their water treatment plant accordingly.

The ECF is divided into two halves by an internal wall that acts like a weir, allowing the dredge slurry to be placed in one half, while the decant water resulting from the settling of suspended solids is pumped from the other half to be treated. It is anticipated that water treatment will consist of pumping decant water into the final settling cell, addition of polymer and eventual treatment by sand filters and granular activated carbon before discharge back into the harbour. As each side of the facility gradually fills up with contaminated sediment, the time allowed for settling of suspended sediment within the two halves of the main cell is decreased. Modeling of the system has been conducted in order to estimate the total suspended solids (TSS) concentrations associated with various stages of the ECF being filled. The benefits of providing an estimate of the chemical loadings associated with different contaminant and TSS concentrations was also noted as this information will allow bidders to better design and price their treatment operations.

In 2012, Environment and Climate Change Canada (EC) created elutriates (at 25, 50 and 75 mg/L TSS), using very heavily contaminated Priority 1 sediments and site water. These elutriates (filtered and unfiltered) were analyzed for concentrations of metals and PAHs, compared to various toxicological reference values, utilized in laboratory toxicity tests and ultimately used to set water quality criteria during dredging. The analytical data from this study has relevance to this study as the high contaminant concentrations in the sediment used provides elevated chemical loadings data. Since the amount of sediment that is at these very high concentrations of contamination is limited at the site, using this data alone would not be representative.

The current study was designed to assess the remaining range of loadings associated with the Priority 1 and 2 sediments and to place the areas associated with such levels at the site into context. The 2016 work utilized similar TSS levels of 20, 50 and 100 mg/L.

2 SCOPE OF WORK

The project consisted of the following tasks:

- Collection of contaminated sediment composite samples from six locations in the Randle Reef project area. The locations chosen were three from the Priority 1 area (the highest concentrations of contaminants) and three from the Priority 2 area. The majority of dredging covers Priority 1 and 2 sediments, with a large portion of the Priority 3 sediments destined for thin layer capping;

- Collection of site water from the project area;
- Analysis of PAHs and metals in the six composite sediment samples;
- Mixing of collected sediment from five of the six locations with site water to achieve three TSS concentrations (20, 50 and 100 mg/L) for each sample location (the 6^{th} site was discarded as it had a low tPAH concentration);
- Filtering of samples for dissolved concentrations and TSS analysis;
- Using regression analysis to determine the relationship between the concentrations of two contaminant types (tPAH and metals) and the associated chemical loadings at three TSS levels (20, 50 & 100 mg/L); and
- Interpretation and discussion of results.

3 METHODS

3.1 FIELD

Contaminated sediment from three Priority 1 and three Priority 2 locations (Figure 2) at the Randle Reef site was collected using a combination of gravity cores and ponar samplers. The samples were composites from a number of advances in the areas shown on Figure 2. Where gravity cores were used (the majority of the time), the sediment retained for analysis and use in the study was the portion that appeared to be the most contaminated (determined through visual / sensory observation (colour, sheen and odour)).

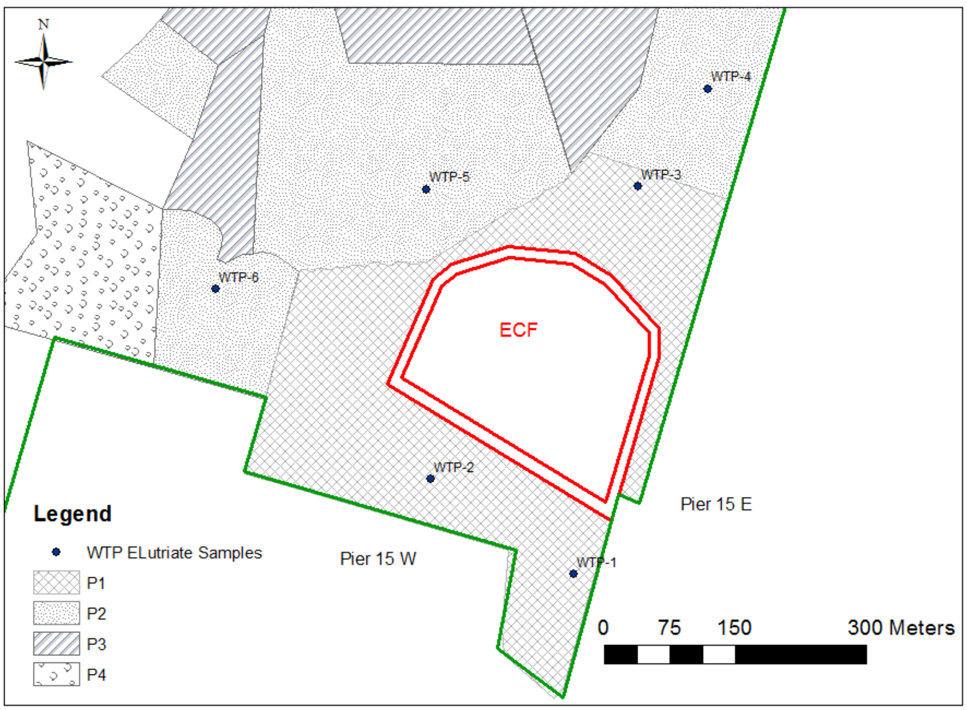

Figure 2 – 2016 Sample Locations.

The sediment collected was placed in a clean stainless steel bowl and mixed with a stainless steel trowel and subsequently placed into jars. All sampling equipment was then decontaminated using laboratory detergent followed by a methanol rinse and then a distilled water rinse.

Site water was also collected in the vicinity of the sediment sampling locations. Site water was pumped into stainless steel containers for future use during the elutriate sampling. All containers had been previously rinsed with methanol and distilled water. Each container was flushed out with harbour water for 5 minutes prior to collecting the sample. The locations of the samples used from the 2012 study were all from Priority 1 areas.

3.2 LABORATORY

3.2.1 Sediment Bulk Chemical Analysis

Prior to the preparation of the elutriate mixtures, the six sediment composite samples were submitted to AGAT laboratories for bulk chemistry analysis. Analysis included PAHs and metals in soil/sediment to determine the contaminant concentrations.

3.2.2 Elutriate Preparation and TSS Testing

Sediment was mixed with site water approximately 1 week after collection to achieve the target TSS concentrations (20, 50 and 100 mg/L). Sediment and site water were mixed using a mechanical mixer set at 250 revolutions per minute, for a period of 10 minutes. Due to low tPAH concentrations within sediment composite sample WTP-6, this sample was excluded from elutriate preparation.

Confirmation that the target TSS concentration had been achieved was determined by TSS analysis conducted by EC at the time of filtering.

TSS measurement was performed in-house by EC. The volume of water passed through a pre-weighed filter was recorded. The filter paper was subsequently dried at 100 degrees Celsius for 1 hour and placed in a desiccator for 10 minutes prior to obtaining the weight of filtrate. All filters used were 0.45 µm cellulose acetate. Those used for filtering metals were pre-soaked in a 5 molar HCl bath and rinsed with deionized water in accordance with protocols developed for Dredging Elutriate Tests (Palermo et al., 2008). Filtered and unfiltered water samples were then shipped to a commercial laboratory (AGAT Laboratories) for analysis of metals and PAHs.

All equipment in contact with the elutriate mix was decontaminated between tests using laboratory grade detergent, methanol rinse and a deionized water rinse.

The work conducted in 2012 followed the same procedures.

3.2.3 Elutriate Analysis

Water samples (both filtered and unfiltered) were analyzed at AGAT laboratories for low level PAHs and standard metals in water. The goal was to ensure the results were comparable to Provincial Water Quality Objectives (PWQOs) although it should be noted that the design specified PAH criteria for some PAHs is above the PWQOs. Filtered samples represent dissolved loadings and unfiltered samples represent total loadings, including contaminants adsorbed to sediment particles as well as those dissolved in the water.

4 RESULTS

4.1 Sediment

4.1.1 PAHs in Sediment

The tPAH results, a sum of the USEPA priority 16 PAHs, found in the sediment samples submitted are listed in Table 5 along with tPAH results from the 2012 work. When rearranged from highest to lowest, the samples display a decent range of contaminant concentrations from the Priority 1 and 2 areas. The Randle Reef site has a site specific clean-up criterion of 100 mg/kg tPAHs, as PAHs are the major driver for remediation at this site. As a result, we can use the level of tPAHs as a surrogate for the severity of contamination.

Table 1 – tPAHs in Sediment

Sample	DRET18 2012	DRET2 2012	DRET15 2012	WTP-2 2016	WTP-3 2016	WTP-4 2016	WTP-1 2016	WTP-5 2016	WTP-6 2016
tPAH (mg/kg)	14,535	8,446	6,725	2,000	460	240	82	71	55

4.1.2 Metals in Sediment

As expected, there were various exceedances of metals in the samples collected as well as in the 2012 samples. The exceedances include copper, iron, lead, manganese, silver and zinc. Complete results can be found in Appendix A.

Table 2– Selected Metals in Sediment

	Units	RDL	MOE SEL	WTP 1	WTP 2	WTP 3	WTP 4	WTP 5	WTP 6	DRET 2	DRET 15	DRET 18
Arsenic	ug/g	1	33	14	31	10	7	12	10	19	18	17
Cadmium	ug/g	0.5	10	3.9	9.9	2.9	1.2	4.5	3.6	9.2	9.3	9
Chromium	ug/g	2	n/v	78	81	59	43	41	56	110	110	110
Copper	ug/g	1	110	125	91	49	57	51	80	110	88	86
Iron	ug/g	50	40000	73900	148000	38800	27800	61800	33500	130000	100000	90000
Lead	ug/g	1	250	427	959	269	92	414	317	930	840	860
Manganese	ug/g	5	1100	1670	3870	1470	1190	1270	1230	2600	2800	2300

Mercury	ug/g	0.1	2	0.58	1.17	0.46	0.19	0.51	0.48	-	-	-
Nickel	ug/g	1	75	31	26	21	18	19	28	35	35	38
Zinc	ug/g	5	820	1970	5060	2020	597	1850	1710	4800	6100	5900

Complete results can be found in Appendix A

4.2 ELUTRIATE

4.2.1 TSS

The TSS achieved (Tables 3 and 4) in the elutriate mixes came relatively close to the target concentrations.

Table 3 Target TSS vs Actual (2016)

Target Concentration (mg/L)	Actual Concentration Achieved (mg/L)					
	WTP-1	**WTP-2**	**WTP-3**	**WTP-4**	**WTP-5**	**WTP-6**
20	15.67	39	22.67	29	24.33	25.67
50	42	73	63	57	61.33	63.33
100	92	92.67	109.33	106	105	109

Table 5 Target TSS vs Actual (2012)

Target Concentration (mg/L)	Actual Concentration Achieved (mg/L)		
	DRET 15C	**DRET 2**	**DRET 18C**
25	22	27	24
50	47	88	45
75	70	122	89

4.2.2 PAHs in Elutriates

The following analysis focuses on the *unfiltered* samples only as they are representative of what the water treatment plant will be receiving. The PAH concentrations in the filtered samples are provided for reference as they represent dissolved contaminants which could remain in the decant water following any settling and filtration stages that may be used by the contractor.

2012 Data:

As expected with the high concentrations of PAHs in the sediment from the 2012 samples, there are numerous exceedances of the PWQOs and the discharge criteria outlined in the engineering specifications in the created elutriates. The unfiltered samples contained higher concentrations of PAHs as compared to filtered, and the PAH concentrations increased as the TSS increased.

2016 Data:

The 2016 data followed the same general trend as 2012. It is noted that even at 20 mg/L TSS and tPAH concentrations less than 100 mg/kg in the sediment, exceedances of the PWQOs and the design specification discharge criteria occur.

The complete analytical results are presented in Appendix A.

4.2.3 Metals in Elutriates

2012 Data:

As expected with the high level of contamination in the sediment from the 2012 study, there are a number of exceedances of the PWQOs, typically for cadmium, copper, iron, lead, silver and zinc. Also, as expected, the unfiltered samples contained higher concentrations of metals as compared to filtered, and the concentrations increased as the TSS increased.

2016 Data:

The 2016 data followed the same general trends as 2012. It should be noted that even at 20 mg/L TSS and with tPAH concentrations less than 100 mg/kg in the sediment, a few metals still exceeded the PWQOs and the design specification discharge criteria.

Complete results are presented in Appendix A.

4.3 QA/QC RESULTS

4.3.1 Field Study

As part of the study's QA/QC procedures, field duplicate samples were collected for sediment from WTP-3 (PAHs only). To assess variability between field duplicates, the relative percent difference (RPD) was calculated for PAH results as follows:

RPD = 100% x ((sample – duplicate) / (sample + duplicate)/2)

An RPD of 40% (BC MOE 2009) applied to values greater than 5 times the MDL was used to identify significant differences between the original and the duplicate. RPD results are presented in Table 6 and show only one PAH compound that is over 40%.

Table 6 - RPDs

Polycyclic Aromatic Hydrocarbons (sediment)		WTP-3	WTP-3A (Dup)	RPD
2-and 1-methyl Naphthalene	ug/g	1.9	2.1	-10.00%
Acenaphthene	ug/g	11	9.6	13.59%
Acenaphthylene	ug/g	4.6	3.1	38.96%
Anthracene	ug/g	26	26	0.00%
Benz(a)anthracene	ug/g	37	36	2.74%
Benzo(a)pyrene	ug/g	27	27	0.00%
Benzo(b)fluoranthene	ug/g	41	39	5.00%
Benzo(g,h,i)perylene	ug/g	14	11	24.00%
Benzo(k)fluoranthene	ug/g	14	13	7.41%
Chrysene	ug/g	28	28	0.00%
Dibenz(a,h)anthracene	ug/g	3.8	2.2	53.33%
Fluoranthene	ug/g	89	88	1.13%
Fluorene	ug/g	11	9.5	14.63%
Indeno(1,2,3-cd)pyrene	ug/g	13	10	26.09%
Naphthalene	ug/g	72	71	1.40%
Phenanthrene	ug/g	64	65	-1.55%
Pyrene	ug/g	3.7	5.1	-31.82%

Randle Reef sediments are known to be highly variable and therefore an elevated RPD to this degree can be contributed to sample heterogeneity. Since all other PAH results fall within the acceptable RPD, the discrepancy with the Dibenz(a,h)anthracene result is not considered an indication of problems with the quality of the results.

5 DISCUSSION

5.1 Overview

As an end result of this work, quantification of predicted chemical loadings from the ECF decant water can be based upon;

- the concentration of sediment contaminants in the dredge areas;
- the corresponding PAH and metals concentrations in water at various TSS levels ; and
- the frequency of which these can be expected to occur.

These key factors can be examined using a few additional lines of evidence:

1. **Concentration Mapping and Distribution** - PAHs are the major driver for remediation at this site. They have also been found to be reasonably well co-related to the concentrations of metals at the site (Graham and Blukacz-Richards, 2015) As a result, we can use the level of tPAHs in sediment as a surrogate representing the general degree of contamination at the site. The range of tPAH concentration in sediment across the site can be grouped and visually presented on a map in order to provide an approximation of the extent of the various levels of contamination from a spatial perspective. Along with the mapping, examining the frequency of occurrence percentiles for each of the concentration range groups, is useful in order to place the various levels of contaminated sediment into context.

2. **Chemical Loading Grouping** - The chemical loadings in the created elutriates can be grouped into the same numerical categories as the mapping ranging from high tPAH concentrations to low. When combined with the mapping, this provides an approximation of the expected chemical loadings associated with the varying levels of contamination across the site. The relationship between metals and tPAHs described under Point 1 are also reinforced through this analysis.

5.2 Concentration Mapping and Distribution:

Mapping:

When considering the chemical concentrations within the sediment used to create the elutriates, the varying concentrations within sediment across the Randle Reef site should be referenced as a comparison.

Figure 3 – Concentration Mapping of tPAHs Across the Site. Note the area inside the ECF will not be dredged.

A large bulk chemistry database for Randle Reef exists which includes over 400 samples where tPAH has been specifically measured. This data was contoured using the "nearest neighbour" algorithm in ESRI ArcGIS 10.1 to produce a map with the tPAH concentration ranging from less than 100 to above 15,000 mg/kg. This map is presented as Figure 3 and also in Appendix B and provides an indication of the surface area impacted by the various levels of contamination that occur across the site. The typical dredge depth at the site is 1m.

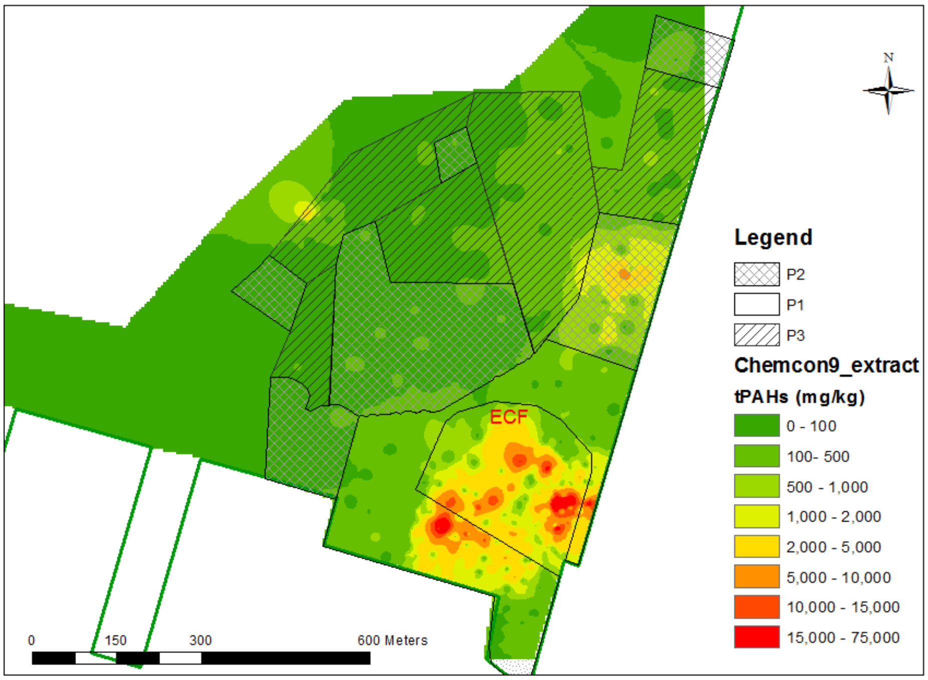

Figure 3 – tPAH concentration mapping

When viewing this map, it should be noted that the dredging includes Priority 1 and 2 sediments and a small amount of Priority 3 sediment located north of the ECF. The highly contaminated sediments located inside the ECF will be left untouched. A second map shows the locations of the samples used in the contouring exercise. It is evident from the map that the majority of the Priority 1 and 2 sediments that are slated for dredging contain tPAH concentrations that are less than 1,000 mg/kg, with large areas of the Priority 2s that are less than 500 mg/kg. The most impacted areas for dredging are located just south of the ECF and in the Priority 2 area directly north of the Priority 1 zone, along the US Steel dock wall. This indicates that the majority of the time (80 to 85%) the dredge will be pumping sediments into the ECF where PAHs are less than 1,000 mg/kg.

It should be noted that one extremely high sample of just over 166,000 mg/kg was removed from the data set prior to contouring as this was a sample of pure coal tar that was found in 2010. When included in the contouring, this sample was found to have too great an influence on the surrounding area (which was also sampled) giving a false representation of the average overall tPAH concentration.

To a lesser degree, a single sample located at the western edge of the Priority 3 areas also resulted in a false representation of tPAH concentrations in the surrounding sediment. Based on the surrounding sample results, the expected tPAH concentrations should be lower. Because this sample influences a smaller area and has a reasonable concentration compared to the average for the site, it has been retained in the database. This particular sample is at a depth of 0.4 to 0.5 m and this area will be capped, so no dredging will occur.

Frequency of Occurrence Percentiles:

Placing the tPAH concentrations across the site into percentiles also provides some perspective as to their frequency of occurrence. While Figure 3 is visually limited due to most of the points being less than 1,000 mg/kg (between 80 and 85% of the time), that in itself is an indication that the majority of samples from the site are less than 1,000 mg/kg.

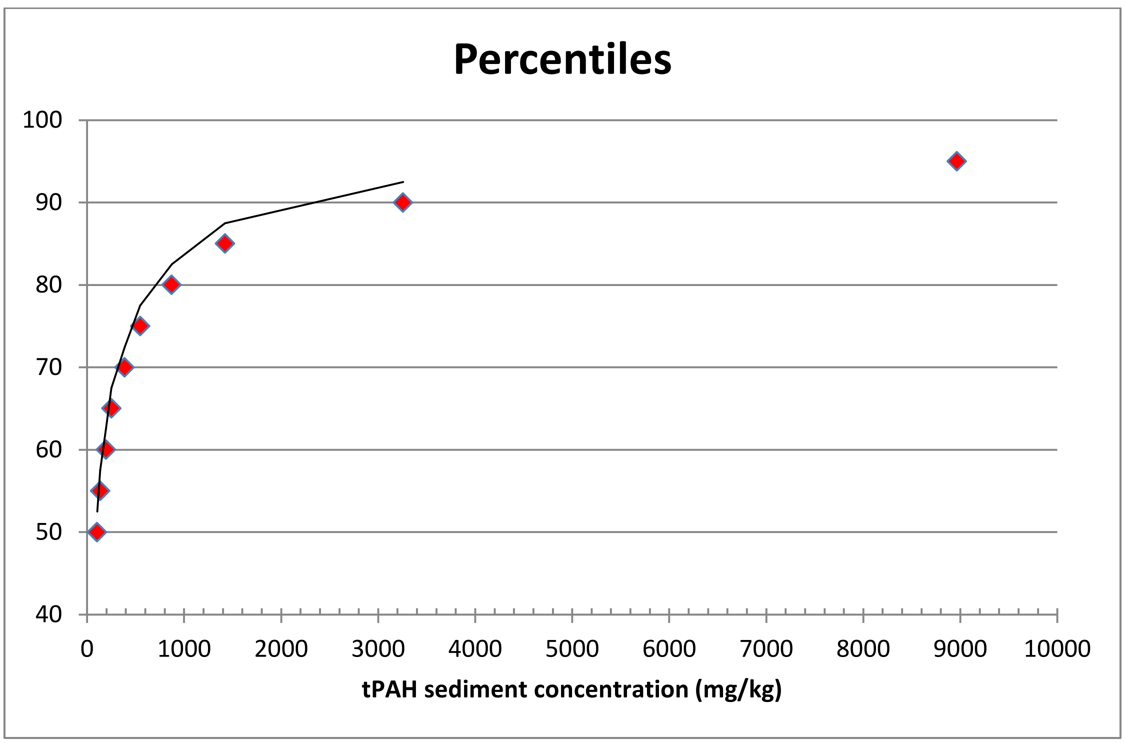

Figure 4 - Frequency of Occurrence Percentile Data for tPAH Concentration in Sediment at the Randle Reef Site.

Table 7 shows the same data in tabular view (50th to 99th percentile). As an example of its usage, the last line of this table indicates that 50% of the time the tPAH concentration can be expected to be below 104 mg/kg.

Table 7 – Frequency of Occurrence Percentiles for the tPAH Concentrations

Percentile	[tPAH](mg/kg)
99	50,399
95	8,966
90	3,257
85	1,422
80	873
75	548
70	387
65	251
60	195
55	136
50	104

It should be noted that the extremely high reading of 166,000 mg/kg was not removed from this data prior to calculating the percentiles as such a reading does not have the same pronounced influence as it does during contouring.

5.3 Chemical Loading Grouping

Table 1 presented previously, has already ordered the sediment samples in terms of the tPAH concentration with a reasonable distribution of concentrations from 55 mg/kg to greater than 14,000 mg/kg.

All chemical loadings are presented in Appendix A. Examining a few select plots of TSS vs contaminant concentrations in the elutriate water shows two obvious and expected trends:

1. As TSS increases, so does the chemical loading in the elutriate; and
2. The higher the concentration of contaminants in the sediment, the higher the chemical loading in the elutriate.

These selected plots are presented in Appendix D.

As a next step, the sediment tPAH concentration range presented in Table 1 can then be utilized with statistical analysis. Regression equations can be developed to estimate the chemical loadings within the resulting elutriate at the same contaminant concentration intervals provided in the concentration mapping exercise (Appendix B). The regressions consist of a combination of linear regression and power functions. In a number of cases, power functions were able to better represent the data. As a result, the better of the 2 methods was utilized.

When the tPAH concentrations in the sediment are regressed against the concentrations of contaminants found in the elutriate liquid, for each TSS level, reasonable relationships were observed for most of the contaminants selected (tPAHs, Naphthalene, Acenaphthylene and 5 key metals. These plots also reinforce the relationship between tPAHs and metal that was found under Graham and Blukacz-Richards (2015). Selected regression plots are presented in Appendix C.

Tables 9 and 11 present the results, including the regression coefficient as well as predicted contaminant loadings for the specific tPAH concentration intervals in the contaminated sediment identified with the concentration mapping. None of the regression coefficients were over 0.9 but most were greater than 0.70, so the resulting equation does introduce some uncertainty when using to estimate elutriate concentrations. It should be noted that environmental data is often quite variable so R^2 values of above 0.7 would be considered to be a good relationship.

Tables 8 and 10 present the actual data with the concentrations of tPAH and the equivalent range from the concentration mapping distribution. As explained previously, this consisted of slotting the actual sample results into intervals that were common to the mapping.

The two types of tables together (regression tables and the equivalent range tables) provide a range of results, however due to the known variability of Randle Reef sediment as well as the uncertainties associated with this analysis, it may be prudent to rely on the more conservative approach which is the regression-generated.

Table 8- Selected PAH Results Organized into Ranges Equivalent to the Mapping

Sample #	DRET18 2012	DRET2 2012	DRET15 2012	WTP-2 2016	WTP-3 2016	WTP-4 2016	WTP-1 2016
[tPAH] in sediment (mg/kg)	14,535	8,446	6,725	2,000	460	240	82
Map Equivalent Range	10,000-15,000	5,000-10,000	5,000-10,000	1,000-2,000	100-500	100-500	0-100
TSS 20 (mg/L)							
tPAH in water (ug/L)	92	25	87	4.47	3.82	0.67	0.83
Naphthalene in water (ug/L)	71	14.1	63	1.05	0.102	0.054	0.113
Anthracene in water (ug/L)	1.35	0.143	1.65	0.081	0.002	0.02	0.016
TSS 50 (mg/L)							
tPAH in water (ug/L)	224	197	127	9.22	13.2	1.08	2.6
Naphthalene in water (ug/L)	195	155	88	1.34	0.413	0.106	0.33
Anthracene in water (ug/L)	2.08	2.5	2.63	0.219	0.393	0.028	0.069
TSS 100 (mg/L)							
tPAH in water (ug/L)	404	185	416	17.9	20.6	1.49	5.56
Naphthalene in water (ug/L)	331	122	339	1.54	0.767	0.144	0.789
Anthracene in water (ug/L)	4.45	3.88	4.72	0.677	0.586	8E-04	0.11

Table 9 - Application of Selected PAH Regression Equations

		[tPAH] sediment (mg/kg)						
		15,000	**10,000**	**5,000**	**2,000**	**1,000**	**500**	**100**
TSS (mg/L)	**R^2**	**tPAH in water (ug/L)**						
20 -25	0.88	100.43	64.40	30.13	11.04	5.17	2.42	0.41
50	0.93	274.69	181.69	88.69	32.89	14.29	4.99	-2.45
75-100	0.82	628.74	383.38	164.56	53.80	23.09	9.91	1.39
TSS (mg/L)	**R^2**	**Naphthalene in water (ug/L)**						
20 -25	0.87	84.93	42.90	13.35	2.85	0.89	0.28	0.02
50	0.86	282.11	138.04	40.68	8.09	2.38	0.70	0.04
75-100	0.8	574.03	271.26	75.31	13.84	3.84	1.07	0.05
TSS (mg/L)	**R^2**	**Anthracene in water (ug/L)**						
20 -25	0.66	2.59	1.40	0.49	0.12	0.04	0.02	0.00
50	0.68	3.88	2.55	1.23	0.43	0.16	0.03	-0.07
75-100	0.52	6.64	4.43	2.22	0.89	0.45	0.23	0.05

Table 10 - Selected Metals Results Organized into Ranges Equivalent to the Mapping

Sample #	DRET18 2012	DRET2 2012	DRET15 2012	WTP-2 2016	WTP-3 2016	WTP-4 2016	WTP-1 2016
[tPAH] in sediment (mg/kg)	14,535	8,446	6,725	2,000	460	240	82
Map Equivalent Range	10,000-15,000	5,000-10,000	5,000-10,000	1,000-2,000	100-500	100-500	0-100
TSS 20 -25 (mg/L)							
Cd in water (ug/L)	0.46	0.66	0.44	0.1	0.2	0.1	0.2
Pb in water (ug/L)	38	64	36	14	5	2	4
Zn in water (ug/L)	260	330	280	83	40	18	32
Cr in water (ug/L)	5	6.4	2.5	3	3	3	3
Fe in water (ug/L)	1700	3700	1700	520	160	150	280
TSS 50 (mg/L)							
Cd in water (ug/L)	0.68	1.3	0.64	0.5	0.1	0.1	0.2
Pb in water (ug/L)	70	130	53	36	14	4	13
Zn in water (ug/L)	430	700	410	221	110	27	64
Cr in water (ug/L)	7.3	13	6.8	3	3	3	4
Fe in water (ug/L)	2500	8000	2600	1320	570	360	630
TSS 75-100 (mg/L)							
Cd in water (ug/L)	1.7	1.9	0.96	1	0.4	0.1	0.4
Pb in water (ug/L)	140	200	100	95	32	7	28
Zn in water (ug/L)	950	1100	780	531	232	46	146
Cr in water (ug/L)	16	20	11	7	5	3	6
Fe in water (ug/L)	5800	14000	4800	3820	1240	750	1940

Table 11 - Application of Selected Metals Regression Results

		[tPAH] in sediment (mg/kg)						
		15,000	10,000	5,000	2,000	1,000	500	100
TSS (mg/L)	**R^2**	**Cd in water (ug/L)**						
20 -25	0.61	0.82	0.57	0.33	0.18	0.13	0.10	0.08
50	0.72	1.38	1.08	0.72	0.41	0.27	0.18	0.07
75-100	0.75	2.41	1.69	0.97	0.54	0.40	0.33	0.27
TSS (mg/L)	**R^2**	**Pb in water (ug/L)**						
20 -25	0.86	66.07	49.43	30.11	15.63	9.52	5.80	1.83
50	0.76	137.17	103.76	64.38	34.26	21.26	13.19	4.36
75-100	0.71	279.77	211.06	130.38	68.97	42.60	26.32	8.60
TSS (mg/L)	**R^2**	**Zn in water (ug/L)**						
20 -25	0.88	391.78	302.72	194.80	108.76	69.99	45.04	16.18
50	0.82	793.15	609.64	388.78	214.50	136.79	87.23	30.69
75-100	0.78	1646.11	1257.66	793.83	432.08	272.73	172.14	59.14
TSS (mg/L)	**R^2**	**Cr in water (ug/L)**						
20 -25	0.44	7.75	5.79	3.84	2.67	2.28	2.08	1.93
50	0.54	12.32	10.49	7.98	5.55	4.22	3.21	1.70
75-100	0.74	23.46	16.83	10.19	6.21	4.88	4.22	3.69
TSS (mg/L)	**R^2**	**Fe in water (ug/L)**						
20 -25	0.77	3397.85	2528.20	1525.18	781.94	471.72	284.57	88.01
50	0.74	5945.67	4597.45	2962.05	1656.55	1067.29	687.63	247.77

75-100	0.68	12750.04	9955.73	6522.38	3729.17	2443.12	1600.58	599.54

6 CONCLUSIONS

Elutriate and the related sediment data from the 2012 and 2016 studies has been summarized and presented in this report along with the spatial representation of tPAH concentrations within the sediment at the Randle Reef site in order to provide insight into the potential chemical loadings for ECF decant water during Stage 2. These concentrations reflect the varying contamination across the dredge area along with the potential loadings of these contaminant concentrations at varying TSS levels.

In general it can be seen from the concentration mapping and the frequency of occurrence percentile data that, of the areas that require dredging, the majority are not heavily contaminated and as such the associated expected chemical loadings will be reduced. The chemistry results indicate that water treatment for PAHs and metals will still be required in areas with low contaminant concentrations, even at low TSS levels.

Due to the known variability of Randle Reef sediment in addition to some uncertainty resulting from the mapping analysis, it may be prudent to rely on the more conservative loadings estimation which is the regression-generated (Tables 8 and 10, Appendix C).

7 ACKNOWLEDGEMENTS

EC would like to acknowledge Christina Jaskot for assistance with the set-up of the laboratory component and Riggs Engineering for advice and guidance in the development of this study.

8 REFERENCES

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Appendix A – Full Chemistry Data

Chemical Results for Sediment

PAH Concentrations in Sediment 2012

Sample No.	Units	RR Clean-up Criteria (mg/kg)	DRET 2	DRET 15C	DRET 18C
Depth (m)			0-0.1	-0.1 - 1.16	-0.1 - 0.84
Naphthalene	mg/kg	-	8100	6100	14000
2-Methylnaphthalene	mg/kg	-	94	110	86
1-Methylnaphthalene	mg/kg	-	24	50	39
Acenaphthylene	mg/kg	-	6.1	8.1	15
Acenaphthene	mg/kg	-	25	52	37
Fluorene	mg/kg	-	23	25	24
Phenanthrene	mg/kg	-	76	120	100
Anthracene	mg/kg	-	24	52	39
Fluoranthene	mg/kg	-	52	110	90
Pyrene	mg/kg	-	37	75	65
Benzo(a)anthracene	mg/kg	-	25	31	27
Chrysene	mg/kg	-	21	31	26
Benzo(b/j)fluoranthene	mg/kg	-	17	45	40
Benzo(k)fluoranthene	mg/kg	-	7.4	13	12
Benzo(a)pyrene	mg/kg	-	13	30	28
Indeno(1,2,3-cd)pyrene	mg/kg	-	9.5	14	13
Dibenzo(a,h)anthracene	mg/kg	-	2.7	5	5
Benzo(ghi)perylene	mg/kg	-	7.6	14	14
Total PAH	mg/kg	100	8446.3	6725.1	14535
TOC	mg/kg	n/v	120000	130000	130000
TOC	%	n/v	12	13	13

Total PAH = the sum of the USEPA 16 priority PAH compound

Analytical Results for PAH Compounds in Sediment 2016

Polyaromatic Hydrocarbons	Units	RDL	RR Clean-up Criteria	WTP 1 7527929	WTP 2 7527932	WTP 3 7527934	WTP 3A 7527937	WTP 4 7527938	WTP 5 7527940	WTP 6 7527942
Acenaphthene	ug/g	0.05	-	1.9	16	11	9.6	3.6	1.2	0.77
Acenaphthylene	ug/g	0.05	-	1.4	4.7	4.6	3.1	3.1	0.66	0.7
Anthracene	ug/g	0.05	-	3.3	17	26	26	12	1.9	2.5
Benzo(a)anthracene	ug/g	0.05	-	7.9	27	37	36	18	5.6	4.3
Benzo(a)pyrene	ug/g	0.05	-	6	19	27	27	12	2.9	3.2
Benzo(b)fluoranthene	ug/g	0.05	-	7.1	23	41	39	17	4.9	4.3
Benzo(g,h,i)perylene	ug/g	0.05	-	2.6	9.5	14	11	8.1	1.3	1.3
Benzo(k)fluoranthene	ug/g	0.05	-	3	10	14	13	5.7	2.2	2.1
Chrysene	ug/g	0.05	-	6.2	18	28	28	15	3.9	3.6
Dibenz(a,h)anthracene	ug/g	0.05	-	0.72	2.7	3.8	2.2	1.5	0.34	0.32
Fluoranthene	ug/g	0.05	-	15	60	89	88	52	11	8.1
Fluorene	ug/g	0.05	-	0.79	13	11	9.5	5.8	18	7.5
Indeno(1,2,3-cd)pyrene	ug/g	0.05	-	2.5	8.9	13	10	7.1	1.2	1.3
Phenanthrene	ug/g	0.05	-	8.3	57	72	71	38	7.2	4.9
Pyrene	ug/g	0.05	-	12	45	64	65	37	8.2	6.5
Naphthalene	ug/g	0.05	-	4.3	1700	3.7	5.1	3	1.2	3.4
2- and 1- methyl Naphthalene	ug/g	0.05	-	0.78	57	1.9	2.1	0.77	0.61	0.34
Total PAH**	**ug/g**	**0.03**	**100**	**82**	**2000**	**460**	**440**	**240**	**71**	**55**

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RDL=Reportable Detection Limit

**Total PAH; the sum of the USEPA 16 priority PAH compound

* - Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An Integrated Approach (Ontario Ministry of the Environment, May 2008)

Metal Concentrations in Sediment 2012

Sample No.	Units	MOE LEL[2]	MOE SEL[2]	DRET 2	DRET 15C	DRET 18C
Sample Date				June 4/12	July 5/12	July 5/12
Depth (m)				0 - 0.1	-0.1 - 1.16	-0.1 - 0.84
Aluminum	mg/kg	n/v	n/v	8600	6600	6700
Antimony	mg/kg	n/v	n/v	2.2	2.3	2.0
Arsenic	mg/kg	6	33	19	18	17
Barium	mg/kg	n/v	n/v	110	100	100
Beryllium	mg/kg	n/v	n/v	1.5	1.2	1.5
Cadmium	mg/kg	0.6	10	9.2	9.3	9.0
Calcium	mg/kg	n/v	n/v	53000	56000	55000
Chromium (Total)	mg/kg	n/v	n/v	110	110	110
Cobalt	mg/kg	n/v	n/v	11	9.1	8.9
Copper	mg/kg	16	110	110	88	86
Iron	%	2	4	13	10	9
Lead	mg/kg	31	250	930	840	860
Magnesium	mg/kg	n/v	n/v	8300	8000	7900
Manganese	mg/kg	460	1100	2600	2800	2300
Mercury	mg/kg	0.2	2	-	-	-
Molybdenum	mg/kg	n/v	n/v	3.7	3.0	2.7
Nickel	mg/kg	16	75	35	35	38
Potassium	mg/kg	n/v	n/v	660	640	610
Silver	mg/kg	n/v	n/v	2.8	3.1	2.9
Sodium	mg/kg	n/v	n/v	260	200	230
Strontium	mg/kg	n/v	n/v	96	99	97
Thallium	mg/kg	n/v	n/v	3.3	3.2	3.3
Total Phosphorus	mg/kg	n/v	n/v	2000	1700	1800
Vanadium	mg/kg	n/v	n/v	42	38	36
Zinc	mg/kg	120	820	4800	6100	5900

2 - *Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An Integrated Approach* (Ontario Ministry of the Environment, May 2008)

Exceeds SEL

n/v' = no criterion value available

'-' = criterion not analyzed for

Analytical Results for Metals in Sediment 2016

Metals	Units	RDL	MOE LEL*	MOE SEL	WTP 1 7527929	WTP 2 7527932	WTP 3 7527934	WTP 4 7527938	WTP 5 7527940	WTP 6 7527942
Arsenic	ug/g	1	6	33	14	31	10	7	12	10
Cadmium	ug/g	0.5	0.6	10	3.9	9.9	2.9	1.2	4.5	3.6
Chromium	ug/g	2	n/v	n/v	78	81	59	43	41	56
Copper	ug/g	1	16	110	125	91	49	57	51	80
Iron	ug/g	50	20000	40000	73900	148000	38800	27800	61800	33500
Lead	ug/g	1	31	250	427	959	269	92	414	317
Manganese	ug/g	5	460	1100	1670	3870	1470	1190	1270	1230
Mercury	ug/g	0.1	0.2	2	0.58	1.17	0.46	0.19	0.51	0.48
Nickel	ug/g	1	16	75	31	26	21	18	19	28
Zinc	ug/g	5	120	820	1970	5060	2020	597	1850	1710

RDL=Reportable Detection Limit

SEL = Severe Effect Level, Guideliness For The Protection And Management Of Aquatic Sediment Quality In Onatrio. August 1993.

* - Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An Integrated Approach (Ontario Ministry of the Environment, May 2008)

Chemical Results for Elutriates

Total PAH Concentrations in Water

Sample No.	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	DRET 2-75 TSS = 25 mg/L	DRET 2-75 TSS = 25 mg/L	DRET 2-155 TSS = 50 mg/L	DRET 2-155 TSS = 50 mg/L	DRET 2-230 TSS = 75 mg/L	DRET 2-230 TSS = 75 mg/L
Naphthalene	7	1.1	7	***14.1***	***83.4***	***155***	***307***	***122***	***549***
Acenaphthylene				0.452	0.0397	1.12	0.0551	1.45	0.0742
Acenaphthene		5.8	5.8	0.124	0.534	2.44	0.782	5.15	1.05
Fluorene	0.2	3	0.2	0.0606	0.141	***2.48***	0.105	***4.51***	0.149
Phenanthrene	0.03	0.4	0.05	***1.62***	***0.12***	***8.75***	***0.0855***	***14.6***	***0.092***
Anthracene	0.0008	0.012	0.05	***0.143***	*0.00551*	***2.5***	*0.0031*	***3.88***	*0.00334*
Fluoranthene	0.0008	0.04	0.05	***1.98***	*0.0104*	***6.72***	*0.00468*	***8.95***	*0.00495*
Pyrene		0.025	0.05	**1.83**	0.00799	**4.78**	0.00418	**6.39**	0.00383
Chrysene	0.0001		0.05	***0.87***	*0.0068*	***2.38***	*0.00431*	***3.34***	*0.00376*
Benzo[b]fluoranthene	0.0002			*0.659*	*0.00491*	*1.72*	*0.00416*	*2.38*	*0.00361*
Benzo[k]fluoranthene	0.0002		0.05	***0.68***	*0.00649*	***2.15***	*0.00455*	***2.74***	*0.00427*
Benzo[a]pyrene				0.85	0.00713	2.35	0.00526	3.03	0.00455
Benzo(a)anthracene	0.0004	0.018	0.05	***0.956***	*0.00705*	***2.33***	*0.00434*	***3.09***	*0.00383*
Dibenz[a,h]anthracene	0.002		0.1	***0.133***	0.00106	***0.359***	0.00087	***0.493***	0.00065
Indeno[1,2,3-cd]pyrene				0.443	0.00343	1.33	0.003	1.82	0.00264
Benzo[ghi]perylene	0.00002		0.1	***0.358***	*0.00294*	***1.01***	*0.00241*	***1.26***	*0.00223*
Total PAHs				**25.2586**	**84.298**	**197.4190**	**308.068**	**185.0830**	**550.403**

Notes

Unfiltered

Filtered

Bold Exceedances of the Specs

Italic Exceedances of the PWQOs but NOT Specs

Bold&Italic Exceedances of PWQOs AND Specs

Values have been changed to the detection limits where the values were under the detection limits

Sample No.	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	DRET 15C-B-75 TSS = 25 mg/L	DRET 15C-B-75 TSS = 25 mg/L	DRET 15C-75 TSS = 50 mg/L	DRET 15C-75 TSS = 50 mg/L	DRET 15C-155 TSS = 75 mg/L	DRET 15C-155 TSS = 75 mg/L
Naphthalene	7	1.1	7	***63.1***	***54***	***87.9***	***69.2***	***339***	***137***
Acenaphthylene				0.273	0.0471	0.589	0.105	1.11	0.204
Acenaphthene		5.8	5.8	2.76	0.981	4.51	1.53	**8.01**	2.32
Fluorene	0.2	3	0.2	***1.65***	0.169	***2.32***	***0.316***	***4.74***	***0.32***
Phenanthrene	0.03	0.4	0.05	***4.95***	0.0619	***7.63***	***0.133***	***16.3***	***0.0715***
Anthracene	0.0008	0.012	0.05	***1.65***	*0.00511*	***2.63***	*0.00901*	***4.72***	*0.00799*
Fluoranthene	0.0008	0.04	0.05	***3.9***	*0.0133*	***5.84***	*0.009*	***12.9***	*0.0155*
Pyrene		0.025	0.05	**2.86**	0.0115	**4.39**	0.00809	**9.43**	0.0136
Chrysene	0.0001		0.05	***1.16***	*0.00737*	***1.81***	*0.00592*	***3.26***	*0.00826*
Benzo[b]fluoranthene	0.0002			*0.854*	*0.00737*	*1.55*	*0.00524*	*2.81*	*0.007*
Benzo[k]fluoranthene	0.0002		0.05	***0.847***	*0.00859*	***1.73***	*0.00576*	***3.14***	*0.00807*
Benzo[a]pyrene				1.03	0.00946	1.74	0.00734	3.4	0.00995
Benzo(a)anthracene	0.0004	0.018	0.05	***1.27***	*0.00892*	***1.97***	*0.00673*	***3.51***	*0.00957*
Dibenz[a,h]anthracene	0.002		0.1	***0.124***	0.00087	***0.218***	0.00054	***0.449***	0.00091
Indeno[1,2,3-cd]pyrene				0.517	0.00411	0.967	0.00285	1.76	0.00453
Benzo[ghi]perylene	0.00002		0.1	***0.434***	*0.00354*	***0.86***	*0.00242*	***1.53***	*0.00395*
Total PAHs				**87.379**	**55.339**	**126.654**	**71.347**	**416.069**	**140.005**

Notes

Unfiltered

Filtered

Bold Exceedances of the Specs

Italic Exceedances of the PWQOs but NOT Specs

Bold&Italic Exceedances of PWQOs AND Specs

Values have been changed to the detection limits where the values were under the detection limits

Total PAH Concentrations in Water

Sample No.	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	DRET 18C-75 TSS = 25 mg/L	DRET 18C-75 TSS = 25 mg/L	DRET 18C-155 TSS = 50 mg/L	DRET 18C-155 TSS = 50 mg/L	DRET 18C-230 TSS = 75 mg/L	DRET 18C-230 TSS = 75 mg/L
Naphthalene	7	1.1	7	***71.4***	***52.1***	***195***	***81.2***	***331***	***269***
Acenaphthylene				0.526	0.149	1.2	0.342	2.14	0.497
Acenaphthene		5.8	5.8	1.66	0.42	2.24	0.753	**5.94**	1.7
Fluorene	0.2	3	0.2	***1.11***	0.0742	***2***	0.183	***4.81***	***0.361***
Phenanthrene	0.03	0.4	0.05	***3.97***	*0.0394*	***6.32***	***0.0745***	***15.4***	***0.12***
Anthracene	0.0008	0.012	0.05	***1.35***	*0.00328*	***2.08***	*0.00561*	***4.45***	*0.0108*
Fluoranthene	0.0008	0.04	0.05	***3.32***	*0.00716*	***4.43***	*0.00995*	***12***	*0.0114*
Pyrene		0.025	0.05	**2.41**	0.00611	**3.24**	0.00791	**8.41**	0.00881
Chrysene	0.0001		0.05	***1.03***	*0.00558*	***1.3***	*0.00606*	***3.15***	*0.00638*
Benzo[b]fluoranthene	0.0002			0.778	0.00505	1.16	0.00543	2.53	0.00602
Benzo[k]fluoranthene	0.0002		0.05	***0.859***	*0.0049*	***1.05***	*0.00574*	***3.26***	*0.00644*
Benzo[a]pyrene				0.96	0.00595	1.3	0.00753	3.31	0.0074
Benzo(a)anthracene	0.0004	0.018	0.05	***1.12***	*0.00661*	***1.45***	*0.00696*	***3.42***	*0.00733*
Dibenz[a,h]anthracene	0.002		0.1	***0.142***	0.00076	***0.224***	0.00101	***0.546***	0.00134
Indeno[1,2,3-cd]pyrene				0.522	0.00264	0.732	0.00366	1.85	0.00374
Benzo[ghi]perylene	0.00002		0.1	***0.445***	*0.00225*	***0.629***	*0.00307*	***1.53***	*0.00327*
Total PAHs				**91.602**	**52.833**	**224.355**	**82.615**	**403.746**	**271.751**

Notes

Unfiltered

Filtered

Bold Exceedances of the Specs

Italic Exceedances of the PWQOs but NOT Specs

Bold&Italic Exceedances of PWQOs AND Specs

Values have been changed to the detection limits where the values were under the detection limits

PAHs in Water - WTP5

	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	RDL	WTP5-20F (ug/L)	WTP5-20U (ug/L)	WTP5-50F(ug/L)	WTP5-50U (ug/L)	WTP5-100F(ug/L)	WTP5-100U(ug/L)
1,3-Dimethylnaphthalene				0.0002	0.0135	0.0027	0.0459	0.0125	0.0967	0.018
1-Chloronaphthalene				0.0003	0.0003	0.0005	0.0003	0.0003	0.0004	0.0006
1-Methylnaphthalene	2		2	0.001	0.0040	0.0040	0.0230	0.0120	0.0680	0.019
2,3,5-Trimethylnaphthalene				0.0006	0.0138	0.0040	0.0292	0.0290	0.0513	0.045
2,6-Dimethylnaphthalene				0.0001	0.0093	0.0077	0.0207	0.0274	0.0421	0.044
2-Chloronaphthalene				0.00002	0.0001	0.0001	0.0001	0.0001	0.0001	0.00011
2-Methylnaphthalene	2		2	0.002	0.0020	0.0070	0.0030	0.0240	0.0040	0.039
Acenaphthylene				0.0001	0.0025	0.0151	0.0052	0.0594	0.0062	0.098
Acenaphthene		5.8	5.8	0.00008	0.0199	0.0052	0.0812	0.0326	0.1150	0.029
Acridine				0.0004	0.0106	0.0097	0.0079	0.0156	0.0099	0.026
Anthracene	0.0008	0.012	0.05	0.0002	*0.0050*	*0.0130*	*0.0110*	*0.0510*	*0.0139*	*0.125*
Benzo[a]Anthracene	0.0004	0.018	0.05	0.00009	*0.0012*	***0.1020***	*0.0012*	***0.4680***	*0.0022*	***0.639***
Benzo[a]Pyrene		0.015	0.015	0.0003	0.0013	**0.1250**	0.0014	**0.4400**	0.0017	**0.707**
Benzo(b+j)fluoranthene				0.0006	**0.0013**	**0.0760**	**0.0017**	**0.3070**	**0.0019**	**0.531**
Benzo(e)pyrene				0.0003	0.0010	0.0687	0.0010	0.2120	0.0014	0.333
Benzo[g,h,i]Perylene	0.00002		0.1	0.0002	*0.0004*	*0.0478*	*0.0009*	***0.1860***	*0.0007*	***0.316***
Benzo[k]Fluoranthene	0.0002		0.05	0.00004	*0.0009*	*0.0473*	*0.0007*	***0.1970***	*0.0010*	***0.36***
Chrysene	0.0001		0.05	0.00009	*0.0015*	***0.1190***	*0.0015*	***0.4270***	*0.0012*	***0.779***
Dibenzo[a,h]Anthracene	0.002		0.1	0.00008	0.0001	*0.0053*	0.0003	*0.0251*	0.0007	*0.0408*
Fluoroanthene	0.0008	0.04	0.05	0.0003	*0.0016*	***0.1520***	*0.0020*	***0.8160***	*0.0032*	***1.06***
Fluorene	0.2	3	0.2	0.0006	0.0150	0.0180	0.0360	0.0221	0.0610	0.0762
Indeno[1,2,3,c-d]Pyrene				0.0002	0.0008	0.0610	0.0007	0.2570	0.0009	0.417
Naphthalene	7	1.1	7	0.01	0.0100	0.0410	0.0100	0.1580	0.0100	0.239
Perylene	0.00007		0.05	0.0001	*0.0003*	*0.0300*	*0.0003*	***0.1070***	*0.0004*	***0.18***
Phenanthrene	0.03	0.4	0.05	0.002	0.0060	*0.0340*	*0.0280*	***0.1130***	***0.0990***	***0.241***
Pyrene		0.025	0.05	0.0009	0.0015	0.2000	0.0020	**0.6820**	0.0026	**0.88**
Quinoline				0.00009	0.0004	0.0006	0.0007	0.0007	0.0001	0.00067
tPAHs (USEPA) Priority 16					0.0678	0.9857	0.1821	3.9342	0.3193	6.007

Unfiltered

Filtered

Bold Exceedances of the Specs

Italic Exceedances of the PWQOs but NOT Specs

Bold&Italic Exceedances of PWQOs AND Specs

Values have been changed to the detection limits where the values were under the detection limits

PAHs in Water - WTP4

	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	RDL	WTP4-20F (ug/L)	WTP4-20U (ug/L)	WTP4-50F(ug/L)	WTP4-50U (ug/L)	WTP4-100F(ug/L)	WTP4-100U(ug/L)
1,3-Dimethylnaphthalene				0.0002	0.0019	0.0017	0.0014	0.0032	0.0015	0.0041
1-Chloronaphthalene				0.0003	0.0004	0.0006	0.0003	0.0009	0.0006	0.0004
1-Methylnaphthalene	2		2	0.001	0.001	0.002	0.001	0.004	0.001	0.005
2,3,5-Trimethylnaphthalene				0.0006	0.0026	0.0017	0.0016	0.002	0.0022	0.003
2,6-Dimethylnaphthalene				0.0001	0.0021	0.0045	0.0024	0.0087	0.0031	0.0118
2-Chloronaphthalene				0.00002	0.00009	0.00008	0.00008	0.0001	0.00008	0.0003
2-Methylnaphthalene	2		2	0.002	0.002	0.005	0.002	0.009	0.003	0.012
Acenaphthylene				0.0001	0.0035	0.0153	0.0086	0.0238	0.0118	0.0329
Acenaphthene		5.8	5.8	0.00008	0.0137	0.008	0.0251	0.014	0.0532	0.0216
Acridine				0.0004	0.007	0.0086	0.0055	0.0081	0.0058	0.0069
Anthracene	0.0008	0.012	0.05	0.0002	*0.0018*	*0.02*	*0.002*	*0.028*	*0.0009*	0.0008
Benzo[a]Anthracene	0.0004	0.018	0.05	0.00009	0.0004	*0.0467*	*0.0005*	***0.077***	*0.0006*	***0.104***
Benzo[a]Pyrene		0.015	0.015	0.0003	0.0004	**0.0708**	0.0005	**0.115**	0.0009	**0.179**
Benzo(b+j)fluoranthene				0.0006	**0.0006**	**0.0501**	**0.0008**	**0.0791**	0.0011	**0.111**
Benzo(e)pyrene				0.0003	0.0005	0.0412	0.0007	0.0633	0.0008	0.105
Benzo[g,h,i]Perylene	0.00002		0.1	0.0002	*0.0002*	*0.0472*	*0.0002*	*0.0764*	*0.0003*	***0.107***
Benzo[k]Fluoranthene	0.0002		0.05	0.00004	0.0002	*0.0254*	0.0002	*0.0484*	*0.0003*	***0.067***
Chrysene	0.0001		0.05	0.00009	*0.0012*	***0.0758***	*0.0009*	***0.0783***	*0.0008*	***0.118***
Dibenzo[a,h]Anthracene	0.002		0.1	0.00008	0.00007	*0.0034*	0.0002	*0.006*	0.0002	***0.0091***
Fluoroanthene	0.0008	0.04	0.05	0.0003	*0.0026*	***0.104***	*0.001*	***0.178***	*0.001*	***0.23***
Fluorene	0.2	3	0.2	0.0006	0.0048	0.007	0.0099	0.012	0.013	0.022
Indeno[1,2,3,c-d]Pyrene				0.0002	0.0002	0.0476	0.0003	0.0788	0.0006	0.115
Naphthalene	7	1.1	7	0.01	0.01	0.054	0.01	0.106	0.01	0.144
Perylene	0.00007		0.05	0.0001	0.0002	*0.0226*	*0.0004*	*0.0366*	*0.0002*	***0.055***
Phenanthrene	0.03	0.4	0.05	0.002	0.003	*0.046*	0.004	***0.0788***	0.005	***0.108***
Pyrene		0.025	0.05	0.0009	0.0019	**0.0993**	0.0018	**0.168**	0.0016	**0.233**
Quinoline				0.00009	0.0003	0.0001	0.0002	0.0001	0.0001	0.0001
tPAHs (USEPA) Priority 16					0.04397	0.6705	0.0652	1.0885	0.1002	1.4914

Unfiltered
Filtered
Bold Exceedances of the Specs
Italic Exceedances of the PWQOs but NOT Specs
Bold&Italic Exceedances of PWQOs AND Specs
Values have been changed to the detection limits where the values were under the detection limits

PAHs in Water - WTP3

	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	RDL	WTP3-20F (ug/L)	WTP3-20U (ug/L)	WTP3-50F(ug/L)	WTP3-50U (ug/L)	WTP3-100F(ug/L)	WTP3-100U(ug/L)
1,3-Dimethylnaphthalene				0.0002	0.0008	0.003	0.0097	0.0146	0.0264	0.0266
1-Chloronaphthalene				0.0003	0.0003	0.0008	0.0003	0.0003	0.0005	0.0004
1-Methylnaphthalene	2		2	0.001	0.001	0.007	0.001	0.024	0.035	0.04
2,3,5-Trimethylnaphthalene				0.0006	0.0015	0.0025	0.005	0.007	0.0123	0.012
2,6-Dimethylnaphthalene				0.0001	0.0014	0.0095	0.0054	0.0304	0.031	0.0612
2-Chloronaphthalene				0.00002	0.00005	0.0001	0.0002	0.00006	0.0001	0.0001
2-Methylnaphthalene	2		2	0.002	0.002	0.018	0.002	0.059	0.018	0.114
Acenaphthylene				0.0001	0.0028	0.0448	0.0136	0.159	0.0161	0.291
Acenaphthene		5.8	5.8	0.00008	0.0325	0.0473	0.322	0.184	1.11	0.314
Acridine				0.0004	0.006	0.0111	0.0076	0.0343	0.0099	0.059
Anthracene	0.0008	0.012	0.05	0.0002	*0.003*	*0.002*	*0.002*	***0.393***	*0.003*	***0.586***
Benzo[a]Anthracene	0.0004	0.018	0.05	0.00009	*0.0028*	***0.361***	*0.0042*	***1.11***	*0.0059*	***2.28***
Benzo[a]Pyrene		0.015	0.015	0.0003	0.0026	**0.401**	0.0048	**1.2**	0.0047	**2**
Benzo(b+j)fluoranthene				0.0006	**0.0022**	**0.315**	**0.0038**	**1.07**	**0.0052**	**2.1**
Benzo(e)pyrene				0.0003	0.0015	0.197	0.0027	0.562	0.0029	0.958
Benzo[g,h,i]Perylene	0.00002		0.1	0.0002	*0.0009*	***0.218***	*0.0013*	***0.72***	*0.0021*	***1.34***
Benzo[k]Fluoranthene	0.0002		0.05	0.00004	*0.0013*	***0.16***	*0.0021*	***0.412***	*0.0023*	***0.226***
Chrysene	0.0001		0.05	0.00009	*0.0019*	***0.263***	*0.0033*	***0.577***	*0.0044*	***1.68***
Dibenzo[a,h]Anthracene	0.002		0.1	0.00008	0.0003	*0.0186*	0.0002	*0.0594*	0.0002	***0.119***
Fluoroanthene	0.0008	0.04	0.05	0.0003	*0.0036*	***0.63***	*0.0077*	***2.73***	*0.0109*	***3.75***
Fluorene	0.2	3	0.2	0.0006	0.0067	0.042	0.128	0.149	***0.504***	***0.249***
Indeno[1,2,3,c-d]Pyrene				0.0002	0.0008	0.206	0.0023	1.01	0.0026	1.54
Naphthalene	7	1.1	7	0.01	0.01	0.102	0.01	0.413	0.01	0.767
Perylene	0.00007		0.05	0.0001	*0.0007*	***0.118***	*0.0008*	***0.358***	*0.0011*	***0.592***
Phenanthrene	0.03	0.4	0.05	0.002	0.011	***0.325***	0.02	***1.13***	***0.524***	***1.94***
Pyrene		0.025	0.05	0.0009	0.0066	**1**	0.0121	**2.95**	0.0169	**3.58**
Quinoline				0.00009	0.0001	0.00009	0.0002	0.0006	0.0001	0.0007
tPAHs (USEPA) Priority 16					0.0868	3.8207	0.5336	13.1964	2.2171	20.662

Unfiltered
Filtered
Bold Exceedances of the Specs
Italic Exceedances of the PWQOs but NOT Specs
Bold&Italic Exceedances of PWQOs AND Specs
Values have been changed to the detection limits where the values were under the detection limits

PAHs in Water - WTP2

	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	RDL	WTP2-20F (ug/L)	WTP2-20U (ug/L)	WTP2-50F(ug/L)	WTP2-50U (ug/L)	WTP2-100F(ug/L)	WTP2-100U(ug/L)
1,3-Dimethylnaphthalene				0.0002	0.0543	0.0099	0.105	0.0262	0.386	0.115
1-Chloronaphthalene				0.0003	0.00003	0.00003	0.00003	0.00003	0.0004	0.0004
1-Methylnaphthalene			2	0.001	0.0078	0.0207	0.0108	0.0548	0.0868	0.183
2,3,5-Trimethylnaphthalene				0.0006	0.02	0.005	0.038	0.014	0.0943	0.096
2,6-Dimethylnaphthalene				0.0001	0.0655	0.0219	0.122	0.06	0.467	0.229
2-Chloronaphthalene				0.00002	0.00003	0.00003	0.00003	0.00003	0.00004	0.00009
2-Methylnaphthalene			2	0.002	0.0011	0.0874	0.0012	0.22	0.0033	0.886
Acenaphthylene				0.0001	0.0079	0.0725	0.0115	0.203	0.0251	0.566
Acenaphthene		5.8	5.8	0.00008	0.108	0.0507	0.162	0.104	0.575	0.334
Acridine				0.0004	0.0082	0.0168	0.0144	0.0493	0.0171	0.104
Anthracene	0.0008	0.012	0.05	0.0002	*0.0265*	***0.081***	*0.046*	***0.219***	***0.13***	***0.677***
Benzo[a]Anthracene	0.0004	0.018	0.05	0.00009	*0.0019*	***0.372***	*0.0028*	***0.721***	*0.0051*	***1.18***
Benzo[a]Pyrene		0.015	0.015	0.0003	0.0024	**0.428**	0.0034	**1.14**	0.0055	**2.12**
Benzo(b+j)fluoranthene				0.0006	0.0026	0.315	0.0036	0.892	0.0046	1.66
Benzo(e)pyrene				0.0003	0.0015	0.21	0.0022	0.565	0.0034	1.27
Benzo[g,h,i]Perylene	0.00002		0.1	0.0002	*0.0009*	***0.224***	*0.0012*	***0.622***	*0.0024*	***1.86***
Benzo[k]Fluoranthene	0.0002		0.05	0.00004	*0.0013*	***0.206***	*0.0015*	***0.572***	*0.0029*	***0.872***
Chrysene	0.0001		0.05	0.00009	*0.0019*	***0.211***	*0.0031*	***0.428***	*0.0048*	***0.618***
Dibenzo[a,h]Anthracene	0.002		0.1	0.00008	0.00007	*0.0261*	0.0002	*0.0748*	0.0002	***0.22***
Fluoroanthene	0.0008	0.04	0.05	0.0003	*0.0033*	***0.444***	*0.005*	***1.04***	*0.009*	***1.79***
Fluorene	0.2	3	0.2	0.0006	0.0513	0.045	0.085	0.084	**0.311**	**0.355**
Indeno[1,2,3,c-d]Pyrene				0.0002	0.0012	0.32	0.0014	0.946	0.0037	2.5
Naphthalene	7	1.1	7	0.01	0.01	1.05	0.01	1.34	0.019	1.54
Perylene			0.05	0.0001	0.0005	0.119	0.0007	0.347	0.0015	0.995
Phenanthrene	0.03	0.4	0.05	0.002	0.014	***0.278***	***0.111***	***0.678***	***0.62***	***1.83***
Pyrene		0.025	0.05	0.0009	0.0036	**0.667**	0.005	**1.05**	0.009	**1.45**
Quinoline				0.00009	0.00007	0.0004	0.0003	0.00009	0.00007	0.0008
tPAHs (USEPA) Priority 16					0.23427	4.4753	0.4491	9.2218	1.7227	17.912

Unfiltered
Filtered
Bold Exceedances of the Specs
Italic Exceedances of the PWQOs but NOT Specs
Bold&Italic Exceedances of PWQOs AND Specs
Values have been changed to the detection limits where the values were under the detection limits

PAHs in Water - WTP1

	PWQOs (ug/L)	CCME (ug/L)	Specs (ug/L)	RDL	WTP1-20F (ug/L)	WTP1-20U (ug/L)	WTP1-50F(ug/L)	WTP1-50U (ug/L)	WTP1-100F(ug/L)	WTP1-100U(ug/L)
1,3-Dimethylnaphthalene				0.0002	0.0006	0.0024	0.0014	0.0065	0.0194	0.0163
1-Chloronaphthalene				0.0003	0.0005	0.00003	0.00003	0.00003	0.00004	0.00005
1-Methylnaphthalene			2	0.001	0.0006	0.0034	0.0004	0.008	0.0009	0.0194
2,3,5-Trimethylnaphthalene				0.0006	0.0016	0.0029	0.0055	0.008	0.0194	0.017
2,6-Dimethylnaphthalene				0.0001	0.0005	0.0049	0.001	0.013	0.011	0.0463
2-Chloronaphthalene				0.00002	0.00007	0.00002	0.00003	0.00002	0.00003	0.00004
2-Methylnaphthalene			2	0.002	0.0009	0.0092	0.0008	0.0217	0.0015	0.0605
Acenaphthylene				0.0001	0.0012	0.0138	0.0019	0.0474	0.0037	0.114
Acenaphthene		5.8	5.8	0.00008	0.0014	0.0043	0.0091	0.0157	0.065	0.0337
Acridine				0.0004	0.0059	0.0079	0.0067	0.015	0.0072	0.0238
Anthracene	0.0008	0.012	0.05	0.0002	*0.0012*	*0.016*	*0.002*	***0.069***	*0.0092*	***0.11***
Benzo[a]Anthracene	0.0004	0.018	0.05	0.00009	*0.001*	***0.0722***	*0.0018*	***0.306***	*0.002*	***0.497***
Benzo[a]Pyrene		0.015	0.015	0.0003	0.0009	**0.0947**	0.0016	**0.335**	0.0018	**0.694**
Benzo(b+j)fluoranthene				0.0006	**0.0012**	**0.0691**	**0.0022**	**0.25**	**0.0024**	**0.564**
Benzo(e)pyrene				0.0003	0.0008	0.0568	0.0015	0.18	0.0015	0.389
Benzo[g,h,i]Perylene	0.00002		0.1	0.0002	*0.0005*	*0.0476*	*0.0008*	***0.179***	*0.0009*	***0.4***
Benzo[k]Fluoranthene	0.0002		0.05	0.00004	*0.0005*	*0.043*	*0.0008*	***0.153***	*0.001*	***0.326***
Chrysene	0.0001		0.05	0.00009	*0.0005*	***0.0718***	*0.0017*	***0.159***	*0.002*	***0.594***
Dibenzo[a,h]Anthracene	0.002		0.1	0.00008	0.0002	*0.0051*	0.0001	*0.0184*	0.0002	*0.0371*
Fluoroanthene	0.0008	0.04	0.05	0.0003	*0.0015*	***0.0801***	*0.0019*	***0.301***	*0.0031*	***0.572***
Fluorene	0.2	3	0.2	0.0006	0.0011	0.004	0.005	0.014	0.024	0.042
Indeno[1,2,3,c-d]Pyrene				0.0002	0.0004	0.0681	0.0013	0.22	0.0013	0.535
Naphthalene	7	1.1	7	0.01	0.01	0.113	0.01	0.33	0.01	0.789
Perylene			0.05	0.0001	0.0002	0.0237	0.0003	0.0824	0.0003	0.165
Phenanthrene	0.03	0.4	0.05	0.002	0.002	*0.042*	0.003	***0.136***	0.005	***0.256***
Pyrene		0.025	0.05	0.0009	0.0029	**0.154**	0.0025	**0.402**	0.003	**0.676**
Quinoline				0.00009	0.00008	0.00008	0.00008	0.00009	0.00008	0.0008
tPAHs (USEPA) Priority 16					0.0253	0.8297	0.0435	2.6855	0.1322	5.6758

Unfiltered
Filtered
Bold Exceedances of the Specs
Italic Exceedances of the PWQOs but NOT Specs
Bold&Italic Exceedances of PWQOs AND Specs
Values have been changed to the detection limits where the values were under the detection limits

Metals Concentrations in Water (2012)

	Units	RDL	PWQOs[1]	Specs	DRET 2-75 TSS = 25 mg/L	DRET 2-75 TSS = 25 mg/L	DRET 2-155 TSS = 50 mg/L	DRET 2-155 TSS = 50 mg/L	DRET 2-230 TSS = 100 mg/L	DRET 2-230 TSS = 100 mg/L
Aluminum (Al)	ug/L	4	75	75	**570**	12	**1400**	14	**2300**	12
Antimony (Sb)	ug/L	3.00	20		ND	ND	0.70	0.62	0.82	ND
Arsenic (As)	ug/L	3.0	100	100	2.1	1.1	3.5	ND	4.7	ND
Barium (Ba)	ug/L	2.0	n/v		38	29	47	31	58	31
Beryllium (Be)[2]	ug/L	1.00	1100	1100	ND	ND	ND	ND	ND	ND
Bismuth (Bi)	ug/L				ND	ND	ND	ND	1.3	ND
Boron (B)	ug/L	10	200	200	57	54	65	61	68	59
Cadmium (Cd)[2]	ug/L	0.10	0.5	0.5	**0.66**	ND	**1.3**	ND	**1.9**	ND
Calcium (Ca)	ug/L				58000	51000	63000	51000	71000	52000
Total Chromium (Cr)	ug/L	3.0	9.9	8.9	6.4	ND	**13**	ND	**20**	ND
Cobalt (Co)	ug/L	0.50	0.9	0.9	ND	ND	**1.2**	ND	**1.8**	ND
Copper(Cu)[2]	ug/L	2.0	5	5	**8.8**	2.8	**15**	2.3	**23**	1.7
Iron (Fe)	ug/L	10	300	300	**3700**	110	**8000**	ND	**14000**	ND
Lead (Pb)[2]	ug/L	1.00	25	25	**64**	ND	**130**	ND	**200**	0.63
Lithium (Li)	ug/L				5.9	7.7	8.1	5.4	8.8	ND
Magnesium (Mg)	ug/L				14000	13000	15000	14000	17000	14000
Manganese (Mn)	ug/L	2.0	n/v		140	31	290	38	450	42
Molybdenum (Mo)	ug/L	2.00	40	40	4.4	4.4	4.4	4.3	4.7	4.2
Nickel (Ni)	ug/L	3.0	25	25	3.7	2.3	6.0	2.2	8.7	2.4
Potassium (K)	ug/L				5100	4700	5400	4700	5800	4900
Silicon (Si)	ug/L				1300	ND	2900	ND	4500	ND
Selenium (Se)	ug/L	4.0	100		ND	**210**	ND	**230**	ND	**210**
Silver (Ag)	ug/L	0.10	0.1	0.1	**0.14**	ND	**0.32**	ND	**0.55**	ND
Sodium (Na)	ug/L				59000	54000	61000	58000	65000	57000
Strontium (Sr)	ug/L	5.0	n/v		500	450	500	470	530	460
Tellurium (Te)	ug/L				ND	ND	ND	ND	ND	ND
Thallium (Tl)	ug/L	0.300	0.3		0.28	ND	**0.52**	ND	**0.75**	ND
Tin (Sn)	ug/L				4.9	ND	10	ND	16	ND
Titanium (Ti)	ug/L	2.0	n/v		16	ND	37	ND	63	ND
Tungsten (W)	ug/L	10.0	n/v		ND	ND	ND	ND	ND	ND
Uranium (U)	ug/L	2.00	5		0.70	0.59	0.76	0.57	0.85	0.60
Vanadium (V)	ug/L	2.00	6	6	2.6	1.5	4.4	ND	**7.2**	ND
Zinc (Zn)	ug/L	5.0	30	30	**330**	5.0	**700**	5.5	**1100**	ND
Zirconium (Zr)	ug/L	4.0	n/v		ND	ND	1.3	ND	1.8	ND

Notes

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2 - Depends on Hardness. According to the Hamilton Harbour Remedial Action Plan Stage 2 Update Report (2003), hardness has always exceeded 200mg/L in the Harbour.

Unfiltered = (dark grey)
Filtered = (light grey)
Bold = Exceedances

Metals Concentrations in Water (2012)

	Units	RDL	PWQOs[1]	Specs	DRET 15C-B- TSS = 25 mg/L	DRET 15C-B-75 TSS = 25 mg/L	DRET 15C-75 TSS = 50 mg/L	DRET 15C-75 TSS = 50 mg/L	DRET 15C-155 TSS = 100 mg/L	DRET 15C-155 TSS = 100 mg/L
Aluminum (Al)	ug/L	4	75	75	**290**	9.7	**430**	15	**760**	8.7
Antimony (Sb)	ug/L	3.00	20		0.68	0.54	0.72	ND	0.84	ND
Arsenic (As)	ug/L	3.0	100	100	1.5	ND	1.8	ND	3	ND
Barium (Ba)	ug/L	2.0	n/v		35	31	37	29	42	30
Beryllium (Be)[2]	ug/L	1.00	1100	1100	ND	ND	ND	ND	ND	ND
Bismuth (Bi)	ug/L				ND	ND	ND	ND	ND	ND
Boron (B)	ug/L	10	200	200	65	63	72	60	69	60
Cadmium (Cd)[2]	ug/L	0.10	0.5	0.5	0.44	ND	**0.64**	ND	**0.96**	ND
Calcium (Ca)	ug/L				53000	54000	56000	53000	56000	53000
Total Chromium (Cr)	ug/L	3.0	9.9	8.9	ND	ND	6.8	ND	**11**	ND
Cobalt (Co)	ug/L	0.50	0.9	0.9	ND	ND	ND	ND	0.87	ND
Copper(Cu)[2]	ug/L	2.0	5	5	**6.1**	2.6	**8**	4.8	**12**	3.1
Iron (Fe)	ug/L	10	300	300	**1700**	ND	**2600**	ND	**4800**	ND
Lead (Pb)[2]	ug/L	1.00	25	25	**36**	ND	**53**	1.9	**100**	0.54
Lithium (Li)	ug/L				5.6	5.3	ND	6.3	5.8	ND
Magnesium (Mg)	ug/L				14000	15000	14000	14000	14000	14000
Manganese (Mn)	ug/L	2.0	n/v		89	5	110	16	210	8.5
Molybdenum (Mo)	ug/L	2.00	40	40	4.1	4.1	4.4	3.8	4.4	4
Nickel (Ni)	ug/L	3.0	25	25	2.8	1.8	3.4	1.7	4.4	2.2
Potassium (K)	ug/L				4800	4900	5000	4800	4800	4900
Silicon (Si)	ug/L				550	ND	880	ND	1400	ND
Selenium (Se)	ug/L	4.0	100		ND	ND	ND	ND	ND	ND
Silver (Ag)	ug/L	0.10	0.1	0.1	**0.13**	ND	**0.17**	ND	**0.38**	ND
Sodium (Na)	ug/L				58000	58000	58000	56000	56000	56000
Strontium (Sr)	ug/L	5.0	n/v		500	490	510	480	490	480
Tellurium (Te)	ug/L				ND	ND	ND	ND	ND	ND
Thallium (Tl)	ug/L	0.300	0.3		0.15	0.07	0.19	ND	**0.38**	0.065
Tin (Sn)	ug/L				5.4	ND	7.7	ND	14	ND
Titanium (Ti)	ug/L	2.0	n/v		8.3	ND	11	ND	21	ND
Tungsten (W)	ug/L	10.0	n/v		ND	ND	ND	ND	ND	ND
Uranium (U)	ug/L	2.00	5		0.59	0.6	0.69	0.61	0.69	0.64
Vanadium (V)	ug/L	2.00	6	6	1.6	0.66	1.9	0.66	3.4	0.66
Zinc (Zn)	ug/L	5.0	30	30	**280**	ND	**410**	33	**780**	11
Zirconium (Zr)	ug/L	4.0	n/v		ND	ND	ND	ND	ND	ND

Notes

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Unfiltered =
Filtered =
Bold = Exceedances

Metals Concentrations in Water (2012)

	Units	RDL	PWQOs[1]	Specs	DRET 18C-75 TSS = 25 mg/L	DRET 18C-75 TSS = 25 mg/L	DRET 18C-155 TSS = 50 mg/L	DRET 18C-155 TSS = 50 mg/L	DRET 18C-230 TSS = 100 mg/L	DRET 18C-230 TSS = 100 mg/L
Aluminum (Al)	ug/L	4	75	75	**290**	9.5	**470**	10	**1000**	9.6
Antimony (Sb)	ug/L	3.00	20		0.78	ND	0.72	ND	0.93	0.59
Arsenic (As)	ug/L	3.0	100	100	1.4	ND	1.7	ND	3.4	ND
Barium (Ba)	ug/L	2.0	n/v		35	30	38	31	47	31
Beryllium (Be)[2]	ug/L	1.00	1100	1100	ND	ND	ND	ND	ND	ND
Bismuth (Bi)	ug/L				ND	ND	ND	ND	ND	ND
Boron (B)	ug/L	10	200	200	64	62	64	61	67	63
Cadmium (Cd)[2]	ug/L	0.10	0.5	0.5	0.46	ND	**0.68**	ND	**1.7**	ND
Calcium (Ca)	ug/L				55000	53000	54000	54000	54000	54000
Total Chromium (Cr)	ug/L	3.0	9.9	8.9	5	ND	7.3	ND	**16**	ND
Cobalt (Co)	ug/L	0.50	0.9	0.9	ND	ND	0.52	ND	**1**	ND
Copper(Cu)[2]	ug/L	2.0	5	5	**5.3**	2.6	**7.7**	2.9	**14**	3
Iron (Fe)	ug/L	10	300	300	**1700**	ND	**2500**	ND	**5800**	ND
Lead (Pb)[2]	ug/L	1.00	25	25	**38**	ND	**70**	0.52	**140**	ND
Lithium (Li)	ug/L				5.3	ND	5.2	ND	6.2	5.1
Magnesium (Mg)	ug/L				15000	14000	14000	14000	15000	15000
Manganese (Mn)	ug/L	2.0	n/v		77	4.9	100	6	230	9.5
Molybdenum (Mo)	ug/L	2.00	40	40	4.2	3.8	4.1	4	4.6	4.1
Nickel (Ni)	ug/L	3.0	25	25	2.7	2.2	4.1	1.9	7.4	3
Potassium (K)	ug/L				4900	4800	4800	4900	5100	4900
Silicon (Si)	ug/L				560	ND	990	ND	1900	ND
Selenium (Se)	ug/L	4.0	100		ND	ND	ND	ND	ND	ND
Silver (Ag)	ug/L	0.10	0.1	0.1	**0.15**	ND	**0.22**	ND	**0.47**	ND
Sodium (Na)	ug/L				60000	56000	57000	58000	60000	57000
Strontium (Sr)	ug/L	5.0	n/v		500	480	480	490	510	490
Tellurium (Te)	ug/L				ND	ND	ND	ND	ND	ND
Thallium (Tl)	ug/L	0.300	0.3		0.14	0.067	0.24	0.071	**0.5**	0.068
Tin (Sn)	ug/L				4.7	ND	7.1	ND	17	ND
Titanium (Ti)	ug/L	2.0	n/v		8	ND	11	ND	26	ND
Tungsten (W)	ug/L	10.0	n/v		ND	ND	ND	ND	ND	ND
Uranium (U)	ug/L	2.00	5		0.61	0.6	0.64	0.63	0.69	0.61
Vanadium (V)	ug/L	2.00	6	6	1.6	0.68	2.1	0.65	4.1	0.57
Zinc (Zn)	ug/L	5.0	30	30	**260**	9.2	**430**	7.3	**950**	6.1
Zirconium (Zr)	ug/L	4.0	n/v		ND	ND	ND	ND	1.3	1.3

Notes

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Unfiltered =

Filtered =

Bold = Exceedances

Metals Concentrations in Water (2016)

Sample No.	Units	RDL	PWQOs[1]	Specs	WTP5-20F(ug/L) 05/06/2016	WTP5-20U(ug/L) 05/06/2016	WTP5-50F(ug/L) 05/06/2016	WTP5-50U(ug/L) 05/06/2016	WTP5-100F(ug/L) 05/06/2016	WTP5-100U(ug/L) 05/06/2016
Aluminum	ug/L	4	75	75	18.0	8.0	18.0	**133.0**	13.0	10.0
Antimony	ug/L	3.00	20		<3	<3	<3	<3	<3	<3
Arsenic	ug/L	3.0	100	100	<3	<3	<3	<3	<3	<3
Barium	ug/L	2.0	n/v		34.0	36.0	34.0	39.0	31.0	41.0
Beryllium[2]	ug/L	1.00	1100	1100	<1	<1	<1	<1	<1	<1
Boron	ug/L	10	200	200	50.0	50.0	50.0	60.0	50.0	50.0
Cadmium[2]	ug/L	0.10	0.5	0.5	<0.1	<0.1	<0.1	0.4	<0.1	**0.6**
Total Chromium	ug/L	3.0	9.9	8.9	<3	3.0	<3	5.0	4.0	6.0
Cobalt	ug/L	0.50	0.9	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper[2]	ug/L	2.0	5	5	5.0	**6.0**	**8.0**	**16.0**	3.0	**8.0**
Iron	ug/L	10	300	300	30.0	**400.0**	20.0	**1320.0**	30.0	**2110.0**
Lead[2]	ug/L	1.00	25	25	<1	9.0	<1	**32.0**	<1	**50.0**
Manganese	ug/L	2.0	n/v		3.0	30.0	6.0	84.0	9.0	119.0
Molybdenum	ug/L	2.00	40	40	5.0	5.0	6.0	5.0	5.0	5.0
Nickel	ug/L	3.0	25	25	<3	<3	<3	<3	<3	<3
Selenium	ug/L	4.0	100		<4	<4	<4	<4	<4	<4
Silver	ug/L	0.10	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	ug/L	5.0	n/v		558.0	566.0	539.0	562.0	473.0	574.0
Thallium	ug/L	0.300	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Titanium	ug/L	2.0	n/v		<2	4.0	<2	6.0	<2	8.0
Tungsten	ug/L	10.0	n/v		<10	<10	<10	<10	<10	<10
Uranium	ug/L	2.00	5		<2	<2	<2	<2	<2	<2
Vanadium	ug/L	2.00	6	6	<2	<2	<2	<2	<2	2.0
Zinc	ug/L	5.0	30	30	13.0	**44.0**	**41.0**	**139.0**	9.0	**216.0**
Zirconium	ug/L	4.0	n/v		<4	<4	<4	<4	<4	<4

Notes

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Unfiltered =
Filtered =
Bold = Exceedances of PWQOs / Specs

Metals Concentrations in Water (2016)

Sample No.	Units	RDL	PWQOs[1]	Specs	WTP4-20F(ug/L)	WTP4-20U(ug/L)	WTP4-50F(ug/L)	WTP4-50U(ug/L)	WTP4-100F(ug/L)	WTP4-100U(ug/L)
Aluminum	ug/L	4	75	75	9.0	5.0	8.0	5.0	7.0	5.0
Antimony	ug/L	3.00	20		<3	<3	<3	<3	<3	<3
Arsenic	ug/L	3.0	100	100	<3	<3	<3	<3	<3	<3
Barium	ug/L	2.0	n/v		31.0	32.0	31.0	34.0	31.0	36.0
Beryllium[2]	ug/L	1.00	1100	1100	<1	<1	<1	<1	<1	<1
Boron	ug/L	10	200	200	50.0	50.0	50.0	60.0	50.0	50.0
Cadmium[2]	ug/L	0.10	0.5	0.5	<0.1	0.1	<0.1	0.1	0.1	<0.1
Total Chromium	ug/L	3.0	9.9	8.9	<3	<3	<3	<3	<3	<3
Cobalt	ug/L	0.50	0.9	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper[2]	ug/L	2.0	5	5	**11.0**	**10.0**	**8.0**	**11.0**	**6.0**	**12.0**
Iron	ug/L	10	300	300	<10	**150.0**	<10	**360.0**	<10	**750.0**
Lead[2]	ug/L	1.00	25	25	<1	2.0	<1	4.0	<1	7.0
Manganese	ug/L	2.0	n/v		5.0	24.0	9.0	44.0	16.0	79.0
Molybdenum	ug/L	2.00	40	40	4.0	4.0	5.0	4.0	5.0	5.0
Nickel	ug/L	3.0	25	25	<3	<3	<3	<3	<3	<3
Selenium	ug/L	4.0	100		12.0	<4	<4	<4	<4	<4
Silver	ug/L	0.10	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	ug/L	5.0	n/v		503.0	515.0	500.0	516.0	503.0	551.0
Thallium	ug/L	0.300	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Titanium	ug/L	2.0	n/v		<2	2.0	<2	5.0	<2	7.0
Tungsten	ug/L	10.0	n/v		<10	<10	<10	<10	<10	<10
Uranium	ug/L	2.00	5		<2	<2	<2	<2	<2	<2
Vanadium	ug/L	2.00	6	6	<2	2.0	2.0	3.0	<2	2.0
Zinc	ug/L	5.0	30	30	12.0	18.0	7.0	27.0	10.0	**46.0**
Zirconium	ug/L	4.0	n/v		<4	<4	<4	<4	<4	<4

Notes

1 - *Water Management - Provincial Water Quality Objectives*
(Ontario Ministry of the Environment, July 1994)

2 - Depends on Hardness. According to the Hamilton Harbour Remedial Action Plan Stage 2 Update Report (2003), hardness has always exceeded 200mg/L in the Harbour.

Unfiltered =
Filtered =
Bold = Exceedances

Metals Concentrations in Water (2016)

Sample No.	Units	RDL	PWQOs[1]	Specs	WTP3-20F(ug/L)	WTP3-20U(ug/L)	WTP3-50F(ug/L)	WTP3-50U(ug/L)	WTP3-100F(ug/L)	WTP3-100U(ug/L)
Aluminum	ug/L	4	75	75	10.0	13.0	8.0	26.0	10.0	9.0
Antimony	ug/L	3.00	20		<3	<3	<3	<3	<3	<3
Arsenic	ug/L	3.0	100	100	<3	<3	<3	<3	<3	<3
Barium	ug/L	2.0	n/v		31.0	31.0	30.0	34.0	30.0	36.0
Beryllium[2]	ug/L	1.00	1100	1100	<1	<1	<1	<1	<1	<1
Boron	ug/L	10	200	200	50.0	50.0	40.0	50.0	50.0	50.0
Cadmium[2]	ug/L	0.10	0.5	0.5	<0.1	0.2	<0.1	<0.1	0.1	0.4
Total Chromium	ug/L	3.0	9.9	8.9	<3	<3	<3	<3	<3	5.0
Cobalt	ug/L	0.50	0.9	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper[2]	ug/L	2.0	5	5	3.0	5.0	4.0	**6.0**	4.0	**7.0**
Iron	ug/L	10	300	300	<10	160.0	<10	**570.0**	<10	**1240.0**
Lead[2]	ug/L	1.00	25	25	<1	5.0	<1	14.0	<1	**32.0**
Manganese	ug/L	2.0	n/v		<2	23.0	5.0	54.0	9.0	105.0
Molybdenum	ug/L	2.00	40	40	5.0	4.0	5.0	4.0	5.0	4.0
Nickel	ug/L	3.0	25	25	<3	<3	<3	<3	<3	<3
Selenium	ug/L	4.0	100		<4	8.0	<4	<4	<4	<4
Silver	ug/L	0.10	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	ug/L	5.0	n/v		507.0	517.0	506.0	518.0	484.0	519.0
Thallium	ug/L	0.300	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Titanium	ug/L	2.0	n/v		<2	3.0	2.0	5.0	<2	7.0
Tungsten	ug/L	10.0	n/v		<10	<10	<10	<10	<10	<10
Uranium	ug/L	2.00	5		<2	<2	<2	<2	<2	<2
Vanadium	ug/L	2.00	6	6	<2	2.0	2.0	3.0	3.0	4.0
Zinc	ug/L	5.0	30	30	9.0	**40.0**	7.0	**110.0**	8.0	**232.0**
Zirconium	ug/L	4.0	n/v		<4	<4	<4	<4	<4	<4

Notes

1 - *Water Management - Provincial Water Quality Objectives*
(Ontario Ministry of the Environment, July 1994)

2 - Depends on Hardness. According to the Hamilton Harbour Remedial Action Plan Stage 2 Update Report (2003), hardness has always exceeded 200mg/L in the Harbour.

Unfiltered =
Filtered =
Bold = Exceedances

Metals Concentrations in Water (2016)

Sample No.	Units	RDL	PWQOs[1]	Specs	WTP2-20F(ug/L)	WTP2-20U(ug/L)	WTP2-50F(ug/L)	WTP2-50U(ug/L)	WTP2-100F(ug/L)	WTP2-100U(ug/L)
Aluminum	ug/L	4	75	75	9.0	8.0	8.0	11.0	9.0	12.0
Antimony	ug/L	3.00	20		<3	<3	<3	<3	<3	<3
Arsenic	ug/L	3.0	100	100	<3	<3	<3	<3	<3	<3
Barium	ug/L	2.0	n/v		32.0	33.0	31.0	36.0	32.0	44.0
Beryllium[2]	ug/L	1.00	1100	1100	<1	<1	<1	<1	<1	<1
Boron	ug/L	10	200	200	50.0	60.0	50.0	50.0	50.0	50.0
Cadmium[2]	ug/L	0.10	0.5	0.5	<0.1	<0.1	<0.1	0.5	<0.1	**1.0**
Total Chromium	ug/L	3.0	9.9	8.9	<3	<3	<3	<3	<3	7.0
Cobalt	ug/L	0.50	0.9	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper[2]	ug/L	2.0	5	5	4.0	5.0	3.0	5.0	3.0	**8.0**
Iron	ug/L	10	300	300	<10	**520.0**	<10	**1320.0**	<10	**3820.0**
Lead[2]	ug/L	1.00	25	25	<1	14.0	<1	**36.0**	<1	**95.0**
Manganese	ug/L	2.0	n/v		3.0	43.0	6.0	92.0	15.0	243.0
Molybdenum	ug/L	2.00	40	40	5.0	5.0	5.0	5.0	5.0	4.0
Nickel	ug/L	3.0	25	25	<3	<3	<3	<3	<3	<3
Selenium	ug/L	4.0	100		6.0	6.0	<4	<4	<4	<4
Silver	ug/L	0.10	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	ug/L	5.0	n/v		518.0	528.0	506.0	529.0	503.0	526.0
Thallium	ug/L	0.300	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Titanium	ug/L	2.0	n/v		<2	3.0	2.0	5.0	<2	10.0
Tungsten	ug/L	10.0	n/v		<10	<10	<10	<10	<10	<10
Uranium	ug/L	2.00	5		<2	<2	<2	<2	<2	<2
Vanadium	ug/L	2.00	6	6	<2	2.0	<2	2.0	<2	4.0
Zinc	ug/L	5.0	30	30	10.0	**83.0**	8.0	**221.0**	9.0	**531.0**
Zirconium	ug/L	4.0	n/v		<4	<4	<4	<4	<4	<4

Notes

1 - *Water Management - Provincial Water Quality Objectives*
(Ontario Ministry of the Environment, July 1994)

2 - Depends on Hardness. According to the Hamilton Harbour Remedial Action Plan Stage 2 Update Report (2003), hardness has always exceeded 200mg/L in the Harbour.

Unfiltered = (dark grey)

Filtered = (light grey)

Metals Concentrations in Water (2016)

Sample No.	Units	RDL	PWQOs[1]	Specs	WTP1-20F(ug/L)	WTP1-20U(ug/L)	WTP1-50F(ug/L)	WTP1-50U(ug/L)	WTP1-100F(ug/L)	WTP1-100U(ug/L)
Aluminum	ug/L	4	75	75	13.0	6.0	17.0	8.0	364.0	215.0
Antimony	ug/L	3.00	20		<3	<3	<3	<3	<3	<3
Arsenic	ug/L	3.0	100	100	<3	<3	<3	<3	<3	<3
Barium	ug/L	2.0	n/v		33.0	35.0	35.0	37.0	42.0	42.0
Beryllium[2]	ug/L	1.00	1100	1100	<1	<1	<1	<1	<1	<1
Boron	ug/L	10	200	200	50.0	50.0	50.0	50.0	50.0	50.0
Cadmium[2]	ug/L	0.10	0.5	0.5	<0.1	0.2	<0.1	0.2	0.4	**0.4**
Total Chromium	ug/L	3.0	9.9	8.9	<3	<3	3.0	4.0	7.0	6.0
Cobalt	ug/L	0.50	0.9	0.9	<0.5	<0.5	<0.5	<0.5	0.6	<0.5
Copper[2]	ug/L	2.0	5	5	5.0	**6.0**	**5.0**	**7.0**	**13.0**	**12.0**
Iron	ug/L	10	300	300	20.0	280.0	20.0	**630.0**	**2030.0**	**1940.0**
Lead[2]	ug/L	1.00	25	25	<1	4.0	<1	13.0	**29.0**	**28.0**
Manganese	ug/L	2.0	n/v		2.0	23.0	4.0	43.0	134.0	128.0
Molybdenum	ug/L	2.00	40	40	5.0	5.0	6.0	5.0	5.0	5.0
Nickel	ug/L	3.0	25	25	<3	<3	<3	<3	<3	<3
Selenium	ug/L	4.0	100		<4	<4	<4	<4	<4	<4
Silver	ug/L	0.10	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	ug/L	5.0	n/v		540.0	559.0	554.0	546.0	568.0	560.0
Thallium	ug/L	0.300	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Titanium	ug/L	2.0	n/v		<2	5.0	<2	5.0	12.0	14.0
Tungsten	ug/L	10.0	n/v		<10	<10	<10	<10	<10	<10
Uranium	ug/L	2.00	5		<2	<2	<2	<2	<2	<2
Vanadium	ug/L	2.00	6	6	<2	<2	<2	<2	3.0	2.0
Zinc	ug/L	5.0	30	30	14.0	**32.0**	11.0	**64.0**	**163.0**	**146.0**
Zirconium	ug/L	4.0	n/v		<4	<4	<4	<4	<4	<4

Notes

1 - *Water Management - Provincial Water Quality Objectives*
(Ontario Ministry of the Environment, July 1994)

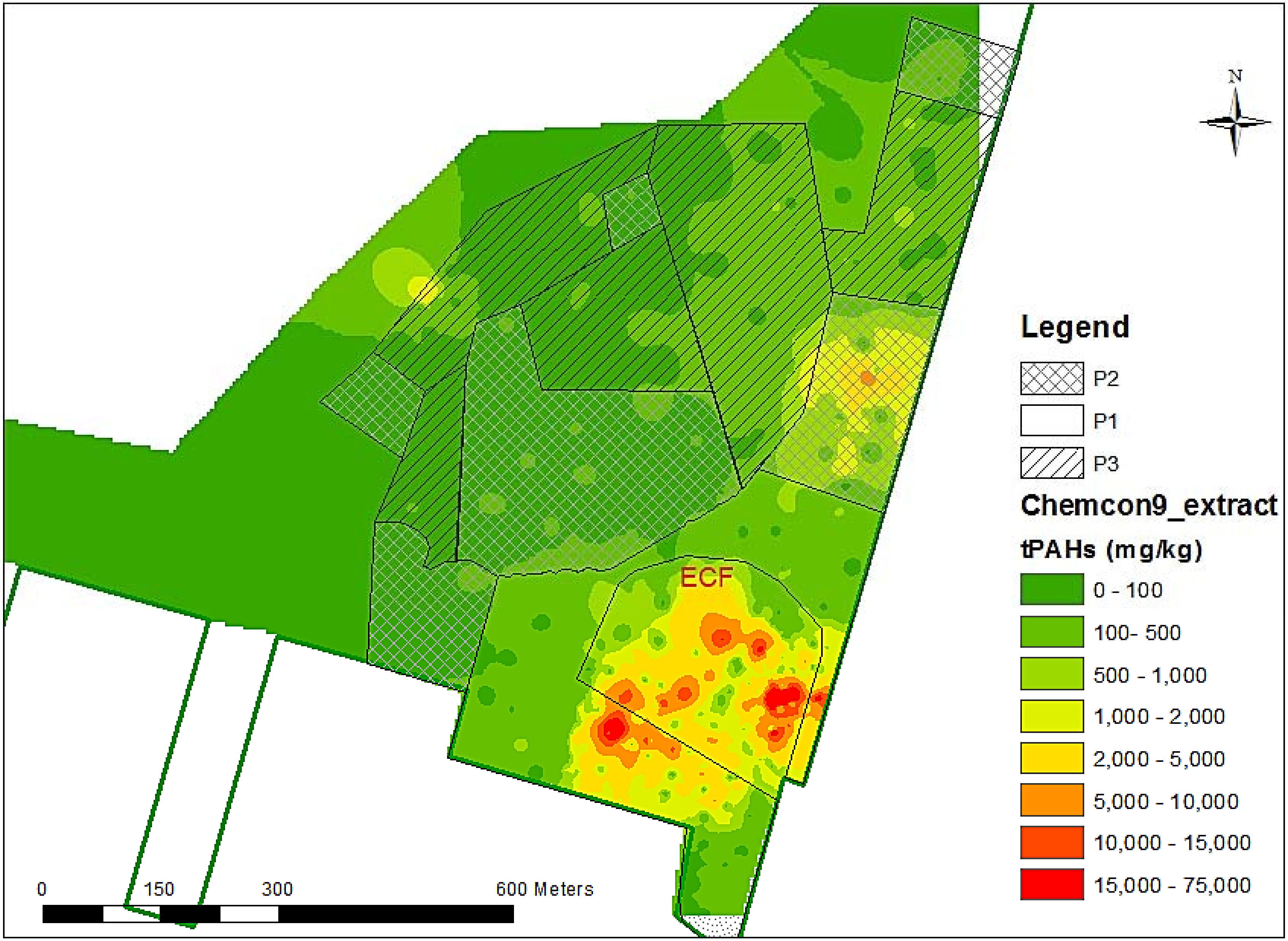
2 - Depends on Hardness. According to the Hamilton Harbour Remedial Action Plan Stage 2 Update Report (2003), hardness has always exceeded 200mg/L in the Harbour.

Unfiltered =

Filtered =

Bold = Exceedances

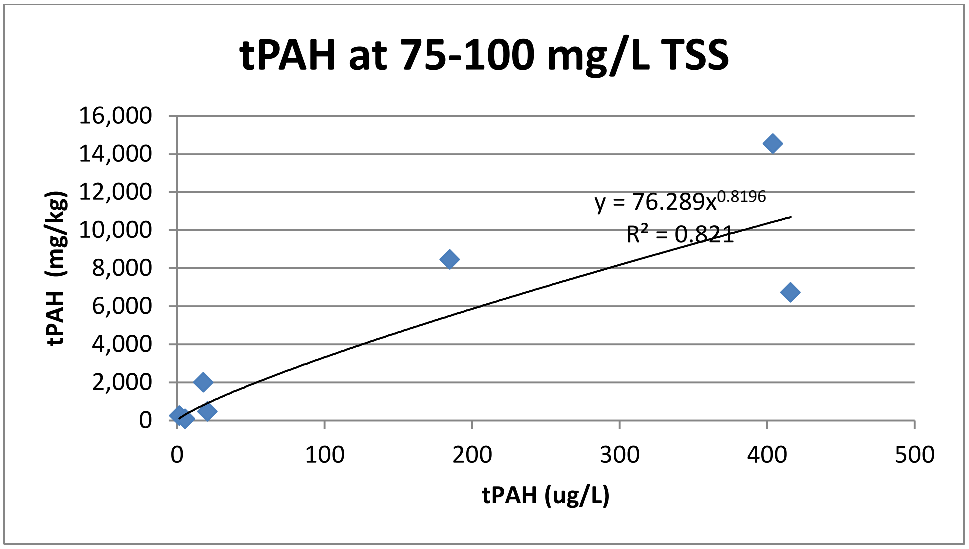
Appendix B – Concentration Maps

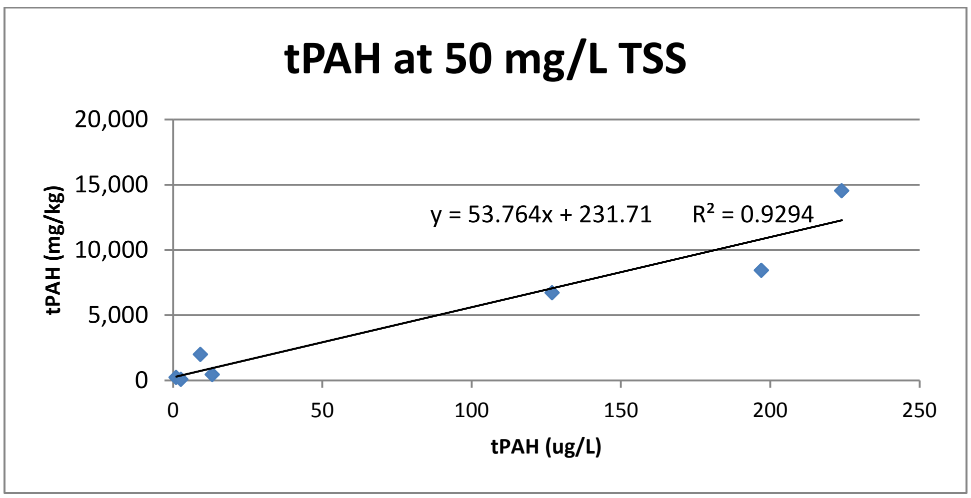


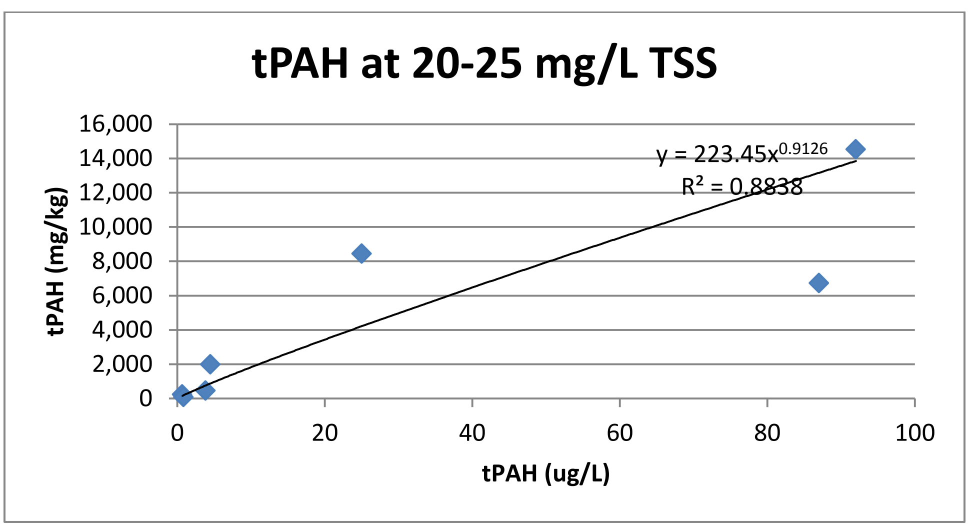
N
ECF
Legend
P2
P1
P3
Chemcon9_extract
tPAHs (mg/kg)
0 - 100
100- 500
500 - 1,000
1,000 - 2,000
2,000 - 5,000
5,000 - 10,000
10,000 - 15,000
15,000 - 75,000
0
150
300
600 Meters

Appendix C – Selected Regressions

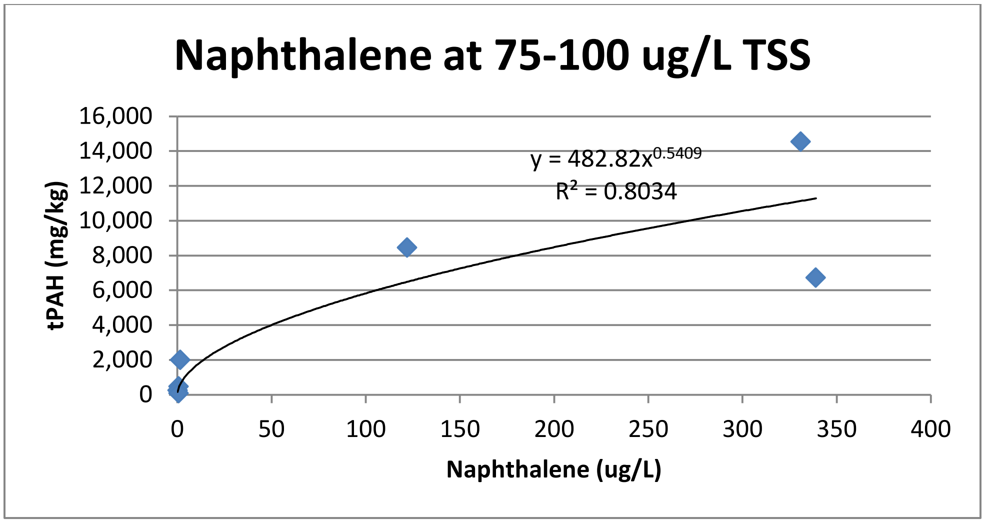
tPAH concentrations (in sediment), used in the makeup of the elutriate vs tPAH concentrations found after mixing with site water.

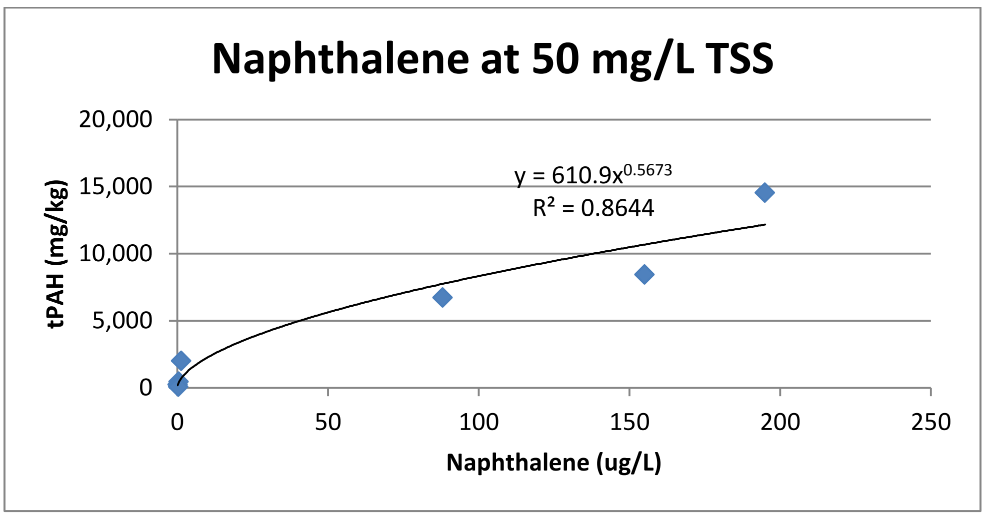


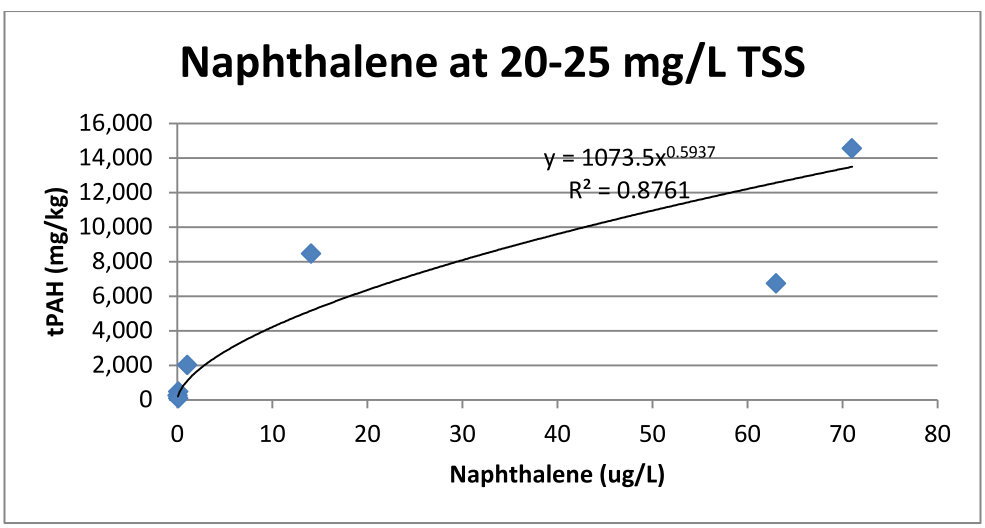




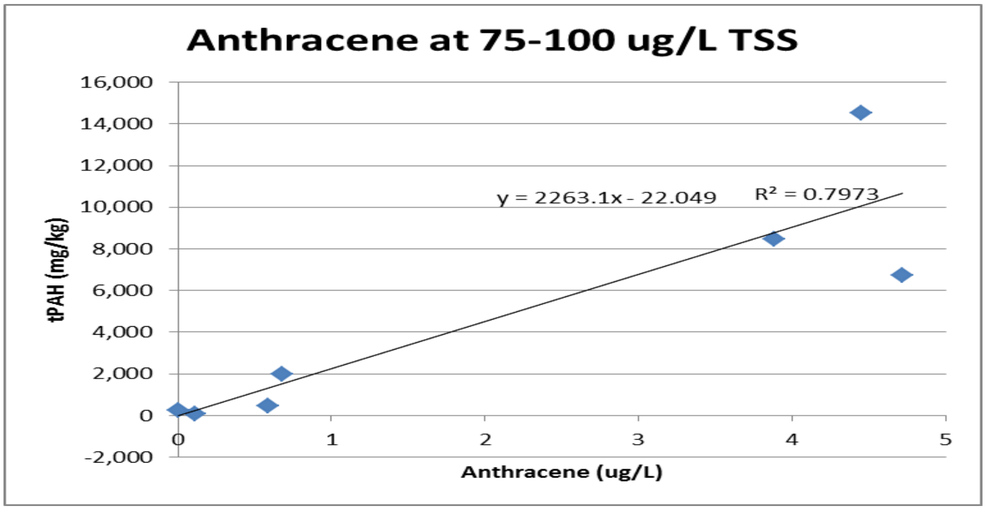
tPAH concentrations (in sediment), used in the makeup of the elutriate vs naphthalene concentrations found after mixing with site water.

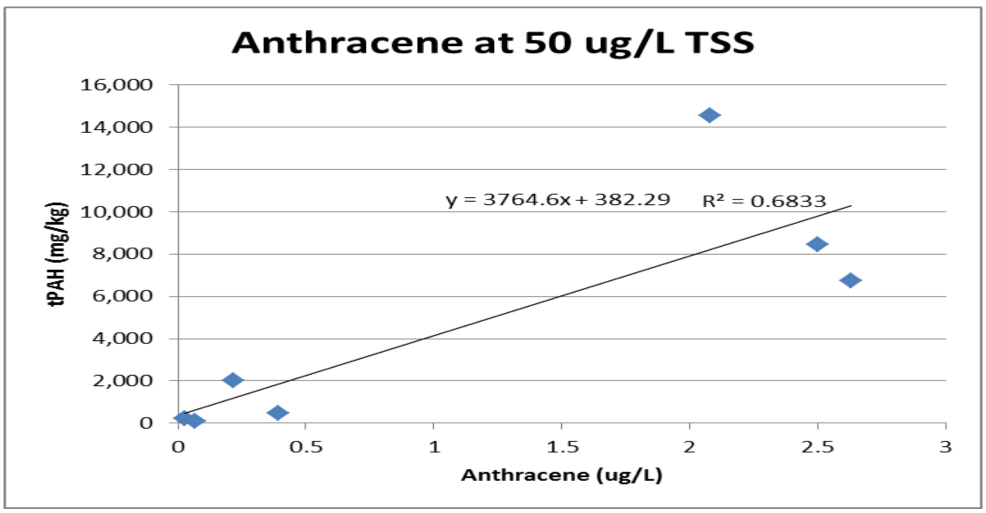


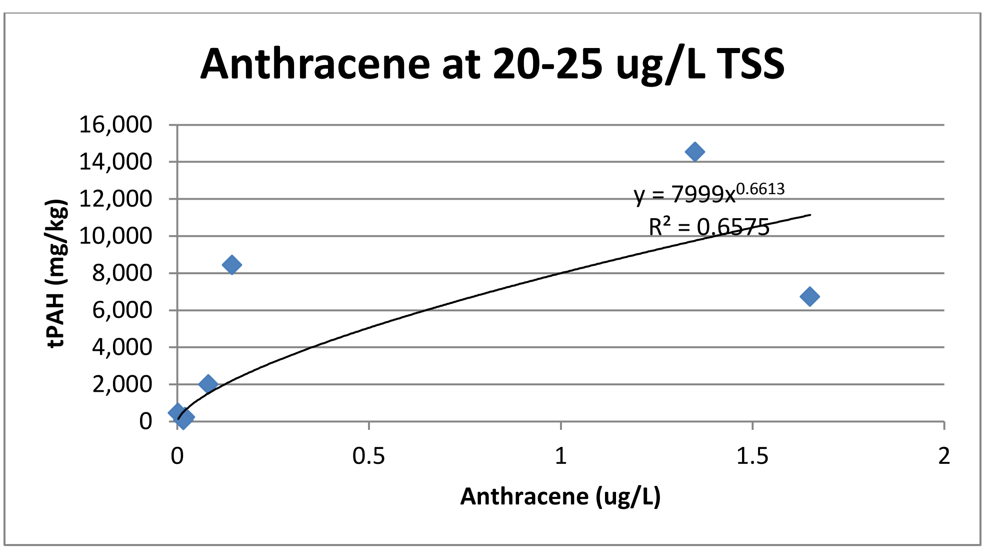




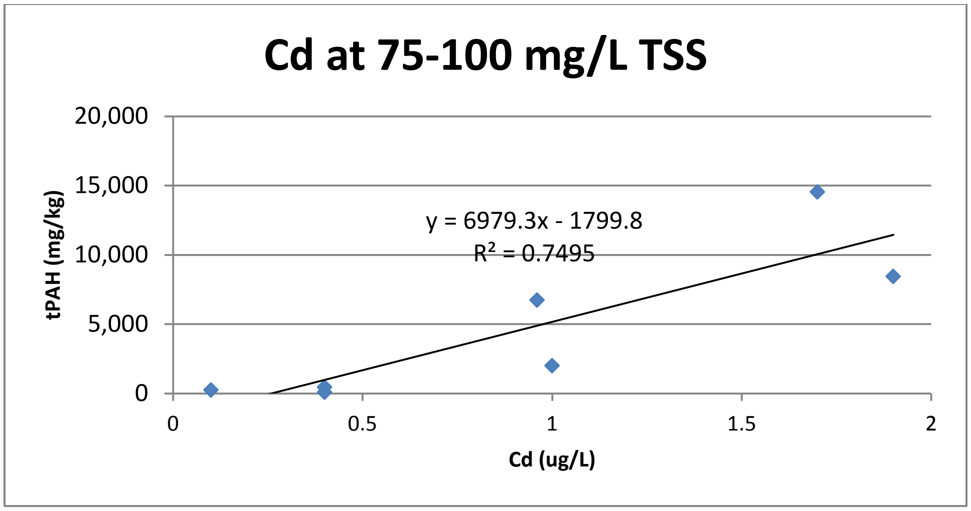
tPAH concentrations (in sediment), used in the makeup of the elutriate vs anthracene concentrations found after mixing with site water.

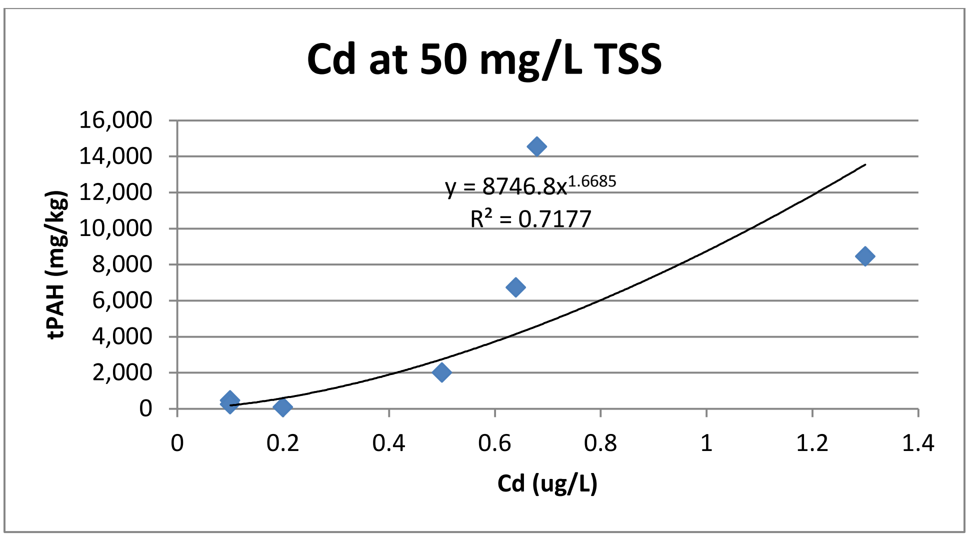


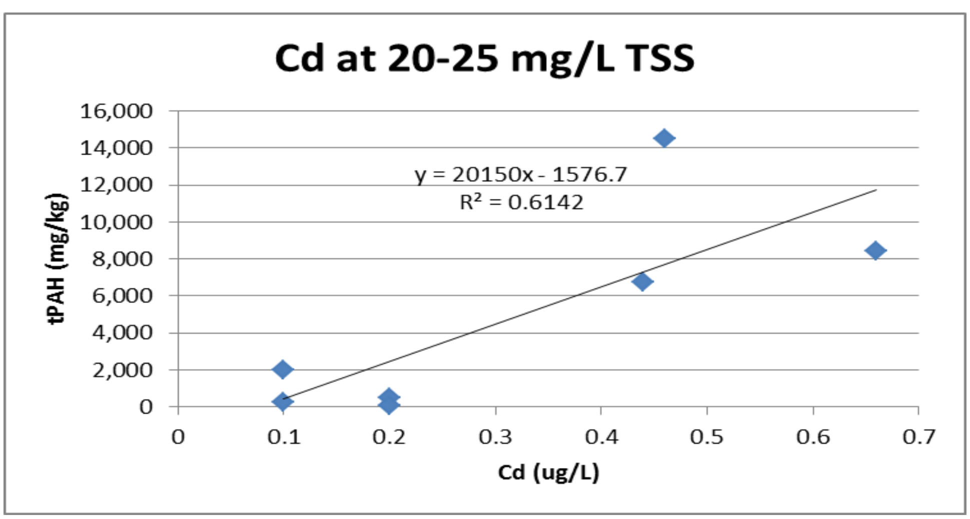




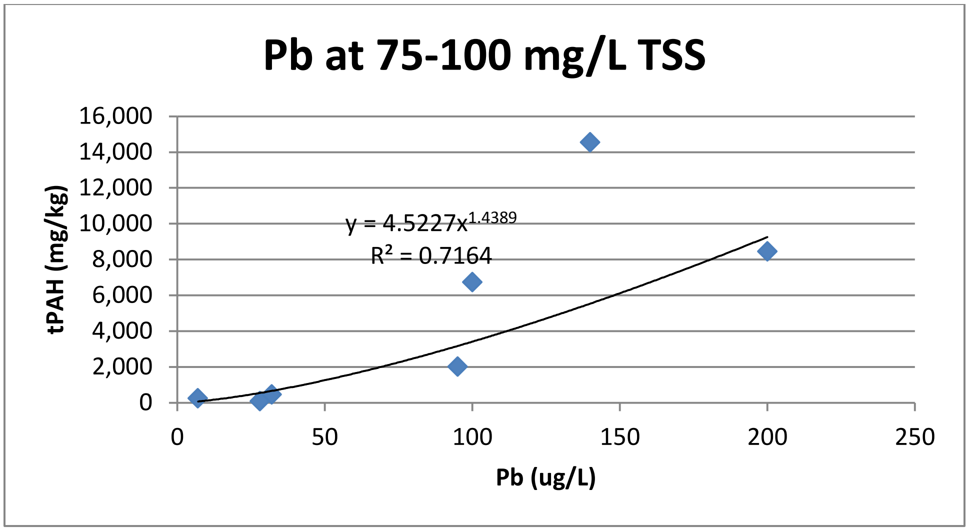
tPAH concentrations (in sediment), used in the makeup of the elutriate vs cadmium concentrations found after mixing with site water.

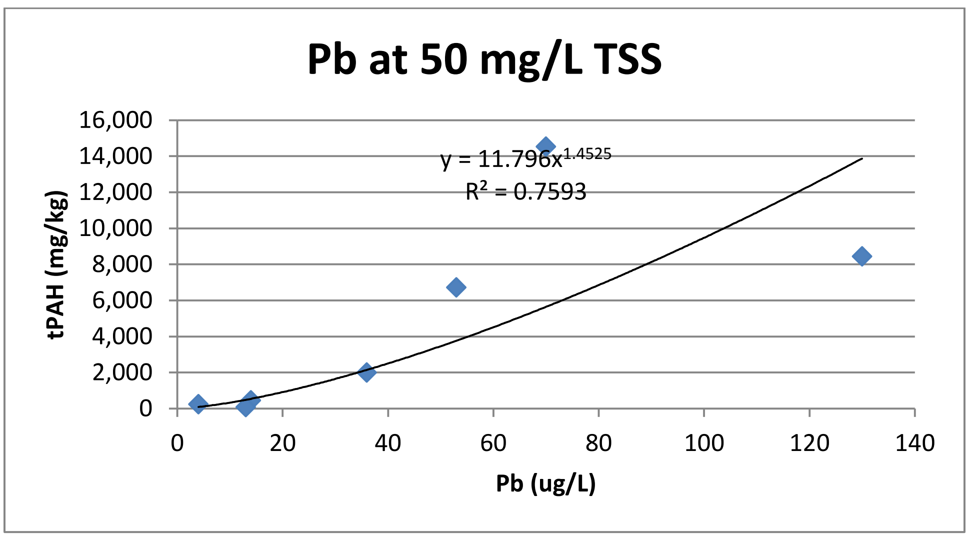


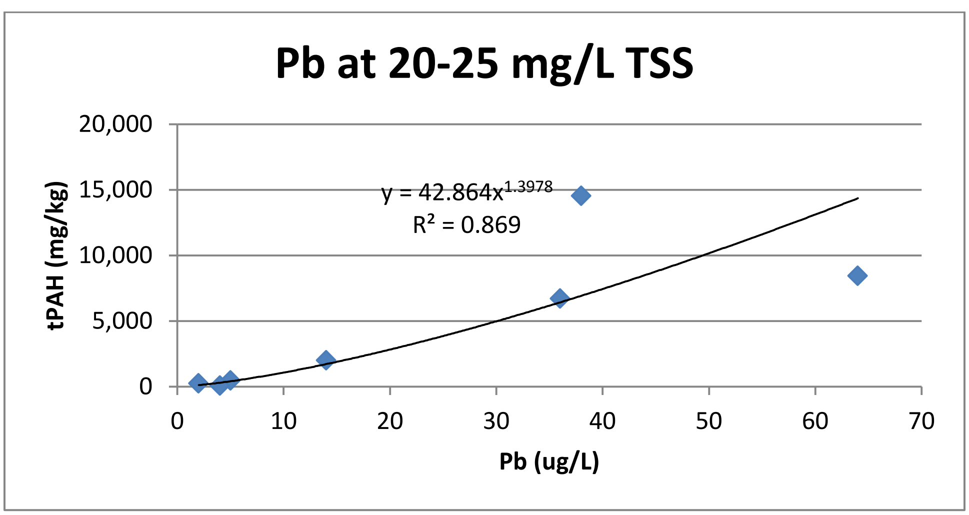




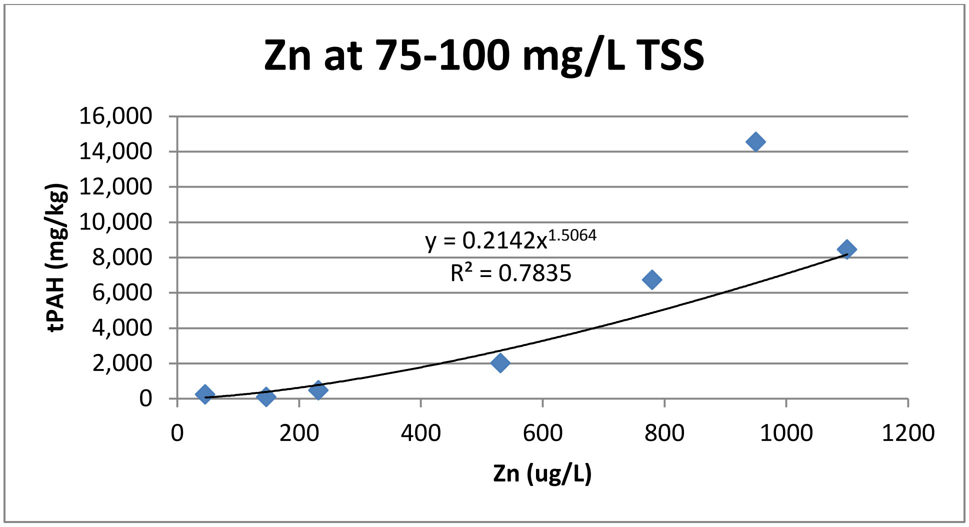
tPAH concentrations (in sediment), used in the makeup of the elutriate vs lead concentrations found after mixing with site water.

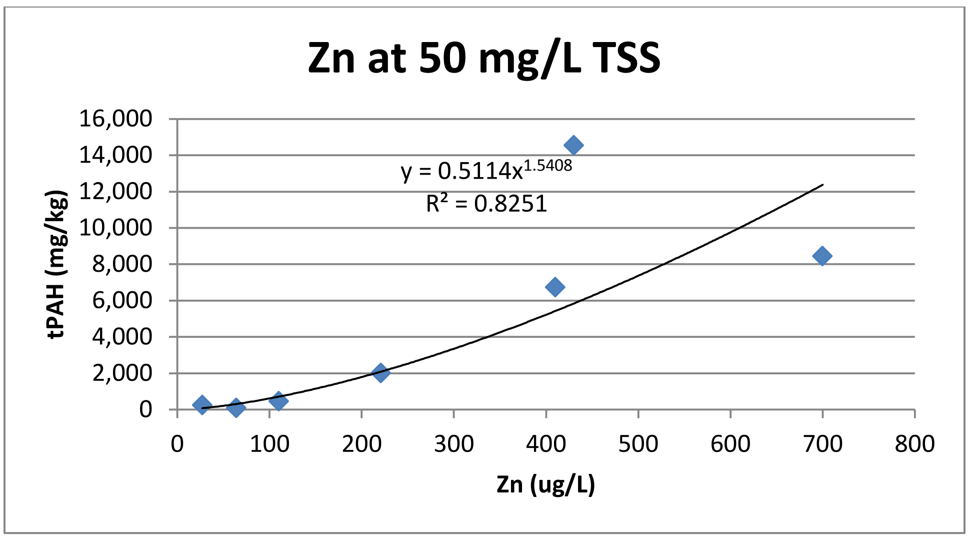


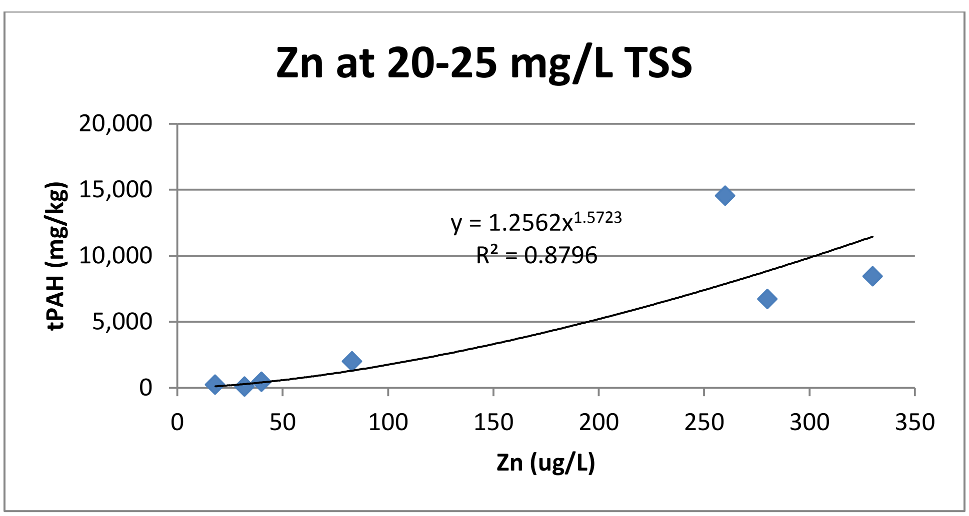




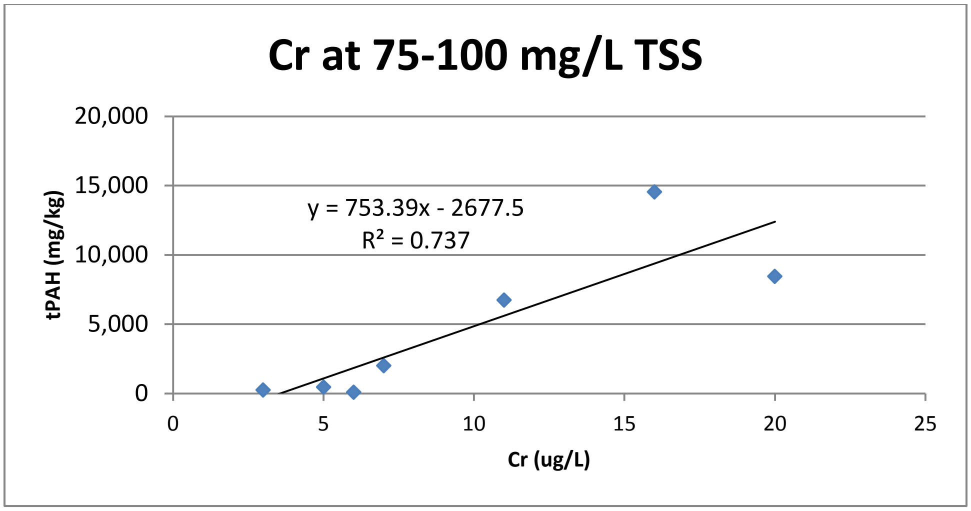
tPAH concentrations (in sediment), used in the makeup of the elutriate vs zinc concentrations found after mixing with site water.

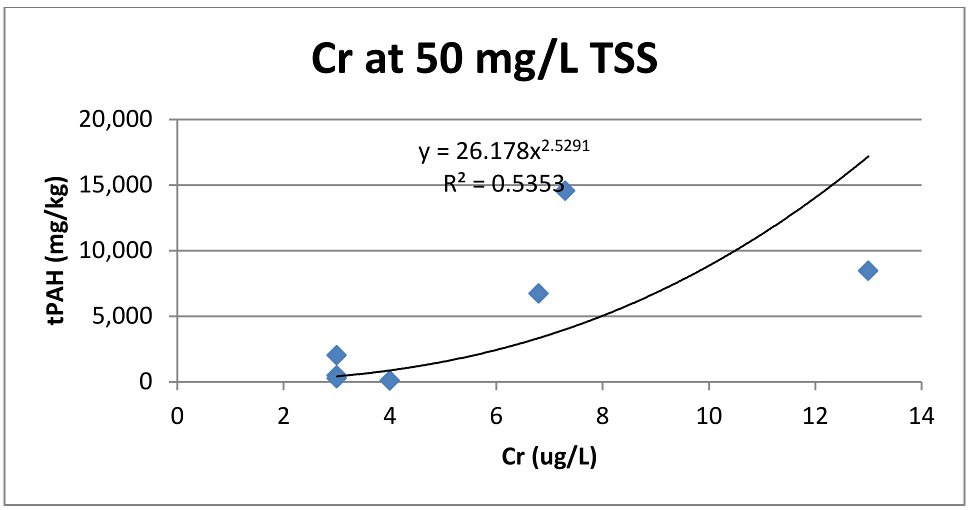


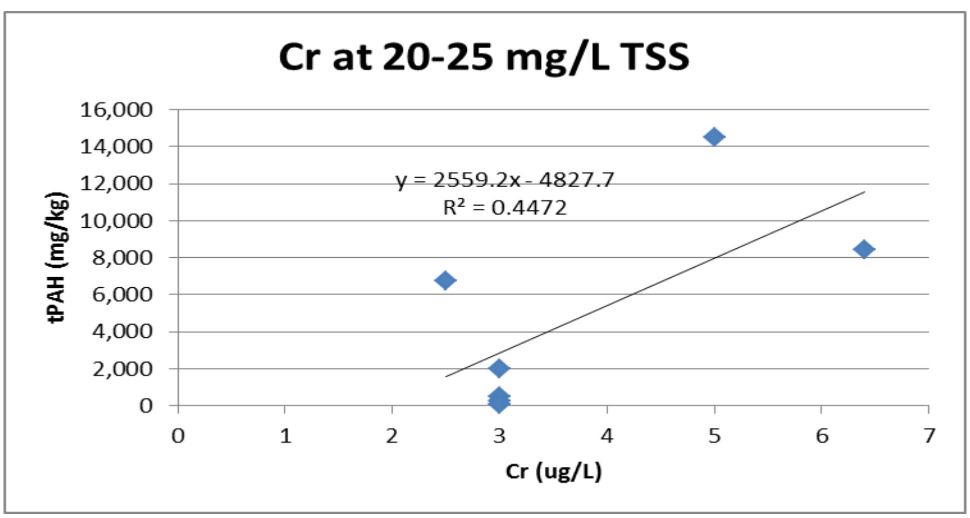




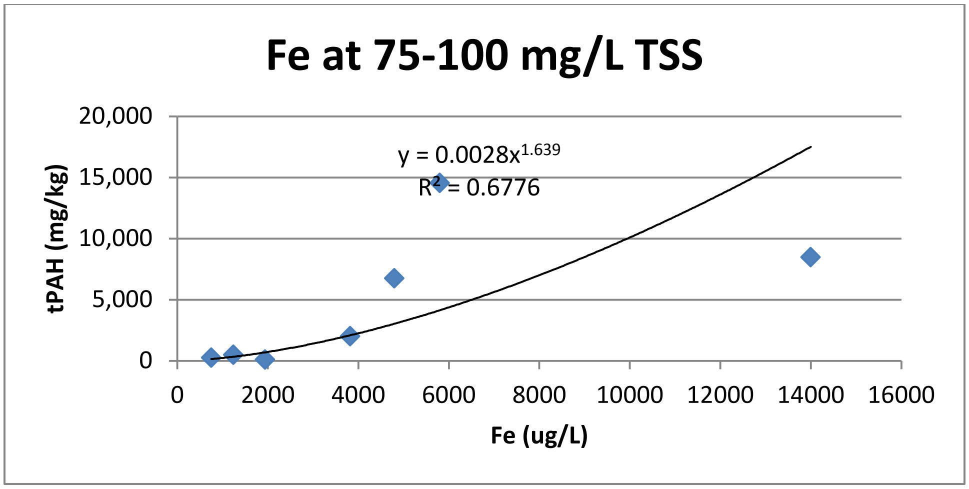
tPAH concentrations (in sediment), used in the makeup of the elutriate vs chromium concentrations found after mixing with site water.

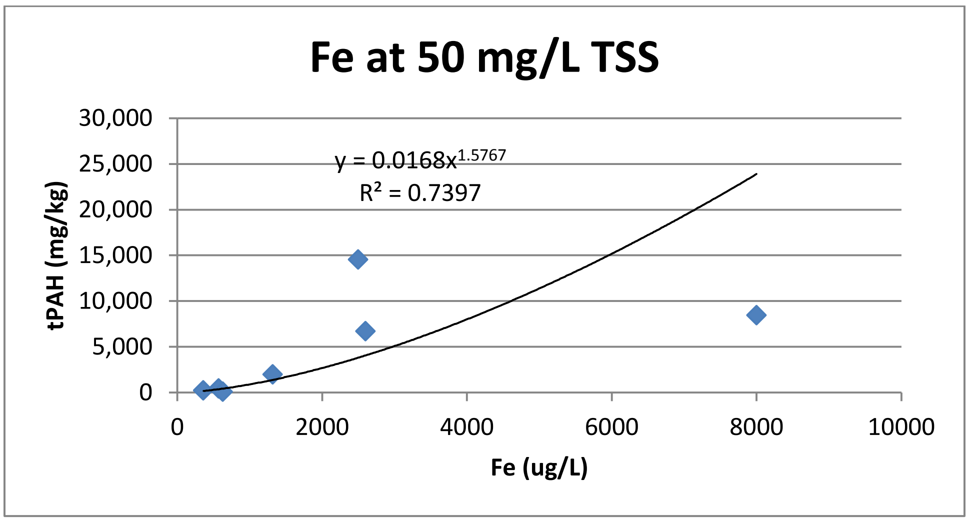


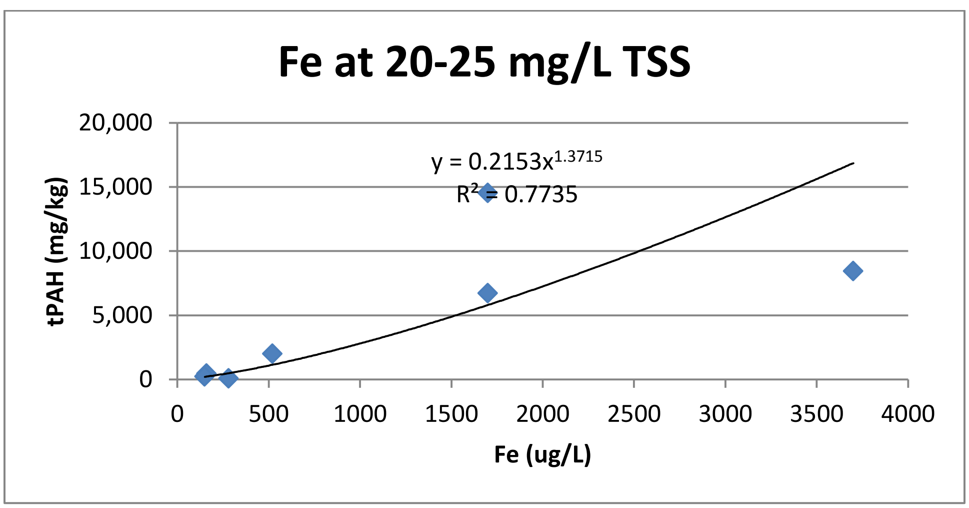




tPAH concentrations (in sediment), used in the makeup of the elutriate vs iron concentrations found after mixing with site water.

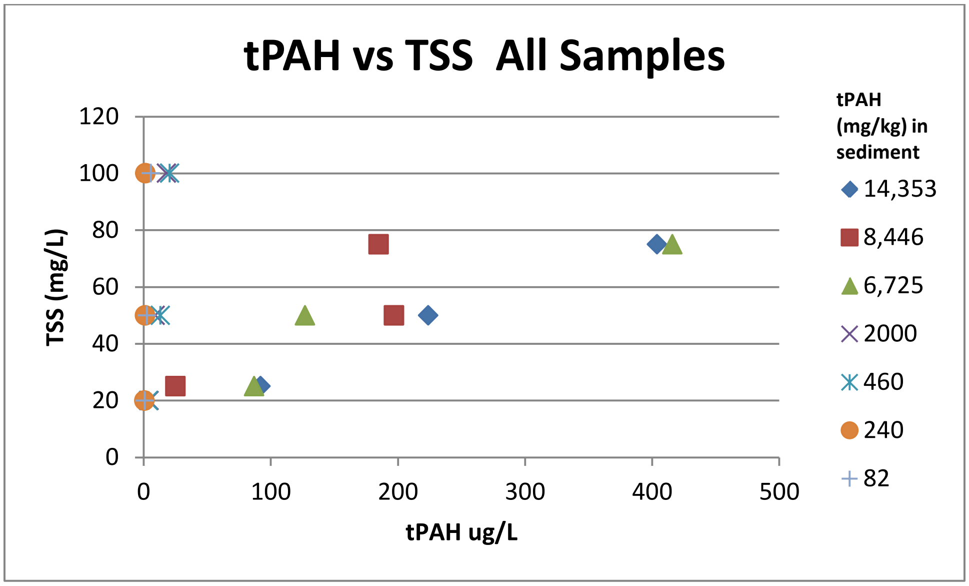


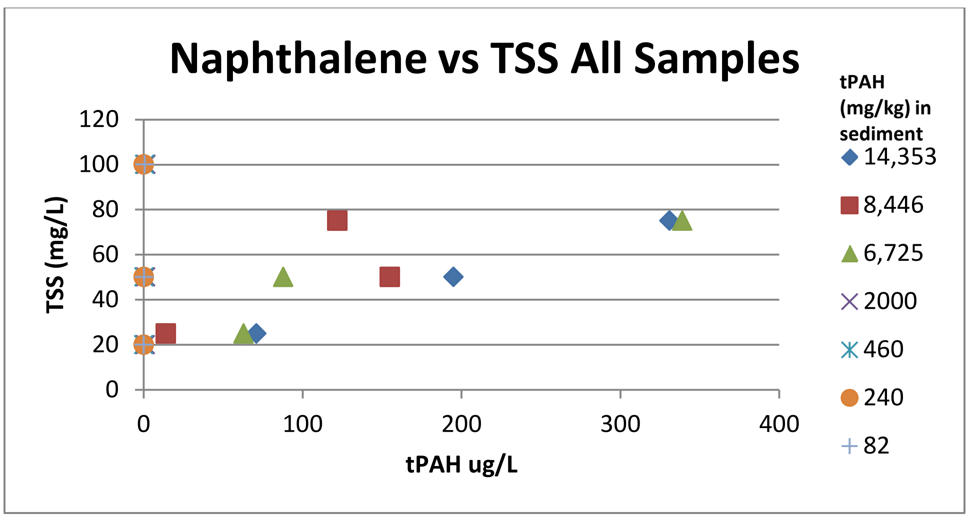


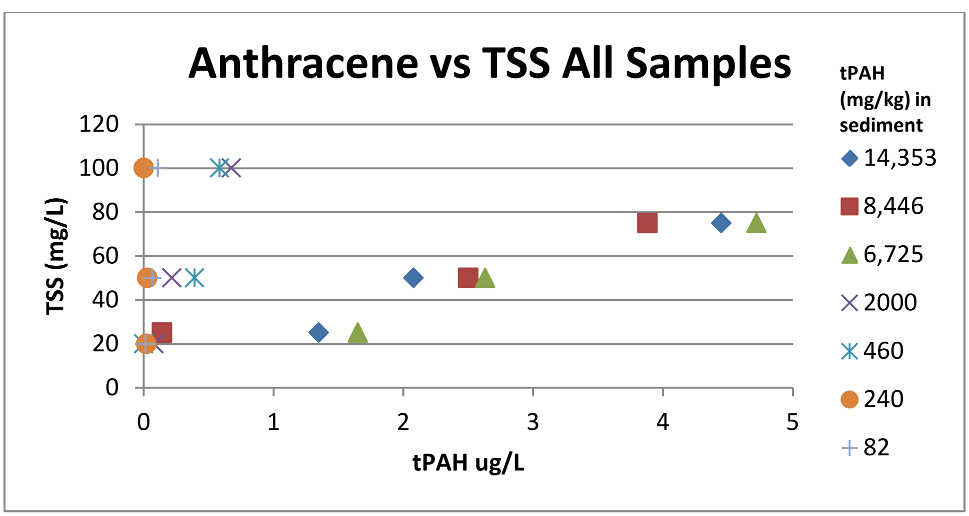


Appendix D – Selected Plots of TSS vs Contaminant Concentrations

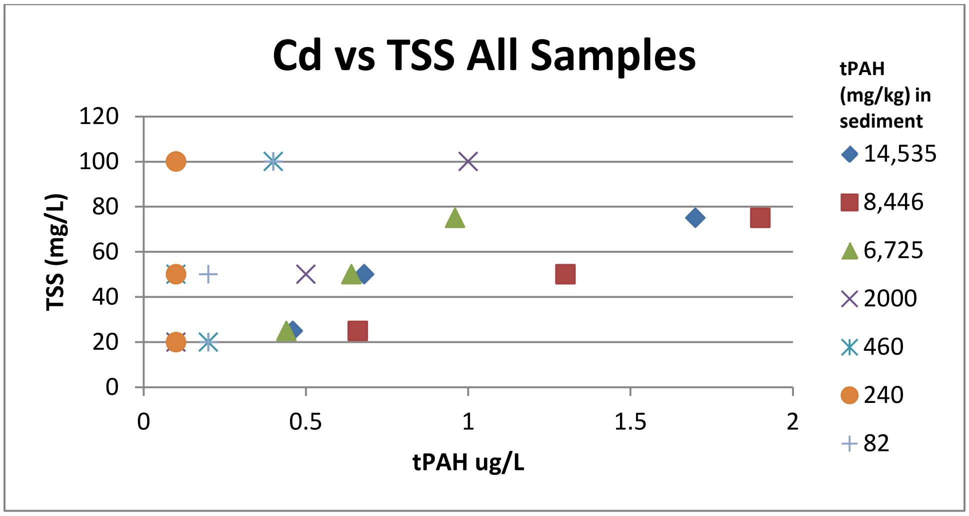
TSS vs selected PAH contaminant loadings in the elutriate after mixing.

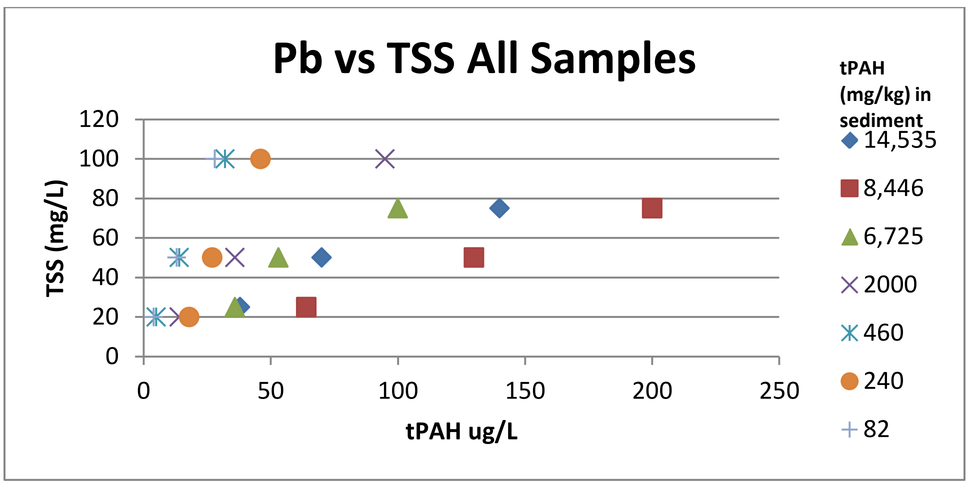


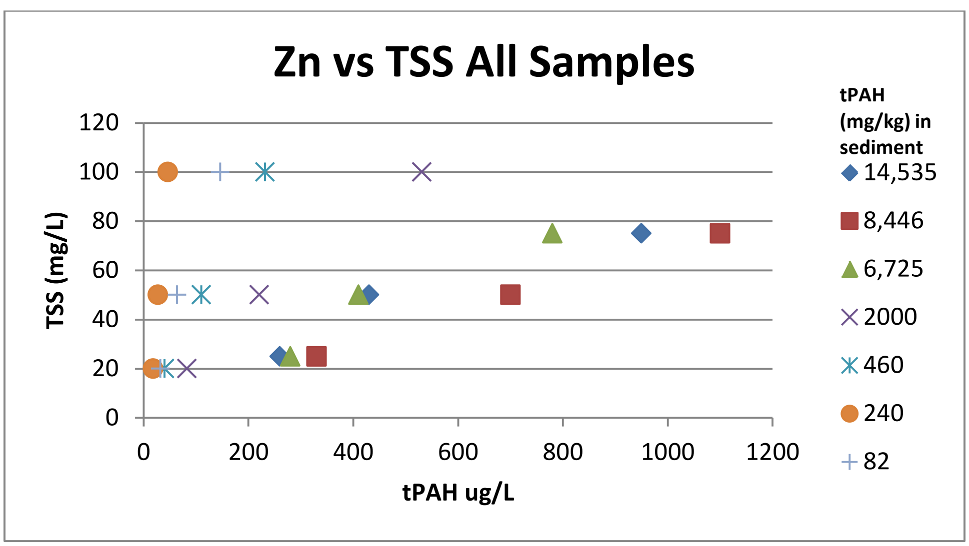


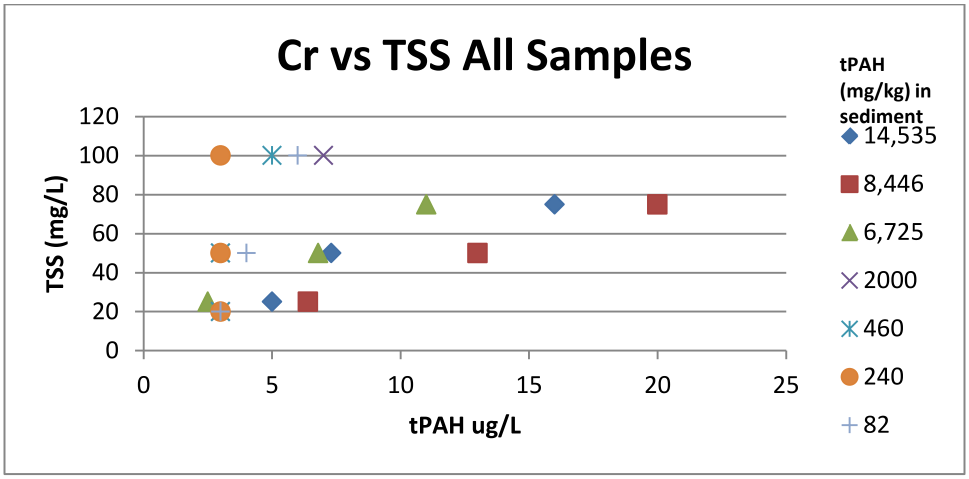


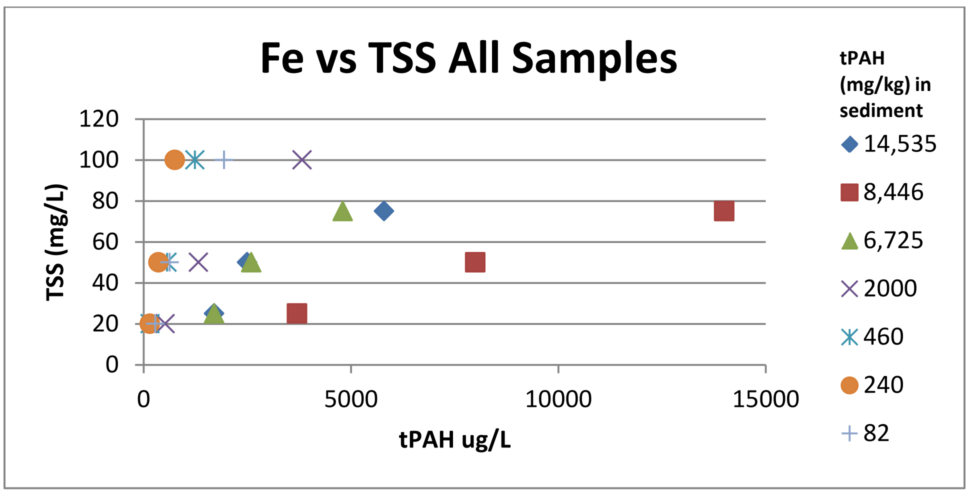
TSS vs selected metal contaminant loadings in the elutriate after mixing.








Cr vs TSS All Samples
TSS (mg/L)
120
100
80
60
40
20
0
0
5
10
15
20
25
tPAH ug/L
tPAH (mg/kg) in sediment
14,535
8,446
6,725
2000
460
240
82


Fe vs TSS All Samples
TSS (mg/L)
120
100
80
60
40
20
0
0
5000
10000
15000
tPAH ug/L
tPAH (mg/kg) in sediment
14,535
8,446
6,725
2000
460
240
82