PROJECT TITLE

STOKES BAY FRONT RANGE LIGHT STATION DFRP No. 10961
KNIFE ISLAND, ONTARIO

LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL

PROJECT NUMBER

R.071694.050

PROJECT DATE

2015-02-19

END OF SECTION

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Title and description of Work.

1.2 PRECEDENCE

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

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises of site preparation (including provision of marine access), abatement (removal) of lead based paint on the exterior of the old light tower and repainting, installation of a sign warning of the presence of lead based paint on the new light tower exterior, removal of debris (i.e. paint cans, batteries, wood debris), and lead contaminated soil removal at the Stokes Bay Front Range, located on Knife Island, Lake Huron, Ontario (identified as PWGSC Project Number R.071694.050).

.2 Contractor must be licensed and have the appropriate regulatory approvals to transport hazardous and non-hazardous over water in accordance with applicable legislation including but not limited to:
- .1 Transport of Dangerous Goods Act
- .2 Canadian Environmental Protection Act
- .3 Ontario Environmental Protection Act
- .4 Ontario Regulation 347
  - .1 Including Certificate(s) of Approval from the Ontario Ministry of the Environment and Climate Change, as applicable.

.3 Contractor must be qualified to conduct hazardous materials (lead in paint) abatement and work at heights in accordance with applicable legislation including but not limited to:
- .1 Canada Labour Code.
- .2 Ontario Occupational Health and Safety Act.

1.4 CONTRACT FORM .1 Construct work under combined price contract.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 MINIMUM STANDARDS

.1 Execute work to meet or exceed:
  .1 Rules and regulations of authorities having jurisdiction.
  .2 Observe and enforce construction safety measures required by National Building Code 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.
  .3 Occupational Health and Safety Act and Regulations for:
    .1 Construction Projects, Revised Statutes of Ontario 1990, Chapter O.1 as amended.
    .2 O.Reg. 490/09 Designated Substances.
    .3 O.Reg. 833/90 Control of Exposure to Biological or Chemical Agents.
    .4 Workplace Safety and Insurance Act and
    .5 Municipal statutes and authorities.
  .4 Environmental Protection Act, Revised Statutes of Ontario 1990, Chapter E19 as amended:
    .1 O. Reg. 102/94, Waste Audits and Waste Reduction Work Plans.
    .2 O. Reg. 103/94 Industrial, Commercial and Institutional Source Separation Programs.
    .3 O. Reg. 153/04 Record of Site Programs.
    .4 O.Reg. 347/90 General Waste Management.
  .5 Canadian Environmental Assessment Act.
  .6 Canadian Environmental Protection Act (New Substance Notification Regulations).
  .7 Transportation of Dangerous Goods Act.
  .8 Fisheries Act.
  .9 Migratory Birds Convention Act.
  .10 Migratory Birds Regulations.

1.2 AUTHORITIES HAVING JURISDICTION

.1 Public Works and Government Services of Canada Fire Protection is the sole authority having jurisdiction over this project with regards to fire standards.

.2 Province of Ontario, Ministry of Labour, is the sole authority having jurisdiction over this project with regards to health and safety requirements of workers.

1.2 AUTHORITIES HAVING JURISDICTION (Cont'd)

.3 Department of Fisheries and Oceans, is the sole authority having jurisdiction with regards to fisheries protection.

1.3 LOAD RESTRICTIONS

.1 Comply with posted restrictions. Acquire and submit to Departmental Representative copies of all necessary permits.

1.4 TAXES

.1 Pay applicable Federal, Provincial and Municipal taxes.

1.5 FEES, PERMITS, CERTIFICATES AND LETTERS

.1 Provide authorities having jurisdiction with information requested.

.2 Pay fees and obtain certificates, permits and letters required.

.3 Furnish certificates, permits and letters when requested.

1.6 EXAMINATION

.1 Examine existing conditions and determine conditions affecting Work.

.2 Notify Departmental Representative in writing of any discrepancies between Contract Documents and site conditions.

1.7 DOCUMENTS

.1 Keep one (1) copy of Contract Documents at the site.

1.8 SUBMITTALS

.1 Submit number of hard copies specified for each type and format of submittal as specified, and also submit in electronic format as .pdf files. Forward .pdf files on USB, through email, or ftp site.

1.9 PRODUCT DATA SHEETS

.1 Submit product data sheets to Departmental Representative for review at least five (5) days before the start of field activities.

1.10 CONSTRUCTION PHOTOGRAPHS

.1 Submit electronic copies of colour digital photography in jpeg format, standard resolution.

.2 Identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints and location of viewpoints determined by Departmental Representative.

.4 Frequency:
  - .1 In each area of Work: before Work starts and at the completion of: site preparation (including grubbing and temporary road access from Work area to mooring location), debris removal, paint abatement (multiple viewpoints per structure), paint encapsulation (multiple viewpoints per structure), repainting (multiple viewpoints per structure), soil removal, and as directed by Departmental Representative.
  - .2 In all areas of: storage, site access, building interiors used: before Work starts (area is used for Work), after area has been restored to original condition upon completion of Work.

1.11 ADDITIONAL DRAWING/PHOTOGRAPHS

.1 Departmental Representative may furnish additional drawings/aerial photographs to clarify work.

.2 Such drawings/aerial photographs become part of Contract Documents.

1.12 PROTECTION

.1 Protect existing Work and on-site structures from damage.

.2 Replace and repair damaged existing Work and on-site structures with material and finish to match original.

.3 Protect existing trees and plants on site and adjacent properties, except as required to provide safe working conditions in the Work area to facilitate Work as specified.

1.13 EXISTING SERVICES

.1 Establish location, protect and maintain existing utility lines.

.2 Maintain existing services in occupied areas.

.3 Provide sanitary facilities at no cost.

.4 Provide water and electrical services at no cost.

1.14 SITE ACCESS

.1 There are no roads connecting Knife Island to the mainland, and there is no wharf, dock facilities, or helipad at the Site. The Site is located approximately 1 km from Shute Point (at the western tip of Black Creek Provincial Park), and approximately 4 km from the community of Stokes Bay. Arrangements for Site access to be completed by the Contractor. The Department of Fisheries and Oceans (DFO) should be consulted to obtain project-specific advice/requirements for in-water work and associated restrictions.

- .1 Refer to Appendix A for the Marine Assessment Report that includes a portion of Navigational Chart 2292: Stokes Bay.

.2 The Contractor is responsible to make their own temporary arrangements to provide safe access to Site (for their workers as well as for other authorized persons including Departmental Representative and regulatory authority representative) and in compliance with all applicable permits, codes, and regulations.

- .1 Marine equipment for transportation of personnel, waste materials and/or equipment to be registered with Transport Canada and have applicable certifications/licenses. Copies of registration and applicable certifications/licenses to be submitted to Departmental Representative at least five (5) business days prior to start of field work.
- .2 Contractor to secure marine permit in the event that work will occur within the DFO fish habitat restricted activity timing window (occurs between October and July) and/or contact DFO to obtain advice to minimize in-water work restrictions based on project-specific details.

1.15 TEMPORARY FACILITIES AND SERVICES

.1 Provide and maintain temporary facilities and services required to carry out Work.

.2 Remove temporary facilities and services on completion of Work.

1.16 METRIC SIZED MATERIALS

.1 SI metric units of measurement are used exclusively on the drawings and in the specifications for this project.

1.17 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.

.4 Operate and maintain equipment in accordance with manufacturer’s recommendations.

.5 For any hazardous products brought to Site, ensure Data Sheets are available, in accordance with applicable legislation.

1.18 CO-ORDINATION AND CO-OPERATION

.1 Site may be visited by authorized persons during the execution of Work. Safe access must be provided to the Site for authorized persons.

.2 Work areas will not be occupied during execution of Work. Inspections of the work by authorized persons will be required and safe access to the Work areas must be provided.

.3 Execute Work with minimum disturbance to on site buildings.

.4 The Site is unsecured. The Contractor will be responsible to secure all materials and equipment brought to the Site.

1.19 ALTERATIONS TO EXISTING SITE

.1 Remove and dispose of:
  .1 Trees, shrubs, grubbing material and other non-contaminated waste as directed by the Departmental Representative.

1.20 INSPECTION AND TESTING

.1 When initial tests and inspections reveal Work the does not satisfy Contract requirements, pay for tests and inspections required by Departmental Representative on corrected Work.

1.21 COST BREAKDOWN

.1 Within 48 hours of notification of acceptance of bid, furnish a cost breakdown by Section aggregating Contract Amount.

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

1.22 SCHEDULING

.1 On Award of Contract, submit bar/Gantt chart construction schedule for Work in accordance with Section 01 32 16.

.2 Carry out Work during normal working hours and coordinate Work to minimize trips to the Site.

1.23 CLEANING

.1 Maintain project free of accumulated waste and rubbish.

.2 Remove all hazardous and non-hazardous waste from the Site in accordance with applicable legislation, except organic waste (vegetation) produced by grubbing that can be left on Site (in location specified by Departmental Representative).

.3 Final cleaning:
  .1 Remove temporary protection, scaffolding and other equipment used to complete the Work.
  .2 Remove dust, dirt and foreign matter from

1.23 CLEANING (Cont'd)

.3 Final cleaning: (Cont'd)
.2 (Cont'd)
surfaces prior to re-painting the exterior of the old lighthouse.
.3 Use vacuum equipped with high efficiency air purifying (HEPA) filter to collect loose paint chips visible on the ground surface in the vicinity of the on-site structures.
.4 Remove temporary laydown area and site access facilities unless specified by the Department Representative.

1.24 CONSTRUCTION AND DEMOLITION WASTE

.1 Submit proof that all hazardous and non-hazardous waste is being disposed of at a suitably licensed landfill 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 Site.

.2 Cooperate with the Department Representative to arrange for segregation of wastes generated and laboratory analysis as required to classify wastes.

1.25 DESIGNATED SUBSTANCES

.1 The project site has been surveyed for the presence of designated substances referred to in Regulations for Construction Projects, O.Reg. 213/91 as amended.

.2 Designated substances present on site include:
.1 Lead in paint.
.2 Lead in soil.
.3 Possible lead in discarded batteries.

.3 Provide Site designated substance information to prospective Subcontractors prior to entering into a contract with them.

.4 Post prominent notices identifying and warning of the hazardous agent in the part of the workplace in which the agent is found or used. Notices shall be in English and other languages prescribed under the Occupational Health and Safety Act.

1.25 DESIGNATED SUBSTANCES (Cont'd)

.5 Ensure all workers have appropriate training in relation to designated substances and hazardous materials, as applicable based on their roles, (e.g., lead based paint abatement, material and disposal handling as required by Transportation of Dangerous Goods, Working at Heights). Provide worker training certificates to the Departmental Representative.

1.26 SPECIAL PROTECTION AND PRECAUTIONS

.1 Comply with the requirements of the 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 HRSDC - Labour Program.

1.27 POLLUTION CONTROL

.1 Spills of deleterious substances:
.1 Immediately contain, limit spread and clean up in accordance with provincial regulatory requirements.
.2 Report immediately to Ontario Spills Action Centre: 1-800-268-6060.
.3 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.

1.28 PROJECT MEETINGS

.1 Administrative:
.1 Schedule and administer project meetings throughout the progress of the Work as directed by the Departmental Representative.
.2 Prepare agenda for meetings.
.3 Distribute written notice of each meeting four (4) days in advance of meeting date to Departmental Representative.
.4 Provide physical space and make arrangements for meetings.
.5 Preside at meetings.
.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
.7 Reproduce and distribute copies of minutes within three (3) days after meetings and transmit to meeting participants and affected parties not in attendance.

1.28 PROJECT MEETINGS (Cont'd)

.1 Administrative: (Cont'd)
.8 (Cont'd)
Representative of Contractor, Subcontractor and Suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

.2 Preconstruction meeting:
.1 Within five (5) days after award of Contract, request a meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities.
.2 Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
.3 Establish time and location of meeting and notify parties concerned minimum five (5) days before meeting.
.4 Agenda to include:
.1 Appointment of official representative of participants in the Work.
.2 Schedule of Work: in accordance with Section 01 32 16.
.3 Schedule of submission of Health and Safety and Environmental Protection Plans.
.4 Requirements for temporary facilities, site signs, offices, storage sheds, utilities and fences.
.5 Site security.
.6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
.7 Take-over procedures, acceptance, warranties.
.8 Progress claims, administrative procedures, photographs, hold backs.
.9 Appointment of inspection and testing agencies or firms.
.10 Insurances and transcript of policies.

.3 Progress meetings:
.1 Project meetings will be requested as required by the Departmental Representative.
.2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.
.3 Notify parties minimum three (3) days prior to meetings.

1.28 PROJECT MEETINGS (Cont'd)

.3 Progress meetings: (Cont'd)
.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days after meeting.
.5 Agenda to include the following:
.1 Review, approval of minutes of previous meeting.
.2 Review of Work progress since previous meeting.
.3 Field observations, problems, conflicts.
.4 Corrective measures and procedures to regain projected schedule.
.5 Revision to construction schedule.
.6 Progress schedule, during succeeding work period.
.7 Review submittal schedules: expedite as required.
.8 Maintenance of quality standards.
.9 Review proposed changes for affect on construction schedule and on completion date.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 – EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 ACCESS AND EGRESS

.1 Design, construct and maintain temporary "access to" and "egress from" Work areas, including stairs, runways, ramps or ladders and scaffolding in accordance with O. Reg. 67/93, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

.2 Access to the Site from the mainland is by water. Refer to the Marine Assessment in Appendix A which provides options for marine access from the mainland.

.3 Access route must be established to old light tower in preparation for lead based paint abatement. Refer to drawing C-02 for proposed access routes.

1.2 USE OF SITE AND FACILITIES

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

.2 Maintain existing services to building and provide for access by authorized persons during the Work as required.

.3 Closures: protect Work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute Work with least possible interference or disturbance to building operations, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of Work.

1.4 EXISTING SERVICES

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

.2 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 to a minimum.

.3 Provide for access by authorized persons as required.

1.4 EXISTING SERVICES (Cont'd)

.4 Construct barriers in accordance with Section 01 56 00.

1.5 SPECIAL REQUIREMENTS

.1 Carry out noise generating Work Monday to Friday from 08:00 to 16:00 hours.

.2 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart.

.3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, security, environmental protection and waste management.

.4 Ensure Site access and any in-water Work is in accordance with applicable legislation and schedule Work to minimize restrictions.

.5 Ingress and egress of Contractor personnel and equipment at Site is limited to Work area and mooring location of the Site.

.6 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.

1.6 SECURITY

.1 Where security is reduced by Work, provide temporary means to maintain security. Of note, the Site is not secured and the Contractor will be required to provide security as deemed necessary for equipment and materials they bring to and store on Site during the Work.

1.7 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions applicable in the jurisdiction. Establish appropriate on-site restrictions based on Site conditions and in consultation with the Departmental Representative.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

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 (5) day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.1 Contractor has option to propose to work Saturday and Sunday upon request and approval from the Department of Fisheries and Oceans (DFO).

.5 Duration: number of work periods (not including holidays or other non-working 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

1.1 DEFINITIONS (Cont'd)

.8 (Cont'd) 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 Detail Schedules are practical and remain within specified Contract duration.

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

.3 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 11 06.

.2 Submit to Departmental Representative within five(5) 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 three (3) working days of receipt of acceptance of Master Plan.

1.4 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule.

.1 Contract work commencement and completion to be coordinated based on most suitable time of year for in-water work.

.2 Certificate of Substantial Performance within five (5) working days of completion of Contract Work.

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 five (5) working days.

.3 Revise impractical schedule and resubmit within two(2) 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 Permits.
- .3 Mobilization and establishing temporary site access.
- .4 Site preparations including initial debris removal and preliminary loose paint chip cleanup.
- .5 Clearing and grubbing.
- .6 Lead based paint abatement and waste containerization.
- .7 Encapsulation/re-painting and signage.
- .8 Soil excavation/removal, segregation and containerization.
- .9 Waste characterization and disposal.
- .10 Site cleanup/restoration.
- .11 Demobilization.
- .12 Anticipated weather delays.

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.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

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 with associated regulations and guidelines that may be applicable to the Work including but not limited to:
1. Regulations for Construction Projects, O. Reg. 213/91 as amended.
2. Regulation for Designated Substances, O. Reg. 490/09.
    1. Guideline - Lead on Construction Projects, April 2011.
3. Workplace Safety and Insurance Act of Ontario, 1997.
4. Municipal statutes and authorities.
5. Workplace Hazardous Materials Information System (WHMIS), R.R.O 1990, Reg. 860, last amended by O. Reg. 36/93.

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

.3 National Building Code 2010 (NBC):
.1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.

.4 National Fire Code 2010 (NFC):
.1 NFC 2010, Division B, Part 2 Emergency Planning, subsection 2.8.2 Fire Safety Plan.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 06.

.2 Submit site-specific Health and Safety Plan: Within five (5) days after date of Notice to Proceed and prior to commencement of on-site 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 operations found in work plan.

1.2 SUBMITTALS (Cont'd)

.2 (Cont'd):

.3 Measures and controls to be implemented to address identified safety hazards and risks.

.4 A Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.3 prior to commencement of work.

.5 Contractors and Subcontractors safety communication plan.

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

.3 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within three (3) days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within two (2) days after receipt of comments from Departmental Representative.

.4 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.

.5 Submit names of personnel and alternates responsible for Site health and safety.

.6 Submit training records for Contractor and Subcontractor workers as applicable for the specific Work tasks they will be involved, including but not limited to WHMIS, work at heights, equipment/barge operators, etc.

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

.8 Submit two (2) copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.

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

.10 Submit copies of incident and accident reports.

1.2 SUBMITTALS (Cont'd)

.11 Submit Material Safety Data Sheets (MSDS) for any products brought to the Site that are covered under WHMIS legislation.

.12 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 WORK PERMIT

.1 Obtain permits related to project prior to commencement of Work.

1.5 SAFETY ASSIGNMENT

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

1.6 MEETINGS

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

1.7 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.

1.8 PROJECT/SITE CONDITIONS

.1 Work at the Site will involve contact with:
- .1 Lead in paint and in soil.
- .2 Batteries (potentially containing lead) and paint cans.
- .3 Vegetation (i.e. trees, shrubs, etc.) in Work area.
- .4 Guano from birds in Work Area.

.2 Access to the Site is by water. Provision of temporary safe Site access (mooring, floating dock) and any required over-water transportation for Contractor, Subcontractor and authorized personnel is included in Contract Work.

1.8 PROJECT/SITE CONDITIONS (Cont'd)

.3 Uneven rocky terrain with no established roads.

1.9 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 standard herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.10 COMPLIANCE REQUIREMENTS

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

1.11 RESPONSIBILITY

.1 Be responsible for health and safety of persons (workers, inspectors, client and other authorized persons/visitors) 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 persons on Site with safety requirements of Contract Documents, applicable federal, provincial 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 for the Province of Ontario.

1.12 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.

1.13 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, a competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
  - .1 Have working knowledge of occupational safety and health regulations.
  - .2 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.
  - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .4 Be on Site during execution of Work and report directly to and be under direction of site supervisor.

1.14 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.

1.14 POSTING OF DOCUMENTS (Cont'd)

.10 Site-Specific Health and 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.

1.15 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.

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

1.16 BLASTING

.1 Blasting or other use of explosives is not permitted at the Site.

1.17 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 a Competent Supervisor to stop or start Work at the Competent Supervisor's discretion when 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 OF SECTION

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 humankind; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 REFERENCES

.1 Franz Environmental (2011). Site Specific Human Health Risk Assessment (SSRA-HA), Site Specific Ecological Risk Assessment (SSERA) and Supplemental Site Investigation, Stokes Bay Front Range, Stokes Bay Rear Range and the Former Squatter’s Area, Knife Island (DFRP# 10961) and Shute Point ((DFRP No. 85917), PWGSC Project No.: R.032955.015. March 2011.

.2 SNC-Lavalin (2015). Confirmation Soil Sampling, SAR Survey Update, DSHMS, Structural Assessment, Marine Assessment and Development of Plans and Specifications for Remediation, Stokes Bay Front Range, Knife Island, Lake Huron, Ontario, DFRP No. 10961 / PWGSC No. R071694.050. March 2015.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 06.

.2 Five (5) days prior to commencing construction activities or delivery of materials to Site, submit an Environmental Protection Plan for review and approval by Departmental

1.3 SUBMITTALS (Cont'd)

.2 (Cont'd)
Representative. The Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required remedial tasks.

.4 Environmental Protection Plan is to include:
.1 Names of persons responsible for ensuring adherence to the Environmental Protection Plan.
.2 Names and qualifications of persons responsible for training site personnel.
.3 Descriptions of environmental protection personnel training program.
.4 Mitigation measures meeting minimum requirements presented in Appendix D of this Specification.
.5 Erosion and sediment control plan which identifies 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, as well as federal, provincial and municipal laws and regulations.
.6 Drawings showing locations of proposed temporary excavations or embankments, access roads, material storage areas, existing structures, construction facilities, temporary barriers and enclosure, sanitary facilities, stockpiles of excess or spoil materials, and temporary waste material containerization storage area including methods to control runoff and to contain materials on Site.
.7 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features to be preserved within authorized work areas.
.8 Spill control plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
.9 Hazardous and non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing/grubbing debris.

1.3 SUBMITTALS (Cont'd)

.10 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become airborne and travel off project Site.

.11 Contaminant prevention plan that identifies potentially hazardous substances to be used on job site, identifies intended actions to prevent introduction of such materials into air, water or ground, and details provisions for compliance with federal, provincial, and municipal laws and regulations for storage and handling of these materials.

.12 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as clean-up water, disinfection water.

.13 Historical, archaeological, cultural resources, biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

.14 Species at Risk (SAR) information and management plan identifying potential SAR at the Site and measures to protect them from disturbance during the Work. The SAR pamphlet from the SNC-Lavalin (2015) report (in Appendix A) can be used as a basis for this plan.

1.4 FIRES

.1 Fires and burning of rubbish on Site are not permitted.

1.5 DISPOSAL OF WASTE

.1 Do not burn or bury rubbish and waste materials on Site.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

.3 Dispose of waste water generated by excavation activities at a licensed disposal facility in accordance with local and/or provincial authorities.

.4 Do not discharge wastes into streams or waterways.

.5 Appropriate procedures shall be implemented for

1.5 DISPOSAL OF WASTE (Cont'd)

.5 (Cont'd)
handling, temporary storage, transport and disposal of debris, impacted soils and waste materials during all phases of the project. Refer to Land Disposal Restrictions in O.Reg. 347 - General Waste Disposal under Ontario EPA and MOE Fact Sheet "Summary of Land Disposal Restrictions, Treatment and Notification Requirements for Waste Generators". Off-site disposal will be by licensed haulers to suitably licensed MOE-approved disposal facilities, as applicable to the type of waste to be disposed.

.6 Submit proof of licensed waste hauler along with proof of licensed waste disposal facilities.

.7 Disposal/recycling of other waste generated during the project shall be done in compliance with Ontario Waste Regulations and the facilities used will be approved by the Departmental Representative.

1.6 SITE ACCESS

.1 Maintenance and Use:
.1 Prevent contamination of access roads.
.2 Immediately scrape up debris or material (including loose paint chips) on access roads which is suspected to be contaminated as determined by Departmental Representative; transport and place into designated area approved by Departmental Representative. Clean access at a frequency designated by the Departmental Representative.
.3 Departmental Representative may collect soil samples for chemical analyses from traveling surfaces of constructed access routes prior to, during and upon completion of Work. Excavate and dispose of clean soil contaminated by Contractor's activities at no additional cost to Departmental Representative.

.2 Vehicles/equipment shall be in good working order and not be leaking any fuel or fluids.

.3 Restrict access of vehicles while on Site to mooring location and Work area.

.4 During remedial activities designated fuelling area(s) will be established.

1.6 SITE ACCESS (Cont'd)

.5 Refuelling of vehicles and equipment shall not be conducted near watercourses or water bodies.

.6 Wastes generated during the Work must be containerized and open waste containers or other loose waste must not be permitted to be discharged onto the ground or into water bodies, especially during off-site removal.

1.7 EQUIPMENT DECONTAMINATION

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

.2 Perform equipment decontamination in a manner to prevent cross contaminating un-impacted areas.

.3 At minimum, perform following steps during equipment decontamination: mechanically remove packed dirt, grit and debris by scraping and brushing. Contractor to pay particular attention to tire treads, equipment tracks, springs, joints, and sprockets.

.4 Use of high-pressure low volume, hot water or steam supplemented by detergents or solvents only as approved by Departmental Representative.

.5 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.

.6 Transfer sediments to a designated area approved by the Departmental Representative.

.7 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection and face shields.

1.8 DRAINAGE

.1 Five (5) days prior to on Site field work, provide erosion and sediment control plan. Plan to include the type and location of erosion and sediment controls to be provided. Include monitoring and reporting requirements to assure that control measures are in compliance with mitigation measures in the Environmental Effects and Proposed Mitigation Measures form (Appendix D), as well as federal, provincial and municipal laws and regulations.

.2 Provide temporary drainage and pumping as necessary to keep excavations and Site free from water.

.3 Do not allow water containing suspended materials to enter into waterways or drainage systems.

.4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.5 Do not direct water flow in a manner which would cause erosion to existing areas.

1.9 SITE CLEARING AND PLANT PROTECTION CONDITIONS

.1 Protect trees and plants on site and adjacent properties where indicated or as directed by the Departmental Representative.

.2 Vegetation and trees will be removed from within the area of contamination and Work area as directed by Departmental Representative.

.3 Cut vegetation and tree material shall be disposed on-site in area as determined based on site conditions and in consultation with the Departmental Representative.

.4 Restrict tree removal to areas indicated or designated by Departmental Representative.

.5 Outside of the Work area, minimize stripping of topsoil and vegetation.

1.10 WORK ADJACENT TO WATERWAYS

.1 Operation of construction or other equipment in waterways only permitted within restricted activity window, and upon authorization from the Department of Fisheries and Oceans (DFO).

.2 Do not use waterway beds for borrow material without Departmental Representative's approval.

.3 Do not dispose of excavated fill, waste material or debris in waterways.

.4 Do not skid logs or construction materials across waterways.

.5 Do not use water from waterways.

.6 Special care shall be exercised while working near water's edge including site-specific erosion and sediment control measures. Silt fences/bale barriers shall be used to minimize sediment transport as well as limit access to watercourses by site personnel.

1.11 POLLUTION CONTROL

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

.2 Vehicles and equipment must be maintained in good working condition, equipped with emission controls as applicable to local authorities emission requirements.

.3 Implement dust abatement measures, as required to control dust.

.4 Control emissions from equipment to local authorities emission requirements.

.5 Prevent lead based paints from contaminating the ground, air and waterways beyond the immediate abatement Work area. Before scaffold construction, lay an impervious polyethylene 6 mm thick tarp around the base of the old lighthouse to collect any paint chips and debris during exterior paint abatement. Routinely collected fallen paint chips and debris from tarp using

1.11 POLLUTION CONTROL (Cont'd)

.5 (Cont'd) vacuum equipped with high efficiency purifying air (HEPA) filter, and containerize for off-site waste disposal. At completion of abatement Work, carefully wrap up tarp to contain paint chips and other small debris without spillage and dispose off site.

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

.7 Ensure hazardous substances (including fuel and lead based paint/abatement waste) are stored, handled and applied in a manner to prevent release to the environment and in a legal manner in accordance with hazardous waste regulations.

.8 Secure all materials at non-productive times (night and shut-down).

.9 Vehicles shall be shut off when not in use. No vehicle idling on-site.

.10 Store all containerized wastes (hazardous, non-hazardous or toxic substances) in a secured and designated area.

.11 Comply with requirements of WHMIS regarding use, handling, storage and disposal of hazardous materials; and regarding labeling and provision of MSDS acceptable to Labour Canada.

1.12 SPILLS OR RELEASE OF DELETERIOUS SUBSTANCES

.1 Immediately contain, limit spread and clean up in accordance with provincial regulatory requirements.

.2 All workers shall be fully aware of the spill prevention and response procedures including notification of Departmental Representative.

.3 The Ontario Ministry of Environment Spills Action Centre must be notified immediately by law at 1-800-268-6060.

.4 The Departmental Representative shall be immediately informed of all spills that occur on Site.

1.12 SPILLS OR RELEASE OF DELETERIOUS SUBSTANCES (Cont'd)

.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.

.6 Spill kits will be kept on the Site during all project phases.

.7 Equipment fuelling or lubricating shall occur in a designated area with proper controls to prevent the release of deleterious substances, and shall be conducted away from any water bodies.

.8 Any equipment remaining on site overnight shall have appropriately placed drip pans.

.9 The rinse, cleaning water or solvents for glues, wood preservatives and other potentially harmful or toxic substances should be controlled so as to prevent leakage, loss or discharge into the marine environment.

1.13 HISTORICAL/ ARCHAEOLOGICAL CONTROL

.1 Provide historical, archaeological, cultural resources, biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be on Site or in area are discovered during construction.

.2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

.3 If archaeological deposits are discovered during the project, Work shall stop immediately and the Departmental Representative shall immediately be notified.

.4 Archaeologically significant material, if found on the property, remains the property of the Crown and shall not be removed from the Site.

1.13 HISTORICAL/ ARCHAEOLOGICAL CONTROL (Cont'd)

.5 Management of the archaeological materials will be coordinated through Departmental Representative.

1.14 NOTIFICATION

.1 Departmental Representative will notify Contractor in writing of observed non-compliance with federal, provincial or municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.

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

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

1.15 SPECIES AT RISK

.1 Should a species at risk (SAR) or its critical habitat be encountered, measures are to be implemented to avoid destruction, injury or interference with the species, its residence and/or its habitat (e.g. through sitting, timing or design changes). If the foregoing cannot be avoided, Contractor shall cease work and contact Departmental Representative for advice regarding mitigation measures.

.2 In the event that it is determined that the project likely may have unexpected adverse effects on a SAR, the Contractor shall notify the Department Representative immediately.

.5 Refer to the SAR pamphlet in the SNC-Lavalin (2015) report (Appendix A) and detailed SAR information in the Franz (2011) report (Appendix C) regarding SAR that may be encountered at the Site and Work area.

1.16 FISH HABITAT

.1 All materials and equipment used will be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt, etc.) as defined by the Fisheries Act from entering surface water.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 – EXECUTION

3.1 NOT USED

.1 Not Used

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Parking.

1.2 REFERENCES

.1 CSA Z797-09(R2014), Code of Practice for Access Scaffold.

.2 Occupational Health and Safety Act Revised Statutes of Ontario, 1990, for provision of sanitary facilities.
 .1 Regulations for Construction Projects, O. Reg. 213/91 as amended.

.3 Workplace Safety and Insurance Act of Ontario, 1997.
 .1 First Aid Requirements, Regulation 1101.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 06.

1.4 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute Work safely and expeditiously.

.2 Remove from Site all such facilities after use.

1.5 SCAFFOLDING

.1 Scaffolding in accordance with CSA Z797.

.2 Provide and maintain scaffolding, ramps, ladders, and platforms as required to safely execute lead based paint abatement on old lighthouse exterior.

.3 Scaffolding shall be designed, drawn and inspected by a registered Professional Engineer experienced in this Work. Provide shop drawings to Departmental Representative for review. All drawings shall be stamped and signed by a registered Professional Engineer.

.4 Professional Engineer shall complete an inspection of the installation prior to using the scaffolding for carrying out the Work and shall provide a written inspection report to the Departmental Representative.

1.6 HOISTING

.1 Provide, operate and maintain hoists/cranes as required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists/cranes shall be operated by qualified operator.

1.7 SITE STORAGE/ HOARDING

.1 Confine Work and operations of employees to areas defined by Contract Documents.

.2 Do not unreasonably encumber premises with products.

.3 Establish laydown area at the Site for storage of equipment, materials and for temporary secured storage of containerized waste pending removal from Site.

1.8 CONSTRUCTION PARKING

.1 Parking will be on the mainland at the Contractor’s mobilization point to the Site.

1.9 OFFICES

.1 Provide a clearly marked and fully stocked first-aid case in a readily available location.

.2 Contractor and their Subcontractors to provide their own offices as necessary. Location of these offices at the Site to be approved by Departmental Representative.

1.10 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.

1.11 SANITARY FACILITIES

.1 No sanitary facilities exist at the Site. Contractor to provide sanitary facilities for work force in accordance with governing regulations and ordinances.

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

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Barriers.

.2 Environmental Controls.

.3 Traffic Controls.

.4 Fire Routes.

1.2 REFERENCES

.1 Ontario Provincial Standard Specifications (OPSS)
  .1 OPSS 805 November 2010, Construction Specification for Temporary Erosion and Sediment Control Measures.

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work safely and expeditiously, with minimal impact to the environment.

.2 Remove from Site all such facilities after use.

1.4 TEMPORARY SITE FENCING

.1 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

.2 Remove from Site all such facilities after use.

1.5 LAYDOWN AREA AND HOARDING

.1 A laydown area shall be established in close proximity to the mooring location at the Site.

.2 Erect a temporary storage area for waste generated on-site (i.e. containerized lead-based paint chips and soil, paint cans, general debris) in close proximity to mooring location (away from water’s edge) and surrounded by temporary fencing.
  .1 Fencing to extend minimum 1.5 m above grade and entrance to be secured with a lock.
  .2 Drums to be stored on wood platform/pallets within temporary storage area.

1.6 EROSION AND SEDIMENT CONTROL

.1 Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas. Prevent erosion and sedimentation.

.2 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical. Strip vegetation, re-grade, or otherwise develop to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems and water courses, and repair damage caused by soil erosion and sedimentation as directed by Departmental Representative.

.3 Provide and maintain temporary measures which include, hay or straw bales required to prevent erosion and migration of silt, mud, sediment, and other debris off site or to other areas of Site where damage might result, or that might otherwise be required by Laws and Regulations. Make sediment control measures available during construction.

.4 Use of straw/hay bales only acceptable sediment/erosion control measure at the Site due to the presence of shallow bedrock
  .1 Sediment control measures in accordance with OPSS 805.

.5 Plan construction procedures to avoid damage to Work or equipment encroachment onto water bodies or drainage ditch banks. In event of damage, promptly take action to mitigate effects. Restore affected bank or water body to existing condition.

.6 Installation:
  .1 Construct temporary erosion control items as required. Actual alignment and/or location of various items as directed by Departmental Representative.
  .2 Do not construct bale barriers in flowing streams or in swales.
  .3 Check erosion and sediment control measures weekly after each rainfall; during prolonged rainfall check daily.

1.6 EROSION AND SEDIMENT CONTROL (Cont'd)

.6 (Cont'd)

.4 Bale barriers removed at beginning of work day must be replaced at end of work day.

.5 Whenever sedimentation is caused by stripping vegetation, re-grading or other development, remove it from adjoining surfaces, drainage systems and watercourses, and repair damage as quickly as possible.

.6 Prior to or during construction, Departmental Representative may require installation or construction of improvements to prevent or correct temporary conditions on Site. Improvements may include berms, mulching, sediment traps, detention and retention basins, grading, planting, retaining walls, culverts, pipes, guardrails, temporary access roads, and other measures appropriate to specific condition. Temporary improvements must remain in place and in operation as necessary or until otherwise directed by Departmental Representative.

.7 Repair damaged bales, end runs and undercutting beneath bales.

.8 Unless otherwise directed by Departmental Representative, remove temporary erosion and sediment control devices upon completion of Work.

.9 Test accumulated sediment to ensure that it meets applicable CCME criteria.

.10 Spread accumulated sediments to form a suitable surface for seeding or dispose of and shape area to permit natural drainage to the satisfaction of Departmental Representative.

.11 Materials once removed become property of Contractor.

.7 Do not disturb existing embankments or embankment protection.

.8 Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

.9 If soil and debris from Site accumulate in low areas, ditches or other areas where in Departmental Representative's determination it is undesirable, remove accumulation and restore area to original condition.

1.7 GUARD RAILS AND BARRICADES

.1 Provide secure barricades at the top of steep slopes.

.2 Provide temporary barricades or guard rails inside or outside old lighthouse as required to facilitate exterior lead based paint abatement.

.3 Provide as required by governing authorities on land and marine vessels.

1.8 ACCESS TO SITE

.1 Provide suitable means to access the Site from mooring location. Acceptable methods are expected to include:

- .1 Temporary floating dock having adequate load rating for transporting equipment/materials extending from the mooring location to the shoreline of the Site.
- .2 Barge equipped with ramp from the mooring location in conjunction with mud mats extending from the ramp to the shoreline of the Site.

.2 Direct consultation with DFO Habitat shall be undertaken as this may identify project-specific restrictions and timing window (different from the generic recommendations for Ontario and/or Lake Huron) based on site-specific conditions, the types of fish species that may be present and their spawning characteristics (i.e., spring versus fall).

.3 Provide and maintain access roads, ramps/docks and construction runways as may be required for access to Work areas at the Site.

.4 Construct access roads as necessary from the mooring location to access the Work area(s) of the Site. Conduct preliminary cleanup of loose paint chips from access roads and from immediate area of old light tower in advance of other Work to prevent cross-contamination during Work.

.5 Location, grade, width and alignment of access subject to approval by Departmental Representative.

.6 Remove upon completion of Work, access roads, ramps/docks and construction runways designated by Departmental Representative.

1.9 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.10 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

PART 2 – PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes contaminated soil removal and offsite disposal.

.2 Soil remediation work includes:

.1 Soil removal, including but not limited to scraping, excavation and vacuuming of contaminated soil from affected area and bedrock crevices.

.2 Transportation of all equipment, personnel and contaminated materials to and from the Site as required.

.3 Coordination, supervision and preparation for remediation of contaminated soil.

.4 Departmental Representative requires one (1) week notice prior to the commencement of Site work for provision of site supervision.

.5 Provision and installation of materials and equipment necessary to remediate contaminated soil.

.6 Implementation of safety work zones, temporary barriers, Health and Safety Plans, Emergency Response Plans and Environmental Protection Plans as specified.

.7 Clearing and grubbing of Work area.

.8 Remove stones and cobbles greater than 100 mm in diameter by screening from contaminated soil (to the extent practical), and place as backfill from excavated areas. No other backfill is required.

.9 Segregate excavated contaminated soil as directed by Departmental Representative based on visual evidence of paint chips and known soil concentrations. Segregate soil to minimize soil requiring disposal as hazardous waste.

1.2 REFERENCES

.1 Franz Environmental (2011). Site Specific Human Health Risk Assessment (SSRA-HA), Site Specific Ecological Risk Assessment (SSERA) and Supplemental Site Investigation, Stokes Bay Front Range, Stokes Bay Rear Range and the Former Squatter’s Area, Knife Island (DFRP# 10961) and Shute Point ((DFRP No. 85917), PWGSC Project No.: R.032955.015. March 2011.

1.2 REFERENCES (Cont'd)

.2 SNC-Lavalin (2015): Confirmation Soil Sampling, SAR Survey Update, DSHMS, Structural Assessment, Marine Assessment and Development of Plans and Specifications for Remediation, Stokes Bay Front Range, Knife Island, Lake Huron, Ontario DFRP No. 10961 / PWGSC No. R071694.050. March 2015.

1.3 MEASUREMENT PROCEDURES

.1 Removal and disposal of contaminated soil shall be measured in metric tonnes of the actual weight of soil disposed (as hazardous and non-hazardous based on waste classification results). Measurement shall be based on the net weight of contaminated soil delivered at the landfill site and substantiated by certified weigh bills from the landfill site.

.1 Remove, segregate and dispose of contaminated soil to the extent and limits as directed on Site by Departmental Representative.

.2 Separate cobbles, stones and boulders larger than 100 mm diameter from contaminated soils, and use as fill in the onsite excavation of soils.

.3 Price shall include: Preparatory tasks including obtaining the required permits and certificates; quality control/quality assurance; other required equipment; implementation of safety work zones; excavation; screening 100 mm and separation of cobbles, stones and boulders from contaminated soil; loading/containerization of soil for disposal; decontamination of construction equipment used in remediation procedures in accordance with Section 01 35 43 required storage and delivery of contaminated soil to the landfill sites; placing separated cobbles, stones and boulders to excavated areas; and making good all disturbed surfaces.

.4 Include working overtime hours if required to complete the Work by the Contract completion date.

.2 Clearing and grubbing shall be measured as a unit price per square metre. Measurement shall be based on the area cleared and grubbed as directed and confirmed on Site by the Departmental Representative.

1.3 MEASUREMENT PROCEDURES (Cont'd)

.2 (Cont'd)
.1 Price shall include: equipment and materials to remove trees and shrubs; and equipment and materials required to protect trees to remain.

.3 All remaining Work is to be included as part of the lump sum price and shall include, but is not limited to, the following tasks:
.1 Mobilization to and demobilization from the Site. The Site does not currently include a functioning dock or wharf. Additional equipment required to transport equipment to and from the Site may be required.
.2 Locating and protecting any buried and above ground utilities, structures and features.

1.4 SUBMITTALS

.1 Provide quality assurance and quality control submittals in accordance with Section 01 11 06 as follows:
.1 Completed Environmental Assessment Mitigation Monitoring Report Form.
.2 Description of emergency plans in case of breakdown, spill or other problems.
.3 Waste management plan and complete list of wastes, including waste registration numbers as required by provincial regulations that will be generated by activities.
.4 Copies of transport manifests, trip tickets and disposal receipts for waste materials removed from Work area.

.2 Provide closeout submittals as follows:
.1 Provide written proof that contaminated soil has been sent to appropriate waste disposal facilities (based on type of waste) authorized by MOE for Province of Ontario.
.2 Provide written proof that other waste and debris have been sent to site authorized by MOE for Province of Ontario or eliminated according to level of contamination.

1.5 QUALITY ASSURANCE

.1 Qualifications:
.1 Provide detailed descriptions of Contractor firm and Subcontractors, indicating experience in soil remediation in the past 5 years including names of individuals in charge of the remediation.

1.5 QUALITY ASSURANCE (Cont'd)

.1 Qualifications: (Cont'd)
  .2 Identify members of project team. Define experience, education and training, qualifications, tasks and responsibilities of each team member. Supply résumés of key technical and management staff.

.2 Regulatory requirements: perform Work in accordance with:
  .1 Acts, Regulations, Laws, guidelines codes of practice, directives and policies of government authorities pertaining to: handling and disposing of contaminated soil; environment; noise; water supply; waste water; air quality; health and safety; transportation; and waste management.
  .2 WHMIS.
  .3 Canadian Environmental Assessment Act.
  .4 Canadian Environmental Protection Act (New Substance Notification Regulations).
  .5 Transportation of Dangerous Goods Act.
  .6 National Building Code of Canada, 2010.
  .7 National Fire Code of Canada, 2010.
  .8 The Fisheries Act.
  .9 Migratory Birds Convention Act.
  .10 Migratory Birds Regulations.
  .11 Ontario Regulation 347/90-General Waste Management.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Contaminated soil:
  .1 Store excavated, contaminated soil as determined by Departmental Representative in drums, soil bags or in soil piles.
    .1 Known or suspected hazardous soil (with significant paint chips and/or based on soil concentrations) should be immediately containerized in sealed and appropriately labeled drums.
    .2 Lesser impacted soil could also be contained in appropriately labeled drums, or in soil bags or soil piles.
    .3 Cover stored, stockpiled contaminated soil with tarp to minimize cross contamination due to water run-off and wind erosion, and underlay contaminated soil with flexible membrane to minimize or prevent leaching losses.

1.6 DELIVERY, STORAGE, AND HANDLING (Cont'd)

.2 Transport and dispose of contaminated soil and water according to current provincial regulations.

.3 Conduct sieving/screening of soils over an impermeable membrane as directed by the Departmental Representative, to minimize cross contamination due to screening activities.

1.7 PROJECT/SITE CONDITIONS

.1 Environmental Requirements:
  .1 Review of Environmental Assessment to be completed by Departmental Representative.

.2 Existing conditions:
  .1 Refer to the Franz (2011) and SNC-Lavalin (2015) reports for details.
  .2 Approximately 15 cubic metres of lead contaminated soil (approximately 0.3 m thickness to underlying bedrock) has been confirmed in the vicinity of the old lighthouse. Hazardous contaminated material is estimated at 10% of the total solid waste. Lesser impacted soil is expected to be non-hazardous for disposal purposes.
    .1 Departmental Representative to collect soil sample(s) during soil removal/segregation activities for toxicity characteristic leaching procedure (TCLP) waste classification analysis prior to removal from site.
  .3 Contaminated soil may be present in the previously unidentified area of debris located southeast of the old lighthouse. For planning purposes, it is estimated that a maximum of 2 cubic meters of non-hazardous soil may require excavation/disposal from this second Work area.
    .1 Departmental Representative to collect soil sample(s) following debris removal to delineate extent of soil impact (if any) at second Work area.

.3 Removal of contaminated soil:
  .1 Set area aside for segregation and temporary storage of contaminated soil.
  .2 Set area aside for screening of cobbles, stones and boulders larger than 100 mm diameter from contaminated soil.

1.7 PROJECT/SITE CONDITIONS (Cont'd)

.3 Removal of contaminated soil: (Cont'd)
  .3 Restore excavated portion with screened cobbles, stones and boulders. No other backfilling is required.
  .4 Protect non-contaminated material from adjacent contaminated soil.

.4 Acceptable marine access to the Work area is through the Stokes Bay Entrance Channel.

1.8 SEQUENCING

.1 Establish site access, laydown area and access roads to Work area(s) around old lighthouse.

.2 Lead based paint abatement (including preliminary cleanup of loose paint chips on the ground in immediate vicinity of the old lighthouse and on access routes to Work area, as well as abatement of lead based paint on old lighthouse exterior) expected to be completed in advance or in conjunction with contaminated soil removal.

.3 Removal of debris (i.e. paint cans, batteries, and wood debris) from areas as indicated. Sampling of underlying soil to be completed by Departmental Representative to assess soil conditions for potential removal.

.4 Removal of contaminated soil from the Work area to be completed following clearing and grubbing.

.5 Collection of representative soil samples for waste classification purposes (i.e. TCLP waste classification analysis for lead containing solid waste) to be completed by Departmental Representative as soil removal/segregation proceeds.

.6 Decontaminate equipment used in remediation procedures before removing equipment from job site.

1.9 MAINTENANCE OF ACCESS ROADS

.1 Unless otherwise directed maintain access roads as follows:
  .1 Obtain permission to use existing roads/paths to access Site.
  .2 Maintain and clean roads/paths for duration of Work.

1.9 MAINTENANCE OF ACCESS ROADS (Cont'd)

.1 (Cont'd):
.3 Repair damage incurred from use of roads/paths.
.4 Provide photographic documentation of roads/paths used by construction vehicles before, during and after Work.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Geomembrane: flexible, impermeable, polyethylene liner; 15mm or heavier.

2.2 EQUIPMENT

.1 Trucks: use watertight truck bodies for transporting contaminated soil.

.2 Drums: use 205 L (54 US gallon), watertight steel drums for containerization of contaminated soil.

.3 Soil bags: capacity to hold one (1) cubic meter. Composed of a 6.5 oz polypropylene outer bag - 0.18 kg (6.5 oz.), 0.15 mm (6 mil) low density polyethylene(LDPE) inner liner, and pull-up duffle sleeve to prevent rainwater from entering.

.4 Marine equipment:
.1 The Department of Fisheries and Oceans (DFO) Habitat shall be contacted to assess most suitable marine equipment with minimal impact and restrictions. Acceptable options include:
.1 The use of tug and deck barge. Spuds shall not be the types that are driven into the lake bottom.
.2 Temporary floating dock to extend from the barge mooring to shore.
.3 Barge equipped with a ramp can be used from the mooring location in conjunction with mud mats extending from the ramp to the shoreline.
.1 Mud mats acceptable material: Double layer of high strength 100% polypropylene, woven geotextile fabric.

.2 Maximum vessel drafts to be approximately 1.7 m (September to October) to 1.9 m (July to August).

2.2 EQUIPMENT (Cont'd)

.5 Vacuum equipped with HEPA filter.

.6 Environmental emergency response equipment.

.7 Safety equipment.

PART 3 - EXECUTION

3.1 EQUIPMENT

.1 Marine equipment:
  .1 Prevent any spillage of soil during all transfers of soil over land or water.

.2 Trucks
  .1 Clean meticulously between loads of contaminated soil.
  .2 Clean meticulously at end of Work.
  .3 Cover truck boxes with tarpaulins during transportation.

.3 Drums and soil bags appropriately labeled. Ensure lids are placed on soil drums and secured, and the tops of the soil bags are knotted closed at the end of each work day or when being transported from the Site.

.4 Ensure that no equipment is driven through or placed within the waterway.

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

3.2 PREPARATION

.1 Preparation:
  .1 The extent of contaminated soil for the site is shown in Appendix B - Drawing C-03.
  .2 Remove obstructions, debris, miscellaneous waste materials (i.e. paint cans, potentially lead containing batteries) from surfaces to be excavated within the limits indicated.
  .3 To avoid cross-contamination and spreading, remove visible loose paint chips on ground in advance of any other Work in the vicinity of the old lighthouse and on access routes to Work areas. Do abatement of lead based paint on old lighthouse exterior in advance of (or in conjunction with)

3.2 PREPARATION (Cont'd)

.1 Preparation: (Cont'd)
.3 (Cont'd)
soil removal to avoid re-contamination of remediation area and/or to conflict between remediation/abatement Work crews.

.2 Clearing and grubbing:
.1 Remove vegetation (including scrub trees and brush) and juvenile trees from the area of contamination as directed by the Departmental Representative and in accordance with Section 01 35 43.
.2 Trees greater than 15 cm in diameter shall have lower branches to a height of 1.5 to 1.8 m removed to create safe Work area.
.3 Vegetative debris shall remain onsite at location(s) away from the water's edge and as directed by Departmental Representative.

3.3 APPLICATION

.1 Soil Management:
.1 Excavation, segregate, store, transport and dispose off-sitein accordance with applicable provincial standards, requirements and regulations.
.2 Do not dilute contaminated soil with less contaminated soil.
.3 Store contaminated soil in drums or soil bags in close proximity to site access mooring location approved by Departmental Representative, and underlay stored contaminated soil with wood platform or geomembrane. Containerized wastes must be secured and labeled in accordance with WHMIS legislation.

3.4 METHOD OF REMEDIATION

.1 Contaminated/volatile waste: store in covered metal containers.

.2 Hazardous waste: dispose in accordance with regulations.

.3 Use removal and off-site disposal for contaminated soil. Soil removal and off-site disposal shall be completed by Contractor and supervised by Departmental Representative. Contractor is responsible to provide schedule for contaminated soil removal. Departmental Representative requires one (1) weeks' notice from Contractor to conduct on-site supervision.

3.4 METHOD OF REMEDIATION (Cont'd)

.4 Soil removal:
.1 Excavate contaminated soil so as to prevent contamination of non-contaminated soil.
.2 Remove contaminated soil down to 300 mm or bedrock and from bedrock crevices using HEPA vacuum, picks, shovels and/or using mini-excavator as required and as directed by Departmental Representative.
.3 Separate cobbles, stones and boulders from contaminated soil using a 100 mm screen.

.5 Contractor to devise method to transport material to and from the Work area and the barge. Method to be approved by Departmental Representative.
.1 Construction of temporary ramps or structures in the water can only occur between restricted activity windows and upon authorization from DFO.

.6 Removal and off-site disposal of contaminated soil in accordance with applicable federal and provincial regulations. Transportation of wastes from the Site to the disposal facility must be completed by MOE licensed waste hauler.

.7 Burying and burning of wastes is not permitted.

.8 Backfill excavation with cobbles and gravel screened from contaminated soil. No other backfill is required.

3.5 RESTORATION

.1 Clean access routes of contamination resulting from project activity at request of Departmental Representative.

3.6 FIELD QUALITY

.1 Site Tests:
.1 Departmental Representative to collect representative soil sample for toxicity characteristic leachate procedure (TCLP) classification purposes.
.2 Soil disposal shall not proceed until TCLP results have been provided to the Contractor.
.3 Departmental Representative to collect post-remediation verification soil sampling, as required, to verify that final conditions meet Site Specific Target Levels (SSTLs) for lead concentrations (Franz, 2011).

3.7 EQUIPMENT DECONTAMINATION

.1 Decontaminate equipment used in remediation process and remove from site at end of remediation activities.
  .1 Contractor to collect and dispose of waste generated during equipment decontamination, at own cost, in accordance with applicable provincial standards, requirements and regulations.

3.8 ENVIRONMENTAL PROTECTION

.1 While executing the project, implement the mitigation measures identified in the Environmental Protection Plan and Environmental Assessment Mitigation Monitoring Report Form (Appendix D) for this project. Complete, sign-off and submit Mitigation Measures Report upon completion of the Work.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing abatement of lead based paint from the old lighthouse exterior and HEPA cleanup of loose lead contaminated paint chips/soil: Type 1 Operation.

.1 Removal of loose paint chips and other potentially lead-contaminated debris (including soil) using a HEPA vacuum.

.2 Removal of lead based containing coatings with a chemical gel or paste and fibrous laminated cloth wrap.

.3 Removal of lead based containing coatings or materials using a power tool with an effective dust collection system equipped with a HEPA filter on exterior surfaces.

.4 Removal of lead based containing coatings or materials with non-powered hand tool.

.5 Repainting of abated surfaces to match original coating colour scheme or as directed by the Departmental Representative as per Section 09 91 13 EXTERIOR RE-PAINTING.

1.2 REFERENCES

.1 Province of Ontario - Ontario Ministry of Labour.

.1 Occupational Health and Safety Branch, Guideline: Lead On Construction Projects, September 2004.

.2 O. Reg. 490/09: Designated Substances made under the Occupational Health and Safety Act (as amended) by O. Reg. 148/12 and O. Reg. 149/12.

.3 O.Reg 833/90 respecting the Control and Exposure to Biological or Chemical Agents(as amended).

.2 Department of Justice Canada

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada

.1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).

1.2 REFERENCES (Cont'd)

.4 Human Resources and Social Development Canada (HRSDC)
.1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.

.5 SNC-Lavalin (2015):
Confirmation Soil Sampling, SAR Survey Update, DSHMS, Structural Assessment, Marine Assessment and Development of Plans and Specifications for Remediation, Stokes Bay Front Range, Knife Island, Lake Huron, Ontario DFRP No. 10961 / PWGSC No. R071694.050. February 2015.

.6 Transport Canada (TC)
.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.7 U.S. Environmental Protection Agency (EPA)
.1 EPA 747-R-95-007-1995, Sampling House Dust for Lead.

.8 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)
.1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).

.9 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances
.1 Lead in Construction Regulation - 29 CFR 1926.62-1993.

1.3 MEASUREMENT PROCEDURES

.1 Lead based-paint abatement will be paid by the square meter of surface abated, and shall include all labour and materials required to perform the specified Work, but not necessarily be limited to:
.1 Removal of lead based containing coatings with a chemical gel or paste and fibrous laminated cloth wrap.
.2 Removal of lead based containing coatings or materials using a power tool with an effective dust collection system equipped with a HEPA filter on exterior surfaces.
.3 Removal of lead based containing coatings or

1.3 MEASUREMENT PROCEDURES (Cont'd)

.3 (Cont'd) materials with non-powered hand tool, other than manual scraping and sanding on exterior.

.2 All remaining Work of this Section shall fall under the lump sum arrangement and shall not be measured separately for payment.

1.4 DEFINITIONS

.1 Abatement Work Area: Restricted area around the old lighthouse as defined on Site during abatement activities and where only qualified/protected workers are permitted access.

.2 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.3 Authorized Visitors: Departmental Representative or designated representatives.

.4 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects over cuts and tears, and elsewhere as required to provide protection and isolation. For protection of underlying surfaces from damage and to prevent lead dust entering in clean area.

.5 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

.6 Action level: employee exposure, without regard to use of respirators, to airborne concentration of lead of 50 micrograms per cubic meter of air (50 ug/m3) calculated as 8-hour time-weighted average (TWA). Minimum precautions for lead abatement are based on airborne lead concentrations less than 0.05 milligrams per cubic metre of air for removal of lead based paint by methods noted in paragraph 1.1.

.7 Competent person: individuals capable of identifying existing lead hazards in workplace taking corrective measures to eliminate them.

1.4 DEFINITIONS (Cont'd)

.8 Lead dust: wipe sampling on vertical surfaces and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 06.

.2 Provide proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of lead based paint waste (expected to be hazardous) in accordance with requirements of authority having jurisdiction.

.3 Provide proof of Contractor's General and Environmental Liability Insurance.

.4 Quality Control:
.1 Provide Departmental Representative necessary permits for transportation and disposal of lead based paint waste and proof that lead based paint waste has been received and properly disposed.
.2 Provide proof satisfactory to Departmental Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, and aspects of work procedures and protective measures.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to lead materials provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time Work is performed.

.2 Health and Safety:
.1 Perform construction occupational health and safety in accordance with Section 01 35 29.
.2 Safety Requirements: worker and visitor protection. Protective equipment and clothing to be worn by workers and visitors in Abatement Work Area include:
.3 Respirator NIOSH approved and equipped with replaceable HEPA filter cartridges with an assigned protection factor of 10, acceptable to

1.6 QUALITY ASSURANCE (Cont'd)

.2 Health and Safety: (Cont'd)
.3 (Cont'd)
Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure. Provide sufficient amount of filters.
.4 Half mask respirator: half-mask particulate respirator with N, R, or P - series filter, and 95, 99 or 100% efficiency could be provided.
.5 Eating, drinking, chewing, and smoking are not permitted in Abatement Work Area.

.3 Ensure workers wash hands and face when leaving Abatement Work Area. Facilities for washing are to be provided by Contractor.

.4 Environmental Protection:
.1 Ensure environmental protection in accordance with Section 01 35 43.
.2 Ensure that lead based paint and related dust generated during abatement is contained and not released to the environment.
.3 Evidence of inappropriate procedures being utilized and/or resulting in possible airborne releases will result in immediate Work Stoppage by the Departmental Representative at no additional cost.

.5 Visitor Protection:
.1 Provide approved respirators to Authorized Visitors to Abatement Work Area.
.2 Instruct Authorized Visitors on procedures to be followed in entering and exiting Abatement Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Provincial and Municipal regulations.

.2 Separate waste materials for re-use and recycling where possible.

.3 Disposal of lead waste generated by removal activities must comply with federal, provincial and municipal regulations. Dispose of lead waste in sealed double thickness 0.152 mm thick bags or leak proof drums. Label containers with appropriate warning labels.

1.7 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

.1 Information pertaining to paints containing lead, to be handled, removed or otherwise disturbed and disposed of during this Project:
  .1 Site Drawings showing the locations of lead containing paints are shown in Appendix B.
  .2 Refer to SNC-Lavalin (2015) report (Appendix A) for Tables showing concentrations of lead in paint.
  .3 Overall, all/any paint on the old lighthouse (and new light tower) must be assumed to be lead based and treated as such during the Work.

.2 Notify Departmental Representative of lead based paint discovered during Work and not apparent from specifications or reports pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 SCHEDULING

.1 Not later than two (2) days before beginning Abatement Work on this Project notify the following in writing:
  .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
  .2 Provincial Ministry of Labour.
  .3 Disposal Authority.

.2 Inform all Subcontractor and other on-site representatives of the presence of lead-containing materials identified in Existing Conditions.

.3 Provide Departmental Representative copy of notifications prior to start of Work.

.4 Hours of Work: perform Work during normal working hours.

1.10 OWNER'S INSTRUCTIONS

.1 Provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of lead exposure, in personal hygiene, in all aspects of work procedures, and in use, cleaning, and disposal of respirators.

.2 Instruction and training related to respirators includes, at minimum:
  .1 Proper fitting of equipment.
  .2 Inspection and maintenance of equipment.
  .3 Disinfecting of equipment.
  .4 Limitations of equipment.

.3 Instruction and training must be provided by competent, qualified person.

.4 Supervisory personnel to complete required training.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Polyethylene 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.

.2 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

.3 Slow - drying sealer: non-staining, clear, water dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual lead paint residue.

.4 Lead waste containers: metal or fibre type acceptable to landfill operator with tightly fitting covers and 0.15 mm thickness sealable polyethylene liners.
  .1 Label containers with pre-printed bilingual cautionary "Warning Lead" clearly visible when ready for removal to disposal site.

PART 3 - EXECUTION

3.1 SUPERVISION

.1 One Supervisor for every ten workers is required.

.2 Supervisor must remain within work area during disturbance, removal or handling of lead based paints.

3.2 PREPARATION

.1 Preliminary cleanup: Before undertaking any other Work in the vicinity of the old lighthouse, to prevent cross-contamination, collect and contain loose paint chips observed on the ground surface in the immediate vicinity of the old lighthouse and in access route to the Work area. Use HEPA vacuum. Do not raise dust. Ensure exterior lead abatement does not cross contaminate the Site.

.2 Abatement Work Area:
  - .1 Lay an impervious polyethylene 6 mm thick tarp around the base of the old lighthouse to contain any paint chips and debris resulting from paint removal.
  - .2 Set up scaffold around old lighthouse exterior to allow safe worker access in accordance with Section 01 56 00.
  - .3 Install polyethylene sheeting wind break on side of scaffold as required depending on Site conditions to minimize spreading of potential disturbed lead based paint and debris.
  - .4 Ensure windows and doors are closed and sealed to prevent dust from entering into buildings.
  - .5 Seal off openings with polyethylene sheeting and seal with tape.
  - .6 Where water application is required for wetting lead containing materials, provide temporary water supply appropriately sized for application of water as required.
  - .7 Provide electrical power and shut off for operation of powered tools and equipment.
  - .8 Provide ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical cables and equipment.

3.2 PREPARATION (Cont'd)

.3 Do not start Abatement Work until:
- .1 Arrangements have been made for disposal of waste.
- .2 Tools, equipment, materials and waste containers are on Site.
- .3 Notifications have been completed and preparatory steps have been taken.

3.3 LEAD ABATEMENT

.1 Removal of loose lead based paint chips/debris; lead based containing coatings with a chemical gel or paste and fibrous laminated cloth wrap; or removal using power tools equipped with HEPA filters, or non-powered hand tools, other than manual scraping and sanding.

.2 Remove lead based paint from the old lighthouse exterior in sections and routinely clean up loose paint chips or debris using HEPA vacuum that may have fallen to the polyethylene sheeting on ground.

.3 Replace rotting or damaged boards on walls or trim to match original as required.

.4 Pack lead containing residue/waste from abatement as it is being removed in sealable 0.15 mm plastic bags and place in labeled containers (e.g. 205 L drums) for temporary on-site storage and eventual off-site transport/disposal.

.5 Coordinate with Departmental Representative for representing sampling/ analysis of lead containing waste for classification for the purposes of determining disposal requirements.

.6 Seal filled waste containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.

.7 After completion of stripping work, wire brush and wet sponge surface from which lead based paint

3.3 LEAD ABATEMENT (Cont’d)

.8 (Cont’d): has been removed to remove visible material. During this work keep surfaces wet.

.9 After wire brushing and wet sponging to remove visible lead based paint, and after encapsulating lead containing material impossible to remove, wet clean entire work area, and equipment used in process. After inspection by Departmental Representative apply continuous coat of slow drying sealer to surfaces of work area. Do not disturb work area for 8 hours, no entry, activity, ventilation or disturbance during this period.

3.4 LEAD SURFACE SAMPLING - WORK AREAS

.1 Final lead surface sampling to be conducted as follows:
  - .1 After work area has passed a visual inspection for cleanliness approved and accepted by Departmental Representative and following application of lock-down agent to surfaces and the appropriate settling period of 8 hours has passed, Departmental Representative will perform lead wipe sampling.
  - .2 Final lead wipe sampling results from horizontal and vertical surfaces must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples collected and analyzed in accordance with EPA 747-R-95-007.
  - .3 If wipe sampling results show levels of lead in excess of 40 micrograms per square foot in excess of 100 micrograms per 100 square centimetres, re-clean work area at contractor's expense and apply another acceptable coat of lock-down agent to surfaces.
  - .4 Repeat as necessary until lead levels are less than 40 micrograms per square foot.

3.5 FINAL CLEANUP

.1 Following specified cleaning procedures, and when lead wipe sampling is below acceptable concentrations, proceed with final cleanup.

.2 Remove polyethylene sheet by rolling it away from edges to centre of Work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.

.3 Place polyethylene sheets, tape, cleaning material, clothing and contaminated waste in plastic bags and sealed labeled waste containers for transport.

.4 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

3.6 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS

.1 Repair or replace objects damaged in course of Work to their original state or better, as directed by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

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

.2 The Master Painters Institute (MPI)
  .1 Maintenance Repainting Manual 2004, Master Painters Institute (MPI), including Identifiers, Evaluation, Systems, Preparation and Approved Product List.

.3 National Fire Code of Canada, 2010 (NFC).

.4 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).

1.2 MEASUREMENT PROCEDURES

.1 Exterior re-painting will be paid by the square meter of surface re-painted, and shall include all labour and materials required to perform the specified Work, but not necessarily be limited to:
  .1 Re-painting lead abated exterior of the old lighthouse to match original colour.

1.3 QUALITY ASSURANCE

.1 Conform to latest MPI requirements for exterior repainting work including cleaning, preparation and priming.

.2 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, and solvents) to be in accordance with the latest edition of the MPI Approved Product List and to be from a single manufacturer for each system used.

.3 Paint materials such as linseed oil, shellac, and turpentine, to be the highest quality product of an approved manufacturer listed in MPI Maintenance Repainting Manual and shall be compatible with other coating materials as required.

1.3 QUALITY ASSURANCE (Cont'd)

.4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

1.4 SCHEDULING

.1 Submit work schedule for various stages of painting to Departmental Representative for review.

.2 Obtain written authorization from Departmental Representative for changes in Work schedule.

.3 Schedule repainting operations to prevent disruption by other trades if applicable.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 06.

.2 Provide samples in accordance with Section 01 11 06.
.1 Submit full range of colour sample chips for review and selection. Indicate where colour availability is restricted.
.2 Submit two 18 cm by 25 cm colour sample chips for each colour used to Departmental Representative for approval before application of paint to site structures.
.3 Maintain one 18 cm by 25 cm colour sample chip for each colour used in Contractor's records.

.3 Provide product data and manufacturer's installation/application instructions for paints and coating products to be used.

.4 Provide WHMIS Material Safety Data Sheets (MSDS) for paints and coating materials to be used.

.5 Quality Assurance Submittals:
.1 Manufacturer's Instructions: manufacturer's installation instructions.

.6 Closeout Submittals:
.1 Provide records of products used. List products in relation to finish system and include following:
.1 Product name, type and use (i.e. materials and location).

1.5 SUBMITTALS (Cont'd)

.6 Closeout Submittals: (Cont'd)
- .1 (Cont'd)
  - .2 Manufacturer's product number.
  - .3 Colour code numbers.
  - .4 MPI Environmentally Friendly classification system rating.
  - .5 Manufacturer's Material Safety Data Sheets.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle materials in accordance with Section 01 11 06, supplemented as follows:
  - .1 Deliver and store materials in original containers, sealed, with labels intact.
  - .2 Labels to indicate:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.
    - .4 Colour number in accordance with established colour schedule.
  - .3 Remove damaged, opened and rejected materials from site.
  - .4 Store and handle in accordance with manufacturer's recommendations.
  - .5 Store materials and equipment in secure, dry, well-ventilated area with temperature range between 7 degrees C to 30 degrees C. Store materials and supplies away from heat generating devices and sensitive products above minimum temperature as recommended by manufacturer.
  - .6 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Departmental Representative.
  - .7 Upon completion of operations, return areas to clean condition to approval of Departmental Representative.
  - .8 Remove paint materials from storage in quantities required for same day use.
  - .9 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

1.6 DELIVERY, STORAGE AND HANDLING (Cont'd)

.1 Packing, shipping, handling and unloading: (Cont'd)
  .1 (Cont'd)
    .10 Fire Safety Requirements:
      .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
      .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site daily.
      .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada.

.2 Waste Management and Disposal:
  .1 Separate waste materials for reuse and recycling in accordance with Section 01 35 43.
  .2 Paint, stain and wood preservative finishes and related materials are hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
  .3 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
  .4 To reduce the amount of contaminants entering waterways or into the ground, the following procedures shall be strictly adhered to:
    .1 Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.
    .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
    .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
    .4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
    .5 Empty paint cans are to be dry prior to disposal or recycling (where available).

1.6 DELIVERY, STORAGE AND HANDLING (Cont'd)

.2 Waste Management and Disposal: (Cont'd)
  .4 (Cont'd)
    .6 Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.
    .7 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.
    .8 Set aside and protect surplus and uncontaminated finish materials. Deliver to or arrange collection by organizations for verifiable re-use or re-manufacturing.

1.7 AMBIENT CONDITIONS

.1 Temperature, Humidity and Substrate Moisture Content Levels:
  .1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer.
  .2 Do not perform repainting work when:
    .1 Ambient air and substrate temperatures are below 10 degrees C.
    .2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.
    .3 Substrate and ambient air temperatures are expected to fall outside paint manufacturer's prescribed limits.
    .4 Relative humidity is above 85% or when dew point is less than 3 degrees C variance between air/surface temperature.
    .5 Rain or snow is forecast to occur before paint has thoroughly cured.
    .6 It is foggy, misty, raining or snowing at site.
  .3 Conduct moisture tests using properly calibrated electronic Moisture Meter, except test existing painted concrete floors for moisture using simple "cover patch test" on failed areas.
  .4 Do not perform repainting work when maximum moisture content of substrate exceeds:
    .1 12% for concrete and masonry (clay and concrete brick/block and stone).
    .2 15% for wood.

1.7 AMBIENT CONDITIONS (Cont'd)

.1 Temperature and Humidity Levels: (Cont'd)
  .4 (Cont'd)
    .3 12% for stucco.
    .4 Test painted concrete, masonry and plaster surfaces for alkalinity as required.

.2 Application Requirements:
  .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind conditions are not such that airborne particles will affect quality of finished surface.
    .1 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted.
    .2 Apply paint when previous coat of paint is dry or adequately cured, unless otherwise pre-approved by specific coating manufacturer.
    .3 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.
    .4 Do not apply paint when:
      .1 Temperature is expected to drop Below 10 degrees C before paint has thoroughly cured.
      .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
      .3 Surface to be painted is wet, damp or frosted.
    .5 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
    .6 Schedule repainting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
    .7 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Paint materials for each coating formulae to be products of a single manufacturer.

.2 Use paint appropriate for the various types of surfaces to be repainted (stone/brick & mortar, wood, metal, drywall, stucco, etc.)

.3 Paint pigment to match existing.

2.2 PAINTING SYSTEMS

.1 REX 5.1 - Structural Steel and Metal Fabrications: (columns, beams, and joists).
  .1 REX 5.1B - Zinc Rich/High Performance Acrylic.
  .2 REX 5.1J - Aluminum Paint.

.2 REX 6.3 - Dressed Lumber: (doors, door and window frames, casings, battens, and smooth fascias).
  .1 REX 6.3A - High Performance Acrylic.
  .2 Latex Flat Finish on Doors.

.3 REX 6.4 - Wood Panelling: (plywood siding, fascias, and soffits).
  .1 REX 6.4B - Alkyd.
  .2 REX 6.4G - Latex.

.4 REX 6.6 - Wood Shingle and Shake Siding.
  .1 REX 6.6A - Latex.
  .2 REX 6.6B - Alkyd.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

.1 Remove existing lead based paint from the exterior of the old lighthouse. Refer to Section 02 83 10 - Lead Based Paint Minimum Precautions for abatement procedures.

3.2 PREPARATION (Cont'd)

.2 Perform preparation and operations for exterior painting in accordance with MPI Maintenance Repainting requirements except where specified otherwise.

.3 Apply paint materials in accordance with paint manufacturer's written application instructions.

.4 Clean and prepare exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  .1 Remove dust, dirt and surface debris by brushing, wiping with dry, clean cloths. Compressed air must not be used.
  .2 Wash surfaces with a biodegradable detergent (and bleach where applicable) and clean warm water using a stiff bristle brush to remove dirt, oil and surface contaminants.
  .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  .4 Use trigger operated spray nozzles for water hoses.
  .5 Allow surfaces to drain completely and to dry thoroughly.
  .6 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.
  .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or such organic solvents to clean up water-based paints.

.5 Clean metal surfaces to be repainted by removing rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Remove such contaminates from surfaces, pockets and corners to be repainted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.

.6 Prevent contamination of cleaned surfaces by salts, acids, alkalis, corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.

3.2 PREPARATION (Cont'd)

.7 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

.8 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects from previously painting (e.g. runs, and sags) that are visible from distance up to 1000 mm.

3.3 EXISTING CONDITIONS

.1 Prior to commencing Work, examine Site conditions and existing exterior substrates to be repainted and report in writing to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions of surfaces that will adversely affect this Work.

.2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Departmental Representative. Maximum moisture content not to exceed specified limits.

.3 No repainting Work to commence until such adverse conditions and defects have been corrected and surfaces and conditions are acceptable to Painting Subcontractor and Inspection Agency.

3.4 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect window surfaces from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

3.4 PROTECTION (Cont'd)

.5 Protect general public and building occupants in and about the building.

.6 Removal of light fixtures, surface hardware on doors, and surface mounted equipment, fittings and fastenings to be done prior to undertaking painting operations. Store items and re-install after painting is completed.

.7 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.8 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of Departmental Representative.

3.5 APPLICATION

.1 Apply paint by method that is best suited for substrate being repainted. Conform to manufacturer's application instructions unless specified otherwise. In each case method of application to be as pre-approved by Departmental Representative before commencing work.

.2 Brush and Roller Application:
.1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
.2 Work paint into cracks, crevices and corners.
.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces to be free of roller tracking and heavy stipple unless approved by Departmental Representative.
.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray Application:
.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

3.5 APPLICATION (Cont'd)

.3 Spray Application: (Cont'd)
 .2 Keep paint ingredients properly mixed in containers during paint application by intermittent agitation as frequently as necessary.
 .3 Apply paint in uniform layer, with overlapping at edges of spray pattern.
 .4 Back roll spray applications and brush out runs and sags immediately.
 .5 Use brushes to work paint into cracks, crevices and places that are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers when no other method is practical in places of difficult access and when specifically authorized by Departmental Representative.

.5 Apply paint coats in a continuous manner and allow surfaces to dry and cure between coats for minimum time period as recommended by manufacturer. Minimum dry film thickness of coats not less than that recommended by manufacturer. Repaint thin spots or bare areas before next coat of paint is applied. Minimum of one coat of primer and two coats of paint required for each surface to be painted.

.6 Sand and dust between coats to remove visible defects.

.7 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

.8 Finish to doors include all edges including top and bottom edges. Surfaces concealed by door hardware to be repainted unless otherwise pre-approved.

3.6 FIELD QUALITY CONTROL

.1 Advise Departmental Representative when each surface and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

3.7 CLEANING

.1 Proceed in accordance with Section 01 11 06.

.2 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.3 Keep work area free from unnecessary accumulation of tools, equipment, surplus materials and debris.

.4 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.

.5 Clean equipment and dispose of wash water used for water borne materials, solvents used for oil based materials as well as cleaning and protective materials (e.g. rags, drop cloths, and masking papers), paints, thinners, paint removers/strippers in accordance with the safety requirements of authorities having jurisdiction and as specified.

.6 Clean painting equipment in leak-proof containers that will permit particulate matter to settle out and be collected. Sediment remaining from cleaning operations to be dispose in manner acceptable to authorities having jurisdiction.

.7 Recycle paint and coatings in excess of repainting requirements as specified.

3.8 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on affected exposed surfaces. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

3.8 RESTORATION (Cont'd)

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation of lead based paint warning signs for the new light tower.

1.2 ACTION SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 06.

.2 Shop Drawings:
  .1 Submit shop drawings and catalogue sheets.
  .2 Indicate materials, thicknesses, sizes, finishes, colours, mounting methods, and schedule of signs.
  .3 Submit drawn-to-scale details for individually fabricated lettering indicating word and letter spacing.

1.3 INFORMATION SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's printed product literature panel signage or components, specifications and datasheet and include product characteristics, physical size and finish.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Acceptable Material for Signs: Engineer-grade reflective aluminum.
  .1 Lettering style: Sans serif.
  .2 Letter height: Minimum 25 mm.

2.2 SIGN GRAPHICS

.1 Sign graphics: well defined, arranged for balanced appearance, and properly word and letter spaced.

.2 Supply three (3) lead-based paint warning signs:

2.2 SIGN GRAPHICS (Cont'd)

.2 (Cont'd) :
  .1 Minimum dimensions: 510 mm x 711 mm.
  .2 Sign background colour: white.
  .3 Lettering colour: black on white.
  .4 Sign messages to read (or equivalent):
    .1 "LEAD-BASED PAINT PRESENT ON STRUCTURE EXTERIOR. DISTURBING LEAD-BASED PAINT CAN BE DANGEROUS TO ONE'S HEALTH AND INCLUDE, BUT NOT LIMITED TO: FERTILITY PROBLEMS, NERVE DISORDERS, OR DIGESTIVE PROBLEMS".

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

.2 Contractor to follow lead based paint abatement procedures (Type 1) in accordance with Section 02 83 10.
  .1 Mechanized grinder without HEPA filter attachment not permitted.
  .2 Existing lead based paint on new light tower to be removed to bare metal in the areas where the signage is to be affixed.

.3 Erect and secure signs plumb and level at locations as indicated.
  .1 Install signs 1.5 m above ground surface.
  .2 Apply surface coating to lead abated surface in accordance with Section 09 91 13 to match existing paint, prior to installation of warning signs.

.4 Comply with sign manufacturer's installation instructions and approved shop drawings.

.5 Mechanical attachment:
  .1 To steel: use bolts with nut and lock washers, self-tapping screws.

END OF SECTION

APPENDIX A – SNC-LAVALIN REPORT (2015)

FINAL REPORT

CONFIRMATION SOIL SAMPLING, SAR SURVEY UPDATE, DSHMS, STRUCTURAL ASSESSMENT, MARINE ASSESSMENT AND DEVELOPMENT OF PLANS AND SPECIFICATIONS FOR REMEDIATION

STOKES BAY FRONT RANGE, KNIFE ISLAND, LAKE HURON, ONTARIO

DFRP No. 10961 / PWGSC No. R071694.050

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA, ON BEHALF OF THE DEPARTMENT OF FISHERIES AND OCEANS

SNC-LAVALIN INC.

March 2015
FINAL REPORT
Project n°623376

EXECUTIVE SUMMARY

The Environment & Water business unit of SNC-Lavalin Inc. (SNC-Lavalin) was retained by Public Works and Government Services Canada (PWGSC), on behalf of the Department of Fisheries and Oceans (DFO), to complete additional Confirmatory Soil Sampling, a Species at Risk (SAR) Survey Update, Designated Substances and Hazardous Materials Survey (DSHMS), Structural Assessment, Marine Assessment, and to develop Plans and Specifications for a remediation program at the Stokes Bay Front Range on Knife Island in Lake Huron, Ontario. The site reference number is DFRP No. 10961. This report documents field work and related studies completed as a basis for development of the remediation plans and specifications that are to be prepared in January-February 2015. SNC-Lavalin completed the environmental investigations (SAR update, DSHMS and shallow soil sampling), and retained the services of subcontractors, R.J. Burnside & Associates Limited (Burnside) and Baird Inc. (Baird), to complete the required structural and marine assessments, respectively. Field work was completed on October 22, 2014.

SITE DESCRIPTION AND BACKGROUND

Stokes Bay Front Range is located on Knife Island (DFRP No. 10961) which is owned by DFO. Knife Island is located in Lake Huron, approximately 4 km southwest of the town of Stokes Bay, Ontario. The Site is registered on the Federal Contaminated Sites Inventory under FCSI # 10961002. Knife Island must be accessed by air or water, as there are no roads connecting it to the mainland.

The Site houses two (2) range towers. The old Front Range tower was constructed in 1904, automated in 1952, and operated until 1998. The old tower is a wood frame structure with a stone foundation approximately 4.7 by 4.7 m in size. The tower is approximately 12.6 m tall. The new Front Range tower was constructed in 1998 to replace the old tower. The new tower is a circular steel tower approximately 1.5 m in diameter and 11.6 m tall, that is anchored to a 3 by 3 m concrete foundation. The tower is hollow inside and a hatch at the roof separates the interior and exterior. The ground around the light towers features mostly exposed bedrock with shallow organic pockets of soil and some trees.

Phase I, II and III Environment Site Assessments (ESAs) as well as a Site Specific Human Health Risk Assessment (SSRA-HH) and a Site Specific Ecological Risk Assessment (SSERA) were previously completed at the Front Range (Franz, 2009 and 2011). Recommendations were made to excavate localized areas where soil concentrations posed unacceptable risk to human and/or ecological receptors. The preferred remedial option was excavation and disposal. Site Specific Target Levels (SSTLs) for lead concentrations were developed in the SSRA-HH (2297 µg/g) and SSERA (7400 µg/g). The estimated extent of required excavation was based on soil concentrations above the $SSTL_{HH}$ of 2297 µg/g which was protective of both human and ecological receptors. It was also recommended that active sources of contamination are present at the Front Range (lead paint on the old and new towers) be mitigated prior to excavating site soil.

RESULTS

Sampling results indicated that lead-based paint was used extensively throughout the exteriors and interiors of the old and new light towers. The lead-based paint observed to be in poor condition and/or missing from the exterior of the old light tower is the most likely source of lead contamination in surface soil at the site (in the vicinity of the light towers). The source of the soil contamination (i.e. the lead-based paint on the towers' exteriors) should be removed to prevent recontamination of the remediated area in future.

Results of the current work program identified only a shallow layer of soil overlying the bedrock, in surface cracks in the bedrock and/or trapped around limited vegetation (including trees, grasses and shrubs) at the site in the vicinity of the light tower. Approximately 2 m^3 of soil exceeding the previously derived $SSTL_{HH}$ (Franz, 2011) was estimated to be present in this area. To be conservative for budget and remediation planning purposes, it should be assumed that surface soil from the entire area where paint chips were observed in the area of the light towers will require removal/disposal. Also, if impacted soil is confirmed in the vicinity of the paint can and battery debris, it would be expected that this soil could be removed/disposed in conjunction with the planned remediation program. Overall then, the total estimated volume of soil requiring remediation at this site is approximately 10 to 15 m^3.

Other potentially hazardous materials at the site include an area of previously unidentified debris (paint cans and batteries, representing a volume of approximately 2 m^3) as well as evidence of limited mould growth in the interior of the old light tower related to water ingress. It is the intent that this or any other debris encountered or generated during work at the site will be addressed concurrently with the planned remediation program.

A visual structural condition evaluation by Burnside of the old and new light towers concluded that the structures were in good to fair condition, were founded on exposed bedrock and not vertically settling and as such, do not require dismantling/replacement at this time. The old light tower would require more extensive repairs to ensure its structural integrity can be maintained in future but also to raise building safety conditions to today's standards. These repairs would be recommended as part of a long term maintenance program for the old light tower but are beyond the current scope of planned remediation work at this site and therefore, not considered further here.

As removal of the old light tower is not required to facilitate soil remediation or due to structural concerns, DFO has indicated it would be their preference for both the old and new light towers to remain on site.

Baird concluded that site access for the purposes of the proposed remediation activities could reasonably be achieved, especially given the limited scope of soil remediation required and plans to repair not dismantle the light towers.

Recommendations

Recommendations and evaluations of potential remediation options were provided to assist with the preparation and implementation of engineering tender documents (including detailed plans and specifications prepared under separate cover) for planned remediation at this site. Recommendations included:

- Establishing a lead management plan for lead-based paint on the new tower exterior, including re-painting the lower section of the tower that has been vandalized and installing signs warning of the presence of this lead-based paint and hazards associated with its disturbance.
- Abatement of lead-based paint from the exterior of the old light tower in accordance with applicable legislation and best industry practice, and re-painting.
- Removing paint can and unused battery debris from a previously unidentified area, completing related shallow soil sampling and depending on results, complete remediation of affected soil in conjunction with other planned contaminated soil removal.
- Removing contaminated soil likely using smaller hand held equipment and/or hand digging assisted by small machinery in some areas depending on access limitations.
- Minor grubbing of scrub trees and bushes in the planned work area.
- Establishing safe and suitable marine access for the site that considers DFO fish habitat protection and restrictions, including completion of a hydrographic survey.
- Waste handling and disposal in accordance with applicable federal and provincial regulations, including segregation and additional waste classification sampling to reduce the quantity of soil considered hazardous for the purposes of off-site disposal.

Structural repairs and/or upgrades to the new and old towers were also recommended to ensure the structural integrity of the light towers remains over time and to raise the old light tower safety conditions to today's standards as recommended by Burnside for the old light tower. However, these should be considered as part of a long term maintenance program for the site and are beyond the current scope of planned remediation work at this site so not considered further here.

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1 INTRODUCTION

The Environment & Water business unit of SNC-Lavalin Inc. (SNC-Lavalin) was retained by Public Works and Government Services Canada (PWGSC), on behalf of the Department of Fisheries and Oceans (DFO), to complete additional Confirmatory Soil Sampling for lead in soil, a Species at Risk (SAR) Survey Update, Designated Substances and Hazardous Materials Survey (DSHMS), Structural Assessment, Marine Assessment, and to develop Plans and Specifications for a remediation program at the Stokes Bay Front Range on Knife Island (the Site) in Lake Huron, Ontario. The site reference number is DFRP No. 10961.

The work program was completed based on the following:

- The September 18, 2014 Statement of Work (SOW) prepared by DFO and PWGSC (Project No. R.071694.050 - Revision 1)
- The SNC-Lavalin proposal dated October 1, 2014
- Various email correspondence and discussions between PWGSC and the SNC-Lavalin project managers

This report documents field work and related studies completed as a basis for remediation plans and specifications prepared under separate cover.

1.1 Project Objectives

As stated in the SOW:

The goals of the SAR Survey update:

- Update the SAR information in the Franz (2011) report where required based on observations made during the site visit.
- Prepare a SAR informational pamphlet to accompany field personnel.

The goals of the DSHM survey:

- Complete a site visit to confirm the condition, location and quantity of DSHMS.
- Identify the designated substances and hazardous materials in particular lead and asbestos containing materials (ACM) found within the old and new light tower towers (including building construction materials, fixtures, and fixed equipment/furniture).
- Complete intrusive sampling for lead and asbestos content where warranted.

The goals of the Confirmatory Soil Sampling program:

- Collect confirmatory soil samples for lead analysis in soil and use analytical results to confirm that there have been no changes of delineation suggested by Franz (2011).
- Document areas of soil cover versus areas of exposed bedrock to prepare accurate site plans and specifications.

The goals of the Structural Assessment:

- Complete site visit to visually inspect the new and old light towers (exterior and interior) and document the overall structural stability and durability of the structures.
- Highlight issues presenting immediate danger.
- It was beyond the scope of the Structural Assessment to prepare drawings documenting conditions of the existing structures and/or detailing recommendations to mitigate/repair structural deficiencies identified.

The goals of the Marine Assessment:

- Evaluate accessibility options for the preferred option remedial works (e.g. soil removal and off-site disposal, backfilling, potential building demolition and/or restoration).

1.2 Scope of Work

The following tasks were undertaken to achieve the project objectives:

- Project preparations
- Field and analytical work including:
  - SAR update
  - DSHMS of the old and new light tower towers
  - Shallow surface soil sampling for lead analysis
  - Structural Assessment of the old and new light towers (by subcontractor)
  - Marine assessment (by subcontractor)
- Data analysis
- Results interpretation
- Recommendations for remediation

- Draft report preparation and submission
- Final reporting

SNC-Lavalin completed the environmental investigations (SAR update, DSHMS and shallow soil sampling), and retained the services of subcontractors, R.J. Burnside & Associates Limited (Burnside) and Baird Inc. (Baird), to complete the required structural assessment and marine assessment, respectively.

1.3 Report Structure

Section 2 of this report provides the site description and background information. Section 3 documents the investigation methodology of the field work program. Section 4 presents the results of the field work program. Section 5 provides discussion and recommendations. References are documented in Section 6 and a Notice to Reader is provided at the end of this report.

2 SITE DESCRIPTION AND BACKGROUND

2.1 PROJECT SETTING

Common Name		Stokes Bay
DFO Regional Office		Central and Arctic Region
DFO Locator Code		FCSI# 10961002
DFRP #		10961
Location	Province	Ontario
	Water body	Lake Huron – Stokes Bay
	Region/District	Northern Bruce Peninsula
	Township/County	Eastnor
Owner		Federal government
Geographic Coordinates		44.96703 N -81.39044 W

2.2 GENERAL PROPERTY AND SITE DESCRIPTION

Stokes Bay Front Range is located on Knife Island (DFRP No. 10961) which is owned by DFO. Knife Island is located in Lake Huron, approximately 4 km southwest of the town of Stokes Bay, Ontario (Figures 1 and 2). The Site is registered on the Federal Contaminated Sites Inventory under FCSI # 10961002. Knife Island must be accessed by air or water, as there are no roads connecting it to the mainland.

The Site houses two (2) range towers and that are shown in Photo 1. The old Front Range tower was constructed in 1904, automated in 1952, and operated until 1998. The old tower is a wood frame structure with a stone foundation approximately 4.7 by 4.7 m in size. The tower is approximately 12.6 m tall. The new Front Range tower was constructed in 1998 to replace the old tower. The new tower is a circular steel tower approximately 1.5 m in diameter and 11.6 m tall, that is anchored to a 3 by 3 m concrete foundation. The tower is hollow inside and a hatch at the roof separates the interior and exterior.

The ground around the light towers features mostly exposed bedrock with shallow organic pockets of soil and some trees (Photos 2 and 3).

2.3 SUMMARY OF PREVIOUS INVESTIGATIONS

Phase I, II and III Environment Site Assessments (ESAs) as well as a Site Specific Human Health Risk Assessment (SSRA-HH) and a Site Specific Ecological Risk Assessment (SSERA) were previously completed by others at the Front Range. SNC-Lavalin reviewed the following reports relating to the site (provided by PWGSC):

- Phase III ESA Stokes Bay Front Range (DFRP#10961) and Rear Range (DFRP#85917), Canadian Coast Guard Navigational Aids, L.L. 797 and L.L. 798, Bruce Peninsula, Ontario. Prepared by Franz Environmental Inc. (Franz) dated October 29, 2009.
- Site Specific Human Health Risk Assessment (SSRA-HH), Site Specific Ecological Risk Assessment (SSERA) and Supplemental Site Investigation, Stokes Bay Front Range, Stokes Bay Rear Range and the Former Squatter's Area Knife Island (DFRP# 10961) and Shute Point (DFRP N. 85917). Prepared by Franz dated March 16, 2011.

Based on the 2009 Phase III ESA results, the Front Range was retained as a contaminated site with identified contaminants of concern (COCs) including arsenic, barium, copper, lead, mercury, selenium, zinc and PHC F3. The site was rated with a National Classification System for Contaminated Sites (NCSCS) score of 54.7 and as Class 2 – Medium Priority for Action. This study recommended that a preferred remedial alternative was to complete a SSRA-HH and SSERA with supplemental sampling.

The SSRA-HH completed in 2011 identified potential unacceptable risks to an infant and toddler recreational visitor exposed to lead in soil at the Front Range. No potential unacceptable risks were identified for the child, teen and adult recreational visitor or the maintenance worker and construction worker at the Front Range.

The SSERA completed in 2011 assessed the potential risks of COCs in soil to terrestrial plants, terrestrial invertebrates, terrestrial birds (American Robin, Northern Cardinal, Herring Gull and Peregrine Falcon), terrestrial mammals (Meadow Vole, Whitetail Deer, Short Tailed Shrew, Red Fox) and terrestrial reptiles (Massassauga Rattlesnake and Five Lined Skink). The overall interpretation of the SSERA included all lines of evidence available including Ecological Screening Quotients derived for combinations of receptors and contaminants of concern, habitat observations made during the site investigation, and results of vegetation and invertebrate testing. The lines of evidence suggested that risks are likely to occur to plants due to lead concentrations in some on-site soil.

Recommendations were made to excavate localized areas where soil concentrations posed unacceptable risk to human and/or ecological receptors. The preferred remedial option was excavation and disposal. Site Specific Target Levels (SSTLs) for lead concentrations were developed in the SSRA-HH (2297 µg/g) and SSERA (7400 µg/g). The estimated extent of required excavation was based on soil concentrations above the $SSTL_{HH}$ of 2297 µg/g which was protective of both human and ecological receptors.

In the SSRA-HH and SSERA report it was also recommended that since active sources of contamination are present at the Front Range (lead paint on the old and new towers) it would be necessary to mitigate these sources prior to excavating site soil. Otherwise, re-contamination of site soil would have the potential to occur.

2.4 Environmental Criteria

2.4.1 DSHMS Guidelines

The site is located on federal land. Federal and secondarily provincial environmental, occupational health and safety, designated substance and building codes, standards and guidelines apply, as warranted. Both federal and provincial regulations, codes and guidelines are representative of best practice. A list of relevant codes, guidelines and regulations is provided in Appendix A. Of particular relevance to this sampling and inspection program are regulations relating to ACMs and lead in paint. These are discussed further here.

2.4.1.1 ACMs

Asbestos is a general name for highly fibrous silicate minerals which are valued for their heat- and chemical-resistant properties. Although there are many types of asbestos, commercially significant types include chrysotile, amosite and crocidolite.

The friability of an ACM is a measure of the ease with which the material can be ground or pulverized, and provides a theoretical measure of the ease with which asbestos fibres can be released into the air. Friable ACMs are generally identified as materials which can be crumbled, pulverized and/or reduced to powder by hand pressure, such as some ceiling tiles, thermal insulation and fire proofing. Non-friable ACMs are hard products with bound asbestos, such as floor tiles, pipes, and asbestos cement (often referred to as transite) products. These products generally pose no danger of releasing airborne fibres unless cut, sawn, ground or sanded, but can deteriorate and become friable over time if exposed to heat and/or moisture.

The Hazardous Products Act and Asbestos Products Regulations (and amending Regulations) apply to protect consumers from potential hazards associated with new products containing asbestos. For existing materials that may be disturbed by building occupants and/or workers the Occupational Health and Safety Act (OHSA) and the “Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations” regulation (Ontario Regulation [O. Reg.] 278/05) made under the OHSA applies. In Ontario, materials containing 0.5% or more asbestos by dry weight are considered to be ACMs requiring specialized handling, removal and disposal practices. O. Reg. 278/05 outlines responsibilities for owners, employers and workers relating to asbestos. Owners and employers are required to conduct inspections to identify asbestos materials in buildings and equipment, develop and update an ACM inventory, provide associated notification and training for workers and building occupants, and ensure appropriate asbestos work procedures are implemented.

O. Reg. 278/05 specifies asbestos work procedures, including requirements for worker training, personal protective equipment, air testing and decontamination. Prior to undertaking demolition or repair work, O. Reg. 278/05 requires that ACMs within the work area be removed and disposed as asbestos waste. Asbestos waste management procedures are provided in the “General Waste

Management" regulation (O. Reg. 347) made under the Ontario Environmental Protection Act. O.Reg. 347 provides procedures to minimize the potential for fibre release and worker exposure during handling, transport and final deposition of asbestos wastes in a Ministry of the Environment licensed facility. Reg. 347 does not include a small quantity exemption for asbestos waste. Transport of asbestos waste must also be conducted in accordance with the Transportation of Dangerous Goods Regulations.

2.4.1.2 Lead in Paint

The Federal Hazardous Products Act (1976) limits the quantity of lead permissible in newly manufactured paints to 0.5% by weight (5,000 µg/g). On May 4, 2005, the Surface Coating Materials Regulations was promulgated (later amended in 2011) and the limit on the amount of lead in paint was reduced to 0.009% by weight (90 µg/g).

Where paints are found to contain lead, torching and grinding of painted building materials should be minimized and/or appropriate exposure control methods should be implemented. Flaking or peeling lead-based paint should be removed or repaired to avoid the potential for direct contact, especially by building occupants (particularly infants and toddlers).

2.4.2 Soil Quality Guidelines

The Site is federally-owned and is consequently subject to federal criteria. In the absence of federal criteria and/or for reference, Ontario Ministry of the Environment (MOE) site condition standards (MOE, 2011) were also considered. The residential/parkland guidelines were considered most appropriate. Site soils were classified as coarse textured. Non-potable groundwater criteria were previously used (Franz, 2011) for the site.

Lead concentrations in soil were compared to the following:

- CCME *Canadian Environmental Quality Guidelines, Chapter 7 - Canadian Soil Quality Guidelines (SQG) for the Protection of Environmental and Human Health, residential/parkland land use* (CCME, 2007).
- MOE *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, Table 3 Full Depth Generic Site Condition Standards, residential/parkland/institutional property use, coarse textured soil and non-potable groundwater protection* (MOE, 2011).
- $SSTL_{HH}$ of 2297 µg/g derived by Franz (2011).

3 FIELD WORK PROGRAM

3.1 ENVIRONMENTAL INVESTIGATIONS

Environmental investigations were designed and implemented by SNC-Lavalin to ensure that environmental conditions at the site were fully understood in preparation for the development of plans and specifications for recommended remediation. The program the following elements:

- Project preparations
- Quality assurance/quality control (QA/QC)
- DSHMS inspection and sampling
- Shallow soil sampling
- Global Positioning System (GPS) mapping

Each of the program elements are described in detail in the following sections. Associated field work was completed on October 22, 2014.

3.1.1 Project Planning

HASP

A site-specific health and safety plan (HASP) was developed for the field program. Appropriate components of the plan were adopted from the SNC-Lavalin Health and Safety Manual. Field workers were instructed on the protocols of the Health and Safety Plan and the proper use of personal protective equipment. Worker health and safety standards were assured by following stringent safety precautions in accordance with the applicable sections specified under the Canada Labour Code, and the Canada Health and Safety Act.

Site Access

Field personnel accessed the site by boat taxi on October 22, 2014. The boat taxi operator was subcontracted by SNC-Lavalin to provide transportation to and from the site for SNC-Lavalin personnel, and subcontractor representatives from Burnside and Baird. At the request of DFO, SNC-Lavalin personnel also met with a member of the non-profit organization, Knife Island Light Tower Restoration Group on Knife Island, who unlocked the door to the old light tower. Keys to the new light tower were provided by DFO.

SAR Update

A pamphlet identifying SAR or SAR habitat that may exist at the site was prepared and discussed with the on-site work crew. No suspected SAR were encountered at the site during field work on October 22, 2014. A copy of the SAR pamphlet is provided in Appendix D.

Site Reconnaissance

A site reconnaissance inspection was completed to assess for evidence (including stressed vegetation) that may be indicative of Areas of Potential Environmental Concern (APECs) not previously identified. An area of previously unidentified debris consisting of paint cans and batteries (possibly lead containing) was observed within the forested area located to the southeast of the old light tower (Photos 4 and 5). The location of this debris (representing a volume of approximately 2 m^3) is shown on Figure 3. The potential for this debris to have caused impact to underlying soil will require further investigation (see recommendations in Section 5.2.2). It is also the intent that this debris and any associated impacted soil will be addressed in conjunction with the planned remediation program (originally focused on soil impacts in the vicinity of the light towers).

No other APECs were apparent, however, paint chips (previously identified) were observed in surface soil surrounding the light towers covering an area of approximately 300 m^2 (Photos 6 and 7).

GPS Mapping

Sampling locations and other site features (including the extent of exposed bedrock surface) were mapped using a hand held GPS unit (Trimble 7000). This mapping data was used as the basis for preparing Figure 3.

3.1.2 Quality Assurance/Quality Control

A quality assurance and quality control (QA/QC) program was implemented to address the office and field programs. All project documentation was maintained and controlled under each specific site file with a unique site identifier.

Field work activities were completed in general accordance with the CSA Standard Z769-00 Phase II Environmental Site Assessment (CSA, 2000), the MOE Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario (MOEE, 1996b), the CCME Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites (CCME, 1993), O. Reg. 153/04 (as amended) and generally accepted industry practices. Asbestos sampling was completed in accordance with O. Reg. 278/05.

A QA/QC program was implemented to ensure sample integrity, and to minimize and identify potential cross-contamination introduced during sample collection, handling, shipping and analysis.

As part of the QA/QC program, sampling protocols included minimizing sample handling, submitting field QA/QC samples, using dedicated non-contaminating sampling equipment, using sample specific identification and labelling procedures, and using chain of custody records. Field duplicate soil and groundwater samples, as well as field and trip blank samples were prepared and analysed as noted below to assess reproducibility of results. For all sampling locations, logs containing pertinent information were prepared and samples were collected directly in appropriate sampling containers.

Soil sampling equipment was decontaminated using a phosphate-free detergent (LiquiNox or equivalent) and clean water before collecting subsequent samples to reduce the risk of cross-contamination between samples. Soil samples were collected in laboratory-supplied sampling containers and immediately placed in a cooler with ice. Laboratory chemical analyses were performed by Maxxam Analytics Inc. (Maxxam) of Mississauga, Ontario that is an analytical laboratory accredited by the Canadian Association for Laboratory Accreditation (CALA) and/or Standards Council of Canada (SCC). A duplicate soil sample was not collected due to limited soil material and excessive paint chips mixed within soil available.

Paint samples were stored in plastic bags and delivered under chain of custody to Maxxam for laboratory analyses of lead. Paint samples were submitted for analysis as individual samples for comparison with federal requirements.

Asbestos samples were stored in plastic bags and delivered under chain of custody to Lex Scientific (Lex) of Guelph, Ontario for laboratory analyses of asbestos by polarized light microscopy (PLM). Lex is accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP 101949). Asbestos samples were submitted as triplicates to confirm absence of asbestos, if applicable, in accordance with provincial requirements (O. Reg 278/05).

Field technical personnel checked that all samples had the proper field identification and sample location. The field technical personnel completed chain of custody forms before releasing selected samples to the laboratory for analysis. Chains of custody accompanied the samples at all points of handling. Laboratory QA/QC samples included the use of duplicates, blanks and spiked samples.

3.1.3 DSHMS Inspection and Sampling

On October 22, 2014, an inspection of the old and new light towers, and immediate surroundings was completed by SNC-Lavalin personnel to assess for the potential presence of DSHMs (including to confirm that previously identified lead and suspected ACM still remain and to assess for any new or not previously identified DSHMs). SNC-Lavalin personnel also made observations as related to the potential presence of mould in the old light tower.

Samples of paints and building materials having the potential to contain lead or asbestos were collected. Sample locations are provided in Figure 4. Sample identification and associated rationale along with Photo references are summarized below. Paint samples were submitted to Maxxam for laboratory analysis of lead. Suspect ACMs were submitted to Lex for laboratory analysis to determine asbestos content.

Paint and Suspect ACM Sampling Locations

Type	Sample ID	Location	Description	Analytical Plan
Paint	PS-1401	Old tower, 3rd floor, interior	Red paint on metal frame surface Photo 8	Lead
Paint	PS-1402	Old tower, 3rd floor, exterior	White paint on wood surface Photo 9	Lead
Paint	PS-1403	Old tower, 3rd floor, exterior	Red paint on wood trim Photo 10	Lead
Paint	PS-1404	Old tower, 1st floor, exterior	White paint on wood Photo 11	Lead
Paint	PS-1405	Old tower, 1st floor, exterior	White paint on wood Photo 12	Lead
Paint	PS-1406	New tower, 1st floor, exterior	Red paint on metal Photo 13	Lead
Asbestos	AS-1401 (1-3)	Old tower, 1st and 2nd floor, interior	White window caulking Photo 14	Asbestos
Asbestos	AS-1402 (1-3)	Old tower, 3nd floor, interior	Black insulating paper Photo 15	Asbestos
Asbestos	AS-1403 (1-3)	New tower, concrete foundation with coating of white plaster	White plaster Photo 16	Asbestos

As noted above, a previously unidentified area of potentially hazardous debris was identified during the site inspection on October 22, 2014 at the location shown on Figure 3. The debris comprised paint cans and batteries (possibly lead containing, Photos 4 and 5). Related shallow soil sampling was beyond the scope of work and no samples were collected during the site visit.

3.1.4 Shallow Soil Sampling

On October 22, 2014 five (5) shallow soil samples were collected to depths between 0.03 m and 0.1 m below ground surface (bgs) using a shovel and hand trowel. Deeper samples could not be collected due to the presence of bedrock. Samples were collected from beyond any visible/observable paint-chips/flakes surrounding the old and new light towers. Shallow soil sample locations are shown on Figure 3. Soil samples were submitted to Maxxam for laboratory analysis of lead by Inductively Coupled Plasma Mass Spectrometry (ICPMS).

Soil near the light towers was generally only present within surface cracks of the bedrock (Photos 17 and 18). A deeper soil deposit (at SS-1401) extending to a depth of 0.1 m bgs was located south of the old light tower (Photo 19).

Shallow Soil Sample Details

Sample ID	Depth (m bgs)	Analytical Plan	GPS Coordinates NAD83 Zone17	
SS-1401	0.10	Lead	4979357.103	469223.328
SS-1402	0.05	Lead	4979354.683	469223.410
SS-1403	0.025	Lead	4979367.586	469226.716
SS-1404	0.01	Lead	4979359.684	469209.257
SS-1405	0.01	Lead	4979360.647	469212.063

3.2 Structural Assessment

SNC-Lavalin retained Burnside to complete a Structural Assessment of the old and new light tower towers at the Stokes Bay Front Range in accordance with the SOW. Related inspections were completed by a qualified person from Burnside on October 22, 2014 in conjunction with other field work activities. The Burnside report is provided in Appendix B.

3.3 Marine Assessment

SNC-Lavalin retained Baird Inc. (Baird) to complete a Marine Assessment of the site as per the SOW. Related inspections were completed by a qualified person from Baird on October 22, 2014 in conjunction with other field work activities. Assumptions that formed the basis of the Marine Assessment (i.e., the expected scope of future site remediation including the possible extent of soil removal and demolition or repairs to the light towers) were adjusted based on results of environmental sampling and the structural condition evaluation. The Baird report is provided in Appendix C.

4 RESULTS AND DISCUSSION

4.1 Confirmatory Soil Sampling

Lead concentrations measured in analysed soil samples are summarized in Table 1 along with the selected CCME CEQG, MOE Table 3 standard and previously derived $SSTL_{HH}$ (Franz, 2011). Results are summarized in Figure 3. Laboratory certificates of analysis for soil samples are provided in Appendix E and laboratory quality control results included therein satisfied laboratory acceptance criteria.

Analytical results indicated that concentrations of lead in analysed soil samples exceeded the CCME CEQG (140 µg/g) and MOE Table 3 standard (120 µg/g) but were below the $SSTL_{HH}$ (2297 µg/g). These results generally confirm previous sampling completed by others at the site, such that there is now sufficient analytical data to provide an estimate on the volume of soil to be removed as part of the planned remediation program to address impacts in the vicinity of the light towers. No additional soil sampling to define the extent of this known impact is necessary. It is noted, however, that additional soil sampling will be required in the vicinity of the paint can and battery debris (new APEC discovered during this work program) to assess the potential for associated contaminated soil (see related recommendations in Section 5.2.2).

The previously estimated extent of the area requiring remediation (to satisfy $SSTL_{HH}$ levels) has been adjusted in Figure 3 to reflect these confirmatory soil sampling results and observations of exposed bedrock in the vicinity of the light towers. It is noted, however, that soil in this area of the site was primarily found within cracks in the bedrock surface and near vegetation. As such, contaminated soil above SSTL levels requiring remediation is estimated to represent a volume of no more than 2 m^3. To be conservative for budget and remediation planning purposes, it should be assumed that surface soil from the entire area where paint chips were observed in the area of the light towers (as shown on Figure 3) will require removal/disposal. Also, if impacted soil is confirmed in the vicinity of the paint can and battery debris, it would be expected that this soil could be removed/disposed in conjunction with the planned remediation program. Overall then, the total estimated volume of soil requiring remediation at this site is approximately 10 to 15 m^3.

4.2 DSHMS

4.2.1 Lead Paint

Lead in paint sample results are summarized in Table 2 along with the Surface Coating Materials Regulations guideline value (0.009% lead by weight). Results are summarized in Figure 4. Laboratory certificates of analysis for paint samples are provided in Appendix E.

Concentrations of lead in the six (6) analysed paint samples collected from various locations on the old and new light towers at the site exceeded the guideline value. Although extensive sampling of potentially different paints (by colour or layer) observed on the light towers was not completed as part of this DSHMS, available results suggest that all interior and exterior paints on the old and new light towers should be considered to be lead-based and treated as such during future renovation or demolition activities. Alternatively, further paint sampling on a renovation project-by-project basis could be considered.

4.2.2 ACMs

Results of analysis for building materials suspected to contain asbestos are summarized in Table 3 along with the O. Reg. 278/05 ACM criteria (<0.5 asbestos by weight). Results are summarized in Figure 4. Laboratory certificates of asbestos analysis are provided in Appendix E.

Asbestos fibres were not detected in the three (3) analysed building materials (sampled/analysed in triplicate) including:

- Caulking around the interior window of the old light tower.
- Tar paper from the interior south wall of the old light tower.
- Plaster coating on the exterior concrete foundation of the new light tower.

These results confirmed the absence of ACMs at the site and as such, no further investigation or related remedial action is required.

4.2.3 Mould

Mould was observed in localized areas within the old light tower (Photo 20). No samples were collected during the site visit and the type of mould was not confirmed.

4.2.4 Debris Consisting of Paint Cans and Batteries

As noted above, a previously unidentified area of potentially hazardous debris was identified during the site reconnaissance inspection on October 22, 2014. The debris comprised paint cans and batteries (possibly lead containing, Photos 4 and 5) and was identified within the forested area located to the southeast of the old light tower (Figure 3). The debris represents a volume of approximately 2 m^3. Sampling to assess the potential for soil impacts associated with this debris was beyond the current scope of work and no samples were collected during the site visit. It is the intent, however, that this debris and any associated impacted soil will be addressed concurrently with originally planned remediation activities at the site as discussed below.

4.3 Structural Condition Evaluation

The structural condition evaluation report prepared by Burnside is provided in Appendix B. The following paragraphs highlight the results of their work at the site.

4.3.1 New Range Tower

The circular steel tower built in the 1990's measures approximately 1.5 m in diameter and 7.5 m high. It was visually identified by Burnside to be in good structural condition and operational.

Although the paint on this new light tower was generally observed to be in good condition, it was confirmed by this study to be lead-based paint (PS-1406, Photo 13). It was observed to be vandalized on the lower sections of the tower (due to lack of overall site security/access restrictions).

4.3.2 Old Range Tower

The original 1904 vintage wood light tower structure is located to the east side of the steel tower and was considered by Burnside to be in generally fair condition. They concluded that the overall old tower structure is not vertically settling or moving, and the basic design appears to be adequate to resist the environmental loading. Burnside observed evidence of previous structural repairs, including replacement of the ground floor structure, concrete foundation repairs and partial cladding of exterior walkways and siding that were deemed to have extended the life of the structure. They concluded that the structure is salvageable but will require a considerable amount of labour to repair and maintain in future. The light tower structures can withstand lead abatement of the interior and exterior surfaces if fall arrest protection is used.

On the south exterior wall, the paint (confirmed by this study to be lead-based, PS-1404, Photo 11) was observed to 95% removed, causing the wooden shingle surface to be directly exposed to on-going weathering. Burnside concluded that material degradation of the concrete base and wooden structure due to water ingress is causing delamination of the concrete and localized wood decay. The southeast interior corner of the old tower was identified to be in poor condition (wood rot) at ground level extending to mid-tower level.

Although Burnside did not complete an exhaustive audit of the building conditions against the National Building Code, they noted a number of places where existing conditions in the old light tower would not meet today's construction standards and/or could pose safety risks to building occupants. They noted that the staircase has a handrail on only one site and has no pickets or mid rails to prevent persons on the stairs from falling off one side or falling below the rail level. A floor opening cut for the stairwell in each tower also has no guard around it and someone on the floor level could fall back through the opening.

4.4 Marine Assessment

The marine assessment report prepared by Baird is provided in Appendix C. The following paragraphs highlight the results of their work at the site.

The main focus of the marine assessment was to determine options for accessing the site during future remediation activities. A possible mooring location was identified at the northwest side of

Knife Island that is preferred for its close proximity to the anticipated Front Range remedial work area and slightly deeper water depths than other locations around the island.

Given the relatively small scope of required remediation at the site (discussed in Section 5 below), Baird concluded that the preferred and least-cost marine access option could likely be achieved through float-in of a small tug and deck barge through the Stokes Bay main access channel. Based on available sounding data, they indicated that it would likely be possible to include a temporary access causeway to extend from the barge mooring location to the shore. Alternative methods of barge to shore access such as a floating dock/ramp or use of mud-mats should be considered during final remediation scoping/planning as any in-water work will restrict the timing window for future work at the site. Baird's report (Appendix C) includes evaluation of alternative access options for larger equipment; however, these are not expected to be required at this site unless the remediation scope changes substantively.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Sampling results indicated that lead-based paint was used extensively throughout the exteriors and interiors of the old and new light towers. The lead-based paint observed to be in poor condition and/or missing from the exterior of the old light tower is the most likely source of lead contamination in surface soil at the site (in the vicinity of the light towers). The source of the soil contamination (i.e. the lead-based paint on the towers' exteriors) should be removed to prevent recontamination of the remediated area in future.

Results of the current work program identified only a shallow layer of soil overlying the bedrock, in surface cracks in the bedrock and/or trapped around limited vegetation (including trees, grasses and shrubs) at the site in the vicinity of the light tower. Approximately 2 m^3 of soil exceeding the previously derived $SSTL_{HH}$ (Franz, 2011) was estimated to be present in this area. To be conservative for budget and remediation planning purposes, it should be assumed that surface soil from the entire area where paint chips were observed in the area of the light towers (as shown on Figure 3) will require removal/disposal. Also, if impacted soil is confirmed in the vicinity of the paint can and battery debris, it would be expected that this soil could be removed/disposed in conjunction with the planned remediation program. Overall then, the total estimated volume of soil requiring remediation at this site is approximately 10 to 15 m^3.

Other potentially hazardous materials at the site include an area of previously unidentified debris (paint cans and batteries, representing a volume of approximately 2 m^3) as well as evidence of limited mould growth in the interior of the old light tower related to water ingress. It is the intent that this or any other debris encountered or generated during work at the site will be addressed concurrently with the planned remediation program.

A visual structural condition evaluation by Burnside of the old and new light towers concluded that the structures were in good to fair condition, were founded on exposed bedrock and not vertically settling and as such, do not require dismantling/replacement at this time. The old light tower would require more extensive repairs to ensure its structural integrity can be maintained in future but also to raise building safety conditions to today's standards. These repairs would be recommended as part of a long term maintenance program for the old light tower but are beyond the current scope of planned remediation work at this site and therefore, not considered further here.

As removal of the old light tower is not required to facilitate soil remediation or due to structural concerns, DFO has indicated it would be their preference for both the old and new light towers to remain on site.

Baird concluded that site access for the purposes of the proposed remediation activities could reasonably be achieved, especially given the limited scope of soil remediation required and plans to repair not dismantle the light towers.

5.2 Recommendations

Recommendations and evaluations of potential remediation options are provided to assist with the preparation and implementation of engineering tender documents (including detailed plans and specifications prepared under separate cover) for planned remediation at this site.

5.2.1 Lead-Based Paint

Although the lead-based paint on the new light tower exterior was found to be in good condition by Burnside, the visible evidence of vandalism on its lower sections suggests that site visitors have likely been exposed to this lead in this paint in the past. To avoid this concern in future, Burnside recommended that the lead-based paint be removed from the new light tower exterior. Alternatively, given that this lead-based paint was observed to be in good condition and therefore poses no immediate risk, a related management plan could be implemented. The management plan could include re-painting the lower section of the tower that has been vandalized and installing signs warning of the presence of this lead-based paint and hazards associated with its disturbance. The potential benefits of removing this lead-based paint or covering it are not believed to be worth the cost. As such, in its current good condition, only the above noted warning signs are recommended. Future touchup painting and/or re-painting of the vandalized lower tower section should be undertaken as part of future routine maintenance that is considered to be beyond the current scope of planned remediation work at this site.

The exterior paint of the old light tower was identified to be in poor condition (95% removed), and associated paint chips were observed scattered on the ground surface and are the likely source of lead contaminated shallow soil at the site. Removing any remaining exterior lead-based paint and repainting/sealing the wood is recommended. It is also recommended to remove any loose paint chips that are visible on the ground surface including those which may be mixed with soil in the cracks of the exposed bedrock (approximate area of 300 m^2 as shown in Figure 3 and discussed in Section 5.2.3 below). Chipping/peeling paint on interior surfaces of the old light tower should be addressed in conjunction with other lead abatement activities. Where interior paints are in good condition, a management plan should be implemented to protect future building occupants. The volume of waste generated during these lead abatement activities is not expected to exceed 2 m^3. It should be assumed for budget purposes that this waste will be classified as hazardous in accordance with Regulation 347 and will require handling/disposal as such.

The “Designated Substances” regulation (O. Reg. 490/09) made under Ontario Occupational Health and Safety Act (OHSA) requires that constructors, employers and project owners in Ontario implement work procedures to protect workers involved in demolition activities which may disrupt Lead Containing Materials (LCMs). Lead-based paint removal and disposal should be conducted in accordance the Ontario Ministry of Labour (MOL) "Guideline – Lead on Construction Projects" (April 2011) and best industry practice. Where lead-based paint is flaking and chipping from the old light tower and is loose on the ground, removal can likely be completed in accordance with MOL Type 1 Lead Removal Operations.

To avoid spreading and cross-contamination, loose paint chips observed on the ground surface in the immediate vicinity of the old light tower and along the established access route(s) to the work area should be collected prior to the onset of any other work at the site. Remaining paint chips trapped around vegetation and mixed with soil can be removed in conjunction with soil remediation activities described below. Given the uneven bedrock surface, removal using a hand held vacuum equipped with a HEPA filter is expected to be the most effective collection/containment method.

Containment of lead-based paint/dust during remediation will be necessary and should be properly planned for prior to field work (including capturing dust, paint chips, etc.). It is recommended that containment barriers be placed around the work area to minimize the spread of loose materials and dust. Considering the access to site and uneven bedrock terrain surrounding the towers, the use of heavy equipment or methods such as wet sand blasting to remove the paint are not feasible. Extensive work using small power tool such as a sander vacuum equipped with filters to reduce dust loose material will likely be required and hand scraping in some locations for both interior and exterior paint removal. A power source such as a generator will need to be brought to site, as no electrical power lines are on the island (solar powered batteries operate the light towers). Consideration of the environment including the close proximity to Lake Huron and possible SAR/SAR habitat should be considered when selecting tools and equipment. Residual paint that is impractical to remove from the light towers (e.g. in cracks or between boards) should be encapsulated with a material surface coating. Exterior surfaces will also require re-painting to protect the structures from weathering.

Working at heights will be required during lead-based paint removal from the light tower, and workers should have proper training and equipment. Proper fall arrest protection, shoring, guards and access scaffolding are critical to site safety and should be incorporated into the work plans. The project should be led by experienced contractors and all workers should be trained and have the proper safety equipment.

5.2.2 Other Potentially Hazardous Materials

Limited mould growth was visible in areas of water ingress in the old light tower where rotten wood was identified by Burnside. Recommended structural repairs (discussed below) are expected to address the evidence of mould growth observed. Work procedures to minimize generation of airborne mould spores and to control worker exposure should be implemented during these repairs. Procedures should be completed using Section 9 of the Canadian Construction Association (CCA) Document CCA 82 – 2004 entitled "Mould Guidelines for the Canadian Construction Industry".

Based on the apparent limited quantities of mould observed, Level 1 procedures are expected to be adequate.

The previously unidentified debris (representing a volume of approximately 2 m^3) located southeast of the old tower should be removed and properly disposed. Once debris is removed, sampling of underlying soil to assess the potential need for and/or scope of remediation should be conducted in conjunction with planned remedial works at the site. A minimum of three (3) shallow soil samples should be collected analysed for COPCs including metals (associated with metal decay of paint cans and likely lead-based paint) and volatile organic compounds (VOCs, associated with possible oil-based paint). One (1) shallow soil sample should be collected for TCLP analysis for proper waste disposal classification. Given the remote site location, additional sampling should be undertaken in the early stages of planned remediation work (e.g., during preparations including temporary access setup or initial lead-based paint cleanup). Related sampling results should be rushed (minimum 1 week turn-around-time including sample transport) to avoid the need to re-mobilize to conduct any follow-up sampling or remediation if required.

No ACMs were identified by this study and no related action is required.

5.2.3 Contaminated Soil

Soil at site is found primarily within cracks in the bedrock and/or surrounding limited vegetation (including trees, grasses and shrubs). Paint chips are scattered and mixed with soil throughout the area surrounding the light towers and the affected soil requires removal to meet the previously derived $SSTL_{HH}$ (Franz, 2011). The approximate extent of the soil exceeding the $SSTL_{HH}$ and CCME SQG for lead is shown in Figure 3 and is estimated to represent a volume of approximately 2 m^3. However, to be conservative for budget and remediation planning purposes, it should be assumed that surface soil from the entire area where paint chips were observed in the area of the light towers (as shown on Figure 3) will require removal/disposal. Also, if impacted soil is confirmed in the vicinity of the paint can and battery debris, it would be expected that this soil could be removed/disposed in conjunction with the planned remediation program. Overall then, the total estimated volume of soil requiring remediation at this site is approximately 10 to 15 m^3. The shallow nature of the soil and extensive area of exposed bedrock limits the equipment that would be effective to remediate/remove contaminated soil at this site. Smaller hand held equipment is recommended for use. Shovels or picks should be used to loosen soil from the bedrock surfaces making it available to be collected/contained using hand held vacuums equipped with HEPA filters. No soil backfill is required to replace the removed soil.

As noted above, loose paint chips observed on the ground surface should be collected prior to the onset of any other work at the site. Vegetation should then be removed to provide a safe work area, free from tripping and impaling hazards. Grubbing should include removal of scrub trees and brush. For larger trees (greater than 15 cm diameter), only lower branches to a height of approximately 1.5 to 1.8 m need to be removed to create a safe work area and to allow access to around the tree bases. Brush generated from clearing and grubbing activities can be left on the site in a suitable area (e.g. away from the water's edge).

5.2.4 Structural Repairs

5.2.4.1 New Range Tower

To ensure the structural integrity of the new light tower remains over time, Burnside recommended repairing the localized corrosion around the interior tower base, and cleaning up the concrete base slab to allow for water to drain properly. It was also recommended to create a battery containment area to contain any future battery leakage and to protect existing surfaces. Future touchup painting and/or re-painting of the vandalized lower tower section, as well as these suggested repairs should be undertaken as part of future routine maintenance that is considered to be beyond the current scope of planned remediation work at this site.

5.2.4.2 Old Range Tower

Based on the results of the structural assessment, the old light tower in its current condition should withstand the proposed lead-based paint abatement program, assuming that fall protection/guards will be implemented to ensure worker protection during the work in areas where guards/barriers might be lacking. Recommended re-painting of the tower exterior following abatement will serve as a means to encapsulate minor quantities of residual lead based paint that would be impractical to remove (e.g. in cracks, between/under board) and will help to protect the tower exterior from weather exposure into the future.

Structural repairs and upgrades to raise the building safety conditions to today's standards as recommended by Burnside should be considered as part of a long term maintenance program for the old light tower. However, these are beyond the current scope of planned remediation work at this site and therefore, not considered further here.

5.2.5 Marine Assessment and Site Access

To facilitate safe site access to complete remediation activities noted above, it is recommended that the work area around the light towers be prepared with a temporary mooring/access point. Based on the expected scope of the remediation project, heavy equipment will not be required. Only access for workers, hand held equipment/tools, scaffolding, limited construction materials (wood posts, beams and boards, concrete mix) and drums for waste containment will be necessary and could be achieved using smaller boats/barges.

A probable and least-cost marine access option was estimated to be achieved through float-in of a small tug and deck barge through the Stokes Bay main access channel. Based on available sounding data, Baird indicated that it would likely be possible to include a temporary access causeway to extend from the barge mooring location to the shore. Alternative methods of barge to shore access such as a floating dock/ramp or mud mats should be considered. It should be noted that any in-water work will restrict the timing window for future work at the site. As such, direct consultation with DFO Habitat should be undertaken during final remediation scoping/planning as this may identify project-specific restrictions and timing window (different from the generic recommendations for Ontario and/or Lake Huron) based on site-specific conditions, the types of fish species that may be present and their spawning characteristics (i.e., spring versus fall).

Baird recommended that the remediation work be planned to start in July (if possible), in order to benefit from higher summer lake levels and lower wind speeds, as well as the end of DFO fish habitat restricted activity timing windows for in-water work (causeway, in-water dock). If the work proceeds in July or August, the maximum draft for construction vessels is estimated to be approximately 1.9 m which is anticipated to provide approximately 245 tonnes of deadweight carrying capacity for material and equipment on a 20 m long deck barge. Should the work proceed in September or October, the maximum draft may be restricted to 1.7 m (215 tonnes deadweight) and there is an increased possibility for fall storms and weather induced downtime.

It is recommended that the following additional task be undertaken prior to starting the remediation work:

- Completion of a hydrographic survey to check for hazards along the route and confirm the extent of navigable water. As well, the hydrographic survey should also confirm near shore water depths at the Front Range work area and preferred shore access location. Rock fill quantities should then be updated following the survey to optimize the amount of material delivered to site for construction of the proposed temporary causeway access structure (if one is deemed to be required).

5.2.6 Waste Management

All wastes generated during the work program must be appropriately handled and disposed in accordance with applicable federal and provincial regulations (e.g. Transportation of Dangerous Goods Act and Ontario Regulation 347). A temporary on-site waste storage area (e.g. wood platform with fence) should be established near the site access/mooring location established for the remediation program. Containerized wastes stored on site temporarily must be secured (e.g. sealed drums in fenced area) and labelled in accordance with Workplace Hazardous Materials Information System (WHMIS) legislation. Wastes must be appropriately classified (as applicable, e.g., toxicity characteristic leaching procedure [TCLP] analysis for lead-containing solid waste) prior to removal from site. Transportation of wastes from the site and to the disposal facilities must be completed by MOE licensed waste hauler(s).

Lead-based paint chips and soil collected by vacuums should be transferred to 205 L drums on a regular basis (at least at the end of each work day). Dust control measures should be implemented during waste transfer. Contaminated soil should be segregated based on field observations for further waste classification as work proceeds. For example, residue from lead-based paint abatement, soil containing a high percentage of paint chips and contaminated soil “hot spots” based on available analytical data is likely to be hazardous waste. Contaminated soil that may be present in the vicinity of the previously unidentified debris and/or in the larger area of visible paint chips (where lead concentrations below the $SSTL_{HH}$ were previously documented in soil that has conservatively been included in the estimate of soil requiring remediation) is expected to be non-hazardous. Remaining waste (e.g. paint can, batteries and other miscellaneous debris generated during the work) should be segregated and appropriately contained for safe off-site disposal. Except as noted above for organic wastes from the vegetation clearing/grubbing, no wastes generated during the work program shall be left at the site. Burying of wastes at the site will also not be permitted.

Summary of Material Volumes for Removal and Off-site Disposal

Material	Quantity
Lead abatement residue	2 m^3 (assume hazardous solid waste)
Contaminated soil	10 to 15 m^3 (assume 10% hazardous solid waste, remaining non-hazardous soil/solid waste)
Paint can / battery debris	2 m^3 (assume small quantity exemption applies, allowing non-hazardous waste disposal)
Other miscellaneous construction debris	1 bin (non-hazardous commercial waste)

6 REFERENCES

Canadian Council of Ministers of the Environment (CCME), 2007. Canadian Environmental Quality Guidelines, Chapter 7 – Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. 1999, updated to 2012.

Franz Environmental Inc. (Franz), 2011. Site Specific Human Health Risk Assessment (SSRA-HH), Site Specific Ecological Risk Assessment (SSERA) and Supplemental Site Investigation, Stokes Bay Front Range, Stokes Bay Rear Range and the Former Squatter's Area Knife Island (DFRP# 10961) and Shute Point (DFRP N. 85917). March 16, 2011.

Franz Environmental Inc. (Franz), 2009. Phase III ESA Stokes Bay Front Range (DFRP#10961) and Rear Range (DFRP#85917) Canadian Coast Guard Navigational Aids L.L. 797 and L.L798 Bruce Peninsula, Ontario. October 29, 2009.

Ontario Ministry of the Environment (MOE), 2011. Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (O. Reg. 153/04 amended to O. Reg. 269/11).

NOTICE TO READER

This report has been prepared and the work referred to in this report have been undertaken by SNC-Lavalin Inc., Environment & Water (SNC-Lavalin) for the exclusive use of Public Works and Government Services Canada on behalf of the Department of Fisheries and Oceans (the Client), who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our original contract and included in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered, site conditions change or applicable standards are amended, modifications to this report may be necessary. The results of this assessment should in no way be construed as a warranty that the subject site is free from any and all contamination.

Any soil and rock descriptions in this report and associated logs have been made with the intent of providing general information on the subsurface conditions of the site. This information should not be used as geotechnical data for any purpose unless specifically addressed in the text of this report. Groundwater conditions described in this report refer only to those observed at the location and time of observation noted in the report.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

The contents of this report are confidential and proprietary. Other than by the Client, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of the Client and SNC-Lavalin.

Respectfully Submitted,

SNC-LAVALIN INC.

PROFESSIONAL GEOSCIENTIST
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PRACTISING MEMBER
2028
23/03/2015
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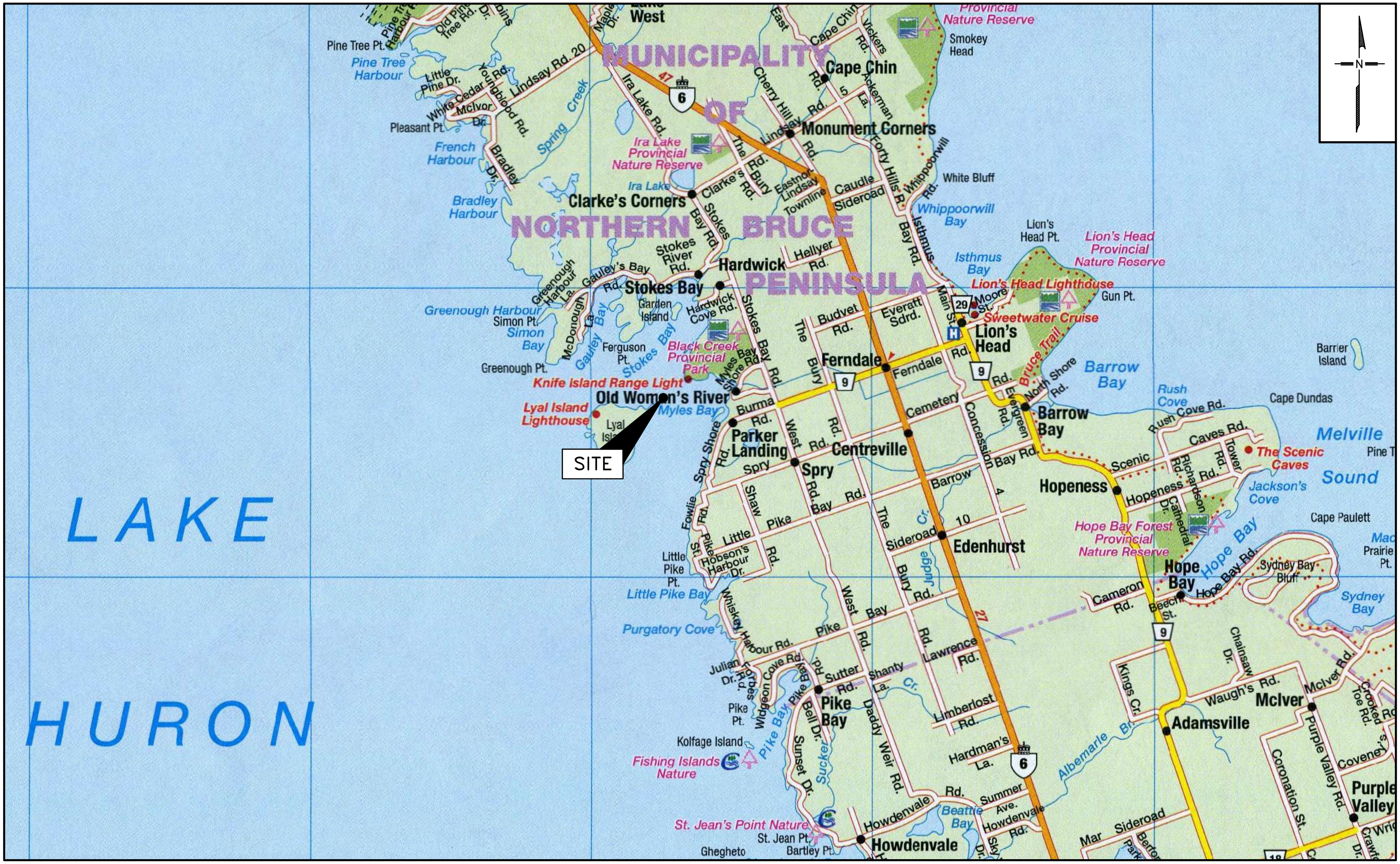
FIGURES



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1. SCHWERDT GRAPHIC ARTS LTD., (MapArt), 2007 EDITION

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Client/Location: PWGSC STOKES BAY FRONT RANGE, KNIFE ISLAND, LAKE HURON, ON		Title: SITE LOCATION PLAN	
Project No: 623376	Filename: 002F01_623376	Date: MARCH 2015	Dwg No: FIGURE 1
Drawn: AG	Verified: JE	Project Manager: JE	

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NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SOURCE(S):
1. FRANZ ENVIRONMENTAL INC., SITE LOCATION AND SURROUNDING LANDS, FIGURE No.2, NOVEMBER 24, 2010

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Client/Location: PWGSC STOKES BAY FRONT RANGE, KNIFE ISLAND, LAKE HURON, ON		Title: SITE LAYOUT AND SURROUNDING LANDS	
Project No: 623376	Filename: 002F02_623376	Date: MARCH 2015	Dwg No: FIGURE 2
Drawn: AG	Verified: JE	Project Manager: JE	

PAGE FORMAT: 8.5x11

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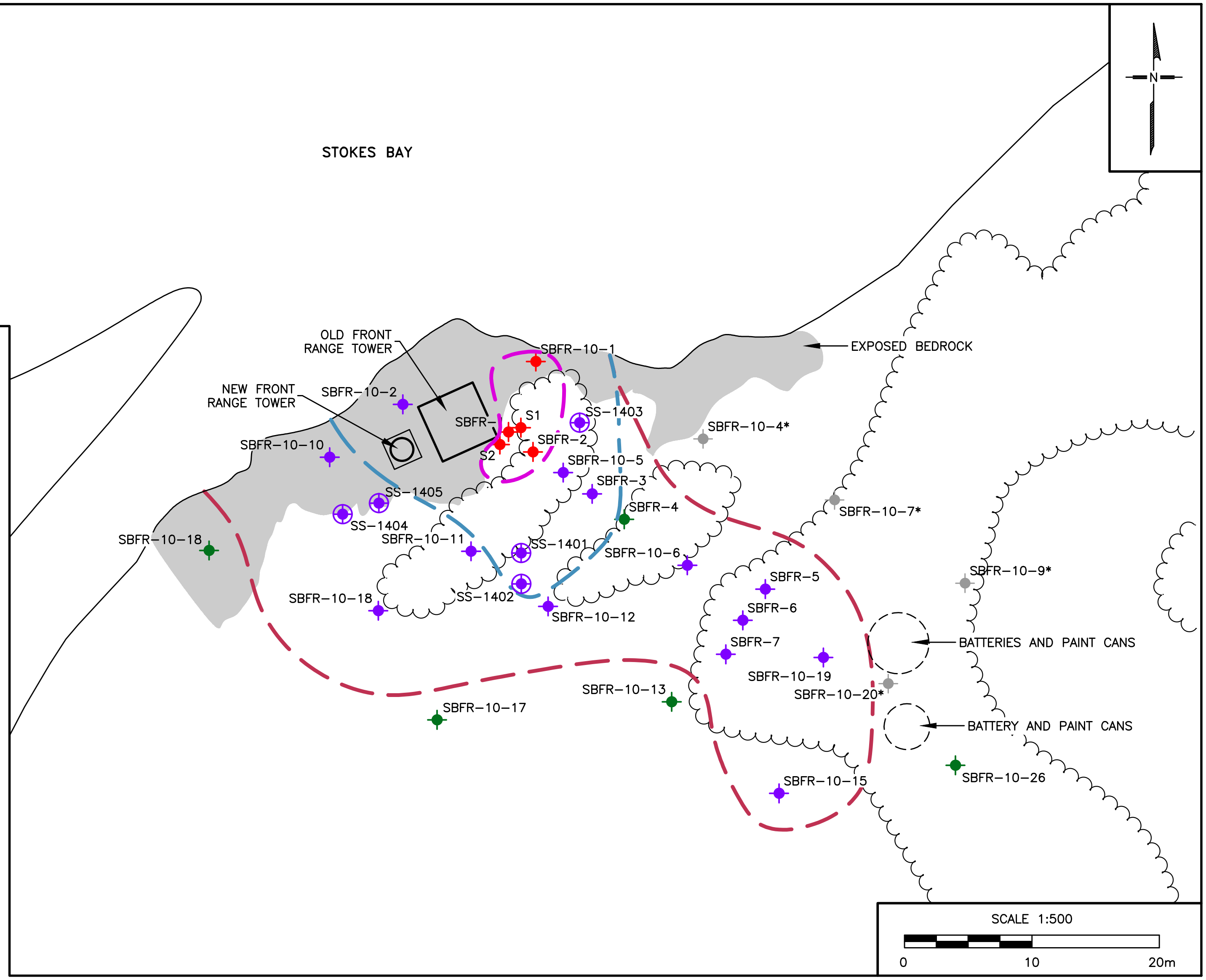

LEGEND

⊕	SOIL SAMPLE LOCATION (SNC–LAVALIN, 2014)
✦ (grey)	PREVIOUS SOIL SAMPLE LOCATION (BY OTHERS)
✦ (green)	CONCENTRATIONS OF ANALYSED PARAMETERS IN SOIL SAMPLE ARE LESS THAN CCME SOIL QUALITY GUIDELINES
✦ ⊕ (purple)	CONCENTRATIONS OF ONE OR MORE ANALYSED PARAMETER IN SOIL SAMPLE ARE BELOW SITE SPECIFIC TARGET LEVELS (SSTL's) BUT GREATER THAN CCME SOIL QUALITY GUIDELINES
✦ (red)	CONCENTRATIONS OF ONE OR MORE ANALYSED PARAMETERS IN SOIL SAMPLE ARE GREATER THAN SITE SPECIFIC TARGET LEVELS (SSTL's) AND CCME SOIL QUALITY GUIDELINES
*	SELENIUM AND/OR PETROLEUM HYDROCARBONS ARE THE ONLY PARAMETER TO EXCEED IN SOIL SAMPLE AND ARE INTERPRETED TO BE BACKGROUND, SEE FRANZ, 2011
— — (dark red)	APPROXIMATE EXTENT OF SOIL CONCENTRATIONS ABOVE CCME SOIL QUALITY GUIDELINES
— — (magenta)	APPROXIMATE EXTENT OF SOIL CONCENTRATION ABOVE SITE SPECIFIC TARGET LEVELS (SSTL's) AND CCME SOIL QUALITY GUIDELINES
— — (blue)	APPROXIMATE EXTENT OF PAINT CHIPS VISIBLE AT GROUND SURFACE

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SOURCE(S):
1. FRANZ ENVIRONMENTAL INC., FRONT RANGE EXTENT OF SOIL CONTAMINATION (AUGUST 2010), FIGURE No.13, MARCH 16, 2011

SNC·LAVALIN

Client/Location:	Title:
PWGSC STOKES BAY FRONT RANGE, KNIFE ISLAND, LAKE HURON, ON	SUMMARY OF SOIL IMPACTS AND 2014 SOIL SAMPLING LOCATIONS

Project No: 623376	Filename: 002F03_623376	Date: MARCH 2015	Dwg No: FIGURE 3
Drawn: AG	Verified: JE	Project Manager: JE	

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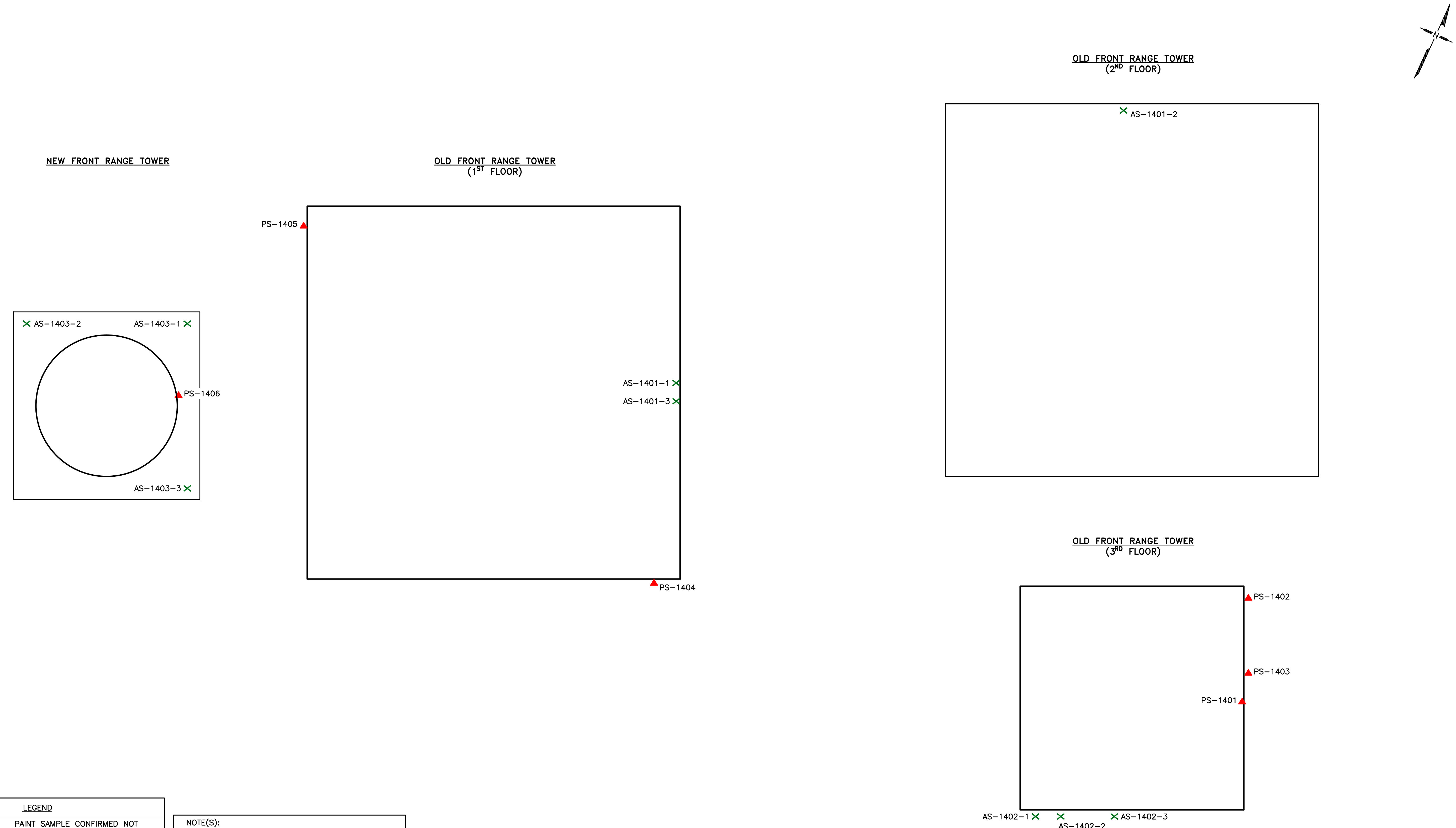

LEGEND

▲ (green)	PAINT SAMPLE CONFIRMED NOT LEAD–BASED (PS–XXXX)
▲ (red)	PAINT SAMPLE CONFIRMED LEAD–BASED (PS–XXXX)
✕ (green)	BUILDING MATERIAL SAMPLE CONFIRMED NOT ASBESTOS CONTAINING (AS–XXXX–X)
✕ (red)	BUILDING MATERIAL SAMPLE CONFIRMED ASBESTOS CONTAINING (AS–XXXX–X)
———	EXISTING BUILDING
———	SITE INFRASTRUCTURE

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. LEAD IN PAINT STANDARD: SAMPLES CONTAINING LEAD ABOVE 0.009% BY WEIGHT (WT/WT) ARE CONSIDERED TO BE LEAD–BASED (CANADA CONSUMER PRODUCT SAFETY ACT, "SURFACE COATINGS MATERIALS REGULATIONS ((SOR/2005–109)")
4. ASBESTOS STANDARD: ACCORDING TO O.REG. 278/05, MATERIALS CONTAINING >0.5% ASBESTOS ARE CONSIDERED TO BE "ASBESTOS CONTAINING MATERIALS"
5. 'm' : METRES

SCALE 1:50

0 1 2m

SNC·LAVALIN

Client/Location: PWGSC STOKES BAY FRONT RANGE, KNIFE ISLAND, LAKE HURON, ON		Title: DSHMS SAMPLING LOCATIONS	
Project No: 623376	Filename: 002F04_623376	Date: MARCH 2015	Dwg No: FIGURE 4
Drawn: AG	Verified: JE	Project Manager: JE	

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TABLES

TABLE 1 SHALLOW SOIL ANALYTICAL RESULTS
Lead
Stokes Bay Front Range, Knife Island, ON

SNC-Lavalin Sample No.	**RDL**	**Units**	**CCME CEQG [1]**	**MOE 2011 Standard Table 1 [2]**	**Site Specific Target Level [3]**	**SS-1401**	**SS-1402**	**SS-1403**	**SS-1404**	**SS-1405**
Laboratory Sample No.	na	na	na	na	na	*YD6806*	*YD6807*	*YD6808*	*YD6809*	*YD6810*
Sampling Date	na	na	na	na	na	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*
Lead	1	µg/g	140	120	2297	***590***	***310***	***1800***	***350***	***540***

µg/g	micrograms per gram
RDL	reportable detection limit unless noted
na	not applicable
<	less than RDL
<###	less than adjusted RDL (###)
-	not analysed
<###	adjusted RDL (###) exceeds criteria
BOLD	exceeds CCME soil quality guidelines
BOLD	exceeds selected MOE standard
Shaded	exceeds Site Specific Target Level
1	Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG), Chapter 7; Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health - Guidelines for Residential/Parkland Land use and Coarse Textured Soil
2	Table 1 full depth background site condition standards for residential/parkland/institutional/industrial/commercial/community property use (MOE, 2011).
3	Site Specific Target Level for lead concentration in soil derived for protection of human health (Franz, 2011).

TABLE 2 ANALYTICAL RESULTS - LEAD IN PAINT SAMPLES
Stokes Front Bay Range, Knife Island, ON

SNC-Lavalin Sample No.	**Detection Limit**	**PS-1401**	**PS-1402**	**PS-1403**	**PS-1404**	**PS-1405**	**PS-1406**
Sampling Date	na	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*
SAMPLE DESCRIPTION							
Colour	na	Red	White	Red	White	White	Red
Condition		Poor	Poor	Poor	Poor	Poor	-
Description	na	Paint	Paint	Paint	Paint	Paint	Paint
Location	na	Interior sheet metal in Old Range Tower	Wooden exterior walls of Old Range Tower	Exterior trim on upper level of Old Range Tower	Wooden exterior walls of Old Range Tower	Wooden exterior walls of Old Range Tower	Metal exterior of New Range Tower
RESULTS							
Lead Detected in Sample (%)	0.01	**8.3**	**28**	**25**	**4.5**	**20**	**7.3**

Analysed by Inductively Coupled Argon Plasma,
Atomic Emission Spectroscopy (ICP-AES)

< ### less than adjusted detection limit (###)
na not applicable
Samples containing lead above 0.009% by weight (wt/wt) are considered to be lead-based (Canada Consumer Product Safety Act, "Surface Coatings Materials Regulations (SOR/2005-109)")

TABLE 3 ANALYTICAL RESULTS - ASBESTOS
Stokes Front Bay Range, Knife Island, ON

	SNC-Lavalin Sample No.	AS-1401	AS-1402	AS-1403
	Sampling Date	*22-Oct-14*	*22-Oct-14*	*22-Oct-14*
	No. of Samples Analysed	3	3	3
RESULTS	**DL**			
% Total Asbestos	0.1	nd	nd	nd
% Asbestos and Type	0.1	nd	nd	nd
SAMPLE DESCRIPTION				
Colour	na	White	Black	White
Layer Analysed	na	na	na	na
Description	na	Caulking	Paper	Plaster
Sampling Location	na	Interior window in Old Range Tower	Interior south wall in Old Range Tower	Exterior concrete foundation of New Range Tower

Notes:
Analysed by Polarized Light Microscopy (PLM)
According to O.Reg. 278/05, materials containing $\geq$ 0.5%
asbestos are considered to be "asbestos containing materials"

DL Detection Limit
nd none detected
na not applicable

BOLD Asbestos containing material ($\geq$0.5% asbestos by weight)

Photograph 1: Stokes Bay Front Range New and Old Light Towers (looking southeast).

Photograph 2: New and Old Light Towers (looking north).

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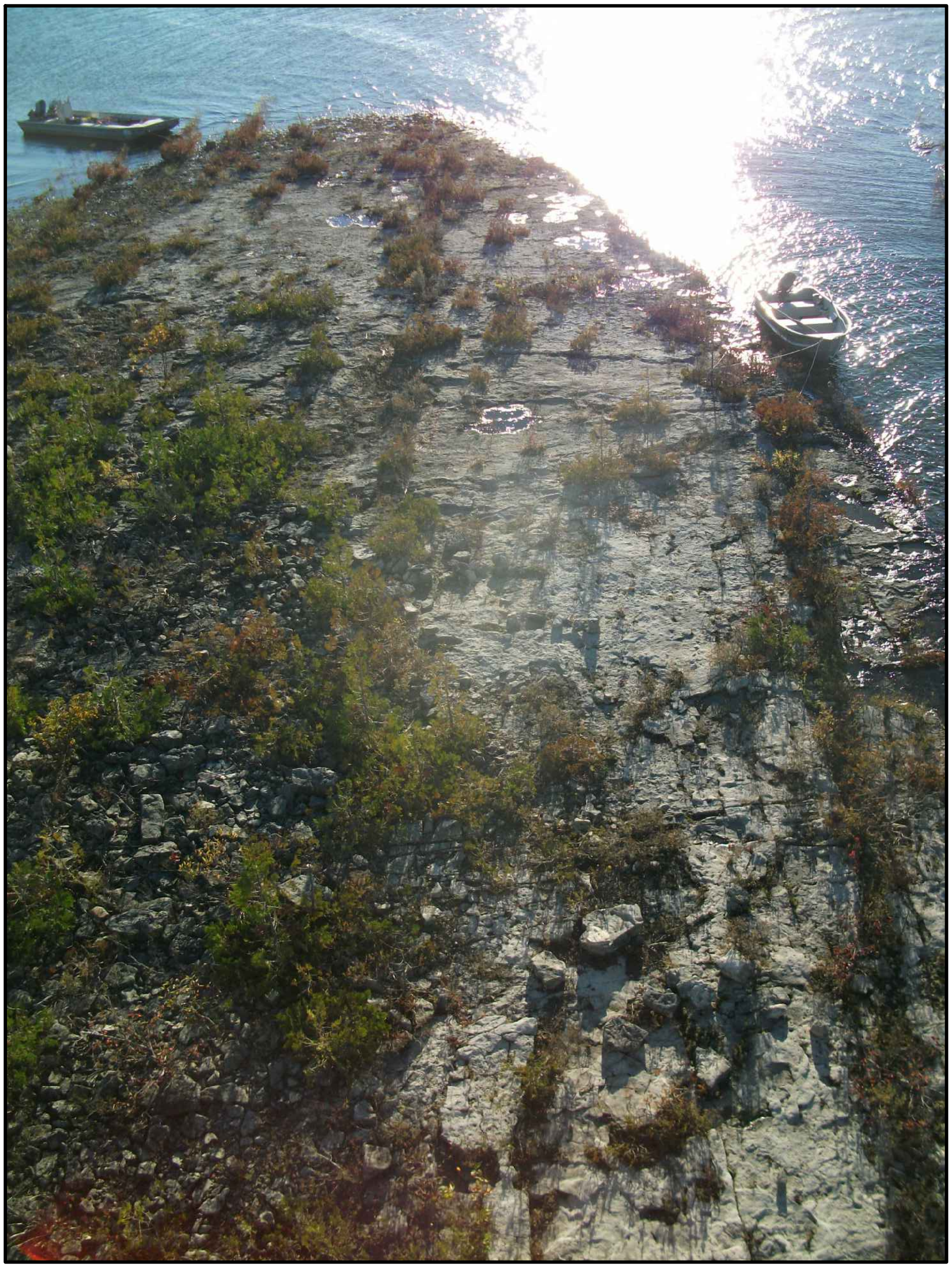

Photograph 3: Exposed bedrock with loose rocks and sparse vegetation (looking southwest from top of light towers).

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Photograph 4: Dumping of paint cans and batteries in forested area southeast of light towers.

Photograph 5: Battery dumped in forested area southeast of light towers.

Photograph 6: Paint chips visible on exposed bedrock between the New and Old Light Towers (looking south).

Photograph 7: Paint chips visible on ground surface at southeast corner of Old Light Tower (looking north).

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Photograph 8: Red lead-based paint (fair condition) on interior metal surface on 3rd floor of Old Light Tower.

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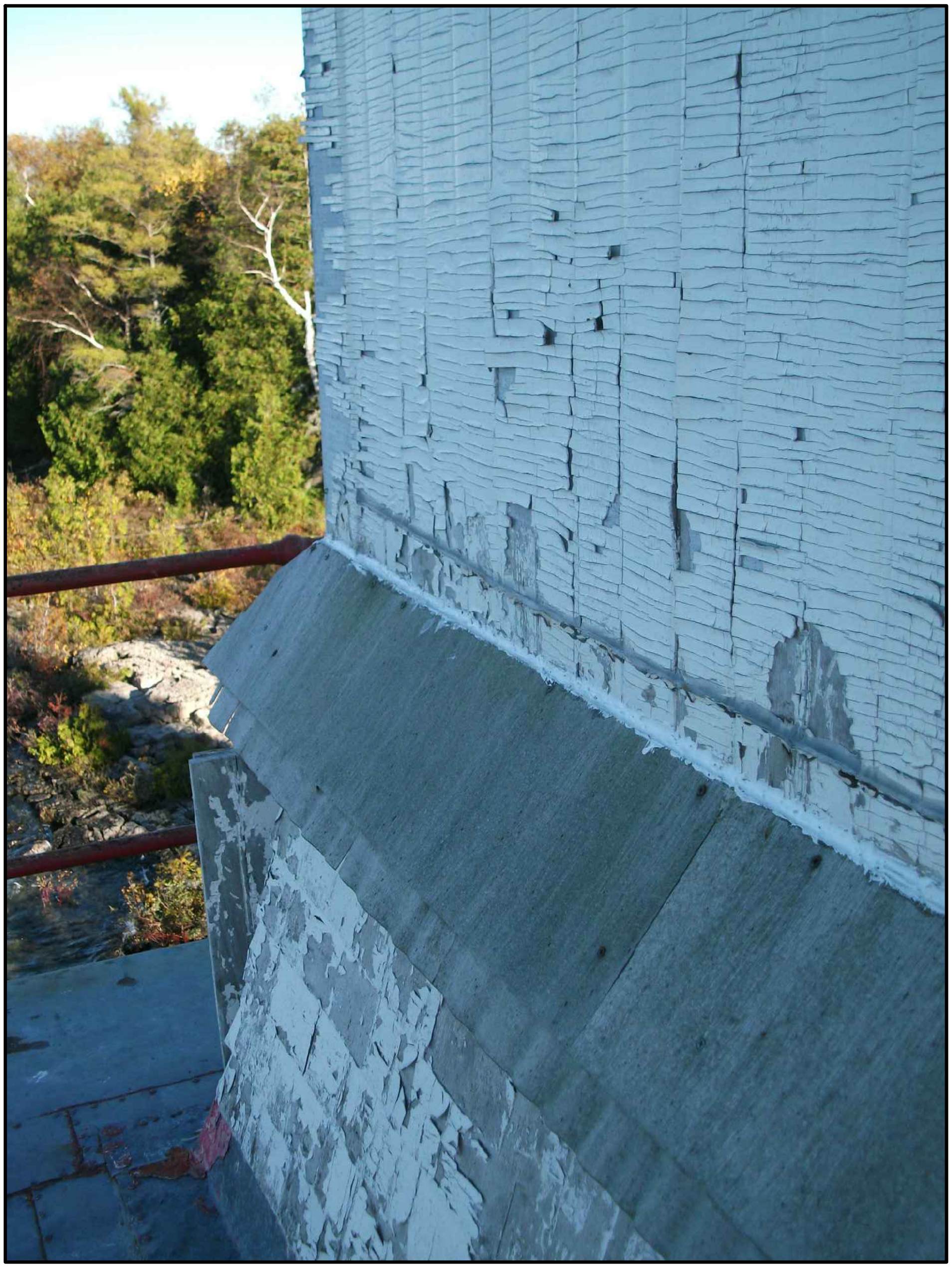

Photograph 9: White lead–based paint on exterior wood surface on 3rd floor of Old Light Tower.

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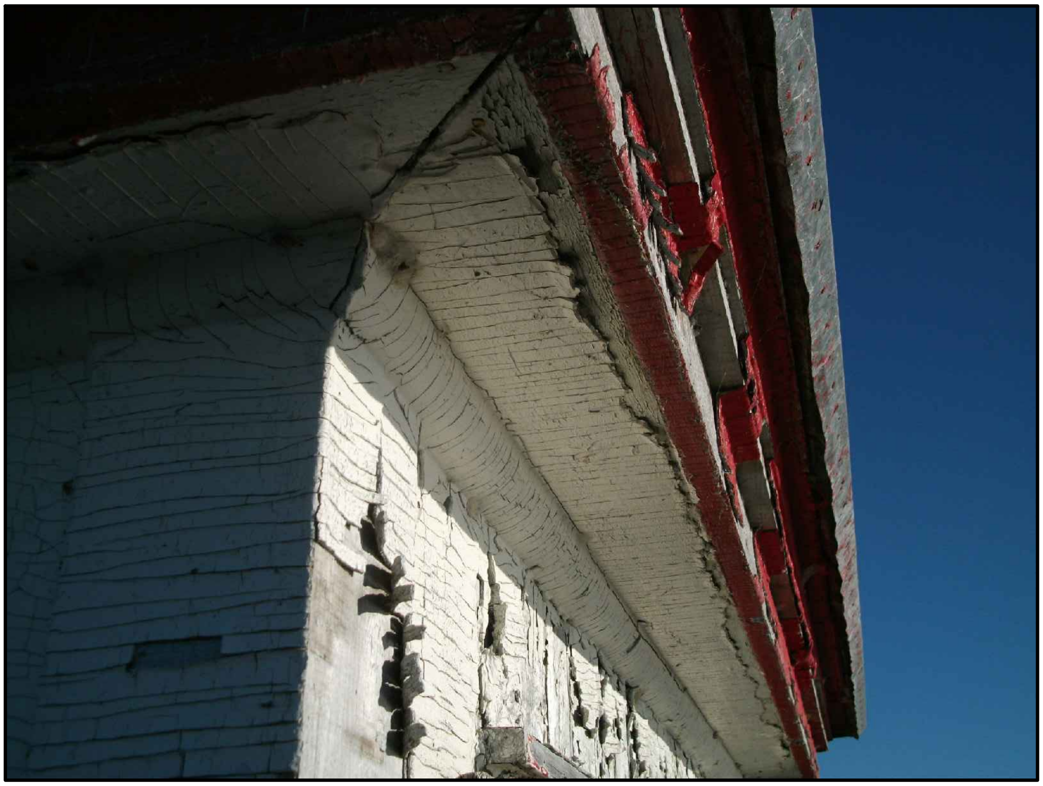

Photograph 10: Red lead-based paint (poor condition) on exterior wood trim on 3rd floor of Old Light Tower.

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Photograph 11: White lead-based paint (poor condition) on exterior wood surface on 3rd floor of Old Light Tower.

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Photograph 12: White lead-based paint (poor condition) on exterior wood surface on west side of 1st floor of Old Light Tower.

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Photograph 13: Red lead-based paint (good condition) on exterior metal surface of New Light Tower (looking south).

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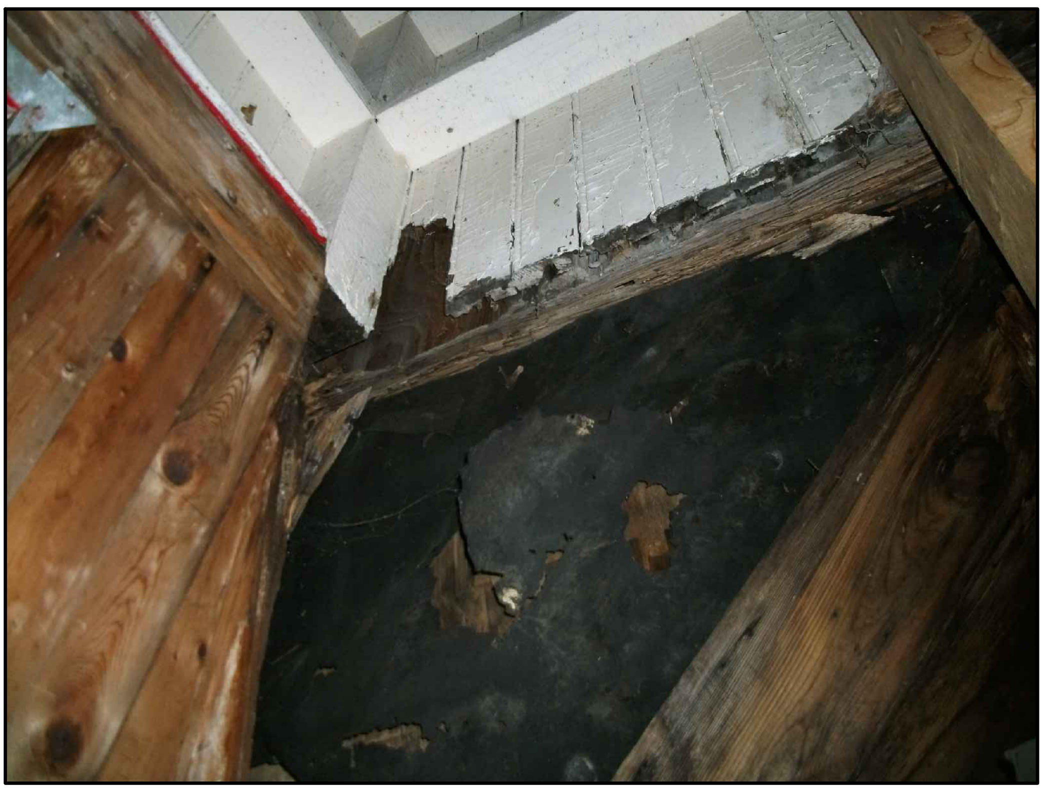
Photograph 14: White caulking (non-ACM) on 1st and 2nd floor windows of Old Light Tower.



Photograph 15: Black insulating paper (non-ACM) visible on 3rd floor of Old Light Tower between layers of wood.

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PROJECT No. 623376

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Photograph 16: White plaster (non-ACM) on concrete base of New Light Tower.

Photograph 17: Limited soil accumulation and vegetation in cracks between bedrock (looking northwest).

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Photograph 18: Limited soil accumulation and vegetation in cracks between bedrock (looking southwest).

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Photograph 19: Greater soil accumulation in vicinity of trees south and east of Old Light Tower (looking north).

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Photograph 20: Suspected mould (white) on wood at southeast interior corner of old tower.

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PROJECT No. 623376

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APPENDIX A

List of Relevant Codes, Guidelines and Regulations

Federal

Canada Labour Code (R.S.C. 1985, c. L-2) (Part I – Interpretation, and Part II – Occupational Health and Safety):

- Canada Occupational Safety and Health Regulations (SOR/86-304, last amended by SOR/2009-147):
  Part I – Interpretation; and
  Part X - Hazardous Substances.

Hazardous Products Act:

- Asbestos Products Regulations (SOR/207-260, last amended by SOR/2011-23
- Controlled Products Regulations (SOR/88-66, last amended by SOR/2010-38); and,
- Surface Coating Materials Regulation (SOR/2005-109, last amended by SOR/2007-230).

Provincial

Occupational Health and Safety Act (R.S.O. 1990, c. O.1):

- Construction Projects (O. Reg. 213/91, last amended by O. Reg. 443/09);
- Designated Substances – (O. Reg. 490/09);
- Asbestos on Construction Projects and in Buildings and Repair Operations (O. Reg. 278/05, last amended by O. Reg. 493/09);
- Workplace hazardous materials information system (WHMIS) (R.R.O. 1990, Reg. 860, last amended by O.Reg. 36/93).

Ministry of Labour (MOL), Occupational Health and Safety Branch, 1985. "Code for the Determination of Asbestos from Bulk Insulation Samples". August 23, 1985.

MOL, Occupational Health and Safety Branch, Health and Safety Guidelines, 2004:

- "Guideline, Lead on Construction Projects", September 2004, revised April 2011.

National Institute for Occupational Safety and Health (NIOSH), 2003. "Manual of Analytical Method 7300, Elements by ICP, Issue 3". March 15, 2003.

Other

NIOSH, 1994. "Manual of Analytical Method 9002, Asbestos (bulk) by PLM, Issue 2". August 15, 1994.

United States Environmental Protection Agency (EPA), 1993. "Methods for the Determination of Asbestos in Bulk Building Materials, EPA Report No. 600/R-93/116". July 1993.

Canadian Construction Association, Standard Construction Document CCA 82 - 2004, "Mould Guidelines for the Canadian Construction Industry", 2004.

APPENDIX B

Structural Conditions Assessment Report

SNC-Lavalin Inc.
Structural Condition Evaluation of Light Towers at Stokes Bay Front Range, Knife Island, Lake Huron ON

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Collingwood ON L9Y 4J6 CANADA

December 2014
300036336.0000

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Record of Revisions

Revision	Date	Description
0	November 21, 2014	Initial Submission to SNC-Lavalin Inc.
1	December 2014	Final Submission to SNC-Lavalin Inc.

R.J. Burnside & Associates Limited

LICENSED PROFESSIONAL ENGINEER
R. A. DE FARIA
DEC 16/14
PROVINCE OF ONTARIO

Report Prepared By:

Richard de Faria, P.Eng.
Senior Engineer
RdF:lm

Executive Summary

This report covers the visual structural assessment of the existing light towers at the Stokes Bay Front Range, at Knife Island in Lake Huron.

The circular steel tower built in the 1990's, is 1500 mm in diameter and 7500 mm high and is in good condition, it is operational, and our recommendation would be for repainting for maintenance purposes only.

The original 1904 vintage wood light tower structure is located just to the east side of the steel tower and is generally in fair condition. Structural repairs in the past including replacement of the ground floor structure, concrete foundation repairs and partial cladding of exterior walkways and siding, has extended the life of the structure. The overall structure does not show signs of vertical settlement and the basic structural design appears to be adequate to resist the environmental loading.

Material degradation is occurring due to freeze thaw cycling of the exposed foundation concrete and due to wood disintegration from water ingress over a long period of time.

We conclude that the structure is salvageable, but will require a considerable amount of labour to repair and maintain.

There should be a clear goal in mind before a restoration project commences so that there is direction on what aspects of the tower will be repaired to match existing conditions, or what components and features require upgrading to suit present safety or appearance standards. Access to various levels of the tower requires adding guards, not only repairing deteriorated materials.

Budget estimates for repairs will vary significantly depending on the level and quality of the building restoration. We have estimated that a basic restoration, including painting and structural repairs may be in the order of $96,000 to $102,000 depending on the selection of some optional items.

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Appendices

1.0 Introduction

1.1 Property Description

The light towers at the Stokes Bay Front Range, which are located on Knife Island in Lake Huron, are situated beside each other and consist of the original wood structure and a newer hollow circular steel tower structure. It is our understanding from information found on the Internet that there was a light tower constructed on the larger Lyal Island in 1885 to guide mariners into Stokes Bay, and the wood structure on Knife Island was added in 1904 as one of two range lights to guide boats into the bay and guide boats past Lyal Island and Mad Reef. The other original range light was located on shore 4250 ft or 1295 m from the structure on Knife Island.

In the 1990's the steel tower was erected and the light in the new tower replaced the functioning light in the original wood structure. Thus the light in the wood structure is no longer in use for guiding boats.

Both light tower structures are located very close to shore and are founded on concrete bases bearing directly on exposed rock on the island surface. There is very little surface soil directly around these structures. The wood structure has a wood framed main floor level covered with solid lumber decking, and there is likely void space below the floor and the native rock surface, however there is no hatch and that space is not accessible. There is a locked door for the entrance to each structure and there is no fence around the area to prevent visitors from reaching either light tower.

1.2 Background

SNC-Lavalin engaged R.J. Burnside & Associates Limited (Burnside) to complete an initial **visual structural assessment** of each of the two light towers. SNC-Lavalin themselves are reviewing other aspects of these facilities and the site, and this structural review forms a portion of the complete study.

It is our understanding that there is a non-profit group called Bruce Peninsula Lightkeeper's Association and their Knife Island Lighthouse Restoration Project's goal is to maintain the wood structure into the future. There is a Facebook site for this group and they are trying to raise funds for their project. This review is independent of this organization and has no vested interest with any parties related to these assets.

On October 22, 2014 Richard de Faria, P.Eng., of Burnside visited the site along with representatives from SNC-Lavalin and other subconsultants. The weather was clear and allowed for a good opportunity to see the two towers. Pictures were taken and copies of some of those photographs are included in the Appendix of this report.

1.3 Scope of Review

The purpose of this report was to identify the current state of the condition of the two towers, report any visually obvious physical material deficiencies and outline suggested repairs and possible order of magnitude repair costs.

If the site is Federally owned then the National Building Code may apply to these structures, whereas if the property is or becomes privately or provincially owned then the Ontario Building Code may be applicable.

The Ontario Building Code Act, 1992 defines a “building” in very general terms, as 1.(1)(a) a structure occupying an area greater than 10 square metres consisting of a wall, roof and floor or any of them or a structural system serving the function thereof including all plumbing, works, fixtures and service systems appurtenant thereto,…and (d) structures designated in the building code.

The wood light tower has a base area larger than 21 sq. metres.

In the 2012 Ontario Building Code (OBC) Part 1 Section 1.1.2.2 defines where Parts 3, 4, 5 and 6 apply and the light tower is not one of the designated occupancies that is applicable. Part 1 applies, but the light tower is **not** listed under Section 1.3.1.1 as a Designated Structure, which means Part 4 is not applicable either. Part 7 relates to Plumbing, which there is none. Part 8 applies to sewage systems, which there are none. Part 9 of the Building Code which covers low hazard industrial occupancies, would apply for new construction. This is also similar with the National Building Code of Canada (NBCC). However, under the Ontario Building Code (there is no Part 11 for the NBCC) this is an existing structure and only Part 11 applies to parts of the building being materially altered or repaired. Under 11.3.3.1 Basic Renovation, the structure can basically be repaired as long as the Performance Level of the structure is not decreased. So in summary, the tower does not require upgrading, except for safety requirements during construction of the repairs as per Ont. Reg. (O.Reg.) 213/91.

The National Building Code of Canada 2010 and the Ontario Fire Code Section 1.4 defines a “building”, “means any structure used or intended for supporting or sheltering any use or occupancy.” Neither tower contains heating, ventilation, plumbing or other necessities required to sustain human occupancy. The structures’ purpose is to act as a support for a guiding light beacon and human access is for maintenance purposes only. Similarly the steel tower with a base area of only 1.8 sq. m and is clearly under the 10 sq. m area for a building designation under the OBC, is not designed for human occupancy either. The island may be beyond the area in which the nearest Fire Department has a response capability. We do not believe the Fire Code would be enforced for these structures.

All of the reasonably accessible areas were reviewed during the on-site visit to the property. No destructive testing or physical sampling was completed. Attention was paid to areas exhibiting existing or potential problems. Deficient elements or problem areas observed during the inspections are discussed in this report. It should be noted that the mandate did not include a review of the Ontario Building and Fire Codes or compliance of the property to these current codes. It should also be noted that the review of any mechanical and electrical systems, and environmental issues, were excluded.

The intent of this review was to provide an overall assessment of the facilities. This report was not prepared with the intent of providing exact repair details or procedures, or as a basis for preparing restoration contract documents.

Definition of Terms: The following terms have been used to describe the building condition where applicable:

Excellent:	New or nearly new condition with no deficiencies or damages.
Good:	Satisfactory condition with no recommendations for repairs or improvements.
Fair:	Satisfactory condition with recommendations to correct minor deficiencies. Immediate attention to minor deficiencies may be required.
Poor:	Unsatisfactory condition and must be replaced or repaired in the short term.

2.0 Observations

2.1 Site Conditions

For the steel tower and the wood light tower, people can access either structure by walking up to them from any direction. There are no defined paths or walkways, ramps or stairs leading to the entrance doors. The ground surface is solid rock, with some boulders and loose stone. The walking surfaces are generally irregular and natural to the island. There is a large rectangular stone below the entrance to the light tower, which appears to be used as a stepping stone to the doorway. This stone is wobbly and not secured to the rock in any manner.

2.2 Wood Framed Light Tower

2.2.1 Exterior Building Envelope

The exterior of the light tower is constructed of four wood framed walls which slope inwards from a square base resting on a poured concrete foundation. The upper level of the structure cantilevers out on all sides of the walls and forms a walkway around the turret area where the light was contained. The bottom of the exterior wall to the underside of the upper walkway – or in other words to the soffit of the walkway is about 6430 mm. The sloping walls also include a door opening on the south side and some window openings with small roof extensions over them. These are best understood by reviewing the photographs in the Appendix.

The walls are constructed with a wood shingle, over a diagonally sheathed lumber cladding on wood framing. The soffit is also formed with a lumber siding. All the exposed wood is painted in red and white paint.

The elevated exterior walkway is covered with sheet steel nailed down to wood framing, and the joints are caulked. Windows have been covered over with wood and steel panelling.

On the south wall, the white paint is roughly 95% gone down to the shingle surface, having flaked off due to poor adhesion and age. Generally all the shingles are visually intact and one can see a few previous patch repairs. The shingles themselves are in fair to good condition and are generally not rotten.

The sill at the front door is covered with galvanized sheet metal, offering some protection against wear and the elements.

The sheet metal on the walkway is in fair to good condition, some of the joints are separating and sealant has been used to attempt to improve the performance of the membrane. The sheet metal returns over the vertical face of the walkway, but does not form, or is not bent into, a drip reveal or edge. Looking at this from ground level it appears that the wood is weathering around this leading edge and has been painted in the past. Since there is no capillary break for the water as it passes over the edge of the walkway, the water flow may return horizontally under the soffit and saturate the wood in this area leading to wood decay.

The southwest side of the light tower, adjacent to the steel tower is similarly constructed. However, from the bottom of the wall and extending upwards 900 mm, sheet steel has been nailed over the wood shingles. Some rust is evident along the top edge of the plate, and some of the nails with lead head washers are loose. There are several joints in the steel and one area has been bashed in or impacted such that the joining edges are not flush. There are a couple patches with some shingles missing on the top surface. The paint on the shingles is fair to poor – better condition than the south side.

We do not know the material condition of the shingles below the steel. However, the bottom edge of the shingles at the bottom edge of the sheet metal was saturated wet in some locations and some wood rot there is likely. It had rained the previous few days.

At the exterior edge of the upper landing some wood rot was noticed, but this area is not readily accessible from the exterior, therefore it was reviewed from ground level.

On the north side (lake side) of the structure, the sheet metal cladding over the wood shingles continued across the north face and up 900 mm from the bottom. The paint on the shingles has mostly disappeared, but the shingle material seemed to be in good condition – based on what is visible. The original window has been covered over with wood.

On the east face of the light tower, the white paint was again in poor condition. The metal band around the lower 900 mm does not extend around this side. There is a small roof over a little window and the window is in fair condition – covered in wood shingles and painted to match the walls.

There may be small gaps between shingles along the corners and edges which may allow water to penetrate beyond the exterior cladding of the structure. The exterior sheathing installed below the shingles acts as a second layer of protection against water ingress; however the lumber sheathing has gaps between the boards and is not waterproof. Water staining on the inside of the structure indicates that water has and likely continues to enter through to the interior.

2.2.2 Exterior Wall Structure

The exterior walls are framed with balloon style framing with the sloping studs made from rough sawn lumber varying from roughly 38 mm (1-1/2”) to 50 mm (2”) in thickness to 150 mm (6”) deep. Spacing varies, but typically ranges from 680 to 750 mm (27” to 30”) on centre. These walls studs slope inward with an angle of 10 to 11 degrees from true vertical. These studs likely extend down to the concrete foundation or some wood beam or sill below the structural floor level. We noticed that on the ground floor level, pressure treated 38 mm x 140 mm planed lumber studs were spliced to most of the original studs and extended 825 mm or 33" above the floor. These studs were fastened to the original studs with about five nails each. These spliced sections are relatively recent. We suspect that the wall studs below the ground floor were rotten and thus spliced with new lumber. For the remainder of the above grade walls, the wall studs are in good condition.

At each wall corner, there is a solid timber 150 mm x 150 mm (6" x 6") member which extends upwards and slopes in two directions. The last wall stud on each wall closest to this corner member extends upwards until it intersects with the corner timber and is attached to it – which is below the next floor level.

The solid 150 mm x 150 mm wood timber in the southeast corner is essentially disintegrated due to wood rot from the second level to the top. It is also rotten at mid-height between the ground and second level. Thus the corner is in very poor material condition and we suspect the exterior sheathing and some shingles attached to the corner will need replacement.

The walls are clad in a 25 x 175 mm (1" x 7") solid lumber sheathing oriented on a diagonal to the stud direction. When standing inside the light tower, it is dark and the sheathing appears tight together and in good condition in most places.

The main floor to the top of the second floor is 3230 mm (10'-7"). From the second level to the top of the third level is 3040 mm (10'), and from the third level to the top of the wall sill is 2300 mm (7'-6").

The exterior door at the main floor was opened by the local representative and is made from Hollow Structural Sections, or in abbreviated form HSS, steel tube 38 mm x 38 mm in size around the perimeter and with matching HSS horizontal pieces at 300 mm on centre vertically. It is clad with a sheet steel skin and all in good condition.

2.2.3 Floor Structure

The light tower has three floor levels. The main floor is just above the surrounding grade and is at the level of the main access door. This is a structurally framed ground floor level, and the top of this floor is above the bottom of the exterior wall as seen in the site pictures. There are a set of wood stairs that allow access to a second floor level which is 3230 mm above the ground floor, and another set of stairs from the second to third floor, which is 3040 mm above the second floor. From the third floor, one can access the exterior perimeter walkway which is supported by the same third floor joists.

The ground floor surface is solid lumber planks 38 mm x 184 mm graded lumber and they are in excellent condition. These planks are not original, the installation date is unknown. Since there is no hatch into what we anticipate as a crawl space area below the floor, we are unable to review the structural floor joists and top of the interior foundation wall. However, the ground floor was measured to be level and it did not deflect noticeably underfoot when walking around the area. The pressure treated wall stud splices which can be seen above the floor indicate that replacement or repairs to the floor joists may have been undertaken at the time that the pressure treated wall splice pieces were added. Based on the nail spacing from the planks to the joists below, the joists are at 660 mm on centre. These joists would be spanning 4600 mm maximum. If the joists were 38 mm wide x 286 mm deep No.1 or 2 grade SPF they could sustain a working vertical live load of 2.4 KPa or 50 pounds per square foot. However, the actual joist size is unknown. If the joists were supported by knee walls or beams to reduce the span below 4600 mm, the capacity would be higher for the same joist size. For reference, normal residential houses require a floor load capacity of 1.9 KPa. However, in our opinion the floor structure appears to be adequate for light loading.

At the second floor level, the solid wood decking is also in good condition, with water stains noted due to water leaks through the walls and roof. The wood joists are visible from the ground floor, and they appear to be the original rough sawn, ungraded lumber of 50 mm x 150 mm in size, at variable spacing. By approximate calculations, if the material is at least as good as a current No. 2 National Lumber Grading Association (NLGA) grade SPF joist, these sizes should also provide close to a live load capacity of 1.9 KPa.

At the third floor, the decking is fair to good, due to some water staining and some very dark areas which were difficult to properly observe, and the floor structure may be attached to some rotting wall wood near the floor edges. The floor joists are the original rough sawn lumber 50 mm x 250 mm in size, which cantilever past the exterior walls to support the exterior walkway. The bottom of these joists past the exterior walls cannot be seen as they are covered with the soffit cladding. If the walkway is leaking or was leaking in the past, some of the supporting joists could also be damaged, although no significant signs of water staining on the painted soffit were noticed. The floor joists run in an east-west direction and cantilever in those directions. The exterior walkway on the north and south sides appear to be supported on short joists spanning north-south and connected to the last perpendicular joist on the north and south sides. An edge beam may exist at the far north and south edges of the exterior walkway, running in an east and west direction, but this cannot be confirmed as the framing is enclosed. Since there is considerable wood rot at the southeast corner of the tower, we suspect that some third floor damage may be present.

The exterior walkway is clad in a sheet steel and there is caulking at the sheet edges. We did not notice any real soft spots while walking on the exterior platform, but we cannot see the material condition below the sheet steel. Previous failures in the sheet steel joints would allow water ingress into the structure. The width of this exterior walkway is 1120 mm from the outside edge to the inside face of the exterior wall, or 914 mm from the exterior edge to the outside face of the exterior wall.

The sheet steel turns down at the leading edge of the exterior walkways, but there is no return steel, reglet, or drip edge. One can observe from ground level that there is rotten wood near the edge, likely as a result of this sheet metal edge detail, as water will likely return horizontally under the soffit, prior to dripping off.

The roof of the light tower is a cottage style wood framed roof, with a round pipe vent at the centre. We could not reach the actual framing, but it looked to be in fair condition. Signs of water ingress and possible wood deterioration near the vent were present, as seen in the photographs.

2.2.4 Miscellaneous – Stairs and Guards

The interior stairs, made with lumber, appear to be in good condition, except there is a handrail on one side only and there is no pickets or mid rails. Considering this, people using the stairs could fall off one side, or fall below the rail level. At each interior floor, the stairwell is cut through a floor opening. There is no guard around the floor opening and no gate at the end of the stair. Thus someone on the floor level could fall back through the opening.

Around the perimeter of the exterior walkway there is a 38 mm diameter steel pipe top and mid rail and post system. The top rail is 914 mm (36") above the walkway level. Current Ontario Building Code requirements call for this guard to be at 1070 mm or 42" above the walkway; however the height is satisfactory under the O.Reg. 213/91 section 26.3 if the required loads can be sustained and a base kick board added. The post bases appear to be secure and fastened down solidly to the structure. A capacity analysis has not been completed, and this cannot be undertaken without knowing fastener details and the framing geometry and material condition at post locations below the sheet steel surface. Physical and documented load testing of the railing system may be another option.

No proper entrance steps at the ground floor are present, and we would consider that situation poor.

2.2.5 Foundations

The foundation wall is only visible from the exterior, below the bottom edge of the sloping walls. The foundation appears to be poured concrete, with a more recently formed concrete wall repair on the west face which partially returns around the north and south sides. This added on area of concrete has a top ledge width of 120 mm at the south end and a ledge of 70 mm at the north end. The concrete wall is cast directly on the bedrock. This added piece of foundation wall is in good material condition and when sounded with a hammer, we did not notice any signs delamination within the concrete.

At the southeast corner, there is 300 mm between the rock grade and the underside of the wood wall overhang. At the southwest corner this dimension is 320 mm, and

490 mm at the northwest and 500 mm at the northeast corner. The foundation width on the south side was 4740 mm, on the west 4700 mm, 4680 mm on the north and 4600 mm on the east. We expect that the original foundation plan size was about 4600 mm (15’) square.

The foundation on the south side has some cracks in it, but we did not see much in the way of delamination. On the west side, there was some delaminated concrete on the original exposed foundation wall above the level of the more recent “added” concrete facing. The north foundation wall was more deteriorated with some delamination present and we would consider the wall in fair to poor condition. The east wall was fair to good condition with some cracking and a bit of previous patching near the base of the wall.

In each corner of the light tower, on the exterior face of the foundation wall there is a steel strap which appears to have two 13 mm diameter bolts connecting it to the foundation wall; on the sides with the added concrete facing to the foundation, these bolts are covered. We believe these steel straps extend up and are fastened to the solid timber sloping corner posts, and provide for “hold down” anchorage due to any lateral loading from wind and seismic forces. All the straps were intact on the wall and not severed, each having some corrosion, but not much loss in the original section area. We could not see the straps on the corner posts; they may not extend above the ground floor level and may be covered in the exterior corner cladding.

The additional concrete facing was likely undertaken to repair the original foundation wall and deteriorating concrete. The other foundation wall faces as noted above require repair, but the overall foundation does not appear to have settled or shifted. We have no knowledge if the concrete is reinforced concrete or plain concrete. There were no areas of rust staining to indicate corroding steel, other than light corrosion at the corner straps.

2.3 Steel Tower

The steel tower is located on the west side of the original wood framed light tower. It is a circular hollow steel pipe of 1525 mm diameter. It is painted in colour bands of red at the bottom, white in the middle and red again at the top. There is a beacon at the top on a small post which extends above the top flat surface. Around the top surface there is a circular steel guardrail. On the south side at the top there is a small solar panel, which charges batteries located inside the base of the tower. There is a steel access door on the east side, which is typically locked.

From the top of the foundation slab to the underside of the flat roof, we measured the height to be 7500 mm.

2.3.1 Exterior Tower Surface

The paint at low levels, within people's reach has been scratched out and scribbled on by various visitors over the years. Otherwise the paint appears to be in good condition, with no signs of peeling or blistering.

2.3.2 Interior Structure and Features

The tower is made of two main vertical steel pipe or tube sections, with a bolted splice at 3750 mm above the foundation. The bolt circle at this splice consists of 10 bolts of 19 mm or ¾" diameter, and these are in good condition. The steel tube is circumferentially welded such that there are three welded sections up to 3750 mm height, and three more sections from mid-height at the 3750 mm level to the flat roof level. We did not notice any corrosion or signs of water leakage at the welds.

At the base of the tower there is a circumferential ring of steel flat bar stock with eight anchor rods of 25 mm or 1" diameter, with double nuts, all in good condition.

A fixed access ladder made with a steel plate stringer and bar rungs extends from the base to the top of the tower. The ladder does not have a safety cage around it, but has a wire rope cable tensioned vertically at mid-width, which is to be used with a ratcheting type safety harness specially matched such that a user has to push the ratcheting device upwards as they climb. Should a person slip, the ratcheting harness connection prevents further downward movement. We did not have such a specialty harness with us, and thus only climbed a short way up the ladder to take some pictures. However, based on our observations, we did not see anything significant related to tower construction details warranting climbing the ladder full height. Anyone wishing to access the top of the tower will need specialty personal protective equipment and a full safety harness.

Two batteries were located at the base, sitting on two pieces of lumber, and are connected to the solar panel. We did not see any signs of battery leakage and did not review this equipment in any detail.

Around the base of the tower, some paint peeling and rusting of the base steel is noted and we would consider this localized area to be in fair condition.

2.3.3 Foundations

The base for the tower is a poured concrete slab placed on the rock surface. The pad is 2360 mm square and is approximately 460 mm above the base rock.

There are two grooves 75 mm wide by 13 mm deep which run in a north-south direction across the top of the slab and extend through the tower. We believe these to be drainage slots to allow any water that gets into the tower, to drain to the exterior. Inside the tower, some debris was accumulating in these slots and should be cleaned out.

The concrete was sounded with a hammer and no delaminations were noted. We do not know if the base slab is reinforced or plain concrete, and no signs of rust or steel corrosion were observed. There are no significant cracks, signs of settlement or other movement. We would consider the foundations to be in good condition.

3.0 Conclusions

O.Reg. 213/91 made under the Ontario Health and Safety Act would be applicable when major restoration or repair work is undertaken. Guards require upgrading unless other fall arrest and fall limiting measures outlined in the Act are undertaken.

Part 11 of the OBC would be applicable if the property is or becomes privately or provincially owned. The current performance level of the structures has to be maintained under basic renovations.

The steel light tower is overall in good condition and appears to be structurally performing well. Some corrosion at the base on the inside was noticed, and can be repaired by cleaning and painting.

The wood light tower structure has experienced some intervention measures since originally constructed, including foundation repairs, replacement of the main floor structure, splicing of wall studs at the base level, closure of glazing with wood and attempts at resealing joints in the exterior envelope, and partial cladding with sheet steel at walls and upper deck levels.

The wood light tower is currently stable but is in need of significant repairs in some areas, such as replacement of a main corner timber at the southeast side, sealing of the building envelope, and some concrete foundation repairs. The basic design, without numerical analysis, has stood the test of time. The main deficiencies are due to age and environmental weathering, and gaps in the maintenance regime which would have prevented or reduced the amount of material deterioration in some areas.

Some aspects of the design from a safety standpoint no longer meet today's standards such as railings, protection against falling through floor openings, potentially slippery walking surfaces, and sturdy entrance access. This report was not intended to address non-structural issues and potential change in use in terms of occupancy requirements.

The wood light tower can be repaired, although the remote location, and the amount of labour required will factor significantly in the costs. Repairs could be done in a staged manner. The proposed end use of the facility, such as whether this is to be a true historical restoration, the desire or not for public access to the ground and upper floors, and/or to improve upon the original design may all be considerations with respect to the project budget and schedules. However, the fundamental end goal should be established, which will aid in the direction of an organized building repair scheme.

Considering the above, estimates for "tower repairs" may vary significantly. Allowances for volunteer labour can also have a large impact on any proposed budgets.

4.0 Recommendations

Recommendations are made herein primarily from a structural aspect, and from a view point to a minimal level of intervention to maintain the structures, not to upgrade or change their original intended function.

4.1 Wood Light Tower

Water has to be prevented from entering the structure and causing wood decay, and main deteriorated members such as the southeast corner post need to be replaced. Repairs to the concrete foundation are also required soon so that conditions do not deteriorate further. Other repairs, such as adding glazing back into windows, and improving access, may not be as critical on the restoration schedule.

Much of the work to be done requires workers to be at heights. Fall arrest protection, guards, and proper shoring and access scaffolding are critical to site safety so the overall project should be lead by experienced contractors and all workers should be trained and have the proper safety equipment. During the repair and restoration process O.Reg. 213/91 – Construction Projects should be followed.

There are environmental considerations that also have to be incorporated in work plans. During the process of writing this report SNC-Lavalin has informed us that the existing paint contains lead, and thus containment of the old paint finish and related clean up and worker protection must be undertaken. We suggest that Ontario Ministry of Labour (MOL) "Guideline – Lead on Construction Projects", issued in April 2011 be consulted and used along with O.Reg. 213/91. We anticipate that the exterior lead paint removal can be completed in accordance with the MOL Type 1 Lead Removal Operations, especially considering the exterior open air type working environment.

Cleaning all exterior wood surfaces, scraping down to bare wood, re-priming and repainting is recommended, right after the main structural work is done. This again will require scaffolding especially for the high level soffit areas at the underside of the exterior walkway.

An alternate to repainting the exterior could be cladding over the existing shingles with a sheet steel cladding, with proper detailing of cap pieces for the sloping corners and for drip edges and flashing. The curved soffit would present a challenge. However, such a cladding system is not a historically accurate repair, and would change the appearance of the structure from a close range.

We do not recommend adding another type of paint coating over the existing paint in its present condition as the adherence of the present paint to the substrate is poor, and the coating durability and lifespan of a new coating over the existing paint would likely be very short.

In order to access the southeast corner post, we anticipate that the wall corner will have to be opened up, requiring some exterior wood shingle and localized wood lumber sheathing removal and creating holes in the corner of the ground floor so that the solid timber can be replaced from where it bears on the foundation wall up to the top of the structure. It appears that the steel exterior tie down strap connects to this corner timber. It is possible that the existing strap may still be intact and can be reconnected, otherwise a new similar strap will have to be fabricated - it should be hot dipped galvanized material if it is replaced. We suggest that the corner timber be supplied in shorter sections and possibly as an alternate, made from built up 38 mm thick members – if historical accuracy of construction details is not a concern. Such sections will have to be spliced together likely using steel straps and hardware such that they can sustain tension loading equal to or greater than the capacity of the steel foundation strap. Making such members equal in length to the height between floor levels may make construction more practical. Once the timbers have been replaced, localized sheathing and roofing repairs can be made.

Removal of the sheet steel cladding on the elevated walkway will allow a review of the structure below it, and replacement of deteriorated members. It is unknown how many members will need to be repaired, but we suspect all edge members around the exterior platform as a minimum will need to be replaced. This would be a similar recommendation for the top roof at the former beacon location.

If a sheet steel roofing product is used to replace the existing at the upper walkway, it must be properly detailed, with flashing that extends up the wall, and with detailing to provide a proper edge reglet or drip edge. Caulking should not be the primary method of sealing any joint. An alternate system may be an exterior adhered membrane, such as those used for pedestrian areas on residential or commercial decks.

If the steel roofing around the walkway is being removed, this will necessitate lifting or possibly complete removal of the perimeter guard rail. It may or may not be possible to disassemble the railing due to the amount of paint on the original fasteners. A choice may need to be made to reinstate the railing as is, or upgrade the railing to one that can sustain building code loads and that will be 1070 mm high and with a base level kick plate. Alternately some other fall arrest anchor point or system could be designed, such that the guard system is not relied upon to resist loads. However, such anchor points require engineering and detailing as the design loads are quite high.

We would recommend removal of the sheet steel covering some of the lower walls and repairing the shingles and sheathing as required below it. It is not known if the sheet steel was added on the north and west sides to protect the tower from shore ice impact from the lake side. The new steel tower on the west side may now offer some protection to the west side of the wood structure. If there is a desire to replace the galvanized sheet steel to the extent and elevation that it is presently installed at, it should be done with perhaps a proper cladding product with lapped joints and detailed so that the shingles lap over the top edge of the sheet steel. This will help prevent water from getting behind the steel, saturating the wood, and extending the time it takes for the wood to dry out.

When cladding is being repaired, foundation repairs should also be undertaken. This will require removing delaminated and deteriorated concrete and at least applying a proper cementitious based repair mortar, or forming up and pouring a cap or facing to the deteriorated wall surfaces. The wood cladding can then be adjusted to ensure there is a drip edge so water does not run behind the concrete repairs.

A proper and secure step at the front entrance is required. A ramp with a 1:12 slope, preferably poured concrete, up to the door sill level would be one option. A simpler option is either a couple of wood steps, or some formed concrete steps. The construction must ensure that the ramp or step allows water to run off the south wall and not be trapped between the wall and the exterior entrance construction.

All hatches, doors and windows should have weather stripping and be sealed to prevent water from penetrating. This should even be completed to temporary closures, if budgeting does not permit replacement of windows, etc. with their final units.

Cost considerations and recommendations related to environmental issues, as well as docking access and providing construction paths to the light tower are beyond the scope of this report, but must be considered in the overall schemes.

4.2 Steel Tower

The steel tower is in good condition. We would recommend repairing the localized corrosion around the tower base on the inside, cleaning up the base slab inside the tower so water can drain out and adding some form of battery containment so that any spillage does not leak out of the tower or over the steel base.

To protect the steel, and due to the level of graffiti at the base section, painting of the tower should be considered. The lead paint issues as noted above in the wood tower section apply, however we anticipate the level of scraping or sanding of existing paint would be nominal in comparison to the wood tower. The Government of Canada, Fisheries and Oceans Canada (DFO) who we understand presently own the facilities, may have a maintenance schedule for periodic repainting.

4.3 Opinion on Potential Repair Costs

There will be a significant variation in any cost estimates for the original wood light tower repair, depending on the schedule, the extent of the repair required, and to suit the final purpose of the light tower. Also due to the remote nature of the site and lack of docking facilities, mobilization and transportation of materials will be more costly than any work done on the mainland.

For the steel tower which is still operating as a navigational beacon, the suggested maintenance is mainly repainting. We trust these budgets are already established by the DFO.

We have added a few categories in the table below to give the reader an idea of possible budget amounts.

No allowance is made for design, engineering, cadd work and other consulting.

Figures do not include taxes.

Table 1: Cost Estimate

Wood Light Tower Repair Item	**Estimated Cost**
Option - Four replacement wood framed windows, to match original sizes	$2,500
Option - New high level galvanized steel pipe guardrail	$3,000
General removal of debris – disposal costs – no environmental surcharge	$250
Hand scrape off old paint and prep for painting	$3,000
Paint exterior wood surfaces, weather stripping and sealing	$2,700
Interior wood railings and guards to stairs and floor openings	$1,000
Front entrance formed and poured concrete steps	$1,000
Concrete foundation repairs	$2,500
Remove steel around low walls, wood and shingle repairs, new sheet steel on north side only	$3,000
Remove high level roof sheet steel, wood repairs and new roofing	$2,000
Remove sheet metal at upper walkway, repair deteriorated wood framing below, new sheet metal and flashing, reinstall existing guardrail with new anchors	$9,000
Rebuild corner southeast post full height	$5,000
General Superintendent for 44 days	$19,000
Construction and renting of scaffolding, preparing a crushed stone base for set up and labour to move scaffolding a couple times	$13,000
Water transportation of goods - allowance	$4,000
Permits	$1,500
General contingency and miscellaneous allowance	$13,000
General Contractor overhead and profit	$16,000
Total Estimate, including options – excluding taxes	**$101,450**

Notes:

These cost figures are based on normal trade rates based on Means Cost Estimating. They are not adjusted for overtime, or special costs for travel or accommodations. The water transportation is an estimate to transport materials back and forth at a rough estimate of $500 per day for 8 days total. Travel for daily access by the trades would be additional and may be on individual pleasure boats, etc.

It is assumed that materials would be delivered to the marina and would be included in normal product costs.

Quantities are very approximate, based on rough field measurements and ideas about general replacement areas.

Some options are indicated. Volunteer labour is not factored in to the above figures and would significantly reduce costs. If the Site Superintendent is also working on the repairs, this may also be a cost reduction.

No allowance is made for engineering and design. Permits may or may not be required.

Appendix A
Statement of Limitations

1.0 Statement of Limitations

This report is intended for SNC-Lavalin Inc. and the Government of Canada, Fisheries and Oceans Canada (DFO). The material in it reflects our best judgment in light of the information reviewed by R.J. Burnside & Associates Limited (Consultant) at the time of preparation, as well as the specific scope of our assignment. Unless otherwise agreed in writing by the Consultant, it shall not be used to express or imply warranty as to the fitness of the property, or infrastructure, OR for a particular purpose. This report is not a certification of compliance with past or present regulations. No portion of this report may be used as a separate entity, it is written to be read in its entirety. **Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the sole responsibility of such third parties.**

This assessment does not wholly eliminate uncertainty regarding the potential for existing or future costs, hazards or losses in connection with a property or infrastructure. No physical or destructive testing and no design calculations have been performed unless specifically recorded and documented. Conditions existing, but not recorded or documented, were not apparent given the level of study undertaken. The Consultant can perform further investigation on items of concern if so required.

Only the specific information and project area identified has been reviewed by the Consultant. The Consultant is not obligated to identify mistakes or inadequacies in the information obtained from any source or to verify the accuracy of the information provided. The Consultant may use such specific information obtained in performing its services and is entitled to rely upon the accuracy and completeness thereof.

Responsibility for detection of or advice about pollutants, contaminants or hazardous materials is not included in our mandate, unless explicitly specified. In the event the Consultant or any other party encounters any hazardous or toxic materials, or should it become known to the Consultant that such materials may be present on or about the job site or any adjacent areas that may affect the performance of the Consultant's services, the Consultant may, at its option and without liability for consequential or any other damages, suspend performance of its services under this Agreement until the Client takes the appropriate action to identify and abate or remove the hazardous or toxic materials and warrants that the job site is in full compliance with all applicable laws and regulations.

Budget figures are the opinion of the Consultant of a probable current dollar value of the work and are provided for approximate budgeting purposes only. Figures that are more accurate can only be obtained by establishing a scope of work and receiving written financial estimates from suitable contractors and/or specialty consultants.

Any time frame given for scheduling work, maintenance or repairs is estimation by the Consultant based on apparent conditions existing at the time of our report. The actual service life of the item, or the optimum repair/replacement process, may vary from the estimate.

The Consultant accepts no responsibility for any decisions made, or actions taken, as a result of this report unless we are specifically advised of, and participate in such action, in which case our responsibility will be as agreed to at that time. Consultant liability is outlined in our Standard Conditions of Service as presented at the commencement of this project.

BURNSIDE

Appendix B
Photographs

Photo 1: View looking in a north direction.

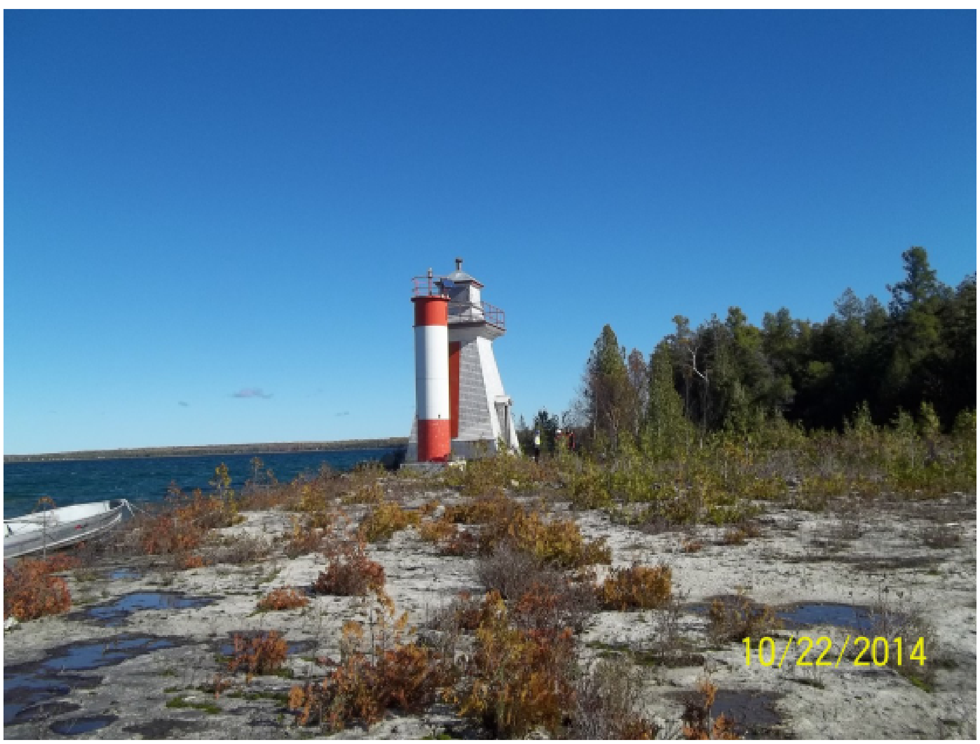

Photo 2: View looking towards the east.

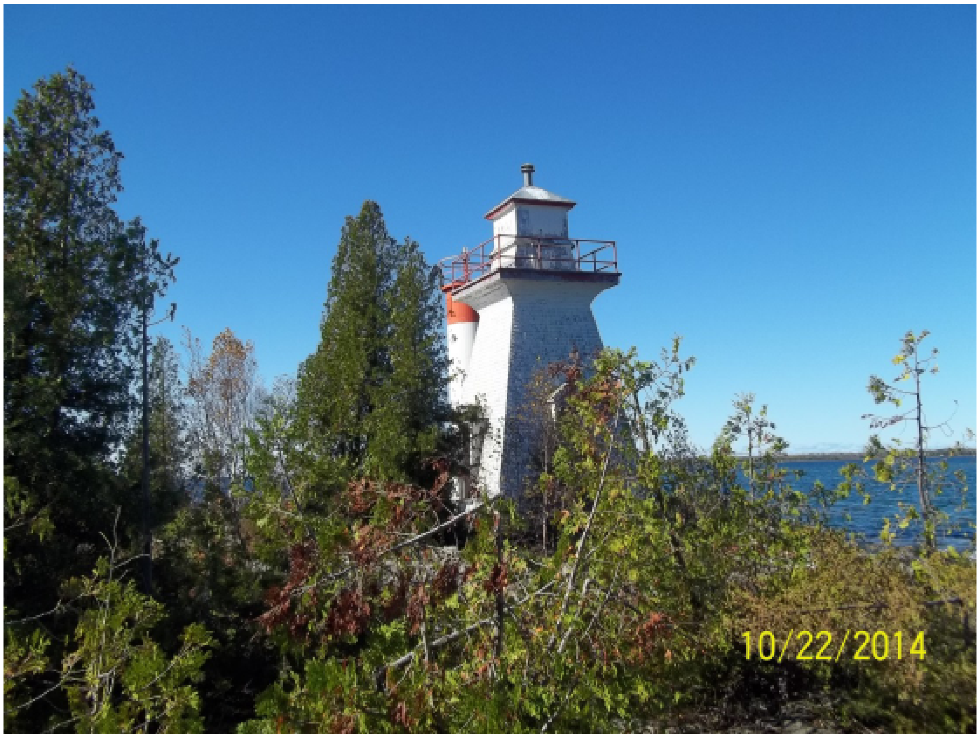

Photo 3: View looking towards the northwest.

Photo 4: View looking towards the north-northwest.

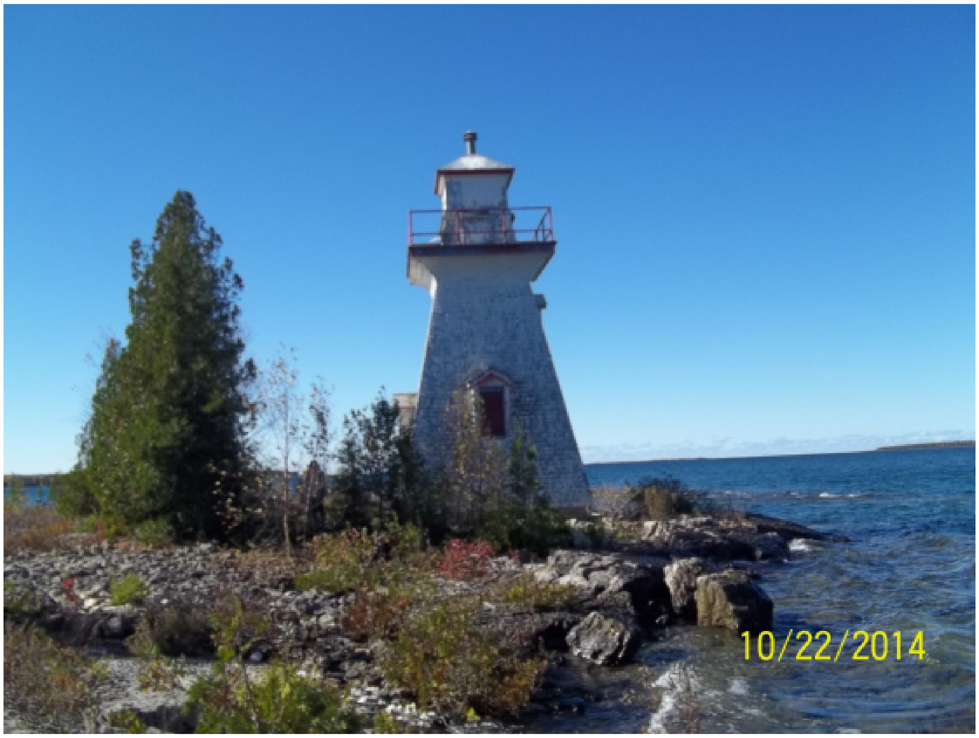

Photo 5: View of lighthouse looking west.

Photo 6: Entrance area of lighthouse, with stepping stone at front entrance.

Photo 7: West side of entrance with sheet steel siding, notice impacted area, and rusting along top edge. Repainted/replaced wood shingles.

Photo 8: Lighthouse southwest corner of foundation, with steel anchorage in foreground and deteriorated concrete foundation wall, with secondary pour on outside showing top ledge. Steel sheet covering wood shake cladding.

Photo 9: Deteriorating foundation wall at southwest corner.

Photo 10: Steel foundation strap at northeast corner.

Photo 11: View of north face of foundation wall.

Photo 12: View from the southwest looking at the top of the lighthouse.

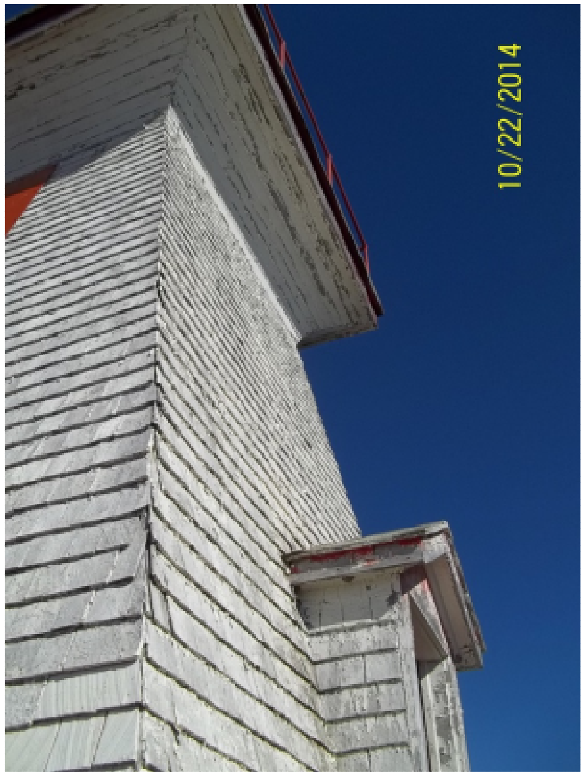

Photo 13: East elevation of lighthouse exterior wall, generally poor paint condition.

Photo 14: Northeast elevation of lighthouse, poor paint condition.

Photo 15: Looking up at underside of lighthouse soffit, decayed wood along edge, under metal roofing.

Photo 16: Some missing wood shingles on sloping wall.

Photo 17: View from upper exterior walkway looking back to hatch door on east side. Door closes but does not seal off opening fully.

Photo 18: View looking east at top walkway. Note lapped and sealed sheet metal roofing joints.

Photo 19: Walkway - view looking north.

Photo 20: Upper level of lighthouse with exposed wood sheathing covering openings.

Photo 21: View northwest from exterior walkway; guard rail height below current heights, sheet steel roofing on walkway, caulked joints.

Photo 22: North wall face at level above exterior walkway, paint in poor condition.

Photo 23: Interior east side with stairs to second level. Note the pressure treated spliced studs with the original studs at the ground floor.

Photo 24: View of interior wall framing at ground level, with base floor in very good condition and pressure treated spliced studs along wall.

Photo 25: Side wall wood stud framing where the studs meet the ground floor. Note the wood rot at and below the floor level.

Photo 26: Southeast corner post rotting at about mid-height.

Photo 27: View of underside of second floor framing, material in good condition but showing water stains.

Photo 28: View of southeast corner post which is rotting.

Photo 29: Second floor with access opening. Note the buckets and plastic used to contain water leaks.

Photo 30: Original window frame viewed from inside, clad over with plywood panel.

Photo 31: Dry rot around the corner post spreading onto diagonal lumber sheathing.

Photo 32: Southeast corner post – disintegrating.

Photo 33: Hatch at upper level looking at base of south wall.

Photo 34: High level southeast corner, some exterior sheathing missing or rotten. Back side of exterior black building paper evident.

Photo 35: Upper level, missing exterior sheathing due to wood rot.

Photo 36: View looking inside at upper level of lighthouse.

Photo 37: Interior view of side wall access door which goes from the high level floor out to the exterior perimeter walkway.

Photo 38: Interior view of the peak of the lighthouse.

Photo 39: Sheet metal roof over the highest part of the lighthouse roof.

Photo 40: Base of steel tower.

Photo 41: View from south looking at the top of the tower and lighthouse.

Photo 42: Top of steel tower showing solar panel on south side.

Photo 43: View from inside looking to the top of the steel tower. Bolted splice connection and ladder with cable for fall arrest device also shown.

Photo 44: Base of steel tower with storage batteries for solar system. Note drainage channel in concrete base (circled 1 of 2).

APPENDIX C

Marine Assessment Report

Baird

oceans
engineering
lakes
design
rivers
science
watersheds
construction

Stokes Bay Front Range Remediation

Knife Island Marine Access Assessment

19 December 2014
12326.101

Stokes Bay Front Range Remediation

Knife Island Marine Access Assessment

Prepared for

SNC·LAVALIN
Environment & Water

Prepared by

Baird

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12326.101

Rev	Date	Status	Comments	Prepared	Reviewed
0	30 Nov 2014	Draft	Issued for Client Review	TRE	MOK
1	19 Dec 2014	Final	Incorporated Client Comments	TRE	MOK

TABLE OF CONTENTS

DEFINITIONS

CD	Chart Datum
CHS	Canadian Hydrographic Service
DFO	Department of Fisheries and Oceans
HH-SSRA	Human Health – Site Specific Risk Assessment
PWGSC	Public Works and Government Services Canada
m	Metre
Mob/Demob	Mobilization and demobilization
t	Metric tonne

1.0 INTRODUCTION

This report summarizes the results of a marine access assessment for the remediation of the Stokes Bay Front Range located on the most westerly of the Knife Islands within Stokes Bay on the east shore of Lake Huron. The marine access assessment was part of a larger scope of services undertaken by SNC Lavalin Inc. for Public Works and Government Services Canada (PWGSC) including a number of work items comprised of the following key tasks:

- An updated species at risk survey;
- A designated substances and hazardous materials survey;
- A structural condition evaluation;
- A Department of Fisheries and Oceans (DFO) preliminary effects assessment; and
- Development of plans and specifications for remedial work.

The emphasis of the marine access assessment was the evaluation of construction access options for the proposed remedial works required at the Stokes Bay Front Range project site, for which the preferred option is excavation and off-site disposal (Franz Environmental, 2011).

1.1 Scope of Services

The scope of work for the marine access assessment consisted of the following six tasks:

1. Review of the Human Health – Site Specific Risk Assessment (HH-SSRA) analysis and preferred option for remediation;
2. Completion of a one-day site visit (bathymetric survey not included);
3. Review of available Canadian Hydrographic Service (CHS) charts;
4. Evaluation of access options for Knife Island and recommendation of the most feasible and cost effective alternative;
5. Determination of vessel options for the remediation work; and
6. Reporting and development of conceptual level costing.

In addition to these specific tasks (defined in the PWGSC scope of work document), two extra tasks were also completed as part of the assessment, namely:

- A brief analysis as to the seasonality of favourable wind and water level conditions for marine operations; and
- Acquisition of the best available CHS digital sounding data for Stokes Bay and approaches.

1.2 Remediation Work

Based on discussions with SNC Lavalin, it is anticipated that the proposed remediation work would consist of the principal tasks as summarized in Table 1.1.

Table 1.1 Anticipated Tasks for the Proposed Front Range Remediation Work

No.	Description	Estimated Quantity	Notes/Details
1	Mobilize & demobilize construction equipment	Assume backhoe, wheel loader, and dump truck (3 pieces)	
2	Excavation of contaminated soil	200 tonnes (maximum)	Quantity potentially less
3	Remove used building material and construction debris	2 m^3 (approximately)	Includes scrap timber, sheet metal, and peeling paint
4	Off-site disposal of all material	200 tonnes (maximum)	Includes contaminated soil and used building material

With respect to mobilization of construction equipment, an initial estimate of remediation equipment operating weights is shown in Table 1.2. The purpose of the estimate is to quantify equipment weights for comparison to the total carrying capacity of the chosen access method (particularly where the disposal of soil might be combined with demobilization of construction equipment in a single trip, or where the total carrying capacity of the chosen transport method is limited).

Considering the small excavation quantity, two scenarios are presented, the first using conventional (full-size) equipment, and the second using “small-scale” equipment for unconventional transport options (Section 4.2 considers smaller “lift-in” vessels as well as construction helicopters in addition to more common tug and barge options).

Table 1.2 Weight Estimate for Representative Equipment (data taken from Caterpillar, 2010)

	Conventional/Full-size		Small-scale	
	Model	**Operating Weight (t)**	**Model**	**Operating Weight (t)**
Tracked Excavator	320D [ab]	20	303.5	4
Wheel Loader	914G	7.5	246C [c]	3.5
Dump Truck	725	22.5	Pickup truck Dump trailer	3.5 [d] 2 [e]
Total (estimated)		50		13

[a] Conservative estimate using excavator weight; 450E backhoe-loader is approximately 50 percent lighter (11 tonnes).
[b] Weight of wheeled excavator similar to tracked excavator (e.g. M318D weight is also 20 tonnes).
[c] Skid steer in lieu of wheel loader.
[d] e.g. Ford F350 Super Duty dual rear wheel with up to 19,000 lb towing capacity.
[e] e.g. 6.5 tonne cargo capacity, 8.5 tonne gross weight.

Table 1.2 suggests that approximately 50 tonnes of equipment might be transported to the project site in a conventional operation (the largest individual piece might weigh approximately 20 tonnes). For a small-scale unconventional operation, it is envisioned that individual pieces of equipment would be transported separately, in multiple trips.

Note that Table 1.2 assumes specific equipment from a particular manufacturer. Construction contractors would almost certainly use different makes and models than those shown in this preliminary assessment. Nevertheless, the weight estimate is assumed to be representative, and is appropriate for initial planning.

2.0 SITE VISIT

A site visit was completed with SNC Lavalin and R.J. Burnside staff on 22 October, 2014.

Access to Knife Island was by shallow draft, flat bottom boat leaving from the boat launch at Stokes Bay Camp and Marina (see Figure 2.1). Photographs and visual observations were taken to document the site conditions. In general, Knife Island is characterized as rocky and undeveloped, with shallow water depths surrounding much of the shore. A photograph of the Front Range work area and adjacent shoreline is shown in Figure 2.2.

Figure 2.1 Stokes Bay Camp & Marina Dock

Figure 2.2 Front Range and Small Boat Mooring

GPS waypoints were also collected at various locations around the island to document the water's edge on the day of the site visit, and to record candidate mooring locations for construction access. The waypoints and field notes are shown overlaid on a satellite image of the island in Figure 2.3.

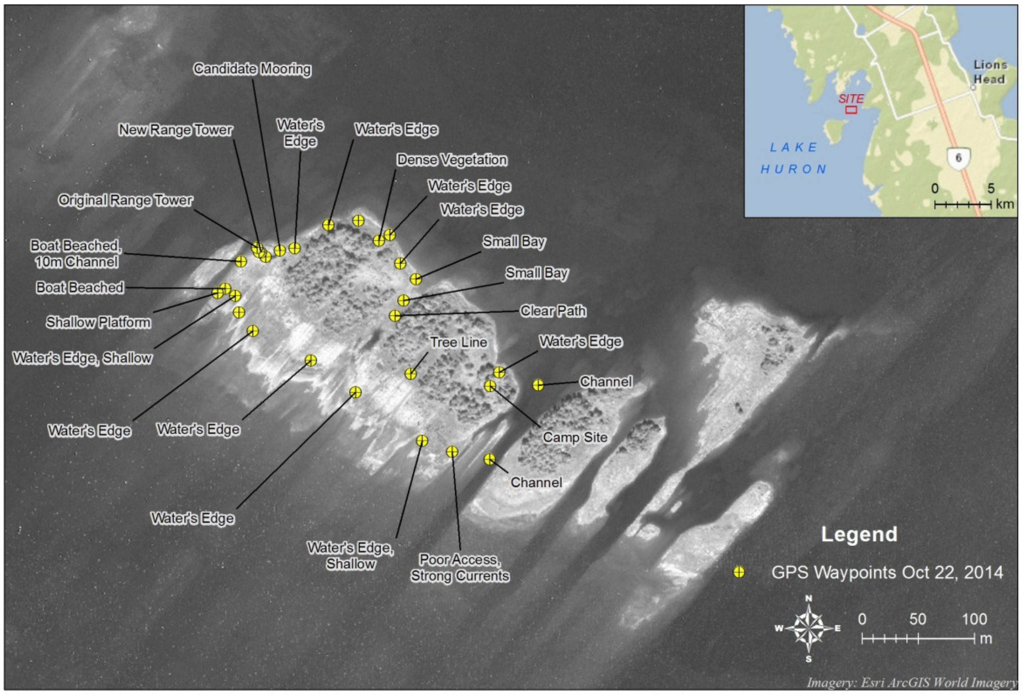

Figure 2.3 Site Visit Waypoints and Field Notes

A possible mooring location was identified at the northwest side of Knife Island – preferred for its close proximity to the Front Range work area and slightly deeper water depths than other locations around the island. A photograph of the preferred mooring location is shown in Figure 2.4.

Figure 2.4 Proposed Access Location (view looking west)

3.0 SITE CONDITIONS

A brief investigation of the site conditions is presented in the sections that follow. In particular, the seasonality of favourable water levels and wind conditions are discussed.

An analysis of wave conditions and ice coverage is beyond the scope of the present work.

3.1 Water Levels

Historic water levels from the latest CHS monthly bulletin are shown below in Figure 3.1. Note that water levels are typically higher in summer months than in winter months. In particular, lake levels in July are, on average, approximately 0.6 m above Chart Datum (CD, a low water datum used on all CHS navigation charts).

If marine access is used, it is recommended that the proposed remediation work be planned to start in July (if possible), in order to benefit from anticipated higher lake levels (and so greater water depths for marine access).

In Figure 3.1, CHS also include a forecast for the probable range of future levels for 2015. It can be seen that the prediction for 2015 is that lake levels are expected to be above the historical average, which is also favourable.

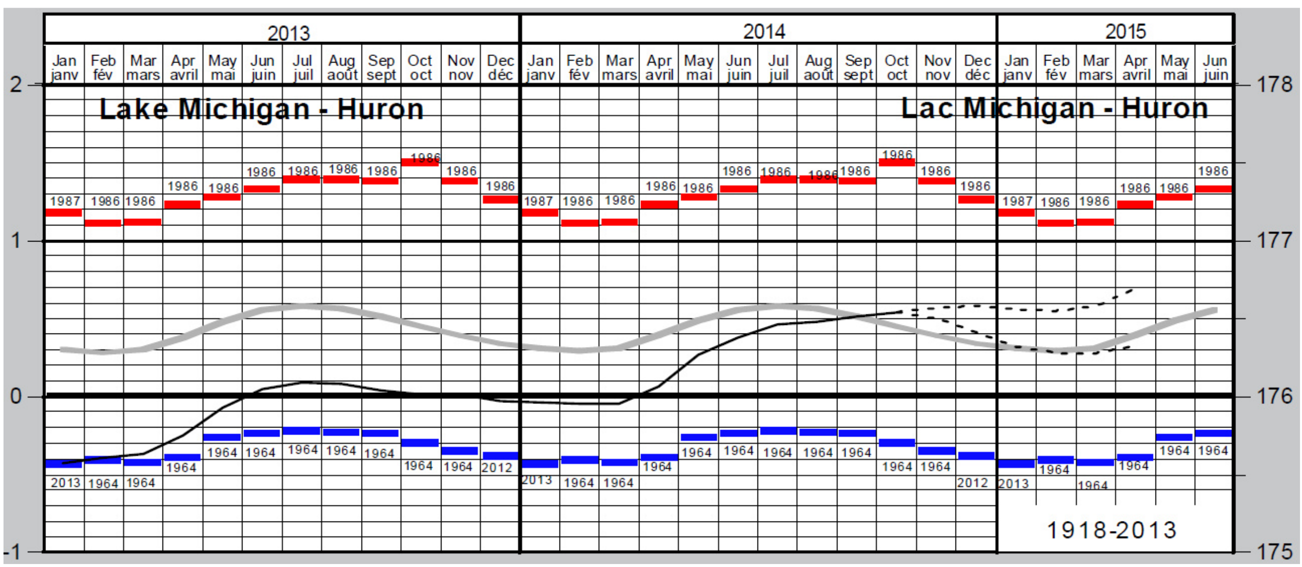

Figure 3.1 CHS Water Level Advisory for October 2014, Water Levels in Metres (Left axis relative to Chart Datum, right axis relative to IGLD85)

3.2 Wind

Wind statistics for Wiarton Airport are shown Figure 3.2 (based on Environment Canada's Climate Normals for the period 1981 to 2010). As was observed for water levels (and as might be expected), there is a seasonality to wind speeds in which lower average speeds occur in summer months and higher average speeds occur in winter months. Maximum wind speeds follow a similar trend (although there is more variability in the recorded extremes than in the mean values).

Note that strong winds can affect vessel mooring loads, and create waves and water level seiches within Stokes Bay. As such, the occurrence of lower wind speeds in summer months reinforces the previous recommendation that the proposed remediation work be planned to start in July, if possible. The work may be done at any other time during the open water season, although early season and late season storms increase the probability for weather induced downtime. Quantification of weather delays and downtime is beyond the scope of the present work.

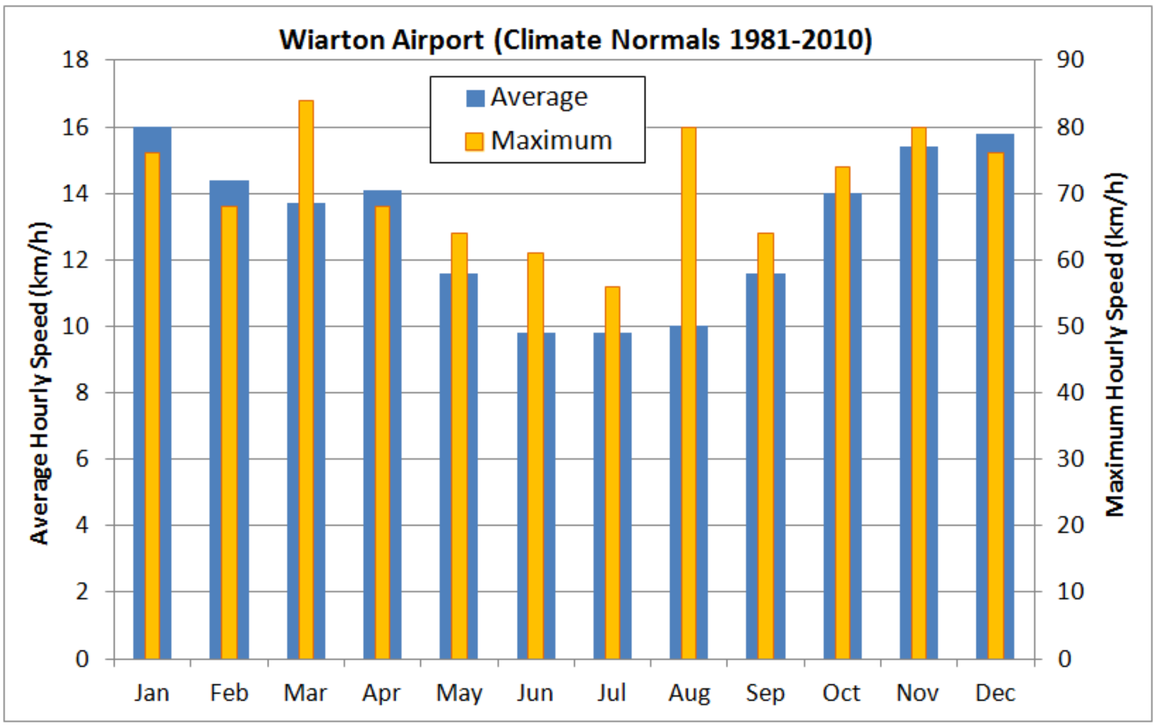

Figure 3.2 Monthly Variation in Wind Speed at Wiarton Airport

4.0 ACCESS OPTIONS

4.1 General

There are no roads connecting Knife Island to the mainland and as such, access to the work area is either by water or air. The Front Range is located approximately 1 km from Shute Point (at the western tip of Black Creek Provincial Park), and approximately 4 km from the community of Stokes Bay which is located at the extreme north end of the Bay. Stokes Bay is relatively shallow; with a number of reefs, shoals and submerged rocks as shown on CHS Chart 2292 (see Figure 4.1).

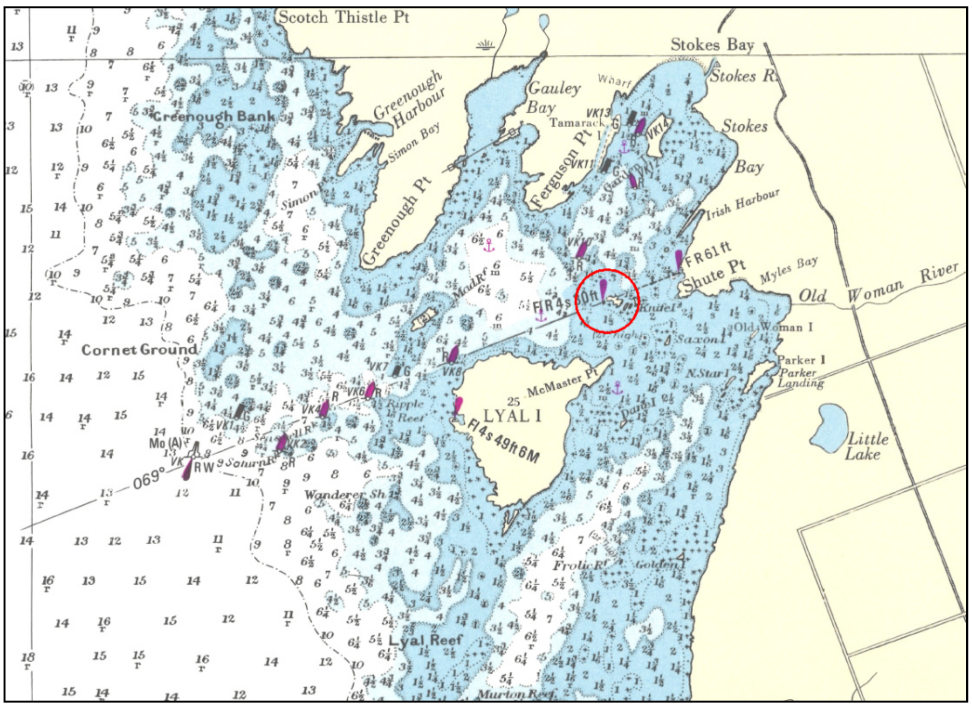

Figure 4.1 Navigation Chart for Stokes Bay
(Portion of CHS Chart 2292, soundings in fathoms, 1 fathom = 1.83 m)

4.2 Equipment Options

Access options were developed using four different types of equipment for three different access methods, namely:

- **Marine access** – float-in of either a tug and deck barge, or alternatively a smaller self-propelled landing craft trucked to site (assuming local contractors within a range of a few hundred kilometers; e.g. Southampton, Meaford, etc.);
- **Air access** – using a heavy-lift construction helicopter (as was used in 2009 for relocation of the Stokes Bay rear range); and
- **Ice access** – using conventional trucking and lowboy-trailers for equipment transport.

The ice access option was considered to be unfeasible due to schedule constraints imposed by the short and unpredictable ice season, probable snow cover of the material to be excavated, and potential safety hazards associated with the uncertainty and variability of ice characteristics where a strong and continuous ice thickness is required to support construction equipment.

Specific details for the remaining three options are summarized in Table 4.1 according to the following main headings:

- Access approach and specific mobilization/demobilization method;
- Typical equipment particulars and payload capacity;
- Number of round trips required to transport 200 tonnes of contaminated material off the island (i.e. off-site disposal of contaminated soil);
- Additional notes are provided as to specific benefits and challenges of each option.

Conceptual cost estimates for the three options are presented in Section 5.0.

Table 4.1 Summary of Equipment Options
(dimensions and capacities are representative and approximate)

	Marine		Air
Equipment	Tug and Barge 	Landing Craft 	Construction Helicopter 
Typical Particulars	20 m length 8 m breadth 2.4 m depth	11 m length 3.7 m breadth 1.8 m depth	Airbus Super Puma AS332 L1
Typical Capacity	285 t at 2.2 m full load draft 230 t at 1.8 m part load draft	8.5 t including dump trailer (0.9 m full load draft) 6.5 t material capacity	4 t including trailer and tether (full fuel) 3 t material capacity
Round Trips (for 200 t)	1	31	67
Mob Demob	Float-in through Stokes Bay Entrance Channel	Truck to site and lift-in with crane (e.g. at DFO wharf) [a]	Canadian operator (sourced from Ohio) Lifts delivered to nearby staging area
Notes	• Tug draft similar (1.8 m) • Roll-off equipment using bow/stern ramps • Spud pile mooring • Reserve capacity for construction equipment • Temporary causeway to shore recommended	• Truckable • Lift-in/lift-out crane required • Limited to small equipment • Roll-on/roll-off dump trailer and equipment at bow gate • Lift-on/lift-off dump trailer at DFO wharf	• 4 t lift less suited to large quantities • Limited to small equipment • Limited number of operators

[a] DFO public wharf capacity would have to be determined.

4.3 Marine Access

Marine access options from the mainland to Knife Island include three principal locations as shown in Figure 4.2 and described below.

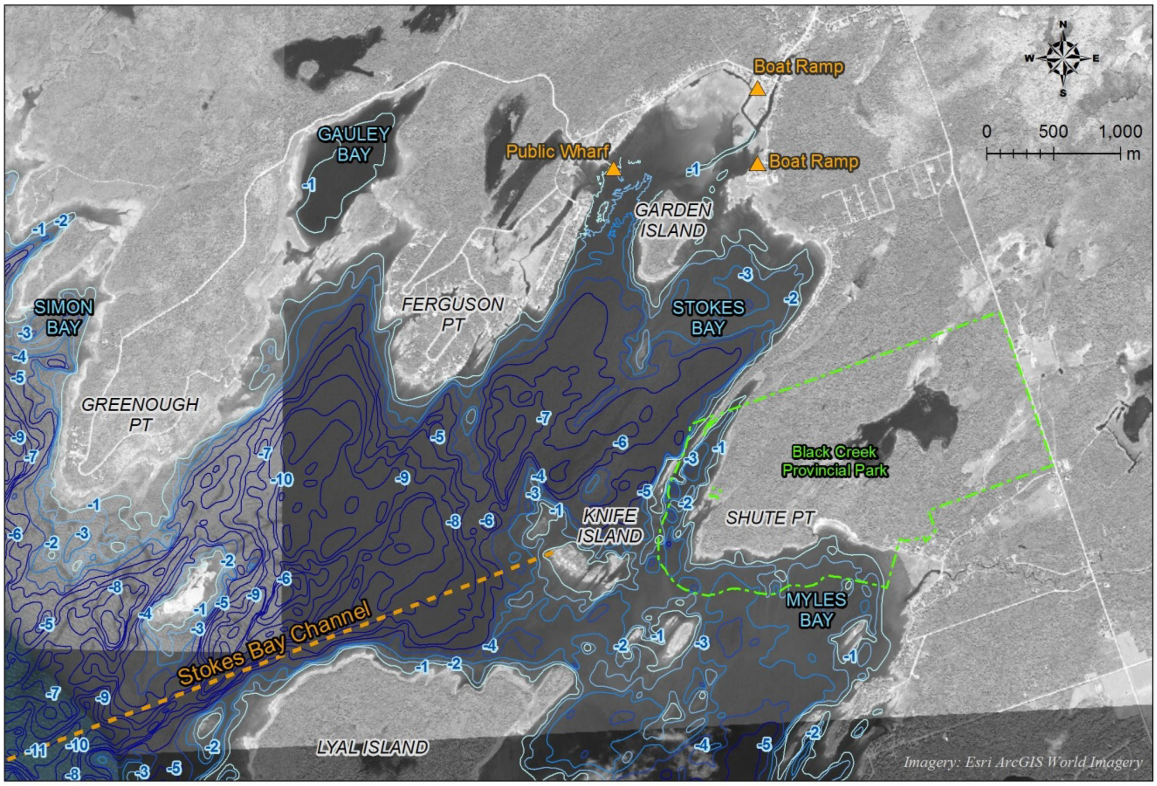

Figure 4.2 Access Options (depth contours in metres, relative to Chart Datum)

4.3.1 Description of Marine Access Options

The three principal options for marine access from the mainland to Knife Island are described as follows:

1. Stokes Bay Entrance Channel (see Figure 4.1 and Figure 4.2)
   - Entered between Lyal Island and Greenough Point
   - Marked by the Stokes Bay Entrance Channel light buoy and additional lateral marks
   - Depths of 4.9 m CD are reported north of Ripple Reef en route to anchorages west of Knife Island (CHS, 2000)
2. Existing Boat Ramps
   - A pair of small craft boat ramps are located north of Garden Island near the town of Stokes Bay
   - Water depths are reported to be approximately 1.5 m CD

3. DFO Public Wharf (see Figure 4.3)
   - Located on the north shore behind Garden Island, accessed from Tamarac Road
   - Channel depths reported to be 2.1 m to 2.7 m CD and marked by buoys (CHS, 2000)
   - Wharf reported to be 47 m long and 7.3 m wide with an elevation of 1.5 m CD
   - Reported water depths of 1.5 m to 2.1 m around the outer part of the wharf, 1.2 m to 1.8 m CD along the southwest face (CHS, 2000)
   - DFO was contacted as to the possibility for equipment access, but at the time of writing, inquiries were ongoing and the load capacity as of yet undetermined.

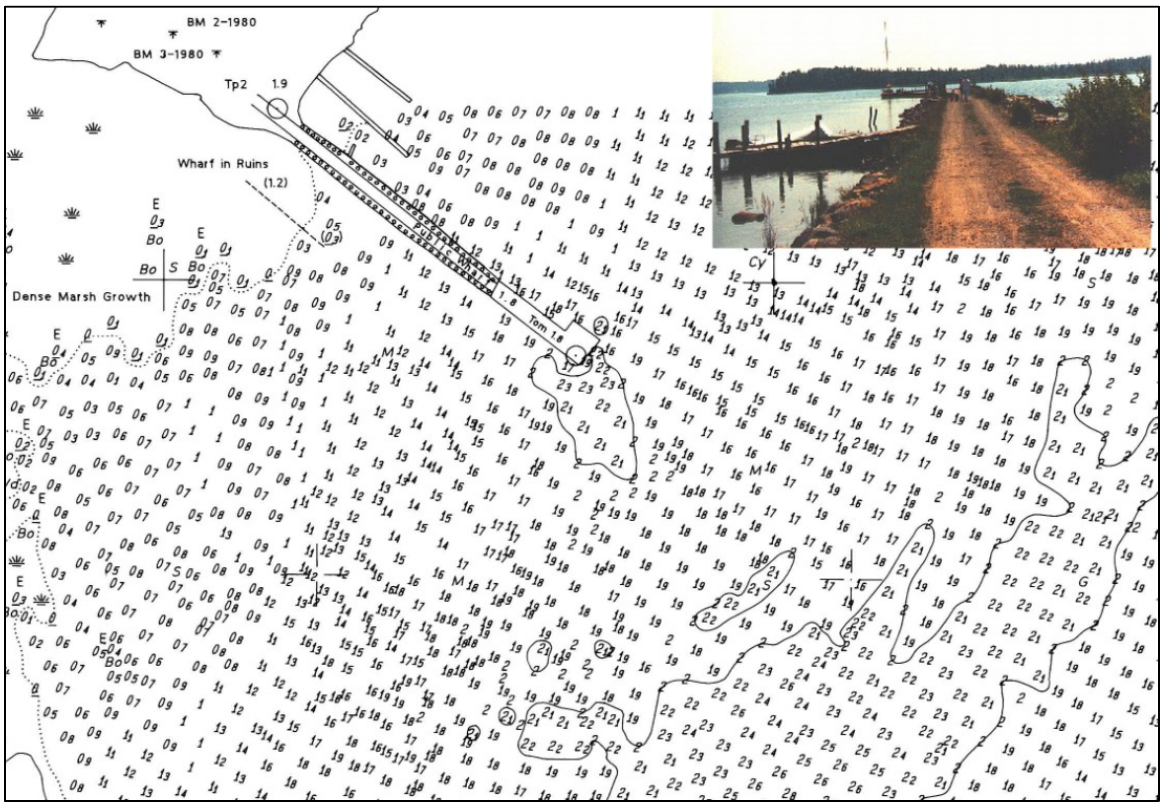

Figure 4.3 DFO Public Wharf – CHS Field Sheet 1200051 (Not for Navigation)
[Product produced by Baird based on CHS data pursuant to CHS Direct User License No. 2014-1105-1260-B]

Of the three options identified, marine access to Knife Island from Lake Huron using the marked Stokes Bay Entrance Channel is the simplest for conventional construction equipment. It was shown previously in the analysis of equipment options (Table 4.1) that using a conventional deck barge for transporting equipment and material is well matched to the excavation quantities and the weight of these vessels is such that float-in (rather than lift-in) is normal practice. Moreover, barges are more common with local construction contractors in the region, whereas landing craft are specialty items operated by either a select few or by larger operations which are generally located farther from the project site (and therefore incur potentially greater mobilization and demobilization costs than local operators).

A review of available sounding data for Knife Island is presented below in order to identify a preferred approach to the Front Range work area and define limiting drafts for construction vessels.

4.3.2 Available Sounding Data

Existing soundings surrounding Knife Island are presented in Figure 4.4 (taken from CHS field sheet 1200029, from echo sounder surveys conducted between 1991 and 1992).

Based on the available data, the recorded water depth at the preferred mooring location (refer to Figure 2.3 and Figure 2.4) is 1.6 m below Chart Datum, and extends to within approximately 25 to 30 m from shore. An alternate access location on the east side of the island has a similar 1.6 m recorded depth, but is farther from the Front Range and is separated from the work area by what was observed to be fairly dense vegetation.

Note that the satellite image in Figure 4.4 also shows what appears to be a series of narrow submerged channels or gouges in the lakebed along the preferred access route. It is recommended that future phases include a hydrographic survey to check for hazards along the route and confirm near shore water depths at the Front Range work area and preferred shore access location. This recommendation applies to any marine access option.

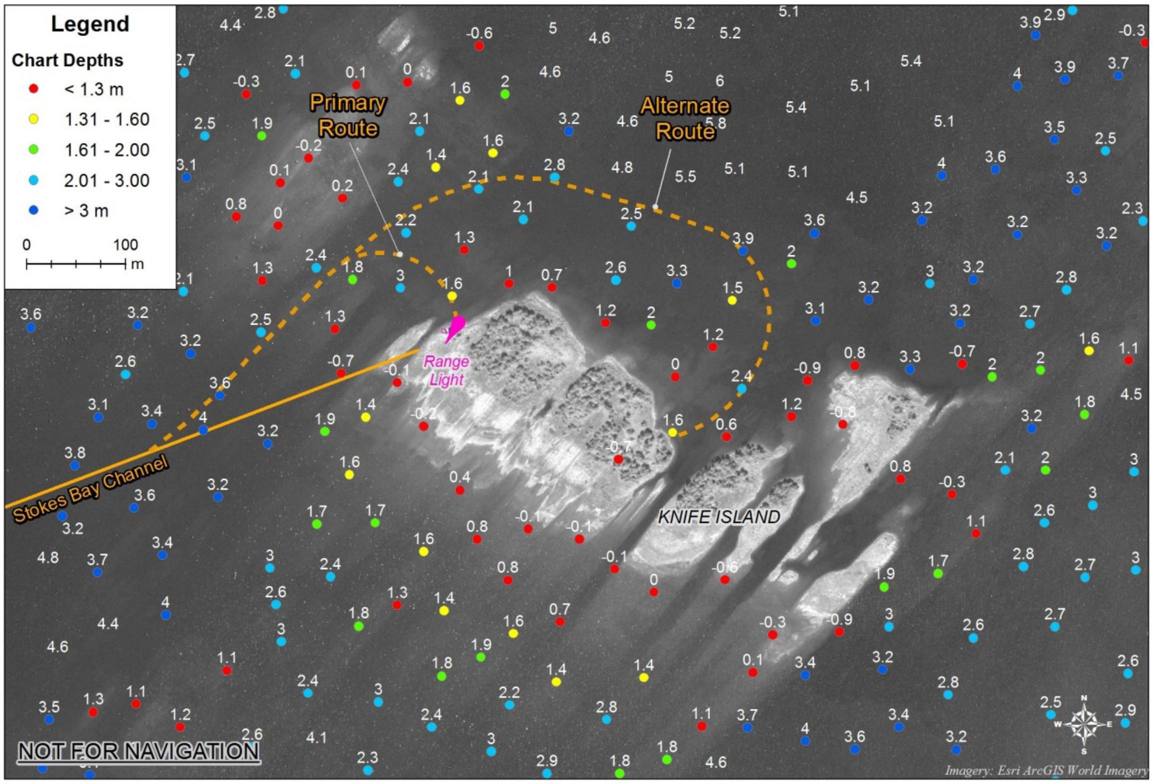

Figure 4.4 CHS Sounding Data for Knife Island

[Product produced by Baird based on CHS data pursuant to CHS Direct User License No. 2014-1105-1260-B]

4.3.3 Estimate of Maximum Vessel Draft

A preliminary estimate of the maximum draft for construction vessels is presented in Table 4.2 using an assumed minimum under keel clearance allowance of 0.3 m. Based on these preliminary assumptions, it is anticipated that contractors may limit vessel drafts to approximately 1.7 to 1.9 m (1.8 m as an average value). It was shown in the analysis of equipment options (Table 4.1) that this is a reasonable value for local marine plant which typically consists of a small tug and barge.

Table 4.2 Preliminary Estimate of Maximum Vessel Draft (assuming remediation undertaken in summer)

	Jul-Aug	**Sep-Oct**
Estimated July/August Water Level (above Chart Datum)	+0.6	+0.4
Minimum Depth (relative to Chart Datum)	-1.6	-1.6
Total Water Depth	**2.2**	**2.0**
Under Keel Clearance Allowance (approx. 15% of draft)	0.3	0.3
Maximum Draft	**1.9**	**1.7**

5.0 COST ESTIMATES

Conceptual cost estimates were prepared for the three access options using equipment specific mobilization and daily rate pricing from recent marine construction projects on the Great Lakes and a quotation for the construction helicopter from an Ontario-based operator. As required by the PWGSC scope of work document, the cost estimates do not include any contingency, markup, or HST.

An estimate of the time on site is also provided for planning purposes (estimated from equipment production rates, and approximate transit times to and from the DFO public wharf if/as required).

Table 5.1 Conceptual Cost Estimates ($, thousands) [a]

	Float-in Tug & Barge	Lift-in Landing Craft	Construction Helicopter
Mob/Demob [b]	18	13	70
Temporary Access Causeway	22 [c]	-	-
Site Costs (at daily rate)	17	48 [d]	80 [e]
Subtotal	57	61	
Hydrographic Survey	15	15	-
Total (excl. contingency)	72	76	150
Total days on-site (rounded)	2.5	6	1.5

[a] Access equipment cost only. Excludes equipment and labour costs for remediation work, costs for disposal of contaminated soil, and supply of clean fill. Prices are indicative and for comparison purposes only.
[b] Mob/demob assumes local marine contractor located with a range of a few hundred kilometers (e.g. Southampton, Meaford, or farther afield), or local construction helicopter operator with helicopter sourced from Ohio.
[c] Includes construction of temporary causeway by remediation excavator using approximately 400 t of rock fill loaded/unloaded at the DFO wharf. Causeway removed prior to demobilization and rock fill material removed from site.
[d] Includes crane cost for lift-in/lift-out of landing craft and dump trailer, and for truck (un)loading at DFO wharf.
[e] Includes excavator cost for truck (un)loading on mainland.

Based on the estimates presented in Table 5.1, the probable least cost alternative is float-in access using a conventional tug and barge operation. Note that approximately one-third of the tug and barge total estimate is associated with the construction of a temporary access causeway. If more detailed sounding surveys were undertaken, it may be possible that a shorter causeway could be constructed and the total cost of this option also might be reduced. Conversely, the survey may show that a longer causeway is required. In either case, greater cost certainty would be achieved.

Compared to the tug and barge alternative, the limited capacity of the landing craft option requires considerably more trip cycles and time on site, whereas the high mobilization/demobilization cost and higher hourly rate combined with a large number of lifts make the construction helicopter less competitive in this particular case.

6.0 SUMMARY & RECOMMENDATIONS

A marine access assessment was completed for the proposed Stokes Bay Front Range remediation at Knife Island located on the eastern shore of Lake Huron. The proposed remediation work is anticipated to include the following main tasks:

- Mobilization and demobilization of construction equipment; and
- Excavation and off-site disposal of up to 200 tonnes of contaminated soil (potentially less) and up to 2 m^3 of building materials.

A possible mooring location was identified at the northwest side of Knife Island, preferred both for its close proximity to the Front Range work area and slightly deeper recorded water depths than other locations around the island.

The probable least cost marine access option was estimated to be achieved through float-in of a small tug and deck barge through the Stokes Bay main access channel. Based on available sounding data, it is recommended that this option include a temporary access causeway to extend from the barge mooring to shore. Other options considered but estimated to be slightly higher cost included a lift-in shallow-draft landing craft option, and the use of a heavy-lift construction helicopter. These latter two options involve specialty equipment that are less common in the region and it is anticipated that market forces may elicit competitive tenders from local contractors using more conventional tug and barge operations. Nevertheless, it is recommended that PWGSC not restrict contractors to a prescribed methodology or particular equipment and that tenderers be permitted to propose the means and methods best suited to their particular operation.

It is recommended that the remediation work be planned to start in July (if possible), in order to benefit from higher summer lake levels and lower wind speeds. If the work proceeds in July or August, the maximum draft for construction vessels is estimated to be approximately 1.9 m which is anticipated to provide approximately 245 tonnes of deadweight carrying capacity for material and equipment on a 20 m long deck barge. Should the work proceed in September or October, the maximum draft might be restricted to 1.7 m (215 tonnes deadweight) and there is an increased possibility for fall storms and weather induced downtime. Quantification of weather delays and downtime is beyond the scope of the present work.

It is recommended that the following tasks be undertaken prior to starting the remediation work:

1. Completion of a hydrographic survey to check for hazards along the route and confirm the extent of navigable water. As well, the hydrographic survey should also confirm near shore water depths at the Front Range work area and preferred shore access location. This recommendation applies to any marine access option and is estimated to cost in the range of $ 15,000 for approximately 1 day on-site for a professional survey crew. The work could be

completed at any time during the open water season (although summer is preferred for reasons outlined previously). Rock fill quantities should then be updated following the survey to optimize the amount of material delivered to site for construction of the proposed temporary causeway access structure.

2. Confirmation of access and load capacity of the DFO public wharf (should contractors propose to use the facility for mobilization of equipment and/or loading/unloading of materials).

7.0 REFERENCES

Caterpillar (2010). Performance Handbook, 40th Edition.

CHS (2000). Sailing Directions: Lake Huron, St. Marys River, Lake Superior – Booklet CEN 305. Hydrographic Chart Distribution Office, Fisheries and Oceans Canada.

Franz Environmental (2011). Site Specific Human Health Risk Assessment (SSRA-HH), Site Specific Ecological Risk Assessment (SSERA) and Supplemental Site Investigation: Stokes Bay Front Range, Stokes Bay Rear Range and the Former Squatter's Area – Knife Island (DFRP# 10961) and Shute Point (DFRP No. 85917). Report Prepared for Public Works and Government Services Canada and Department of Fisheries and Oceans Canada. Final Report. March 2011.

APPENDIX D

SAR Pamphlet

Stokes Bay Front Range, Knife Island, Ontario Species at Risk

Species at Risk Legislation

Federal Species at Risk Act (SARA)
Provincial Endangered Species Act (ESA)

- Both work to protect species that are at risk **and** their habitats.
- Identify species at risk (SAR) based on the best available scientific information and community knowledge.

SAR Classification

Endangered – species that is facing imminent extirpation or extinction.

Threatened – species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern – species that may become a threatened or an endangered species due to a combination of biological characteristics and identified threats.

Species at Risk Mammals

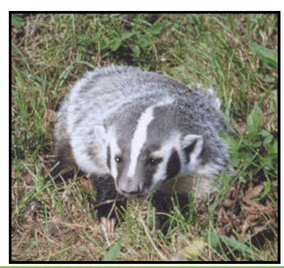

Photo:
Rondeau Provincial Park
www.rom.on.ca

AMERICAN BADGER
SARA/ESA Endangered

•A large carnivore in the weasel family that has the elongated body shape and short legs characteristic of the group. Its fur is grey, with bold black and white stripes on the head and face.

•Prefers tall grass prairie, sand barrens and farmland.

Photo:
Nick Dunlop
http://www.nickdunlop.com

GREY FOX

SARA/ESA Threatened

- About the size of a small dog and is grey, with a reddish chest and sides of the belly, and white underparts. It is also distinguished by its black-tipped tail.
- Prefers deciduous forests, especially swampy areas.

Species at Risk
Birds

Photo:
SAR Listing
https://www.ontario.ca

HENSLOW'S SPARROW

SARA/ESA Endangered

- May be distinguished from other small sparrows by its pale olive green head and hind neck, chestnut wings, and brown and black streaked back.
- Prefers old fields, pastures and wet meadows that have not been extensively invaded by shrubs. As a ground nester, it requires dense, tall grasses, and thatch, or decaying plant material for cover.

Photo:
George Peck
www.rom.on.ca

KING RAIL

SARA/ESA Endangered

- A large, chicken-sized marsh bird with a long bill, brown streaked back, rich brown breast and bold barring on the flanks.
- Inhabits shallow, densely vegetated freshwater marshes but is rarely seen. In Ontario, it is a very rare summer resident in the larger marshes on the shores of lakes.

Photo:
Mark Peck
www.rom.on.ca

LEAST BITTERN

SARA/ESA Threatened

- More likely heard than seen, as it "coos" softly. Smallest of the North American herons and is distinguished by large chestnut patches on its wings.
- In Ontario, it is mainly found in large, quiet cattail marshes near the Great Lakes.

Photo:
SAR Listing
https://www.ontario.ca

LOGGERHEAD SHRIKE

SARA/ESA Endangered

- A robin-sized song bird with a robust hooked bill, black face mask, white under parts, and black wings with a prominent white wing patch. Easily confused with the Northern Shrike, the Loggerhead is somewhat smaller in size and its face mask extends across the base of the bill.
- Prefers a combination of pasture or other grassland with scattered low trees and shrubs.

Photo:
Mark Peck
www.rom.on.ca

PIPING PLOVER

SARA/ESA Endangered

- Named for its "piping" call, a small stubby- billed shorebird with a thin, often incomplete, black neck band.
- Lays its eggs directly on the beach in what is little more than a shallow, scraped out area in the sand. Forages for insects and small crustaceans along the water's edge and in small beach pools.

Photo:
George Peck
www.rom.on.ca

PEREGRINE FALCON

SARA/ESA Special Concern

- The adult Peregrine is best identified by its distinctive black facial mask, resembling a helmet, and by its black malar stripe, or "moustache". It has a slate blue-grey back and whitish under parts with fine, dark barring on the thighs and lower breast.
- Prefers to nest on steep cliff ledges adjacent to large water bodies.

Photo:
SAR Listing
https://www.ontario.ca

WHIP-POOR-WILL

SARA/ESA Threatened

- A medium-sized bird with mottled brown and grey feathers that help it blend in with its surroundings.
- Prefers areas with a mix of open and forested areas, such as savannahs, open woodlands or openings in more mature, deciduous, coniferous and mixed forests.

Species at Risk Herptiles

Photo:
www.earthrangers.com

BLANDING'S TURTLE

SARA/ESA Threatened

- Medium-sized turtle easily identified by its characteristic bright yellow throat and jaw and smooth, domed shell.
- Inhabits a network of lakes, streams, and wetlands, preferring shallow wetland areas with abundant vegetation.

Photo:
ROM
www.rom.on.ca

EASTERN FOX SNAKE

SARA Endangered/ESA Threatened

- Usually grows to about one metre long and has a reddish head and a yellowish-brown body with dark blotches down the back and a row of smaller blotches along each side.
- Prefers water in both marsh and woodland, and often near human habitation. Will enter barns and travel along roads and ditches when hunting for small rodents and birds.

Photo:
SAR Listing
https://www.ontario.ca

MASSASSAUGA RATTLESNAKE
SARA/ESA Threatened

- Ontario's only venomous snake. It has a triangular head and a tail that ends in a small rattle that creates a buzzing sound when the tail shakes. The body is grey to dark brown with darker brown "butterfly" or "saddle-shaped" blotches down the back, with alternating blotches along the sides.
- Lives in a range of open habitats and shifts its home range seasonally, spending the summer in dry, upland sites, and the rest of the year in swamps (forested wetlands).

Photo:
SAR Listing
https://www.ontario.ca

QUEENSNAKE
SARA/ESA Endangered

- Adults are slender and grow to approximately 60 cm, though some grow as long as 90 cm. It is brown-olive above, with a pale stripe along each side and three dark stripes down the back. The belly is yellow with four dark stripes.
- Is aquatic, living in clear, smaller rivers where there is good rock cover.

Species at Risk
Fish

Photo:
Erling Holm
www.rom.on.ca

REDSIDE DACE
SARA Special Concern/ESA Endangered

- Has an unusually large mouth for a minnow. Adults are silvery with red sides and a purple sheen. They grow to about 11 cm long.
- Prefers clear, cool streams with a rubble and gravel bottom, and a mixture of pool and riffle habitats.

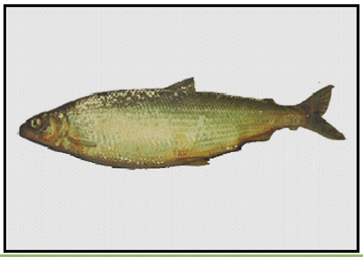

Photo:
N.R. Payne
www.rom.on.ca

SHORTNOSE CISCO
SARA/ESA Endangered

•It has a short head and snout, small eyes, and a tiny mouth. All of the fins are small compared to its somewhat stocky body, which usually grows to a length of 25 centimetres. It has a yellow-green back, silver sides, and a white belly and has dark markings on its snout.
•Lives in the deep, cold water of the Great Lakes, usually at depths between 22 to 110 metres.

Species at Risk
Plant, Lichens and Mosses

Photo:
SAR Listing
https://www.ontario.ca

DWARF LAKE IRIS
SARA Threatened/ESA Special Concern

•A flowering plant that is special to the Great Lakes region of North America, where it grows in cedar swamps and swales in clearings in forested sand-dunes. Can be found along the beaches of the Bruce Peninsula.
•Small and seldom grows taller than 10 cm, although its strap-like leaves can be up to 18 cm long.

Photo:
Don Cuddy
www.rom.on.ca

EASTERN PRAIRIE FRINGED-ORCHID
SARA/ESA Endangered

•An impressive flowering plant that grows in swamps and wet tall grass prairie. It produces large flowers (up to 3 cm wide) that are white and have the characteristic "lip". Each flower has a very deep "nectar spur" that contains lots of nectar.
•In Ontario, there are about 20 small populations in remnant prairie habitat in Bruce, Essex and Lambton counties, and in Tamarack swamps in the Bruce Peninsula and Ottawa area.

Photo:
Jane M. Bowles
www.rom.on.ca

GATTINGER'S AGALINIS
SARA/ESA Endangered

•A branching, slender plant that produces showy, pink or rose-purple bell-shaped flowers in late summer. Yellow lines and red spots on the inside of the flower's "throat" may serve as nectar guides for visiting insect pollinators.

•Grows in dry prairie and dry, open oak savannah habitats. Occurs at two sites on the Bruce peninsula.

Photo:
Donald Kirk
www.rom.on.ca

HILL'S THISTLE
SARA/ESA Threatened

•A relatively short (60 cm), native thistle with hairy stems and a flower head that is bright pink and composed of a mass of tiny flowers .

•Grows in a variety of open sites, including prairies and woodland alvars. Alvars -- a special habitat type that, in North America, is largely restricted to the Great Lakes region -- are limestone plains where the rock underlies shallow soil.

Photo:
SAR Listing
https://www.ontario.ca

LAKESIDE DAISY
SARA/ESA Threatened

•A small plant in the aster family that is characterised by a basal rosette of leaves, a tall flowering stalk, and a bright yellow flower head composed of strap-like ray flowers surrounding a central button of tiny disk flowers.

•Mainly found in alvar habitats in the Great Lakes region. It is one of a set of distinctive species that are specialized for living on shallow soil overlaying limestone bedrock.

Photo:
SAR Listing
https://www.ontario.ca

PITCHER'S THISTLE
SARA Endangered/ESA Threatened

•It has prickly leaves which are characteristic of thistles, and the stem and underside of the leaves are densely covered with white hairs. Pinkish-white flower heads are produced in mid-summer. Seeds have a downy white "parachute".

•Prefers relatively undisturbed sandy shorelines and on old dunes stabilized by vegetation.

Photo:
Donald Kirk
www.rom.on.ca

SMALL WHITE LADY'S-SLIPPER
SARA/ESA Endangered

•The Small White Lady's-slipper orchid is distinguished by its small size, of only 6 to 12 inches, and by its white inflated "lip", or flower pouch, which is delicately lined inside with purple.

•In Ontario, this species grows in open wet prairie and marly fen habitats.

Photo:
Donald Kirk
www.rom.on.ca

TUBEROUS INDIAN-PLANTAIN
SARA/ESA Special Concern

•Grows as a flat rosette of leaves that hug the ground, but in spring sends up a tall flower stalk that produces a flat-topped cluster of white flowers.

•Prefers wet, sandy areas along river banks and wetlands near Lake Huron, especially the west side of the Bruce Peninsula.

What to do if you find a SAR?

- Prior to the start of the construction project, the area will be inspected by a qualified biologist to ensure that there are no SAR within the work limits.
- Do **NOT** touch a SAR if you are lucky enough to see one.
- Record date, time, and location (UTM or lat/long) of observation.
- If possible, take a photo.
- Contact Scott Clemow with these details **immediately** from the site.
- A permit under the *Species at Risk Act* is legally required to relocate any individuals of any SAR observed on site.

Scott.Clemow@snclavalin.com
613-791-2200

APPENDIX E

Laboratory Certificates of Analysis

Your P.O. #: TOD-2014-0421
Your Project #: 623376
Site#: KNIFE ISLAND, ON
Site Location: STOKES BAY FRONT RANGE
Your C.O.C. #: 469177

Attention:Robert Mitzakov

SNC-Lavalin Inc
20 DeBoers Drive
Suite 200
Toronto, ON
CANADA M3J 0H1

Report Date: 2014/10/30
Report #: R3205233
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B4J9743
Received: 2014/10/24, 13:10

Sample Matrix: Soil
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Strong Acid Leachable Metals by ICPMS	5	2014/10/29	2014/10/29	CAM SOP-00447	EPA 6020A m

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons.

Maxxam Analytics is accredited by SCC (Lab ID 97) for all specific parameters as required by GUCSO and O.Reg 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

All data is in statistical control and has met all QC and method performance criteria unless otherwise flagged. All samples were analysed within hold time unless otherwise flagged. All soil samples for BTEX analysis were methanol extracted within 24 hours unless otherwise flagged.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Ema Gitej
30 Oct 2014 12:20:27 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B4J9743
Report Date: 2014/10/30

SNC-Lavalin Inc
Client Project #: 623376
Site Location: STOKES BAY FRONT RANGE
Your P.O. #: TOD-2014-0421

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		YD6806	YD6807	YD6808	YD6809	YD6810		
Sampling Date		2014/10/22 14:45	2014/10/22 15:00	2014/10/22 15:15	2014/10/22 15:45	2014/10/22 16:00		
COC Number		469177	469177	469177	469177	469177		
	Units	**SS-1401**	**SS-1402**	**SS-1403**	**SS-1404**	**SS-1405**	**RDL**	**QC Batch**
Metals								
Acid Extractable Lead (Pb)	ug/g	590	310	1800	350	540	1.0	3803197

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B4J9743
Report Date: 2014/10/30

SNC-Lavalin Inc
Client Project #: 623376
Site Location: STOKES BAY FRONT RANGE
Your P.O. #: TOD-2014-0421

TEST SUMMARY

Maxxam ID: YD6806
Sample ID: SS-1401
Matrix: Soil

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	3803197	2014/10/29	2014/10/29	Viviana Canzonieri

Maxxam ID: YD6807
Sample ID: SS-1402
Matrix: Soil

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	3803197	2014/10/29	2014/10/29	Viviana Canzonieri

Maxxam ID: YD6808
Sample ID: SS-1403
Matrix: Soil

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	3803197	2014/10/29	2014/10/29	Viviana Canzonieri

Maxxam ID: YD6809
Sample ID: SS-1404
Matrix: Soil

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	3803197	2014/10/29	2014/10/29	Viviana Canzonieri

Maxxam ID: YD6810
Sample ID: SS-1405
Matrix: Soil

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	3803197	2014/10/29	2014/10/29	Viviana Canzonieri

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.7°C

Results relate only to the items tested.

Maxxam Job #: B4J9743
Report Date: 2014/10/30

SNC-Lavalin Inc
Client Project #: 623376
Site Location: STOKES BAY FRONT RANGE
Your P.O. #: TOD-2014-0421

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3803197	VIV	Matrix Spike	Acid Extractable Lead (Pb)	2014/10/29		NC	%	75 - 125
3803197	VIV	Spiked Blank	Acid Extractable Lead (Pb)	2014/10/29		99	%	80 - 120
3803197	VIV	Method Blank	Acid Extractable Lead (Pb)	2014/10/29	<1.0		ug/g	
3803197	VIV	RPD	Acid Extractable Lead (Pb)	2014/10/29	0.60		%	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

Maxxam Job #: B4J9743
Report Date: 2014/10/30

SNC-Lavalin Inc
Client Project #: 623376
Site Location: STOKES BAY FRONT RANGE
Your P.O. #: TOD-2014-0421

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics Inc 6740 Campobello Road, Mississauga, ON L5N 2L8 Phone: 905-817-5700 Fax: 905-817-5778 Toll Free: (800) 563-6266

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE INFORMATION

Company Name: SNC-Lavalin
Contact Name: Sheri Schembri
Address: 20 DeBoers Drive, Suite 200 Toronto, ON, M3J 0H1
Phone: 416-635-5882 Fax: 416-635-5353
Email: scheri.schembri@snclavalin.com

REPORT INFORMATION (if differs from invoice)

Company Name:
Contact Name: Robert Mitzakov
Address:
Phone: Fax:
Email: robert.mitzakov@snclavalin.com

PROJECT INFORMATION

Quotation #: B41942
P.O. #: TOD-2014-0421
Project #: 623376
Project Name: Stokes Bay Front Range
Location: Knife Island, ON
Sampled By: BRIAN MACRO

MAXXAM JOB NUMBER

CHAIN OF CUSTODY # 00 469177

REGULATORY CRITERIA

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form.

- [ ] MISA
- [ ] PWQO
- [ ] Reg. 558
- Reg. 153: [x] Table 1 [ ] Table 2 [ ] Table 3
- Sewer Use: [ ] Sanitary [ ] Storm Region:
- [x] Other: CCME (specify)

Report Criteria on C of A? [ ]

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	Regulated Drinking Water? (Y / N)	Metals Field Filtered? (Y / N)	Lead (Pb)	# of Cont.	COMMENTS / TAT COMMENTS
1	SS-1401	Oct-22/14	14:45	Soil	-	-	X	1	
2	SS-1402	↓	15:00	↓	-	-	X	1	
3	SS-1403	↓	15:15	↓	-	-	X	1	
4	SS-1404	↓	15:45	↓	-	-	X	1	
5	SS-1405	↓	16:00	↓	-	-	X	1	
6									
7									
8									
9									
10									
11									
12									

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT: [x] 5 to 7 Working Days

Rush TAT: Rush Confirmation #: (call Lab for #)

[ ] 1 day [ ] 2 days [ ] 3 days

DATE Required:

TIME Required:

Please note that TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

24-Oct-14 13:10
Ema Gitej
B4J9743
EAL ENV-773

RELINQUISHED BY (Signature/Print)	RECEIVED BY (Signature/Print)	Date	Time
BRIAN MACRO / Brian Macro		Oct.23/14	16:00
	RACHEL DEVLIN	2014/10/24	13:10

Laboratory Use Only

Temperature (°C) on Receipt	Condition of Sample on Receipt
2/2/1	[ ] OK [ ] SIF

***MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.**

ENVCOC-ONT-05/06 White: Maxxam Yellow: Mail Pink: Client

Your P.O. #: TOD-2014-0421
Your Project #: 623376
Site#: STOKES BAYFRONT RANGE
Site Location: KNIFE ISLAND, ON
Your C.O.C. #: 469178

Attention:Robert Mitzakov

SNC-Lavalin Inc
20 DeBoers Drive
Suite 200
Toronto, ON
CANADA M3J 0H1

Report Date: 2014/10/29
Report #: R3204972
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B4J9760
Received: 2014/10/24, 13:10

Sample Matrix: Paint
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Metals in Paint	6	2014/10/27	2014/10/28	CAM SOP-00408	EPA 6010C m

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons.

Maxxam Analytics is accredited by SCC (Lab ID 97) for all specific parameters as required by GUCSO and O.Reg 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

All data is in statistical control and has met all QC and method performance criteria unless otherwise flagged. All samples were analysed within hold time unless otherwise flagged. All soil samples for BTEX analysis were methanol extracted within 24 hours unless otherwise flagged.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Ema Gitej
29 Oct 2014 22:11:01 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B4J9760
Report Date: 2014/10/29

SNC-Lavalin Inc
Client Project #: 623376
Site Location: KNIFE ISLAND, ON
Your P.O. #: TOD-2014-0421
Sampler Initials: BM

ELEMENTS BY ATOMIC SPECTROSCOPY (PAINT)

Maxxam ID		YD6871		YD6872	YD6873		YD6874		YD6875		
Sampling Date		2014/10/22 16:30		2014/10/22 16:45	2014/10/22 16:50		2014/10/22 17:00		2014/10/22 17:10		
COC Number		469178		469178	469178		469178		469178		
	Units	**PS-1401**	**RDL**	**PS-1402**	**PS-1403**	**RDL**	**PS-1404**	**RDL**	**PS-1405**	**RDL**	**QC Batch**
Metals											
Lead (Pb)	%	8.3	0.01	28	25	0.1	4.5	0.01	20	0.1	3799892

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		YD6876		
Sampling Date		2014/10/22 17:20		
COC Number		469178		
	Units	**PS-1406**	**RDL**	**QC Batch**
Metals				
Lead (Pb)	%	7.3	0.05	3799892

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Maxxam Job #: B4J9760
Report Date: 2014/10/29

SNC-Lavalin Inc
Client Project #: 623376
Site Location: KNIFE ISLAND, ON
Your P.O. #: TOD-2014-0421
Sampler Initials: BM

TEST SUMMARY

Maxxam ID: YD6871
Sample ID: PS-1401
Matrix: Paint

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	3799892	2014/10/27	2014/10/28	Archana Patel

Maxxam ID: YD6872
Sample ID: PS-1402
Matrix: Paint

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	3799892	2014/10/27	2014/10/28	Archana Patel

Maxxam ID: YD6873
Sample ID: PS-1403
Matrix: Paint

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	3799892	2014/10/27	2014/10/28	Archana Patel

Maxxam ID: YD6874
Sample ID: PS-1404
Matrix: Paint

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	3799892	2014/10/27	2014/10/28	Archana Patel

Maxxam ID: YD6875
Sample ID: PS-1405
Matrix: Paint

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	3799892	2014/10/27	2014/10/28	Archana Patel

Maxxam ID: YD6876
Sample ID: PS-1406
Matrix: Paint

Collected: 2014/10/22
Shipped:
Received: 2014/10/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	3799892	2014/10/27	2014/10/28	Archana Patel

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B4J9760
Report Date: 2014/10/29

SNC-Lavalin Inc
Client Project #: 623376
Site Location: KNIFE ISLAND, ON
Your P.O. #: TOD-2014-0421
Sampler Initials: BM

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.7°C

Metals: Due to high concentrations of the target analytes, all samples required dilution. Detection limits were adjusted accordingly.

Sample YD6876-01 : Metals: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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Maxxam Job #: B4J9760
Report Date: 2014/10/29

SNC-Lavalin Inc
Client Project #: 623376
Site Location: KNIFE ISLAND, ON
Your P.O. #: TOD-2014-0421
Sampler Initials: BM

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3799892	APT	Matrix Spike	Lead (Pb)	2014/10/28		92	%	75 - 125
3799892	APT	QC Standard	Lead (Pb)	2014/10/28		107	%	75 - 125
3799892	APT	Method Blank	Lead (Pb)	2014/10/28	<0.0001		%	
3799892	APT	RPD	Lead (Pb)	2014/10/28	11		%	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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Maxxam Job #: B4J9760
Report Date: 2014/10/29

SNC-Lavalin Inc
Client Project #: 623376
Site Location: KNIFE ISLAND, ON
Your P.O. #: TOD-2014-0421
Sampler Initials: BM

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CHARTERED Eva Pranjic CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics Inc 6740 Campobello Road, Mississauga, ON L5N 2L8 Phone: 905-817-5700 Fax: 905-817-5778 Toll Free: (800) 563-6266

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE INFORMATION	REPORT INFORMATION (if differs from invoice)	PROJECT INFORMATION	MAXXAM JOB NUMBER
Company Name: SNC-Lavalin	Company Name:	Quotation #: B41942	
Contact Name: Sheri Schembri	Contact Name: Robert Mitzakov	P.O. #: TOD-2014-0421	CHAIN OF CUSTODY #
Address: 20 De Boers Drive, Suite 200 Toronto, ON, M3J 0H1	Address:	Project #: 623376	00469178
Phone: 416-635-5882 Fax: 416-635-5353	Phone: Fax:	Project Name: Stokes Bay Front Range	
Email: sheri.schembri@snclavalin.com	Email: robert.mitzakov@snclavalin.com	Location: Knife Island, ON	
		Sampled By: BRIAN MACRO	

REGULATORY CRITERIA

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form.

☐ MISA Reg. 153 ☐ Table 1 ☐ Table 2 ☐ Table 3 Sewer Use ☐ Sanitary ☐ Storm Region: ☐ Other specify
☐ PWQO
☐ Reg. 558
Report Criteria on C of A? ☐

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT: ☒ 5 to 7 Working Days

Rush TAT: Rush Confirmation #: (call Lab for #)

☐ 1 day ☐ 2 days ☐ 3 days

DATE Required:

TIME Required:

Please note that TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	Regulated Drinking Water? (Y / N)	Metals Field Filtered? (Y / N)	Lead (Pb) in paint	# of Cont.	COMMENTS / TAT COMMENTS
1	PS-1401	Oct. 22/14	16:30	Paint	-	-	X	1	
2	PS-1402	↓	16:45	↓	-	-	X	1	
3	PS-1403	↓	16:50	↓	-	-	X	1	
4	PS-1404	↓	17:00	↓	-	-	X	1	
5	PS-1405	↓	17:10	↓	-	-	X	1	
6	PS-1406	↓	17:20	↓	-	-	X	1	24-Oct-14 13:10
7									Ema Gitej
8									
9									B4J9760
10									
11									EAL ENV-773
12									

RELINQUISHED BY (Signature/Print)	RECEIVED BY (Signature/Print)	Date	Time	Laboratory Use Only
BRIAN MACRO		Oct. 23/14	16:00	Temperature (°C) on Receipt: 2/2/1
Brian Macro	RACHEL DEVLIN	2014/10/24	13:10	Condition of Sample on Receipt: ☐ OK ☐ SIF

***MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.**

ENVCOC-ONT-05/06 White: Maxxam Yellow: Mail Pink: Client

LEX SCIENTIFIC INC.

SOLUTIONS
FOR A WORKING WORLD

CERTIFICATE OF ANALYSIS

Company:	SNC-Lavalin Environment (Toronto)	**Report Date:**	03-Nov-14
Contact:	Mr. Robert Mitzakov	**Analysis Date:**	31-Oct-14
Client Address:	20 DeBoers Drive, Suite 200, Toronto, ON	**Received Date:**	27-Oct-14
Client Reference:	623376	**LEX Project Number:**	08141475
Sampling Date:	22-Oct-14	**Number of Analyses:**	9

Analysis Requested **Bulk Asbestos by PLM**

Analysis was performed in accordance with the method EPA/600/R-93/116, Method for the Determination of Asbestos in Bulk Building Materials adopted in Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act Ontario Regulation 278/05. LEX Scientific Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP 101949) by the National Institute of Standards and Technology for analysis of bulk materials for asbestos.

German Leal, B.Sc.
Laboratory Manager

		Fibrous Asbestos Content %		Other Materials Content %	
Client Sample:	AS-1401-1	**Asbestos Detected?**	**No**		
LEX Sample:	01	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	White	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Caulking (white)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

		Fibrous Asbestos Content %		Other Materials Content %	
Client Sample:	AS-1401-2	**Asbestos Detected?**	**No**		
LEX Sample:	02	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	White	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Caulking (white)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	AS-1401-3	**Asbestos Detected?**	**No**		
LEX Sample:	03	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	White	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Caulking (white)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	AS-1402-1	**Asbestos Detected?**	**No**		
LEX Sample:	04	**Chrysotile:**	None Detected	**Cellulose:**	45
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	1
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	15
Description:	Paper (Black)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	39
		Comments:	N/A		
Client Sample:	AS-1402-2	**Asbestos Detected?**	**No**		
LEX Sample:	05	**Chrysotile:**	None Detected	**Cellulose:**	25
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	1
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	10
Description:	Paper (Black)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	64
		Comments:	N/A		
Client Sample:	AS-1402-3	**Asbestos Detected?**	**No**		
LEX Sample:	06	**Chrysotile:**	None Detected	**Cellulose:**	45
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	1
Colour:	Black	**Crocidolite:**	None Detected	**Other Fibres:**	15
Description:	Paper (Black)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	39
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

LEX SCIENTIFIC INC.

		Fibrous Asbestos Content %		Other Materials Content %	
Client Sample:	AS-1403-1	**Asbestos Detected?**	**No**		
LEX Sample:	07	**Chrysotile:**	None Detected	**Cellulose:**	1
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	White	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Plaster (white)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	99
		Comments:	N/A		
Client Sample:	AS-1403-2	**Asbestos Detected?**	**No**		
LEX Sample:	08	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	White	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Plaster (white)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		
Client Sample:	AS-1403-3	**Asbestos Detected?**	**No**		
LEX Sample:	09	**Chrysotile:**	None Detected	**Cellulose:**	None Detected
Layers Analyzed:	Sample Homogenized	**Amosite:**	None Detected	**MMVF:**	None Detected
Colour:	White	**Crocidolite:**	None Detected	**Other Fibres:**	None Detected
Description:	Plaster (white)	**Other Amphiboles:**	None Detected	**Non Fibrous:**	100
		Comments:	N/A		

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool
PLM - method detection limit is 0.1%

Analyst

LEX SCIENTIFIC INC.

LEX SCIENTIFIC INC. 2 Quebec Street, Suite 204, Guelph, ON N1H 2T3
Fax: 519-824-5784
lab@lexscientific.com

Contact:

Name: Robert Mitzakou

Company: SNC-Lavalin

Address: 20 DeBoers Drive, Suite 200, Toronto, ON M3J 0H1

Phone: 416-635-5882 Ext. 55805 Fax: 416-635-5353

Cell: e-mail: robert.mitzakou@snclavalin.com

Project Name/No.: # 623376 P.O. No. TOD-2014-0425

Sampling Date: Oct. 22, 2014 Location: Stokes Bay Front Range, Knife Island, ON

Special Instructions: Positive Stop

Send initial results by: Fax ☐ Phone ☐ Cell ☐ e-mail ☒ choose one only

FOR ASBESTOS, BULK, PLM ANALYSIS: TAT REQUIRED: Immediate 6-Hours 1-Day 2-Days **3 - 5 Days**

lab use	Sample ID	Sample Description / Matrix	Layered?	Layering: Describe each layer to be analyzed
01-03	AS-1401-1 to-3	Caulking (white)	No	
04-06	AS-1402-1 to-3	Paper (Black)	No	
07-09	AS-1403-1 to-3	Plaster (white)	No	
			No Yes	
			No Yes	
			No Yes	
			No Yes	
			No Yes	
			No Yes	
			No Yes	

Use Page 2(a) for additional PLM samples | Each layer will be charged as a separate analysis

☐ Asbestos, Air, PCM
☐ Asbestos, TEM, Chatfield
☐ Asbestos, TEM, Conventional
☐ Asbestos, TEM NOB Gravimetric
☐ Fungal Spore, Air-O-Cell, Count, ID
☐ Fungal Spore, ID
☐ Mould, Culture, Count
☐ Mould, Culture, Count, ID
☐ Lead
☐ Radon
☐ Formaldehyde
☐ UFFI
☐ Particle Size
☐ Gravimetric analysis
☐ Microscopic analysis
☐ SEM/EDXA
☐ Other analysis (not listed)

TAT REQUIRED: (Not all TATs are available for all tests. Please contact Sample Reception for information)

Immediate 6-Hours 1-Day 2-Days 3-Days 4-Days 5-Days 6-Days 7 - 10 Days 12-Days 2-Weeks

lab use	Sample ID	Sample Description / Matrix	Additional details for requested analysis

RECEIVED
LEX Scientific Inc.
OCT 27 2014
Project #: 08141475
By: KF At: 10:35

Use Page 2(b) for additional samples

Authorization signature: Brian Macro BRIAN MACRO Date: Oct. 24, 2014
(signature and full name must appear on the form for work to proceed)

SNC·LAVALIN
20 DeBoers Drive, Suite 200
Toronto (Ontario) Canada, M3J 0H1
Tel.: (416) 635-5882
Fax: (416) 635-5353
www.snclavalin.com

APPENDIX B - SITE DRAWINGS

Public Works
Government Services
Canada

Architectural and
Engineering Services

Ontario Region

Travaux publics
Services gouvernementaux
Canada

Services d'architecture
et de génie

Région de l'Ontario

STOKES BAY BAY FRONT RANGE, LIGHT STATION

KNIFE ISLAND, LAKE HURON, ON

LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL

PWGSC Proj. No.: R.071694.050

LIST OF DRAWINGS

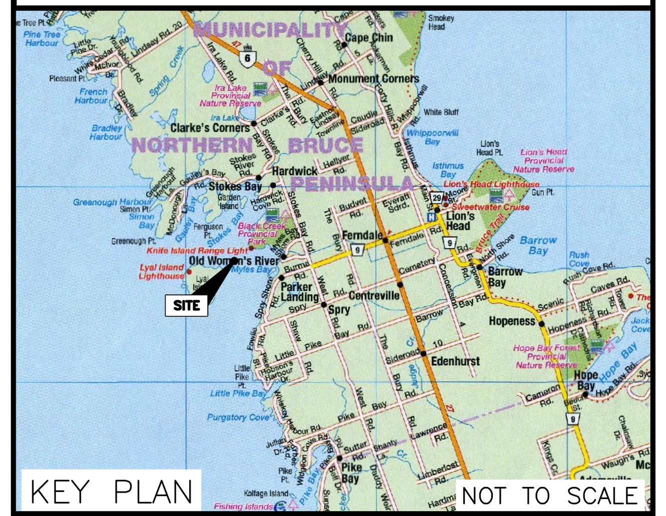
REMEDIATION

C-01	SITE LOCATION PLAN
C-02	OVERVIEW OF SITE WORK AREA LOCATION
C-03	LEAD IMPACTED SOIL REMOVAL
C-04	LEAD BASED PAINT ABATEMENT – OLD LIGHTHOUSE

Canadä

Public Works and
Government Services Canada
Travaux publics et
Services gouvernementaux Canada

SNC·LAVALIN



revision		date
02	ISSUED FOR TENDER	2015-03-23
01	ISSUED FOR CLIENT REVIEW	2015-02-20

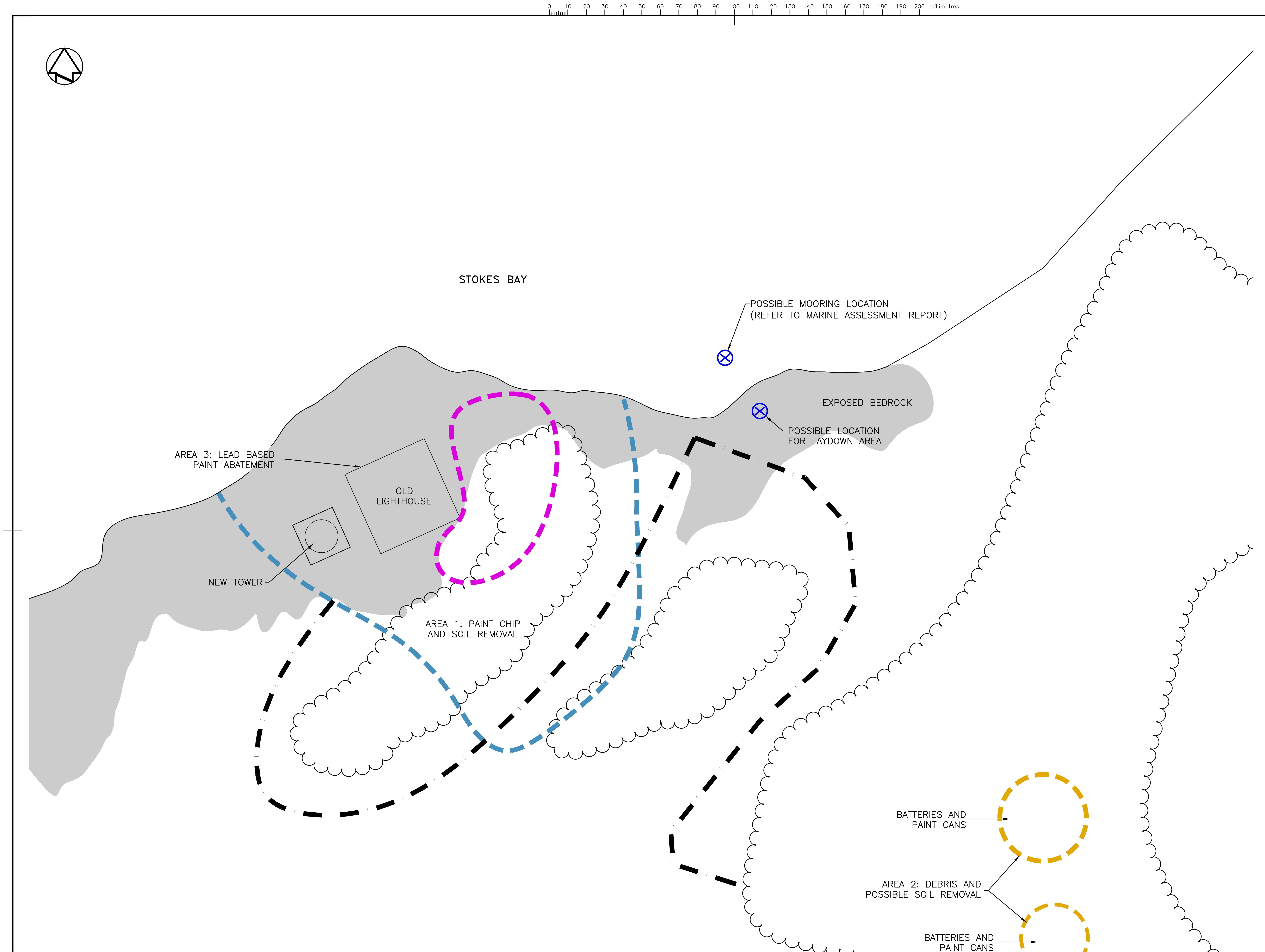
Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the Departmental Representative of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL
STOKES BAY FRONT RANGE, LIGHT STATION
KNIFE ISLAND, ONTARIO

drawing title / titre du dessin
SITE LOCATION PLAN

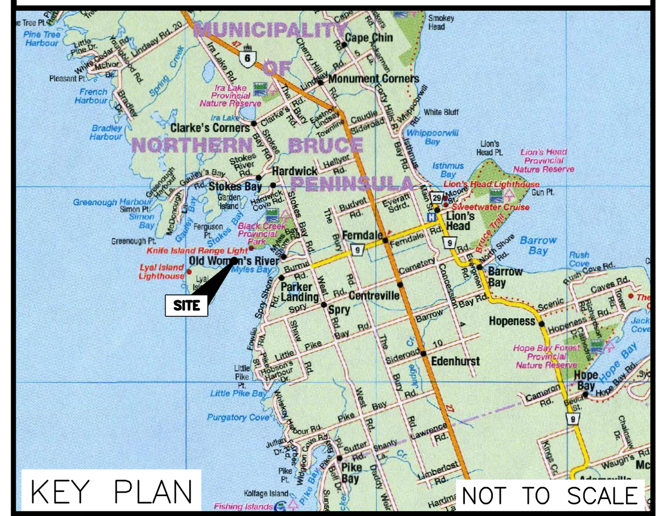
drawn by / dessine par: AG
designed by / conc par: RM
approved by / approuve par: SF
bid / offre: RM — project manager / administrateur de projets
project date / date du projet: 2015-02-19
project no. / no. du projet: R.071694.050
drawing no. / dessine no.: C-01



NOTE(S):
1. CONTRACTOR TO FINALIZE MOORING, LAYDOWN AREA AND ACCESS ROUTE LOCATIONS BASED ON SITE CONDITIONS AND WITH APPROVAL FROM THE DEPARTMENTAL REPRESENTATIVE (RELATED COSTS MUST BE INCLUDED IN PROJECT LUMP SUM QUOTE)
2. AREA 2: TO BE CONFIRMED BASED ON ADDITIONAL FIELD SAMPLING BY DEPARTMENTAL REPRESENTATIVE. ASSUMED 2m^3 OF NON-HAZARDOUS SOIL REQUIRING DISPOSAL FOR BUDGET PURPOSES
3. REFER TO SNC-LAVALIN (2015) REPORT IN APPENDIX A OF THE SPECIFICATION FOR ADDITIONAL DETAILS

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

SNC·LAVALIN



LEGEND

- APPROXIMATE EXTENT OF LEAD IMPACTED SOIL AND/OR VISIBLE PAINT CHIPS (300m^2)
  - ESTIMATED AREA REQUIRING LOOSE PAINT CHIP REMOVAL
  - ESTIMATED AREA REQUIRING GRUBBING
- APPROXIMATE EXTENT OF SOIL EXCEEDING SSTLs REQUIRING SOIL REMEDIATION (50m^2)
- APPROXIMATE EXTENT OF POSSIBLE IMPACTED SOIL (30m^2)

TOTAL ESTIMATED VOLUME OF SOIL (INCLUDING PAINT CHIPS) REQUIRING REMEDIATION = 10–15m^3

- TREE/SHRUB LINE
- PROPOSED ACCESS ROUTE

revision		date
01	ISSUED FOR TENDER	2015-03-23
01	ISSUED FOR CLIENT REVIEW	2015-02-20

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the Departmental Representative of all discrepancies.

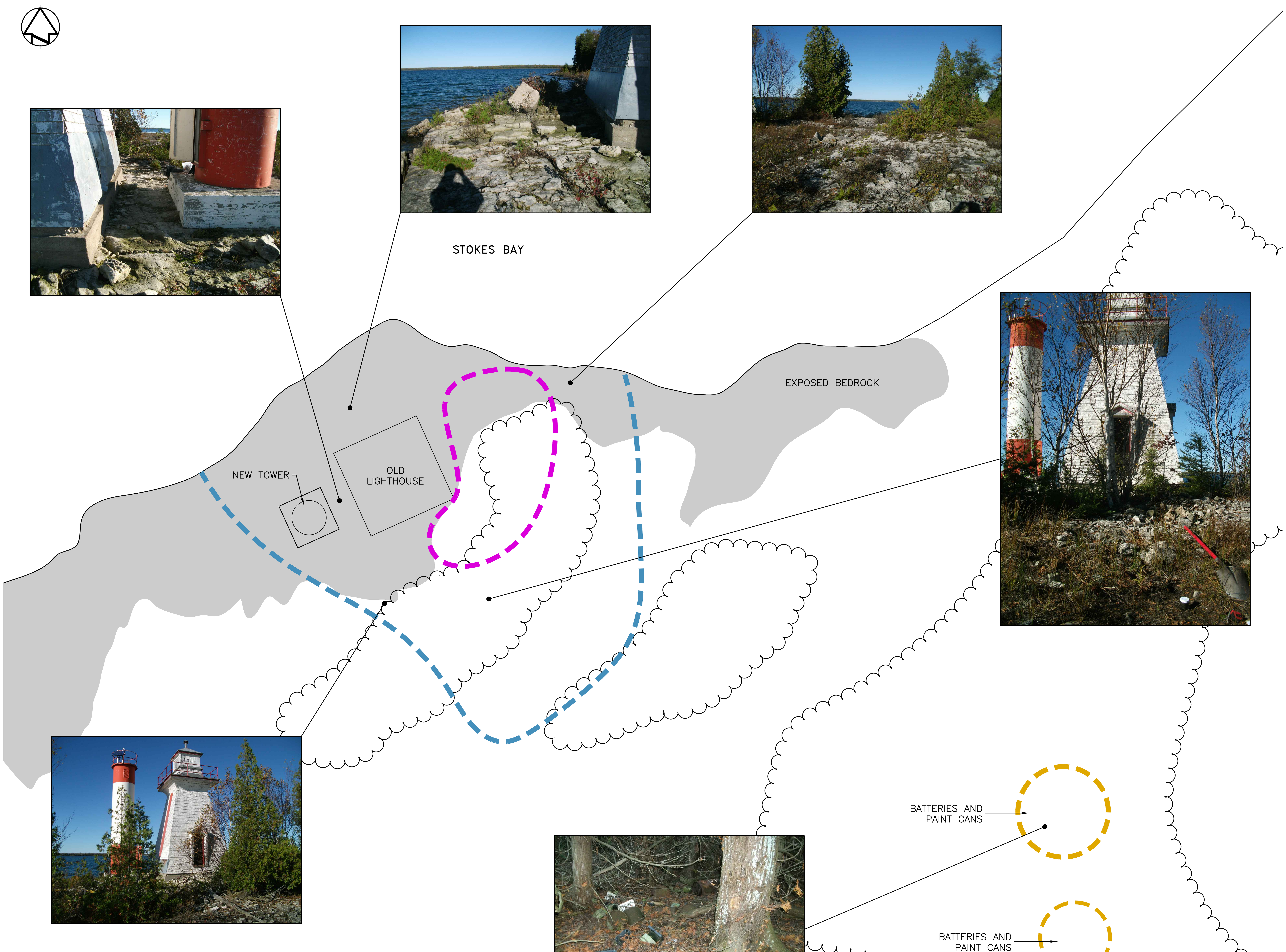
A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL
STOKES BAY FRONT RANGE, LIGHT STATION
KNIFE ISLAND, ONTARIO

drawing title / titre du dessin
OVERVIEW OF SITE WORK AREA LOCATIONS

drawn by / dessiné par: AG
designed by / conc par: RM
approved by / approuvé par: SF
bid / offre: RM — project manager / administrateur de projets
project date / date du projet: 2015-02-19
project no. / no. du projet: R.071694.050
drawing no. / dessin no.: C-02

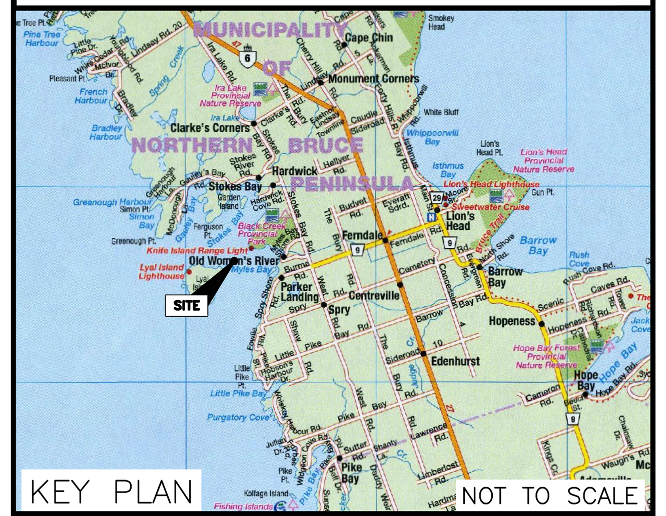
GSC-A1 DATE PLOTTED: 2015-02-02 PLOT SCALE: 1:1 CAD FILE: P:\PWGSC\Stokes Bay Front Range\623376\4.0 Execution\4.7 Working Version\CAD_GIS\003\03-C02_R071694.050.DWG



NOTE(S):
1. AREA 2: TO BE CONFIRMED BASED ON ADDITIONAL FIELD SAMPLING BY DEPARTMENT REPRESENTATIVE. ASSUMED $2m^3$ OF NON-HAZARDOUS SOIL REQUIRING DISPOSAL FOR BUDGET PURPOSES
2. SOIL AND PAINT CHIPS WILL REQUIRE SEGREGATION DURING REMEDIATION FOR WASTE CLASSIFICATION. ASSUME THAT WORST CASE SOIL/PAINT CHIPS WILL REQUIRE DISPOSAL AS HAZARDOUS WASTE (10% OF TOTAL VOLUME)
3. REFER TO SNC-LAVALIN (2015) REPORT IN APPENDIX A OF THE SPECIFICATION FOR ADDITIONAL DETAILS REGARDING SCOPE OF SOIL/PAINT CHIPS REMEDIATION

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

SNC·LAVALIN



LEGEND

- APPROXIMATE EXTENT OF LEAD IMPACTED SOIL AND/OR VISIBLE PAINT CHIPS ($300m^2$)
  - ESTIMATED AREA REQUIRING LOOSE PAINT CHIP REMOVAL
  - ESTIMATED AREA REQUIRING GRUBBING
- APPROXIMATE EXTENT OF SOIL EXCEEDING SSTLs REQUIRING SOIL REMEDIATION ($50m^2$)
- APPROXIMATE EXTENT OF POSSIBLE IMPACTED SOIL ($30m^2$)

TOTAL ESTIMATED VOLUME OF SOIL (INCLUDING PAINT CHIPS) REQUIRING REMEDIATION = 10–$15m^3$

TREE/SHRUB LINE

revision		date
02	ISSUED FOR TENDER	2015–03–23
01	ISSUED FOR CLIENT REVIEW	2015–02–20

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the Departmental Representative of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL
STOKES BAY FRONT RANGE, LIGHT STATION
KNIFE ISLAND, ONTARIO

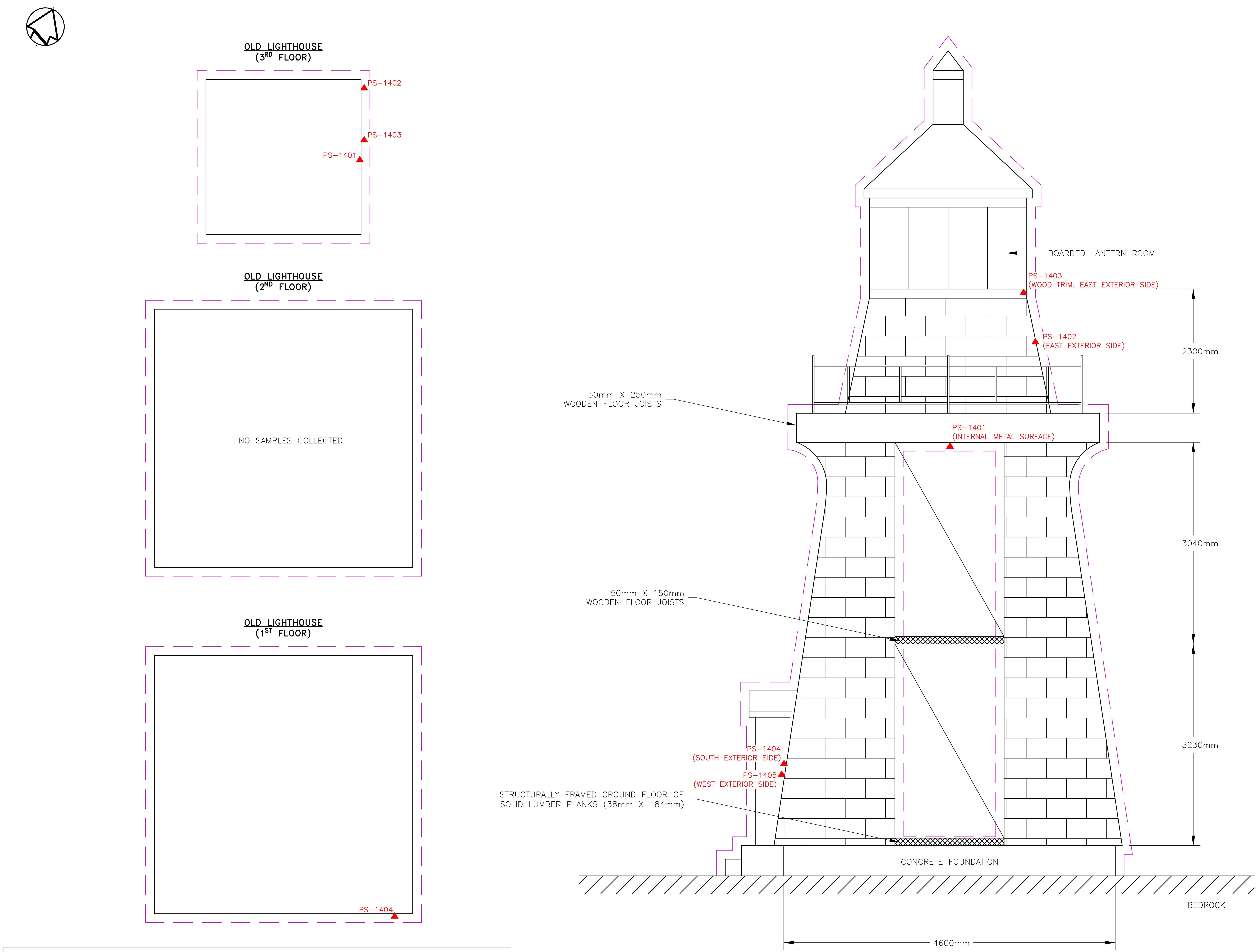
drawing title / titre du dessin
SOIL REMEDIATION

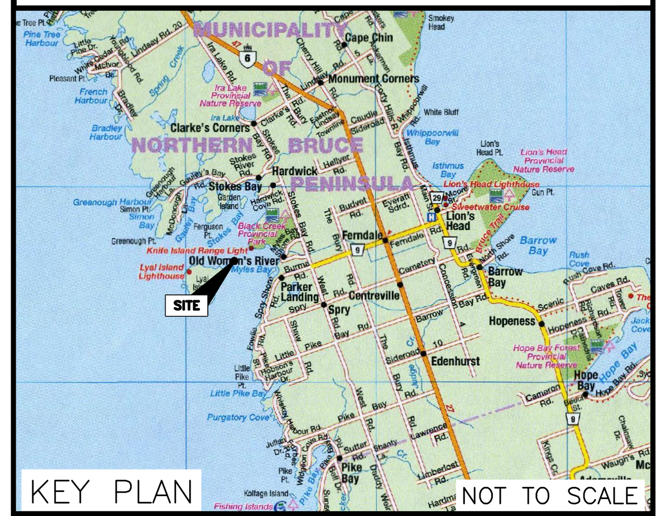
drawn by / dessine par: AG
designed by / conc par: RM
approved by / approuve par: SF
bid / offre: RM
project manager / administrateur de projets
project date / date du projet: 2015–02–19
project no. / no. du projet: R.071694.050
drawing no. / dessine no.: C–03

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 millimetres

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

SNC·LAVALIN





LEGEND

EXISTING INFRASTRUCTURE

APPROXIMATE EXTENT OF LEAD BASED PAINT (EXTERIOR)

PAINT SAMPLE CONFIRMED LEAD–BASED (PS–XXXX)

revision		date
02	ISSUED FOR TENDER	2015–03–23
01	ISSUED FOR CLIENT REVIEW	2015–02–20

Do not scale drawings.
Verify all dimensions and conditions on site and immediately notify the Departmental Representative of all discrepancies.

A Detail No. / No. du détail
B drawing no. – where detail required / dessin no. – où détail exigé
C drawing no. – where detailed / dessin no. – où détaillé

project title / titre du projet
LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL
STOKES BAY FRONT RANGE, LIGHT STATION
KNIFE ISLAND, ONTARIO

drawing title / titre du dessin
LEAD BASED PAINT ABATEMENT – OLD LIGHTHOUSE

drawn by / dessine par: AG

designed by / conc par: RM

approved by / approuve par: SF

bid / offre: RM — project manager / administrateur de projets

project date / date du projet: 2015–02–19

project no. / no. du projet: R.071694.050

drawing no. / dessine no.: C–04

NOTE(S):
1. DRAWING IS NOT TO SCALE
2. DIMENSIONS ARE APPROXIMATE
3. PAINT RESIDUE GENERATED DURING DISPOSAL WILL REQUIRE WASTE CLASSIFICATION, BUT SHOULD BE ASSUMED IT WILL REQUIRE DISPOSAL AS HAZARDOUS–WASTE
4. REFER TO SNC–LAVALIN (2015) REPORT IN APPENDIX A OF THE SPECIFICATION FOR ADDITIONAL DETAILS
5. 'mm' : MILLIMETERS

APPENDIX C – FRANZ ENVIRONMENTAL REPORT (2011) -
Section 8: Site Specific Ecological Risk Assessment, and
Appendices, B, G and K

8.0 SITE SPECIFIC ECOLOGICAL RISK ASSESSMENT

This section presents the assumptions, methodologies and results of the Site Specific Ecological Risk Assessment (SSERA) that was conducted to determine the potential risks to ecological receptors based on the environmental conditions at the Site. The underlying data and other information regarding the characteristics, hydrogeology, environmental conditions, and contaminant transfer and impacts have been discussed in previous sections.

8.1 SSERA OBJECTIVES

The primary objective of the SSERA was to determine if previously identified CoCs in soil represent a potential risk to ecological receptors and, if so, to propose risk management strategies to reduce exposure of receptors to acceptable levels.

8.2 APPROACH TO THE SSERA

The SSERA followed guidance provided in the DFO Terms of Reference Module – Site Specific Ecological Risk Assessment dated April 2010, and was based on the CCME's ecological risk assessment framework, and followed the guidance on the CCME document entitled: "A Framework for Ecological Risk Assessment: General Guidance" (CCME 1996), and "A Framework for Ecological Risk Assessment: Technical Appendices" (CCME 1997). Other risk assessment guidance and technical documents from the MOE, US EPA and Oak Ridge National Laboratory (ORNL) were also employed, where applicable.

8.2.1 Selection of Assessment and Measurement Endpoints

The assessment endpoints for a SSERA should be relevant to the site-specific contamination and should be capable of being assessed based on the available data (CCME, 1996). In contrast to human assessment endpoints that focus on the most sensitive individual, the assessment endpoints for a SSERA are selected to evaluate the potential for site-specific toxic effects that could result in reduction of populations of valued ecological receptors, relative to comparable non-contaminated sites or background areas.

For this SSERA, population level measurement endpoints (i.e., effects on survival, reproduction, and/or growth) were selected for the contaminants of concern in order to determine exposure limits and toxicity benchmarks for the selected receptors. The threshold for significant effects of the screening benchmarks selected for this SSERA were based on a twenty five percent reduction in growth, or reproduction, or activity. This threshold value is consistent with other ecological screening benchmarks and is consistent with the objective of the risk assessment to protect the viability of the population and community of organisms within the ecosystem.

8.3 PROBLEM FORMULATION

The objective of the problem formulation is to identify which chemicals can potentially cause risks to ecological receptors.

For the problem formulation component of the SSERA, an evaluation of CoCs, ecological receptors, and relevant pathways of exposure was conducted in order to identify which substances had the potential to cause adverse effects to ecological receptors. This information was used to develop an Ecological Conceptual Site Model (ECSM) that represents the current understanding of the sources of contaminants, release and transport mechanisms within and among environmental media, and exposure pathways by which ecological receptors may be exposed to contaminants.

8.3.1 Contaminants of Concern

As described in Section 6 (Chemical Screening), CoCs for ecological receptors were identified by comparing the maximum detected concentration in soil preferentially to the corresponding CEQG developed by the CCME. For those constituents with no CCME guidelines the maximum value was compared to the MOE Table 1 Full Depth Background Site Condition Standards. If no CCME and MOE guidelines/standards were available then the maximum detected concentration in soil was compared to the background soil concentration. Considering the characteristics of the Site, the most appropriate CEQGs were deemed to be those derived for a residential/parkland land use scenario. Parameters that exceeded the CEQG or the MOE Table 1 standards or the background as applicable were carried forward into the quantitative risk assessment.

CoCs selected for ecological risk assessment include the following:

<u>Front Range:</u>

<u>Metals and organometals:</u>

- **Barium, copper, lead, selenium, and zinc**

<u>PHCs:</u>

- None (considered background explanation provided in **Section 6.4**).

<u>Rear Range:</u>

<u>Metals and organometals:</u>

- **Barium, copper, lead, mercury, methylmercury, selenium, tin, and zinc**

<u>PHCs:</u>

None (considered background explanation provided in **Section 6.4**).

PCBs:

- No PCBs were identified as CoCs.

Squatter`s Area:

Metals:

- **Selenium and zinc**

8.3.2 Ecological Conceptual Site Model

The Ecological Conceptual Site Model (ECSM) is a description of how ecological receptors may be exposed to contaminants present on a site. It requires not only an identification of ecological receptors and exposure routes, but also incorporates site-specific information on the environmental conditions such as depth of contamination, type of soil, depth of groundwater unit(s), contaminant transport with the groundwater, distance to the nearest body of water, and future land development.

The SSERA was conducted for species known or likely to be onsite, or in the immediate vicinity of the Site. The ECSM developed and relied upon for this assessment is shown in **Figure 8.1.**

8.4 RECEPTOR CHARACTERIZATION

Ecological habitat, and species at risk are presented on Section 2 of this report. The information on site ecology was used to identify ecological receptors that use or could potentially use or inhabit the area. As previously described Stokes Bay Front Range and Squatter`s Area are both located on Knife Island, whereas Stokes Bay Rear Range is located on the southeastern shoreline of Stokes Bay in the mainland. Given that Stokes Bay Front Range and Squatter’s Area are located in a small island with a total area of 2.3 ha and considering the home ranges of white tailed deer of 59 to 520 ha and red fox of 96-717 ha it is reasonable to assume that medium to large mammals are unlikely to be present at Knife Island. On the other hand the Rear Range is located on mainland and therefore would be assessable to medium to large mammals. Therefore, receptors selected for the Front Range and Squatter`s Area do not include medium to large animals.

8.4.1 Valued Ecosystem Components (VECs)

The selection of Valued Ecosystem Components (VEC) and receptor species were based on criteria developed by the CCME (1997) and Suter (1989) and included the following:

- are important to human populations and have economic and/or social significance

- have intrinsic ecological significance and include threatened or endangered species

- sensitivity to the chemical and other stressors at the site
- serve as a baseline from which the impacts of development can be evaluated, including changes in management or regulatory policies

VECs were selected in order to represent, where possible, both taxonomic and/or ecological guilds. The following are descriptions of the VECs selected for this SSERA, with rationale provided for each selection.

8.4.2 Former Squatter`s Area, Front Range and Rear Range Areas:

Terrestrial Plants:
Plants are a primary feature of terrestrial habitats and provide an important food source for herbivores. Exposure to CoCs may result in a loss of net ecosystem productivity by directly impacting the ability of plant species to photosynthesize and produce biomass and/or reproduce. Disruption of ecosystem function may also occur indirectly through negative health impacts for organisms that consume plant tissues contaminated by CoCs.

Soil Invertebrates:
Soil-dwelling invertebrates can be also at considerable risk for negative impacts from continuous exposure to CoCs in soil. These organisms play an important role in the degradation of organic materials and also serve as a significant food source for animals higher up the food chain. Negative impacts to soil invertebrates could impair nutrient cycling and adversely impact the health and population dynamics of animals that feed upon them.

Birds:
The American Robin (*Turdus migratorius*) inhabits most of continental North America and nests in a variety of habitats including forests, swamps, open woodlawn, orchards, parks and lawns. The American Robin forages on the ground by hopping along the ground in search of ground-dwelling invertebrates and by searching for fruit and foliage-dwelling insects in shrubs and low tree branches. The diet of the American robin changes seasonally between fruits and insects depending on availability. The American robin is selected as VEC given that due to its feeding habits, it is directly exposed to terrestrial invertebrates, and it is a suitable surrogate species for other birds that consume insects and toxicological data are readily available for this species.

The Northern Cardinal (*Cardinalis cardinalis*) is a herbivore and was selected as a VEC since it is a prey item for the higher trophic levels (i.e., red fox and peregrine falcon) and it provides a link between the plants (and therefore, the contaminated soil) and the higher trophic levels.

The Herring Gull (*Larus argentatus*) is an omnivorous scavenger and is selected as a VEC as it is a prey item for the higher trophic levels (i.e. red fox and peregrine falcon) and it has different feeding habits than the American Robin.

Peregrine Falcon (*Falco peregrinus*) is a carnivore and as such it is at the top of the food chain.

Mammals:

Mammals may be exposed to CoCs by consuming contaminated vegetation, soil invertebrates exposed to contaminated soil, by inhaling or ingesting soil particulates, or by coming in direct dermal contact with contaminated soil by digging or burrowing.

Small mammals that may be expected to inhabit or feed within all areas include shrews, voles, mice, squirrels and chipmunks. From an ecological viewpoint, small mammals play important roles in insect control, seed dispersal and as prey for higher trophic level predators. Small mammals selected for assessment are described below:

Herbivorous Mammals:

Meadow vole (*Microtus pennsylvanicus*) is primarily granivorous and lives in a large variety of habitats including woodland, prairies, rocky habitats, tundra and desert. It eats principally forage species of vegetation such as seeds, green vegetation, roots, fruits and fungi as available. It is a prey item for the higher trophic level receptors. The vole was selected to represent a terrestrial herbivorous mammal because of its feeding habits, it is a suitable surrogate for other herbivorous rodents.

Insectivorous Mammals:

Shrews are small insectivorous mammals that range throughout the north-central and northeastern United States and Canada. They eat insects, worms, snails, and other invertebrates. Shrews are an important component of the diet of many owls and are also prey for other raptors, fowl, weasels, and other carnivorous mammals. The Short-tailed Shrew (*Blarina brevicauda*) was chosen to represent a terrestrial insectivore because of its feeding habits, it is a suitable surrogate for other insectivorous rodents.

Reptiles:

Reptiles are not commonly included in ecological risk assessment due to limited toxicity data. However, as indicated in Section 2.9 the Massasauga Rattlesnake, a threatened species, might potentially inhabit the Squatter's Area, Front and Rear Ranges reptiles were included in this SSERA. The reptiles included are described below:

Massasauga Rattlesnake (Sistrurus catenatus) was formerly widely distributed in southwestern Ontario, it is now found only in rocky and scrub habitat near the shores of lakes Huron, Erie and Georgian Bay. The Massasauga preys on warm-bodied prey and feeds mostly on rodents.

Five-lined skink (Eumeces fasciatus) forages for food and feeds mostly on worms, insects and other invertebrates. It usually prefers wooded locations with sand soil and ground cover but also frequent rocky habitat with crevices for concealment.

8.4.3 Rear Range:

In addition to the receptors described above the following receptors were also included in the Rear Range assessment.

Herbivorous Mammals:

Whitetail Deer (Odocoileus virginianus) is a herbivore likely to consume mostly browse species of plants. This species was included as a VEC and it has very different exposure characteristics than the meadow vole.

Carnivorous Mammals:

Red fox (Vulpes vulpes) is a carnivore and it was selected to represent the carnivorous mammal guild.

8.4.4 Off-Site Receptors

Aquatic receptors

Aquatic receptors include aquatic primary produces, benthic invertebrates, and fish which inhabit the waters of Lake Huron. Aquatic receptors were not included in this risk assessment. It is very likely that any off-site migration of CoCs through soil dust, and / or groundwater discharge of CoCs would be greatly diluted within the surface water of Lake Huron and therefore concentrations of any CoCs on site is interpreted to be of no risk to aquatic receptors off-site. In addition an assessment of the potential leaching of CoCs in soil was conducted by comparing the maximum concentration of CoCs in soil with the MOE 2009 S-GW3 component screening values which are protective of groundwater discharging into surface water. All organic parameters were below the S-GW3. The MOE does not provide S-GW3 for most metals, however given the characteristic of the Site and the neutral soil pH (average of 6.9 at the Front Range & Squatter's Area and average of 6.8 at the Rear Range) metals are likely to have low mobility. The screening against the S-GW3 value is presented on **Table 8.1** in **Appendix K.** Furthermore, two sediment samples were collected at the Front Range and analyzed for metals, methylmercury and total organic carbon and the concentrations of all parameters were less than the applicable CCME ISQG and PEL guidelines.

8.5 EXPOSURE ASSESSMENT

An exposure pathway is a mechanism by which a receptor, in this case an ecological receptor, is exposed to chemicals from a source. The following four elements constitute a complete exposure pathway:

- A source and mechanism of chemical release;
- A retention or transport medium;
- A point of potential receptor contact with the affected medium, and
- A means of entry into the body (e.g. ingestion) at the contact point.

Only complete pathways including all four elements result in exposure. An exposure assessment estimates how much of a particular compound each identified receptor may potentially be exposed to. The following sections present identified complete exposure pathways and VECs at the Site and the rationale for inclusion (or not) into the risk estimates.

8.5.1 Pathway Analysis

Pathway analysis identifies all possible exposure routes through which on-site and off-site ecological receptors may come into contact with CoCs detected at a site. Ecological receptors may be exposed to chemicals via multiple exposure pathways, such as ingestion, inhalation and dermal contact with contaminated media. The exposure pathways considered in the quantitative assessment are described below.

8.5.2 Direct Contact with Soil

Plants, soil microorganisms, soil invertebrates and various animals that burrow or dig for food may come into direct contact with CoCs present in the soil. CoCs can be accumulated by dermal absorption (plants and animals), soil particle inhalation (animals) or soil particle ingestion (animals). Of these pathways, soil particle ingestion (animals) and dermal absorption (plants) were considered the most significant exposure pathways. Direct contact with soil CoCs is only relevant for surficial soil, as the majority of animal activity and plant fine root colonization is relevant to the upper 1.0 m to 1.5 m. The following paragraphs describe how ecological receptors may be exposed to CoCs detected in soil at the Site.

Terrestrial Plants:

All plants were assumed to be exposed to impacted soil, as their roots have the potential to take up materials from the soil. This was considered the most relevant and significant exposure pathway to CoCs in soil by plants. Exposure to CoCs by off-site plants was not considered because the entrainment and migration of dust from the Site to off-site locations is an intermittent process and would not contribute significantly to contaminant concentrations off-site.

Soil Invertebrates:

Soil invertebrates may be exposed through ingestion of contaminated soil or via direct dermal contact of CoCs in soil. Dermal contact was considered relevant only for surficial soil as the vast majority of soil invertebrates reside in upper 1.0 m to 1.5 meters of soil.

Terrestrial Birds, Mammals and Reptiles:

Birds, mammals and reptiles may be exposed to CoCs in soil via ingestion, inhalation of vapours and particulates and dermal contact with soil.

8.5.3 Inhalation of Vapours and Particulates

Inhalation of vapours is considered a negligible exposure pathway given that VOCs were not identified as CoC, albeit the PHC F2 and mercury identified at the Front Range can release vapours the current scientific knowledge is very limited with respect to the inhalation exposure pathway which precludes a quantification of this exposure pathway. Therefore it is interpreted that inhalation of volatiles is not a dominant exposure route for animals.

Inhalation of particles is also a possible pathway for animals, however the present status of scientific knowledge does not allow for the quantitative evaluation of ecological risk based on inhalation pathway, therefore assessment of the inhalation exposure pathway will be qualitative due to lack of suitable TRVs specifically for the inhalation pathway.

8.5.4 Dermal Contact with Soil

While dermal exposure is possible, it is assumed to be a minor exposure pathway for birds and mammals given that it has been reported that feathers or fur effectively reduce dermal exposure by limiting the contact of skin with chemicals (Sample et al. 1997).

There is very little information on the overall ecotoxicology for reptiles and as such quantification of dermal exposure to the CoC on soil is very difficult to estimate, therefore it is assumed that dermal exposure is negligible relative to oral exposure.

8.5.5 Ingestion of Contaminated Food Items

Ingestion of food items (including terrestrial plants and animals) potentially contaminated with CoCs by any of the previously described routes also represents a potential exposure pathway for mammals and birds. Incidental ingestion of contaminated soil along with food items is also considered in this risk assessment.

8.6 Quantitative Exposure Assessment

The approaches used to estimate and quantify exposure to CoCs for each exposure pathway considered and the results of the quantitative exposure assessment are described below.

8.6.1 Concentrations of CoCs in Soil Used for the Quantitative Assessment

The exposure concentrations in site media should be derived such that they represent a reasonable maximum for the Site. To evaluate the reasonable maximum exposure (RME) case, the US EPA recommends a measure of the 95 percent upper confidence limit (95% UCLM) of the mean contaminant concentration for the Site. The 95% UCLM value utilizes the entire range of the available data and inherently incorporates both a measure of central tendency and a measure of data variability.

As per DFO recommendation (DFO Terms of Reference Appendix, DFO Guidance on Screening Level Ecological Risk Assessment, May 2009) the 95% UCLM is most representative of the reasonable maximum and should be used for soil exposures estimation for all receptors, including plants and invertebrates. DFO also indicates that in situations where discrete areas within the Site are contaminated and other areas are not, the exposure estimate for foraging wildlife that would move around the Site can be represented using a spatially weighted average of the 95% UCLMs. In this SSERA the sampling program was targeted at hot spots and therefore a spatially weighted average would be biased towards areas of high concentrations. Therefore, the 95% UCLM was used for exposure estimation for all ecological receptors assessed including the sessile receptors.

In order to provide a consistent and scientifically rigorous approach to the derivation of the 95% UCLM, the ProUCL Version 4.00.02 (ProUCL 4.00) which is an upgrade of ProUCL Version 3.0 developed by the US EPA in 2004 was used and was described in further depth in section 7.3.4.

For this assessment two sets of 95%UCLMs were calculated, one set included the data for the Front Range and Squatter`s Area and a second set included the data for the Rear Range only. The data available for the Stokes Front Range and Squatter`s Area was combined in the calculation of the 95% UCLM, as they are both located within Knife Island, and it is assumed that the receptors have equal access to both locations. The 95%UCLM for the Rear Range was done separately as the Rear Range is located on the mainland. The concentrations of the CoC used for the exposure estimations are provided on **Table 8.2a (Front Range & Squatter`s Area)** and **Table 8.2b (Rear Range)** in **Appendix K.**

8.6.2 CoCs Concentration in Food Items of Used for the Quantitative Assessment

8.6.2.1 Plant Tissue Concentrations:

Vegetation samples collected were grouped according to whether they were forage or browse as previously described in section 5.3.1 of this report. Forage species are low lying vegetation such as ground covering plants, and browse species include mostly shrubs and trees. The plant tissue CoC concentrations of metals and mercury were analysed and the laboratory CoC concentrations for each plant species analysed were converted from dry weight to wet weight based on moisture content also provided by the laboratory.

Table 8.2a (Front Range & Squatter`s Area) and **Table 8.2b (Rear Range)** in **Appendix K** summarizes the mean concentrations for forage and browse used in the risk assessment.

8.6.2.2 Tissue CoCs Concentration in Soil Invertebrates (earthworms):

One invertebrate sample was collected and analysed for metals and mercury and therefore the metals and mercury results were used as the tissue CoC concentrations for invertebrates.

The measured tissue concentrations for invertebrates are presented in **Appendix K** in **Table 8.2a (Front Range & Squatter`s Area)** and in **Table 8.2b (Rear Range).**

8.6.2.3 Tissue CoCs Concentration in Prey Items (small mammals and small birds):

The contaminant concentration in the tissues of prey items (i.e., meadow vole, shrew, robin and cardinal) is the result of the ingestion of plants (herbivorous prey) or invertebrates (insectivorous prey) or plants and invertebrates (omnivorous prey), plus the ingestion of soil, and the ingestion of water. In this risk assessment the exposure to CoCs through ingestion of water was not considered. An example for the meadow vole, which is considered an herbivorous mammal, is provided below:

<u>Contaminant Concentration in the Tissue of Meadow Vole:</u>

$$C_{MV} = (C_P * BCF_{P\text{-}MV} * F_P * P_P) + (C_s * BCF_{s\text{-}MV} * P_s)$$

Where:

C_{MV} = CoC concentration in meadow vole (mg CoC/kg $_{WW}$ tissue)

C_P = CoC concentration in plants (mg CoC/kg $_{WW}$)

$BCF_{P\text{-}MV}$=Bioconcentration factor for plant-to-meadow vole (unitless [(mgCoC/kg $_{WW}$tissue)/(mgCoC/kg $_{WW}$)]

F_P = Fraction of diet comprised of terrestrial plants (1, assumed 100%)

P_P = Proportion of plant in diet that is contaminated (1, assumed 100%)

C_s = CoC concentration in soil (mg CoC/kg $_{DW}$ soil)

$BCF_{S\text{-}MV}$ = Bioconcentration factor for soil-to-meadow vole unitless [(mg CoC/kg $_{WW}$tissue)/(mg CoC/kg $_{DW}$soil)]

P_s = Proportion of ingested soil that is contaminated (1, assumed 100%)

$_{WW}$= wet weight, $_{DW}$ = dry weight

Bioconcentration Factors for mammals and birds are presented on **Table 8.3a** for plants to wildlife and **Table 8.3b** for soil to wildlife (**Appendix K**).

8.6.3 Exposure Equations

Parameters including body weight, dietary composition, and soil ingestion rates are required in order to determine wildlife exposure to the CoCs. The selected wildlife parameters were obtained from the USEPA 1993 "*Wildlife Exposure Factors Handbook*" as well as other sources identified on **Appendix K**. The receptor characteristics used in this exposure assessment are presented in **Appendix K** in **Table 8.4** for mammals, **Table 8.5** for birds and **Table 8.6** for reptiles.

Exposure estimations for wildlife (birds, mammals and reptiles) are based on the generic equations provided in the CCME guidance document (CCME 1996).

Exposure via Ingestion:

$$E_{ingestion} = E_{food} + E_{water} + E_{soil}$$

Where:

$E_{ingestion}$ = total ingestion exposure (mg/kg$_{ww}$-day)
E_{food} = exposure from food consumption (mg/kg$_{ww}$-day)
E_{water} = exposure from water (mg/kg$_{ww}$-day)*
E_{soil} = exposure from soil (mg/kg$_{ww}$-day)

* exposure from water was not included in this risk assessment.

The following equations were employed to calculate the terms of $E_{food,}$ E_{water} and E_{soil} in the above equation.

Food Ingestion ($E_{\mathbf{food}}$):

$$E_{food} = (C_{food} * IR_{food})$$

Where:

E_{food} = exposure from food consumption (mg/kg$_{ww}$-day)
C_{food} = CoC concentration in food (mg$_{ww}$/kg)
IR_{food} = food ingestion rate (kg/kg$_{BW}$-day)

Water Ingestion (E_{water}):

$$E_{water} = (C_{water} * IR_{water})$$

Where:

E_{water}	=	exposure from water (mg/kg-day)
C_{water}	=	CoC concentration in water (mg/L)
IR_{water}	=	water ingestion rate (L/L_{BW}-day)

Water ingestion was not included in the exposure since there are no ponds on the Site.

Ingestion of Soil (E_{soil}):

$$E_{soil} = (C_{soil} * IR_{soil})$$

Where:

E_{soil}	=	exposure from soil (mg/kg_{ww}-day)
C_{soil}	=	CoC concentration in soil (mg/kg DW)
IR_{soil}	=	ingestion rate of soil (kg/ kg_{BW}-day)

Exposures were calculated as daily doses of each of the CoCs and the total exposure through ingestion of contaminants is calculated as the summation of food, water and soil consumption.

The final intake from each location is calculated as the total exposure through ingestion multiplied by the fraction of home range the receptor is present on the area. For animals with small home ranges, the impacted area may make up all or a large portion of the area they cover to obtain food. For animals with large home ranges, the impacted area may only make up a small portion of the area in which they cover to obtain food. To illustrate the approximate area of soil impacts at the Rear Range is approximately 0.19 ha, the meadow vole has a home range of 0.059 ha therefore the fraction of home range on the contaminated area of the Rear Range is 100% or 1, on the other hand the home range of the red fox is 96 ha, therefore the fraction of home range on the contaminated area of the Site for the fox is approximately 0.20% or 0.002. Home range fraction values are presented with receptor characteristics in **Table 8.4**, **Table 8.5** and **Table 8.6** located within **Appendix K.**

Estimated exposures for the mammals, birds and reptiles are provided in the following tables located within **Appendix K**:

- Estimated exposures for birds are presented in **Table 8.7a (Front Range & Squatter`s Area) and in Table 8.7b (Rear Range);**
- Estimated exposures for mammals are presented in **Table 8.8a (Front Range & Squatter`s Area) and in Table 8.8b (Rear Range);**

- Estimated exposures for reptiles are presented in **Table 8.9a (Front Range & Squatter`s Area) and in Table 8.9b (Rear Range)**

8.7 HAZARD ASSESSMENT

Hazard Assessment describes the relationship between the CoCs and the most important ecological end-points. Within the context of the SSERA hazard assessment is usually accomplished by the measurement of a toxicity of a substance. For this hazard assessment the individual responses of survival, growth and reproduction were selected as end-points since they have the potential affect the success of the population, which in turn may cause effects at the community and ecosystem levels.

Toxicological reference values (TRVs) by definition, represent the exposure dose (or concentration) that is considered to pose negligible risk of adverse effect for short- and long-term exposure. For a site specific ecological risk assessment, it is important to emphasize that the goal is not to protect each individual organism, but rather to protect enough individuals so that a viable population and community of organisms can be maintained. However, if there are endangered or threatened species those species should be protected at the individual level. In practice however, it is very difficult to ensure that the individual species is protected, and one way to ensure adequate protection is to apply the most conservative TRV available, which can be done by applying safety factors to TRVs as explained below.

TRVs adopted for this assessment are summarized in the following sections.

8.7.1 Toxicological Reference Values (TRVs)

Toxicological reference values represent the concentrations of CoCs that are considered to be protective of sensitive ecological receptors, assuming continuous exposure for an entire lifetime.

Exposure limits for terrestrial plants and invertebrates, mammals and birds were adopted from several sources as presented and summarized on **Table 8.10** in **Appendix K**. Lowest-observed-adverse effect levels (LOAELs) for mammals and birds and Lowest-observed-effect-concentration (LOEC) for plants and invertebrates were used whenever possible. For reptiles, there were no available TRVs for the CoCs therefore the TRVs from mammals with an uncertainty factor of 10 was applied. In addition, given that the Massasauga Rattlesnake (a threatened species) is present on site and in order to ensure adequate protection of this species the LOAELs were converted to NOAELs by applying an uncertainty factor of 10. Therefore, the TRVs from mammals were multiplied by 0.01 and then used for the risk estimation for reptiles.

Allometric dose scaling to estimate a toxicity value for the VEC using toxicity data from tested organism and correcting for differences in body weight was not used in this ecological risk assessment. Recently, there has been controversy as to the applicability of allometric dose scaling derived for acute toxicity when the effect of interest is chronic (UBC Risk Symposium, 2007). TRVs selected for the evaluation of ecological risks are provided on **Table 8.10** in **Appendix K.**

8.8 RISK ESTIMATION

Risk estimation was quantified using the quotient method to calculate an Ecological Screening Quotient (ESQ). The ESQ is the quotient of the CoC estimated exposure level (EEL) divided by the CoC and measurement receptor specific TRV, as follows:

$$ESQ = EEL/TRV$$

Where:

ESQ = Ecological screening quotient (unitless)
EEL = CoC estimated exposure level (mass CoC/mass media [communities] or mass daily dose CoC ingested/mass body weight-day [class-specific guilds])
TRV = CoC toxicity reference value (mass CoC/mass media [communities] or mass daily dose CoC ingested/mass body weight-day [class-specific guilds])

ESQs for community measurement (i.e., terrestrial plants and invertebrates) receptors were calculated using EELs specific to the CoC 95% UCLM concentration in the corresponding soil. A CoC specific ESQ is calculated for each community measurement receptor at each location evaluated, as appropriate for the food web being analyzed in the risk assessment. As per recommendation of DFO the 95 % UCLM (DFO Appendix for SLERA, May 2010) was used to calculate ESQs for plants and soil invertebrates.

For calculating ESQs for class-specific guild measurement receptors, the EEL is the daily dose of CoC ingested. A CoC specific ESQ is also calculated for each class-specific guild measurement receptor at each location evaluated, as appropriate for the food web being analyzed in the risk assessment.

An ESQ less than 1 indicates that adverse effects are not expected. When interpreting the results, it is important to consider that the assessment endpoint selected was a sustainable level of ecological health. As such, ESQ values greater than 1 indicate that adverse effects to individual receptors are possible but not necessarily likely, nor does it indicate that adverse effects to receptors will necessarily translate into risk at the population level. Following the MOE 2007 technical training session with respect to the quantitative interpretation during risk characterization an ESQ > 1 indicates that potential risks are possible, whereas an ESQ greater than 10 indicates that potential risks are likely to occur.

The results of the risk characterization for the quantitative ecological assessment are summarized in the following tables located in **Appendix K**:

- ESQs for plants and invertebrates are presented in **Table 8.11a (Front Range & Squatter`s Area) and Table 8.11b (Rear Range)**
- ESQs for birds are presented in **Table 8.12a (Front Range & Squatter`s Area) and Table 8.12b (Rear Range)**
- ESQs for mammals are presented in **Table 8.13a (Front Range & Squatter`s Area) and Table 8.13b (Rear Range)**
- ESQs for reptiles Site are presented in **Table 8.14a (Front Range & Squatter`s Area) and Table 8.14b (Rear Range)**

8.8.1 Summary of Ecological Risks

Ecological Screening Quotients were calculated for all combinations of CoCs and receptors of concern at the Site. The results are summarized below.

Stokes Bay Front Range & Squatter`s Area

At the Front Range & Squatter's Area ESQs associated with lead and zinc exposures were above 1 for terrestrial plants and invertebrates.

For all birds, mammals and reptiles calculated ESQs were below 1 for all CoCs assessed.

Lead:

For terrestrial plants the calculated ESQ of 10.4 is above the target level of 1 which indicates that potential risks are possible and is also slightly above 10 suggesting the risks are likely to occur. For plants the ESQ is based on a LOEC of 740 mg/kg associated with reduced seedling emergence in lettuce (Environment Canada 1995). The same study provided an EC50 of 876 mg/kg which is only an increase of 16% in lead concentration with respect to the LOEC tested but with the potential to affect 50% of the individuals tested. Considering that the ESQ of 10.4 is based on the 95%UCLM it is likely that plant growth is reduced in locations with excessively high lead concentration (i.e. 36,100 mg/kg near the old Front Range Tower).

For terrestrial invertebrates the calculated ESQ of 5.2 is above the target level of 1 but below 10 which indicates that potential risks are possible but unlikely to occur. The ESQ is based on a TRV developed through a study with *E. foetida* and the NOEC concentration. Therefore, it is interpreted that risks due to lead concentrations is minimal.

Zinc:

For terrestrial plants and invertebrates the ESQs of 1.7 and 1.4 respectively are above the target level of 1 and indicate that potential risks are possible but unlikely to occur. For plants and invertebrates the ESQ was based on toxicological benchmarks developed by the MOE 2009. The ESQ for plants is based on a LOEC associated with effects on biomass and seedling emergence, and the ESQ for invertebrates is based on a LOEC associated with decrease in growth with earthworms. Based on this information and the low ESQs potential risks to plants and invertebrates are interpreted to be minimal.

Stokes Bay Rear Range

At the Rear Range ESQs associated with copper, lead, mercury and zinc exposures were above 1 for terrestrial plants and/or invertebrates.

For mammals the ESQ associated with exposure to zinc was above 1 for the short-tailed shrew. Calculated ESQ for all other parameters and mammals receptors were below 1.

For birds the ESQ associated with exposure to zinc was above 1 for the American robin, ESQ for all other CoCs and the three other birds assessed were below 1.

For reptiles ESQs were below 1 for all CoCs assessed.

The significance of those results is discussed below:

Copper:
For terrestrial plants and invertebrates the calculated risk quotients of 1.8 indicates that potential risks are possible but very unlikely. For plants and invertebrates the ESQ was based on a direct soil contact concentration for plants and invertebrates developed by the MOE 2009. The direct contact concentration value is based on six soil invertebrate studies and 12 vegetation studies. The MOE used a weight of evidence method, which uses the distribution of effects/no-effects data was used to derive a direct soil contact value for copper. The 25th percentile of the rank distribution was 141 µg/g, and the 50th percentile was 232 µg/g. Based on this information and considering that low level of the ESQ risks to plants and invertebrates are interpreted to be minimal.

Lead:
For terrestrial plants the calculated ESQ of 1.1 is marginally above the target level of 1 which indicates that potential risks are possible but very unlikely. For plants the ESQ is based on a LOEC associated with reduced seedling emergence in lettuce. Therefore, given that the ESQ is based on a LOEC and considering the relatively low ESQ < 10 risks to plants due to exposure to lead in soil are interpreted to minimal.

Mercury
For terrestrial invertebrates the calculated ESQ of 1.6 is slightly above the target level of 1 which indicates that potential risks are possibly but unlikely to occur. The ESQ is based on a

TRV developed through a study with methylmercury chloride and *E. fetida* was cultured for 84 days with a reduced survival by 21%. Considering the low ESQ calculated the risks to invertebrates at the Rear Range are interpreted to be low.

Zinc:
For terrestrial plants and invertebrates the ESQs of 22.3 and 18.6 respectively are above 10 and indicate that potential risks are possible and likely to occur. For plants and invertebrates the ESQ was based on toxicological benchmarks developed by the MOE 2009. The ESQ for plants is based on a LOEC associated with effects on biomass and seedling emergence, and the ESQ for invertebrates is based on a LOEC associated with decrease in growth with earthworms. Based on this information potential risks to plants and invertebrates are likely to occur and the Rear Range.

For the American robin an ESQ of 3.0 is above the target level of 1 and indicates that potential risks are possible but unlikely to occur (ESQ<10). The ESQ is based on a TRV developed through a study with leghorn hens that derived a chronic LOAEL associated with an egg hatchability was <20% of controls. Given the relatively low ESQ and the level of effect reported in the study it is interpreted that risks to the American robin due exposure to zinc is low.

An ESQ of 1.3 was calculated for the short-tailed shrew and indicates that potential risks are possible but very unlikely. The ESQ is based on a TRV developed through a study with rats hens that derived a chronic LOAEL associated with an increased rates of fetal reabsorption and reduced fetal growth rates. Given the low ESQ and the level of effect reported in the study it is interpreted that risks to the small mammals due exposure to zinc is low.

8.8.2 Discussion of Uncertainty

This risk assessment incorporated conservative approaches so that ecological receptors are adequately protected. Each step in an SSERA process involves the use of assumptions and protocols that impart uncertainty to the final results. As noted above, whenever possible, assumptions that tend to increase conservativism are adopted to ensure the likelihood for underestimating the potential effects is minimized. In some cases however, the absence of technical information concerning the toxicology of a given constituent to other factors precludes the consideration of a chemical or exposure route in the quantitative assessment. Some of the primary sources of uncertainty and their probable effect on the overall conservativism inherent in the analysis of this SSERA are presented below:

8.8.2.1 Representative Chemical Concentrations:

Soil:

A source of uncertainty is the representation of the chemical concentrations used in the exposure calculation. It this assessment, the sampling program was targeted at potential “hotspots” and it is reasonable to assume that the data collected is representative of the highest concentrations at the Site. However contaminant concentrations across much of the Stokes Front Range & Squatter`s Area, and Rear Range are likely much lower than those used in the calculations, thus the risk estimates are conservatively high.

Using the 95%UCLM to estimate exposures to relatively sessile receptors such as plants and invertebrates may underestimate the actual risk given plants and/or invertebrates may be present at locations were concentrations are considerably higher than the 95%UCLM.

Vegetation:
For metals and mercury the concentrations in plant tissue were empirically measured and therefore the uncertainties would tend to reduce.

Invertebrates:
Likewise for invertebrates the metal and mercury concentrations in invertebrate tissue were empirically measured, however only one sample of invertebrate was collected which does not represent well the metals concentration distribution in invertebrates. Nevertheless, a site specific measured value is more reliable that a modeled value and therefore the uncertainties would tend to reduce.

Prey Items:
The contaminant concentration in the tissues of prey items (i.e., meadow vole, shrew, robin and cardinal) was calculated by applying media to wildlife bioconcentration factors available from the US EPA Screening Level Protocol. For some parameters BCFs of 1 are used and the use of a BFC of 1 is very conservative and likely to overestimate the concentrations in prey tissues used as food sources for the higher trophic level receptors.

8.8.2.2 Receptor Characteristics:

In this assessment, the most conservative assumptions regarding area use, bioavailability, body weight, ingestion rate, and other exposure parameters were adopted, leading to a conservative estimate of potential exposure.

8.8.2.3 Ecological TRVs:

A source of uncertainty is the applicability of the TRVs to the various exposure pathways and ecological receptors identified in this report. TRVs were obtained from reputable sources, however the TRVs are based on toxicity data from laboratory species such as rats and mice. A common procedure to extrapolate laboratory toxicity data to wildlife species is the use of allometric dose scaling using body mass. In this risk assessment allometric dose scaling was not applied for adjustment of the selected TRVs. The objective of allometric dose scaling is to reduce uncertainty by accounting for interspecies differences in susceptibility to a toxicant. These scaling factors are usually based on acute toxicity estimates with 50 percent mortality as the effects endpoint (Sample et. al., 1996, Sample and Arenal 1999). However, a recent risk symposium (UBC Risk Symposium, 2007) concluded that the application of allometric dose scaling (derived for acute toxicity) is not appropriate for chronic toxicity data.

It is difficult to ascertain if the use of TRVs without the allometric dose scaling will under or overestimate the risks for the wildlife receptor.

Uncertainty factors were applied in the derivation of the TRVs to convert acute to chronic effects, median lethal dose to the LOAEL (excluding the reptiles were a NOAEL was used) in addition UF were also applied for interspecifc extrapolation. The use of UFs are intended to augment the level of conservativism and therefore likely overestimate the risks.

No TRVs for Some CoCs:

The lack of TRV values for combinations of receptors and CoCs represents a great degree of uncertainty. In this risk assessment no TRVs were available for PHCs associated with effects on birds and therefore the TRVs from mammals were applied with an additional UF of 10. In addition for reptiles for all CoCs the TRVs used were from mammal studies with an added UF of 10 for interspecific variability.

8.8.3 Overall Interpretation of Ecological Risks

The overall interpretation of the SSERA should include all lines of evidence available at hand. Three lines of evidence are available for interpretation of risks, the ESQs derived for combinations of receptors and CoCs, the habitat observations made during the site investigation and the results of vegetation testing. The integration of the three lines of evidence at the Front Range & Squatter’s Area and at the Rear Range is presented below.

Stokes Bay Front Range & Squatter`s Area

At the Front Range & Squatter’s Area ESQs associated with lead and zinc exposures were above 1 for terrestrial plants and invertebrates. For birds, mammals and reptiles all ESQs were below 1. With respect to the level of ESQ, lead is the only CoC which generated an ESQ above 10.

The ESQ for lead was derived based on the 95%UCLM (7731 mg/kg) and on a LOEC of 740 mg/kg for seedling emergence in lettuce (Environment Canada, 1995) the same study provided an EC50 of 876 mg/kg which is only 16% higher than the LOEC. Looking at the lead concentration in soil it is noted lead concentrations near the vicinity of the old tower at the Front Range varies from about 3,000 mg/kg to 36,000 mg/kg and therefore based on this line of evidence alone it is interpreted that plants located near the old tower are likely to be negatively affected by the high lead concentrations. Lead concentrations in soil at the Squatter's area are much lower (highest of 233 mg/kg), and therefore it is interpreted that plants at the Squatter's Area are not at risk due to lead concentrations.

Looking at the visual observations during the site visit vegetation including plants, trees and shrubs were observed to be generally in good condition however, some evidence of stress was noted in some species both at the Front Range and in the surrounding area and included:

- Red Osier Dogwood shrubs showed significant leaf deformation and discoloration on and around the Front Range (within 50 m of the Light Tower). Some similar distress was noted at a distance of 100 m from the Front Range but it appeared more pronounced near the Light Tower.
- Various plants to the east (down-wind) of the Light Tower exhibited signs of stress. These plants were observed in the area which is believed to be in the down-wind plume of the Light Tower and may have been influenced by loose paint chips. Paint chips were observed in the areas of the distressed vegetation, although limited amounts were observed. Plants observed to be stressed included white cedar, raspberry, red osier dogwood and aspen/poplar.

Therefore, observations of the plant conditions near the Front Range tower provides further evidence that lead concentrations at this location may be impacting the local plants.

Lastly, lead concentrations were measured in 20 plants collected from the Front Range with detected concentrations varying from 1.1 to 26.5 µg/g, and of the 20 plants analysed four samples were below the detection limit of 1.0 µg/g. In contrast, at the background location of the 20 plant samples collected 18 plants had lead concentrations less than the laboratory detection limit of 1.0 whereas only two plant samples presented lead concentrations of 1.4 and 2.4 µg/g.

Based on the above discussion, it is interpreted that risks are likely to occur to plants due to the lead concentrations at the Front Range.

Stokes Bay Rear Range

At the Rear Range ESQs associated with copper, lead, mercury and zinc exposures were above 1 for terrestrial plants and/or invertebrates. For mammals the ESQ associated with exposure to zinc was above 1 for the short-tailed shrew. Calculated ESQs for all other parameters and mammals receptors were below 1. With respect to birds the ESQ associated with exposure to zinc was above 1 for the American robin, ESQ for all other CoCs and the three other birds assessed were below 1. For reptiles ESQs were below 1 for all CoCs assessed.

With respect to the level of ESQ, zinc is the only CoC for which an ESQ >10 was derived. For terrestrial plants and invertebrates the ESQs of 22.3 and 18.6 respectively are above 10 and indicate that potential risks are possible and likely to occur. The ESQ for plants and invertebrates was derived based on a 95%UCLM of 22294 mg/kg of zinc in soil, whereas if the maximum concentration of 172,000 mg/kg ESQs of 695 (plants) and 620 (invertebrates) would have been derived. Therefore, based on this line of evidence alone it is interpreted that plants and invertebrates are likely at risk in locations where zinc is at excessively high concentrations.

Looking at the visual observations during the site visit vegetation including plants, trees and shrubs were observed to be generally in good condition with some evidence of stress noted in some species both at the Rear Range and in the surrounding area. No particular species of vegetation was observed to exhibit obvious signs of distress that could be attributed to any source other than lack of moisture. Some plants in sandy, unforested areas exhibited signs of stress believed to be caused by dry conditions however the exact cause of stress cannot be determined. Based on visual observations the stress noted in some plants can not be attributed to the zinc concentrations detected.

With respect to the zinc concentrations measured in the 20 plants collected at the Rear Range all plants had values above detection limit with concentrations ranging from 12 to 740 µg/g. In addition six plant species had higher zinc concentrations than the Ontario ULN values. At the background location three plants had zinc concentrations below the laboratory detection limit of 10 µg/g and the remaining 17 samples had zinc concentrations ranging from 10-239 µg/g, and all plants had zinc values below the Ontario ULN. Those results indicate that the high zinc concentrations in soils at the Rear Range are being reflected in the zinc concentrations of plants at this location. Further, given that 6 plant species had values above the ULN those results suggests that the stress observed in the plants is likely related to the zinc concentrations in soil rather than the dry conditions.

Lastly, the one invertebrate sample had a zinc concentration of 1200 µg/g at the Rear Range whereas at the background location the zinc concentration was 90 µg/g. Albeit with limited data this result suggests that high zinc concentrations in soils at the Rear Range can be reflected in the zinc concentration of invertebrates at this location. Considering that invertebrates can be used as food sources for other animals such as birds and small mammals this result also suggests that zinc has the potential to be transferred to higher trophic level receptors through the food chain.

Therefore, based on the above discussion, it is interpreted that the zinc concentrations in soil at the Rear Range are likely to be detrimental to plants as well as invertebrates, and can potentially be reflected into higher trophic levels through the food chain. Furthermore, low level risks associated with zinc exposure were also estimated for the American robin and the shrew.

8.9 SSERA CONCLUSIONS

The primary objective of the SSERA was to determine if previously identified CoCs in soil represent a potential risk to ecological receptors and, if so, to propose risk management strategies to reduce exposure of receptors to acceptable levels. The SSERA followed guidance provided in the DFO Terms of Reference Module – Site Specific Ecological Risk Assessment dated April 2010, and was based on the CCME's ecological risk assessment framework, and followed the guidance on the CCME document entitled: "A Framework for Ecological Risk Assessment: General Guidance" (CCME 1996), and "A Framework for Ecological Risk Assessment: Technical Appendices" (CCME 1997). Other risk assessment guidance and technical documents from the MOE, US EPA and Oak Ridge National Laboratory (ORNL) were also employed, where applicable.

The SSERA assessed the potential risks of CoCs in soil to terrestrial plants, terrestrial invertebrates, terrestrial birds (American Robin, the Northern Cardinal, the Herring Gull and the Peregrine Falcon), terrestrial mammals (Meadow vole, Whitetail Deer, Short-tailed Shrew, Red fox) and terrestrial reptiles (Massasauga Rattlesnake and Five Lined skink).

Based on the results of the chemical screening and quantitative ecological risk assessment, ESQs above 1 were calculated for copper, lead, mercury and zinc for one or more receptors at the Stokes Bay Rear Range, whereas ESQs above 1 were calculated for lead and zinc at the Stokes Bay Front & Squatter`s Area. In this risk assessment an ESQ less than 1 indicates that adverse effects are not expected, an ESQ value greater than 1 indicates that adverse effects to individual receptors are possible but not necessarily likely, and an ESQ greater than 10 indicates that potential risks are likely.

With the exception of lead (Front Range) and zinc (Rear Range) the calculated ESQs for copper and mercury were below 10 for all receptors indicating that potential risks are possible but not likely. On the other hand the ESQ for plants and exposure to lead (10.4) at the Front Range and the ESQ for plants (22.3) and invertebrates (18.6) exposed to zinc at the Rear Range are higher than 10 indicating that potential risks are likely to occur.

Risks to the SAR that potentially inhabit the ranges (the Massasauga Rattlesnake) were assessed at an individual level instead of a population level by using NOAELs instead of LOAELs for estimations of ESQs. For all CoCs the ESQs were below 1 indicating that risks to the SAR are unlikely to occur.

The overall interpretation of the SSERA included all lines of evidence available at hand including the ESQs derived for combinations of receptors and CoCs, the habitat observations made during the site investigation and the results of vegetation and invertebrate testing. With respect to the Front Range the lines of evidence suggest that risks are likely to occur to plants due to the lead concentrations in soil. At the Rear Range it is interpreted that the zinc concentrations in soil are likely to be detrimental to plants as well as invertebrates, and can potentially be reflected into higher trophic levels through the food chain.

8.9.1 Derivation of Site Specific Target Levels

As part of the SSERA, ESQs values were used to derive site specific target levels (SSTLs) for potential site remediation. The SSTLs replace the generic criteria and reflect the concentration of contaminants in the Site that do not represent an unacceptable risk to wildlife. For chemicals considered as CoC that generated an unacceptable risk to any of the ecological receptor, a SSTL was calculated by determining the concentration in soil that would not result in unacceptable risks to all ecological receptors. This was accomplished by setting the SSTL to the value protective of the most sensitive ecological receptor (i.e., with the highest risk).

As indicated previously, risks to plants and invertebrates associated with the concentrations of lead at the Front Range have been identified. At the Rear Range risks to plants, invertebrates, and potentially American robin and short-tailed shrew associated with zinc concentrations in soil have been identified. For all other CoCs potential risks were interpreted to be low to minimal. Therefore, SSTLs' were only developed for lead at the Front Range and zinc and the Rear Range. SSTL's were developed for target ESQs of 1 and 10.

The following equation was used to calculate the SSTLs:

$SSTLs_r = (C_{soil}/ESQ_{calculated}) \times ESQ_{target}$

Where:

SSTLs = site-specific target concentration (mg/kg)
C_{soil} = 95% UCLM measured soil concentration (mg/kg)

ESQ_{Target}= 1 and 10
$ESQ_{calculated}$ = Screening Ecological Value Based on Exposure Assessment

The SSTLs calculated are presented in the table below.

CoC	**SSTL ESQ=1 (mg/kg)**		**SSTL ESQ=10 (mg/kg)**	
	Front Range	**Rear Range**	**Front Range**	**Rear Range**
Lead	740	ND	7400	ND
Zinc	ND	1000	ND	10000

The SSTLs were calculated for ESQs of 1 and ESQs of 10. In this SSERA an SSTL based on an ESQ of 10 is considered appropriate for evaluating ecological risks given the level of conservatism used throughout the risk assessment as presented previously in Section 8.2.2.

APPENDIX B

SPECIES AT RISK

Ontario

Ministry of Natural Resources

Natural Heritage Information Centre

Rare Species by Jurisdiction Query Results

Scientific Name	Common Name	COSEWIC	MNR	Srank	Grank
Elements from County BRUCE_CNTY -- (99 records)					
Ixobrychus exilis	Least Bittern	THR	THR	S4B	G5
Ardea alba	Great Egret			S2B	G5
Nycticorax nycticorax	Black-crowned Night-heron			S3B,S3N	G5
Buteo lineatus	Red-shouldered Hawk	NAR		S4B	G5
Rallus elegans	King Rail	END	END	S2B	G4
Charadrius melodus	Piping Plover	END	END	S1B	G3
Larus marinus	Great Black-backed Gull			S2B	G5
Hydroprogne caspia	Caspian Tern	NAR	NAR	S3B	G5
Chlidonias niger	Black Tern	NAR	SC	S3B	G4
Asio flammeus	Short-eared Owl	SC	SC	S2N,S4B	G5
Lanius ludovicianus	Loggerhead Shrike	END	END	S2B	G4
Dendroica discolor	Prairie Warbler	NAR	NAR	S3B	G5
Dendroica cerulea	Cerulean Warbler	SC	SC	S3B	G4
Ammodramus henslowii	Henslow's Sparrow	END	END	SHB	G4
Ichthyomyzon fossor	Northern Brook Lamprey	SC	SC	S3	G4
Acipenser fulvescens	Lake Sturgeon	END, THR,	SC	S3	G3G4
Coregonus hoyi	Bloater	NAR	NAR	S4	G4
Coregonus reighardi	Shortnose Cisco	END	END	S1	GH
Clinostomus elongatus	Redside Dace	END	END	S2	G3G4
Moxostoma erythrurum	Golden Redhorse	NAR	NAR	S4	G5
Moxostoma valenciennesi	Greater Redhorse			S3	G4
Myotis leibii	Small-footed Bat			S2S3	G3
Myotis septentrionalis	Northern Long-eared Bat			S3?	G4
Urocyon cinereoargenteus	Common Gray Fox	THR	THR	SNA	G5
Taxidea taxus	American Badger	END	END	S2	G5
Emydoidea blandingii	Blanding's Turtle	THR	THR	S3	G4
Elaphe gloydi	Eastern Foxsnake	END	THR	S3	G3
Regina septemvittata	Queen Snake	THR	THR	S2	G5
Sistrurus catenatus	Massasauga	THR	THR	S3	G3G4
Cicindela hirticollis	Beach-dune Tiger Beetle			S4	G5
Brychius hungerfordi	Hungerford's Crawling Water Beetle			S1	G1
Erynnis brizo	Sleepy Duskywing			S1	G5
Stylogomphus albistylus	Least Clubtail			S4	G5
Aeshna verticalis	Green-striped Darner			S3	G5
Boyeria grafiana	Ocellated Darner			S4	G5

Somatochlora tenebrosa	Clamp-tipped Emerald			S2S3	G5
Somatochlora walshii	Brush-tipped Emerald			S4	G5
Somatochlora williamsoni	Williamson's Emerald			S4	G5
Sympetrum danae	Black Meadowhawk			S4	G5
Amphiagrion saucium	Eastern Red Damsel			S4	G5
Stylurus scudderi	Zebra Clubtail			S4	G4
Vertigo nylanderi	Deep-throat Vertigo			SH	G3G4
Vertigo paradoxa	Classification Uncertain			S2S3	G4G5Q
Amblyodon dealbatus	A Moss			S1	G3G5
Bryum gemmiparum	A Moss			S1	G3G5
Grimmia teretinervis	A Moss			S2	G3G5
Tortula cainii	A Moss			S1	G1
Pseudocalliergon turgescens	A Moss			S2	G3G5
Zizia aptera	Heart-leaved Alexanders			S1	G5
Adenocaulon bicolor	Trail-plant			S1	G5?
Cirsium hillii	Hill's Thistle	THR	THR	S3	G3
Cirsium pitcheri	Pitcher's Thistle	END	END	S2	G3
Erigeron philadelphicus var. provancheri	Provancher's Philadelphia Fleabane			SU	G5T2Q
Packera obovata	Round-leaved Groundsel			S3	G5
Solidago houghtonii	Houghton's Goldenrod	SC	THR	S2	G3
Solidago simplex ssp. randii	Rand's Goldenrod			S3	G5T4T5
Arnoglossum plantagineum	Tuberous Indian-plantain	SC	SC	S3	G4G5
Hymenoxys herbacea	Lakeside Daisy	THR	THR	S3	G3
Astragalus neglectus	Cooper's Milk-vetch			S3	G4
Gentianella quinquefolia	Stiff Gentian			S2	G5
Monarda didyma	Scarlet Beebalm			S3	G5
Linum medium var. medium	Stiff Yellow Flax			S3?	G5T3T4
Pterospora andromedea	Woodland Pinedrops			S2	G5
Salix myricoides var. myricoides	Blue-leaf Willow			S2S3	G4T4
Agalinis gattingeri	Gattinger's Agalinis	END	END	S2	G4
Hybanthus concolor	Eastern Green-violet			S2	G5
Sagittaria cristata	Crested Arrowhead			S3	G4?
Peltandra virginica	Green Arrow-arum			S2	G5
Carex haydenii	Long-scaled Tussock Sedge			S4	G5
Carex tetanica	Rigid Sedge			S3	G4G5
Eleocharis rostellata	Beaked Spike-rush			S3	G5
Scleria verticillata	Low Nutrush			S3	G5
Iris lacustris	Dwarf Lake Iris	THR	THR	S3	G3
Juncus greenei	Greene's Rush			S3	G5
Aplectrum hyemale	Puttyroot			S2	G5
Cypripedium arietinum	Ram's-head Lady's-slipper			S3	G3
Cypripedium candidum	Small White Lady's-slipper	END	END	S1	G4
Platanthera leucophaea	Eastern Prairie Fringed-orchid	END	END	S2	G3
Platanthera macrophylla	Large Round-leaved Orchid			S2	G4
Spiranthes magnicamporum	Great Plains Ladies'-tresses			S3?	G4
Ammophila breviligulata	Marram Grass			S4	G5

Bromus pumpellianus	Pumpelly's Brome			SH	G5T5
Calamovilfa longifolia var. magna	Great Lakes Sand Reed			S3	G5T3T5
Elymus lanceolatus ssp. psammophilus	Great Lakes Wild Rye			S3	G5T3
Poa secunda	Curly Blue Grass			S1	G5
Sporobolus compositus	Longleaf Dropseed			S4	G5
Sporobolus heterolepis	Prairie Dropseed			S3	G5
Hesperostipa spartea	Porcupine Grass			S4	G5
Potamogeton hillii	Hill's Pondweed	SC	SC	S2	G3
Sparganium androcladum	Branching Burreed			SH	G4G5
Pellaea atropurpurea	Purple-stemmed Cliff-brake			S3	G5
Asplenium ruta-muraria	Wallrue Spleenwort			S2	G5
Asplenium scolopendrium var. americanum	American Hart's-tongue Fern	SC	SC	S3	G4T3
Gymnocarpium robertianum	Limestone Oak Fern			S2	G5
Phegopteris hexagonoptera	Broad Beech Fern	SC	SC	S3	G5

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Modified 06-27-2008

Number of natural areas selected: **1**

LYAL ISLAND **AREA_ID: 629**

Significance	Area Type	Size	Centroid UTM	Map #
Provincial	Life Science ANSI	741.0 ha	17,468000,4977500	41A/14

Description

Island supports dolostone rockland forests and wetlands, coastal shorelines shingle ridge communities and a peatland pond and is essentially undeveloped. There is excellent representation of contemporary and ancient shingle beach ridges on backshore and northwest portion of the island. The shoreline of the island is generally characterized by coastal dolostone plain, except in protected bays where sand deposits are deeper. Shoreline pavement has open meadow alvar or shrub cover. Discontinuous backshore limestone pavement alvar occurs with more closed meadows, scrub and groves. Where sand deposits occur, coastal sandland occurs, with active wet sandy beach with open to closed marsh and wet meadow communities, and backshore sand beach ridge meadow, srub and grove communities. Around the periphery of the island, coastal/interior shingle beach ridge communities are occupied by mesic forests in drier areas and wet swamp shrubs and forests in wetter depressions. Dolostone plain coniferous forest of balam fir and white cedar with white spruce, aspen or white birch is common in the interior of the island.

Vegetation

Eight environmental systems were identified and described encompassing 38 community patterns; notable among these are good representations of the Lake Huron coastal dolostone plain shore and backshore barrens, rich dry and wet meadows and groves, coastal backshore and interior shingle storm beach ridge groves and forests and backshore organic basin pond, heath and forest. Associated with these are over 90 species of its 273 vascular plant flora which are significant at provincial, district or general levels. [Macdonald 1982]

Representation

The site is significant in being representative of the western coast of the Bruce Peninsula; as well it provides excellent displays of the dolostone plain and shingle ridge associated features which occur only locally in the site district. [Macdonald 1982]

Landform

The study area encompasses the Guelph Formation Dolostone which is extensively exposed along the coast and commonly inland as flat to very gently swelling pavements which have only very shallow, southwesterly gradients. Most of the island appears to be of the non-reefal phase of this formation which presents distinct strata and other bedding features that appear only as low, 1 to 1.5 metre cliffs and shelves on the westerly and northerly shores. As well, there are indications that the more massive reefal phases may appear locally in the western and southern portions of the island. The bedrock is quite impermeable and generally restricts the percolation of water from depressions; hence, periodically high water tables and standing water is a chronic situation even on the upland forest situations. Additionally, the shallowness of the overlying materials exposes the sites to ready dessication, restricting the variety of tolerant species able to survive. The calcareous nature of this bedrock provides good habitat conditons for calciphilous species such as the many coastal herbs which are distinctive to the Bruce Peninsula.

The exposure of this island to the stormy forces of Lake Huron over the centuries has allowed a splendid development of contemporary and ancient shingle beach ridges to develop. These chains of ridges provide an interesting physiography for the island which, in general, appears as an essentially flat dolostone plain in its centre with a line of the ridges around its periphery, much like a plate with a line of peas around its rim. Sand deposits appear only at the northeastern end of the island where suitably protected waters are provided by the shoreline pavement and associated shoals extending towards McMaster Point. [Macdonald 1982]

References

- Cuddy, D.G., K.M. Lindsay and I.D. Macdonald. 1976. Significant Natural Areas along the Niagara Escarpment: A Report on Nature Reserve Candidates and other Significant Natural Areas in the Niagara Escarpment Planning Area. Ontario Ministry of Natural Resources, Parks Planning Branch, Toronto. 426 pp.
- Macdonald, I.D. 1982. Life science inventory of Lyal Island, Bruce Peninsula. Environmental Planning Series. Ontario Ministry of Natural Resources, Parks and Recreational Areas Branch, Southwestern Region, London, Ontario. OFER 8207. Unpublished report. v + 91 pp.

Number of natural areas selected: **1**

CRANE ISLAND **AREA_ID: 4632**

Significance	Area Type	Size	Centroid UTM	Map #
	International Biological Program site	0.8 ha	17,469400,4977100	41A/14

Description
6E3; small limestone shingle and rockland island in Lake Huron; open thicket and meadow vegetation (2 communities); restricted termperate biota, but with large nesting bird colony; undisturbed; OMNR-SW, Parks Canada. [Falls et al. 1990]

Vegetation
Vegetation Summary:
3C2-: open shoreline; Carex viridula - Scirpus americanus - Rhynchospora spp.; I2; boulders and limestone plain; 0.2 ha.
2E21: weedy shallow limestone plain (island); Ulmus thomasii - Thuja occidentalis - Sambucus pubens - Physocarpus opulifolius - Solanum dulcamara - Urtica dioica - Calamagrostis canadensis - Sisymbrium officinalis; I2 - F1; soil only in crevices in flat dolomitic limestone bedrocks; 0.8 ha. [Elliott 1969]

Island densely covered with a very few species of dominant plants. Trees - one large rock elm (Ulmus thomasii) containing 7 herons nests. Other plants (very abundant) - red elder (Sambucus pubens), nightshade (Solanum dulcamara), bluejoint grass (Calamagrostis canadensis), nettle (Urtica dioica) and hedge mustard (Sisymbrium offininale). Locally abundant, a few large clumps - jewelweed (Impatiens capensis), herb robert (Geranium robertianum) and round leaf mallow (Malva neglecta). An occasional plant of white cedar, 2 plants (Thuja occidentalis), ragweed (Ambrosia artemisiifolia), pussy willow (Salix discolor), swamp rose (Rosa palustris), ninebark (Physocarpus opulifolius), catnip (Nepeta cataria), bull thistle (Circium vulgare), hemp nettle (Galeopsis tetrahit) and soft maple (Acer saccharinum). [Elliott 1969]

Representation

Landform
Landscape description: Narrow island running east-west; flat rocky shores; area varies greatly with yearly lake level and seiche tides.

Major soils: Regosols.

Aquatic habitats: Surrounded by waters of Lake Huron. [Elliott 1969]

Soil: no soil except loose organic material wedged between the rocks, dead gulls, dead plants, bird manure, etc. Entire island covered with loose rocks, some angular, some beach-pebble type - 3" to 3 feet, on top of flat dolomite bed-rock.

General landscape: A flat-lying dolomite reed east of (½ mile) Lyal Island surrounded by shallow water, as deep as 5 feet on the west and sloping gradually to a 20 feet depth in Stokes Bay to the east. [Elliott 1969]

References

- Elliott, H.V. 1969. International Biological Programme, Checksheet for Region 5, Area 277: Crane Island.
- Falls, J.B., I.D. Macdonald and T.J. Beechey. 1990. Catalogue of IBP/CT Areas in Ontario with an Assessment of their Current Conservation Status. Unpublished report. 94 pp.

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All Endangered, Threatened, and Special Concern Species with a Map

Number of Species
- 1
- 2 - 3
- 4 - 6
- 7 - 10
- 11 - 15
- > 15

Map Layers
- Cities & Towns
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Redraw Map

Notes:
- Click a taxonomic group to view the list of species at risk for that group.
- Click a numeric value to display only the distribution maps for the species that belong to the selected taxonomic group and risk category.
- Click for more information about a species.
- Click to view the species distribution map.

Pale highlighting
Species that belong to the selected taxonomic group and risk category (by default, all taxonomic groups and risk categories have been

Mammals Birds Reptiles... Fishes Lepidopterans Molluscs Plants... All

All Taxa

All 363 Endangered 169 Threatened 110 Special Concern 84

Mammals

All 40 Endangered 16 Threatened 12 Special Concern 12

- American Badger jacksoni subspecies
- American Badger jeffersonii subspecies
- Beluga Whale (St. Lawrence Estuary population)
- Black–tailed Prairie Dog
- Blue Whale (Atlantic population)
- Blue Whale (Pacific population)

selected).
Bright highlighting
Species that were found in the query area.

- Eastern Mole
- Eastern Wolf
- Ermine haidarum subspecies
- Fin Whale (Atlantic population)
- Fin Whale (Pacific population)
- Grey Fox
- Grey Whale (Eastern North Pacific population)
- Harbour Porpoise (Pacific Ocean population)
- Humpback Whale (North Pacific population)
- Killer Whale (Northeast Pacific northern resident population)
- Killer Whale (Northeast Pacific offshore population)
- Killer Whale (Northeast Pacific southern resident population)
- Killer Whale (Northeast Pacific transient population)
- Mountain Beaver
- Newfoundland Marten
- North Atlantic Right Whale
- North Pacific Right Whale
- Northern Bottlenose Whale (Scotian Shelf population)
- Pacific Water Shrew
- Pallid Bat
- Sea Otter
- Sei Whale (Pacific population)
- Spotted Bat
- Steller Sea Lion
- Swift Fox
- Townsend's Mole
- Vancouver Island Marmot
- Wolverine (Eastern population)
- Wood Bison
- Woodland Caribou (Atlantic–Gaspésie population)
- Woodland Caribou (Boreal population)
- Woodland Caribou (Northern Mountain population)
- Woodland Caribou (Southern Mountain population)
- Woodland Vole

Birds

All 48 Endangered 25 Threatened 10 Special Concern 13

- Acadian Flycatcher
- Ancient Murrelet
- Barn Owl (Eastern population)
- Barn Owl (Western population)
- Barrow's Goldeneye (Eastern population)
- Burrowing Owl
- Cerulean Warbler
- Eskimo Curlew
- Flammulated Owl
- Greater Sage-Grouse urophasianus subspecies
- Harlequin Duck (Eastern population)
- Henslow's Sparrow

- Hooded Warbler
- Horned Lark strigata subspecies
- Ivory Gull
- King Rail
- Kirtland's Warbler
- Least Bittern
- Lewis's Woodpecker
- Loggerhead Shrike excubitorides subspecies
- Loggerhead Shrike migrans subspecies
- Long–billed Curlew
- Marbled Murrelet
- Mountain Plover
- Northern Bobwhite
- Northern Goshawk laingi subspecies
- **Peregrine Falcon anatum subspecies**
- Peregrine Falcon pealei subspecies
- Pink–footed Shearwater
- Piping Plover circumcinctus subspecies
- Piping Plover melodus subspecies
- Prothonotary Warbler
- Red Crossbill percna subspecies
- Roseate Tern
- Ross's Gull
- Sage Thrasher
- Savannah Sparrow princeps subspecies
- Short–tailed Albatross
- Spotted Owl caurina subspecies
- Sprague's Pipit
- Western Screech-Owl kennicottii subspecies
- Western Screech-Owl macfarlanei subspecies
- White–headed Woodpecker
- Whooping Crane
- Williamson's Sapsucker
- Yellow Rail
- Yellow-breasted Chat auricollis subspecies (British Columbia population)
- Yellow-breasted Chat virens subspecies

Reptiles and Amphibians

All 44 Endangered 13 Threatened 18 Special Concern 13

- Allegheny Mountain Dusky Salamander
- Blanding's Turtle (Great Lakes / St. Lawrence population)
- Blanding's Turtle (Nova Scotia population)
- Blue Racer
- Butler's Gartersnake
- Coast Tailed Frog
- Coastal Giant Salamander
- Coeur d'Alene Salamander
- Eastern Foxsnake
- Eastern Hog–nosed Snake

Eastern Hog–nosed Snake
Eastern Ratsnake
Eastern Ribbonsnake (Atlantic population)
Eastern Ribbonsnake (Great Lakes population)
Eastern Yellow–bellied Racer
Fowler's Toad
Great Basin Gophersnake
Great Basin Spadefoot
Great Plains Toad
Jefferson Salamander
Leatherback Seaturtle
Massasauga
Milksnake
Nightsnake
Northern Cricket Frog
Northern Leopard Frog (Southern Mountain population)
Northern Leopard Frog (Western Boreal/Prairie populations)
Northern Map Turtle
Oregon Spotted Frog
Prairie Skink
Queen Snake
Red–legged Frog
Rocky Mountain Tailed Frog
Rubber Boa
Sharp–tailed Snake
Small–mouthed Salamander
Spiny Softshell
Spotted Turtle
Spring Salamander
Stinkpot
Tiger Salamander (Southern Mountain population)
Western Rattlesnake
Western Skink
Western Toad
Western Yellow–bellied Racer

Fishes

All **39** Endangered **15** Threatened **13** Special Concern **11**

"Eastslope" Sculpin (St. Mary and Milk River populations)
Atlantic Salmon (Inner Bay of Fundy populations)
Atlantic Whitefish
Atlantic Wolffish
Aurora Trout
Banded Killifish (Newfoundland population)
Benthic Enos Lake Stickleback
Benthic Paxton Lake Stickleback
Benthic Vananda Creek Stickleback
Blackstripe Topminnow
Bridle Shiner

- Carmine Shiner
- Channel Darter
- Columbia Mottled Sculpin
- Cultus Pygmy Sculpin
- Eastern Sand Darter
- Grass Pickerel
- Green Sturgeon
- Lake Chubsucker
- Lake Utopia Dwarf Smelt
- Limnetic Enos Lake Stickleback
- Limnetic Paxton Lake Stickleback
- Limnetic Vananda Creek Stickleback
- Morrison Creek Lamprey
- Nooksack Dace
- Northern Madtom
- Northern Wolffish
- Pugnose Minnow
- Pugnose Shiner
- Salish Sucker
- Shorthead Sculpin
- Silver Chub
- Spotted Gar
- Spotted Sucker
- Spotted Wolffish
- Vancouver Lamprey
- Warmouth
- Western Silvery Minnow
- White Sturgeon

Molluscs

All 17 Endangered 11 Threatened 2 Special Concern 4

- Banff Springs Snail
- Dromedary Jumping–slug
- Hotwater Physa
- Kidneyshell
- Mudpuppy Mussel
- Northern Abalone
- Northern Riffleshell
- Olympia Oyster
- Oregon Forestsnail
- Rayed Bean
- Rocky Mountain Ridged Mussel
- Round Hickorynut
- Round Pigtoe
- Snuffbox
- Warty Jumping–slug
- Wavy–rayed Lampmussel
- Yellow Lampmussel

Lepidopterans

All **15** Endangered **8** Threatened **5** Special Concern **2**

- Behr's (Columbia) Hairstreak
- Dakota Skipper
- Dun Skipper (Western population)
- Island Blue
- Maritime Ringlet
- Monarch
- Mormon Metalmark (Prairie population)
- Mormon Metalmark (Southern Mountain population)
- Ottoe Skipper
- Poweshiek Skipperling
- Sand–verbena Moth
- Taylor's Checkerspot
- Weidemeyer's Admiral
- White Flower Moth
- Yucca Moth

Plants, Lichens, and Mosses

All **160** Endangered **81** Threatened **50** Special Concern **29**

- Alkaline Wing–nerved Moss
- American Chestnut
- American Ginseng
- American Hart's–tongue Fern
- American Water–willow
- Anticosti Aster
- Athabasca Thrift
- Baikal Sedge
- Banded Cord–moss
- Barrens Willow
- Bashful Bulrush
- Bearded Owl–clover
- Bear's–foot Sanicle
- Bird's–foot Violet
- Blue Ash
- Bluehearts
- Blunt–lobed Woodsia
- Bog Bird?s–foot Trefoil
- Boreal Felt Lichen (Atlantic population)
- Boreal Felt Lichen (Boreal population)
- Branched Bartonia
- Branched Phacelia
- Buffalograss
- Butternut
- Cliff Paintbrush
- Climbing Prairie Rose
- Coastal Scouler's Catchfly
- Coastal Wood Fern
- Colicroot
- Columbian Carpet Moss
- Common Hoptree

- Crooked–stem Aster
- Cucumber Tree
- Deerberry
- Deltoid Balsamroot
- Dense Blazing Star
- Dense Spike–primrose
- Dense–flowered Lupine
- Drooping Trillium
- Dwarf Hackberry
- **Dwarf Lake Iris**
- Dwarf Sandwort
- Eastern Lilaeopsis
- Eastern Mountain Avens
- Eastern Prairie Fringed–orchid
- Eastern Prickly Pear Cactus
- Engelmann's Quillwort
- False Hop Sedge
- False Rue–anemone
- Felt–leaf Willow
- Fernald's Braya
- Fernald's Milk–vetch
- Floccose Tansy
- Flooded Jellyskin
- Forked Three–awned Grass
- Frosted Glass–whiskers (Nova Scotia population)
- Furbish's Lousewort
- Gattinger's Agalinis
- Golden Crest
- Golden Paintbrush
- Goldenseal
- Grand Coulee Owl–clover
- Gulf of St. Lawrence Aster
- Hairy Prairie–clover
- Haller's Apple Moss
- Heart–leaved Plantain
- Hill's Pondweed
- **Hill's Thistle**
- Hoary Mountain–mint
- Horsetail Spike–rush
- Houghton's Goldenrod
- Howell's Triteleia
- Juniper Sedge
- Kellogg's Rush
- Kentucky Coffee–tree
- Lakeside Daisy
- Large Whorled Pogonia
- Large–headed Woolly Yarrow
- Lemmon's Holly Fern
- Long's Braya
- Lyall's Mariposa Lily
- Mackenzie Hairgrass
- Macoun's Meadowfoam
- Margined Streamside Moss

- Mexican Mosquito–fern
- Mountain Holly Fern
- New Jersey Rush
- Nodding Pogonia
- Phantom Orchid
- Pink Coreopsis
- Pink Milkwort
- Pink Sand–verbena
- Pitcher's Thistle
- Plymouth Gentian
- Poor Pocket Moss
- Prairie Lupine
- Prototype Quillwort
- Purple Sanicle
- Purple Twayblade
- Pygmy Pocket Moss
- Red Mulberry
- Redroot
- Riddell's Goldenrod
- Rigid Apple Moss
- Rosy Owl–clover
- Round–leaved Greenbrier (Great Lakes Plains population)
- Rusty Cord–moss
- Sand–dune Short–capsuled Willow
- Scarlet Ammannia
- Seaside Birds–foot Lotus
- Seaside Centipede Lichen
- Showy Goldenrod
- Showy Phlox
- Silver Hair Moss
- Skinner's Agalinis
- Slender Bush–clover
- Slender Collomia
- Slender Mouse–ear–cress
- Small White Lady's–slipper
- Small Whorled Pogonia
- Small–flowered Lipocarpha
- Small–flowered Sand–verbena
- Small–flowered Tonella
- Soapweed
- Southern Maidenhair Fern
- Spalding's Campion
- Spoon–leaved Moss
- Spotted Wintergreen
- Stoloniferous Pussytoes
- Streambank Lupine
- Swamp Rose–mallow
- Sweet Pepperbush
- Tall Bugbane
- Tall Woolly–heads
- Thread–leaved Sundew
- Tiny Cryptanthe
- Toothcup

- Toothcup
- Tubercled Spike–rush
- Tuberous Indian–plantain
- Turnor's Willow
- Twisted Oak Moss
- Van Brunt's Jacob's–ladder
- Vancouver Island Beggarticks
- Victorin's Gentian
- Victorin's Water–hemlock
- Virginia Goat's–rue
- Water–pennywort
- Water–plantain Buttercup
- Western Blue Flag
- Western Prairie Fringed–orchid
- Western Silvery Aster
- Western Spiderwort
- White Meconella
- White Prairie Gentian
- White Wood Aster
- White–top Aster
- Wild Hyacinth
- Willowleaf Aster
- Wood–poppy
- Yellow Montane Violet

Top of Page

Number of natural areas selected: **1**

BLACK CREEK **AREA_ID: 4674**

Significance	Area Type	Size	Centroid UTM	Map #
	International Biological Program site	323.7 ha	17,471500,4980000	41A/14

Description
6E3; extensive gently rolling dolostone plain with frequent ridges and depressions, and a small sand plain; coniferous, mixed and deciduous forests and open sandplain meadows and groves (4 communities); diverse, temperate biota, with provincially and regionally significant flora; disturbance from local past cutting, and use of beach as a day-use park; OMNR-SW, I.D. Macdonald. [Falls et al. 1990]

Vegetation
Vegetation Summary:
1A22: Trembling Aspen/Black Ash/White Birch; Populus tremuloides - Fraxinus nigra - Betula papyrifera - Cornus stolonifera - Alnus rugosa - Fraxinus nigra - Calamagrostis canadensis - Geranium robertianum - Rubus pubescens; O; muck soils; 12.1 ha.
1A17a: White Spruce/Balsam Fir/White Cedar; Picea glauca - Abies balsamea - Thuja occidentalis - Cornus rugosa - Abies balsamea - Thuja occidentalis; Linnaea borealis - Cornus canadensis - Musci; I2; Breypen Series, thin loam soils with a great deal of bedrock with some granitic erratics; 304 ha.
1G14/1G21: Shrubby Cinquefoil/White Cedar/Ninebark; Potentilla fruticosa - Thuja occidentalis - Physocarpus opulifolius - Potentilla anserina - Solidago ohioensis - Calamagrostis canadensis; I2; Breypen Series, sand and muck; 8.1 ha.
1C21: Beach Cherry/Bearberry/Junipers; Prunus pumila - Arctostaphylos uva-ursi - Juniperus communis - Juniperus horizontalis - Artemesia caudata - Agrostis stolonifera - Andropogon scoparius; I2; sand dunes; 1.0 ha. [Waldron and Hay 1971]

With the exception of no soil cover, trees cover the whole area. The largest community is made of Balsam Fir (Abies balsamea), Trembling Aspen (Populus tremuloides), and White Cedar (Thuja occidentalis). Other common trees are White Spruce (Picea glauca), White Birch (Betula papyrifera), Red Maple (Acer rubrum) and White Pine (Pinus strobus). All the trees are young to, intermediate in age; Dray roads cut through the area everywhere.

The swamp forest consists of intermediate to mature trees of Populus tremuloides, P. balsamifera, Black Ash (Fraxinus nigra) and Betula papyrifera. This forest is open in the canopy resulting in a thick layer. Important shrubs are Red-osier Dogwood (Cornus stolonifera) and Speckled Alder (Alnus rugosa), the latter growing to 25 feet high.

Although very small, an example of a typical sand dune community does exist on the dunes. While most of this sand land in various stages of succession, it does show the succession state of dune stabilization. Northern Dwarf Cherry (Prunus pumila), Bentgrass (Agrostis stolonifera) and Beardgrass (Andropogon scoparius) lead, followed by Juniperus spp. and Bearberry (Arctostaphylos uva-ursi) and White Birch (Betula papyrifera), White Pine (Pinus strobus) and White Spruce (Picea glauca). Since this area is popular for picnics and swimming, there is considerable trampling. [Waldron and Hay 1971]

Representation
Exceptional interest of IBP area: Small dune area; a good example of such terrain and accompanying vegetation patterns which are not all common in the district. [Waldron and Hay 1971]

Landform
General landscape: An area of limestone bedrock gently sloping south-westward into Lake Huron with a stream occupying a central depression, sand dunes, pebble beaches and beaver ponds.

Special landscape features: Dunes, pebble beaches, fissured bedrock. [Waldron and Hay 1971]

The area has a low relief with its highest point only twenty feet above lake level. For the most part it is shelved limestone which dips gently down into Lake Huron. A series of parallel fort east to southwest ridges runs out into the water, one off these creating Irish Harbour.

The beaches consist mostly of dolomite and erratic pebbles and coarse sand with one area of Line sand beach at the mouth of Black Creek. This area is backed by low (3 foot amplitude) dune ridges. At the peninsula tip the beach areas fort between the bedrock whale backs.

Black Creek is a shallow, slow flowing stream on which there is a complex system of beaver ponds in the centre of the area. A small area of swamp is also found on the east side.

Soils are uniformly thin loams over pocked and striated limestone except for the muck soils in the swamp and the sandy dune soils of the beach at the mouth of Black Creek. [Waldron and Hay 1971]

References

- Falls, J.B., I.D. Macdonald and T.J. Beechey. 1990. Catalogue of IBP/CT Areas in Ontario with an Assessment of their Current Conservation Status. Unpublished report. 94 pp.
- Waldron, G. and S. Hay. 1971. International Biological Programme, Checksheet for Black Creek.

Number of natural areas selected: **1**

BLACK CREEK SWAMP- WETLAND **AREA_ID: 7176**

Significance	Area Type	Size	Centroid UTM	Map #
Provincial	Wetland	37.9 ha	17,471500,4980000	41A/14

Description
A Provincially Significant, Coastal wetland, composed of two wetland types (57% swamp and 43% marsh) (Morton and Payton, 1987).

Vegetation
Dominant Vegetation Forms (Morton and Payton, 1987):
26% floating plants, 20.9% dead coniferous trees, 13.9% submergents, 12.9% dead deciduous trees, 11.5% dead coniferous trees, 9.8% deciduous trees, 3.5% narrow-leaved emergents, 2.4% coniferous & deciduous trees;

Vegetation Communities (Morton and Payton, 1987):
S1: dead deciduous trees; submergents- Najas flexilis; narrow-leaved emergents- Cyperaceae spp.;
S2: deciduous trees- Fraxinus spp.; narrow-leaved emergents- Poaceae spp., Cyperaceae spp.; dead deciduous trees; low shrubs- Cornus spp.;
S3: dead deciduous trees; narrow-leaved emergents- Poaceae spp., Cyperaceae spp.; ground cover; tall shrubs- Fraxinus spp.;
S4: dead deciduous trees; narrow-leaved emergents- Poaceae spp., Cyperaceae spp.; robust emergents- Typha latifolia;
S5: dead coniferous trees; floating plants- Polygonum amphibium; narrow-leaved emergents- Cyperaceae spp.;
S6: deciduous trees- Fraxinus spp.; tall shrubs- Fraxinus spp., Thuja occidentalis; dead deciduous trees; narrow-leaved emergents- Poaceae spp.; mosses; ground cover;
S7: dead deciduous & coniferous trees; tall shrubs- Salix spp.; low shrubs- Myrica gale; narrow-leaved emergents- Poaceae spp., Cyperaceae spp.;
S8: dead deciduous & coniferous trees; floating plants- Nymphaea odorata; narrow-leaved emergents- Poaceae spp.;
S9: dead deciduous & coniferous trees; narrow-leaved emergents- Poaceae spp., Cyperaceae spp.; floating plants- Nymphaea odorata, Polygonum spp.; free-floating plants- Lemna spp.; submergents- Chara spp.;
S10: coniferous trees- Thuja occidentalis; narrow-leaved emergents- Poaceae spp.; low shrubs- Abies balsamea;
S11: dead coniferous trees; coniferous trees- Thuja occidentalis; narrow-leaved emergents- Cyperaceae spp.; floating plants- Nymphaea odorata, Polygonum amphibium;
S12: dead deciduous & coniferous trees; narrow-leaved emergents- Poaceae spp., Cyperaceae spp.; ground cover; mosses;
S13: dead deciduous trees; ground cover- Impatiens capensis; low shrubs- Abies balsamea;
S14: dead deciduous trees; free-floating plants- Lemna spp,; ground cover; low shrubs- Cornus spp.;
M1: narrow-leaved emergents- Cyperaceae spp.; floating plants- Nymphaea odorata; submergents- Najas flexilis;
M2: submergents- Ceratophyllum demersum, Najas flexilis, Chara spp.; floating plants- Nymphaea odorata, Polygonum amphibium;
M3: floating plants- Nymphaea odorata; narrow-leaved emergents- Cyperaceae spp.; submergents- Ceratophyllum demersum, Chara spp.;
M4: floating plants- Nymphaea odorata, Polygonum amphibium; submergents- Najas flexilis; narrow-leaved emergents- Cyperaceae spp.;

Representation

Landform
Soils (Morton and Payton, 1987): 100% organic;

Site Type (Morton and Payton, 1987): 100% palustrine;

References

- Cuddy, D.G. and R.F. Norman. 1973. Ecological Inventory of the Black Creek Property, Bruce Peninsula, Ontario. Ontario Ministry of Natural Resources. iii + 24 pp + maps + appendices.
- Morton, J. and G. Payton. 1987. Wetland Data Record and Evaluation- Black Creek Swamp. Second Edition. July 2, 1987. Grey Sauble Conservation Authority. Manuscript. 12 pp + 2 map + 4 pp supplement.

Number of natural areas selected: **1**

BLACK CREEK SWAMP **AREA_ID: 1064**

Significance	Area Type	Size	Centroid UTM	Map #
Provincial	Life Science ANSI	80.0 ha	17,472000,4980000	41A/14

Description

During the survey of the Black Creek Park Reserve during 1972, the beaver pond complex in the central part of the reserve was identified as the most ecologically significant section of the reserve. The pond shows several generations of beaver activity and in 1972 was at a high point with extensive drowning of a young mixed forest about its margin. The pond appears undisturbed by humans and is very rich in wildlife. Water snakes, red-winged blackbirds (nesting) and bull frogs were present in abundance. A nesting ring-necked duck (first record for Bruce County) and the presence of a green heron heighten the significance of the pond system.

In considering the area as a candidate nature reserve, I would recommend that the pond area not be made accessible to the public when plans for the park reserve are developed. Unless a comprehensive study shows otherwise it is best to assume that the pond ecosystem is too fragile to allow trails, boardwalks or canoeing. [Cuddy et al 1976]

Vegetation

Representation

Landform

References

- Cuddy, D.G. and R.F. Norman. 1973. Ecological Inventory of the Black Creek Property, Bruce Peninsula, Ontario. Ontario Ministry of Natural Resources. iii + 24 pp + maps + appendices.
- Cuddy, D.G., K.M. Lindsay and I.D. Macdonald. 1976. Significant Natural Areas along the Niagara Escarpment: A Report on Nature Reserve Candidates and other Significant Natural Areas in the Niagara Escarpment Planning Area. Ontario Ministry of Natural Resources, Parks Planning Branch, Toronto. 426 pp.

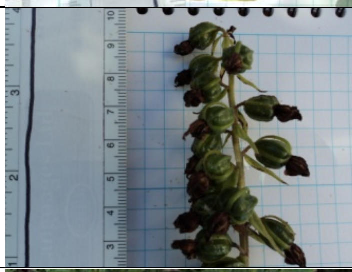
APPENDIX G

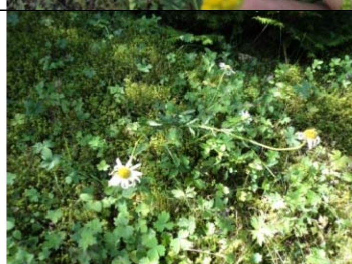
VEGETATION SAMPLE LOGS

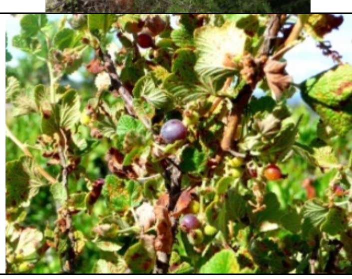
Sample ID	Picture	Species	Location	Description / Comments
SBFR-V1		*Betula papyrifera*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	White Birch (photo provided is not from the Site)
SBFR-V2		*Thuja occidentalis*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Eastern White Cedar (photo provided is from another nearby DFO site)
SBFR-V3		*Larix laricina*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Tamarack (photo provided is from an online source)
SBFR-V4		*Rubus idaeus*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Wild raspberry (photo provided is from another nearby DFO site)
SBFR-V5		*Salix spp.*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Willow
SBFR-V6		*Solidago canadensis*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Goldenrod (photo provided is from another nearby DFO site)

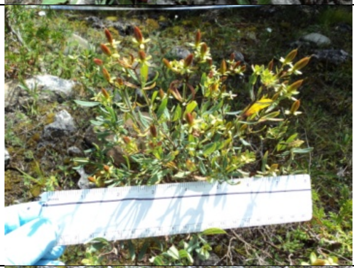
Sample ID	Picture	Species	Location	Description / Comments
SBFR-V7		*Potentilla anserine*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Silverweed
SBFR-V8		*Cornus stolonifera*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Red Osier Dogwood
SBFR-V9		*Impatiens capensis*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Jewel Weed / touch-me-not
SBFR-V10		*Hypericum perforatum*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	St. John's Wart (photo provided is from an online source)
SBFR-V11		*Fragaria spp.*	Located 16 m southeast of the southeast corner of the old front range tower	Wild Strawberry (photo provided is from another nearby DFO site)

Sample ID	Picture	Species	Location	Description / Comments
SBFR-V12		*Verbascum thapsis*	Located 14 m southeast of the southeast corner of the old front range tower	Mullein (photo provided is not from the Site)
SBFR-V13		*Juncus effusus*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Soft Rush (photo provided is not from the Site)
SBFR-V14		*Picea glauca*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	White Spruce (photo provided is not from the Site)
SBFR-V15		*Potentilla fruticosa*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Shrubby Cinquefoil

Sample ID	Picture	Species	Location	Description / Comments
SBFR-V16		*Solanum spp.*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Nightshade with berries
SBFR-V17		*Lonicera*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Honeysuckle
SBFR-V18		*Epipactis helleborine*	Taken from an area adjacent to the east side of the old front range tower 8 m in the east-west direction and 15 m in the north south direction	Helleborine Orchid
SBFR-V19		*Thuja occidentalis*	Located 12 m southeast of the southeast corner of the old front range tower	Eastern White Cedar (photo provided is from another nearby DFO site)
SBFR-V20		*Salix candida*	Located 23 m southeast of the southeast corner of the old front range tower	Hoary Willow

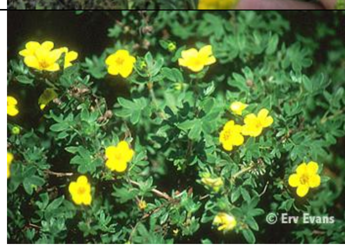
Sample ID	Picture	Species	Location	Description / Comments
SBRR-V1		*Thuja occidentalis*	Located adjacent to the southeast corner of the rear range tower	Eastern White Cedar
SBRR-V2		*Solidago canadensis*	Located 2 m south of the southwest corner of the rear range tower	Goldenrod (photo provided is from another nearby DFO site)
SBRR-V3		*Chrysanthemum leucanthemum*	Located 4 m south of the southwest corner of the rear range tower	Ox-eye Daisy (photo provided is from another nearby DFO site)
SBRR-V4		*Fragaria spp.*	Located 2 m south of the south side of the rear range tower	Wild strawberry (photo provided is from another nearby DFO site)
SBRR-V5		*Abies balsamea*	Located 1 m south of the south side of the rear range tower	Balsam Fir
SBRR-V6		*Rubus idaeus*	Located 1 m east of the northeast corner of the rear range tower	Wild Raspberry (photo provided is from another nearby DFO site)

Sample ID	Picture	Species	Location	Description / Comments
SBRR-V7		*Sphagnum sp.*	Located 3 m south of the south side of the rear range tower	Peat Moss
SBRR-V8		unknown	Located 6 m west of the northwest corner of the rear range tower	Wild Grass
SBRR-V9		*Larix laricina*	Located 2 m south of the south side of the rear range tower	Tamarack
SBRR-V10		*Betula papyrifera*	Located 1 m east of the southeast corner of the rear range tower	White Birch
SBRR-V11		*Ribes spp.*	Located 5 m west of the south side of the rear range tower	Currant Note: photo was taken from Google Images

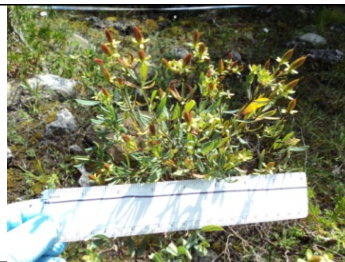
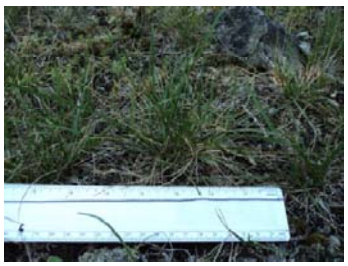
Sample ID	Picture	Species	Location	Description / Comments
SBRR-V12		*Cornus stolonifera*	Located 6 m west of the southwest corner of the rear range tower	Red-Osier Dogwood
SBRR-V13		*Aquilegia spp.*	Located 9 m southwest of the southwest corner of the rear range tower	Columbine
SBRR-V14		*Potentilla fruticosa*	Located 11 m northeast of the northeast corner of the rear range tower	Shrubby Cinquefoil
SBRR-V15		*Myrica gale*	Located 8 m northeast of the northeast corner of the rear range tower	Sweet Gale
SBRR-V16		*Hypericum perforatum*	Located 5 m northeast of the northeast corner of the rear range tower	St. John's Wort

Sample ID	Picture	Species	Location	Description / Comments
SBRR-V17		*Picea glauca*	Located 11 m southwest of the southwest corner of the rear range tower	White Spruce
SBRR-V18		*Salix spp.*	Located 11 m southwest of the southwest corner of the rear range tower	Willow
SBRR-V19		*Juncus effusus*	Located 12 m southwest of the southwest corner of the rear range tower	Soft Rush
SBRR-V20		*Campanula fotundifolia*	Located 9 m southwest of the southwest corner of the rear range tower	Common Harebell

Sample ID	Picture	Species	Location	Description / Comments
SBRR-BKV1		*Cornus stolonifera*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Red-Osier Dogwood
SBRR-BKV2		*Thuja occidentalis*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Easter White Cedar (photo provided is from another nearby DFO site)
SBRR-BKV3		*Salix spp.*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Willow
SBRR-BKV4		*Abies balsamea*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Balsam Fir
SBRR-BKV5		*Hypericum perforatum*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	St. John's Wort

Sample ID	Picture	Species	Location	Description / Comments
SBRR-BKV6		*Myrica gale*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Sweet Gale
SBRR-BKV7		*Solidago canadensis*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Goldenrod (photo provided is from another nearby DFO site)
SBRR-BKV8		*Potentilla fruticosa*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Shrubby Cinquefoil (photo provided is not from the Site)
SBRR-BKV9		*Juncus effusus*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Soft Rush Various small plants in sandy, open areas exhibited signs of stress believed to be caused by dry conditions.
SBRR-BKV10		*Ribes spp.*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Currant Note: photo was taken from Google Images

Sample ID	**Picture**	**Species**	**Location**	**Description / Comments**
SBRR-BKV11		*Picea glauca*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	White Spruce (photo provided is not from the Site)
SBRR-BKV12		*Sphagnum spp.*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Peat Moss Various small plants in sandy, open areas exhibited signs of stress believed to be caused by dry conditions.
SBRR-BKV13		*Fragaria spp.*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Wild Strawberry (photo provided is from another nearby DFO site)
SBRR-BKV14		*Larix iaricina*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Tamarack (photo provided is from an online source)
SBRR-BKV15		*Rubus idaeus*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Wild Raspberry (photo provided is from another nearby DFO site)

Sample ID	Picture	Species	Location	Description / Comments
SBRR-BKV16		*Aquilegia spp.*	Located within a range of 65 to 120 m northeast of the north corner of the Rear Range Tower along the treeline	Columbine
SBRR-BKV17		*Arctostaphylos uva-ursi*	Located 125 m southeast of the south corner of the Rear Range Tower along the treeline	Common Bearberry
SBRR-BKV18		*Unknown*	Located within a range of 140 to 210 m southeast of the south corner of the Rear Range Tower along the treeline	Wild Grass with Seeds Note: picture was taken at Lyal Island Various small plants in sandy, open areas exhibited signs of stress believed to be caused by dry conditions.
SBRR-BKV19		*Betula papyrifera*	Located within a range of 140 to 210 m southeast of the south corner of the Rear Range Tower along the treeline	White Birch (photo provided is not from the Site)
SBRR-BKV20		*Thuja occidentalis*	Located within a range of 140 to 210 m southeast of the south corner of the Rear Range Tower along the treeline	Easter White Cedar (photo provided is from another nearby DFO site)

APPENDIX K

ECOLOGICAL EXPOSURE CALCULATIONS

Table 8.1
Screening of Potential Contaminant Migration
to Groundwater Discharging to a Surface Water Body

Parameter	**Maximum Soil Concentration Front Range and Squatters Area(µg/g)**	**Maximum Soil Concentration Rear Range (µg/g)**	**MOE Table 3[1] SGW3 (µg/g)**
BTEX			
Benzene	0.002	0.002	14
Toluene	0.002	0.002	68
Ethylbenzene	0.002	0.002	17
Total Xylenes	0.002	0.002	26
PHCs			
PHC F1	5	5	55
PHC F2	269	67	230
PHC F3	918	728	NV
PHC F4	1018	678	NV
PHC F4-Gravimetric	2250	1740	NV
Metals			
Aluminum	3420	4850	NV
Antimony	2.6	1.9	NV
Arsenic	12.3	8.6	NV
Barium	2890	774	NV
Beryllium	0.5	0.5	NV
Bismuth	1	1	NV
Boron (Total)	30.3	17.3	NV
Boron (Hot Water Soluble)*			NV
Cadmium	4.9	9.4	NV
Calcium	141000	154000	NV
Chromium Total	34.3	18	NV
Chromium VI	0.2		NV
Cobalt	5.2	14.3	NV
Copper	206	1970	NV
Iron	8340	6000	NV
Lead	36100	4380	NV
Magnesium	89300	90600	NV
Manganese	178	139.5	NV
Mercury	7.23	71.9	1.2E+14
Molybdenum	3	3	NV
Nickel	21.6	29.4	NV
Phosphorus	796	590	NV
Potassium	794	528	NV
Selenium	2.4	2.7	NV
Silver	0.8	0.2	NV
Sodium	263	586	NV
Strontium	88.4	54.8	NV
Thallium	0.5	0.5	NV
Tin	15.7	51.7	NV
Titanium	187	192	NV
Uranium	1	1.7	NV
Vanadium	17	14	NV
Zinc	7110	172000	NV
Zirconium	3.8	4.1	NV

Table Notes:

[1] Ontario Ministry of the Environment (MOE) : Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act 2009; Table 3: Full Depth Non Potable Water Scenario, Soil Leaching S-GW3.

Table 8.2a: Terrestrial Plant and Invertebrate Concentration Calculations for Stokes Bay Front & Squaters Area				
Parameter	95%UCLM - soil (mg/kg dry wt)	Concentration in Invertebrates (mg/kg(ww))	Concentration in Plants (mg/kg(ww))	
			Forage (mg/kg(ww))	Browse (mg/kg(ww))
Metals				
Barium	475.8	5.4E+01	1.18E+02	8.7E+01
Copper	66.4	7.1E+02	1.31E+01	1.1E+01
Lead	7731.0	9.3E+01	4.95E+01	1.2E+01
Selenium	1.4	5.2E+00	3.31E+00	2.6E+00
Zinc	1703.0	4.1E+03	4.33E+02	4.0E+02

Table 8.2b: Terrestrial Plant and Invertebrate Concentration Calculations for Stokes Rear Range

Parameter	95%UCLM - soil (mg/kg dry wt)	Concentration in Invertebrates (mg/kg(ww))	Concentration in Plants (mg/kg(ww))	
			Forage (mg/kg(ww))	Browse (mg/kg(ww))
Metals				
Barium	138.9	5.4E+01	5.76E+01	4.3E+01
Copper	259.7	7.1E+02	2.40E+01	1.1E+01
Lead	815.1	9.3E+01	3.99E+01	3.0E+00
Mercury	19.5	7.4E+00	1.70E-01	1.3E-01
Selenium	1.3	5.2E+00	3.02E+00	2.6E+00
Tin	23.9	5.5E+00	5.18E+00	5.1E+00
Zinc	22294.0	4.1E+03	6.95E+02	6.2E+02

Table 8.3a: BCF for Plants to Wildlife Measurement Receptors

	American Robin	Cardinal	Meadow Vole	Short Tailed Shrew
Arsenic	9.60E-04	9.60E-04	1.20E-03	1.24E-03
Barium	7.37E-05	7.37E-05	9.21E-05	9.30E-05
Boron	4.79E-04	4.79E-04	5.99E-04	6.20E-04
Copper	8.00E-01	8.00E-01	1.00E+00	1.00E+00
Lead	1.47E-04	1.47E-04	1.84E-04	1.86E-04
Mercury	1.06E-02	1.06E-02	4.68E-04	4.84E-04
Selenium	5.02E-01	5.02E-01	1.36E-03	1.41E-03
Tin	5.02E-01	5.02E-01	1.36E-03	1.41E-03
Zinc	3.89E-02	4.42E-05	5.53E-05	5.58E-05

Bioconcentration Factors obtained from: United States Environmental Protection Agency. 1999. Screening Level Ecological Risk Assessment Protocol. August 1999. Appendix D. Bioconcentration Factors (BCFs) for Wildlife Measurement Receptors.

Table 8.3b: BCF for Soil to Wildlife Measurement Receptors

	American Robin	Cardinal	Meadow Vole	Short Tailed Shrew
Arsenic	2.30E-06	2.30E-06	2.88E-06	2.37E-05
Barium	1.73E-07	1.73E-07	2.16E-07	2.05E-06
Boron	8.00E-01	8.00E-01	1.00E+00	1.00E+00
Copper	8.00E-01	8.00E-01	1.00E+00	1.00E+00
Lead	3.46E-07	3.46E-07	4.32E-07	4.09E-06
Mercury	3.42E-04	3.42E-04	1.12E-06	1.06E-05
Selenium	1.61E-02	1.61E-02	3.27E-06	3.10E-05
Tin	8.00E-01	8.00E-01	1.00E+00	1.00E+00
Zinc	1.25E-04	1.59E-05	1.29E-07	1.23E-06

Bioconcentration Factors obtained from: United States Environmental Protection Agency. 1999. Screening Level Ecological Risk Assessment Protocol. August 1999. Appendix D. Bioconcentration Factors (BCFs) for Wildlife Measurement Receptors.

Table 8.4: Mammals Receptor Characteristics

Parameters	Meadow Vole	Short Tail Shrew	White Tailed Deer	Red Fox
Body Weight (kg)	0.044	0.015	56.5	4.5
Body weight reference	1	1	3	1
Food Ingestion Rate (kg/d) Wet weight	0.0050	0.009	1.740	0.46
Food Ingestion Rate reference	1	1	3	2
Dietary Composition	100% plants	100% invertebrates	100% plants	93% mammals, 7% plants
Fraction of Forage	1	0	0.5	0.07
Fraction of Browse	0	0	0.5	0
Fraction of Invertebrates	0	1	0	0
Fraction of Mammals	0	0	0	0.93
Fraction of Birds	0	0	0	0
Fraction of Ingestion Reference	2	2	4	2
Soil Ingestion Rate (kg/d)	1.80E-05	3.39E-04	5.22E-03	4.12E-03
Soil Ingestion reference	2	2	3	2
Home Range (ha)	0.059	0.39	59-520	96-717
Fraction of Home Range on Front & Squatters'	1.00	0.17	NA	NA
Fraction of Home Range on Rear Range	1.00	0.22	0.00064	0.00040
Water Ingestion Rate (L/d)	1.40E-04	2.23E-04	3.70E+00	8.40E-05
Water Ingestion Rate Reference	2	2	3	2

Table Notes:

1: Sample B.E., Opresko, D.M. and G.W Suter II, 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory Oak Ridge TN. ES/ER/TM-86/R3.

2: US EPA, 1993. Wildlife Exposure Factors Handbook. Volume I & II. Office of Research and Development. EPA/600/R-93/187

3: Sample and Sutter II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-125.

Table 8.5: Birds Receptor Characteristics

Parameters	**American Robin**	**Northern Cardinal**	**Herring Gull**	**Peregrine Falcon**
Body Weight (kg)	0.077	0.045	1.184	0.907
Body weight reference	1	3	2	3
Food Ingestion Rate (kg/d) Wet weight	0.093	0.029	0.342	0.28
Food Ingestion Rate reference	1	2	2	2
Dietary Composition	52.25% browse 47.75% Invertebrates	100 plants	50% mammals, 50% birds	50% mammals, 50% birds
Fraction of Forage	0	0	0	0
Fraction of Browse	0.52	1	0	0
Fraction of Invertebrates	0.48	0	0	0
Fraction of Mammals	0	0	0.5	0.5
Fraction of Birds	0	0	0.5	0.5
Fraction of Ingestion Reference	2	assumed	asssumed	assumed
Soil Ingestion Rate (kg/d)	2.02E-03	8.56E-05	0	0
Soil Ingestion reference	2		4 (assumed negligible)	5 (assumed negligible)
Home Range (ha)	0.81	21.2	10000	17700
Fraction of Home Range on Front & Squatt	0.0420	0.0016	0.0000	0.0000
Fraction of Home Range on Rear Range	1.00	0.49	0.00322	0.00198
Water Ingestion Rate (L/d)	1.40E-04	4.18E-01	5.70E-05	1.55E-01
Water Ingestion Rate Reference	2	2	2	2

Assumed all of these birds would migrate, therefore would be absent from the site 50% of the year.

Front Range & Squatters' contmin	0.068
Rear Range contamintaded area (	0.19

Table Notes:

1: Sample B.E., Opresko, D.M. and G.W Suter II, 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory Oak Ridge TN. ES/ER/TM-86/R3.

2: US EPA, 1993. Wildlife Exposure Factors Handbook. Volume I & II. Office of Research and Development. EPA/600/R-93/187

Table 8.6: Reptiles Receptor Characteristics

Parameters	Massasauga Rattlesnake	Five-Lined Skink
Body Weight (kg)	0.142	0.006
Body weight reference	1	3
Food Ingestion Rate (kg/d) Wet weight	6.00E-05	2.49E-07
Food Ingestion Rate reference	calculated **	calculated *
Dietary Composition	100% small rodents	100% Invertebrates
Fraction of Forage	0	0
Fraction of Browse	0	0
Fraction of Invertebrates	0	1
Fraction of Mammals	1	0
Fraction of Birds	0	0
Fraction of Ingestion Reference	assumed	assumed
Soil Ingestion Rate (kg/d)	6.00E-08	2.49E-10
Soil Ingestion reference	assumed similar to southern hognose (1% of diet)	assumed similar to southern hognose (1% of diet)
Home Range (ha)	0.98	0.039
Fraction of Home Range on Front & Squatters'	0.03	0.50
Fraction of Home Range on Rear Range	0.10	0.50
Water Ingestion Rate (L/d)	assumed negligible	assumed negligible
Water Ingestion Rate Reference		

Table notes:

1= ODNR 2007 Ohio Department of Natural Resources. Eastern Massasauga Rattlesnake.

2 = CDEP 2007

3: Sample and Sutter II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-125.

* calculated using the equation for insectivore reptiles FI = $0.013WT^{0.773}$ (US EPA 1993)

** calculated as 0.06 g/g bw based on feeding once per week and two mice per feeding.

Table 8.7a: Estimated Exposures for Birds at Stokes Bay Front Range and Squatters Area

Parameter	American Robin						Northern Cardinal				
	EE soil (mg/d)	EE plants (mg/d)	EE invertebrates (mg/d)	Tissue Concentration (mg/kg)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)	EE soil (mg/d)	EE plants (mg/d)	EE invertebrates (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)
Metals											
Barium	9.61E-01	4.21E+00	2.42E+00	2.60E+01	3.19E-01	4.14E+00	4.07E-02	3.41E+00	0.00E+00	5.54E-03	1.23E-01
Copper	1.34E-01	5.40E-01	3.16E+01	4.01E+02	1.35E+00	1.76E+01	5.69E-03	3.79E-01	0.00E+00	6.17E-04	1.37E-02
Lead	1.56E+01	5.96E-01	4.14E+00	4.45E+01	8.54E-01	1.11E+01	6.62E-01	1.44E+00	0.00E+00	3.37E-03	7.48E-02
Selenium	2.83E-03	1.28E-01	2.32E-01	3.84E+00	1.52E-02	1.98E-01	1.20E-04	9.60E-02	0.00E+00	1.54E-04	3.43E-03
Zinc	3.44E+00	1.93E+01	1.85E+02	2.00E+03	8.71E+00	1.13E+02	1.46E-01	1.25E+01	0.00E+00	2.04E-02	4.52E-01

Table Notes:
EEsoil= exposure from soil
EEplants= exposure from consumption of plants
EEinvertebrates=exposure from consumption of invertebrates

Table 8.7a: Estimated Exposures for Birds at Stokes Bay Front Range and Squatters Area

Parameter	Herring Gull					Peregrine Falcon				
	EE soil (mg/d)	EE mammals (mg/d)	EE birds (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/kg-d)	EE soil (mg/d)	EE mammals (mg/d)	EE birds (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/kg-d)
Metals										
Barium	0.00E+00	1.87E-03	4.44E+00	1.51E-05	1.28E-05	0.00E+00	1.53E-03	3.64E+00	6.99E-06	7.70E-06
Copper	0.00E+00	1.36E+01	6.86E+01	2.80E-04	2.36E-04	0.00E+00	1.11E+01	5.62E+01	1.29E-04	1.43E-04
Lead	0.00E+00	2.13E-03	7.62E+00	2.59E-05	2.19E-05	0.00E+00	1.74E-03	6.24E+00	1.20E-05	1.32E-05
Selenium	0.00E+00	7.71E-04	6.57E-01	2.24E-06	1.89E-06	0.00E+00	6.31E-04	5.38E-01	1.03E-06	1.14E-06
Zinc	0.00E+00	4.13E-03	3.42E+02	1.16E-03	9.83E-04	0.00E+00	3.38E-03	2.80E+02	5.38E-04	5.94E-04

Table Notes:
EEsoil= exposure from soil
EEbirds= exposure from consumption of other birds
EEmammals=exposure from consumption of small mammals

Table8.7b: Estimated Exposures for Birds at Stokes Bay Rear Range

Parameter	American Robin						Northern Cardinal				
	EE soil (mg/d)	EE plants (mg/d)	EE invertebrates (mg/d)	Tissue Concentration (mg/kg)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)	EE soil (mg/d)	EE plants (mg/d)	EE invertebrates (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)
Metals											
Arsenic	7.55E-03	1.27E-01	1.52E-01	1.63E+00	3.35E-02	4.36E-01	3.20E-04	8.76E-02	0.00E+00	3.94E-04	8.75E-03
Barium	2.81E-01	2.08E+00	2.42E+00	2.60E+01	5.60E-01	7.27E+00	1.19E-02	1.67E+00	0.00E+00	7.54E-03	1.67E-01
Copper	5.25E-01	5.12E-01	3.16E+01	5.56E+02	3.82E+00	4.96E+01	2.22E-02	6.96E-01	0.00E+00	3.22E-03	7.15E-02
Lead	1.65E+00	1.47E-01	4.14E+00	4.45E+01	6.96E-01	9.04E+00	6.98E-02	1.16E+00	0.00E+00	5.50E-03	1.22E-01
Mercury	3.93E-02	6.29E-03	3.30E-01	3.56E+00	4.41E-02	5.73E-01	1.67E-03	4.93E-03	0.00E+00	2.96E-05	6.57E-04
Selenium	2.61E-03	1.27E-01	2.32E-01	3.83E+00	4.24E-02	5.51E-01	1.11E-04	8.76E-02	0.00E+00	3.93E-04	8.73E-03
Tin	4.82E-02	2.48E-01	2.46E-01	2.43E+01	6.35E-02	8.25E-01	2.04E-03	1.50E-01	0.00E+00	6.82E-04	1.52E-02
Zinc	4.50E+01	3.00E+01	1.85E+02	2.01E+03	3.05E+01	3.96E+02	1.91E+00	2.02E+01	0.00E+00	9.89E-02	2.20E+00

Table Notes:
EEsoil= exposure from soil
EEplants= exposure from consumption of plants
EEinvertebrates=exposure from consumption of invertebrates

Table8.7b: Estimated Exposures for Birds at Stokes Bay Rear Range

Parameter	Herring Gull					Peregrine Falcon				
	EE soil (mg/d)	EE mammals (mg/d)	EE birds (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/kg-d)	EE soil (mg/d)	EE mammals (mg/d)	EE birds (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/kg-d)
Metals										
Arsenic	0.00E+00	6.22E-04	2.80E-01	2.66E-06	2.25E-06	0.00E+00	5.09E-04	2.29E-01	1.23E-06	1.36E-06
Barium	0.00E+00	9.12E-04	4.44E+00	4.22E-05	3.56E-05	0.00E+00	7.47E-04	3.64E+00	1.95E-05	2.15E-05
Copper	0.00E+00	4.85E+01	9.50E+01	1.36E-03	1.15E-03	0.00E+00	3.97E+01	7.78E+01	6.31E-04	6.95E-04
Lead	0.00E+00	1.31E-03	7.62E+00	7.24E-05	6.11E-05	0.00E+00	1.08E-03	6.24E+00	3.35E-05	3.69E-05
Mercury	0.00E+00	1.73E-05	6.09E-01	5.78E-06	4.88E-06	0.00E+00	1.42E-05	4.98E-01	2.68E-06	2.95E-06
Selenium	0.00E+00	7.03E-04	6.55E-01	6.23E-06	5.26E-06	0.00E+00	5.76E-04	5.36E-01	2.88E-06	3.18E-06
Tin	0.00E+00	4.08E+00	4.16E+00	7.83E-05	6.61E-05	0.00E+00	3.34E+00	3.40E+00	3.62E-05	3.99E-05
Zinc	0.00E+00	7.07E-03	3.44E+02	3.27E-03	2.76E-03	0.00E+00	5.79E-03	2.82E+02	1.51E-03	1.67E-03

Table Notes:
EEsoil= exposure from soil
EEbirds= exposure from consumption of other birds
EEmammals=exposure from consumption of small mammals

Table 8.8a: Estimated Exposures for Mammals at Stokes Bay Front Range & Squatters Area

	Meadow Vole					Short Tailed Shrew				
Parameter	**EE soil (mg/d)**	**EE plants (mg/d)**	**Tissue Concentration (mg/kg)**	**Total Ingestion (mg/d)**	**Total Intake (mg/Kg-d)**	**EE soil (mg/d)**	**EE invertebrates (mg/d)**	**Tissue Concentration (mg/kg)**	**Total Ingestion (mg/d)**	**Total Intake (mg/Kg-d)**
Metals										
Barium	8.56E-03	5.89E-01	1.09E-02	5.97E-01	1.36E+01	1.61E-01	7.84E-01	8.71E+01	1.65E-01	1.10E+01
Lead	1.39E-01	2.48E-01	1.25E-02	3.87E-01	8.79E+00	2.62E+00	1.11E-01	1.24E+01	4.76E-01	3.18E+01
Selenium	2.52E-05	1.66E-02	4.51E-03	1.66E-02	3.77E-01	4.75E-04	2.38E-02	2.64E+00	4.23E-03	2.82E-01
Zinc	3.07E-02	2.16E+00	2.42E-02	2.19E+00	4.99E+01	5.77E-01	3.59E+00	3.99E+02	7.27E-01	4.85E+01

Table Notes:

EEsoil=exposure from soil

EEplants=exposure from consumption of plants

EEinvertebrates=exposure from consumption of invertebrates

Table8.8b: Estimated Exposures for Mammals at Stokes Bay Rear Range

	Meadow Vole					Short Tailed Shrew				
Parameter	EE soil (mg/d)	EE plants (mg/d)	Tissue Concentration (mg/kg)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)	EE soil (mg/d)	EE invertebrates (mg/d)	Tissue Concentration (mg/kg)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)
Metals										
Arsenic	6.73E-05	1.51E-02	3.63E-03	1.52E-02	3.45E-01	1.27E-03	2.36E-02	2.62E+00	1.21E-02	8.07E-01
Barium	2.50E-03	2.88E-01	5.33E-03	2.90E-01	6.60E+00	4.71E-02	3.87E-01	4.30E+01	2.11E-01	1.41E+01
Copper	4.67E-03	1.20E-01	2.84E+02	1.25E-01	2.83E+00	8.80E-02	9.52E-02	2.70E+02	8.93E-02	5.95E+00
Lead	1.47E-02	1.99E-01	7.69E-03	2.14E-01	4.87E+00	2.76E-01	2.74E-02	3.04E+00	1.48E-01	9.86E+00
Mercury	3.50E-04	8.50E-04	1.01E-04	1.20E-03	2.73E-02	6.60E-03	1.17E-03	1.30E-01	3.79E-03	2.52E-01
Selenium	2.33E-05	1.51E-02	4.11E-03	1.51E-02	3.44E-01	4.38E-04	2.36E-02	2.62E+00	1.17E-02	7.80E-01
Tin	4.30E-04	2.59E-02	2.39E+01	2.63E-02	5.98E-01	8.09E-03	4.62E-02	2.90E+01	2.64E-02	1.76E+00
Zinc	4.01E-01	3.48E+00	4.13E-02	3.88E+00	8.82E+01	7.56E+00	5.58E+00	6.20E+02	6.40E+00	4.27E+02

Table Notes:

EEsoil=exposure from soil

EEplants=exposure from consumption of plants

EEinvertebrates=exposure from consumption of invertebrates

Table8.8b: Estimated Exposures for Mammals at Stokes Bay Rear Range

	White Tailed Deer				Red Fox				
Parameter	**EE soil (mg/d)**	**EE plants (mg/d)**	**Total Ingestion (mg/d)**	**Total Intake (mg/kg-d)**	**EE soil (mg/d)**	**EE plants (mg/d)**	**EE mammals (mg/d)**	**Total Ingestion (mg/d)**	**Total Intake (mg/kg-d)**
Metals									
Arsenic	1.95E-02	3.79E+00	1.23E-02	2.17E-04	1.54E-02	9.72E-02	1.55E-03	2.26E-04	5.02E-05
Barium	7.25E-01	6.62E+01	2.15E-01	3.81E-03	5.72E-01	1.85E+00	2.28E-03	4.81E-03	1.07E-03
Copper	1.36E+00	2.12E+01	7.26E-02	1.29E-03	1.07E+00	7.72E-01	1.21E+02	2.44E-01	5.42E-02
Lead	4.25E+00	2.26E+01	8.64E-02	1.53E-03	3.36E+00	1.28E+00	3.29E-03	9.19E-03	2.04E-03
Mercury	1.02E-01	1.98E-01	9.65E-04	1.71E-05	8.02E-02	5.47E-03	4.34E-05	1.70E-04	3.77E-05
Selenium	6.74E-03	3.79E+00	1.22E-02	2.16E-04	5.32E-03	9.72E-02	1.76E-03	2.06E-04	4.59E-05
Tin	1.25E-01	7.05E+00	2.31E-02	4.09E-04	9.83E-02	1.67E-01	1.02E+01	2.07E-02	4.61E-03
Zinc	1.16E+02	8.87E+02	3.23E+00	5.72E-02	9.19E+01	2.24E+01	1.77E-02	2.26E-01	5.03E-02

Table Notes:
EEsoil=exposure from soil
EEplants=exposure from consumption of plants
EEmammals=exposure from consumption of mammals

Table 8.9a: Estimated Exposures for Reptiles at Stokes Bay Front and Squaters Area

Parameter	Massasauga Snake				Five-lined Skink			
	EE soil (mg/d)	EE meadow vole (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)	EE soil (mg/d)	EE invertebrates (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)
Metals								
Barium	2.85E-05	6.57E-07	1.01E-06	7.14E-06	1.18E-07	2.17E-05	1.09E-05	1.82E-03
Lead	4.64E-04	7.47E-07	1.61E-05	1.14E-04	1.93E-06	3.07E-06	2.50E-06	4.16E-04
Selenium	8.40E-08	2.70E-07	1.23E-08	8.66E-08	3.49E-10	6.57E-07	3.29E-07	5.48E-05
Zinc	1.02E-04	1.45E-06	3.60E-06	2.53E-05	4.24E-07	9.94E-05	4.99E-05	8.32E-03

Table Notes:
EEmeadow vole=exposure from soil
EEsoil=exposure from consumption of meadow vole

Table 8.9b: Estimated Exposures for Reptiles at Stokes Bay Rear Range

Parameter	Massasauga Snake				Five-lined Skink			
	EE soil (mg/d)	EE meadow vole (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)	EE soil (mg/d)	EE invertebrates (mg/d)	Total Ingestion (mg/d)	Total Intake (mg/Kg-d)
Metals								
Arsenic	2.24E-07	2.18E-07	4.29E-08	3.02E-07	9.31E-10	6.52E-07	3.27E-07	5.44E-05
Barium	8.33E-06	3.20E-07	8.39E-07	5.91E-06	3.46E-08	1.07E-05	5.36E-06	8.94E-04
Copper	1.56E-05	1.70E-02	1.65E-03	1.16E-02	6.47E-08	2.63E-06	1.35E-06	2.25E-04
Lead	4.89E-05	4.61E-07	4.79E-06	3.37E-05	2.03E-07	7.57E-07	4.80E-07	8.00E-05
Mercury	1.17E-06	6.08E-09	1.14E-07	8.02E-07	4.85E-09	3.24E-08	1.86E-08	3.10E-06
Selenium	7.75E-08	2.47E-07	3.14E-08	2.21E-07	3.22E-10	6.52E-07	3.26E-07	5.44E-05
Tin	1.43E-06	1.43E-03	1.39E-04	9.79E-04	5.94E-09	1.28E-06	6.42E-07	1.07E-04
Zinc	1.34E-03	2.48E-06	1.30E-04	9.15E-04	5.55E-06	1.54E-04	8.00E-05	1.33E-02

Table Notes:
EEmeadow vole=exposure from soil
EEsoil=exposure from consumption of meadow vole

Table 8.10: Ecotoxicity TRVs for the COCs (Metals)

COCs	Tested Species	Endpoint	TRV Value	VEC	Applied	Units	Reference
Barium	barley	Chronic LOAEL - shoot growth	500	terrestrial plants	500	mg/kg	Chaudry et al. 1977 as cited in the EPA Screening Level Ecological Risk Assessment Protocol August 1999. Appendix E.
	Eisenia fetida	LOEC, mortality	2894	terrestrial invertebrates	2894		Environment Canada (1996) as cited in the CCME CSQG for protection of environmental and human health. Barium.
	1 day old chicks	Chronic LOAEL derived based on chicks exposed to 4000 ppm which experienced 5 % mortality	41.7	American Robin Northern Cardinal Herring Hull Peregrine Falcon	41.7	mg/kg$_{\text{-bw}}$-d	Johnson et al. 1960 as cited in Sample et al. 1996. 1 day old chicks, LOAEL, mortality.
	rat	Chronic LOAEL - mortality	19.8	Short-tailed shrew Meadow vole White-tailed deer Red fox	19.8	mg/kg$_{\text{-bw}}$-d	As barium chloride. Borzelleca et al.1988 as cited in Sample et at. 1996. Exposure of rats to 300 mg/kg/d BaCl for 10 days resulted in 30% mortality to female rats. The 300 mg/kg/d dose was considered to be a subchronic LOAEL. A chronic LOAEL was estimated by multiplying the subchronic LOAEL by a subchronic to chronic uncertainty factor of 0.1.
Copper	several	LOEC	141	terrestrial plants	141	mg/kg	Ontario Ministry of the Environment (MOE) Standards Development Branch (2008). Rationale for the Development of Generic Soil and Groundwater Standards for Use at Contaminated Sites In Ontario. Table 4.28 Summary Table of Plant and Soil Invertebrate Protection Values.
	several	LOEC	141	invertebrates	141	mg/kg	
	day old chicks	Chronic LOAEL - growth, mortality	61.7	American Robin Northern Cardinal Herring Hull Peregrine Falcon	61.7	mg/kg$_{\text{-bw}}$-d	Mehring et al. 1960 as cited in Samples et al. 1996.
	mink	Chronic LOAEL - reproduction	15.14	Short-tailed shrew Meadow vole White-tailed deer Red fox	15.14	mg/kg$_{\text{-bw}}$-d	Aulerich et al. 1982 as cited in Samples et al. 1996. The study was approximately one year in duration and considered exposure during reproduction, the 50 ppm supplemental Cu (110.5 ppm total Cu) dose was considered to be achronic LOAEL.

Table 8.10: Ecotoxicity TRVs for the COCs (Metals)

COCs	Tested Species	Endpoint	TRV Value	VEC	Applied	Units	Reference
Lead	lettuce	LOEC, seedling emergence	740	terrestrial plants	740	mg/kg	Environment Canada 1995. As cited in the CCME Guidelines for Lead. Environment Canada (1995) reported a NOEC, LOEC, EC25, and EC50 values forseedling emergence of lettuce (Lactuca sativa) were 416,740, 667, and 876 mg Pb·kg-1, respectively. The LOEC of 740 was selected.
	Eisenia fetida	NOEC	1480	invertebrates	1480	mg/kg	Environment Canada (1995) reported LC25, LC50, and LC70values of 2067, 2500, and 3070 mg·kg-1, respectively, forthe earthworm Eisenia foetida in artificial soil. The NOECwas reported at 1480 mg Pb·kg-1.
	japanese quail	Chronic LOAEL -reproduction	11.3	American Robin Northern Cardinal Herring Hull Peregrine Falcon	11.3	mg/kg$_{-bw}$-d	Edens et al. 1976 as cited in Sample et al. 1996. the study considered exposure over 12 weeks and throughout a critical lifestage (reproduction). Final LOAEL: 11.3 mg/kg/d
	rat	Chronic LOAEL - reproduction	80	Short-tailed shrew Meadow vole White-tailed deer Red fox	80	mg/kg$_{-bw}$-d	Azar et al. 1973 as cited in Sample et al. 1996. Pb exposure of 1000 and 2000 ppm resulted in reduced offspring weights and produced kidney damage in the young. Therefore the 1000 ppm Pb dose was considered to be achronic LOAEL.
Mercury	barley	Exposure to mercury waste for 7 days reduced seedling weight by 19%, Chronic LOEC	64	terrestrial plants	64	mg/kg	Panda et al 1992 as cited in Sample et al. 1997. Barley exposure to mercury waste for 7 days seedling height was reduced by 19%.
	Eisenia fetida	Reduction of survival (21%) and regenaration of excised segment (69%). Chronic LOEC	12.5	invertebrates	12.5	mg/kg	Beyer et al. 1985 as cited in Efroymoson et al. 1997. Methyl mercury chloride was added at 12.4 ppm and E.fetida was cultured for 84 days.
	japanese quail	decrease in fertility and hatchability, Chronic LOAEL	0.9	American Robin Northern Cardinal Herring Hull Peregrine Falcon	0.9	mg/kg$_{-bw}$-d	Hill and Schaffner 1976 as cited in Sample et al. 1996. Adverse effects of Hg were evident at the 8 mg Hg /kg dose. Because the study consideredexposure during reproduction, the 4 and 8 mg/kg dose levels were considered to be chronic NOAELsand LOAELs respectively.Final LOAEL: 0.9 mg/kg/d
	mink	kit weight reduced by 9% relative to control, Chronic NOAEL	1	Short-tailed shrew Meadow vole White-tailed deer Red fox	1.00	mg/kg$_{-bw}$-d	Aulerich et al. 1974 as cited in Samples et al. 1996. While kit weight was somewhat reduced (9% relative to controls), fertility, and kitsurvival were not reduced. Because the study considered exposure through
Selenium		Ecotoxicity Criteria	10	terrestrial plants	10	mg/kg	MOEE. 1996 Rationale Document. Ecotoxicity Criteria.
	Eisenia fetida	LOAEL -growth, reproduction	70	invertebrates	70	mg/kg	Fischer and Koszorus (1992) as cited in Sample et al. 1997. (as sodium arsenite).
	mallard ducks	Chronic LOAEL - mortality as sodium selenite	6.3	American Robin Northern Cardinal Herring Hull Peregrine Falcon	6.3	mg/kg-bw/d	Heinz et al. 1988, as cited in the CCME Canadian Soil Quality Guidelines, Scientific Criteria Document. CCME 2009 Table 10
	mouse	LD50 as selenium dioxide	17	Short-tailed shrew Meadow vole White-tailed deer Red fox	1.7	mg/kg-bw/d	Singh and Junnarkar 1991, as cited in the CCME Canadian Soil Quality Guidelines, Scientific Criteria Document. CCME 2009

Table 8.10: Ecotoxicity TRVs for the COCs (Metals)

COCs	Tested Species	Endpoint	TRV Value	VEC	Applied	Units	Reference
Tin	bush beans	LOEC weight reduction of 22%	500	terrestrial plants	500	mg/kg	Romney et al. (1975) as cited in Sample et. al. 1997. Shoot weight of bush beans growth. LOEC, weight reduction of 22% at 500.
	--	toxicological benchmark	2000	invertebrates	2000	mg/kg	Al-Khafaji and Tabatabai, 1979, as cited in Sample et al.1997.
	japanese quail	Chronic LOAEL -reproduction	16.9	American Robin Northern Cardinal Herring Hull Peregrine Falcon	16.9	mg/kg-bw-d	Edens et al. 1976 as cited in Sample et al. 1996. the study considered exposure during reproduction, egg weight and hatchability were reduced among quail consuming dietscontaining 150 mg TBTO/kg.
	mouse	Chronic LOAEL - reproduction	35	Short-tailed shrew Meadow vole White-tailed deer Red fox	35.0	mg/kg-bw-d	Davies et al. 1987 as cited in Sample et al .1996. the study considered exposure during gestation, the 23.4 and 35 mg/kg/d dose levels wereconsidered to be chronic NOAELs and LOAELs respectively.
Zinc	*Brassica rapa*	LOEC, biomass, seddling emergence	1000	terrestrial plants	1000.0	mg/kg	MOE 2009, Sheppard et al. 1993. LOEC. Brassica rapa, biomass, seedling emergency, natural soil
	eartworm	LOEC	1200	invertebrates	1200.0	mg/kg	MOE 2009, Earthworm, weight, 21 days, LOEC Spurgeon and Hopkin 1996b.
	White leghorn hens	Chronic LOAEL reproduction	131	American Robin Northern Cardinal Herring Hull Peregrine Falcon	131.0	mg/kg-bw-d	Stahl et al. 1990 as cited in Sample et al. 1996. egg hatchability was <20% of controls among hens consuming 2028 ppm zinc. the study wasgreater than 10 weeks in duration and considered exposure during reproduction, the 2028 ppm dose was considered a chronic LOAEL.
	Rat	Chronic LOAEL - reproduction	320	Short-tailed shrew Meadow vole White-tailed deer Red fox	320.0	mg/kg-bw-d	Schlicker and Cox 1968 as cited in Sample et al. 1996.

Table 8.11a: Calculation of Plants and Invertebrates Ecological Screening Quotient (ESQ) at Stokes Bay Front and Squaters Area

Parameter	Toxicological Reference Values				ESQ	
	Terrestrial Plants	units	Terrestrial Invertebrates	units		
Metals						
Barium	5.00E+02	mg/kg	2.89E+03	mg/kg	9.52E-01	1.64E-01
Copper	1.41E+02	mg/kg	1.41E+02	mg/kg	4.71E-01	4.71E-01
Lead	7.40E+02	mg/kg	1.48E+03	mg/kg	**1.04E+01**	**5.22E+00**
Selenium	1.00E+01	mg/kg	7.00E+01	mg/kg	1.40E-01	2.00E-02
Zinc	1.00E+03	mg/kg	1.20E+03	mg/kg	**1.70E+00**	**1.42E+00**

Table Notes:
NV = no value
NC = not calculated
bold values = RQ higher than 1.

Table 8.11b: Calculation of Plants and Invertebrates Ecological Screening Quotient (ESQ) at Stokes Bay Rear Range						
Parameter	**Toxicological Reference Values**				**ESQ**	
	Terrestrial Plants	**units**	**Terrestrial Invertebrates**	**units**		
Metals						
Barium	5.00E+02	mg/kg	2.89E+03	mg/kg	2.78E-01	4.80E-02
Copper	1.41E+02	mg/kg	1.41E+02	mg/kg	**1.84E+00**	**1.84E+00**
Lead	7.40E+02	mg/kg	1.48E+03	mg/kg	**1.10E+00**	5.51E-01
Mercury	6.40E+01	mg/kg	1.25E+01	mg/kg	3.04E-01	**1.56E+00**
Selenium	1.00E+01	mg/kg	7.00E+01	mg/kg	1.29E-01	1.85E-02
Tin	5.00E+02	mg/kg	2.00E+03	mg/kg	4.77E-02	1.19E-02
Zinc	1.00E+03	mg/kg	1.20E+03	mg/kg	**2.23E+01**	**1.86E+01**

Table Notes:
NV = no value
NC = not calculated
bold values = RQ higher than 1.

Table 8.12a: Calculation of ESQ for Birds at Stokes Bay Front and Squaters Area

	American Robin			Northen Cardinal			Herring Gull			Peregrine Falcon		
Parameter	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ
Metals												
Barium	4.14E+00	4.17E+01	9.92E-02	1.23E-01	4.17E+01	2.95E-03	1.28E-05	4.17E+01	3.06E-07	7.70E-06	4.17E+01	1.85E-07
Copper	1.76E+01	6.17E+01	2.85E-01	1.37E-02	6.17E+01	2.22E-04	2.36E-04	6.17E+01	3.83E-06	1.43E-04	6.17E+01	2.31E-06
Lead	1.11E+01	1.13E+01	9.82E-01	7.48E-02	9.00E-01	8.31E-02	2.19E-05	9.00E-01	2.43E-05	1.32E-05	9.00E-01	1.47E-05
Selenium	1.98E-01	1.00E+00	1.98E-01	3.43E-03	1.00E+00	3.43E-03	1.89E-06	1.00E+00	1.89E-06	1.14E-06	1.00E+00	1.14E-06
Zinc	1.13E+02	1.31E+02	8.63E-01	4.52E-01	1.31E+02	3.45E-03	9.83E-04	1.31E+02	7.50E-06	5.94E-04	1.31E+02	4.53E-06

Table 8.12b: Calculation of ESQ for Birds at Stokes Bay Rear Range

	American Robin			Northen Cardinal			Herring Gull			Peregrine Falcon		
Parameter	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**
Metals												
Arsenic	4.36E-01	7.40E+00	5.89E-02	8.75E-03	7.40E+00	1.18E-03	2.25E-06	7.40E+00	3.04E-07	1.36E-06	7.40E+00	1.83E-07
Barium	7.27E+00	4.17E+01	1.74E-01	1.67E-01	4.17E+01	4.02E-03	3.56E-05	4.17E+01	8.55E-07	2.15E-05	4.17E+01	5.16E-07
Copper	4.96E+01	6.17E+01	8.05E-01	7.15E-02	6.17E+01	1.16E-03	1.15E-03	6.17E+01	1.87E-05	6.95E-04	6.17E+01	1.13E-05
Lead	9.04E+00	1.13E+01	8.00E-01	1.22E-01	9.00E-01	1.36E-01	6.11E-05	9.00E-01	6.79E-05	3.69E-05	9.00E-01	4.10E-05
Mercury	5.73E-01	9.00E-01	6.36E-01	6.57E-04	9.00E-01	7.30E-04	4.88E-06	9.00E-01	5.43E-06	2.95E-06	9.00E-01	3.28E-06
Selenium	5.51E-01	1.00E+00	5.51E-01	8.73E-03	1.00E+00	8.73E-03	5.26E-06	1.00E+00	5.26E-06	3.18E-06	1.00E+00	3.18E-06
Tin	8.25E-01	1.69E+01	4.88E-02	1.52E-02	1.69E+01	8.97E-04	6.61E-05	1.69E+01	3.91E-06	3.99E-05	1.69E+01	2.36E-06
Zinc	3.96E+02	1.31E+02	**3.02E+00**	2.20E+00	1.31E+02	1.68E-02	2.76E-03	1.31E+02	2.11E-05	1.67E-03	1.31E+02	1.27E-05

Table 8.13a: Calculation of ESQ for Mammals at Stokes Bay Front and Squaters Area						
	Meadow Vole			**Short Tailed Shrew**		
Parameter	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**
Metals						
Barium	1.36E+01	1.98E+01	6.85E-01	1.10E+01	1.98E+01	5.55E-01
Lead	8.79E+00	8.00E+01	1.10E-01	3.18E+01	8.00E+01	3.97E-01
Selenium	3.77E-01	1.70E+00	2.22E-01	2.82E-01	1.70E+00	1.66E-01
Zinc	4.99E+01	3.20E+02	1.56E-01	4.85E+01	3.20E+02	1.52E-01

Table 8.13b: Calculation of ESQ for Mammals at Stokes Bay Rear Range

	Meadow Vole			Short Tailed Shrew			White Tailed Deer			Red Fox		
Parameter	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**	**Exposure (mg/kg-day)**	**TRV (mg/kg-day)**	**ESQ**
Metals												
Arsenic	3.45E-01	1.50E+00	2.30E-01	8.07E-01	1.50E+00	5.38E-01	2.17E-04	1.50E+00	1.45E-04	5.02E-05	1.50E+00	3.35E-05
Barium	6.60E+00	1.98E+01	3.33E-01	1.41E+01	1.98E+01	7.11E-01	3.81E-03	1.98E+01	1.93E-04	1.07E-03	1.98E+01	5.39E-05
Copper	2.83E+00	1.51E+01	1.87E-01	5.95E+00	1.51E+01	3.93E-01	1.29E-03	1.51E+01	8.49E-05	5.42E-02	1.51E+01	3.58E-03
Lead	4.87E+00	8.00E+01	6.08E-02	9.86E+00	8.00E+01	1.23E-01	1.53E-03	8.00E+01	1.91E-05	2.04E-03	8.00E+01	2.55E-05
Mercury	2.73E-02	1.00E+00	2.73E-02	2.52E-01	1.00E+00	2.52E-01	1.71E-05	1.00E+00	1.71E-05	3.77E-05	1.00E+00	3.77E-05
Selenium	3.44E-01	1.70E+00	2.02E-01	7.80E-01	1.70E+00	4.59E-01	2.16E-04	1.70E+00	1.27E-04	4.59E-05	1.70E+00	2.70E-05
Tin	5.98E-01	3.50E+01	1.71E-02	1.76E+00	3.50E+01	5.04E-02	4.09E-04	3.50E+01	1.17E-05	4.61E-03	3.50E+01	1.32E-04
Zinc	8.82E+01	3.20E+02	2.75E-01	4.27E+02	3.20E+02	**1.33E+00**	5.72E-02	3.20E+02	1.79E-04	5.03E-02	3.20E+02	1.57E-04

Table 8.14a: Calculation of ESQ for Reptiles at Stokes Bay Front and Squaters Area

Parameter	Massasauga Rattlesnake			Five-lined skink		
	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ
Metals						
Barium	7.14E-06	1.98E+00	3.60E-06	1.82E-03	1.98E+00	9.18E-04
Lead	1.14E-04	8.00E+00	1.42E-05	4.16E-04	8.00E+00	5.20E-05
Selenium	8.66E-08	1.70E-01	5.09E-07	5.48E-05	1.70E-01	3.22E-04
Zinc	2.53E-05	3.20E+01	7.91E-07	8.32E-03	3.20E+01	2.60E-04

Table 8.14b: Calculation of ESQ for Reptiles at Stokes Bay Rear Range

Parameter	Massasauga Rattlesnake			Five-lined skink		
	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ	Exposure (mg/kg-day)	TRV (mg/kg-day)	ESQ
Metals						
Arsenic	3.02E-07	1.50E-01	2.01E-06	5.44E-05	1.50E-01	3.63E-04
Barium	5.91E-06	1.98E+00	2.98E-06	8.94E-04	1.98E+00	4.52E-04
Copper	1.16E-02	1.51E+00	7.68E-03	2.25E-04	1.51E+00	1.49E-04
Lead	3.37E-05	8.00E+00	4.21E-06	8.00E-05	8.00E+00	1.00E-05
Mercury	8.02E-07	1.00E-01	8.02E-06	3.10E-06	1.00E-01	3.10E-05
Selenium	2.21E-07	1.70E-01	1.30E-06	5.44E-05	1.70E-01	3.20E-04
Tin	9.79E-04	3.50E+00	2.80E-04	1.07E-04	3.50E+00	3.06E-05
Zinc	9.15E-04	3.20E+01	2.86E-05	1.33E-02	3.20E+01	4.17E-04

APPENDIX D – PROJECT EFFECTS DETERMINATION REPORT, AND ENVIRONMENTAL EFFECTS AND PROPOSED MITIGATION MEASURES

FISHERIES AND OCEANS
CANADIAN ENVIRONMENTAL ASSESSMENT ACT (CEAA) 2012
PROJECT EFFECTS DETERMINATION REPORT

GENERAL INFORMATION

1. Project Title: Lead Based Paint Abatement and Contaminated Soil Removal - Stokes Bay Front Range Light Station, Knife Island, Ontario

2 Proponent: Lawrence Swift, Real Property Director DFO ☐ **Other** ___________________________ (proponent's name)

3. Other Contacts (Proponent, Consultant, Contractor or another DFO Sector):
Haya Finan, Environmental Officer, DFO

4. Role of each contact:

5. Source of Project Information if project is a referral (DFO sector, company, organization, provincial or federal department): **N/A**

6. Project Review Start Date: 2015

7. PATH No.:

8. DFO File No:

9. Other relevant file numbers: DFRP No. 10961, FCSI No. 10961002, PWGSC Project No. R.071694.050

BACKGROUND

10. Background about Proposed Development (including a description of the proposed development):
The known soil contaminants of concern (COCs) requiring remediation identified by site investigations include lead. Lead based paint on the former lighthouse was identified as the main source of the surface soil contamination and loose paint chip are present on the ground around the old light tower and new (operational) light tower at the site. Upon completion of a site specific human health risk assessment (SSRA-HH) and an ecological risk assessment (SSERA) by Franz Environmental Inc. (Franz) in 2011, potential unacceptable risks were identified to infants and toddlers as well as plants due to contact with lead contaminated surface soil at the site. Recommendations were made to excavate localized areas where soil concentrations posed unacceptable risk to human and/or ecological receptors, and to abate/remediate the lead based paint on the light towers. The area for soil remediation is shown on Drawing C-03 (attached).

PROJECT REVIEW

11. DFO's rationale for the project review:

Project is on federal land X <u>and</u>;

X DFO is the proponent
☐ DFO to issue *Fisheries Act* Authorization or *Species at Risk Act* Permit
☐ DFO to provide financial assistance to another party to enable the project to proceed
☐ DFO to issue licence or lease federal land to enable the project to proceed

12. Fisheries Act Section(s) (if applicable):
For marine access, DFO Habitat should be consulted prior to mobilizing to the site. The Fisheries timing for no in water works (October to July) was considered based on access to site is only by boat. This time may have flexibility based on the location of the site. This restriction is identified in the Plans and Specifications document attached.

13. Species at Risk Act Section(s) (If applicable):
No SARA Permit was deemed to be required based on the SSERA report. No SAR were identified in the 2014/2015 works. Mitigation measures are described in Table 1 and the Plans and Specifications document attached.

14. Primary Authority:
DFO

15. Primary Authority's rationale for involvement:
Federal land controlled by DFO.

16. Other Authorities involved in review: N/A

17. Each Authority's rationale for involvement: N/A

18. Other Jurisdictions involved in review: N/A

19. Other Expert Departments Providing Advice:
DFO Habitat (contact prior to mobilization of equipment to site).

20. Areas of Interest of Other Expert Departments: N/A

21. Other Contacts and Responses: None required.

22. Scope of Project (details of the project subject to review):

Lead based paint abatement and repainting of the old light tower. Soil remediation/removal of lead contaminated soil, and removal of miscellaneous debris and surrounding soil.

The scope of the project is documented in the Plans and Specifications document attached.

23. Location of Project:

Stokes Bay Front Range is located on Knife Island which is owned by DFO (DFRP No. 10961). Knife Island is located in Lake Huron, approximately 1 km from Shute Point (at the western tip of Black Creek Provincial Park) and is approximately 4 km southwest of the town of Stokes Bay, Ontario. There are no roads connecting Knife Island to the mainland, and there is no wharf, dock facilities or helipad at the site.

24. Environment Description:

The ground around the two light towers features mostly exposed dolomite bedrock with shallow organic pockets of soil, and some scrub trees and other vegetation. Soil is predominately located within cracks within the bedrock.

25. Scope of Effects Considered (section 5(1) and 5(2)):

Knife Island is not inhabited and the on-site light towers are not occupied (un-manned navigational lights). Several SAR species were identified during the SSERA (2011). The potential impacts and mitigation measures to address the potential impacts to receptors including identified SAR species as well as other environmental, biological and human are described in Table 1 (attached).

26. Environmental Effects of Project:

Water:

Changes to surface water quality could result from lead abatement and soil excavation/removal including storage. Fine soil particles, lead based paint chips, and organic debris might enter the aquatic environment due to Project activities. These environmental effects would be temporary, only occurring during the Project work.

Land:

Site access and machinery operation could contribute to soil erosion and changes to soil stability. Removal of contaminated soil may physically change the soil structure in a localized manner, allowing fines and foreign debris to enter the terrestrial environment. Lead based paint could impact soil at the site if not properly controlled during abatement activities. The environmental effects should only occur during Project activities.

Atmosphere:

Localized atmospheric effects including noise, dust, and fumes (from machinery) may result from operations to abate lead and remove soil.

Ecological Effects:

Aquatic and terrestrial species might experience short term disturbance and negative effects from localized Project activities including some habitat loss (grubbing of shrubs and trees). The positive effects associated with the Project activities include removing the source of contaminants (lead). The lead abatement and soil removal are minor remediation activities and the environmental effects associated with them are minor and short term. The overall effect of the Project is to remove risks to human health and ecosystem health.

Socio-Economic Effects:

Project crews are vulnerable to health risks from exposure to airborne lead particulate during abatement and fumes from machinery. Proper mitigation as described in Table 1 should be implemented by work crew(s) onsite.

Accidents:

Accidents or malfunctions occurring and causing negative environmental impacts due to Project activities including physical work is minimal. Potential accidents may occur during on-water access/egress from the site, during lead abatement and during soil removal. These may include:

- Spills or leaks into the marine environment (boat motor)
- Release of airborne lead particulates due to failure of abatement enclosure
- Spills from equipment operated onsite
- Mechanical failures

The project activities that could result in accidents are largely related to operation and maintenance of machines. Mechanical failures including spills and leaks are attributed to human error or improper storage of materials.

27. Mitigation Measures for Project (including Habitat Compensation if applicable):

Table 1 attached provides mitigation measures for each valued ecosystem to be potentially affected by the Project.

Notably, potentially suitable habitat for the Massassauga Rattlesnake (Franz, 2011) may exist in the area of the light towers and there is a possibility for one or more individuals to occur within the area to be remediated. The presence of workers on-site and movement of equipment should alarm any wildlife (including snakes) and cause them to disperse. This is a desired effect as it will clear the area of mobile wildlife and avoid the need for work stoppage.

28. Description of any Significant Adverse Environmental Effects of the project (after applying mitigation):

No adverse environmental effects are anticipated if mitigation measures and best management practices are implemented. The Project is not likely to result in significant adverse environmental effects. The Project is similarly not likely to results in significant adverse cumulative effects.

29. Other Considerations (Public Consultation, Aboriginal Consultation, Follow-up)

None required.

30. Other Monitoring and Compliance Requirements (e.g. *Fisheries Act* or *Species at Risk Act* requirements)

None required.

CONCLUSION

31. Conclusion on Significance of Adverse Environmental Effects:

No adverse environmental effects are anticipated if mitigation measures and best management practices are implemented. The Project is not likely to result in significant adverse environmental effects. The Project is similarly not likely to results in significant adverse cumulative effects.

32. Prepared by: ______________________________ **33. Date:**

34. Name: **Jennifer Etherington**

35. Title: Project Hydrogeologist, Environment & Water, SNC-Lavalin Inc.

36. Approved by: _________________________ **37. Date:**

38. Name: **Lawrence Swift**

39. Title: Director, Department of Fisheries and Oceans Canada

DECISION

40. Decision Taken

☐ The project is not likely to cause significant adverse environmental effects, and DFO may exercise its power, duty or function.

☐ The project is likely to cause significant adverse environmental effects, and DFO has decided not to exercise its power, duty or function.

☐ The project is likely to cause significant adverse environmental effects, and DFO will ask the Governor in Council to determine if the significant adverse environmental effects are justified in the circumstances

41. Approved by: ________________________________ **42. Date:** ________________

43. Name: - **Lawrence Swift**

44. Title: **Director, Real Property,** Department of Fisheries and Oceans Canada

45. References:

Franz Environmental (2011). Site Specific Human Health Risk Assessment (SSRA-HA), Site Specific Ecological Risk Assessment (SSERA) and Supplemental Site Investigation, Stokes Bay Front Range, Stokes Bay Rear Range and the Former Squatter's Area, Knife Island (DFRP# 10961) and Shute Point ((DFRP No. 85917), PWGSC Project No.: R.032955.015. March 2011.

SNC-Lavalin (2015). Confirmation Soil Sampling, SAR Survey Update, DSHMS, Structural Assessment, Marine Assessment and Development of Plans and Specifications for Remediation, Stokes Bay Front Range, Knife Island, Lake Huron, Ontario, DFRP No. 10961 / PWGSC No. R071694.050. February 2015.

STOKES BAY FRONT RANGE LIGHT STATION DFRP No. 10961, KNIFE ISLAND, ONTARIO, LEAD BASED PAINT ABATEMENT AND CONTAMINATED SOIL REMOVAL, Project Specifications PWGSC Number R. 071694.050, 2015.02.19

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Air Quality	**Site Preparation, Soil Removal and Demobilization:** Potential for air emissions from construction vehicles, machinery and equipment to degrade local air quality.	• Maintain vehicles (including boats and barges), machinery and equipment in good repair, equipped with emission controls, as applicable, and operate them within regulatory requirements. • Comply with operating specifications for vehicles, machinery and equipment. • Minimize operation and idling of gas-powered equipment and vehicles. • No burning of waste or excess materials is permitted.	Low emissions from Project activities. Low potential for residual effect if mitigation measures applied.	-1	No

	Site Preparation, Lead Abatement Soil Removal: Potential impact to air quality and human health due to release of dust, lead based paint, soil and other airborne particles.	• Suppress releases of dust/paint chips using high-pressure high efficiency particulate air (HEPA) vacuum attached to equipment, water mist or other appropriate methods of control during site preparation, lead abatement on towers, soil removal, and loading and unloading of materials.
		• Soil and lead based paint will only be transported in secure holdings to limit losses as dust.
		• Use controlled work procedures in order to eliminate release of dust and lead based paint from construction works including:
		  ○ Use covered containers to hold removed soil and lead based paint until removal offsite.
		  ○ Avoid activities with potential to release airborne particulates during windy and prolonged dry periods.
		• Workers to wear personal protective equipment (*e.g.*, safety work boots, respirators, hard hats, etc.) in accordance with applicable legislation.
		• Work to be complete in accordance with Ontario Ministry of Labour (MOL) *Guideline: Lead on Construction Projects.*
		• Work shall be carried out in compliance with the Canadian *Environmental Protection Act* (*CEPA*), and applicable air emission regulations and by-laws.
			Low potential for fugitive dust during Project activities.
			
			Low potential for residual effect if mitigation measures applied.
				-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Noise	**Site Preparation, Lead Abatement and Soil Removal:** Temporary disturbance to terrestrial biota from noise generated by lead abatement, site preparation and soil removal activities (machinery, human presence).	• Where applicable, appropriate ear protection equipment must be worn by employees working on site. • Install noise mufflers on construction machinery to reduce noise levels, as applicable. • Contractors should avoid excess and unnecessary noise.	Low potential for residual effect as generation of noise will be limited and temporary.	-1	No
Surficial Geology and Soil	**Site Preparation and Soil Removal:** Site clearing and soil removal will result in temporary exposure of some portions of the Project site to wind and surface run-off.	• Stabilize soil after soil removal to prevent its erosion and transport. • Develop and implement an erosion control plan. • Undertake earthworks using construction techniques designed to prevent sedimentation (e.g., use straw bales to minimize runoff).	Low potential for residual effect if mitigation measures applied.	-1	No
	Soil Removal: Contaminated soil removal.	• Contaminated soil identified to exceed site-specific target levels will follow appropriate management strategies. • In areas where soil/loose paint chips require removal from cracks and crevices in the bedrock, use a HEPA vacuum unit to remove these. • Store contaminated soil/lead based paint in drums or soil bags in close proximity to site access mooring location, and underlay stored contaminated soil with wood platform or geomembrane.	Low potential for residual effect if mitigation measures applied.	-1	No
	Site Preparation, Soil Removal and Demobilization: Potential for leak or spill of petroleum products and other deleterious substances from vehicles, equipment and machinery to contaminate the soil.	• Ensure that absorbent materials are available on-site in the event that a spill of deleterious substances should occur. • All spills and leaks of deleterious substances must be immediately contained and cleaned up in accordance with Provincial regulatory requirements and reported immediately to the Ontario Spills Action Centre (1-800-268-6060). Maintain a logbook detailing any such measures. • Apply elements of Spill Response Plan as outlined in Table 2: Accidents and Malfunctions.	Low potential for residual effect if mitigation measures applied.	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up

Surface Water	**Site Preparation, Soil Removal and Demobilization:**
	Potential for leaks or spills of fuel, or other hazardous substances to be released into surface water during Project activities.
		• An erosion control plan should be developed to mitigate potential effects on water quality with respect to the transport and movement of remediation equipment and contaminated sediments and remediation soils.
		• Appropriate measures should be adopted to minimize any impacts of accidental spills during transport, staging and maintenance activities.
		  • Ensure that absorbent materials are available on-site in the event that a spill of deleterious substances should occur.
		• Transportation of the contaminated soil via barges to the mainland will be properly contained and secured so that wind does not blow contaminated soil particles into the water. Transportation across the water during storms with heavy rainfall or high winds should be avoided to minimize risk.
		• Ensure that hazardous substances (including fuel) are handled and applied in a manner to prevent release into the environment. All deleterious substances should be stored away from the water. In the scenario that a barge and ramp are used for transport of equipment and waste for disposal (including lead paint chips and soil), deleterious substances must be transported in appropriate containers and be properly secured at all times.
		• Apply elements of Spill Response Plan.
		  • All spills and leaks of deleterious substances must be immediately contained and cleaned up in accordance with Provincial regulatory requirements and reported immediately to the Ontario Spills Action Centre (1-800-268-6060). Maintain a logbook detailing any such measures.
		• Construction machinery and equipment (including ramping structures) are to arrive on-site in a clean condition and be maintained free of fluid leaks.
		• Any washing, refueling or servicing to construction equipment in use on the island is to take place a minimum of 10 m from the lake shoreline and within a flat, impermeable stable surface to prevent any deleterious substances from entering the water.
		• Store all oils, lubricants, fuels and chemicals in secure areas on impermeable pads a minimum of 10 m from water.
		• Stockpiled material will be stored a safe distance from all surface water to ensure that no deleterious substances enter Lake Huron.
			Low potential for residual effect if mitigation measures applied	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
		• Removed soils will only be transported in secured units to ensure no loss to the environment. • Apply elements of Spill Response Plan as outlined in Table 2: Accidents and Malfunctions. • Apply Mitigation Measures under Fish/Fish Habitat VEC/VSC as per Water quality impairments (sediment loading; fuels and lubricants from machinery).			
	Site Preparation, Soil Removal and Demobilization: Potential for the release of deleterious substances and soil into the surface water during ground disturbance and precipitation events.	• Site remediation should be completed at a time of year (*e.g.*, during periods of dry weather) that will minimize the potential for sediment, debris and/or other contaminants to enter Lake Huron. • An erosion control plan should be developed to mitigate potential effects on water quality with respect to the transport and movement of remediation equipment and contaminated sediments • Control disposal of runoff of water containing harmful substances through the use of silt screens or other methods. • Runoff water from the soil removal, soil stockpile area (if any), and decontamination pad will be collected, analyzed, and disposed of according to applicable regulations. • A spill response kit to be on site in the event of a spill. Immediately contain and clean up any spills in accordance with provincial regulatory requirements. Report spill to the Ontario Spills Action Centre (1-800-268-6060) • Apply elements of Spill Response Plan as outlined in Table 2: Accidents and Malfunctions.	Low potential for residual effect if mitigation measures applied	-1	No
	Lead Based Paint Abatement: Potential for the release of contaminated dust, lead paint chips into the surface water during lead abatement and precipitation events.	• Enclose working area and use controls for lead abatement to minimize release of dust/paint chips to air and surface water. • Work to be complete in accordance with Ontario Ministry of Labour (MOL) *Guideline: Lead on Construction Projects.*	Low potential for residual effects if mitigation measures applied.	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Vegetation	**Site Preparation:** Loss of existing vegetation and associated wildlife habitat as a result of proposed Project activities.	• Minimize as much as possible any disturbance to existing vegetation. •	Minor loss of vegetated area due to Project activities. Low potential for residual effect if mitigation measures applied.	-1	No
	Site Preparation and Soil Removal: Potential for contamination.	• Ensure hazardous substances, if required, are stored, handled and applied in accordance with local regulations and in a manner which prevents re-release into the environment. • Any hazardous substances stored within the designated hold areas (containers) will be properly contained to prevent its re-release into the environment. • Ensure a contingency plan is developed and implemented in the event of an accidental spill from construction vehicle, machinery or equipment.	Low potential for residual effect if mitigation measures applied.	-1	No
Mammals	**Site Preparation and Soil Removal:** Temporary habitat loss and potential accidental mortality due to Project activities.	• Minimize as much as possible any disturbance to vegetation on-site which serves as potential mammal habitat.	Temporary and minor loss of habitat due to Project activities. Low potential for residual effect if mitigation measures applied.	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Birds	**Site Preparation and Soil Removal:** Temporary habitat loss and potential accidental mortality due to Project activities.	• Minimize as much as possible any disturbance to on-site vegetation. • Apply mitigation measures as per "Species at Risk listed under *SARA/ESA*" and "Vegetation" VECs.	Temporary and minor loss of habitat due to Project activities. Low potential for residual effect if mitigation measures applied.	-1	No
Amphibians and Reptiles	**Site Preparation and Soil Removal:** Temporary habitat loss and potential accidental mortality due to Project activities.	• Minimize as much as possible any disturbance to on-site vegetation. • Notably, potentially suitable habitat for the Massassauga Rattlesnake (Franz, 2011) may exist in the area of the light towers and there is a possibility for one or more individuals to occur within the area to be remediated. The presence of workers on-site and movement of equipment should alarm any wildlife (including snakes) and cause them to disperse. This is a desired effect as it will clear the area of mobile wildlife and avoid the need for work stoppage. • Construct silt fencing or provide other barriers to keep amphibian and reptiles out of Project footprint. Avoid use of silt fencing with nylon mesh netting reinforcing the regular, woven plastic strand material. Large-bodied snakes become entangled in this mesh and perish. • Apply mitigation measures as per "Species at Risk listed under *SARA/ESA*" and "Vegetation" VECs.	Minor loss of habitat due to Project activities. Low potential for residual effect if mitigation measures applied.	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Fish and Fish Habitat	**Demobilization:** Potential for harmful alteration of fish habitat during the island access and demobilization phase.	• Work will be carried out in accordance with the requirements outlined by DFO under Section 35 of the federal *Fisheries Act*. Section 35 states that No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery.. • Consult with DFO throughout the Project's lifespan to obtain input and requirements to be accommodated. • Apply mitigation measures as per "Species at Risk listed under	Low potential for residual effect if mitigation measures applied	-1	No
	Demobilization: Water quality impairments (sediment loading; fuels and lubricants from machinery).	• Sediment and erosion control measures will be installed and will be maintained during the work phase, and until the site has been stabilized. • Control measures should be inspected daily to ensure they are functioning and are maintained as required. If the control measures are not functioning properly, no further work will occur until the problem is resolved. • Any washing, refuelling or servicing to construction equipment in use on the island is to take place a minimum of 10 m from the lake shore (cobble beach) and within a flat, impermeable stable surface to prevent any deleterious substances from entering the water. • All materials and equipment used will be operated and stored in a manner that prevents any deleterious substances from entering the water. • Store and stabilize stockpiled materials, including any hazardous materials such as fuels and lubricants, a minimum of 10 m away from any surface waters. • Ensure equipment entering the water is free of fluid leaks and externally cleaned/degreased to prevent any deleterious substance from entering Lake Huron. • Establish spill management techniques prior to commencement of work. • Keep an emergency spill kit on site in case of fluid leaks or spills from machinery into the lake.	Low potential for residual effect if mitigation measures applied	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Species at Risk listed under *SARA/ESA*	**Site Preparation, Lead Abatement and Soil Removal:** Habitat loss and potential accidental mortality of the species due to Project activities.	• Notably, potentially suitable habitat for the Massassauga Rattlesnake (Franz, 2011) may exist in the area of the light towers and there is a possibility for one or more individuals to occur within the area to be remediated. The presence of workers on-site and movement of equipment should alarm any wildlife (including snakes) and cause them to disperse. This is a desired effect as it will clear the area of mobile wildlife and avoid the need for work stoppage. • Construct silt fencing or provide other barriers to keep SAR species out of Project footprint. Avoid use of silt fencing with nylon mesh netting reinforcing the regular, woven plastic strand material. Large-bodied snakes become entangled in this mesh and perish. • Should any other SARA/ESA species be encountered during further inventories or during the progress of construction within the study area, work shall cease and EC and/or MNR will be contacted immediately to determine any requirements pursuant to SARA and ESA, respectively.	Low potential for residual effect if mitigation measures applied.	-1	No
Aesthetics	**Site Preparation, Soil Removal and Demobilization:** Temporary visual disruption of aesthetic appearance	• Minimize period of disturbance. •	Low potential for residual effect if mitigation measures applied.	-1	No
	Lead Abatement Temporary visual disruption of aesthetic appearance	• Minimize period of disturbance. • Maintain site barriers, scaffold and work enclosures to keep work area tidy. • Re-paint lighthouse exterior as soon as possible after abatement complete.	Low potential for residual effect if mitigation measures applied.	-1	No
Land Use	**Site Preparation, Soil Removal and Demobilization:** Potential disturbance to surrounding lands.	• NA (no occupants on island).	NA	-	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Navigation	**Site Preparation, Soil Removal and Demobilization:** Boat use required.	• Apply and comply with Transport Canada legislation and regulations (Navigation Protection Act and associated applicable regulations).	Short duration activity. Low potential for residual effect if mitigation measures applied.	-1	No
Cultural Resources	**Soil Removal:** Potential accidental damage to cultural resources.	• NA	NA	-	No
Archaeology	**Site Preparation, Soil Removal:** Potential to uncover of artifacts.	• Immediately suspend all work in the vicinity of the discovery, should human remains be found during soil removal. Notify the Ontario Provincial Police, or local police, for them to conduct a site Investigation and to contact the district coroner. Also notify the Ministry of Culture at 1-800-461-7629. • Should other un-recorded cultural heritage values (archaeological or historical features) be identified during the construction, suspend all activities in the vicinity of the discovery and contact DFO and the Ministry of Culture.	Low potential for residual effect if mitigation measures applied.	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Human Health and Safety	**Site Preparation, Lead Abatement, Soil Removal and Demobilization:** Potential adverse safety conditions to workers during the Project activities.	• All Project work, including Working at Heights, to be completed in accordance with *Canada Labour Code, Canada Health and Safety Act* and *Ontario Occupational Health and Safety Act (OHSA), 213/91 Construction Projects, as amended.* • Develop and implement a Health and Safety Plan (HASP) for the Project that meets all applicable regulatory requirements. • Clearly define the Project work areas and restrict access to those areas to suitably qualified workers. Adequate safety barriers and signs should be used to provide a safe environment for workers. • Workers to wear personal protective equipment (*e.g.*, safety work boots, respirators, hard hats, safety vests, etc.) in accordance with applicable legislation. • Minimize worker exposure to lead by completing work in accordance with Ontario Ministry of Labour (MOL) *Guideline: Lead on Construction Projects.* • Ensure appropriate training and certification/licensing of all workers for required tasks of Project (Boat Operator license, WHMIS, Working at Heights, etc.). • A plan must be developed to prevent the public from mooring at the site, and to avoid accidental exposure to contaminated soil and lead based paint. The use of a security guard onsite when the workers have left for the day may be required.	Low potential for residual effect if mitigation measures applied.	-1	No

Table 1: Identification of Environmental Effects and Proposed Mitigation Measures

Valued Ecosystem / Social Component	Description of Potential Project Interaction with VEC/VSC	Proposed Mitigation Measures & Best Management Practices	Residual Effects	Significance of Residual Effects [1]	Further Study or Follow-up
Waste	**Soil Removal and Lead Abatement:** Generation, storage and disposal of wastes during the lead abatement and contaminated soil removal.	• The Project will implement a solid waste management program. • The contractor is required to submit proof that a licensed waste hauler is transporting the waste to a facility certified to accept waste material (hazardous and non-hazardous, as applicable). A copy of waste disposal/transfer site's Environmental Compliance Approval (ECA) (formerly known as Certificate of Approval, CoA) and a letter verifying that the said disposal/transfer site will accept the waste must be supplied to the Proponent prior to removal of waste from site. • Potentially hazardous wastes will be separated from construction and non-hazardous waste or recyclable materials through segregation of storage areas and proper labeling of containers. All registered waste will be removed from the site by licensed waste contractors and disposed at approved facilities. • Lead paint chips and worst case soil is expected to be hazardous waste. Less-contaminated soil may be non-hazardous. All waste generated must be segregated to minimize the volume of hazardous waste requiring disposal. Segregated waste must be adequately characterized (i.e., TCLP analysis by a certified CALA laboratory) for proper waste classification. • All waste generated will be transported and disposed according to applicable regulations (*i.e.*, TDG, O. Reg. 347 as amended). • No burning or burying of waste or excess materials is permitted.	Low potential for residual effect if waste management measures applied	-1	No

[1] Significance of Residual Impacts rated as follows:

0 = None, 1 = Not significant, 2 = Significant, 3 = Unknown, Positive (+), Negative (-).

Table 2: Accidents and Malfunctions

Accident or Malfunction	Description of Effect	Required Mitigation	Likelihood Residual Effects	Significance of Residual Effects [1]
Leak or spill of petroleum and/or other deleterious substances from vehicles (boats, barges) and equipment.	Contamination of soil and water.	• Protocols for management of hazardous materials (e.g., responsibilities, emission control, safe storage practices, refueling protocols, spill containment; emergency response, regulatory compliance, accident/incident reporting) should be in place. • Ensure spill response plan and clean up materials are available at the site when hazardous materials are being used. • Immediately contain and clean up spills in accordance with provincial regulatory requirements. • All personnel will be trained to respond to a spill. • Report spills immediately to Ontario Spills Action Centre at 1-800-268-6060 or by calling 416-325-3000 and DFO.	Low potential for residual effect if mitigation measures applied	-1 Insignificant due to small magnitude and limited geographical extent, duration and frequency. No residual permanent adverse effect.
Failure of lead abatement enclosure (release of lead based paint to the environment as dust or chips)	Contamination of soil and water.	• Protocols for management of hazardous materials (responsibilities, safe storage of materials, emergency response, accident reporting) should be in place. • Ensure spill/release response plan and clean up materials are available at the site when hazardous materials are being used. • Immediately contain and clean up spills/release of lead based materials in accordance with provincial regulatory requirements. • Report spills immediately to Ontario Spills Action Centre at 1-800-268-6060 or by calling 416-325-3000 and DFO.	Low potential for residual effect if mitigation measures applied	-1 Insignificant due to small magnitude, duration and frequency. No residual permanent adverse effect (post cleanup).
Failure of scaffolding	Harm to workers.	• Ensure scaffolding used on Project complies with applicable legislation, is in good working order and is regularly inspected for potential defects. • Erection and dismantling procedures for scaffolding are to be conducted by qualified technicians. Ensure scaffolding is appropriately anchored and/or secured as appropriate. • Provide adequate safety barriers and signs to protect safety of workers. • Make medical provisions prior to Project's start for prompt medical aid in the event of serious injury.	Low potential for residual effect if mitigation measures applied	-2 Significant due to long term/permanent worker injury, lost time. Potential for permanent adverse effect.

Table 2: Accidents and Malfunctions

Accident or Malfunction	Description of Effect	Required Mitigation	Likelihood Residual Effects	Significance of Residual Effects [1]
Worker falling from heights (failure to properly use fall restraints or failure of fall restraints)	Harm to workers.	• Develop and implement a site specific HASP in accordance with applicable legislation. • Ensure workers are appropriately trained for Working at Heights and understand related legislative requirements for 100% tie-off. • Ensure appropriate fall protection equipment is used by workers as per OHSA 213/91 (as amended), and is regularly tested and inspected for potential defects.	Low potential for residual effect if mitigation measures applied	-2 Significant due to long term/permanent worker injury, lost time. Potential permanent adverse effect to injured worker.

[1] Significance of Residual Impacts rated as follows:

0 = None, 1 = Not significant, 2 = Significant, 3 = Unknown, Positive (+), Negative (-).