

PROJECT TITLE: Remediation of the Garden River Old Dump Site, Alberta

PROJECT DATE: 12/06/2015

END OF SECTION

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Supporting Documentation		
Remediation Action Plan for the Garden River Contaminated Site Remediation Project. Prepared by Environmental Sciences Group, July 2015.		
Little Red River Forestry Ltd. Corporate Profile		
Garden River Remediation Project – Detailed Landfill Design Report by SLR, March 2015.		
Garden River Remediation Project – Groundwater Characterization Report by SLR, Feb 2015.		
Garden River Remediation Project – Landfill Operations, Maintenance & Closure Plan by SLR, March 2015.		
Garden River, AB Community Airstrip and Old Landfill Reports Review and Remediation Options Analysis. Prepared by EBA, March 2013.		
Detailed Site Assessment – Garden River Old Dump in Wood Buffalo National Park. Prepared by Columbia Environmental Consulted Ltd. and Franz Environmental Inc, Feb 2011.		
Contaminated Site Assessment Initial and Detailed Testing Programs, Wood Buffalo National Park, Various Locations in the Community of Garden River, Alberta. Prepared by EBA, Feb 2009.		
Background Soil Assessment at Garden River in Wood Buffalo National Park, Alberta 2014. Prepared by Environmental Sciences Group, July 2015.		

List of Drawings	
200.02005.00000-01	Proposed Site Layout
200.02005.00000-02	Proposed Cell A
200.02005.00000-03	Not included
200.02005.00000-04	Section A-A' Thru Site
200.02005.00000-05	Sections & Typical Details
200.02005.00000-06	Details
200.02005.00000-07	Push Up and Pull Down Schematic
200.02005.00000-08	Monitoring Well Construction Detail

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises construction of a new landfill cell (here-on-in referred to as cell A), waste removal from the Old Dump and placement in the new cell, and capping of the new landfill cell, located at Garden River, Wood Buffalo National Park. Work includes but is not limited to:
 - .1 Project preparations including:
 - .1 Utility locates.
 - .2 Protection of existing monitoring wells.
 - .3 Road construction to new landfill Cell A.
 - .4 Clearing and grubbing of location of new landfill Cell A.
 - .5 Installation of fencing around new landfill Cell A.
 - .2 Construction of new landfill cell, Cell A.
 - .1 Prepare subgraded surface as indicated.
 - .2 Supply and installation of geomembrane, geotextile, and Geosynthetic Clay Liner (GCL) at base of Cell A, including construction of anchor trench.
 - .3 Supply, transport and placement of gravel leachate collection layer.
 - .3 Excavation of waste materials from Old Dump located within the community of Garden River, including:
 - .1 Managing water in the excavation through dewatering and containment throughout as required.
 - .2 Facilitating collection of base and wall soil samples by the Owner's sub-consultant.
 - .3 Transport of Old Dump wastes via road for placement in Cell A.
 - .4 Supply, transportation, and placement of limited fill and topsoil to reshape or regrade the Old Dump area, followed by seeding.
 - .4 Cell A:
 - .1 Waste grading and compaction in Cell A.
 - .2 Supply, transportation, and placement of grading fill materials and sand gas collection layer.

- .3 Supply and installation of geomembrane, geotextile, and GCL over the waste and fill materials, including construction of anchor trench.
- .4 Supply, transportation, and placement of gravel drainage layer and topsoil cover above GCL, compacted and shaped to final grades, followed by seeding.
- .5 Installation of gas vents.
- .6 Re-grading and ditchwork around Cell A to direct surface water run-off away from Cell A.

1.3 CONTRACT METHOD

- .1 Construct Work as per contract method stated in invitation to tender.

1.4 WORK BY OTHERS

- .1 Co-operate with the Owner and their sub-consultants in carrying out their respective works and carry out instructions from the Owner. Work on this project must include provisions for coordinating related work, identified in Contract Documents, for following principal items.
 - .1 Collection of soil samples from the base and walls of completed excavation by Owner's sub-consultant.
 - .2 Co-operate with the PCA Representative and their sub-consultants in carrying out their respective works and carry out instructions from the PCA Representative.

1.5 WORK SEQUENCE

- .1 Conduct Work to provide for continuous public usage of the existing landfill during construction.
- .2 Required stages:
 - .1 Clearing and grubbing of site areas.
 - .2 Construction of road extension to Cell A.
 - .3 Construction of Cell A, including installation of geomembrane, geotextile and GCL.
 - .4 Plan excavation and backfilling activities to accommodate 10 day turnaround time for sample analysis following removal of waste material from the Old Dump.
 - .5 Backfill Old Dump as indicated.
 - .6 Complete waste placement in Cell A, and place cover materials, including installation of geomembrane, geotextile and GCL.
 - .7 Complete final grading, seeding, fence installation, restore all disturbed areas, and complete final cleaning.
- .3 Maintain fire access/control.

1.6 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance, however access must be maintained to allow:

- .1 Public usage of the existing landfill adjacent to location of Cell A.

1.7 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

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 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with PCA Representative to facilitate work as stated.
- .2 Maintain existing services and provide for vehicle access.
- .3 Contractor will be responsible for providing sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .4 Closures: protect work temporarily until permanent enclosures are completed.

1.2 EXISTING SERVICES

- .1 Notify PCA Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Provide for pedestrian and vehicular traffic.
- .3 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 SPECIAL REQUIREMENTS

- .1 Carry out noise generating Work Sunday to Saturday from 07:00 to 19:00 hours.
- .2 Submit schedule in accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart.
- .3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .4 Keep within limits of work and avenues of ingress and egress.
- .5 Ingress and egress of Contractor vehicles at site is limited to pre-existing roads or new roads constructed to access work areas as indicated.

1.4 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted.

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 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work at the call of PCA Representative or Owner.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting three (3) days in advance of meeting date to PCA 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 two (2) days after meetings and transmit to meeting participants and, affected parties not in attendance and Owner.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within ten (10) days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Owner, Owner's sub-consultant, 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 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings and samples. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, onsite accommodations, site signs, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

- .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Monthly progress claims, administrative procedures, photographs, hold backs.
- .11 Appointment of inspection and testing agencies or firms.
- .12 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work and one (1) week prior to project completion, schedule progress meetings weekly.
- .2 Contractor, major Subcontractors involved in Work, PCA Representative, and Owner are to be in attendance.
- .3 Notify parties minimum three (2) days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within two (2) 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 Problems which impede construction schedule.
 - .5 Review of delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for affect on construction schedule and on completion date.
 - .12 Health, safety, and environmental incidents.
 - .13 Other business.

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 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 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: Sunday to Saturday, inclusive, will provide seven (7) day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by PCA Representative to enable monitoring of project work in relation to established milestones.

1.3 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 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to PCA Representative within seven (7) 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 PCA Representative within five (5) working days of receipt of acceptance of Master Plan.

1.5 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 PCA 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 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization & Site Setup.
 - .5 Construction of Landfill Cell A.
 - .6 Geomembrane Installation in Base of Cell A.
 - .7 Geosynthetic Clay Liner Installation.
 - .8 Landfill Cell A is Ready to Accept Waste.
 - .9 Excavation from Old Dump and Waste Relocation.
 - .10 Backfill and/or Regrading and Seeding of Old Dump.
 - .11 Closure of Landfill Cell A
 - .12 Geomembrane Installation in Cap of Cell A.
 - .13 Capping and Seeding of Cell A.

- .14 Site Restoration.
- .15 Final Inspection.
- .16 De-Mobilization.

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. A recovery plan by the Contractor may be required to address activities behind 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 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 ADMINISTRATIVE

- .1 Submit to PCA Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to PCA Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project requirements will be returned without being examined and considered rejected.
- .6 Notify PCA Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify that field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by PCA Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by PCA Representative review.
- .10 Shop Drawings which require approval of any legally constituted authority having jurisdiction shall be provided to such authority by the Contractor for approval.
- .11 Keep one reviewed hard copy of each submission on site.
- .12 Submit number of hard copies specified for each type and format of submittal and also submit in electronic format as PDF files as directed by PCA Representative.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow three (3) days for PCA Representative's review of each submission.
- .5 Adjustments made on shop drawings by PCA Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to PCA Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as PCA Representative may require, consistent with Contract Documents. When resubmitting, notify PCA Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.

- .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After PCA Representative's review, distribute copies.
- .10 Submit one (1) electronic copy and one (1) hard copy of shop drawings in format requested for each requirement requested in specification Sections and as PCA Representative may reasonably request.
- .11 Submit one (1) electronic copy and one (1) hard copy of product data sheets or brochures for requirements requested in specification Sections and as requested by PCA Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit one (1) electronic copy and one (1) hard copy of test reports for requirements requested in specification Sections and as requested by PCA Representative.
- .1 Report signed by authorized official of testing laboratory that material or product identical to material or product to be provided has been tested in accordance with specified requirements.
 - .2 Testing must have been within one (1) year of date of contract award for project.
- .13 Submit one (1) electronic copy and one (1) hard copy of certificates for requirements requested in specification Sections and as requested by PCA Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit one (1) electronic copy and one (1) hard copy of manufacturers instructions for requirements requested in specification Sections and as requested by PCA Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Delete information not applicable to project.
- .17 Supplement standard information to provide details applicable to project.
- .18 If upon review by PCA Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

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

1.4 SAMPLES

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to PCA Representative's business address if prior to start of Work, or site office if Work has commenced.
- .3 Notify PCA Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Adjustments made on samples by PCA Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to PCA Representative prior to proceeding with Work.
- .5 Make changes in samples which PCA Representative may require, consistent with Contract Documents.
- .6 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, fine resolution as directed by PCA Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: at least 2 locations.
 - .1 Viewpoints and their location as determined by PCA Representative.
- .4 Frequency of photographic documentation: weekly or as directed by PCA Representative.
 - .1 Upon completion of: Landfill Cell A base preparation for Geosynthetic installation, Landfill Cell A ready to accept waste, excavation of Old Dump, placement of waste in Cell A, backfill and/or regrading of Old Dump, backfill of Cell A, Cell A ready for Geosynthetic installation, capping of Cell A, final grading around cell A, final cleaning Work, and as directed by PCA Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.

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 RELATED REQUIREMENTS

- .1 Section 31 12 10 - Landfill Construction Requirements.
- .2 Section 31 12 15 - Removal of Waste from Old Dump.

1.2 REFERENCES

- .1 Transportation and Dangerous Goods Act (1999)
- .2 Canadian Council of Ministers of the Environment (CCME) Documentation

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals for Progress Meetings: make submittals at least 24 hours prior to scheduled progress meetings as follows:
 - .1 Updated progress schedule detailing activities. Include review of progress with respect to previously established dates for starting and stopping various stages of Work, major problems and action taken, injury reports, equipment breakdown, and material removal.
 - .2 Weekly copies of site entry and work area logbooks with information on worker and visitor access.
 - .3 Other information required by PCA Representative or relevant to agenda for upcoming progress meeting.
- .3 Site Layout: within seven (7) days after date of Notice to Proceed and prior to mobilization to site, submit site layout drawings showing existing conditions and facilities, construction facilities and temporary controls provided by Contractor including following:
 - .1 Equipment and personnel decontamination areas.
 - .2 Means of ingress, egress and temporary traffic control facilities. Refer to Section 01 56 00 - Temporary Barriers and Enclosures for traffic control.
 - .3 Equipment and material staging areas.
 - .4 Exclusion Zones, Contaminant Reduction Zones, and other zones specified in Contractor's site-specific Health and Safety Plan.
 - .5 Wastewater storage tanks.
- .4 Equipment Decontamination Pad: submit equipment decontamination pad design to PCA Representative for review seven (7) days prior to commencing construction.

1.4 REGULATORY REQUIREMENTS

- .1 Provide erosion and sediment control in accordance with applicable regulations.
- .2 Comply with federal, provincial, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

- .3 Work to meet or exceed minimum requirements established by federal, provincial, and local laws and regulations which are applicable.
 - .1 Contractor: responsible for complying with amendments as they become effective.
- .4 In event that compliance exceeds scope of work or conflicts with specific requirements of contract notify PCA Representative immediately.

1.5 SEQUENCING AND SCHEDULING

- .1 Do not commence Work involving contact with potentially contaminated materials until decontamination facilities are operational and approved by PCA Representative.

1.6 EQUIPMENT DECONTAMINATION FACILITY

- .1 Prior to commencing work involving equipment contact with potentially contaminated materials, construct temporary equipment decontamination pad to accommodate largest piece of on-site potentially contaminated equipment.
- .2 Provide, operate, and maintain suitable portable, high-pressure, low-volume decontamination wash unit equipped with self-contained water storage tank and pressurizing system and capable of heating and maintaining wash waters to 80 degrees C and providing nozzle pressure of 1,035 kpa.
- .3 Provide, operate, and maintain necessary equipment, pumps, and piping required to collect and contain equipment decontamination wastewater and sediment and transfer materials to approved storage facilities.

1.7 WASTEWATER STORAGE TANK

- .1 Provide, operate, and maintain wastewater storage tanks to store wastewaters.
- .2 Wastewater includes water collected from dewatering operations; and water collected from Equipment Decontamination Facility.
- .3 Discharges: comply with applicable discharge limitations and requirements; do not discharge wastewaters to site drainage systems that do not conform to or are in violation of such limitations or requirements; and obtain PCA Representative's approval prior to discharge of wastewater.
- .4 Install wastewater storage tanks in locations as directed by PCA Representative.
- .5 Notify PCA Representative 72 hours minimum in advance of when wastewater storage tank is anticipated to be full.
 - .1 Do not discharge additional liquids to filled tank following sampling by Contractor.
 - .2 PCA Representative will determine appropriate disposition of wastewaters based on sample analysis.
- .6 Transport and dispose of wastewaters that cannot be disposed of on-site, at off-site disposal facility as identified by Contractor and approved by PCA Representative.

1.8 VEHICULAR ACCESS AND PARKING

- .1 Maintenance and Use:
 - .1 Prevent contamination of access roads. Immediately scrape up debris or material on access roads which is suspected to be contaminated as determined by PCA Representative; transport and place into designated area approved by PCA Representative. Clean access roads at least once per shift.
 - .2 PCA Representative may collect soil samples for chemical analyses from traveling surfaces of constructed and existing access routes prior to, during, and upon completion of Work. Excavate and dispose of clean soil contaminated by Contractor's activities at no additional cost to PCA Representative.

1.9 DUST AND PARTICULATE CONTROL

- .1 Execute Work by methods to minimize raising dust from construction operations.
- .2 Implement and maintain dust and particulate control measures as determined necessary by PCA Representative during construction and in accordance with Federal and Province of Alberta regulations.
- .3 Provide positive means to prevent airborne dust from dispersing into atmosphere. Use water for dust and particulate control.
- .4 As minimum, use appropriate covers on trucks hauling fine or dusty material. Use watertight vehicles to haul wet materials.
- .5 Prevent dust from spreading to adjacent property sites.
- .6 PCA Representative will stop work at any time when Contractor's control of dusts and particulates is inadequate for wind conditions present at site, or when air quality monitoring indicates that release of fugitive dusts and particulates into atmosphere equals or exceeds specified levels.
- .7 If Contractor's dust and particulate control is not sufficient for controlling dusts and particulates into atmosphere, stop work. Contractor must discuss procedures that Contractor proposes to resolve problem. Make necessary changes to operations prior to resuming excavation, handling, processing, or other work that may cause release of dusts or particulates.

1.10 POLLUTION CONTROL

- .1 Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious toxic substances and pollutants produced by construction operations.
- .2 Be prepared to intercept, clean up, and dispose of spills or releases that may occur whether on land or water. Maintain materials and equipment required for cleanup of spills or releases readily accessible on site.
- .3 Promptly report spills and releases potentially causing damage to environment to:
 - .1 Authority having jurisdiction or interest in spill or release including conservation authority, water supply authorities, drainage authority, road authority, and fire department.

- .2 Owner of pollutant, if known.
- .3 Person having control over pollutant, if known.
- .4 PCA Representative.
- .4 Contact manufacturer of pollutant if known and ascertain hazards involved, precautions required, and measures used in cleanup or mitigating action.
- .5 Take immediate action using available resources to contain and mitigate effects on environment and persons from spill or release.
- .6 Provide spill response materials including, containers, adsorbent, shovels, and personal protective equipment. Make spill response materials available at all times in which hazardous materials or wastes are being handled or transported. Spill response materials: compatible with type of material being handled.

1.11 EQUIPMENT DECONTAMINATION

- .1 Commence Work involving equipment contact with potentially contaminated material only after Equipment Decontamination Facility is operational.
- .2 Decontaminate equipment after working in potentially contaminated work areas and prior to subsequent work or travel on clean areas.
- .3 Perform equipment decontamination on Contractor-constructed temporary equipment decontamination pad.
- .4 At minimum, perform following steps during equipment decontamination: mechanically remove packed dirt, grit, and debris by scraping and brushing without using steam or high-pressure water to reduce amount of water needed and to reduce amount of contaminated rinsate generated. Use high-pressure, low-volume, hot water or steam supplemented by detergents or solvents as appropriate and as approved by PCA Representative. Pay particular attention to tire treads, equipment tracks, springs, joints, sprockets, and undercarriages. Scrub surfaces with long handle scrub brushes and cleaning agent. Rinse off and collect cleaning agent. Air dry equipment in Clean Zone before removing from site or travelling on clean areas. Perform assessment as directed by PCA Representative to determine effectiveness of decontamination.
- .5 Each piece of equipment will be inspected by PCA Representative after decontamination and prior to removal from site and/or travel on clean areas. PCA Representative will have right to require additional decontamination to be completed if deemed necessary.
- .6 Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens.
- .7 Collect decontamination wastewaters and sediments which accumulate on equipment decontamination pad. Transfer wastewaters to designated wastewater storage tank or drums.
- .8 Transfer sediments to a designated area approved by the PCA Representative.
- .9 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.
- .10 Have on hand sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies,

including power outage, and competent workers for operation of pumping equipment. Maintain piping and connections in good condition and leak-free.

1.12 WATER CONTROL

- .1 Maintain excavations free of water.
- .2 Prevent surface water runoff from leaving work areas.
- .3 Do not discharge decontaminated water, or surface water runoff, or groundwater which may have come in contact with potentially contaminated material, off site or to municipal drainage systems.
- .4 Direct surface waters that have not contacted potentially contaminated materials to existing surface drainage systems.
- .5 Control surface drainage including ensuring that gutters are kept open, water is not directed across or over pavements or sidewalks except through approved pipes or properly constructed troughs, and runoff from unstabilized areas is intercepted and diverted to suitable outlet.
- .6 Dispose of water in manner not injurious to public health or safety, to property, or to any part of Work completed or under construction.
- .7 Provide, operate, and maintain necessary equipment appropriately sized to keep excavations, staging pads, and other work areas free from water.
- .8 Have on hand sufficient pumping equipment, machinery, and tankage in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment.
- .9 Contain and collect wastewaters and transfer such collected wastewaters to Contractor supplied wastewater storage tanks.

1.13 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, regrade, 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 PCA Representative.
- .3 Provide and maintain temporary measures which may include, silt fences, hay or straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other construction 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 Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

- .5 Do not disturb existing embankments or embankment protection.
- .6 Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- .7 If soil and debris from site accumulate in low areas, storm sewers, roadways, gutters, ditches, or other areas where in PCA Representative's determination it is undesirable, remove accumulation and restore area to original condition.

1.14 PROGRESS CLEANING

- .1 Maintain cleanliness of Work and surrounding site to comply with federal, provincial, and local fire and safety laws, ordinances, codes, and regulations.
- .2 Co-ordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials.

1.15 FINAL DECONTAMINATION

- .1 Perform final decontamination of construction facilities, equipment, and materials which may have come in contact with potentially contaminated materials prior to removal from site.
- .2 Perform decontamination as specified to satisfaction of PCA Representative. PCA Representative will direct Contractor to perform additional decontamination if required.

1.16 REMOVAL AND DISPOSAL

- .1 Remove surplus materials and temporary facilities from site.
- .2 Dispose of non-contaminated waste materials, litter, debris, and rubbish off site, or in on-site facilities with the approval of the PCA Representative and the Garden River Public Works department.
- .3 Do not burn or bury rubbish and waste materials on site.
- .4 Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
- .5 Do not discharge wastes into streams or waterways.
- .6 Dispose of following materials at appropriate off-site facility identified by Contractor and approved by PCA Representative, or in on-site facilities with the approval of the PCA Representative and the Garden River Public Works department:
 - .1 Debris including excess construction material.
 - .2 Non-contaminated litter and rubbish.
 - .3 Disposable PPE.
 - .4 Wastewater generated from decontamination operations or from wastewater storage tank.
- .7 Wastewater sample and analysis: PCA Representative will perform sampling and analysis of stored wastewater for disposal purposes prior to removal from site. Results of analyses will determine appropriate methods of disposal. Upon receipt of analytical results, transfer tank contents without spills or release, as directed by PCA Representative, to

liquid waste tankers or disposal area. Following completion of tank emptying, decontaminate tank interior with steam or high-pressure water wash supplemented by detergent. Dispose of tank decontamination water with tank contents.

- .8 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

1.17 RECORD KEEPING

- .1 Maintain adequate records to support information provided to PCA Representative regarding exception reports, annual reports, and biennial reports.
- .2 Maintain bills of lading for minimum of 375 days from date of shipment or longer period required by applicable law or regulation.

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 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Province of Alberta
 - .1 Occupational Health and Safety Act, R.S.A. - Updated [2013].
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .4 Transportation of Dangerous Goods Act (1999).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation.
 - .3 Site health and safety measures to minimize hazards.
 - .4 Emergency medical procedures that will be followed in case of accident requiring medical attention, including a muster point, contact list of emergency personnel and hospitals, and fire department.
 - .5 List of health and safety equipment that will be on-site, including but not limited to personal protective equipment (PPE), first aid kit, fire extinguishers, and spill kits.
- .3 Submit two (2) copies of Contractor's authorized representative's work site health and safety inspection reports to PCA Representative.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors to PCA representative.
- .5 Submit copies of incident and accident reports to PCA representative.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets to PCA representative.
- .7 PCA Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within five (5) days after receipt of plan. Revise plan as

appropriate and resubmit plan to PCA Representative within two (2) days after receipt of comments from PCA Representative.

- .8 PCA 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.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to PCA Representative.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

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

1.6 REGULATORY REQUIREMENTS

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.
- .2 Comply with Acts and regulations of the Province of Alberta.
- .3 Comply with specific standards and regulations to ensure safe operations at site.
- .4 In event of conflict between any provisions of specified standards and regulations, the most stringent provisions apply.

1.7 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Unknown landfill contents, including but not limited to: household waste; soil and groundwater potentially contaminated with petroleum hydrocarbons, inorganic elements, polycyclic aromatic hydrocarbons, volatile organic compounds; large debris including appliances, etc.

1.8 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 PCA Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.10 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act, General Safety Regulation, Alberta.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.11 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Alberta having jurisdiction and advise PCA Representative verbally and in writing.

1.12 HEALTH AND SAFETY CO-ORDINATOR

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

1.13 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Alberta having jurisdiction, and in consultation with PCA Representative.

1.14 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by PCA Representative.
- .2 Provide PCA Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 PCA Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 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.

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 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 REFERENCES

- .1 Province of Alberta
 - .1 Occupational Health and Safety Act [2013].
 - .2 Occupational Health and Safety regulations (2013)
 - .3 Occupational Health and Safety Codes (2009)
- .2 Canada Labour Code, Canada Occupational Health and Safety Regulations [2013].
- .3 Health Canada/Workplace Hazardous Material Information System (WHMIS)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan, within seven (7) days after date of Notice to Proceed and prior to mobilization to site. Address following items:
- .3 Safety and health risk or hazard analysis for each site task and operation found in work plan.
- .4 Develop checklist for items to be inspected on a daily basis. Document actions taken.
- .5 Personnel training requirements including:
 - .1 Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.
 - .2 Work practices by which personnel can minimize risks from hazards, safe use of engineering controls and equipment on site, medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards, and elements of site-specific Health and Safety Plan.
- .6 Personal protective equipment (PPE) program addressing:
 - .1 Donning and doffing procedures.
 - .2 PPE selection based upon site hazards.
 - .3 PPE use and limitations of equipment.
 - .4 Work mission duration, PPE maintenance and storage.
 - .5 PPE decontamination and disposal.
 - .6 PPE inspection procedures prior to, during, and after use.

- .7 Evaluation of effectiveness of PPE program, and limitations during temperature extremes, and other appropriate medical considerations.
 - .8 Medical surveillance requirements for personnel assigned to work at site.
 - .9 Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment.
 - .10 Site control measures employed at site including site map, site work zones, use of 'buddy system', site communications including site security, alerting means for emergencies, standard operating procedures or safe work practices, and identification of nearest medical assistance.
 - .11 Decontamination procedures for both personnel and equipment.
 - .12 Emergency response requirements addressing: pre-emergency planning, personnel roles, lines of authority and communication, emergency recognition and prevention, safe distances and places of refuge, site security and control, evacuation routes and procedures, decontamination procedures not covered under decontamination section, emergency medical treatment and first aid, emergency alerting and response procedures, critique of response and follow-up, PPE and emergency equipment, site topography, layout, prevailing weather conditions, and procedures for reporting incidents to local, provincial, or federal agencies.
 - .13 Written respiratory protection program for project activities.
 - .14 Procedures dealing with heat and/or cold stress.
 - .15 Confined space entry procedures.
 - .16 Spill containment program if drummed waste material is generated, excavated, stored, or managed on site.
- .7 PCA Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within five (5) days after receipt of plan. Revise plan as appropriate and resubmit plan to PCA Representative within two (2) days after receipt of comments from PCA Representative.
 - .8 Respirator Fit Testing: submit proof of respirator fit testing for site personnel, within seven (7) days after date of Notice to Proceed and prior to mobilization to site.
 - .9 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.
 - .10 Off-site Contingency and Emergency Response Plan:
 - .1 Prior to commencing Work involving handling of hazardous materials, develop off-site Contingency and Emergency Response Plan.
 - .2 Plan must provide immediate response to serious site occurrence such as explosion, fire, or migration of significant quantities of toxic or hazardous material from site.

1.4 REGULATORY REQUIREMENTS

- .1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.
- .2 Comply with Acts and regulations of the Province of Alberta.

- .3 In event of conflict between any provisions of specified standards and regulations, the most stringent provisions apply.

1.5 SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Unknown landfill contents, including but not limited to: household waste; soil and groundwater potentially contaminated with petroleum hydrocarbons, inorganic elements, polycyclic aromatic hydrocarbons, volatile organic compounds; large debris including appliances, etc..

1.6 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan prior to commencing site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Ensure Health and Safety guidelines provide for safe and minimal risk working environment for site personnel and minimize impact of activities involving contact with hazardous materials or hazardous wastes on general public and surrounding environment.
- .3 Relief from or substitution for portion or provision of minimum Health and Safety Guidelines specified or reviewed site-specific Health and Safety Plan must submitted to PCA Representative in writing. PCA Representative will respond in writing, either accepting or requesting improvements.

1.7 RESPONSIBILITY

- .1 Be responsible for safety of persons and property on site and for protection of persons off site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 HAZARD COMMUNICATION REQUIREMENTS

- .1 Comply with Chemical Hazards Regulation, Alta. Reg.
- .2 Comply with Occupational Health and Safety Regulations, Part XXII Controlled Products - Workplace Hazardous Materials Information System.
- .3 Comply with Workplace Hazardous Materials Information System (WHMIS) Regulations, O.I.C.
- .4 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations, Part X - Hazardous Substances.
- .5 Provide PCA Representative with Material Safety Data Sheets (MSDS) and documentation on any "hazardous" chemical that Contractor or Contractor Representatives plan to bring onto site.

1.9 WORK STOPPAGE

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

- .2 Assign responsibility and obligation to Health and Safety Officer where required to stop or start Work when, at Health and Safety Officer's discretion, it is necessary or advisable for reasons of health or safety. PCA Representative may also stop Work for health and safety considerations.

1.10 UNFORESEEN HAZARDS

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

1.11 HEALTH AND SAFETY OFFICER

- .1 Employ and assign to Work competent and authorized representative as Health and Safety Adviser. Health and Safety Adviser must:
 - .1 Have minimum 2 years' site-related working experience specific to activities associated with landfill construction and landfill excavation.
 - .2 Have basic working knowledge of specified occupational safety and health regulations.
 - .3 Be responsible for completing Health and Safety Training Session and ensuring that personnel not successfully completing the required training are not permitted to enter site to perform Work in Exclusion Zone or Contaminant Reduction Zone.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Health and Safety Plan.
 - .5 Be on site during execution of Work.
 - .6 Be available as required for emergency situations.

1.12 PERSONNEL HEALTH, SAFETY, AND HYGIENE

- .1 Medical Surveillance:
 - .1 Conduct medical surveillance of personnel as required by specified regulations.
- .2 Training: ensure personnel entering site are trained in accordance with specified personnel training requirements. Training session must be completed by Health and Safety Officer.
- .3 Levels of Protection: establish levels of protection for each Work area based on planned activity and location of activity. Minimum PPE required for each level of protection as follows:
 - .4 Level B:
 - .1 Respiratory: SCBA.
 - .2 Head, Eye, Ear Protection: hard hat, safety glasses with sideshields, ear muffs or plugs.
 - .3 Hand Protection: gloves, and chemically resistant gloves.
 - .4 Foot Protection: safety shoes/boots.
 - .5 Clothing: chemically resistant coverall.
 - .5 Level C/Modified Level C:

- .1 Respiratory: halfmask respirator.
- .2 Head, Eye, Ear Protection: hard hat, safety glasses with sideshields, ear muffs or plugs.
- .3 Hand Protection: gloves, and chemically resistant gloves.
- .4 Foot Protection: safety shoes/boots.
- .5 Clothing: chemically resistant coverall.
- .6 Level D:
 - .1 Head, Eye, Ear Protection: hard hat, safety glasses with sideshields, ear muffs or plugs
 - .2 Clothing: standard work uniform.
- .7 Anticipated levels of personal protection based on work activity are as follows:

Work Activity	Anticipated Level of Personal Protection
Landfill construction and capping	Level D
Waste excavation, placement, compaction	Level C

- .8 Personal Protective Equipment:
 - .1 Furnish site personnel with appropriate PPE as specified above. Ensure that safety equipment and protective clothing is kept clean and maintained.
 - .2 High visibility vest.
 - .3 Provide additional PPE (high visibility vest, gloves, hardhat and safety glasses) for PCA representative and site visitors.
- .9 Develop protective equipment usage procedures and ensure that procedures are strictly followed by site personnel; include following procedures as minimum:
 - .1 Ensure prescription eyeglasses worn are safety glasses and do not permit contact lenses on site within work zones.
 - .2 Ensure footwear is steel-toed safety shoes or boots and is covered by rubber overshoes when entering or working in potentially contaminated work areas.
 - .3 Dispose of or decontaminate PPE worn on site at end of each workday.
 - .4 Decontaminate reusable PPE before reissuing.
 - .5 Ensure site personnel have passed respirator fit test prior to entering potentially contaminated work areas.
 - .6 Ensure facial hair does not interfere with proper respirator fit.
- .10 Respiratory Protection:
 - .1 Provide site personnel with extensive training in usage and limitations of, and qualitative fit testing for, air purifying and supplied-air respirators in accordance with specified regulations.
 - .2 Develop, implement, and maintain respirator program.
 - .3 Monitor, evaluate, and provide respiratory protection for site personnel.
 - .4 Ensure levels of protection as listed have been chosen consistent with site-specific potential airborne hazards associated with major contaminants identified on site.

- .5 In absence of additional air monitoring information or substance identification, develop action levels for increasing levels of respiratory protection for measured sustained Total Organic Vapour concentrations above background:

.1 Table:

Level of Respirator Protection Required
Half-facepiece air-purifying respirator, Level C
Full-facepiece air-purifying respirator, Level C
Shut down activities, evaluate the need for Level B or higher respiratory protection

- .6 Immediately notify PCA Representative when level of respiratory protection required increases.
- .7 Ensure appropriate respiratory protection during work activities. As minimum requirement, ensure that persons entering potentially contaminated work areas are supplied with and use appropriate respiratory protection.
- .8 Assess ability for site personnel to wear respiratory protection.
- .9 Ensure site personnel are able to pass respirator fit test prior to entering potentially contaminated work areas.
- .11 Heat Stress/Cold Stress: implement heat stress and/or cold stress monitoring program as applicable and include in site-specific Health and Safety Plan.
- .12 Personnel Hygiene and Personnel Decontamination Procedures. Provide minimum as follows:
- .1 Suitable containers for storage and disposal of used disposable PPE.
- .2 Potable water and suitable sanitation facility.
- .13 Emergency and First-Aid Equipment:
- .1 Locate and maintain emergency and first-aid equipment in appropriate location on site including first-aid kit to accommodate number of site personnel; portable emergency eye wash; two 9 kg ABC type dry chemical fire extinguishers.
- .2 two self-contained breathing apparatus units; blankets and towels; stretcher; and 1 hand-held emergency siren.
- .3 As minimum, provide 1 certified first-aid technician on site at all times when work activities are in progress.
- .14 Site Communications:
- .1 Post emergency numbers near site telephones.
- .2 Ensure personnel use of "buddy" system and develop hand signal system appropriate for site activities.
- .3 Provide employee alarm system to notify employees of site emergency situations or to stop Work activities if necessary.
- .4 Furnish selected personnel with 2-way radios.
- .5 Safety Meetings: conduct mandatory daily safety meetings for personnel, and additionally as required by special or work-related conditions; include refresher training for existing equipment and protocols, review ongoing safety issues and protocols, and examine new site conditions as encountered. Hold additional safety meetings on as-needed basis.

1.13 AIR MONITORING

- .1 Air Monitoring Program:
 - .1 Develop air monitoring program meeting specified requirements.
 - .2 During progress of work activities, monitor air quality in and around work zones. Conduct monitoring on regular periodic basis, and additionally as required by special or work-related conditions. Report departures from general background to PCA Representative who will, in conjunction with Health and Safety Officer, determine when operations should be shut down and restarted.
 - .3 Provide minimum required instruments for air monitoring as follows:
 - .1 Photoionization detector (PID).
 - .2 Personal particulate monitor.
 - .3 Combustible gas detector (CGS).
 - .4 Operate air monitoring equipment with personnel trained in equipment provided and under control of Health and Safety Officer.
 - .5 Conduct air monitoring on routine basis around active work locations. Perform hourly monitoring minimum and additionally as dictated by site activities.
 - .6 Furnish wind speed and direction indicator capable of providing permanent record, at unobstructed location on site located above elevation of work area with unobstructed view to affected workers.
- .2 Air Monitoring Reporting: report air monitoring results daily to PCA Representative on separate form.

1.14 CONTINGENCY AND EMERGENCY RESPONSE

- .1 Meet specified requirements.
- .2 Arrange and attend co-ordination meeting held with appropriate authorities as applicable including: Fire, Hospital, RCMP, Ministry of Health, and Community Emergency Co-ordinator; meeting will identify off-site Emergency Response Co-ordinator through whom information and co-ordination will occur in event of incident.

1.15 SITE CONTROL

- .1 Meet specified requirements.
 - .1 Open excavations to have restricted access by installation of temporary fencing and gates to prevent unauthorized entry.
 - .2 Signage to be provided to all work areas.
- .2 Prior to commencing work involving handling of drums and other containers, submit procedures for safe handling of drums and other containers. Implement and enforce drum handling program during activities involving drummed waste characterization including but not limited to handling, opening, sampling, staging, and consolidating.

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 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 Canadian and Alberta Environmental Protection Acts and pursuant regulations including but not limited to:
 - .1 Canadian Environmental Assessment Act (1999) and pursuant regulations.
 - .2 Transportation of Dangerous Goods Act and pursuant regulations.
 - .3 Environment Canada's "Best practices for the Reduction of Air Emissions from Construction and Demolition Activities".
 - .4 Canadian Council of Ministers for the Environment (CCME) Documentation, including but not limited to:
 - .1 Canadian Environmental Quality Guidelines.
 - .5 Alberta Environmental Protection and Enhancement Act (2000) and pursuant regulations.
 - .6 Alberta Tier 1 and Tier 2 Soil and Groundwater Remediation Guidelines.
 - .7 Department of Fisheries and Oceans (DFO) "Measures to Avoid Causing Harm to Fish and Fish Habitat".
 - .2 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-[92], Storm Water Management for Construction Activities, Chapter 3.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements, and 01 35 29.14 – Health and Safety Requirements for Contaminated Sites.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by PCA Representative.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .6 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations and EPA 832/R-92-005, Chapter 3.
 - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
 - .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
 - .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
 - .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
 - .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
 - .11 Waste disposal plan for wastes generated by contractor.
 - .12 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
 - .13 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
 - .14 Wastewater Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as clean-up water, dewatering of ground water, etc.

1.3 DISPOSAL OF WASTE

- .1 With the exception of excavated waste from the Old Dump to be transported and buried at Landfill Cell A, and selected other materials as directed by PCA Representative, do not bury rubbish and other liquid and solid waste materials in Cell A.
- .2 Do not dispose of waste or volatile materials, such as oils, etc., onto the ground or into waterways, streams, or drainage ditches.
- .3 Separate and dispose of accumulated waste generated from the construction work in accordance with Federal and Provincial regulations. Dispose of waste in appropriate offsite facilities, or in onsite facilities with the approval of the PCA Representative and the Garden River Public Works department. Waste materials include but are not limited to:
 - .1 Debris including excess construction materials.
 - .2 Non-contaminated litter and rubbish.
 - .3 Disposable PPE.
 - .4 Wastewater from decontamination operations or from wastewater storage tank.
- .4 Implement appropriate procedures for handling of excavated wastes and impacted soils during all phase of the project. Non-hazardous wastes excavated from the Old Dump of an appropriate size shall be relocated to Cell A. Oversized items excavated from the Old Dump shall be stockpiled at a location designated by the PCA representative for processing prior to being transported to Cell A. Suspect waste materials such as sealed drums will be segregated and disposed of in accordance with work plans approved by the PCA representative.
- .5 Disposal/recycling of other waste generated during the project shall be done in compliance with Alberta Waste Regulations and the facilities used will be approved by the PCA Representative.

1.4 VEHICLE ACCESS AND PARKING

- .1 Maintenance and Use:
 - .1 Prevent contamination of access and haul roads. Immediately scrape up debris or material on access roads which is suspected to be contaminated as determined by PCA Representative.
 - .2 PCA Representative may collect soil samples for chemical analysis from traveling surfaces of constructed and existing access routes prior to, during, and upon completion of Work. Excavate and dispose of soil contaminated by Contractor's activities at no additional cost to PCA Representative.
 - .3 Vehicles/equipment shall be in good working order and not be leaking any fuel or fluids.
 - .4 During construction, if fuel is brought in and stored on site, store it in compliance with applicable Federal and Provincial regulations in a designated fuelling area approved by the PCA representative.
 - .5 Implement traffic management measures (such as 'Traffic Control Person'), if required, at site access points to direct traffic and minimize impacts to the community.

1.5 EQUIPMENT DECONTAMINATION

- .1 Commence work involving equipment contact with potentially contaminated materials only after Equipment Decontamination Pads are operational.
- .2 Decontaminate equipment after working in potentially contaminated work areas and prior to subsequent work or travel on clean areas.
- .3 Perform equipment decontamination on Contractor-constructed equipment decontamination pad to prevent cross contaminating unimpacted areas.
- .4 Equipment Decontamination Pads to include pad, potable wash water system, and a lined dyked containment area with a water collection sump. Remove equipment decontamination pads prior to conclusion of the project.
- .5 Decontamination steps to include, but are not limited to:
 - .1 Mechanically remove packed dirt, grit, and debris by scraping and brushing without using steam or high-pressure water to reduce the amount of water needed and to reduce amount of contaminated rinsate generated.
 - .2 Use high-pressure, low-volume, hot water or steam supplemented by detergents or solvents as appropriate and as approved by PCA Representative. Pay particular attention to tire treads, equipment tracks, springs, joints, sprockets, and undercarriages.
 - .3 Scrub surfaces with long handled scrub brushes and cleaning agent. Rinse off and collect cleaning agent.
 - .4 Air dry equipment in Clean Zone before removing from site or travelling on clean areas.
 - .5 Perform assessment as directed by PCA Representative to determine effectiveness of decontamination.
 - .6 Each piece of equipment will be inspected by PCA Representative after decontamination and prior to removal from site and/or travel on clean areas. PCA Representative will have right to require additional decontamination to be completed if deemed necessary.
 - .7 Take appropriate measure necessary to minimize drift of mist and spray during decontamination including provision of wind screens.
 - .8 Collect decontamination wastewater which accumulates on equipment decontamination pad. Transfer wastewater to designated wastewater storage tank.
 - .9 Collect decontamination sediment which accumulates on equipment decontamination pad. Transfer sediment to designated area approved by the PCA Representative.
 - .10 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.
 - .11 Provide sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies, including power outages, and competent workers for operation of pumping equipment. Main piping and connections in good condition and leak-free.

1.6 FIRES

- .1 Fires and burning of rubbish on site is not permitted.

1.7 DRAINAGE

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Provide temporary drainage and pumping required to keep excavations and site free from water. Potentially impacted water within the Old Dump excavation footprint or landfill Cell A (i.e. groundwater or rainwater in direct contact with potentially contaminated soils) will be pumped to wastewater storage tanks for testing by PCA Representative.
- .3 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.8 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .3 Minimize stripping of topsoil and vegetation.
- .4 Restrict tree removal to areas indicated or designated by PCA Representative.
- .5 All trees planned for removal must be removed by forestry professionals.

1.9 WORK ADJACENT TO WATERWAYS

- .1 Construction equipment to be operated on land only.
- .2 Waterways to be kept free of excavated fill, waste material and debris.
- .3 Design and construct temporary crossings to minimize erosion to waterways.
- .4 Do not skid logs or construction materials across waterways.
- .5 Avoid indicated spawning beds when constructing temporary crossings of waterways.

1.10 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment in accordance with local authorities' emission requirements.
- .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .4 Execute work by methods to minimize raising dust from construction operations.

- .5 Implement and maintain dust and particulate control measures as determined necessary by PCA Representative during construction and in accordance with Federal regulations.
- .6 As minimum, use appropriate covers on trucks hauling fine or dusty materials. Use watertight vehicles to haul wet materials.
- .7 Prevent dust from spreading to adjacent sites.
- .8 PCA Representative will stop work at any time when Contractor's control of dusts and particulates is inadequate for wind conditions present at Site, or when air quality monitoring indicates that release of fugitive dusts and particulates into atmosphere equals or exceeds specified levels.
- .9 If Contractor's dust and particulate control is not sufficient for controlling dusts and particulates into atmosphere, stop work. Contractor must discuss procedures that Contractor proposes to resolve problem. Make necessary changes to operations prior to resuming excavating, handling, processing, or other work that may cause release of dusts or particulates.
- .10 Ensure hazardous substances (including fuel) are stored, handled and applied in a manner to prevent release to the environment and in a manner in accordance with applicable regulations including hazardous waste regulations.
- .11 Secure all materials when not in use and at non-productive times (night and shut-down).
- .12 Vehicles shall be shut off when not in use. No vehicle idling on-site.
- .13 Store hazardous or toxic substances in a designated area as approved by PCA Representative.
- .14 Comply with requirements of WHMIS regarding use, handling, storage and disposal of hazardous materials; and regarding labelling and provision of MSDS acceptable to Labour Canada.
- .15 Regularly inspect work areas and surrounding lands to collect wind-blown litter. During placement and compaction of waste in Cell A, limit the working face at any given time to a small and distinct area to allow better control of potential litter dispersal.

1.11 NOISE CONTROL

- .1 All Construction equipment shall be operated with exhaust systems in good repair to minimize noise.
- .2 Construction activated that could create excessive noise shall be restricted to daylight hours.
- .3 Ensure that noise control devices (i.e. mufflers, silencers) on construction equipment are properly maintained.

1.12 NOTIFICATION

- .1 PCA Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform PCA Representative of proposed corrective action and take such action for approval by PCA Representative.

- .1 Take action only after receipt of written approval by PCA Representative.
- .3 PCA 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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from PCA Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with codes that apply at the Federal, Provincial or local level such that in case of conflict or discrepancy between applicable codes, the more stringent requirements apply.
- .2 Meet or exceed requirements of the following items; if there is a discrepancy between the items the more stringent requirement applies:
 - .1 Contract documents, including amendments.
 - .2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Stop work immediately and notify PCA Representative if designated substances, toxic and/or hazardous waste are discovered during excavation of the Old Dump.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

1.4 NATIONAL PARKS ACT

- .1 Perform Work in accordance with National Parks Act when projects are located within boundaries of National Park.

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 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 INSPECTION

- .1 Allow PCA Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by PCA Representative, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 PCA Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, PCA Representative shall pay cost of examination and replacement.
- .5 The Contractor shall furnish promptly to the PCA Representative two copies of certificates and inspection reports relating to the Work.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies may be engaged by PCA Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by PCA Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by PCA Representative at no cost to PCA Representative. Pay costs for retesting and re-inspection.

1.4 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

- .2 Co-operate to provide reasonable facilities for such access.

1.5 PROCEDURES

- .1 Notify appropriate agency and PCA Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store test samples.

1.6 REJECTED WORK

- .1 Promptly remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by PCA Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 If in opinion of PCA Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by PCA Representative and Owner.

1.7 REPORTS

- .1 Submit copies of inspection and test reports to PCA Representative.
- .2 Provide copies to subcontractor of work being inspected or tested or manufacturer or fabricator of material being inspected or tested.

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 RELATED REQUIREMENTS

- .1 Section 31 12 10 – Landfill Construction Requirements.
- .2 Section 31 12 15 – Removal of Waste from Old Dump.
- .3 Section 31 32 19 01 – Geotextile.
- .4 Section 31 32 19 02 – HDPE and LLDPE Geomembrane.
- .5 Section 31 32 19 03 – Geosynthetic Clay Liner.

1.2 REFERENCES

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.5 DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water. Potentially impacted water within the Old Dump excavation footprint (i.e. groundwater or rain water in direct contact with excavation footprint) will be pumped to wastewater storage tanks for testing by PCA Representative.

1.6 WATER SUPPLY

- .1 Contractor will provide continuous supply of potable water for construction use.
- .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
- .3 Pay for utility charges at prevailing rates.

1.7 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps, or arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

1.8 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone, fax, data hook up, lines and equipment necessary for own use and use of PCA Representative.

1.9 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.
- .2 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .3 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas for temporary access roads and gate, construction laydown, vehicle parking, equipment decontamination pad, and topsoil stockpiling.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.4 SITE STORAGE/LOADING

- .1 The Contractor shall confine Construction Equipment, Temporary Work, storage of Products, waste products and debris, and operations of employees and Subcontractors to limits indicated by laws, ordinances, permits, or the Contract Documents and shall not unreasonably encumber the Place of the Work.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.5 CONSTRUCTION PARKING

- .1 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Maintain existing, new and temporary roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.6 ACCOMODATIONS

- .1 The Contractor is informed that there are no onsite accommodations available.
- .2 Provision of an onsite construction camp, including its facilities, utilities, services, location and operation is subject to the approval of the PCA Representative. The camp is to be designed, established and operated in accordance with applicable Federal and Provincial codes, regulations and requirements governing construction camps.
- .3 Provide one room for the PCA Representative for the duration of the project.

1.7 OFFICES

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
- .3 PCA Representative's Site office.
 - .1 Provide temporary office for PCA Representative.
 - .2 Inside dimensions minimum 3.6 m long x 3 m wide x 2.4 m high, with floor 0.3 m above grade, complete with 4 50% opening windows and one lockable door.
 - .3 Insulate building and provide heating system to maintain 22 degrees C inside temperature at -20 degrees C outside temperature.
 - .4 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19 mm thick plywood.
 - .5 Install electrical lighting system to provide min 750 lx using surface mounted, shielded commercial fixtures with 10 % upward light component.
 - .6 Provide private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain supply of paper towels and toilet tissue.
 - .7 Equip office with 1 x 2 m table, 4 chairs, 6 m of shelving 300 mm wide, one 3 drawer filing cabinet, one plan rack and one coat rack and shelf.
 - .8 Maintain in clean condition.
 - .9 Offices shall be locked at all time when not occupied.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in 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 manner to cause least interference with work activities.

1.9 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.10 CONSTRUCTION SIGNAGE

- .1 Direct requests for approval to erect Consultant/Contractor signboard to PCA Representative. For consideration general appearance of Consultant/Contractor signboard must conform to project identification site sign. Wording in both official languages and the local dialect.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by PCA Representative.

1.11 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by PCA Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. Where required, construct temporary pull over areas in order to allow for the safe passing of heavy equipment.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by PCA Representative.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, access and haul roads designated by PCA Representative.

1.12 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 12 10 - Landfill Construction Requirements.
- .2 Section 31 12 15 - Removal of Waste from Old Dump.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-O121-[M1978(R2003)], Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

1.3 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.4 HOARDING

- .1 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m on centre. Provide one lockable truck gate. Maintain fence in good repair and remove at end of project.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.
- .3 Erect additional barriers (e.g. fencing and silt fencing) as deemed necessary by the PCA Representative.

1.5 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations,.
- .2 Provide as required by governing authorities.

1.6 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.7 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.8 FIRE ROUTES

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

1.9 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 RELATED REQUIREMENTS

- .1 Section 31 12 10 - Landfill Construction Requirements.
- .2 Section 31 12 15 - Removal of Waste from Old Dump.
- .3 Section 31 32 19.02 – HDPE and LLDPE Geomembrane.
- .4 Section 31 32 19.03 – Geosynthetic Clay Liner.

1.2 REFERENCES

- .1 Owner's identification of existing survey control points and property limits.

1.3 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Place of Work, acceptable to PCA Representative.

1.4 SURVEY REFERENCE POINTS

- .1 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .2 Make no changes or relocations without prior written notice to PCA Representative.
- .3 Report to PCA Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .4 Require surveyor to replace control points in accordance with original survey control.

1.5 SURVEY REQUIREMENTS

- .1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill and topsoil placement.
- .4 Stake slopes and berms.
- .5 Establish pipe invert elevations.

1.6 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of and major site work, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of utility lines.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to PCA Representative.
- .2 On request of PCA Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform, and do not conform, with Contract Documents.

1.8 SUBSURFACE CONDITIONS

- .1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

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 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by PCA Representative. Do not burn waste materials on site, unless approved by PCA Representative.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris generated through project work.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Dispose of waste materials and debris in accordance with arrangements and permits from local authorities.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris generated through project work.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by PCA Representative. Do not burn waste materials on site, unless approved by PCA Representative.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

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 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor to conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify PCA Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request PCA Representative inspection.
 - .2 PCA Representative Inspection:
 - .1 PCA Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Work: complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by PCA Representative, and Contractor.
 - .2 When Work incomplete according to PCA Representative, complete outstanding items and request re-inspection.
 - .5 Declaration of Substantial Performance: when PCA Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
 - .6 Final Payment:
 - .1 When PCA Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
 - .7 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.2 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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 RELATED REQUIREMENTS

- .1 Section 31 32 19.02 – HDPE and LLDPE Geomembrane.
- .2 Section 31 32 19.03 – Geosynthetic Clay Liner.

1.2 REFERENCES

- .1 Not Used.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to completion of work with Contractor PCA Representative, in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review warranty requirements.
 - .2 PCA Representative to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide evidence, if requested, for type, source and quality of products supplied.

1.5 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by section numbers and sequence presented in the Table of Contents.
- .6 Text: manufacturer's printed data, or typewritten data.
- .7 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .8 Provide 1:1 scaled CAD files in dxf and dwg and PDF format on CD.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, at site for PCA Representative, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by PCA Representative.
- .6 Turn one set, paper copy and electronic copy, of AS-BUILT drawing and specifications over to PCA Representative on completion of work. Submit files on CD.
- .7 If project is completed without significant deviations from Contract drawings and specifications, submit to PCA Representative one set of drawing and specifications marked "AS-BUILT".

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, provided by PCA Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .2 Field changes of dimension and detail.
 - .3 Changes made by change orders.
 - .4 Details not on original Contract Drawings.
 - .5 References to related shop drawings and modifications.

- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.8 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 WARRANTIES

- .1 Submit, warranty information made available during construction phase, to PCA Representative for approval prior to each monthly pay estimate.
- .2 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties until time specified for submittal.

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 FAMILIARIZATION

- .1 The Contractor is advised that the work identified in the Drawings will be organized into several Construction Contracts to be undertaken at separate points in time. Only work related to Cell A and the Old Dump will be undertaken as part of this contract.
- .2 Prior to implementing any of the work described in this Section, Related Sections, and Drawings, become thoroughly familiar with the division of work.

1.2 SECTION INCLUDES

- .1 Installation of protective fencing around monitoring wells.
- .2 Clearing and grubbing.
- .3 Excavation and preparation of Cell A.
- .4 Supply and placement of granular drainage media in Cell A.
- .5 Supply and placement of high density polyethylene perforated and non perforated piping in Cell A.
- .6 Grading of wastes prior to final cover construction in Cell A.
- .7 Supply and placement of granulars for new access roads.
- .8 Supply and installation of culvert.
- .9 Excavation and grading of surface water ditches.
- .10 Supply and placement of erosion control blankets.
- .11 Supply and placement of landfill gas venting layer in final cover.
- .12 Supply and installation of landfill gas vents.
- .13 Supply and placement of topsoil layer in final cover, including seeding.
- .14 Supply and installation of fencing and access control gate.

1.3 RELATED SECTIONS

- .1 Section 31 12 15 Removal of Waste from Old Dump.
 - .2 Section 31 32 19.01 Geotextile.
 - .3 Section 31 32 19.02 HDPE and LLDPE Geomembrane.
 - .4 Section 31 32 19.03 Geosynthetic Clay Liner (GCL).
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1.4 REFERENCES

- .1 AWWPA Standard M4-06. Standard for the Care of Preservative-Treated Wood Products.
- .2 ASTM International (ASTM):
 - .1 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D422-63 (Reapproved 2007), Standard Method for Particle-Size Analysis of Soils.
 - .3 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft³ (600 kN m/m³)).
 - .4 ASTM D2216-10, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
 - .5 ASTM D2974-07a, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
 - .6 ASTM D3350 - 12e1 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 - .7 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - .8 ASTM D4643-08, Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating.
 - .9 ASTM D4972-01(2007), Standard Test Method for pH of Soils.
 - .10 ASTM D5268-07, Standard Specification for Topsoil Used for Landscaping Purposes.
 - .11 ASTM D6938-10, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- .3 Canadian Standards Association (CSA):
 - .1 CSA B182.11. Standard Practice for the Installation of Thermoplastic Drain, Storm and Sewer Pipe and Fittings.
 - .2 CSA O80-97 (R2007) Wood Preservation
 - .3 CSA O80.2-97 Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes.
 - .4 CSA G401, Corrugated steel pipe products.
- .4 CAN3-G401.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 At least two weeks prior to the start of construction submit to the PCA Representative:
 - .1 The locations and name of the source of:
 - .1 Granular materials (100 mm Minus Gravel, 19 mm Minus Gravel) to be used for access roads.
-

- .2 50 mm clear stone to be used for leachate drainage media in Cells A and B.
- .3 Topsoil.

- .2 A 20 kg sample of each material.
- .3 The name and location of the laboratory that will be used for soil analyses as specified.
- .4 Shop drawings showing all components of the piping systems and drainage sump chambers including pipes, joints, fittings, welds, and perforations.
- .5 Shop drawing showing detail of gas vents.
- .6 Details of seed mixture proposed for final cover.
- .7 Details of proposed temporary sedimentation and erosion control measures.
- .3 At least one week before the start of construction provide laboratory test results for the following parameters:
 - .1 Soil for Cell Base Grading:
 - .1 Grain size analysis including hydrometer.
 - .2 Water content of the soil at its in-situ source.
 - .3 Standard proctor analysis.
 - .2 Clear Stone:
 - .1 Grain size analysis.
 - .3 Granular Aggregates:
 - .1 Grain size analysis.
 - .2 Standard proctor analysis.
 - .4 Soil for Gas Venting Layer
 - .1 Grain size analysis.
 - .2 Standard proctor analysis.
 - .5 Topsoil:
 - .1 Organic matter per ASTM D2974.
 - .2 Physical Evaluation per ASTM D5268.

1.6 QUALITY CONTROL

- .1 Provide field quality control for compaction of various materials in accordance with the following:
 - .1 Following proof-rolling of native material in base of cells: minimum one test per 625 m² for each lift placed.
 - .2 Granular roadways: Minimum one test per lift per 625 m² of roadway constructed.
- .2 Provide laboratory analysis for the following parameters:
 - .1 Soil for Cell Base Grading (four per cell):

- .1 Grain size analysis.
- .2 Water content of the soil at its in-situ state.
- .3 Standard proctor analysis.
- .2 Granular Aggregate (every 350 m³ material placed):
 - .1 Grain size analysis.
 - .2 Standard proctor analysis.

1.7 EXISTING CONDITIONS

- .1 Before commencing work verify location of buried services on and adjacent to site.

Part 2 MATERIALS

2.1 TEMPORARY SEDIMENTATION AND EROSION CONTROL MEASURES

- .1 Silt fencing and straw bales to the satisfaction of the PCA Representative.

2.2 TEMPORARY PROTECTIVE FENCING

- .1 Prefabricated, brightly coloured plastic snow fencing 1.2 m high.
- .2 1.8 m long supporting posts: Steel 'T' bars or 50 mm x 50 mm wooden stakes.

2.3 SOIL FOR CELL BASE GRADING

- .1 Select native sand excavation spoil from Cell A.
- .2 Sand to be screened or otherwise processed to be free of stones or debris greater than 100 mm in any dimension.

2.4 SOIL FOR LANDFILL GAS VENTING LAYER

- .1 Select native sand excavation spoil from Cell A.
- .2 Sand to be screened or otherwise processed to be free of stones or debris greater than 100 mm in any dimension.

2.5 GRANULAR AGGREGATES

- .1 Granular aggregate shall be composed of inert, clean, tough, durable particles of crushed rock, gravels, sand and fines capable of withstanding the deleterious effects of exposure to water, freeze-thaw, handling, spreading and compacting. The aggregate particles shall be uniform in quality and free from clay lumps, wood and free from an excess of flat or elongated pieces. Screen granular to remove all stones in excess of maximum diameter specified. Gradation of aggregates shall be as follows:
 - .1 100 mm Minus Granular

Sieve Designation	Percent Passing	
100 mm	--	100
75 mm	--	100
50 mm	70	100
25 mm	50	100
4.75 mm	22	100
2.36 mm	10	85
0.075 mm	2	8

.2 19 mm Minus Granular

Sieve Designation	Percent Passing	
19 mm		100
12.5 mm	75 –	100
9.5 mm	60 –	90
4.75 mm	40 –	70
2.36 mm	27 –	55
1.18 mm	16 –	42
0.600 mm	8 –	30
0.300 mm	5 –	20
0.75 mm	2 –	8

.3 CLEAR STONE: Uniformly graded clear stone, 50 mm diameter.

2.6 TOPSOIL AND SEED

.1 Topsoil

- .1 Mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
- .2 Soil texture to consist of 20 to 70 % sand, minimum 7 % clay, and contain 5 to 15 % organic matter by weight.
- .3 Contain no toxic elements or growth inhibiting materials.
- .4 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material greater than 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
- .5 Consistency - friable when moist.

.2 Seed.

- .1 Mixture of grass varieties native to northern Alberta.
 - .2 Draught resistant.
-

- .3 Provides good soil retention.
- .4 Mixture to the satisfaction of the PCA Representative.

2.7 LEACHATE COLLECTION PIPE

- .1 200 mm, DR9 high-density polyethylene (HDPE) perforated and non-perforated pipes with the following properties:
 - .1 Where approved by the PCA Representative, 8 inch nominal size DR9 pipe may be substituted for 200 mm size.
 - .2 The pipe is made from a polyethylene resin compound with a minimum cell classification of 345464C as defined in ASTM D3350.
 - .3 The pipe is made from materials meeting the designation of PE3408 or PE3608 as assigned by the Plastic Pipe Institute.
 - .4 The pipe material shall contain minimum 2% of well dispersed carbon black as UV stabilizer.
 - .5 The pipe shall be supplied by a manufacturer with a proven track record of producing quality HDPE pipes.
 - .6 Classification shall be marked on the pipe.
 - .7 Perforated piping as per Drawings.
 - .8 HDPE End caps, couplings, elbows, T-sections manufactured for use with the 200 mm DR9 pipe.
 - .9 The pipe material shall contain minimum 2% of well dispersed carbon black as UV stabilizer.
 - .10 The pipe shall be supplied by a manufacturer with a proven track record of producing quality HDPE pipes.
 - .11 Classification shall be marked on the pipe.

2.8 SUMP CHAMBERS

- .1 Sump Chambers shall be composed of HDPE 500 mm non-perforated DR17 piping with the following properties:
 - .1 Diameter and SDR value per Drawings.
 - .2 The pipe is made from a polyethylene resin compound with a minimum cell classification of 345464C as defined in ASTM D3350.
 - .3 The pipe is made from materials meeting the designation of PE3408 or PE3608 as assigned by the Plastic Pipe Institute.
 - .4 The design hydrostatic stress at 23 deg. C shall be minimum 800 psi (5.5 MPa).
 - .5 The pipe material shall contain minimum 2% of well dispersed carbon black as UV stabilizer.
 - .6 HDPE End caps, couplings, elbows, T-sections manufactured for use with the 500 mm DR17 pipe.
 - .7 The pipe shall be supplied by a manufacturer with a proven track record of producing quality HDPE pipes.
 - .8 Classification shall be marked on the pipe.

2.9 CULVERT

- .1 Nominal diameter 600 mm.
- .2 Manufactured from high quality, hot dipped zinc Steel Pipe coated culvert sheet. Culvert to be #14 gauge and are to be of helical lock-seam CSP with 68 mm x 13 mm corrugation profile.
- .3 Provided and installed with a galvanized apron end section at both ends. Galvanized end sections shall be of approved manufacture to match size and style of culvert.

2.10 EROSION CONTROL BLANKETS

- .1 Blanket consisting of a layer of 100% straw fiber stitched between biodegradable natural fiber top and bottom nets.
- .2 Nets composed of biodegradable jute fibre.
- .3 Fully biodegradable thread.
- .4 Rated for 12 months of erosion protection and mulching.
- .5 Weight of top and bottom nets between 3.7 to 4.5 kg/100 m².
- .6 Straw fiber weight approximately 0.27 kg/m².

2.11 LANDFILL GAS VENTS

- .1 300 mm diameter stainless steel, with stabilizing collar and cap w/ bird screen.
- .2 Perforated section for installation within sand gas venting layer.

2.12 PERMANENT FENCING

- .1 Wood Posts
 - .1 Straight peeled jack pine or lodgepole pine 4300 mm long with a minimum tip diameter of 150 mm and a maximum butt diameter of 200 mm. The bottoms of the wood posts must be tapered to a rounded end for driveability. Round wood posts shall be treated in accordance with CSA O80-97, and in particular, CSA O80.5-97 Preservative Treatment of Posts by Pressure Processes. Sawn timber posts and members shall be treated for ground contact in accordance with CSA O80-97, and in particular, CSA O80.2-97 Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes.
 - .2 Preservative Treatment for Protecting Field Cut Wood and Bolt Holes
 - .1 Field cuts and bolt holes shall be protected in accordance with AWPA Standard M4. The colour of the preservative treatment used for protecting field cut wood and bolt holes shall match the original preservative treatment colour, where possible.

.3 Fabric

- .1 Fence fabric shall be 2.44 m (8 ft) high with 150 mm (6 in) horizontal and graduated vertical spacing, 12.5 gauge high tensile wire with a twisted friction type joint at each horizontal/vertical contact point. The fence fabric will have a minimum of 20 horizontal wires, with graduated vertical spacing ranging from 7.62 cm (3 inches) at the bottom to 17.78 cm (7 inches) at the top. The fence material will be galvanized to a retention of not less than Class 3 coating, 240 g/m². The horizontal wires will have a minimum tensile strength of 1234 MPa (179 ksi).

2.13 ACCESS CONTROL GATE

- .1 Double swing gate spanning entire width of entrance.
- .2 Galvanized steel-framed gate with either 11 gauge, 50 mm wire mesh or fence fabric noted in this specification.
- .3 Galvanized hinges, ties, and fittings.

Part 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- .1 Temporary Erosion and Sedimentation Control
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent areas.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during cell construction, contaminated soil excavation and placement, final cover placement, and until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Drainage of Water and Prevention of Contamination
 - .1 Keep the Works area free of standing water at all times during the Contract period. Discharge points are to be agreed with the PCA Representative prior to any discharge occurring.
 - .2 Take measures to ensure that no contamination will take place of the natural ground and surface water as a result of run-off from the works.
 - .3 Fuel tanks and drums stored at a location approved by the PCA Representative.
- .3 Inclement Weather
 - .1 Inclement weather may comprise high winds, rain, snow, freezing, excessive temperatures or a combination of these conditions.

- .2 When weather conditions are such that the quality of the Works may be impaired or the conditions of the materials impaired then the Works will be stopped with the agreement of the PCA Representative.
- .3 Make good any works carried out in inclement weather conditions that have been adversely affected.
- .4 Finished Tolerances
 - .1 Within plus or minus 15 mm of specified grade and cross-section but not uniformly high or low.
 - .2 Ensure finished subgrade surface has no irregularities exceeding 15 mm when checked with a 3 m straight edge placed in any direction.
 - .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Preparation and Protection
 - .1 Protect excavations from freezing.
 - .2 Protect soil, sand, and granular stockpiles from freezing.
 - .3 Seal stockpiles of soil at the end of each working day by crowning pile to shed runoff and packing stockpile surface with compactor or dozer tracking.
 - .4 Keep excavations clean, free of standing water, and loose soil.
 - .5 Where soil is subject to significant volume change due to change in moisture content, cover and protect to PCA Representative approval.
 - .6 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
 - .7 Protect buried services that are required to remain undisturbed.

3.2 PROTECTIVE FENCING AROUND MONITORING WELLS

- .1 Install fencing to provide an enclosure with a 2 m radius centered around each monitoring well.
- .2 Drive support posts 0.6 m into ground and securely attach fence fabric.
- .3 Provide access point for entry into the fenced area to the satisfaction of the PCA Representative.

3.3 CLEARING AND GRUBBING

- .1 The work area contains trees, minor shrubs/brush or sparsely vegetated areas.
 - .2 Clear the area shown on the Drawings by removing all standing and fallen trees, stumps, logs, upturned roots, rotten wood and all other vegetation growth and accumulation of rubbish of whatsoever nature and any other objectionable material.
-

- .3 Removal and dispose of all stumps, roots and embedded logs to a depth of 0.2m below the ground line or as required to reach mineral soil. It shall be carried out over the entire area to be cleared.
- .4 Place cleared vegetation, grubbed and stripped material in a location within the property as designated by the PCA Representative. Unless specified otherwise all timber becomes property of Contractor. Cleared wood shall be burned, chipped and distributed over land, or hauled away.
- .5 Burn only with the approval of the PCA Representative, and in accordance with Provincial and Municipal regulations.
- .6 Leave ground surface in condition suitable for immediate grading operations or stripping of topsoil if so specified.

3.4 EXCAVATION AND PREPARATION OF CELL A AND SURFACE WATER DITCHES

- .1 Assume full responsibility for, and execute complete layout of work to locations, lines, and grades indicated on Drawings.
- .2 Strip topsoil from areas to be covered by new cells and new granular roadway including sufficient additional area so that excavated material may be stockpiled without covering topsoil. Stockpile topsoil on site for later use.
- .3 Excavate cell bases, sump depressions, and ditches as shown in Drawings.
- .4 Do not disturb soil beneath grades shown.
- .5 Notify PCA Representative when excavations are complete.
- .6 Following excavation proof roll entire excavated surface with minimum 3 passes with a 15 tonne sheepsfoot or padfoot roller, to the satisfaction of the PCA Representative.
- .7 Any soft spots identified in the excavated surface shall be excavated to the satisfaction of the PCA Representative and backfilled.
- .8 Place replacement fill in 150 mm lifts and compact each lift to minimum 95% Modified Proctor density.
- .9 Adjust soil moisture to within 2% of optimum moisture content prior to compaction.
- .10 Conduct further compaction to achieve 95% Standard Proctor Density in the base and side slopes of the excavation.
- .11 Conduct further compaction to achieve 98% Standard Proctor Density in sump areas.
- .12 Install geosynthetic clay liner, geomembrane, geotextile, and erosion control mats as specified.

3.5 PLACEMENT OF GRANULAR DRAINAGE MEDIA IN CELL A

- .1 The clear stone shall be placed to cover the geotextile within time limits in accordance with Specification 31 32 19.01.
- .2 No equipment or vehicle traffic, even for the placement of granular material, shall be permitted directly on the exposed geotextile.
- .3 Granular material is to be placed in loose lifts of maximum 0.3 m thickness using low ground pressure equipment in a manner which does not damage or disturb the geotextile and work below.
- .4 Equipment shall be operated such that spinning tracks and sharp turns are avoided. Affected areas are to have granular material removed and geotextile inspected for damage.
- .5 Place granular material such that wrinkle development underlying geomembrane and geotextile is prevented. Take the following precautions:
 - .1 Spread granular material in a fan shape pattern, lifting the dozer blade gradually as granular material is spread.
 - .2 Place granular material from bottom to top on slopes.
 - .3 Isolate and cover small wrinkles as quickly as possible to prevent their growth.
 - .4 Ensure wrinkles from being folded over.

3.6 HDPE PIPING AND SUMPS IN CELL A

- .1 Piping
 - .1 Install plastic pipe and fittings in accordance with CSA B182.11.
 - .2 Ensure granular materials or debris does not enter pipes during installation. Temporarily cover open pipe ends with geotextile to prevent granular entry.
 - .3 Join pipe sections in accordance with manufacturer's recommendations and as accepted by the PCA Representative.
 - .4 Install slip-fit end caps on all pipe ends.
- .2 Sumps
 - .1 Place sump chamber as shown in Drawings.
 - .2 Exercise extreme caution when placing chamber base to prevent damage to underlying geotextile and geomembrane.
 - .3 Place minimum of 100mm 19 MM minus gravel on geotextile surface beneath sump and compact to minimum 95% Standard Proctor Density. Bedding, laying and jointing in accordance with the specification and manufacturers recommendations.
 - .4 Construct sumps in general accordance with the lines, grades and locations specified on the drawings. Culverts are to be field fitted by the Contractor to reflect actual conditions encountered on site and approved by the PCA Representative.
 - .5 Place 50 mm clear stone in layers alternately on each side of the sump so as not to displace it. Compact each layer to a minimum 95% Standard Proctor density taking special care to obtain required density under haunches.

3.7 GRADING OF WASTES IN CELL A PRIOR TO FINAL COVER CONSTRUCTION

- .1 Proof roll final waste surface with minimum of 5 passes of 15 tonne sheepsfoot roller.
- .2 Haul and place a 0.3 m layer of sand (excavation spoil from Cell A excavation) over entire regarded waste surface. Compact sand with minimum 5 passes of a smooth drum roller. Place additional sand, as required, to eliminate any waste visible on landfill surface.
- .3 Final surface of sand shall be rolled with a smooth drum roller to form a smooth surface free from ruts, troughs, or depressions to the satisfaction of the PCA Representative.
- .4 Construct final cover system as per Specifications and as shown in Drawings.

3.8 PLACEMENT OF GRANULARS FOR NEW ACCESS ROADS

- .1 General Requirements
 - .1 Road Construction will generally comprise of the following materials unless specified otherwise:

Material	Material	Thickness (mm)	Special Requirements
FINISHING	Rolled and crowned 3% cross fall		
GRANULAR SURFACE COURSE	19mm minus gravel	50	Placed and compacted as specified
GRANULAR BASE COURSE	100 mm minus gravel material	300	2 layers of 150mm thickness, compacted as specified
GEOTEXTILE	As specified in 31 32 19.01		
SUBGRADE	Proof rolled and tested		

- .2 Preparation of Subgrade
 - .1 Defer final excavation to subgrade level until immediately before compaction of subgrade.
 - .2 Soft spots must be brought to the attention of the PCA Representative. Obtain instructions before proceeding.
 - .3 Subgrade must be dry at time of compaction.
 - .4 Compact subgrade with minimum of three (3) passes of 15 tonne sheepsfoot compactor, or to satisfaction of PCA Representative.
 - .5 Where use of a roller is impractical use a suitable mechanical tamper.

- .6 Where local excavation and backfilling has taken place make additional passes of the roller.
 - .7 The completed surface of the sub-grade shall conform to the line, grade and cross section to an accuracy ± 50 mm, neither uniformly high nor low.
 - .8 Place separator geotextile in accordance with 31 32 19.01.
- .3 Placement and Compaction of Granulars
- .1 Do not place granular base until finished subgrade surface, and the geotextile, is inspected and approved by the PCA Representative.
 - .2 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
 - .3 Begin spreading base material on crown line or on high side of one-way slope.
 - .4 Place base material using methods which do not lead to segregation or degradation of aggregate.
 - .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. The PCA Representative may authorise thicker layers if specified compaction can be achieved.
 - .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - .7 Remove and replace portion of any layer in which material has become segregated during spreading.
 - .8 Compact to density not less than 95% Standard Proctor density.
 - .9 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .2 Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .3 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers.
- .4 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.9 INSTALLATION OF CULVERT

- .1 Place minimum of 100mm of 19 mm minus gravel as bedding on bottom of excavation and compact to minimum 95% Standard Proctor Density. Bedding, laying and jointing in accordance with the specification and manufacturers recommendations.
- .2 Construct culvert in general accordance with the lines, grades and locations specified on the drawings. Culverts are to be field fitted by the Contractor to reflect actual conditions encountered on site and approved by the PCA Representative.
- .3 Place 100 mm minus gravel in 150 mm thick full width, alternately on each side of the culvert so as not to displace it. Compact each layer to a minimum 95% Standard Proctor

density taking special care to obtain required density under haunches. Protect installed culvert with minimum 600mm of compacted fill before heavy equipment is permitted to cross during construction of the project. Width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1 in 2.

3.10 PLACEMENT OF EROSION CONTROL BLANKETS

- .1 Prepare grade soil surface smooth to design profile and remove debris and large rocks and place topsoil.
- .2 Seed before the placement of blanket.
- .3 Dig a 150 mm x 150 mm anchor trench both up-slope and down-slope of the area to be covered.
- .4 Secure the blanket with staples in the trenches every 0.3 m and backfill and compact.
- .5 Roll the blankets vertically down the slope or in the direction of flow for channels.
- .6 Staple the blanket at 0.6 m horizontal and vertical spacing.
- .7 Overlap blankets 150 mm at all sides and staple. Place downslope blanket underneath upslope blanket to form a shingle pattern. Install additional staples to ensure blanket is sufficiently secured.
- .8 Ensure intimate contact between blanket and soil.

3.11 FENCING AND ACCESS CONTROL GATE

- .1 Install wood posts plumb and to a depth of 1500 mm.
 - .2 Posts may be either driven or set in excavated holes, provided that a rigid installation is achieved, capable of withstanding a horizontal load of 32 kg (70 lb), applied 1.5 m above the ground, in any direction in the horizontal plane, without any movement in excess of 25 mm.
 - .3 When a wood post is set in an excavated hole, the soil around the wood post must be compacted to the satisfaction of the PCA Representative.
 - .4 Conduct load test after the post is installed but before the fabric wire is attached.
 - .5 Record load test and submit to the PCA Representative.
 - .6 Adjust gate lock assemblies to work in the field.
 - .7 Set gates to achieve a minimum of 150mm clearance from the ground.
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3.12 CAPPING AND RESTORATION

.1 Landfill Gas Venting Layer

- .1 Place venting layer sand layer in location and thickness shown in Drawings.
- .2 Adjust sand moisture to within 2% of optimum moisture content prior to compaction.
- .3 Compact sand to achieve minimum 95% Standard Proctor Density.
- .4 Ensure final surface of sand cushion layer is smooth and free from ruts, troughs, or depressions to the satisfaction of the PCA Representative.

.2 Landfill Gas Vents

- .1 Install vents after placement of LLDPE geomembrane and overlying cushion geotextile.
- .2 Cut opening through geomembrane and drill to required depth for firm anchoring of vent in underlying layers.
- .3 Ensure perforated portion of vent is situated within sand gas venting layer.
- .4 Backfill around vent with sand and compact.
- .5 Repair geomembrane and geotextile as per Specifications.
- .6 Minimize disturbance of vent during placement of subsequent final cover layers and ensure vent is plumb.

.3 Topsoil and Seeding

- .1 Place topsoil after PCA Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 250 mm.
- .3 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
- .4 Consolidate topsoil using equipment approved by PCA Representative.
- .5 Leave surfaces smooth, uniform and firm against deep footprinting.
- .6 Cultivated areas identified as requiring cultivation to depth of 25 mm.
- .7 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
- .8 Obtain PCA Representative's approval of grade and topsoil depth before starting to seed. Seed with a mix native to northern Alberta.
- .9 Fertilize and water during establishment and until acceptance according to an agreed upon program between the Contractor and PCA Representative.
- .10 Reseed dead or bare spots to allow establishment of vegetation until acceptance by PCA Representative.
- .11 Seeded areas will be accepted by PCA Representative when plants are uniformly established and seeded areas are free of rutted, eroded, bare or dead spots.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Excavation of waste from Garden River Old Dump and placement in Cell A.

1.2 RELATED SECTIONS

- .1 Section 31 12 10 Landfill Construction Requirements.
- .2 Section 31 32 19.01 Geotextile.
- .3 Section 31 32 19.02 HDPE and LLDPE Geomembrane.
- .4 Section 31 32 19.03 Geosynthetic Clay Liner (GCL).

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 At least two weeks prior to the start of construction submit a Work Plan to the PCA Representative that addresses:
 - .1 Schedule of Activities.
 - .2 Worker Health and Safety Plan.
 - .3 Method of excavation and equipment to be used.
 - .4 Excavation Sequencing Plan.
 - .5 Excavation Support and Protection Plan.
 - .6 Water Management Plan.
 - .7 Storage methods and locations for suspect or liquid wastes encountered.
 - .8 Method for safely removing suspect or liquid wastes and haulage to a licensed disposal facility.
 - .9 Methods for reducing size of encountered waste materials prior to placement in Cell A.
 - .10 Method for placement of waste in Cell A so that damage to liner system is prevented.
 - .11 Proposed temporary haul routes.
 - .3 No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved by the PCA Representative.
 - .4 No adjustment for time or money shall be made if re-submittals of the Work Plan are required.
 - .5 Submit to PCA Representative as excavation proceeds:
 - .1 Written record of volume of waste removed from excavation and volume placed in Cell A.
-

1.4 QUALITY CONTROL

- .1 Provide field topographic survey control to measure volume of materials removed from excavation and volume of materials placed in Cell A. On a daily basis measure volumes removed from excavation and volume placed and provide written record of these volumes to PCA Representative.
- .2 Contractor is advised that confirmatory sampling of the base and sides of the excavation will be conducted by PCA Representative.
- .3 At least one week before the start of construction provide laboratory test results for the following parameters:
 - .1 Soil for Backfilling of Remedial Excavation:
 - .1 Grain size analysis including hydrometer.
 - .2 Water content of the soil at its in-situ source.
 - .3 Standard proctor analysis.
 - .4 Provide field quality control for compaction of remedial excavation backfill, at a minimum frequency of one test per 625 m² for each lift placed.

Part 2 MATERIALS

2.1 WASTE TO BE EXCAVATED

- .1 The following information on the wastes contained in the Garden River Old Dump is appended to these Specifications:
 - .1 *Garden River, AB Community Airstrip and Old Landfill Reports Review and Remediation Options Analysis.* Prepared by EBA. March 2013.
 - .2 *Detailed Site Assessment – Garden River Old Dump in Wood Buffalo National Park.* Prepared by Columbia Environmental Consulting Ltd. and Franz Environmental Inc. February 2011.
 - .3 *Contaminated Site Assessment Initial and Detailed Testing Programs, Wood Buffalo National Park, Various Locations in the Community of Garden River, Alberta.* Prepared by EBA. February, 2009.
- .2 The Contractor is advised that site conditions may be different than documented in these reports. In particular, the Contractor is advised that the waste to be excavated may contain suspect or liquid waste which may not be placed in Cell A.

2.2 SOIL FOR BACKFILLING OF REMEDIAL EXCAVATION

- .1 Soil for backfilling of remedial excavation will be provided by the PCA Representative from an existing borrow pit owned by PCA which is located immediately west of the location of the newly constructed landfill cells. Contractor is responsible for sampling

and laboratory analysis, loading at the borrow pit, hauling to the remedial excavation area, and placing and compacting the backfill material within the remedial excavation.

2.3 EQUIPMENT

- .1 All equipment cabs shall be enclosed and have a standard air filtration system. Air filtration systems shall be operational at all times during contaminated soil excavation.
- .2 Edges of excavator buckets shall be equipped with heavy gauge brass plate to minimize potential for sparking on stones or other debris encountered in the remedial excavation.
- .3 Haulage truck boxes and tailgates shall be in good repair such that release of soil or liquids from the box during haulage activities is minimized to the satisfaction of the PCA Representative.
- .4 Dozers used to maneuver and place waste in Cell A shall exert a ground pressure of no more than 35 KPa.
- .5 Provide pad foot compactor to compact waste in Cell A.

2.4 TOPSOIL AND SEED

- .1 Topsoil
 - .1 Mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .2 Soil texture to consist of 20 to 70 % sand, minimum 7 % clay, and contain 5 to 15 % organic matter by weight.
 - .3 Contain no toxic elements or growth inhibiting materials.
 - .4 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material greater than 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .5 Consistency - friable when moist.
 - .2 Seed.
 - .1 Mixture of grass varieties native to northern Alberta.
 - .2 Draught resistant.
 - .3 Provides good soil retention.
 - .4 Mixture to the satisfaction of the PCA Representative.
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Part 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established, per requirements of Section 31 12 10.

3.2 PREPARATION/PROTECTION

- .1 Keep excavations free of standing water.
- .2 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .3 Protect buried services that are required to remain undisturbed.

3.3 TEMPORARY ROADS AND ACCESS RAMPS

- .1 Construct and maintain all temporary access roads and ramps into and within Cell A to allow efficient waste placement to the satisfaction of the PCA Representative.
- .2 Relocate temporary access roads as appropriate to suit the waste placement operations.

3.4 WASTE EXCAVATION

- .1 Confirm area and depth of required excavation with PCA Representative prior to commencing excavation.
 - .2 Excavation shall be performed in a manner that limits spills and the potential for waste to come into contact with clean material.
 - .3 Excavated waste shall be loaded directly into trucks and hauled to Cell A for placement subject to segregation requirements specified herein.
 - .4 For the initial layer of waste to be placed in Cell A (1 m thickness), select or process waste to be particles no larger than 100 mm.
 - .5 Utilize a spotter at the excavation area to identify oversize materials.
 - .6 Sealed drums, boxes and other containers encountered in the excavation shall be removed intact wherever possible.
 - .7 Entry into excavations shall be limited to required personnel only. If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by applicable legislation.
 - .8 Suspend excavation during periods of rain, snow, or prolonged freezing temperatures, at the discretion of the PCA Representative.
 - .9 Notify the PCA Representative when the bottom of the excavation is reached.
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- .1 Excavate test pits in the base of the excavation, while the PCA Representative is present, to confirm no further debris is present. Excavate any additional debris that is found.
 - .2 Allow the PCA sub-consultant to collect floor and wall soil samples from the open excavation.
 - .3 PCA will pay for the analysis of the samples.
 - .10 Obtain PCA Representative approval of completed excavation.

3.5 SUSPECT WASTE MATERIALS

- .1 Segregate suspect or liquid wastes in accordance with submitted work plans approved by the PCA Representative.

3.6 OVERSIZED MATERIALS

- .1 Oversized items shall be temporarily stockpiled at a location designated by the PCA Representative for processing prior to being transported to Cell A.
- .2 Disassembling, crushing, cutting and/or similar suitable methods shall be carried out at the oversized items stockpile area where it is practicable to reduce voids in these items.
- .3 Items shall be processed by such suitable method(s) so that when they are placed in Cell A, spaces around and between them can be filled easily with other waste.

3.7 PLACEMENT OF INITIAL LAYERS OF WASTE IN CELL A

- .1 Place an initial layer of select/processed soil in Cell A to protect the base liner system. This initial layer shall not contain materials with any dimension exceeding 100 mm and shall be minimum 1.0 m thick.
 - .2 This initial layer shall be built up in two lifts, each 0.5 m thick, using a low ground pressure (maximum 35 kPA) tracked bulldozer.
 - .3 Wastes shall be placed so that the liner and drainage sump is not damaged or disturbed.
 - .4 Compact initial lift by tracking with low ground pressure bulldozer.
 - .5 After placement of the first 500 m² of the initial lift, hand-dig minimum of three test pits down to level of geotextile to confirm no damage to geotextile and geomembrane has occurred.
 - .6 Haulage trucks will only be permitted to travel on the surface of waste being placed in the cell where a minimum 1 m thick of waste has first been placed. Increase the thickness of the buffer layer if any evidence of rutting is observed at the interface between the soil and the underlying geotextile, as determined by the PCA Representative.
 - .7 The dozer operator shall be assisted at all times by a spotter on the ground to help confirm that the proper buffer thickness is being maintained and to spot for oversized debris in the waste.
 - .8 In manoeuvring equipment when placing waste, exercise extreme care not to damage the underlying geotextile and geomembrane by avoiding spinning tracks and sharp turns. If
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unintentional track spinning or sharp turning of the dozer occurs, or if such occurrences are evident from the track patterns, the PCA Representative shall be immediately be notified. The waste in the affected area shall be carefully removed and the geotextile and/or geomembrane inspected for potential damage. Where damage is identified, perform repairs following the relevant procedures in these Specifications, to the satisfaction of the PCA Representative.

3.8 PLACEMENT OF SUBSEQUENT LAYERS OF WASTE

- .1 Each layer placed after the initial layer shall be typically 0.5 m thick. Wastes that are weak or soft shall be placed in thinner layers as necessary to maintain stability.
- .2 Distribute debris to minimize voids and to maximize packing of wastes around debris pieces.
- .3 Mix wastes of different properties by selective loading to haulage trucks, or during spreading of the waste to improve the physical properties of weak or soft materials.
- .4 Different types of waste shall be placed randomly where practicable to achieve a good spatial distribution to create a more homogeneous waste mass and to minimize differential settlement.
- .5 Compact wastes by three passes of a compactor except where the slope or the waste is not stable enough to support the equipment.
- .6 Grade final surface of waste in Cell A to form the specified slopes toward the perimeter of the cell, to the satisfaction of the PCA Representative. Grade reversals (e.g. depressions) shall be eliminated.
- .7 Final surface of waste in Cell A shall be rolled with a smooth drum roller to form a smooth surface free from ruts, troughs, or depressions to the satisfaction of the PCA Representative.
- .8 Construct final cover as per Specifications and Drawings.

3.9 BACKFILLING AND RESTORATION OF REMEDIAL EXCAVATION

- .1 Upon completion of excavation, the excavation shall be backfilled.
- .2 Backfill shall be placed in maximum 0.3 m thick lifts and compacted to 95% Standard Proctor Density for the backfill material.
- .3 Topsoil and Seeding
 - .1 Place topsoil after PCA Representative has accepted subgrade.
 - .2 Spread topsoil in uniform layers not exceeding 250 mm.
 - .3 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
 - .4 Consolidate topsoil using equipment approved by PCA Representative.
 - .5 Leave surfaces smooth, uniform and firm against deep footprinting.

- .6 Cultivated areas identified as requiring cultivation to depth of 25 mm.
- .7 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
- .8 Obtain PCA Representative's approval of grade and topsoil depth before starting to seed. Seed with a mix native to northern Alberta.
- .9 Fertilize and water during establishment and until acceptance according to an agreed upon program between the Contractor and PCA Representative.
- .10 Reseed dead or bare spots to allow establishment of vegetation until acceptance by PCA Representative.
- .11 Seeded areas will be accepted by PCA Representative when plants are uniformly established and seeded areas are free of rutted, eroded, bare or dead spots.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Supply and installation of geotextiles as a separator layer between the subgrade and granulars in the new access roads;
- .2 Supply and installation of geotextiles as a protective layer over textured high density polyethylene (HDPE) base liner in Cell A;
- .3 Supply and installation of geotextiles as a protective layer for the textured linear low density polyethylene (LLDPE) geomembrane in the final cover, and also a separation layer for the final cover drainage layer in Cell A.

1.2 RELATED SECTIONS

- .1 Section 31 12 10 Landfill Construction Requirements.
- .2 Section 31 12 15 Removal of Waste from Old Dump.
- .3 Section 31 32 19.02 HDPE and LLDPE Geomembrane.
- .4 Section 31 32 19.03 Geosynthetic Clay Liner (GCL).

1.3 REFERENCES

- .1 Society for Testing and Materials International (ASTM):
 - .1 ASTM D4354 - 99(2009) Standard Practice for Sampling of Geosynthetics for Testing.
 - .2 ASTM D4355-07, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 - .3 ASTM D4491-99a (Reapproved 2009), Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .4 ASTM D4533-04 (Reapproved 2009), Standard Test Method for Trapezoidal Tearing Strength of Geotextiles.
 - .5 ASTM D4632-08, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - .6 ASTM D4751-04, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - .7 ASTM D4759 - 02(2007) Standard Practice for Determining the Specification Conformance of Geosynthetics.
 - .8 ASTM D4833-07, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - .9 ASTM D4884 - 9 Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles.
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- .10 ASTM D5261-10, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

1.4 SUBMITTALS

- .1 Submittals shall be made in accordance with Section 01 33 00.
- .2 Submit to PCA Representative at least 28 days prior to installation:
- .1 Name, location, and contact information for qualified and accredited Geosynthetic Quality Assurance Laboratory to be used for independent geotextile material testing.
- .3 Submit to PCA Representative at least 14 days prior to installation:
- .1 The method of sewing seams, and shop drawing showing method of fastening geotextile to pipe penetrations.
 - .2 2 m long sample of geotextile across entire roll width.

1.5 CERTIFICATES

- .1 Submit to PCA Representative at least 28 days prior to installation:
- .1 Manufacturer's certificate stating that the geotextile meets the requirements of this specification. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors.
 - .2 Mill certificates from manufacturer with minimum average roll values for all parameters identified in this Specification.
- .2 Submit to PCA Representative at least 14 days prior to installation:
- .1 Results of independent laboratory testing for all parameters listed in this Specification.

1.6 QUALITY CONTROL

- .1 Collect quality control samples in accordance with ASTM D4354. Collect one sample per 1,500 m² from the rolls intended to be provided for this project and submit samples for independent laboratory testing for parameters listed in this Specification.
- .2 Discard the outer layer of the geotextile roll and collect by cutting a minimum 1 m sample over the full-width of the geotextile sheet. Cover the roll immediately with the protective covering immediately after sampling.
- .3 Samples will be tested to verify that geotextile meets the requirements of physical properties specified in this specification excluding UV Resistance per test method ASTM D 4355. Geotextile product acceptance shall be based on ASTM D4759.
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- .4 Demonstrate to the PCA Representative that field seam made by the proposed method sewing meet the requirements of this specification.
- .5 After placement of backfill on top of the geotextile, excavate test pits as directed by the PCA Representative to allow inspection of the geotextile and seam. The Contractor shall repair any defect and improve the method of construction and/or the seam strength.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver the geotextile in advance to allow time for quality assurance sampling, testing, and re-testing if required.
- .2 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 MATERIAL

- .1 Composed of: minimum 85% by mass of polypropylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.
- .2 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.
- .3 Geotextile to be supplied in rolls.
- .4 Properties
 - .1 Woven Geotextile for Subgrade Separation:

Property	Test Method	Unit	Value
Tensile Strength	ASTM D4632	N	1110
Trapezoidal Tear	ASTM D4533	N	400
Puncture Strength	ASTM D4833	N	450
Mullen Burst	ASTM D3786	kPa	3447

Elongation	ASTM D4632	%	15
AOS	ASTM D4751	mm	0.6
Permittivity	ASTM D4491	sec ⁻¹	0.05
Flow Rate	ASTM D4491	l/min/m ²	160
UV Resistance %	ASTM D4355	500 hrs	70

.2 Nonwoven Geotextile for HDPE Base Liner Cushion Function:

Property	Test Method	Unit	Value
Mass per unit area	ASTM D5261	g/m ²	542
Tensile Strength (any principal direction, wet condition)	ASTM D4632	N	1700
Elongation at Break (any principal direction)	ASTM D4632	%	Min. 50%
Seam Strength	ASTM D4884	%	60
Trapezoidal Tear	ASTM D4533	N	640
CBR Puncture	ASTM D6241	N	4820
AOS	ASTM D4751	mm	0.15
Permittivity	ASTM D4491	sec ⁻¹	0.6
UV Resistance	ASTM D4355	% retained after 500 hrs	70

.5 Geotextile for Final Cover Cushion and Separation Functions

Property	Test Method	Unit	Value
Mass per unit area	ASTM D5261	g/m ²	395
Tensile Strength (any principal direction, wet condition)	ASTM D4632	N	1330
Elongation at Break (any principal direction)	ASTM D4632	%	Min. 50%
Seam Strength	ASTM D4884	%	60
Trapezoidal Tear	ASTM D4533	N	511
CBR Puncture	ASTM D6241	N	3780
AOS	ASTM D4751	mm	0.15
Permittivity	ASTM D4491	sec ⁻¹	1.0

UV Resistance	ASTM D4355	% retained after 500 hrs	70
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Part 3 EXECUTION

3.1 INSTALLATION

- .1 Place geotextile by unrolling onto graded surface of work that was inspected and accepted by the PCA Representative and retain the geotextile in position with sand bags or similar method.
- .2 Place geotextile smooth and free of tension stress, folds, wrinkles and creases.
- .3 Place geotextile on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile where feasible.
- .4 Join successive strips of geotextile by sewing.
- .5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6 Cover geotextile with overlying layer within 24 hours of placement of geotextile unless otherwise agreed by the PCA Representative.
- .7 Replace damaged or deteriorated geotextile to approval of PCA Representative.
- .8 Granular or soil materials on top of geotextile shall be placed in accordance with Specification Section 31 12 10 and 31 12 15.
- .9 Install double layer of geotextile within drainage sump in each cell.

3.2 CLEANING

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

3.3 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

1.1 GENERAL

1.2 SECTION INCLUDES

- .1 Supply and installation of textured high density polyethylene (HDPE) geomembrane in the base liner system of Cell A.
- .2 Supply and installation of textured linear low density polyethylene (LLDPE) geomembrane in the final cover system of Cell A.

1.3 RELATED SECTIONS

- .1 Section 31 12 10 Landfill Construction Requirements.
- .2 Section 31 12 15 Removal of Waste from Old Dump.
- .3 Section 31 32 19.01 Geotextile.
- .4 Section 31 32 19.03 Geosynthetic Clay Liner (GCL).

1.4 REFERENCES

- .1 Society for Testing and Materials International (ASTM)
 - .1 ASTM D1004-09 Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
 - .2 ASTM D1238-10 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
 - .3 ASTM D1505-03 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - .4 ASTM D1603-06 Standard Test Method for Carbon Black Content in Olefin Plastics.
 - .5 ASTM D3895-07 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry.
 - .6 ASTM D4437-08 Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
 - .7 ASTM D4833-07 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - .8 ASTM D5199-01 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
 - .9 ASTM D5397-07 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
 - .10 ASTM D5596-03(2009) Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
 - .11 ASTM D5721-08 Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
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- .12 ASTM D5885-06 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
- .13 ASTM 5994 Test method for measuring the core thickness of Textured Geomembranes.
- .14 ASTM D6392-08 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
- .15 ASTM D6693-04(2010) Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
- .16 ASTM D7002-03 Standard Practice for Leak Location on Exposed Geomembranes Using the Water Puddle System.
- .17 ASTM D7466 Test method for Measuring the asperity Height of Textured Geomembranes.

1.5 SUBMITTALS

- .1 Submittals shall be made in accordance with Section 01 33 00.
- .2 Submit to PCA Representative at least 14 days prior to beginning Work:
 - .1 Name, location, and contact information for qualified and accredited Geosynthetic Quality Assurance Laboratory to be used for independent geomembrane testing.
 - .2 Minimum 2 m length of standard width membrane.
 - .3 Minimum of 1 m seam with at least 300 mm of membrane on both sides of seam.
 - .4 Submit shop drawings in accordance with Section 01 33 00. The shop drawings shall indicate installation layout with field panel and identification code, dimensions and details, including fabricated and field seams, anchor trenches, sealed pipe penetration and protrusion details.
 - .5 Qualifications of Manufacturer.
 - .6 Qualifications of Installer.
 - .7 Qualifications of master seamer and personnel performing seaming operations.
 - .8 Installation schedule, including information such as date of manufacturing, delivery dates, geomembrane installation by location (i.e. Cell number) testing schedule and final walk over.
 - .9 Construction Quality Control Plan.
- .3 Submit to PCA Representative as installation proceeds:
 - .1 Written documentation of the product received including individual roll numbers, square metres of product per roll and total square metres of product in the shipment.
 - .2 Quality control documentation recorded during installation.
 - .3 Sub-base surface acceptance certificates, which certify that the geomembrane installer has inspected the surface of the subgrade and that it conforms to these Specifications, for each area that will be covered directly by geomembrane shall be submitted prior to geomembrane deployment.

.4 Material and Installation Warranty from manufacturer.

.4 Submit to PCA Representative following completion of geomembrane installation:

.1 As-built drawings as specified.

.2 Geomembrane installer's quality control documentation as specified.

.3 Written certification that the geomembrane system has been installed as specified.

1.6 CERTIFICATES

.1 Submit to PCA Representative at least 14 days prior to start of work:

.1 Origin (supplier's name and production plant) and identification (brand name and lot number) of resin used to manufacture geomembrane.

.2 Copies of dated quality control certificates issued by resin supplier.

.3 Results of tests conducted by geomembrane manufacturer to verify that resin used to manufacture geomembrane meets the properties in this Specification.

.4 Statement that amount of reclaimed polymer added to resin during manufacturing does not exceed 2% by weight.

.2 Submit to PCA Representative at least 14 days prior to delivery to job site, including:

.1 Manufacturer's written certification that the geomembrane to be supplied meet all the requirements stated in this Specification.

.2 Quality control certificates, signed by geomembrane manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests. Testing shall be for all parameters listed in this Specification.

.3 Certificate that extrudate to be used is comprised of the same resin as geomembrane to be used.

.3 Results of independent laboratory testing for all parameters listed in this Specification.

.4 Submit to PCA Representative as installation proceeds:

.1 Results of independent laboratory testing of destructive seam samples.

1.7 MANUFACTURER

.1 Manufacturer:

Manufacturer shall have minimum 5 yrs continuous experience in manufacture of textured geomembranes and experience totaling 1,000,000 sq m of manufactured textured geomembranes for minimum of 10 completed facilities.

.2 Installer:

Personnel performing seaming operations shall be qualified by experience or successfully passing seaming tests. Minimum of one seamer shall have experience

seaming a minimum of 200,000 sq m of textured HDPE and 200,000sq m of textured LLDPE geomembrane using the same type of seaming apparatus in use at site.

1.8 QUALITY CONTROL

- .1 Manufacturer and installer shall participate in and conform to items and requirements as outlined in this specification.
 - .2 Tests and inspections performed by geomembrane manufacturer shall at a minimum be in accordance with the requirements in this Specification.
 - .3 Material
 - .1 Independent laboratory test results from membrane rolls intended for use for this project. All parameters listed in this Specification to be tested at a minimum frequency of one set of tests per 1,500 m² membrane.
 - .4 Visual Inspection:
 - .1 PCA Representative will examine seam and non-seam areas of geomembrane for identification of defects, holes, blisters, non-dispersed raw materials, and any sign of contamination by foreign matter.
 - .2 Clean and wash geomembrane surface if PCA Representative determines that amount of dust or mud inhibits examination.
 - .3 Do not seam any geomembrane panels that have not been examined for flaws by PCA Representative.
 - .4 Non-destructively test seams and any non-seam areas identified by PCA Representative.
 - .5 Trial Seams:
 - .1 Make trial seams on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming.
 - .2 Make trial seams at beginning of each seaming period, and at least once each 5 hrs, for each production seaming apparatus used that day. Each seamer shall make at least one trial seam each day.
 - .3 Make trial seams under same conditions as actual seams.
 - .4 Make trial seams only under observation of PCA Representative.
 - .5 Seam overlap shall be as indicated for finished seam.
 - .6 Trial seam sample shall be at least 1.6 m (5 ft) long by 0.3 m (1 ft) wide (after seaming) with seam centered lengthwise.
 - .7 Cut 3 specimens from sample with 25 mm (1 in.) wide die. These specimen locations shall be selected randomly along trial seam sample by PCA Representative. Test specimens in peel using field tensiometer. The results shall meet the shear and peel criteria stated in this Specification.
 - .8 If specimen fails, entire trial seam operation shall be repeated. If additional specimen fails, do not use seaming apparatus and seamer until deficiencies are corrected and 2 consecutive successful trial welds are achieved.
-

.9 Cut remainder of successful trial seam into three pieces; one to be retained in PCA Representative's archives, one to be retained by Contractor, and one to be retained by PCA Representative for possible laboratory destructive seam testing. If required by PCA Representative, remaining portion of trial seam sample may be subjected to destructive testing.

.6 Non-Destructive Seam Testing:

.1 General

- .1 Purpose of non-destructive tests is to check continuity of seams. It will not provide quantitative information on seam strength.
- .2 Non-destructively test field seams over their full length using vacuum test for extrusion seams, air pressure for double-fusion seams or other PCA Representative approved method. Document results.
- .3 Perform non-destructive testing as seaming work progresses.

.2 Vacuum Testing for Extrusion Seam:

- .1 Energize vacuum pump and reduce tank pressure to approximately 35 kPa gauge pressure.
- .2 Wet strip of geomembrane approximately 0.3 m by 1.2 m (12 in. by 48 in.) with soapy solution.
- .3 Place box over wetted area.
- .4 Close bleed valve and open vacuum valve.
- .5 Ensure that leak-tight seal is created. For minimum of 10 sec, apply vacuum and examine geomembrane through viewing window for presence of soap bubbles.
- .6 If no bubbles appear within 10 sec, close vacuum valve and open bleed valve, move box over to next adjoining area with minimum 75 mm (3 in.) overlap and repeat process.
- .7 Mark and repair areas where soap bubbles appear.

.3 Air Pressure Testing for Double-Fusion Seam:

- .1 Seal both ends of seam to be tested.
 - .2 Insert needle or other approved pressure feed device into air channel created by fusion weld.
 - .3 Insert protective cushion between air pump and geomembrane.
 - .4 Pressurize air channel to pressure of approximately 200 kPa (30 psi). Close valve and allow pressure to stabilize for approximately 2 min.
 - .5 Observe air pressure 5 minutes after initial 2 minute stabilization period ends. If pressure loss exceeds Maximum Permissible Pressure Differential or pressure does not stabilize, locate faulty area and repair.
 - .6 Maximum Permissible Pressure Differential After Five Minutes:
 - .1 1.5 mm Material - 20 KPa
 - .7 Cut opposite end of tested seam area once testing is completed to verify continuity of air channel. If air does not escape, locate blockage and retest un-pressurized area. Repair cut end of air channel.
-

- .8 Remove needle or other approved pressure feed device and repair hole in geomembrane.
 - .4 Inaccessible Seams:
 - .1 Cap-strip seams that cannot be non-destructively tested.
 - .2 Cap-strip material shall be composed of same type and thickness geomembrane as geomembrane to be capped.
 - .3 Examine cap-stripping operations with PCA Representative for uniformity and completeness. Document observations.
 - .7 Destructive Seam Testing:
 - .1 General:
 - .1 Purpose of destructive seam testing is to evaluate seam strength.
 - .2 Perform destructive seam test as seaming progresses. Document results.
 - .3 Failed destructive seam sample shall result if grips of testing machine cannot be closed on sample test flap (available flap is 13 mm long or less) due to excessive temporary welding.
 - .2 Location and frequency:
 - .1 Test at minimum frequency of one test location per 150 m (500 ft) of seam length performed by each welding machine. This minimum frequency to be determined as average taken throughout entire facility.
 - .2 Test locations shall be determined during seaming, at PCA Representative's discretion.
 - .3 Contractor will not be informed in advance of locations where seam samples will be taken.
 - .4 PCA Representative reserves right to increase frequency of testing in accordance with performance results of samples previously tested.
 - .3 Sampling Procedures:
 - .1 Cut samples at locations chosen by PCA Representative.
 - .2 PCA Representative shall number each sample and record sample number and location in panel layout drawing.
 - .3 Repair holes in geomembrane resulting from destructive seam sampling immediately in accordance with repair procedures described in this Specification.
 - .4 Continuity of repair and seams shall be tested in accordance with vacuum testing requirements.
 - .4 Sample Dimensions: Take two 25 mm wide samples for field testing prior to cutting full laboratory sample.
 - .1 Field Testing: Cut 25 mm (1 in.) wide samples, 200 mm long with seam centered parallel to width. Distance between these 2 samples shall be 1.1 m(42 in.). Test both samples on field tensiometer in peel. If both samples pass field test, take sample for laboratory testing.
 - .2 Laboratory Testing: Take laboratory test sample from between samples taken for field testing. Cut sample for laboratory testing 0.3 m (12 in.) wide by 1.1 m (42 in.) long with seam centered lengthwise. Cut this sample into three parts. PCA Representative shall distribute parts as follows:
-

- .1 One part to Contractor for optional laboratory testing, 0.3 m by 0.3 m (12 in. by 12 in.).
 - .2 One part to Geosynthetic Quality Assurance Laboratory for testing, 0.3 m by 0.5 m (12 in. by 18in.).
 - .3 One part to PCA Representative for archive storage, 0.3 m by 0.3 m (12 in. by 12 in.).
 - .3 Final determination of sample sizes shall be agreed upon at pre-construction meeting.
 - .4 Submit laboratory sample for quantitative testing.
 - .5 Destructive Test Failure Procedures: When sample fails destructive testing, Contractor has the following options:
 - .1 Repair seam between any 2 passing destructive test locations.
 - .2 Trace welding path to intermediate point 3 m (10 ft) minimum from point of failed test in each direction) and take small sample with 25 mm (1 in.) wide die for an additional field test at each location. If these additional samples pass test, then take full laboratory samples. If these laboratory samples pass tests, repair seam between these locations. If either sample fails, repeat process to establish zone in which seam should be repaired.
 - .3 Acceptable repaired seams shall be bound by 2 locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 50 m(150 ft) of repaired seam, PCA Representative may have Contractor destructive test repair seam.
 - .4 When sample fails, PCA Representative may require additional testing of seams that were welded by same welder and/or welding apparatus during same time shift.
 - .5 Passing laboratory destructive tests of trial seam samples may be used as boundary for failing seam.
 - .8 Repair Verification:
 - .1 PCA Representative shall observe number and log each repair.
 - .2 Nondestructively test each repair.
 - .3 Nondestructive test results that pass shall indicate adequate repair.
 - .4 Repairs more than 50 m long may require destructive test sampling.
 - .5 Failed destructive or nondestructive tests indicate that repair shall be redone and retested until passing test results.
 - .9 Large Wrinkles: Wrinkle is considered to be large when geomembrane can be folded over onto itself.
 - .1 When seaming of geomembrane is completed, and prior to placing overlying materials, PCA Representative shall identify large geomembrane wrinkles which should be cut and resealed.
 - .2 Cut and reseat wrinkles identified by PCA Representative. Seams produced while repairing wrinkles shall be nondestructively tested.
 - .3 Repair wrinkles identified by PCA Representative. Repair during coldest part of installation period.
-

.10 Electrical Leak Detection Survey

- .1 Allow and facilitate the PCA Representative to conduct leak detection survey by a company experienced in electrical leak detection survey. Make good all defects identified by the survey.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Packing and Shipping:

- .1 Manufacturer shall protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site. Each roll delivered to site is to be identified with following:

- .1 Manufacturer's name.
- .2 Product Identification.
- .3 Thickness.
- .4 Roll number.
- .5 Roll dimensions.

.2 Acceptance at Site:

- .1 Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
- .2 Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
- .3 Rolls or portions of rolls without Identification labeling will be rejected and shall be removed from site.

.3 Storage and Protection:

- .1 Contractor will provide on-site storage area for geomembrane rolls from time of delivery until deployment.
- .2 Contractor shall, protect geomembrane from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, rodents, water, and other sources of damage.
- .3 Preserve integrity and readability of geomembrane roll labels.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Fold up metal banding, flatten and place in designated area for recycling.
-

Part 2 PRODUCTS

2.1 MATERIALS

- .1 The 2.0mm (80 mils) textured HDPE geomembrane for the base liner shall have properties meeting or exceeding those requirements listed in the table in this Specification entitled 'Textured HDPE Geomembrane Properties'. The Contractor shall verify the quantity of textured HDPE geomembrane required for the work accounting for overlaps, seaming, repairs, and wastage.
- .2 The 1.0mm (40 mils) textured LLDPE geomembrane for cover system liner shall have properties meeting or exceeding those requirements listed in the table in this Specification entitled 'Textured LLDPE Geomembrane Properties'. The Contractor shall verify the quantity of textured LLDPE geomembrane required for the work accounting for overlaps, seaming, repairs, and wastage.
- .3 Geomembrane shall be manufactured from virgin polyethylene resin designed and manufactured specifically for use in HDPE and LLDPE geomembranes respectively. No post consumer resin of any type shall be used. Use of geomembrane recycled during manufacturing process shall be permitted if recycled geomembrane does not exceed 2% by weight and it is of the same type of material as the geomembrane roll. The virgin resin shall have the following properties:
 - .1 Minimum resin density of 0.932 g/cm³ (ASTM D792, Method B or ASTM D1505).
 - .2 Minimum formulated sheet density of 0.94 g/cm³ (ASTM D792, Method B or ASTM D1505).
 - .3 Maximum Melt Index of 1.0 g/10 min. (ASTM D1238, Condition 190/2.16).
- .4 Geomembrane Characteristics:
 - .1 Supplied in rolls of 6.0 m minimum width.
 - .2 Contain maximum of 1% by weight of additives, fillers or extenders (not including carbon black).
 - .3 No pinholes, bubbles or other surface features that compromise geomembrane integrity. Free of blisters, non-dispersed raw materials, or other signs of contamination by foreign matter.

2.2 SEAMING AND TESTING EQUIPMENT

- .1 Welding:
 - .1 Maintain on-site minimum of 1 spare operable seaming apparatus, unless otherwise agreed upon at pre-construction meeting.
 - .2 Seaming equipment shall not damage geomembrane.
 - .3 Use extrusion welding apparatus equipped with gauges giving temperature of extrudate at nozzle of apparatus.
 - .4 Use fusion-welding apparatus which are self-propelled devices equipped with following:
-

- .5 Gauge indicating temperature of heating element.
- .6 Place electric generator on smooth base such that no damage occurs to geomembrane.

- .2 Vacuum Testing Equipment:
 - .1 Vacuum box assembly consisting of: rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing, porthole or valve assembly, and vacuum gauge.
 - .2 Pump assembly equipped with pressure controller and pipe connections.
 - .3 Pressure/vacuum rubber hose with fittings and connections.
 - .4 Soapy solution to wet test area.
 - .5 Means of applying soapy solution.

- .3 Air Pressure Testing Equipment:
 - .1 Air pump (manual or motor driven), equipped with pressure gauge, capable of generating, sustaining, and measuring pressure between 160 and 240 kPa (24 and 35 psi), and mounted on cushion to protect geomembrane.
 - .2 Rubber hose with fittings and connections.
 - .3 Sharp hollow needle, or other approved pressure feed device.
 - .4 Air pressure monitoring device.

- .4 Tensiometer Testing Equipment:
 - .1 Tensiometer shall be capable of maintaining constant jaw separation rate of 50 mm per min, and shall be calibrated, with certificate of calibration less than 1 year old kept with tensiometer.

Part 3 EXECUTION

3.1 QUALITY CONTROL SAMPLING

- .1 Contractor shall make rolls available and assist PCA Representative in obtaining material inventory and material samples.

- .2 Rolls represented by quality assurance testing shall be rejected if test failure. Contractor may at their expense request additional testing to validate individual rolls. Rolls bracketed by passing tests will be allowed to be deployed and seamed.

3.2 PREPARATION

- .1 Surface Preparation:
 - .1 Contractor is responsible for preparing supporting surface for geomembrane placement. The surface must be smooth, unrutted, undamaged and with no visible stones or foreign materials that may damage the geomembrane.
 - .2 After prepared surface has been accepted in accordance with QAP, report to PCA Representative any change in supporting surface condition that may require repair work. Maintain prepared surface.
-

- .3 Do not place geomembrane onto area which has become softened by precipitation or cracked due to desiccation. Observe and report surface condition daily to evaluate degree of softening and desiccation cracking.
- .4 Repair damage to prepared surface caused by installation activities at Contractor's expense.

3.3 INSTALLATION

.1 Panel Nomenclature:

- .1 Field panel is defined as roll or portion of roll cut and seamed in field, excluding patches and cap strips.
- .2 Identify each field panel with identification code (number or letter-number) consistent with Contractor's layout plan. This identification code shall be agreed upon by the Contractor and PCA Representative.
- .3 Writing on liner with colored markers shall be as follows:
 - .1 Contractor - white marker.
 - .2 PCA Representative – yellow marker.
 - .3 Only authorized personnel shall be permitted to write on liner.

.2 Protection:

- .1 Do not use equipment which damages geomembrane.
- .2 Ensure prepared surface underlying geomembrane has not deteriorated since previous acceptance, and remains acceptable immediately prior to geomembrane deployment.
- .3 Keep Geosynthetic elements immediately underlying geomembrane clean, and free of water, snow and debris.
- .4 Do not permit personnel to smoke or wear shoes that can damage geomembrane while working on geomembrane. Personnel shall not bring glass bottles on geomembrane.
- .5 Unroll panels in manner which does not cause excessive scratches or crimps in geomembrane and does not damage supporting soil.
- .6 Place panels in manner which minimizes wrinkles (especially differential wrinkles between adjacent panels).
- .7 Prevent wind uplift by providing adequate temporary loading and/or anchoring (e.g., sandbags, tires) that shall not damage geomembrane. In case of high winds, continuous loading is recommended along panel edges.
- .8 Protect geomembrane in areas where excessive traffic is expected with geotextiles, extra geomembrane, or other suitable materials.
- .9 Protect installed geomembrane from displacement, damage or deterioration before, during or after placement of material layers.
- .10 Do not permit vehicular traffic directly on geomembrane.

.3 Field Panel Deployment:

- .1 Install field panels at locations indicated on Contractor's layout plan.
- .2 Replace seriously damaged (torn, twisted or crimped) field panels, or portions thereof, at the Contractor's cost. Repair less serious damage as specified. PCA Representative shall determine if material shall be repaired or replaced.

- .3 Remove damaged panels or portions of damaged panels which have been rejected from work area.
 - .4 Do not proceed with deployment at ambient air temperature below 5°C (41°F) or above 40°C (104°F) unless otherwise authorized, in writing, by PCA Representative. Ambient air temperature is to be measured 300 mm above geomembrane. Welding at temperatures lower than 5°C may be undertaken if the contractor can demonstrate that their proposed method is in accordance with GRI Test Method GM9 - "Cold weather Seaming of Geomembranes".
 - .5 Do not deploy during precipitation, in presence of excessive moisture (fog, dew), or in presence of excessive winds.
 - .6 Do not undertake deployment if weather conditions will preclude material seaming on same day as deployment.
 - .7 Do not deploy more geomembrane field panels in one day than can be seamed during that day.
 - .4 Double Layer of HDPE Geomembrane:
 - .1 Install double layer of geomembrane within drainage sump in each cell.
 - .5 Seam Layout:
 - .1 Orient seams parallel to line of maximum slope, i.e., oriented along, not across, slope unless it is not feasible and permitted by PCA Representative.
 - .2 No horizontal seam shall be less than 1.5 m (5 ft) from toe of slope unless it is not feasible and permitted by PCA Representative.
 - .3 In general, maximize lengths of field panels and minimize number of field seams.
 - .4 Align geomembrane panels to have nominal overlap of (75 mm) (3 in.) for extrusion welding and (100 mm to 150 mm) (4 to 6 in.) for fusion welding. Final overlap shall be sufficient to allow peel tests to be performed on seam.
 - .6 Temporary Bonding:
 - .1 Hot air device (Liestar) may be used to temporarily bond geomembrane panels to be extrusion welded.
 - .2 Do not damage geomembrane when temporarily bonding adjacent panels. Apply minimal amount of heat to lightly tack geomembrane panels together. Control temperature of hot air at nozzle of any temporary welding apparatus to prevent damage to geomembrane.
 - .3 Do not use solvent or adhesive.
 - .7 Seaming Methods:
 - .1 Approved processes for field seaming are extrusion fillet welding and fusion welding. Proposed alternate processes shall be documented and submitted to PCA Representative for approval. Alternate procedures shall be used only after being approved in writing by PCA Representative.
 - .2 Seams shall meet the requirements in the table in this Specification entitled 'Minimum Field Seam Properties'.
 - .3 Use double-fusion welding as primary method of seaming adjacent field panels.
-

- .1 For cross seam tees, associated with fusion welding, extrusion weld to minimum distance of 100 mm on each side of tee.
- .2 Place welder on protective pad to prevent geomembrane damage between seaming.
- .3 When sub-grade conditions dictate, use movable protective layer (e.g. extra piece of geomembrane) directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between sheets and prevent debris from collecting around pressure rollers. The movable protective layer shall not be left in place after seaming.
- .4 Use extrusion fillet welding as secondary method for seaming between adjacent panels and as primary method of welding for detail and repair work.
- .5 Purge heat-degraded extrudate from barrel of extruder under following conditions:
 - .1 Prior to beginning seam.
 - .2 Whenever extruder has been inactive.
- .6 Place smooth insulating plate or fabric beneath hot welding apparatus after usage.
- .7 Use clean and dry welding rods or extrudate pellets.
- .8 Complete grinding process without damaging geomembrane within 1 hr of seaming operation.
- .9 Minimize exposed grinding marks adjacent to extrusion weld. Do not allow exposed grinding marks to extend more than 6 mm outside finished seam area.
- .10 Grind perpendicular to seam.
- .8 Seaming Procedures:
 - .1 Seaming shall only be conducted when ambient air temperature is between 5°C and 35°C unless approved by the PCA Representative.
- .9 Seam Repair Procedures
 - .1 Repair portions of geomembrane exhibiting flaw, or failing destructive or non-destructive test.
 - .2 Final decision as to repair procedure shall be determined by the PCA Representative.
 - .3 Acceptable repair procedures include following:
 - .1 Patching: Piece of same geomembrane material extrusion welded into place. Use to repair large holes, tears, non-dispersed raw materials, and contamination by foreign matter.
 - .2 Spot welding or seaming: Bead of molten extrudate placed on flaw. Use to repair, pinholes, or other minor, localized flaws.
 - .3 Capping: Strip of same geomembrane material extrusion welded into place over inadequate seam. Use to repair large lengths of failed seams.
 - .4 Extrusion welding flap: Bead of molten extrudate placed on exposed flap of fusion weld. Use to repair areas of inadequate fusion seams, which have exposed edge. Repairs of this type shall be approved by PCA Representative and shall not exceed 30 m (100 ft) in length.
 - .5 Removal and replacement: Remove bad seam and replace with strip of same geomembrane material welded into place. Use to repair large lengths of failed seams.

- .4 For each repair method:
 - .1 Ensure surfaces are clean, dry, and prepared in accordance with specified seaming process.
 - .2 Ensure seaming equipment used in repairing procedures meet requirements of this Specification.
 - Extend patches or caps at least 150 mm (6 in.) beyond edge of defect.
 - Round corners of patches with radius of approximately 75 mm (3 in.).
- .5 Do not place overlying layers over locations which have been repaired until appropriate acceptable non-destructive and destructive (laboratory) test results are obtained.

Textured HDPE Geomembrane Properties

Properties ⁽¹⁾	Standard	Specifications
1. a) Density of Formulated Sheet b) Thickness c) Asperity Height ⁽²⁾	ASTM D1505 or D792 Method B ASTM D5199 ASTM D7466	0.94 g/cc 80 mil, 2.0 mm (minimum average) 0.40mm
2. Mechanical Properties a) Tensile Properties ⁽³⁾ • Tensile Strength at Yield • Tensile Strength at Break • Elongation at Yield • Elongation at Break b) Puncture Resistance c) Tear Resistance	ASTM D6693 Type IV (33 mm gauge length) (50 mm gauge length) ASTM D4833 ASTM D1004	29 kN/m 40 kN/m 12 % 700 % 434 N 249 N
3. Environmental Properties a) Stress Crack Resistance ⁽⁴⁾ b) Carbon Black Content c) Carbon Black Dispersion d) Oxidative Induction Time, OIT ⁽⁷⁾ a) Standard OIT -----or----- b) High Pressure OIT e) Oven Aging at 85°C, % retained after 90 day ⁽⁷⁾⁽⁸⁾ a) Standard OIT -----or----- b) High Pressure OIT f) UV Resistance ⁽⁹⁾ a) High Pressure OIT, % retained after 1600 hrs. ⁽¹⁰⁾	ASTM D5397 Appendix ASTM D1603 ⁽⁵⁾ ASTM D5596 ASTM D3895 ASTM D5885 ASTM D5721 D 3895 D5885 D5885	500 hours 2% to 3% (See Note 6) 100 min. 400 min. 55% 80% 50%

- Note:
- The average of the test results should be calculated per the respective standard cited and compared to the minimum value listed in the table, unless otherwise specified.
 - The average of the 10 asperity height readings should not be less than the minimum stated in the table. Furthermore, at least 8 of the 10 readings must be greater or equal to 0.18 mm (7 mils), and no reading is less than 0.13 mm (5 mils).
 - In both directions based on 5 test specimens each direction
 - The yield stress used to calculate the applied load for the SP-NCTL test should be the mean value based on the manufacturer's MQC testing or the independent laboratory testing as appropriate.
 - Other methods such as D4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.
 - Carbon black dispersion (only near spherical agglomerates) for 10 different views: at least 9 in Categories 1 or 2 and, no more than 1 in Category 3.
 - Either one of the OIT methods listed may be selected to evaluate the antioxidant content of the geomembrane.
 - The samples should also be evaluated and recorded at 30 and 60 days to compare with the 90 day response.
 - .1 The condition of this test should be 20 hr. UV cycle followed by 4 hr. condensation at 60°C
 - UV resistance is based on percent retained value regardless of the original HP-OIT value.

Textured LLDPE Geomembrane Properties

Properties ⁽¹⁾	Standard	Specifications
1. d) Density of Formulated Sheet e) Thickness f) Asperity Height ⁽²⁾	ASTM D1505 or D792 Method B ASTM D5199 ASTM D7466	0.94 g/cc 40 mil, 1.0 mm (minimum average) 0.40mm
2. Mechanical Properties d) Tensile Properties ⁽⁵⁾ • Tensile Strength at Break • Elongation at Break e) Puncture Resistance f) Tear Resistance	ASTM D6693 Type IV (50 mm gauge length) ASTM D4833 ASTM D1004	11 N/mm 250 % 100 N 200 N
3. Environmental Properties g) Carbon Black Content h) Carbon Black Dispersion i) Oxidative Induction Time, OIT ⁽⁷⁾ b) Standard OIT -----or----- b) High Pressure OIT j) Oven Aging at 85°C, % retained after 90 day ⁽⁷⁾⁽⁸⁾ c) Standard OIT -----or----- d) High Pressure OIT k) UV Resistance ⁽⁹⁾ a) High Pressure OIT, % retained after 1600 hrs. ⁽¹⁰⁾	ASTM D1603 ⁽³⁾ ASTM D5596 ASTM D3895 ASTM D5885 ASTM D5721 D 3895 D5885 D5885	2% to 3% (See Note 6) 100 min. 400 min. 35% 60% 35%

- Note:
- The average of the test results should be calculated per the respective standard cited and compared to the minimum value listed in the table, unless otherwise specified.
 - The average of the 10 asperity height readings should not be less than the minimum stated in the table. Furthermore, at least 8 of the 10 readings must be greater or equal to 0.18 mm (7 mils), and no reading is less than 0.13 mm (5 mils).
 - In both directions based on 5 test specimens each direction
 - The yield stress used to calculate the applied load for the SP-NCTL test should be the mean value based on the manufacturer's MQC testing or the independent laboratory testing as appropriate.
 - Other methods such as D4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.
 - Carbon black dispersion (only near spherical agglomerates) for 10 different views: at least 9 in Categories 1 or 2 and, no more than 1 in Category 3.
 - Either one of the OIT methods listed may be selected to evaluate the antioxidant content of the geomembrane.
 - The samples should also be evaluated and recorded at 30 and 60 days to compare with the 90 day response.
 - .1 The condition of this test should be 20 hr. UV cycle followed by 4 hr. condensation at 60°C
 - UV resistance is based on percent retained value regardless of the original HP-OIT value.

Minimum Field Seam Properties

Property	Method	HDPE Specified Value	LLDPE Specified Value
1. Shear Strength--	ASTM D 6392 (N/25mm)	525	263
2. Shear Elongation at Break	ASTM D 6392 (%)	50	50
3. Peel Strength (hot wedge seams)	ASTM D 6392 (N/25mm)	398	219
4. Peel Strength (extrusion fillet seams)	ASTM D 6392 (N/25mm)	340	190
5. Peel Separation	ASTM D 6392 (%)	25	25

Modifications to ASTM 6392:

1. Value listed for all tests are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.
2. For locus-of-break patterns for peel strength, the following are unacceptable break codes:
 - a. Hot wedge seams: AD and AD-Brk > 25%
 - b. Extrusion Fillet Seams: AD1, AD2 and AD-WLD (unless strength is achieved)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Supply and installation of Geosynthetic Clay Liner (GCL) in the base liner system of Cell A.

1.2 RELATED SECTIONS

- .1 Section 31 12 10 Landfill Construction Requirements.
- .2 Section 31 12 15 Removal of Waste from Old Dump.
- .3 Section 31 32 19.01 Geotextile.
- .4 Section 31 32 19.02 HDPE and LLDPE Geomembrane.

1.3 REFERENCES

- .1 Society for Testing and Materials International (ASTM)
 - .1 ASTM D5261-92(2003), Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.
 - .2 ASTM D5887-09, Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens using a Flexible Wall Permeameter.
 - .3 ASTM D5888-06, Standard Guide for Storage and Handling of Geosynthetic Clay Liners.
 - .4 ASTM D5890-06, Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
 - .5 ASTM D5891-02, Standard Test Method for Fluid Loss of Clay Mineral Component of Geosynthetic Clay Liners.
 - .6 ASTM D5993-99(2004), Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners.
 - .7 ASTM D6072-09, Standard Practice for Obtaining Samples of Geosynthetic Clay Liners.
 - .8 ASTM D6243-09, Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.
 - .9 ASTM D6496-RevA, Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
 - .10 ASTM D6766-09, Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquid.
 - .11 ASTM D6768-04, Tensile Strength of Geosynthetic Clay Liners.
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1.4 SUBMITTALS

- .1 All submittals are to be made to the PCA Representative. Submittals are to be in accordance with Section 01 33 00.
 - .2 28 days or more prior to installation of the GCL:
 - .1 Submit qualifications of the GCL Manufacturer. The GCL manufacturer selected for use on this project shall have successfully produced at least 1,000,000 square metres of needle-punched thermally reinforced GCL.
 - .2 Submit GCL sample to PCA Representative for independent GCL/permeant compatibility conformance test. Sample shall be obtained and packaged in accordance with ASTM D6072. Sample is to be full width by 1 m long.
 - .3 14 days or more prior to installation of the GCL:
 - .1 Submit results of two (2) GCL/permeant compatibility tests as performed under the responsibility of the Contractor.
 - .2 Compatibility test is to be conducted according to ASTM D6766.
 - .3 Permeant for testing is to be produced and have the following chemistry as below:
 - Major ion composition:
 - Calcium, 50 mg/L.
 - Chloride, 10 mg/L.
 - Magnesium, 25 mg/L.
 - Sulphate, 70 mg/L.
 - Sodium, 30 mg/L.
 - Potassium, 4 mg/L.
 - Alkalinity, 190 mg/L.
 - pH, 8.
 - Vertical confining pressure is to be 35 kPa.
 - For conformance, final measured hydraulic conductivity shall be less than 5×10^{-9} cm/s.
 - .4 Submit shop drawings. Indicate installation layout, sequence, dimensions and details, including fabricated and field seams, anchor trenches and protrusion details where applicable. Installation shall generally be from high to low to minimize pre-mature hydration by rain and surface runoff.
 - .5 Submit qualifications of the GCL Installer. The GCL installer shall have successfully installed not less than 200,000 m² of GCL in the last 5 years.
 - .4 14 days prior to delivery of GCL to site:
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- .1 Submit written certification that components and the finished GCL are in compliance with this Specification and including certification of the following:
 - Certification that the GCL production includes continuous inspection for broken needles using full-width metal detector, and removal by hand or in-line full width magnet.
- .2 Two Samples to PCA Representative for Construction Quality Assurance testing. Samples are to be obtained and packaged in accordance with ASTM D6072. Sample is to be full width by 1 m long. The testing shall include, as a minimum, one set of testing per 20,000 m² of the manufactured GCL on bentonite mass per unit area, moisture content, tensile strength, and peel strength, and at least one test on permeability.
- .5 On each delivery of GCL to site:
 - .1 Shipment packing list.
 - .2 Bill of lading.
 - .3 Letter of certification.
 - .4 Roll identification numbers.
 - .5 Physical properties sheet with tests and frequency in accordance with this Specification, signed by the quality control manager.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery, storage and handling of the GCL shall be in accordance with ASTM D 5888 and the manufacturer recommendations.
 - .2 The party responsible for unloading the GCL shall contact the manufacturer prior to shipment to determine the correct unloading methods and equipment if different from the pre-approved and specified methods.
 - .3 GCL delivered to the site shall be free from blisters, undispersed raw material, striations, any physical damage or contamination by foreign matter. Rolls exhibiting damage shall be marked and set aside for closer examination during deployment. Minor rips and tears in the plastic packaging shall be repaired with moisture resistant tape prior to being placed in storage to prevent moisture damage.
 - .4 GCL rolls not indicated on GCL manufacturing quality control certificates will not be accepted.
 - .5 All GCL shall be stock-piled and maintained dry in a flat location area away from high-traffic.
 - .6 Rolls are not to be stored outside on the ground; store on pallets or elevated structures.
 - .7 During delivery and storage, protect the GCL from moisture, direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.
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- .8 GCL shall be stored no higher than three to four rolls high, as recommended by the manufacturer, or limited to the height at which the handling apparatus may be safely handled by installation personnel. Stacks or tiers of rolls shall be situated in a manner that prevents sliding or rolling by "choking" the bottom layer of rolls.
- .9 Rolls shall not be stacked on uneven or discontinuous surfaces in order to prevent bending, deformation, damage to the GCL or cause difficulty inserting the core pipe.
- .10 An additional tarp or plastic sheet shall be used over the stacked rolls to provide extra protection for GCL material stored outdoors.
- .11 Bagged bentonite material shall be stored and tarped next to GCL rolls unless other more protective measures are available. Bags shall be stored on pallets or other suitably dry surface to prevent pre-hydration.
- .12 The presence of free-flowing water within the packaging shall be cause for rejection of that roll.
- .13 Each roll is to be clearly marked with the following information:
 - .1 Manufacturer.
 - .2 Product type and width of roll.
 - .3 Total weight of roll.
 - .4 Type of GCL material.
 - .5 Production Lot Number and individual Roll Number.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan
- .3 Fold up metal banding, flatten and place in designated area for recycling

Part 2 PRODUCTS

2.1 MATERIALS

- .1 The GCL product supplied to the project shall be in full accordance with the requirements of the table in this Specification entitled 'Geosynthetic Clay Liner Properties'.
 - .2 The GCL is to be needle-punched thermally reinforced and comprise of a uniform layer of granular sodium bentonite encapsulated between 2 non-woven geotextiles. The top layer is a
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staple fiber non-woven geotextile while the bottom layer is a scrim reinforced nonwoven geotextile. The needle-punched fibres are thermally fused to the scrim reinforced non-woven geotextile to enhance the reinforcing bond.

- .3 No glues, adhesives or other non-mechanical bonding processes shall be used in lieu of the needle-punch process.
- .4 The minimum acceptable dimensions for the GCL panels shall be 4.7 m wide and 45 m long unless smaller dimensions are agreed to by the PCA Representative.
- .5 A 300 mm overlap line and a 375 mm match line shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable, waterproof, non-toxic ink.
- .6 The separate components and finished GCL shall comply with the properties, test methods and testing frequencies given in this Specification. Material which does not comply will be replaced at the Contractor's expense.

Part 3 EXECUTION

3.1 SUBGRADE CONDITIONS

- .1 Maintain area of installation free of water and snow accumulation.
 - .2 Replace soft and wet supporting materials.
 - .3 Sub-grade Preparation - The finish of the sub-grade materials to be prepared and made suitable for the placement of GCL material.
 - .4 The surface upon which the GCL material will be installed shall be inspected and certified by the Contractor and the PCA Representative to be in accordance with the requirements of this specification.
 - .5 Site specific compaction requirements shall be followed in accordance with the project drawings and specification of the subgrade materials where applicable. Equipment used in the handling and installation of GCL shall not damage the subgrade.
 - .6 The subgrade surfaces shall be smooth and free of any debris, vegetation, roots, sticks, sharp rocks, or other deleterious materials larger than 50 mm as well as free of any voids, large cracks of standing water or ice.
 - .7 Directly prior to deployment of the GCL, the sub-grade shall be final-graded to fill remaining voids or desiccation cracks, and proof-rolled to eliminate sharp irregularities or abrupt elevation changes. The surfaces to be lined shall be maintained in this smooth condition.
 - .8 The sub-grade shall be inspected by the PCA Representative prior to GCL placement.
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- .9 Subsequent to the PCA Representative's approval, it shall be the Contractor's responsibility to indicate to the PCA Representative any change in the sub-grade condition that could cause it to be out of compliance with any of the requirements of this section or the project specification.

3.2 GCL HANDLING

- .1 GCL shall be supported during handling to ensure worker safety and prevent damage to the liner. Under no circumstances shall the rolls be dragged, lifted from one end, lifted with only the forks of a lift truck or pushed to the ground from the delivery vehicle.
- .2 The Contractor shall verify that proper handling equipment will be used. The equipment shall not pose any danger to installation personnel or risk of damage or deformation to the liner material itself. Provided that it is demonstrated to be suitable, handling equipment may include, but not limited to, the following:
- .1 Spreader Bar Assembly - A spreader bar assembly shall include both a core pipe or bar and a spreader bar beam.
- .2 Stinger - a stinger is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment. If a stinger is used, it should be fully inserted to its full length into the roll to prevent excessive bending of the roll when lifted.
- .3 Roller Cradles - Roller cradles consist of two large diameter rollers spaced approximately 75mm apart which both support the GCL roll and allow it to freely unroll. The use of roller cradles shall be permitted if the rollers support the entire width of the GCL roll.
- .4 Straps - Straps may be used to support the ends of spreader bars but are not recommended as the primary support mechanism. As straps may damage the GCL where strapped around the roll and generally do not provide sufficient uniform support to prevent roll bending or deformation, great care must be exercised when this option is used.

3.3 INSTALLATION

- .1 GCL Placement - GCL shall be placed in general accordance with the shop drawings and procedures specified below, or modified to account for site specific conditions.
- .1 Where possible, all slope panels shall be installed parallel to the maximum slope while panels installed in flat areas require no particular orientation.
- .2 The GCL may be deployed on slopes by pulling the material from a suspended roll, or securing a roll end into an anchor trench and unrolling each panel as the handling equipment slowly moves backwards.
- .3 Deployment on flat areas shall be conducted in the same manner as that for the slopes, however, care should be taken to minimize "dragging" the GCL. Slip-sheet may be used to facilitate positioning of the liner while ensuring the GCL is not damaged from underlying sources.
- .4 The contractor shall only install as much GCL that can be covered at the end of the day. No GCL shall be installed when rain is anticipated before the GCL can be covered and protected adequately.
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- .5 Trimming of the GCL shall be done with great care such that fugitive clay particles do not come into contact with drainage materials.
 - .2 Joining - Adjacent GCL are to be joined by overlapping according to the following:
 - .1 Installers are to overlap GCL edges such that the minimum overlap guideline is covered and match line is not covered, thus ensuring a minimum of 300 mm overlap.
 - .2 Overlap seams shall be a minimum of 600 mm on panel ends.
 - .3 Loose granular bentonite should be placed between panels at a rate of 0.40 kg/m of seam.
 - .4 Overlaps shall be free of wrinkles, folds or "fish-mouths".
 - .5 GCL ends should be overlapped such that the upstream GCL is over the downstream GCL at the overlap (i.e. "shingled").
 - .3 Damage Repair - Prior to cover material placement, damage to the GCL shall be identified and repaired by the Contractor. Damage is defined as any rips or tears in the geotextiles, delamination of geotextiles or a displaced panel.
 - .1 Rip and Tear Repair (Flat Surfaces) – Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place), with a minimum overlap of 300 mm on all edges.
 - .2 Accessory bentonite shall be placed between the patch edges and the repaired material at a rate of 0.4 kg/m of edge spread in a continuous 150 mm fillet.
 - .3 Rip and Tear Repair (Slopes) - Damaged GCL material on slopes shall be repaired by the same procedures above; however, the edges of the patch shall also be adhered to the repaired liner with an adhesive to keep the patch in position during backfill or cover operations.
 - .4 Panels - Displaced panels shall be adjusted to the correct position or orientation. The adjusted panel shall then be inspected for any geotextile damage or bentonite loss. Damage shall be repaired by the above procedure.
 - .5 Premature Hydration - If the GCL is prematurely hydrated, Contractor shall notify the PCA Representative for a site specific determination as to whether the material is acceptable.
 - .6 Covering:
 - .1 GCL shall not be covered until it has been inspected by the PCA Representative.
 - .2 GCL shall be covered in a timely manner to reduce the potential for damage due to unconfined hydration of the GCL. It is essential that GCL installation be rapidly followed by installation of the geomembrane, geotextiles, and granular drainage layer.
 - .3 The cover materials shall be placed such that both the GCL and the underlying subgrade are not damaged.
 - .4 No GCL shall be left exposed overnight.
 - .5 The GCL shall be covered before a rainfall or snow event occurs.
 - .6 The uncovered edge of GCL panels shall be protected at the end of the working day with a waterproof sheet which is secured adequately with ballast.
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- .7 Protect installed liner from displacement, damage or deterioration before, during and after placement of material layers.

GEOSYNTHETIC CLAY LINER PROPERTIES

Geosynthetic Clay Liner Properties	Test Method	Minimum Test Frequency	Required Value
Geotextile			
Cap – Nonwoven Mass per Unit Area	ASTM D5261	20,000 sq. m	200 g/m ² MARV ₁
Carrier - Scrim Nonwoven Mass per Unit Area	ASTM D5261	20,000 sq. m	240 g/m ² MARV ₁
Bentonite Properties			
Swell Index	ASTM D5890	50,000 kg	24 ml/2g min.
Fluid Loss	ASTM D5891	50,000 kg	18 ml max.
Moisture Content	ASTM D4643	50,000 kg	12% max.
Finished GCL Properties			
Bentonite Mass Per Unit Area ₂	ASTM D5993	4,000 sq. m	3.7 kg/m ² MARV
Moisture Content	ASTM D5993	4,000 sq. m	35% max.
Tensile strength, (machine direction)	ASTM D6768	4,000 sq. m	7.8 kN/m MARV
Peel Strength	ASTM D6496	4,000 sq. m	610 N/m MARV
Permeability ₃	ASTM D5887	25,000 sq. m	5 x 10 ⁻¹¹ m/s max
GCL Durability Permeability (35 kPa) ₄	ASTM D6766	Yearly	1 x 10 ⁻⁸ m/s max
GCL Durability Permeability (500 kPa) ₄	ASTM D6766 (mod)	Yearly	5 x 10 ⁻¹⁰ m/s max
Internal Shear Strength ₅	ASTM D6243	Periodic	24 kPa Typical

Notes:

1. MARV = Minimum average roll value.
2. Mass of bentonite is measured after oven drying per the stated method.
3. Permeability to be tested under an effective confining stress of 35 kPa and hydraulic gradient of 20 using deionized water.
4. Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g CaCl₂ in 1 litre water); for termination see GRI-GCL3.
5. Typical peak value for specimen hydrated for 24 hours and sheared under a 9.6 kPa normal stress.

END OF SECTION