Notice of Alteration Form

Manitoba

File No. : 3851.00	Environment Act Licence No. : 2177 E R5

Legal name of the Licensee: Waste Connections of Canada Inc.

Name of the development: Prairie Green Integrated Waste Management Facility

Category and Type of development per Classes of Development Regulation:

Waste Treatment and Storage — Class 1 Waste Disposal Grounds

Licensee Contact Person: Chris Visser, P. Eng, Canadian Region Engineering Manager

Mailing address of the Licensee: 10-116E Prairie Green Road

City: Winnipeg Province: MB Postal Code: R3C 2E6

Phone Number: (647) 539-5923 Fax: Email: chris.visser@wasteconnections.com

Name of proponent contact person for purposes of the environmental assessment (e.g. consultant):

Fiona Scurrah, M.Sc., R.P. Bio., P. Biol. of WSP Canada Inc.

Phone: (431) 482-2925 Fax:	Mailing address: 6 High Level Road, Oak Bluff, MB R2G 0E2

Email address: fiona.scurrah@wsp.com

Short Description of Alteration *(max 90 characters):*

Proposed Design Change to the Humanitarian Search Facility Pad

Alteration fee attached: Yes: ☐ No: ☐

If No, please explain: Waived.

Date: 2024-08-09	Signature: [redacted] Printed name:

A complete Notice of Alteration **(NoA)** consists of the following components:

- ☐ **Cover letter**
- ☑ **Notice of Alteration Form**
- ☑ **1 electronic copy of the NoA detailed report** (see "Information Bulletin - Alteration to Developments with Environment Act Licences")
- ☐ **$500 Application fee, if applicable** (Cheque, payable to the Minister of Finance)

Submit the complete NoA to:
Director, Environmental Approvals Branch
Environment and Climate Change
Box 35, 14 Fultz Blvd
Winnipeg MB R3Y 0L6
EABDirector@gov.mb.ca

For more information:
Toll-Free: 1-800-282-8069
Phone: 204-945-8321 Fax: 204-945-5229
https://www.gov.mb.ca/sd/permits_licenses_approvals/eal/ licence/index.html

Note: Per Section 14(3) of the Environment Act, Major Notices of Alteration must be filed through submission of an Environment Act Proposal Form (see "Information Bulletin – Environment Act Proposal Report Guidelines")

August 9, 2024

Ms. Agnes Wittman

Director, Environmental Approvals Branch
Manitoba Environment and Climate Change
Box 35, 14 Fultz Boulevard
Winnipeg, MB R3Y 0L6

Subject: **Notice of Alteration: *Environment Act* Licence 2177 E R5 Proposed Design Change to the Humanitarian Search Facility Pad**
Manitoba File No.: 3851.00

Dear Ms. Wittman:

On June 4, 2024, Waste Connections Canada Inc. (WCC) submitted a Notice of Alteration (NoA) associated with *Environment Act* Licence (EAL) No. 2177 E R5, in relation the Humanitarian Search Project at the Prairie Green Integrated Waste Management Facility (the Facility), located in the Rural Municipality of Rosser (RM of Rosser), Manitoba. The NoA consisted of the Design and Operations (D&O) Report, which outlined how the search facility would be designed and operated. The D&O Report provided a design for the search facility area pad, which has since undergone design changes. The intent of this NoA application is to provide Manitoba Environment and Climate Change (MECC) with a description of the proposed changes related to the design for the search facility area pad liner, the search facility area overall footprint and ancillary items related to construction activities for the search facility area pad.

The leachate management in the search facility area pad and the search operations as outlined in the D&O Report are not expected to change as a result of the changes to the search facility area pad design.

WSP Canada Inc., (WSP) has been retained by WCC to submit this NoA on their behalf.

1. PROPONENT CONTACT INFORMATION

Project Name	**NoA Prairie Green Integrated Waste Management Facility – Search Facility Area Pad**
Name of Proponent	Waste Connections Canada Inc.
Address of Proponent	10-116E Prairie Green Road, Winnipeg, MB R3C 2E6
Contact Information for the NoA	Chris Visser, P. Eng. Canadian Regional Engineering Manager Phone: (647) 539-5923 Email: chris.visser@wasteconnections.com

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2. SEARCH FACILITY AREA PAD FOOTPRINT

As noted in the D&O Report, the search facility area pad footprint was to be determined at the detailed design stage. The proposed search facility area pad as outlined in the attached drawings consists of two (2) Phases. The area delineated as Phase 1 will be the location of the search facility, while Phase 2 is not part of the proposed scope of work for which approval is requested under this NoA.

The Phase 1 footprint including the search facility area pad and the leachate pond to the north is approximately 4 hectares.

3. SEARCH FACILITY PAD DESIGN

Within the original D&O Report, the search facility pad was to be comprised of the following components:

- a compacted clay subgrade levelling layer to achieve design grades;
- a 0.6 m thick compacted clay liner (CCL); and
- a 0.8 to 0.95 m thick layer of granular material.

An asphalt floor was to be placed on top of the granular base inside the search facility.

Surface water run-off was to be directed to the north and the south of the search facility pad and collected into ponds completed with the following liner on the base and side slopes:

- a 0.6 m thick CCL; and
- a 0.5 m thick compacted clay layer.

Clause 18 of the NoA as approved on 11 June 2024 outlines the specifications with respect to the search facility clay liner components:

> *18. The licensee must construct and maintain all clay-lined component(s) of the search facility with the following specifications:*
>
> *a) the clay liner of the search facility base is compacted to a minimum thickness of 0.6 metres and covered with a clay layer of 0.5 metres; and*
>
> *b) the hydraulic conductivity of the clay liner is $1x10^{-7}$ cm/s or less.*

As the project has progressed, with consideration for the additional 0.5 m thick compacted clay layer over the entire search facility pad, it has been determined that there would be a large quantity of clay material required to be imported to the facility for the levelling layer, the CCL and the compacted clay layer. The volume of these components was calculated to be approximately 134,000 m^3. Concerns have been raised regarding finding a borrow source that would have material of suitable quality and quantity to construct the individual layers. In addition, since the location of the borrow source had not been identified, the costs related to hauling the clay material to the site could not be determined but were considered to be significant.

Due to the volume of clay material required, and the developing schedule for the project, it was determined that there may not be sufficient time with suitable weather conditions to allow for proper conditioning and compaction of the CCL. As a result, an alternative design of a synthetic liner with a reduced construction schedule is being proposed, which is outlined in the section that follows.

The search facility area pad is now proposed to include a high-density polyethylene (HDPE) geomembrane liner. This proposed HDPE geomembrane liner will replace the CCL outlined in the D&O Report. With the

proposed liner design changes, a CCL is no longer applicable and WCC will not be able to conform to Clause 18 from the 11 June NoA approval.

The Design Drawings for the proposed design and the HDPE geomembrane specifications are attached to this application.

SYNTHETIC LINER DESIGN

Following discussions with MECC on 24 July 2024 and on 7 August 2024, WCC is proposing the following design changes to the search facility area pad liner design:

- levelling layer consisting of 100 mm crushed rock to achieve design grades (minimum 0.3 m thickness);
- heavy weight non-woven geotextile cushion;
- smooth 1.5 mm (60 mil) thick HDPE geomembrane;
- 0.3 m thick sand cushion layer;
- woven geotextile separator; and
- a 0.5 to 0.65 m thick layer of 100 mm crushed rock fill.

Asphalt will be placed in the area of the search facility building only.

The HDPE geomembrane material will meet current industry standards for manufacture and in particular will meet the requirements of the Geosynthetic Research Institute (GRI) specification GM-13 for geomembranes. Other aspects of its construction will include:

a) the liner will be constructed from HDPE geomembrane;

b) the liner will have a nominal thickness of 1.5 mm (60 mil);

c) all sections of the liner will be joined by dual track seaming with extrusion welding used for detail work and any repairs;

d) the liner will be installed over the base and interior side slopes of perimeter berms;

e) the liner will be installed following the ASAE Standard EP340.2 for the installation of Flexible Membrane Linings;

f) non-destructive test methods will be used to test the integrity of:

   i. all field seams joining liner sections following the ASTM Standard D 5820-95 (Reapproved 2006); and

   ii. all other field seams following ASTM Standard D 4437-99;

g) the liner will be secured to prevent lifting of the liner by placement of the cushion sand layer and crushed rock fill above; and

h) Within 60 days of completion of the liner construction, a CQA report will be submitted to MECC . The CQA report will include a cover letter with a declaration that the liner is a continuous underlying component and installation of the liner was done under the supervision of a qualified professional. The CQA report will include the test results, a discussion of the results, and a declaration that the liner was installed following the manufacturer's requirements.

SURFACE WATER AND LEACHATE MANAGEMENT

Consistent with the original design approved in the D&O Report, surface water run-off will be directed to the north end of the search facility area pad Phase 1 and collected into the search facility area pond. This pond was designed with a storage capacity to contain two 1:100-year rainfall runoff events with a 0.3 m freeboard. It is assumed the search facility area pad run-off could be impacted by leachate, and a pond liner system is therefore proposed. The liner system for the pond will consist of:

- prepared subgrade;
- Geosynthetic Clay Liner (GCL) on the base and side slopes;
- textured 1.5 mm (60 mil) textured HDPE geomembrane above the GCL on the base and side slopes;
- 0.3 m thick sand cushion;
- woven geotextile separator; and
- 0.8 m thick layer of 100 mm crushed rock fill.

As noted in the D&O Report (June 2024), it is assumed the contents of the search facility area pond will be impacted by leachate, unless determined otherwise through laboratory analysis. Water collected in the ponds will be temporarily stored to allow evaporation unless pond target or maximum design levels are reached. When water level reaches the target or maximum levels, and it is determined through laboratory analysis the water is impacted by leachate, the pond will be pumped out by WCC's on site tanker truck and hauled to the City of Winnipeg's Wastewater Treatment Plant for disposal under an existing disposal agreement (discharge permit is valid until 2026).

To mitigate potential damage to the search facility area pond liner system and prevent pond aggregate from being pulled into the hose intake during pond water removal operations, the hose will be attached to a floating dock and suspended in the water column to ensure the intake is not in contact with the bottom of the pond. This practice is currently employed by WCC for the existing Leachate Pond 1. In addition, a pipe intake screen will be installed on the suction hose to further reduce the potential for pond aggregate to be inadvertently pumped out during the draining of the ponds.

4. GAS VENTING REQUIREMENT ASSESSMENT

The design considered potential liner uplifting associated with gas buildup under the liner, and the requirement to install a gas venting system. It was determined that a gas venting system for the proposed liner is not required for the following reasons:

- The potential for gas buildup associated with leakage of leachate is low because the organic mass that may accumulate under the liner will be relatively low;
- Since there is no waste fill under the liner, and no subsurface migration of landfill gas emanating from the landfill area in the search facility area pad, there will not be an upward gas gradient related to solid waste generated landfill gas;
- In the unlike event or gas buildup under the liner, there is sufficient ballast to counterweight the gas pressure. The ballast load was estimated at about 20 Kpa above the pond liner and 16 Kpa above the search facility area pad liner; this ballast load is sufficient to control any liner heave caused by the gas pressure buildup; and

- The granular layer underneath the liner and berms will serve as a continuous gas drainage layer that will vent gas.

5. TEMPORARY CONSTRUCTION ACCESS

In anticipation of the construction activities for the search facility pad, there may be a need to construct a temporary construction access road into the Facility . This temporary construction access road would be required in order to minimize disruptions to the Facility's waste acceptance and disposal operations in light of the anticipated volume of construction truck traffic. As part of the consideration for construction of a proposed temporary construction access, the RM of Rosser will be contacted to determine the size of any road crossing culverts that might be required at the proposed access point, as well as obtain permission from the RM of Rosser for the construction of this temporary access point. The temporary construction access point will include a lockable gate as part of the existing Facility perimeter fencing to ensure no unauthorized access occurs. Once the construction of the search facility pad has been completed, this temporary construction access road, gate and any culverts will be decommissioned, and the area restored to original conditions.

6. EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS

WSP has reviewed the proposed changes to the search facility design. These proposed changes do not change the environmental aspects that were identified in the D&O Report. As noted in the D&O Report, there are mitigation strategies and monitoring programs currently in place at the Facility and these will continue as part of the Facility operations.

As noted in the D&O Report, the potential for encountering asbestos during the excavation of material from the cells is considered low and WCC has an asbestos management plan in place in the event that the operators encounter bags containing asbestos or remnants of asbestos containing materials. This process is outlined in Appendix E of the D&O Report. The likelihood of asbestos containing materials being placed in the search facility is considered low, however it is noted that there will be an asbestos monitoring and management plan developed for work being conducted inside the search facility. In addition to the use of appropriate PPE (e.g., respirator, Tyvek suit) by the searchers, and other mitigation strategies, such as air sampling within the search facility, will be undertaken on a regular basis to determine if there are contaminants such as asbestos fibres being released during the search activities.

Given the above, and that the alterations as described are minor in scope, environmental impacts would be deemed insignificant.

7. CLOSING

Should you have any questions regarding this submission, please contact Barry Blue, Waste Connections Canada at chris.visser@wasteconnections.com or (647) 539-5923 and/or Fiona Scurrah at Fiona.scurrah@wsp.com or (431)482-2925 at your convenience.

Kind Regards,

WSP Canada Inc.

[redacted]

Fiona Scurrah, M.Sc., R.P. Bio., P. Biol.
Project Manager
Senior Principal Environmental Scientist

[redacted]

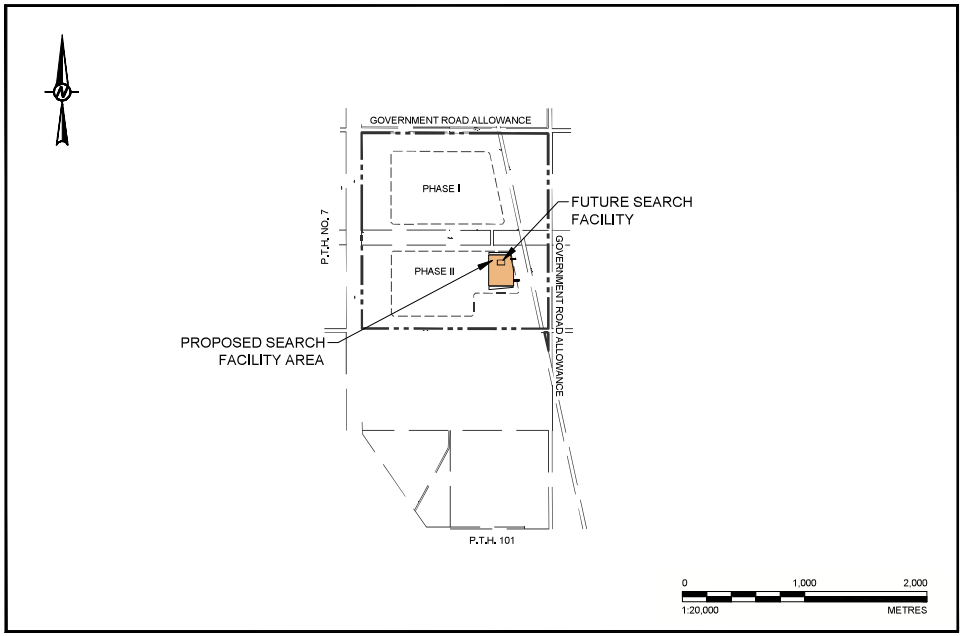
Fabiano Gondim, M. Eng., P. Eng.
Senior Waste Engineer

Copy to: Chris Visser, P. Eng., Canadian Region Engineering Manager, WCC
Barry Blue, District Manager, WCC
Laurel Hoffarth, P. Eng., PMP, Region Engineer, WCC

Encl. Design Drawings
HDPE Geomembrane Specifications

WASTE CONNECTIONS OF CANADA INC.

SEARCH FACILITY AREA CONSTRUCTION - PHASE 1
PRAIRIE GREEN INTEGRATED WASTE MANAGEMENT FACILITY
RURAL MUNICIPALITY OF ROSSER, MANITOBA



SHEET LIST TABLE	
SHEET NUMBER	SHEET TITLE
1	COVER PAGE
2	GENERAL SITE PLAN AND PROPOSED SEARCH FACILITY AREA
3	NOT USED
4	NOT USED
5	SITE PLAN FOR THE SEARCH FACILITY AREA
6	SECTIONS A-A' AND B-B' FOR THE SEARCH FACILITY AREA AND ACCESS ROAD DETAIL
7	LINER DETAILS
8	NOT USED
9	GENERAL SITE PLAN - QUONSET

NOT FOR CONSTRUCTION

PRELIMINARY

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
C	20024-08-07	ISSUED FOR EAB APPROVAL	FRG	WS	FRG	FSB
B	2024-07-19	ISSUED FOR BID	FRG	WS	FRG	FSB
A	2024-07-18	ISSUED FOR CLIENT REVIEW	FRG	WS	FRG	FSB

SEAL

PROVINCE OF MANITOBA
August 12, 2024
F.R. GONDIM
Member
[redacted]
REGISTERED PROFESSIONAL ENGINEER

CLIENT
WASTE CONNECTIONS OF CANADA INC.

CONSULTANT
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WSP Canada Inc.
6925 Century Avenue, Suite #600
Mississauga, Ontario
Canada
wsp.com

PROJECT
SEARCH FACILITY AREA CONSTRUCTION - PHASE 1
PRAIRIE GREEN INTEGRATED WASTE MANAGEMENT FACILITY
WINNIPEG, MANITOBA

TITLE
COVER PAGE

PROJECT NO.	CONTROL	REV.	of	DRAWING
CA0039180.5749	0001	C		1

LEGEND

- PROPERTY LIMITS
- APPROVED SITE BOUNDART
- APPROVED LIMITS OF WASTE
- CELL DIVIDE
- EXISTING GRAVEL ROAD
- EXISTING PAVED ROAD
- EXISTING RAILWAY (CPR)
- EXISTING FENCING
- EXISTING DRAINAGE DITCH
- EXISTING WATER BODY
- EXISTING TREE LINE
- EXISTING MONITORING WELL LOCATION (GOLDER ASSOCIATES, 1994)
- EXISTING GROUND SURFACE CONTOUR (INTERVAL 1.0 masl)
- FUTURE ROAD
- 1 PHASE I AND II CELL ID
- CPT-26 EXISTING GEODETIC CONTROL POINTS (CPT)
- APPROXIMATE PHASE 1 CONSTRUCTION LIMIT

NOTE(S)

1. PROJECTION IS LOCAL SITE COORDINATE SYSTEM.

REFERENCE(S)

1. EXISTING GROUND SURFACE, DATED MAY 11, 2024 BY CANADIAN UAV SURVEY.
2. GROUND FEATURES DATED MAY 08, 2021 BY THE BASE MAPPING CO. LTD.

GEODETIC CONTROL POINT

CPT NO.	NORTHING (m)	EASTING (m)	ELEVATION (masl)
25	12302.202	12406.277	232.627
26	12955.452	12266.259	232.619
28	12299.139	12069.919	232.937
29	12286.631	11129.633	234.123
30	13090.732	11130.736	233.414
31	12996.690	11892.251	233.084

NOT FOR CONSTRUCTION

PRELIMINARY

0 200 400

1:4,000 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
C	2024-08-07	ISSUED FOR EAB APPROVAL	FRG	WS	FRG	FSB
B	2024-07-19	ISSUED FOR BID	FRG	WS	FRG	FSB
A	2024-07-18	ISSUED FOR CLIENT REVIEW	FRG	WS	FRG	FSB

SEAL

PROVINCE OF MANITOBA — August 12, 2024 — F.R. GONDIM — Member — [redacted] — REGISTERED PROFESSIONAL ENGINEER

CLIENT

WASTE CONNECTIONS OF CANADA INC.

CONSULTANT

wsp

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Mississauga, Ontario
Canada
wsp.com

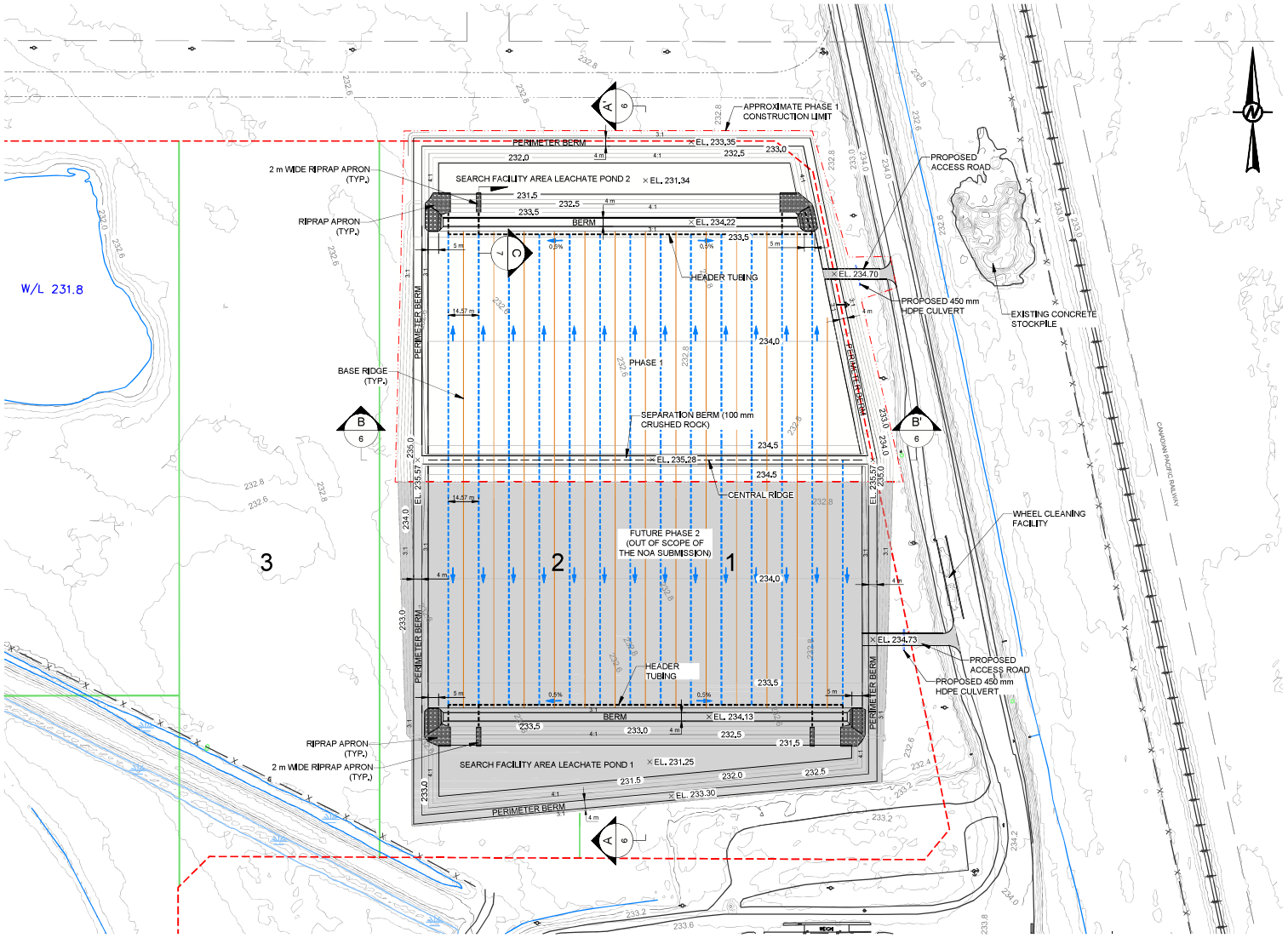
PROJECT

SEARCH FACILITY AREA CONSTRUCTION - PHASE 1
PRAIRIE GREEN INTEGRATED WASTE MANAGEMENT FACILITY
WINNIPEG, MANITOBA

TITLE

GENERAL SITE PLAN AND PROPOSED SEARCH FACILITY AREA

PROJECT NO.	CONTROL	REV.	of	DRAWING
CA0039180.5749	0001	C		2



LEGEND

- PROPERTY LIMITS
- APPROVED SITE BOUNDART
- APPROVED LIMITS OF WASTE
- CELL DIVIDE
- EXISTING GRAVEL ROAD
- EXISTING PAVED ROAD
- EXISTING RAILWAY (CPR)
- EXISTING FENCING
- EXISTING DRAINAGE DITCH
- EXISTING WATER BODY
- EXISTING TREE LINE
- EXISTING GROUND SURFACE CONTOUR (INTERVAL 0.2 masl)
- EXISTING HYDRO POLE
- EXISTING CULVERT
- EXISTING HYDRO POLE AND GUY WIRE
- FUTURE ROAD
- 1 — PHASE II CELL ID
- PROPOSED 100 mm DIA. PERFORATED HDPE TUBING WRAPPED IN NONWOVEN GEOTEXTILE FILTER
- PROPOSED 250 MM DIA. PERFORATED HDPE TUBING WRAPPED IN NONWOVEN GEOTEXTILE FILTER
- DRAINAGE FLOW DIRECTION
- DESIGN FINISHED CONTOURS

NOTE(S)

1. PROJECTION IS LOCAL SITE COORDINATE SYSTEM.

REFERENCE(S)

1. TOPOGRAPHIC BASE PLAN FROM 9 cm GROUND SAMPLING DISTANCE, DATED MAY 08, 2021 BY THE BASE MAPPING CO. LTD.
2. APPROVED WASTE LIMITS AND PROPERTY LIMITS FROM FIGURE 2 - 2018 FISCAL PLANNING MODEL PREPARED BY DILLON CONSULTING.

NOT FOR CONSTRUCTION

PRELIMINARY

0 50 100

1:1,000 METRES

C	2024-08-07	ISSUED FOR EAB APPROVAL	FRG	WS	FRG	FSB
B	2024-07-19	ISSUED FOR BID	FRG	WS	FRG	FSB
A	2024-07-18	ISSUED FOR CLIENT REVIEW	FRG	WS	FRG	FSB

PROVINCE OF MANITOBA — August 12, 2024 — F.R. GONDIM — Member [redacted] — REGISTERED PROFESSIONAL ENGINEER

WASTE CONNECTIONS OF CANADA INC.

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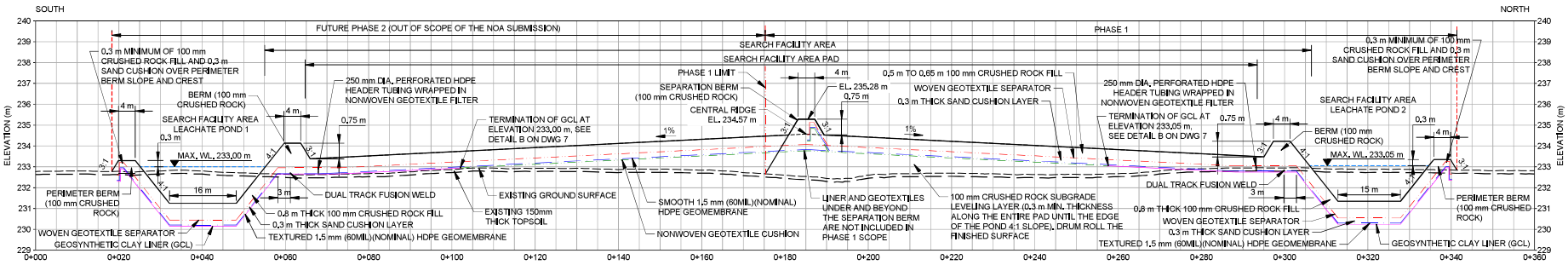
SEARCH FACILITY AREA CONSTRUCTION - PHASE 1
PRAIRIE GREEN INTEGRATED WASTE MANAGEMENT FACILITY
WINNIPEG, MANITOBA

SITE PLAN FOR THE SEARCH FACILITY AREA

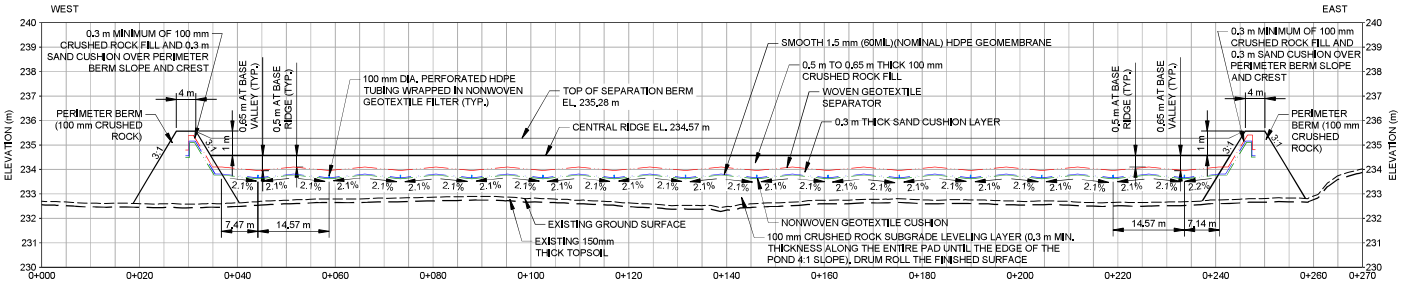
CONTROL: CA0039180.5749 0001 C

DRAWING: 5



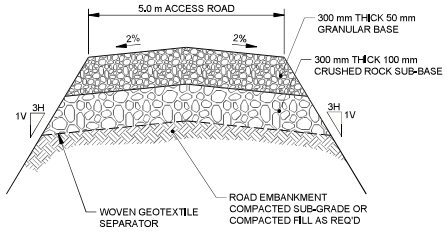
SCALE 1:500 m
V. E.=5X

A 5 SECTION A-A'



SCALE 1:500 m
V. E.=5X

B 5 SECTION B-B'



ACCESS ROAD DETAIL
SCALE N.T.S.

NOTE(S)

1. SYNTHETIC MATERIALS SHOWN EXAGGERATED FOR CLARITY.
2. ANCHOR ALL SYNTHETIC MATERIALS IN ANCHOR TRENCH.

NOT FOR CONSTRUCTION

PRELIMINARY

HOR. 0 20 40
1:500 METRES

VER. 0 5 10
1:100 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
D	2024-08-07	ISSUED FOR EAB APPROVAL	FRG	WS	FRG	FSB
C	2024-07-25	BID ADDENDUM No. 1	FRG	WS	FRG	FSB
B	2024-07-19	ISSUED FOR BID	FRG	WS	FRG	FSB
A	2024-07-18	ISSUED FOR CLIENT REVIEW	FRG	WS	FRG	FSB

SEAL

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PROJECT
SEARCH FACILITY AREA CONSTRUCTION - PHASE 1
PRAIRIE GREEN INTEGRATED WASTE MANAGEMENT FACILITY
WINNIPEG, MANITOBA

TITLE
SECTIONS A-A' AND B-B' FOR THE SEARCH FACILITY AREA AND ACCESS ROAD DETAIL

PROJECT NO.	CONTROL	REV.	of	DRAWING
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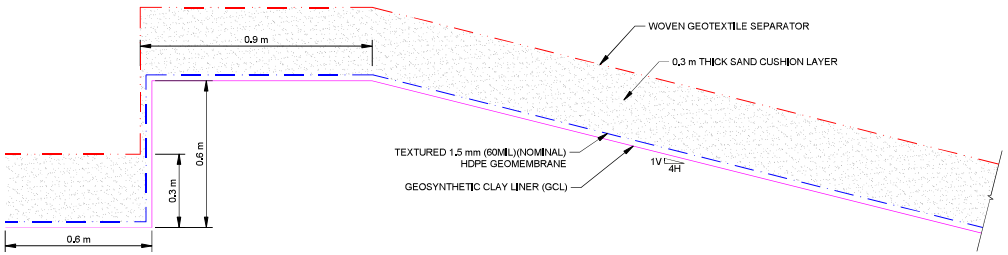
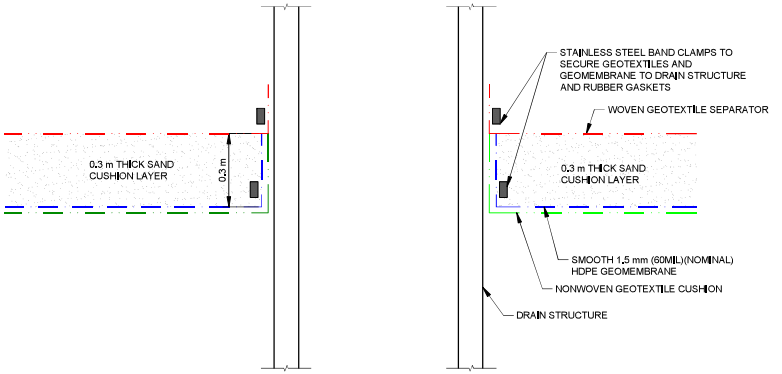
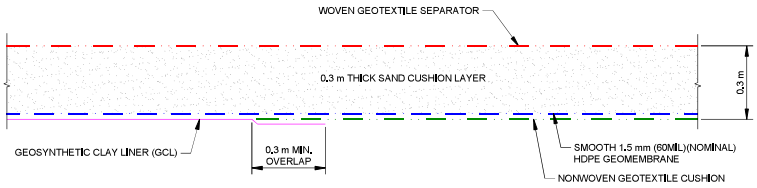


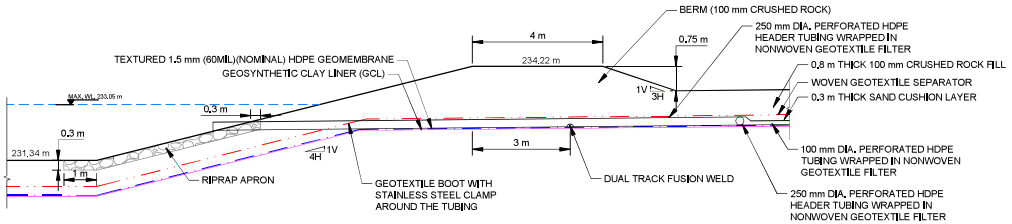
SCALE 1:10 m A 6 PERIMETER BERM ANCHOR TRENCH DETAIL



SCALE 1:10 m C 6 GEOMEMBRANE LINER TERMINATION AT DRAIN STRUCTURE DETAIL



SCALE 1:10 m B 6 GCL LINER TERMINATION DETAIL



SCALE 1:75 m C 5 SECTION C-C' SHOWING TUBING OUTLET DETAIL

NOTE(S)
1. SYNTHETIC MATERIALS SHOWN EXAGGERATED FOR CLARITY.
2. ANCHOR ALL SYNTHETIC MATERIALS IN ANCHOR TRENCH.

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PRELIMINARY

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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SEAL

PROVINCE OF MANITOBA — August 12, 2024 — F.R. GONDIM — Member [redacted] — REGISTERED PROFESSIONAL ENGINEER

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PROJECT
SEARCH FACILITY AREA CONSTRUCTION - PHASE 1
PRAIRIE GREEN INTEGRATED WASTE MANAGEMENT FACILITY
WINNIPEG, MANITOBA

TITLE
LINER DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
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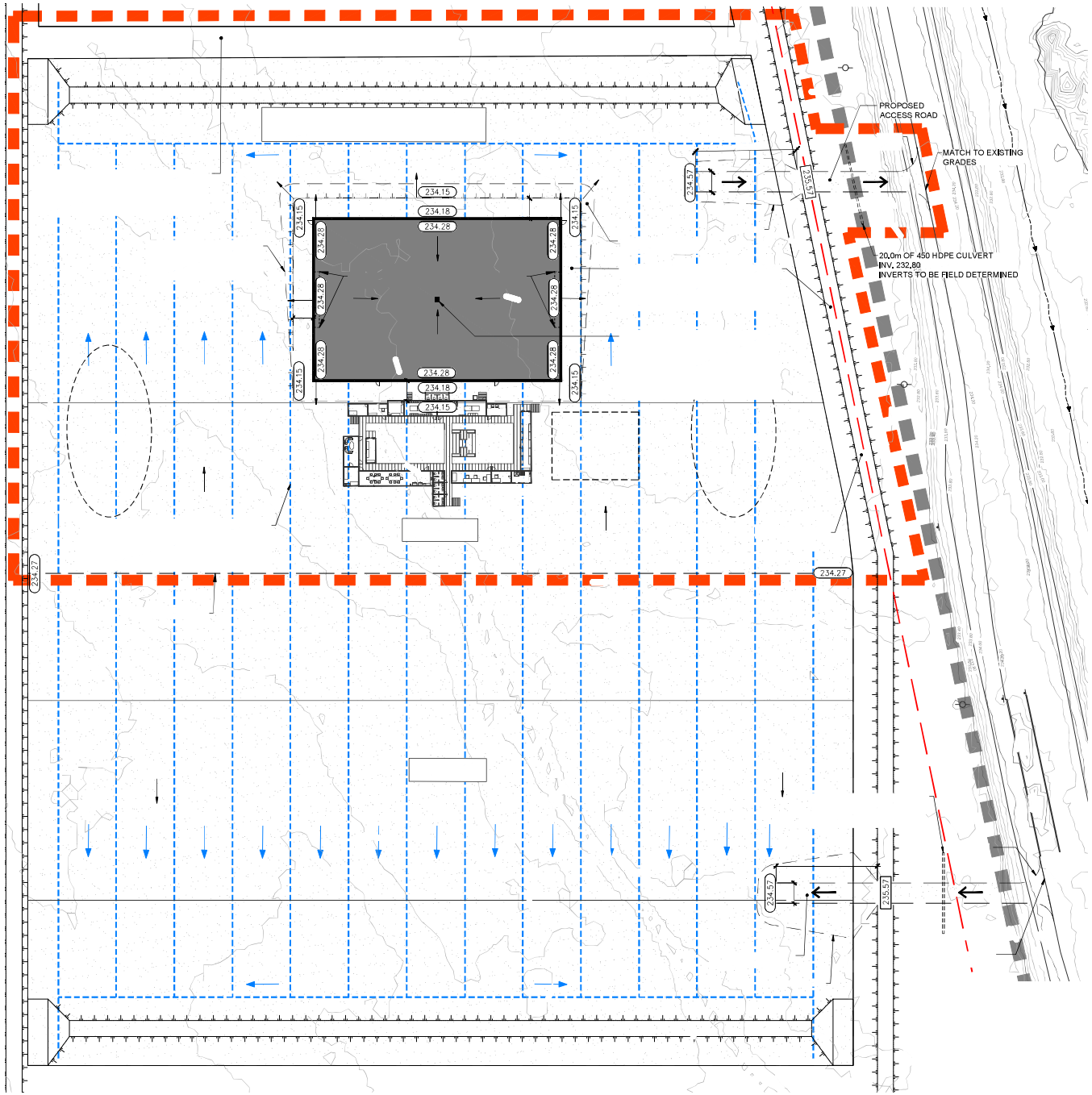

LEGEND

- APPROVED SITE BOUNDARY
- APPROVED LIMITS OF WASTE
- EXISTING GRAVEL ROAD
- PROPOSED GRAVEL ROAD
- EXISTING PAVED ROAD
- EXISTING DRAINAGE DITCH
- EXISTING GROUND SURFACE CONTOUR (INTERVAL 0.2 msd)
- EXISTING HYDRO POLE
- EXISTING CULVERT
- PROPOSED CULVERT
- EXISTING HYDRO POLE AND GUY WIRE
- 1 — PHASE II CELL ID
- PROPOSED 100 mm DIA. PERFORATED HDPE TUBING WRAPPED IN NONWOVEN GEOTEXTILE FILTER
- DRAINAGE FLOW DIRECTION
- GRAVEL
- ASPHALT
- 000.00 — PROPOSED PAVEMENT ELEVATION
- 000.00 — PROPOSED LOT ELEVATION
- PROPOSED FLOW DIRECTION
- TRAFFIC FLOW DIRECTION
- PROPOSED CB

NOTE(S)

1. PROJECTION IS LOCAL SITE COORDINATE SYSTEM.

METRIC

WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

ENGINEERS GEOSCIENTISTS MANITOBA
Certificate of Authorization
WSP Canada Inc.
No. 5750

REFERENCE(S)

1. EXISTING GROUND SURFACE, DATED MAY 11, 2024 BY CANADIAN UAV SURVEY.

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI

PART 1 – GENERAL

1.1 Description

.1 These specifications describe the requirements for the manufacture, supply, and installation of 1.5 mm (60 mil) smooth High Density Polyethylene (HDPE) geomembrane over the base area of the Search Facility Pad and 1.5 mm (60 mil) thick double sided textured HDPE geomembrane over the side slope areas of the Ponds, including quality control requirements that have to be met for both the raw materials and manufactured product.

1.2 Related Work

.1 Section 06 - Geosynthetic Clay Liner

1.3 Definitions

.1 Owner:

The term Owner means the Owner or his authorized agent or representative as designated in the Contract in writing, but does not include the Construction Quality Assurance (CQA) Consultant.

.2 CQA Consultant:

The term CQA Consultant means the independent third party inspector or inspector's firm/company responsible for assuring that the works are carried out in general accordance and compliance with the Contract Documents, Technical Specifications and Construction Drawings. The CQA Consultant will be appointed by the Owner.

.3 Contractor:

The term Contractor means the Geosynthetics Installer or his authorized representative as designated to the Owner in writing. The Contractor is ultimately responsible for the work carried out by his subcontractors. The Contractor is responsible for manufacture, supply, delivery, installation, quality control, and quality assurance of all materials specified in this contract, and all other items incidental to the works.

.4 Subcontractor:

The term Subcontractor means having direct contact with the Contractor to perform a part or parts of the Work, or to supply products worked to a special design according to the Contract Documents, and may include the Geomembrane Manufacturer, the Geomembrane Supplier, and/or the Geomembrane Installer.

.5 "Extrusion Weld" means a bond between two high density polyethylene (HDPE) materials, which is achieved by extruding a bead of HDPE over the leading edge of the seam between the upper and lower sheet using a hand-held apparatus.

.6 "Fusion Weld" means a bond between two high density polyethylene (HDPE) materials which is achieved by fusing both HDPE surfaces in a homogeneous bond of the two surfaces using a power driven apparatus capable of heating and compressing the overlapped portions of the geomembrane sheets.

.7 "HDPE Geomembrane" or "Geomembrane" means a relatively impermeable thin sheet of high density polyethylene used as a barrier liner or cover to prevent liquid or vapour migration into or from liquid or solid waste storage facilities.

.8 "Textured Geomembrane" means a geomembrane with roughened, high friction surfaces created by co-extrusion, impingement, lamination, or other methods commonly employed by the Industry.

.9 "Geomembranes" means smooth membrane and textured geomembrane.

1.4 Reference Standards

.1 Latest version of the Geosynthetic Research Institute (GRI) Standard Specifications:

a) GRI GM 9, Cold Weather Seaming of Geomembranes.

b) GM 10, Specification for the Stress Crack Resistance of Geomembrane Sheet.

c) GM 11, Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation

Exposure Device.

d) GM 12, Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage.

e) GM 13, Test Methods, Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

f) GRI GM 14, Test Frequencies for Destructive Seam Testing.

g) GRI GM 17, Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.

h) GRI GM 19a, Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers.

.2 Latest version of the American Society of Agricultural and Biological Engineers (ASAE) Standard:

a) ASAE EP 340.2, Installation of Flexible Membrane Linings

.3 Latest version of the American Society for Testing and Materials (ASTM) Standards:

a) A) ASTM D 792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

b) ASTM D 1004, Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

c) ASTM D 1238, Test Method for Flow Rates of Thermoplastics by Extrusion Plastomer.

d) ASTM D 1505, Test Method for Density of Plastics by the Density-Gradient Technique.

e) ASTM D 1603, Test Method for Carbon Black in Olefin Plastics.

f) ASTM D 3895, Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.

g) ASTM D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

h) ASTM D 5199, Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

i) ASTM D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.

j) ASTM D 5596, Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.

k) ASTM D 5721, Practice for Air-Oven Aging of Polyolefin Geomembranes.

l) ASTM D 5820, Standard Practice for Air Channel Evaluation of Dual Seamed Geomembranes.

m) ASTM D 5885, Test method for Oxidative Induction Time of Polyolefin Geomembranes by High Pressure Differential Scanning Calorimetry.

n) ASTM D 5994, Test Method for Measuring the Core Thickness of Textured Geomembranes.

o) ASTM D 6370, Standard Test Method for Rubber-Compositional Analysis by Thermogravimetry (TGA).

p) ASTM D 6392, Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

q) ASTM D 6693, Standard Test Method for Determining Tensile Properties of Non-reinforced Polyethylene and Non-reinforced Flexible Polypropylene Geomembranes.

r) ASTM D 7238, Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

s) ASTM D 7466, Standard Test Method for Measuring the Asperity Height of Textured Geomembrane.

1.5 **Geomembrane Manufacturer, Supplier, and Contractor Qualifications**

.1 Geomembrane Manufacturer, Supplier, and Contractor may be separate companies or a single company.

.2 Company (companies) shall be recognized, well established firm(s) with proven ability with HDPE geomembrane.

.3 Company (companies) to provide all quality control certification required by these specifications.

.4 Contractor to provide detailed resumes of previous projects completed within the last five (5) years installing HDPE geomembrane. If installation is to be carried out by a subcontractor, include this information from the subcontractor also.

.5 Provide information regarding corporate background, manufacturing, and/or installation capabilities and quality control procedures.

.6 Manufacture shall have at least five years of experience with over 1,000,0000 m^2 in manufactured product over those five years. Installer must be approved by Manufacturer have at least three years of experience with over 500,000 m^2 of geomembrane installed over 10+ projects in the last three years. The supervisor must have over 500,000 m^2 of supervision or installation experience over 10 projects. A detailed résumé of the proposed Master Seamer is required with the bid submission.

.7 The work must be performed by a Qualified Geomembrane Installer.

.8 At least one “Master-Seamer” shall be pre-qualified. All seaming shall be performed under the direct supervision of the “Master-Seamer.” The “Master-Seamer” shall be an experienced employee having seamed similar material to that specified (using the equipment proposed for this project) totaling at least 300,000 square metres of installed material.

1.6 **Quality Control Certificates**

.1 At least two (2) weeks prior to delivery of materials to job site, furnish the Engineer and CQA Consultant with copies of quality control certificates as detailed below. Failure to do so may result in rejection of materials.

.1 Manufacturer:

a) Origin of resin, brand name, number, and production date.

b) Certificate that all resin used in the manufacture of the geomembrane for this project complies with the requirements specified.

c) Quality Control certificates issued by the resin supplier.

d) Quality Control certificates and certification that the geomembrane supplied complies with the project requirements specified.

e) Certification that the geomembrane and extrudate rod have the same properties.

1.7 **Shop Drawings**

.1 At least two (2) weeks prior to placement of geomembrane, provide shop drawings identifying proposed placement pattern, roll numbers, and field seam locations for approval by CQA Consultant. Provide reproducible copy of approved shop drawings.

.2 Provide shop drawings for sealing of pipe penetrations and appurtenances through the geomembrane for approval by CQA Consultant.

1.8 **Material Warranty**

.1 The Manufacturer shall provide a written warranty for the membrane against manufacturing defects for a period of twenty (20) years from the date of installation.

1.9 **Guarantee**

.1 The Installer shall guarantee the HDPE membrane against defects in installation and workmanship for a period of five (5) years from the date of final acceptance.

1.10 **Storage**

.1 Protect HDPE geomembrane from direct sunlight, excessive heat, mud, debris, dust, and deformation.

PART 2 –PRODUCTS

2.1 **Raw Materials**

.1 Geomembrane shall be unsupported High Density Polyethylene (HDPE) manufactured from virgin first-quality polyethylene resin designed and manufactured specifically for use in HDPE geomembrane.

.2 Reclaimed polymer or reprocessed geomembrane shall not be added to the virgin resin, however, the use of edge trimmings recycled during the manufacturing process of the same batch of geomembrane is permitted if recycled polymer does not exceed 10 percent by weight. No post-consumer resin of any type shall be added to the formulation.

.3 Resin raw material specifications are:

.1 Minimum Specific Gravity (ASTM D792 Method B or ASTM D1505): 0.932 g/ml.

.2 Maximum Melt Index (ASTM D1238, Condition 190/2.16): 1.0 g/10 min.

.4 Manufacturer's certificates must be provided to the owner, including a certification that the geomembrane and welding rod supplied for the project are made from the same material type and are compatible.

2.2 **Manufactured Geomembrane**

.1 Material specifications to meet or exceed those listed in Tables 1 and 2.

.2 HDPE Geomembrane to consist of smooth and textured sheets containing no plasticizers, chemical additives, fillers, or extenders, excluding the carbon black content as specified in Tables 1 (smooth geomembrane) and 2 (double-sided textured geomembrane).

.3 The values listed in Tables 1 and 2 are to be interpreted according to the designated test method.

.4 Textured HDPE geomembrane to be manufactured by extrusion or impingement of the texturing onto both sides of the sheet, such that the texturing is additional to the nominal thickness of the sheet specified. The texturing to be consistent throughout the same roll and among rolls.

.5 Geomembrane to be free of pinholes, blisters, undispersed raw material, striations, roughness, or any sign of contamination by foreign matter.

.6 Rolls to be minimum 6.5 m in width consisting of a continuous width seamless panel. Minimum length to be Manufacturer's standard length for the specified thickness and such that seaming requirements are minimized.

.7 Each roll to be clearly marked on the roll with the following information:

.1 Manufacturer Name.

.2 Product Type/ID Thickness.

.3 Resin Lot Number.

.4 Roll Number.

.5 Roll Dimensions.

.6 Roll Weight.

.8 Failure to label each roll with the above information shall be cause for rejection.

2.3 **Extrudate Rod and/or Bead**

.1 The manufacturer will supply a certification that the geomembrane and welding rod supplied for the project are made from the same material type and are compatible.

PART 3 – EXECUTION

3.1 Resin

.1 Contractor to test each batch of resin to verify raw material consistently meets or exceeds specified requirements given in Item 2.1 of this Specification. Failure to meet specifications shall be cause for rejection.

3.2 Geomembrane

.1 Contractor to provide written certification and supporting documentation/test results to Engineer that all raw materials used to manufacture geomembrane and extrudate rod and/or bead meet or exceed all specifications as shown in Tables 1 and 2 for Engineer's review and satisfaction prior to delivery of manufactured materials to the site.

.2 Geomembrane failing to meet requirements of these specifications shall be rejected.

.3 Contractor to perform a minimum of one complete set of quality control tests on geomembrane rolls at the frequencies given in Tables 1 and 2 to verify that all other specified parameters are in compliance with the material specifications.

.4 Test samples which fail to meet strength and environmental specifications shall result in rejection of applicable rolls. Conduct further testing on geomembrane manufactured from same resin batch to determine acceptability.

.5 Contractor to provide written certification to Engineer, for review and acceptance, confirming required quality control has been done and certifying quality of the geomembrane, prior to delivering to job site. Quality control certificate required for each batch of resin and each production shift. Certificate to include:

- .1 Product Identification
- .2 Roll Numbers
- .3 Sampling Procedures
- .4 Test Methods
- .5 Test Results (as per Table 1 and 2)
- .6 Signature of Responsible Party

.6 The Engineer may also request that all production line records be submitted for review.

.7 Owner and/or Engineer shall have authority to visit manufacturing facility at any time to witness production and quality control testing, examine production records, and to take independent samples. Contractor/Manufacturer to extend full cooperation in this regard.

3.3 Construction Sequence

.1 Coordinate the geosynthetic installation (GCL, HDPE geomembrane, Geocomposite) with the Earthworks Contractor to ensure smooth transfer of responsibilities between earthworks and geosynthetics contracts and operations.

.2 Be responsible for the condition of the prepared subgrade and surface of the compacted soil liner once these surfaces have been accepted from the Earthworks Contractor. Once this has been accepted by the Geosynthetics Installer, it will be their responsibility to maintain the tie-in until the geomembrane work is complete and the area has been accepted by the owner.

.3 Be responsible for the condition of the geosynthetic materials until these installations have been accepted by the Earthworks Contractor or Owner.

3.4 Installation

.1 Geomembrane to be delivered to the site with each roll clearly identified on two separate locations on the roll as specified, for verification prior to installation. Extensively damaged rolls shall be rejected and replaced.

.2 Prior to installation, Contractor to inspect the subgrade and provide written certification to the CQA Consultant stating the prepared surface is suitable for membrane installation.

.3 Placement of geomembrane to be done in accordance with sequence on approved shop drawings, and as may be revised on-site, with the approval of the CQA Consultant, to suit field conditions.

.4 On slopes steeper than 10 percent, all seams shall be oriented down slope and not across the slope. No horizontal seams shall occur less than 1.5 m (and preferably 3 m) from the crest or toe of such slopes.

.5 Install panels so overlaps are primarily downstream and downwind. Install panels to eliminate the alignment of butt seams of successively joined panels; butt seams should be offset a minimum of 500 mm after production welding, as directed by CQA Consultant. Install panels so that seams in collection areas or depressions are minimized and preferably eliminated.

.6 Equipment used to handle and weld the geomembrane shall not cause any damage to the geomembrane or on the subgrade due to handling, trafficking, leakage of hydrocarbons, or an other means. All damage of soils to be corrected to CQA Consultant's satisfaction prior to geomembrane deployment.

.7 Personnel shall not engage in activities or wear footwear which could damage the geomembrane. Smoking will not be permitted on the liner.

.8 Apart from approved welding equipment, no mechanical equipment shall be allowed on the geomembrane unless approved by CQA Consultant.

.9 Place panels in such a way as to minimize scratches, crimps, and other damage to material. Minimize wrinkles and "fishmouths" along seams.

.10 Do not deploy geomembrane panels if moisture prevents proper placement or seaming.

.11 Do not allow geomembrane to "bridge over" voids or low areas in the subgrade. Repair subgrade if required and place geomembrane such that it rests on the subgrade surface.

.12 At the end of each day or installation segment, all unseamed edges shall be anchored by rope, sand bags, or other approved device. Sandbags securing the geomembrane on the side slopes should be connected by rope fastened at the top of the slope section by a temporary anchor. Staples, U-shaped rods, or other penetrating anchors shall not be used to secure the geomembrane. Any damage to the liner or to accepted liner subgrade due to inclement weather shall be the sole responsibility of the Contractor, defined in Section 1.3.3.

.13 Any panel or part thereof which becomes seriously damaged shall be replaced at no additional cost to the Owner. Such damaged panels shall be removed from the site immediately. Minor damage such as crimps, wrinkles, etc., shall be repaired as described in this Section.

.14 Contractor to provide site protection as required to prevent bird and/or animal attack on the geomembrane.

3.5 Seaming

.1 Seams and Joints:

.1 Contractor to provide proposed method of performing seaming and joining operations including details of equipment to be used.

.2 Seam to have Minimum Bonded Seam Shear and Peel Adhesion Strengths (force per unit width at yield) as given in these Specifications in Table 3.

.2 Materials and Equipment:

.1 Only methods and equipment previously approved by the CQA Consultant may be used. Approved seaming methods are extrusion welding for patching and double wedge fusion welding for general seaming.

.2 All geomembrane seams to be welded.

.3 Seaming shall primarily be performed using automatic fusion welding equipment and techniques and extrusion welding when fusion welding is not possible, such as at pipe penetrations, patches, repairs, and short (less than a roll width) runs of seams.

.4 Seaming to be a continuous operation along entire seam with a minimum number of interruptions along any given seam.

.5 At least one operable spare welding unit for each seaming method shall be on-site at all times.

.6 Artificially induced cooling of welded seams is not allowed.

.7 Extrusion welding equipment to be equipped with gauges indicating barrel and nozzle temperatures. Alternatively, provisions shall be made to measure extrudate temperatures using a portable pyrometer at predetermined intervals. Extruder to be purged of all heat degraded extrudate prior to commencement of each seaming sequence.

.8 Fusion welder to be equipped with gauges which indicate applicable temperatures and speeds during welding.

.3 Overlap and Preparation:

.1 Minimum overlap to be 75 mm (3 inches) for extrusion welding and 125 mm (5 inches) for fusion welding.

.2 Sufficient overlap must be provided on both sides of the double fusion weld to allow for destructive testing in accordance with the specified ASTM procedures.

.3 If hot air leisters are used to provide temporary bonding, no damage to geomembrane will be permitted. If, upon visual inspection or destructive testing techniques damage is noted, it will be repaired to the satisfaction of the CQA Consultant.

.4 Align seams to provide minimum wrinkles and “fishmouths.” Seam area to be free of dirt, dust, moisture, debris, or any other foreign matter.

.5 Grinding required along a seam shall be done concurrent with or within ten minutes of the seaming operation. The top and bottom edge of cross-seams shall be ground to a smooth transition prior to seaming. If grinding is required along seam, do so according to Manufacturer’s recommendations, but abrasive buffing to be performed using No. 80 grit or finer sandpaper.

.4 Climatic Conditions

.1 Seaming procedures described in this Section relate to ambient temperatures between 5□C and 40□C. Do not perform seaming when ambient temperatures are greater than 40°C or material temperatures are greater than 75°C.

.2 Welding may be permitted below 5°C subject to approval of CQA Consultant and if seam is protected, to prevent excessive cooling from wind or other adverse conditions. Procedures such as controlled preheating of the seam area may be required. Such work will be subject to an extended trial seam testing program under the same ambient temperature and procedures, including preheating, as the production seams. Additional destructive testing may also be taken at the discretion of the CQA Consultant.

.3 Do not place geomembrane under conditions of rain or snow or in the presence of excessive fog or dew.

.4 Keep seam areas clean, dry, and sheltered from wind if required, during seaming operation.

.5 Generally seaming should not be performed when material temperatures below 0°C.

.5 Test Seams:

.1 Each seamer and his welding unit shall produce a test seam at the start of each shift, when the temperature falls to 2oC, has fallen by 5oC since the last test seam, after equipment breakdown, or after 5 hours of continuous seaming. If a seamer is required to use a different welding unit, new test seams will be required prior to seaming operations with each new unit.

.2 Test seems to be made on piece of geomembrane identical to that being installed. Sample to measure 1 m long by 0.3 m wide with the seam centred lengthwise and overlapped as specified. Test seam welding to be carried out under ambient conditions that replicate actual field conditions.

.3 Six adjoining 25 mm wide specimens from the test seam sample shall be tested each in shear and in peel using a field tensiometer. The sample shall not fail in the seam. If a seam fails, a second seam shall be produced and tested. A second failure shall result in rejection of either the seamer and/or equipment until the deficiency has been corrected. This shall be verified by the production and successful testing of two consecutive test seams.

.6 Non-destructive Testing

.1 All seems to be subject to non-destructive testing for their full length. Perform non-destructive testing concurrently using equipment and methods approved by the CQA Consultant.

.2 Provide all equipment and manpower required for non-destructive testing. All testing to be witnessed by CQA Consultant. Notice is to be given to the CQA Consultant of locations and number of non-destructive testing crews on a daily basis.

.3 Repair and test again any seam failing a test.

.4 Cap seams which cannot be subjected to a non-destructive test using geomembrane of the same batch under the supervision of the CQA Consultant. Test the cap seams. Alternatively, remove the seam and adjacent geomembrane panel, replace and test. The method of remediation shall be directed by the CQA Consultant.

.5 At least one spare operable testing unit shall remain on-site at all times.

.6 All extrusion welds shall be subjected to vacuum box testing. Once a tight seal is established, maintain pressure at between approximately 21 and 35 kPa for a minimum of 10 to 15 seconds to observe whether bubbling of the soapy solution occurs. Continue process for entire seam length with a 75 mm overlap between successive test sections.

.7 All defects to be clearly marked for repair. Ensure that all repairs and associated testing is complete prior to requesting final checking by the CQA Consultant.

.8 When double fusion seaming method is used, air pressure testing in accordance with ASTM D5820 is to be employed. Central air channel to be pressurized to at least 210 kPa (30 psi) after a 2 minute stabilization period. A pressure gauge shall be used at one end of channel. Maximum pressure drop at either end not to exceed 21 kPa (3 psi) over five-minute period or seam will be rejected.

.9 Faulty seams to be repaired and retested. Holes created for pressure testing to be sealed on completion of test. If a seam or section of seam cannot be air pressure tested, either removal of the seam or reconstruction by extrusion fillet welding of the seam overlap and vacuum box testing of the reinstated seam length will be considered acceptable.

.7 Destructive Testing:

.1 Destructive seam testing to be performed concurrently with seaming.

.2 Samples to be taken for testing at a frequency of one sample per 150 m of seam. This frequency may be adjusted up during the course of the project based on destructive test results, seaming conditions, and general contractor performance. However, frequency will not be less than one sample per 300 lineal metres of seam. Locations to be predetermined by CQA Consultant, however, Contractor shall not be informed of preselected locations.

.3 Testing frequency may be increased by CQA Consultant if there is reason to suspect the presence of excess crystallinity, contamination, offset welds, or any other potential defect. Poor test results may also result in an increased testing frequency.

.4 Samples to be cut by Contractor under direction of CQA Consultant. Each sample to be numbered and its location recorded by the CQA Consultant on the shop drawings.

.5 Each sample to be 0.3 m wide by 1.2 m long with the seam centred lengthwise. One 25 mm wide sample to be taken from each end for shear and peel testing by Contractor. Seam shall not fail in either

test.

.6 Remainder of sample to be cut into three equal portions: one for the Contractor, one for the CQA Consultant, one for the Owner. Results of field laboratory tensiometer testing by CQA Consultant shall determine acceptability. In case of disputes, samples shall be sent to the Geosynthetics CQA Laboratory for confirmation verification testing and the results shall determine acceptability.

.7 The CQA Consultant shall cut and test ten (10) 25 mm wide replicate specimens from his sample and shall test five (5) specimens for seam shear strength and five (5) for peel strength. To be acceptable, four out of the five (5) replicate specimens must pass for each mode of testing. All specimens must fail in Film Tear Bond (FTB); any specimen that fails through the weld, or by adhesion at the weld- sheet interface, is a non-film Tear Bond break and shall be considered a failure.

.8 The test method and procedures to be used by the CQA Consultant shall employ a grip separation rate of 50 mm/minute for peel and shear.

.9 Area of test strip to be repaired as described in this Section. All seams created by repair to be non-destructively tested.

.8 Acceptance of Seams:

.1 A seam shall be considered acceptable only when it is bounded by two destructive test locations which meet the specified criteria.

.2 A double hot wedge fusion seam shall be considered acceptable only when both outside and inside track welds are destructively tested and meet the specification criteria.

.3 If a seam fails the destructive test, the seam shall be repaired between the two nearest passed locations on both side of the failed destructive sample location.

.4 In lieu of .3 above, Contractor may trace the extent of unacceptable seam. Take 25 mm samples at minimum 3 m distance on each side of failed section. Test in both shear and peel. If one or both tests fail, continue along seam at minimum 3 m increments. Continue until tests indicate pass results. Then take large samples for field laboratory tensiometer testing. If field laboratory tests pass, make repairs – if fail, continue.

.5 Reconstruction or repair of failed seam lengths shall be either by capping of the failed seam (extrusion or fusion weld) or, in the case of a double fusion weld, by extrusion fillet welding, the overlap to the bottom sheet. Cutting off the overlap and topping the failed fusion weld with extrudate will not be permitted.

.6 If the overlap of the outside (i.e., visible) weld is less than 30 mm extrusion welding of the overlap to the bottom sheet in the failed section will not be permitted.

.7 Continuity of all reconstructed seams to be subject to non-destructive testing. If reconstructed length exceeds 50 m, sample shall be taken for destructive testing.

.8 Cost of all failed laboratory destructive tests to be deduced from monies owing to the Contractor. Actual cost to be based upon testing company invoices.

.9 Repairs:

.1 Entire geomembrane surface to be examined to confirm it is free of damaged areas, defects, pinholes, blisters, undispersed raw material, or contamination by foreign matter.

.2 If necessary, Contractor to clean surface to enable CQA Consultant to perform inspection.

.3 Gouges or scratches associated with grinding or from other sources whose depth is in excess of 10 percent of the geomembrane thickness shall be classified as defects and will require appropriate repairs in accordance with these specifications.

.4 Suspect areas shall be non-destructively tested, marked, repaired, and non-destructively tested as directed by CQA Consultant.

.5 Small tears, wrinkles, or pinholes to be repaired by seaming or patching. Other areas to be patched or capped.

.6 Patches shall be round or oval, of the same material and thickness, and shall extend a minimum of 150 mm beyond the damaged or faulty area in all directions.

.7 Geomembrane surfaces to be patched shall be abraded, in accordance with these Specifications. Surfaces must be clean and dry.

.8 Use approved extrusion welding equipment.

.9 All repairs to be non-destructively tested.

.10 Cut and repair any large wrinkles or "fishmouths" identified by CQA Consultant.

3.6 Liner Acceptance

.1 The geomembrane liner will be accepted by the CQA Consultant when:

.1 The geomembrane is clean.

.2 The entire installation, or an agreed section of the installation, is finished.

.3 All documentation pertaining to the installation has been submitted to the CQA Consultant.

.4 Verification of the adequacy of all field seams, repairs, and associated testing is complete.

3.7 Disposal of Scrap Material

.1 On a daily basis, remove scrap material and trash from the site and dispose in a location to be approved by the Owner. No scrap material shall be left on the geomembrane surface.

.2 Subsequent installation of other geosynthetics or soil over the geomembrane shall not proceed until the geomembrane is accepted.

3.8 Documentation

.1 Provide the necessary field assistance, notes, test results, etc. necessary for the CQA Consultant.

.2 Provide to the CQA Consultant an "As-Built" drawing which documents the location of all panels, seams, tests, repair, and other pertinent data.

PART 4 – MEASUREMENT AND PAYMENT

4.1 Measurement and Payment

.1 Payment will be based upon square metres installed, including the surface area of geomembrane in the anchor trench and all connections and associated works/materials at pipe penetrations and appurtenances through the geomembrane liner. Allowance for overlaps and wastage shall be included in the Contractor's unit cost per square metre installed.

.2 Unit price to be full compensation for supply and installation of geomembrane, including all labour, materials, equipment and associated field facilities required for proper installation of the geomembrane.

.3 All testing required for quality control certificates to be by Contractor at no cost to Owner.

.4 Destructive testing conducted by testing company on field seams ordered by CQA Consultant to be at Owner's cost. Exception is that cost of "failed" tests shall be deducted from monies owing to the Contractor.

TABLE 1: REQUIRED PROPERTIES FOR HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE – SMOOTH (SOURCE: GRI GM13)

Properties	Test Method	Test Value							Testing Frequency (minimum)
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness - (min. ave.) - mm • lowest individual of 10 values - %	D5199	nom. -10	nom. -10	nom. -10	nom. -10	nom. -10	nom. -10	nom. -10	per roll
Formulated Density (min. ave.) - g/cc	D 1505/D 792	0.940	0.940	0.940	0.940	0.940	0.940	0.940	90,000 kg
Tensile Properties *(1)* (min. ave.) • yield strength - kN/m • break strength - kN/m • yield elongation - % • break elongation - %	D 6693 Type IV	 11 20 12 700	 15 27 12 700	 18 33 12 700	 22 40 12 700	 29 53 12 700	 37 67 12 700	 44 80 12 700	9,000 kg
Tear Resistance (min. ave.) - N	D 1004	93	125	156	187	249	311	374	20,000 kg
Puncture Resistance (min. ave.) - N	D 4833	240	320	400	480	640	800	960	20,000 kg
Stress Crack Resistance *(2)* - hr.	D 5397 (App.)	500	500	500	500	500	500	500	per GRI GM-10
Carbon Black Content (range) - %	D 4218 *(3)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	9,000 kg
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(5)* (a) Standard OIT - min. — or — (b) High Pressure OIT - min.	 D 8117 D 5885	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	90,000 kg
Oven Aging at 85°C *(5), (6)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 8117 D 5885	 55 80	 55 80	 55 80	 55 80	 55 80	 55 80	 55 80	per each formulation
UV Resistance *(7)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 7238 D 8117 D 5885	 N. R. *(8)* 50	 N.R. *(8)* 50	 N.R. *(8)* 50	 N.R. *(8)* 50	 N.R. *(8)* 50	 N.R. *(8)* 50	 N.R. *(8)* 50	per each formulation

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm
(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(3) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3
(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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TABLE 2: REQUIRED PROPERTIES FOR HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE – TEXTURED (SOURCE: GRI GM13)

Properties	Test Method	Test Value							Testing Frequency (minimum)
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness (min. ave.) - mm	D 5994	nom. -5%	nom. -5%	nom. -5%	nom. -5%	nom. -5%	nom. -5%	nom. -5%	per roll
• lowest individual for 8 out of 10 values - %		-10	-10	-10	-10	-10	-10	-10	
• lowest individual for any of the 10 values - %		-15	-15	-15	-15	-15	-15	-15	
Asperity Height mils (min. ave.) - mm	D 7466	0.40	0.40	0.40	0.40	0.40	0.40	0.40	every 2nd roll *(1)*
Formulated Density (min. ave.) - g/cc	D 1505/D 792	0.940	0.940	0.940	0.940	0.940	0.940	0.940	90,000 kg
Tensile Properties (min. ave.) *(2)*	D 6693								9,000 kg
• yield strength - kN/m	Type IV	11	15	18	22	29	37	44	
• break strength - kN/m		8	10	13	16	21	26	32	
• yield elongation - %		12	12	12	12	12	12	12	
• break elongation - %		100	100	100	100	100	100	100	
Tear Resistance (min. ave.) - N	D 1004	93	125	156	187	249	311	374	20,000 kg
Puncture Resistance (min. ave.) - N	D 4833	200	267	333	400	534	667	800	20,000 kg
Stress Crack Resistance *(3)* - hr.	D 5397 (App.)	500	500	500	500	500	500	500	per GRI GM10
Carbon Black Content (range) - %	D 4218 *(4)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	9,000 kg
Carbon Black Dispersion	D 5596	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(6)*									90,000 kg
(a) Standard OIT - min.	D 8117	100	100	100	100	100	100	100	
— or —									
(b) High Pressure OIT - min.	D 5885	400	400	400	400	400	400	400	
Oven Aging at 85°C *(6), (7)*	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 8117	55	55	55	55	55	55	55	per each formulation
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80	80	80	80	80	80	80	
UV Resistance *(8)*	D 7238								
(a) Standard OIT (min. ave.)	D 8117	N.R. *(9)*	N.R. *(9)*	N.R. *(9)*	N.R. *(9)*	N.R. *(9)*	N.R. *(9)*	N.R. *(9)*	per each formulation
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(10)*	D 5885	50	50	50	50	50	50	50	

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm

(3) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(4) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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TABLE 3: REQUIRED SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HDPE GEOMEMBRANES (SOURCE: GRI GM19)

Geomembrane Nominal Thickness	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams[1]							
shear strength, N/25 mm.	250	350	438	525	701	876	1050
shear elongation at break[2], %	50	50	50	50	50	50	50
peel strength, N/25 mm	197	263	333	398	530	661	793
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
shear strength, N/25 mm	250	350	438	525	701	876	1050
shear elongation at break[2], %	50	50	50	50	50	50	50
peel strength, N/25 mm	170	225	285	340	455	570	680
peel separation, %	25	25	25	25	25	25	25

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END OF SECTION