



SATELLITE BAY IWB WL N5L8-1837

CONSOLIDATED QA/QC PLAN

Submitted to:
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REPORT

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PURPOSE

The purpose of this document is to consolidate all Quality Assurance and Quality Control (QA/QC) documents for work detailed in the Remediation Action Plan (Updated 2018) to be undertaken at Satellite Bay in 2018 and during subsequent monitoring events as required by the Inuvialuit Water Board Water Licence N5L8-1837. Appended herein are the QA/QC plans for the Surveillance Network Program, for the Construction and for the Remedial Action Plan.

Note numbering of the sections contained within this document are preserved from their parent document.

REFERENCES

Golder (Golder Associates Ltd). 2017. *2017 Surveillance Network Program*. Submitted March 2017

Golder 2017. *2017 Construction Specifications*. Submitted March 2017.

Golder 2018. *2018 Remedial Action Plan*. Submitted March 2018.

IWB (Inuvialuit Water Board). 2016. *Inuvialuit Water Board Water Licence N5L8-1837*. Authorized August 24, 2016.



SURVEILLANCE NETWORK PROGRAM QA/QC

4.0 QUALITY ASSURANCE / QUALITY CONTROL PLAN

Quality assurance/quality control (QA/QC) procedures and requirements are an important aspect of any field or laboratory testing program. The objective of the QA/QC program is to standardize methods so that field sampling, data entry, data analysis, and report preparation produce technically sound and scientifically defensible results. An overall QA/QC Plan has been compiled and includes a copy of this SNP QA/QC Plan.

4.1 Sampling Equipment

A list of sampling equipment is included in Table 4.

Table 4: List of Sampling Equipment

Equipment	
pH probe and calibration solutions	Field notebook
Turbidity meter and calibration vials	Sharpie markers
Camera	Pencils
GPS	Nitrile gloves
Sample bottles	Project documentation (Work Plans, safety plans, etc)
Sample preservatives	Maps
Deionized water	SNP Plan document
Ice packs	Chain of custody forms
Bottle labels	Field data sheets
Total Residual Chlorine Test Kit	GeoPump, tubing and filters (for filtering CaCO ₃ samples)

4.2 Sampling Methods

Golder has developed technical procedures for water sampling (Golder 2016b) which are consistent with the methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater* (Standard Methods 2016).

4.2.1 Field Analysis Samples

Field analyses will be conducted for pH, turbidity, and total residual chlorine as described in Table 5.

Table 5: Surveillance Network Program Sample Bottles Summary

Analysis	Testing method	Notes
pH	Handheld pH probe	Field pH must be collected because laboratory hold time for pH is 15 minutes, which is not possible to meet
Turbidity	Field test kit	Turbidity is not required in the Water Licence; however, it will be collected to establish a correlation between turbidity and TSS for 1837-5a and 1837-5b samples. This will allow for real-time TSS monitoring at the Project site.
TRC	Field test kit	Field TRC must be measured because laboratory hold time for TRC is 15 minutes, which is not possible to meet

Notes: TRC = total residual chlorine; TSS = total suspended solids



Although Total Suspended Solids cannot be directly measured in the field, a correlation between turbidity and TSS will be established, as described in numerous studies including Ballentine et al. 2015; Gippell 1995; Irvine et al. 2002; Hannouche 2012; Nasrabadi et al. 2016. Establishing this correlation will allow field crews to calculate TSS immediately in the field based on field turbidity measurements, rather than waiting for laboratory results.

4.2.2 Laboratory Analysis Samples

Sample bottles and preservatives for all analyses to be conducted at the laboratory will be provided by ALS Environmental in Yellowknife, Northwest Territories and are summarized in Table 6. Note analyses are to be conducted by ALS Environmental in Edmonton, Alberta.

Some samples require addition of a laboratory provided preservative.

Table 6: Surveillance Network Program Sample Bottle Summary

Analysis	Bottle	Preservative	Notes
TSS and pH	1 L HDPE bottle	none	No preservative required
Oil and grease	1 L amber glass bottle	2 mL 1:1 hydrochloric acid	Preservative to be added
Benzene, toluene, ethylbenzene, xylene; F1 [component of TPH]	3 x 40 mL glass vials	Sodium bisulphate (pre-charged)	Preservative pre-charged in vials; do not add preservative
Total lead	250 mL HDPE bottle	3 mL 1:3 nitric acid	Preservative to be added
F2, F3, and F4 [component of TPH]	2 x 60 mL amber glass vials (F2, F3 and F4) 3 x 40 mL glass vials (BTEX)	Sodium bisulphate (pre-charged)	Preservative pre-charged in vials; do not add preservative
Hardness (as CaCO ₃)	250 mL HDPE bottle	3 mL 1:3 nitric acid	Field filtering required; no preservative required

Note: TPH comprises BTEX (benzene, toluene, ethylbenzene, and xylene) and F1 sampled from three 40 mL glass vials, and F2, F3 and F4 hydrocarbon fractions sampled from two 60 mL amber glass vials.

4.2.3 Field Data Recording

Field data will be recorded on the Field Data Sheet (Appendix B). All sections of the Field Data Sheet must be filled out, and sections that are not applicable must have a 'strike-through'. Field data sheets must be reviewed by a second person, and stored electronically at the end of each day (digital photo) in addition to the original hard copy.

Each collected sample will have corresponding photographs taken of the sampling site and the sample bottles following collection. The photograph reference numbers will be entered onto the field data sheet.



4.2.4 Field Sample Collection

Surface water sampling will be conducted at the stations and following the schedule described in the Section 5.0 Sampling Summary. A new field data sheet, with all sections completed, will be used for each sample collected. A photograph of the sample location and filled sample bottles will be taken for each sample collected.

The following field tests will be conducted, as applicable:

- 1) Field pH: tested using a hand-held pH meter, calibrated daily;
- 2) Turbidity: field test kit, calibrated daily; and
- 3) Total Residual Chlorine: Digital Colorimeter, calibrated daily.

Following sampling, calibration checks will be conducted to detect calibration drifts between the start and end of each sampling session

Following data recording on the field data sheet, a water sample will be collected using the following procedure:

- 1) Confirm station location;
- 2) Confirm bottle label contains all relevant information: sample control number, date, time, sampling personnel, analysis to be performed, and project;
- 3) Using new nitrile gloves, remove sample bottles from plastic bags;
- 4) Insert new 1 L routine sample bottle into sampling device (dipper), collect sample water by extending sampling device into water at sample location, and then decant sample water into target bottles;
- 5) Discard 1 L routine sample bottle used for collecting sample water following each sample collection;
- 6) Following laboratory handling instructions regarding preserving samples;
- 7) Replace sample bottle cap;
- 8) Place sample bottle into a cooler with ice packs; and
- 9) Enter sample details into the chain of custody form.

Specific sampling requirements for each SNP station are shown in Table 7.



Table 7: Specific Sampling Method Requirements for SNP Stations

Station	Specific Method Requirements
1837-1	Use designated (clean) stirring device to gently mix tank contents from top of tank. Wait five minutes. Collect sample using remote sampling device (dipper device).
1837-2a	Use caution to avoid mobilizing sediment into sample location water. Collect sample using remote sampling device (dipper device) as required.
1837-2b	Use caution to avoid mobilizing sediment into sample location water. Collect sample using remote sampling device (dipper device) as required.
1837-3a	Use caution to avoid mobilizing sediment into sample location water. Collect sample using remote sampling device (dipper device) as required.
1837-3b	Use caution to avoid mobilizing sediment into sample location water. Collect sample using remote sampling device (dipper device) as required.
1837-5a	Use caution to avoid mobilizing sediment into sample location water. Stand downstream of sample location..
1837-5b	Use caution to avoid mobilizing sediment into sample location water. Stand downstream of sample location.

4.2.5 QA / QC Sample Collection

The following quality control samples will be collected following the schedule shown in Section 5.0:

10) Duplicate Samples:

- a. Prepare and label two bottle sets with the location sample control number and appropriate duplicate sample control number;
- b. Collect sample water in the sampling device;
- c. Use water in sampling device to alternate filling sample bottles in the ‘sample’ and ‘duplicate’ bottle suites. Preserve samples if required; and,
- d. Store and transport the sample sets together under the same conditions.

11) Field Blank Samples:

- a. Prepare and label two bottle sets with the location sample control number and appropriate blank sample control number;
- b. For the location sample, collect sample water using the appropriate/specified method from the desired source, fill all sample bottles and preserve if required;
- c. For the field blank sample, fill all required sample bottles directly at the sampling location using laboratory-supplied deionized water and preserve if required; and
- d. Store and transport the blank samples together with the corresponding sample location under the same conditions.



12) Travel Blank Samples:

- a. Check that the laboratory-prepared blank is sealed and full; keep the bottles sealed throughout the field program;
- b. Transport the blank samples into the field with the other sample bottles;
- c. Label the blank bottles with the appropriate sample control number; and
- d. Store and transport the blank samples together with the corresponding sample location under the same conditions.

13) Stream Crossing Baseline Samples:

- a. Immediately upon arrival at the Project site, and before any in-stream work or stream crossings, collect a sample from stations 1837-5a and 1837-5b and submit to the laboratory for TSS analysis.

All analytical data will be uploaded directly to the EQUIS database by ALS to allow for efficient QA/QC data processing.

4.2.6 Sample Handling

All samples will be handled using nitrile gloves, and packed into coolers containing ice packs immediately following sample collection. If shipping is occurring the same day, coolers can be prepared for shipping as described in Section 4.3. If shipping is occurring at a later date, store samples in a designated (non-food) fridge until just prior to shipping.

4.3 Sample Shipping and Tracking

4.3.1 Packaging

Samples must be packed into coolers with ice packs to maintain samples as close to 4 degrees Celsius as possible, and packaging material (e.g. bubble wrap) to prevent breakage or leakage. Seal coolers closed using packing tape or straps, and securely affix a shipping label on the cooler top indicating the sender, receiver, and number of coolers. Also indicated on the shipping label which cooler contains the chain of custody form (see section 4.3.2).

4.3.2 Chain of Custody Forms

The chain of custody form is a critical piece of documentation used to record the sample handling from the source water to the laboratory. The chain of custody form must be filled out accurately, signed by sampling personnel, and shipped with the samples to the receiving laboratory. A chain of custody form is included as Appendix C.



4.3.3 Tracking

Sample tracking methods will be established with the charter airline prior to project initiation. Samples will be handed from the Golder representative on site to the charter airline, and will be picked up by ALS employees in Yellowknife. Sample shipping will be monitored by personnel in Yellowknife.

4.3.4 Hold Times

The laboratory recommends that a set amount of time between sample collection and sample extraction at the laboratory, referred to as the 'hold time', is not exceeded or uncertainty in analytical results may be present. It is anticipated that hold times will be met, notwithstanding flight delays or other unavoidable circumstances.

A summary of analyses, hold times, and comments is shown in Table 8.

Table 8: Surveillance Network Program Water Sample Hold Times

Analysis	Hold Time	Notes
Hardness as CaCO ₃	6 months	Sampled in field and submitted to lab for analysis
Total lead	6 months	Sampled in field and submitted to lab for analysis
TRC	15 minutes	Analyzed in field
pH	15 minutes	Analyzed in field; sample collected and submitted to lab for quality control comparison to field pH
Turbidity	n/a	Analyzed in field; correlation between TSS and turbidity used to calculate TSS

TSS = total suspended solids; TRC = total residual chlorine; TPH = Total petroleum hydrocarbons comprising BTEX (benzene, toluene, ethylbenzene, and xylene) and F1, F2, F3 and F4 hydrocarbon fractions; n/a = not applicable.

4.4 Laboratory Analysis

4.4.1 Laboratory Accreditation

Laboratory Accreditation from ALS is shown in Appendix D and a quote showing analyses is included as Appendix E. The QA/QC section of this SNP Plan document will be submitted to the analyst; Taiga Environmental Laboratories for approval. Laboratory Accreditation from ALS is shown in Appendix D and a quote showing analyses is included as Appendix E.

4.4.2 Laboratory Analysis Methods, Hold Times and Targeted Report Detection Limits

A summary of the laboratory analysis methods and targeted report detection limits for analyses required in the SNP are included as Table 9. These detection limits are listed as 'targets' because sample characteristics can affect detection limits used by the laboratory.

Table 9: Surveillance Network Program Laboratory Analysis and Targeted Report Detection Limits

Analysis	Field / Laboratory Analysis	Targeted Report Detection Limit
TSS	Laboratory	3.0 mg/L
Oil and Grease	Laboratory	1.0 mg/L
Benzene	Laboratory	0.00050 mg/L
Toluene	Laboratory	0.00050 mg/L



Table 9: Surveillance Network Program Laboratory Analysis and Targeted Report Detection Limits

Analysis	Field / Laboratory Analysis	Targeted Report Detection Limit
Ethylbenzene	Laboratory	0.00050 mg/L
Xylene	Laboratory	0.00050 mg/L
TPH	Laboratory	0.37 mg/L
Hardness as CaCO ₃	Laboratory	0.053 to 0.50 mg/
Total lead	Laboratory	0.00005 mg/L
TRC	Field	0.02 mg/L
pH	Field / Laboratory	0.01 units
Turbidity	Field	0.01 units

Note: TSS = total suspended solids; TPH = Total petroleum hydrocarbons comprising BTEX (benzene, toluene, ethylbenzene, and xylene) and F1, F2, F3 and F4 hydrocarbon fractions; TRC = total residual chlorine.

4.5 Data Analysis

Data will be managed in Excel format. Golder will use a multi-step data validation process to evaluate data quality as follows:

- 1) Check 100% of results in Excel export document versus ALS Certificate of Analysis (COA) Published Document Format (PDF) document for consistency;
- 2) Confirm that all parameters requested in quote and on chain of custody form were collected and analyzed;
- 3) Identify and investigate all lab qualifiers;
- 4) Confirm sample temperature and integrity acceptable on arrival to lab;
- 5) Confirm field readings were similar to lab results for pH;
- 6) Confirm detection limits match quote;
- 7) Confirm analysis methods match quote;
- 8) Check for hold time exceedances;
- 9) Check for parameters detected in blank samples above 5 times the detection limit;
- 10) Confirm correct units used on lab reports;
- 11) Check for duplicate results not within 20% for parameter concentrations greater than 5 times detection limit;
- 12) For low level results (less than 5 times detection limit), the precision objective is for the difference of the two results to be less than 2 times the detection limit and,
- 13) Check internal lab QC samples.



4.6 Notifications and Reporting

All SNP data will be reported in the Water Licence Annual Report, due to the IWB on March 31 on the year following a sampling year. Ongoing notification requirements are shown in Table 10.

Table 10: Surveillance Network Program Notification Requirements

Notification	Trigger
SNP Station Locations – Signage Posting	Within 7 days prior to discharge
Greywater Discharge	5 days prior to discharge
SNP Station Water Quality Exceedances	Immediately



CONSTRUCTION QA/QC

3.0 AGGREGATE QUARRY OPERATIONS

The material to be used to construct the thermal cover, as well as the backfill for the contaminated soil excavations, will be sourced from the aggregate borrow area located as shown on Figure G2 (Appendix H of the 2017 Annual Report). The overall operations will involve use of a tracked bulldozer to push up available material down to the seasonal frost line to promote further thaw. Borrow areas will be mined in a series of horizontal excavations as the ground thaws. The excavation will progress in wide shallow cuts with ongoing contouring to reduce the occurrence of steep slopes/sharp edges and facilitate non-channelized drainage. Given the short operational window to complete the site work, it may become necessary to equip the dozer with a frost ripper attachment to speed stockpiling and promote thawing of the borrow material.

Temporary ditching and berms will be constructed up-slope to divert surface water away from the borrow area; silt fencing will be installed on steeper slopes between excavation areas and any nearby surface water. The excavation base will be shaped/graded to direct and contain surface runoff and direct the water within the borrow area to sumps for settling/clarification as required. Any surface water accumulated in sumps will be contained within the limits of the borrow area until sampled and discharge approved for release by the Engineer, in accordance with the Surveillance Network Program Plan.

Thawed material will be pushed into stockpiles to allow drainage as required and for ease of access and loading into haul trucks as required for construction purposes. Where areas of overall coarser or finer aggregate are encountered, this material will be segregated to optimize the thermal cover fill, in order to preferentially place finer material on within the first lift and coarser material within the last lift.

After all required borrow materials have been extracted, the aggregate borrow area will be graded and re-contoured to minimize the impact to local permafrost and ponding. Once the excavation is completed, the area will be final graded to minimize any direct water flow paths between excavations and natural waterways.

The quarry operations will be conducted in accordance with the Quarry Operations Plan (April 2016), prepared by Golder Associates Ltd. and the Government of the Northwest Territories (GNWT) Quarry Permit No. 2016QP0028. The quarrying operations will follow the Construction Specifications (Appendix A), notably Excavation and Fill (Section 31 23 00) and Erosion and Sediment Control (Section 01 57 13).

No excavation will be undertaken within 30 metres (m) of a water body. The excavations will be advanced in a manner meeting the requirements of the Quarry Permit to obtain the required volumes and prevent over-cut of lower areas where final drainage contouring could be impacted. The aggregate extraction limits will be established in the field prior to commencement of operations to ensure they are at least 30 m from a water body. A survey will be completed before and after the excavation operations to confirm that the extraction operations remain within the approved volumes. If it is anticipated that the volumes will need to be exceeded, the Quarry Permit will be amended following the process described by the GNWT Lands Department. Interim grade surveys will be undertaken to confirm that the base of the excavation does not go below the planned final grades.

4.0 BACKFILL FOR CONTAMINATED SOIL EXCAVATION AND PONDED AREAS

Excavation and Fill Specifications are provided in Appendix A, Section 31 23 00. The overall intent of the QA/QC controls for the excavation backfill will be to ensure that fill is placed in lifts that are compacted suitably to prevent



potential future settlement of the filled excavations and the ponded areas in the vicinity of the containment cell. The final layer of fill will be graded to match the local grades in a manner that prevents ponding.

A number of areas of contaminated soil are located outside of the limits of the containment structure area, as shown on Drawing G3 (Appendix H of the 2017 Annual Report). These will be excavated and the contaminated soil removed and placed in the containment structure as described in Section 5 below. Following confirmatory sampling (as described in the Remediation Action Plan developed for the IWB) to determine that all contaminated soil has been removed, and Engineer approves the results of each excavation, the excavation areas will be backfilled with clean fill material obtained from the on-site aggregate borrow.

Backfilling and compaction specifications require that aggregate be placed in loose lifts with a thickness of 300 millimetres (mm) and compacted with a smooth drum roller or vibratory tamper or walk behind compactor until no further appreciable density increase can be achieved. The standard for achieving this density in the excavated pits will be based on compaction settlement observed by the Engineer, of no more than 5 mm consolidation following the final compaction.

As identified on Figure C2 (Appendix H of the 2017 Annual Report), fill will be placed in the dewatered ponds located within the footprint of the Ponded Area Fill Buffer Zone. This fill will be placed in 300 mm lifts and compacted with a smooth drum roller and (as necessary in smaller areas) a portable plate compactor. Sand fill placed where some residual surface water or seepage is present may result in soil becoming loose and saturated. As a result, fill placed in the dewatered ponded areas may require an initial lift on the order of 600 mm or more before compaction can be achieved, and the slope of material placed in ponded water may need to be flattened.

5.0 CONTAINMENT STRUCTURE QA/QC OVERSIGHT

Fulltime QA/QC monitoring during construction of the containment cell will be carried out by a NWT licensed Engineer to verify compliance with the Construction Specifications (Appendix A) and Design Drawings (Appendix H of the 2017 Annual Report). The general order of the inspection and oversight activities will include the following steps:

- Placement and compaction of contaminated soil from the remediation areas outside of the contaminated soil cell and installation of the lower Digital Temperature Cable (DTC; also referred to as “thermistor”);
- Completion and approval of final grades of the top of the contaminated soil cell and the liner anchor trench;
- Installation and approval of the lower geotextile cushion layer;
- Testing (by the Engineer) and approval of the installation of the contaminated soil cell geomembrane liner;
- Installation and approval of the upper geotextile cushion layer and upper DTC;
- Inspection and oversight of the hauling, spreading and compaction equipment on the upper geotextile surface during placement of the soil cover lifts;
- Control formation/propagation of wrinkles in the geosynthetic liner system during spreading of the cover soil and approval prior to placement of the next lift;
- Placement of subsequent lifts of aggregate for the thermal cover, to the specified loose thickness followed by specified compaction (i.e., number of passes of compaction equipment);



- Installation of the support post and remote readout panel and solar panel for the DTC; and,
- Approval of the condition and finished thickness of the cover soil surface and the completion of grades at the toe of slope of the containment cell.

5.1 Geotextile Cushion Layers

Details for the specification, installation and QA/QC for the geotextile cushion layers are provided in Appendix A, Geotextile Cushion, Section 31 05 19.13. The overall intent of the QA/QC controls for the geotextile cushion layers will be to ensure that the material is placed in a manner that protects the liner from punctures and tears.

The geotextile cushion above and below the geomembrane will be a non-woven, needle-punched polypropylene or polyester material meeting or exceeding the criteria outlined in Appendix A (Table 1 Section 31 05 19.13). Narrower geotextile rolls than the standard may be used to fabricate a standard 6.5 m width, such that the fabricated panel has no more than two fabrication seams. Threads for sewn seams are to be polymeric threads of the same material and as chemically resistant and durable as the geotextile. The Engineer may require testing to verify the integrity of any pre-fabricated seams.

At least two weeks prior to delivery of materials to the site, the geotextile manufacturer must furnish the Engineer with copies of quality control test data and a certificate stating that the geotextile to be delivered to the site meets the requirements given in Appendix A.

Geotextile labelling, shipment and storage on site shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name and roll number. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight and contaminants.

Prior to installation, the finished surface of the contaminated soil cell, referred to herein as the liner subgrade, will be compacted using a smooth drum roller, fine graded to the grades and elevations stated in the Design Drawings using a bulldozer and proof rolled using a smooth drum roller to confirm its strength/stability. Any soft areas will be re-compacted and proof rolled again to confirm stable ground conditions. Any standing water will be removed prior to installation of the geotextile cushion layer. The Engineer will inspect the finished subgrade surface to ensure the surface is smooth and uniform without ruts or depressions and free of standing water. All angular stones that are protruding more than 10 mm from the finished sub-base surface will be removed or further depressed into the subbase using a smooth drum roller.

The Engineer will monitor the placement of the geotextile cushion to ensure compliance with the Construction Specifications and Design Drawings. Special attention will be given to field seaming operations and movement of personnel and equipment on the geotextile. Any holes or tears in the geotextile will be repaired by heat bonding in place, a patch made from the same geotextile with a minimum of 600 mm overlap in all directions. Care will be taken to remove any soil or other material which may have penetrated the torn geotextile.

Atmospheric exposure of the geotextile to the elements following lay down will be limited to 14 days to prevent damage.

5.2 Geomembrane Liner

Details for the specification, installation and QA/QC for the contaminated soil geomembrane over-liner (liner) are provided in Appendix A, Geomembrane Liner, Section 31 05 19.16. The overall intent of the QA/QC controls for



the liner installation will be to ensure that the material is placed and seamed in a manner that prevents punctures and tears and achieves the specified strength and impermeability of the seams.

The geomembrane liner covering the contaminated soil in the containment cell will be a 1.0 mm (40 mil) thick smooth Linear Low Density Polyethylene (LLDPE) geomembrane. The geomembrane is to be supplied in three to five panels, which will be deployed and seamed by specialized installers (Terrafix) using specialized equipment.

At least two weeks prior to delivery of materials, the geomembrane manufacturer must provide the Engineer with copies of quality control test data and a certificate stating that the geomembrane meets the requirements provided in Appendix A (Table 1(b), Section 31 05 19.16).

Each geomembrane panel will be clearly marked with the product information including the Manufacturer, product type, thickness, lot number, roll number, length and width. The geomembrane will be protected from direct sunlight, excessive heat, mud, debris, dust, snow and deformation.

Prior to installation, the geotextile cushion will be inspected by the Engineer for damage and completeness of seaming. The Engineer will monitor the placement of the geomembrane to ensure compliance with the Construction Specifications and Design Drawings. Field seaming will commence once a passing trial seam meeting the requirements outlined in Appendix A (Table 2(b) Section 31 05 19.16) is produced. All seams will be subjected to non-destructive (air pressure or vacuum box) testing for their full length under the observation of the Engineer. Defects identified during testing will be clearly labelled, repaired and retested to confirm acceptance. Any holes or tears in the geomembrane will be repaired by seaming or patching using the same geomembrane material. Destructive seam testing will be performed concurrent with seaming at a frequency of one sample per 150 m of seam. The location of the destructive test samples will be in accordance with the Construction Specifications and must meet the acceptance criteria outlined in Appendix A.

5.3 Thermal Cover Soil Layer

Details for the specification, installation and QA/QC for the thermal cover soil layer are provided in Appendix A, Section 31 23 23. The overall intent of the QA/QC controls for the thermal cover will be to ensure that the material is placed to the specified thickness, in a manner that prevents punctures and tears of the geosynthetic liner system and is compacted to achieve the required final stability.

The thermal cover soil material will consist of a clean native material obtained from the on-site borrow area as shown on the Design Drawings and described above in Section 3. The material to be used will be free of refuse, organic matter and construction debris or other deleterious materials. The suitability of the aggregate will be confirmed by the Engineer prior to placement.

Approval of the installation of the thermal cover soil layer will be based on the following criteria:

- Cover soil spread with a low ground pressure bulldozer (maximum ground pressure of 35 kPa) in lifts of 300 mm \pm 30 mm compacted thickness;
- Each lift compacted with a minimum of four one way passes of a smooth drum roller;
- Minimum finished soil liner thickness of 2400 mm \pm 50 mm (measured perpendicular to the surface of the geomembrane liner) as per the Construction Drawings; and,



- Smooth finished surface of cover soil layer to the design elevations and grades specified in the Design Drawings.

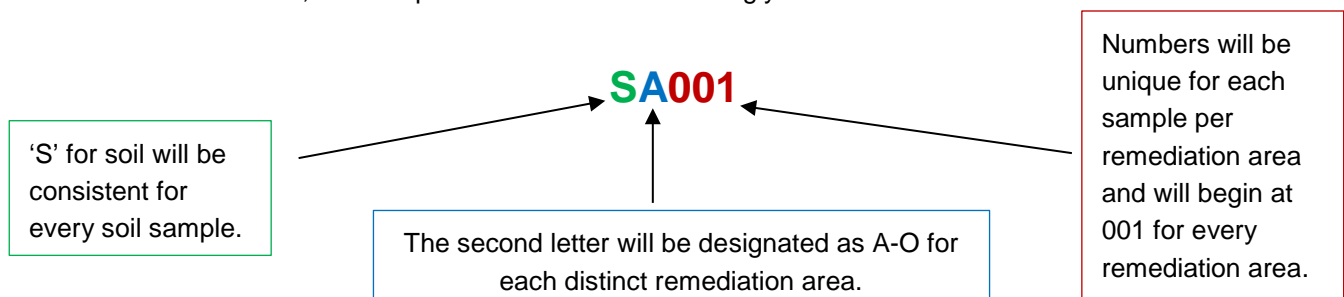
REMEDIAL ACTION PLAN QA/QC

The Remedial Action Plan details confirmatory and background soil samples to be taken. The soil samples will be collected using industry standard protocols which include the use of laboratory supplied pre-charged methanol vials, single use Terra Core Samplers in addition to 125 millilitre (ml) glass jars with Teflon-lined lids. Terra Core samplers, vials and jars are provided by the lab. Soil samples will be collected by hand using a single-use disposable nitrile gloves. The soil samples will be collected using industry standard protocols including decontamination of the sampling shovel with soap and water, methyl hydrate and rinsing with distilled water before each use. Soil samples will be collected by hand using a single-use disposable nitrile glove and placed into new/clean glass sample jars provided by the laboratory. They will be clearly labelled and submitted to the laboratory with a completed Chain of Custody (COC) form. There will be sufficient soil within the sample for the analyses, as some parameters require more sample material than others. Soil samples will be stored in ice-packed coolers and submitted to the lab within the appropriate time frame.

Each container will be labelled with the following information:

- Sample name;
- Date;
- Project number;
- Sampler's name

The naming convention of samples is designed to follow that used in similar years: two capital letters followed by three numbers. For 2016, soil samples will be named accordingly:



Universal Transverse Mercator (UTM) coordinates will be taken for every sample using handheld Global Positioning System (GPS) units. Coordinates will be tied in to previous locations using Real-Time Kinematic Global Positioning System (RTK-GPS) surveying.

Analytical Requirements and QA/QC

Chain of Custody (COC) documentation will be prepared legibly and accurately. Samples will be shipped to ALS Laboratories. Dedicated flights may be considered to facilitate timely analysis of critical confirmatory samples. Samples will be submitted with one-day turnaround requested, but understanding that this may become a two or



three day turnaround depending on analysis and time of day. Samples will be analyzed, based on the concerns for that location, for any of BTEX, PHC fractions F1 to F4 and CCME Tier 1 metals with additional analyses for specific chemicals of concern to be added as required. These analyses are similar to those of previous years but will be focused to address those contaminants that have previously been identified as exceedances at the Site and specifically in each of the areas A through Q.

The laboratory will conduct internal duplicate analysis on samples to assess whether the accuracy and repeatability of the analysis program was within acceptable ranges. The relative percent differences (RPD) between the samples' results were used to assess the sample variability. The RPD is a measure of the variability between two outcomes from the same procedure or process and is calculated by the following formula:

$$absolute\left(\frac{(x_1 - x_2)}{average(x_1, x_2)}\right) \times 100$$

where x_1 is the original sample result and x_2 is the field duplicate result.

Theoretically, the duplicate samples should have identical chemical concentrations (*i.e.*, RPD = 0). However, due to factors such as sample matrix heterogeneity, natural variations or variations in sample collection, handling or analysis, a minor variation in chemical concentration may occur (*i.e.*, RPD > 0). Moreover, the reproducibility of duplicate analyses at concentrations near the reported detection limit (RDL) can be poor, resulting in RPD values of greater than the allowable limits. Therefore, the use of the RPD is limited to analytical values that are greater than five times the detection limit. For duplicate concentrations greater than 5 times the detection limit, a relative percent difference value of +/- 50% is considered acceptable for organic compounds in soils, +/- 40% is considered acceptable for inorganic compounds in soils, +/-30% for organic compounds in water, and +/- 25% for inorganic analytes in water. RPD values greater than the project objectives suggest variability had been introduced through sample collection, sampling handling, or sample analysis.

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