Technical Specification for Tailings Containment Area and Surface Infrastructure Components

Doris North Project, Hope Bay, Nunavut, Canada

Prepared for

Miramar Hope Bay Ltd.

Prepared by

SRK Consulting
Engineers and Scientists

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Technical Specifications Tailings Containment Area and Surface Infrastructure Components

Doris North Project, Hope Bay Nunavut, Canada

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General Requirements

1 General Requirements

1.1 Part 1 – General

1.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.1.2 Definitions

1. The following definitions and interpretations shall apply to the Technical Specifications:
   (1) PROJECT means the total construction contemplated, of which the Works may be the whole or part.
   (2) OWNER is defined as an authorized representative of Miramar Hope Bay Ltd. (MHBL).
   (3) ENGINEER is defined as a representative appointed and authorized by the Owner. The Engineer shall be a registered Professional Engineer in the Territory of Nunavut, or a designated site representative under his supervision during construction.
   (4) QUALITY ASSURANCE TEAM is defined as the individual(s) working under the direction of the Engineer to perform on-site Quality Assurance (QA) tasks for the Owner.
   (5) CONTRACTOR is defined as the party that has executed a contract agreement for the specified Works with the Owner.
   (6) SPECIFICATIONS are defined as this document of Technical Specifications prepared by SRK Consulting (Canada) Inc. for Miramar Hope Bay Ltd.
   (7) DRAWINGS are defined as all drawings, plans, sketches and maps issued with these Specifications, or subsequently, as provided for in the Contract, and includes any drawings submitted by the Contractor, if signed as approved by the Engineer.
   (8) MODIFICATIONS are defined as changes made to the Specifications or the drawings that are approved by the Owner and Engineer in writing after the Specifications and the drawings have been finalized.
   (9) ON-SITE MATERIAL is defined as borrow materials obtained from within designated facility excavations.
   (10) OFF-SITE MATERIAL is defined as material obtained from sources other than on-site.
   (11) RECORD DOCUMENTS are defined as the documents prepared and certified by the Land Surveyor, Material Testing Technician, Quality Control and Assurance Personnel, and Specialist Professionals documenting the progress, location, type and quantity of materials placed to complete the Works.

(12) PRODUCTS are defined as processed fill material, machines, components, equipment, fixtures, and systems forming the Works. This does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Works. Products may also include existing material or components required for reuse.

(13) WORKS is defined as the entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents. Works is the result of performing services, furnishing labour, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

(14) CONTRACT DOCUMENTS are defined as the agreement, addenda (which pertain to the Contract Documents), Contractor's bid (including documentation accompanying the bid and any post-bid addenda submitted) when attached as an exhibit to the agreement, the bonds, the general conditions, the supplementary conditions, these Technical Specifications, the drawings, together with all modifications issued after the execution of the agreement.

(15) WCB means the Workers' Compensation Board of Nunavut.

(16) Miramar Hope Bay Ltd., Owner, and MHBL, shall have common meaning.

(17) All slopes are described in terms of horizontal distance to vertical distance (i.e., 2H:1V shall be read as 2 horizontal to1 vertical).

(18) PLANT means all the components and structures used in fill processing, concrete mixing and explosives production.

(19) EQUIPMENT means all construction mobile equipment that will be used for the Works.

1.1.3 Summary of Works

1. Throughout the period of the contract comply and demonstrate compliance with Miramar Hope Bay Ltd.'s Environmental Management and Procedures Manual (EMPM) which will be provided to the Contractor.

2. The Works under this contract is for the construction in part of the Doris North Project as shown on the drawings. The Works under this contract for construction of the Tailings Containment Area (TCA) and selected surface infrastructure components, will include, but are not limited to:
   (1) Staged mobilization of all equipment and material required for the Works.
   (2) Construction of winter roads and winter airstrip as required for the Works.
   (3) Supply, construction, operation and management of a construction camp complete with facilities for potable water treatment, garbage incineration and sewage effluent treatment.
   (4) Implementation, operation, maintenance and removal of construction sediment and runoff control.
   (5) Construction of permanent surface water management controls, including contour berms, pollution control ponds and sumps.
   (6) Operation and management of permanent surface water management controls up to the time of complete demobilisation.

(7) Clearing, stripping and excavation in required areas.

(8) Development of borrow areas and borrow access roads.

(9) Construction, installation and operation of a suitably licensed temporary explosives storage facility to service the construction phase. The Owner will supply the explosives, magazines, mixing plant and office.

(10) Produce construction material specified in these Technical Specifications, and on the drawings.

(11) Construction of permanent roads, including;

a) the Primary road between Roberts Bay and the camp/mill,

b) the Secondary road between the camp/mill complex and the South Dam, and

c) all other facility access roads.

(12) Construction of all road turnouts and caribou crossings along Primary, Secondary, and facility access roads.

(13) Supply and installation of all ancillary structures for permanent roads, including signage, safety guardrails, safety berms, culverts and pipe crossings.

(14) Construction of Jetty, as well as supply and installation all ancillary equipment including, chains, shackles, buoys and mooring lines.

(15) Construction of Beach Laydown area.

(16) Construction of Fuel Transfer Station, including supply and installation of liner system. Pumps and piping are excluded from the Works.

(17) Construction of permanent Airstrip and Apron, including installation (but not supply) of ancillary equipment such as aviation lights and safety shelter.

(18) Construction of permanent Explosives Storage Facility, and installation (but not supply) of ancillary structures such as magazines, explosives mixing plant and office.

(19) Construction of Fuel Tank Farm, including supply and installation of liner system. Tanks, pumps and piping are excluded from the Works.

(20) Construction of Camp Pad, and installation (but not supply) of ancillary structures including 175 man camp, dry, offices, environmental laboratory, first aid station, potable water treatment plant, sewage treatment plant, garbage incinerator, workshop and supply room.

(21) Construction of Mill Pad, and installation (but not supply) of ancillary structures including building foundations and shells for the mill and crusher.

(22) Construction of Pad and perimeter berms for the temporary waste rock pile.

(23) Construction of temporary waste rock pile Pollution Control Pond, including supply and installation of liner system.

(24) Construction of camp/mill complex Sedimentation Pond, including supply and installation of liner system.

(25) Installation (but not supply) of Float Plane Dock, including all ancillary equipment such as chains and shackles.

(26) Construction of Landfill, including supply and installation of perimeter fence and access gate.

(27) Construction of Landfarm, including supply and installation of liner system, perimeter fence and access gate.
(28) Construction of bridge abutments, including supply and installation of ancillary equipment such as guard rails.
(29) Assemble and install (but not supply) prefabricated steel bridge, including ancillary structures such as pre-fabricated concrete wing walls and guard rails.
(30) Construction of North and South Dams, including supply and installation of liner and thermosyphons.
(31) Construction of spillway.
(32) Assemble and install (but not supply) the following pipelines, including all associated ancillary equipment and structures;
  a) Tailings Deposition (Slurry) Line,
  b) Reclaim Water Line,
  c) Fresh Water Make-Up Line, and
  d) Decant Line.
(33) Construction of Pump House Pad, and installation (but not supply) of pump house building.
(34) Installation (but not supply) of floating barge.
(35) Construction of Emergency Dump Catch Basins, including supply and installation of liner system.
(36) Installation (but not supply) of all permanent monitoring instrumentation for the Works, including, thermistors, settlement plates and survey beacons.
(37) Supply and installation of shoreline erosion protection measures.
(38) Preparation of appropriate stockpiles of construction materials for maintenance to be carried out by the Owner.
(39) Demobilization, including removal of temporary structures, shaping, contouring, grading final surfaces, and removal of any temporary access roads.

3. Any electrical connections are excluded from this scope of work.

1.1.4 Contradictions

1. Should any contradiction, either implied or real, exist between the specifications and the drawings, the Contractor shall:
   (1) Notify the Owner and Engineer.
   (2) Stop all Works that concern the contradiction until the contradiction is remedied or clarified by the Engineer.

2. The decision of the Engineer is final.

1.1.5 Contractor's Responsibilities

1. The Contractor shall:
   (1) Comply with Nunavut Worker Compensation Board, Northern Canada Mine Safety Act and any other relevant required health and safety regulations.
   (2) Comply with Miramar Hope Bay Ltd.'s Environmental Management and Procedures Manual (EMPM). The Owner will provide the Contractor with a copy of this document.
   (3) Provide evidence and documentation of all contract related insurance coverage.
   (4) A performance bond will be required from the Contractor and will be discussed during final contract negotiation.
   (5) Provide evidence and documentation of training certificates, training plans and safety organization.
   (6) Provide Owner with copy of their Health and Safety Plan, which has been specifically prepared for this Project.
   (7) Become familiar with the relevant regional and site-specific conditions, which may have an impact upon the Works.
   (8) Be responsible for making his own measurements and installing the Works to fit the conditions encountered.
   (9) Before proceeding with the Works, examine all drawings and report to the Engineer any apparent discrepancies or interferences. The Engineer shall have the privilege of making minor alterations to the drawings and the Specifications. All alterations shall be issued under a covering Works order signed by the Owner prior to the start of alteration, if the alteration will affect the terms of contract.

1.1.6 Testing by the Owner and the Engineer

1. Testing the Works
   (1) The Engineer will undertake testing at a frequency and at the locations specified in the various sections of these Specifications. The Engineer may undertake any additional testing which he deems necessary on any part of the Works.
   (2) Performance of testing by the Engineer shall in no way relieve the Contractor of its sole responsibility for completing the Works in accordance with the specified requirements.
   (3) The Contractor shall undertake his own quality control and quality assurance, and shall outline his Quality Assurance/Quality Control (QA/QC) program in the bid, in addition to any other submittals required in these Specifications. All quality control or other test data, survey data or the like, shall be made available to the Owner and Engineer at no cost.

1.1.7 Submittals

1. The Contractor shall submit information as specified for the Engineer's approval. All submittals shall require written approval from the Engineer before Works can commence.

1.1.8 Construction Schedule

1. Description
   (1) The contactor shall prepare a time scaled, network construction schedule in the form of a horizontal bar chart. Show all the principal phases and elements of the Works and include all resources related to the Works. The construction schedule will provide a basis for determining the progress status of the project relative to the completion time specific dates and for determining the acceptability of the Contractor's request for payment.

2. Required schedules
   (1) The Contractor must submit the following schedules to the Engineer:
      a) Construction schedule.
      b) List of Contractor's processing plant for each phase and stage of Works.
      c) List of equipment for the Project.

3. Submission
   (1) It is intended that the Engineer will meet with the Contractor as soon as practical after Notice of Award to review significant aspects of the overall schedule of the Works, and establish suitable intermediate milestones in keeping with the constraints at the work site.
   (2) Within seven days following Notice of Award and prior to commencement of Works at the Works site, the Contractor shall prepare for submission to the Engineer the schedules listed in the contract agreement, including construction milestone dates, along with the other supporting information.
   (3) The Engineer will review the schedules and return one reviewed copy to the Contractor, within seven calendar days after receipt.
   (4) The Contractor will resubmit finalized schedules to the Engineer within seven days after return of review copy.

4. Contents of construction schedule to be provided by the Contractor
   (1) Include the complete sequence of construction activities.
   (2) Include the dates for the commencement and completion of each major element of the design, supply, construction and installation.

5. Updates to construction schedule
   (1) The Contractor will update the schedules listed in the contract agreement (or as often as directed by the Engineer) and submit to the Engineer within the first seven days of the month for which the schedules are issued.

6. Project milestone dates

(1) The Contractor will schedule the Works in accordance with the project milestone dates listed in Table 1.1.

Table 1.1: Project milestone dates

Component	Date
Contract award	1 February 2007
Complete procurement of equipment and materials no later than	1 June 2007
Complete Contractor mobilization to Hay River staging area no later than	30 June 2007
Arrival of barge at Roberts Bay no later than	30 August 2007
Complete Contractor barge offloading and wintering of equipment and materials no later than	15 September 2007
Complete pre-construction mobilization no later than	30 December 2007
Complete all earthworks requiring tundra access no later than	30 April 2008
Complete dams no later than	30 April 2008
Complete installations not requiring tundra access no later than	30 July 2008
Complete jetty construction no later than	15 August 2008
Complete Contractor demobilization from site no later than	30 October 2008

1.1.9 List of Drawings

1. The drawings that form part of these Specifications are listed in Table 1.2:

Table 1.2: List of drawings

Drawing Number	Drawing Title
P-01	Title Page
G-01	Location Plan
G-02	General Arrangement
G-03	Index
G-04	Thermistors and Geotechnical Drill Hole Plan and Details
G-05	Construction Fill Material Specifications
J-01	Jetty Plan
J-02	Jetty Typical Sections and Details - Sheet 1 of 2
J-03	Jetty Typical Sections and Details - Sheet 2 of 2
S-01	Beach Laydown Area and Fuel Transfer Station Plan
S-02	Beach Laydown Area and Fuel Transfer Station Typical Section and Details
S-03	Airstrip and Apron Plan, Typical Sections and Details
S-04	Explosives Facility Plan, Typical Sections and Details
S-05	Fuel Tank Farm Plan
S-06	Fuel Tank Farm Typical Sections and Details
S-07	Camp and Mill Pad Plan
S-08	Camp and Mill Pad Typical Sections and Details
S-09	Float Plane Dock Plan, Typical Sections and Details
S-10	Caribou Crossing Typical Plan and Section
S-11	Culvert and Road Turnout Typical Plan, Sections and Details
S-12a	Bridge Crossing Plan and Typical Sections
S-12b	Bridge Crossing Typical Section and Detail
S-13	Landfill and Landfarm Typical Plan
S-14	Landfill and Landfarm Typical Sections and Details
S-15	North Primary Road Plan and Profile (Station 0+00 - 11+79)
S-16	South Primary Road Plan and Profile (Station 0+00 - 20+00)
S-17	South Primary Road Plan and Profile (Station 20+00 - 24+00) and Typical Section

Drawing Number	Drawing Title
S-18	Secondary Road Plan and Profile (Station 0+00 - 20+00)
S-19	Secondary Road Plan and Profile (Station 20+00 - 40+00)
S-20	Secondary Road Plan and Profile (Station 40+00 - 54+70) and Typical Section
S-21	Primary and Secondary Road Stake Out Points
S-22	Explosives Storage Facility and Landfill/Landfarm Access Road Plan and Profile
S-23	Camp and Fuel Tank Farm and Access Road Plan and Profile
S-24	Float Plane Dock and Portal Access Road Plan and Profile
S-25	Decant and Tail Lake Discharge Access Road Plan and Profile
S-26	Spillway Access Road Plan and Profile and All Access Road Stake Out Points
T-01	Tailings Containment Area Stage Curves and Deposition Plan
T-02	North Dam Layout and Key-Trench Details
T-03	North Dam Sections
T-04	North and South Dam Typical Details
T-05	South Dam Layout and Key-Trench Details
T-06	South Dam Sections
T-07	Typical Thermosyphon Details
T-08	Spillway Plan, Typical Sections and Details
T-09	North Dam Instrumentation Layout and Typical Details
T-10	South Dam Instrumentation Layout and Typical Details
T-11	Tailings Slurry, Reclaim, Fresh Water Make-Up and Decant Pipelines Layout
T-12	Typical Pipeline Details
T-13	Emergency Dump Catch Basin Layout and Typical Details
T-14	Shoreline Erosion Protection Typical Details

END OF SECTION 1

Section 2
Measurement and Payment

2 Measurement and Payment

2.1 Part 1 – General

2.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

2.1.2 Definitions

1. The following words and terms, unless the context otherwise requires, in this Specification, shall have the meanings set out below:
   (1) EXTRA WORK shall mean the furnishing of labour, materials, plant, equipment, or any combination of them, and the doing of Works not directly or by implication called for in the Contract Documents.
   (2) STANDBY TIME shall mean non-working time spent by manned plant, equipment or labour. Standby rime will only apply to time pre-approved in writing by the Engineer as a result of a delay requested by the Engineer.
   (3) STANDDOWN TIME shall mean an extended period of non-working time by non-manned Contractor's plant or equipment. Standdown time will only apply to time pre-approved in writing by the Engineer as a result of a delay requested by the Engineer.
   (4) DOWNTIME shall mean a period of time when the plant, equipment or work force is unavailable due to weather delays, breakdowns, or the like.

2.1.3 Measurement and Payment

1. Any Works called for in the Contract Documents, and which is necessary for completion of the Works and which is not specifically listed as a separate pay item in **Schedule 1** shall be deemed incidental to the Works and no separate measurement or payment will be made for such Works.

2. The amount of Works to be performed with respect to each unit price pay item has been estimated as set out in **Schedule 1**. Notwithstanding, the Owner reserves the right to increase or decrease the amount of work of any Works item as required, and the Contractor shall make no claim for anticipated profit, for damages, or for any extra payment whatsoever, except as provided for in the contract.

3. If quantities are stated on the drawings, they are provided as information only. Where an item has been measured as a lump sum, the Contractor is responsible for determining all related costs necessary to complete the lump sum item including that of labour, materials, plant and equipment.

4. Where an item is measured as a unit quantity, the quantity is subject to a baseline survey completed prior to commencement of Works and a re-measurement after the item under consideration has been satisfactorily completed. The final quantity for the item shall be the installed quantity as agreed with the Engineer. Surveys are to be completed by the Contractor, with approval from the Engineer.
5. The methods of measurement shall be in accordance with the relevant section of the Specifications for the respective types of work.
6. The Contractor shall obtain prior approval of its quantity survey methods, including presentation format and details. This approval may require that the Engineer also conduct a survey for confirmation. The Engineer will conduct such confirmation surveys as it considers necessary. If errors and omissions are found in the Contractor's surveys, the Contractor shall rectify them forthwith.
7. A given type of work shall not proceed until relevant initial surveys are approved in writing.
8. No Works shall be undertaken that would preclude verification of any initial condition surveys.
9. The Contractor shall prepare all monthly estimates and a final statement of Works performed together with such supporting data and computations as are deemed necessary by the Engineer to determine the accuracy of the estimates, all of which shall be submitted in an approved format.
10. All original field notes, electronic files, quantity computations, cross sections and other records taken by the Contractor, or required by the Engineer for the purpose of quantity surveys, shall be furnished promptly to the Engineer and shall become the property of the Owner.
11. In addition to the aforementioned surveys, the Contractor shall submit Daily Reports containing a complete and accurate account of the previous day's progress to help support quantity estimates for progress payments. The Contractor is to supply a typical example Daily Report to the Engineer for approval at the appropriate time.
12. Payment for the Works will be made at the respective lump sums and unit rates stated in **Schedule 1**.
13. Except as otherwise specifically provided, the prices entered in **Schedule 1** for the various items of Works shall constitute full compensation for supplying, operating and maintaining temporary Works, materials, plant, equipment, labour, supervision, environmental controls, public impact mitigation measures and all other costs for performing all the Works required by the contract. Payment under the various pay items will only be made for Works satisfactorily completed in accordance with the Contract Documents.
14. No separate measurement or payment will be made for any items not specifically stated in **Schedule 1**. All such items will be considered incidental, including but not necessarily limited to:
    (1) Any activities related to the various pay items stated in **Schedule 1**.
    (2) Travel time, under any circumstance.
    (3) Pollution control and waste disposal.

(4) Contractor's security.
(5) Delays due to plant and equipment servicing and breakdown, or lack of materials.
(6) Delays due to weather except as provided elsewhere in the Contract Documents.
(7) Consumables.
(8) Attending safety meetings.
(9) Obtaining permits.
(10) Implementing any public impact mitigation or environmental protection measure.

15. Mobilization shall be to the work site and shall include all costs required to:
    (1) Mobilize Contractor's plant, equipment, labour, supervision, technical personnel and other services required for the Works to a staging area in Hay River.
    (2) Offload barge and winterize materials, plant and equipment in a temporary lay-down area at Roberts Bay.
    (3) Mobilize plant, equipment, labour, supervision, technical personnel and other services required for the Works from the temporary lay-down area at Roberts Bay to the work site.
    (4) Furnish and install temporary roads, facilities, utilities and all other preparation required for performing the Works.
    (5) Insurance and permits.
    (6) Set up and assemble plant and equipment and move to the first specific Works location.
    (7) Attend ongoing work site safety orientations for every new worker.
16. Demobilization will be considered complete when all labour, plant, equipment, temporary facilities and surplus and waste materials resulting from the Contractor's operations have been removed from the work site, and the work site has been cleaned and restored to the satisfaction of the Engineer.
17. There shall be no payment by the Owner to the Contractor for any costs associated with downtime.

2.1.4 Applications for Payment

1. Refer to Contract Document.
2. The Contractor shall use the forms for submission of progress claims that are provided by the Owner or in a format acceptable to the Owner.
3. Submit a draft invoice prior to the end of each month of work, but in any event not less than three days before the end of the month, for comment and approval by the Engineer and submit formal invoice following the Engineer’s approval within seven days after the end of the monthly period.
4. A hold back of 10 percent of monthly invoiced amount will be retained by Owner and paid out end of Project subject to substantial completion of the Project.

5. Application for payment of mobilization and demobilization shall be at the respective lump sum prices stated in **Schedule 1**, on the following basis:
   (1) Fifty percent (50%) of the mobilization lump sum price shall be paid upon mobilization of plant and equipment to the staging area at Hay River, but only after acceptance by the Owner of the construction schedule, the safety program, and acceptance of the quality control program as detailed in Section 1.
   (2) The remainder of the mobilization lump sum price on a pro-rata basis over the contract period.
   (3) The demobilization lump sum price shall only be paid upon Contractor's complete demobilization and submission of all deliverables.
6. Prior to first payment and arrival on the Works site, submit a WCB of Nunavut clearance letter. Submit with each application after the first, a WCB clearance letter and a Statutory Declaration from the Contractor and its subcontractors related to the previous progress payment.
7. Submit with each application for payment, a Weekly Report with a marked up Progress Measurement Spreadsheet in approved format showing actual progress against established progress milestones. The construction schedule shall describe each element of the Works in a manner acceptable to the Engineer, such that the progress applicable to each element of work is clearly evident, defined and traceable.
8. Submit applications based on the Schedules to the contract. The Contractor, upon request from the Owner, shall provide a revised breakdown of the contract price from that shown in **Schedule 1** for the purposes of establishing progress payments.
9. Show previous amounts claimed, and the amount claimed for the period ending. Show percentage of Works completed to date and hold back retained.
10. Include all Change Orders and Field Orders approved prior to the application date and for each Change Order submit a breakdown of the cost against any and all individual items identified in the Change Order.
11. Change Orders and Field Orders shall be invoiced separately from the original contract.
12. Submit a Statutory Declaration from the Contractor and its subcontractors related to deficiencies, certificates of completion, and payment upon substantial completion, on a form satisfactory to the Engineer.

2.1.5 Changes in the Works

1. The Owner, without invalidating the contract, may order extra work, or make changes by altering, deleting or adding to the Works, and the contract price shall be adjusted accordingly. All such Extra Work shall be executed under the conditions of the contract, except that any claim for extension of time caused thereby shall be adjusted at the time that the Change Order or Field Order for Extra Work is prepared.

2. In giving instructions, the Engineer shall have the authority to make minor changes to the Works not involving extra costs, and not inconsistent with the purposes of the construction, and such changes shall not be considered as Extra Work. A Field Memo form shall be used for such instances.

3. The price to be paid for any Extra Work shall be determined by the Engineer, based on the Contractor's quotation in the schedules in response to a contemplated change order, using one or more of the methods specified in the Contract Documents.

4. It is expressly agreed and understood that no claim for an addition to the contract price shall be valid except by agreement of a written Change Order or Field Order.

5. If the conditions under which the contract is to be performed should be substantially changed, and the Contractor should feel that it is entitled to extra compensation for Extra Work, it shall make a written claim to the Engineer for such extra compensation within 48 hours of such change; otherwise such claim need not be considered by the Engineer.

6. Extra Work will be documented using the following forms:
   (1) FIELD ORDER will be used when an instruction is given to the Contractor in the field, which may result in an adjustment to the contract price. A Field Order signed by the Engineer and the Owner is authorization to proceed with the Works on a lump sum, unit price or force account/time and material basis as stipulated on the Field Order form. Extra Work shall not commence until the Contractor receives a copy of the Field Order signed by the Owner and the Engineer.
   (2) FIELD MEMO will be issued by the Engineer and will be used as an instruction in situations where the change is not anticipated to result in an adjustment to the contract price.
   (3) CHANGE ORDER will be used for additions or deletions to the Works which originate in the form of revisions to drawings and Specifications, and which may result in a change to the contract price. A Change Order signed by the Engineer and the Owner is authorization to proceed with the Works as stipulated in the Change Order. Extra Work shall not commence until the Contractor receives a copy of the Change Order signed by the Owner and Engineer.

7. Contemplated Change Order
   (1) Where Extra Work is contemplated, the Engineer will give the Contractor written notice by issuing a contemplated Change Order. Such notice requires that the Contractor submit either a lump sum quotation or an estimate based on unit prices and quantities, or labour and equipment rates in **Schedules 2** and **3**, to the Engineer within the time specified on the form. Such notice is for information only and is not an instruction to execute changes, or to stop Works in progress. The Contractor's quotation shall:

      a) Make reference to the contemplated Change Order notice;

      b) Be set out in sufficient detail acceptable to the Engineer;

c) Indicate the methodology and resources that the Contractor shall use to perform the Extra Work;

d) Indicate the cost or credit to complete the Extra Work;

e) Indicate the schedule to perform the Extra Work;

f) Indicate any incremental cost impact included in quotation to maintain the completion date;

g) Indicate that quotation will remain open for acceptance by the Owner for 30 days; and

h) Submit all required back-up documents.

(2) The Engineer will review the Contractor's quotations for contemplated Change Orders to determine whether the quotation is acceptable, require resubmittal or should be rejected. Additional substantiating data must be provided by the Contractor if requested by the Engineer.

(3) When the quotation has been evaluated and is deemed acceptable to the Engineer, the Engineer will prepare and complete a Change Order entering the acceptable quotation adjustments to the contract price and completion date for the Owner's signature. Once the Change Order is signed and fully executed by the Owner, it will then be forwarded to the Contractor for signature. The Change Order, signed by the Owner, records and authorizes the Contractor to proceed with the Works.

8. Methods for valuing and evaluating changes in the Works

(1) Lump sum Change Orders and Field Orders.

a) The content of Change Orders or Field Orders will be based on a prior quotation from the Contractor and agreed to by the Engineer and the Owner.

b) The Contractor shall submit all necessary backup documentation and the quotation shall be broken down as much as required by the Engineer.

(2) Unit price Change Orders and Field Orders.

a) The content of Change Orders or Field Orders will be based on either prior agreed quantities or a survey of completed Works.

b) The amounts of unit prices shall be those quoted in the Schedules to the contract.

c) When quantities can be determined prior to start of Works, the Engineer will prepare and complete a Change Order or Field Order describing the Works and entering the agreed confirmed unit prices, total quantities and total cost adjustments to the contract price and the construction schedule, for the Owner's signature. Once the Change Order or Field Order is signed and fully executed by the Owner, it will then be forwarded to the Contractor for signature. The Change Order or Field Order,

signed by the Owner, records and authorizes the Contractor to proceed with the Works.

d) When quantities cannot be determined prior to start of Works, the Engineer will assign to the Contractor a Field Order signed by the Owner agreeing and authorizing the described Works to proceed immediately on the basis of the unit prices and an estimate mutually agreed upon. Upon completion of the changes involved, the Engineer will complete the Field Order entering the final total cost of the Works based on agreed confirmed unit prices and actual measured quantities as support data submitted for the Owner's signature to adjust the contract price and completion date as applicable.

(3) Force account/time and material Change Orders and Field Orders.

a) When a change in the Works cannot be agreed upon by the lump sum and unit price methods, the Engineer may authorize the Works to be carried out on a force account/time and material basis.

b) The Engineer will provide the Contractor with a Field Order, signed by the Owner agreeing and authorizing the described Extra Work to proceed immediately on a force account/time and material basis as reviewed on the work site.

c) The Contractor shall support claims for changes determined by this method via numbered Daily Time Sheets (DTS) submitted the day following the work with dates and times the Works was performed and by whom; time record, summary of hours worked and hourly rates paid; receipts and invoices for equipment used, listing dates and times of use; materials and products used, listing quantities; subcontracts.

d) Submit claims on Owner's standard DTS form in accordance with approved procedures and requirements.

e) Upon completion of the changes, the Engineer will complete the Field Order entering the final approved total cost for the Extra Work involved, based on agreed confirmed time and material support data, invoices, time sheets and records submitted for the Owner's signature to adjust the contract price and completion date as applicable.

(4) Quotations for changes in the Works shall show credits for Works deleted from the contract as a result of the change in the Works, if applicable.

(5) The mark-up on each change shall be applied to the net difference between credits and extras except in the case where the change results in a net credit to the contract price, in which case the Contractor is not entitled to charge mark-up on the net credit. Any dispute arising under this Section shall be governed by dispute resolution procedures set out elsewhere in the Contract Documents.

2.1.6 Standby Time and Standdown Time

1. Any payment by the Owner to the Contractor for Standby time or Standdown time will require approval by the Owner and will apply only during delays caused by or requested by the Engineer or the Owner. The sum of work hours and Standby time or Standdown time due to approved delays shall not exceed twelve hours per day.
2. During Standby time, the Contractor shall clean the work site and engage in any other Works as approved and directed by the Engineer.

END OF SECTION 2

Section 3
Mobilization and Demobilization

3 Mobilization and Demobilization

3.1 Part 1 – General

3.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

3.1.2 Description

1. The Works covered by this section consists of supplying all plant, labour, materials and equipment, and performing all Works necessary for the Contractor's mobilization and demobilization.

2. Mobilization shall be to site and shall include all costs required to:
   (1) Provide the Owner with a complete list of plant, equipment, tools, supplies (including a reasonable supply of spare parts for plant and equipment) and materials that will require barging from Hay River. This list must be complete with individual piece shipping dimensions and weight. Barge transport will be arranged by the Owner.
   (2) Provide the Owner with a complete inventory of fuel requirements for completion of the Works.
   (3) Provide the Owner with a complete inventory of the explosives requirements of the Works.
   (4) Mobilize all plant, equipment, tools, supplies and materials to a staging area in Hay River.
   (5) Offload and winterize all plant, equipment, labour, tools, supplies and materials in a temporary lay-down area at Roberts Bay.
   (6) Mobilize all labour, supervision, technical personnel and other services required for completion of the Works to the work site.
   (7) Mobilize all plant, equipment, tools, supplies and materials from the temporary lay-down area at Roberts Bay to the work site.
   (8) Furnish and install temporary facilities and utilities required for construction including Engineer's work station.
   (9) Setup and assemble plant and equipment and move to the first specific Works location.
   (10) For each new person through the life of the Works, attend an initial, and all subsequent Health and Safety site briefings as discussed in the Contractor's and Owner's Health and Safety Plans.

3. Demobilization shall be considered complete when all plant, labour, equipment, temporary facilities and surplus and waste materials resulting from the Contractor's operations have been removed from site and the work areas have been cleaned, reclaimed, and graded to the satisfaction of the Engineer.

3.1.3 Submittals

1. At most 30 days after award of the contract, the Contractor shall submit a mobilization plan, including:

   (1) Shipping dimensions and weights of all plant, supplies, tools, equipment and materials.

   (2) Complete fuel requirements to carry out the Works, including plant, equipment, explosives mixing, heat and any other incidental requirements. An appropriate contingency volume must be allowed for as a separate item.

   (3) Complete explosives requirements to carry out the Works, including Bulk Ammonium Nitrate (ANFO), stick explosives, detonator cord and detonators. An appropriate contingency volume must be allowed for as a separate item.

   (4) The relevant information required under the Section entitled “General Requirements”;

   (5) A layout drawing of the Contractor’s temporary facilities, including potable water source.

   (6) Layout drawings of all disposal areas for treated sewage effluent or other similar wastes.

   (7) Contractor Health and Safety Plan.

2. By June 20, 2008 at the latest, the Contractor shall submit a demobilization plan, including:

   (1) Shipping dimensions and weights of all plant, supplies, tools, equipment and materials.

   (2) Shipping dimensions and weights of any waste that will be shipped out.

3.1.4 Execution

1. Mobilization:

   (1) The mobilization will take place in a number of stages requiring significant lead times.

   (2) The first stage requires mobilization of all the plant, tools, supplies, equipment and materials to a staging area in Hay River early summer. These will be loaded on barges and shipped to Roberts Bay for arrival in late summer.

   (3) Barging will be arranged for by the Owner.

   (4) The Contractor will arrange offloading of the barges and winterizing of plant, tools, supplies, equipment and materials.

   (5) Once complete winter conditions has set in, the Contractor will mobilize all labour, supervision, technical personnel and other services required to carry out the Works to the Works site.

2. Demobilization:

   (1) Demobilization will take place in a number of stages requiring significant lead times.

   (2) The first stage requires mobilization of all the plant, tools, supplies, equipment and materials to the beach laydown area at Roberts Bay.

   (3) The Contractor will assist in loading the barges upon arrival at Roberts Bay, at which time demobilization from site will be deemed complete, provided all other conditions as stipulated by the contract and these Specifications has been met.

3.2 Part 2 – Execution

3.2.1 Mobilization

1. The Contractor shall maintain the scope and delivery schedule of all major mobilization items including barge load dimensions and weights, fuel requirements and explosives requirements in accordance with the submitted and approved mobilization plan.

3.2.2 Demobilization

1. Demobilization shall be carried out to the satisfaction of the Engineer.
2. The site shall be cleaned up, all surplus and waste materials removed and sanitary and petroleum wastes disposed off site to the satisfaction of the Engineer.
3. Borrow area slopes shall be trimmed to stable and reasonably uniform slopes. Inverts of the impervious borrow areas shall be sloped to drain.
4. Construction sedimentation ponds shall be removed and backfilled to blend with existing contours, and reclaimed to the satisfaction of the Engineer.
5. Should the Contractor fail to complete the demobilization and after being requested to do so by the Engineer, the Owner may without further notice, perform such Works with his own forces and charge the cost thereof to the Contractor.

3.3 Part 3 - Measurement and Payment

1. Progress payments will be made against the lump sum prices entered in **Schedule 1** under - “Mobilization” and “Demobilization”.
2. Progress payments will be made in proportion to the completed mobilization and demobilization activities for which approved submittals are received, as determined by the Engineer and Owner.

END OF SECTION 3

Section 4
Clearing and Stripping

4 Clearing and Stripping

4.1 Part 1 – General

4.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

4.1.2 Definitions

1. The following words and terms, unless the context otherwise requires, in this Specification, shall have the meanings set out below:
   (1) CLEARING means Works involved in the removal of snow and ice on natural ground or subgrade surface to the satisfaction of the Engineer.
   (2) STRIPPING means Works involving excavation and removal of unsuitable material including organics and ice rich materials.

4.1.3 Description

1. The Works covered by this section consists of supplying all labour, materials, and equipment, and performing all Works necessary for clearing and striping.
2. The Contractor shall clear or clear and strip the Works areas as required including, but not limited to; borrow areas, disposal areas, stockpile areas, laydown areas, water management areas, and foundation zones, as shown on the drawings, or inferred by these Specifications.
3. Clearing and stripping in all areas shall require written approval by the Engineer before such Works begins.

4.1.4 Submittals

1. At least five days prior to clearing, striping, or clearing and stripping, the Contractor shall submit to the Engineer for approval a Clearing and Stripping Work Plan describing the schedule, locations and extent of the clearing and striping, and the proposed methods for disposal of clearing and stripping products.

4.1.5 Permits and Regulations

1. The Contractor shall conduct his work in accordance with the Owner's and all applicable Federal, Territorial, local or landowner regulations regarding the disposal of materials from clearing and stripping.
2. It is the Contractor's responsibility to be aware of the Owner's, and other applicable regulations.

4.1.6 Protection

1. Unless otherwise instructed, the Contractor is to take all necessary precautions to prevent damage to natural features, monuments, survey marks, archaeological sites, and the sensitive tundra landscape.
   (3) If damage has occurred inadvertently the Contractor shall repair such damage to the approval of the Owner.
   (4) The Contractor shall compensate the Owner for any inadvertent damage, where repair or equivalent replacement is considered by the Engineer to be impractical.
   (5) Valuation for damage and replacement shall be at the sole discretion of the Engineer.
2. The Contractor may not perform any Works outside of the permitted and pre-approved construction area.

4.2 Part 2 – Execution

4.2.1 Preparation

1. The Contractor shall confirm the clearing or stripping limits by having his surveyor layout and flag the extents at all areas of work, prior to commencement of clearing or stripping. The Engineer will confirm all clearing or stripping limits, and inspect the areas of work with the Contractor before commencement of the Works.
2. The Contractor shall inspect the Works site and verify with the Engineer and the Owner, any restrictions within or adjacent to the clearing limits. The Contractor shall inspect areas adjacent to the work site to undergo clearing or stripping.
3. Unless specifically instructed otherwise, the Contractor shall locate and protect natural features, monuments, survey marks, archaeological sites, and the sensitive tundra landscape.

4.2.2 Clearing

1. Snow and ice shall be removed from all construction footprint areas with a maximum tolerance of 2.5cm of snow material left above natural ground, or otherwise approved by the Engineer.
2. Should snow fall on previously cleared or stripped surfaces, that have been prepared and approved for construction, the Contractor will carry out any additional clearing as required by the Engineer.
3. The Contractor shall take all necessary precautions to prevent damage to natural and frozen ground, unless otherwise specified by the Engineer.

4.2.3 Stripping

1. Where required and as a minimum in areas to be excavated, areas subjected to clearing shall undergo stripping to the depth necessary to remove all soil, including permafrost and other organic material necessary to expose bedrock, or other suitable foundation conditions as directed by the Engineer.

2. Should blasting be required of permafrost soils, the Contractor will comply to all Specifications associated with blasting, in addition to those listed in this Section.

4.2.4 Finished Surface

1. The Contractor shall leave the cleared and/or stripped surface clear, smooth, debris- and snow-free, in a condition suitable for receiving fill.

4.2.5 Disposal

1. Snow and ice cleared off the construction area shall be stockpiled downstream and outside of the construction area where it will not affect the construction or any constructed elements during thaw. The stockpile area shall be approved by the Engineer. A water management plan must be in place prior to stockpiling snow and ice in the specified area for the spring melt.
2. Soil and organic material stripped off the construction areas shall be stockpiled in designated areas approved by the Engineer with proper sediment control as instructed according to the drawings and Specifications.

4.3 Part 3 – Measurement and Payment

4.3.1 Measurement

1. Areas cleared, with material removed, handled and delivered as specified herein and in accordance with the drawings, or as directed or approved by the Engineer will be measured. Measurement will be of the horizontal plan area.
2. Areas stripped, with material removed, handled and delivered as specified herein, and in accordance with the drawings, or as directed or approved by the Engineer will be measured. Measurement will be by original in-place volume.
3. No measurement or payment shall be made for clearing outside of surveyed construction areas.

4.3.2 Payment

1. Payment will be made at the unit rates entered under “Clearing and Stripping” in **Schedule 1**.

END OF SECTION 4

Section 5
Excavation

5 Excavation

5.1 Part 1 – General

5.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

5.1.2 Description

1. The excavation Works entails excavation of soil and other materials below original ground surface to neat lines as indicated on the drawings.
2. The Works to be done under this Section consists of furnishing all labour, material, plant and equipment, and the performance of all Works necessary to carry out rock, soil and permafrost excavation as shown on the drawings, and as specified herein, which will include, but is not limited to the following:
   (1) Excavation of material at the Fuel Tank Farm.
   (2) Excavation of material at the Landfill.
   (3) Excavation of material at the Landfarm.
   (4) Excavation of material at the Mill Pad.
   (5) Excavation of material in the Dam key trenches.
   (6) Excavation of material in the Spillway.
3. The Works shall also include the loading, transportation and permanent disposal of all excavated materials which are deemed by the Engineer to be surplus, or unsuitable for use as a construction material, and the loading, transportation and possible temporary stockpiling and re-handling of acceptable materials to locations where they can either be used as part of the temporary or permanent structures, or stockpiled in readiness for future temporary or permanent use.

5.1.3 Definitions

1. The following words and terms, unless the context otherwise requires, in this Specification, shall have the meanings set out below:
   (1) SOIL means general overburden material including glacial marine clays, silty clays, sand, and any combination of these materials, which can be used in part as bedding material for liners or concrete aggregate if they are free of contaminants, snow, ice and organic material, and if approved by the Engineer.
   (2) PERMAFROST means soil that is permanently frozen.
   (3) ROCK means quarried material from a designated quarry site, or from a designated foundation excavation.

(4) UNSUITABLE MATERIAL means any soil or rock that does not meet the Specifications for the use of this project.

(3) BLASTED MATERIAL means any material produced by production blasting at all quarry or excavation sites that is deemed to be suitable for construction material.

(4) NEAT LINE means the final line or grade to which excavation is to be performed.

(5) QUARRY and BORROW areas meaning is interchangeable.

(6) COMMON EXCAVATION means excavation of all materials, including rock, weathered bedrock, soil and unsuitable material by mechanical means.

5.1.4 Procedures

1. The details of the surface excavations shown on drawings represent an engineered design encompassing drainage under particular assumed conditions. Variations in site conditions may require adjustments to the excavation shape, slope reinforcement and drainage under the Engineer's discretion.
2. If, in a specific area, a plan that has been previously adopted does not fit the site conditions in accordance with the requirements of these Specifications, the Engineer shall submit a revised plan to the Contractor before continuing excavation in identified areas.
3. All earthworks that will potentially disturb the original ground shall be constructed during the winter season to prevent damage to the tundra. All construction Works and traffic shall be within the constructed footprint during summer months.
4. Water management measures shall be constructed and implemented during the winter months, and only emergency adjustments can made during the following spring and summer.

5.1.5 Submittals

1. The Contractor shall submit a detailed excavation plan outlining his intended methods for general and open cut rock excavation within a given area at least one week prior to the commencement of Works including the following details:

   (1) Typical equipment deployment.

   (2) Work schedule including number of workers, Works area, volume, stockpile area, traffic pattern and hours of operation.

   (3) Contingency plans for change in weather conditions and other foreseeable risks.

   (4) Sediment and runoff control around the intended Works area.

   (5) Typical blast method including hole size, depth, spacing, burden and loading details for production, buffer, pre-split holes, if required.

2. The Contractor's plan must be approved by the Engineer.

5.2 Part 2 – Execution

5.2.1 Preparation

1. Prior to beginning grading or excavation operation in any area, all necessary clearing and stripping in that area shall have been performed in accordance with the Specifications.
2. The Contractor shall satisfy himself as to the character, quantity, and distribution of all the material to be excavated. No payment will be made for any excavated material that is used for purposes other than those designated or specified by the Engineer.
3. The Contractor shall have a contingency plan for sudden unforeseeable change of weather conditions in place prior to excavation commencement. The Contractor shall have a daily Works plan in relation to the weather conditions, equipment, operator availability, area of Works, and schedule.
4. The Contractor shall be responsible for sediment and runoff control around the construction area to ensure there is minimal impact on the natural state of the surrounding environment. The Engineer will inspect and approve the condition and performance of the sediment and runoff control measures.

5.2.2 Common Excavation Methods

1. Common excavation of weathered bedrock and soil, including permafrost, shall be performed as indicated on the drawings, or as directed by the Engineer to the lines, grades, and elevations, and shall be finished to a reasonable smooth and uniform surface.
2. Should the Contractor, through carelessness or other fault, excavate beyond the designated grades, he shall replace the excavation in an approved method, in accordance with the Specification, at his own expense.
3. All excavated material determined unsuitable shall be disposed of as directed by the Engineer.
4. At all times during construction, the Contractor shall adopt excavation procedures such that at no time shall the stability of any slope be impaired.
5. The final excavation surface exposed by each lift shall be supported to the Engineer's satisfaction, before commencing excavation of the next lift.

5.2.3 Excavation in Quarry Areas

1. Borrow excavation shall be performed as indicated on the drawings or as directed by the Engineer to the lines, grades, and elevation.
2. Borrow development will be the responsibility of the Contractor in accordance with staged plans submitted to the Engineer for approval prior to undertaking the Works.
3. Methods of access and excavation in the borrow areas will be determined by the Contractor.

4. The Contractor shall use appropriate blasting methods to control the height of each bench and grain sizes. The Contractor is responsible for fragmentation and throw of the material to ensure ease of excavation.
5. Excavation in the borrow area should be optimized by the Contractor for safety of equipment operation, water control, and bench stability.
6. Prior to excavation of the material, certified personnel must inspect the blast pattern to ensure all blasting agents were ignited and none were left behind.

5.2.4 Control of Surficial Water

1. Surface water flows during the melting seasons shall be directed away from the Works by means of diversion berms, ditches or other acceptable means and, in any case, all surface flows on the Works area shall be satisfactorily controlled, and to the environmental standards specified.
2. See Section 10 for Surficial Water Management details. Plans and appropriate structures shall be installed during winter construction period in preparation for spring melt.

5.2.5 Scaling and Safety

1. Immediately following excavation and at any time during the Contract, all loose material on slopes, which appears to be unsafe or to endanger workmen, structures or equipment, shall be scaled and removed.
2. All scaling will be considered incidental to the Works, and will be the responsibility of the Contractor.

5.3 Part 3 - Measurement and Payment

5.3.1 Measurement

1. Measurement for payment for excavation of soil, permafrost and weathered bedrock for construction of permanent Works shall be measured in place, after construction, to the nearest cubic metre for the actual volume of rock excavated, to the neat lines shown on the drawings. Measurement shall be based on survey done by the Contractor before and after the Works is completed, and approved by the Engineer.
2. Excavation to neat lines for permanent Works in quarry will not be measured for payment.
3. Excavated materials for construction and future maintenance stockpiles will be measured volumes from the difference between the original ground survey prior to work and survey of the as-built excavation.
4. No separate measurement will be made for scaling or barring rock faces.

5.3.2 Payment

1. Payment for excavation for permanent Works to neat lines will be made at the relevant unit prices per cubic metre in **Schedule 1**, measured as specified and will include all costs to access the Works, excavate, remove and dispose of material, as specified in the drawings.
2. Payment for stockpiled material will be made at the relevant unit prices per cubic metre in **Schedule 1**.
3. No payment will be made for over-excavation, as determined by the Engineer.
4. Scaling and barring of all temporary construction rock slopes will be considered incidental to the Works.
5. Reinforcement and drainage of rock slopes for permanent Works, if required by the Engineer, will be paid for as Extra Work. Reinforcement required due to blast damage will not be paid for.

END OF SECTION 5

Section 6
Drilling and Blasting

6 Drilling and Blasting

6.1 Part 1 – General

6.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

6.1.2 Description

1. All blasting operations must be performed in accordance with Miramar Hope Bay Ltd.'s EMPM and all Federal and Territorial Regulations.
2. Blasting near water bodies frequented by fish, will require lower powder factors, as determined by strict Guidelines provided by the Department of Fisheries and Oceans.
3. The Contractor will be responsible to familiarize himself with all appropriate conditions that would apply to blasting.
4. The Works to be done under this Section consists of supplying all labour, materials, plant and equipment, and performing all Works necessary to carry out drilling and blasting with certified personnel and chemical agents as shown on drawings and specified herein.
5. The Works shall include; but is not limited to:
   (1) Provide a typical list of safety protocols, chemical blasting agents, blast patterns and powder factors that will be suitable for carrying out the Works, and for producing the specified construction materials.
   (2) Drilling with appropriate equipment, to appropriate depth and grade to execute the Works, develop rock quarries and any other common excavation as shown on the drawings, or as directed by the Engineer.
   (3) Provide suitably qualified personnel, with current blasting certificates to carry out all required safety protocols for blasting regulations prior to ignition.

6.1.3 Definitions

1. The following words and terms, unless the context otherwise requires, in this Specification, shall have the meanings set out below:
   (1) CERTIFIED PERSONNEL means a suitably qualified person that hold current blasting certificates issued by all necessary Territorial and Federal Regulatory agencies for the Project.
   (2) CHEMICAL BLASTING AGENTS means any form of agents, and components that are suitable for use in the Project.

6.1.4 Submittals

1. Work shall not start until applicable approvals are obtained from the Engineer in writing.
2. The Contractor shall submit a Drilling and Blasting Plan describing the schedule, and proposed methods for borrow development and common excavation.
3. Approval of submittals shall not relieve the Contractor of its sole responsibility to construct the Works in accordance with specified requirements.

6.2 Part 2 – Products and Personnel

1. The Contractor is responsible to procure all necessary supplies and equipment for drilling and blasting operations, excluding the chemical blasting agents, detonators and detonator cords, which will be supplied by the Owner.
2. The Contractor is responsible to acquire all required licenses and notifications from Territorial and Federal Regulatory Agencies.
3. The Contractor is responsible to have appropriately qualified and certified persons to handle all aspects of the drilling and blasting Works, including, but not limited to management of inventory, mixing of explosives, storage of explosives, transportation of explosives, placing of charges, ignition of explosives, and clearing of explosives after ignition.
4. The Contractor is responsible for management, maintenance and security of the Explosives Facility,

6.3 Part 3 – Execution

6.3.1 Drilling

1. The Contractor will lay out the appropriate blast pattern for the specified material grade required, at appropriate locations.
2. The Contractor will drill blast holes in accordance with the blast pattern requirements, taking due care to prevent over-breaking.
3. The Contractor will ensure that the appropriate surface water containment and management procedures are followed when drilling.

6.3.2 Blasting

1. The Contractor's Health and Safety Plan, list of blasting agents, technician's certificates, and proposed methods of blasting will be provided by the Contractor 14 days prior to blasting operation, for Engineer's approval.
2. The Contractor will provide appropriately qualified and certified personnel to manage all aspects of the blasting.
3. The Contractor will be responsible for notifying all air and land traffic of the time and location of any blast at least 24 hours in advance.

4. The Contractor will be responsible for putting in place all protocols and physical barriers to warn and prevent land and air traffic from entering the designated blast zone, according to all applicable Territorial and Federal Regulations and the Contractors Health and Safety Plan.
5. The Contractor should use controlled blasting methods to ensure production of specified materials, ease of excavation and to minimize processing requirements.
6. Certified Personnel must inspect the blast pattern post blasting to ensure there are no unexploded agents and explosives left behind prior to excavation. If unexploded material is found in the pattern, Certified Personnel must remove the danger material according to normal practice and the Contractor's Health and Safety Plan.

6.4 Part 4 – Measurement and Payment

6.4.1 Measurement

1. No measurement will be made for drilling and blasting as the work is incidental to fill material production, stripping or excavation.

6.4.2 Payment

1. No payment will be made for drilling and blasting for fill material production, stripping or excavation.

END OF SECTION 6

Section 7
Fill Material Specifications

7 Fill Material Specifications

7.1 Part 1 – General

7.1.1 Documents

1. This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

7.1.2 Description

1. The sources and borrow areas of all fill are shown on the drawings or as designated by the Engineer. For the types of material and related Specifications, see the gradation envelopes in the drawings. The material types required for completion of the Works are labelled as:
   (1) Riprap
   (2) Run-of-Quarry
   (3) Select subgrade
   (4) Surfacing
   (5) Pipe bedding
   (6) Drainage gravel
   (7) Core material
   (8) Transition material
2. All construction materials shall be non acid generating, free of organic matter or similar impurities, as well as snow and ice.
3. The Contractor is responsible for supplying, installing, operating and maintaining all the necessary plant, equipment, materials, labour and supervision to produce the specified construction material on site.

7.1.3 Submittal

1. The Contractor shall submit a complete list of plant, equipment, materials and spare parts, that will be use to produce the specified fill materials, prior to mobilization for Engineer's approval.

7.2 Part 2 – Product

7.2.1 General

1. Quarry areas
   (1) Fill, required for the Works, shall be obtained and manufactured by the Contractor from designated borrow areas as shown on the drawings, and from the excavation of selected foundations.
   (2) Unsuitable material from an excavation for the Works shall be disposed of in a designated onsite disposal area as directed by the Engineer.

(3) If the Contractor proposes to obtain any fill from an area not within the excavations or designated areas shown on the drawings, he shall first obtain the necessary approvals and permits to carry out such sub-surface investigation and obtain and submit such samples, as are required, to enable the Engineer to assess the suitability of the fill for the Works.

(4) The Contractor shall keep accurate exploration records of any test pit, trench or drill hole which it makes for the purpose of investigating borrow material, and a copy of such records shall be submitted to the Engineer within seven days of the completion of exploration Works.

(5) The Contractor shall give the Engineer not less than 14 days notice of his intention to develop any potential borrow area not shown on the drawings.

(6) The Contractor shall make his own determination of the adequacy of any borrow source he intends to exploit.

2. Foundation excavation
   (1) Fill acquired from foundation excavation shall meet the Specifications.
   (2) Fill shall be used in place with minimum handling to minimize degradation and segregation.
   (3) Unsuitable material from the excavation for the Works shall be disposed of in a designated onsite disposal area as directed by the Engineer.
3. Core material handling
   (1) The Contractor shall supply, operate and maintain all necessary plant to ensure that the appropriate moisture conditioning and placement of the Core material can be carried as specified.

7.2.2 Riprap

1. Riprap material shall be competent non acid generating rock sourced from the quarries or foundation excavations, and that is free from organic matter, snow and ice.
2. The gradation of the Riprap material shall meet the specifications shown on the drawings.
3. Basic screening or manual selection may be used to achieve the desired gradation.
4. The Riprap material shall be washed to remove blast residue or fines, unless otherwise directed by the Engineer.

7.2.3 Run-of-Quarry Material

1. Run-of-Quarry (ROQ) material shall consist of competent non acid generating material sourced from the quarries or foundation excavations, and that is free of organic matter, snow and ice.
2. The gradation of the ROQ material shall meet the specifications shown on the drawings.
3. Basic screening, or crushing and screening may be used to achieve the desired gradation.
4. The ROQ material shall be washed to remove blast residue or fines, unless otherwise directed by the Engineer.

7.2.4 Select Subgrade Material

1. Select subgrade material shall consist of competent non-acid generating material sourced from the quarries or foundation excavations, and that is free of organic matter, snow and ice.
2. The gradation of the Select subgrade material shall meet the specifications shown on the drawings.
3. Crushing and screening will be required to meet the Specifications.
4. The Select subgrade shall be washed to remove blast residue or fines, unless otherwise directed by the Engineer.

7.2.5 Surfacing Material

1. Surfacing material shall consist of competent non acid-generating material from the quarries or foundation excavations, and that is free of organic matter, snow and ice.
2. The gradation of the Surfacing material shall meet the specifications shown on the drawings.
3. Crushing and screening will be required to meet the Specifications.
4. The Surfacing material shall be washed to remove blast residue or fines, unless otherwise directed by the Engineer.

7.2.6 Pipe Bedding Material

1. Pipe bedding material shall consist of competent non acid-generating material from the quarries or foundation excavations, including soil, and that is free of organic matter, snow and ice.
2. The gradation of the Pipe bedding material shall meet the specifications shown on the drawings.
3. Crushing and screening will be required to meet the Specifications when using rock sources.
4. Screening and washing shall be required, unless otherwise directed by the Engineer, when using soil sources.
5. The Pipe bedding material will require moisture conditioning prior to placement to ensure that it is workable and that it does not become a hard frozen layer that cannot act as a protective layer, at least whilst construction takes place.

7.2.7 Drainage Gravel

1. Drainage gravel material shall consist of competent non acid-generating material from the quarries or foundation excavations, including soil, and that is free of organic matter, snow and ice.
2. The gradation of the Drainage gravel material shall meet the specifications shown on the drawings.
3. Crushing and screening will be required to meet the Specifications when using rock sources.
4. Screening and washing shall be required, unless otherwise directed by the Engineer, when using soil sources.

7.2.8 Core Material

1. Core material shall consist of competent, non-saline, non-acid generating material from the quarries or foundation excavations, and that is free of organic matter, snow and ice.
2. The gradation of the Core material shall meet the specifications shown on the drawings.
3. Crushing and screening of the Core material will be required to meet the Specification.
4. The Core material will require moisture conditioning during placement to a moisture content representing a minimum average degree of saturation of 85% with none below 80%. The material will be placed in winter and will require heating to maintain compaction capability prior to freezing.
5. The Core material shall be washed to remove blast residue or fines, unless otherwise directed by the Engineer.

7.2.9 Transition Material

1. The Transition material shall consist of competent non acid-generating material from the quarries or foundation excavations, and that is free of organic matter, snow and ice.
2. The gradation of the Transition material shall meet the specifications shown on the drawings.
3. Crushing and screening will be required to meet the Specification.
4. The Transition material shall be washed to remove blast residue or fines, unless otherwise directed by the Engineer.

7.3 Part 3 – Measurement and Payment

1. Measurements of the fill materials will be done in unit volume after it is compacted in place for specified permanent Works. The measurement shall be done by survey from the Contractor. See Section 9 for details.
2. No special payment will be made for moisture control or any special handling requirements to ensure that the fill Specifications are met.

END OF SECTION 7

Section 8
Geosynthetic Specifications

8 Geosynthetic Specifications

8.1 Part 1 – General

8.1.1 Documents

1. This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts
2. This section specifies requirements for the supply and installation of the following geosynthetic products:
   (1) Textured High Density Polyethylene (HDPE) Liner;
   (2) Non-Woven Geotextile Fabric;
   (3) Geosynthetic Clay Liner (GCL);
   (4) Geogrid;
   (5) Extrusion rod; and
   (6) Bentonite powder.

8.1.2 Description

1. The Works to be done under this Section consists of furnishing all labour, materials and equipment and the performance of all Works necessary to carry out geosynthetic installations as shown on the drawings and as specified herein, which will include, but is not limited to the following:
   (1) Install geogrid at the Jetty;
   (2) Install geotextile and HDPE liner at the Fuel Transfer Station;
   (3) Install geotextile and HDPE liner at the Fuel Tank Farm;
   (4) Install geotextile and HDPE liner at the temporary waste rock pile Pollution Control Pond;
   (5) Install geotextile and HDPE liner at all Emergency Dump Catch Basins; and
   (6) Install geosynthetic clay liner at the North and South Dams.

8.2 Part 2 – Products

8.2.1 Submittals

1. The Contractor will submit the following information at least 14 days prior to material arrival at the Hay River marshalling area:
   (1) Manufacturer's written certification that the HDPE liner, GCL, geotextile and geogrid to be used, meets the Specifications, and has been continuously inspected.
   (2) The certification shall identify the origin and the manufacturer of any resin used in manufacturing of the geotextile.

8.2.2 Definitions

1. The following words and terms, unless the context otherwise requires, in this Specification, shall have the meanings set out below:
   (1) GEOSYNTHETICS includes textured HDPE liner, GCL, geotextile, geogrid and other supplies used in liner, geotextile or geosynthetic, deployment.
   (2) HDPE Liner means textured High Density Polyethylene liner, as specified.
   (3) GCL means Geosynthetic Clay Liner, as specified.
   (4) GEOTEXTILE means woven or non-woven geotextile, as specified.
   (5) EXTRUSION RODS means HPDE rods that are fed into an apparatus for extrusion welding.
   (6) BENTONITE POWDER means sodium montmorillonite clay used as a high swelling soil sealant, as specified.

8.2.3 Quality Control and Assurance

1. The Contractor must ensure that all geosynthetic manufacturers have an internal product quality control program that meets contract requirements.

2. The Contractor is responsible to ensure that all geosynthetic material delivered to site meet the Specifications.

3. Geosynthetics that do not meet the Specifications will be rejected, at no additional cost to the Owner. The Contractor will replace any rejected material with new material that meets the Specifications, at no additional cost to the Owner.

4. The Contractor must ensure that the geosynthetic installations are carried out by a suitably qualified and experienced team or subcontractor.

5. Delivery, storage and handling
   (1) Packing and shipping
      a) Supply geosynthetics in rolls with straps for unloading.
      b) Supply geosynthetics marked or tagged with the following information:
         i. Manufacturer's name
         ii. Product information
         iii. Roll number
         iv. Batch or lot number
         v. Roll dimensions
      c) Ensure that geosynthetics are properly loaded and secured to prevent damage during transit.
      d) Protect geosynthetics from excessive cold, heat, puncture, cutting, or other damaging or deleterious conditions.
      e) Ensure personnel responsible for loading, transport and unloading of geosynthetics are familiar with the handling and transport constraints imposed by the manufacturer.

(2) Acceptance at Works site

a) Engineer may perform inventory and surface inspection for defects and damage of geosynthetic rolls upon delivery.
b) The Engineer will unroll and inspect any geosynthetic roll that may appear to be damaged below surface layers.
c) The Contractor will repair damage resulting from handling and transport of geosynthetics at no cost to the Owner. If irreparable, in the opinion of the Engineer, the Contractor will replace damaged materials at no cost to the Owner.

(3) Storage and protection

a) Contractor will provide on-site area for storage of geosynthetic rolls from time of delivery until installation with the approval from the Engineer.
b) Prepare storage area so that the geosynthetic products are stored off the ground and protected from the elements (e.g. ultraviolet light, water, moisture, etc.).
c) After removing material from storage area, protect geosynthetics from puncture, dirt, groundwater, moisture, mud, mechanical abrasion, excessive heat and cold, ultraviolet light exposure, and other sources of damage.
d) Keep geotextile rolls in relatively opaque and water tight wrappings.
e) Preserve integrity and readability of the geosynthetics roll labels, and store such that Engineer shall have access to the package slips or roll labels for each roll to verify roll acceptance.

6. Subgrade preparation

(1) Prior to HDPE liner, GCL and geotextile deployment, all subgrade surfaces shall be compacted when specified, and free of debris including hard or sharp protruding objects. All subgrade must be approved by the Engineer prior to geosynthetics deployment.

(2) Prior to geogrid deployment, the subgrade surface shall be inspected to ensure that all cobbles and boulders have been removed. The subgrade must be approved by the Engineer prior to geogrid deployment.

7. The Contractor shall supply all testing technicians and equipment required in the Quality Assurance and Quality Control Program (QA/QC).

8. The Contractor's testing technicians shall be responsible for panel labelling, destructive testing, repair labelling and inspections, overall quality control of Works, and record keeping.

9. The Contractor shall have the records listed below for the review by the Engineer upon request and provide them to the Owner upon completion of the Works:

(1) Record of material deployment.

(2) As-built panel layout with panel number and associated roll number finalized in AutoCAD format.

(3) All destructive test results with panel numbers and associated roll numbers.

8.2.4 Product Specifications

1. The High Density Polyethylene (HDPE) liner shall be textured, and have a nominal thickness of at least 1.4mm (57 mil). The basic liner requirements are listed in Table 8.1.

Table 8.1: HDPE liner specifications (typical product)

Parameter	Standard	HDPE 60 Textured
Nominal Thickness	ASTM D5199	1.42 mm (57 mil)
Density (Untextured)	ASTM D792	0.94
Tensile Strength Modified Type IV Die	ASTM D638 (Stress at Yield)	22.0 kN/m (126 ppi)
	ASTM D638 (Stress @ Break)	15.8 kN/m (90 ppi)
	ASTM D638 (Strain @ Yield 33mm Gauge)	12%
	ASTM D638 (Strain @ Break 50mm Gauge)	100%
Tear Resistance	ASTM D1004	187 N (42 lbs)
Dimensional Stability	ASTM D1204 (Max Cng).	± 2%
Notched Constant Load ESCR	ASTM D5397	200 Hours
Punctured Resistance	ASTM D4833	400N (90 lbs)
Carbon Black Content	ASTM D1603	2.0 – 3.0%
Carbon Black Dispersion	ASTM D5596	CAT 1 or 2
Bonded Seam Strength Test Temp 23°C, 73°F	ASTM D6392	21 N/mm (120 ppi)
Peel Adhesion Test (FTB) Test Temp 23°C, 73°F	ASTM D6392	14 N/mm (78 ppi)

2. The Geosynthetic Clay Liner (GCL) shall satisfy the Specifications as listed in Table 8.2.

Table 8.2: GCL specifications (typical product)

Parameter	Standard	GCL VN
Bentonite Mass per Unit Area[1]	ASTM D5993	3.67 kg/m^2 (0.75 lb/ft$^{2)}$
Grab Tensile Strength[2]	ASTM D4632	420 N (95 lbs)
Peel Strength	ASTM D4632	66 N (15 lbs)
Hydraulic Conductivity[3]	ASTM D5321	5x10^{-9}cm/sec max.
Internal Shear Strength (Typical) at 200 psf normal stress (10 kPa)	ASTM D5321	24 kPa (500 psf)
Geotextile Component Properties		
Mass per Unit Area	ASTM D5261	non-woven 200 g/m^2 (6.0 oz/yd^2)
Mass per Unit Area	ASTM D5261	woven 105 g/m^2 (3.1 oz/yd^2)
Bentonite Component Properties		
Swell Index	ASTM D5890	24 ml/2 g min.
Moisture Content	ASTM D4643	12% max.
Fluid Loss	ASTM D5891	18 ml max.

[1] Oven-dried measurements
[2] Measured in weakest principal direction
[3] De-aired tap water @ 5 psi effective stress and 2 psi head

3. The geotextile shall be a non-woven needle-punched fabric with a nominal weight of at least 385g/m^2 (12 oz), and must satisfy the Specifications listed in Table 8.3:

Table 8.3: Geotextile specifications (typical product)

Parameter	Standard	LP12
Grab Tensile	ASTM D4632	1,330 N
Elongation	ASTM D4632	50%
Tear	ASTM D4533	510 N
Puncture	ASTM D4833	775 N
Mullen Burst	ASTM D3786	3,995 kPa
AOS	ASTM D4751	150 microns
Permittivity	ASTM D4491	0.9 sec-1
Water Flow	ASTM D4491	2,648 l/min/m^2
Weight	ASTM D5261	385 g/m^2 (Nominal)
Thickness[1]	ASTM D5199	3.0 mm (Nominal)
UV (500 hrs)	ASTM D4355	70%
Roll Size	n/a	4.57 X 91.4 m
Roll Weight[1]	n/a	181 kg

[1] Typical values. All other values are minimum average roll values (MARV)

4. The geogrid shall be a bi-axial polypropylene geogrid with a nominal aperture size of at least 40 x 40 mm, and must satisfy the Specifications listed in Table 8.4.

Table 8.4: Geogrid specifications (typical product)

Standard	Standard	E'GRID 3030
Aperture Size (Typical)	n/a	40 x 40 mm
Wide width Tensile (MD/CD)	ISO 10319	30/30 kN/m
Strength @ 2% Strain (MD/CD)	ISO 10319	10.5/30 kN/m
Strength @ 5% Strain (MD/CD)	ISO 10319	21/21 kN/m
Junction Efficiency	GRI GG2	> 90%
Flexural Rigidity	ASTM D1388	1,6000,000 mg-cm
Torsional Stiffness	US Army Corps of Engineers	3.6 kg-cm/degree
Roll Size	n/a	3.9 x 75 m
Roll Weight (Typical)	n/a	88 kg

5. Extrusion rods and other welding supplies shall conform to the following Specifications:
   (1) Extrudate material shall be made from same type resin as the HDPE liner.
   (2) The extrusion rod has compatible diameter for proposed apparatus.
   (3) Contractor shall submit product certificates for Engineer's approval prior to deployment.
   (4) Additives shall be thoroughly dispersed.
   (5) Material shall be free of contamination by moisture or foreign matter.

6. Bentonite powder specification:
   (1) The bentonite supplied as a soil sealant shall be high swelling sodium montmorillonite clay.
   (2) High swelling is defined as the ability of 2 grams of bentonite, when mechanically reduced to a minus 0.15mm particle size, to swell in water to an apparent volume of 1.6cm^3 when added to 100cm^3 of water.
   (3) The dry fineness of the soil sealant shall be 98% minimum passing 4.75mm mesh and 5% maximum passing 0.85mm mesh.
   (4) The bentonite shall be stored in a dry area, and shall not be used if hydrated.
   (5) Contractor shall submit the manufacturer's product specification for approval by the Engineer, 14 days prior to procurement.

8.2.5 Equipment

1. The Contractor shall supply proper handling equipment, as recommended by the manufacturer, for the geosynthetic installation, which does not pose any danger to installation personnel or risk damage or deformation of the geosynthetics. Examples of suitable handling equipment include:
   (1) Spreader bar assembly
   (2) Stinger
   (3) Roller cradles
   (4) Straps

2. Equipment for welding HDPE:
   (1) A self propelled fusion wedge welder and an extrusion welding apparatus from a recognized manufacturer.
   (2) The fusion wedge welder shall have certified working gauges showing working temperature and speed.
   (3) An adequate number of extrusion welding apparatus shall be available to maximize production.
   (4) The Contractor must supply an adequate power source, capable of providing constant voltage under combined line load.
   (5) The Contractor must provide a suitable shelter and heater to ensure that a suitable environment can be created for completion of seams according to the Specifications.

8.3 Part 3 – HDPE Liner Installation

8.3.1 Installation

1. Deployment
   (1) The Contractor must submit a proposed liner layout 14 days prior to deployment for Engineer's approval.
   (2) An anchor trench shall be excavated by the Contractor to the lines and grades shown on the drawings or as directed by the Engineer.
   (3) The liner should cover the depth and width plus minimum 200mm slack beyond the width of the trench.

(4) The liner shall not be excessively dragged across the subgrade.

(5) Assign each panel a simple and logical identifying code. The coding system shall be subject to Engineer's approval and shall be determined at the site.

(6) Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.

(7) Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

a) Unroll the geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage.

b) Unroll the geomembrane with the textured surface on top. Its purpose for this Project is to provide some slip resistance for workers, as opposed to structural integrity.

c) Place ballast on geomembrane which will not damage or puncture the geomembrane to prevent wind uplift.

d) Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage the liner. Smoking will not be permitted on the geomembrane.

e) Do not allow heavy vehicular traffic directly on geomembrane. Low bearing vehicles under 42 kPa might be permitted with Engineer's approval.

f) Protect geomembrane in areas of heavy traffic by placing protective cover over the liner. The protective cover should as a minimum consist of 0.30m of approved fill material. This thickness is subject to change by the Engineer depending on site conditions.

(8) The Contractor shall determine to his own satisfaction that sufficient extra material for anchor embedment, seams, slack, thermal expansion and contraction of the material and waste are included on top of the neat area given in **Schedule 1** for the liner installation.

2. Field seaming

(1) Fusion weld seams shall meet the following requirements:

a) To the maximum extent possible, orient seams parallel to line of slope.

b) Minimize number of field seams in corners, odd-shape geometric locations and outside corners.

c) Slope seams shall extend a minimum of 1.5m beyond the grade break into the flat area.

d) Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the Engineer.

e) Align seam overlaps consistent with the requirements of the welding equipment being used. A minimum 150mm overlap is recommended to ensure proper welding.

f) Use manufacturer's recommended temperature and speed for the wedge welders.

g) Clean seam area of dust, mud, moisture and debris immediately ahead of wedge welder.

h) Protect against moisture build-up between sheets due to condensation.

(2) Extrusion welding
   a) Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.
   b) Clean and roughen geomembrane surfaces by disc grinder or equivalent.
   c) Purge extrusion welding apparatus of heat-degraded extrudate before welding.

(3) Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Contractor shall demonstrate that acceptable seaming can be performed by completing a weld and obtaining approval by the Engineer.

(4) Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available to the Engineer.

3. Field Quality Assurance

(1) Non-destructive testing may be carried out as the seaming progresses.
   a) Vacuum testing shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
   b) Air pressure testing shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembrane.

4. Destructive testing
   a) One sample per 450m liner seam length or as Engineer requested.
   b) Contractor shall cut samples at locations designated by the Engineer as the seaming progresses in order to obtain field laboratory test results.
   c) Destructive testing shall be performed in accordance with ASTM D 6392, Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

(2) Failed seam procedures
   a) Reconstruct the seam between any two passed test locations. Or,
   b) Trace the weld to intermediate location at least 3m minimum, or where the seam ends in both directions from the location of failed test.
   c) Extrude weld or cap the failed section tying into passed seam.

(3) Repair procedure
   a) Contractor shall be responsible for repair of defective areas.
   b) Remove damaged geomembrane and replace with acceptable geomembrane material if damage cannot be satisfactorily repaired.
   c) All repairs shall be verified by the Engineer.

8.3.2 Liner Cover

1. All exposed HDPE liner will be covered with minimum 0.2m of Surfacing material unless stated otherwise. The material shall be deployed with care to ensure that the liner will not be damaged during the operation. The material is to be spread evenly without any compaction. Traffic shall not be permitted directly on the geomembrane.
2. Unless specifically indicated by the Engineer, HDPE liner shall at all times be placed between two geotextiles.

8.4 Part 4 – GCL Installation

8.4.1 GCL Deployment

1. The Contractor shall submit a proposed panel lay out plan for Engineer's approval 14 days prior to deployment
2. The Contractor shall have sufficient amount of ballast weights, such as sand bags, during the deployment to hold and keep panels in place as protection against wind.
3. GCL panels should be placed with the non-woven side up to maximize the shear strength characteristics.
4. GCL shall not be excessively dragged across the subgrade.
5. Where possible, all slope panels should be installed parallel to the maximum slope while panels installed in flat areas require no particular orientation.
6. Overlaps shall be a minimum of 1m and be free of wrinkles, folds, or fish-mouths.
7. GCL shall not be more than 30% pre-hydrated anytime during deployment. If GCL is hydrated over 30% during deployment, the sections or panels shall be replaced with new pieces or as directed by the Engineer.
8. Loose granular bentonite should be placed between panels, with 500mm overlaps at a rate of 375 grams per lineal meter for seaming and sealing.
9. Damaged areas shall be repaired with a GCL patch covering the specified area with minimum 1m overlap on all edges. If damaged areas are on slopes, repair patches are required to be adhered by heating to the existing GCL to keep them in position during cover placement.
10. Field Quality Assurance
    (1) Engineer will visually inspect all deployed panels, seam and bentonite sealing to ensure quality of Works.
    (2) Engineer will visually inspect all repaired areas to ensure quality of Works.
    (3) Contractor shall acquire Engineer's written approval of GCL installation completion prior to cover placement, including verification of all repairs.

8.5 Part 5 – Geotextile Installation

8.5.1 Geotextile Deployment

1. The Contractor shall submit a proposed panel layout 14 days prior to deployment for Engineer's approval.
2. The Contractor shall have sufficient amount of ballast weights, such as sand bags, during the deployment to hold and keep the deployed panels in place as protection against wind.
3. The geotextile shall be unrolled as smoothly as possible on the prepared subgrade in the direction of construction traffic.
4. Geotextile rolls shall be overlapped in the direction of sub-base placement.
5. The geotextile shall be 200mm minimum overlapped and stitched together. The Engineer will inspect the stitching to ensure quality of Works.
6. On curves, the geotextile may be folded or cut and overlapped to conform to the curve.
7. The fold or overlap shall be in the direction of construction and shall be held in place as prescribed above.
8. The geotextile shall not be excessively dragged across the subgrade.
9. Damaged geotextile, as identified by the Engineer, shall be repaired immediately. The damaged area plus an additional 1m around the damaged area shall be cleared of all fill material. A geotextile patch extending 1m beyond the perimeter of the damage shall be constructed as directed by the Engineer.
10. Sewing of a geotextile patch may be required over soft subgrade as directed by the Engineer. Damaged geotextile shall be repaired at no cost to the Owner.
11. Quality Assurance
    (1) Engineer will visually inspect all deployment and repairs to ensure the quality of Works.
    (2) The Contractor must acquire Engineer's written approval prior to cover placement.

8.6 Part 6 – Geogrid Installation

8.6.1 Geogrid Deployment

1. The Contractor shall submit a proposed panel layout 14 days prior to deployment for Engineer's approval.
2. The Contractor shall have sufficient amount of underwater ballast to hold the panel in place during the deployment and fill placement.
3. The Contractor shall stake the limits of geogrid deployment as shown on the drawings.
4. The Engineer will review the limits of deployment prior to deployment.
5. The geogrid shall be unrolled as smoothly as possible on the ocean floor to the staked limits.

6. Two layers of geogrid will be placed off axial from each other on the ocean floor within the staked footprint.
7. The geogrid layers must be installed by certified divers. Certified divers must be available at all time during construction to ensure that the Geogrid is installed according the appropriate specifications.
8. The two layers of geogrid must be bound together according to the manufacturer's recommendations.
9. The Contractor shall acquire the Engineer's written approval prior to fill placement.
10. Quality Assurance
    (1) The Contractor shall submit Daily Reports including photographs to the Engineer for review.
    (2) The Contractor shall provide means for the Engineer to inspect and review the deployment including but not limited real time video.
    (3) The Contractor shall provide as built drawings, deployment and material records, in AutoCAD compatible format upon finalization of Works.

8.7 Part 8 – Measurement and Payment

8.7.1 Measurement

1. Measurements of geosynthetics are done by surveyed area in square meters, and do not include required overlap areas. Overlap are considered incidental to the Works.
2. Measurements will be done on accepted installed product approved by the Engineer.
3. Unless otherwise specified, the required quantities of materials are listed in **Schedule 1**.
4. The cost of periods of Works cessation shutdowns due to weather conditions will be deemed incidental to the Works.
5. Any defective and spoiled materials will not be measured and will be replaced with new material.

8.7.2 Payment

1. Payment will be made at the unit rates entered in **Schedule 1**.

END OF SECTION 8

Section 9
Fill Placement

9 Fill Placement

9.1 Part 1 – General

9.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

9.1.2 Description

1. The Works specified in this section includes furnishing all supervision, labour, materials, tools and equipment for placement of fill material to the lines and grades shown on the drawings and specified herein.

2. The Works shall include, but is not limited to the following:
   (1) Foundation preparation to receive fill.
   (2) The supply, hauling, placing, and compacting of the specified fill materials as shown on the drawings.
   (3) All related surveys for layout and control of the Works and applicable quantity surveys for payment.
   (4) Assisting the Engineer in QA/QC testing.
   (5) Maintenance of haul roads (as applicable) including snow and ice removal.
   (6) The development, maintenance, and restoration of fill material borrow areas.
   (7) Any other related Works not covered elsewhere.

3. Fill material required to be placed include, but are not limited to the following:
   (1) Haul, place and compact Run of Quarry (ROQ) material as base layer, as a thermal protection layer, or as an erosion protection layer.
   (2) Haul, place and compact Select subgrade material as transitional layer between ROQ and Surfacing material.
   (3) Haul, place, and compact Surfacing material as final trafficking surfaces.
   (4) Haul and place Riprap as an erosion protection or wave energy dissipation layer.
   (5) Haul and place Drainage gravel as a liner bedding material.
   (6) Haul and place Pipe bedding material beneath pipelines as grading and protection layer as specified by the Engineer.
   (7) Haul, place, moisture condition and compact Core material as an impermeable permanently frozen water retaining barrier.
   (8) Haul, place and compact Transition material as a filter layer between Core and ROQ material.

9.1.3 Codes and Standards

1. The Quality Control and Assurance Program (QA/QC) shall use testing procedures from, but not limited to the list of American Society of Testing and Materials Standards in Table 9.1.

Table 9.1: List of QA/QC testing standards

Test	Topic
ASTM D2487	Classification of Soils for Engineering Purposes.
ASTM D2216	Water (Moisture) Content in Soil and Rock.
ASTM D422	Particle Size Analysis of Soils.
ASTM D854	Specific Gravity of Soils.
ASTM D698 Procedure A, B or C	Laboratory Compaction Characteristics of Soil Using Modified Effort (Modified Proctor Density test).
ASTM D2922	Density of Soil in Place by Nuclear Methods.

9.1.4 Submittals

1. The Contractor shall submit the information requested below. Works shall not start until applicable approvals are obtained in writing.
2. The Contractor shall submit with the bid, a list of equipment types, capacities and sources to be used for the various components of the Works including borrow pit operations, stockpile, haul vehicles, spreading, watering and compaction equipment. The equipment information shall demonstrate suitability to achieve the schedule and technical requirements of the project to the Engineer's discretion.
3. Acceptance or approval of the Contractor's equipment shall not relieve the Contractor of his sole responsibility to construct the Works in accordance with specified requirements.
4. The Contractor shall submit with the bid, a QA/QC manual outlining testing and procedures to ensure Works quality. This manual is subject to Engineer's review and approval.
5. Testing
   (1) Testing will be done by the Contractor and the Engineer independently to ensure products meet the Specifications.
   (2) The Contractor is responsible to ensure the Specifications are met as demonstrated by test results or otherwise specified by the Engineer.
   (3) The Engineer's testing shall not relieve the Contractor of his sole responsibility to construct the Works in accordance with specified requirements.

9.2 Part 2 - Execution

9.2.1 Compaction Equipment

1. The compaction equipment shall be the appropriate size and type to achieve the specified densities of the respective fill materials.
2. Where compaction procedure (lift thickness, number of passes compactor type) is specified the Contractor shall provide compactors that meet or exceed those described in the Specification.
3. A vibratory plate jumping jack tamper will be required for compaction around instrumentation and beside the bridge retaining wall. The hand compactor shall be rated to provide sufficient pressure to meet compaction requirements.
4. Notwithstanding the requirements stated above, the equipment and compaction procedures employed by the Contractor shall be subject to approval from the Engineer.

9.2.2 Snow Removal Equipment

1. Care shall be taken when clearing snow above or adjacent to previously placed compacted material to avoid ripping and subsequent damage. Any material, which, in the opinion of the Engineer, has been damaged, shall be removed and replaced at no cost to the Owner.
2. Care shall be taken when clearing snow from original ground to prevent damage to the tundra.

9.2.3 Foundation Preparation

1. The Contractor shall prepare an acceptable foundation surface to receive the specified fill material. An acceptable foundation surface is a surface, which is clean, sound and firm, and which does not contain any loose, softened or disturbed foundation material as determined by the Engineer.
2. ROQ, Select subgrade, Core and Transition materials shall be graded in accordance with the drawings, compacted in lifts and be free of snow, ice, and any other loose or deleterious material.
3. Dense foundation surfaces to receive fill shall be free from uncompacted fill, snow, ice or other unsuitable materials. The surfaces shall be inspected by the Engineer, who may direct proof rolling with a loaded haul truck, and/or local over excavation and backfilling with approved material. Placement shall be completed as outlined in the applicable sections of these Specifications.
4. Where depressions or holes exist in the foundation material, acceptable fill shall be placed in depressions, as directed, and compacted as specified herein. Special techniques, handwork and the like shall be required as necessary.
5. Fill shall not be placed on the prepared foundations until they have been inspected and approved in writing by the Engineer.

9.2.4 Fill Placement

1. The Contractor shall dump, spread and level fill in such a manner as to avoid segregation and to obtain a reasonably well graded mass.
2. The direction of fill placement and construction equipment traffic shall be parallel to the long axis of the structure being built, or as directed by the Engineer.
3. The compaction operations for fill shall be conducted within the same work day to provide a smooth compact surface and meet the density requirements shown in Table 9.2. Adjacent individual passes of the compactor shall overlap by approximately 1/3 of the width of the compactor's drum. New fill shall be "keyed" into existing approved fill. Keying in is by placing new fill adjacent to exposed compacted fill. The Contractor is responsible to repair all damages on unfinished work from the previous work day.
4. Any placed material, which does not meet the specified requirements, shall be removed and disposed of or reworked at the cost of the Contractor to produce a material which does satisfy the specified requirements.
5. Construction material maximum lift thicknesses and compaction requirements shall be as indicated in Table 9.2.

Table 9.2: Compaction requirements

Fill Description	Maximum Lift Thickness Before Compaction (mm)	Minimum Density % of the Modified Proctor Maximum Dry Density	Placed Consolidated Density[1] Tonne/m^3	Minimum Passes/Lift & Compactor Type[2]	Construction Tolerance
Run of Quarry (ROQ) Material	500	90	1.90	4, 15t vibratory roller	±0.1 m
Select Subgrade Material	300	90	2.00	4, 15t vibratory roller	±0.05 m
Surfacing Material	200	90	2.00	4, 15t vibratory roller	±0.02 m
Riprap	N/A	By gravity	-	n/a	-
Drainage Gravel	300	By traffic	-	n/a	-
Pipe Bedding	300	By traffic	-	n/a	-
Core Material	300	Core placed and compacted to achieve saturation level, not density	1.80	6, 15t vibratory roller	±0.05 m
Transition Material	300	90	2.00	4, 15t vibratory roller	±0.05 m

[1] Density herein is assumed. Field tests will confirm the actual densities from quarry material.
[2] Compaction effort might be adjusted by field compaction trial result. The Engineer will determine on site if the compaction specification must be adjusted to reflect the results.

6. Frozen Core material in the North and South Dams shall require special handling and placement, as follows:
   (1) Frozen Core material shall meet these Specifications and any additional requirements as shown on the drawings.
   (2) Placement shall be carried out during winter months such that each lift of placed material can freeze. The time for freezeback shall vary depending on such factors as the moisture content, wind speed, air temperature, and solar radiation.
   (3) The Core material shall be mixed using a method approved by the Engineer to create a homogeneous, fully-thawed mixture.
   (4) A test fill pad shall be constructed when the air temperature is low enough as specified by the Engineer.
      - The following test fill characteristics shall be evaluated:
        - Optimum moisture content;
        - Optimum lift thickness;
        - Bonding with the foundation and between lifts;
        - Freezeback time for a lift given the ambient climatic conditions; and
        - Contractor's placement methodology.
      - The test fill pad shall be a minimum 4 m wide and 4 m long. A minimum of two lifts of material shall be placed.
      - Test fill properties shall be evaluated from core samples and percolation tests. Test fill should be removed if it is within the core footprint and has been judged unsuitable by the Engineer.
   (5) The placed core material shall have, on average, 85% saturation or higher, with no results falling below 80%. The moisture content shall be adjusted so that the material shall be nearly-saturated and flows easily, but shall not produce significant free water when placed. The optimum moisture content shall be determined from the results of test fill pad construction prior to commencing fill placement. The established moisture content may require regular adjustment during construction, based on the results of the quality assurance tests.
   (6) The core construction will require heating capability to condition the core material to the proper moisture content prior to placement.
   (7) The material shall be spread and levelled immediately following placement. The materials shall be compacted by numerous passes of a vibratory, steel-drum compactor before the lift begins to freeze. Reworking of the material following compaction is not permitted. Equipment is not permitted on the placed material during freezing.
   (8) Core material must be placed and compacted without free ice blocks or lenses.
   (9) The lift shall achieve 100% freezeback before the next lift is placed. Freezeback is defined as a maximum lift temperature of -2^{o}C. The lift thickness may be adjusted, depending on climatic conditions, placed moisture content, and results of quality control tests.
   (10) All snow and ice shall be removed from the foundation surface and between placed lifts prior to core placement and compaction.

7. Compaction trials shall be undertaken to determine the compaction effort requirements for the vibratory hand compactor at specified areas. The Engineer will subsequently set site specific compaction standards for the hand compactor.

8. The Contractor shall be solely responsible for achieving the specified density as indicated in Table 9.2 above.

9.2.5 Tolerances

1. Fill shall be placed in horizontal lifts to the lines and levels shown on the drawings or as directed and to the tolerances as shown in Table 9.2, in elevation and horizontal dimensions.

9.2.6 Compaction Trials

1. Compaction trials shall be performed upon production of fill material to determine site specific parameters such as density and compaction standards. The trials shall be carried out as part of the fill placing operation and shall not be the subject of a claim for Extra Work nor shall it attract extra payment.

2. The Engineer may instruct, or the Contractor may periodically conduct field trials to optimize moisture conditioning, lift thickness and compaction effort.

3. The Contractor shall obtain the Engineer's written approval before implementing any change to the Specifications.

9.2.7 Restrictions Due To Weather and Suspension of Operations

1. The Contractor shall not place any fill when conditions for such operations are unsatisfactory due to heavy snowfall, extraordinarily freezing conditions, or any other reason determined by the Engineer.

2. Where operations have been discontinued by the Contractor or suspended by the Engineer, the effects of adverse conditions shall be assessed by the Engineer and the surficial layers of fill treated or replaced to the satisfaction of the Engineer before resumption of fill placement.

3. Before suspension of operations each day, or each construction shift, as described in this Section, and before suspension due to inclement weather, Core material fill in place shall be:
   (1) Surface shaped to drain excess water.
   (2) Rolled smooth to seal against ice lenses development.
   (3) The Engineer will examine the quality of surficial fill to determine if rework is required to meet foundation requirements. Foundations shall be prepared in accordance to Section 9.2.3 and rejected materials shall be reworked to meet the Specifications.

4. In freezing conditions, the Contractor shall:
   (1) Provide satisfactory snow and ice removal from subgrade surface.
   (2) Provide heating capabilities to condition the Core material to the specified moisture content during placement and compaction.

5. In conditions that is warmer than -10°C during the Core material placement, the Contractor shall:
   (1) Prove to the Engineer that a satisfactory uniformly frozen core without free ice lenses can be constructed.

9.2.8 Sediment and Runoff Control

1. The Contractor shall provide facilities such as diversion berms, sediment ponds, and other measures as are required to prevent the discharge of fines from construction areas and from entering any natural water courses downstream of the Works during the spring melt season immediately following construction.
2. In general, when placing fill material, the Contractor shall slope the surfaces toward collection channels for surface water management.
3. The Contractor shall not excavate any ditches in the original ground, especially in permafrost overburden. Diversion berms will be the preferred method to re-route surface water.

9.2.9 Quality Control

1. Quality Control (QC) shall be done regularly by the Contractor to ensure the quality of products and Works. The QC testing methods, procedures and frequencies shall be done according to the Specifications by the Contractor to his own satisfaction.
2. The Contractor shall submit a proposed Quality Control schedule for Engineer's review prior to starting the Works.
3. The Contractor's Quality Control shall be done independently from Engineer's Quality Assurance. All data and results acquired from QC testing shall be available to the Owner and Engineer upon request.
4. QC testing shall include, but is not limited to:
   (1) Gradation testing on all fill materials.
   (2) Surveys of ongoing construction for construction limits and grades.
   (3) Field compaction tests for fill placement.
   (4) Moisture content tests on Core material placement.

9.2.10 Quality Assurance

1. The Contractor shall be responsible for the quality of fill. The Engineer will undertake testing on in-place fill including laboratory and field tests to check on quality after placement of the fill materials.
2. Notwithstanding any testing carried out by the Engineer, the Contractor shall be responsible for conducting a Quality Control Program as necessary to control the quality of the fill in accordance with the Specification.

3. The Contractor shall give the Engineer every opportunity to make Quality Assurance tests and shall render such assistance as is necessary to enable sampling and testing to be carried out expeditiously. The undertaking of such tests by the Engineer, or the time taken to interpret the results shall not constitute grounds for a claim by the Contractor for an extension of time.
4. Testing shall be performed in accordance with the principles and methods prescribed by the American Society for Testing and Materials (ASTM) and other such recognized authorities.
5. Testing shall be carried out across the full length, width and depth of the various fill zones so as to fully represent the overall quality of the structure.
6. The Contractor shall conduct regular topographic surveys to demonstrate the placement of fill to the specified lines, levels, grades and tolerances. The Engineer may from time to time conduct check surveys. Survey results shall be reported to the Engineer within 24 hours of the completion of each survey.

9.2.11 Testing by the Engineer

1. As a minimum, the Engineer will conduct the testing program on the compacted fill shown on Table 9.3. The Engineer will at his discretion, carry out tests on areas where listed placement volumes are not met.

Table 9.3: Testing by Engineer

Fill	Tests and Frequency (1 test per Vol. in m^3)[1]				
Description	**Moisture Content**	**In-situ Density**	**Gradation**	**Placed Bulk Density**	**Modified Proctor**
Run of Quarry Material	-	-	8,000	-	-
Select Subgrade Material	-	-	8,000	-	-
Surfacing Material	8,000	4,000	8,000	-	16,000
Drainage Gravel	-	-	8,000	-	-
Pipe Bedding Material	-	-	8,000	-	-
Core Material	8,000 500	4,000 500	8,000 one per 2 days	2 per lift or day.	-
Transition Material	8,000	4,000	8,000	-	-

[1] Volume is measured as in place volume.

9.2.12 Acceptance

1. Final acceptance of earthworks will be made only after fill materials have been dumped, spread, moisture conditioned, and compacted, and tests and surveys have demonstrated compliance with the Specifications.
2. If on the basis of the sampling and testing, or if in the opinion of the Engineer, an area of the fill does not meet the specified requirements, such fill shall be removed and replaced with conforming material at no cost to the Owner. Rejection of fill material by the Engineer may be made at source, in transporting vehicles, or in place.
3. The Engineer can re-inspect previously approved areas for damages and the Contractor is responsible for the repair if the damages are caused by negligence. The Owner is responsible for the damages caused by unforeseeable natural causes.

9.3 Part 3 - Measurement and Payment

9.3.1 Measurement

1. Fill material
   (1) The obtaining, furnishing, processing, hauling, placement, and compaction of fill materials will be measured to the nearest cubic metre as the number of cubic metres of approved fill satisfactorily placed and compacted to the lines and levels shown on the drawings or directed by the Engineer. The measurement will reflect in-place volumes after compaction.
   (2) Fill quantities will be based on surveys carried out by the Contractor following completion of stripping and common excavation to the lines and levels shown on the drawings or as otherwise approved by the Engineer. Fill placed beyond the lines and levels specified will not be measured for payment.
   (3) The cost of periods of Works cessation shutdowns due to unforeseen sudden change in weather conditions will be deemed incidental to the Works.
   (4) Fill materials left in stockpiles, except as directed by the Engineer, will not be measured for payment.

9.3.2 Payment

1. Payment will be made for fills at the relevant unit prices entered in **Schedule 1**.
2. No payment will be made for removal and replacement of fill that has been rejected by the Engineer.
3. No payment will be made for removal and replacement of damaged fill that has been previously inspected and approved, if such damage was as a result of negligence by the Contractor. If such damage was caused due to unforeseeable natural causes, payment for the repairs will be made based on the conditions referred to in these Specifications relating to Extra Work.

END OF SECTION 9

Section 10
Surface Infrastructure Components

10 Surface Infrastructure Components

10.1 Part 1 – General

10.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

10.1.2 Description

1. The Works to be done under this Section consists of performing all Works necessary to carry out the Works as shown on the drawings and specified herein. The Works shall include, but is not limited to:
   (1) Jetty construction, including all ancillary facilities
   (2) Road construction
   (3) Installation of road traffic signs
   (4) Beach Laydown area construction
   (5) Fuel Transfer Station construction
   (6) Explosives Storage Facility construction, and installation of ancillary facilities
   (7) Airstrip and apron construction
   (8) Installation of aviation runway lights and related airstrip instrumentation
   (9) Fuel Tank Farm construction
   (10) Installation of geotechnical monitoring instrumentation
   (11) Mill Pad construction, and installation of ancillary facilities
   (12) Camp Pad construction, and installation of ancillary facilities
   (13) Float Plane Dock assembly and installation
   (14) Temporary waste rock pile pad construction
   (15) Bridge abutment construction, bridge assembly and installation
   (16) Temporary waste rock pile pollution control pond construction
   (17) Camp/Mill sedimentation pond construction
   (18) Other surface runoff management facilities
   (19) Caribou crossings construction
   (20) Road turnouts construction
   (21) Culvert installations
   (22) Landfill construction
   (23) Landfarm construction
   (24) Fence erection
   (25) Pump house pad construction

10.2 Part 2 – Components

10.2.1 Jetty

1. General
   (1) The jetty is a rockfill structure 6m wide and 103m long with a 25m x 6m wide terminus face against which barges will be moored.
   (2) The jetty terminus will be in water depth of at least 5m as measured from the lowest low tide level. The Engineer may require some site adjustment to the jetty terminus location to ensure that this condition is met.
   (3) About two-thirds of the length of the jetty will be constructed in water depths of less than 3m.
   (4) Two independent sets of mooring attachments are required for the jetty. Spring lines will be affixed to the jetty terminus via concrete anchor blocks, and shore lines will be affixed to rockfill anchor mounds constructed on the shoreline via anchor blocks.
   (5) The Contractor is responsible for the supply and installation of all components of the jetty as indicated on the drawings and listed in these specifications.

2. Timing
   (1) The jetty must be constructed during the open water season, but not during the annual fish spawning period in Roberts Bay. For that reason actual construction of the jetty may not be done after July 15, 2007.
   (2) The jetty must be completed and ready to accept barges by August 30, 2007 at the latest.

3. Foundation
   (1) The jetty foundation consists of extremely weak marine clays. Along the first 50m of the jetty as measured from the shoreline, there is permafrost present, whilst for the remainder of the length of the Jetty there is no permafrost.
   (2) Complete details of the foundation conditions, as determined from a series of in-situ geotechnical investigations are available for review by the Contractor. The drawings provide details of these reference documents.

4. Submittals
   (1) The Contractor shall submit a construction plan and schedule for the jetty at the time of the tender submission.

5. Products
   (1) Geogrid
      a) Two primary layers of geogrid will be placed on the ocean floor within the footprint of the Jetty as base layer before placement of any fill material.
      b) Both geogrid layers will extend 5m beyond the toe of the jetty along its entire perimeter.
      c) The geogrid layers must be installed in accordance with Section 8.6.1.

d) The two layers of geogrid must be bound together according to manufacturer's recommendations.

(2) Fill material

a) Fill material for the Jetty construction shall be ROQ material, Select Grade material and Surfacing material.

b) ROQ material must be placed from the shoreline, progressively working towards the terminus. It is anticipated that significant settlement of the ROQ material will occur initially. The Contractor will conduct daily surveys of material placed, to allow the Engineer to assess the rate of settlement.

(3) Anchor mounds

a) Anchor mounds constructed from ROQ material will completely cover the concrete anchor blocks to which the shore mooring lines will be connected.

(4) Concrete anchor blocks

a) Concrete anchor blocks shall be pre-cast reinforced concrete with smooth form finish and minimum 30 MPa compressive strength prior to placement. Anchor blocks shall be cast to the specification shown on the drawings.

b) Suitable marine grade steel shackles, as specified below, must be pre-cast into the anchor blocks as indicated in the drawings.

(5) Blast mats

a) The blast mats will be deployed as a cushioning layer for the barges mooring against the jetty.

b) The blast mats shall be angle-lay medium weight rubber woven with cable with super duty lifting ring manufactured from Dynmat or equivalent approved by the Engineer. The mat shall have a 170kg per m^2 density and all cables and mounting hardware shall be graded for specified load and marine use.

c) The blast mats will be deployed seasonally, and will only be in place for the short season that the barges are off-loading supplies and equipment. For the remainder of the year the mats will be stored at the Beach laydown area.

d) The blast mats shall be installed as shown in the drawings.

e) Inspection shall be done on the blast mats prior to deployment to ensure all linkage and hardware is in working condition according to the manufacturer's specifications.

(6) Mooring hardware

a) Mooring chains, shackles and other connecting hardware are to be Grade 2 steel or better.

b) Mooring chains shall have 39.7mm stud links, with a minimum breaking strength of 90 tonnes.

c) Mooring lines will be 28.6mm diameter Amsteel Blue, manufactured by Samson, with a minimum strength of 60 tonnes or equivalent approved by the Engineer.

Mooring lines are to be supplied with test certificates for testing to 50% of their minimum breaking strength for review by the Engineer.

d) Weld or use other means to ensure shackles and other connecting hardware will not work loose during operation.

e) Floating buoys will be 0.6m in diameter with HDPE shell and ultraviolet inhibited. The buoys shall be completely urethane foam filled. The buoys shall be attached the 1.4m concrete anchors specified in the drawings with chains placed at the locations shown on the drawings. The chains shall meet the mooring chain requirements above.

10.2.2 Roads

1. All permanent roads shall have an overall final compacted fill thickness of at least 1.0m
2. The primary road, and some facility access roads will have a minimum width of 6.0m.
3. The secondary road, and some facility access roads will have a minimum width of 5m.
4. All roads shall be crowned from center line at 0.5%.
5. All road construction fill shall, as a minimum, comprise of 0.2m Surfacing material, 0.3m Select subgrade material and 0.5m of ROQ material.
6. All roads shall be constructed according to the drawings and the Specifications.
7. Safety berms are not required along any roads, unless expressly noted, or as directed by the Engineer.

10.2.3 Traffic Signs

1. Traffic Signs shall be installed as required according to the MHBL Health and Safety Manual and all relevant rules and regulations.

10.2.4 Beach Laydown Area

1. The beach laydown area shall be a fill pad measuring at least 60m x 100m, with one edge being communal with the primary road.
2. The pad will have a minimum overall total fill thickness of 1m.
3. The pad surface shall be graded at 0.5% away from the road.
4. The fill requirements for the pad will be similar to those used for construction of the roads.
5. Safety berms are not required around the beach laydown area.

10.2.5 Fuel Transfer Station

1. The fuel transfer station is a lined containment facility with overall dimensions of 16.5m by 32m.
2. The containment area is 1 m deep, and shallow access ramps on opposing ends allow for through-travel of fuel trucks.

3. Containment will be achieved through lining using an HDPE liner sandwiched between two protective layers of geotextile, and covered with appropriate fill material as specified on the drawings.
4. The floor of the containment area will have 0.5% grade toward a sump.
5. The minimum fill thickness beneath the containment area invert level will be 1m.
6. Fill material shall consist of various thickness of Surfacing material, Select subgrade material, ROQ material, and Drainage gravel.
7. Mechanical and/or electrical connections to the fuel transfer station do not form part of this scope of work.

10.2.6 Explosives Storage Facility

1. The location and layout of the explosives storage facility have been selected to ensure compliance with minimum regulatory safety distances. No changes are allowed to this layout unless approved by the Engineer.
2. The explosives storage facility shall consist of at least seven individual construction pads ranging in size from 31 x 16m to 22 x 9m.
3. These pads shall be level at grade, and at least 1m thick.
4. A nominal containment berm must be constructed around three perimeter edges of the ANFO bulk storage area.
5. Barrier berms are located at critical positions between individual sections of the explosives storage facility. The size and location of these structures can only be altered with express approval from the Engineer.
6. The pads and connecting roads will be constructed with the same fill requirements as all other roads. The barrier berms will be constructed with only ROQ material.
7. The Contractor will install all magazines, the explosives mixing plant, and the portable office as indicated on the drawings. These structures will consist of pre-assembled trailer and/or seacan units supplied by the Owner.
8. Mechanical and/or electrical connections to the explosives storage facility does not form part of this scope of work.

10.2.7 Airstrip and Apron

1. The airstrip will be 23m wide and 914m long.
2. The airstrip will have an overall minimum fill thickness of at least 2m.
3. The airstrip surface shall be crowned from the center line at 0.5%.
4. Fill material shall consist of 0.2m of Surfacing material, 0.3m of Select subgrade material, and 1.5m of ROQ material.

5. The airstrip will double as the primary road during periods that there are no planes using the airstrip.
6. On either end of the airstrip the primary road will have a gradual ramp at a minimum grade of 5H:1V leading up to the airstrip to compensate for the fill thickness between the road and the airstrip.
7. A 40m long by 17m wide apron shall be constructed alongside the airstrip.
8. The apron will have an overall minimum thickness of 2m.
9. The apron will be crowned and graded a 0.5% along it longitudinal access.
10. The apron will be constructed with the same fill requirements as that used for the airstrip.
11. Mechanical and/or electrical connections to the airstrip and apron does not form part of this scope of work.

10.2.8 Airstrip (Runway) Lighting and Instrumentation

1. General
   (1) The Owner will supply airstrip lighting and instrumentation, to be installed by the Contractor.
   (2) Mechanical and/or electrical connection of these systems, other than the primary installation of the mentioned units are excluded from this scope of work.
2. Runway wide markers
   (3) Both sides of the runway will be outlined with medium intensity lights of at least 45 watts per bulb, spaced at intervals not exceeding 60m.
   (4) Runway side marker lights shall be white.
   (5) The markers should be at least 60cm in height and must be frangible.
3. Runway end markers
   (1) Both ends of the runway will be outlined with medium intensity lights of at least 45 watts per bulb, spaced at intervals of 3m leaving the centre 18m of the runway clear.
   (2) Runway end marker lights shall be green.
4. Apron
   (1) The apron, areas intended for use as taxiways, turnaround area, and parking area shall be outlined with medium intensity lights of at least 45 watts per bulb at the corners, plus side lights spaced at 20m intervals.
   (2) Taxiway, parking and unloading lights shall be blue.
5. Approach lighting
   (1) Ten medium intensity lights of least 45 watts per bulb at intervals of 60m extending from the ends of the airstrip. These light shall be exactly centred on the extend runway centreline to define the approach course.
   (2) Approach lights shall be white.

6. Instrumentation
   (1) A wind sock and anemometer shall be installed at a suitable spot on the apron. The location shall be site fitted and installed according to the manufacturer's recommendations.

10.2.9 Fuel Tank Farm

1. The fuel tank farm is a lined containment facility with overall dimensions of 60m by 60m.
2. The containment area is 0.8m deep, with a single shallow access ramp on one side to allow for fuel truck offloading.
3. Containment will be achieved through lining using an HDPE liner sandwiched between two protective layers of geotextile, and covered with appropriate fill material as specified on the drawings.
4. The floor of the containment area will have 0.5% grade toward a sump.
5. The fuel tank farm must be completely founded on competent bedrock.
6. The minimum fill thickness beneath the containment area invert level will be 0.2m and will be adjusted to fit site conditions under the Engineer's direction.
7. Fill material shall consist of various thickness of Surfacing material, Select subgrade material, ROQ material, and Drainage gravel.
8. Mechanical and/or electrical connections to the fuel tank farm do not form part of this scope of work

10.2.10 Geotechnical Monitoring Instrumentation

1. Geotechnical monitoring instrumentation will consist of new or existing thermistor installations.
2. The Owner will supply the instrumentation to be installed beneath the jetty, construction pads, roads, the airstrip, apron and at various other locations as shown on the drawings.
3. The exact locations of the instrumentation are not fixed, and may be altered with express approval from the Engineer.
4. New installations will require drilling of a vertical hole in the permafrost overburden to a depth of at least 5.0m. The hole must be sufficiently large to receive a cable with a maximum diameter of 25mm.
5. The Contractor must install each thermistor string down the hole, with the Engineer being present to inspect the installation.
6. The cable lead must be sufficiently protected to ensure that construction over the hole will not damage the cable.
7. Upon completion of the infrastructure, the cable lead must be mounted to a permanent wooden post with the connection terminal mounted and marked as per the drawings.

8. Old installations must be removed from their mounting posts, cable lead lengths must be attached as per the manufacturer's instructions, and then be protected as per new installations.

10.2.11 Mill Pad

1. The mill pad will comprise of a single level bench consisting of a cut and fill into bedrock.
2. The cut will be adjusted so that all proposed crushing, grinding and milling facilities will be completely founded on bedrock.
3. The entire pad will receive a nominal thickness of Surfacing material to ensure an even workable surface.
4. The pad will be graded away from the high wall toward the camp/mill sedimentation pond.
5. Mechanical and/or electrical connections to the mill pad do not form part of this scope of work.

10.2.12 Camp Pad

1. The camp pad shall be 2m minimum in total fill thickness and will measure about 67m wide and 162m long.
2. The pad shall consist of 0.2m of Surfacing material, 0.3m of Select subgrade material, and 1.5m of ROQ material.
3. On either end of the camp pad the access roads will have a gradual ramp at a minimum grade of 5H:1V leading up to the camp pad to compensate for the fill thickness between the roads and the pad.
4. The entire pad will be graded at 0.5% towards the camp/mill sedimentation pond.
5. Mechanical and/or electrical connections to the camp pad do not form part of this scope of work.

10.2.13 Float Plane Dock

1. The Contractor shall be responsible of the assembly and installation of the float plane dock and access ramp.
2. The minimum deck width is 4m, with a length of approximately 20m. The deck shall be fitted with mooring hardware.
3. Two shore anchors will be site fitted by the Engineer depending on the finalized location of the dock. Two 146mm diameter holes shall be drilled 5m into competent bedrock. Two bollards 139mm in diameter manufactured from Grade 2 steel with 5mm wall thickness, or equivalent approved by Engineer, shall be installed in the holes and grouted in place.
4. The Contractor shall deploy six weighted anchors into the lake as shown on the drawing.
5. The dock shall be secured in place with 19mm diameter polyester mooring ropes and Grade 2 mooring chains to the land bollards and to the submerged weighted anchors.
6. The dock laydown area shall be 12m by 12m with minimum overall 1m fill thickness.

7. The access road shall tie into the dock with an access ramp at 5H:1V as shown on the drawings.

10.2.14 Temporary Waste Rock Pile Pad

1. The temporary waste rock pile pad is approximately 100m by 200m.
2. The temporary waste rock pile will be constructed on a 1m thick pad built from ROQ material, according to the lines and grades shown on the drawings.
3. The pad will be constructed on natural ground with a general slope toward the waste rock pile pollution control pond.
4. A 1m high berm will be built on sides of the pad that are perpendicular to the contours to route the water toward the pollution control pond. The berm will be constructed from Select subgrade material. The Engineer will site fit the berm as necessary.

10.2.15 Bridge and Bridge Abutments

1. The bridge will be a pre-manufactured steel modular unit made to specified crossing dimensions. The Contractor is responsible for obtaining suitable lifting equipment to install the bridge and assemble the bridge components as specified by the manufacturer.
2. There must be 4.1m of clearance between the average creek level and bottom of the bridge.
3. Contractor shall take extra caution during construction to ensure that the stream is not impacted, especially as a result of constructing the winter ice-bridge.
4. The abutment construction must be during winter to ensure frozen ground conditions below the foundation. The abutment shall be constructed as shown on the drawings.
5. The abutment shall be minimum 5m away from the edge of the creek.
6. A pre-cast concrete retaining wall for the bridge shall be installed at appropriate lines and levels, and according to manufacturer's specifications prior to completion of the abutment backfill.
7. A pre-cast concrete sill for the bridge shall be placed in front of the retaining wall at appropriate lines and levels according to the drawings and manufacturer's recommendations.
8. The abutment shall be ramped a minimum 5H:1V up to the bridge deck level.
9. W-beam flex guardrails affixed to 0.6m tall galvanized posts will be installed on the bridge as well as along a 120m section of both sides of the bridge abutments.

10.2.16 Temporary Waste Rock Pile Pollution Control Pond

1. The pollution control pond will be located downstream of the temporary waste rock pile and situated on natural ground.
2. The pollution control pond is a lined containment facility with overall dimensions of about 30m by 50m (the pond is however not rectangular).
3. A 1 to 3m high containment berm shall be constructed as shown on the drawings.

4. The deepest part of the containment area is 3m deep, with an increasing grade toward the upstream area.
5. Containment will be achieved through lining using an HDPE liner sandwiched between two protective layers of geotextile, and covered with appropriate fill material as specified on the drawings.
6. The containment berm for the pollution control pond shall be constructed from various thicknesses of Surfacing material and ROQ material.
7. Pumping requirements from the pollution control pond do not form part of this scope of work.

10.2.17 Camp/Mill Pad Sedimentation Pond

1. The sedimentation pond will be located downstream of the camp pad and directly upstream of pollution control pond. It will be situated on natural ground and will not be lined.
2. The sedimentation pond is a facility with overall dimensions of about 50m by 50m (the pond is however not rectangular).
3. The sedimentation pond will utilize the upstream part of the containment berm of the pollution control pond.
4. The deepest part of the containment area is 3 m deep, with an increasing grade toward the upstream area.
5. Pumping requirements from the sedimentation pond do not form part of this scope of work

10.2.18 Other Surface Runoff Management Facilities

1. Runoff management facilities will consist of diversion berms and sedimentation ponds.
2. The Engineer will identify the locations and sizes of runoff management facilities as necessary around the Project.
3. All facilities will be constructed with fill material and above ground surface to prevent disturbance to the permafrost. Geotextile and silt fences shall be used as a filtering layer in the ponds, as directed by the Engineer.
4. Diversion berms shall be a minimum of 0.5m high and constructed from compacted Selected subgrade material.

10.2.19 Caribou Crossings

1. The general locations of caribou crossings are identified on the drawings. The final location of the crossings will be decided upon after inspection of the site with the local elders and the landowner.
2. These crossings shall be constructed using 5H:1V approach slopes and shall be at least 10 m wide perpendicular to the roads.

3. The fill material shall consist of various thicknesses of Surfacing material, Select subgrade material, and ROQ material.

10.2.20 Road Turnout Areas

1. There are road turnout areas along the primary and secondary roads as identified on the drawings.
2. The areas will be an extension of the road to 7.5m width by 30m long along the secondary road and 4m wide by 30m long along the primary road.
3. These areas will have the same construction as the roads and shall be built according to the drawings and specifications.
4. The locations of the turnout areas can be adjusted to fit site conditions as directed by the Engineer.

10.2.21 Culvert Installations

1. The culverts shall be placed on original ground with no excavation unless otherwise directed by the Engineer.
2. The locations, typical dimension and configuration of the culverts are shown on the drawings.
3. The culverts will be Hel-Cor Lock Seam corrugated galvanized steel pipes with minimum 900mm inside diameter and 3.5mm wall thickness, or equivalent approved by the Engineer.
4. There shall be a minimum of 0.5m fill cover over the culvert. The road surface shall be raised to accommodate this cover with a minimum 5H:1V approach over the culverts.
5. The culverts shall be fitted with steam pipes to allow active thaw of the culverts.
6. The steam pipes shall be galvanized steel plumbing pipe of 51mm outside diameter laid inside along the full length of the culvert.
7. The steam pipe shall be secured by welding to the bottom of the culverts.
8. The steam pipes shall have their downstream side end capped. The upstream side shall have a 500mm vertical stickup for steam delivery. The stickup shall have an elbow bend toward the side of the culvert to avoid blocking the entrance.

10.2.22 Landfill

1. The landfill shall be an area measuring about 100m by 100m.
2. The landfill will be situated on bedrock in a section of the developed rock quarry #2. The Engineer will work with the Contractor to decide upon a final landfill shape taking into account the proposed quarry development plan put forward by the Contractor.
3. The landfill floor shall be within 0.3m of the access road surface elevation.
4. The landfill floor need not be at one grade, but must generally slope towards a single sump.

5. A 1.0m diversion berm built from Selected Subgrade material shall be constructed around the landfill to ensure external surface runoff does not enter the landfill area.
6. A chain link fence shall be constructed on the crest of the diversion berm.
7. Access to the landfill shall be via a lockable vehicle gate.

10.2.23 Landfarm

1. The landfarm shall be an area measuring about 50m by 25m.
2. The landfarm shall be situated on bedrock in a section of the developed rock quarry #2. The Engineer will work with the Contractor to decide upon a final landfarm shape taking into account the proposed quarry development plan put forward by the Contractor.
3. The landfarm floor shall be within 0.3m of the access road surface elevation.
4. There shall be a nominal layer of Surfacing material on the landfarm to create an even floor.
5. A 1m containment berm shall be constructed around the landfarm.
6. Containment shall be achieved through lining using an HDPE liner sandwiched between two protective layers of geotextile, and covered with appropriate fill material as specified on the drawings.
7. Fill material shall consist of various thickness of Surfacing material, Select subgrade material, and ROQ material.
8. A chain link fence shall be constructed on the crest of the diversion berm.
9. Access to the landfarm shall be via a lockable vehicle gate.

10.2.24 Fence

1. The fence specifications shall be presented in Imperial units.
2. The chain link fence shall be 8 feet tall.
3. The chain link fence shall be a 9 gauge galvanized steel fence fabric with twisted top end and knuckled bottom end.
4. The fence posts shall be 3-inch outside diameter SS 20 galvanized steel pipe with 0.11 inch wall thickness. The post shall be 8.5 feet above ground fill surface.
5. The posts shall be imbedded 3 feet in bedrock below the diversion berm. The posts shall be secured in bedrock with grout cement.
6. Contractor shall supply all caps, bolts and fasteners as part of fence installation and all parts shall be galvanized.
7. The lockable gate shall cover an opening of 6m.

10.2.25 Pump House Pad

1. The pump house pad shall be an area approximately 10m by 10m and shall have a minimum overall thickness of 1m.
2. The Pad shall be constructed as an extension of the secondary road, and shall be at a similar elevation as the road.
3. The pad shall have a 0.5% grade away from the road alignment.
4. The locations of the pad are shown on the drawings and may be adjusted by the Engineer to fit site conditions.

10.3 Part 3 – Measurements and Payment

1. Jetty construction
   (1) Jetty construction fill and ancillary installations will be measured and paid according to the lump sum and quantity measurements listed in **Schedule 1**.
   (2) The Contractor shall be paid for excess fill used due to settlement of the jetty, measured to the nearest cubic meter fill unit used from the "Material Stockpile" in **Schedule 1**.
2. Road construction
   (1) Road construction will be measured and paid according to fill quantities placed, as listed in **Schedule 1**.
3. Traffic signs
   (1) Traffic signs will be measured and paid according to installed units as listed in **Schedule 1.**
4. Beach laydown area
   (1) Beach laydown area fill will be measured and paid according to quantities placed, as listed in **Schedule 1**.
5. Fuel transfer station
   (1) Fuel transfer station fill will be measured and paid according to quantities placed, as listed in **Schedule 1**.
   (2) Geosynthetic installation will be measured and paid by final installed surface area, as listed in **Schedule 1**.
6. Explosives storage facility
   (1) Explosives storage facility fill will be measured and paid according to quantities placed, as listed in **Schedule 1**.
   (2) Installation of ancillary structures will be measured a paid according to lump sum as listed in **Schedule 1**.
7. Airstrip and apron
   (1) Airstrip and apron fill will be measured and paid according to quantities placed, as listed in **Schedule 1**.

8. Airstrip (runway) lighting and instrumentation
   (1) Aviation lights and instrumentation installation will be measured and paid according to lump sum as listed in **Schedule 1**.

9. Fuel tank farm
   (1) Fuel tank farm fill will be measured and paid according to quantities excavated and placed, as listed in **Schedule 1**.
   (2) Geosynthetic installation will be measured and paid by final installed surface area, as listed in **Schedule 1**.

10. Geotechnical instruments
   (1) Instrument installation will be measured by labour time and associated material, if any.
   (2) Engineer will approve the timesheets for instrument installations.

11. Mill pad
   (1) Mill pad excavation and fill will be measured and paid according to quantity excavated and placed, as listed in **Schedule 1**.

12. Camp pad
   (1) Camp pad fill will be measured and paid according to quantity placed, as listed in **Schedule 1**.

13. Float plane dock
   (1) Float plane dock installation will be a lump sump cost according to **Schedule 1**.

14. Temporary waste rock pile pad
   (1) Waste rock pile pad fill will be measured and paid according to quantity placed, as listed in **Schedule 1**.

15. Bridge erection
   (1) Bridge erection will be lump sum for the bridge deck installation and paid according to **Schedule 1**.
   (2) Bridge abutments will be measured and paid according to quantities placed, as listed in **Schedule 1**.
   (3) Surface water management will be measured and paid according to **Schedule 1**.

16. Temporary waste rock pile pollution control pond
   (1) Pollution control pond embankment construction will be measured and paid according to quantity placed, as listed in **Schedule 1**.
   (2) Geosynthetic installation will be measured and paid by final installed surface area, as listed in **Schedule 1**.

17. Camp/mill sedimentation pond
   (1) Sedimentation pond embankment construction will be measured and paid according to quantity placed, as listed in **Schedule 1**.

18. Other surface runoff management facilities
    (1) Surface runoff management facilities shall be measured and paid according to quantity placed, as listed in **Schedule 1**.
    (2) Silt fence installation will be measured by labour time and associated material, if any.

19. Caribou crossings
    (1) Caribou crossings fill will be measured and paid according to quantity placed, as listed in **Schedule 1**.

20. Road turnout areas
    (1) Road turnout areas fill will be measured and paid according to quantity placed, as listed in **Schedule 1**.

21. Culverts
    (1) Culvert installation will be measured by labour time and associated material, if any.

22. Landfill
    (1) Landfill construction will be measured and paid according to time and materials, as listed in **Schedule 1**.

23. Landfarm
    (1) Landfarm fill will be measured and paid according to quantity placed, as listed in **Schedule 1**.
    (2) Geosynthetic installation will be measured and paid by final installed surface area, as listed in **Schedule 1**.

24. Fence
    (1) Fence installation will be measured and paid according to material placed in linear meter, as shown on **Schedule 1**.
    (2) Gate installation will be measured in labour time and material, if any.

25. Pump house pad
    (1) Pump house pad fill will be measured and paid according to quantity placed, as shown in **Schedule 1**.

END OF SECTION 10

Section 11
Tailings Containment Area Components

11 Tailings Containment Area Components

11.1 Part 1 – General

11.1.1 Documents

1. This section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

11.1.2 Description

1. The Works to be done under this Section includes, but is not limited to the following:
   (1) Construct the North and South Dams complete with:
      a) Key trench excavation
      b) Thermosyphon installation
      c) GCL deployment
      d) Core, Transition and ROQ material placement
      e) Monitoring instrumentation installation
   (2) Spillway construction
   (3) Supply and install the following pipelines:
      a) Tailing delivery, complete with discharge points
      b) Reclaim, complete with intake barge
      c) Fresh water make-up
      d) Decant
   (4) Construct emergency dump catch basins
   (5) Implement shoreline erosion protection Works

11.2 Part 2 – Product

11.2.1 Submittals

1. Submit the following information at least 14 days prior to material arrival at the Hay River marshalling area for Engineer's review:
   (1) The Contractor shall submit a QA/QC manual that meets applicable industry standards for the installation of the pipelines.
   (2) Manufacturer's written certification that the carbon dioxide used in the thermosyphons meets the specifications and has been continuously inspected.
   (3) Manufacturer's written certification that all the piping and insulation meets the specifications and has been continuously inspected.
   (4) The certification shall identify the origin and the manufacturer of any resin and insulation used in manufacturing of pipes and insulation components.

11.2.2 Definitions

1. The following words and terms, unless the context otherwise requires, in this specification, shall have the meanings set out below:
   (1) EVAPORATOR means portion of the thermosyphon consisting of steel pipe embedded below ground surface where heat is extracted from the ground.
   (2) RISER means portion of the thermosyphon linking the evaporator pipe with the radiator.
   (3) RADIATOR means portion of the thermosyphon exposed to the ambient air that provides the overall cooling when the ambient air is colder than the ground.
   (4) THERMOSYPHONS means hollow pipe system filled with pressurized carbon dioxide (CO_2) installed partially in the ground that acts as a heat exchanger when the ambient temperature is colder than the ground.
   (5) RADIATOR PILE SUPPORT means structural component to support the radiator for the thermosyphons, consisting of steel pipe installed in bedrock inside a pre-drilled hole and backfilled with grout, as shown on drawings.
   (6) DR means dimension ratio for pressure rating.
   (7) ELECTROFUSION FITTING means an electrical resistance element is incorporated in the socket of the fitting which, when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.

11.2.3 Product Specifications

1. Thermosyphons
   (1) Two-phase, liquid-vapour type thermosyphons charged with carbon dioxide as the refrigerant.
   (2) Compressed carbon dioxide with a minimum purity of 99.9 percent or better.
   (3) Thermosyphons constructed with A53B Schedule 40 steel pipe.
   (4) Radiators constructed with 75mm O.D. pipe with 32mm high by 0.012mm nominal thickness carbon steel fins. Fin density shall be four rows of fins per 25mm of pipe.
   (5) Evaporators and radiators to sizes as shown on the drawings or as specified by Engineer.
   (6) Radiators and vertical risers sand blasted, aluminized and painted white as shown on the drawings or as specified by Engineer.
   (7) Radiator pile support using seamless pipes of size and wall thicknesses as indicated on drawings.
   (8) Pipe material to have following minimum tensile properties:
      a) Yield strength: 241 MPa
      b) Tensile strength: 414 MPa
   (9) Provide a five year manufacturer's warranty against loss of heat transfer for thermosyphons.

2. Pipelines

(1) HDPE pipe shall be manufactured from type III, Category 5, Class C, Grade P34 in ASTM D-1 248 high density polyethylene resin. This material shall have a long term hydrostatic design stress of 5.5 MPa for PE 3408 materials.

a) The tailings delivery pipeline shall consist of, but is not limited to:
   i. 130mm diameter HDPE lined Schedule 40 steel pipe, flanged
   ii. 130mm diameter HDPE DR 7.3 pre-insulated pipe, fusion welded, bends to suite pipeline route
   iii. 130mm diameter HDPE DR 9 pre-insulated pipe, fusion welded, bends to suite pipeline route
   iv. 130mm diameter HDPE DR 11 pre-insulated pipe, fusion welded, bends to suite pipeline route
   v. 130mm diameter HDPE DR 13.5 pre-insulated pipe, fusion welded, bends to suite pipeline route
   vi. 130mm diameter HDPE DR 17 pre-insulated pipe, fusion welded, bends to suite pipeline route
   vii. 130mm steel Tee, one end flanged (drain pipe connection)
   viii. 130mm HDPE Tee, one end flanged (drain pipe connection)
   ix. 130mm HDPE Tee, two ends flanged (deposition pipe connection)
   x. 130mm x 90° HDPE bend (deposition pipe connection)
   xi. 130mm drain valves (knife gate or similar), flanged
   xii. 130mm isolating valves (knife gate or similar), flanged
   xiii. 130mm diameter HDPE DR 17 pre-insulated pipe, fusion welded (deposition pipes)

b) The reclaim water pipeline shall consist of, but is not limited to:
   i. 250mm diameter HDPE DR 17 pipe, pre-insulated and heat traced, fusion welded (pump station inlet pipe)
   ii. 100mm diameter HDPE DR 17 pipe, pre-insulated and heat traced, fusion welded, bends to suite pipeline route
   iii. 100mm diameter HDPE Tee, one end flanged (drain pipe connection)

c) The fresh water make-up pipeline shall consist of, but is not limited to:
   i. 100mm drain valves (gate valve or similar), flanged
   ii. 250mm diameter HDPE DR 17 pipe, pre-insulated and heat traced, fusion welded (pump station inlet pipe)
   iii. 100mm diameter HDPE DR 17 pipe, pre-insulated and heat traced, fusion welded, bends to suite pipeline route

d) The decant pipeline shall consist of, but is not limited to:
   i. 400mm diameter HDPE DR 17 pipe, fusion welded (pump station inlet pipe)
   ii. 360mm diameter HDPE DR 32.5 pipe, fusion welded, bends to suite pipeline route

(2) Pipe insulation

a) Material: rigid polyurethane foam, factory applied
b) Insulation thickness: 50mm for freeze protection
c) Density: 35 to 46 kg/m^3
d) Water absorption: 4% by volume
e) Closed cell content: 90% minimum
f) System compressive strength: 414 to 552 kPa
g) Thermal conductivity: 0.020 to 0.026 W/m°C
h) Service temperature range: -450°C to 148°C

(3) Outer jacket on pipe insulation

a) The pipe shall be factory jacketed with UV inhibited polyethylene
b) Sealant: butyl rubber
c) Thickness: 1.27mm
d) Minimum elongation: 300%
e) Service temperature range: - 450°C to 850°C
f) Tensile strength: 8.9 kg/cm

(4) Insulated pipe joints

a) Pre-formed urethane half shells with heat shrink sleeves shall be used at butt fused joints.
b) All exposed ends of insulation shall be coated with an approved waterproofing sealant, as recommended by the supplier, after field cutting or trimming has been carried out.

(5) Pipeline heat trace

a) The pipes shall be insulated by the manufacturer's insulation process, with an integral conduit for electrical heat trace cable on the pipeline and a 1.27mm thick polyethylene outer jacket.
b) The outer jacket shall be UV inhibited. Polymer coated; form fitting insulation kits shall be used to insulate elbows, tees, saddles and other fittings, according to the manufacturer's recommendations.
c) Heat tracing conduits shall consist of an extruded plastic moulding applied to the pipe prior to the application of the insulation.
d) The conduit will be securely fastened to the pipe and sealed to prevent the ingress of foam during the insulation process.
e) Each conduit shall be checked after insulating to ensure they are not blocked.

11.2.4 Quality Assurance

1. Thermosyphons
   (1) Test all pipe welds and pipe sections for leaks using a helium leak detecting mass spectrometer prior to burial. If a leak is detected:
      a) Replace pipe if within pipe section.
      b) Redo weld if weld is faulty.
   (2) Check final above ground joints on the riser for leaks once the unit has been charged using a leak detection solution. No leakage is allowed.
   (3) Monitor the operation of the thermosyphons upon completion with a contact thermometer or an infrared surface temperature measuring device to confirm operation.
      a) Initial operation of the thermosyphon will be considered adequate if the temperature along the riser or the radiator is warmer than the ambient air.
      b) Monitor temperature of thermosyphon at least twice a month during the first three months of operation, provided that the ambient air temperature is colder than the ground.
   (4) Performance of the thermosyphons will be evaluated using ground temperature measurements collected from the thermistor cables installed inside the dam, as shown on drawings and as specified in Section 11.3.5.
   (5) All pipe and parts installations are subjected to Engineer's inspection.

2. Pipelines
   (1) Pipe marking:
      a) During extrusion production, the HDPE pipe shall be continuously marked with durable printing including the following information:
         i. Nominal size
         ii. Dimension ratio
         iii. Manufacturer name and product series
         iv. Cell class
         v. ASTM basis
         vi. Pipe test category
         vii. Plant identification
         viii. Production date
         ix. Operator number (shift letter optional)
         x. Resin supplier code
      b) For pipe diameters greater than or equal to 3" IPS, PE345444C shall be used as a cell class and F714 shall be used as the ASTM Basis. An example of the print string will read as follows:

5" IPS DR21 Driscopipe 1000 PE345444C ASTM F714 C3 ST5 08April97 14AP

(2) Quality Assurance

a) All pipes are to be thoroughly checked by the pipe manufacturer to ensure conformance to applicable industry standards.

b) Pipes are visually checked by the Engineer for damage in transport or handling prior to insulation.

c) The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor.

d) The fittings shall be manufactured from the same resin type and cell classification as the pipe itself.

e) The fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.

f) Each batch of rigid polyurethane insulation foam is laboratory tested to ensure conformance to published specifications.

g) Each pipe is verified during and after foaming to ensure proper centering and trimming.

h) All pipes installed and jointed are subjected to Engineer's inspection.

11.3 Part 3 – North and South Dam Construction

11.3.1 Key Trench Excavation

1. The construction activities shall be initiated with the removal of the vegetation cover within the footprint of the dam, the excavation of the key trench and the preparation of the abutments.
2. The excavation of the key trench shall be a minimum 2m deep and shall reach competent ground conditions.
3. The key trench can be shallower than the 2m depth if competent bedrock is encountered and inspected and approved by the Engineer.
4. Loose frozen soil, peat, boulders, weathered bedrock and protruding frozen ground shall be removed to provide a clean key trench.
5. The excavated material shall be stockpiled in a suitable area, with water management, for future use.
6. Field investigation by the Engineer will be carried out concurrently with the excavation to confirm that the key trench is within ice saturated soils or competent rock.

11.3.2 Thermosyphon Installation

1. Install evaporator pipes at the spacing and locations indicated on drawings.
2. Evaporator pipes must have positive gradient from the lowest point at the end of the loops. There shall be no localized low spot in the
3. Evaporator pipe that has been damaged or accidentally kinked during installation shall be reported to the Engineer and replaced, at the discretion of the Engineer. Test all piping prior to burial as specified herein.

4. Erect radiators plumb and attach to the radiator pile support as shown on drawings.
5. Drill holes for radiator pile supports to diameters and depths indicated on drawings.
6. Have the opened drilled hole inspected by Engineer to verify ground conditions and to confirm depth of hole before installing the piles. Remove all loose material, foreign matter and water from the hole.
7. Install the radiator pile support inside the drilled hole. Prevent infiltration of deleterious materials or degradation of the drilled hole.
8. Fill the radiator pile support and the outer annular space with cement grout to ground surface. Pour grout in a manner to prevent formation of voids. If settlement of grout is evident, place additional grout to bring grout to ground surface.
9. The Contractor shall acquire Engineer's written approved prior to fill placement on the thermosyphons.

11.3.3 GCL Installation

1. GCL installation shall be according to the general specification listed in Section 8 in addition to specifics herein.
2. The subgrade shall be even, compacted, free of loose material, frozen and approved by the Engineer in writing prior to GCL deployment.
3. The Contractor shall acquire Engineer's written approval prior to covering the GCL.

11.3.4 Core, Transition and ROQ Material Placement

1. All fill placement shall be done according to the general specifications in Section 8 and 9 in addition to the specifics herein.
2. The placement of core material shall require the addition of heat and water to achieve a high degree of saturation and to ensure that it is ice-free at the time of placement.
3. The moisture content of the core material shall be adjusted to prevent excess water that could form free ice lenses while maintaining the degree of saturation at 90% or higher.
4. The Core material cover on the GCL shall be even and compacted prior to Transition material placement.
5. The Transition material slope contact with the ROQ material shall be compacted according to the specifications prior to ROQ placement.

11.3.5 Monitoring Instrumentation

1. The Contractor shall supply and install all monitoring instrumentation at locations shown on the drawings or as directed by the Engineer.
2. All monitoring instrumentation shall be installed according to manufacturer's specifications.

3. Vertical ground thermistors shall be drilled and installed to specified depths after all fill has been placed.
4. Horizontal ground thermistors shall be placed at specified locations after the thermosyphon installation on fill cover but prior to the bulk fill placement.
5. All monitoring instrumentation shall be installed at specified elevation and extended to finished grade in stages in relation to fill lift placements.
6. Contractor shall take extra caution when working around installed instrumentation. Hand compaction will be required as specified in Section 9 around the instrumentation.
7. Instruments shall be tested by the Engineer at each staged extension to ensure functionality.
8. The Contractor shall be responsible for the cost of reinstallation if the instrumentation is damaged during construction due to fault or negligence by the Contractor.

11.4 Part 4 - Spillway Construction

1. The operational spillway shall be 18m wide and have a constant gradient of 0.8%.
2. The spillway shall be excavated to grades and limits as shown on the drawings.
3. The spillway side slopes shall be excavated at 2.5H:1V into the natural ground and 4H:1V into the dam.
4. Permafrost encountered on side slopes surfaces shall be 2m over excavated and sloped at 2H:1V.
5. A 2m over excavation where permafrost is encountered on the spillway channel shall be replaced with compacted Transition material. Transition material shall be placed and compacted according to Section 9.

11.5 Part 5 –Pipeline Installations

11.5.1 Tailings Delivery Pipe Installation

1. The Contractor shall package the pipes in a manner designed to deliver the pipes to the project neatly, intact, and without physical damage.
2. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipes must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer’s recommendations.
3. When staging for installation, the transportation carrier shall use appropriate methods and intermittent checks to ensure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged.
4. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.
5. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

6. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed.
7. Tailings delivery pipe shall share secondary road surface with traffic. The pipe shall be aligned 0.3m away from the downstream shoulder of the road.
8. Steel flanges shall be coupled with appropriate bolts and nuts and torque to specified values according to manufacturer's specifications. Sealing shall be done according to manufacturer's specifications.
9. Fresh, even surface sections of HDPE pipe shall be joined by the butt fusion process into continuous lengths at the job site.
10. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations.
11. The heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer.
12. Properly executed electrofusion fittings may be used according to manufacturer's recommendations.
13. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important.
14. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings, and some mechanical couplings may be used to mechanically connect HDPE pipe according to the manufacturer's recommendations.
15. Values and flanges shall be installed in the pipeline directly upstream of the emergency dump catch basins as shown on the drawings.
16. Tailings delivery pipe shall be inserted in pipe crossings upstream of emergency dump catch basins and road junctions as shown on the drawings.

11.5.2 Reclaim Water Pipe Installation

1. The HDPE pipes shall be installed according the tailings delivery pipe specification in addition to the Specification herein.
2. The reclaim water pipeline shall be insulated and heat traced according to manufacturer's specifications.
3. Mechanical and/or electrical connections for the heat trace do not form part of this scope of work.
4. The reclaim water pipe shall share the access road surface with the tailings delivery pipe and traffic. The reclaim water pipe shall be aligned directly downstream beside the tailings delivery pipe.
5. The Engineer shall site fit the valves, flanges and pipe crossings upstream of the emergency dump catch basins to optimize the configuration.

11.5.3 Fresh Water Make-up Pipe Installation

1. The HDPE pipes shall be installed according to tailings delivery pipe specification in addition to the Specification herein.
2. The fresh water pipeline shall be insulated and heat traced according to manufacturer's specifications.
3. Mechanical and/or electrical connections for heat trace do not form part of this scope of work.
4. The fresh water make-up pipe shall share the access road surface with traffic. The pipe shall be aligned 0.3m away from the downstream shoulder of the road and directly beside other pipes where it is applicable.
5. The Engineer shall site fit the valves, flanges and pipe crossings upstream of the emergency dump catch basins to optimize the configuration.

11.5.4 Decant Pipeline Installation

1. The HDPE pipes shall be installed according to tailings delivery pipe specification in addition to the Specification herein.
2. The decant pipe shall share the access road surface with traffic. The pipe shall be aligned 0.3m away from the downstream shoulder of the road and directly beside other pipes where it is applicable.
3. The Engineer shall site fit the exit point of pipe at the end of the decant access road.

11.6 Part 6 – Emergency Dump Catch Basins

1. The basins shall be 14m by 14m and minimum 1m deep with 2H:1V inside side slopes.
2. The basin floors shall be designed to lie on the tundra with nominal levelling Surfacing material of minimum 0.1m thick prior to HDPE liner deployment.
3. Containment shall be achieved through lining using an HDPE liner sandwiched between two protective layers of geotextile, and covered with appropriate fill material as specified on the drawings.
4. A 0.5 inner diameter Schedule 40 steel pipe shall be placed along the secondary road beside the emergency dump catch basin for pipe routing.
5. The steel pipe shall have a wall thickness that can meet the load of a Cat 988 Loader. Contractor shall submit the steel pipe specification for Engineer's approval prior to procurement.
6. The steel pipe shall be painted to be weather resistant.

11.7 Part 7 – Implement Shoreline Erosion Protection Works

1. The shoreline erosion protection Works locations are shown on the drawings.
2. The Contractor shall be responsible for access into the work area.

3. The dimensions and configuration of the erosion protection Works shall be site fitted by the Engineer to cover sensitive permafrost.

4. The erosion protection Works shall be underlain by a layer of geotextile on natural ground that extends 1m below the lake surface. The upper limits for the Works shall be fitted to the 29.4m contour.

5. A 0.5m thick layer of uncompacted ROQ material shall be spread evenly over the lined area.

11.8 Part 8 – Measurement and Payment

1. Key trench excavation
   (1) The measurement of the key trench excavation will be done by survey before and after the Works and paid by the material quantity removed according to **Schedule 1**.

2. Thermosyphon installation
   (1) The thermosyphon installation will be paid as a lump sump upon acceptance.

3. GCL installation
   (1) The GCL installation will be measured final installed area and paid according to **Schedule 1**.

4. Core, Transition and ROQ material placement
   (1) The measurement of the Core, Transition and ROQ material shall be done by survey for the in place volume and paid by the material quantity placed according to **Schedule 1**.

5. Monitoring instrumentation
   (1) The instrumentation installations will be measured and paid by the labour and equipment time.

6. Spillway construction
   (1) The measurement for the spillway excavation will be done by survey before and after the Works and paid by the material quantity removed and placed according to **Schedule 1.**

7. Tailings delivery pipeline installation
   (1) The tailings delivery pipe will be measured and paid by the linear meter according to **Schedule 1**.

8. Reclaim water pipeline installation
   (1) The measurement for the reclaim water pipe will be done by survey and be paid by the linear meter according to **Schedule 1**.

9. Fresh water make-up pipeline installation
   (1) The measurement for the fresh water make-up pipe will be done by survey and be paid by the linear meter according to **Schedule 1**.

10. Decant pipeline installation
    (1) The measurement for the decant pipe will be done by survey and be paid by the linear meter according to **Schedule 1**.

11. Emergency dump catch basin construction
    (1) The emergency dump catch basins will be measured by survey and paid by the material quantity placed.
    (2) Geosynthetics will be measured by area and paid according to "Geosynthetics" in **Schedule 1**.
    (3) Steel pipe installation and pipeline arrangement will be paid by labour time and material, if any.

12. Shoreline erosion protection Works construction
    (1) The shoreline erosion protection Works will be measured by survey and paid by the material quantity placed.
    (2) Geosynthetics will be measured by area and paid according to geosynthetics in **Schedule 1**.

END OF SECTION 11

This report "**Technical Specification for Tailings Containment Area and Surface Infrastructure Components, Doris North Project, Hope Bay, Nunavut, Canada**" has been prepared by SRK Consulting (Canada) Inc.

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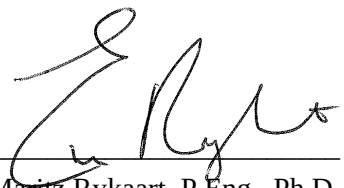

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