Special Provisions

The following section will form part of the contract.

1. The contract will be based on stipulated price. Use Appendix C.
2. The contractor is required to obtain a quarry use permit for the supply of granular material for this project. The geotechnical report by AMEC is appended to Section 02 of the specifications for your review. The report clearly indicates that the in-situ material will require processing (screening) to produce acceptable material for the project.
3. The GN has applied for the project Water Licence from the Nunavut Water Board. The GN will not award the project construction contract until the licence has been received from the Nunavut Water Board.
4. The contractor will provide a Site Sign to be located at the entrance gate. The sign will be installed at the completion of the final inspection. The sign will be 1.2 meters by 1.2 meters. The language and wording of the sign will be provided by the owner.

CONTENTS

SECTION 1 CONTENTS

PART 1 GENERAL

1.1 Section Includes

.1 Kugaaruk Sewage Lagoon and Solid Waste Sites.

.2 Work Covered by Contract Documents.

.3 Contract Method.

.4 Work by Others.

.5 Contractor use of premises.

1.2 Work Covered by Contract Documents

.1 Work of this Contract comprises general construction, located at Kugaaruk, Nunavut Territory; and further identified as:

.1 Site clearing;

.2 Rock removal;

.3 Berm construction;

.4 Truck turnaround pad construction;

.5 Discharge flume supply and installation;

.6 Overflow weir supply and installation;

.7 Decant system supply and installation

1.3 Contract Method

.1 Construct the Work under a single fixed price contract.

.2 Payment will only be made for actual work completed and on materials complete and delivered to site in Kugaaruk NU.

.3 Work to be completed in two phases. Phase 1: rock removal to be completed prior to November 2006. Phase 2: all remaining work to be completed prior to November 2007. Atmospheric temperatures in the winter months are expected to remain around minus forty degrees Celsius (-40ºC).

1.4 Contractor Use of Premises

.1 Contractor has unrestricted use of site.

PART 2 PRODUCTS

2.1 Not Used

.1 Not used.

PART 3 EXECUTION

3.1 Not Used

.1 Not used.

END OF SECTION

Part 1 General

1.1 GENERAL

1. Payments will be made on the basis of the lump sum prices bid and the unit prices bid in the TENDER and in accordance it the GENERAL CONDITIONS.
2. The prices bid for various items of work, unless specifically noted otherwise, shall include the supply of all labour, material, plant and equipment necessary to construct the WORK in accordance with the specifications.
3. The prices bid for supply of materials and installation of materials shall be full compensation of supplying, hauling, installing, cleaning, testing and placing in services together with all other work subsidiary and incidental thereto for which separate payment is not provided elsewhere.
4. The method of measurement for payment and the basis for payment will be in accordance with the following items of this section. All measurement will be done by the ENGINEER using generally accepted field survey methods.
5. Where the TENDER shows separate items for supply and installation, the unit prices or lump sum prices bid for supply shall include supplying, delivering, loading, unloading, and all allowances for handling, storage, breakage and waste. Payment will be made only for items actually installed.
6. All materials on site whether existing structures, vegetation, topsoil, gravel, sand or other excavated or piled material are the property of the OWNER or the owner of the land on which the WORK is located. Only those materials specifically noted in the SPECIFICATION or on the DRAWINGS as belonging to the CONTEACTOR shall become the CONTRACTOR's property.
7. Where there are excess excavated materials, unsuitable materials excavated or materials of any kind that are excavated but not used in the WORK, such materials are not the property of the CONTRACTOR unless authorized in writing bye the ENGINEER or specified to be disposed of by the CONTRACTOR.
8. Where WORK is called for in these SPECIFICATIONS and is not specifically designated for payment under a pay item, the CONTRACTOR shall deem such WORK as incidental to the most closely associated pay items and make appropriate allowances in his bid price. The CONTRACTOR will not be allowed an additional amount for any items not included in the TENDER BID but which are required to make the WORK complete.

1.2 MEASUREMENT AND PAYMENT CLAUSES (MOBILIZATION AND DEMOBILIZATION)

1. Mobilization and demobilization shall include the CONTRACTOR's costs of mobilization at the beginning of the project; and the cost of demobilization at the end of the project

2. Included in mobilization are such items as:

   - bonding, insurance and permits

   - moving personnel, materials and equipment to the site, setting p temporary facilities and all preparation for performing the WORK.

   - inspection and acceptance by the ENGINEER of all materials and equipment received, including as necessary, the opening of crates and recrating by the CONTRACTOR at his expense.

   - the storing in an adequate and approved warehouse of those materials and equipment which will not be immediately used for construction.

   - supply of literature and data for O&M Manuals

   - return of Government property in compliance with the CONTRACT DOCUMENTS

3. Included in demobilization are removal of all personnel, materials and equipment, once work as been completed, tested and accepted by the ENGINEER and general cleanup of the site and the WORK.

4. The lump sub bid for this work shall be relative to the cost involved.

5. Upon completion of mobilization as noted above, the CONTRACTOR shall be entitled to claim an amount not exceeding 70% of the lump sum amount stated under the item. Prior to billing for completion of mobilization, the CONTRACTOR will have complied with the conditions of Section 01700 in that all required Operations and Maintenance Manual Data and Manufacturer's Literature for material provided will have been provided to the ENGINEER. The remaining 30% shall be paid to the CONTRACTOR only after work for demobilization is competed to the satisfaction of the ENGINEER notwithstanding the holdback amount, incompliance with the SPECIFICATIONS, and the CONTRACT DOCUMENTS and the Record Drawings are turned over toe the ENGINEER.

1.3 LUMP SUM CONTRACTS

1. Payments will be made on the basis of the following:

   - Lump sum in the SCHEDULE OF ITEMS AND PRICES in the TENDER

   - Unit prices bid in the SCHEDULE OF UNIT PRICES in the TENDER for provisional items

   - Changes in the WORK for items not covered by unit 46 to 49 of the CONTRACT.

2. The CONTRACTOR must supply copes of invoices to substantiate claims if requested. Deletions will be proportioned on lump sum items or determined on the basis of unit prices.

3. For each lump sum item in the SCHEDULE OF BREAKDOWN PRICES, the ENGINEER will, in percentage of the item completed at the end of the payment period.

PART 1 GENERAL

1.1 Section Includes

.1 Product Installation Alternatives to Agreement.

1.2 Requirements

.1 Referenced specification Sections stipulate pertinent requirements for products and methods to achieve the Work stipulated under each Alternative.

.2 Coordinate affected related Work and modify surrounding Work to integrate the Work under each Alternative.

1.3 Award/Selection of Alternatives

.1 Indicate variation of Bid Price for Alternatives described below and listed in Bid Form. Note that this form requests a 'difference' in Bid Price by adding to or deducting from the base Bid price.

.2 Bids shall be evaluated on 'Base Bid' price. After determination of lowest Bidder, consideration will be given to Alternatives and Bid Price adjustments.

1.4 Alternatives

.1 Further to Clause 8 of the Instructions to Tenderers:

.1 No substitutions will be permitted without prior written approval of Engineer.

.2 Proposals for substitution may only be submitted after award of contract. Such request must include statements of respective costs of items originally specified and the proposed substitution.

.3 Proposals may be considered by Engineer if:

.1 materials selected by tenderer from those specified, are not available;

.2 delivery date of materials selected from those materials specified would unduly delay completion of contract, or

.3 alternative material to those specified, which are brought to the attention of and considered by Engineer as equivalent to the material specified and will result in a credit to the Contract amount.

.4 Should proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of substitutions will be determined by Engineer and Contract Price will be reduced accordingly.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Coordination Work with other contractors.

.2 Scheduled preconstruction and progress meetings.

1.2 Related Sections

.1 Section 01110 - Summary of Work

.2 Section 01810 - Commissioning.

1.3 Description

.1 Coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities, and construction Work, with progress of Work of other contractors under instructions of Engineer.

.2 The following persons have been designated by the Department of Community and Government Services: Mr. Navjit Sidhu, Project Officer, Projects, Cambridge Bay, Nunavut, Ph: (867) 983-4142.

1.4 Construction Organization and Start-up

.1 Within 15 days after award of Contract, attend a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Owner, Engineer, Contractor, Consultant, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 Meeting will be held in a location deemed suitable to all parties.

.4 Agenda to include following:

.1 Appointment of official representative of participants in Work.

.2 Schedule of Work, progress scheduling.

.3 Schedule of submission of shop drawings, samples.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.

.5 Delivery schedule of specified equipment.

.6 Site security in accordance with Section 01520 - Construction Facilities.

.7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements (GC).

.8 Record drawings in accordance with Section 01770 - Closeout Procedures.

.9 Maintenance in accordance with Section 01770 - Closeout Procedures.

.10 Take-over procedures, acceptance, and warranties in accordance with Section 01770 - Closeout Procedures.

.11 Monthly progress claims, administrative procedures, photographs, and holdbacks (GC).

.12 Appointment of inspection and testing agencies or firms in accordance with Section 01450 - Quality Control.

.13 Insurances and transcript of policies (GC).

.5 Comply with Engineer's allocation of mobilization areas of site; for field offices and sheds, for access, and parking facilities.

.6 During construction coordinate use of site and facilities through Engineer's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.7 Comply with instructions of Engineer for use of temporary utilities and construction facilities.

.8 Coordinate field engineering and layout work with Engineer.

1.5 On-Site Documents

.1 Maintain at job site, one copy each of the following:

.1 Contract drawings.

.2 Specifications.

.3 Addenda.

.4 Reviewed shop drawings.

.5 Change orders.

.6 Other modifications to Contract.

.7 Field test reports.

.8 Copy of approved Work schedule.

.9 Manufacturers' installation and application instructions.

.10 Labour conditions and wage schedules.

.11 Approvals / Permits

1.6 Schedules

.1 Submit preliminary construction progress schedule to Engineer coordinated with Engineer's project schedule.

.2 After review, revise and resubmit schedule to comply with revised project schedule.

.3 During progress of Work revise and resubmit as directed by Engineer.

1.7 Construction Progress Meetings

.1 During course of Work, attend bi-weekly progress meetings.

.2 Owner, Engineer, Consultant, Contractor and major subcontractors involved in Work are to be in attendance.

.3 Notify parties a minimum of 5 days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 5 days after meeting.

.5 Agenda to include following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for affect on construction schedule and on completion date.

.12 Other business.

1.8 Closeout Procedures

.1 Notify Engineer when Work is considered ready for Substantial Completion inspection.

.2 In the event the facility is not ready for inspection or cannot be successfully commissioned on the date set for commissioning and the Contractor has not notified the Engineer in sufficient time to prevent unnecessary travel, the Contractor shall pay for travel and accommodation costs for subsequent trips by the Engineer and Owner and all of their agents and representatives.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Schedule, form, content.

.2 Scheduled revisions.

.3 Critical path scheduling.

1.2 Related Sections

.1 Section 01770 - Closeout Procedures.

1.3 Schedules Required

.1 Submit schedules as follows:

.1 Construction Progress Schedule.

.2 Submittal Schedule for Shop Drawings and Product Data.

.3 Submittal Schedule for Samples.

.4 Submittal Schedule for timeliness of Owner furnished Products.

.5 Product Delivery Schedule.

.6 Cash Allowance Schedule for purchasing Products.

.7 Shutdown or closure activity.

.8 Within ten working days after each March 31 and September 30 occurring between commencement of Work and final completion, and within ten working days after final completion, provide to Engineer:

.1 Statement of total person days of labour used on site in performance of Contract, including labour provided under sub-contracts, as of dates identified in General Conditions 23.1.

.2 Estimate of total value in dollars of material delivered to site and installed, including material provided and installed under sub-contracts, as of dates identified in General Conditions 23.1.

1.4 Format

.1 Prepare schedule in form of a horizontal Gant bar chart.

.2 Provide a separate bar for each major item of work trade or operation.

.3 Split horizontally for projected and actual performance.

.4 Provide horizontal time scale identifying first work day of each week.

.5 Format for listings: chronological order of start of each item of work.

.6 Identification of listings: By Systems description.

1.5 Submission

.1 Submit initial format of schedules within 15 working days after award of Contract.

.2 Submit schedules in electronic format, forward through e-mail as pdf files.

.3 Submit 2 copies to be retained by Engineer.

.4 Engineer will review schedule and return review copy within 10 days after receipt.

.5 Resubmit finalized schedule within 7 days after return of review copy.

.6 Submit revised progress schedule with each application for payment.

.7 Distribute copies of revised schedule to:

- .1 Job site office.
- .2 Subcontractors.
- .3 Other concerned parties.

.8 Instruct recipients to report to Contractor within 10 days, any problems anticipated by timetable shown in schedule.

1.6 Critical Path Scheduling

.1 Include complete sequence of construction activities.

.2 Include dates for commencement and completion of each major element of construction as follows.

- .1 Site survey and layout
- .2 Granular source permitting and development
- .3 Site clearing.
- .4 Rock Removal
- .5 Berm Construction.
- .6 Culvert supply and Installation.
- .7 Discharge flume supply and installation
- .8 Discharge piping and control structure supply and installation
- .9 Training and commissioning

.3 Show projected percentage of completion of each item as of first day of month.

.4 Indicate progress of each activity to date of submission schedule.

.5 Show changes occurring since previous submission of schedule:

- .1 Major changes in scope.
- .2 Activities modified since previous submission.
- .3 Revised projections of progress and completion.

.4 Other identifiable changes.

.6 Provide a narrative report to define:

.1 Problem areas, anticipated delays, and impact on schedule.

.2 Corrective action recommended and its effect.

.3 Effect of changes on schedules of other prime contractors.

1.7 Progress Photographs

.1 Sizes: Prints 100 x 150 mm.

.2 Type: semi-matt colour with binding margin at one end.

.3 Paper: single weight, mounted.

.4 Number of prints required: 2 sets.

.5 Identification: typewritten name and number of project and date of exposure on 25 x 50 mm white patch, reverse side.

.6 Viewpoints: interior and exterior locations: viewpoints determined by Engineer.

.7 Frequency: monthly with progress statement.

.8 Submit all negatives of before final acceptance.

.9 Insert negatives or digital files in envelopes and identify with name and number of project. Indicate exposure dates and view points of each frame of 35 mm film strips.

1.8 Submittals Schedule

.1 Include schedule for submitting shop drawings, product data, samples.

.2 Indicate dates for submitting, review time, resubmission time, last date for meeting fabrication schedule.

.3 Include dates when delivery will be required for Owner-furnished products.

.4 Include dates when reviewed submittals will be required from Consultant.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Shop drawings and product data.

.2 Samples.

.3 Certificates and transcripts.

1.2 Related Sections

.1 Section 01450 - Quality Control.

1.3 Administrative

.1 Submit to Engineer submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Work affected by submittal shall not proceed until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

.6 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer’s review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.

.10 Keep one reviewed copy of each submission on site.

1.4 Shop Drawings and Product Data

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow 5 working days for Engineer's review of each submission.

.4 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.

.5 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.

.6 Accompany submissions with transmittal letter, in duplicate, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Other pertinent data.

.7 Submissions shall include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.8 After Engineer's review, distribute copies.

.9 Submit 8 prints of shop drawings for each requirement requested in specification Sections and as consultant may reasonably request.

.10 Submit 8 copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Engineer where shop drawings will not be prepared due to standardized manufacture of product.

.11 Delete information not applicable to project.

.12 Supplement standard information to provide details applicable to project.

.13 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

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

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Requirements and Procedures

.1 .....This section specifies general requirements and procedures for contractor’s submissions of shop drawings, product data, samples and mock-ups to Engineer for review. Additional specific requirements for submissions are specified in individual sections of Divisions 2 to 16.

.2 .....Do not proceed with work until relevant submissions are reviewed by Engineer.

.3 .....Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 .....Where items or information is not produced in SI Metric units converted values are acceptable.

.5 .....Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submissions.

.6 .....Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 .....Make any changes in submissions, which Engineer may require, consistent with Contract Documents and resubmit as directed by Engineer.

1.2 Submission Requirements

.1 .....Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.

.2 .....Allow 5 working days for Engineer's review of each submission.

.3 .....Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address, and subcontractor (if applicable)
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Name, address and telephone numbers of supplier and manufacturer.
- .6 Contractor's stamp, signed by Contractor’s authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

1.3 Shop Drawings

.1 .....The term "Shop Drawings" shall mean any of the following:

- .1 Original drawings or modified standard drawing prepared by the Contractor, or any of his subcontractors or equipment suppliers.
- .2 Manufacturer's catalogue sheets, brochures, literature, performance charts and diagrams and similar documentation used to illustrate manufactured products.

.2 .....Shop drawings shall clearly indicate details of construction of the work, including:

.1 Layout, showing dimensions, including identified field dimensions and clearances

.2 Setting or erection details

.3 Capacities

.4 Performance characteristics

.3 .....Submit a minimum of eight (8) copies of all shop drawings. After review, Engineer will distribute:

.1 Two (2) copy to Engineer's files.

.2 Six (6) Copies to be returned to the Contractor for inclusion within O&M manuals.

.3 The submissions of Shop Drawings to the Contractor is intended to supplement the O&M Manual and are not the sole intent of the six (6) copies. O&M Manual data and information shall conform to the requirements of Section 1731 – Operations and Maintenance Manual.

PART 2 PRODUCTS

2.1 Not Used

.1 .....Not used.

PART 3 EXECUTION

3.1 Not Used

.1 .....Not used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 References and Codes.

1.2 References and Codes

.1 Perform Work in accordance with National Building Code of Canada (NBC) including all amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 NU Public Health Act.

.3 Municipal Bylaws.

.4 Canadian Standards Association (CSA).

.5 Cold Regions Utilities Monograph.

.6 Water Supply for Public Fire Protection (Fire Underwriter's Survey)

.7 Environmental Protection of the GN.

.8 Nunavut Water Board

.9 Department of Fisheries and Oceans Canada (DFO)

.10 Indian and Northern Affairs Canada (INAC)

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Inspection and testing, administrative and enforcement requirements.

1.2 Related Sections

.1 Section 01330 - Submittal Procedures.

1.3 Inspection

.1 Allow Engineer access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Engineer instructions, or law of Place of Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 Engineer may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.

1.4 Access to Work

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

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

1.5 Procedures

.1 Notify appropriate agency and Engineer in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labor and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 Rejected Work

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Engineer as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 If in opinion of Engineer it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract

Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Engineer.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Temporary utilities.

1.2 Related Sections

.1 Section 01520 - Construction Facilities.

.2 Section 01560 - Temporary Barriers and Enclosures.

1.3 Installation and Removal

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 Dewatering

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.5 Temporary Power and Light

.1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.

.2 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.

1.6 Fire Protection

.1 Provide and maintain temporary fire protection equipment during performance of Work required by federal/municipal/territorial regulators and insurance companies having jurisdiction.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Construction aids.

.2 Parking.

.3 Project identification.

1.2 Related Sections

.1 Section 01510 - Temporary Utilities.

.2 Section 01560 - Temporary Barriers and Enclosures.

1.3 Installation and Removal

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 Site Storage/Loading

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.5 Construction Parking

.1 Provide and maintain adequate access to project site.

.2 Build and maintain temporary roads where required and provide snow removal during period of Work.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.6 Sanitary Facilities

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

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

1.7 Construction Signage

.1 If required, erect Owner supplied project sign in a location designated by Engineer.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Construction Safety Measures

.1 Observe construction safety measures of the National Building Code 1995 Part 8, Territorial Government, Nunavut Territory Workers' Compensation Board and Municipal authority provided that in any case of conflict or discrepancy more stringent requirements shall apply.

.2 Comply with the requirements of the Safety Act of the Nunavut Territory.

1.2 Overloading

.1 Ensure no part of Work is subjected to loading that will endanger its safety or will cause permanent deformation.

1.3 WHMIS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, and storage, of hazardous materials; and regarding labeling of containers and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada and Health and Welfare Canada.

.2 Deliver copies of MSDS sheets to Engineer on delivery of materials.

1.4 Sheeting and Shoring

.1 Provide sheeting and shoring as required for installation of underground works to provide construction safety for workmen in accordance with National and Territorial regulations.

1.5 Propane Cylinders

.1 Propane cylinders shipped to site must be provided with a locked, tamper proof, closure cap for the operating valve.

.2 Propane to be stored in accordance with Territorial regulations.

.3 Propane cylinders and containers of other flammable materials to be stored in a locked and well ventilated area to prevent theft, vandalism etc.

PART 2 PRODUCTS

2.1 Not Used

.1 Not used.

PART 3 EXECUTION

3.1 Not Used

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Barriers.

.2 Environmental Controls.

1.2 Related Sections

.1 Section 01510 - Temporary Utilities.

.2 Section 01520 - Construction Facilities.

1.3 Installation and Removal

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.4 Guard Rails and Barricades

.1 Provide secure, rigid guard rails and barricades around excavations and open ice areas.

1.5 Access to Site

.1 Provide and maintain access roads as may be required for access to Work.

1.6 Protection for Off-Site and Public Property

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

.2 Be responsible for damage incurred.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Fires

.1 Fires and burning of rubbish on site in not permitted.

1.2 Disposal of Wastes

.1 Do not bury rubbish and waste materials on site unless approved by Engineer.

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

.3 All waste material is to be disposed of at the community landfill site. The Contractor is responsible to obtain all permits.

1.3 Drainage

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with municipal and territorial requirements.

1.4 Work Adjacent to Waterways

.1 Do not operate construction equipment in waterways without proper silt containment measures in place.

.2 Use borrow material from watercourse beds when approved by Engineer.

.3 Do not dump excavated fill, waste material or debris in waterways, except as authorized.

1.5 Pollution Control

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

.2 Use of silt curtain is required when excavating in waterways.

.3 Control emissions from equipment and plant to municipal and Territorial emission requirements.

.4 Develop a spill contingency plan in accordance with the requirements of the Environmental Protection Division of the GN for all construction related activities.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 General

.1 Use new material and equipment unless otherwise specified.

.2 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.

.3 Use products of one manufacturer for material and equipment of same type or classification unless otherwise specified.

1.2 Manufacturers Instructions

.1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.2 Notify Engineer in writing of any conflict between these specifications and manufacturers instructions. Engineer will designate which document is to be followed.

1.3 Delivery and Storage

.1 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.

.2 Prevent damage, adulteration and soiling of material and equipment during delivery, handling and storage. Immediately remove rejected material and equipment from site.

.3 Store material and equipment in accordance with supplier’s instructions.

.4 Touch-up damaged factory finished surfaces to Engineer's satisfaction. Use primer or enamel to match original..

PART 2 PRODUCTS

2.1 Materials

.1 Quality:

.1 Refer to GC 22.

.2 Unless otherwise stipulated elsewhere in the Contract Documents, the Contractor shall provide and pay for labour, products, tools, construction machinery and equipment, water, heat, light, power, transportation and other facilities and services necessary for the performance of the work in accordance with the Contract.

.3 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in the work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.4 Defective products, whenever identified prior to the completion of work, will be rejected, regardless of previous inspections. Inspection does not relieve

responsibility, but is a precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.5 Should any dispute arise as to the quality or fitness of products, the decision rests strictly with the Engineer based upon the requirements of the Contract Documents.

.6 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item.

.2 Availability:

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of work.

.2 In the event of failure to notify the Engineer at commencement of work and should it subsequently appear that work may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

.3 Transportation:

.1 Pay costs of transportation and handling of products required in the performance of work.

PART 3 EXECUTION

3.1 Not Used

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 Labour Standards Act of the Nunavut Territory, Canada Occupational Safety and Health Regulations.

.2 Canadian Standards Association (CSA)

.3 Nunavut Territory

.1 Safety Act, R.S.N.W.T. 2003.

1.2 Work Permit

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

1.3 Safety Assessment

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

1.4 Meetings

.1 Pre-construction meetings: attend health and safety pre-construction meeting.

1.5 Regulatory Requirements

.1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

1.6 Responsibility

.1 Be responsible for safety of persons and property on site and for protection of persons off site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 Unforseen Hazards

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

1.8 Correction of Non-Compliance

.1 Immediately address health and safety non-compliance issues identified by Engineer.

.2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

1.9 Work Stoppage

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

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

PART 2 PRODUCTS

2.1 Not Used

.1 Not used.

PART 3 EXECUTION

3.1 Not Used

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 Record Drawings

.1 Engineer will provide two (2) sets of white prints for record drawing purposes.

.2 Maintain project record drawings and record accurately deviations from Contract documents.

.3 Record changes in red. Mark on one set of prints and at completion and prior to final inspection, neatly transfer notations to second set and submit both sets to Engineer.

.4 Record following information:

.1 Depths of various elements of culvert installation in relation to project benchmark.

.2 Horizontal and vertical location of utilities and appurtenances referenced to project benchmark.

.3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

.4 Field changes of dimension and detail.

.5 Changes made by Change Order or Field Instruction.

.5 Redlined drawings:

.1 Redlined drawings must be completed by the Contractor and submitted to Engineer. Engineer will update electronic copies of drawings.

.2 Provide reduced copies of as-built drawings received from Engineer for inclusion in Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used

PART 3 EXECUTION

3.1 Not Used

.1 Not Used

END OF SECTION

PART 1 GENERAL

1.1 Operations and Maintenance Manual

.1 Operations and Maintenance Manuals for the project will be produced by the Contractor, as outlined in Section 2.1.2.

.2 Manuals are to cover all installed items requiring or likely to require operating, maintenance, or repairs.

.3 The Contractor's work includes: the complete authoring, organization, and supply of O&M manual material as detailed in this section.

.4 All work described in this section is the Contractor's work except where specifically indicated otherwise.

.5 The number of copies required is six (6).

.6 The draft Operation and Maintenance manual is to be submitted for review by the Engineer a minimum of four (4) weeks prior to requesting Substantial Completion.

.7 The final approved and completed Operation and Maintenance Manuals are to be delivered to the Engineer at least 14 days before the Substantial Completion inspection. The data is to be separated into individual manual sets, organized into applicable categories of work parallel to the specification sections and each chapter in order and identified.

1.2 Reference Standards

.1 The Contractor's Operation and Maintenance manual submissions are to conform to the current edition of "Specifications for Operations and Maintenance Manuals", Department of Public Works and Services, Government of Northwest Territories.

PART 2 FORMAT

2.1 Organization

.1 The provision of Binders and Dividers are the responsibility of the Contractor.

.2 The completed manual will contain 10 chapters. The responsibility for production of each chapter is indicated below:

.1 Introduction (by Consultant)

.2 Index (by Contractor)

.3 Background, Design Data (by Consultant)

.4 Schematic, Functional Data (by Consultant)

.5 Components Details (by Contractor)

.6 Operating Procedures (by Consultant and Contractor)

.7 Maintenance Procedures (by Contractor)

.8 Testing and Certification Data (part by Contractor)

.9 Manufacturer Data and Service Information (by Contractor)

.10 Appendices (by Contractor)

.3 Group information logically by system within chapters to the greatest possible extent. Organize the information on each system in the most logical fashion, for example, from supply point through to point of use.

2.2 Language

.1 English for all information.

2.3 Testing and Certification Data (Chapter 8)

.1 List all items that require periodic inspection by independent inspectors. List the frequency of inspection, the inspection agency to contact, including address and current phone number.

.2 Include a photocopy of each certificate issued by the independent inspectors who make inspections pursuant to health, safety, and other regulations of a similar nature. Indicate where the original of each such certificate is filed and where it is to remain displayed.

.3 Include the originals of manufacturer's warranties and certificates issued by the independent inspectors in Copy 1 of the manual.

.4 Include clear, legible photocopies of manufacturers' warranties and certificates issued by the independent inspectors in copies 2 through 6.

.5 Group warranties together to form a section in Chapter 8.

2.4 Manufacturer's Information (Chapter 9)

.1 This chapter of the Operation and Maintenance manual provides a collection of all manufacturer's service manuals, parts lists, operating and maintenance instructions, and other applicable data that may be required in future years.

.2 Include information needed for operation, maintenance and repair of every system component , and any other system requiring or likely to require operation or routine maintenance.

.3 Preface this section with an index. List in order each item by the manufacturer's name and the pieces of equipment to which it refers. Include supplier's name, address, and phone number.

.4 Include:

.1 Maintenance instructions for finished surface and materials.

.5 Include all service manuals, data sheets, and other manufacturer's information for each component.

.6 Manufacturer's information is to be original in all copies of the manual. Photocopies are not acceptable.

.7 On the first page of each inclusion, identify the piece of equipment to which it refers.

.8 Remove pages from manufacturer's information that are irrelevant to the equipment provided to this project.

.9 Where tables and curves are given for the full range of sizes, underline in red in all copies the data that refers to the installed equipment. If more than one size or type in the same table was used, add the identification for each in the margin to assist positive identification. Draw a thick diagonal black line across all data not applicable to equipment provided.

.10 If any warning instructions are included which, if ignored, could significantly affect the equipment, mark these with red arrows in all copies, to draw to the operator's attention.

.11 Service manuals must be the operating and maintenance type, which gives parts lists, preferably including an exposed or sectioned drawing for guidance in assembling, installation details, lubrication, and operations details. Sales types of brochures, which give only a very general description and few details, are not acceptable.

.12 Mount any items that are smaller than 8½"x 11", on a full page, for inclusion in the manual.

.13 Include all wiring diagrams complete with wire coding.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 Related Sections

.1 Section 01810 - Commissioning.

1.3 Inspection and Declaration

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Engineer in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.2 Request Engineer’s Inspection.

.2 Engineer’s Inspection: Engineer and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.3 Completion: submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Operation of systems have been demonstrated to Owner's personnel.

.5 Work is complete and ready for Final Inspection.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Owner, Engineer and Contractor. If Work is deemed incomplete by Owner and Engineer, complete outstanding items and request re-inspection.

.5 Declaration of Substantial Completion: when Owner and Engineer consider deficiencies and defects have been corrected and final Operations and Maintenance Manuals are ready for submission, make application for certificate of Substantial Completion by way of GN form.

.6 Commencement of Warranty Periods: date of Owner’s acceptance of submitted declaration of Substantial Performance shall be dated for commencement for warranty period.

.7 Final Payment: When Owner and Engineer agree that final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, Contractor shall apply for Final Inspection. If Work is deemed incomplete, complete outstanding items and request re-inspection.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

Approved: 2002-12-04

Part 1 General

1.1 SECTION INCLUDES

.1 Includes general requirements for commissioning facilities and facility systems.

1.2 RELATED SECTIONS

.1 Section 01210 - Allowances.

.2 Section 01450 - Quality Control.

1.3 QUALITY ASSURANCE

.1 Provide testing organization services under provisions specified in Section 01450 - Quality Control.

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.4 SUBMITTALS

.1 Prior to start of Work, submit name of Contractor personnel proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.

.2 Submit documentation to confirm personnel compliance with quality assurance provision.

.3 Submit 3 preliminary specimen copies of each of report forms proposed for use.

.4 Fifteen days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

.5 Submit reports of testing, adjusting, and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.5 PROCEDURES - GENERAL

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Notify Engineer 7 days prior to beginning of operations.

.3 Accurately record data for each step.

.4 Report to Engineer any deficiencies or defects noted during performance of services.

1.6 FINAL REPORTS

.1 Organization having managerial responsibility shall make reports.

.2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

1.7 CONTRACTOR RESPONSIBILITIES

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

1.8 PREPARATION

.1 Provide instruments required for testing, adjusting, and balancing operations.

.2 Make instruments available to Engineer to facilitate spot checks during testing.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 Related Sections

.1 Section 01770 - Closeout Procedures

.2 Section 01810 - Commissioning.

1.3 Description

.1 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 Quality Control

.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5 Submittals

.1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Engineer’s approval.

.2 Give time and date of each demonstration, with list of persons present.

1.6 Preparation

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

1.7 Demonstration and Instructions

.1 Review contents of manual in detail to explain all aspects of operation and maintenance.

.2 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

SECTION 2 CONTENTS

PART 1 GENERAL

1.1 Related Work

.1 Section 01330 - Submittal Procedures.

.2 Section 02315 - Excavating, Trenching and Backfilling.

.3 Section 02317 - Roadway Excavation Embankment and Compaction.

1.2 References

.1 Construction Quality Assurance (CQA) Plan.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM D 5084, Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

.2 ASTM D 5890, Standard Test Method for Water Absorption of Bentonite by the Porous Plate Method, Swell Index Test.

.3 ASTM D 4354, Standard Practice for Sampling of Geosynthetics for Testing.

.4 ASTM D 5993 Test Method for Measuring Mass per Unit Area of Geotextiles

.5 ASTM D 5891 Fluid Loss in Bentonite ClaysAmerican Society for Testing and Materials (ASTM)

1.3 Quality Control Certificates

.1 At least two (2) weeks prior to start of work, furnish CQA Consultant with copies of mill test data and certificate that GCL delivered to job site meets requirements of this Section.

The certificate shall include:

- Roll numbers and identification,
- Sampling procedures, and
- Results of quality control tests, including a description of test methods used.

.2 Remove and replace uncertified material and replace with new material at no cost to the Owner.

1.4 Material Warranty

.1 Provide the Owner with a written warranty against manufacturing defects for period of twenty (20) years from the date of installation.

1.5 Guarantee

.1 Provide the Owner with a written guarantee against defects in installation and workmanship for a period of five (5) years from the date of final acceptance, including the services of qualified technicians and materials necessary to make repairs, at no cost to the Owner.

PART 2 PRODUCTS

2.1 Material

.1 The geotextile component to be non-woven, needle punched polypropylene or polyester material with Minimum Average Roll Values meeting or exceeding the criteria specified Table 1523-3-1.

.2 Provide test results from the Manufacturer for the product, as well as a certification that the material properties meet or exceed the specified values, at the frequency indicated in Table 1523-3-2.

.3 Synthetic material to be manufactured from inert polymeric materials which retain their structure during handling, placement and long-term service, have satisfactory resistance to acid and alkali action, are indestructible by micro-organisms and insects and are ultra violet light resistant.

.4 GCL to be manufactured by either adhesive /glue bonding or the mechanical bonding of the needlepunch process. Bentonite to consist of montmorillonite (sodium bentonite).

.5 If manufactured by needle punch process, verify that the geotextile component has been inspected continuously for the presence of broken needles using an in-line metal detector. Employ a method acceptable to the CQA Consultant for removal of broken needles.

.6 Verify that the proper mass per unit area of bentonite has been added to the product as specified in Table 1523-3-1.

.7 Test all material in accordance with the Manufacturer's quality control program. Samples not satisfying the Manufacturer's specifications shall result in the rejection of the applicable rolls. At the Manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify the non-complying rolls and/or qualify individual rolls.

.8 GCL to be supplied in rolls of minimum 3.6 metre continuous width.

.9 Minimum roll length to equal Manufacturer's standard minimum length.

.10 During shipping and on-site storage, protect the GCL at all times against exposure from sun; moisture, contamination by mud, dust, dirt; puncture; tearing and any other damaging or deleterious conditions. Contaminated GCL may require removal as directed by Engineer.

2.2 Labeling

.1 Each GCL roll to have a waterproof label which contains the following information:

- Manufacturer's name
- Production Identification
- Lot Number
- Roll Number
- Roll Weight; and
- Roll Dimensions

PART 3 EXECUTION

3.1 Installation

.1 The installation of the liner shall be completed by a company with minimum five (5) years similar experience.

.2 Place Handle all GCL in such a manner as to ensure it is not damaged in any way.

.3 In the presence of wind, sufficiently weight all GCL's with sandbags or the equivalent. Install such sandbags during placement and maintain in place until replaced with cover material.

.4 Cut GCL using an utility blade in a manner recommended by the Manufacturer and exercise due care to prevent damage to any underlying or adjacent liner system components during cutting.

.5 Take care during placement not to entrap stones or moisture under the GCL and not to walk on or drag equipment across the exposed GCL.

.6 Replace or properly repair any GCL damaged by stones or other foreign objects, or installation activities at no additional cost to Owner.

.7 If white coloured geotextile is used to encapsulate the bentonite, take precautions against "snowblindness" of personnel.

.8 Do not install the GCL on standing water. Install the GCL in a way that reduces the potential for hydration of the mat prior to completion of construction of the overlying liner system.

.9 Do not install the GCL during precipitation, high winds or other conditions that may cause rapid hydration of or damage to the GCL.

.10 Install the GCL as indicated by the Manufacturer or Engineer.

.11 Place soil layers (clay liner, granular sub-liner sampler blanket) or geomembrane overlying the geosynthetic clay liner, immediately following the installation of the GCL. Remove the GCL and replace if it becomes hydrated before the overlying soil layer or geomembrane is placed, at Contractor's expense.

.12 Remove and replace all hydrated GCL with new material at no additional cost to Owner.

3.2 Overlaps

.1 Overlap all GCL panels. Along the length of the mat, the overlap shall be a minimum of 150 mm or as specified by the Manufacturer. Along the width of the mat, the overlap shall be a minimum of 0.3 m, as specified by the Manufacturer or Engineer. The edges of the GCL panels should be adjusted to smooth out any wrinkles, creases, or "fishmouths" in order to maximize contact with the underlying panel.

.2 Do not nail or staple the overlaps to the underlying materials.

.3 Place panels from the highest to the lowest elevation within the area to be lined. Up-slope panels to be shingled over down-slope panels in order that flow is over the seam and not into the seam.

.4 After panels are placed establish proper overlap orientation and pull back the edge of the panel to expose the overlap zone. Remove any soil or other deleterious material present in the overlap zone.

.5 Place or pour a fillet of granular bentonite, Volclay®, or other sealing material acceptable to the Engineer, in a continuous manner along the overlap zone at a rate of at least 1800 grams per lineal metre (0.25 pound per lineal foot) to seal the overlaps.

.6 No vehicles permitted directly on geotextile.

3.3 Repair

.1 Repair any holes or tears in the GCL by placing a GCL patch over the hole, overlapping the edges of the hole or tear by at least 0.3 m in all directions. The patch may be secured with a water-based adhesive approved by the Manufacturer.

.2 Take care to remove any soil or other material which may have penetrated the torn GCL.

.3 Make all repairs at no additional cost to Owner.

.4 Do not nail or staple patches.

3.4 Placement of Overlaying Materials

.1 Place materials above the GCL in such a manner as to ensure that the GCL is not damaged.

.2 Do not drive equipment used for placing other materials directly on the GCL. In areas of heavy vehicle traffic, such as access ramps, the soil thickness should be at least 1.0 m.

.3 Ensure that the GCL is not damaged while working around the appurtenances and ensure that connections of the GCL to appurtenances are properly sealed, including using bentonite if required.

3.5 Product Protection

.1 Protect all prior work and materials.

.2 In the event of damage, immediately make all repairs and replacements necessary, to the approval of Engineer and at no additional cost to the Owner.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 02701 - Aggregates: General.

1.2 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C 117- 03, Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C 136- 01, Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D 422- 63(2002), Test Method for Particle-Size Analysis of Soils.

.4 ASTM D 698- 00, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3).

.5 ASTM D 4318- 00, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1- 88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2- M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1- 94, Concrete Materials and Methods of Concrete Construction.

.4 Contractor is to complete his work in compliance with the Department of Fisheries Authorization. A letter of authorization has been applied for by the Owner. The Contractor shall be responsible to meet the terms and conditions of the letter of Authorization from DFO. The cost to provide a silt curtain around the excavation throughout the underwater section shall be included in the contract price.

1.3 Definitions

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock : any solid material in excess of 0.25 m^3 and which cannot be removed by means of duty mechanical excavating equipment having a 0.95 to 1.15 m^3 bucket. Frozen material not classified as rock.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Waste material: excavated material unsuitable for use in work or surplus to requirements.

.3 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work.

.4 Unsuitable materials:

.1 Weak and compressible materials under excavated areas.

.2 Frost susceptible materials under excavated areas.

.3 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 : Sieve sizes to CAN/CGSB-8.1.

.2 Table

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45

.3 Coarse-grained soils containing more than 20 % by mass passing 0.075 mm sieve.

.5 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 Samples

.1 Submit samples in accordance with Section 01330 - Submittal Procedures.

.2 Inform Engineer at least four (4) weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.

.3 Submit 70 kg samples of type of fill specified.

.4 Ship samples prepaid to Ottawa, in tightly closed containers to prevent contamination.

1.5 Protection of Existing Features

.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing excavation work, notify applicable owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by careful test excavations.

.2 Surface features:

.1 Conduct, with Engineer, condition survey of existing service poles, wires, survey bench marks and monuments which may be affected by work.

.2 Protect existing surface features from damage while work is in progress. In event of damage, immediately make repair to approval of Engineer.

1.6 Shoring, Bracing and Underpinning

.1 Protect existing features in accordance with Section 01560 - Temporary Barriers and Enclosures and applicable local regulations.

.2 Engage services of qualified professional engineer who is registered or licensed in the Nunavut Territory, Canada in which work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for work.

.3 Submit design and supporting data at least two (2) weeks prior to commencing work.

.4 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Nunavut Territory, Canada.

PART 2 PRODUCTS

2.1 Materials

.1 Type 1 and Type 2 fill: properties to section 02701 - Aggregates: General and the following requirements:

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

.3 Table

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

.2 Type 3 fill: selected material from excavation or other sources, approved by Engineer for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Unshrinkable fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.

.2 Maximum Portland cement content of 25 kg/m^3.

.3 Minimum strength of 0.07 MPa at 24 h.

.4 Concrete aggregates: to CAN/CSA-A23.1.

.5 Portland cement: Type 10.

.6 Slump: 160 to 200 mm.

.4 Silt Curtian

.1 The silt curtain to be constructed of a woven geo-texile. Standard of Acceptance: Typar 3401.

.2 Curtain to be weighted using standard heavy gage chain, or similar stable material. Weights to be free of all grease or other soluble materials.

PART 3 EXECUTION

3.1 Site Preparation

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Install silt curtain prior to any excavation of riverbed materials below the water elevation. Silt curtain to extend from the top of the ice surface to the top of the riverbed. Gaps in the silt curtain are not permitted.

3.2 Stockpiling

.1 Stockpile fill materials in areas designated by Engineer. Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

3.3 Excavation

.1 Advise Engineer at least seven (7) days in advance of excavation operations for initial cross sections to be taken.

.2 Excavate to lines, grades, elevations and dimensions as indicated Engineer.

.3 For trench excavation, unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.4 Dispose of surplus and unsuitable excavated material off site.

.5 Do not obstruct flow of surface drainage or natural watercourses.

.6 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.7 Notify Engineer when bottom of excavation is reached.

.8 Obtain Engineer approval of completed excavation.

.9 Remove unsuitable material from trench bottom to extent and depth as directed by Engineer.

.10 Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with fill concrete.

.2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected maximum dry density.

.11 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Engineer.

3.4 Fill Types and Compaction

.1 Use fill of types as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTMD698.

.1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95%.

.2 Place bedding and surround material in unfrozen condition.

3.5 Backfilling

.1 .....Do not proceed with backfilling operations until Engineer has inspected and approved installations.

.2 .....Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators.

.5 Vibratory compaction equipment: Use a hand compactor in trench.

.6 Shape bed true to grade to provide continuous uniform bearing surface for pipe using type I material.

.7 Shape transverse depressions in bedding as required to suit joints.

.8 Compact each layer full width of bed to at least 95% maximum density to ASTMD698.

.9 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

3.6 Restoration

.1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by Engineer.

.2 Clean and reinstate areas affected by work as directed by Engineer.

END OF SECTION

Approved: 2001-12-04

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01330 - Submittal Procedure.

.2 Section 01560 - Temporary Barriers and Enclosures.

.3 Section 01705 - Health and Safety.

.4 Section 02315 - Excavating, Trenching and Backfilling.

1.2 MEASUREMENT PROCEDURES

.1 Quantities will be taken from cross section showing original rock surface and actual grade line set by Engineer, except that minimum depth of rock required to be excavated to be considered as 50 mm.

1.3 DEFINITION

.1 Rock: any solid material in excess of 0.25 m^3 and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m^3 bucket. Frozen material not classified as rock.

.2 PPV: peak particle velocity.

1.4 SUBMITTALS

.1 Blasting Operation

.1 Submit to Engineer and local authorities having jurisdiction for approval, written proposal of operations for removal of rock by blasting, in accordance with Section 01330 - Submittal Procedures.

.2 Indicate proposed method of carrying out work. Include details on protective measures, time of blasting and other pertinent details.

.3 Submit records to Engineer at end of each shift. Maintain complete and accurate record of drilling and blasting operations.

1.5 QUALIFICATIONS

.1 Retain licensed explosives expert to program and supervise blasting work, and to determine precautions, preparation and operations techniques.

1.6 BLASTING SURVEY AND MONITORING

.1 Engineer will visit property holders of adjacent buildings and structures to determine existing conditions and describe blasting and seismic recording operations.

1.7 BLASTING AND VIBRATION CONTROL

.1 Reduce ground vibrations to avoid damage to structures or remaining rock mass.

Part 2 Products

2.1 MATERIALS

.1 Not used.

Part 3 Execution

3.1 PROTECTION

.1 Prevent damage to surroundings and injury to persons in accordance with Section 01560 - Temporary Barriers and Enclosures. Erect fencing, post guards, sound warnings and display signs when blasting to take place.

3.2 ROCK REMOVAL

.1 Co-ordinate this Section with Section 01705 - Health and Safety.

.2 Remove rock to alignments, profiles, and cross sections as indicated.

.3 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize overbreak, and to avoid damage to adjacent structures.

.4 Excavate trenches to lines and grades to minimum of 50 mm below pipe invert indicated. Provide recesses for bell and spigot pipe to ensure bearing will occur uniformly along barrel of pipe.

.5 Cut trenches to widths as indicated.

.6 Use pre-shearing, cushion blasting or other smooth wall drilling and blasting techniques or directed by Engineer.

.7 Remove boulders and fragments which may slide or roll into excavated areas.

.8 Correct unauthorized rock removal at no extra cost, in accordance with Section 02315 - Excavating, Trenching and Backfilling.

3.3 ROCK DISPOSAL

.1 Dispose of surplus removed rock off site.

.2 Do not dispose removed rock into landfill. Material must be sent to appropriate location as approved by the Engineer.

END OF SECTION

Part 1 GENERAL

1.1 References

.1 ASTM D698-98, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft3) (600 kN-m/m3).

1.2 Definitions

.1 Rock Excavation: excavation of:

.1 Material from solid masses of igneous, sedimentary or metamorphic rock which, prior to removal, was integral with parent mass. Material that cannot be ripped with reasonable effort from Caterpilar D9L or equivalent to be considered integral with parent mass.

.2 Boulder or rock fragments measuring in volume one (1) cubic meter or more.

.2 Common Excavation: excavation of materials that are not Rock Excavation or Stripping.

.3 Unclassified Excavation: excavation of whatever character other than stripping encountered in the work.

.4 Stripping: excavation of organic material covering original ground.

.5 Over Haul: authorized hauling in excess of free haul distance that excavated material is moved.

.6 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.

.7 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.

.8 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.

1.3 Requirements of Regulatory Agencies

.1 Adhere to regulations of authority having jurisdiction if blasting is required.

.2 Adhere to Territorial and National Environmental requirements if potentially toxic materials are involved.

Part 2 PRODUCTS

2.1 Materials

.1 Embankment materials require approval by Engineer.

.2 Borrow material:

.1 Obtain from borrow pit to be approved by Engineer.

Part 3 EXECUTION

3.1 Compaction Equioment

.1 Compaction equipment must be capable of obtaining required densities in materials on project. Equipment that does not achieve specified densities must be replaced or supplemented.

.2 Operate minimum equivalent of one 12 tonne vibratory packer continuously in each embankment when placing material.

3.2 Excavating

.1 General:

.1 Notify Engineer whenever waste materials are encountered and remove to depth and extent directed.

.2 Subcut 500 mm below subgrade in cut sections unless otherwise directed. Compact top 150 mm below subcut to minimum 95% maximum dry density, ASTM D698 (AASHTO T99). Replace with approved embankment material and compact.

.3 Where subgrade is on transition from excavation to embankment treat ground slopes at grade points as directed by Engineer.

.2 Drainage:

.1 Maintain profiles, crowns and cross slopes to provide good surface drainage.

.2 Provide ditches as work progresses to provide drainage.

.3 Construct interceptor ditches as shown on plans or as directed before excavating or placing embankment in adjacent area.

.3 Rock excavation:

.1 If, during excavation, material appearing to conform to classification for rock is encountered, notify Engineer and provide sufficient time to enable measurements to be made to determine volume of rock.

.2 Shatter rock to 300 mm below subgrade elevation as indicated on plans.

.3 Reduce overbreak and increase stability of all rock faces by using smooth blasting techniques, such as pre-shearing, cushion blasting, buffer blasting, perimeter blasting and line drilling.

.4 Scale rock backslopes to achieve smooth, stable face, free of loose rock and overhangs to design backslope.

.5 Control blasting to minimize flying particles.

.4 Borrow Excavation:

.1 Completely use in embankments, suitable materials removed from right-of-way excavations before taking material from borrow areas.

.2 Obtain embankment materials in excess of what is available from cut areas from designated borrow areas.

.1 Engineer to designate extent of borrow areas and allowable depth of excavation.

.2 Remove waste and stripping material from borrow pits to designated locations.

.3 Slope edges of borrow areas to minimum 3:1 and provide drainage as directed.

.4 Trim and leave borrow pits in condition to permit accurate measurement of material removed.

3.3 Embankments

.1 When directed, scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces. Method used to be subject to prior approval of Engineer.

.2 Break up or scarify existing road surface prior to placing embankment material.

.3 Do not place material which is frozen nor place material on frozen surfaces except in areas authorized.

.4 Maintain crowned surface during construction to ensure ready run-off of surface water.

.5 Drain low areas before placing materials.

.1 Place and compact to full width in layers not exceeding 200 mm loose thickness. Engineer may authorize thicker lifts if specified compaction can be achieved and if material contains more than 25% by volume stone and rock fragments larger than 100 mm.

.6 Where material consists of rock:

.1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1 m.

.2 Carefully distribute rock material to fill voids with smaller fragments to form compact mass.

.3 Fill surface voids at subgrade level with rock spalls or selected material to form an earth-tight surface.

.4 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of subgrade elevation.

.7 Deductions from excavation will be made for overbuild of embankments.

3.4 Subgrade Compaction

.1 Break material down to sizes suitable for compaction and mix for uniform moisture to full depth of layer.

.2 Compact each layer to minimum 95% maximum dry density, ASTM D698 (AASHTO T99) except top 150 mm of subgrade. Compact top 150 mm to 100% maximum dry density.

.3 Add water or dry as required to bring moisture content of materials to level required to achieve specified compaction.

3.5 Finishing

.1 Shape entire roadbed to within 50 mm of design elevations.

.2 Finish slopes, ditch bottoms and borrow pits to neat condition, true to lines, grades and drawings where applicable.

.3 Remove rocks over 150 mm in any dimension from slopes and ditch bottoms.

.4 Hand finish slopes that cannot be finished satisfactorily by machine.

.5 Round top of backslope 1.5 m both sides of top of slope.

.6 Trim between constructed slopes and edge of clearing to provide drainage and free of humps, sags and ruts.

3.6 Protection

.1 Maintain finished surfaces in condition conforming to this section until acceptance by Engineer.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

.1 Not used

PART 2 PRODUCTS

2.1 Stone

.1 Hard, with relative density (formally specific gravity) not less than 2.65, durable quarry stone, free from seams, cracks or other structural defects, to meet following size distribution for use intended:

.1 Random rip-rap:

.1 Not more than 10% of total volume of stones with individual diameters less than 300 mm.

.2 Not less than 50% of total volume of stones with individual diameters of 600 mm or more.

.3 Remaining percentage of total volume to have uniform distribution of stones between 300 mm and 600 mm size.

PART 3 EXECUTION

3.1 Placing

.1 Grade areas above water line to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.

.2 Place rip-rap to thickness and details as indicated.

.3 Place stones in manner approved by Engineer to secure surface and create a stable mass. Place larger stones at bottom of slopes.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01561 - Environmental Protection.

1.2 Environmental Requirements

.1 Operation of construction equipment in water is prohibited.

.2 Use borrow material from watercourse beds when approved by Engineer.

.3 Design and construct temporary crossings to minimize environmental impact to watercourse.

.4 Constructing temporary crossings of watercourses when spawning beds are indicated is prohibited.

.5 Placing material in watercourse is to be completed in accordance with the Department of Fisheries and Oceans requirements.

PART 2 PRODUCTS

2.1 Preparation

.1 Obtain work permits from governing Federal, Territorial and/or Municipal authorities.

PART 3 EXECUTION

3.1 Existing Conditions

.1 Maintain existing flow pattern in natural watercourse systems.

3.2 Site Clearing

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

3.3 Drainage

.1 Pumping water containing suspended materials into watercourse is prohibited.

END OF SECTION

.....1996-06-30

PART 1 GENERAL

1.1 Related Work

.1 Section 02701- Aggregates: General

.2 Section 02315 - Excavating, Trenching and Backfilling

1.2 References

.1 ASTM D1759 Standard Practice for Design of HDPE Manholes for Subsurface Applications.

.2 ASTM F894 Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

.3 ASTM F714 Standard Practice or Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.4 ISO 9001:2000 Quality management systems - Requirements

1.3 Material Certification

.1 Submit manufacturer's test data and certification at least four (4) weeks prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.

PART 2 PRODUCTS

2.1 Materials

.1 The riser pipe shall only be manufactured from a closed profile high density polyethylene pipe that conforms to the requirements of section 5.1 ‘Base Materials’ of ASTM F894, and that no materials other than the approved base materials shall be used to manufacture the pipe. When requested to do so, the manufacturer shall certify that the materials used to manufacture the riser pipe meets these requirements.

.2 All solid wall pipe used in the manhole fabrication shall meet the requirements of ASTM F714 and shall conform to the OD and DR requirements specified on the contract documents.

.3 The polyethylene raw material for riser pipe and solid wall pipe shall contain a minimum of 2%, well dispersed finely divided carbon black for UV stabilization. Additives that can be conclusively proven not to be detrimental to the pipe may also be used provided that the pipe produced meets or exceeds all of the requirements of this specification.

.4 The pipe shall contain no recycled compound except that generated in the manufacturers’ own plant.

.5 The pipe manufacturers Quality System shall be certified as meeting the requirements of an ISO 9001:2000 Quality management system, by a qualified independent body.

.6 The riser pipe material and all solid wall pipe shall be resistant to corrosion resulting from the presence of Hydrogen Sulfide and to pH values between 2 and 13.

.7 The riser pipe shall be manufactured with dimensions and tolerances in accordance with the manufacturer's internal manufacturing standard. The pipe must meet the requirements of ASTM F894 when the pipe is marked as such. The nominal inside diameter of the pipe shall be true to the specified pipe size. The pipe shall be manufactured by the continuous winding of a closed profile onto suitably sized mandrels. It shall be produced to constant internal diameters.

.8 When more than 1 length of riser pipe is used to fabricate the riser, the termination of the helically wound profile that forms the pipe shall be manufactured with a 30° plated end cut.

.9 The pipe shall be manufactured in such a manner that the pipe is available in lengths from 3-60 feet. A variety of lengths are available to accommodate installation, storage or varying ground conditions. Unless otherwise stated, the standard laying length shall be 50 feet (15 meters). Each standard and random length of pipe in compliance with ASTM F894 shall be clearly marked as such as required by the standard.

.10 The pipe shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

.11 Manholes shall be designed in accordance with the requirements of ASTM D1759. The design shall be based on the site conditions identified on the project drawings and / or as identified by the owner.

PART 3 EXECUTION

3.1 Excavation and Backfill

.1 Excavate and backfill in accordance with Section 02315 - Excavating Trenching and Backfilling and as indicated.

.2 Obtain approval of Engineer before installing outfall structures and manhole.

3.2 Installation

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Dewater excavation to approval of Engineer and remove soft and foreign material before placing base.

.3 Set manhole base on 150 mm minimum of granular bedding compacted to 100% maximum density to ASTM D 698.

.4 Compact granular backfill to [95]% maximum density to ASTM D 698.

.5 Place unshrinkable backfill in accordance with Section 02315 - Excavating, Trenching and Backfill.

.6 Place frame and cover on top section to elevation as indicated. If adjustment required use mandhole riser ring.

.7 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

.8 Install safety platforms in manholes having depth of five (5) m or greater, as indicated.

.9 Manholes shall be factory fabricated to ensure consistency in product assembly.

.10 All joints in riser pipe sections shall be formed by extrusion welding along the helical 'profile cut' joints. Unless otherwise specifically noted on the contract documents, the profile winding shall be cut and sealed at a 30 ° angle, prior to extrusion welding of adjacent sections, to prevent flow along the pipe wall helix.

.11 All joints in solid wall pipe shall be by fusion welding unless specifically stated otherwise on the contract documents.

.12 All joints between the HDPE base plate, manhole base slope sections, manhole riser pipe, and mainline pipe extensions, shall be by extrusion welding. All extrusion welds shall conform to the requirements of the contract documents and WPS KWH01 (or equivalent).

.13 Connection of solid wall (ASTM F714) manhole stub extensions to HPDE mainline pipe meeting the same specification may be by mechanical connection, or by fusion welding.

.14 All fusion welds must be made following the fusion equipment manufacturers recommendations or the pipe manufacturers' butt fusion procedures.

3.3 Leakage Test

.1 Install watertight plugs or seals on inlets and outlets of each new manhole and fill manhole with water. Leakage not to exceed 0.3% per hour of volume of manhole.

.2 If permissible leakage is exceeded, correct defects. Repeat until acceptable to Engineer.

.3 Engineer will issue Test Certificate for each manhole passing test.

.4 Leak Testing: Installed sections of the fabricated HDPE manhole shall be examined for leaks by in-filtration where the ground water is 'high', or by ex-filtration where the ground water is 'low'.

.5 In-filtration Testing: The ground water table around the manhole must be at least 1 foot above the highest fabrication weld elevation of the section being examined. The joints may be examined visually for leaks. **No leaks should be observed**. If a leak is observed, it will be necessary to lower the water table below the area of the leak, and to completely dry and clean the area prior to undertaking a repair weld.

.6 Ex-filtration Testing: Establish a water level within the manhole that is at least 1 foot above the highest fabrication weld. Allow to stand for a minimum of 12 hours. *(The profile wall PE pipe will 'relax' due to the imposed internal pressure by minor deflection of the inside surface of the profile wall, increasing the volume inside the pipe.)* Add additional water as required to return the height of water to the original level. Let stand for 1 hour and measure the amount of water required to return the standing head to the initial level. Repeat three (3) times. The volume of 'make-up' water required in each subsequent step should be less than the preceding step. The values of 'make-up' water over time should trend to zero (0).

END OF SECTION

..... 1999-12-16

PART 1 GENERAL

1.1 Related Sections

.1 Section 02315 - Excavating, Trenching and Backfilling.

.2 Section 02317 - Roadway Excavation, Embankment and Compaction.

.3 Section 02701- Aggregates: General

.4 Section 01330 - Submittal Procedures

.5 Section 01355 - Waste Management and Disposal

.6 Section 01610 - Basic Product Requirements

1.2 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C 117-95, Standard Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C 136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D 698-91(1998), Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m3).

.4 ASTM D 1248-98, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.

.5 ASTM F 667-97, Standard Specification for 8, 10, 12, and 15 inch Corrugated Polyethylene Tubing and Fittings.

.2 Canadian Standards Association (CSA)

.1 CAN3-G401-93, Corrugated Steel Pipe Products.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire.

.2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

1.3 Samples

.1 Submit samples in accordance with Section 01330 - Submittal Procedures.

.2 Inform Engineer at least four (4) weeks prior to commencing work, of proposed source of bedding materials and provide access for sampling.

1.4 Material Certification

.1 Submit manufacturer's test data and certification at least four (4) weeks prior to commencing work.

.2 Certification to be marked on pipe.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01610 - Basic Product Requirements.

PART 2 PRODUCTS

2.1 Corrugated Steel Pipe

.1 Corrugated steel pipe: to CAN3-G401.

.2 Water-tight cut-off collars: as indicated.

.3 Prefabricated end sections: as indicated.

.4 Corrugated fluming: to CAN3-G401.

2.2 Granular Bedding and Backfill

.1 Granular bedding and backfill material to Section 02701- Aggregates: General and following requirements:

.1 Crushed pit run or screened stone, gravel or sand.

PART 3 EXECUTION

3.1 Trenching

.1 Do trenching work in accordance with Section 02315- Excavating Trenching and Backfilling.

.2 Obtain Engineer's approval of trench line and depth prior to placing bedding material or pipe.

3.2 Bedding

.1 Dewater excavation, as necessary, to allow placement of culvert bedding in the dry.

.2 Place minimum thickness of 200 mm of approved granular material on bottom of excavation and compact to minimum 95% maximum density to ASTM D 698.

.3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Engineer, free from sags or high points.

.4 Place bedding in unfrozen condition.

3.3 Laying Corrugated Steel Pipe Culverts

.1 Commence pipe placing at downstream end.

.2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.

.3 Lay pipe with outside circumferential laps facing upstream and longitudinal laps or seams at side or quarter points.

.4 Lay paved invert or partially lined pipe with longitudinal centre line of paved segment coinciding with flow line.

.5 Do not allow water to flow through pipes during construction except as permitted by Engineer.

3.4 Joints: Corrugated Steel Culverts

.1 Corrugated steel pipe:

.1 Match corrugations or indentations of coupler with pipe sections before tightening.

.2 Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.

.3 Insert and tighten bolts.

.4 Repair spots where damage has occurred to spelter coating by applying two coats of asphalt paint approved by Engineer or two coats of zinc rich epoxy paint.

.2 Structural plate:

.1 Erect in final position by connecting plates with bolts at longitudinal and circumferential seams.

.2 Drift pins may be used to facilitate matching of holes.

.3 Place plates in sequence recommended by manufacturer with joints staggered so that not more than three plates come together at any one point.

.4 Draw bolts up tight, without overstress, before beginning backfill.

.5 Repair spots where damage has occurred to spelter coating by applying two coats of asphalt paint or two coats of zinc rich epoxy paint approved by Engineer.

3.5 Backfilling

.1 Backfill around and over culverts as indicated or as directed by Engineer.

.2 Place granular backfill material, in 150 mm layers to full width, alternately on each side of culvert, so as not to displace it laterally or vertically.

.3 Compact each layer to 95% maximum density to ASTM D 698 taking special care to obtain required density under haunches.

.4 Protect installed culvert with minimum 500 mm cover of compacted fill before heavy equipment is permitted to cross. During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.

.5 Place backfill in unfrozen condition.

3.6 Fluming

.1 Assemble and install fluming as indicated.

.2 Set top edges of fluming flush with side slope.

END OF SECTION

..... 1996-06-30

PART 1 GENERAL

1.1 Related Work

.1 Section 01330 - Submittal Procedures

.2 Section 02231- Clearing and Grubbing

.3 Section 02371- Rip-Rap

.4 Section 02631- Manholes and Catch Basins.

.5 Section 02701- Aggregates: General

1.2 References

.1 ASTMC117-90, Test Method for Material Finer Than 0.075mm Sieve in Mineral Aggregates by Washing.

.2 ASTMC136-84a, Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTMD698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m3).

.4 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire.

.5 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

1.3 Samples

.1 Submit samples in accordance with Section 01330 - Submittal Procedures.

.2 Submit to Engineer for testing, samples of following materials at least four (4) weeks prior to commencing work:

.1 Two samples 3600mm square of flexible lining including joint or intersecting joints if included in work.

.2 Two samples 600mm long of flexible lining including joint or intersecting joints if included in work.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures.

.2 Indicate following items:

.1 Liner panels, details of anchoring panels, material, thickness and reinforcement.

.2 Projections through liner and method of sealing.

.3 Piping.

.4 Sluice or slide gates.

.5 Valves.

1.5 Classification of Excavation

.1 General: excavation of rock, common and unclassified materials shall include placing of suitable excavated materials in embankment fills or dikes, and disposal of unsuitable material.

.2 Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of]m^3.

.3 Common excavation: excavation of all materials of whatever nature, which are not included under definition of rock excavation, including dense tills, hardpan and frozen materials.

.4 Unclassified excavation: excavation of deposits of whatever character encountered in work.

1.6 Measurement for Payment

.1 Construction of sewage lagoon: lump sum payment.

PART 2 PRODUCTS

2.1 Materials

.1 Rip-rap: to Section 02371- Rip-Rap.

.2 Granular material to Section 02701- Aggregates: General and following requirements:

.1 Stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTMC136 and ASTMC117. Sieve sizes to CAN/CGSB-8.1.

.3 Table

PART 3 EXECUTION

3.1 Stripping of Topsoil

.1 Commence topsoil stripping of area as directed by Engineer after area has been cleared and grubbed.

.2 Strip topsoil to depths as directed by Engineer. Avoid mixing topsoil with subsoil.

.3 Stockpile in locations as directed by Engineer.

.4 Dispose of unused topsoil as directed by Engineer.

3.2 Excavation

.1 Excavate effluent ditches, by-pass ditches or re-routed surface drainage ditches as indicated.

.2 Remove unsuitable materials from dike foundation to depth as indicated.

.3 Excavate basin for lagoon to lines and elevations indicated.

3.3 Dike Construction

.1 Construct dikes as indicated.

.2 Place dike material in unfrozen condition.

.3 Place dike materials in layers of 150mm compacted thickness. Compact each layer to 95% maximum density to ASTM D 698.

.4 Hand finish or grade slopes and top of completed dike to remove stones over 25 mm in size and other debris.

.5 Finish slopes and top of dike as indicated.

.6 Rip-rap areas indicated in accordance with Section 02454- Rip-Rap.

3.4 Installation of Sewers

.1 Construct and install required manholes in accordance with Section 02631- Manholes and Catch Basins.

.2 Install valves, sluice gates, and slide gates in accordance with manufacturer's recommendations.

3.5 Flexible Lining

.1 Place compacted layer of granular material in unfrozen condition on bottom and sides of lagoon as indicated.

.2 Check surface on which flexible liner is to be placed and remove projections that may puncture lining.

.3 Place liner panels as directed by Engineer or as indicated. Anchor panels temporarily using sand bags or other weights that will not damage liner.

.4 Excavate anchor trenches at locations as indicated.

.5 Place and secure liner in anchor trenches.

.6 Backfill and compact anchor trenches.

.7 Clean edges of panels to be spliced and join as outlined in manufacturer's recommendations.

.8 Complete anchoring of panels at base of slope.

.9 Cut liner sheets to fit accurately around inlets, outlets, sleeves, concrete structures and other projections through lining.

.10 Complete flashing and sealing of penetrations as indicated.

.11 Place cover blanket as indicated.

3.6 Rip-Rap

.1 Place rip-rap in accordance with Section 02371- Rip-Rap and as indicated.

3.7 Clean Up

.1 Remove surplus material and debris from site.

END OF SECTION

Part 1 GENERAL

1.1 Related Sections

.1 Section 02315 – Excavating, Trenching and Backfilling

.2 Section 03302 – Cast-In-Place Concrete.

.3 Section 01330 - Submittal Procedures.

1.2 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.3 Samples

.1 Submit samples in accordance with Section 01330 - Submittal Procedures.

.2 Allow continual sampling by Engineer during production.

.3 Provide Engineer with access to source and processed material for sampling.

.4 Install sampling facilities at discharge end of production conveyor, to allow Engineer to obtain representative samples of items being produced.

.5 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

Part 2 PRODUCTS

2.1 Materials

.1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.

.2 Flat and elongated particles of coarse aggregate: to ASTM D4791.

.1 Greatest dimension to exceed five times least dimension.

.3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:

.1 Natural sand.

.2 Manufactured sand.

.3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:

.1 Crushed rock.

.2 Gravel and crushed gravel composed of naturally formed particles of stone.

.3 Light weight aggregate, including slag and expanded shale.

2.2 Source Quality Control

.1 Inform Engineer of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.

.2 If, in opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.3 Advise Engineer 4 weeks in advance of proposed change of material source.

.4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 EXECUTION

3.1 Preparation

.1 Aggregate source preparation

.1 Prior to excavating materials for aggregate production, clear area to be worked, and strip unsuitable surface materials. Dispose of cleared and unsuitable materials as directed by Engineer.

.2 When excavation is completed dress sides of excavation to nominal [1.5:1] slope, and provide drains or ditches as required to prevent surface standing water.

.3 Trim off and dress slopes of waste material piles and leave site in neat condition.

.2 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Engineer.

.3 Wash aggregates, if required to meet specifications. Use only equipment approved by Engineer.

.4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.

.3 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

.4 Stockpiling

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Engineer.

.2 Stockpile aggregates in sufficient quantities to meet Project schedules.

.3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.

.5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

.6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Engineer within 48 h of rejection.

.7 Stockpile materials in uniform layers of thickness as follows:

.1 Max 1.5 m for coarse aggregate and base course materials.

.2 Max 1.5 m for fine aggregate and sub-base materials.

.3 Max 1.5 m for other materials.

.8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.9 Do not cone piles or spill material over edges of piles.

.10 Do not use conveying stackers.

.11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.2 CLEANING

.1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed by Engineer.

.3 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.

END OF SECTION

..... 1996-06-30

PART 1 GENERAL

1.1 Related Sections

.1 Section 02317 - Roadway Excavation, Embankment and Compaction.

.2 Section 02701- Aggregates General

.3 Section 02722- Granular Sub-base

1.2 References

.1 ASTMC117-90, Test Method for Material Finer Than 0.075mm Sieve in Mineral Aggregates by Washing.

.2 ASTMC131-89, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTMC136-92, Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTMD698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft3) (600kN-m/m3).

.5 ASTMD1557-91, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft3) (2,700kN-m/m3).

.6 ASTMD1883-92, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTMD4318-84, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.8 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.

.9 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

1.3 Delivery, Storage, and Handling

.1 Deliver and stockpile aggregates in accordance with Section 02701- Aggregates General. Stockpile minimum 50% of total aggregate required prior to commencing operation.

.2 Store cement in weathertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment.

PART 2 PRODUCTS

2.1 Materials

.1 Granular base: material to Section 02701- Aggregates: General and following requirements:

.1 Crushed stone or gravel.

.2 Gradations to be within limits specified when tested to ASTMC136. Sieve sizes to CAN/CGSB-8.1.

.1 Gradation to:

Sieve Designation	% Passing		
	1	2	3
100 mm	-	-	-
75 mm	-	-	-
50 mm	100	-	-
37.5 mm	70-100	-	-
25 mm	-	100	-
19 mm	50-75	-	100
12.5 mm	-	65-100	70-100
9.5 mm	40-65	-	-
4.75 mm	30-50	35-60	40-70
2.00 mm	-	22-45	23-50
0.425 mm	10-30	10-25	7-25
0.180 mm	-	-	-
0.075 mm	3-8	3-8	3-8

.2 Material to level surface depressions to meet gradation (2) limits in accordance with 2.1.1.2.1.

.3 Liquid limit: to ASTMD4318, maximum25

.4 Plasticity index: to ASTMD4318, maximum6

.5 Los Angeles degradation: to ASTMC131. Max. % loss by weight: 45

.6 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTMC136.

Passing		Retained on
50 mm	to	25 mm
25 mm	to	19.0 mm
19.0 mm	to	4.75 mm

.7 Soaked CBR: to ASTMD1883, min 80, when compacted to 100% of ASTMD1557.

PART 3 EXECUTION

3.1 Sequence of Operation

.1 Place granular base after sub-base surface is inspected and approved by Engineer.

.2 Placing

.1 Construct granular base to depth and grade in areas indicated.

.2 Ensure no frozen material is placed.

.3 Place material only on clean unfrozen surface, free from snow and ice.

.4 Begin spreading base material on crown line or on high side of one-way slope.

.5 Place material using methods which do not lead to segregation or degradation of aggregate.

.6 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.

.7 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Engineer may authorize thicker lifts (layers) if specified compaction can be achieved.

.8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace that portion of layer in which material becomes segregated during spreading.

.3 Compaction Equipment

.1 Compaction equipment to be capable of obtaining required material densities.

.2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Engineer before use.

.3 Equipped with device that records hours of actual work, not motor running hours.

.4 Compacting

.1 Compact to density not less than 100% maximum dry density in accordance with ASTMD1557.

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Engineer.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.5 Proof rolling

.1 For proof rolling use standard roller of 45400kg gross mass with four pneumatic tires each carrying 11350kg and inflated to 620kPa. Four tires arranged abreast with centre to centre spacing of 730mm.

.2 Obtain approval from Engineer to use non standard proof rolling equipment.

.3 Proof roll at level in granular base as indicated. If use of non standard proof rolling equipment is approved, Engineer to determine level of proof rolling.

.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

.5 Where proof rolling reveals areas of defective subgrade:

.1 Remove base, sub-base and subgrade material to depth and extent as directed by Engineer.

.2 Backfill excavated subgrade with common material and compact in accordance with Section 02317 - Roadway Excavation, Embankment and Compaction.

.3 Replace sub-base material and compact in accordance with Section 02317 - Roadway Excavation, Embankment and Compaction.

.4 Replace base material and compact in accordance with this section.

.6 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Engineer and replace with new materials in accordance with Section 02722- Granular Sub-base and this section at no extra cost.

3.2 Site Tolerances

.1 Finished base surface to be within plus or minus 10mm of established grade and cross section but not uniformly high or low.

3.3 Protection

.1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by Engineer.

END OF SECTION

Approved: 2002-12-04

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01355 - Waste Management and Disposal.

.2 Section 02701 - Aggregates: General.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C117-95, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422-63(1998), Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.5 ASTM D1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft^3) (2,700kN-m/m^3).

.6 ASTM D4318-00, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

Part 2 Products

2.1 MATERIALS

.1 Granular sub-base material: in accordance with Section 02701 - Aggregates: General and following requirements:

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.

.3 Table

Sieve Designation	% Passing			
100 mm	-	-	-	-
75 mm	100	100	100	-
50 mm	-	-	-	100
37.5 mm	-	-	-	-
25 mm	55-100	-	-	60-100
19 mm	-	-	-	-

Sieve Designation	% Passing			
12.5 mm	-	-	-	38-70
9.5 mm	-	-	-	-
4.75 mm	25-100	25-85	-	22-55
2.00 mm	15-80	-	-	13-42
0.425 mm	4-50	5-30	0-30	5-28
0.180 mm	-	-	-	-
0.075 mm	0-8	0-10	0-8	2-10

.4 Other Properties as follows:

.1 Liquid Limit: to ASTM D4318, Maximum 25.

.2 Plasticity Index: to ASTM D4318, Maximum 6.

.3 Particles smaller than 0.02 mm: to ASTM D422, Maximum 3%.

.4 Soaked CBR: to ASTM D1883, Min 40 when compacted to 100% of ASTM D1557.

Part 3 Execution

3.1 PLACING

.1 Place granular sub-base after subgrade is inspected and approved by Engineer.

.2 Construct granular sub-base to depth and grade in areas indicated.

.3 Ensure no frozen material is placed.

.4 Place material only on clean unfrozen surface, free from snow or ice.

.5 Begin spreading sub-base material on crown line or high side of one-way slope.

.6 Place granular sub-base materials using methods which do not lead to segregation or degradation.

.7 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.

.8 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Engineer may authorize thicker lifts (layers) if specified compaction can be achieved.

.9 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.10 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 COMPACTION

.1 Compaction equipment to be capable of obtaining required material densities.

.2 Compact to density of not less than 98% maximum dry density in accordance with ASTM D698.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.

.4 Apply water as necessary during compaction to obtain specified density.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Engineer.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 SITE TOLERANCES

.1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.4 PROTECTION

.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Engineer.

END OF SECTION

AMEC Geotechnical Investigation

31 October 2005
YX00749

Dillon Consulting Limited
P.O. Box 1409,
4920 47th Street
Yellowknife, NT X1A 2P1

Attention: Mr. Gary Strong, P.Eng.
Project Manager.

Dear Mr. Strong:

Re: Geotechnical Investigation for Sewage Lagoon, Kugaaruk, NU

At the request of Mr. Gary Strong, on behalf of Dillon Consulting Limited (DCL), AMEC Earth & Environmental (AMEC), a division of AMEC Americas Limited conducted a site reconnaissance, compiled geotechnical information for the Kugaaruk area and conducted geothermal modeling for a proposed sewage treatment system in Kugaaruk, NU. The purpose of the investigation is to assist DCL in the design of a new Sewage and Solid Waste Facility in Kugaaruk, as requested by the Government of Nunavut, Department of Community and Government Services (DCGS).

Authorization to proceed with the investigation was received by signing Dillon's Short Form Agreement for Sub-Consultant Service dated June 3, 2005 for the above noted project.

1.0 BACKGROUND INFORMATION AND SCOPE OF WORK

The community of Kugaaruk is located on the southwest shore of the Simpson Peninsula on St Peter Bay near the mouth of the St. Peter River. The community is located approximately 1312 km northeast of Yellowknife.

The proposed sewage lagoon dyke is intended to replace the existing dyke that was built approximately 15 years ago. It is understood that the preferred design of the dyke consist of either a frozen-core, low permeability core, or synthetic liner dam concept. The purpose of the undertaken geothermal analysis was to confirm that the frozen core option is feasible for climate conditions of the Kugaaruk area.

In accordance with AMEC's proposal dated April 29, 2005 and subsequent discussions with DCL, the original scope of the study was to carry out a full scale of geotechnical investigation, including a field reconnaissance, drilling of 6 to 10 boreholes, interpretation of aerial photographs and numerical modeling of the temperature regime of the sewage lagoon dyke.

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Following the site reconnaissance and discussions with DCL, the drilling program and aerial photograph interpretation were not undertaken due to sufficient information being obtained to design the new lagoon dyke on the basis of the site reconnaissance alone.

AMEC conducted the site reconnaissance between July 3 and 6, 2005. Representatives of DCL and DCGS were also on site during the site reconnaissance. The site reconnaissance was conducted by Mr. Keith Barnes, P.Eng. of AMEC's Calgary office. Based on the initial review and site reconnaissance, AMEC was able to:

- Identify or characterize the climate, geological and permafrost conditions within the Kugaaruk area;
- provide a geotechnical characterization of existing dyke;
- perform geothermal modeling of the dyke temperatures; and
- prepare recommendations for the development of low permeability lagoon dyke.

Results and findings of this investigation are presented in subsequent sections of this report.

2.0 EXISTING DYKE DESCRIPTION

The existing lagoon dyke is located about 1 km, south-southwest of the community of Kugaaruk and about 2.4 km southwest of the airport (Figure 1, Appendix A). It is understood that the existing sewage lagoon has been in operation for about 15 years and is of a traditional operational design. Effluent in the lagoon is intended to slowly filter through the downstream berm. It is understood that current water quality tests from water taken downstream of the dyke appears to indicate that the effluent exceeds acceptable values.

Based on discussions with Hamlet personnel and observations made during the site reconnaissance, it appears that the crest of the downstream berm had been breached at times in the past. The effluent appears to flow directly from the lagoon, through or over the breached berm and then downstream. Hence, minimal filtering of the effluent by the berm occurs. Photos 1 and 2 (Appendix A) show the breached portion of the dyke.

One gravel sample was taken from the existing dyke structure in order to assess grain size and moisture content. Results of the testing are presented in Appendix C.

3.0 CLIMATE, GEOLOGY AND PERMAFROST

Kugaaruk is located geographically at approximately 68°32' N latitude and 89°49' W longitude. No weather station is located in the community and therefore climate records for Kugaaruk were estimated based on Igloolik data for the period from 1971 to 2000. Igloolik is located approximately 300 km to the northeast. The average annual mean temperature in Igloolik is reported to be –13.2 °C. The average thawing and freezing indices are calculated to be about 405 °C-days and -5169 °C-days, respectively.

The bedrock in the community and surrounding area generally consists of granite gneiss that is weathered, jointed and foliated extensively. The lines of intersection of these discontinuities have created numerous large rock wedges that have been dislodged to some extent by repeated freeze-thaw cycles.

During the period between the last glaciation and isostatic rebound (approximately 10000 years ago), the waters from Gulf of Boothia inundated coastal areas to an elevation of about 125 m above the recent sea level. The marine waters reworked the surficial glacial sediments and as a result, fine grained sediments can be found between bedrock ridges at the lower elevations.

Kugaaruk is located north of the Arctic Cycle within the continuous permafrost zone. The depth of seasonal thaw has been estimated to vary from about 0.7 m to 1.3 m, depending on ground vegetative cover and surface disturbance. Mean annual permafrost temperature within the study area is estimated to be about -7°C to –11°C at depth of 12 m to 15 m. The lower permafrost temperatures would be typical for terrains with organic cover and small snow cover, while warmer ground temperature would prevail near the ocean shoreline in gravelly and coarse grained sandy soils.

4.0 INFERRED SUBSURFACE CONDITIONS

Based on the field reconnaissance, it is concluded that lagoon site is covered with an organic mat, 50 mm to 100 mm thick (Photographs 3 and 4, Appendix A). Poorly drained, saturated fine grained marine deposits (sand and silt with gravel and inclusions of cobbles and boulders) likely underlie the organics. It is expected that the thickness of the overburden would be 1 to 3 meters. Bedrock outcrops can be encountered randomly over the lagoon impoundment (Photographs 5 and 6, Appendix A).

The mean annual permafrost temperature is expected to be in a range of -10 °C to -11 ^{o}C at a depth of about 15 m at the lagoon site. The thickness of the active layer is expected to be 0.7 m to about 1.0 m. This corresponds to sandy/gravelly saturated soil with the organic mat.

5.0 ENGINEERING RECOMMENDATIONS

This section provides recommendations on design and construction of the dyke and results of the dyke temperature modelling.

5.1 Proposed Sewage Dyke - Liner Option

Figure 2 and 3 (Appendix B) provides a cross section of the sewage dyke as it is proposed by DCL. The upstream and downstream slopes of the dyke are 1V:2 H, corresponding to a slope steepness of about 26.5 degrees. The proposed dyke is 5 m high and 4 m wide at the crest.

Silty sand, sand and gravel may be used for the dyke construction. This material should be screened and cobbles and boulders should be removed. One potential material could be from the granular deposit east of the proposed site. Results of material testing conducted on a stockpiled granular deposit east of the proposed site are presented in Appendix C.

The material used for dyke construction should be unfrozen at the time of placement and should be spread by lifts, 250 mm thick or less (compacted thickness). The compaction can be undertaken by bulldozers, D-6 or heavier. Placement and compaction of fill should not be conducted in freezing conditions. At least three bulldozer passes per lift should be applied. The

upper layer, 0.5 m thick can contain cobbles, up to 200 mm in size, protecting the dyke slopes against water erosion.

An appropriate synthetic liner should be installed in a near vertical position to an assumed elevation of 98.5 m, 1.5 m below existing ground surface, near the upstream slope. The liner should extend into a 1.5 m deep cut-off trench below the base of the dyke. The cut-off trench should be backfilled with compacted clayey material or grouted. The liner curtain should then extend straight up to the top of the dyke as shown at Figure 2, Appendix B. An alternative liner option is shown at Figure 3, Appendix B. It is understood that the constructability of the alternative option is more favourable however the liner is almost twice as long.

A low-permeability soil cut-off wall within the dyke, designed for unfrozen performance may also be considered. Due to the minimal amounts of fine grained soils observed in the lagoon area, this option was not considered feasible.

5.2 Proposed Sewage Dyke - Frozen Core Option

As it was described in Section 3.0, the Kugaaruk region is characterized by a mean annual air temperature of about -13.2 ^{o}C. AMEC considers that the concept of a frozen core dyke to provide primary containment of lagoon waters is technically feasible. Based on the proposed water level being located 1 m below the dyke crest, a 50 mm thick insulation layer (Styrofoam HI, or equivalent) should be placed immediately below the dyke crest. The intent of the insulation is to reduce the seasonal and long-term thawing that could penetrate the dyke crest, leading to increased percolation of effluent through the dyke. The insulation should be placed on the compacted and smooth gravelly / sandy surface. A sand layer, 100 mm thick, should be placed and compacted on the insulation to 95% of standard Proctor maximum dry density. A protective layer of rock fill about 400 mm thick should be placed over the sand layer (Figure 4, Appendix B).

5.3 Existing Dyke Repair

If it is desired to re-design the existing dyke with a frozen core, the dyke should be re-built to the dimensions presented in Figure 4. All loose material should be removed from the existing dyke surface and all erosion features should be cleaned of water and ice. The erosion features should be backfilled with engineered fill and compacted with a heavy bulldozer.

Following to the removal of the loose material and backfilling of the erosion features, the dyke should be raised to the design elevation in 250 mm (compacted) lifts. A 50 mm insulation layer should be placed on the compacted and smooth gravelly / sandy surface of the dyke crest as shown at Figure 4, Appendix B. A sand layer, 100 mm thick, should be placed and compacted on the insulation to 95% of standard Proctor maximum dry density. A protective layer of rock fill about 400 mm thick should be placed over the sand layer.

5.4 Sewage Dyke Geothermal Analyses

The geothermal modeling program SIMPTEMP, 2D version, (developed in-house by AMEC) was used to analyze the geothermal regimes for the two types of dykes. The geothermal simulator uses the finite element method to compute a numerical solution of the heat transfer problem. Physical/mathematical algorithms used in the SIMTEMP model have been published, and the simulation process has been verified- both against well-known analytical solutions of the heat transfer problem, and as compared with numerical solutions produced by other commercial/non-commercial geothermal software. AMEC has successfully used the SIMPTEMP program for a variety of geothermal applications over a ten years period.

Detailed geothermal analysis has been carried out to assess the present and future thermal regime within the Kugaaruk sewage lagoon dyke, and within the dyke foundation soils. The analysis considered the following geometry:

- Height of dyke is 5 m.
- Width of crest is 4 m.
- Upstream and Downstream slopes of dyke are 1V:2H.
- Local soil (silty sand, sand and gravel) is proposed for the dyke core construction.
- Water proof liner is proposed to place over core material at upstream slope of the dyke (see Figure 3).
- The dyke core will be covered up with rockfill, about 0.5 m thick.

This section briefly describes the initial geothermal conditions assumed for dyke subgrade, the model setup, input parameters and the result of the SIMPTEMP analysis.

5.4.1 Boundary Conditions for Dyke Numerical Analysis

The air temperature data and snow depth used for the present analysis were based on the Climate Normals for Igloolik weather station for period from 1970 to 2000. The data on snowfall were converted in thickness of the snow cover assuming the following snow densities:

- September through December - 0.22 g/cm^3;
- January through March – 0.25 g/cm^3;
- April and May – 0.27 g/cm^3.

The mean monthly air temperatures and calculated snow thicknesses used for the SIMPTEMP model are presented in Table 1.

Table 1: Mean Monthly Air Temperatures and Snow Thicknesses

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp., ^{o}C	-30.6	-31.2	-28.0	-19.3	-8.3	1.6	7.0	4.9	-0.4	-8.9	-19.5	-26.1
Snow, m	0.43	0.47	0.53	0.55	0.63	---	---	---	0.07	0.22	0.35	0.43

Mean monthly surface temperatures were applied over the exposed dyke surface, ground surface beyond downstream slope of the dyke and over water surfaces beyond upstream slope

of the dyke. To obtain the mean monthly surface temperatures, various n-factor coefficients were used over the dyke, downstream ground surface beyond the dyke and water surface. No allowance for climate warming was made to the air temperatures over the period of the simulation.

Dyke slopes and crest. It was assumed that practically no snow would accumulate on the dyke slopes and crest. Therefore, an n-factor of 0.9 was applied to the mean monthly air temperatures to obtain the mean monthly winter temperatures on the dyke surfaces. An n-factor of 1.2 (which corresponds to a bare rockfill surface) was applied to the mean monthly air temperatures to obtain the dyke surface temperature in the summertime.

Downstream Terrain Beyond Dyke. It was assumed that snow could accumulate beyond the toe of the dyke. The calculated snow thickness for the Kugaaruk area is similar to the measured snow thicknesses at the Cape Dorset weather station. It was therefore assessed that the n-factors for the Kugaaruk lagoon site would be 0.65 and 0.83 for the winter and summer air temperatures, respectively. The n-factors represent the insulating/warming effect of snow cover in the winter, and the cooling effect of the moss/lichen vegetation in the summer.

Water (Upstream Beyond Dyke). It was assumed that snow could accumulate on the ice surface. Similar to the downstream terrain area, an n-factor of 0.65 was applied to the mean monthly air temperatures for the winter months (October through May). From June through September, it was assumed that the water temperature over the entire depth of the water column was the same as the mean monthly air temperatures (n – factor = 1.0). Table 2 provides data on the mean monthly surface temperatures that were applied over the upper boundary of the geothermal models.

Table 2: Mean Monthly Surface Temperatures on Model Mesh

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dyke Crest and Slopes	-27.5	-28.0	-25.2	-17.4	-7.5	1.9	8.4	5.9	-0.4	-8.0	-17.6	-23.5
Downstream Surface	-19.9	-20.3	-18.2	-12.5	-5.4	1.3	5.8	4.1	-0.3	-5.8	-12.7	-17.0
Water / Ice Surface	-19.9	-20.3	-18.2	-12.5	-5.4	1.6	7.0	4.9	-0.3	-5.8	-12.7	-17.0
						Water Temperature equals air temperature						

5.4.2 Physical and Thermal Soil Properties

Estimates of physical properties for various typical soils expected to be encountered within the dyke and dyke foundation were based on the published information (see Section 3.0) and results of the tested material obtained during the site reconnaissance. Thermal properties of the materials (thermal conductivity and heat capacity) were selected based on available published data, and on previous experience with similar materials. Table 3 summarizes the material physical and thermal properties applied for the geothermal analyses.

Table 3: Physical and Thermal Soil Properties

Soil Type	Dry Density, kN/m^3	Moisture Content, %	Thermal Conductivity, W/m/^{o}C		Heat Capacity, MJ/m^3/^{o}C	
			Frozen	Unfrozen	Frozen	Unfrozen
Bedrock	28	2	2.90	2.90	2.58	2.58
Unsaturated overburden and dyke sand and gravel	20	7	2.90	2.73	2.26	2.68
Saturated rockfill, overburden and dyke sand and gravel	19.6	15	2.61	2.26	2.26	2.51
Unsaturated rockfill	20	5	2.9	2.73	2.09	2.26
Water	10	---	2.20	0.58	1.95	4.19

5.4.3 Grid and Soil Layers Description

The following soils/materials were identified within the sewage dyke cross-section:

- Unsaturated Rockfill on downstream face of dyke
- Saturated Rockfill on upstream face of dyke
- Unsaturated dyke core and native overburden
- Saturated dyke core and native overburden
- Bedrock
- Water

Dimensions of each of the individual layers are shown on the Figures of Appendix B. Physical and thermal properties of the constituent soils/materials identified are provided in Section 5.3.2.

The geothermal modeling grid extended about 104 m below the crest of the dyke and contained 9350 finite elements and 4816 nodes. The average dyke and active layer initial temperatures were taken as +2 ^{o}C, corresponding to the assumed dyke material temperature and active layer temperature at the end of summer. The initial water temperature was also taken as +2 ^{o}C. The initial soil temperature from the base of the active layer and to a depth of 12 m was taken to decrease gradually from 0 ^{o}C to -5 ^{o}C. The soil temperature was then warmed gradually down to the bottom of the grid with the geothermal gradient of 0.02 ^{o}C/m.

Zero heat flux was applied at lateral boundaries of the grid, while the heat flux at the mesh bottom corresponded to the geothermal gradient of 0.02 ^{o}C/m.

5.5 Results of Geothermal Modelling

Containment Dyke with Liner

Figure 5 (Appendix B) shows that after the first year of the dyke operation, the active layer at the dyke crest is about 1.7 m. The majority of the dyke core has a temperature in a range from -1 ^{o}C to -2 ^{o}C while the ground temperature under the dyke is about -4 ^{o}C. One can see that due

to the warming effect of the lagoon water the ground temperature beyond the upstream slope of the dyke is about 2 degrees warmer than the ground temperature beyond the downstream slope of the dyke.

Figures 6 through 9 (Appendix B) show that no significant changes in the dyke temperature regime were observed from the fifth to thirtieth year of the dyke operation. It can be seen that the thickness of the unfrozen zone under the lagoon increases up to 5 m, while the ground temperature at the base of the central part of the dyke decreases down to -5 ^{o}C.

Frozen Core Containment Dyke

Figure 10 (Appendix B) shows that the placement of insulation across the crest of the dyke decreases the thickness of the active layer at the crest to about 0.75 m. A comparison of Figures 5 and 10 shows that the active layer thickness is reduced by about 1 m. The insulation did not change the internal dyke temperature and after the first year of the operation, the majority of the dyke core has a temperature in a range from -1 ^{o}C to -2 ^{o}C.

Figures 11 through 14 (Appendix B) shows that after five years of the operation, the thickness of the active layer at the crest of the dyke is decreased to about 0.5 m. No significant changes in the dyke temperature regime are observed from the fifth to thirtieth year of the dyke operation (dyke temperature remains in a range from -1 ^{o}C to -5 ^{o}C, considerably colder than after the first year of operation). It can be seen that the unfrozen zone thickness under the lagoon is increased up to 5 m, while the ground temperature at the base of the central part of the dyke is decreased down to -7 ^{o}C. These latter temperatures are the same both design options.

Conclusions from Numerical Analyses

The numerical simulation of the liner and frozen core dyke options show that both options are technically feasible. The performance of each option are however dependant on many variables that can not be simulated in a numerical model. For example, for the liner option, cuts and tears in the liner will result in seepage that will cause warming of the core and the potential weakening and settlement of the dyke structure (and piping losses). Extreme climate warming effects could result in a thicker than predicted active layer across the dyke crest, which would lead to increased seepage.

5.6 Monitoring and Contingency Planning

If a frozen core design option is implemented, then monitoring observations should confirm that the design assumptions made during design are still valid over the life of the structure. Monitoring provides an opportunity to identify variations from the design basis and gives advance warning of developing issues. This monitoring is intended to provide lead time so that contingency measures may be developed and implement in a pro-active approach, rather than reacting to problems as they arise.

Monitoring should consist of the following:

- multi-bead thermistor cables installed through the dyke and into the native foundation. A minimum of two thermistor cables should be installed along the crest of the dyke. These thermistor cables are intended to provide information on the temperatures within the dyke and foundation. They should be read on a bi-monthly basis (six times per year) by

local personnel for the first ten years and quarterly (every three months) thereafter. If temperature anomalies are identified, increased monitoring should be initiated.

- At the time of bi-monthly temperature readings, a visual inspection should also be conducted of the dyke. The inspection should be conducted to confirm dyke integrity and locate any seepage paths that may have formed.

AMEC may provide additional information on the monitoring program and instrumentation upon request.

Contingency planning for potential performance issues in the dykes should be part of the design process. For example, in the event that deeper than expected thawing across the crest of the dyke occurs, the installation of thermosyphons to intercept surface warming may be needed. The design of the dykes should address how and when mitigation options should be installed.

The owner and operators of the dykes should be advised that monitoring of the dykes is an important component of an operations plan and that mitigation against potential seepage and thawing may be needed to address future events.

6.0 CLOSURE

The engineering recommendations presented herein are based on results of the site reconnaissance, geothermal analysis and review of the available information. No drilling was undertaken at the prospective borrow source locations to determine soil composition.

Results of the geothermal modeling have shown that the dyke temperature range should be from -1 ^{o}C to -5 ^{o}C during the operation years. The dyke may be designed with a liner placed as shown in Figures 2 and 3, Appendix B. An alternative option would be to construction a clayey cut-off core of the dyke. Implementation of this latter option depends on quality and quantity of the available clayey material within the Kugaaruk area (which is expected to be minimal in the vicinity of the site). If insulation is placed within the dyke structure as shown at Figure 4, Appendix B, then a frozen core dyke can be designed. A frozen core design is also suitable for the repair of the existing dyke structure. Monitoring of the performance of the dyke is considered an important component of the design of all options.

It should be stated that the results of modelling are valid for the boundary conditions and soil properties described in Section 5.4. If actual boundary conditions (soil properties) will differ considerably of applied parameters, then the actual temperatures of the dyke would vary from the predicted temperatures. Performance of the dyke will vary accordingly.

This report has been prepared for the exclusive use of Dillon Consulting Limited and its agents for the specific application described in this report. The use of this report by third parties is done so at the sole risk of those parties. It has been prepared in accordance with generally accepted permafrost and foundation engineering practices. No other warranty, expressed or implied, is made.

All field work conducted in regards to this work was for the sole purpose of determining geotechnical parameters. No environmental assessment of the existing dykes or surrounding areas was conducted by AMEC. An appropriate environmental assessment of the dykes and surrounding lands should be completed prior to undertaking any remedial work or new construction.

Respectfully submitted,

AMEC Earth & Environmental,
a division of AMEC Americas Limited

Keith Barnes, P.Eng.
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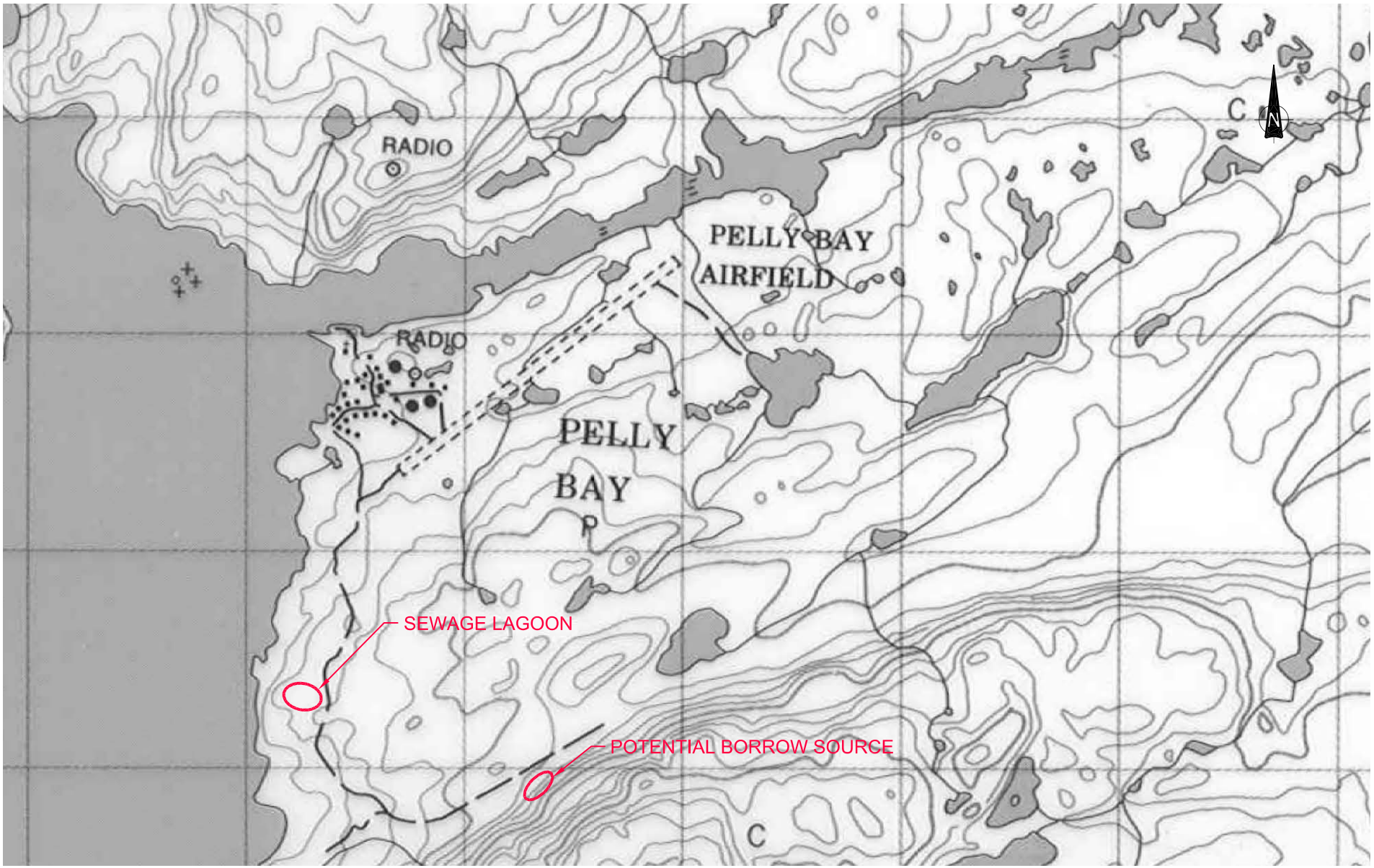
Reviewed by: Jim Oswell, P. Eng.,
Senior Permafrost Engineer

Appendix A

Figure 1: Site Location Plan
Plates: Select Photographs



SCALE
1: 25 000
0 250 500 m

amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: SITE LOCATION PLAN

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B03.dwg	FIGURE 1	A

Plate 1: View looking east at existing downstream lagoon.
Note breach in dyke

Plate 2: View looking west at existing downstream lagoon.
Note breach in dyke

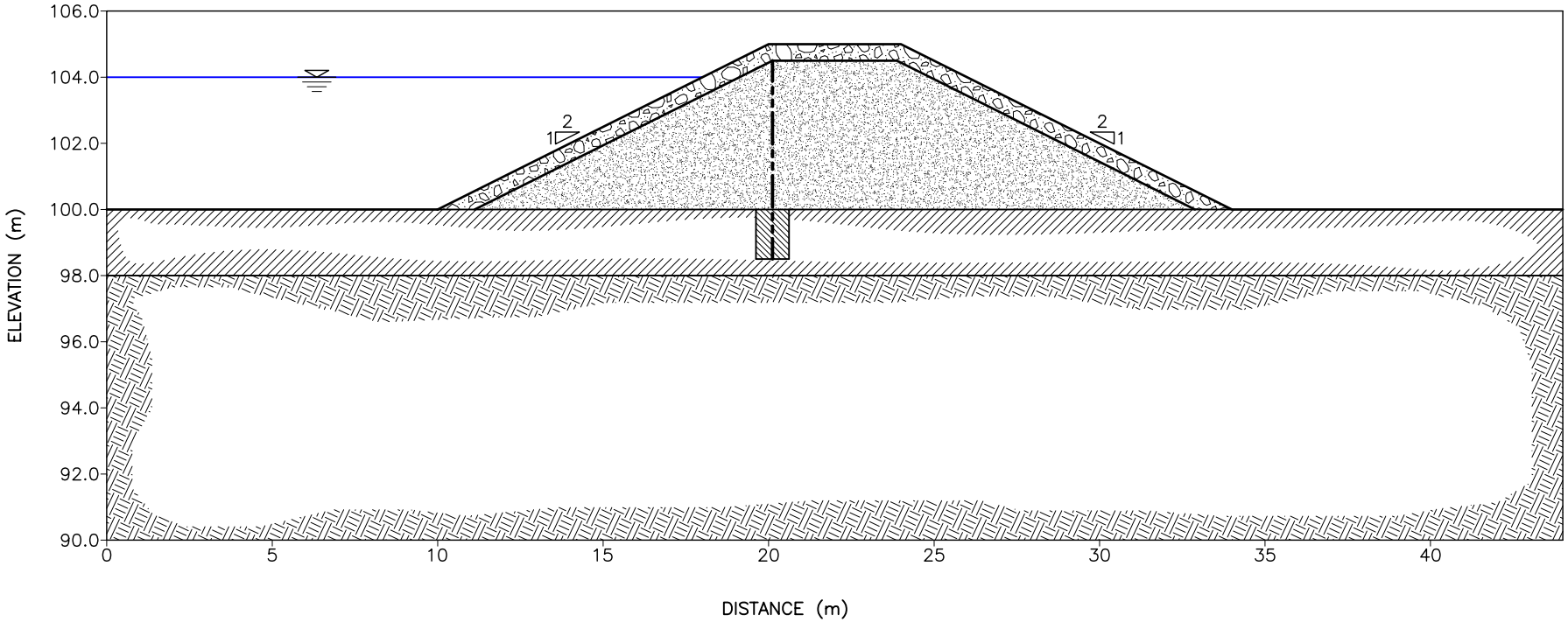
Plate 3: View looking west at potential site of new lagoon.
Note thin organic mat

Plate 4: View looking southwest at potential site of new lagoon.
Note thin organic mat

Plate 5: View looking northwest at potential site of new lagoon.
Note bedrock outcrops

Plate 6: View looking southwest at potential site of new lagoon.
Note bedrock outcrops

Appendix B



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE
1: 200
0 1 2 3 4 m

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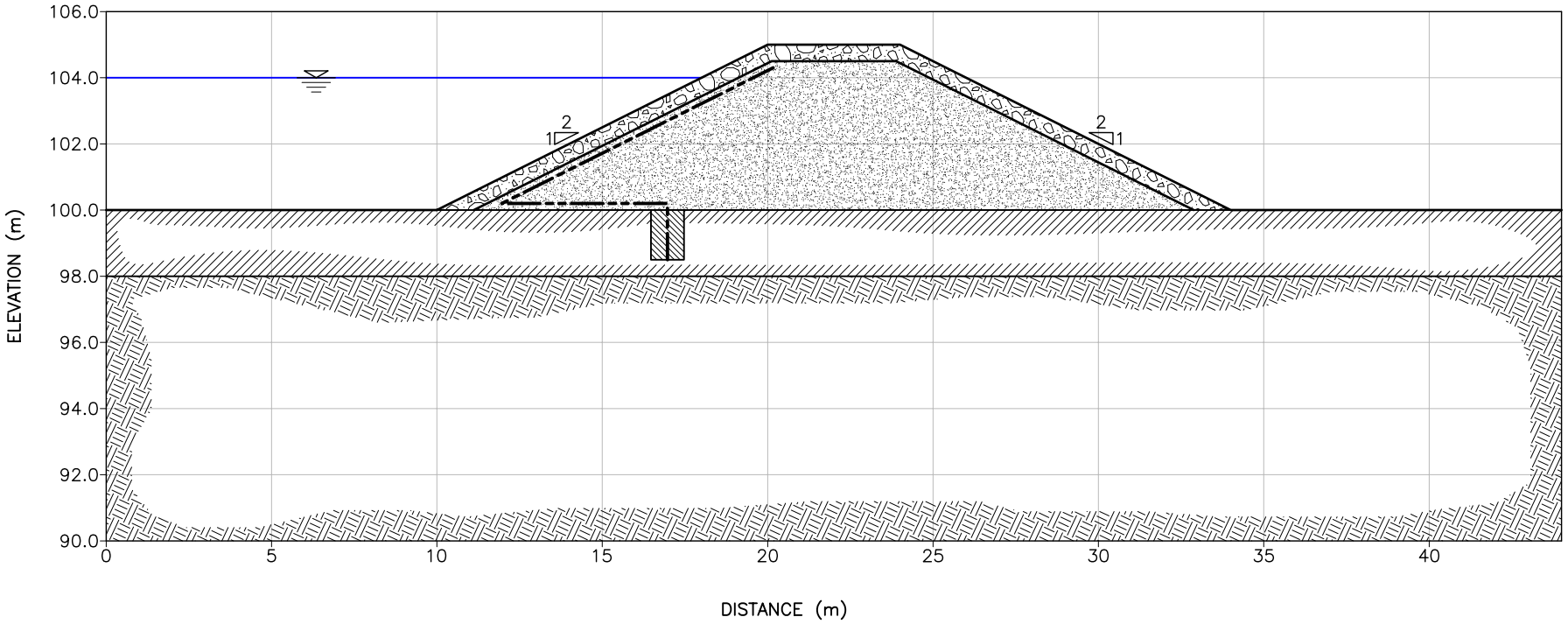
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: PROPOSED DYKE CROSS SECTION OPTION 1

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 2	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE
1: 200
0 1 2 3 4 m

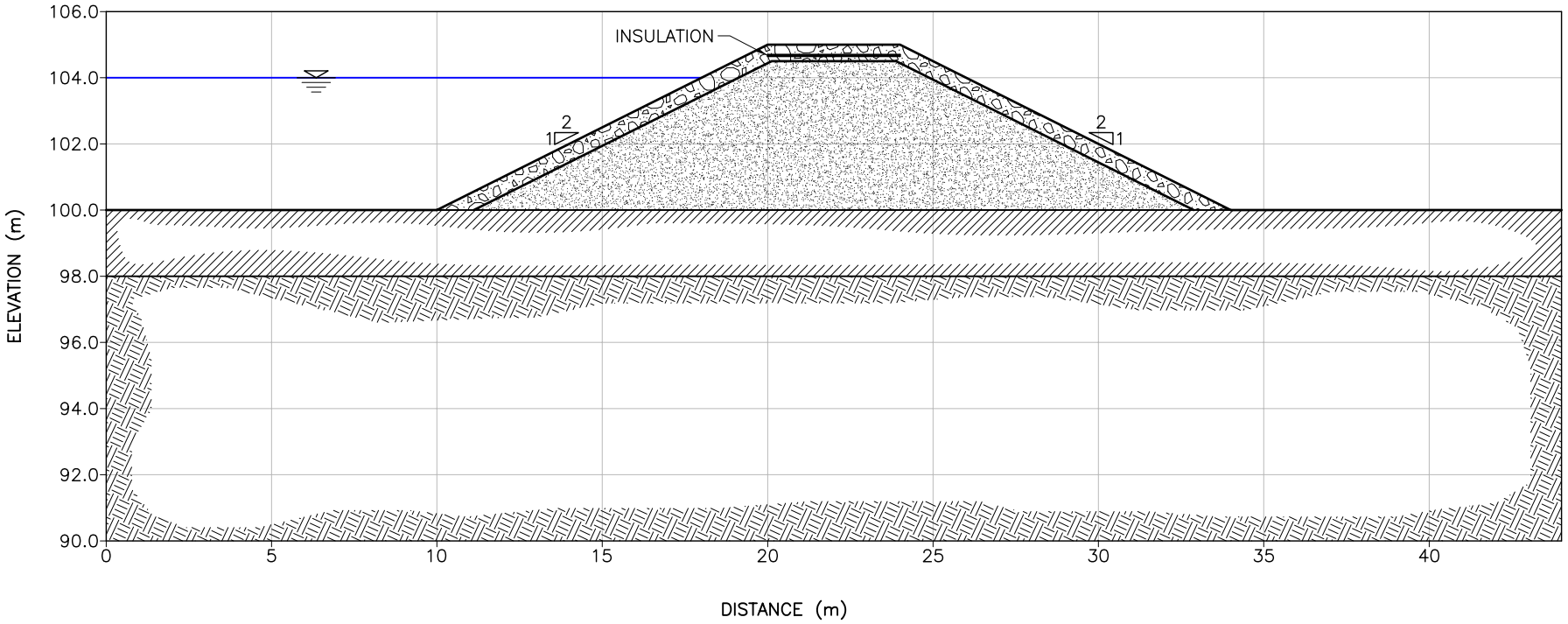
amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: PROPOSED DYKE CROSS SECTION OPTION 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 3	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK

SCALE
1: 200
0 1 2 3 4 m

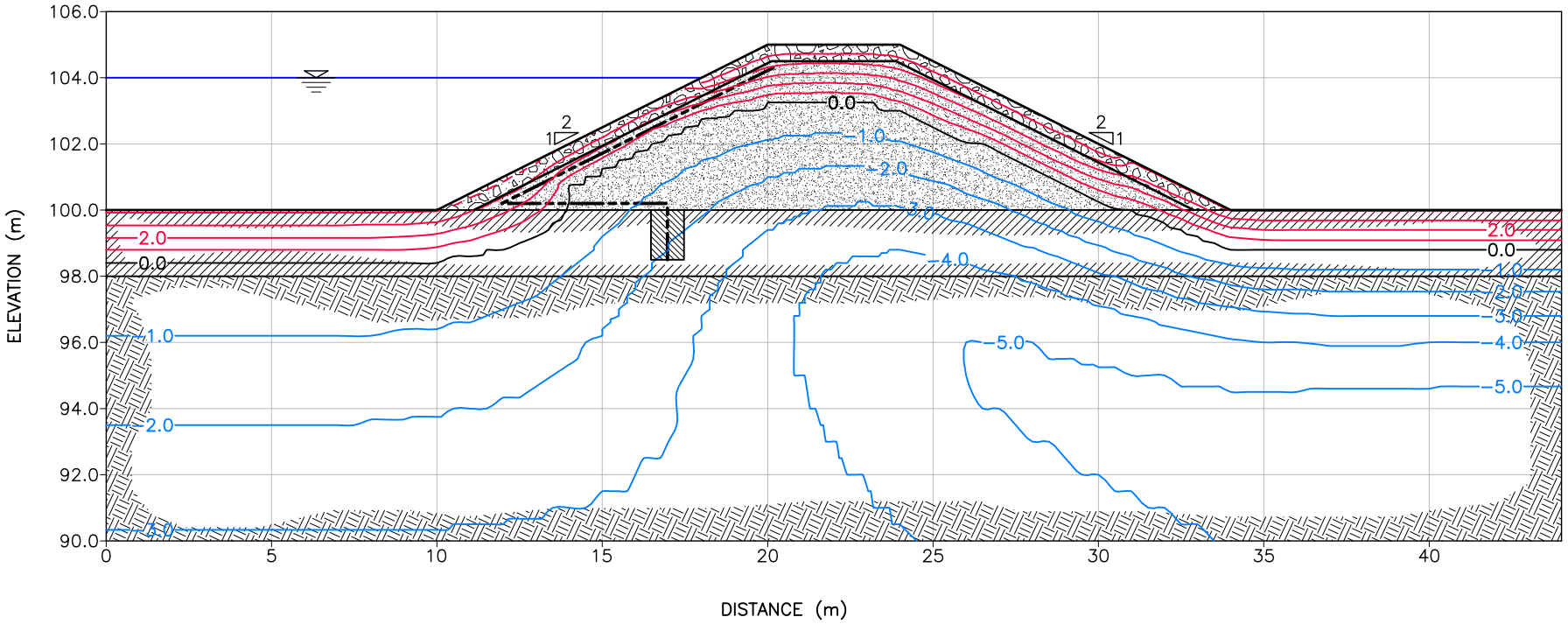
amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: PROPOSED DYKE CROSS SECTION - FROZEN CORE OPTION

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B02.dwg	FIGURE 4	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE

1: 200

0 1 2 3 4 m

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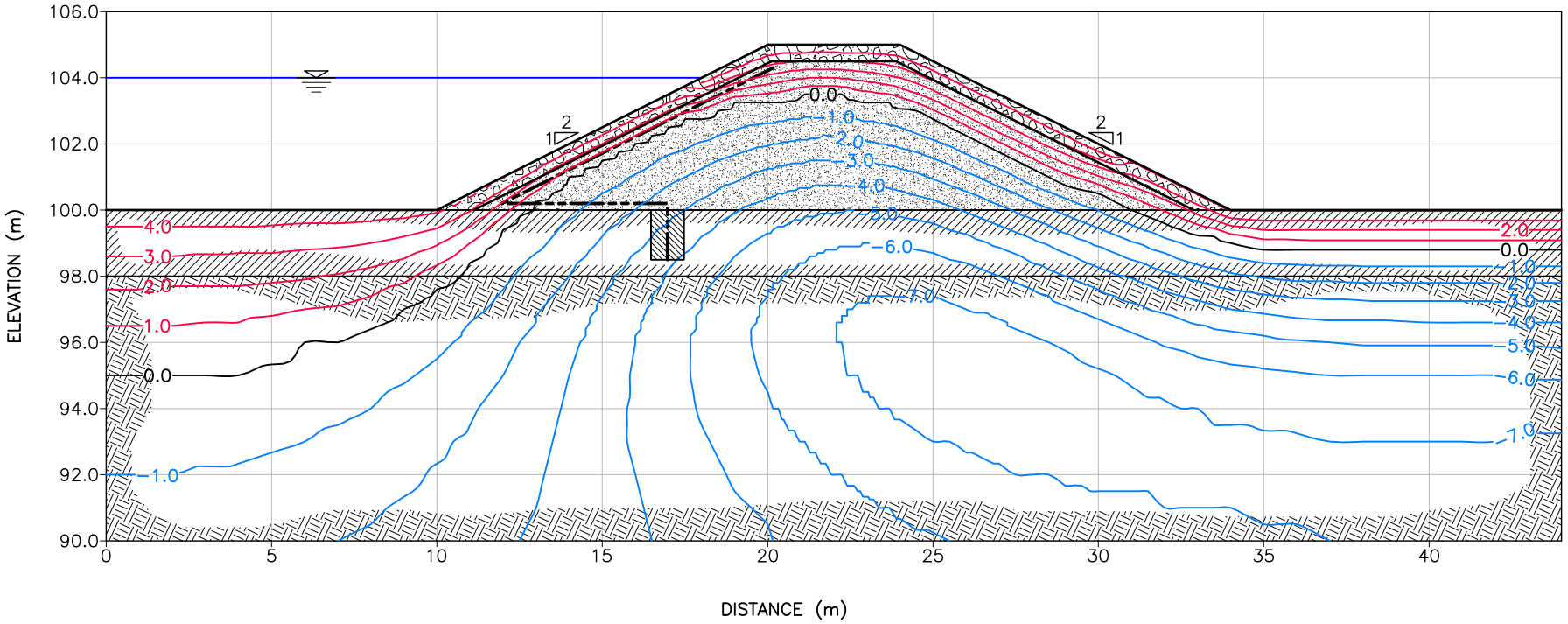
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 1 YEAR OF OPERATION, OPTION 1 & 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 5	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE

1: 200

0 1 2 3 4 m

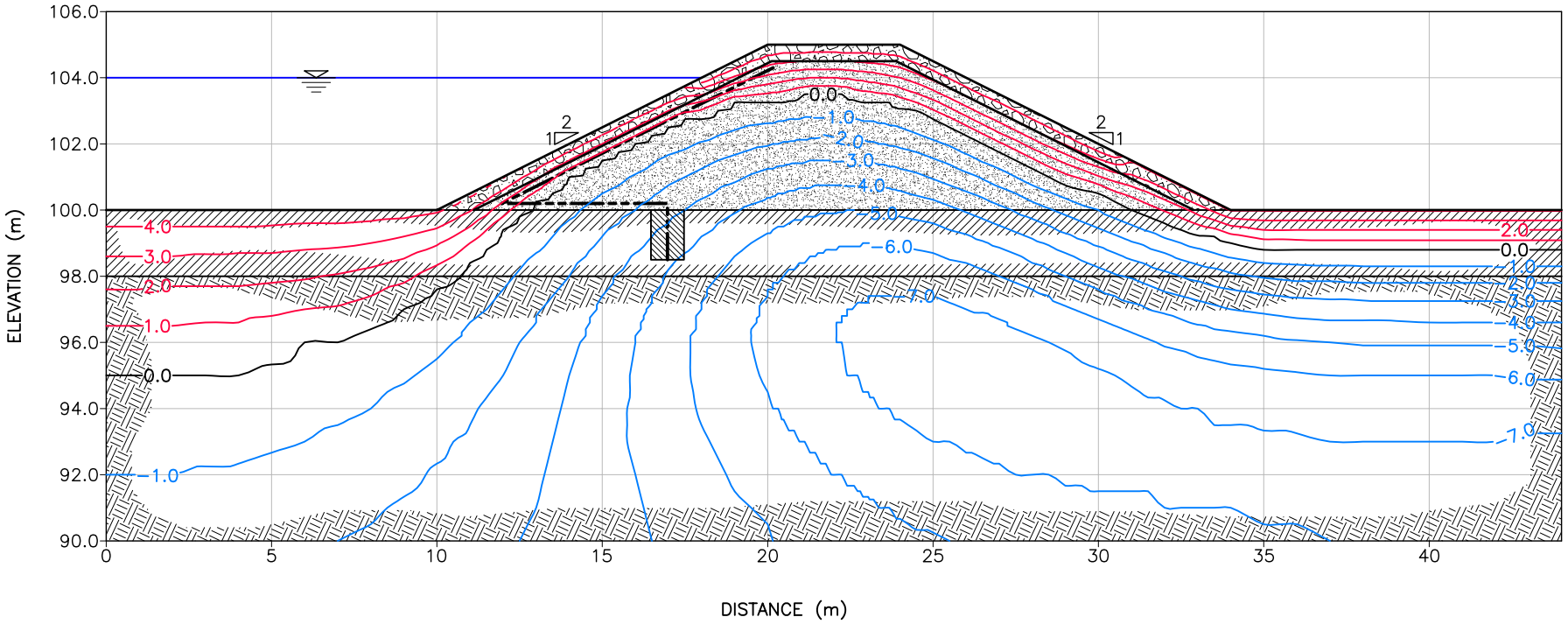
amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 5 YEARS OF OPERATION, OPTION 1 & 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 6	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE

1: 200

0 1 2 3 4 m

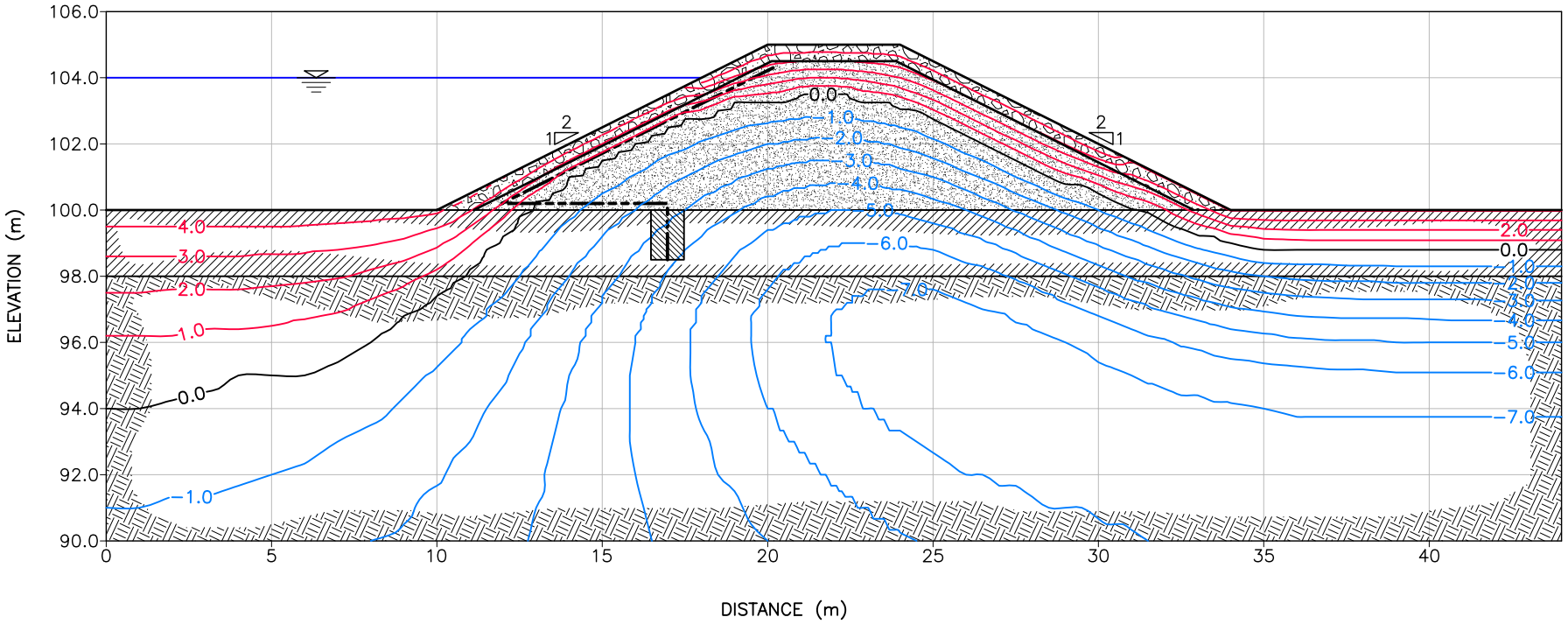
amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 5 YEARS OF OPERATION, OPTION 1 & 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 6	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE

1: 200

0 1 2 3 4 m

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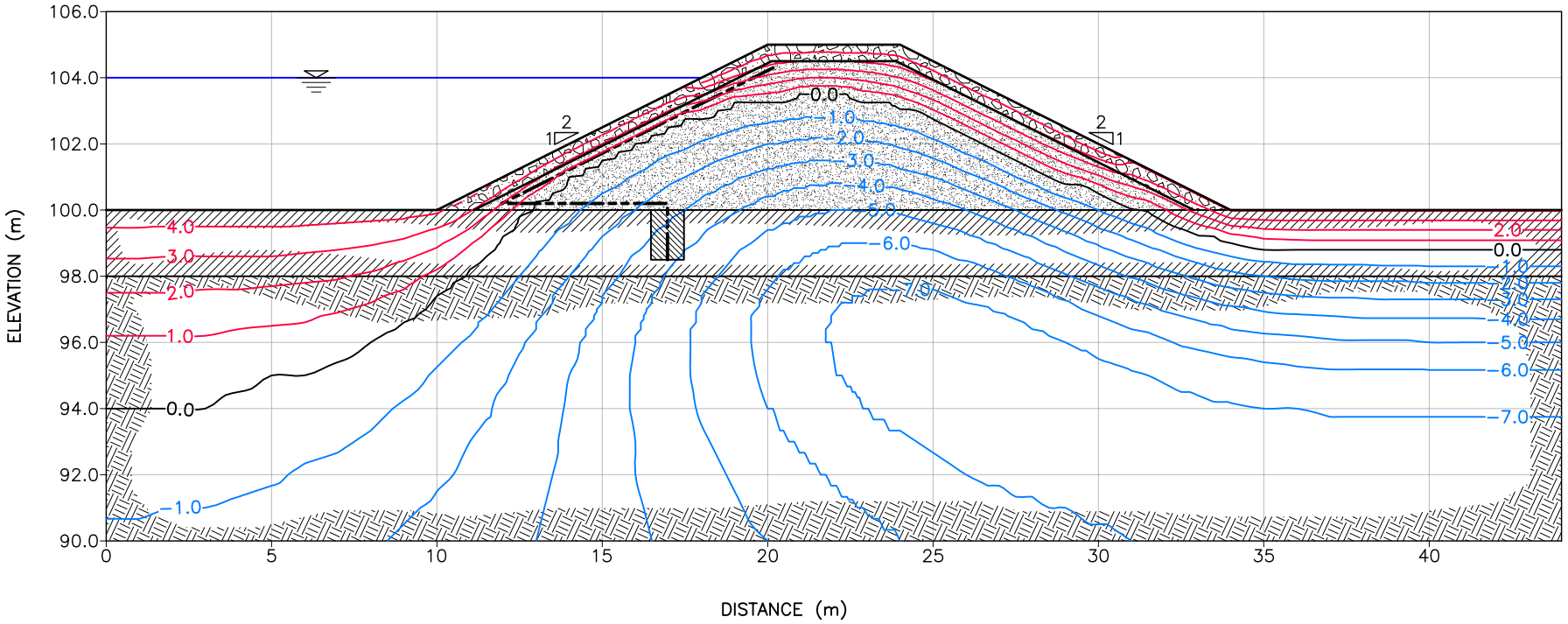
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 10 YEARS OF OPERATION, OPTION 1 & 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 7	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE
1: 200
0 1 2 3 4 m

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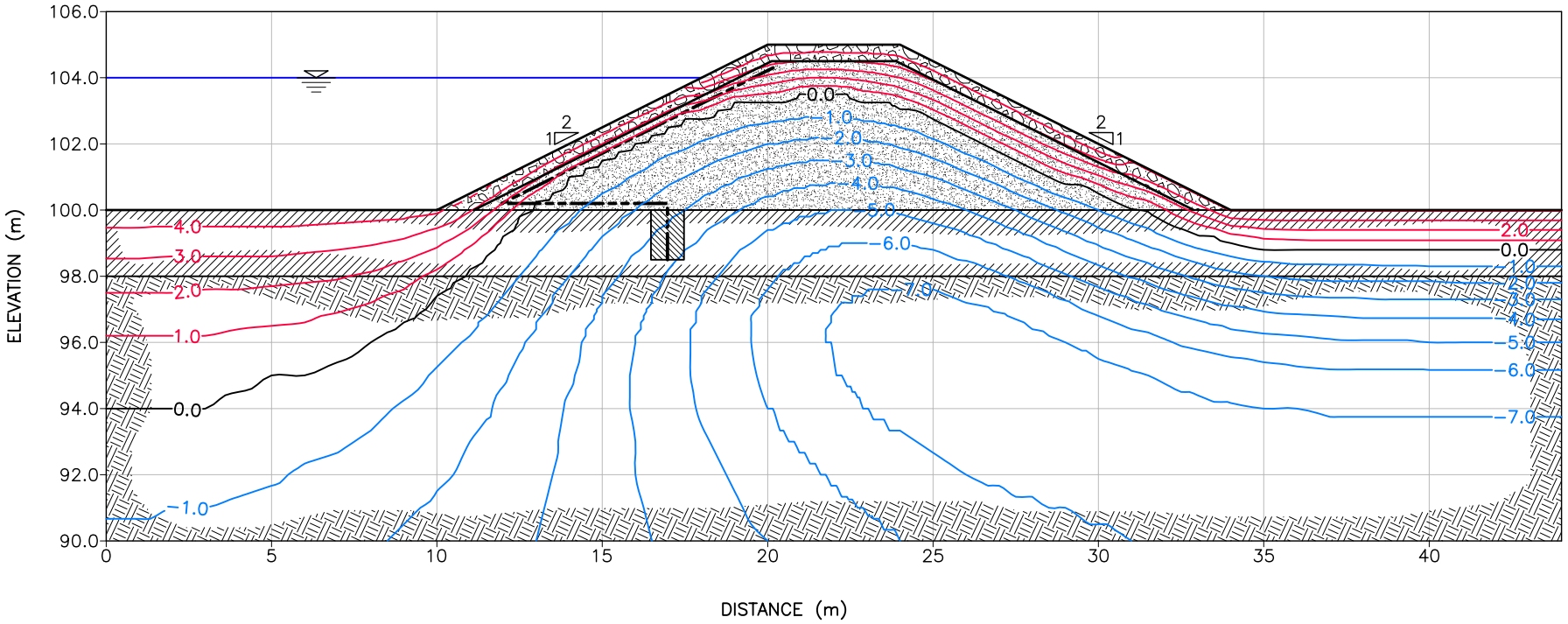
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 20 YEARS OF OPERATION, OPTION 1 & 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 8	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK
- CLAY OR GROUT
- HDPE LINER

SCALE

1: 200

0 1 2 3 4 m

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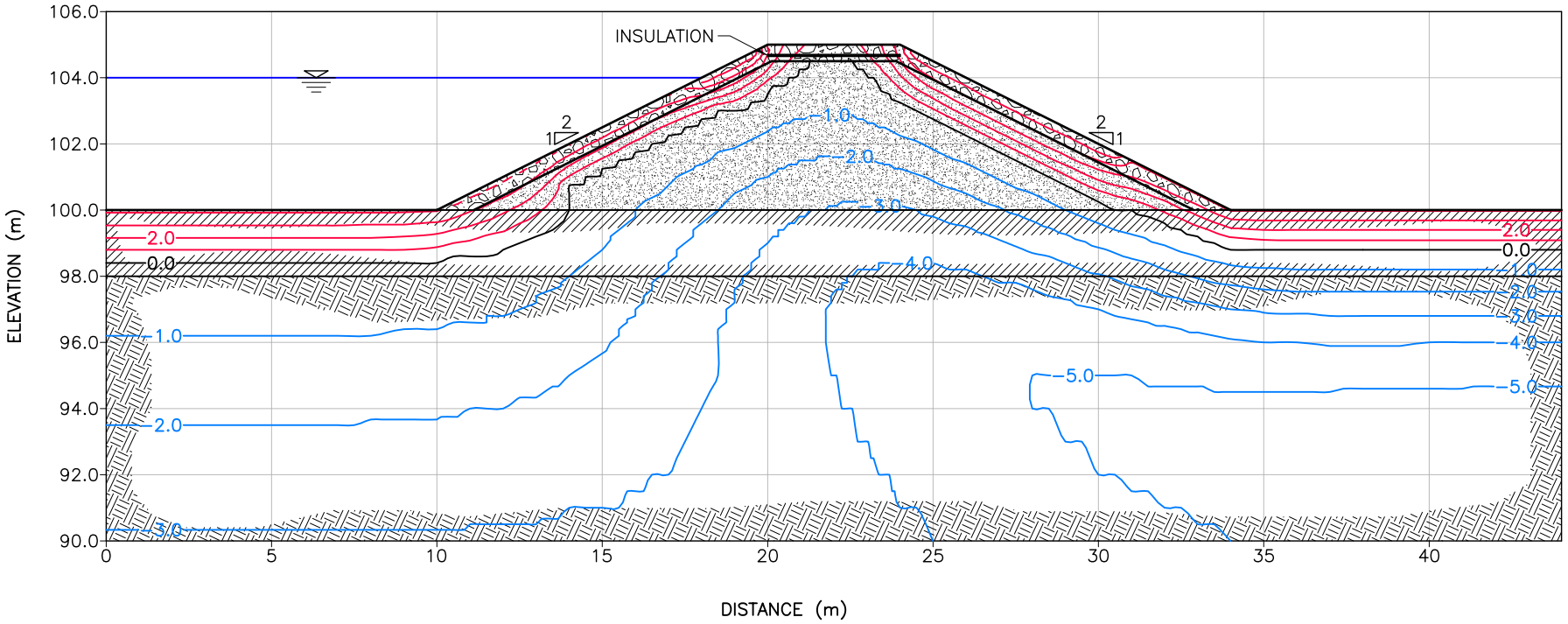
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 30 YEARS OF OPERATION, OPTION 1 & 2

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B01.dwg	FIGURE 9	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK

SCALE
1: 200
0 1 2 3 4 m

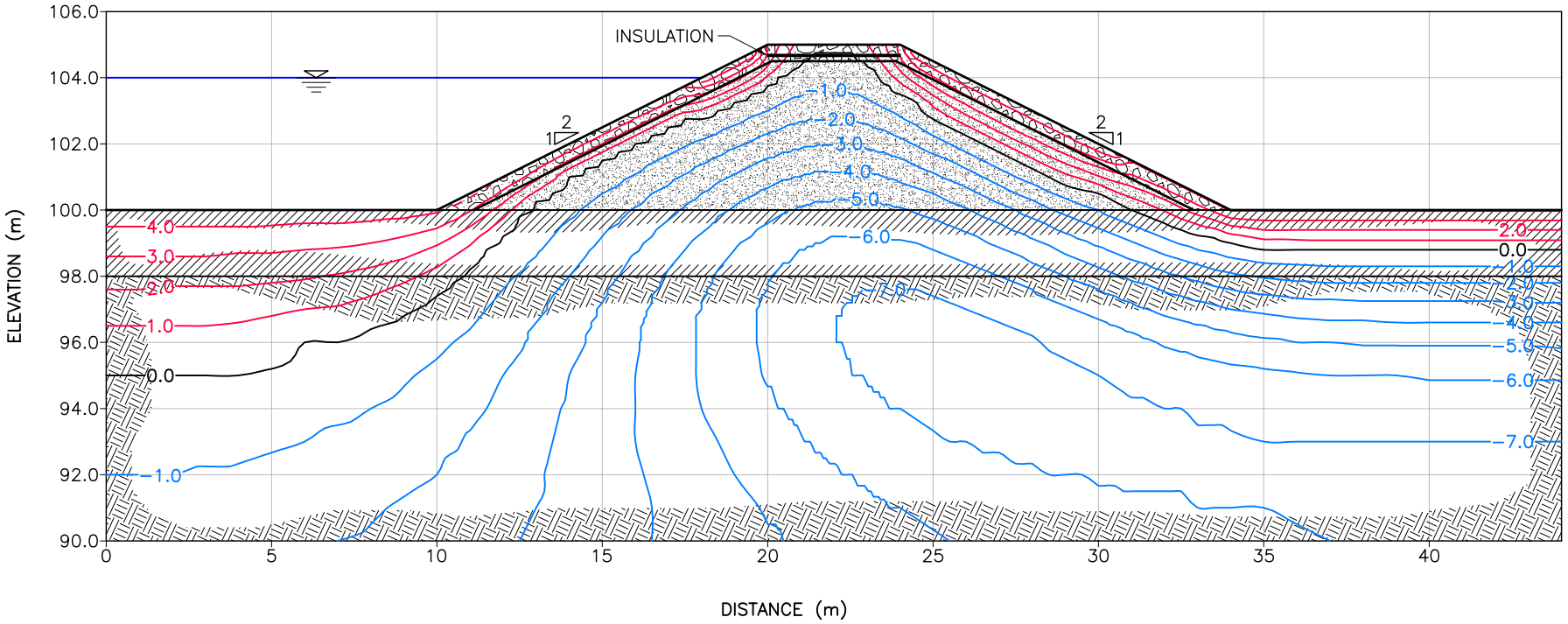
amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 1 YEAR OF OPERATION, FROZEN CORE OPTION

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B02.dwg	FIGURE 10	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK

SCALE
1: 200
0 1 2 3 4 m

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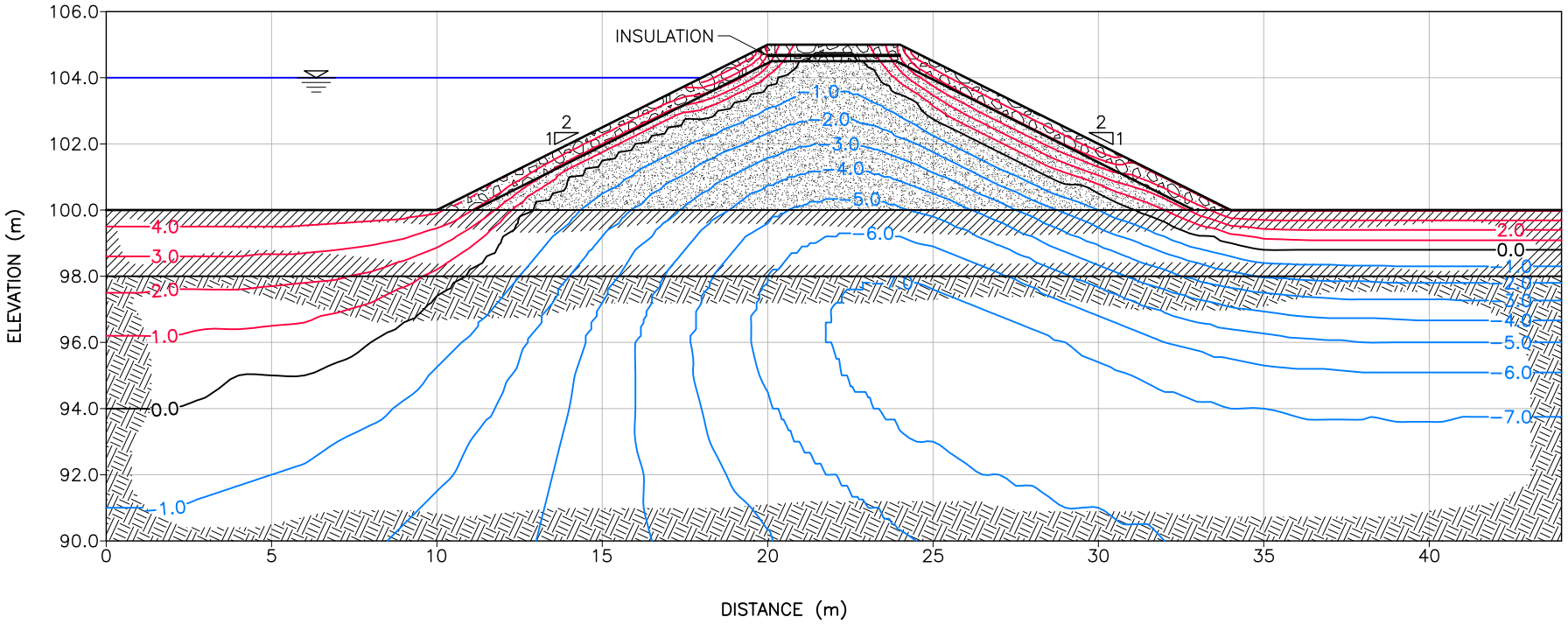
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 5 YEARS OF OPERATION, FROZEN CORE OPTION

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B02.dwg	FIGURE 11	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK

SCALE
1: 200
0 1 2 3 4 m

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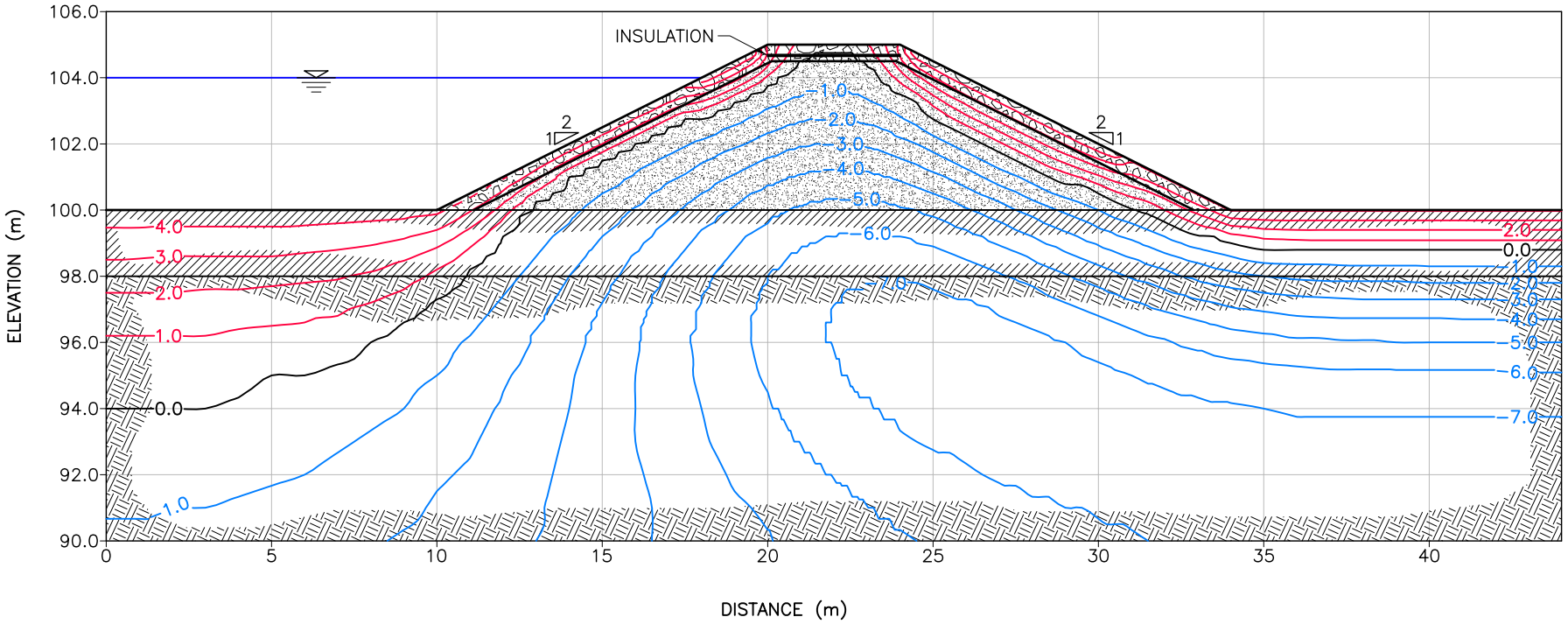
CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 10 YEARS OF OPERATION, FROZEN CORE OPTION

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B02.dwg	FIGURE 12	A



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK

SCALE
1: 200
0 1 2 3 4 m

amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

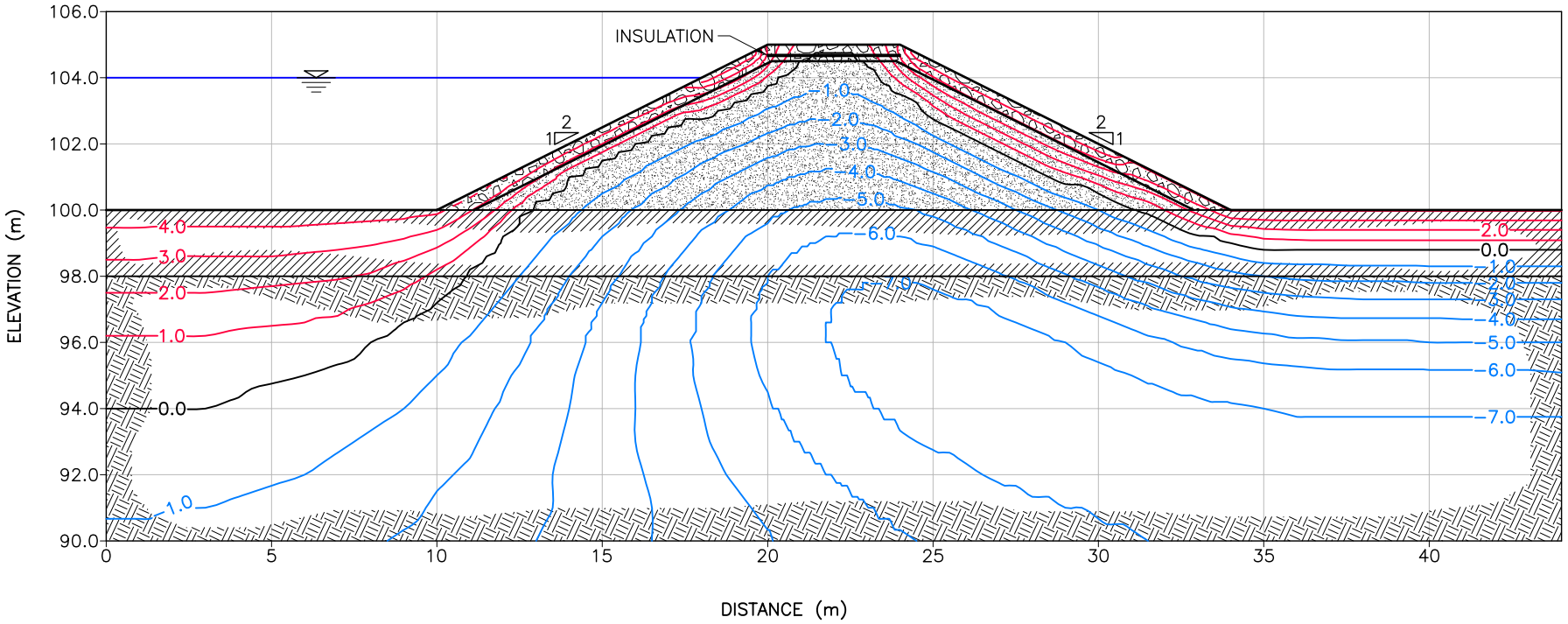
PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 20 YEARS OF OPERATION, FROZEN CORE OPTION

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B02.dwg	FIGURE 13	A

*PLOT 1:1=A (L)

I:\YX\00749\00749B02.dwg – FIGURE13 – Dec. 01, 2005 2:03pm – shelley.brown



LEGEND:

- ROCKFILL
- SAND AND GRAVEL
- OVERBURDEN
- BEDROCK

SCALE
1: 200
0 1 2 3 4 m

amec Earth & Environmental

CLIENT: DILLON CONSULTING LIMITED

PROJECT: GEOTECHNICAL INVESTIGATION FOR SEWAGE LAGOON, KUGAARUK, NU

TITLE: DYKE TEMPERATURES AFTER 30 YEARS OF OPERATION, FROZEN CORE OPTION

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
OCTOBER 2005	YX00749	00749B02.dwg	FIGURE 14	A

Appendix C

Grain Size Analysis

SIEVE ANALYSIS REPORT

AMEC Earth & Environmental
a Division of AMEC Americas Limited

To: Dillon Consulting Limited
Suite 303, 4920 47 Street,
PO Box 1409
Yellowknife, NT X1A 2P4

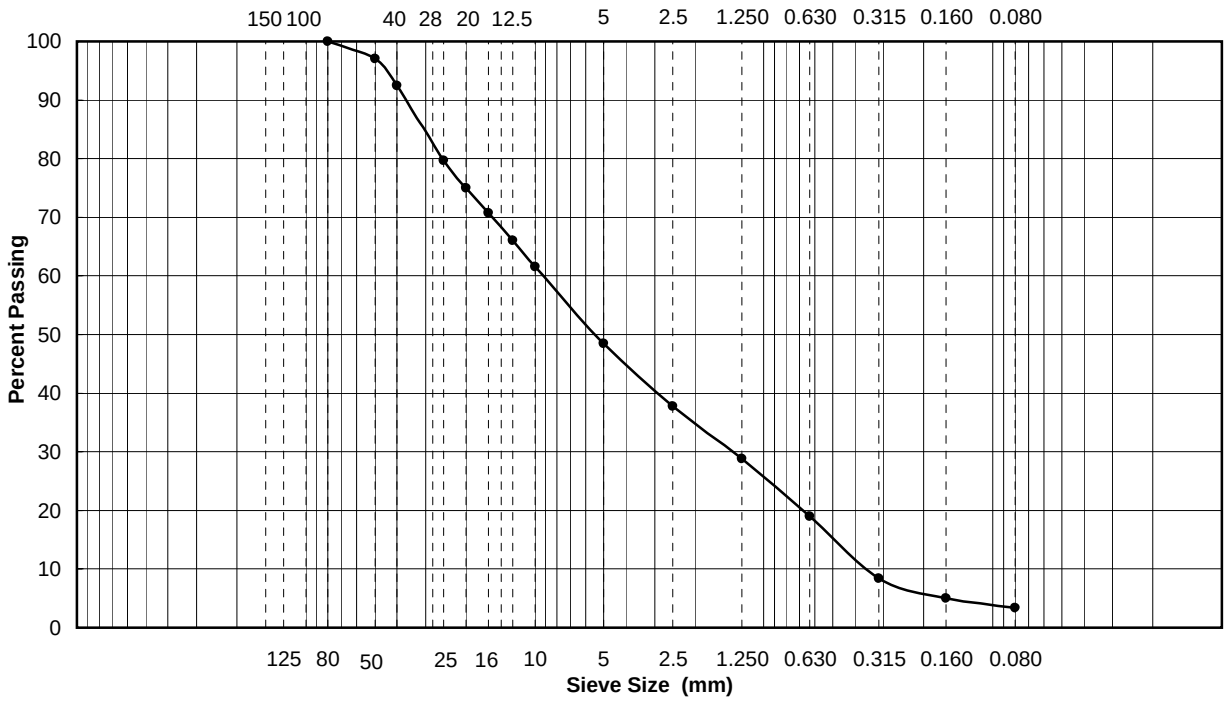
Office : Calgary
Project No: YX00749
Client : Dillon Consulting Limited
Copies to : Client

Attn: Gary Strong

Project: Sewage and Solid Waste Facility, Kugaaruk

Sample ID: 05-391 **Sample Type:** Sand and Gravel **Sampled By:** AMEC

Date Sampled: **Date Received:** **Date Tested:** 20-Oct-05



Sieve Size	% Passing
150.0	
125.0	
100.0	
80.0	100.0
50.0	97.1
40.0	92.4
28.0	
25.0	79.7
20.0	75.0
16.0	70.7
14.0	
12.5	66.1
10.0	61.6
5.0	48.5
2.5	37.8
1.250	28.8
0.630	19.0
0.315	8.4
0.160	5.0
0.080	3.4
C_u	
C_C	

Source: Bucket #1, Potential Borrow Source
Sample Description: Sand and Gravel with trace fines
Comments : No Specifications
Fracture Count = n/a

AMEC Earth & Environmental
a Division of AMEC Americas Limited

Per: _____

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.

SIEVE ANALYSIS REPORT

AMEC Earth & Environmental
a Division of AMEC Americas Limited

To: Dillon Consulting Limited
Suite 303, 4920 47 Street,
PO Box 1409
Yellowknife, NT X1A 2P4

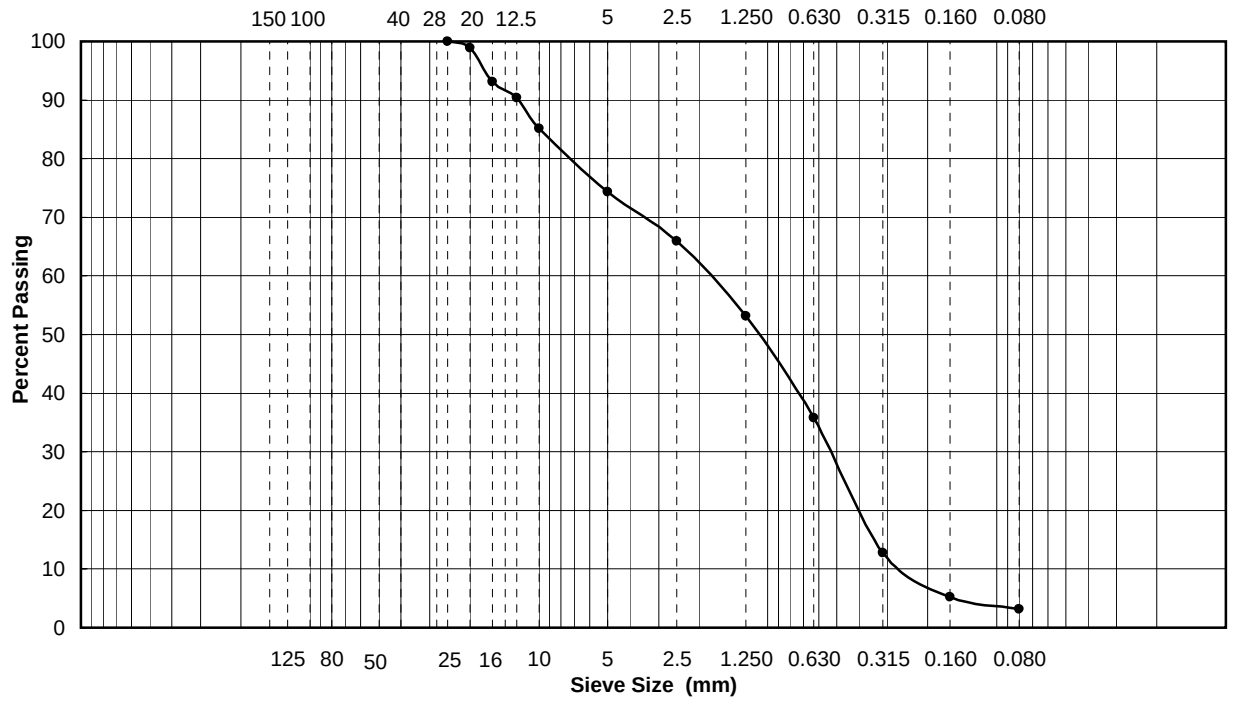
Office : Calgary
Project No: YX00749
Client : Dillon Consulting Limited
Copies to : Client

Attn: Gary Strong

Project: Sewage and Solid Waste Facility, Kugaaruk

Sample ID: 05-392 **Sample Type:** Gravelly Sand **Sampled By:** AMEC

Date Sampled: **Date Received:** **Date Tested:** 20-Oct-05



Sieve Size	% Passing
150.0	
125.0	
100.0	
80.0	
50.0	
40.0	
28.0	
25.0	100.0
20.0	99.0
16.0	93.1
14.0	
12.5	90.4
10.0	85.2
5.0	74.4
2.5	65.9
1.250	53.1
0.630	35.8
0.315	12.7
0.160	5.3
0.080	3.1
C_u	
C_C	

Source: Bucket #2, Existing Dyke
Sample Description: Gravelly Sand with trace fines
Comments : No Specifications
Fracture Count = n/a
Sample had a distinct odor

AMEC Earth & Environmental
a Division of AMEC Americas Limited

Per: _____

SECTION 3 CONTENTS

1.0 General

.1 STANDARD

.1 Concrete materials and methods of construction: to CAN/CSA-A23.1 unless otherwise specified.

.2 INSPECTION

.1 Concrete testing: to CAN/CSA-A23.2 by testing laboratory designated and paid for by Engineer, including on site storage and shipping. Contractor to provide access to the site. Engineer will complete at least 1 set of 3 cylinders for each pour that they inspect. Cost associated with production of the concrete for testing will be the responsibility of the contractor.

.2 Give Engineer minimum 48 hours notice before each concrete pour.

.3 TESTING

.1 The contractor to complete 1 set of 3 cylinders for all concrete pours on the reservoir. This testing is in addition to the testing completed by the engineer.

.2 Concrete testing: to CAN/CSA-A23.2 by testing laboratory designated and paid for by contractor, including on site storage and shipping.

2.0 Products

.1 MATERIALS

.1 Portland cement: to CAN/CSA-A5, Type 50.

.2 Reinforcing bars: to CAN/CSA-G30.18, Grade 400.

.3 All other concrete materials: to CAN/CSA-A23.1.

.2 MIX PROPORTIONS

.1 Method: Alternative (1) of CAN/CSA-A23.1, Table 11.

.2 Cement type: as specified under 2.1.

.3 Minimum 28 day compressive strength shall be 32 MPa and exposure classification S-2.

.4 Nominal size of coarse aggregate: Clause 14 of CAN/CSA-A23.1.

.5 Slump: to Table 6 of CAN/CSA-A23.1. Slump to be 80 mm +/- 20 mm

.6 Air content: all concrete to contain purposely entrained air in accordance with category 2, Table 9 of CAN/CSA-A23.1. Air Content to be 5 to 8 %

.7 Admixtures: to Clause 6 of CAN/CSA-A23.1.

3.0 Execution

.1 INSERTS

.1 Cast in sleeves, anchors, reinforcement, frames, conduit, bolts and other inserts required to be built-in.

.2 FINISHES

.1 Formed surfaces shall receive a rough-form finish in accordance with CAN/CSA-A23.1.

.3 CURING

.1 Cure and protect concrete in accordance with CAN/CSA-A23.1, except that curing compounds shall not be used.

END OF SECTION

SECTION 15 CONTENTS

PART 1 GENERAL

1.1 Related Work

Section 02315 Excavating, Trenching and Backfilling

1.2 References

.1 ASTMC518- 91, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.2 ASTMD638M- 89, (D638-90), Test Method for Tensile Properties of Plastics.

.3 ASTMD1248- 84(1989), Specification for Polyethylene Plastics Molding and Extrusion Materials.

.4 ASTMD1505- 90, Test Method for Density of Plastics by the Density-Gradient Technique.

.5 ASTMD1621- 73(1979), Test Method for Compressive Properties of Rigid Cellular Plastics.

.6 ASTMD1622- 88, Test Method for Apparent Density of Rigid Cellular Plastics.

.7 ASTMD2657- 90, Practice for Heat Joining of Polyolefin Pipe and Fittings.

.8 ASTMD2837- 90, Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

.9 ASTMD2856- 87, Test Method for Open Cell Content of Rigid Cellular Plastics by the air Pycnometer.

.10 ASTMF714- 90, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.11 ASTMG14- 83, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).

.12 CAN/CSA-B137.1- M89, Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services.

1.3 Product Data

.1 Submit product data in accordance with Section 01330 - Submittal Procedures.

1.4 Material Certification

.1 At least 4 weeks prior to commencing work submit manufacturer’s test data and certification that materials meet requirements of this section.

.2 Record Drawings

.3 Provide data necessary to produce record drawings on project completion in accordance with the following requirements:

.1 Give details of pipe material, location of fittings, maintenance and operating instructions.

PART 2 PRODUCTS

2.1 Pipe

.1 Polyethylene pressure pipes to CSAB137.1 ASTMF714:

.1 Type PE3408 for ASTMF714, DR 17.

.2 Pressure rating:

.1 DR 17 for ASTMF714.

.2 Polyethylene to polyethylene joints: thermal butt fusion joined to ASTMD2657.

.3 Polyethylene fittings: to AWWA C906 for pipe sizes NPS4 to NPS63.

2.2 Pipe Bedding and Surround Materials

.1 granular material to following requirements:

.1 Crushed or screened stone or sand consisting of hard, durable, particles, free from clay lumps, cementation, organic material and other deleterious materials to Section 02315.

.2 ASTMC136 and ASTMC117. Sieve sizes to CAN/CGSB-8.1.

2.3 Backfill Materials

.1 Backfill material in accordance with Section 02315 Excavating, Trenching and Backfilling.

PART 3 EXECUTION

3.1 Unloading and Handling of Polyethylene Pipe

.1 Unload from trucks or containers by hand or by lifting apparatus with fabric slings. Do not use cables or chains.

.2 Once removed, store on smooth surface. Lay pipes flat. Where sleepers are desired use several lengths of wide planks to provide broad bearing surface.

.3 Lift, do not drag, insulated pipes from storage area to job site.

.4 Follow manufacturer’s recommendations.

3.2 Trenching

.1 Do trenching work in accordance with Section 02315 - Excavating, Trenching and Backfilling.

.2 Trench depth to provide cover over pipe of not less than 1 m from finished grade.

.3 Trench alignment and depth require Engineer's approval prior to placing bedding material or pipe.

3.3 Granular Bedding and Surround

.1 Place bedding and surround material in unfrozen condition.

.2 Place materials in uniform layers not exceeding 150 mm compacted thickness up to 300 mm above top of pipe. Compact each layer before placing succeeding layer. Avoid compaction directly over pipe with less than 300 mm of cover.

.3 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.

.4 Shape transverse depressions in bedding as required to make joints.

.5 Compact each layer full width of bed to at least 90 % maximum density to ASTMD698.

.6 Fill authorized excavation or unauthorized over excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.4 Pipe Installation

.1 On dry ground, assemble shipping lengths of pipe into suitable installation lengths by heat butt-fusion.

.2 Provide trained personnel and jointing machine approved by pipe manufacturer for butt-fusion jointing of polyethylene pipe. Obtain services of trained technician from pipe manufacturer to certify and/or train Contractor's personnel on jointing procedures and inspect jointing machine. Obtain letter from manufacturer certifying that Contractor's representative(s) who will perform jointing, is/are qualified and that jointing equipment has been inspected and is suitable for pipe supplied.

.3 Follow manufacturer’s instructions in butt-fusion of joints.

.4 Join pipes at flanged ends in accordance with manufacturer’s recommendations.

.5 Recheck pipe joints assembled above ground after placing in trench to ensure no movement of joints has taken place.

.6 Allow joint and sleeve to cool for at least 30 min before lowering pipe into trench.

.7 Lay pipes on prepared bed, true to line and grade as indicated. No deviations to be made without written approval of Engineer. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take out and replace defective pipe. Correct pipe that is

not in true alignment or grade, or pipe that shows undue settlement after installation. Change method or equipment for setting alignment or grade if requested by Engineer.

.8 Do not lay pipe on frozen bedding.

.9 Do not let rocks or other foreign material, which might damage insulation jacket, fall on pipe.

.10 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Install removable watertight bulkhead at open end of pipe to prevent entry of foreign materials.

3.5 Pipe Backfilling

.1 Do backfilling work in accordance with Section 02315 - Excavating Trenching and Backfilling.

.2 Lay continuous runs of warning tape on top of surround material 300 mm directly above water mains.

.3 Upon completion of pipe laying and after Engineer has inspected work in place, surround and cover pipes between joints.

.4 Protect pipe from freezing if temperatures lower than minus 5°C.

.5 When Engineer accepts testing results, surround and cover joints and fittings with surround material placed and compacted as specified.

.6 Place backfill material above pipe surround, in uniform layers not exceeding 150 mm compacted thickness.

.7 Mechanically compact each layer to at least 90 % maximum density to ASTMD698.

3.9 Testing

1. Give five (5) days written notice of date for tests.

2. Insulted or conceal work only after testing and approval by Engineer.

3. Engineer reserves the right to be present during testing.

4. Bear costs including retesting and making good.

5. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

6. Hydrostatically test the high density polyethelene piping systems prior to installation in accordance with the following procedures, as recommended by the pipe manufacturer:

    .1 Over a period of three (3) hours, slowly raise the pressure in the pipe to 1.5 times the rated pressure of the pipe.

.2 During the next 1 hour, maintain the required test pressure.

.3 Start the test after the above described initial "pipe stretch" period.

.4 Observe and record the hydrostatic pressure in the pipe over the next 3 hour period at ½ hour intervals.

.5 At the end of the 3 hour test period, measure the amount of makeup water required to be added to the system to return the pipe to the test pressure.

.6 An acceptable test is one for which the amount of makeup water does not exceed the following:

Nominal Pipe Size	**Maximum Allowable Makeup Water @ 23°C.**
100	5.0
250	7.8
300	12.6

Correction (Multiplication) factor to be applied to make up water.

Pipe Testing Temperature	**Allowance in Table Above**
23°C	1.0
22°C	0.875
20°C	0.75
18°C	0.66
16°C	0.60
14°C	0.53
12°C	0.47
10°C	0.42
8°C	0.36
6°C	0.325

For pipe testing temperatures between those listed above, interpolate correction factor.

For pipe testing temperatures above or below limits tabulated, contact Engineer.

.7 Allow a minimum of 8 hours between successive polyethelene pipe tests to allow pipe to "relax".

.8 Hydrostatically test steel piping system by pressurizing with water to 860kPa, and maintaining this pressure for a period of 4 hours without leakage.

.9 Flush out all new piping with fresh, clean water for a period of one (1) hour following final pressure test.

.10 Provide written documentation of all test results, for acknowledgement by Engineer.

END OF SECTION