APPENDIX E
EROSION & SEDIMENT CONTROL PLAN

Aklavik Airport Drainage Improvements Erosion and Sediment Control Plan
Revision 01

Government of the Northwest Territories

OCTOBER 2019
ISSUED FOR USE | REVISION 01
FILE: 704-ENW.EENW03288-01

Tetra Tech Canada Inc.
Box 2244, 201, 4916 - 49 Street
Yellowknife, NT X1A 2P7 CANADA
Tel 867.920.2287 Fax 867.873.3324

This page intentionally left blank.

TABLE OF CONTENTS

APPENDIX SECTIONS

APPENDICES

1.0 INTRODUCTION

This Erosion and Sediment Control Plan (ESCP) outlines the plan for managing erosion and sediment control issues associated with the Aklavik Airport Drainage Improvements Project. The ESCP is a living document which will be updated based on regular yearly reviews including management reviews, incident investigations, regulatory, or project-specific protocol changes. This ESCP was originally included as Appendix E in the Project Description Report for the Aklavik Airport Drainage Improvements Project (the Project).

The purpose of this ESCP is to provide a strategic action plan for effectively managing potential erosion and sedimentation issues that may occur in relation to any component of the Project. The Plan is a working document which may be updated during the construction and operations phases of the Project. The GNWT will update this Plan to verify conformance on an as-needed basis as per the conditions of any land use permits or water licenses granted for the Project.

The objectives of the ESCP are to minimize potential effects from erosion and sedimentation on the environment, and to comply with all applicable legislation, regulations, authorizations, permits and licences for the duration of the Project.

The ESCP will be posted at the Project site and will be provided to all employees and contractors.

2.0 COMPANY NAME, CONTACT, AND EFFECTIVE DATE

The Government of the Northwest Territories (GNWT) is the proponent for the proposed Project. Key contact information for the Project is as follows:

Moshiur Rahman, Airport Planner
Government of the Northwest Territories
Department of Infrastructure
5015 – 49 Street Yellowknife, NT, X1A 2L9
Phone: (867) 767-9084 ext. 31079
Fax: (867) 873-0297
Email: Moshiur_Rahman@gov.nt.ca

The information presented herein is current as of May, 2019.

3.0 PROJECT DESCRIPTION

The purpose of the Project is to improve the drainage at the Aklavik Airport, specifically two problem areas (Area 1 and Area 2). The Aklavik Airport is located at 68º13’23.57” N, 135º00’23.03” W, within the Hamlet of Aklavik (Hamlet).

Significant portions of the Hamlet and Aklavik Airport flood in the spring during “break-up”. After flood waters recede, Areas 1 and 2 do not drain completely which has reportedly been a problem for the Hamlet and the airport. The purpose of the Project is to develop a practical plan to drain Areas 1 and 2 by gravity after flood waters subside.

The Project would have Area 1 graded with a perimeter swale constructed around it. The perimeter swale would drain to an existing ditch that runs along the airport runway. The ditch would be reworked to daylight into the Peel Channel, south of the airport. Area 2 would have a swale constructed through the centre of it. The swale would lead to a short ditch that would daylight into the Peel Channel, north of the airport.

The construction of the swales and ditches would be as follows:

- Typically, a 2 metre (m) wide base constructed with 200 millimetre (mm) granular ditch bedding over geotextile.
- The swales would have back slopes to match the existing ground elevations to a maximum slope of 3:1.
- The ditches would typically have back slopes at 3:1.
- The ditch for Area 1 would daylight into the Peel Channel at 68º13'07.35" N, 134º59'57.21" W, and ditch for Area 2 would daylight into the Peel Channel at 68º13'45.23" N, 135º00'46.44" W.
- The length of the ditch from Area 1 to the Peel Channel would be approximately 855 m long.
- The length of the short ditch for Area 2 would be approximately 55 m long.

It is anticipated that the heavy equipment used for the Project will include a backhoe.

4.0 REGULATORY ENVIRONMENT

Several statutes apply to erosion and sediment control planning in the Northwest Territories. These include:

- Territorial Lands Act and Regulations;
- *Northwest Territories Waters Act* and Regulations;
- *Mackenzie Valley Resource Management Act* and Regulations;
- *Fisheries Act* and Regulations;
- *Arctic Waters Pollution Prevention Act* and Regulations;
- Canadian *Environmental Assessment Act* and Regulations; and
- Canadian Environmental Protection Act and Regulations.

In consideration of the federal *Fisheries Act* and Regulations, a request was submitted to the Department of Fisheries and Oceans (DFO) to review this Project. The DFO approval noted that the Project will not result in serious harm to fish or prohibited effects on listed aquatic species at risk. As such, DFO stated that an authorization under the Fisheries Act or a permit under the Species at Risk Act is not required.

5.0 BACKGROUND

Surface erosion is the process of physical and chemical weathering of rock and soil, and the transport of the resulting particulates by water, wind, gravity, and thermal processes (Claridge and Mirza 1981). Although erosion occurs naturally, it can be exacerbated by human activities that result in soil exposure or increases or changes in water transport patterns. The deposition of both inorganic and organic particulates in water bodies can result in adverse impacts to aquatic biota and their habitats. In most cases, however, the extent, duration, and consequences of erosion can be avoided or mitigated through proper planning, the application of suitable designs, effective monitoring, and timely maintenance.

Erosion and sediment control at the Project site will be guided by existing industry and government best management practices including INAC's Northern Land Use Guidelines for Access Roads and Trail (INAC 2010), and the Department of Fisheries and Oceans (DFO) Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993). Although the DFO guidelines were developed for conditions in Alberta and British Columbia, they are generally applicable for northern areas, with the understanding that subarctic climatic, vegetation, and

particularly, permafrost conditions may require modification of designs and procedures to effectively manage erosion and sedimentation.

This version of the ESCP is focused on the best management practices and general mitigation methods that may be applicable before, during and after construction. This plan will be updated as necessary in the future as the Project progresses through the detailed design and main construction and operations phases.

6.0 EROSION AND SEDIMENT CONTROL MEASURES

This section outlines the main Best Management Practices (BMPs) that will be considered and applied as appropriate during the Project. More detailed BMPs for the main erosion and sediment control measures to be implemented as necessary during construction are provided in Appendix E-1 to E-5.

6.1 Procedural Best Management Practices

Procedural BMPs are non-structural methods or procedures that can reduce erosion and sediment transport at a construction site. These include site management and scheduling practices that may use structural erosion or sediment control BMP's to achieve their goals. Commonly used procedural BMPs are provided in the following sections.

6.1.1 Site Management

- Minimize Project Footprint – Construction boundaries will be carefully defined to restrict surface disturbance to active development sites. There is no vegetation at Areas 1 and 2 and machinery will be mainly limited to these locations.
- Perimeter Control –The minimized limits of construction activity will be clearly marked.
- Minimize Exposed Surfaces – By minimizing the total disturbed surface area at any time, the erosion potential is reduced and the quantity of sediment control measures is reduced.

6.1.2 Surface Water Management BMPs

Water management BMP's are non-structural methods or procedures that include on-site and offsite measures, focusing on surface water management. Some surface water management BMPs that may be used on the Project include

- Use Existing Drainage – Existing watercourses tend to be well-vegetated and have natural rates of erosion. If necessary, discharges from the construction site will filtered through silt fencing prior to conveyance down gradient to an existing watercourse.
- Design Drainage Channels Appropriately – Drainage channels, if required, will be designed and approved by a registered professional engineer to ensure appropriate depths, slopes, cross-sections and linings (armored or vegetated).
- Flow Isolation – Clean water drainage from upstream areas, if present, should be diverted around the construction site wherever practical, to reduce the quantity of water that must be managed on site. This can be achieved using ditches, berms, pipes or culverts as appropriate.

6.1.3 Erosion Control BMPs

Erosion control BMP's are intended for application to exposed soil/sediments where there is a need to reduce the potential for erosion due to wind, rain splash or flowing water. Preventing erosion at the source reduces the amount of sediment that needs to be managed by downstream sediment control measures. Erosion can be controlled by protecting surfaces from runoff (exposed surface protection) or by reducing the quantity or velocity of flow (runoff control). Some examples that may be used on this Project include:

- Riparian Zone Preservation – Watercourse erosion potential is significantly reduced by preserving adjacent natural vegetation, to reduce runoff velocity and enhance infiltration (Refer to Appendix E-1).
- Slope Texturing/Grading – The accumulation of water and its movement over a large surface area can cause erosion, and this can be exaggerated by a topography promoting high runoff velocity. Re-contouring methods and roughing up the surface area can help to reduce the risk of erosion. Re-contouring the surface can reduce erosion by shortening the length and decreasing the angle of the slope. Texturing of slopes, either by roughening the surface, tracking the surface, or installing grooves or benches. Texturing reduces the runoff velocity, traps sediment, and increases the infiltration of water into the ground (Refer to Appendix E-3).
- Mulching – Application of organic material or other normally biodegradable substances as a protection layer to the soil surface to minimize raindrop/runoff erosion and conserve a desirable soil moisture property for plant growth, and/or to promote seed germination and plant growth (Refer to Appendix E-5).

6.1.4 Sediment Control BMPs

Sediment control BMP's are intended for application to flowing water where the risk assessment indicates the need to retain mobilized sediment. It is advisable to install sediment control measures within the construction site, close to the sediment source. This reduces the quantity of water that must be managed and reduces the consequences of a failure. Sediment control can be accomplished by filtering or settling sediment-laden runoff water. Some examples of sediment control BMPs that could be used on this Project include:

- Natural Vegetation – Natural vegetation can slow runoff through surface vegetation and trap it by infiltration or by settling as the flow velocity reduces within the vegetation.
- Hand Seeding – Can be conducted if needed to supplement natural re-vegetation. Seeds to be used should be collected from local grasses and other riparian vegetation as locally available (Refer to Appendix E-4).
- Silt Fencing – Silt fencing is a permeable fabric barrier installed vertically on support posts typically along contours to capture and filter sediment laden sheet flow runoff. It causes water to pond allowing sediment to settle out as water filters through fabric. It also entraps and minimizes coarse sediment from sheet flow or overland flow from entering water bodies. It serves as a perimeter control for sediment transport and deposition. Alternative barriers of equivalent performance may also be utilized (Refer to Appendix E-2).
- Dust Control – Water will be applied as necessary during dry periods to increase soil cohesion in accordance with the GNWT Guideline for Dust Suppression (GNWT 1998).

6.2 Site Monitoring

All erosion and sediment control structures should be monitored throughout construction. In particular, the structures should be monitored during periods with rainfall and immediately after heavy rainfall events and maintained to verify proper functioning. Increased monitoring may also be completed during the spring melt.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,

FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288

Prepared by:
Michael Blanchette, P.Eng.
Environmental Engineer
Direct Line: 587.460.3462
Michael.Blanchette@tetratech.com

FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288
FILE: 704-ENW.EENW03288

Reviewed by:
Rick A.W. Hoos, R.P. Bio.
Principal Consultant
Direct Line: 604.608.8914
Rick.Hoos@tetratech.com

/cee

REFERENCES

Department of Fisheries and Oceans (DFO). 1993. Land Development Guidelines for the Projection of Aquatic Habitat. Retrieved from: http://www.dfo-mpo.gc.ca/Library/165353.pdf.

Claridge, Frederic B. and Ashraf M. Mirza. 1981. Erosion control along transportation routes in northern climates. Arctic 34(2): 147-157.

Government of the Northwest Territories (GNWT). 1998. Guideline for Dust Suppression. Retrieved from: http://www.enr.gov.nt.ca/library/pdf/eps/dustsupression.pdf

Indian and Northern Affairs Canada (INAC). 2010. Northern Land Use Guidelines. Access: roads and trails. Catalogue R2-226/6-2010E-PDF.

APPENDIX E-1 TO E-5

BEST MANAGEMENT PRACTICES FOR SEDIMENT AND EROSION CONTROL

Appendix E-1 Riparian Zone Preservation
Appendix E-2 Silt Fence
Appendix E-3 Slope Texturing Grading
Appendix E-4 Hand Seeding
Appendix E-5 Mulching

E-1: RIPARIAN ZONE PRESERVATION

EROSION CONTROL BMP

Description and Purpose

- Protection of existing plants in the riparian zone around the construction area.
- Existing vegetation acts as an effective vegetative buffer strip as a form of erosion and sediment control measure.

Applications

- Permanent measure.
- Existing established vegetation acts as an effective sediment control and erosion control buffer strip barrier to slow down runoff and allow sedimentation filtration to occur.
- To be used along Project footprint boundary to minimize sediment transport off construction site.

Limitations

- Protection of riparian zone may interfere with construction efficiency.
- Careful planning is required to work around protected riparian zones.

Construction

- Define and delineate riparian zones to be protected prior to commencement of construction.
- Clearly mark riparian zones to be protected at the site (with construction fencing, survey flagging, or other highly visible measure) so all personnel involved with construction operations can identify areas to be preserved.
- It is highly important to preserve an established vegetative buffer as freshly planted vegetation generally require substantial growth periods before they are as effective as established riparian zones.
- Wherever possible, retain as much existing vegetation as possible between construction areas and sensitive zones (e.g. wetlands, marshes) to entrap sediment and to minimize sediment transport off of the construction site into these sensitive zones.

Construction Considerations

- Riparian zones must be fenced off immediately to ensure effectiveness of riparian zone is maintained.
- Do not allow equipment to enter areas not necessary to construction.
- Based on site-specific situations, establish buffer zones of adequate width.

Inspection and Maintenance

- Maintain fences/flagging protecting riparian zones from construction area.

E-2: SILT FENCE

SEDIMENT CONTROL BMP

Description and Purpose

- A silt fence is a temporary sediment barrier consisting of fabric stretched across and attached to supporting posts and entrenched into the soil. It is generally installed perpendicular to the flow direction to slow or stop water and to allow filter/perimeter protection, settling of soil particles, and/or reduce water velocity/erosive forces.
- The purpose of this BMP includes, but is not limited to:
  - Intercepting sheet flow.
  - Intercepting and detaining small amounts of water from disturbed areas during construction operations in order to allow for filtering or settling of soil particles.
  - Decreasing down slope sheet flow velocity.
  - Retain soil particles on site.

Applications

- This BMP may be used for perimeter protection. It may be used in combination with other BMPs.
- This BMP may be used below disturbed areas subject to sheet and rill erosion where drainage area is no greater than 0.25 acre per 30 m of barrier and the slope behind the barrier should be no steeper than 2 horizontal feet to 1 vertical. On relatively flat slopes, the maximum disturbed slope distance should not exceed 30 m. The allowable disturbed slope distance decreases as the slope gets steeper.

Limitations

- This BMP should not be used:
  - Directly in perennial streams or water courses.
  - As a diversion dam.

Construction Considerations

- The BMP should be placed along ground contours.
- The bottom of the fabric must be continuously and securely anchored for its entire length to reduce undermining.
- The height of the fence should be adequate to reduce the potential of silt from leaving the job site.
- There must be at least a 1 m overlap at vertical seams to avoid leakage. Both ends of the overlap must be securely attached to posts.
- Increase the elevation at the ends of the BMP installation to prevent "end runs."

Inspection and Maintenance

- During construction, inspect BMPs daily during the workweek. Schedule additional inspections during storm events. Make any required repairs.
- Replace damaged sections of fabric.
- Repair damaged fencing due to end runs or undercutting.
- Sediment should be removed when deposits reach one-half the height of the BMP.

E-3: SLOPE TEXTURING/GRADING

EROSION CONTROL BMP

Description and Purpose

- Texturing of back slopes, either by roughening the surface, tracking the surface, or installing grooves or benches.
- Texturing reduces the runoff velocity, traps sediment, and increases the infiltration of water into the soil.
  - Surfacing Roughening.
  - Grooved or Serrated Slope.
  - Benched Slope.

Applications

- Temporary measure.
- May be used to roughen the exposed soils on the slope surface in the direction of water flow to minimize erosion and to entrap some sediments.
- May be used on fresh cut or fill slopes (8 m length or longer; practical travel reach of a dozer) with gradients of generally 3:1 or steeper (2:1 as general steepness limit) constructed in cohesive soils.
- May be used on slope subgrade that will not be immediately top-soiled, vegetated or otherwise stabilized.
- May be applied to top-soiled slope to provide track serration to further reduce erosion potential.
- May be used in graded areas with smooth and hard surfaces.
- As part of slope design, benching may be used to effect a reduction of erosion hazard where a long slope length needs to be shortened into smaller sectional lengths with mid-benches; normally a 3 m wide bench can be appropriate.
- Benching is usually a permanent slope design feature and should be designed by a qualified geotechnical engineer.
- Benching of a long slope section to divide into short sections can reduce erosion hazard in the range of 30 to 50% (e.g., sediment yield for 15 m high 3:1 slope with mid-bench).

Limitations

- Surface roughening and tracking may increase grading costs.
- Surface roughening and tracking may cause sloughing in certain soil types (i.e., sandy silt) and seepage areas; geotechnical advice is recommended.
- Texturing provides limited sediment and erosion control and should be used as a temporary measure prior to top-soiling.

- Should be used in conjunction with other erosion and sediment control measures (i.e., offtake ditches) to limit the sheet flow downslope.

Construction

- Surface Roughening
  - Leave soil in rough grade condition, do not smooth grade soil.
  - Large lumps of soil will aid in decreasing runoff velocities, trap sediment, and increase infiltration of water.
- Surface Tracking
  - Using tracked construction equipment to move up and down the slope, leaving depressions perpendicular to the slope direction; limit passes to prevent over-compaction of the surface.
  - Depressions in the soil will aid in decreasing runoff velocities, trap sediment, and increase infiltration of water.
- Grooving
  - Excavating shallow furrows across the width of the slope, perpendicular to the direction of the slope.
  - If used, contour grooves should be approximately 0.1 m to 0.2 m in depth.
  - Grooves can be made by using equipment or hand.
- Benching
  - Construction of narrow, flatter sections of soil on the slope, perpendicular to the direction of the slope.
  - Benches should be designed by qualified geotechnical engineer.

Construction Considerations

- During tracking operations, care must be taken to minimize disturbance to the soil where the equipment turns or changes direction.
- Minimize the number of tracking passes to 1 or 2 times to avoid over-compaction, which can negatively impact the vegetation growth.
- It is practical to track roughen a slope length of greater than 8 m for practical up/down slope operation of a small bulldozer. It is important to minimize the loosening of soil caused by turning movement of the bulldozer at the end of each pass. As the erosion potential is lower for slope of low vertical height (<3 m height and 3:1 slope), the tracking of low height slope is not required and not practical for bulldozer tracking operation.

E-4: HAND SEEDING

PROCEDURAL BMP

Description and Purpose

- Hand seeding is broadcasting grass seed on disturbed areas by hand or a hand seeding device. This BMP is used to reduce potential for soil becoming water or air borne, to reduce water velocity/erosive forces after vegetation establishment and to aid in habitat protection/maintenance.
- The purpose of this BMP includes establishing vegetation in sparse, bare and/or exposed soil areas and decreasing soil erosion.

Applications

- This BMP may be used after soil disturbance is completed at construction sites. This BMP may be used in areas that need to be permanently or temporarily vegetated. It may be used in conjunction with other BMPs.

Limitations

- In months when seed germination will not occur. (In winter months, see "Mulching" BMPs).

Construction Considerations

- Seed mixes vary. Seeds to be used should be collected from local grasses and other riparian vegetation as locally available.
- Spread seed uniformly over disturbed areas to be revegetated.
- Cover with other methods as needed to protect surface (for example, light application of mulch, jute matting).

Inspection and Maintenance

- Inspect during seed establishment period. Re-seed, due to mortality, as necessary.
- Schedule additional inspections during storm events and/or heavy rainfall. Check for scour and sloughing; any required repairs shall be made.

E-5: MULCHING

PROCEDURAL BMP

Description and Purpose

- Application of organic material or other normally biodegradable substances as a protection layer to the soil surface to: minimize raindrop/runoff erosion and conserve a desirable soil moisture property for plant growth, and/or (ii) to promote seed germination and plant growth.
- Mulches conserve soil moisture, reduce runoff velocities and surface erosion, control weeds, help establish plant cover, and protect seeds from predators, raindrop impact, and wind/water erosion.

Applications

- Temporary measure.
- Can be used as an organic cover or growth medium for seeds where topsoil is not readily available.
- Can be used to provide temporary and permanent erosion control.
- May be used with or without seeding in areas that are rough graded or final graded.
- May be applied in conjunction with seeding to promote plant growth.
- May comprise organic mulches (such as straw, wood fibres, peat moss, wood chips, pine needles, compost).

Limitations

- Application of mulch may be difficult on steep slopes.
- May require spray-on method to apply mulch with tackifier to provide adhesion to steep slopes.

Installation

- Prepare soil surface by removing large rocks or other deleterious materials.
- Apply topsoil and seed, if required, and if topsoil is readily available.
- Apply mulch as per supplier's recommendations.
- Certain mulches may require additional anchoring to minimize loss of mulch due to wind or water erosion.
- Install mulches as per manufacturers' or suppliers' recommendations.
- Organic mulches
  - Straw
    - Refers to stalks or stems of small grain (primarily wheat) after drying and threshing.
    - Straw should be free of weeds.
    - Loose straw is very susceptible to movement by blowing wind and water runoff and should be anchored either with landscape netting.

- When properly secured to surface, straw is highly suitable for promoting good grass cover quickly; however, it may be a fire hazard in dry conditions.

- Raw Wood Fibre
  - Mixture of cellulose fibres; a minimum of 4 mm in length extracted from wood.
  - Wood fibres usually require a soil binder and should not be used as erosion control during periods of hot dry weather in the summer or for late fall seeding unless it is used in conjunction with another suitable mulch as it is prone to removal by blowing wind or water runoff.
  - Wood fibre is primarily used in hydroseeding-hydromulching operations where it is applied as part of a slurry and when used in conjunction with a tackifier; it is well suited for tacking straw mulch on steep slopes.
- Peat Moss
  - Comprises partly decomposed mosses and organic matter under conditions of excessive moisture.
  - Usually available in dried and compressed bundles.
  - Should be free of coarse material.
  - Useful soil conditioner to improve organic content of soil promoting plant growth.
  - Highly susceptible to removal by blowing wind and water runoff if dry and spread on top of soil.
- Wood Chips
  - By-products of timber processing comprised of small, thin pieces of wood.
  - Decompose slowly.
  - Suitable for placing around individual plants (shrubs and trees) and for areas that will not be closely mowed.
  - Highly resistant to removal by blowing wind and water runoff.
- Bark Chips (Shredded Bark)
  - By-products of timber processing comprised of small, thin pieces of tree bark.
  - Suitable for areas that will not be closely mowed.
  - Have good moisture retention properties and are resistant to removal by blowing wind and water runoff.
- Pine Needles
  - Comprise needles from coniferous trees (pine, spruce).
  - Needles should be air dried and free of coarse material.
  - Decompose slowly.

- Suitable for use with plants that require acidic soils.
- Resistant to removal by blowing wind and water runoff.

– Compost (Straw Manure)

- Comprised of organic residues and straw that have undergone biological decomposition until stable.
- Should be well shredded, free from coarse material, and not wet.
- Has good moisture retention properties and is suitable as a soil conditioner promoting plant growth.
- Relatively resistant to removal by blowing wind and water runoff if not dried out completely.

Inspection and Maintenance

- During construction, inspect silt fence daily during the work week.
- Schedule additional inspections during storm events. Make any required repairs.
- Additional mulch should be applied where erosion or scouring occurs.
- If a tear occurs in the cover netting or matting, repair as necessary.