WLWB Registry

From: Sarah Baines [sbaines@wlwb.ca]
Sent: Monday, July 09, 2007 12:05 PM
To: registry@wlwb.ca
Subject: FW: Access Permit Request - Snare Forks Channel
Attachments: Tlicho Access Permit Request 01-11-07.pdf

N1L4-0150 – weir breach repair – access to Snare Forks Channel

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From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Thursday, January 11, 2007 11:51 AM
To: Joline Huskey
Cc: Brian Willows; Robert Schmidt; Sarah Baines; Clint Ambrose; stewarts@inac.gc.ca
Subject: Access Permit Request - Snare Forks Channel

Good morning Joline,

Please find attached the letter requesting an Access Permit to the Snare Forks Channel to conduct winter work in remediation of the effects of the June 2005 dyke breach. Please advise as to when this letter will be reviewed by the Tlicho Lands Protection Department as time is off the essence with this project.

Sincerely,

Eddie Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286
esmith@ntpc.com

NORTHWEST TERRITORIES
POWER
CORPORATION

Environmental Affairs, 4 Capital Drive, Hay River, NT, X0E 1G2 Phone (867) 874-5327 Fax (867) 874-5286
www.ntpc.com

January 11, 2007

Joline Huskey
Lands Administration Officer
Tlicho Lands Protection Department
Behchoko, NWT

Dear Joline:

Re: Snare Forks Channel Access Permit Request

The Northwest Territories Power Corporation (NTPC) is planning to implement sedimentation mitigation measures in the elbow of the Snare Forks Channel in mid-January. The channel was formed by the June 15th breach of Dyke 1. The project involves construction of a filter berm to prevent sediment from entering Strutt Lake. In order to commence the project an access must be built to the channel from the Snare road. NTPC is requesting an access permit from the Tlicho Lands Protection Department.

This project has been approved by the Department of Fisheries and Oceans, the Wek'eezhii Land and Water Board, and Indian and Northern Affairs Canada who have provided an amendment to Landuse Permit MV2000F0058.

The proposed access to the channel is from the Snare road west of Dyke 1 down the old winter road south towards Strutt Lake, then east through approximately 50m of forest to the edge of the bank (see attached photos). A road will then be made down the bank to reach the channel bottom where the filter berm will be constructed (see enclosed photos). The old winter road has sparse tree growth on it, so some trees will be removed and laid along the edges of the cut line. Through the forested area trees will also be removed and placed neatly on the access edges. At no point does this access cross any water body.

The access will be composed of compacted snow and may be watered to make it smoother and harder. An excavator and grader will be used to construct the road to the edge of the channel bank and the excavator will then construct the road down the bank using clay material on hand and gravel. Work on the berm will be done with an excavator and a loader. A dump truck will be used to stockpile sandy gravel on the access and the loader will then carry this material into the channel. All stockpiled gravel will be removed from the access after the project is completed. Sandy gravel stockpiled under a previous quarry permit in the Snare Forks quarry will be used for the project.

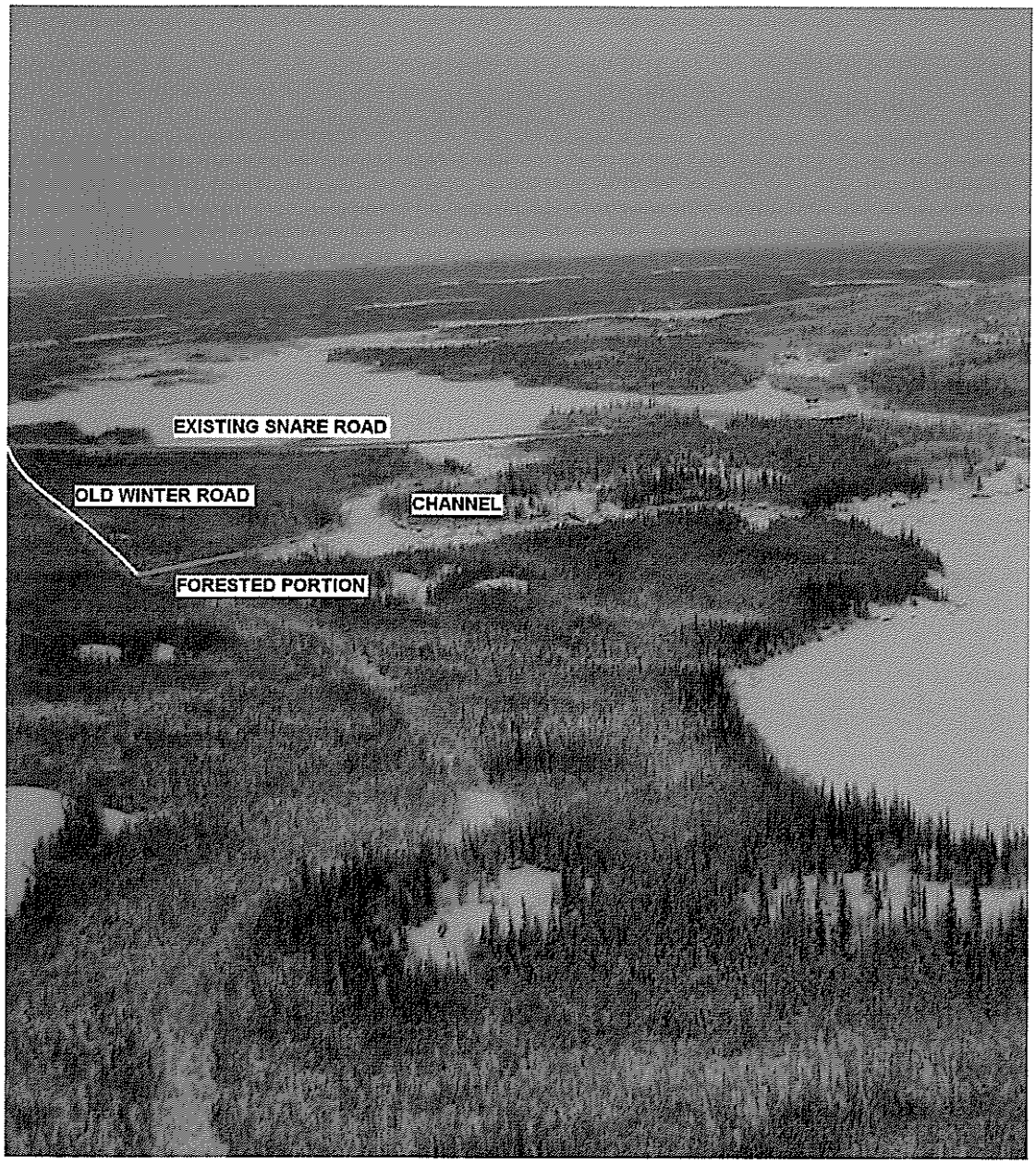
This project is an important step in the remediation of the effects of the dyke breach and is of a very time sensitive nature. We would appreciate if the Tlicho Lands Protection Department would review this letter and respond as soon as possible. If you have any questions or concerns, please contact me at your convenience at (867) 874-5327.

Sincerely,

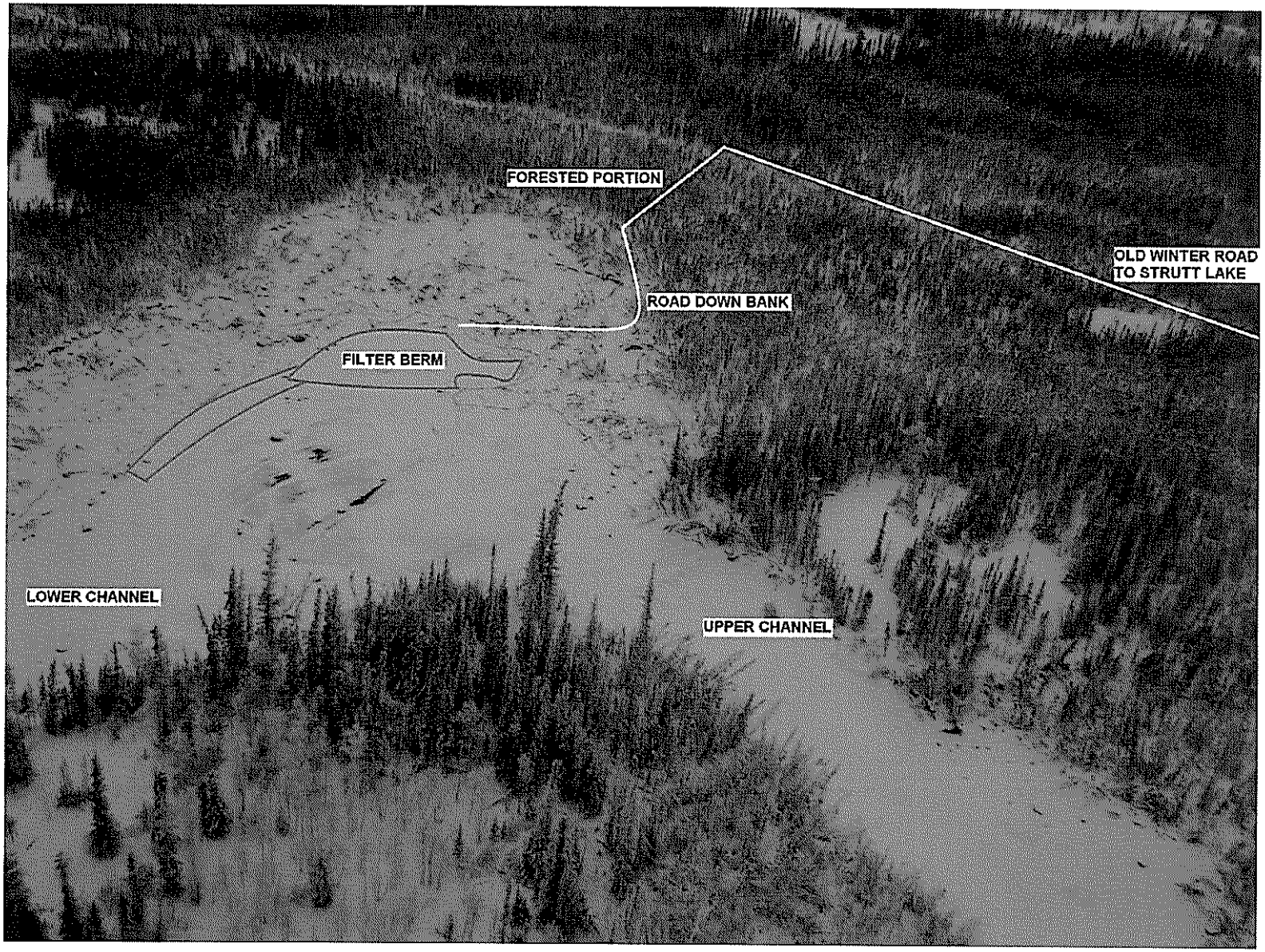
Eddie Smith
Environmental Analyst

Cc: Sarah Baines - Wek'eezhii Land and Water Board
Scott Stewart - INAC
Clint Ambrose - INAC
Robert Schmidt - NTPC
Brian Willows - NTPC

Encl: 2 photos



Snare Forks Channel Access Route – View 1



Snare Forks Channel Access Route – View 2

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Monday, October 30, 2006 5:08 PM
To: permits@mvlwb.com
Subject: FW: Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan

N1L4-0150 - Snare Forks weir breach - update
-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Monday, October 02, 2006 3:14 PM
To: DonnellyP@DFO-MPO.GC.CA
Cc: WatsonE@DFO-MPO.GC.CA; fillatreg@DFO-MPO.GC.CA; stewarts@inac.gc.ca; Baines, Sarah; Robert Schmidt; Brian Willows
Subject: Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan

Good afternoon Paul,

Please find attached the Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan for your review. Please contact me with any questions or comments. I am in the process of completing a summary of works completed at site last week and will forward this to you tomorrow.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan

Northwest Territories Power Corporation
Snare Forks, NT

Prepared for:

NORTHWEST TERRITORIES POWER CORPORATION
4 Capital Drive
Hay River, NT
X0E 1G2

Prepared by:

KEYSTONE ENVIRONMENTAL LTD.
Suite 320 - 4400 Dominion Street
Burnaby, BC
V5G 4G3

Project No. 9157
September 2006

LETTER OF TRANSMITTAL

September 25, 2006

Northwest Territories Power Corporation (NTPC)
4 Capital Drive
Hay River, NT
X0E 1G2

Attention: Mr. Edward Smith

Dear Mr. Smith:

Re: **Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan**
Northwest Territories Power Corporation, Snare Forks, NT

This report is respectfully submitted to the Northwest Territories Power Corporation (NTPC) by Keystone Environmental Ltd.

We appreciate the opportunity to have assisted in this matter and if there are any questions, please do not hesitate to contact the undersigned.

Keystone Environmental Ltd.

per: Richard P. Johns, P.Eng.
Project Engineer

per: Francisco Perello, P.Eng.
Senior Technical Review

per: Steven S. Clark, R.P.Bio.
Project Manager

EXECUTIVE SUMMARY

This report presents findings of the Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan conducted for the channel formed by the dyke breach west of the Snare Forks dam on June 15, 2006.

The objectives of the long-term mitigation plan are to reduce the concentration of suspended sediments entering Snare River to within acceptable levels and protect the remaining soil and vegetation on the channel banks from further erosion.

To achieve these objectives, Keystone Environmental completed a feasibility study to identify and evaluate the erosion control and sediment filtration technologies to meet the mitigation objectives and prepared an action plan to implement the recommended technologies.

In this study, eleven potential mitigation approaches were identified and evaluated in terms of mitigation objectives, site characteristics, and design constraints. Based on the recommendations of this report, eight mitigation technologies have been chosen to be implemented at the site in a series of three phases: ecological retaining walls, rock retaining walls, riprap armouring, erosion control mats, mechanical slope stabilization, re-vegetation, filter berms and silt curtains.

The Phase 2A mitigation activities includes the installation of erosion control mats, the installation of additional silt curtains, the maintenance of the existing curtains and the construction of one filter berm. This section is estimated to cost approximately $60,000.

The Phase 2B mitigation activities include the mechanical slope stabilization of the steep banks of the channel and the installation of riprap armouring and rock retaining walls. This section is estimated to cost in the range of $50,000 to $100,000.

The Phase 2C mitigation activities include the installation of additional erosion control mats and ecological retaining walls. This section is estimated to cost in the range of $50,000 to $100,000.

The re-vegetation plan will be implemented in conjunction with the Phase 2C mitigation activities. The re-vegetation plan will be reviewed after the initial phases of the mitigation activities are completed. The schedule and costs associated with seeding and planting the contoured channel banks will be determined at a later date.

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1.0 INTRODUCTION

This report presents findings of the Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan conducted for the channel formed by the dyke breach west of the Snare Forks dam on June 15, 2006. This project is conducted by Keystone Environmental Ltd. (Keystone) at the request of the Northwest Territories Power Corporation (NTPC).

The report is organized in the following format:

Section 1.0: Site background, mitigation objectives and a summary of the existing mitigation works (Phase 1)

Section 2.0: Site description and regulatory framework

Section 3.0: Description and evaluation of erosion control and filtration technologies

Section 4.0: Phase 2 Action Plan including the recommended technologies and implementation schedule

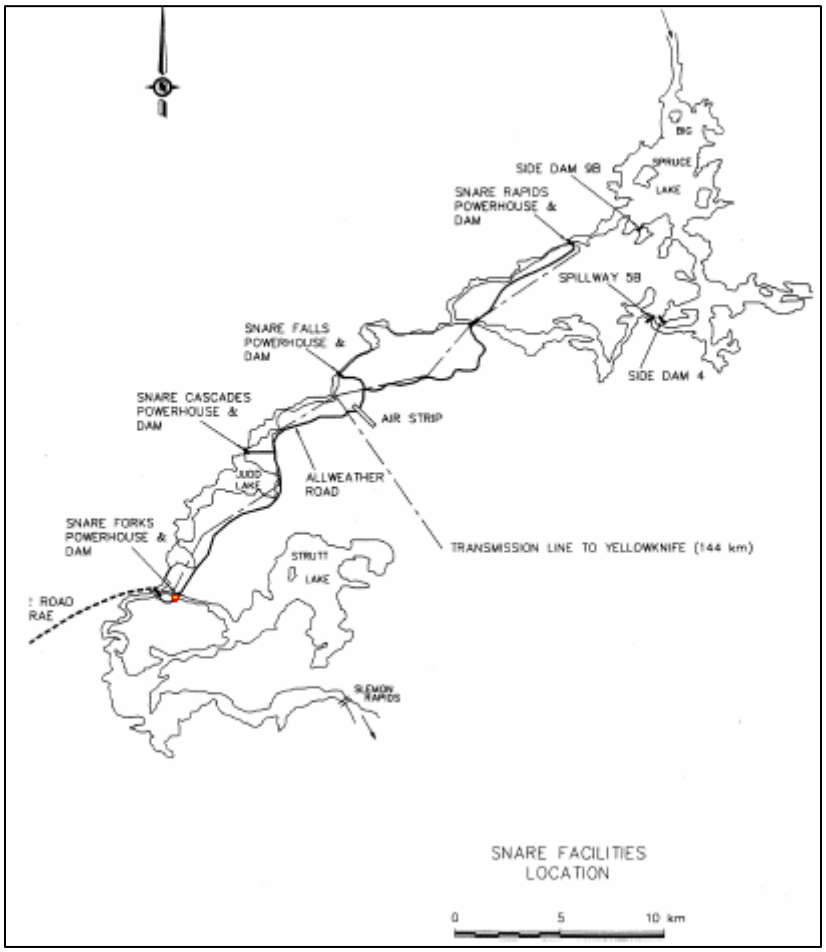
Section 5.0: Conclusion

1.1 Background

NTPC retained Keystone in June 2006 to assist in developing a mitigation strategy and related tactics to reduce potential impacts to fish and fish habitat from sedimentation caused by the release of a large volume of water through Dyke No. 1 at the Snare Forks hydroelectric facility.

NTPC owns and operates three hydroelectric generating facilities on the Snare River system that supply power to the communities of Rae/Edzo, Dettah and Yellowknife. The Snare Forks facility is furthest downstream and was constructed in the mid-1970s. In 1996, the Dogrib Power Corporation completed a fourth generating station on the Snare River (Snare Cascades) between Snare Falls and Snare Forks. Refer to Exhibit 1 for the layout of the Snare River Hydroelectric Facilities. NTPC operates this station under agreement with the Dogrib Power Corporation. NTPC holds a single water license (License Number N1L40150) for the Snare Rapids, Snare Falls and Snare Forks facilities. NTPC received a 25-year water license for its three stations on the Snare River system in 1999.

Exhibit 1: Snare River Hydroelectric Facilities



Keystone Environmental first visited the new channel (the 'site') on June 21, 2006. Keystone began to develop a work program to protect the remaining soils from further erosion. Phase 1 of the mitigation activities was conducted in August 21-25, 2006. A summary of the Phase 1 work is included in Section 1.4. Keystone returned to the site on September 5 to assess the installed silt curtains and meet with NTPC and the Department of Fisheries and Oceans (DFO) to discuss the future mitigation works planned for the site. On September 12, 2006, the DFO directed NTPC to complete the next phase of mitigation work by September 29, 2006. This feasibility study provides recommendations for additional mitigation technologies to be installed at the site.

1.2 Objectives

The objectives of the long-term mitigation plan are to:

- Reduce the concentration of suspended sediments entering the Snare River to within acceptable levels; and
- Protect the remaining soil and vegetation on the channel banks from further erosion.

Based on the site conditions, the initial assessment and the Phase 1 temporary mitigation works, the objectives of this study were determined to include:

- identify the mitigation options to meet the long-term objectives to reduce suspended sediments and protect the channel from erosion;
- evaluate the cost-effectiveness of each mitigation technology; and
- provide a design basis for the recommended long-term mitigation technologies.

1.3 Study Limitations

The recommendations of the feasibility study are based upon (i), a review of existing conventional erosion control and sediment filtration technologies; (ii) information provided by NTPC and (iii), the results of field observations and photographs of the site. Photographs and observations reflect conditions encountered at the specific time the field work was conducted. Site conditions (geologic, hydrogeologic, and chemical characterization) may vary from that extrapolated from the observations made during this field work. Consequently, while findings and conclusions documented in this report have been prepared in a manner consistent with that level of skill and care normally exercised by other members of the environmental science and engineering profession practising under similar circumstances in the area at the time of the performance of the work, this report is not intended, nor is it able, to provide a totally comprehensive review of past, present or future site environmental conditions.

This report has been prepared solely for the internal use of Northwest Territories Power Corporation (NTPC) pursuant to the agreement between Keystone Environmental Ltd. and NTPC. Any use which other parties make of this report, or any reliance on or decisions based on it, are the responsibility of such parties. Keystone Environmental Ltd. accepts no responsibility for damages, if any, suffered by other parties as a result of decisions made or actions based on this report.

1.4 Phase 1 Temporary Mitigation Works Summary

The Phase 1 temporary mitigation works primarily applied to the channel reach between Dyke No. 1 and the rock cascade, which is a distance of approximately 200 metres. The key objective was to mitigate the suspended sediments in the upper reach of the channel, thus controlling the load of suspended sediments downstream. The Phase 1 temporary mitigation works were installed August 21-25, 2006. Refer to Figure 1 for the location of the silt curtains.

Eight 15 m lengths of silt curtain were installed in four locations (#1 - #4) as shown on Figure 1. Silt Curtains #1 and #2 in the upper reach (refer to photographs 2 and 3) were located such that they would reduce the water flow at pinch points in the upper reach and promote settling. The silt curtains were placed such that they made use of the existing narrow sections of the channel and augmented the existing sedimentation pools that were

already aiding in settling out sediment according to recent photographs. Silt curtain # 3 was installed in the lower reach to retain sediment within the channel on a short term basis. This silt curtain was installed in a baffle formation between the two bedrock promenades such that the flow of water would slow to pass the baffles and sediments could settle out of suspension.

Silt Curtain #4 was placed across the mouth of the channel at Strutt Lake. This final curtain is a final redundant system to settle out any remaining sediment to ensure that the least amount of sediment enters into Strutt Lake. In addition to promoting settling, the orientation of the silt curtains in the channel maximizes silt isolation and trapping on the curtain mesh.

A monitoring program for suspended solids was initiated as part of Phase 1 of the work plan. Various locations are to be monitored on a set basis to determine the current levels of sediment entering Strutt Lake and measure the effectiveness of the silt curtains at removing sediment. The monitoring program will be used to determine if adjustments are needed to the filtering mechanism, to determine the areas of the channel that are contributing the most sediment so that they can be given priority in Phase 2 and confirm that the suspended solids concentrations have reduced to within acceptable levels.

An ancillary objective of the short-term plan was to prevent the creation of new channels and additional sources of sedimentation and erosion. A plug comprised of sandbags was installed near the small waterfall on the exposed bedrock to prevent water entering a side channel on the rock cascade that led to the pool at the elbow. It was determined that additional measures may be required to reduce the seepage of water into this pool from the forested area above the elbow. This portion of the channel will be further investigated during the Phase 2A mitigation work.

The field observations for the feasibility study of mitigation measures for the lower reach of the channel were conducted in conjunction with the construction oversight of the silt curtains in the upper and lower reaches of the channel.

2.0 SITE CHARACTERISTICS

The Snare Forks Dam is located approximately 150 km north of Yellowknife, NT. Year-round access to the site is by air and seasonal access is winter road. The site is located in the sub-arctic region and permafrost exists below the surface throughout the year. The temperatures at the site are below 0^{o}C from October to May. All materials to be brought to the site must consider these restrictions.

2.1 Site Description

The site consists of a newly formed channel that was created by floodwaters during the dyke breach in June 2006. There are many different geological formations within the channel. Refer to the Photographs in Appendix C for examples of these formations. Parts of the channel have been eroded to bedrock, sand and silt have been deposited in banks on the sides of the channel, gravel and river rock have been exposed in sections where the silt was washed downstream, and steep banks up to 15 m high with overhanging trees continue to slump and deposit sediment into the water body. This study accounts for each of these sections in the evaluation of mitigation technologies.

All figures completed as part of this study are based on site observations and photographs, in the absence of detailed topographic survey data of the project area. The distances and grades are difficult to judge on the photographs and the installation of mitigation technologies will require field verification.

The geotechnical evaluation of the channel was completed by GeoPacific Consultants Ltd. A copy of the report is included in Appendix A. They reported '…ongoing sloughing of these very steep slopes is occurring and that we expect the majority of the slopes which were not sloughing were only marginally stable' and 'the erosion of the toe of the slopes is likely to induce further instability up slope'. The erosion control technologies chosen will focus on slope stabilization and support for the base of these slopes.

2.2 Regulatory Framework

The governing regulatory body for Strutt Lake is the Federal Department of Fisheries and Oceans (DFO). They have verbally commented on the mitigation approaches presented by NTPC and Keystone since June 2006. NTPC and Keystone met with DFO on September 5, 2006 at the site to observe the existing silt curtains and discuss the implementation of additional mitigation technologies. On September 12, 2006, the DFO directed NTPC to complete the next phase of mitigation work by September 29, 2006. A copy of this letter is included in Appendix B.

3.0 MITIGATION TECHNOLOGIES FOR PHASE 2

The selection of the mitigation technologies is based on three criteria: mitigation objectives, site conditions, and design constraints. The mitigation objectives of the site are described in Section 1.2. Some of the site conditions affecting the mitigation technologies include the sediment size of the suspended solids, the flow and velocity of water in the channel, the precipitation rates, the drainage area for the channel, and the permeability of the new dyke.

Hydrogeological conditions such as groundwater flow and soil permeability also affect the selection of the mitigation technologies. The design constraints of selected mitigation technologies include the accessibility to the channel, remote location of site, availability of equipment and materials, costs, and long-term impact of mitigation technologies.

Erosion control is the practice of preventing or controlling water erosion in land development. This usually involves the creation of a physical barrier, such as vegetation or rock, to absorb some of the energy of the water that is causing the erosion. In this study, seven erosion control mitigation technologies are considered and evaluated in terms of mitigation objectives, site conditions, and design constraints:

- Ecological/green retaining walls;
- Rock retaining walls;
- Riprap armouring;
- Erosion control mats;
- Geogrids;
- Mechanical slope stabilization; and
- Re-vegetation.

Most of these erosion control technologies are based on slope stabilization principles. The soil mechanics of slope stability is the geotechnical analysis of a soil covered bank and its potential to undergo mass wasting. Slope stability is the product of the balance between shear stress and shear strength. Triggering factors of a slope failure can be climatic events that can then make a slope unstable, leading to mass movements. Mass movements can be caused by increases in shear stress, such as loading, lateral pressure or transient forces. Alternatively, shear strength may be decreased by weathering, changes in pore-water pressure or organic material.

The following mitigation technologies were considered for the reduction of suspended solids concentrations in the water leaving the channel:

- Filter socks;
- Check dams;
- Filter berms; and
- Silt curtains.

Several other mitigation options were considered but discarded during the early stages of the process as not being suitable for the site, as follows:

- Construction of an impermeable barrier and other improvement to the dyke was considered to be outside the scope of this study;
- Construction of a second dyke at the mouth of the channel was considered a non-feasible option given the current site access restrictions;
- The addition of polymers to improve the settling of sediments in the channel was considered to have limited impact on sediment removal due to the magnitude of the flow and channel dimensions; and
- The preliminary concept of multiple check dams and filter berms suggested in August 2006 was rejected given the logistics of constraints associated with transport of the materials to the construction locations in the channel.

The next sections include the description of the technologies, the applicability to the site and some of the advantages and disadvantages of each technology.

3.1 Rock Retaining Walls

A rock retaining wall is a structure typically comprised of rock in a casing that holds back earth. Retaining walls stabilize soil and rock from down slope movement or erosion and provide support for vertical or near-vertical grade changes.

Segmental retaining walls are more economical, easier to install and considered more environmentally sound as drainage pathways remain intact. The most important consideration in proper design and installation of retaining walls is that the retained material is attempting to move forward and down slope due to gravity. This creates a soil pressure behind the wall. This pressure is smallest at the top and increases toward the bottom and will push the wall forward or overturn it if not properly addressed. Also any groundwater behind the wall that is not dissipated by a drainage system causes an additional horizontal hydraulic pressure on the wall.

A small rock retaining wall may be useful for the footing of slopes, especially next to water bodies, to reduce the potential for sloughing into the water bodies and creating suspended sediments. A geotechnical assessment and design would be required for larger rock retaining walls. Refer to Exhibit 2 for an example of a rock retaining wall.

Exhibit 2: Example of a Rock Retaining Wall

Existing wood debris may be removed from the banks of the channel and used to construct makeshift retaining walls above the rock retaining walls.

Advantages

- The rock retaining walls are much stronger than the ecological retaining walls;
- They can be used within the water channel;
- They allow water to drain through the wall and capture sediment; and
- They can be used to protect vulnerable curves in the channel.

Disadvantages

- Impractical to transport the rock materials available from the quarry to the point in the channel where they are needed;
- They remain a permanent feature within the channel; and
- Excessive costs due to site location, logistics and bank heights.

3.2 Ecological/Green Retaining Walls

This technology uses interlocked soil bags to form a retaining wall to promote slope stability. The ecological retaining walls provide a vegetated face for slopes and walls to aid in erosion control, slope repair, bank protection and earth retention applications. Some of the ecological retaining wall manufacturers claim that their systems offer the strength of stone and concrete while maintaining a natural looking feature. The soil bags can be seeded or planted to re-vegetate the bank. Refer to Exhibit 3 for an example of an ecological retaining wall.

Exhibit 3: Example of an Ecological Retaining Wall

Advantages

- Materials can be brought to the point of use with ease;
- The slope soils can be used to fill the bags;
- They can be used within the water channel;
- They promote re-vegetation;
- They allow water to drain through the wall and capture sediment; and
- They are biodegradable over many years and blend into the natural surroundings.

Disadvantages

- Permanent plastic interlocking bag clips remain;
- Less strength compared to rock retaining walls; and
- Labour intensive to fill and place bags.

3.3 Riprap Armouring

Riprap armouring consists of rock materials used in bank stabilization. Riprap reduces water erosion by resisting the hydraulic forces and dissipating the energy of precipitation or flowing water. The shape of rock is important. Coarse, angular rock, usually made by crushing, is more effective at ground reinforcement. A correct mixture of aggregate size can also aid riprap's ability to create an interlocking structure. Refer to Exhibit 4 for an example of riprap.

Exhibit 4: Example of Riprap Slope Stabilization

Riprap can be used in conjunction with a geotextile fabric or in gabion baskets (caged riprap for erosion control), as discussed in the previous section. Gabion baskets have some advantages over loose riprap because of their modularity and ability to be stacked in various shapes. They also have advantages over more rigid structures because they can conform to ground movement, dissipate energy from flowing water and drain freely. Their strength and effectiveness may increase with time, in some cases, as silt and vegetation fill the interstitial voids and reinforce the structure.

Advantages

- The riprap armouring provides a strong barrier against the erosion of the stream;
- It allows water to drain through the wall and capture sediment;
- It can be placed on top of erosion control mats at the edge of the water; and
- It can be applied to small or large sections of the bank as needed.

Disadvantages

- Impractical to transport the rock materials available from the quarry to the point in the channel where they are needed; and
- It remains a permanent feature within the channel.

3.4 Erosion Control Mats

Erosion control mats (ECMs) are a temporary degradable rolled erosion control product composed of processed natural or polymer fibres mechanically, structurally or chemically bound together to form a continuous mat to provide erosion control and facilitate vegetation establishment. They are stapled onto the ground over an area that has been or will later be seeded and fertilized. As the vegetation grows through the ECM, the ECM provides erosion protection, a microclimate for seed germination, and protection of the

immature plants from mechanical damage. Refer to Exhibit 5 for an example of erosion control mats.

Exhibit 5: Example of Erosion Control Mats

There are several different types of ECMs including Straw Mats, Coir Mats, Excelsior Mats, Turf Reinforcement Mats, Concrete Mats and Synthetic Mats. The highlights of each of the types of mats are included in bullet form below.

Straw Mats

- These mats are made from agricultural wheat straw, sometimes combined with other organic materials such as coconut;
- They are held together by photodegradable mesh net;
- They are applicable to less steep slopes (maximum slope is 2:1) and very low flow conditions;
- They are typically lightweight mats that last less than 2 years.

Coconut (Coir) Fibre Mats

- These mats are biodegradable, woven together from coconut and held together by photodegradable mesh;
- They may be 100% coconut or combined with straw, excelsior, or other materials;
- They are typically rated for moderate to steep slopes and are used for stream channel lining;
- Their durability is dependent on the net mesh and the combination of materials added to the coir material; and
- They typically last 2 to 4 years.

Excelsior Mats

- These mats are produced from wood excelsior (often aspen and poplar);
- They are composed mostly of a single specified length of fibrous material (e.g., 150 mm) and are held together with netting and mesh materials;
- They are applicable for moderate to steep slopes and low-flow ditches; and
- They are biodegradable and can last several years.

Turf Reinforcement Mats

- These mats can be made from both organic and synthetic materials, including coir and polypropylene;
- They are used to reinforce vegetation for permanent applications against extreme scour and erosive forces;
- They are applicable to stream channels and on slopes;
- They are more durable than the straw, coir or excelsior mats and generally cost twice the price of those mats.

Concrete Mats

- The basic design of these mats is a woven fabric mat that is filled with fine concrete or grout;
- They are very strong and permanent;
- They can be applied for erosion control on slopes, ditches, spillways, stream banks, and shorelines; and
- They are more costly than the previously listed mats.

Synthetic (Geosynthetic) Mats

- There are many different styles of synthetic mats which can be composed of polypropylene, polyolefin, polyvinyl chloride (PVC) monofilaments, monofilament yarns, various types of plastics, polyester fibres, and various other geosynthetics;
- They can be composed of photodegradable or permanent material;
- They can be customized to meet a variety of erosion control needs and fit special situations; and
- They are typically the most expensive form of ECMs.

Based on the mitigation objectives, site conditions and design constraints, Coir Mats and Turf Reinforcement Mats were chosen as the preferred ECMs.

Advantages

- They can be used on different slopes ranging from flat ground to a 1:1 grade;
- They allow water to drain through the wall;
- They provide a good base for re-vegetation;
- They are low cost, compact for transport, easy to install; and
- They are biodegradable.

Disadvantages

- They provide a relatively thin layer of protection and fine sediments can seep through; and
- They require many stakes to hold the mats in place (approximately 2-3 stakes per cubic metre of ECM).

3.5 Geogrids

Geogrids are meshes usually made of a regular pattern of fairly rigid, plastic tensile bars. These meshes are typically used to strengthen fill materials in geotechnical applications. The bars are oriented in one principle strength direction. Geogrids interlock with the soil and have excellent long term creep strength. Their tensile strength can prevent or decrease the degree of differential settlement in some applications by transmitting the load over a broader area of soil, thereby diminishing the vertical stress in the soil. The strength of a geogrid allows positive reinforcement of embankments and retaining walls. Refer to Exhibit 6 for an example of a geogrid.

Exhibit 6: Example of a Geogrid

Geogrids are typically installed horizontally between layers of fill material to reduce the likelihood of sloughing.

Advantages

- They provide a strong barrier to prevent soil creep; and
- They are compact for transport.

Disadvantages

- They are only useful for horizontal placement;
- Excavation of the current banks would be required to install them;
- They are costly and permanent; and
- Additional erosion control features are required for the face of the slope.

3.6 Mechanical Slope Stabilization

Mechanical slope stabilization is the physical process of contouring the channel banks to promote slope stabilization. Excavation equipment is required to complete this work on a large scale. The aim of this process is to cut away at the material at the top of the banks and place it at the bottom of the banks to reduce the grade.

Advantages

- It reduces the grade of the slope to allow the use of other mitigation technologies; and
- A reduced grade promotes natural drainage and infiltration.

Disadvantages

- Requires large excavation machinery;
- The lower reach of the channel can only be accessed by this machinery in the winter; and
- Excavating the overhanging slopes could be a hazardous process.

3.7 Re-Vegetation

Re-vegetation is the process of seeding and replanting the soil of disturbed land. This is a natural process produced by plant introduction, colonization and succession designed to repair damage to a landscape due to flood or other cause. The process is typically one of applying seed and fertilizer to disturbed lands, usually grasses or clover. The fibrous root network of grasses is useful for short-term erosion control, particularly on sloping ground. Establishing long-term plant communities requires the establishment of woody plants.

Advantages

- A natural barrier to improve drainage and protect from erosional forces;

- Supports bank stabilization; and
- Eventually returns the construction site to a natural part of the landscape.

Disadvantages

- The planting of appropriate plants can be costly;
- Season limitations can reduce planting windows; and
- Growth in the sub-arctic climate can be slow.

3.8 Filter Socks

Filter socks are comprised of a geotextile material filled with wood fibre or crushed rock. They are typically placed across small ditches to reduce the water flow and capture suspended sediment.

Filter socks can be stacked or combined with other erosion control technologies for larger flows. Custom filter socks can be sewn from most geotextile types for drainage applications. It is important to design the filtration properties of the geotextile to the soil at the site. The geotextile for the filter socks must be sized so that it is small enough to prevent soil fines from flowing through and large enough not to clog and prevent water flow. Refer to Exhibit 7 for an example of a filter sock.

Exhibit 7: Example of a Filter Sock

Advantages

- They can filter sediments from ditches and small streams;
- They can be filled with local materials; and
- The geotextile can be transported to the site with ease.

Disadvantages

- They are not suitable for large scale application;

- A large amount of labour time is required to fill the filter socks manually; and
- They are temporary and require maintenance and replacement.

3.9 Check Dams

A check dam is a small dam designed to reduce flow velocity and aid in settling out suspended sediments. Check dams typically consist of loose rock that promotes sediment trapping until the spaces between rocks are filled, at which point the water will overflow at a low point constructed in the middle of the dam. Water flow is thereby diverted to the centre of the channel away from the eroding banks. The rise in water level on the upstream side of the check dam will allow additional settling in the basin that forms upgradient of the dam. Refer to Exhibit 8 for an example of a check dam.

Exhibit 8: Example of a Check Dam

Advantages

- The check dams can hold and store a large amount of sediment before plugging;
- They can be used at low points within the water channel;
- They allow some water to drain through the dam and capture sediment; and
- They are a strong physical barrier that can be left in place to form sediment ponds once they clog up.

Disadvantages

- They are not very good at filtering fine silt such as at this site;
- Impractical to transport the rock materials available from the quarry to the point in the channel where they are needed; and
- Significant construction is involved.

3.10 Filter Berms

Filter berms are typically used in low to moderate flow applications to reduce flow and aid in the control of sediments. They can be combined with check dams for larger applications.

The filter berms are constructed of a geotextile material surrounded by burlap sand bags and drainage rock that spans the width of the drainage channel. The edges of the filter berms can be comprised of check dam materials. The filter berm is constructed in the overflow drainage channel of the check dam. While the check dam may clog with sediment, the filter berm requires regular maintenance to clean or replace the geotextile material to continue filtering out suspended sediments.

Additional filter material in the form of filter socks (which consist of granular material or mulch wrapped in filter cloth) can be added to this section if overflows are frequent. Refer to Exhibit 9 for an example of a filter berm.

Exhibit 9: Example of a Filter Berm (geotextile fabric not visible)

Advantages

- They can be installed temporarily to improve filtration and removed as needed without a great deal of manpower;
- The geotextile is more likely to capture the fine silts at the site; and
- Site materials can be used to support the geotextile lining.

Disadvantages

- They can only be used under specific site conditions (typically low flow); and
- They typically fill up with sediment quickly and require maintenance to remain useful.

3.11 Silt Curtains

The floating silt curtains are comprised of a geotextile material that is suspended from a float that is strung across the channel in a series of baffles to catch sediment and reduce the water flow.

A baffle is typically configured by securing a silt curtain on one bank, extending it to a point that is about 2/3 to 3/4 the width of the water channel and then anchoring another line to the opposite bank. This process is repeated from the opposite bank, just up or downstream of the other curtain, to form one baffle to slow the flow rate and promote sediment filtering. Refer to Exhibit 10 for an example of a silt curtain.

Exhibit 10: Example of a Silt Curtain

Silt curtains provide an effective and price sensitive system for isolating silt in an aquatic ecosystem. The orientation of the silt curtains can be used to direct flow away from vulnerable portions of bank that are more likely to be eroded.

The geotextile mesh can be customized to collect specific sizes of sediment. The shape of the silt curtains can be customized to fit the shape of the water body. High durability silt curtains are available for moderate to high flow applications.

Advantages

- They provide filtration for sediments in the water body;
- They can be easily installed at the site; and
- They are inexpensive.

Disadvantages

- They are not durable and could break loose during high water flow events; and
- The silt curtains require regular maintenance.

3.12 Mitigation Technologies Evaluation

Based on the previous discussions of the different types of erosion control and filtration technologies, the advantages and limitations of these mitigation options are summarized in Tables 3-1 and 3-2.

Table 3-1 Evaluation of Erosion Control Technologies

Options	Mitigation Objectives	Site Conditions	Design Constraints	Limitations
1) Rock retaining walls	• Protect soil from further erosion; and • Sediment filtration.	Suitable for the site.	• Low costs if rock material available; • Permanent; and • Requires geotechnical investigation and design for complex wall.	• Limited ability to re-vegetate; and • Impractical to bring materials to point of use.
2) Ecological /green retaining walls	• Protect soil from further erosion; and • Sediment filtration.	Suitable for the site.	• Moderate costs; • Labour intensive; and • Biodegradable.	• Limited strength
3) Riprap armouring	• Protect soil from further erosion.	Suitable for the site.	• Riprap has low costs if rock material available; and • Permanent.	• Designed to reduce sloughing; and • Impractical to bring riprap to point of use.
4) Erosion control mats	• Protect soil from further erosion; and • Sediment filtration.	Suitable for the site.	• Low to high costs dependent on the ECM chosen; • Biodegradable; and • Require staking to the bank.	• Designed to reduce sloughing; and • Fine sediments can pass through.
5) Geogrids	• Protect soil from further erosion.	Not suitable for the site.	• Moderate costs; • Only useful in horizontal applications; • Must be combined with other retaining features; and • Suitable for long-term stabilization.	• Designed for new, (non-existent) slopes.
6) Mechanical slope stabilization	• Reduces slope of bank	Suitable for the site.	• Low costs; • Applicable to steep slopes where other technologies are inappropriate; and • Must be combined with other erosion control technologies.	• Access to site only during frozen periods.
7) Re-vegetation	• Protect soil from further erosion	Suitable for the site.	• Moderate costs; and • Manual seeding and replanting.	• Planting season; and • Reduced sunlight for growth.

Table 3-2 Evaluation of Filtration Technologies

Options	Mitigation Objectives	Site Conditions	Design Constraints	Limitations
8) Filter socks	• Reduce suspended sediments.	Not suitable for channel banks. Suitable for low flows entering channel.	• Low costs; • Suitable for low flows; and • Regular maintenance required.	• Once plugged, water overflows.
9) Filter berms	• Reduce suspended sediments.	Suitable for the site.	• Moderate costs; • Suitable for moderate flows; and • Regular maintenance required.	• Once plugged, water overflows
10) Check dams	• Reduce suspended sediments.	Suitable for the site.	• Moderate costs if materials available; • Suitable for moderate flows; and • Suitable for long-term operations.	• Once plugged, water overflows; and • Impractical to transport materials to point of use.
11) Silt curtains	• Reduce suspended sediments.	Suitable for the site.	• Low costs; and • Suitable for moderate flows.	• Once plugged, water flows around curtains.

4.0 PHASE 2 ACTION PLAN

The recommended mitigation technologies that were deemed suitable and applicable to the site were used in the design of the Phase 2 Action Plan. Refer to Figures 2 through 4 for the application locations of the technologies that are discussed below.

The mitigation works at the site have been split into three sub-phases:

- Phase 2A - To be completed by Sept 29, 2006

  - Temporary mitigation works to be completed prior to the winter freeze up.
  - Maintenance of Phase 1 silt curtains, installation of new silt curtains in the lower reach, installation of coir erosion control mats (ECMs) in the lower and upper reach, installation of a filter berm at the outlet of a cascade pool, and installation of silt fencing along the channel banks.

- Phase 2B - To be completed by April 1, 2007

  - Slope reduction and stabilization works to be completed during winter period to facilitate excavation vehicles to channel.
  - Installation of rock retaining walls at footing of new slopes.

- Phase 2C - To be completed by June 1, 2007

  - Follow-on slope stabilization works to be conducted after snow melt, if necessary.
  - Maintenance and replacement of Phase 2A silt curtains, installation of ECMs to protect new slopes.
  - Seeding and planting of new slopes to promotes re-vegetation of new slopes.

4.1 Action Plan for Phase 2A

The Phase 2A mitigation activities are considered temporary measures to reduce soil erosion and improve sediment settling prior to the winter freeze-up. Three mitigation technologies are being used during this interim period: ECMs, silt curtains, a filter berm, and silt fencing.

The objectives of the Phase 2A mitigation activities are to provide temporary stabilization of the channel banks prior to the winter freeze-up and during the initial Spring thaw before the Phase 2C improvements can be completed. The additional silt curtains are intended to minimize the sediments entering Strutt Lake by reducing the flow of the channel and allowing sediment to settle out.

The ECMs are to be placed on the sections of the channel banks that are currently accessible, clear of debris, have a grade of less than 1:1, and particularly those areas

where silt deposits have formed and require protection from re-suspension. These areas are outlined on Figure 2. Refer to photographs 1, 9, 10 and 11.

Currently eight silt curtains are in place across the upper and lower reaches of the channel. An additional eight curtains are recommended to be added to the lower reach. The lower reach has been observed to contain a greater concentration of suspended sediments than the upper reach. This is due to the turbulence from the water flowing down the rock cascade re-suspending sediment and continuing erosion from the lower reach slopes, particularly at the elbow of the channel. The new silt curtains are to add to the existing baffle silt curtain system to slow the flow of the water in the channel and promote settling. Keystone will perform maintenance on the existing silt curtains to make certain they are securely anchored and functioning properly.

One filter berm is recommended for the gravel area immediately downgradient of the channel elbow. Refer to the location of note B on Figure 2. A filter berm consisting of geotextile material surrounded by sand bags and gravel from the area is to be placed across this drainage point to improve the filtering of suspended sediment and eventually clog up with silt and cause the level in the channel elbow pool to increase to overflow the filter berm and increase the settling time in the pond.

An additional mitigation project that can be undertaken as part of the Phase 2A mitigation works is the diverting of flow at the shallow area upgradient of Silt Curtain # 1 on Figure 1 and 2. The flow should be diverted towards the centre of the channel to reduce the erosion of the western bank. Labourers should be able to manually move some of the rocks in this area to improve flow in the middle of the channel and reduce flow at the western edge. One of the extra silt curtains may be placed to aid in this project.

4.2 Action Plan for Phase 2B

The Phase 2B mitigation activities are intended to alter the grades of the channel banks to reduce the effects of surface run-off and the in-channel water flow on the soil banks. The reduction in the grade of the slopes will facilitate the placement of erosion control technologies such as the ECMs and ecological retaining walls. The mechanical slope stabilization is to be conducted during the winter freeze-up to facilitate the access of excavation equipment to the lower reach of the channel. The frozen ground should provide more stability to excavate the existing steep slopes, particularly near the elbow of the channel. Three mitigation technologies are being used during the Phase 2B mitigation work: Mechanical Slope Stabilization, Riprap and Rock Retaining Walls.

The objectives of the Phase 2B mitigation activities are to permanently alter the flow of water through the channel to reduce erosion at the sides of the water body, eliminate the greatest source of suspended sediments currently entering the water body and improve the grading of the channel banks to reduce the erosional effects and provide a base for ECMs and vegetation.

The Mechanical Slope Stabilization in the upper channel will focus on the small sheer banks located particularly on the western side of the channel. By reducing the grade of these banks and armouring them with riprap, we shall reduce the erosional forces on the bank. The excavator may also be used to increase the depth of the middle of the channel to improve the flow down the middle of the channel and away from the sides. This shall reduce the higher flow rates at the side of the channel that have currently been eroding away the banks. The riprap can be transported into place by the excavator during the winter period.

The Mechanical Slope Stabilization in the lower reach will be a much greater undertaking. Some of the steep slopes in this area are up to 15 m high with grades higher than 1:1. The aim of the mechanical slope stabilization shall be to cut away at the material and overhanging trees at the top of the banks and place it at the bottom of the banks to reduce the grade to approximately 1:3. Refer to photographs 4 through 8.

The pool that currently exists at the channel elbow is recommended to be filled in to eliminate the greatest source of suspended sediment at the site. Currently the groundwater and surface run-off is entering this pool through the steep slopes at the elbow and transporting large amounts of sediment through the pool and into the main water body of the channel. By filling in the pool, creating a reduced grade from the high point of the banks to the main water body and through the later addition of ECMs and vegetation, we aim to eliminate or greatly reduce any sediment entering the channel from this point. The excavator would be required to remove the ice from this pool before it can be filled in and graded.

The footings of the slopes should be supported by a small (approx 1 m high) rock retaining wall (caged riprap). These modular sections shall most easily be installed during the winter period when these heavy items can be brought down to the lower reach over the frozen water.

4.3 Action Plan for Phase 2C

The Phase 2C mitigation activities are intended to protect the newly contoured banks of the channel and begin to restore the vegetation so as to create a natural protection from erosion. The installation of ecological retaining walls and ECMs at the base of the banks will provide structural support from soil creep and promote vegetation. The seeding and planting of the new slopes will aid in slope stabilization and improve drainage.

Three mitigation technologies are being used during the Phase 2C mitigation work: ECMs, ecological retaining walls and re-vegetation. Other mitigation technologies that will still be in place from previous phases include: Silt curtains, rock retaining walls, and riprap. These technologies may require maintenance as part of this phase of work.

The objectives of the Phase 2C mitigation activities are to protect the features created as part of the Phase 2B work, aid in slope retention and surface drainage and create a

natural-looking vegetated channel. Once the erosion control technologies have reduced the sediment entering the channel water body, the silt curtains can be removed from the channel.

The new ECMs are to be placed on the sections of the channel banks that were re-graded as part of the Phase 2B mitigation work. These areas are outlined on Figure 4. A large amount of slope stabilization is to take place in the lower reach and it will be important to cover and protect these new features as early in the year as possible (preferably before the Spring run-off begins). The ecological retaining walls should be used on small sections that require additional protection as they are in a more vulnerable location or have a greater slope. The point at which the bank slope intersects the water body may be protected by rock retaining walls near the rock cascade but may require additional protection towards Strutt Lake. The basic concept of the re-vegetation plan and how it applies to this site are discussed in Section 4.4.

4.4 Re-Vegetation Plan

The goal of the re-vegetation plan is to speed up the natural process of succession following a significant disturbance. Re-vegetation of areas of exposed soil should be conducted in a phased approach. The available growing season in this region is a limiting factor. As freezing temperatures and frost may begin to occur in late September, planting or seeding should be delayed until spring 2007. A seed mixture consisting of indigenous sedges and grasses is recommended for the first phase of the re-vegetation plan. This will help to stabilize exposed slopes and will increase organic matter and nutrient contents in these areas. Once grasses, sedges and legumes have become established and soil chemistry is deemed amenable to further planting, the second phase of re-vegetation can incorporate the introduction of perennial, indigenous plant species, shrubs and trees. Due to the limited growing season and slow growth rates expected in the Snare River region, completion of the first phase of planting/seeding may take several growing seasons. Completion of the second phase with planted shrubs and trees becoming well established in formerly exposed areas may take over 10 years for some areas depending on location and exposure.

Each area requiring re-vegetation must be assessed to determine the substrate that is present as surface substrate may limit suitable plant and grass species. Slope angle and aspect or exposure will also be a determining factor for species selection. Given the low solar angle at this latitude, timing of snow melt, soil temperature, sunlight, and resulting soil moisture levels can vary significantly based on direction of exposure and slope angle. North-facing slopes, particularly those opposite the rock cascade area, may receive very little direct sunlight, whereas south facings slopes along the north side of the lower portion of the channel may receive higher levels of sunlight with resulting early snow melt and relatively dry soil conditions during the summer months. An assessment of soil conditions at these various locations may be beneficial as grain size, pH, moisture content, organic matter and nutrient content can have a profound influence on what

species may establish successfully. Further research may also be needed to investigate suitable plant and grass species for this area based on exposure and soil chemistry.

Annual ryegrass has been used successfully in sub-arctic environments and boreal forest for areas that require rapid erosion control. This non-native grass dies at the end of the growing season and does not reseed; therefore, spread of this non-native species is avoided. Annual ryegrass can be mixed with a native legume and wheatgrass mix and/or planted with container grown perennial grasses, herbs, shrubs and tree seedlings indigenous to the Snare River area (Phase 2 of the re-vegetation plan). The recommended seeding rate for annual ryegrass is 3.5-8.0 kg/ha or 130-300 seeds/m^2. Seeded areas should be fertilized with a slow release fertilizer formula suitable to the soil conditions. Seeding should be conducted in the early spring (May) and should be applied by removing the ECMs installed the previous fall, if present, and raking seed into the exposed soil. The ECMs may be replaced temporarily until germination and growth begins. The ECMs must be removed before germinating grasses and/or legumes begin to grow through the mats, as removal of the mats will damage the underlying vegetation if not done early enough.

The primary goal of the re-vegetation plan is to control erosion along exposed banks. The ultimate goal is to achieve a stable environment and restore ecosystem function within disturbed areas. A more detailed re-vegetation plan will be completed once the impacts of the earlier phases have been assessed and exposed slopes have been stabilized. The detailed re-vegetation plan will include information on specific species of plants, shrubs and trees to be used in Phase 2 of the plan as well as options for obtaining seeds/seedlings and methods for planting and maintaining re-vegetated areas.

4.5 Construction and Post-Construction Monitoring

Water quality monitoring of the construction activities at the site will be conducted by Keystone personnel when they are onsite and by NTPC otherwise. The construction monitoring shall include the monitoring of water quality at multiple locations in the upper and lower reaches of the channel to identify any increased suspended solids concentrations associated with the installation of mitigation activities and the need for additional mitigation measures. Silt fences can be temporarily installed downstream of the work location to aid in trapping sediments that may be re-suspended during construction. Additional silt fences can be installed if the monitoring results indicate the sediment concentrations are elevated beyond reasonable expectation. Keystone proposes the purchase of a dedicated water quality meter (approximately $5,000) which will be used during the construction monitoring and to remain at the site for post-construction monitoring.

A post-construction monitoring program for suspended solids was initiated as part of Phase 1 of the work plan. Various locations are to be monitored on a set basis to determine the current levels of sediment entering Strutt Lake and measure the effectiveness of the existing and/or implemented mitigation technologies at removing

sediment. Keystone can conduct the monitoring program while on-site and on-site NTPC employees can continue monitoring thereafter. The post-construction monitoring program will be used to determine the need for adjustments to the filtering mechanism of the filter berm and silt curtains, and to determine the areas of the channel that are contributing the most sediment. Potential adjustments will be made during the implementation of the various phases to ensure that the suspended solids concentrations have reduced to within acceptable levels.

4.6 Mitigation Action Plan Time Table

To efficiently implement the mitigation works, a series of activities are required. Table 4-1 lays out the time sequence of activities and planned starting date for each activity. The initial Phase 2A mitigation works are to be installed by September 28, 2006, prior to the winter season. The remaining Phase 2 mitigation works are to be completed during the winter season to facilitate access to the site and after the winter season.

Table 4-1 Proposed Schedule for Mitigation Action Plan

Date	Activity
September 18-22, 2006	Mobilize equipment to site
September 25-29, 2006	Installation of Phase 2A mitigation works
October 13, 2006	Report on Phase 2A field work
February 2007	Preparation for Phase 2B mitigation works
February 2007	Installation of Phase 2B mitigation works
March 2007	Report on Phase 2B field work
May 2007	Preparation for Phase 2C mitigation works
June 2007	Installation of Phase 2C mitigation works
June 2007	Report on Phase 2C field work
July 2007	Continued monitoring of erosion control technologies
August 2007	Adjustments and upgrades to erosion control technologies (if necessary)
September 2007	Final Closure Report (if all works completed)

5.0 CONCLUSION

In this study, eleven potential mitigation approaches were identified and evaluated in terms of mitigation objectives, site characteristics, and design constraints. Based on the recommendations of this report, eight mitigation technologies have been chosen to be implemented at the site in a series of three phases: Ecological retaining walls, rock retaining walls, riprap armouring, erosion control mats, mechanical slope stabilization, re-vegetation, filter berms and silt curtains.

These mitigation technologies are to be implemented at the appropriate site locations to meet the mitigation objectives:

- Reduce the concentration of suspended sediments entering Snare River to within acceptable levels; and
- Protect the remaining soil and vegetation on the channel banks from further erosion.

The challenges of the site mitigation include: accessibility to the channel, remote location of site, availability of equipment and materials, costs, and long-term impact of mitigation technologies.

The construction and implementation of the recommended mitigation activities were spilt into three sections.

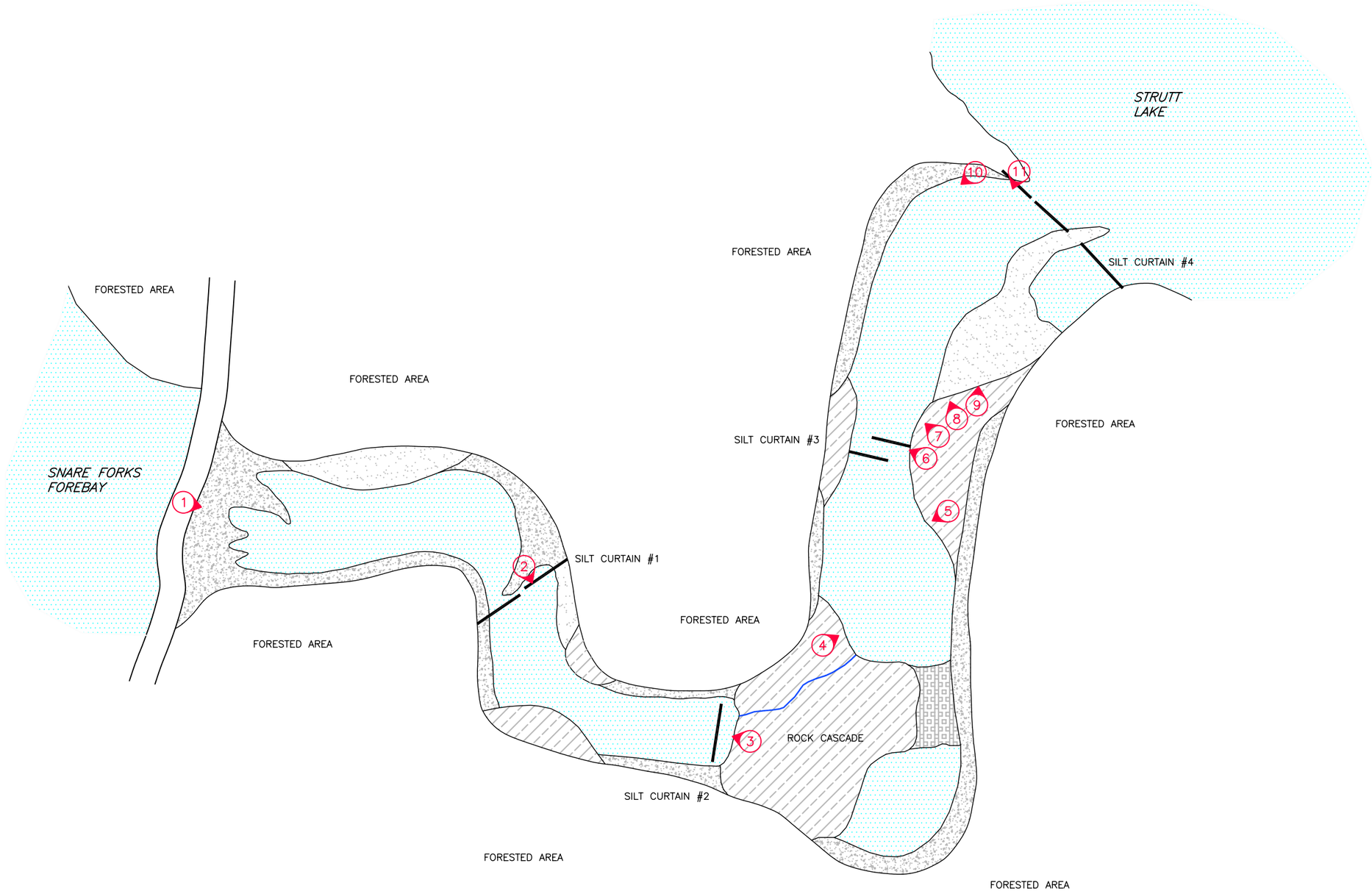
The Phase 2A mitigation activities include the installation of ECMs, the installation of additional silt curtains, maintenance of the existing curtains and the construction of one filter berm. This section is estimated to cost approximately $60,000.

The Phase 2B mitigation activities include mechanical slope stabilization of the steep banks of the channel and the installation of riprap armouring and rock retaining walls. This section is estimated to cost in the range of $50,000 to $100,000.

The Phase 2C mitigation activities include the installation of additional erosion control mats and ecological retaining walls. This section is estimated to cost in the range of $50,000 to $100,000.

The re-vegetation plan will be implemented in conjunction with the Phase 2C mitigation activities. The re-vegetation plan will be reviewed after the initial phases of the mitigation activities are completed. The schedule and costs associated with seeding and planting the contoured channel banks will be determined at a later date.

Figures



LEGEND

- WATER
- EXPOSED BEDROCK
- DEPOSIT OF SILT
- GRAVEL DRAINAGE FROM ELBOW
- SLOUGHED BANKS
- SILT CURTAIN
- (1) PHOTOGRAPH LOCATION & DIRECTION

No.	DATE	REVISIONS DESCRIPTION	BY	APPROVED
0	9/15/06	Issued for client review	MS	RPJ

NOTE: THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.

KEYSTONE ENVIRONMENTAL

Keystone Environmental Ltd.
Ste. 320 4400 Dominion Street
Burnaby, British Columbia

Snare River

Snare River, Northwest Territories

DESIGN RPJ	APPROVED
DRAWN MS	CHECKED FAP
SCALE NOT TO SCALE	

CLIENT: Northwest Territories Power Corporation

Figure 1
Phase 1 Remedial Works
Existing Silt Curtains

DATE	Sept. 2006
SHEET No.	1 OF 4
PROJECT No.	9157-02
REVISION No.	00
DRAWING No.	06-9157-01

PLOT SCALE: 1:1

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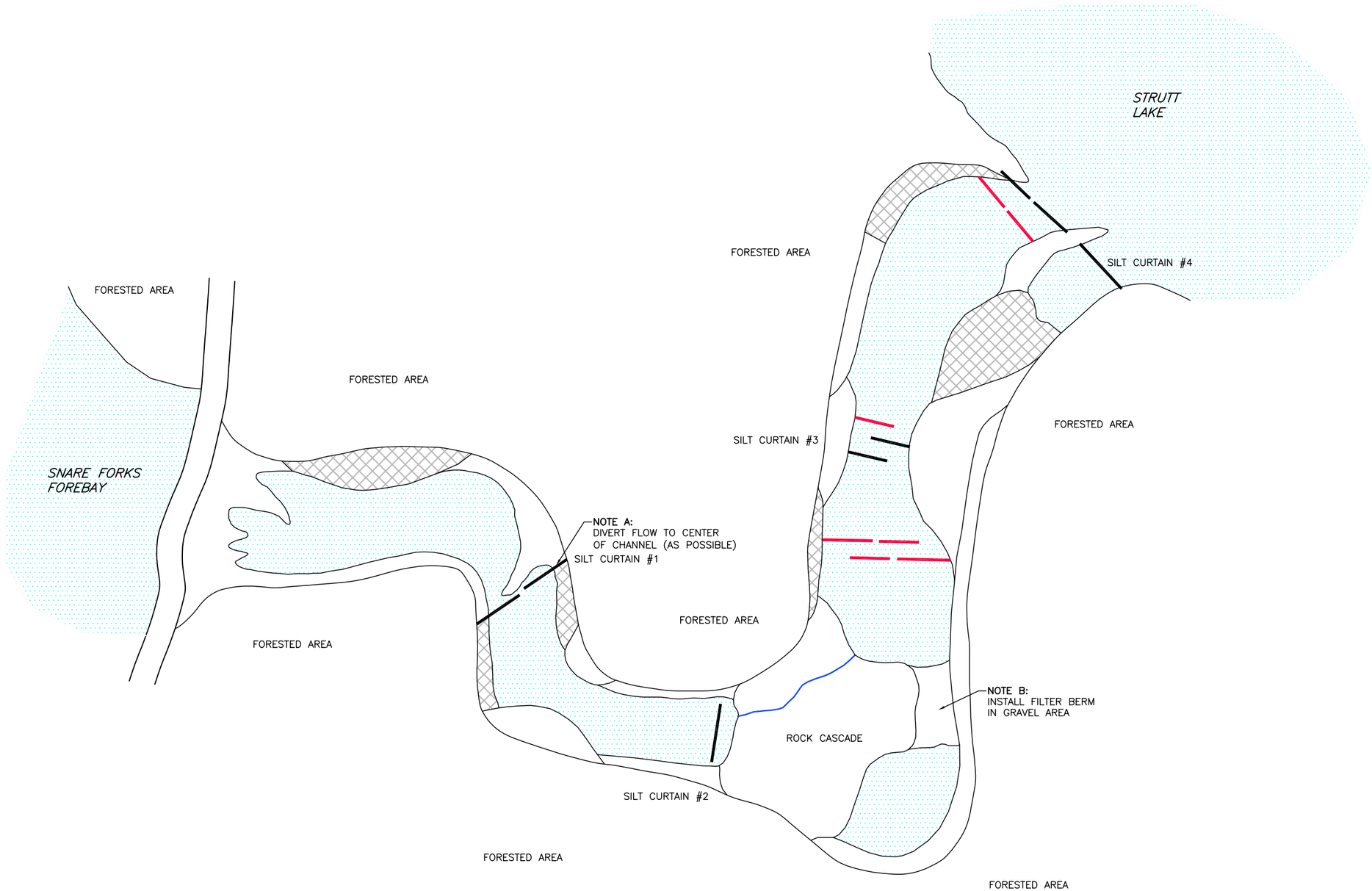

LEGEND

- WATER
- PRIMARY AREAS FOR EROSION CONTROL MATS
- SILT CURTAIN
- NEW SILT CURTAIN

No.	DATE	DESCRIPTION	BY	APPROVED
0	9/15/06	Issued for client review	MS	RPJ

REVISIONS

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Keystone Environmental Ltd.
Ste. 320 4400 Dominion Street
Burnaby, British Columbia

Snare River

Snare River, Northwest Territories

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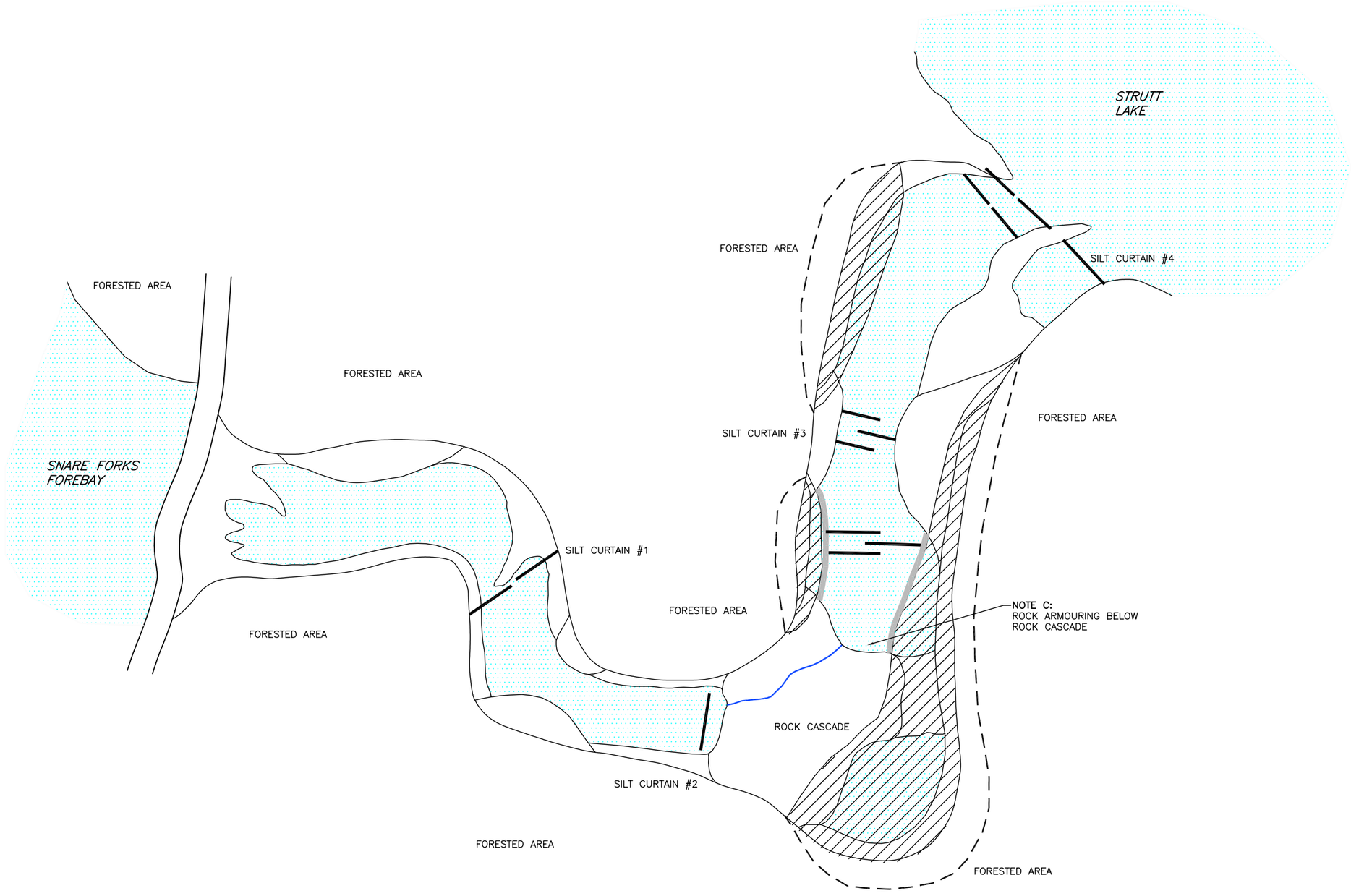
Figure 2
Phase 2A Remedial Works
New Silt Curtains & Erosion Control Mats

DATE	Sept. 2006
SHEET No.	2 OF 4
PROJECT No.	9157-02
REVISION No.	00
DRAWING No.	06-9157-02

PLOT SCALE: 1:1

CADD FILE NO. 9157\Phase 2\Figs\06-9157-02-R0.dwg



LEGEND

- WATER
- FILL–IN AREAS TO REDUCE SLOPES
- SILT CURTAIN
- RETAINING WALL FOOTINGS (IF NECESSARY)
- CUT INTO BANKS TO STABILIZE BANKS

No.	DATE	DESCRIPTION	BY	APPROVED
0	9/15/06	Issued for client review	MS	RPJ

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Keystone Environmental Ltd.
Ste. 320 4400 Dominion Street
Burnaby, British Columbia

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Snare River, Northwest Territories

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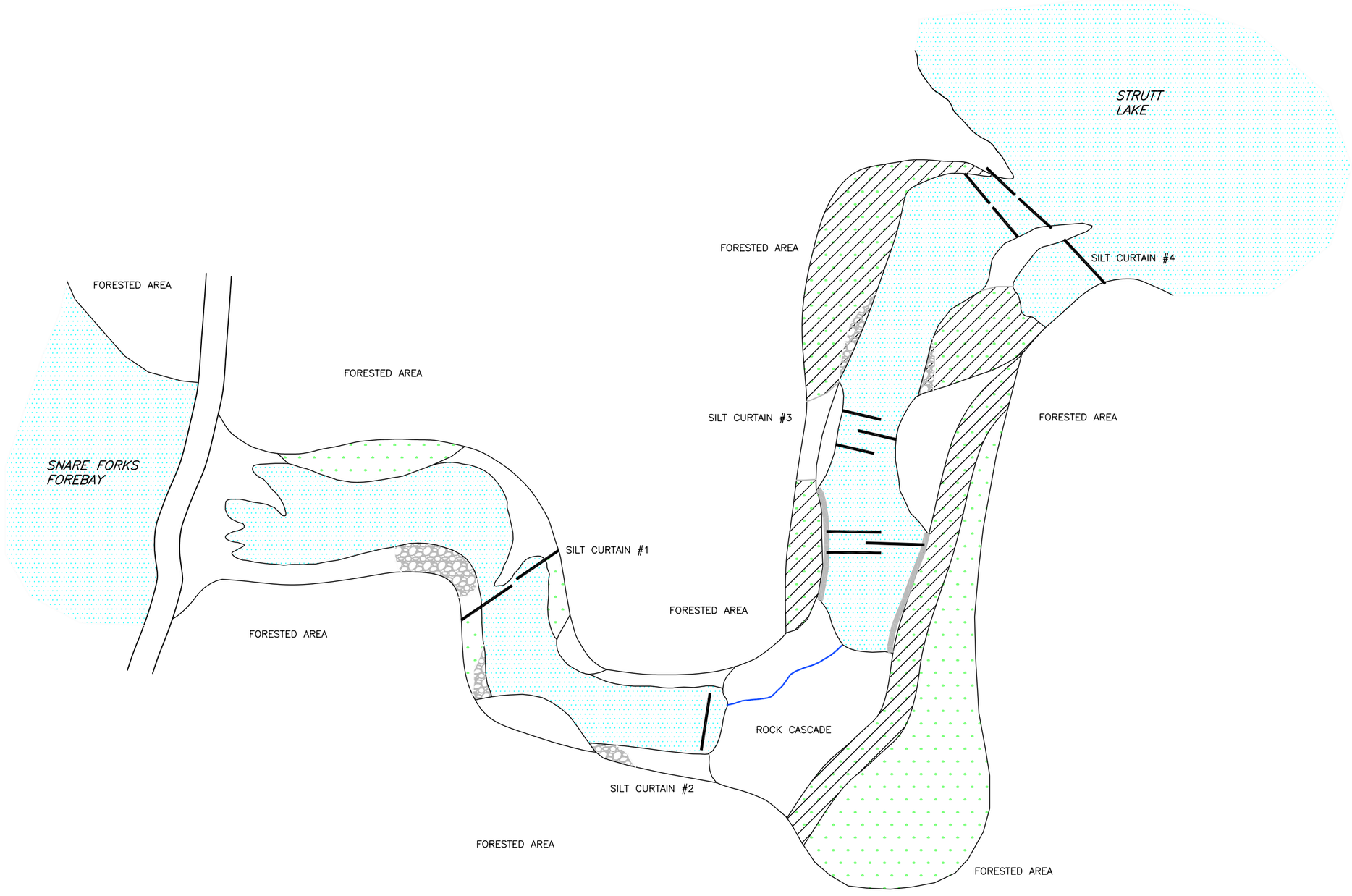
Figure 3
Phase 2B Remedial Works
Slope Reduction/Stabilization

DATE	Sept. 2006
SHEET No.	3 OF 4
PROJECT No.	9157–02
REVISION No.	00
DRAWING No.	06–9157–03

PLOT SCALE: 1:1
CADD FILE NO. 9157\Phase 2\Figs\06-9157-03-R0.dwg



LEGEND

- WATER
- NEW EROSION CONTROL MATS
- RIP RAP
- RE–VEGETATED AREA
- SILT CURTAIN
- RETAINING WALL FOOTINGS (IF NECESSARY)

No.	DATE	DESCRIPTION	BY	APPROVED
		REVISIONS		
0	9/15/06	Issued for client review	MS	RPJ

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KEYSTONE ENVIRONMENTAL

Keystone Environmental Ltd.
Ste. 320 4400 Dominion Street
Burnaby, British Columbia

Snare River

Snare River, Northwest Territories

DESIGN	APPROVED
RPJ	
DRAWN	CHECKED
MS	FAP

SCALE: NOT TO SCALE

CLIENT: Northwest Territories Power Corporation

Figure 4
Phase 2C Remedial Works Erosion Control Mats & Re–vegetation

DATE	Sept. 2006
SHEET No.	4 OF 4
PROJECT No.	9157–02
REVISION No.	00
DRAWING No.	06–9157–04

PLOT SCALE: 1:1

CADD FILE NO. 9157\Phase 2\Figs\06–9157–04–R0.dwg

Appendix A

Channel Slope Rehabilitation, Snare Falls Dyke,
GeoPacific Consultants Ltd.
letter dated September 8, 2006
to Keystone Environmental Ltd.

9157-02/4.0

GeoPacific
Consultants Ltd.

#410 -1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Phone (604) 439-0922 / Fax (604) 439-9189

Keystone Environmental
#320 - 4400 Dominion Street
Burnaby, B.C.
V5G 4M7

September 8, 2006
Our File #: 6727

Attention: Francisco Perello

Re: Channel Slope Rehabilitation - Snare Falls Dyke

We note that relatively considerable damage to the forested area downstream of the failed portion of the Snare Falls dyke occurred after the dyke failure. The damage consisted of significant scour down to bedrock in most locations as well as the cutting of relatively very steep to near vertical side slopes along the new channel. The slopes were noted to be smallest along the upper portion of the channel, becoming very large (up to approximately 15 metres in height) downstream of the newly formed falls at approximately the midpoint of the channel. During our review of the site we noted that ongoing sloughing of these very steep slopes is occurring and that we expect the majority of the slopes which were not sloughing were only marginally stable.

We understand that preliminary ideas to rectify the slope stability problem in the new channel have involved conventional regrading via cutting the slopes back as well as filling to generate flatter slopes. As well, we understand that the installation of retaining walls has also been considered. Based on our review of the site, the observed relatively poor access, and the likely excessive costs it is our opinion that the installation of retaining walls is not likely to be the most viable option. We recommend that regrading of the slopes be considered as a primary option. Regrading of the slopes would not likely require purchase or transport of significant construction materials, which would likely be required for retaining wall construction. We envisage that regraded slopes would be graded to 2:1 (Horizontal:Vertical) or flatter depending on the conditions and then would be revegetated and/or armoured with rip-rap to minimize the possibility of erosion. We expect that slopes may be stabilized by either cutting the existing slopes back or by filling to achieve flatter slopes. We envisage that the placement of filter cloth along with rip-rap is likely to also be required in any areas that have the potential to be located below water at any time throughout the year. Due to the relatively fine grained nature of the soils observed on-site we expect that there is relatively high likelihood of erosion of the base of the slopes if they are not protected. Erosion of the toe of the slopes is likely to induce further instability up slope.

We note that a rock quarry is located relatively nearby to the dam site and as a result rip-rap material is expected to be readily available.

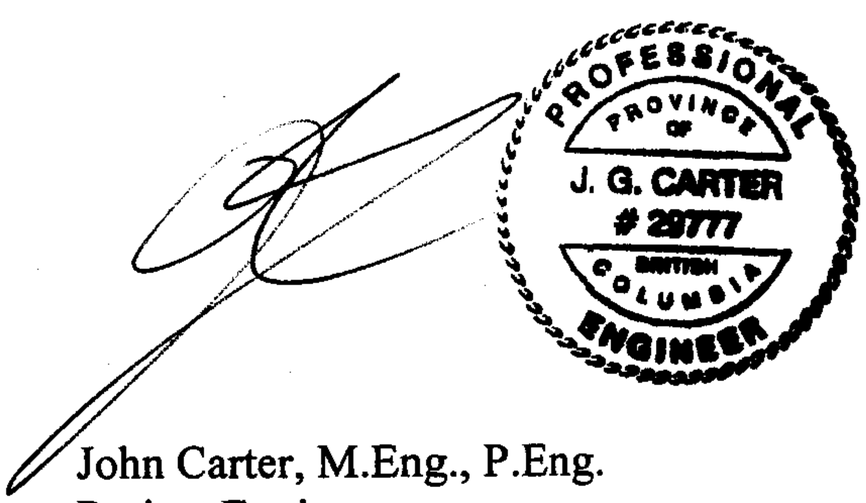
Due to the observed cracking and instability at the tops of the slope we do not recommend having personnel or equipment work at the tops of the slopes. All work should be undertaken from the base of the slope and should be done with excavation vehicles capable of providing some protection to the site personnel. Ideally, the work would be undertaken during the winter months when the presence of frozen soil is likely to improve the stability of the slopes.

A topographic survey of the entire channel downslope of the existing dyke to Struitt Lake should also be

undertaken to confirm the current grades of the slopes. The topographic survey would also be employed to develop a slope rehabilitation design for the channel. We recommend that the survey work be delayed until the winter months until the slopes freeze in order to limit risk to site survey personnel due to slope instability. GeoPacific will prepare a slope rehabilitation design upon request.

We are pleased to be of assistance to you with this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes at this time. We look forward to your response to our recommendations.

For:
GeoPacific Consultants Ltd.



John Carter, M.Eng., P.Eng.
Project Engineer

Reviewed By:

Matt Kokan, M.A.Sc., P.Eng.
Review Principal

Appendix B

Inspector's Direction Pursuant to Section 28(6) of the Fisheries Act,
Department of Fisheries and Oceans,
letter dated September 12, 2006
to the Northwest Territories Power Corporation.

Central & Arctic Region Conservation & Protection

Phone: (867)669-4900
Fax: (867)669-4940
Suite 101, 5204-50 Ave, Yellowknife NT X1A 1E2

Date : September 12, 2006

Pages to follow/Pages à suivre : 1 Facsimile N°/N° de télécopieur : (867)669-4940

Sender's Name/Nom de l'expéditeur : Paul Donnelly

Telephone N°/N° de téléphone : (867) 669-4920

Subject/Sujet :

Name/Nom	Organization/Organisation	Facsimile N°/ N° de télécopieur
Eddie Smith	NWT Power Corporation	867-874-5286

REMARKS:

☒ Urgent ☐ For your information / Pour votre information ☐ Action / Faire le nécessaire ☐ As requested / À votre demande

PLEASE SEE THE ATTACHED 3 PAGES.

Fisheries and Oceans / Pêches et Océans

Fisheries and Oceans Canada
Conservation and Protection
101- 5204 – 50th Avenue
Yellowknife, NT X1A 1E2

Our file / Votre référence
YK-06- 15

INSPECTOR'S DIRECTION

Pursuant to Section 38(6) of the Fisheries Act

September 12, 2006

To:
The Northwest Territories
Power Corporation,
4 Capitol Drive
Hay River, NT
X0E 1G2
Fax: 867-874-5286

Attention: Edward Smith

Description of Occurrence:

On September 5th 2006,

At the Snare Forks Hydroelectric Facility directly upstream of Strutt Lake, NT a site inspection was conducted by fishery officer Paul Donnelly, fishery officer Gerald Fillatre and area habitat biologist Ernie Watson, all of the Department of Fisheries and Oceans (DFO) in Yellowknife.

It was observed that the flow of water from a reconstructed dyke down a newly eroded channel has continued to erode material from the channel's banks and resulted in the deposit of sediment laden water into Strutt Lake.

Strutt Lake and its downstream waters are considered habitat for fresh water sport fish species including but not limited to: lake trout, walleye and northern pike.

From the Fisheries Act R.S., c. F-14

> ***Section 36(3); No person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.***
>
> ***Fish Habitat: Spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.***

It is the opinion of Fisheries and Oceans Canada that the above mentioned situation will continue to occur if immediate measures are not taken to remedy the situation. Therefore, the unstable bank conditions and inadequate sediment and erosion control measures present on the site poses a serious and imminent danger to fish and fish habitat.

On June 15th 2006 a breach occurred on a dyke at the Snare Forks Hydroelectric Facility resulting in the erosion of a new channel connecting the breach to Strutt Lake.

On June 29th 2006, DFO was informed the breach in the dyke that created the channel was closed.

On July 28th via a telephone conversation between Ernie Watson, Paul Donnelly and Eddie Smith, DFO staff clearly explained that the site needed short term stabilization measures to prevent further deposition of sediment and long term measures prior to spring freshet.

On August 14, 2006 in an email to Edward Smith from fishery officer Paul Donnelly, it was clearly explained that DFO's primary concern was the continued deposit of sediment into waters downstream of the dyke failure. DFO was also concerned that the spring freshet could result in a significant amount of sediment moving into downstream water bodies.

On September 5th 2006, DFO staff met on site with NWT Power staff Edward Smith, and Steven Clark and Francisco Perello of Keystone Environmental. It was observed that the measures taken were not satisfactory to prevent continued deposit of sediment into Strutt Lake. Therefore:

Pursuant to Section 38(6) of the Fisheries Act, you are directed to take any and all reasonable measures consistent with safety and conservation of fish and fish habitat to prevent the above mentioned occurrence or to counteract, mitigate, or remedy any adverse effects that have resulted or may reasonably be expected to result from the above mentioned occurrence.

Additionally:

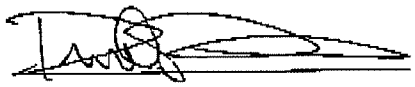
- Prevent any sediment laden water from entering the Strutt Lake.
- Ensure appropriate sediment and erosion control measures are installed correctly and are functioning as intended.

All measures are to be completed to Fisheries and Oceans Canada's satisfaction by Friday September 29th 2006 at 12 noon.

Name of Inspector Designated under *Section 38 of the Fisheries Act*

Paul Donnelly
Fishery Officer/Habitat Inspector
Fisheries and Oceans Canada
Conservation and Protection
Western Arctic Area, Yellowknife, NT
Phone: 867-669-4920

Signature of Habitat Inspector:



NOTES:

1) ***Compliance with this order does not preclude any legal action this department may take with respect to this matter.***
2) ***Failure to comply with the whole or any part of the direction of an inspector is a violation of Section 40(3)(1) of the Fisheries Act.***

Appendix C

Photographs

Appendix A

Channel Slope Rehabilitation, Snare Falls Dyke,
GeoPacific Consultants Ltd.
Letter to Keystone Environmental Ltd.
September 8, 2006

9157-02/4.0

GeoPacific
Consultants Ltd.

#410 -1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Phone (604) 439-0922 / Fax (604) 439-9189

Keystone Environmental
#320 - 4400 Dominion Street
Burnaby, B.C.
V5G 4M7

September 8, 2006
Our File #: 6727

Attention: Francisco Perello

Re: Channel Slope Rehabilitation - Snare Falls Dyke

We note that relatively considerable damage to the forested area downstream of the failed portion of the Snare Falls dyke occurred after the dyke failure. The damage consisted of significant scour down to bedrock in most locations as well as the cutting of relatively very steep to near vertical side slopes along the new channel. The slopes were noted to be smallest along the upper portion of the channel, becoming very large (up to approximately 15 metres in height) downstream of the newly formed falls at approximately the midpoint of the channel. During our review of the site we noted that ongoing sloughing of these very steep slopes is occurring and that we expect the majority of the slopes which were not sloughing were only marginally stable.

We understand that preliminary ideas to rectify the slope stability problem in the new channel have involved conventional regrading via cutting the slopes back as well as filling to generate flatter slopes. As well, we understand that the installation of retaining walls has also been considered. Based on our review of the site, the observed relatively poor access, and the likely excessive costs it is our opinion that the installation of retaining walls is not likely to be the most viable option. We recommend that regrading of the slopes be considered as a primary option. Regrading of the slopes would not likely require purchase or transport of significant construction materials, which would likely be required for retaining wall construction. We envisage that regraded slopes would be graded to 2:1 (Horizontal:Vertical) or flatter depending on the conditions and then would be revegetated and/or armoured with rip-rap to minimize the possibility of erosion. We expect that slopes may be stabilized by either cutting the existing slopes back or by filling to achieve flatter slopes. We envisage that the placement of filter cloth along with rip-rap is likely to also be required in any areas that have the potential to be located below water at any time throughout the year. Due to the relatively fine grained nature of the soils observed on-site we expect that there is relatively high likelihood of erosion of the base of the slopes if they are not protected. Erosion of the toe of the slopes is likely to induce further instability up slope.

We note that a rock quarry is located relatively nearby to the dam site and as a result rip-rap material is expected to be readily available.

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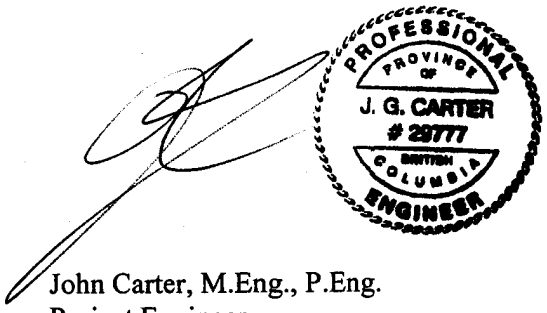
A topographic survey of the entire channel downslope of the existing dyke to Struitt Lake should also be

undertaken to confirm the current grades of the slopes. The topographic survey would also be employed to develop a slope rehabilitation design for the channel. We recommend that the survey work be delayed until the winter months until the slopes freeze in order to limit risk to site survey personnel due to slope instability. GeoPacific will prepare a slope rehabilitation design upon request.

We are pleased to be of assistance to you with this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes at this time. We look forward to your response to our recommendations.

For:
GeoPacific Consultants Ltd.



John Carter, M.Eng., P.Eng.
Project Engineer

Reviewed By:

Matt Kokan, M.A.Sc., P.Eng.
Review Principal

Appendix B

Inspector's Direction Pursuant to Section 28(6) of the Fisheries Act,
Department of Fisheries and Oceans,
letter dated September 12, 2006
to the Northwest Territories Power Corporation.

Central & Arctic Region Conservation & Protection

Phone: (867)669-4900
Fax: (867)669-4940
Suite 101, 5204-50 Ave, Yellowknife NT X1A 1E2

Date : September 12, 2006

Pages to follow/Pages à suivre : 1 Facsimile N°/N° de télécopieur : (867)669-4940

Sender's Name/Nom de l'expéditeur : Paul Donnelly

Telephone N°/N° de téléphone : (867) 669-4920

Subject/Sujet :

Name/Nom	Organization/Organisation	Facsimile N°/ N° de télécopieur
Eddie Smith	NWT Power Corporation	867-874-5286

REMARKS:

☒ Urgent ☐ For your information / Pour votre information ☐ Action / Faire le nécessaire ☐ As requested / À votre demande

PLEASE SEE THE ATTACHED 3 PAGES.

Fisheries and Oceans / Pêches et Océans

Fisheries and Oceans Canada
Conservation and Protection
101- 5204 – 50th Avenue
Yellowknife, NT X1A 1E2

Our file / Votre référence
YK-06- 15

INSPECTOR'S DIRECTION

Pursuant to Section 38(6) of the Fisheries Act

September 12, 2006

To:
The Northwest Territories
Power Corporation,
4 Capitol Drive
Hay River, NT
X0E 1G2
Fax: 867-874-5286

Attention: Edward Smith

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On September 5th 2006, DFO staff met on site with NWT Power staff Edward Smith, and Steven Clark and Francisco Perello of Keystone Environmental. It was observed that the measures taken were not satisfactory to prevent continued deposit of sediment into Strutt Lake. Therefore:

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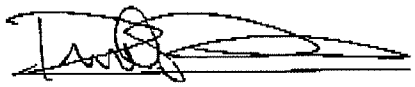
Name of Inspector Designated under *Section 38 of the Fisheries Act*

Paul Donnelly
Fishery Officer/Habitat Inspector
Fisheries and Oceans Canada
Conservation and Protection
Western Arctic Area, Yellowknife, NT
Phone: 867-669-4920

Signature of Habitat Inspector:



NOTES:

1) ***Compliance with this order does not preclude any legal action this department may take with respect to this matter.***
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Appendix C

Photographs

Photograph 1: View from Dyke No. 1 into Upper Reach

Photograph 2: View of Upper Reach from Silt Curtain #1

Photograph 3: View of Upper Reach from Rock Cascade (Silt Curtain #2)

Photograph 4: View into Lower Reach from Rock Cascade

Photograph 5: View of Lower Reach and Rock Cascade

Photograph 6: View of Lower Reach

Photograph 7: View of Lower Reach

Photograph 8: View of Lower Reach towards Strutt Lake

Photograph 9: Channel mouth, view towards Strutt Lake

Photograph 10: View of Lower Reach from Strutt Lake

Photograph 11: View into Lower Reach from Strutt Lake

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Monday, October 30, 2006 5:07 PM
To: permits@mvlwb.com
Subject: FW: Snare Forks Channel Work Plan - Sept. 25 to 28, 2006

N1L4-0150 - Snare Forks weir breach update

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Friday, September 22, 2006 2:38 PM
To: DonnellyP@DFO-MPO.GC.CA
Cc: WatsonE@DFO-MPO.GC.CA; fillatreg@DFO-MPO.GC.CA; Robert Schmidt; Brian Willows; Judith Goucher; ewatson@theedge.ca; stewarts@inac.gc.ca; Baines, Sarah
Subject: Snare Forks Channel Work Plan - Sept. 25 to 28, 2006

Hi Paul,

A team of 10 (5 Keystone personnel, 4 labourers, and I) will be onsite at the Snare Forks Channel from September 25 to 28, 2006 to install sediment mitigation and erosion control measures. This includes the installation of additional silt curtains, maintenance of the existing silt curtains, the installation of silt fencing along the channel banks, and the installation of erosion control mats on the channel banks. We will ensure that the sediment and erosion control measures are installed correctly and are functioning as intended to minimize the deposit of sediment into Strutt Lake.

We are concerned with the term in the September 12, 2006 Inspector's Direction that suggests NTPC must "Prevent any sediment laden water from entering the Strutt Lake." The expectation to prevent any sediment from entering Strutt Lake is likely impossible to meet, certainly within the time frame specified in the Direction (by September 29, 2006) and is not consistent with the requirement for reasonable measures consistent with safety and conservation. The work we will be doing represents reasonable measures to deal with the issues identified and we will be proceeding to install them as part of a phased approach. The *Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan* will be completed and forwarded to you for comment shortly.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Monday, October 30, 2006 5:01 PM
To: permits@mvlwb.com
Subject: FW: Snare Forks Channel Works Update - Sept. 25 to 28, 2006

N1L4-0150 - weir breach update

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Thursday, October 05, 2006 2:01 PM
To: DonnellyP@DFO-MPO.GC.CA
Cc: WatsonE@DFO-MPO.GC.CA; stewarts@inac.gc.ca; Baines, Sarah; Robert Schmidt; Brian Willows; Judith Goucher
Subject: RE: Snare Forks Channel Works Update - Sept. 25 to 28, 2006

Hi Paul,

Thank you for your email and the advice that NTPC has met the terms of the Inspector's Direction. As you can see from the pictures in the Tuesday, September 03, 2006 email report we have put a great deal of work into the project. I spoke with Ernie Watson this morning who advised me that since DFO is satisfied that NTPC has met the Inspector's Direction you will no longer be travelling to the site tomorrow for an inspection. If you do plan to travel to site in the future I would appreciate if you would you advise me in advance, if possible, so I can attend with you.

In an earlier conversation with Ernie he indicated that he had reviewed and was satisfied with the *Snare Forks Breach Channel Mitigation Feasibility Study and Action Plan* submitted to DFO on September 02, 2006. We discussed NTPC's plans to deal with the permafrost degradation at the channel elbow and our intention to access these banks with heavy equipment over the rock cascade once the channel freezes. This sedimentation source is one of the main conditions making the prevention of any sediment laden water from reaching the lake impossible. I understand that both you and Ernie are satisfied with the Action Plan and with the works completed at site to meet the terms of the Inspector's Direction, however if you have specific comments please forward them to me by email or letter. I will continue to keep you posted as developments take place.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

From: DonnellyP@DFO-MPO.GC.CA [mailto:DonnellyP@DFO-MPO.GC.CA]
Sent: Wednesday, October 04, 2006 4:31 PM
To: Edward Smith
Subject: RE: Snare Forks Channel Works Update - Sept. 25 to 28, 2006

Good Afternoon Eddie,

Based on the pictures and the descriptions of the sediment and erosion control measures at Snare Forks sent on Tuesday October 3rd 2006, I believe the conditions set out in the inspector's direction sent to you on September 12th 2006 have been satisfied. I appreciate your continued cooperation in this matter and look forward to the implementation of the long term measures to stabilize the channel set out in the feasibility study. Thanks again,

Paul Donnelly

Fishery Officer
Fisheries & Oceans Canada
101, 5204-50th Ave,
Conservation & Protection
Western Arctic Area
Yellowknife, NT X1A 1E2
Tel: (867) 669-4920
Fax:(867) 669-4940

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Tuesday, October 03, 2006 4:41 PM
To: DonnellyP@DFO-MPO.GC.CA
Cc: WatsonE@DFO-MPO.GC.CA; fillatreg@dfo-mpo.gc.ca; stewarts@inac.gc.ca; Baines, Sarah; Brian Willows; Robert Schmidt; Judith Goucher
Subject: Snare Forks Channel Works Update - Sept. 25 to 28, 2006

Good morning Paul,

On Monday, September 25 five Keystone Environmental technicians and I travelled to the Snare Forks Channel with four labourers. The next 3.5 days were spent installing the following sedimentation mitigation and erosion control measures:

- At the midpoint of the upper reach a gravel bar had formed due to the breach that was directing water towards the west bank through a narrow side-channel. This caused erosion of the exposed bank and the mobilization of sediment to areas downstream of this location. Rocks were relocated by hand from the center of the gravel bar to the opening of the side-channel to prevent flow along the exposed bank and to allow for increased flow towards the center of the main channel. A rock berm was added at the downstream side of the gravel bar to redirect flow away from the edge of the downstream silt curtain, to prevent overflow during periods of heavy runoff, and to encourage ponding and settling of suspended sediment on the upstream side of the silt curtains at this location. The water now flows among the rocks on the central portion of the channel at this location and there is no fast moving water in the upper reach of the Snare Forks Channel in contact with the banks. This measure eliminates one of the main sources of sedimentation in the upper reach (see photos 1, 2).

- Silt fencing was installed along the stable, exposed banks in both the upper and lower reaches of the channel from Dyke 1 to Strutt Lake. Fencing is held in place by 3 foot wooden stakes and was installed by digging a trench and anchoring the bottom edge of the geotextile fabric within the trench with native soil. The silt fencing is designed and was installed in such a manner as to intercept small land slide or sloughing events and to reduce surface runoff. Accessible exposed banks within the upper reach were lined with silt fencing. The area opposite the rock cascade was lined with silt fencing and the remainder of the accessible and stable slopes within the lower reach were also lined with silt fencing. The gravel bar at the outfall to Strutt Lake was lined with silt fencing to help reduce/contain sediment inputs from wave action and surface runoff at this location (see photos 3 - 7).

- Erosion control matting was installed on relatively flat areas consisting of exposed silt and mud to help mitigate erosion of these areas and act to reduce sediment laden inputs of surface runoff. The biodegradable mats are constructed of a fine coconut weave and are proven to be effective in this application. These were installed in suitable locations within both the upper and lower reaches of the channel (see photos 3 - 7).

- Existing silt curtains in both the upper and lower reaches of the channel were checked and maintained as needed to ensure functionality.

- Ten new silt curtains were installed in the lower reach of the channel to slow and filter the water flowing through the channel. The curtains were installed in a manner designed to reduce the flow

velocity of water within the lower reach, to encourage settling, and to allow for limited filtration of the water through the curtains. It is anticipated that the water level in the lower reach will fluctuate with the level of Strutt Lake by up to 1 meter, and this has been provided for through the installation of silt curtains with depth enough to deal with the maximum depth of the channel (see photos 8, 9).

- Two filter berms were constructed near the base of the rock cascade to filter or help retain sediment laden groundwater that has collected in the area opposite the rock cascade and is discharging to the main channel near the bottom of the falls. The upstream berm (Filter Berm 1) was constructed by digging a trench perpendicular to the flow, anchoring a silt curtain within the trench, and supporting and anchoring the back-side of the curtain with a rock berm. The groundwater flowing from this area appears to pond in front of this berm. A second berm (Filter Berm 2) was constructed downstream of the first using sand bags filled with a mixture of sand, gravel and smaller crushed rock. These sand bags were placed within the channel in an attempt to slow the flow and encourage filtration of the runoff through the sand bags and settlement of suspended sediment upstream of the berm (see photos 10, 11).

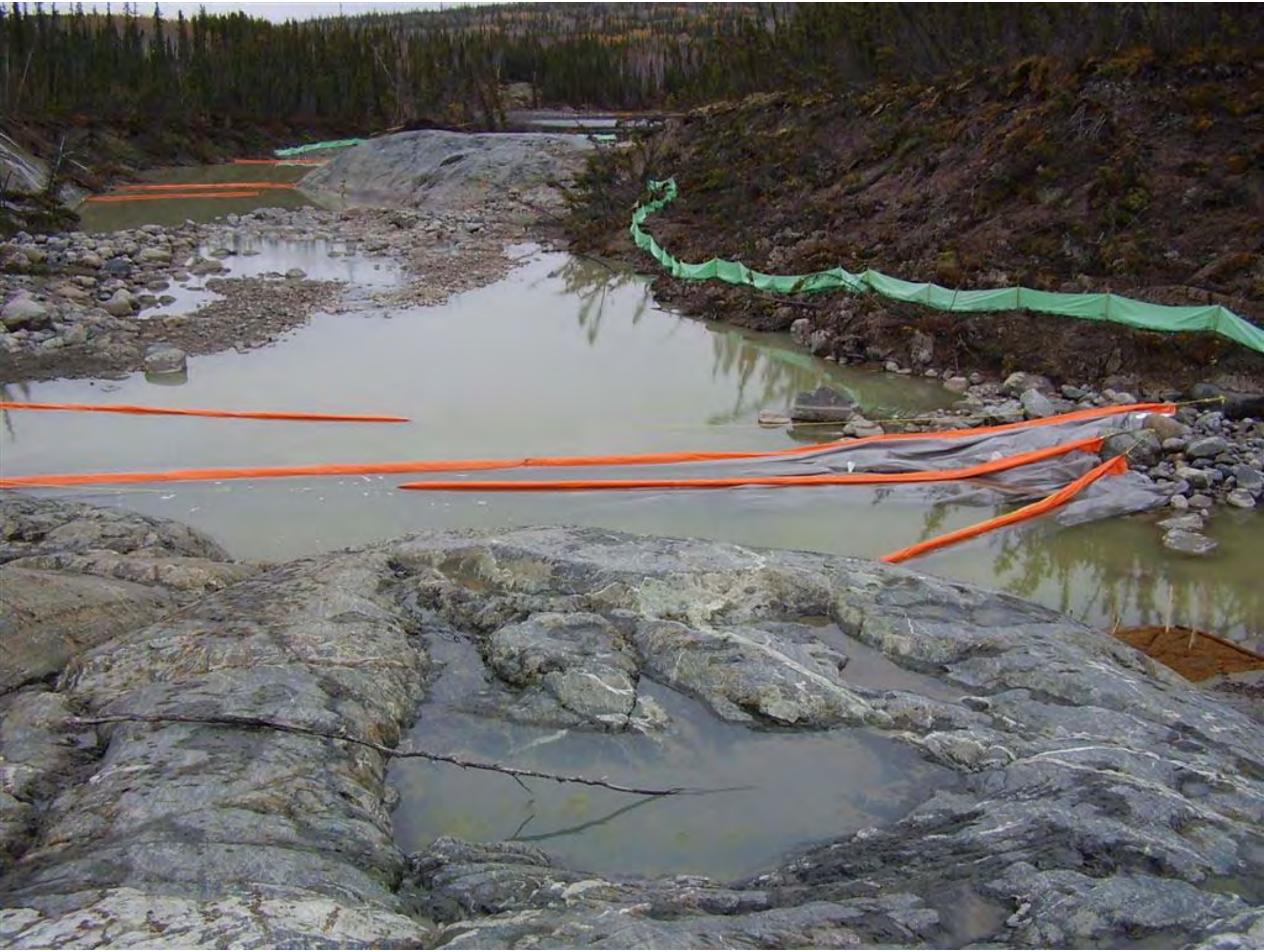
If there are any questions or comments, please feel free to contact me.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286


29 11:12


29 10:58



Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Wednesday, September 13, 2006 9:51 AM
To: permits@mvlwb.com
Subject: FW: Snare Forks Freeboard Dyke 1 Breach Report - August 2006

N1L4-0150

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Wednesday, August 30, 2006 1:43 PM
To: Patty Ewaschuk
Cc: Norm McBride; Randy Patrick; Ken Dies; Judith Goucher; Brian Willows; stewarts@inac.gc.ca; Baines, Sarah; Leon Courneya
Subject: Snare Forks Freeboard Dyke 1 Breach Report - August 2006

Good afternoon Patty,

Attached is NTPC's report on the June 15 Snare Forks dyke breach detailing the events prior to and following the breach. The report includes the amounts of rock and fill material used in the closure groyne under the emergency authorization provided by INAC.

If you have any questions or concerns please let me know.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

NORTHWEST TERRITORIES
POWER
CORPORATION

Snare Forks
Freeboard Dyke 1 Breach
June 15, 2006

EXECUTIVE SUMMARY

On June 15, 2006 a section of Snare Forks Dyke 1 was washed away by waters from the Snare Forks forebay. The Northwest Territories Power Corporation (NTPC) assembled an Emergency Response Team immediately upon discovery of the breach and hastened to mobilize personnel and equipment for the emergency.

Crews already onsite for scheduled maintenance of the dyke began placing rock in the breach to form a closure groyne. All appropriate regulatory bodies and surrounding community governments were notified of the event and kept apprised of the situation as progress was made.

Work on the groyne proceeded from June 16 to June 28 when closure of the breach was achieved. Crews then focussed on reducing the flow through the dyke by placing granular material and riprap on the upstream face of the dyke. Work on the dyke is ongoing and is expected to be complete in September, 2006.

During the repair period NTPC kept in regular communication with the Community of Behchoko to ensure they were aware of the breach and the efforts made to close it and that the breach did not negatively impact the community.

NTPC has worked closely with both Indian and Northern Affairs Canada and the Department of Fisheries and Oceans to ensure environmental obligations and responsibilities are met. Mitigation measures of the downstream effects of the breach are currently underway and include sedimentation reduction and periodic water quality monitoring which includes Behchoko drinking water.

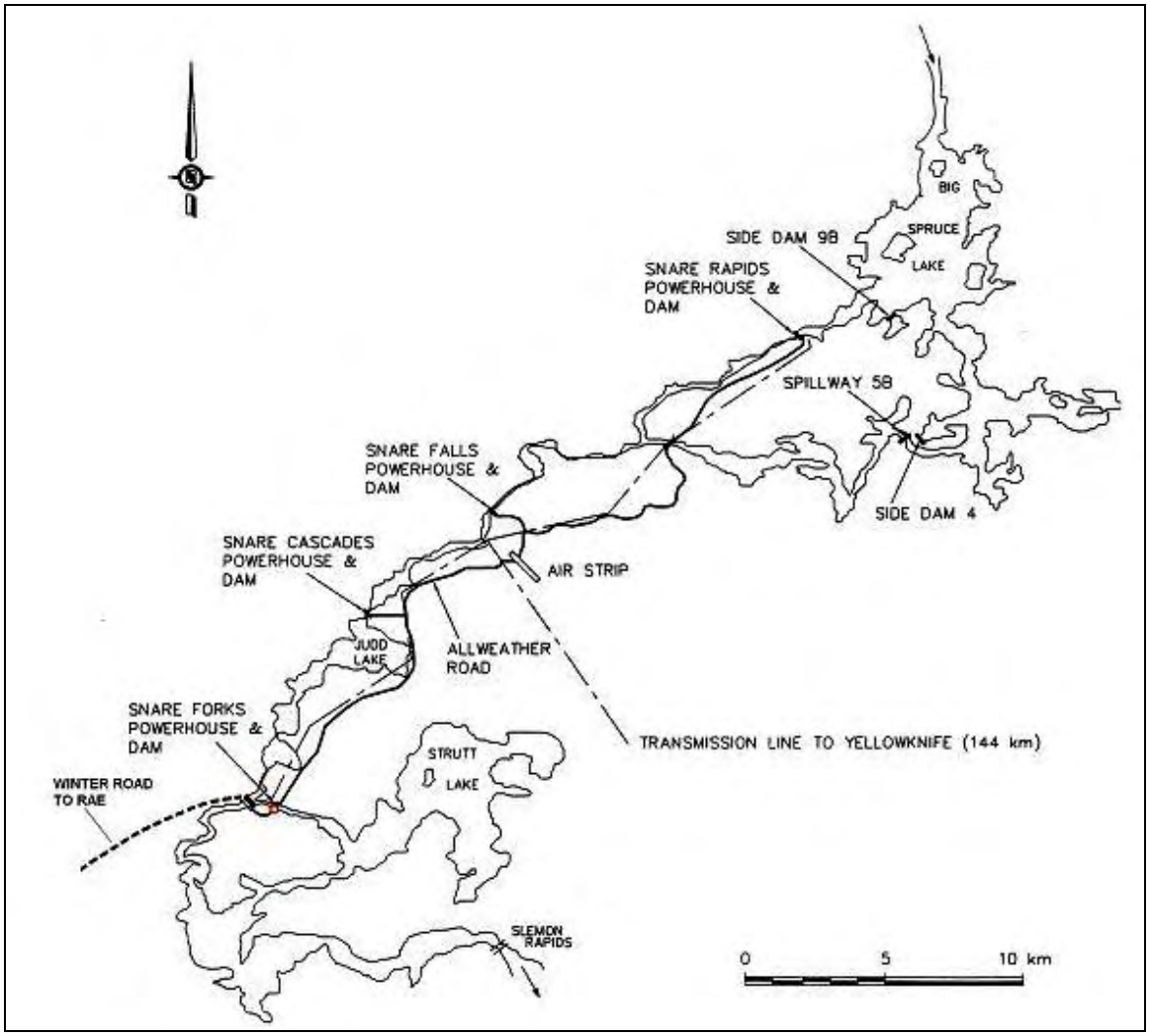
INTRODUCTION

This report is to comply with Water Licence N1L4-0150 which states the following:

> *Part E, Item 6*: The Licensee shall implement the Emergency Preparedness Plan and notify an Inspector immediately should a failure of any of the structures associated with the Power Generation Facility occur, or seem likely to occur, which would result in an uncontrolled release of water.
>
> *Part E, Item 7*: The Licensee shall provide the Board with detailed written reports of each event referred to in Part E, Item 6. These reports shall be submitted to the Board not later than thirty (30) days after the event has terminated.

Dyke 1 breached on June 15, 2006 and was closed on June 28. Further repair of the dyke continued until July 30. Although some additional work is required, for the purposes of this report the breach event is considered terminated as of July 31, 2006.

Figure 1: Snare Hydro System



GEOGRAPHIC SETTING

The Snare Hydro system is located approximately 144 km north-northwest of Yellowknife, NT on the Lower Snare River. The system is a cascade type development comprised of four hydro plants: Snare Rapids, Snare Falls, Snare Cascades, and Snare Forks. The 63.3 m difference in elevation between the Big Spruce Reservoir (located above Snare Rapids Generating Station (GS)) and Strutt Lake (located below Snare Forks GS) is used for electric power production. The drainage area supplying the Snare Rapids GS/Big Spruce Reservoir is 15,200 km^2 producing a mean annual flow of 48.3 m^3/s. The incremental drainage areas intercepted by each of the three downstream plants are minimal and produce negligible increases to the flow as measured at Snare Rapids.

The Big Spruce Reservoir is a medium sized reservoir with a maximum surface area of 130 km^2. When full, the Big Spruce Reservoir has a live storage volume of 546 million m^3 between the full supply level (elevation) of 222.3 m and the low supply level of 217.9 m. This volume is sufficient to provide flow regulation on an annual cycle, but too small to support multi-year regulation. Storage volumes in the forebay reservoir of the downstream plants are relatively limited; sufficient for daily regulation at Snare Falls and Snare Forks but too small for any practical regulation at Snare Cascades. Rated plant capacities in Megawatts (MW) are as follows:

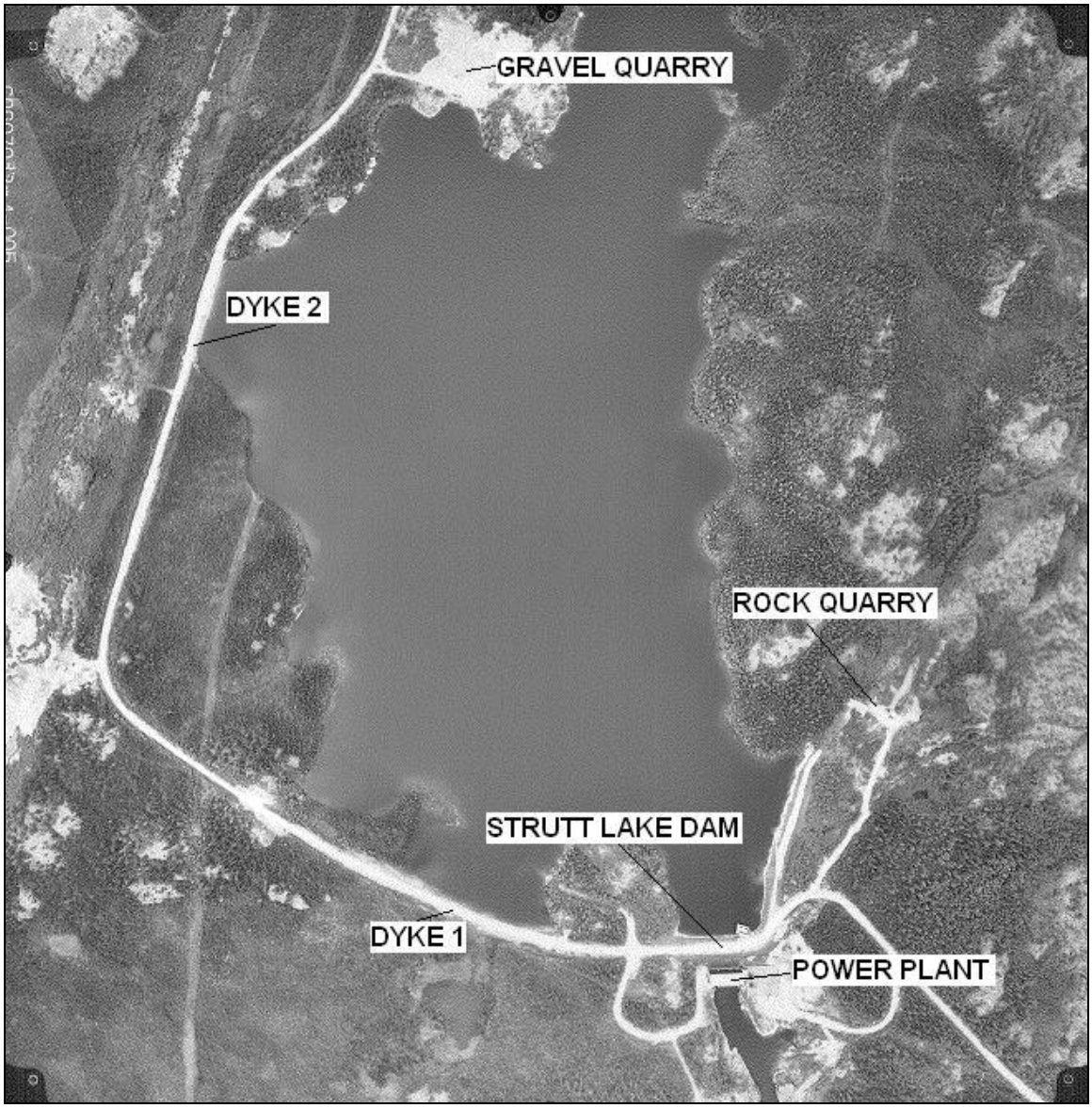
Snare Rapids:	8.5 MW
Snare Falls:	7.4 MW
Snare Cascades:	4.3 MW
Snare Forks:	9.2 MW

The Snare Hydro System is connected to Yellowknife by a 144 km long transmission line operating at a voltage of 115 kV. Other communities served by the system include Ft. Rae and Edzo from a 115 kV, 39 km long tie line and Dettah via a 6.9 kV, 11 km long feeder off the Bluefish transmission tie line, which connects the Bluefish GS to the Snare Yellowknife system. Currently the Snare Hydro system supplies 60% of the capacity and 80% of the energy requirements of the Yellowknife market.

The geographic locations of the Snare Hydro plants are as follows:

Snare Rapids GS	Latitude	63^0 31’ N
	Longitude	116^0 00’ W
Snare Falls GS	Latitude	63^0 26’ N
	Longitude	116^0 11’ W
Snare Cascades GS	Latitude	63^0 25’ N
	Longitude	116^0 13’ W
Snare Forks GS	Latitude	63^0 20’ N
	Longitude	116^0 20’ W

Figure 2: Aerial View of Snare Forks Hydro Development



DESCRIPTION OF SNARE FORKS GENERATING STATION

The Snare Forks GS is located 10 km downstream of Snare Cascades. It is the plant furthest downstream in the cascade and discharges into Strutt Lake. The Plant has been in service since 1976.

The design of this plant takes advantage of the natural topographic features of the site, namely the fork in the Snare River where the river splits around an island. The powerhouse is located in the south channel at the toe of the Strutt Lake Dam while the spillway is adjacent to the west channel of the Snare River into which it discharges. The Snare Forks Forebay Reservoir is contained by the Strutt Lake Dam, the Snare Forks

Dam, three freeboard dykes (Dykes 1, 2, and 3) and the spillway weir, and floods back to the tailrace of the Snare Cascades GS. Both the Snare Forks Dam and the Strutt Lake Dam are conventional rock fill dams with sloping impervious cores of glacial till. Under normal operating conditions there is no water against the face of the freeboard dykes except for occasional small, wind-driven waves.

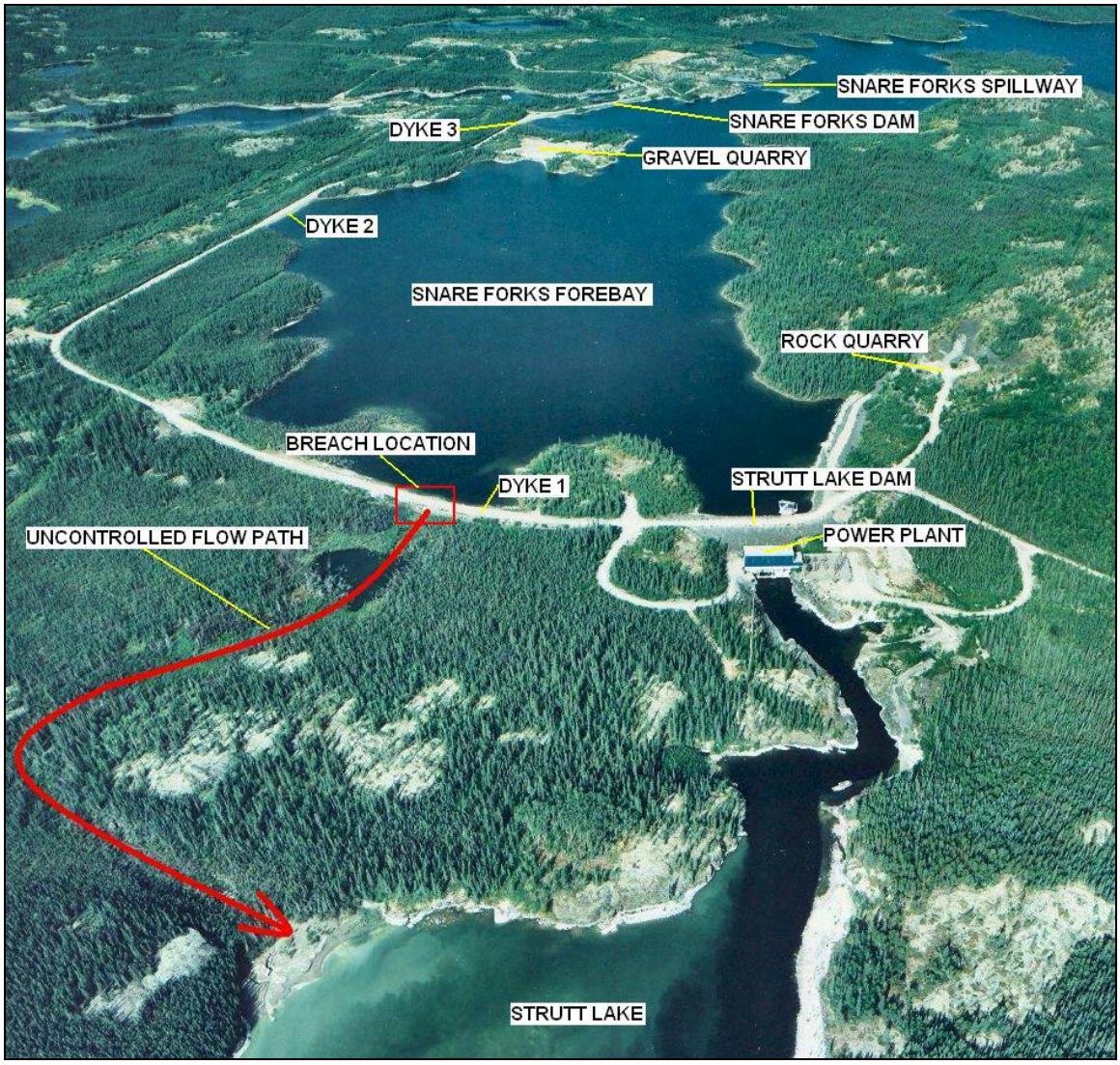
Snare Forks powerhouse contains two generating units each rated at 4.6 MW. These units were originally located at Ontario Hydro's Notch GS on the Montreal River, Ontario. They were purchased and rebuilt to suit the head and flow conditions at Snare Forks. The main parameters of the Snare Forks GS are below:

Forebay Reservoir	
Full Supply Level (FSL):	173.7 m
Low Supply Level (LSL):	173.1 m
Surface Area:	6.7 km^2
Live Storage:	4.0 million m^3
Overflow Spillway	
Length:	100.0 m
Sill Elevation:	173.7 m
Strutt Lake Dam	
Length:	160.0 m
Max. Height:	18.0 m
Snare Forks Dam	
Length:	105.0 m
Max. Height:	10.0 m
Forebay Containment Dykes 1, 2, 3	
Low Earth Fill Structures:	2 to 3 m in height
Powerhouse	
Rated Gross Head:	14.3 m
Rated Plant Output:	9.2 MW (2 x 4.6 MW units)
Flow at FSL (units at full load):	82.0 m^3/s
Average Annual Energy Output:	41.2 GWh

EVENTS LEADING TO BREACH

On June 13, 2006 the elevation of the Snare Rapids reservoir was 222.27 m. NTPC was spilling 161 m^3/s from the 5B spillway and logs were pulled to increase the spill flow to 269 m^3/s. That afternoon the Snare operator reported that Dyke 1 at Snare Forks had eight to ten inches of freeboard. The forebay level at Snare Forks was 174.5 m and the spillway was passing 198 m^3/s. It was decided to send in personnel to top up the dyke. On June 14 three contract heavy equipment operators were contacted and notified of the dyke topping to be done at Snare Forks. On June 15 a charter plane was arranged for 09:00 to transport the equipment operators to Snare. The flight was delayed and did not arrive until 12:00. Upon arrival the equipment operators received a site orientation and readied their equipment.

Figure 3: Dyke 1 Breach Discharge Route



BREACH EVENT

On June 15, 2006 at 15:20 the Snare operator reported that Dyke 1 at Snare Forks had been breached by water and a section of the dyke approximately 12.0 m wide by 4.5 m deep had washed away. The water travelled through the breach and passed through a forested area, re-entering the Snare River system in Strutt Lake and forming a channel approximately 500 m long.

The Snare Forks reservoir level at the time of the June 15 breach was 174.0 m. By June 23 the reservoir had stabilized at 174.3 m. On June 23 the flows passing the Forks development consisted of 90 m^3/sec at the overflow spillway, 82 m^3/sec through the powerhouse units and 97 m^3/sec through the breach. When the breach was closed off on June 28 the reservoir climbed back to 174.7 m with 187 m^3/sec at the overflow spillway and 82 m^3/sec through the powerhouse units.

ONSITE EQUIPMENT AND MATERIALS

Onsite heavy equipment, which includes two dump trucks, one dozer, one loader, one excavator and one grader, is maintained year round for use in maintenance and emergencies.

Fill material available at Snare Hydro includes sand, crushed gravel, and blast rock. At the time of the breach 800 m^3 of blasted rock was available in the Snare Forks rock quarry.

RESPONSE

June 15

- Upon notification at 15:20 of the Snare Forks Dyke 1 breach NTPC assembles an Emergency Response Team (ERT) which meets at 15:45. The ERT meets at least once daily until after breach closure and then continues to meet regularly regarding further dyke work and mitigation measures of downstream effects. The ERT consists of the following individuals:

Leon Courneya	President & CEO
Judith Goucher	Director, Finance & CFO
Al Dube	Director, Engineering & CE
John Locke	Director, IT & CIO
Randy Patrick	Director, North Slave
Brian Willows	Director, Corporate Operations
Paul Campbell	Assistant Director, Hydro Division
Robert Schmidt	Corporate Safety & Environment Manager
Norm McBride	Plant Operations Manager
Greg Haist	Projects Manager
Ken Dies	System Control & Hydro Planning Manager
Rod Gray	Logistics Manager
Cory Strang	Treasurer
Chris Zorica	Marketing & Communications Officer
Colin Stang	Civil Engineer
Lloyd Courage	Consulting Engineer
Edward Smith	Environmental Analyst
Stuart Robinson	Hydro Maintenance Planner
Ginger Lester	Administrative Assistant to CFO

- At 16:30 Colin Stang, Norm McBride and Stuart Robinson travel to Snare by helicopter. They arrive at 17:45 and conduct an aerial inspection, then land and complete a more extensive inspection. The breach has now grown to approximately 30 m.

- A crew starts placing large boulders in the breach using a dump truck, loader and excavator, and makes 1.7 m to 3.4 m of progress by the time Colin, Norm and Stuart arrive.

- Dykes 2 and 3 are inspected and no concerns are noted.

- Colin Stang, P.Eng, NTPC is designated Project Monitor and Site Commander.

- The ERT reconvenes at 19:00, receives reports from onsite personnel. It is determined that two more equipment operators, a mechanic and a geo-technical specialist will be sent to Snare.

- A mechanic travels to Snare that evening to ensure the heavy equipment, although regularly maintained, will be capable of transporting large volumes of rock for an undetermined amount of time.

- The following organizations are contacted:

  GNWT Emergency Measures Organization (EMO)
  Wek'eezhii Land and Water Board (WLWB)
  Indian and Northern Affairs Canada (INAC) (contacted by WLWB as per communication protocol)
  Department of Fisheries and Oceans (DFO) (contacted by EMO as per communication protocol)
  Rae/Edzo Senior Administrative Officer (SAO)

June 16

- Breach is estimated at 40 m wide.

- Equipment operators from Camco Construction Ltd. arrive at Snare. They begin dumping rock into the breach to form a closure groyne.

- Geo-technical specialist Dave Matheson arrives from Calgary to inspect Dyke 1. He believes that the breach can be closed but is concerned that as progress is made on the east bank the west bank will erode. Plans are made to armour the west bank with sand bags to prevent this erosion.

- NTPC Environmental Analyst Eddie Smith contacts INAC, DFO and Environment Canada directly to discuss the breach and arrange a site visit. At 11:00 Water Resource Officer Scott Stewart of INAC and Fisheries Biologist Ernie Watson of DFO accompany Smith to site by helicopter. Photographs of the breach and channel are taken and water is sampled above the breach and in Strutt Lake by INAC. Matheson discusses the dyke with the regulators providing background on the site and the incident, as well as on plans to close the breach.

- Regulators request that NTPC close the breach as quickly as possible rather than allowing water levels in the forebay to recede before beginning the project.

- NWT Rock Services travels to site to assess the quarry in preparation to blast for larger rock.

- Crews have reduced the width of the breach to approximately 26 m.

June 17

- Equipment operators continue to place rock fill with an average diameter of 0.6 m or greater into the breach and continue to make progress with the closure groyne.

- Forty 2000 lb. sand bags are placed by helicopter on the west bank of the breach to prevent erosion. With the west bank armoured the equipment operators are averaging 5 loads per hour and have made 3.1 m of progress.

June 18

- Crews continue to dump rock into breach. The width of breach sits at approximately 20 m and as progress is made the west bank continues to erode.

June 19

- Water erodes underneath and around the sand bags placed on the west bank and they are swept downstream by the current.

- NWT Rock Services discover an existing drill pattern in the quarry from the original 1976 construction eliminating the need to drill. They will instead clean out existing drill holes and blast saving three days of work.

- Although the west bank does erode as the east bank is filled in, it is felt that with a second equipment crew and twenty-four hour filling the breach can be closed.

June 20

- INAC forwards authorization to drill and blast to obtain material to repair the breach under the Mackenzie Valley Landuse Regulations Section 17.

- Keystone Environmental is requested to visit the site and provide professional environmental expertise and advice.

- Work continues on filling the breach and work begins to raise the crest elevation of the dyke using gravel fill.

- At 18:00 the closure groyne is measured at 25 m and the breach at 31 m.

June 21

- Keystone Environmental sends Steve Clark to Yellowknife to travel to site with Eddie Smith.

- DFO personnel - Enforcement Officers Paul Donnelly (lead) and Gerald Fillatre and Fisheries Biologist Ernie Watson visit the site collecting water samples and photographs.

- NTPC, DFO, and Keystone meet on Dyke 1 to discuss the breach, channel, and downstream effects. DFO reiterates the urgency to close the breach as soon as possible.

June 22

- Work continues on hauling, placing, and compacting fill on Dyke 1.
- NWT Rock Services finishes cleaning out the existing drill holes and prepares the quarry for blasting.
- Ongoing repairs to heavy equipment are necessary as the gravel trucks are not made for hauling rock in large volumes on a continual basis.

June 23

- Lloyd Courage arrives at Snare to take over site command duties from Colin Stang.
- NWT Rock Services blast a supply of larger rock from the quarry.
- Round the clock shifts are implemented from June 23 to July 1 to fill the breach and stabilize the dyke.

June 24

- Filling of the breach continues. Rapid erosion of the west bank of the breach is observed overnight.

June 25

- It is decided to change the alignment of the rock fill dyke to the upstream direction to direct the main flow away from the eroding dyke face, as the west bank is eroding too quickly to allow closure.
- As a contingency plan a large helicopter is located that is capable of slinging large rocks to armour the west bank of the breach against erosion.
- A smaller grade of rock fill is used to bring the crest of the dyke to grade.

June 26

- The breach is now approximately 20 m wide and the closure groyne is 41 m long.
- It is decided that the large helicopter will not be needed as clear progress is now being made in closing the breach.
- Work continues to fill the breach.

June 27

- The breach is now approximately 10 m wide.
- Flow is reduced through the Snare Falls spillway to reduce flow through the breach and allow for a final push to close it.

Figure 3 - Snare Forks Breach June 27, 2006

June 28

- The breach is officially closed at 11:00.
- The flow through the dyke is estimated to be 10 m3/s.
- Equipment operators begin placing finer material on the upstream edge of the dyke to reduce the flow of water through the larger rocks of the dyke.
- The low section on the east side of Dyke 2 is topped up.

June 30 to July 14

- Finer materials are placed on the upstream face of the Dyke 1 and the flow through the dyke is reduced to less than 1 m3/s.

July 15 to July 30

- Transition rock/gravel, impervious gravely till and rock riprap wave erosion protection materials are placed on the upstream face of the rock fill section of the dyke to reduce leakage, secure the breach and stop wave action from eroding the finer material used to seal the dyke.
- The road across the crest of Dyke 1 is topped up.

July 31

- All crews working on the dyke depart from Snare.
- Total leakage through Dyke 1 is estimated at 0.03 m3/s (1 cubic foot/second) as observed at the bedrock exposure 250 m downstream of the dyke.

WORK TO BE DONE

When the reservoir level at the Snare Forks facility normalizes (reaches full supply level (FSL) with no spilling through the 5B spillway) the riprap placed on the upstream face of the dyke will have to be reworked and added to, as when the riprap was originally placed water levels were approximately 1 m above normal forebay FSL. The crest of Dyke 1 will be graded 175.78 m and maintained at not less than 175.70 m. Dykes 2 and 3 will be rehabilitated and raised to the same elevation.

ENVIRONMENTAL MONITORING

The NTPC Environmental Department is conducting an ongoing water monitoring program of the Snare system. Sampling locations include the four Snare Hydro forebays (Snare Rapids, Snare Falls, Snare Cascades and Snare Forks), each lake downstream of the dyke breach (Strutt Lake, Slemon Lake, Russell Lake, Marian Lake and Great Slave Lake), and the Fort Rae and Edzo water intakes. Samples were taken June 16, June 24, and July 24 to date and a monthly sampling regimen is currently being followed. Water samples are analyzed for pH, electrical conductivity, solids, turbidity, and metals.

NTPC has also commenced measures to mitigate the movement of further sediment from the new channel into Strutt Lake.

POINTS OF NOTE

- At its largest the breach was approximately 40 m wide.
- It took 14 days to close the breach.
- It took 33 days (June 29 to July 31) to complete the rock placement and construct the upstream blanket consisting of rock spalls, sand & gravel, impervious glacial till and rock riprap wave erosion protection sealing the dyke to approximately 0.03 m^3/sec of leakage flow.
- The approximate quantities of materials used were as follows:
  - Quarry Rock: 7863 m^3 (from quarry east of Strutt Lake Dam)
  - Sand & Gravel: 3870 m^3 (from borrow pit west of Dyke 2)
  - Glacial Till: 6690 m^3 (from borrow pit west of Dyke 2)
- At no point was the Snare Forks reservoir level above the maximum high flow level of 175.26 m.
- At no point was the spill through the Snare Forks spillway beyond the designed capacity of 378 m^3/s.

QUARRY ROCK USAGE

Raise & widen dyke section east of the breach:	186 m^3
Rock fill closure section of breach, 88 m wide:	3675 m^3
Downstream rock toe:	720 m^3
Riprap wave erosion protection (full length of Dyke 1 is 260m):	2607 m^3
Outwash fan (rock washed downstream by the breach flow):	675 m^3
Total quarry rock used:	7863 m^3

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Tuesday, August 29, 2006 10:15 AM
To: permits@mvlwb.com
Subject: FW: Snare Forks Channel Update - August 22, 2006

N1L4-0150 - Snare Forks Channel Update - August 22, 2006

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Tuesday, August 22, 2006 4:28 PM
To: DonnellyP@DFO-MPO.GC.CA
Cc: watsone@DFO-MPO.GC.CA; Robert Schmidt; Brian Willows; Judith Goucher; stewarts@inac.gc.ca; Baines, Sarah
Subject: Snare Forks Channel Update - August 22, 2006

Hi Paul,

As we discussed on Friday here is an update on the sediment mitigation measures implemented in the Snare Forks Channel during my site visit with Keystone on August 15 and 16, 2006. Silt curtains were strategically placed at four locations in the channel. See green lines on Figure 1 for curtain locations as well as attached photographs:

Upper Channel
1) downstream of the narrows
2) upstream of the falls in the upper channel

Lower Channel
3) at the bedrock outcrop
4) at the mouth of the channel

The silt curtains appear to be very well suited to the width, depth, and low flow rate of this channel and are under very little stress from the water flow. The curtains replace the check dams identified in Keystone's preliminary work plan, and the set at the mouth of the channel is an extra measure. A plug was also placed on the rock cascade (see red dot on Figure 1) to prevent water from entering the side channel as identified in the preliminary work plan, however once onsite it was decided that the second plug did not need to be installed.

I look forward to meeting you at site on August 30.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Tuesday, August 29, 2006 10:21 AM
To: permits@mvlwb.com
Subject: FW: Snare Rapids Restoration

N1L4-0150 - DFO position on stabilization of dams post wier breach

-----Original Message-----
From: Patty Ewaschuk [mailto:pewaschuk@wlwb.ca]
Sent: Friday, August 18, 2006 12:03 PM
To: 'Zabey Nevitt'; 'Sarah Baines'
Subject: FW: Snare Rapids Restoration

-----Original Message-----
From: Paula Spencer [mailto:Spencerp@inac-ainc.gc.ca]
Sent: August 18, 2006 9:50 AM
To: pewaschuk@wlwb.ca
Subject: Fwd: Snare Rapids Restoration

>>> <DonnellyP@DFO-MPO.GC.CA> 08/14/06 9:18 AM >>>
Hi Paula,

I am writing to express DFO's current position on the remediation efforts taking place at the NWT Power Snare Rapids Facility. DFO's involvement stems from two sections of the Fisheries Act, Section 35(1) and Section 36(3). Section 35 (1) speaks to the disruption or destruction of fish habitat, while section 36(3) speaks to allowing the deposit of deleterious substances to waters frequented by fish. At the present time, DFO's primary concern is the continued deposit of sediment into the waters downstream of the dam failure that occurred in June. The erosion of a new channel has exposed banks which have the increased risk of movement of sediment material downstream as the permafrost in those banks thaws. NWT Power has proposed a plan to install rock check dams to slow down the flow in this system in order to reduce sedimentation in addition to other intermediate measures such as silt curtains. At the present time DFO is most concerned about getting stabilization measures in prior to winter as a spring freshette could result in a significant amount of material moving into the lakes below and

therefore considers it an emergency situation. In speaking with you on the phone it is my understanding that INAC also considers this an emergency situation and that NWT Power needs to get the site stabilized in the next few months prior to winter. Please confirm that this is also your position and outline any additional concerns you may have.

Thanks,

Paul Donnelly

Fishery Officer

Fisheries & Oceans Canada

101, 5204-50th Ave,

Conservation & Protection

Western Arctic Area

Yellowknife, NT X1A 1E2

Tel: (867) 669-4920

Fax:(867) 669-4940

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Tuesday, August 29, 2006 10:16 AM
To: permits@mvlwb.com
Subject: FW: DFO/NTPC Phone Meeting Summary - August 10th 2006

N1L4-0150 - DFO/NTPC Phone Meeting Summary - August 10th 2006 - weir breach

-----Original Message-----
From: Sarah Baines [mailto:sbaines@mvlwb.com]
Sent: Thursday, August 17, 2006 8:22 AM
To: 'Patty Ewaschuk'
Subject: FW: DFO/NTPC Phone Meeting Summary - August 10th 2006

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Thursday, August 10, 2006 5:23 PM
To: DonnellyP@DFO-MPO.GC.CA; watsone@DFO-MPO.GC.CA
Cc: Brian Willows; Robert Schmidt; Judith Goucher; Baines, Sarah; stewarts@inac.gc.ca
Subject: DFO/NTPC Phone Meeting Summary - August 10th 2006

Hi Paul and Ernie,

Thanks for meeting with me this afternoon. I've summarized our conversation and will discuss these concerns with Keystone.

DFO received and reviewed the work plan for the Snare Forks channel. Since delivery of the plan to DFO tentative changes had been made which I summarized:

- Keystone are now leaning towards using high quality silt curtains in place of the rock check dams: quicker and easier installation, functional in such a low flow system (1 cubic foot/second), will cause less sedimentation during installation, will not require a road to be built immediately.
- Keystone are planning on travelling to site the week of August 14th to install silt curtains.
- Keystone are planning on travelling to site the week of August 28th to conduct feasibility study as outlined in work plan.
- Keystone have recommended June 2007 to begin Phase 2 work as determined by the feasibility study.

DFO had the following concerns with the work plan and new information:

- Will the silt curtains be a suitable replacement for the rock check dams? They are a good interim measure, but will they "blow out" in the spring?
- If installing the silt curtains in place of the dams, there should be a contingency in the plan for check dams in case there are problems with the curtains.
- Check dams may be more permanent than silt curtains. NTPC should monitor the efficiency of the curtains and conduct ongoing maintenance and replacement of curtains as required. A permanent solution is preferable to a temporary one.
- The silt curtains must be able to withstand influxes of water (rain events, freshet). Do not want high waters in the spring to wash out the curtains.
- Curtains will have to be anchored and weighted accordingly.
- If check dams are constructed, there is concern with backwater (standing water above dams) causing additional permafrost degradation.
- Proposed dyke at base of channel may be a good idea, but will be scrutinized in the feasibility study.
- Is there any possibility to make Dyke 1 impermeable? NTPC engineering has indicated that this is not a possibility. Keystone has mentioned lining the upstream face to further reduce flows through the dyke, the possibility of which will be examined in the feasibility study.
- DFO would like to conduct a site visit while Keystone is onsite. Ernie Watson is tentatively available for a site visit August 30th, I will remain in touch with Paul Watson regarding the date of this visit.

- The proposed date of August 28th for the feasibility study is acceptable to DFO.
- If Keystone and NTPC are confident that spring break-up will not destroy the mitigation measures in place causing sediment deposition into Strutt Lake, DFO is satisfied with Phase 2 of the work plan being carried out as proposed in June 2007.

NTPC will continue to update DFO as the work plan evolves and will ensure that the sediment filtration measures will be hardy enough to remain in place and effective through rain events and freshet.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Tuesday, August 29, 2006 10:11 AM
To: permits@mvlwb.com
Subject: FW: NTPC-DFO Meeting - July 31, 2006

N1L4-0150 - DFO discussions with NTPC re weir breach

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Monday, July 31, 2006 5:18 PM
To: DonnellyP@DFO-MPO.GC.CA; watsone@DFO-MPO.GC.CA
Cc: stewarts@inac.gc.ca; Baines, Sarah; Robert Schmidt; Brian Willows; Judith Goucher; Colin Stang; fillatreg@DFO-MPO.GC.CA
Subject: NTPC-DFO Meeting - July 31, 2006

Hi Paul and Ernie,

Thank you for your call today, it has provided a great deal of clarification on how we will move forward. Here is a summary of our 2pm telephone conversation on July 31, 2006. Please review and contact me if any changes are required:

The Northwest Territories Power Corporation's (NTPC) first priority with the Snare Falls Dyke Breach was to close the breach in Dyke 1. The breach was closed as of June 28, 2006 and since then work has continued to fortify the dyke to current standards. The current state of Dyke 1 as requested by the Department of Fisheries and Oceans (DFO) is as follows:

> By design this is a semi-permeable dyke, constructed to allow a slight flow of water through. This type of construction is common for freeboard dykes where there is little head against the structure and an impermeable core is not necessary. Dykes 2 and 3 nearby share this design.
>
> Prior to the June 15th 2006 dyke breach there was standing water on the downstream face of Dyke 1 that was filled through the semi-permeable dyke and made its way to Strutt Lake through a small creek. This creek can be seen in aerial photos taken prior to June 15th. The dyke is based on permafrost and is constructed mainly of blast rock with an upstream blanket of gravel and silt to seal the dyke. This upstream blanket is necessary to slow flows through the dyke. This blanket material was specified by professional engineers as it effectively fills the pores in the dyke. The gradation of the blanket is such that no long term sedimentation is expected. The dyke has sufficient freeboard for the inflow design flood. The placement of riprap on the upstream side is to protect the blanket against wave erosion and is the final stage in the construction of the dyke. The majority of this work has been completed; however additional material must be placed below the waterline for when the reservoir is operating at a lower level. Flow through the dyke is currently estimated at 1 cubic foot per second and is not expected to increase. This flow will be monitored.

NTPC will forward an update on Dyke 1 to the Department of Fisheries and Oceans (DFO) including its current condition, construction, stage of development, and the rate of seepage through the dyke.

The work that NTPC did on Dyke 2 did not involve the deposition of any material into the water, only the placement of material on top of the dyke to increase the freeboard. NTPC is aware of the requirement to inform DFO of any work in and around water prior to conducting the work.

NTPC has a monthly water sampling program in place covering the Snare Rapids, Falls, Cascades, and Fork forebays, Strutt, Slemon, Russell, Marian, and Great Slave Lakes, and the Rae and Edzo drinking water intakes and treated water. Sampling results to date show significant drops in metals, dissolved and suspended solids, and turbidity in the areas downstream of the Snare Forks dyke breach. NTPC will continue with the water monitoring program as deemed necessary, as although this is not a requirement by DFO it is a valuable source of information.

Keystone Environmental (Keystone) have reviewed background information on the area and have been to site twice to conduct measurements and assess the effects of the breach. Keystone are prepared to submit mitigation recommendations once NTPC discusses with DFO the areas of immediate concern. This will ensure that NTPC's actions are aligned with DFO's primary concerns. NTPC preferred to receive input from DFO on where to focus mitigation efforts, not on how to conduct these efforts, which will be in Keystone's hands.

DFO's primary concerns are with the further movement of sediment through the new channel into Strutt Lake. This includes sediment entering the channel through the dyke and sediment exiting the channel into Strutt Lake. Stabilization of the channel, slumping of materials, and ongoing permafrost degradation as they contribute to sedimentation are also of high concern. DFO wishes to see immediate and realistic actions taken to provide sediment erosion control over both the short term and long term. NTPC will work with Keystone to prepare an immediate work plan to prevent the ongoing deposit of sediment into downstream areas and submit it to DFO for approval.

DFO will determine the downstream effects of the breach and will then contact NTPC to discuss downstream mitigation measures.

NTPC remains committed to mitigating the effects of the Snare Forks Dyke Breach and will continue to keep an open dialogue with DFO.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: sbaines@mvlwb.com
Sent: Wednesday, August 02, 2006 7:52 AM
To: permits@mvlwb.com
Subject: [Fwd: NTPC-DFO Meeting - July 31, 2006]

untitled-2.htm (10 KB)

N1L4-0150 - Snare Forks weekly update on weir breach

---------- Original Message ----------
Subject: NTPC-DFO Meeting - July 31, 2006
From: "Edward Smith" <ESmith@ntpc.com>
Date: Mon, July 31, 2006 5:17 pm
To: DonnellyP@DFO-MPO.GC.CA
watsone@DFO-MPO.GC.CA
Cc: stewarts@inac.gc.ca
"Baines, Sarah" <sbaines@mvlwb.com>
"Robert Schmidt" <RSchmidt@ntpc.com>
"Brian Willows" <BWillows@ntpc.com>
"Judith Goucher" <JGoucher@ntpc.com>
"Colin Stang" <CStang@ntpc.com>
fillatreg@DFO-MPO.GC.CA

Hi Paul and Ernie,

Thank you for your call today, it has provided a great deal of clarification on how we will move forward. Here is a summary of our 2pm telephone conversation on July 31, 2006. Please review and contact me if any changes are required:

The Northwest Territories Power Corporation's (NTPC) first priority with the Snare Falls Dyke Breach was to close the breach in Dyke 1. The breach was closed as of June 28, 2006 and since then work has continued to fortify the dyke to current standards. The current state of Dyke 1 as requested by the Department of Fisheries and Oceans (DFO) is as follows:

By design this is a semi-permeable dyke, constructed to allow a slight flow of water through. This type of construction is common for freeboard dykes where there is little head against the structure and an impermeable core is not necessary. Dykes 2 and 3 nearby share this design.

Prior to the June 15th 2006 dyke breach there was standing water on the downstream face of Dyke 1 that was filled through the semi-permeable dyke and made its way to Strutt Lake through a small creek. This creek can be seen in aerial photos taken prior to June 15th. The dyke is based on permafrost and is constructed mainly of blast rock with an upstream blanket of gravel and silt to seal the dyke. This upstream blanket is necessary to slow flows through the dyke. This blanket material was specified by professional engineers as it effectively fills the pores in the dyke. The gradation of the blanket is such that no long term sedimentation is expected. The dyke has sufficient freeboard for the inflow design flood. The placement of riprap on the upstream side is to protect the blanket against wave erosion and is the final stage in the construction of the dyke. The majority of this work has been completed; however additional material must be placed below the waterline for when the reservoir is operating at a lower level. Flow through the dyke is currently estimated at 1 cubic foot per second and is not expected to increase. This flow will be monitored.

NTPC will forward an update on Dyke 1 to the Department of Fisheries and Oceans (DFO) including its current condition, construction, stage of development, and the rate of seepage through the dyke.

The work that NTPC did on Dyke 2 did not involve the deposition of any material into the water, only the placement of material on top of the dyke to increase the freeboard. NTPC is aware of the requirement to inform DFO of any work in and around water prior to conducting the work.

NTPC has a monthly water sampling program in place covering the Snare Rapids, Falls, Cascades, and Fork forebays, Strutt, Slemon, Russell, Marian, and Great Slave Lakes, and the Rae and Edzo drinking water intakes and treated water. Sampling results to date show significant drops in metals, dissolved and suspended solids, and turbidity in the areas downstream of the Snare Forks dyke breach. NTPC will continue with the water monitoring program as deemed necessary, as although this is not a requirement by DFO it is a valuable source of information.

Keystone Environmental (Keystone) have reviewed background information on the area and have been to site twice to conduct measurements and assess the effects of the breach. Keystone are prepared to submit mitigation recommendations once NTPC discusses with DFO the areas of immediate concern. This will ensure that NTPC's actions are aligned with DFO's primary concerns. NTPC preferred to receive input from DFO on where to focus mitigation efforts, not on how to conduct these efforts, which will be in Keystone's hands.

DFO's primary concerns are with the further movement of sediment through the new channel into Strutt Lake. This includes sediment entering the channel through the dyke and sediment exiting the channel into Strutt Lake. Stabilization of the channel, slumping of materials, and ongoing permafrost degradation as they contribute to sedimentation are also of high concern. DFO wishes to see immediate and realistic actions taken to provide sediment erosion control over both the short term and long term. NTPC will work with Keystone to prepare an immediate work plan to prevent the ongoing deposit of sediment into downstream areas and submit it to DFO for approval.

DFO will determine the downstream effects of the breach and will then contact NTPC to discuss downstream mitigation measures.

NTPC remains committed to mitigating the effects of the Snare Forks Dyke Breach and will continue to keep an open dialogue with DFO.

Sincerely,

Edward Smith

Environmental Analyst

NWT Power Corporation

Phone: 867-874-5327

Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Wednesday, July 26, 2006 6:18 AM
To: permits@mvlwb.com
Subject: FW: Snare Forks Update: Water Sampling July 24th

N1L4-0150 - weir breach update

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Tuesday, July 25, 2006 5:11 PM
To: donnellyp@dfo-mpo.gc.ca
Cc: watsone@dfo-mpo.gc.ca; fillatreg@dfo-mpo.gc.ca; Robert Schmidt; Brian Willows; Judith Goucher; stewarts@inac.gc.ca; Colin Stang; Sarah Baines
Subject: Snare Forks Update: Water Sampling July 24th

Hi Paul,

On July 20th I travelled to the site of the Snare Forks breach with Steve Clark and Bruce Mattock from Keystone Environmental to assess the effects of the breach.

On July 24th Jayda Robillard (NTPC Environmental Analyst) and I flew by helicopter to Snare Hydro to sample the waters both upstream and downstream of the site of the Snare Forks breach. This was exactly one month after the samples taken in June and the same sampling sites were used as for last month's samples. Samples will be analyzed for metals, total suspended solids, total dissolved solids, pH, electrical conductivity, and turbidity and will provide sufficient date for trend analysis.

As of our Emergency Response Team meeting yesterday flows through Dyke #1 are now at one cubic foot per second.

I will continue to provide updates as required.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Tuesday, July 25, 2006 7:13 AM
To: permits@mvlwb.com
Subject: FW: Snare Forks Update: Site Visit July 20th

N1L4-0150 - weir breach update

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Monday, July 17, 2006 4:28 PM
To: donnellyp@dfo-mpo.gc.ca
Cc: watsone@dfo-mpo.gc.ca; fillatreg@dfo-mpo.gc.ca; Robert Schmidt; Brian Willows; Judith Goucher; stewarts@inac.gc.ca; Colin Stang; Sarah Baines
Subject: Snare Forks Update: Site Visit July 20th

Hi Paul,

Work on Dyke 1 is progressing well and flows are now reduced to acceptable levels for this type of construction. We are mostly done placing the upstream blanket of material on Dyke 1 and will continue to trim slopes and place riprap. This work is expected to be complete within two to three weeks. We will continue to monitor the dyke to ensure the construction is sound and to add further material if required. We are applying for a landuse permit amendment with the Wek'eezhii Land and Water Board so that we can blast more rock material to keep on hand for dyke maintenance. Blasting will take place in late August or September, depending on the length of the permitting process.

Steve Clark and Bruce Mattock from Keystone Environmental will be travelling to Yellowknife on July 20th. I will be travelling with them to the site of the Snare Forks breach later that afternoon (3:30 or 4:00 pm) to observe the new channel now that the flow has subsided to levels typical of the semi-permeable dyke. We will be conducting an improved assessment of conditions in the new channel and the extent of recovery downstream of the dyke and will be refining previously identified mitigation measures based on site observations.

Will you be available Thursday afternoon at 3pm for a brief meeting before we travel to site? I would like to discuss our site visit and make sure we're on the same page as DFO in terms of the data we will be collecting during this visit.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Friday, July 28, 2006 3:36 PM
To: permits@mvlwb.com
Subject: FW: Snare Forks Pictures - July 20, 2006

weekly update of Snare Forks breach repairs - N1L4-0150

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Friday, July 28, 2006 4:27 PM
To: donnellyp@dfo-mpo.gc.ca
Cc: watsone@dfo-mpo.gc.ca; fillatreg@dfo-mpo.gc.ca; Robert Schmidt; Brian Willows; Judith Goucher; stewarts@inac.gc.ca; Colin Stang; Sarah Baines
Subject: Snare Forks Pictures - July 20, 2006

Hi Paul,

As discussed on the phone this afternoon here are a few pictures of the channel taken from my site visit with Keystone on July 20th. As you can see the flow through the channel has been greatly reduced (down to about 1 cubic foot per second) and the sedimentation in Strutt Lake has also been significantly reduced. The photo “SK Dyke” shows the fine material that has been placed on the upstream face of the dyke. This is in the process of being covered by riprap.

Please call if you would like to discuss the photos. As you will not be able to conduct a site visit next week I would prefer to postpone our meeting until you are able to view the site firsthand and witness the current condition of the channel and the downstream areas. At that point we will be better able to discuss the impacts of the breach and DFO’s concerns with the area.

Once you have decided on a date for the site visit please let me know and we can arrange a meeting date.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Friday, July 28, 2006 7:13 AM
To: permits@mvlwb.com
Subject: FW: Snare Forks Update - July 05, 2006

N1L4-0150 - weekly update of Snare Forks breach

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Wednesday, July 05, 2006 4:24 PM
To: donnellyp@dfo-mpo.gc.ca
Cc: stewarts@inac.gc.ca; watsone@dfo-mpo.gc.ca; fillatreg@dfo-mpo.gc.ca; Judith Goucher; Brian Willows; Robert Schmidt; Colin Stang; Baines, Sarah; hornbye@inac.gc.ca
Subject: Snare Forks Update - July 05, 2006

Hi Paul,

Work continued on Dykes #1 and #2 at Snare Forks over the weekend. Crews worked on placing smaller rock on the upstream surface of Dyke #1 to slow the flow of water through the large rock making up the dyke. Flow has been reduced to approximately $5m^3/s$. Crews have also been increasing the freeboard of both dykes. Our Engineering Department will prepare a work plan to complete work on the dykes in the coming weeks.

A second site visit by Keystone Environmental personnel has been tentatively set for July 20th. I will continue to provide updates as significant steps are made. Please contact me if you require further info.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Thursday, July 27, 2006 2:15 PM
To: permits@mvlwb.com
Subject: FW: Snare Forks Update - Breach Closed

N1L4-1050 - weir breach update continued

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Wednesday, June 28, 2006 3:39 PM
To: donnellyp@dfo-mpo.gc.ca
Cc: stewarts@inac.gc.ca; watsone@dfo-mpo.gc.ca; fillatreg@dfo-mpo.gc.ca; Judith Goucher; Brian Willows; Robert Schmidt; Colin Stang; Baines, Sarah
Subject: Snare Forks Update - Breach Closed

Hi Paul,

I am pleased to announce that as of 11:00 the breach on Snare Forks Dyke No.1 was closed. A vehicle can now cross safely and crews are now working on raising the level of the dyke. Some water is still flowing through the rocks that make up the dyke, and our operational efforts will now turn to sealing the upstream surface.

Keystone Environmental will return to site to inspect the area and assess the downstream effects. I will continue to keep you updated on our progress.

Regards,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Thursday, July 27, 2006 2:16 PM
To: permits@mvlwb.com
Subject: FW: Snare Forks Update - June 29, 2006

N1L4-0150 - weir breach update continued

-----Original Message-----
From: Edward Smith [mailto:ESmith@ntpc.com]
Sent: Thursday, June 29, 2006 10:45 AM
To: donnellyp@dfo-mpo.gc.ca
Cc: stewarts@inac.gc.ca; watsone@dfo-mpo.gc.ca; fillatreg@dfo-mpo.gc.ca; Judith Goucher; Brian Willows; Robert Schmidt; Colin Stang; Baines, Sarah
Subject: Snare Forks Update - June 29, 2006

Hi Paul,

As indicated in yesterday's update, the situation with the Snare Forks breach is now under control. I have attached a aerial photograph of the dyke taken on the afternoon of June 28, 2006. Now that the breach is closed NTPC will put its efforts towards properly engineering the next phase of this work, which will involve constructing a semi-pervious blanket on the upstream face of the new rock fill. This work is expected to commence early next week.

The campaign over the last 13 days to close the breach has taken its toll on our personnel and equipment. While we are planning the upcoming work we will be giving the crews a much needed break and taking time for maintenance and repair of the equipment.

I will continue to provide updates as significant developments occur. Please let me know if you have any concerns with this course of action.

Sincerely,

Edward Smith
Environmental Analyst
NWT Power Corporation
Phone: 867-874-5327
Fax: 867-874-5286


28 11:08

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Monday, June 26, 2006 11:24 AM
To: permits@mvlwb.com
Subject: FW: Snare Forks Weir Breach

N1L4-0150 - reporting requirments for weir breach

-----Original Message-----
From: Sarah Baines [mailto:sbaines@mvlwb.com]
Sent: Friday, June 23, 2006 5:06 PM
To: 'Myra Berrub'
Cc: 'Judith Goucher'; 'Zabey Nevitt'
Subject: RE: Snare Forks Weir Breach

Hi Myra,

I spoke with the INAC Inspector, Scott Stewart, and he informed me that he, DFO and Environment Canada are currently looking into the matter. Scott indicated that the WLWB will continue to be copied on any correspondence or communications that may be forthcoming from INAC. The Board requests that NTPC do the same. If this is done, the Board considers NTPC's reporting requirements to the Board on this issue fulfilled.

Regards,
Sarah

-----Original Message-----
From: Myra Berrub [mailto:MBerrub@ntpc.com]
Sent: Friday, June 23, 2006 11:52 AM
To: Sarah Baines
Cc: Judith Goucher
Subject: FW: Snare Forks Weir Breach

Hi Sarah,

As per our discussion yesterday, it is my understanding that NTPC has done our due diligence in reporting the incident of the Snare Forks Weir Breach to you, Regulatory Officer for MVLWB and Week'eezhii Water Board, under the Conditions for water license N1L4-0150. In the event that I do not hear back from you, it is my understanding that you are in agreement with this email.

Regards,
Myra

Myra Berrub, MSc, PEng
Coordinator, Business and Energy Development
NWT Power Corporation
4 Capital Drive
Hay River, NT X0E 1G2
T 867.874.5223
C 867.875.8223
F 866.732.6545

From: Myra Berrub

Sent: Thursday, June 15, 2006 8:40 PM
To: Sarah Baines
Cc: Judith Goucher
Subject: FW: Snare Forks Weir Breach

Hi Sarah,

As required by Water License N1L4-0150 (Snare Rapids, Snare Falls and Snare Forks), by way of this email, I am notifying the MVLWB of a weir breach that occurred today at the Snare Forks hydroelectrical generating station facility. Details of this breach can be found below. As required by the water license, please forward this information to the INAC Inspector.

If there is a need to visit the site, please contact Colin Steed at 867.669.3335. There will be a charter going out first thing Friday morning.

I will contact you as more information becomes available.

Regards,
Myra

From: Judith Goucher
Sent: Thursday, June 15, 2006 8:26 PM
To: Myra Berrub
Cc: Brian Willows
Subject: FW: Snare Forks Weir Breach

Please forward this message to the INAC investigator. Thanks.

From: Brian Willows
Sent: Thursday, June 15, 2006 8:14 PM
To: 'Eric_Bussey@gov.nt.ca'
Cc: Judith Goucher
Subject: Snare Forks Weir Breach

Eric,

Please see below the synopsis from the ERT struck by the Power Corporation regarding a weir breach on the Snare system.

The ERT convened again at 7:00pm tonight to review the photos and speak to the crew sent out to assess the situation.

Based on the crew's assessment, the new estimate for the width of the breach is 100-120ft. A review of the situation indicates there are no other areas of concern. It was however noted that the lake down stream (Strutt Lake) is showing signs of murkiness that is not normally present.

NTPC has contacted a geo-technical specialist who will be onsite mid-morning, Friday, June 16th. Any remedial action will take place after experts review the situation. There is no immediate concern with any down stream stakeholders.

Just to confirm our conversation, I understand per communication protocol that you will contact the Department of Fisheries and Oceans.

I will call to provide an update after our 08:15 ERT meeting scheduled for June 16th.

Thank you,

Brian

Attached is a photo illustrating the impact of a weir breach that occurred this afternoon at Snare Forks hydro plant.

- At 3:20pm, the Central Control Room in YK heard from employees at Snare that the Snare Forks side weir had breached due to high water. This is not the main dam which would have caused flooding of the plant.
- This weir is a road as well (from the power house to the spillway) which means that access to other side weirs and the spillway has been cut off. Water has self-diverted into the bush downstream of the side weir.
- The breach is approximately 40 feet wide and 15 feet deep.
- The breach is a good distance from the plant, so it is felt that it probably won't result in plant flooding.
- There is heavy equipment on site. The operators have been instructed to use large rocks as rip rap to stabilize the one side of the breach.
- Colin Stang, Stuart R. and Norm will be flying out to Snare by helicopter at 4:30 to assess the breach and determine if there are other areas of concern.
- The water levels are very high, and as such, the forebay is full. NTPC has had to spill water for a while due to the high water levels. Reports are that the highest water level may still occur within the next 10 days.

At this time, an Emergency Response team is in place. The next call will take place at 7 pm June 15, 2006 to get a report on the assessment of the situation by the crew that is traveling to Snare by helicopter. Further updates will follow.

Brian K.Willows
Director Corporate Operations
Northwest Territories Power Corporation
Ph. 867-874-5276
Fax. 867-874-5229

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Thursday, June 22, 2006 7:33 AM
To: 'MVLWB'
Subject: FW: Snare Forks Blasting

SNARE_FORKS_BLA
STING_AUTHORIZA.

N1L4-0150 - Inspector authorization of blasting as follow-up to dam breach

-----Original Message-----
From: Scott Stewart [mailto:stewarts@inac-ainc.gc.ca]
Sent: Tuesday, June 20, 2006 10:59 AM
To: watsone@dfo.gc.ca; Anne Wilson; Sarah Baines; Edward Smith; KDies@ntpc.com
Cc: Clint Ambrose; Kenneth Dahl; Ed Hornby; Paula Spencer
Subject: Snare Forks Blasting

Hello,

Please find attached a letter to follow up discussion held at the Snare Forks Hydro facility with respect to emergency blasting to repair a side dam breach. If you have any questions or concerns please contact me.

Scott

Scott Stewart
Water Resource Officer
Indian and Northern Affairs Canada
South Mackenzie District

140 Bristol Avenue
Yellowknife, NT
X1A 3T2
Phone: (867) 669-2764
Fax: (867) 669-2720

Indian and Northern Affairs Canada
#16 Yellowknife Airport **Phone: (867) 669-2764**
Yellowknife, NT X1A 3T2 **Fax: (867) 669-2720**

June 19, 2006

Northwest Territories Power Corporation **N1L4-0150**
P.O. Box 2250
Yellowknife, NT
X1A 2P7

Attention: Ken Dies
Hydro Officer

Re: Emergency drilling and blasting to obtain material to repair side dam breach at the Snare Forks dam.

Dear Mr. Smith;

An Inspection of the water retaining structures at the Snare Forks Hydro facility revealed a breach in a side dam to the east of the Snare Forks Powerhouse and Dam. The dam breach constitutes an emergency under the Mackenzie Valley Land Use Regulations as it threatens the environment immediately downstream. As per discussions at the site of the breach with Northwest Territories Power Corporation (NTPC) personnel and Ernie Watson from the Department of Fisheries and Oceans; all reasonable measures must be taken to prevent continued damage to the downstream environment.

There is a shortage of material on site that is suitable to form a dam. As a result, the dam material must be obtained from an alternate source. The option presented by NTPC staff is to drill and blast the required material. Under the Mackenzie Valley Land Use Regulations Section 17

(1) Notwithstanding any other provisions of these Regulations or the conditions of any permit, where an emergency threatens life, property or the environment, a person may carry out such land-use operations as are neccessary to cope with the emergency.

(2) A person who carries out a land-use operation under subsection (1) shall immediately thereafter send a written report to the board describing the duration, nature and extent of the operation.

Drilling and blasting to obtain material appears to be the most efficient method to obtain the material required to repair the breach. Please provide the Inspector with a map showing the location of the drilling and blasting as well as an estimate of the volume of material that will be required to repair the breach before commencing with blasting. In addition, please ensure that no water body will be impacted by the drilling and blasting.

If you have any questions or concerns please contact me.

Sincerely,

Original Signed By

Scott Stewart
Water Resource Officer
Indian and Northern Affairs Canada
South Mackenzie District
stewarts@inac.gc.ca

cc.

Mackenzie Valley Land and Water Board - Sarah Baines
Department of Fisheries and Oceans - Ernie Watson
Environment Canada - Anne Wilson

Wek'èezhìi Land and Water Board
c/o Mackenzie Valley Land and Water Board
Box 2130
YELLOWKNIFE NT X1A 2P6
Tel: (867) 669-0506
Fax: (867) 873-6610

BRIEFING NOTE

Company: Northwest Territories Power Corporation (NTPC)	
Location: Snare Forks Hydro Site	**Water Licence:** N1L4-0150
Date Prepared: July 4, 2006	**Meeting Date:** July 13, 2006
Subject: Side weir breach	

Purpose of Briefing Note

The purpose of this briefing note is to provide the Board with an update on the breach of the side weir (Dyke #1) at the Snare Forks Hydro Facility (Snare Forks) operated by the Northwest Territories Power Corporation (NTPC).

Description of Breach

The structure that was breached is a side weir on the southwest side of the Snare Forks forebay. The side weirs are used to increase the storage capacity of the forebay and form part of the road from the power plant to the spillway.

The breach was approximately 100-120 feet wide, cutting off access to other side weirs and the spillway. However, the breach occurred well away from the main power plant dam so no plant flooding resulted.

Waters diverted into the surrounding bush and Strutt Lake showed signs of murkiness that is not normally present.

Figure 1: Breach in side weir (Dyke #1)

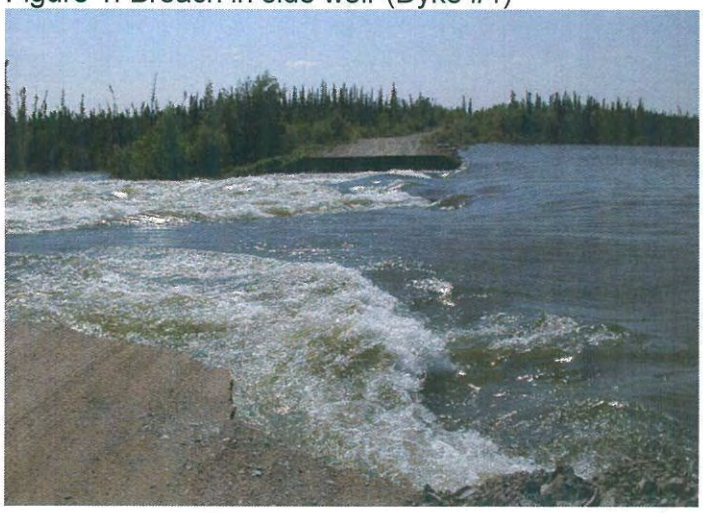
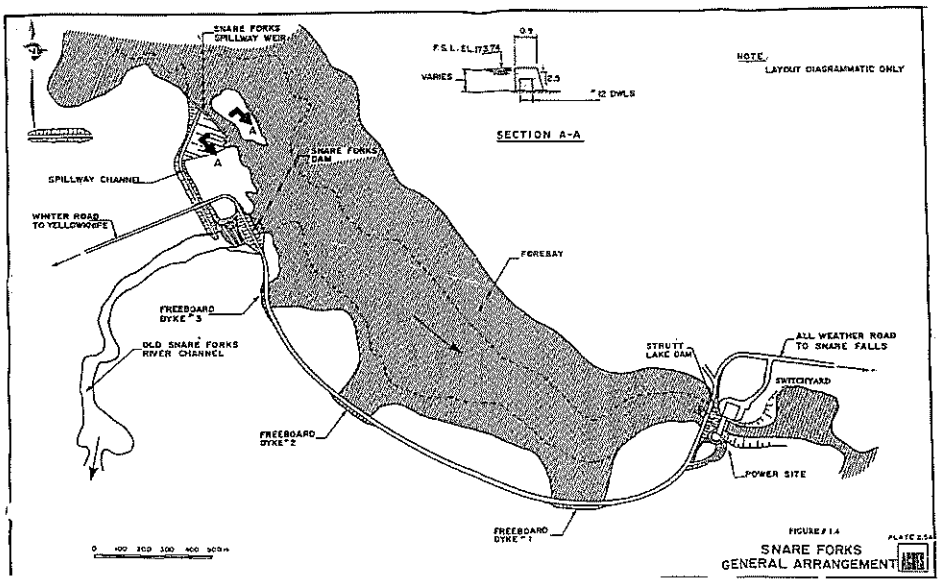


Figure 2: Layout of Snare Forks Hydro Facility



Chronology of Events

**Please note that this summary may be incomplete as it is primarily the Inspector who deals with emergency situations.

June 15, 2006:

- 3:20 pm the Central Control Room in Yellowknife was notified by the employees on site at Snare that the Snare Forks side weir had breached due to high water (the forebay was full).
- Operators were instructed to use the on-site heavy equipment to use large rocks as rip rap to stabilize the one side of the breach.
- 4:30 pm NTPC senior managers flew to the site by helicopter.
- 7:00 pm NTPC emergency response team convened. No other areas of concern, including the safety of downstream stakeholders, were identified.
- 8:40 pm Board staff and the INAC Inspector were notified of the breach. DFO informed as well but time unknown.

June 16, 2006

- Environment Canada and DFO representatives and the INAC Inspector visited the site.
- NTPC brought in a geotechnical expert to review the situation.

June 19, 2006

- INAC Inspector and DFO agree that *"all reasonable measures must be taken to prevent continued damage to the downstream environment."* Therefore, the INAC Inspector authorizes the drilling and blasting of rock from the Snare Forks quarry as there is a shortage of material on site that is suitable to form a dam.

  This quarrying was done under the provisions of section 17 of the Mackenzie Valley Land Use Regulations (MVLUR), which allows land use operations to

proceed without land use permits in emergency situations. Section 17 reads as follows:

> *(1) Notwithstanding any other provisions of these Regulations or the conditions of any permit, where an emergency threatens life, property or the environment, a person may carry out such land-use operations as are necessary to cope with the emergency.*

June 28, 2006

- 11:00 am breach closed. Vehicles safely crossed the weir and crews began raising the level of the weir. Some water still flowed through the rocks that make up the dyke but operational efforts turned to sealing the upstream surface. Granular material required for this sealing will be taken from the pits near the Snare Forks reservoir.

Figure 3: Breach closure

- Return visit by NTPC's independent geotechnical consultants planned for an inspection of the area and an assessment of the downstream effects.

Follow-up and Future Activities

- INAC and DFO will continue to look into the matter to determine if a full investigation is required. Reports will be filed with the Board.
- NTPC, as per section 17 of the MVLUR, will provide a written report describing the duration, nature and extent of the emergency quarrying carried out under the provisions of section 17 once the work is finished.
- NTPC and the Inspector will continue to copy the Board on any correspondence exchanged on this matter.
- Board staff will provide the Board with written updates as necessary.

Respectfully submitted,

S Baines

Sarah Baines
Technical Coordinator, Regulatory Reviews

Indian and Northern Affairs Canada
www.inac.gc.ca

Affaires indiennes et du Nord Canada
www.ainc.gc.ca

Indian and Northern Affairs Canada
#16 Yellowknife Airport
Yellowknife, NT X1A 3T2

Phone: (867) 669-2764
Fax: (867) 669-2720

Your file - Votre référence

Our file - Notre référence

June 19, 2006

N1L4-0150

Wek'èezhìi Land & Water Board
File

JUN 2 7 2006

Northwest Territories Power Corporation
P.O. Box 2250
Yellowknife, NT
X1A 2P7

Application # N1L4-0150
Copied To SB Reg

Attention: Ken Dies
Hydro Officer

Re: Emergency drilling and blasting to obtain material to repair side dam breach at the Snare Forks dam.

Dear Mr. Smith;

An Inspection of the water retaining structures at the Snare Forks Hydro facility revealed a breach in a side dam to the east of the Snare Forks Powerhouse and Dam. The dam breach constitutes an emergency under the Mackenzie Valley Land Use Regulations as it threatens the environment immediately downstream. As per discussions at the site of the breach with Northwest Territories Power Corporation (NTPC) personnel and Ernie Watson from the Department of Fisheries and Oceans; all reasonable measures must be taken to prevent continued damage to the downstream environment.

There is a shortage of material on site that is suitable to form a dam. As a result, the dam material must be obtained from an alternate source. The option presented by NTPC staff is to drill and blast the required material. Under the Mackenzie Valley Land Use Regulations Section 17

(1) Notwithstanding any other provisions of these Regulations or the conditions of any permit, where an emergency threatens life, property or the environment, a person may carry out such land-use operations as are neccessary to cope with the emergency.

(2) A person who carries out a land-use operation under subsection (1) shall immediately thereafter send a written report to the board describing the duration, nature and extent of the operation.

Drilling and blasting to obtain material appears to be the most efficient method to obtain the material required to repair the breach. Please provide the Inspector with a map showing the location of the drilling and blasting as well as an estimate of the volume of material that will be required to repair the breach before commencing with blasting. In addition, please ensure that no

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water body will be impacted by the drilling and blasting.

If you have any questions or concerns please contact me.

Sincerely,

Original Signed By

Scott Stewart
Water Resource Officer
Indian and Northern Affairs Canada
South Mackenzie District
stewarts@inac.gc.ca

cc.

Mackenzie Valley Land and Water Board - Sarah Baines
Department of Fisheries and Oceans - Ernie Watson
Environment Canada - Anne Wilson

Pearl Liske

From: Sarah Baines [sbaines@mvlwb.com]
Sent: Thursday, June 22, 2006 8:52 AM
To: 'MVLWB'
Subject: FW: Snare Forks Weir Breach

N1L4-0150 - NTPC notification of weir breach

-----Original Message-----
From: Myra Berrub [mailto:MBerrub@ntpc.com]
Sent: Friday, June 16, 2006 8:15 AM
To: dahlk@inac-ainc.gc.ca; ambrosec@inac-ainc.gc.ca
Cc: Judith Goucher; Greg Haist; Sarah Baines
Subject: FW: Snare Forks Weir Breach

From: Myra Berrub
Sent: Thursday, June 15, 2006 8:40 PM
To: Sarah Baines
Cc: Judith Goucher
Subject: FW: Snare Forks Weir Breach

Hi Sarah,

As required by Water License N1L4-0150 (Snare Rapids, Snare Falls and Snare Forks), by way of this email, I am notifying the MVLWB of a weir breach that occurred today at the Snare Forks hydroelectrical generating station facility. Details of this breach can be found below. As required by the water license, please forward this information to the INAC Inspector.

If there is a need to visit the site, please contact Colin Steed at 867.669.3335. There will be a charter going out first thing Friday morning.

I will contact you as more information becomes available.

Regards,
Myra

From: Judith Goucher
Sent: Thursday, June 15, 2006 8:26 PM
To: Myra Berrub
Cc: Brian Willows
Subject: FW: Snare Forks Weir Breach

Please forward this message to the INAC investigator. Thanks.

From: Brian Willows
Sent: Thursday, June 15, 2006 8:14 PM
To: 'Eric_Bussey@gov.nt.ca'
Cc: Judith Goucher
Subject: Snare Forks Weir Breach

Eric,

Please see below the synopsis from the ERT struck by the Power Corporation regarding a weir breach on the Snare system.

The ERT convened again at 7:00pm tonight to review the photos and speak to the crew sent out to assess the situation.

Based on the crew's assessment, the new estimate for the width of the breach is 100-120ft. A review of the situation indicates there are no other areas of concern. It was however noted that the lake down stream (Strutt Lake) is showing signs of murkiness that is not normally present.

NTPC has contacted a geo-technical specialist who will be onsite mid-morning, Friday, June 16th. Any remedial action will take place after experts review the situation. There is no immediate concern with any down stream stakeholders.

Just to confirm our conversation, I understand per communication protocol that you will contact the Department of Fisheries and Oceans.

I will call to provide an update after our 08:15 ERT meeting scheduled for June 16th.

Thank you,

Brian

Attached is a photo illustrating the impact of a weir breach that occurred this afternoon at Snare Forks hydro plant.

- At 3:20pm, the Central Control Room in YK heard from employees at Snare that the Snare Forks side weir had breached due to high water. This is not the main dam which would have caused flooding of the plant.
- This weir is a road as well (from the power house to the spillway) which means that access to other side weirs and the spillway has been cut off. Water has self-diverted into the bush downstream of the side weir.
- The breach is approximately 40 feet wide and 15 feet deep.
- The breach is a good distance from the plant, so it is felt that it probably won't result in plant flooding.
- There is heavy equipment on site. The operators have been instructed to use large rocks as rip rap to stabilize the one side of the breach.
- Colin Stang, Stuart R. and Norm will be flying out to Snare by helicopter at 4:30 to assess the breach and determine if there are other areas of concern.
- The water levels are very high, and as such, the forebay is full. NTPC has had to spill water for a while due to the high water levels. Reports are that the highest water level may still occur within the next 10 days.

At this time, an Emergency Response team is in place. The next call will take place at 7 pm June 15, 2006 to get a report on the assessment of the situation by the crew that is traveling to Snare by helicopter. Further updates will follow.

Brian K.Willows
Director Corporate Operations
Northwest Territories Power Corporation
Ph. 867-874-5276
Fax. 867-874-5229