Environmental Assessment Registration Document

Sandy Lake Spillway Storage Increase

March 2011

Prepared By:

Newfoundland Power Inc.

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1. Name of the Undertaking

Sandy Lake Spillway Storage Increase

2. Proponent

(i) Name of Corporate Body: Newfoundland Power Inc.

(ii) Address: P.O. Box 8910, 55 Kenmount Road, St. John's, NL A1B 3P6

(iii) Principal Contact Person:

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3. The Undertaking

3.1. Nature of the Undertaking

Newfoundland Power owns and operates a 5.5 MW Hydroelectric Generating station at Sandy Brook. Sandy Lake is located upstream of the generating station and is the largest storage reservoir in the development. In 2011 we plan on returning the full supply elevation of the lake to historical levels by increasing the spill elevation of the spillway by 1 metre.

In addition to the proposed spillway modifications, Newfoundland Power is proposing the construction of 1.5 kilometres of new access road along with refurbishing a 1.2 kilometres existing unused haul road. This will provide improved site access reducing construction and operating costs.

3.2. Purpose/Rationale/Need for the Undertaking

The Sandy Brook Hydroelectric Development went into service in 1963 and is constructed downstream of Sandy Lake. A spillway on Sandy Lake was first constructed in 1939 by the A.N.D. Company for the purpose of pulpwood transportation. The original timber crib structure was replaced in the early 1950's with another timber crib structure. The use of this structure halted in 1976 because of deterioration. Despite the construction of the plant in 1963, the primary purpose of the reservoir remained the transportation of pulpwood. In 1984 Newfoundland Power rebuilt the spillway for the purpose of storing water for the Sandy Brook Hydroelectric Development.

The intent of the spillway constructed in 1984, was to restore the maximum level of Sandy Lake to its previous value. Our records indicate the new spillway was constructed approximately 1 metre lower than the original structure. This was clearly evident to Newfoundland Power staff as early as 1985 when comparing high water marks. Figure B-6 in Appendix B clearly illustrates the high levels of the reservoir prior to 1976. The average annual spill from the Sandy Brook system is 5.65 GWh. By raising the Sandy Lake Spillway 1 metre, some of this spill is captured, increasing plant production by 0.86 GWh.

4. Description of the Undertaking:

4.1. Geographical Location

The Sandy Lake spillway is located approximately 35 kilometres south-west of Grand Falls-Windsor and is accessible by forestry access roads. The Sandy Brook powerhouse is located 13.5 kilometres west of Grand Falls-Windsor, accessible also by forestry access roads. Maps of the area can be found in Appendix A.

Table 1: Universal Transverse Mercator (UTM) Coordinates:

Location	Easting	Northing
Sandy Lake Spillway	571 200	5 398 100
Sandy Brook Powerhouse	586 300	5 416 000

4.2. Physical Features

The current spillway is constructed with a galvanized metal cutoff wall with a system of impervious, filter and riprap materials providing seepage control and erosion protection. The controlled outlet is a concrete channel with a wooden gate and steel support structure. It is located near the north abutment and is accessed by a steel catwalk.

The primary physical feature of this undertaking is the modifications to the Sandy Lake Spillway. The spillway will be raised 1.0 metre by extending the steel core and raising the embankment accordingly. As a result of the modifications, a new concrete outlet will be required. It will be constructed 14 metres from the existing outlet in the north abutment to allow construction in dry conditions as well as improved safety for the operator.

As a result of the increase in the normal full supply level, approximately 100 hectares of additional land could be flooded during spring runoff. This land was previously flooded in years prior to 1976 when log sluicing ceased at this location. Only limited vegetation has developed in this area.

As part of the project, Newfoundland Power proposes to upgrade and extend an existing access road to Sandy Lake Spillway. 1.5 kilometres of new road will be constructed to connect existing roads and 1.2 kilometres of existing haul road will be upgraded. From Grand Falls-Windsor, the current access route is 78 kilometres and takes approximately 3 hours to travel. The proposed road upgrades will provide a more direct route to the site, reducing travel distance to 44.1 kilometres and travel time to approximately 1 hr. A right of way will be cleared and grubbed through mature forest and a driving surface of 4.0 metre shoulder to shoulder will be constructed with ditching and culverts. The road will remain after construction allowing operations staff to complete their duties more efficiently. Details of the access routes can be found in Appendix A: Figure A-1: Site Access. A plan of the road construction and upgrading can be found in Appendix A: Figure A-2: Access Road Upgrades.

4.3. Construction

The first phase of the project will be the upgrades to the access road. All timber and brush will be cut and cleared from the right of way and all merchantable timber salvaged. The stripped organic material will be piled along the edge of the right of way. Subgrade material will be obtained from cuts and ditches along the road. Drainage culverts will be installed as required. The new section of road crosses no water bodies identified on the 1:50,000. The section to be upgraded crosses one unnamed stream. The existing crossing will be assessed and upgraded if necessary.

The road will be constructed using the same techniques as used in the construction of forestry roads. Most of the construction will be completed with excavators, with dump trucks utilized as required. Construction is scheduled for June 2011, allowing the start of the construction on the spillway site to begin in July 2011.

Modifications to the spillway are expected to take two months. Construction is scheduled for July and August 2011 when water levels and inflows are at their lowest. New outlet construction and raising the spillway crest, starting at the south abutment will proceed simultaneously. The new outlet will be constructed 14 metres north of the existing outlet in the north abutment. The original ground is expected to provide a sufficient cofferdam to allow construction of the new outlet. Flow will be maintained through the existing outlet during construction of the new outlet. After the new outlet is constructed and the cofferdam removed, flow will be maintained through the new outlet.

The raising of the spillway crest will start at the south abutment and progress north toward the outlet. The south extent of the existing cut-off wall will require extension southward by 5.0 metres to ensure the design flood can be passed. This extension will be the full depth and may require a small cofferdam during construction. After the south extension is complete, the existing spillway will be extended upward 1.0 metres from the south extension to the existing outlet. The top 1.0 metres of the spillway will be excavated to allow the connection between the existing steel wall and the extension. It will be backfilled as outlined on the drawings in Appendix D.

After the new outlet has been completed, the old outlet can be removed. The existing cut-off wall between the old outlet and new will be removed and a new section installed from the remaining wall to the new outlet. This work will require a cofferdam. Backfilling will follow as outlined on the drawings in Appendix D.

4.4. Environmental Concerns during Construction

Newfoundland Power has policies and procedures in place to mitigate any environmental risk during construction. All contractor employees working for Newfoundland Power are required to complete Health and Safety and Environmental training dealing with the hazards and risks specific to Newfoundland Power's work environment.

When using heavy equipment, there is always a risk of a spill of petroleum products. Newfoundland Power has policies and procedures in place to minimize this risk. Contractors are expected to have all heavy equipment in good working order and are required to have sealed spill kits on every piece of machinery. Newfoundland Power representatives will be onsite to ensure these regulations are followed.

During construction water levels in the reservoir will be drawn down to the minimal level and the outlet gate will be opened to maintain flows downstream for fisheries. All concrete work will be completed in dry conditions preventing any fresh concrete from getting into the surrounding water body.

All waste materials associated with the project will be removed and disposed of at an approved waste disposal site. All vehicles and equipment will be clean and in good repair, free of mud and oil that could impair surrounding water quality. All backfill materials will be of good quality and free from metals, organics and chemicals that can be harmful to the surrounding waterways. Any areas where siltation may occur will be adequately protected with a filter fabric curtain or similar materials.

Some vegetation removal may be required on the slopes of the spillway as well as a small area beyond the toe of the existing spillway. Small trees will be chipped and piled or burned. Care will be taken to prevent chips or cleared vegetation from entering any water body. Grub material will be placed at an appropriate spoil site and covered with organic material to promote natural re-vegetation.

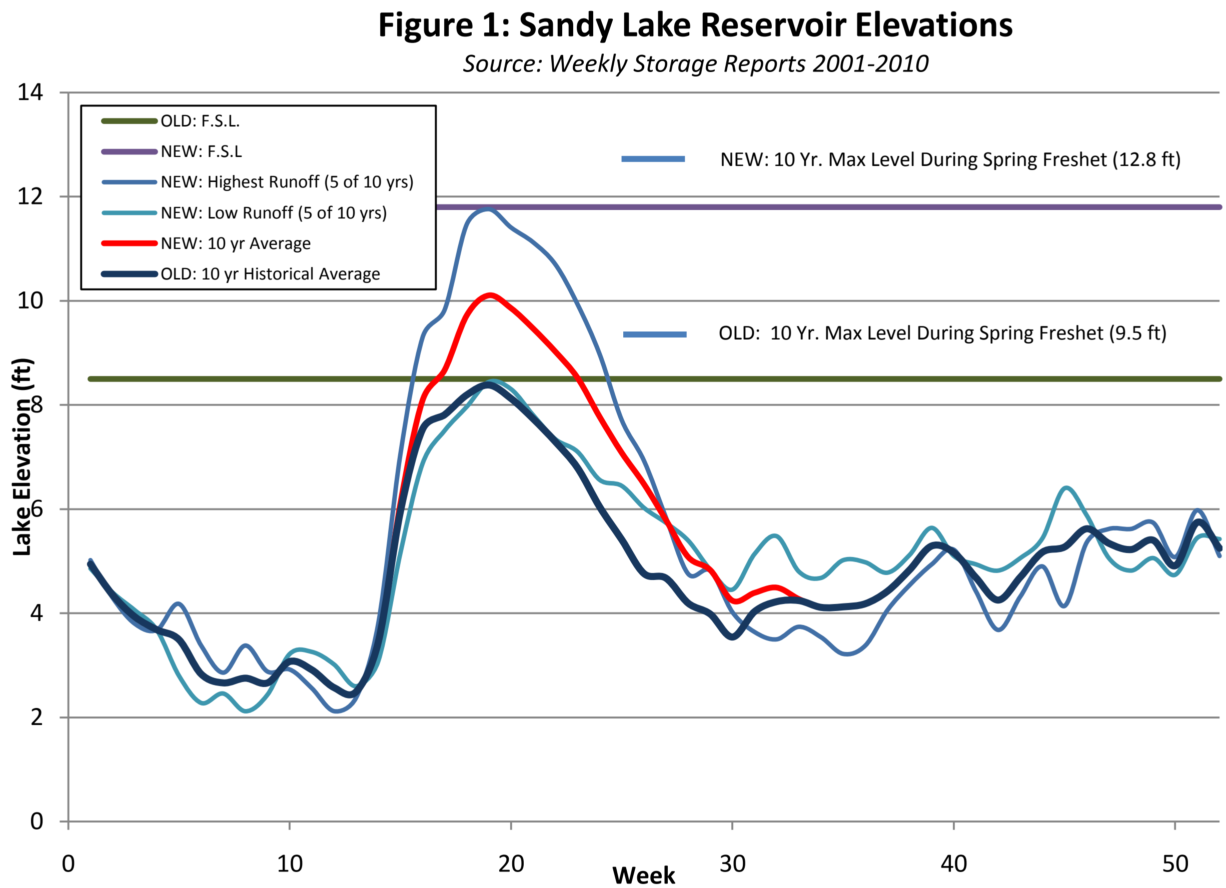
The new outlet will be of similar design to the old outlet and will therefore have similar flow characteristics to the existing spillway after construction is complete. All embankments will be sloped and graded with rock fill so as to prevent erosion.

It is anticipated that the construction activities will be executed with minimal disruption to land, vegetation and surrounding areas. All areas that may be affected will be restored to promote natural regeneration.

4.5. Operation

The spillway has an expected life of 50 years before it will require a major refurbishment. Maintenance activities like brush clearing and riprap repair may be required throughout the life of the structure. As per Newfoundland Power's Dam Safety Policy, operator inspections of the structure will take place quarterly, inspections by engineering staff bi-annually and a thorough review by an independent consultant every 7 years. This will ensure the safety and integrity of the spillway.

As a result of the change in crest elevation of the spillway, the typical reservoir levels will change during some seasons. The raised spillway will capture water that is currently spilled during spring runoff and slowly release that water through the summer. After modifications are complete, the reservoir will be able to fill 1.0 metres higher than the previous full supply level. Based on historical data and the physical modifications, the maximum level of the reservoir may also increase 1.0 metres during the spring freshet. As outlined in Figure 1 below, the new characteristics will only change the normal level of the reservoir from Week 15 (mid-April) to Week 34 (mid-August). On average, water levels will be above the previous full supply level for 6 weeks.



4.6. Occupations

The number of personnel on site during construction will vary throughout the project. The work relating to construction will be procured using invited tenders. The estimated maximum number of employees, by trade along with the estimated hours of work is summarized in Table 2 following.

After construction, no full time employees will be dedicated to the operation of this spillway structure. Newfoundland Power staff will be utilized as required to monitor, operate and inspect the structure.

Table 2: Construction Employment

Labour	Occupation	Max Employed	Est. Hours
Newfoundland Power	Engineer	1	250
	Engineering Technologist	1	600
Contract	Superintendent	1	600
	Logger/Brush Clearers	4	400
	Equipment Operator	4-5	2800
	Truck Driver	2	1200
	Carpenters	3	1200
	Iron Workers	2	800
	Welders	2	400
	Labourers	2	800
	Surveyors	2	50
		Total	7900

4.7. Project Related Documents

4.7.1. Drawings

The following drawings are available in Appendix D

Table 3: Drawing List

Newfoundland Power Drawing #	Title
6-602-21-211	Existing Plan & Details
6-602-21-212	Dam/Spillway Plan, Section and Details

4.7.2. Existing Environmental Work

Fisheries and Oceans Canada requested Newfoundland Power provide additional information concerning the fisheries in this reservoir. A report prepared by AMEC – Earth and Environmental characterizes fish habitat, fish species and surrounding vegetation as well as the Areal extent of Sandy Lake after the modifications are complete. This report is presented in Appendix C.

5. Approval of the Undertaking

The following approvals are required for the project:

- Department of Environment and Conservation: Environmental Assessment Registration
  - Spillway Modification- > 50 hectares Flooded.
  - Access Road > 500 metres from an existing right of way.
- Department of Environment and Conservation: Application for Permit to Alter a Body of Water
- Department of Fisheries and Oceans: Request for Project Review
- Crown Lands – Application for new corridor

6. Schedule

The proposed schedule for the project is as follows.

Table 4: Proposed Schedule

Stage	Timeline
Preliminary Design	Fall 2010
Approvals	Fall 2010/Winter 2011
Detailed Design	Winter 2011
Tendering	May 2011
Road Construction	June 2011
Spillway Construction	July and August 2011

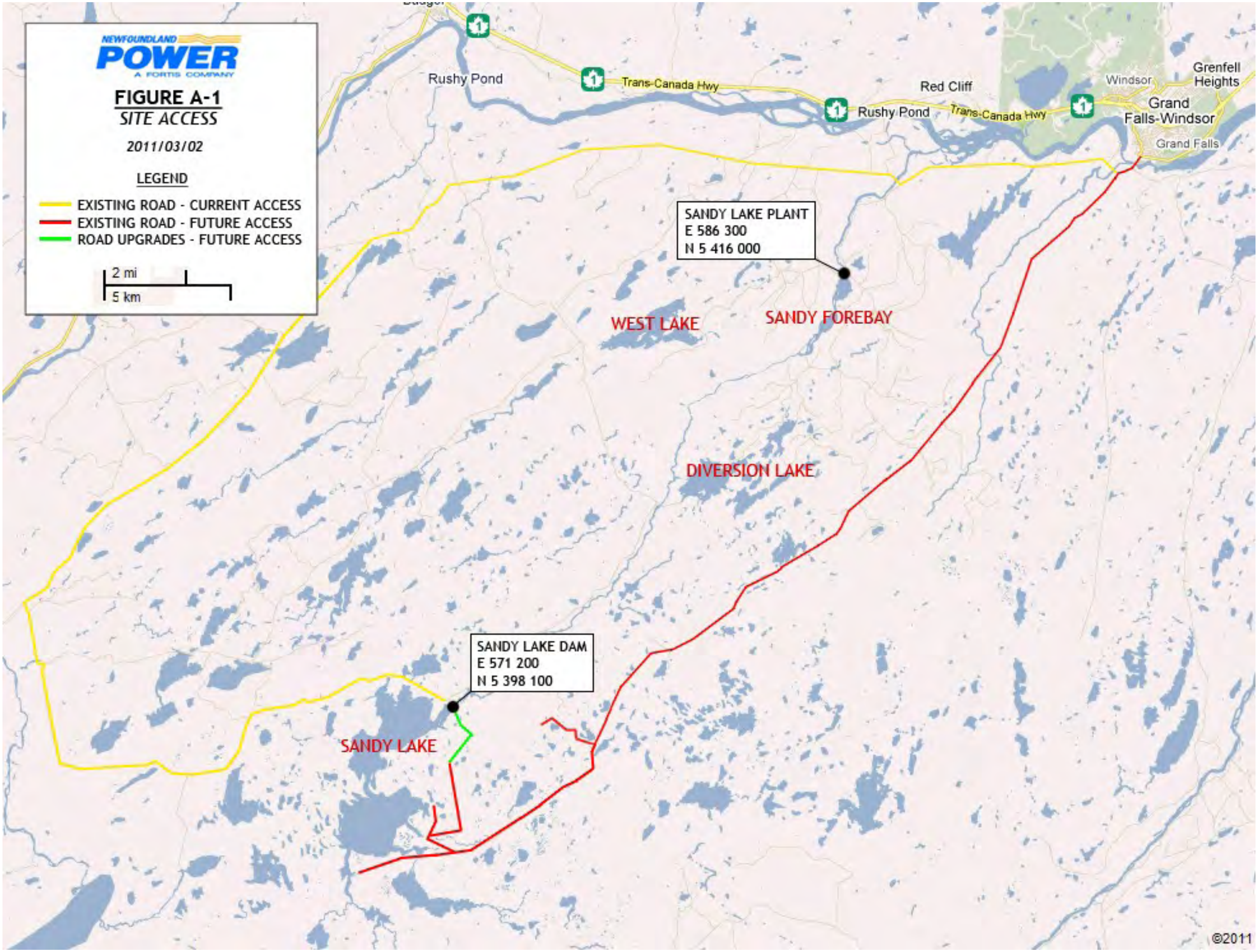
7. Funding:

The work has been approved by the Public Utilities Board and will be carried out as part of the Company's 2011 capital program at an estimated total project cost of $612,000, including engineering work completed in 2010.

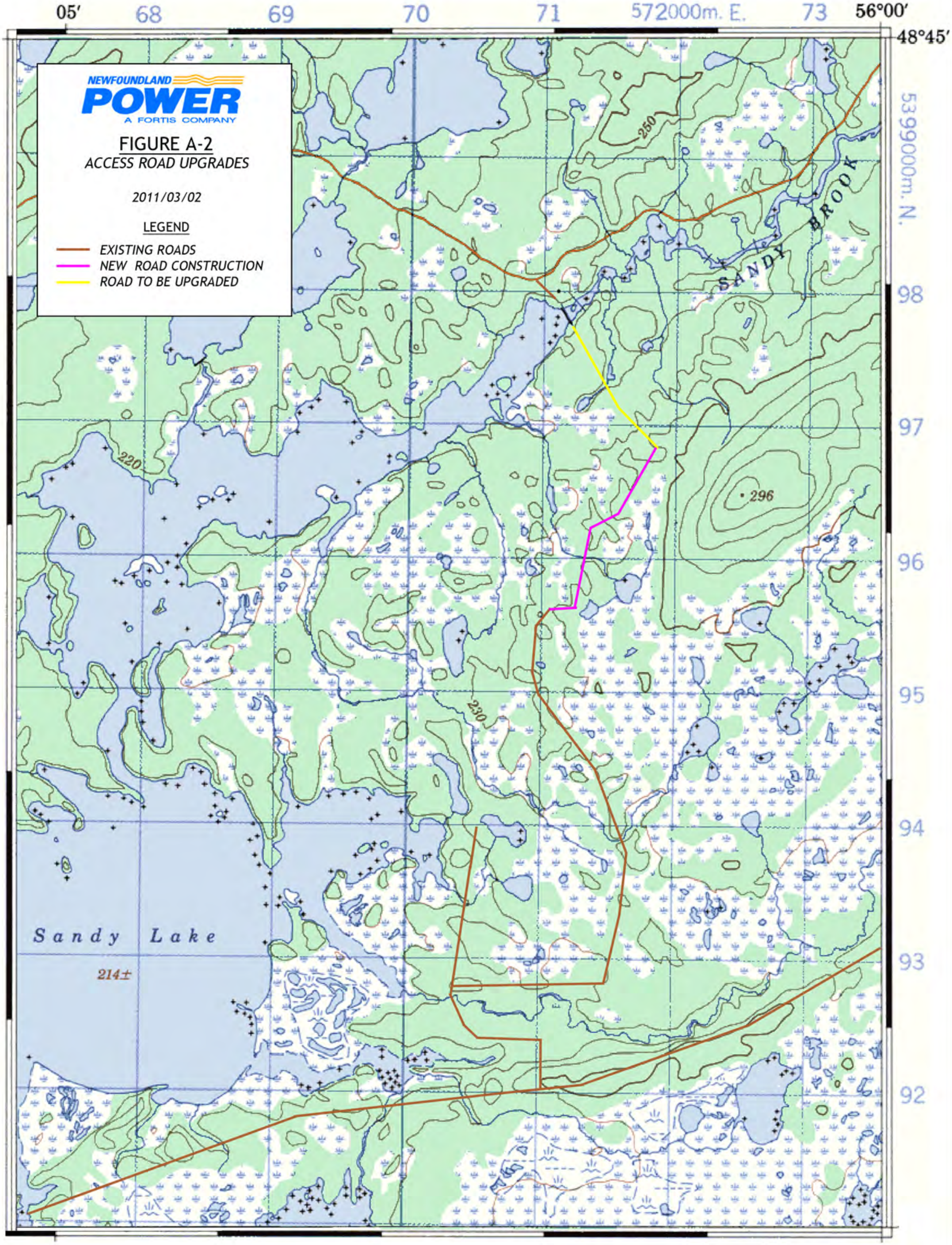
Date: __________________________ Signature: _________________________________

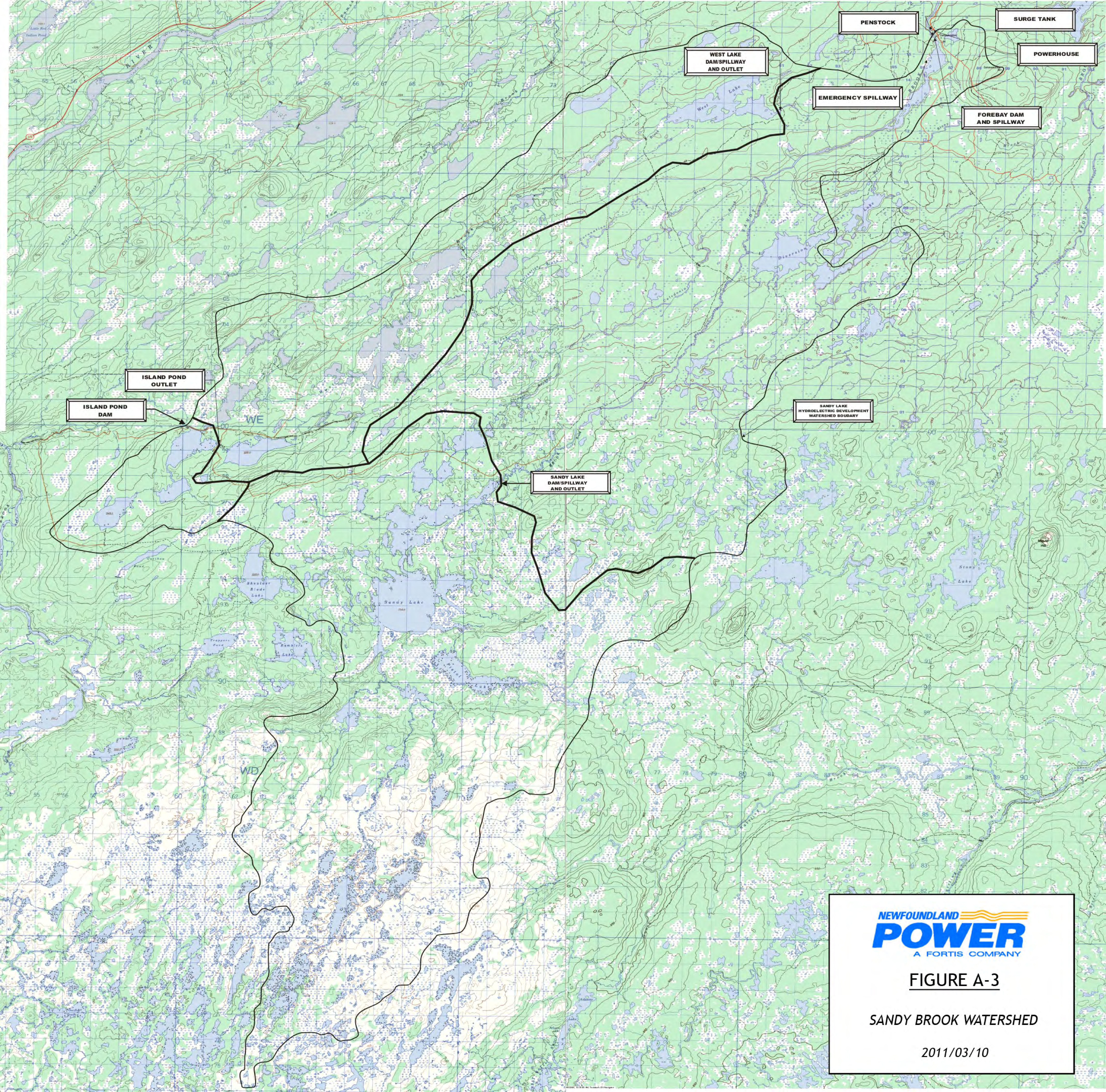
Appendix A

Location Maps



NEWFOUNDLAND POWER
A FORTIS COMPANY
FIGURE A-1
SITE ACCESS
2011/03/02
LEGEND
EXISTING ROAD - CURRENT ACCESS
EXISTING ROAD - FUTURE ACCESS
ROAD UPGRADES - FUTURE ACCESS
2 mi
5 km
Rushy Pond
Trans-Canada Hwy
Red Cliff
Rushy Pond
Trans-Canada Hwy
Windsor
Grenfell Heights
Grand Falls-Windsor
Grand Falls
SANDY LAKE PLANT
E 586 300
N 5 416 000
WEST LAKE
SANDY FOREBAY
DIVERSION LAKE
SANDY LAKE DAM
E 571 200
N 5 398 100
SANDY LAKE
©2011


NEWFOUNDLAND POWER
A FORTIS COMPANY
FIGURE A-2
ACCESS ROAD UPGRADES
2011/03/02
LEGEND
EXISTING ROADS
NEW ROAD CONSTRUCTION
ROAD TO BE UPGRADED
05′
68
69
70
71
572000m. E.
73
56°00′
48°45′
5399000m. N.
98
97
96
95
94
93
92
SANDY BROOK
Sandy Lake
214±
250
220
230
296



NEWFOUNDLAND POWER
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FIGURE A-3

SANDY BROOK WATERSHED

2011/03/10

Appendix B

Photographs

Photographs

*Water Levels expected to be much lower during summer construction season.

Figure B-1 – Upstream side of North abutment and existing outlet.

Figure B-2 – Downstream side of North abutment and existing outlet.

Figure B-3 – Upstream side of spillway

Figure B-4 – Downstream side of spillway

Figure B-5– Overview of site.

Figure B-6 – Aerial Photo, Taken July 28th, 1966, Showing historical high waters.

Appendix C

Environmental Investigation, Sandy Lake Dam Storage Increase

AMEC Earth & Environmental
A Division of AMEC Americas Limited

Environmental Investigation,
Sandy Lake
Dam Storage Increase
TF1005976

Prepared by:
James McCarthy

Reviewed by:
David A. Robbins

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Prepared for:
Newfoundland Power

March 11, 2011

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1.0 INTRODUCTION

The 5.5MW Sandy Brook Hydroelectric development was placed into service in 1963 (Figure 2.1). The dam on Sandy Lake was first constructed in 1939 for the purpose of pulp wood transportation, and in 1984 Newfoundland Power refurbished the dam as it was no longer maintaining its former water elevations within the Sandy lake reservoir. Refurbishment was intended to restore the full supply level of Sandy lake reservoir to its former elevation by capturing additional spring freshet flows, however it has been noted by Newfoundland Power that the dam was not constructed to its former elevation resulting in 0.86 GWh of lost energy annually. Newfoundland Power has proposed to again refurbish this dam to capture the spring freshet flows that are currently lost. The project has been approved by the Board of Commissioners of Public Utilities because of its low cost to the electricity customers of the island.

The project description to increase the height of the Sandy Lake dam was submitted to Fisheries and Oceans Canada's (DFO) local Area Habitat Biologist where it was determined that additional environmental information would be required of the Sandy Lake system and specific aspects of the project that may be determined to affect fish and fish habitat.

2.0 SURVEY OBJECTIVES

To collect the information required by DFO, Newfoundland Power contracted AMEC Earth & Environmental under its Standing Offer Agreement 09-013C to provide environmental site investigation services as directed by Newfoundland Power's Company Representative. The investigation included collection of data in order to assist DFO in its determination:

1. An estimate of the areal extent of Sandy Lake after the proposed works is completed.
2. Characterization of the fish habitat before and after the proposed project.
3. Characterization and estimate of the areal extent of fish habitat in areas of tributaries to Sandy Lake that would be inundated or affected by the project.
4. A description of the vegetation immediately adjacent to Sandy Lake that may be affected by increased storage capacity.

An outline of the methodologies utilized is provided in the appropriate sections below.

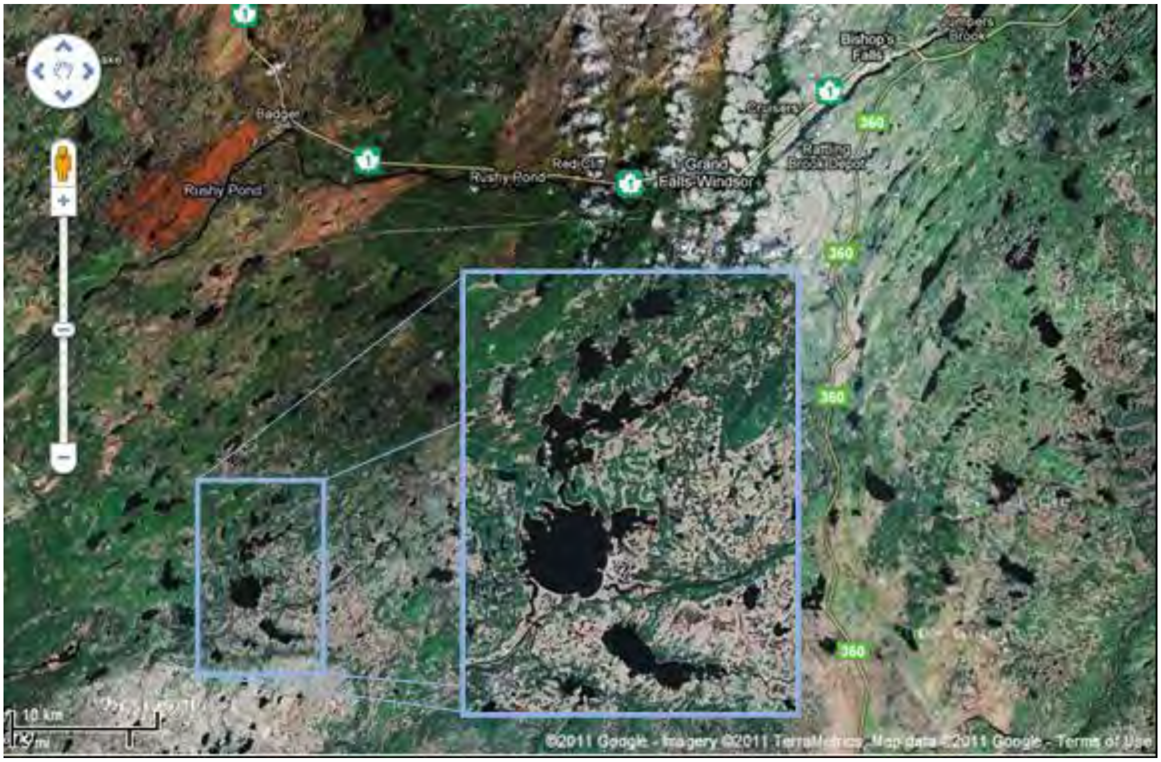


Figure 2.1 Sandy Lake reservoir location

3.0 PROPOSED TEAM

The proposed team provides scientific defensibility, experience and depth to ensure thoroughness throughout the program. The key AMEC team members are presented below.

James McCarthy, M.Sc., is a biologist and Certified Fisheries Professional with over eighteen years of experience. He has been involved in a wide range of hydroelectric projects and environmental impact assessments in Newfoundland and Labrador including the Churchill River Power Project, the Granite Canal Hydroelectric Development, the Rose Blanche Hydroelectric Development, the Southern Head Oil Refinery EA, the Long Harbour Nickel Processing Plant EA and the Belleoram Quarry EA. Projects have generally entailed the design and implementation of:

- Environmental impact assessments;
- Fisheries compensation plan design;
- Fish and fish habitat protection;
- Construction support;
- Environmental effects monitoring programs; and
- Baseline studies related to various human activities.

Mr. McCarthy has also managed a large number of water quality, biological and assessment projects. Mr. McCarthy was senior biologist and Project manager.

David A. Robbins, M.Env.Sc., is the regional Vice President for AMEC Earth & Environmental, a multi-disciplinary, international environmental and engineering firm. As the senior manager in Newfoundland & Labrador, he is responsible for fiscal management and technical direction for the regions business units and 125 engineers and scientists. As a senior scientist, Mr. Robbins has extensive experience in fisheries biology and aquatic sciences, public participation, environmental impact assessment, environmental site assessments and biophysical studies throughout Newfoundland and Labrador. He has been involved as a senior scientist with the Voisey's Bay Mine /Mill Environmental Impact Assessment and was responsible for developing a corporate Environmental Management Plan for Voisey's Bay Nickel Company's exploration works. He has designed numerous baseline water quality, aquatic and marine biological studies in support of proposed hydroelectric, thermal power generation, oil and gas, mining and forestry projects. In support of the Lower Churchill Hydroelectric Generation Project, Mr. Robbins participated as a study team member responsible for the Aquatic Baseline Description and Impact Assessment sections of the EIS, and Fish and Fish Habitat Compensation planning.

David was responsible for project senior review.

Ms. Juanita Abbott, B.A. (Geography, GIS) is a GIS Specialist with over 12 years applicable work experience with Geographic Information Systems, Databases Applications and Cartography along with its many components and applications. Ms. Abbott is experienced in completing GIS projects requiring conceptual planning, digitizing, database management, performing geographical analysis and presentation of final results. She was assisted in many fisheries studies where mapping and delineation of habitat was required. She recently provided habitat mapping and quantification for various projects including the baseline habitat study for the Labrador-Island Transmission Project, Long Harbour Fish Habitat Compensation Plan, and the lower Churchill River Hydroelectric Generation Project.

Ms. Abbott was responsible for habitat mapping and quantification using GIS.

Mr. Matthew Gosse, is an Environmental Technician with the AMEC St. John's office with over ten years experience in field sampling programs. He has been involved in numerous fisheries and water quality projects throughout Newfoundland and Labrador. Efforts on these projects have included the use of a variety of skills, including: collection, consolidation and analysis of data; literature reviews; species identification, classification and description; bathymetric and electrofishing surveys; invertebrate, fish, water, sediment sampling; as well as collecting and assessing data on physical habitats within riverine, lacustrine and marine environments.

He has been involved in the following projects through AMEC: the Geoplan Opus Torbay Bypass highway construction, the Defense Construction Canada, 5 Wing Goose Bay, the Voisey's Bay Nickel Company's (VBNC) Long Harbour Processing Plant Site, the Southern head proposed refinery, and Lab Mag GP Incorporated, Iron Ore Project.

Mr. Gosse was Environmental Technician and assisted in generation of areal extent calculations and report preparation.

4.0 SURVEY METHODOLOGY

The following outlines the survey methods completed to achieve the objectives outlined above. They are generally based on standard survey methods utilized within the province of Newfoundland and Labrador as outlined by DFO for quantifying fish and fish habitat within a proposed undertaking and for determination of any Harmful Alteration, Disruption, and Destruction (HADD) under Section 35 of the *Fisheries Act*. Where methods differed from those typically used, they have been further explained in the appropriate sections below.

All field data was collected during a site investigation on December 14, 2010. The site was accessed by helicopter. The entire Sandy Lake area was surveyed from the air. The helicopter was landed in any location requiring habitat measurements. These included most of the larger tributary streams and areas of shoreline which would be inundated.

4.1 FISH SPECIES PRESENCE

Typical determination of fish species present within a project area includes sampling of all habitat types within the proposed footprint. This not only provides data on species within the area but also generates indices of utilization for each of the habitat types. These indices are used to quantify the Habitat Equivalent Units (HEUs) for existing and any predicted future habitat that can be used in HADD determination. Sampling within Sandy Lake was not completed given the lateness of the season (December 2010). In this case, the species present within Sandy Lake was determined based on past experience of the local DFO Area Habitat Biologist, Newfoundland Power and local outfitters. The identified species were assumed to be within the entire Sandy Lake watershed, including tributaries, and to use the habitat present as expected based on DFO documentation (for example Grant and Lee 2004 and Bradbury et al. 1999). In this way, lack of sampling does not discount any habitat utilization nor does it reduce the overall HEUs generated for the existing and proposed future habitat.

4.2 HABITAT QUANTIFICATION

Habitat quantification, along with fish species present, provides most of the information requested (objectives 1-3). Habitat quantification is typically completed in two phases; determination of the quantity of each fish habitat type present and the calculation of the quality of each fish habitat type present for each species present. This is completed for the existing pre-project habitat as well as the proposed post-project habitat such that predicted changes can be assessed and used in HADD determination. This is typically completed using DFO documentation for lacustrine and riverine habitats (see Bradbury et al. 2001 and McCarthy et al. 2007).

The difference in reservoir habitat and area has been conducted using existing imaging to represent both existing and predicted future conditions. Existing habitat quantity has been estimated using the 1:50,000 topographic mapping while the future conditions have been estimated using 1966 black and white air photos. Each were incorporated into GIS for shoreline delineation and direct calculation of habitat areas.

4.2.1 Lacustrine Habitat

Lacustrine habitat quantification as per Bradbury et al. (2001) was completed for Sandy Lake; however, given the lateness of the season, a full bathymetric survey of Sandy Lake was not conducted. Instead, the depth of light penetration (which is used as the delineation between littoral and non-littoral habitat) was estimated based on visibility of bottom substrate at various locations from helicopter. In the methodology, the zones of littoral (nearshore) habitat is sub-divided into large ranges (eg. 0-1m, 1-2m, 2-5m, 5-10m, and 10+m). In this respect, the estimate of light penetration depth was determined such that it could be placed within one of these categories.

The quantity of lacustrine habitat in each of the types was generated using GIS and digital aerial photographs of the existing Sandy Lake shoreline and the proposed future shoreline. The proposed future shoreline was determined from air photos taken in 1966 which represent the water elevation that the re-habilitated control structure would maintain. It is assumed that the same depth of light penetration will occur in the future Sandy lake expansion based on substrate types observed (i.e. limited fine shoreline material).

Shoreline substrate composition was determined from shoreline inspections. Substrate composition is recorded as the percent coverage of each standard substrate classification.

All data was input to the DFO spreadsheet for calculation of Habitat Equivalent Units (HEUs) for both existing and future lacustrine conditions.

The water levels within the Sandy Lake reservoir have been modelled in terms of anticipated weekly water level fluctuations throughout the year based on existing flow duration curves, water use and designed water control structure at the outlet. Both the existing water level fluctuations and anticipated post-project fluctuations have been presented such that a comparison between the two can be made and differences can be put in proper context with respect to fish and fish habitat.

4.2.2 Riverine Habitat

Riverine habitat potentially affected by the re-establishment of the Sandy Lake reservoir shoreline to that identified in the 1966 air photos was surveyed on December 14, 2010. Standard stream conditions at the time of the survey were recorded including an estimate of the quantity of riverine habitat between the existing and future maximum shoreline (i.e., the habitat potentially affected) and estimates of its condition (eg. mean water depth, velocity, substrate composition).

While not all smaller tributaries were surveyed, the GIS was used to calculate the total length of stream habitat potentially affected. A sub-set was surveyed in the field to represent conditions and composition throughout.

4.2.3 Shoreline Vegetation

Shoreline vegetation between the existing shoreline and the proposed future shoreline were inspected and field surveyed.

5.0 RESULTS

The site was visited by helicopter on December 14, 2010 in order to document both existing lacustrine and riverine habitat. Air photos were used in GIS to estimate the change in habitat quantities based on differing water levels. Provided below are the results of field surveys, air photo interpretation, and GIS analysis of the existing and future fish and fish habitat at Sandy Lake.

5.1 SANDY LAKE WATER LEVELS

The existing water levels within the Sandy Lake reservoir have been measured over the past ten years and presented in Figure 5.1. Also presented within the figure is the anticipated change in water levels as a result of the refurbished water control structure. As shown, the increase in structure height will allow the capture and storage of a greater quantity of spring freshet to be used for generation at the Sandy Brook Hydroelectric Plant during periods of low inflow. Figure 5.2 presents the relative increase in reservoir size related to the increase in water elevation.

As indicated by Figure 5.2, the water levels within the reservoir are anticipated to be similar to existing conditions through the fall, winter and early spring seasons. Table 5.1 presents a brief summary of information represented in Figure 5.1 where differences in elevation are predicted. In general, water elevations will be increased between weeks 15 and 34 (i.e., between ~April 10 - August 21) with a maximum increase of 1m between peak water storage. In particular, the time period between the end of August and the spring freshet will remain unchanged.

Table 5.1. Summary of water level data, weekly water storage reports, 2001-2010.

Parameter	Existing Condition	Future Condition	Net Change
Peak Water Storage Elevation (ft)	8.5	11.8	+3.3
Elevation – Annual Week 15 (ft)	6.0	6.1	+0.1
Elevation – Annual Week 16 (ft)	7.5	8.1	+0.6
Elevation – Annual Week 19 (ft)	8.4	10.1	+1.7
Elevation – Annual Week 23 (ft)	6.8	8.5	+1.7
Elevation – Annual Week 30 (ft)	3.5	4.2	+0.7
Elevation – Annual Week 31 (ft)	4.0	4.4	+0.4
Elevation – Annual Week 32 (ft)	4.2	4.5	+0.3
Elevation – Annual Week 33 (ft)	4.2	4.3	+0.1
Elevation – Annual Week 34 (ft)	4.1	4.1	0.0

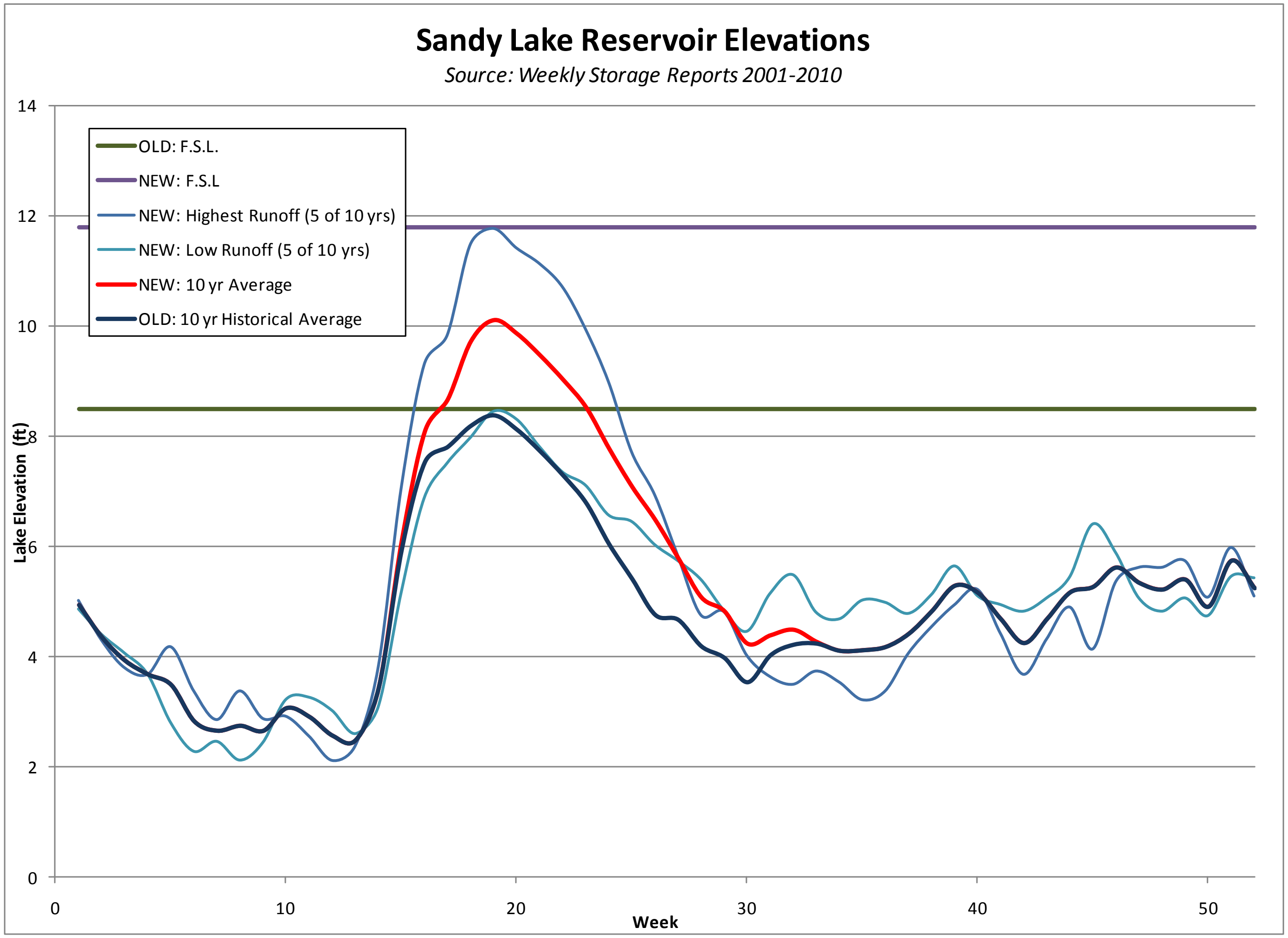


Figure 5.1 Sandy Lake Existing and Proposed Water Elevations

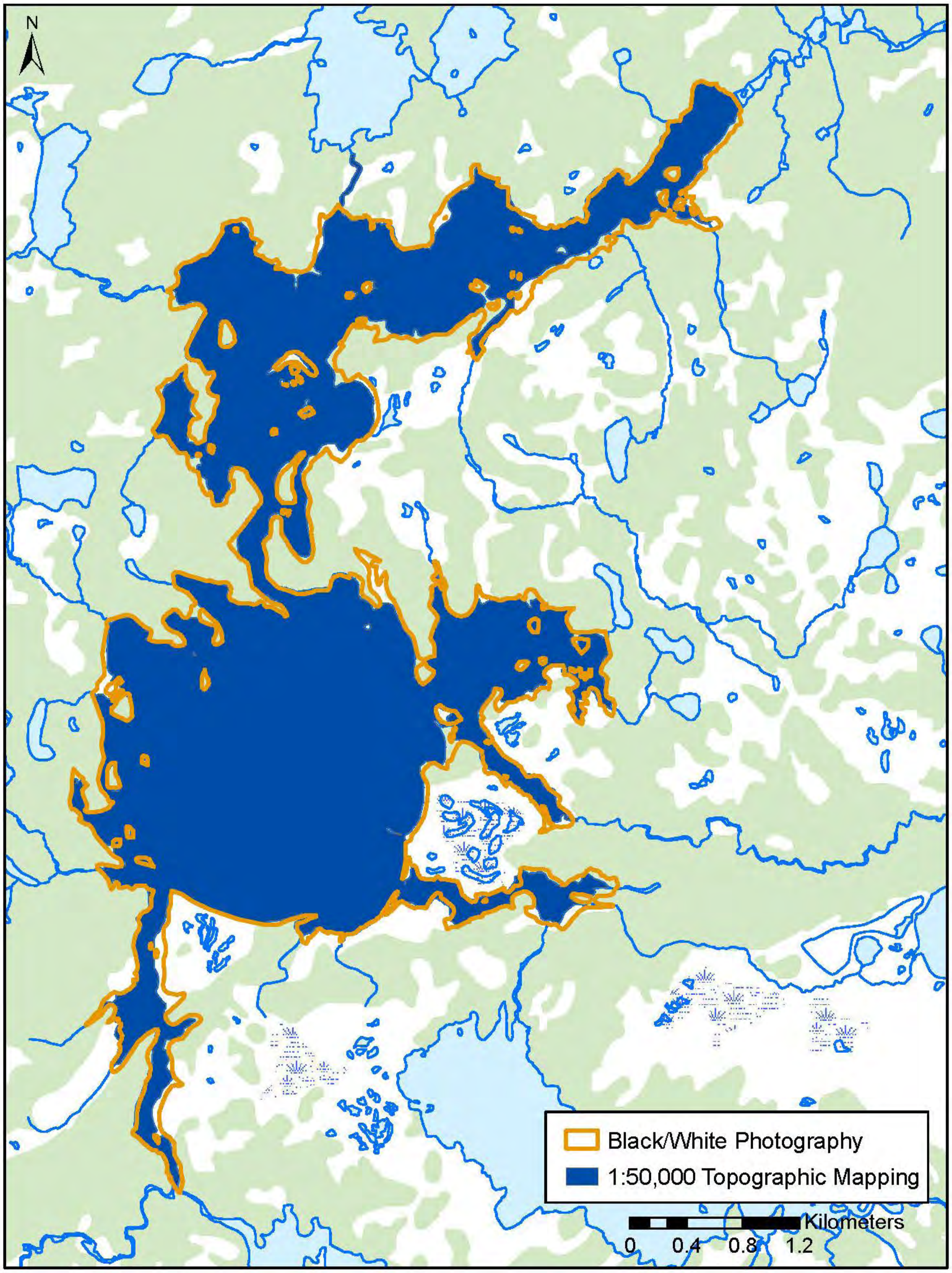


Figure 5.2 Sandy Lake Existing and Proposed Surface Area

5.2 LACUSTRINE HABITAT

A summary comparison of the existing and proposed lacustrine habitat, and the calculated Habitat Equivalent Units (HEUs) based on the DFO spreadsheet, are presented in Tables 5.2 – 5.7. Because the area of new inundation will not remain flooded, but will return to existing water levels once the spring freshet is slowly released over the spring and summer months (see Figure 5.1), it has been classified as littoral zone habitat with vegetation. As shown, with an estimated maximum increase in water depth of 0.5m, the littoral zone habitat is increased and hence HEUs are also increased for each species utilizing the lacustrine habitat within Sandy Lake reservoir for that time period when water levels would be increased. But it should be noted, that this increase would be temporary.

While some of the larch may recede to the new shoreline, as described further below, the vegetation currently covering the majority of the area proposed for inundation is semi-aquatic (most of the grasses) and will most-likely be able to withstand the additional temporary increase in water levels for quite some time, particularly since the zone of ice scour will remain similar to existing conditions.

Table 5.2. Summary of existing habitat, Sandy Lake reservoir.

Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated automati

Enter Lake name: Existing Sandy Lake

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m:		OR	IF Lake Depth is greater than 10 m:	
Path 1			**Path 2**	
A Enter Depth of Littoral Zone:	3		A-1 Enter mean depth of Non-Littoral Zone:	0
B Enter Mean Depth of Lake:	7		B-1 Enter depth of Benthic Zone:	0

Path 2 (Continued…)

IF Lake Depth is greater than 10 m:			
	Mean depth of Non-Littoral Zone:		*(Reduced Value)*
	Depth of the Benthic Zone:		*(Reduced Value)*
	Benthic Pelagic ratio:		

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	2,623,582.70	Sand:	771,641.97
	Boulder:	1,234,627.15	Cobble:	1,157,462.96	Silt:	0.00
			Gravel:	77,164.20	Muck:	1,851,940.73
					Clay:	0.00
	SubTotals:	1,234,627		3,858,210		2,623,583

Littoral Zone (Vegetation)

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	0.00
					Clay:	0.00
	SubTotals:	0		0		0

Non-Littoral Zone

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	1,945,852.30
					Clay:	0.00
	SubTotals:	0		0		1,945,852

Part 3 Summary Table for Bottom Surface Area Totals:

Habitat Types	Bottom Surface area (m²)
Littoral Coarse/No vegetation	1,234,627
Littoral Medium/No vegetation	3,858,210
Littoral Fine/No vegetation	2,623,583
subtotal Littoral/No vegetation	**7,716,420**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	0
Subtotal Littoral/Vegetation	**0**
Subtotal Littoral	**7,716,420**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	1,945,852
Subtotal nonlittoral	**1,945,852**
Total Available Habitat	**9,662,272**

Table 5.3. Summary of existing life-cycle stage suitabilities, Sandy Lake reservoir.

STEP 4 | Lake name: Existing Sandy Lake

Part 1

Table: Habitat Suitability Indices for all Fish species, including their respective life stages, which are present within the lake

	Species	Life Stage	Littoral Zone: Coarse/No Vegetation	Littoral Zone: Medium/No Vegetation	Littoral Zone: Fine/No Vegetation	Littoral Zone: Coarse/Vegetation	Littoral Zone: Medium/Vegetation	Littoral Zone: Fine/Vegetation	Non-Littoral Zone: Coarse/Pelagic	Non-Littoral Zone: Medium/Pelagic	Non-Littoral Zone: Fine/Pelagic
1	Atlantic Salmon (freshwater resident)	Spawning	0.00	0.19	0.00	0.00	0.19	0.00	NA	NA	0.00
		YOY	0.33	0.22	0.00	0.33	0.22	0.00	NA	NA	0.00
		Juvenile	0.95	0.63	0.00	0.95	0.63	0.00	NA	NA	0.34
		Adult	0.00	0.78	0.61	0.00	0.78	0.61	NA	NA	0.84
2	Brook Trout (freshwater resident)	Spawning	0.00	0.72	0.64	0.00	0.72	0.64	NA	NA	0.07
		YOY	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.00
		Juvenile	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.07
		Adult	0.00	0.67	0.34	0.00	0.67	0.39	NA	NA	0.17
3	Threespine stickleback (Freshwater resident)	Spawning	0.00	0.56	0.89	0.00	0.59	0.82	NA	NA	0.13
		YOY	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	0.00
		Juvenile	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	0.00
		Adult	0.00	0.67	0.84	0.00	0.78	0.89	NA	NA	1.00

Table 5.4. Summary of existing Habitat Equivalent Units, Sandy Lake reservoir.

STEP 5 | Lake name: Existing Sandy Lake

Table 1: Habitat Equivalent Units for each individual fish species present within the lake.

	Species	Littoral Zone: Coarse/No Vegetation	Littoral Zone: Medium/No Vegetation	Littoral Zone: Fine/No Vegetation	Littoral Zone: Coarse/Vegetation	Littoral Zone: Medium/Vegetation	Littoral Zone: Fine/Vegetation	Non-Littoral Zone: Coarse/Pelagic	Non-Littoral Zone: Medium/Pelagic	Non-Littoral Zone: Fine/Pelagic	Total Available Habitat
☐ 1	Atlantic Salmon (freshwater resident)	1172896	3009404	1626621	0	0	0	0	0	1634516	7443436.5
☐ 2	Brook Trout (freshwater resident)	1234627	3858210	1705329	0	0	0	0	0	330795	7128961.0
☐ 3	Threespine stickleback (Freshwater resident)	0	2585001	2334989	0	0	0	0	0	1945852	6865841.6

Table 5.5. Summary of future habitat, Sandy Lake reservoir.

Step 1	**Note:** Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated automatical						
	Enter Lake name:	Future Sandy Lake					
Part 1 Entering Lake depth(s):							
IF Lake Depth is less than or equal to 10 m:		**OR**	**IF Lake Depth is greater than 10 m:**				
Path 1			**Path 2**				
A Enter Depth of Littoral Zone:	3		**A-1 Enter mean depth of Non-Littoral Zone:**				0
B Enter Mean Depth of Lake:	7		**B-1 Enter depth of Benthic Zone:**				0
Path 2 (Continued…)							
IF Lake Depth is greater than 10 m:	**Mean depth of Non-Littoral Zone:**			*(Reduced Value)*			
	Depth of the Benthic Zone:			*(Reduced Value)*			
	Benthic Pelagic ratio:						

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):						
Substrate:	**Coarse**	m^2	**Medium**	m^2	**Fine**	m^2
	Bedrock:	**0.00**	Rubble:	**2,623,582.70**	Sand:	**771,641.97**
	Boulder:	**1,234,627.15**	Cobble:	**1,157,462.96**	Silt:	**0.00**
			Gravel:	**77,164.20**	Muck:	**1,851,940.73**
					Clay:	**0.00**
	SubTotals:	1,234,627		3,858,210		2,623,583

Littoral Zone (Vegetation)						
Substrate:	**Coarse**	m^2	**Medium**	m^2	**Fine**	m^2
	Bedrock:	**0.00**	Rubble:	**347,071.32**	Sand:	**102,079.80**
	Boulder:	**163,327.68**	Cobble:	**153,119.70**	Silt:	**0.00**
			Gravel:	**10,207.98**	Muck:	**244,991.52**
					Clay:	**0.00**
	SubTotals:	163,328		510,399		347,071

Non-Littoral Zone						
Substrate:	**Coarse**	m^2	**Medium**	m^2	**Fine**	m^2
	Bedrock:	**0.00**	Rubble:	**0.00**	Sand:	**0.00**
	Boulder:	**0.00**	Cobble:	**0.00**	Silt:	**0.00**
			Gravel:	**0.00**	Muck:	**1,945,852.30**
					Clay:	**0.00**
	SubTotals:	0		0		1,945,852

Part 3 Summary Table for Bottom Surface Area Totals:

Habitat Types	**Bottom Surface area (m^2)**
Littoral Coarse/No vegetation	1,234,627
Littoral Medium/No vegetation	3,858,210
Littoral Fine/No vegetation	2,623,583
subtotal Littoral/No vegetation	**7,716,420**
Littoral Coarse/Vegetation	163,328
Littoral Medium/Vegetation	510,399
Littoral Fine/Vegetation	347,071
Subtotal Littoral/Vegetation	**1,020,798**
Subtotal Littoral	**8,737,218**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	1,945,852
Subtotal nonlittoral	**1,945,852**
Total Available Habitat	**10,683,070**

Table 5.6. Summary of future life-cycle stages suitabilities, Sandy Lake reservoir.

STEP 4 | **Lake name:** Future Sandy Lake

Part 1

Table Habitat Suitability Indices for all Fish species, including their respective life stages, which are present within the lake

	Species	Life Stage	Littoral Zone						Non-Littoral Zone		
			Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
		Spawning	0.00	0.19	0.00	0.00	0.19	0.00	NA	NA	0.00
		YOY	0.33	0.22	0.00	0.33	0.22	0.00	NA	NA	0.00
		Juvenile	0.95	0.63	0.00	0.95	0.63	0.00	NA	NA	0.34
1	Atlantic Salmon (freshwater resident)	Adult	0.00	0.78	0.61	0.00	0.78	0.61	NA	NA	0.84
		Spawning	0.00	0.72	0.64	0.00	0.72	0.64	NA	NA	0.07
		YOY	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.00
		Juvenile	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.07
2	Brook Trout (freshwater resident)	Adult	0.00	0.67	0.34	0.00	0.67	0.39	NA	NA	0.17
		Spawning	0.00	0.56	0.89	0.00	0.59	0.82	NA	NA	0.13
		YOY	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	0.00
		Juvenile	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	0.00
3	Threespine stickleback (Freshwater resident)	Adult	0.00	0.67	0.84	0.00	0.78	0.89	NA	NA	1.00

Table 5.7. Summary of future Habitat Equivalent Units, Sandy Lake reservoir.

STEP 5 | **Lake name:** Future Sandy Lake

Table 1: **Habitat Equivalent Units for each individual fish species present within the lake.**

	Species	Littoral Zone						Non-Littoral Zone			
		Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
1	Atlantic Salmon (freshwater resident)	1172896	3009404	1626621	155161	398111	215184	0	0	1634516	8211893.0
2	Brook Trout (freshwater resident)	1234627	3858210	1705329	163328	510399	225596	0	0	330795	8028283.7
3	Threespine stickleback (Freshwater resident)	0	2585001	2334989	0	398111	308893	0	0	1945852	7572845.8

5.3 STREAM HABITAT

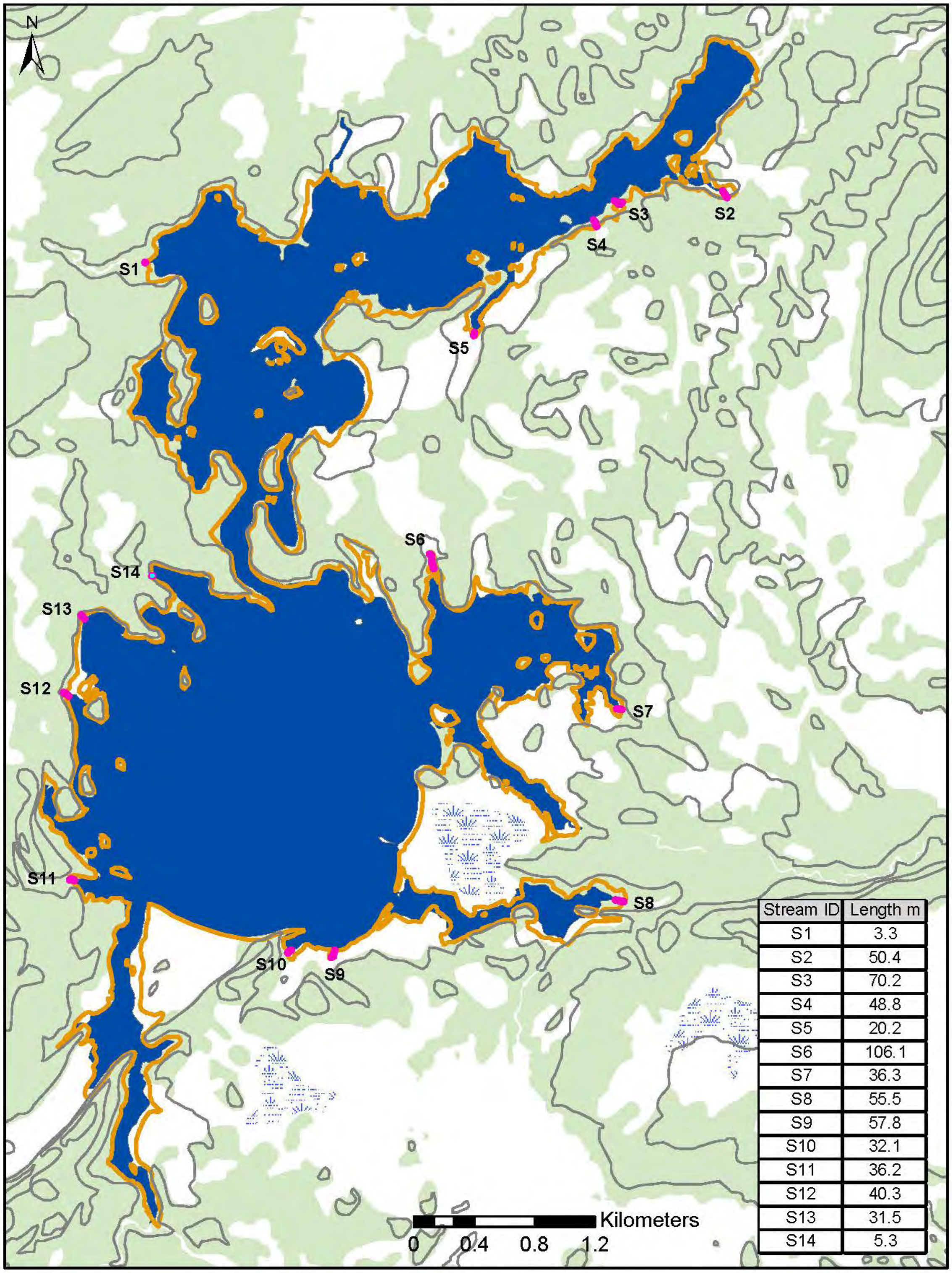
The stream habitat within the area of inundation was quantified using GIS analysis of the air photo series representing existing and proposed future shoreline extents. Figure 5.3 presents the locations of stream habitat that would be inundated. Representative streams were surveyed to provide a description of the habitat types that would be inundated under the increase in water level. Using the habitat characteristics of the streams surveyed, the total riverine habitat can be estimated and characterized (Table 5.9). With a maximum increase in water depth of approximately 1m, a total of 594m of stream would be inundated during the spring and summer for a total of 52.02 units of riverine habitat including primarily steady habitat with some pool and riffle.

It should be noted that this riverine habitat will be inundated for the spring and summer months only and at an estimated maximum water depth of 1m. The use of the riverine habitat for such life-cycle stages and processes such as spawning, egg incubation and hatching are not expected to be affected by the capture of the spring freshet and temporary increase in water levels.

5.4 SHORELINE VEGETATION

The existing shoreline shows signs of the water levels being previously elevated for log driving activities. For example, much of the existing treeline boundary still follows the former shoreline (Figure 5.4). While there has been some re-establishment of trees (small quantity of juniper, birch and fir) and shrubs (alders) below the former flood elevation, most are primarily grasses and sedges that are tolerant of a wetter environment (Figure 5.5). At the time of the survey, much of the shoreline between the lake and the former flood level was wet and indicative of a flooded or wet environment (Figure 5.5).

With the estimation that water levels will be similar during the winter freeze up (i.e. around week 48-52 in Figure 5.1), it can be anticipated that the effect of ice scour would remain unchanged with respect to shoreline vegetation and aquatic habitat. However, with an increase in spring inundation level, some grasses may show reduced growth over time where inundation would be greatest.



Stream ID	Length m
S1	3.3
S2	50.4
S3	70.2
S4	48.8
S5	20.2
S6	106.1
S7	36.3
S8	55.5
S9	57.8
S10	32.1
S11	36.2
S12	40.3
S13	31.5
S14	5.3

Figure 5.3. Stream locations and lengths in area of spring inundation.

Table 5.8. Summary of riverine habitat, Sandy Lake reservoir.

Stream ID	Length (m)[1]	Mean Width (m)	Units ($100m^2$)	Habitat Characterization	Substrate Composition						
					Be	B	R	C	G	S	O
1[2]	3.3	5	0.17	riffle/pool	0	6.7	66.7	24.3	2.3	0	0
2	50.4	6	3.02	steady	0	50	27.5	19.5	0.5	0	2.5
3[2]	70.2	6	4.21	steady	0	50	27.5	19.5	0.5	0	2.5
4	48.8	6	2.93	steady	0	50	27.5	19.5	0.5	0	2.5
5	20.2	6	1.21	steady	0	50	27.5	19.5	0.5	0	2.5
6	106.1	6	6.37	steady	0	50	27.5	19.5	0.5	0	2.5
7[2]	36.3	25	9.15	steady/riffle	0	0	0	0	0	30	70
8	55.5	25	13.88	steady/riffle	0	0	0	0	0	30	70
9	57.8	6	3.47	steady	0	0	0	0	0	30	70
10	32.1	6	1.93	steady	0	0	0	0	0	30	70
11	36.2	5	1.81	riffle/pool	0	0	0	0	0	30	70
12	40.3	5	2.02	riffle/pool	0	6.7	66.7	24.3	2.3	0	0
13	31.5	5	1.58	riffle/pool	0	6.7	66.7	24.3	2.3	0	0
14	5.3	5	0.27	riffle/pool	0	6.7	66.7	24.3	2.3	0	0

[1] based on GIS air photo interpretation, unless otherwise noted.
[2] based on field measurements.

Figure 5.4. Evidence of former Sandy Lake shoreline (treeline and driftwood).

Figure 5.5. Typical shoreline vegetation composition.

6.0 REFERENCES

Grant, C.G.J. and E.M. Lee. 2004. Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador, with Major Emphasis on riverine Habitat Requirements. Can. Manuscr. Rep. Fish. Aquat. Sci. 2672: xii + 262p.

Bradbury, C. M.M. Roberge, and C.K. Minns. 1999. Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador, with Major Emphasis on Lake Habitat Characteristics. Can. MS Rep. Fish. Aquat. Sci. 2485:vii+150p.

Bradbury, C.,A.S. Power and M.M. Roberge. 2001. Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador. Fisheries and Oceans, St. John's, NF. 60p.

McCarthy, J. H., C. Grant and D.A. Scruton. 2007 Draft. Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador. Department of Fisheries and Oceans, St. John's, NL.

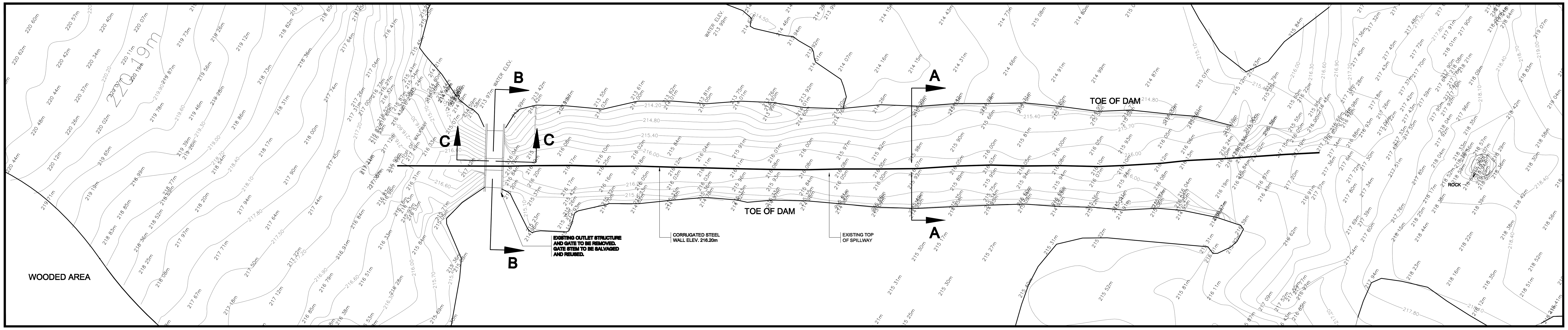
Appendix D

Drawings

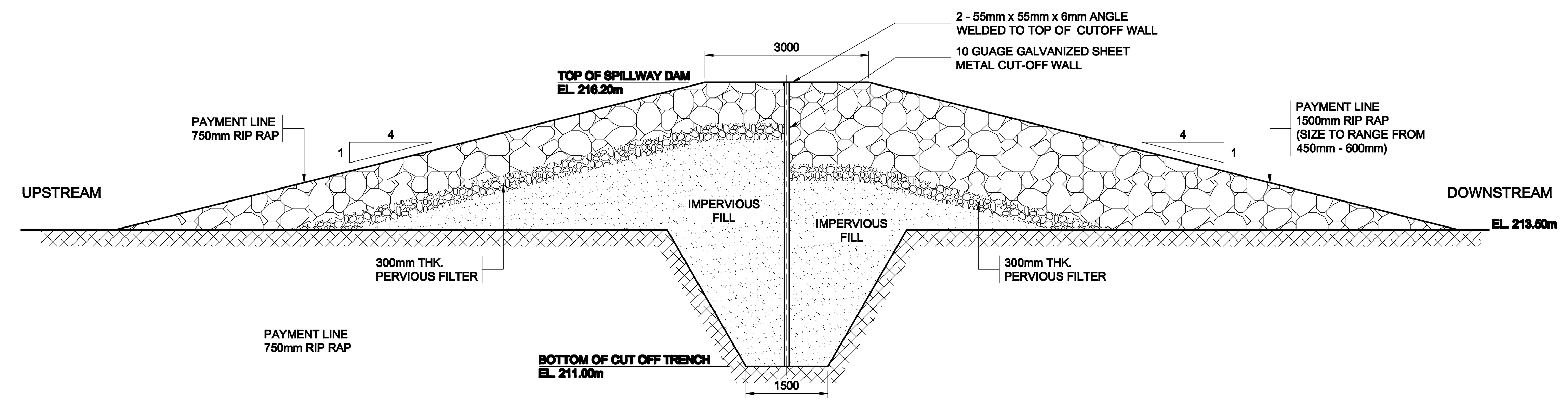
List of Drawings

6-602-21-211: Existing Plan & Details

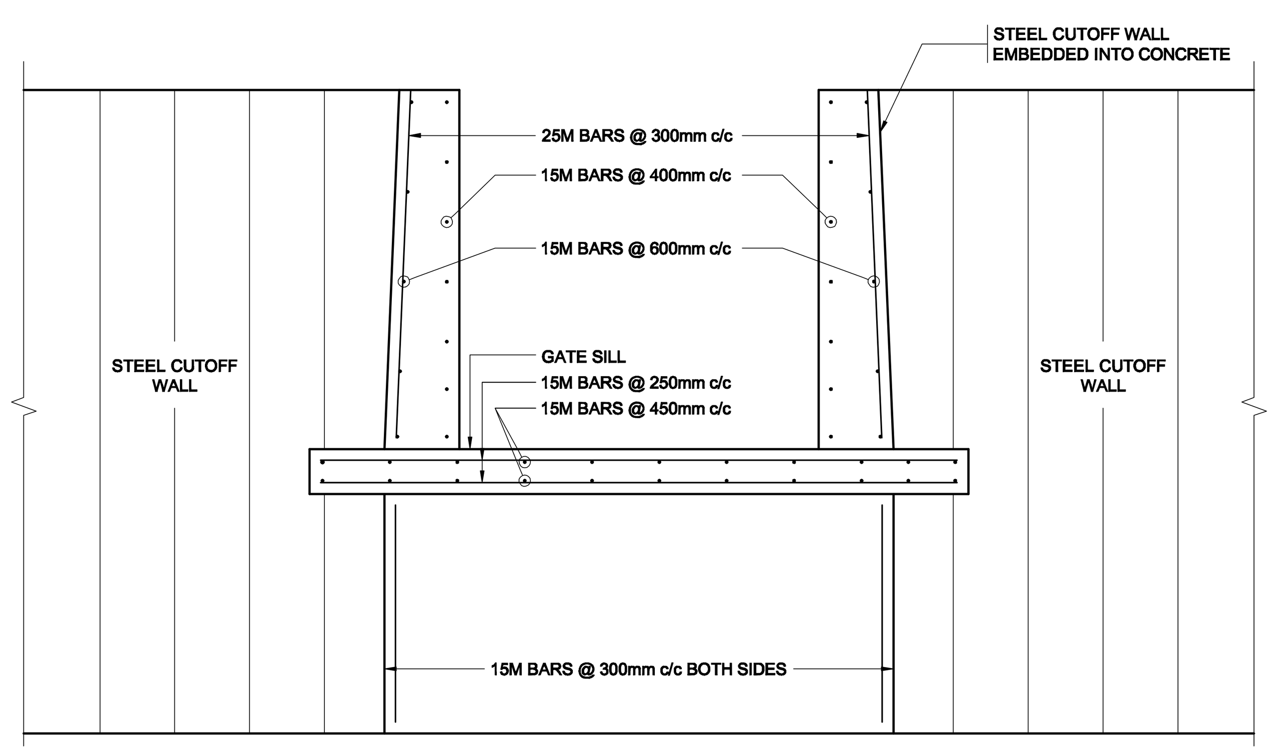
6-602-21-212: Dam/Spillway Plan, Section and Details



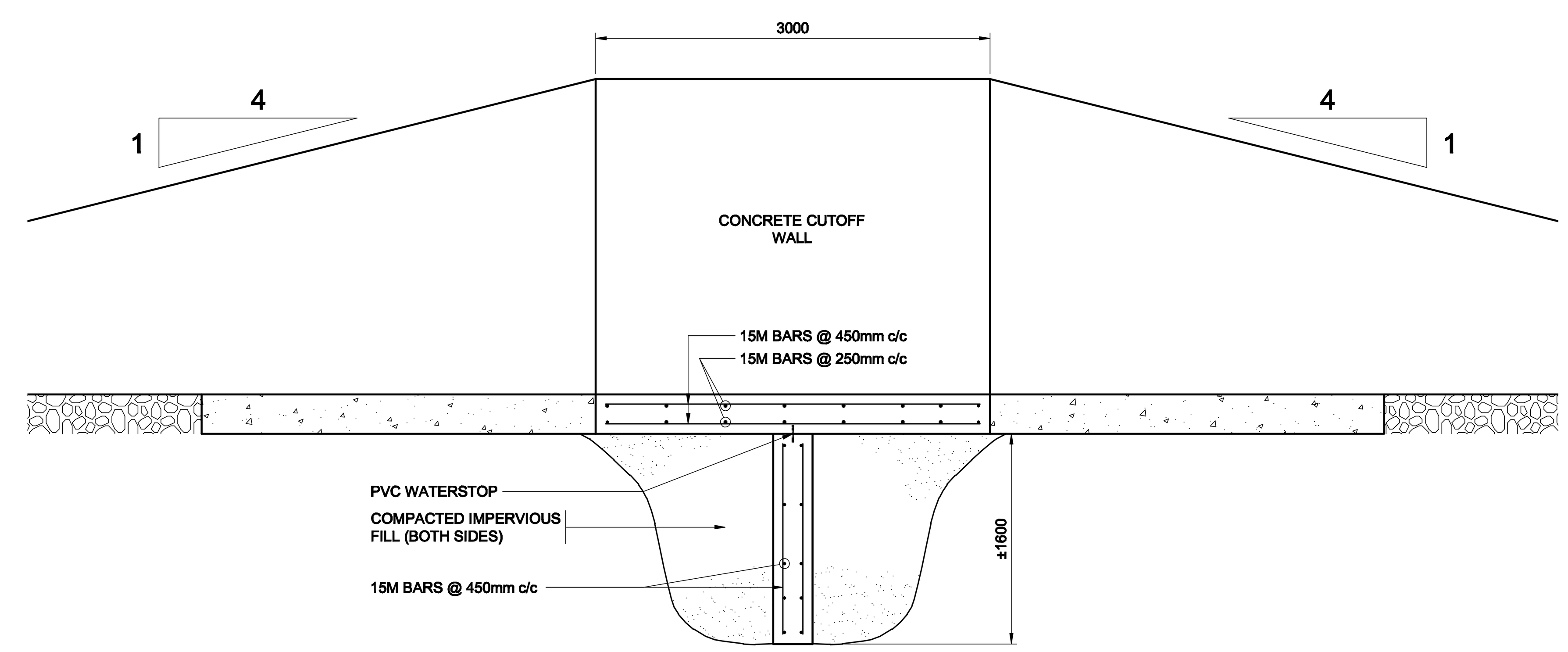
EXISTING PLAN - TOPOGRAPHIC SURVEY
SCALE 1:300



SECTION A-A
TYPICAL SECTION THROUGH EXISTING SPILLWAY
SCALE 1:75



SECTION C-C
TYPICAL SECTION THROUGH EXISTING OUTLET STRUCTURE
SCALE 1:40



SECTION B-B
TYPICAL SECTION THROUGH EXISTING OUTLET STRUCTURE
SCALE 1:40

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
This Permit Allows
NEWFOUNDLAND POWER INC.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by APEGN D0134 which is valid for the year 2010

NOTES

1. ALL ELEVATIONS IN METERS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE.

REFERENCE DRAWINGS

DWG #	TITLE

REVISIONS

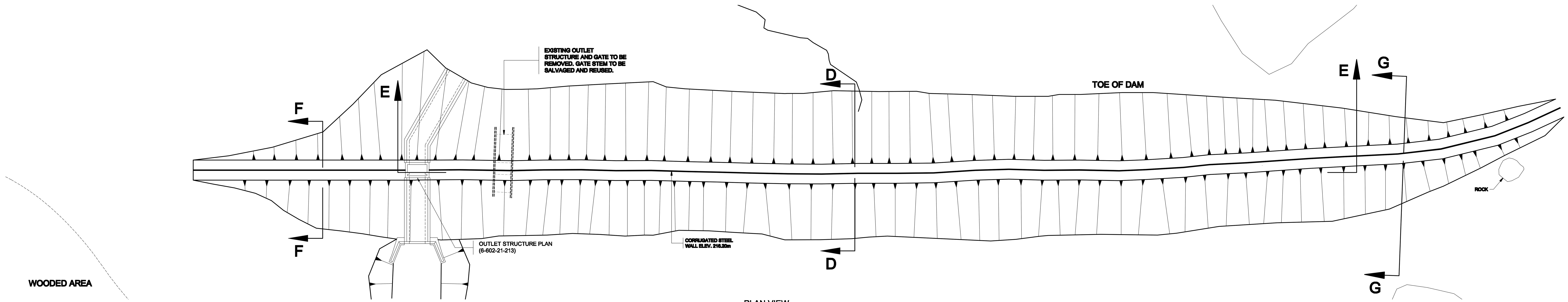
REV	DATE	DESCRIPTION	DRAWN BY	MADE BY	APP. BY	COMMISSIONED BY

NEWFOUNDLAND POWER
A FORTIS COMPANY

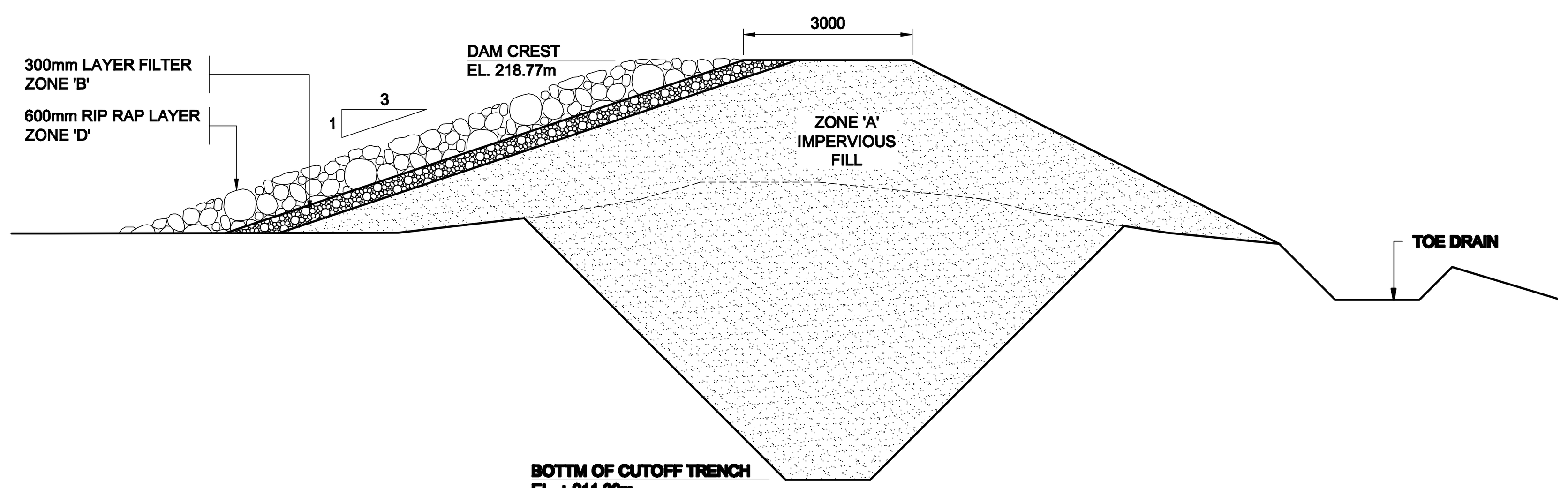
Project: SANDY BROOK DEVELOPMENT STRUCTURE REHABILITATION

Title: EXISTING PLAN AND SECTIONS

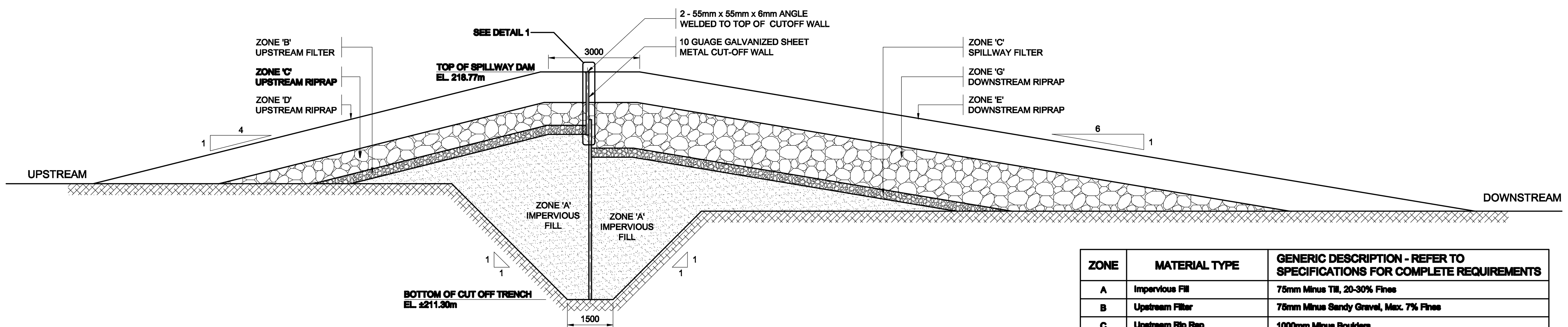
DESIGNED:	
DRAWN:	R. POWER
CHECKED:	
APPROVED:	
PASSED:	
Scale:	AS NOTED
Date:	2010-04-22
DWG. NO.	6-602-21-211



PLAN VIEW
SCALE 1:300

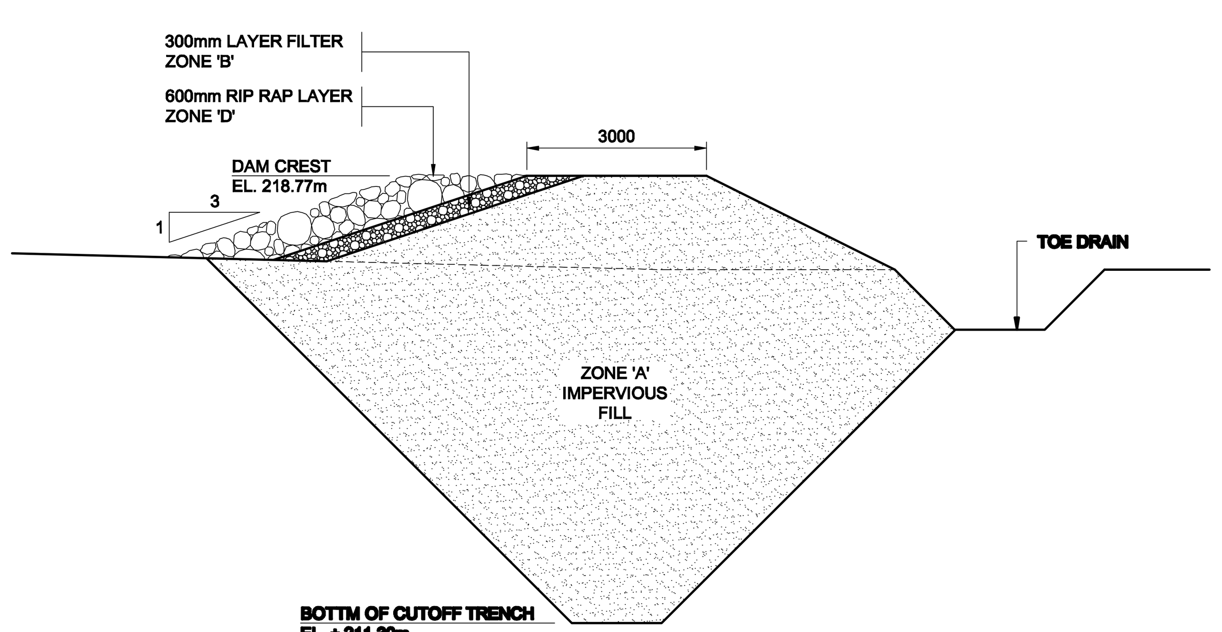


SECTION F-F
TYPICAL SECTION THROUGH ABUTMENT
SCALE 1:100

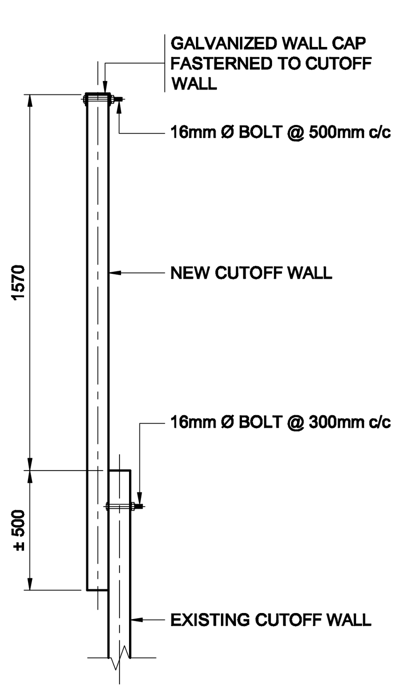


SECTION D-D
TYPICAL SECTION THROUGH SPILLWAY
SCALE 1:100

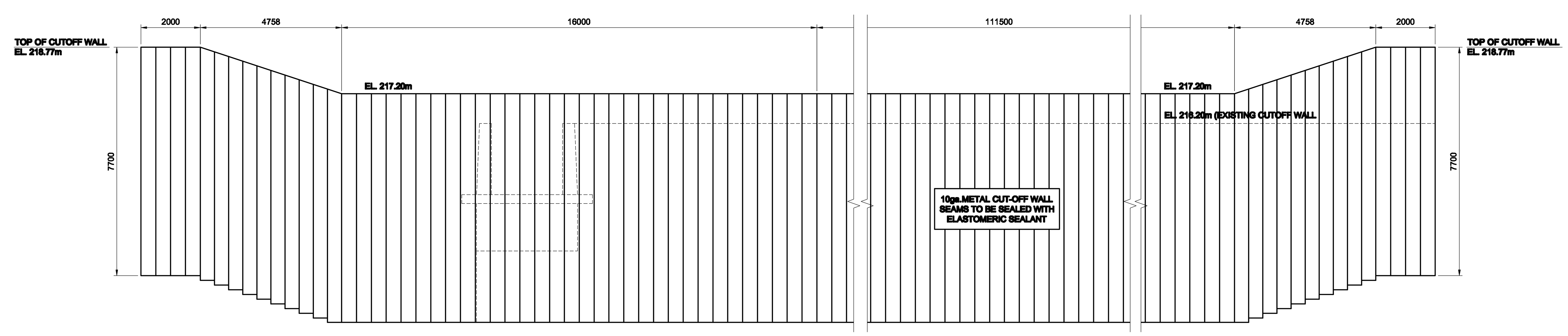
ZONE	MATERIAL TYPE	GENERIC DESCRIPTION - REFER TO SPECIFICATIONS FOR COMPLETE REQUIREMENTS
A	Impervious Fill	75mm Minus Till, 20-30% Fines
B	Upstream Filter	75mm Minus Sandy Gravel, Max. 7% Fines
C	Upstream Rip Rap	1000mm Minus Boulders
D	Spillway Filter	150mm Minus Granular Fill, Max. 7% Fines.
E	Downstream Rip Rap	1200mm Minus Boulders



SECTION G-G
SCALE 1:100



DETAIL 1
SCALE 1:25



SECTION E-E
SPILLWAY SECTION
SCALE 1:100

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
This Permit Allows
NEWFOUNDLAND POWER INC.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by APEGN D0134 which is valid for the year 2011.

NOTES

1. ALL ROCK SURFACES TO RECEIVE GROUT MUST BE THOROUGHLY CLEANED OF ALL GRAVEL AND ORGANIC MATERIALS BEFORE PLACING, USING HIGH PRESSURE WATER SPRAY OR ALTERNATE METHOD, APPROVED BY THE OWNERS REPRESENTATIVES.
2. METAL CUTOFF WALL JOINT SEALANT TO BE SIKAFLEX 2C OR APPROVED EQUAL.
3. ALL ELEVATIONS IN METERS.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE.

REFERENCE DRAWINGS

DWG #	TITLE

REVISIONS

REV	DATE	DESCRIPTION	DRAWN BY	MADE BY	CHKD. BY	APP. BY	COMM. BY

NEWFOUNDLAND POWER
A FORTIS COMPANY

Project: SANDY BROOK DEVELOPMENT STRUCTURE REHABILITATION

DESIGNED: T. WHITE
DRAWN: R. POWER
CHECKED: G. HUMBY
APPROVED:
PASSED:

Title: DAM/SPILLWAY/OUTLET PLAN, SECTIONS AND DETAILS

Scale: AS NOTED
Date: 2010-04-22
DWG. NO. 6-602-21-212