

ANNEX 1-C

**PROPOSED OPERATING FLOWS AND LEVELS
FOUR SLIDE FALLS HYDRO PROJECT**



PROPOSED OPERATING FLOWS AND LEVELS **Four Slide Falls Hydro Project**

A Report to: Xeneca Power Development Inc.
5160 Yonge Street, Suite 520
Toronto, Ontario
M2N 6L9

Submitted by: ORTECH Consulting Inc.
804 Southdown Road
Mississauga, Ontario
L5J 2Y4

Date: July 2011

ACKNOWLEDGEMENT AND AUTHENTICATION

This Conceptual Operation Plan document was prepared by Xeneca Power Development Inc. (Xeneca). Xeneca acknowledges the following assistance and input from ORTECH Consulting Inc. (ORTECH) and Canadian Projects Limited.

- ORTECH developed the Operation Plan and prepared the body of the report.
- Canadian Projects Limited completed the hydrotechnical analysis including, extension of existing synthetic flow datasets, characterization of headpond/reservoir dynamics, modelling of flows and calculation of key hydrologic statistics.

The main participants responsible for completing the Conceptual Operation Plan were:

NAME	POSITION	RESPONSIBILITIES
Xeneca Power Development Inc.		
Nava Pokharel	Senior Project Manager	Project Management and Coordination
ORTECH Consulting Inc.		
Uwe Roeper	Principal	Overall development and preparation of the Operation Plan including the plant operating parameters; Figure 1
Canadian Projects Limited		
Richard Slopek, P.Eng. Wes Dick	Project Manager Senior Hydrotechnical Engineer	Hydrology and hydraulic analysis including preparation of the figures and tables except Figure 1.

TABLE OF CONTENTS

ACKNOWLEDGEMENT AND AUTHENTICATION	1
TABLE OF CONTENTS	1
1 OPERATIONS PLAN.....	2
1.1 Mode of Operation	2
2 UPSTREAM STORAGE EFFECTS	5
2.1 Shoreline Erosion	5
2.2 Aquatic Habitat Upstream	6
2.3 Civil Structures and Private Property	7
3 DOWNSTREAM FLOW EFFECTS.....	9
3.1 Downstream Aquatic Habitat.....	9
3.2 Navigation.....	10
3.3 Public Safety & Civil Structures.....	11
3.4 Ice Scour	11
3.5 Water Management Plan	12
4 SEASONAL OPERATIONS.....	13
5 PROPOSED OPERATING FLOWS AND LEVELS	16
5.1 Upstream Operation Parameters	16
5.2 Downstream Operation Parameters.....	19
5.3 Special Event Operation	24
6 SUMMARY DISCUSSION ON OPERATIONS.....	26

Attachment 1: Four Slide Falls Hydro Project Headpond Inundation Mapping

1 OPERATIONS PLAN

This section describes how the facility will be operated on an on-going basis. Discussed are the mode of operation, the potential effects on the river, the seasonal considerations and the proposed operating rules and target limits.

The operations plan proposed herein was based on various background studies listed below and further referenced in the bibliography of the environmental assessment document:

1. Lidar Survey: detailed topographic mapping of the upstream and downstream river reach.
2. Conceptual Design: drawings of the structures as conceptually proposed for the project.
3. Hydrology Study: an analysis of the natural river flows.
4. Bathymetric Study: a field study of water depths upstream and downstream of the project location and a spot measurement of flows required for hydraulic model calibration.
5. Hydraulic Study: a detailed hydraulic engineering analysis was carried out under separate cover (i.e. a 1-dimensional HEC-RAS model) to better understand the various hydraulic parameters relevant to assess operational and environmental matters.
6. Erosion Survey: a desktop survey of upstream locations that could be sensitive to future shoreline erosion after the project is built.
7. Environmental Field Studies: studies of environmental areas and aspects of interest as documented in other parts of this environmental assessment.

It is noted the operations plan presented herein is based on the conceptual engineering design information and environmental information as it was available at the time of writing. The final engineering design or other information that becomes available over time may require minor adjustments to this plan to ensure that the objectives of mitigation and limiting impacts as contemplated herein are met.

1.1 Mode of Operation

The electricity generated from this project has been contracted to the Ontario Power Authority under a FIT Contract. The terms and conditions of the FIT Contract encourage the facility to generate electricity when needed most in Ontario, between the hours of 11:00 a.m. and 7:00 p.m. on business days. The mode of operation takes into account the objective of building and operating the project in an environmentally sensible manner, while trying to achieve the socio-economic objective of generating power when it is needed in the Province.

It is proposed to operate the facility as a “modified run-of-river” generating facility. During certain times, the facility would operate at the same rate as the natural flow in the river (i.e. “run-of-river”) with no variation in upstream water levels due to operation and no man-made variation

in downstream flows from those experienced naturally. At other times, the facility would “modify” the natural flow in the river by storing some of the natural river flow during night time and/or weekend hours to be used during daytime hours (i.e. on business days from 11:00 a.m. to 7:00 p.m.) when the need for electricity in the Province is greater.

Run-of-river operation would occur during two (2) types of natural flow conditions:

1. When natural river flows are greater than the maximum turbine capacity (Q_{Tmax}): Since the natural flow exceeds the amount of water that can be processed through the turbine, any excess water is bypassed through the spillway structure. The combined flow of the water used in the turbine to generate electricity and the water bypassed over the spillway equals the natural flow. This situation occurs primarily during spring thaw run-off conditions and during major storm events in the spring, summer and fall.
2. When natural flows are so low that any available water must be released downstream to protect the environment: The flow in this situation is typically too low to generate electricity. This situation occurs primarily in late summer and late winter when natural flows are typically very low. This situation may also occur during certain years when spring run-off flow is unusually low and the amount of water available is needed downstream to protect the environment.

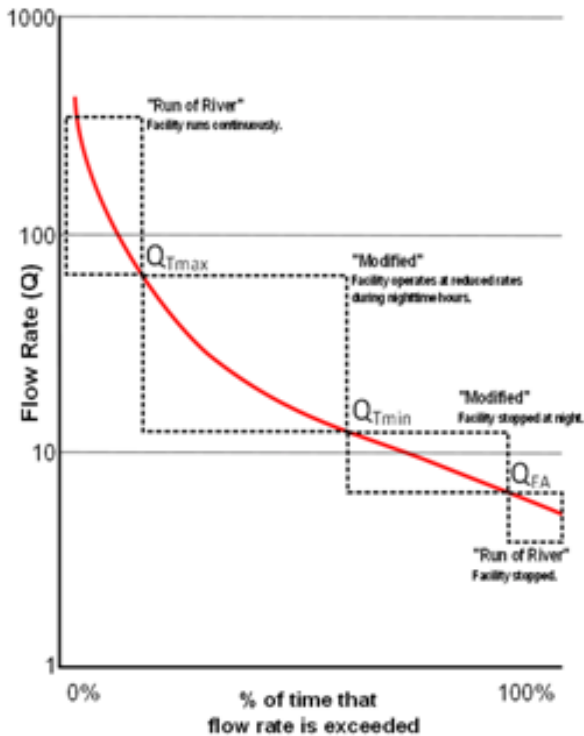
Modified run-of-river operation would occur during moderate and low flows when the natural flow in the river is below the maximum turbine flow capacity (Q_{Tmax}) but above the minimum flow required to protect the environment (Q_{EA}). During these flow conditions, some of the natural river flow during night-time and/or weekend hours can be stored and used to produce electricity during daytime hours. There are two modes of modified operation as follows:

1. Facility runs at reduced rate at night: When natural river flows are moderate (i.e. between the minimum (Q_{Tmin}) and the maximum (Q_{Tmax}) rate of turbine capacity), the facility runs continuously, but some of the water is saved during night-time and/or weekend hours. This operation results in downstream flows that are smaller than natural river flows during night-time and/or weekend hours and larger than natural river flows during daytime hours when electricity use is higher. However, the minimum flow in this mode of operation is not less than the minimum turbine capacity (Q_{Tmin}).
2. Facility is stopped at night: When natural river flows are low (i.e. below the minimum turbine capacity (Q_{Tmin})), the facility will need to stop operation during some night-time hours and save water until operation is again possible. The lower the natural river flow, the longer the period of stoppage will be. When the facility operates, it operates at a rate less than maximum turbine capacity (Q_{Tmax}). To ensure that the downstream river reach receives enough water flow to protect the environment (Q_{EA}), the appropriate amount of water is released through a bypass while the turbine operation is stopped.

Figure 1 illustrates the mode of operation that occurs depending on the amount of natural flow in the river.

An important factor in modified run-of-river operation is the availability of storage upstream of the facility. As described in the project description section of the environmental assessment, the

Figure 1
Operating Modes
Illustration of Operating Modes



amount of storage created as part of the project is very limited. To achieve the objective of building a project with limited environmental impact, the conceptual design of the facility limits the height of structure, the depth and the area of inundation upstream. Consequently, the amount of storage available for operation is inherently limited in relation to the natural flow in the river, thereby limiting the storage to a few hours during moderate and low flows. The ability to use this storage is further constrained by environmental constraints outlined in other parts of the environmental assessment document. It is the limited storage that differentiates modified run-of-river projects from hydroelectric projects that create large storage reservoirs with the ability to store water for weeks or seasons to “peak” when seasonal periods of hot or cold spells raise the need for extra electricity production. Typically, modified run-of-river projects have significantly less

environmental impact than peaking hydroelectric projects.

2 UPSTREAM STORAGE EFFECTS

During periods of moderate and low flows when the facility operates in modified run-of-river operation mode, water levels upstream of the facility will fluctuate from daytime to night-time hours. Water levels will rise during the night as production is reduced below the natural rate of river inflow. Conversely, water levels will fall during the next business day as production is increased above the natural rate of river inflow. The fluctuations can affect:

1. Shoreline erosion
2. Aquatic Habitat
3. Civil Structures & Private Property

2.1 Shoreline Erosion

The fluctuation in daily water levels upstream can increase the amount of shoreline erosion that would occur without modified operation. A small amount of shoreline erosion occurs naturally in the river; however, accelerated and persistent shoreline erosion is undesirable for the following reasons:

1. Natural shoreline vegetation cannot establish where accelerated erosion occurs on an ongoing basis.
2. Shoreline aquatic habitat can be affected negatively in the immediate area around the erosion location.
3. In extreme cases, erosion can cause an increase in the overall sediment load in the river with the potential for secondary effects on water turbidity and aquatic conditions.

For significant and persistent acceleration of shoreline erosion to occur, two (2) conditions must coincide:

1. Slope: the slope of the ground must be steep at the location where it intersects the shoreline of the inundated area upstream of the facility.
2. Soil Material: the soil material must be susceptible to erosion (i.e. this depends on the type of soil material and can range from negligible for rock to very high for pure silt with negligible clay content and cohesion).

An erosion survey was completed along the upstream shoreline to identify those locations where the potential for erosion will exist after inundation. The proposed mitigation is to:

1. Limit the maximum daily fluctuations of upstream water levels: The operating plan parameters proposed herein for daily fluctuation have been chosen to be less than the amount of seasonal and inter-annual fluctuation that has been occurring naturally over time in the upstream river reach prior to the construction of the project. By limiting the daily fluctuation, vegetation will naturally establish at the shoreline immediately above the narrow range of daily fluctuation and thereby limit erosion potential.

2. Limit the rate of change of upstream water level change: Rapid changes in shoreline water level can increase erosion. Where pore water in the soil dissipates too quickly, pore pressure can loosen soil grains and cause loss of stability in the soil structure, thereby enhancing erosion. By limiting the rate of change, this erosion mechanism is avoided.
3. Monitoring: The locations where the potential for erosion has been identified in the erosion survey will be inspected and assessed in year one (1) and year five (5) of the operation to document if and/or to what degree erosion has occurred.
4. Mitigation Follow up: Where monitoring reveals significant erosion and the potential for adverse environmental effects, further monitoring and/or mitigation strategies will be developed as required.

Based on the erosion survey completed, the potential for significant erosion is deemed to be limited. The above approach is believed to reasonably address this matter as it relates to safe and environmentally responsible operation of the project.

2.2 Aquatic Habitat Upstream

Daily fluctuation of water levels during periods of modified run-of-river operation may impact certain sensitive aquatic habitat at the upstream shoreline area. The existence and extent of any sensitive aquatic habitat areas have been documented as part of environmental field studies that are presented in other sections of this environmental assessment document. The impact of daily water level fluctuation is typically very limited but specific effects can include such things as:

1. Effects on fish spawning in shallow water areas along the shoreline where daily fluctuations are significant in relation to the typical water depth.
2. Effects on water mammal habitat such as beaver houses where significant water level fluctuations create unfavorable conditions in shallow areas.
3. Movement of ice causing sediment scouring, sediment movement or turbidity at affected shoreline locations.
4. Effects on avian nests, typically found in shallow water areas only.

The significant aquatic habitat issues identified in the field studies were reviewed and considered in developing this operating plan. Also considered was the time of year when various habitat activities occur. To reduce the potential for negative habitat impact upstream during a modified run-of-river operation, the following step was taken in developing the specific operating parameters proposed herein:

1. Limit the maximum daily fluctuations of upstream water levels: The operating plan parameters proposed herein for daily fluctuation have been chosen to be less than the amount of seasonal and inter-annual fluctuation that has been occurring naturally over time in the upstream river reach prior to the construction of the project. This step does not eliminate the potential for effects but it limits the potential extent of impact to the

point possible while still maintaining the socio-economic benefit of shifting some electricity production to times when electricity usage is high in the Province.

Combined with the steps taken in the conceptual design to limit the environmental footprint of the project, the proposed operating parameters are believed to avoid significant impacts on upstream habitat associated with the project.

2.3 Civil Structures and Private Property

Civil structures are man-made structures, such as bridges, roads, transmission lines, water intakes, boat launches and docks. Private property includes any leased, deeded, eased or owned real property (i.e. land). During the conceptual engineering design of the project, the upstream area that could be affected by the project and by inundation was reviewed. A static inundation map was created to identify potential sites of concern where the upstream inundation of the project could affect civil structures. Where the potential for effects on civil structures exists, steps were taken in the conceptual design to avoid or minimize impacts. These matters are discussed in other sections of this document.

In developing the operating plan, the additional effect created by modified operation of the project was assessed. Extensive hydraulic modeling was carried out as part of the HEC-RAS Study to evaluate the following:

1. Upstream water levels during various natural river flows and under operating conditions.
2. Backwater effects beyond the static inundation considered in the conceptual design work.
3. The upstream distance from the facility to where the flood levels and inundation will not be affected by the project.
4. Mapping of the estimated natural High Water Mark (i.e. the visible demarcation left in the vegetated shoreline from repeated annual flooding).
5. Any upstream locations where the facility operation could impact the natural High Water Mark.

A map showing the various inundation levels that occur during various flood stages is attached to this document. Another attached plan shows a river profile of the water depths for pre- / post-construction and for various flows. The river profile clearly shows how far upstream the backwater effect extends. More detailed information is contained in the HEC-RAS Study referenced at the start of this section.

Xeneca has taken reasonable steps to ensure that civil structures and private property will not be impacted beyond what already occurs naturally or as specifically agreed with relevant parties on a bilateral basis. Any stakeholder with a concern about upstream impacts on any specific civil structures and/or private property is encouraged to review the available study information and/or contact Xeneca for additional clarification and bilateral discussion as necessary.

In addition to the above, the following steps were taken in developing the proposed operating parameters for the Project:

1. Set the maximum upstream operating water level: The maximum upstream operating water level was carefully set based on the results of the HEC-RAS Study to specifically avoid infringing on the pre-construction High Water Mark at any civil structure or private property. More specifically, the proposed operating values were reviewed to ensure that any backwater effect does not exceed the natural High Water Mark in areas where the potential for impact exists.
2. Limit the maximum daily fluctuations of upstream water levels: The operating plan parameters proposed herein for daily fluctuation were reviewed to ensure that impact on civil structures would not be a concern.
3. Manage flood events to minimize backwater effects: During flood passage where the natural flow exceeds the maximum turbine capacity (Q_{Tmax}), the facility will be operated to minimize flood impacts upstream by operating the spillway, turbine and bypass structures accordingly.
4. Spillway and bypass design: The spillway and bypass structures will be sized and designed to provide the amount of flood passage capacity required to meet the objectives of the operating plan. This step will be assessed in more detail at a later time in the detailed engineering design stage.

Daily fluctuations in upstream water levels can have several implications related to ice cover. Rising and falling water levels can create and subsequently fill cracks in the ice cover, resulting in significant forces on structures, which must be considered in the structural design. During thawing conditions and spring breakup, the release of ice over the structure can contribute to downstream ice jams.

The extent of ice related impacts will be more fully assessed during the detailed engineering stage of the facility. The assessment will consider, where practical, adjustments to the normal operating plan for the duration of ice breakup that minimizes the risk of downstream ice jams.

3 DOWNS TREAM FLOW EFFECTS

During periods of moderate and low flows when the facility operates in modified run-of-river operation mode, the flows downstream of the facility will vary from certain daytime to night-time hours. At certain night-time hours (i.e. outside of the hours of 11:00 a.m. to 7:00 p.m. on business days), flows will be substantially lower than natural river flows. At certain daytime hours (i.e. during the hours of 11:00 a.m. to 7:00 p.m. on business days), flows will be greater than natural river flows.

The variability in flow can be significant from an area immediately downstream of the facility to a distance downstream where the variability in flow is attenuated by the presence of a lake or confluence with another significant tributary (the “Variable Flow Reach”). Within the Variable Flow Reach, water depth, flow velocity and wetted perimeter will change from daytime to night-time while the modified operation is occurring.

The degree of variability depends on the mode of operation and the difference between the daytime and night-time flow. While the facility is operating continuously, but at a reduced rate at night, the amount of water discharged at all times is very significant. Also, the rate of variability is in the same general range where daytime flow is typically not more than four (4) times larger than night-time flow. Under continuous operation, the potential for environmental impact is limited as flows will be substantial enough at all times for most environmental requirements.

While the facility is operating intermittently (i.e. stopped at certain times at night), the variability in the flow can be large. The amount of water released at night is only the minimum amount required to protect the environment. The minimum amount released while operating is at least the minimum turbine capacity (Q_{Tmin}) or more. The difference in this mode of operation can result in daytime flows that are 10+ times larger than at night-time. Out of the four (4) operating modes, it is this mode that warrants the greatest consideration for operations planning.

In this mode, the variability can affect:

1. Aquatic Habitat
2. Navigation
3. Public Safety & Civil Structures
4. Ice scour

3.1 Downstream Aquatic Habitat

The daily variability in flow during modified operation may impact certain sensitive aquatic habitat in the Variable Flow Reach downstream of the facility. Examples of possible concerns include:

1. Effects on fish spawning and foraging.
2. Effects on benthic organisms in the river sediment.

The significant aquatic habitat issues that were identified in the field studies were reviewed and considered in developing the operating plan. To reduce the potential for impact in the Variable Flow Reach during intermittent operations, the following approach was taken in setting operating parameters:

1. Timing of Event: Special attention was given to the timing of aquatic habitat events and the relationship to the range of natural flows that could occur during that period. Where intermittent operation could occur during those periods, the bypass flow provided while the facility is stopped was given special consideration.
2. Sizing of bypass flows: Bypass flows were considered in the context of the associate water depth, flow velocity and wetted perimeter in the Variable Flow Reach. The objective is to minimize the amount of water released during times when the facility is stopped, while providing enough water to minimize stress on the aquatic environment.
3. Controlled ramping of flows: To minimize the sudden release of water that occurs during start up, a ramping procedure was put into place. The ramping procedure requires the facility to start at minimum turbine capacity (Q_{Tmin}) and gradually ramp up output to the desired operating rate.
4. Limiting maximum turbine flow (Q_{Lim}): During intermittent operation, the turbine flow was set to not exceed an upper limit to minimize the amount of flow variability that occurs on a daily basis.

The proposed operating parameters and objectives are believed to avoid significant impacts on the downstream habitat associated with the project.

It should be noted that the operating parameters for turbine flows depend on the final design and equipment selected at construction. Some variation in the related parameters can occur, however, the objectives of the mitigation and environmental flows (Q_{EA}) provided would not change.

3.2 Navigation

Navigation impacts could result during times of modified run-of-river operation in the Variable Flow Reach. During certain hours, the flows and water depths would be lower than normal. During certain other hours, the flows and water depth would be greater than normal.

The river is not used for commercial navigation but sporadically for recreational canoeing. This matter is being addressed through the stakeholder consultation process. It should be recognized that intermittent operation would occur only during low flows, most of which occur during the winter months when the river is frozen and not navigable. During summer months, some consideration was given to increasing the environmental flows (Q_{EA}) that occur when the facility is stopped to mitigate potential restrictions to canoeing.

3.3 Public Safety & Civil Structures

Public safety considerations could arise due to variability in flows and the rate of change in flows and levels in the Variable Flow Reach. Possibly affected could be recreational uses such as camping, fishing or hiking at the edge of the river in this area. The effect on uses is being assessed as part of the public stakeholder consultation associated with the environmental assessment process.

The scope of the potential change in water flows due to intermittent operation was addressed in the HEC-RAS Study referenced earlier in this operations plan. The model provides information about the water depth at various flows, including an assessment of the changes in flows and water depths that occur during an intermittent operations event. The expected water flow changes are included in the section on the proposed operating flows and levels presented below.

It should be recognized that intermittent operation would only occur during low flows, most of which occur during the winter months when the river is frozen and recreational uses are limited. During the summer months, some consideration was given to increasing the environmental flows (Q_{EA}) that occur when the facility is stopped to mitigate potential restrictions to canoeing. Safety issues that are identified will be addressed through an awareness plan once the facility goes into operation.

The civil structures are not expected to be affected by the changes in daily flows related to the modified operation. The range of flows associated with the daily variation of turbine discharge is well within the range of flow for which civil structures are designed. The maximum downstream river flows associated with maximum turbine capacity (Q_{Tmax}) are in the range of normal river flows and well below the flood flows experienced during spring freshet or major rain events. Impacts on civil structures and private property located in the Variable Flow Reach downstream of the facility are not anticipated.

3.4 Ice Scour

Ice scour can occur where water levels fluctuate during the winter months and where soft river bottom sediments exist. The action of broken ice wedging into the river sediments and moving up and down with repeated water level fluctuations can disturb certain shoreline habitat such as benthic organisms or winter spawned fish eggs.

To address the matter the following considerations were made:

1. In most sections of the Variable Flow Reach, the river bed consists of hard bedrock that is not sensitive to ice scour. Soft sediments exist primarily at the higher lying shorelines and in deeper sections of the river and in pools where slow moving water has allowed local deposition of soft sediments. The dispersed nature of the soft sediments suggests that ice scour is limited to certain areas or sections of the Variable Flow Reach.

2. The greatest potential for ice breakage and ice scour exists when the difference in daytime and night-time flow is the greatest (i.e. during intermittent operation). This situation occurs when natural river flows are low, primarily during the winter. At these low flows, the higher lying river bank sections, where soft sediment is primarily found are not affected. This limits the areas of interest to locations where soft sediments occur in the primarily rocky river bed.

The above considerations suggest that the potential for significant impact related to ice scour in the prevailing river bed conditions is limited. However, it is difficult to predict the exact potential for ice scour. To address this matter, the following mitigation strategy is proposed:

1. A monitoring location with soft sediments and potential for ice scour will be established prior to construction in an accessible area of the Variable Flow Reach.
2. The monitoring location will be documented with photographs taken during low flows in late summer.
3. The monitoring location will be assessed for visible effects of ice scour after year 1 and year 5 of operation (i.e. during low flows in late summer). The assessment will be documented with photographs.
4. The monitoring location will be assessed in the winter while modified operation is ongoing in year 1 and year 5 to determine if and how much ice breakage and wedging occurs.
5. Based on the results of the assessment, the operating plan will be adjusted to mitigate where a significant adverse effect is determined to occur as a result of modified operation.

3.5 Water Management Plan

The Lakes and Rivers Improvement Act provides for the creation of water management plans for operating facilities where such plans are deemed necessary by the regulatory authority. The purpose of these plans is to ensure operations practices are consistent with other uses of the river and public safety objectives. Where a regulatory authority requests the creation of a Water Management Plan for the facility, or incorporation of the facility in any existing Water Management Plan, Xeneca will facilitate the regulatory requirements as required.

With respect to the operations plan presented herein, it is contemplated that this plan and associated studies, once finalized through the environmental assessment process would form the basis for any Water Management Plan as it relates to the facility.

4 SEASONAL OPERATIONS

Environmental protection requirements vary significantly depending on the time of the year. Operating parameters have to be set accordingly to address these changing requirements throughout the year.

For operating purposes, operating seasons can be defined in various ways, including calendar seasons, periods of consistent meteorological conditions and periods of special environmental significance. The approach used in this operating plan divides the year into the following operating seasons:

1. **Spring Freshet:** The spring freshet period begins with the rapid increase in the spring snow melt flow on the hydrograph of average annual flows and ends with the levelling off of flows after flood waters have receded. The period coincides with increases in water temperature and flows that trigger various aquatic activities in the river.
2. **Summer Low:** The summer low period begins with the end of the freshet and lasts until the upward inflection that occurs on the hydrograph of average annual flows in early fall. The period typically exhibits warm water temperatures and a high degree of activity in the entire food chain. Flows are generally low but highly variable, depending on rainfall events.
3. **Fall Freshet:** The fall freshet begins with the upward inflection on the hydrograph of average annual flows and ends with the levelling off of flows after the freshet flows have receded. The period exhibits decreasing water temperatures and moderate flows. The insect activity has become minimal due to cool air temperatures above the water and the associated food chain activity is slowing down.
4. **Winter Low:** The winter low period begins with the end of the fall freshet and finishes when the spring freshet starts. Water and air temperatures are cold. Most water surfaces freeze during this period and various fish and aquatic species either hibernate or seek deeper waters such as pools and lakes. Flows are generally low and decrease gradually but continuously until spring freshet.

The start and end dates for the above operating seasons have been picked from the hydrograph of average annual flows (see Figure 2) and summarized in Table 1. A flow exceedance curve is provided for each season in Figure 3.

Table 1

Season	Season Start Date
Spring	March 23
Summer	July 1
Fall	October 10
Winter	January 15

Figure 2

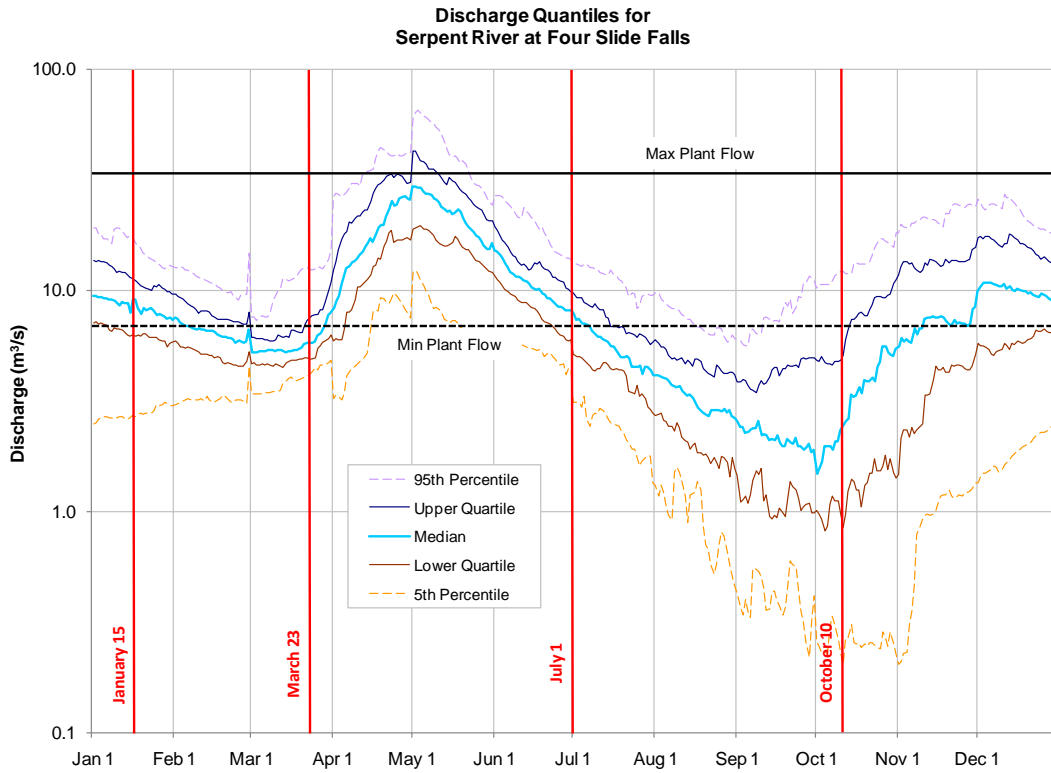
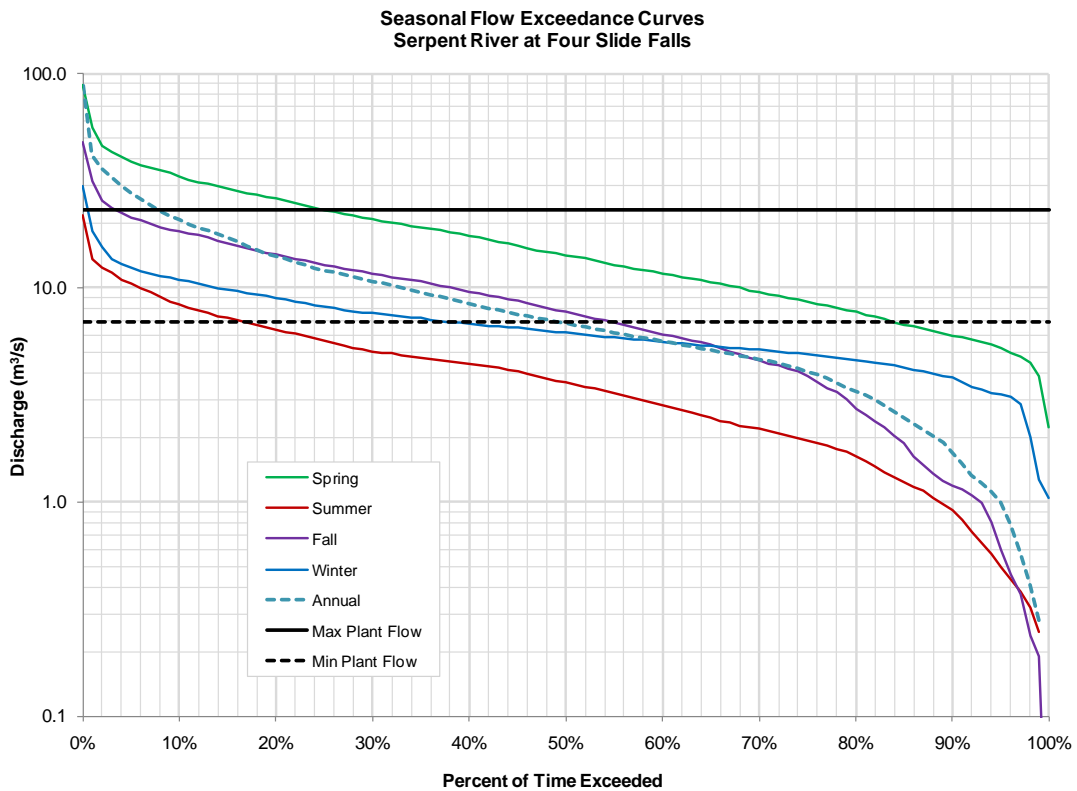


Figure 3



As shown on the hydrograph, flows vary substantially for the same day from one year to the next. While the hydrograph of the average annual flow provides a reasonable representation of the typical start and end times for each operating season, the actual start and end times will vary every year. This weather related aspect means that calendar dates can only serve as approximations of the actual timing of natural events. For the purposes of the operating plan, the start and end dates in the table will be used to govern the operation until a better technique for defining the start and end date becomes available.

5 PROPOSED OPERATING FLOWS AND LEVELS

This section summarizes the proposed operations parameters for the project. In selecting the operations parameters, the environmental aspects outlined in the previous sections were considered so as to provide a reasonable balance among operational constraints, environmental aspects and mitigation of possible impacts. Different operating parameters are proposed for each of the ecological seasons to reflect different needs and mitigation objectives for various times of the year.

It should be noted that changes in upstream levels and downstream flows related to operation occur only when the facility is in modified run-of-river operations mode. While the facility is in run-of-river mode and subject to the amount of natural flow in the river, the upstream levels will be maintained at a constant level and downstream flows will equal the natural flow in the river.

5.1 Upstream Operation Parameters

The operating parameters that can be used to mitigate upstream impacts are:

1. Maximum Daily Fluctuation of Upstream Water Levels: Under normal operation and during normal river flows, upstream water levels can be controlled as required by the rate of electricity production and hence water use. In modified run-of-river facilities, a portion of the normal river flow is typically stored during night-time hours causing water levels to rise upstream until the rate of production is increased again during daytime hours when electricity demand is higher. The limiting factor is the range of daily water fluctuation that is deemed acceptable in the inundated area upstream of the facility. The proposed operating parameters set a maximum range of upstream water levels during normal operation to mitigate upstream impacts.
2. Rate of upstream water level change: To a limited degree, the rate of change of upstream water levels can be managed by the rate of electricity production during operating hours. The possible production rates range from the minimum turbine flow (Q_{Tmin}) to the maximum turbine flow (Q_{Tmax}). The limiting factor is the rate of rise or fall that is deemed acceptable to protect shoreline habitat.
3. Minimum Upstream Operating Water Level: The minimum upstream operating water level is the water level below which no power is generated during normal operations. It should be noted that the need to provide environmental flows may result in drops of upstream water levels below the minimum water level even if no power is generated. This situation can occur during prolonged periods of drought and cannot be controlled by plant operation.
4. Maximum Upstream Operating Water Level: The maximum upstream operating water level is the water level beyond which water is bypassed through the spillway during normal operations to avoid further water level rise upstream. It should be noted that during flood conditions water levels may rise above this level due to natural factors. It is noted that various engineering documents or drawings may refer to this level as the Normal Operating Level (NOL) or the Full Supply Level (FSL).

The proposed operating parameters for upstream water levels are provided below. Operating parameters are provided for each of the operating seasons discussed above. The maximum and minimum normal operating levels are applicable except during flood and drought events as described in the section on special event operation elsewhere in this document.

Table 2

Upstream Operating Parameters

Inundation Area at LTAF	165	ha
Inundation Area - Pre-project	18	ha
Upstream Extent	6.8	km
Maximum Operating Level	284.0	m MSL
Minimum Operating Level	283.0	m MSL
Maximum Daily Fluctuation	1.0	m

Note: values are for normal flow conditions, parameters may vary during droughts or floods due to factors of nature.

Figures 4 and 5 show the amount of storage available and the amount of time required to fill the available storage (i.e. to raise level 1 metre) at various flow conditions. As is apparent, the amount of available storage is small. At low flow conditions it takes longer to fill the storage, illustrating that the limited storage available is most useful at low flow conditions.

Figure 4

**Four Slide Falls
Headpond Storage Rating Curve**

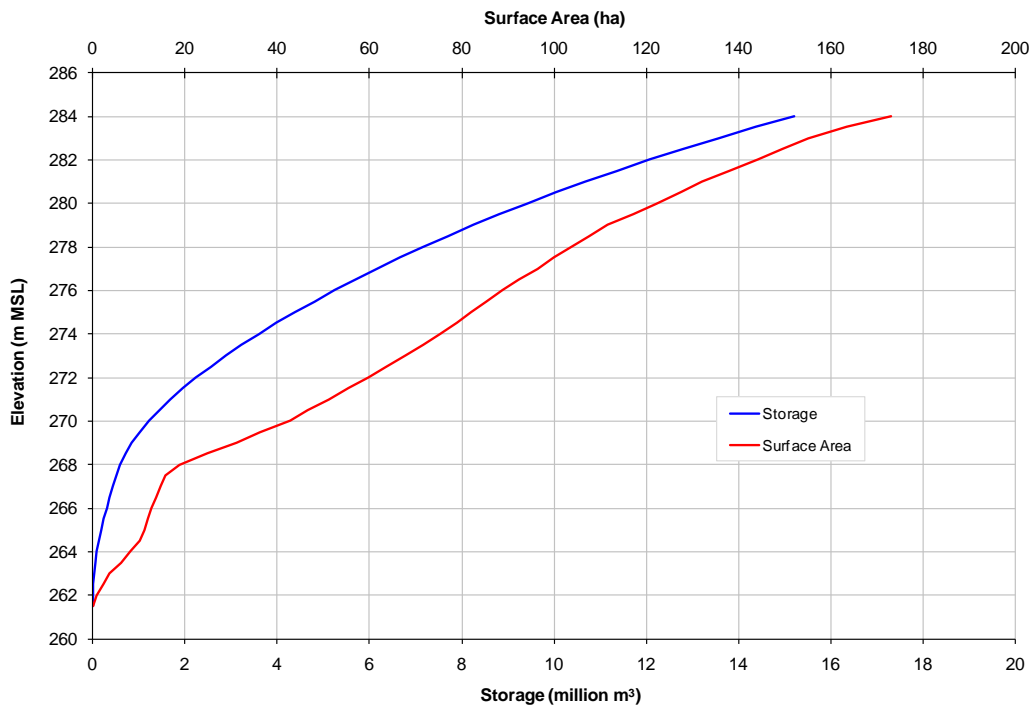
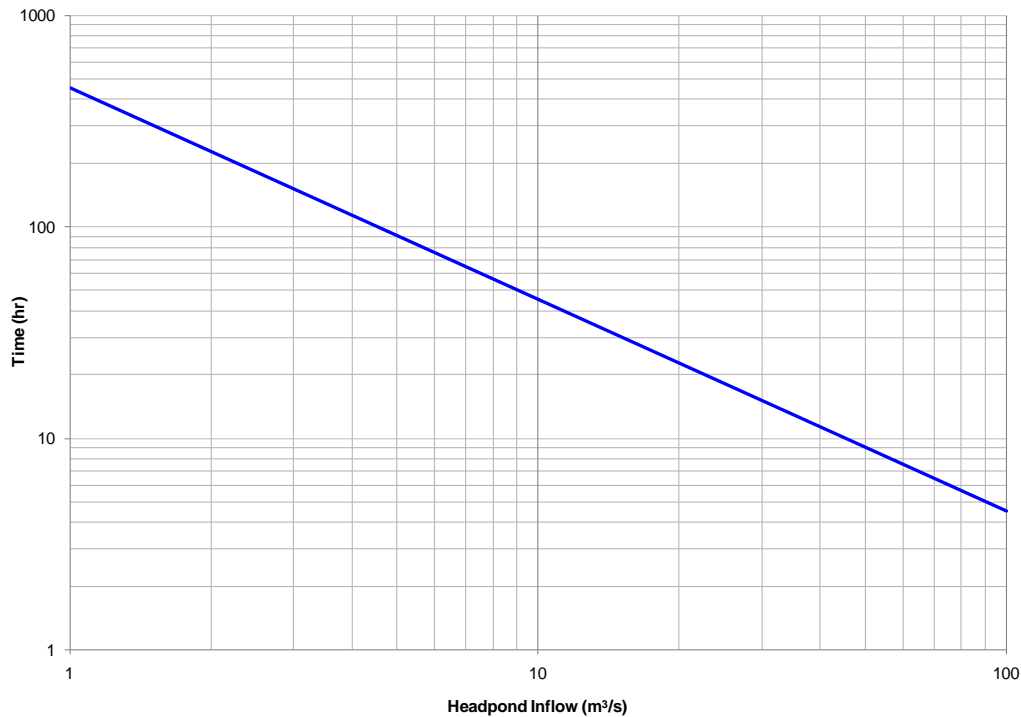


Figure 5

**Four Slide Falls
Time to Fill 1m of Headpond Below Normal Operating Level**



5.2 Downstream Operation Parameters

The operating parameters that can be used to mitigate downstream impacts are:

1. Upper Turbine Limit (Q_{TL}): The maximum amount of flow generated by the facility operation while intermittent turbine operation is occurring. The turbine(s) can be operated in a range of flows and outputs ranging from the flow associated with the minimum turbine capacity (Q_{Tmin}) to the maximum turbine capacity (Q_{Tmax}). Where it is desirable to minimize the difference between daytime and night-time flows, the upper limit of turbine operation can be set as an operating parameter. Setting the upper limit has to take into account that the turbines do not operate very efficiently below roughly 65% of their maximum capacity (Q_{T65}).
2. Turbine Ramp Time: The time during which a turbine is taken to the desired operating flow (Q_{OP}). Turbine start up involves going from stopped operation to minimum turbine flow (Q_{Tmin}) in a very short period of time. Once the turbine is operating, the turbine capacity can be increased gradually to the desired operating flow (Q_{OP}). By increasing the flow gradually, some downstream impacts can be reduced.
3. Turbine Down Ramp Time: The time during which a turbine is taken down to minimum turbine flow (Q_{Tmin}) prior to shut down. By decreasing the flow gradually some downstream impacts can be reduced.
4. Environmental Flow (Q_{EA}): The amount of flow that is provided to the Variable Flow Reach during intermittent operation when the turbine is stopped. It should be noted that the environmental flow provided through operations cannot be larger than the natural flow upstream in the river.
5. Compensatory Bypass Flow (Q_{Comp}): The amount of flow that is provided at all times to the very short river reach between the containment structure and the powerhouse tailrace outflow. This flow is only relevant where the final design involves a separation between the containment structure and the powerhouse tail water outflow and where this design creates a section of reach that is by-passed. This flow is not applicable where the final design involves a close coupled design where the powerhouse tailrace outlet is immediately downstream of the containment structure. Where this parameter is applicable it is independent of the facility operation mode or status.

The proposed operating parameters for downstream flows are provided below. Operating parameters are provided for each of the operating seasons and relate primarily to an intermittent operation (i.e. when natural flows in the river are low but still above the minimum environmental flow (Q_{EA})). This mode of operation is most likely to occur in late summer and during the winter.

Table 3
Downstream Operation Parameters

Acronym	Description	Project & Streamflow Conditions (m ³ /s)			
		Spring (Mar 23- Jun 30)	Summer (Jul 1- Oct 9)	Fall (Oct 10 – Jan 14)	Winter (Jan 15 – Mar 22)
Q ₉₉	Streamflow exceeded 99% of time	3.89	0.25	0.19	1.28
Q ₉₅	Streamflow exceeded 95% of time	5.22	0.49	0.59	3.16
Q ₈₀	Streamflow exceeded 80% of time	7.70	1.63	2.71	4.56
Q ₅₀	Streamflow exceeded 50% of time	14.1	3.62	7.72	6.17
Q ₂₀	Streamflow exceeded 20% of time	26.0	6.34	14.3	8.98
Q _{EA}	Downstream environmental flow target	No Int. Op.	1	0.5	0.5
Q _{COMP}	Compensatory flow (between tailrace and dam)	0.2	0.2	0.2	0.2
Q _{Tmax}	Maximum turbine capacity	23.0			
Q _{Tmin}	Minimum turbine flow	6.9			
Q _{TL}	Limited turbine flow - modified ROR	15.0			
LTAF	Long term annual flow, average annual mean	9.59			
Q _{MED}	Median streamflow value	6.80			
7Q2	2 year return period 7-day-average-low flow	1.16			
7Q10	10 year return period 7-day-average-low flow	0.304			
7Q20	20 year return period 7-day-average-low flow	0.208			
Q _{HWM}	Streamflow corresponding to high water mark	25.0			
Q _{1:2}	High streamflow event; occurrence of 1 in 2 yr	33.3			
Q _{1:100}	High streamflow event; occurrence of 1 in 100 yr	59.1			
	Turbine Ramp Time	20 minutes			
	Turbine Down Ramp Time	20 minutes			

Table 4
Operating Mode Occurrence by Season

		Spring	Summer	Fall	Winter	Annual
Flood Flow	$>Q_{Tmax}$	25%	0%	4%	1%	8%
Moderate Flow	$Q_{Tmin} - Q_{Tmax}$	59%	17%	51%	38%	41%
Low Flow	$Q_{EA} - Q_{Tmin}$	15%	82%	44%	61%	50%
Very Low Flow	$<Q_{EA}$	1%	1%	1%	1%	1%
		100%	100%	100%	100%	100%

The following graphs illustrate the relationship between flow and water depth, water velocity and wetted perimeter at a typical cross-section downstream. A drawing of the cross-section associated with the data is shown on Figure 6. The relationships were derived from the HEC-RAS Study for various cross-sections downstream in the Variable Flow Reach. A river profile shown on Figure 7 illustrates how water depth varies from one location to another along the Variable Flow Reach. The HEC-RAS Study document should be consulted for further information about specific locations of environmental interest.

Figure 6

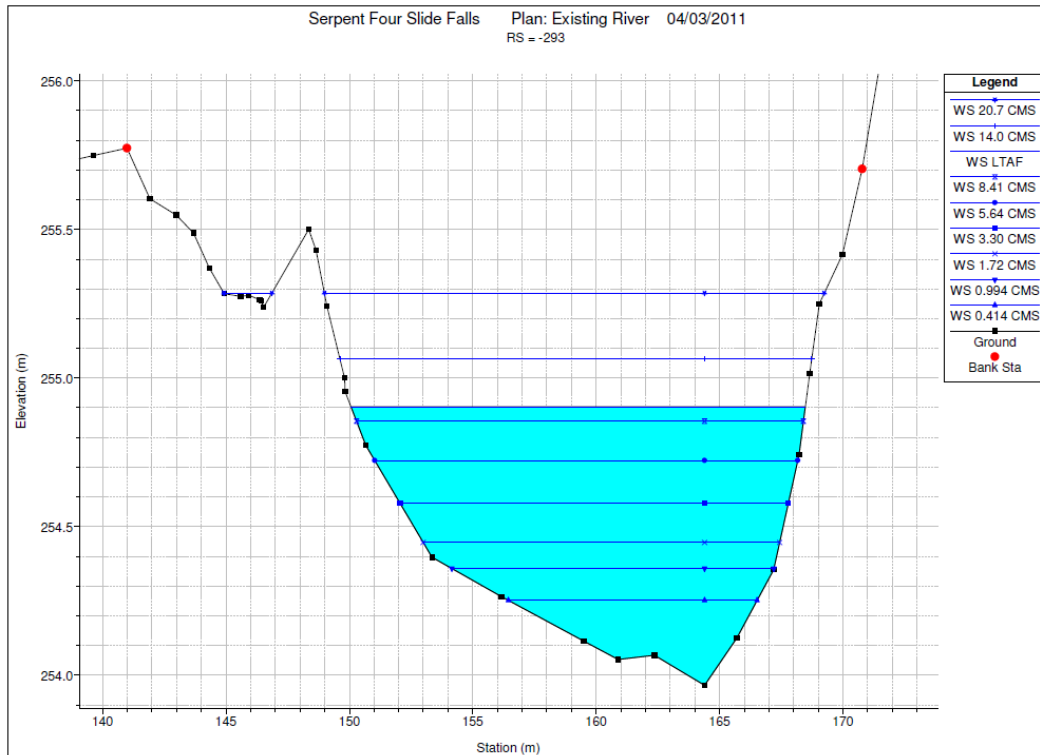


Figure 7

**Four Slide Falls - Serpent River
Variable Flow Reach Low Flow Profiles**

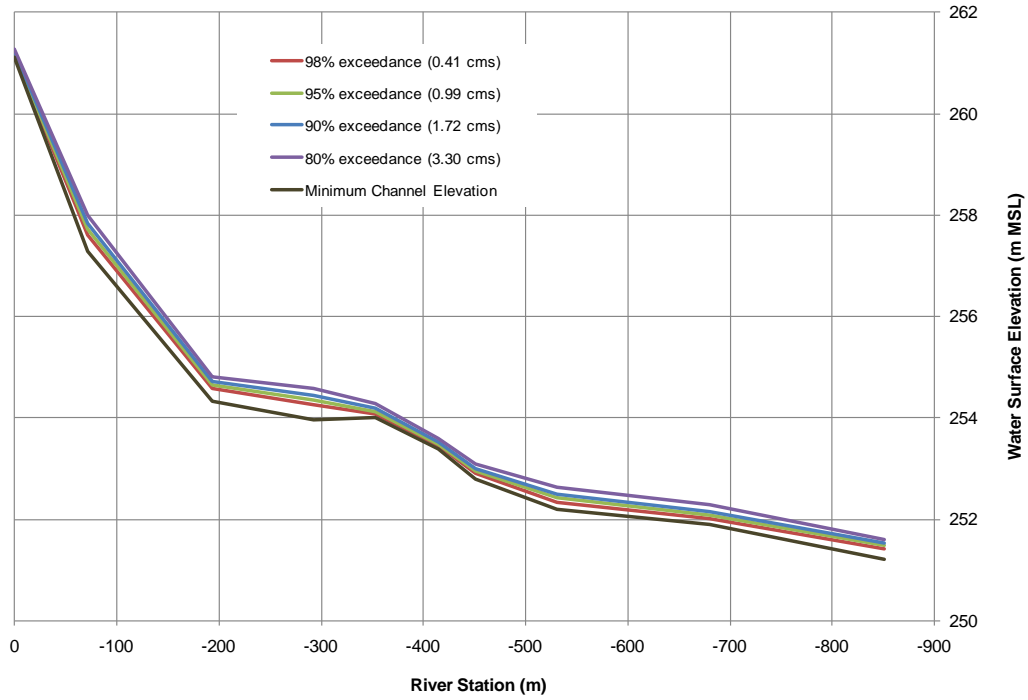


Figure 8

**Four Slide Falls - Serpent River - Station -0+293
Wetted Perimeter Rating Curve**

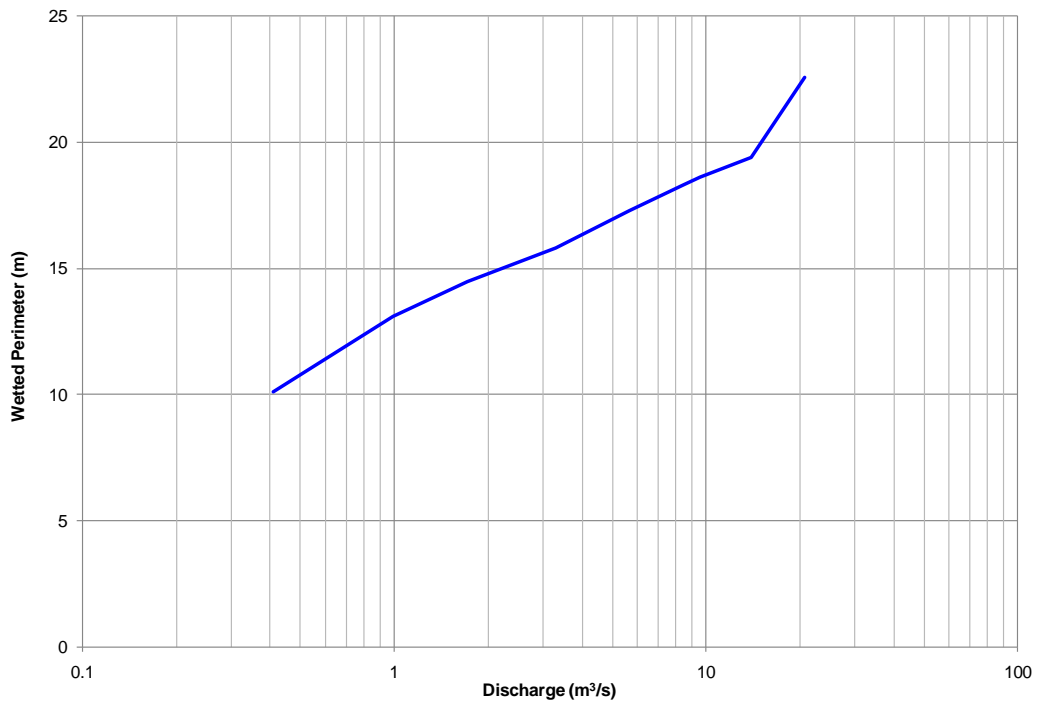


Figure 9

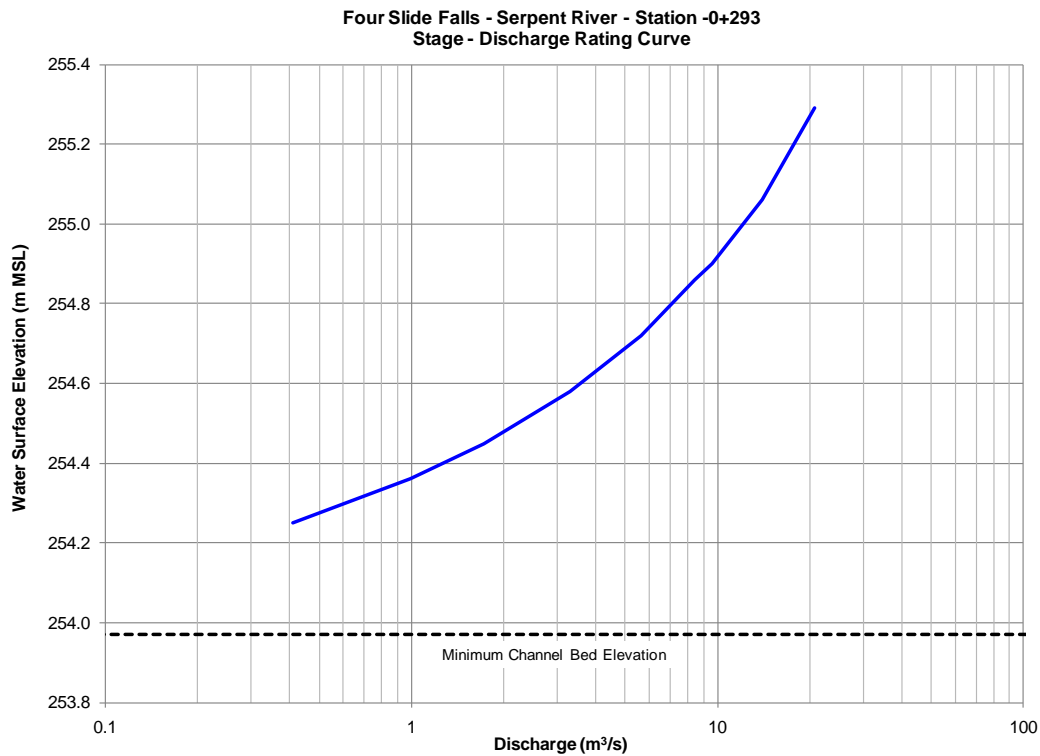
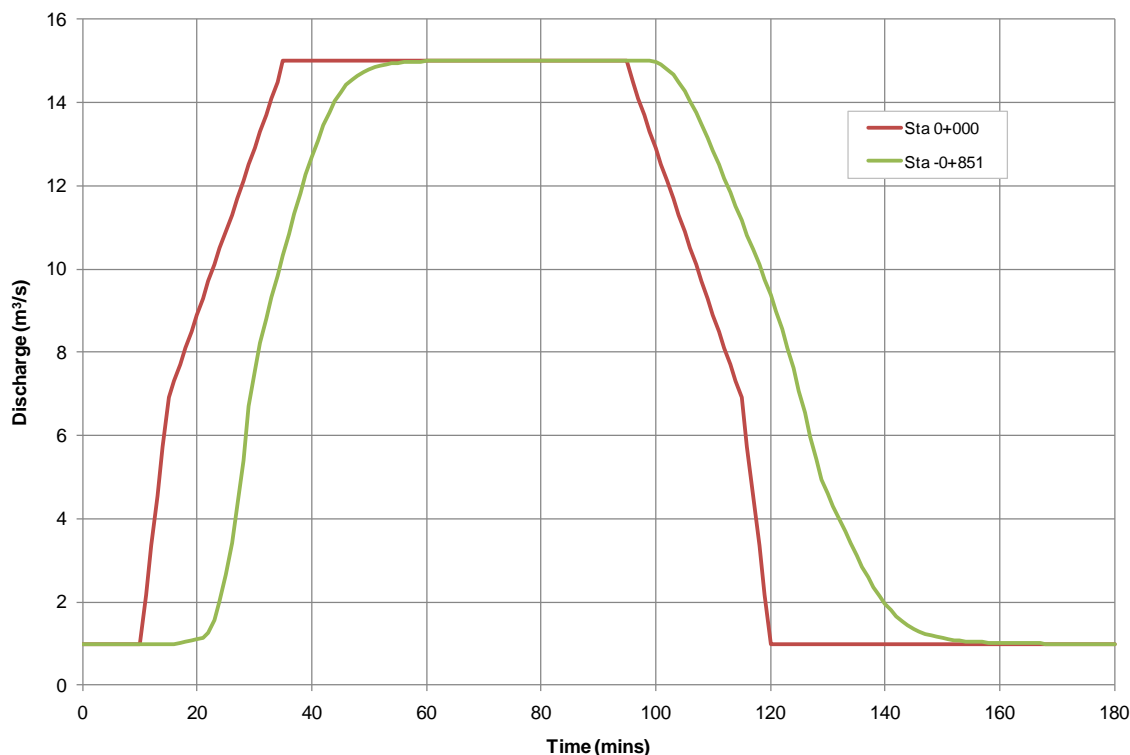


Figure 10 illustrates a typical operating cycle during intermittent operation, including the rapid increase in flow during start-up, the gradual increase in flow from minimum turbine flow (Q_{Tmin}) to 65% turbine capacity (Q_{T65}), a 1 hour run time and gradual shut down. The figure also illustrates the attenuation of the flow as the water moves downstream in the Variable Flow Reach.

Figure 10

Four Slide Falls
Typical Operating Cycle and Downstream Attenuation

5.3 Special Event Operation

During special events, such as floods, droughts and safety emergencies, it will be necessary to deviate from the normal operating parameters to manage flows and mitigate impacts.

1. Normal Flood Operation: Normal flood events are defined as event flows that exceed the maximum throughput capacity of the plant (Q_{Tmax}) up to and including the one in two year flood event level (Q1:2). Flood events of this magnitude are normal occurrences in the river and present little concern for safety or environmental impacts. During these periods, the facility is operated to manage water levels upstream below the maximum upstream operating water level where possible. This is achieved by allowing any water that is in excess of the maximum turbine capacity (Q_{Tmax}) to bypass the facility through the spillway and by operating the spillway and the power generation in a manner that achieves this objective.
2. High Flood Operation: High flood events are defined as events that exceed the one in two year flood event level (Q2) but are within the safe design level of the facility. Flood events of this frequency occur only infrequently over the life of the facility. The emphasis on operation is on ensuring public safety. This is typically achieved by allowing any water that is in excess of the maximum turbine capacity (Q_{Tmax}) to bypass the facility through the spillway and by operating the spillway and the power generation in a manner that achieves this objective.

3. **Extreme Flood Operation:** Extreme flood events are defined as events at which the facility cannot be attended safely by operators and where the risk of flooding of the generation equipment is possible. The emphasis on operation is on ensuring public and operator safety. Where advance warning is received that an extreme event may occur, the facility will be prepared in advance of the flood peak to maximize the ability to pass water and provide minimal obstruction to the passing flood waters.

The inundation map and river profile referenced in the section on “Upstream Storage Effects” shows the water depths and extents for various flood conditions. The objective of flood operation for the spillway, turbine and bypass is to ensure that the backwater effect is minimized and kept within the projected distance limits.

It should be recognized that the facility is not designed to mitigate the effects of naturally occurring events such as floods and droughts. However, there are circumstances where the existence of the facility can either aid in managing a special event or pose an additional risk. The flood risk aspects are managed, in part, through the government approval under the Lakes and Rivers Improvement Act of the engineering plans and specifications for the design of the facility. The purpose of this process is to ensure that the flood passage capacity of the facility is adequate and that the risk to property and public safety is duly considered. This aspect of the approval process will be dealt with after the environmental assessment process is completed and when the detailed engineering design has been finalized.

Where the operation of the facility requires co-ordination with other facilities and government agencies, Xeneca will work collaboratively with those entities on a bilateral or group basis to ensure that operating objectives are met. Examples of areas and events where coordination is required include where:

1. Normal facility operation impacts other facilities or uses on the river system;
2. Flood flow events pose risks to property or public safety;
3. Drought flow events pose risks to aquatic habitat or water uses downstream.

6 SUMMARY DISCUSSION ON OPERATIONS

The Four Slide Falls facility has effects on upstream water levels and downstream flows. This operating plan considers these effects and sets operating objectives and parameters that minimize potential impacts on the environment and recreational uses.

The facility will operate as a “modified run-of-river” facility. In this mode of operation, the amount of water passed through the facility over a period of several days is equal to the natural run of the river flows. However, on a short term basis, flows are reduced (i.e. modified) at night and on weekends to allow more electricity to be produced during weekdays when electricity demand is high.

The ability to modify flow is directly dependent on the available storage. However, the available storage and generator size have been limited in the project design to minimize the environmental footprint. Due to this constraint, modified operation of the facility is typically constrained to moderate and low flow periods, when the inflow rate is slow and the amount of available storage is useable.

Most of the year, the facility will operate continuously; however, when natural flows fall below the minimum turbine capacity, operation becomes intermittent. Low flow conditions occur primarily during the winter and late summer. Intermittent operation creates the greatest potential for impacts on downstream uses.

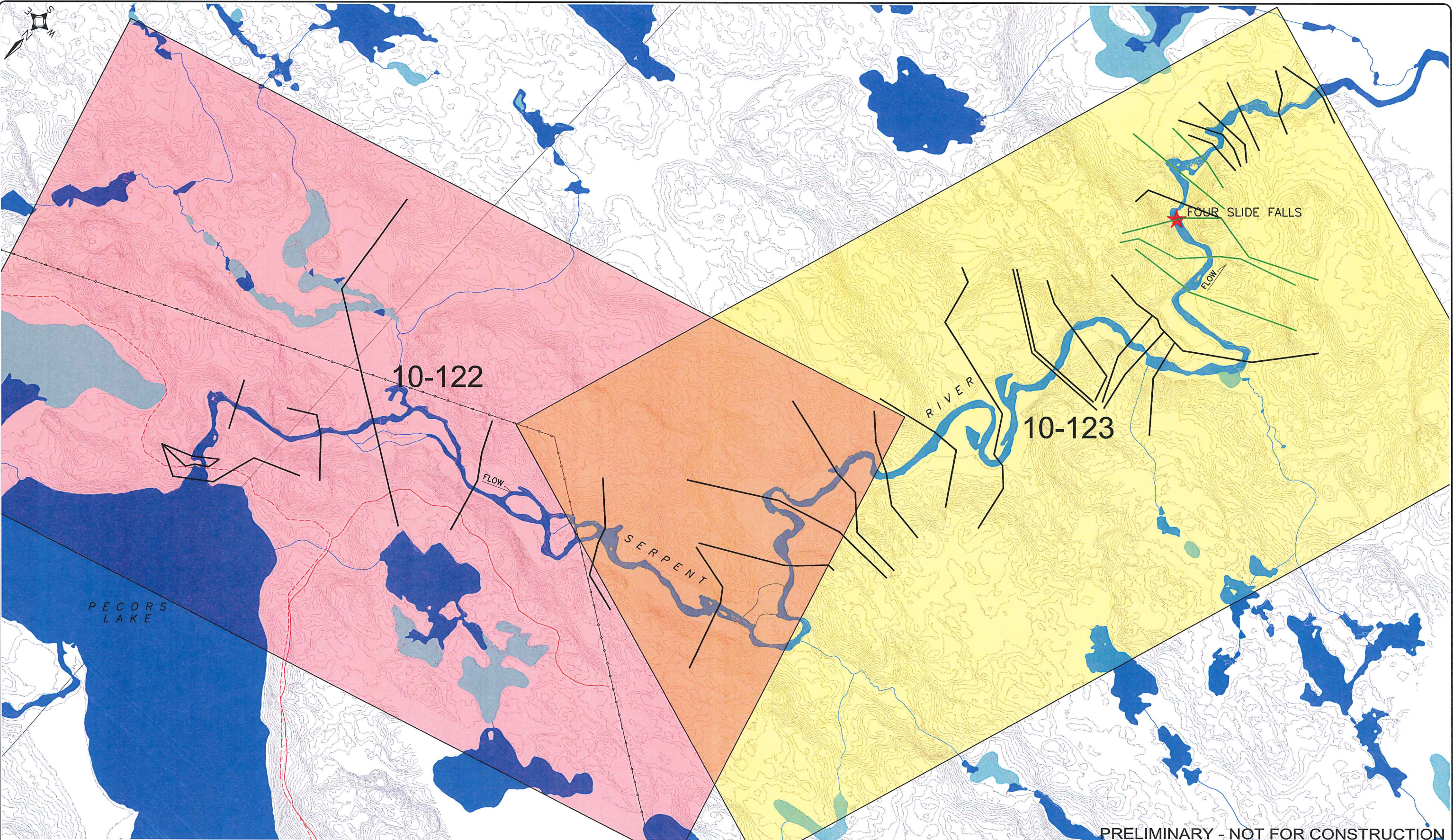
Key operating objectives and parameters in this plan relate to the following:

1. The project creates as significant headpond inundation. The existing riverine environment will change to a much larger lake environment.
2. The headpond is not connected hydraulically to Pecor Lake and will not impact its flows or levels.
3. The headpond will be operated in a narrow operating range to mitigate potential shoreline impacts.
4. The headpond creates a small wetland in a tributary area in the northeastern portion of inundation. The potential exists to operate water levels in a manner that would enhance the habitat aspects of this wetland by keeping inundation levels 1 metre higher in the spring than in late summer. **[NTD: still in stakeholder discussion]**
5. 4.2 km Downstream Reach: It was recognized that variable flows associated with intermittent operation will affect a long river reach. Spawning and foraging habitat exists in this reach for trout. The following operations objectives will apply to mitigate impacts:
 - a. Spring Operation: No intermittent operation will occur during this period to protect spawning and other habitat considerations.
 - b. Summer Operation: Possible intermittent operation with minimum flows set at a level that considers significant habitat activity during this period.
 - c. Fall Operation: Intermittent operation can occur but with minimum flows set at a level that considers reduced habitat activity.

- d. Winter Operation: Minimum flows are set at a level that reflects minimal habitat activity in the shallow reaches. Ramp rates were set to minimize sudden changes in flow.

**Attachment 1: Four Slide Falls Hydro Project Headpond Inundation Mapping
(4 pages)**

THIS DRAWING SHALL NOT BE REPRODUCED IN ANY MANNER, OR FOR ANY PURPOSE, EXCEPT BY WRITTEN PERMISSION OF CANADIAN PROJECTS LIMITED AND IS PROTECTED BY COPYRIGHT LAW. © 2010 THIS DRAWING MUST BE STAMPED, SIGNED AND DATED TO BE APPROVED FOR CONSTRUCTION. VOID ALL DRAWINGS BEARING AN EARLIER DATE OR REVISION NUMBER.



- NOTES**
1. ALL DIMENSIONS, ELEVATIONS AND STATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
 2. 0.5m INTERVAL CONTOURS FROM LIDAR FLOWN SUMMER, 2008.
 3. BASE MAPPING OBTAINED FROM ONTARIO MINISTRY OF NATURAL RESOURCES DECEMBER, 2010.

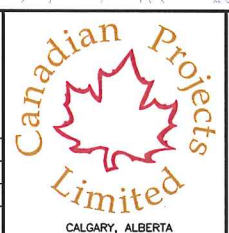
- LEGEND**
- WATER
 - WETLAND
 - BUILDING
 - ROAD
 - UTILITY LINE
 - SECTION WITH ASSUMED BATHYMETRY
 - SECTION WITH SURVEYED BATHYMETRY
 - PROPOSED STRUCTURE LOCATION

SCALE 1:12 500

0 125 250 375 500 625

METRES

A	11	01	26	FOR REVIEW	SMS	WD	DMB	ADF
REV	Y	M	D	REVISION DESCRIPTION	DES	CHK	DRN	CHK

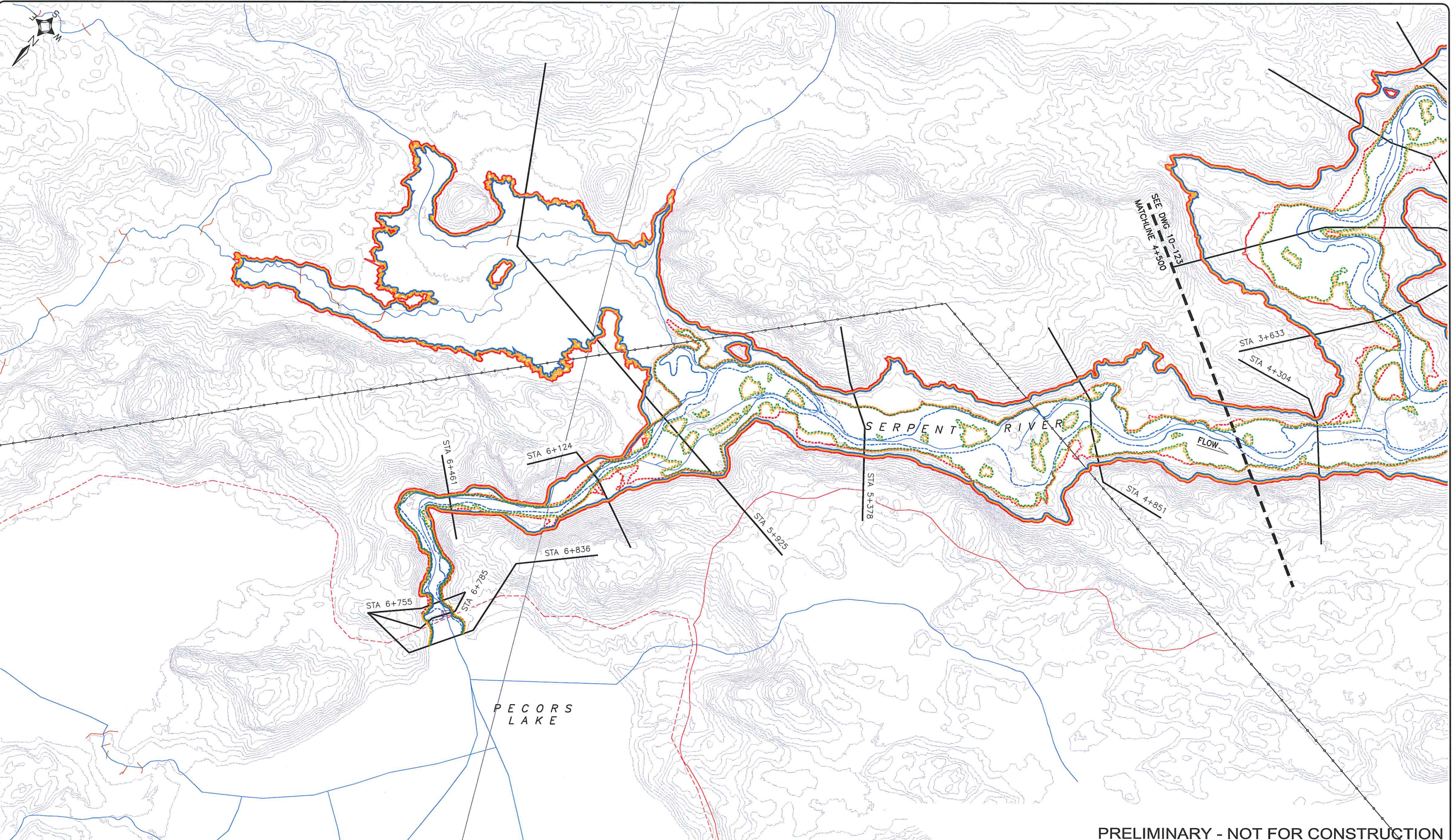


PRELIMINARY - NOT FOR CONSTRUCTION

XENECA POWER DEVELOPMENT INC.

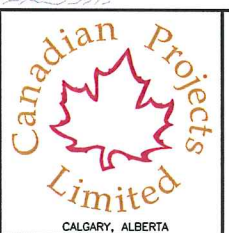
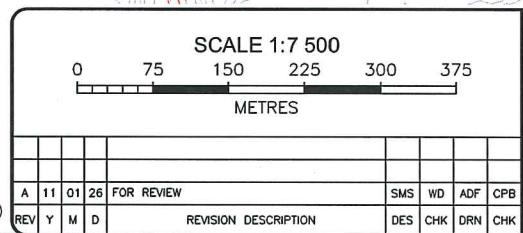
FOUR SLIDE FALLS HYDRO PROJECT	PROJECT NUMBER 1052-001
PROJECT - GENERAL	CADD NUMBER 4.3.028
HEADPOND INUNDATION MAPPING	DRAWING NUMBER 10-121
KEY PLAN	

THIS DRAWING SHALL NOT BE REPRODUCED IN ANY MANNER, OR FOR ANY PURPOSE, EXCEPT BY WRITTEN PERMISSION OF CANADIAN PROJECTS LIMITED AND IS PROTECTED BY COPYRIGHT LAW. © 2011 THIS DRAWING MUST BE STAMPED, SIGNED AND DATED TO BE APPROVED FOR CONSTRUCTION. VOID ALL DRAWINGS BEARING AN EARLIER DATE OR REVISION NUMBER.



- NOTES**
1. ALL DIMENSIONS, ELEVATIONS AND STATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
 2. 2.5m INTERVAL CONTOURS FROM LIDAR FLOWN SUMMER, 2008.
 3. BASE MAPPING OBTAINED FROM ONTARIO MINISTRY OF NATURAL RESOURCES DECEMBER, 2010.

- LEGEND**
- ROAD
 - UTILITY LINE
 - SECTION WITH ASSUMED BATHYMETRY
 - SECTION WITH SURVEYED BATHYMETRY
- INUNDATION EXTENTS AT:**
- LTAF (EXISTING)
 - LTAF (PROPOSED)
 - HWM FLOW (EXISTING)
 - 1:2 YEAR FLOW (EXISTING)
 - 1:2 YEAR FLOW (PROPOSED)
 - 1:100 YEAR FLOW (EXISTING)
 - 1:100 YEAR FLOW (PROPOSED)



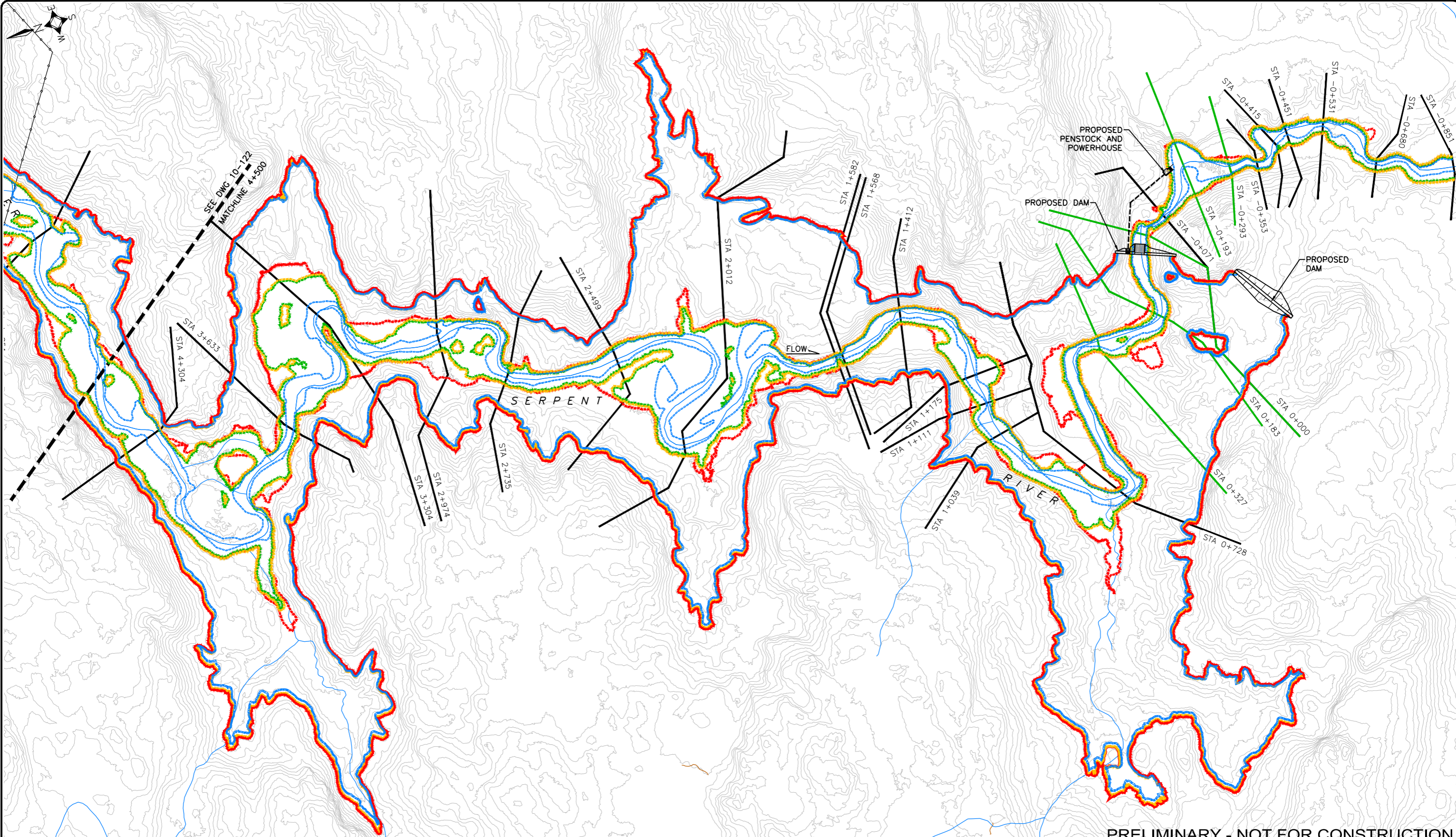
PRELIMINARY - NOT FOR CONSTRUCTION

XENECA POWER DEVELOPMENT INC.

FOUR SLIDE FALLS HYDRO PROJECT
PROJECT - GENERAL
HEADPOND INUNDATION MAPPING
STATION 6+836 TO 4+500

PROJECT NUMBER	1052-001
CADD NUMBER	4.3.028
DRAWING NUMBER	10-122

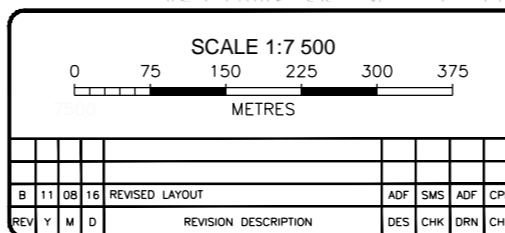
THIS DRAWING SHALL NOT BE REPRODUCED IN ANY MANNER OR FOR ANY PURPOSE, EXCEPT BY WRITTEN PERMISSION OF CANADIAN PROJECTS LIMITED AND IS PROTECTED BY COPYRIGHT LAW. © 2011 THIS DRAWING MUST BE STAMPED, SIGNED AND DATED TO BE APPROVED FOR CONSTRUCTION. VOID ALL DRAWINGS BEARING AN EARLIER DATE OR REVISION NUMBER.



- NOTES**
1. ALL DIMENSIONS, ELEVATIONS AND STATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
 2. 2.5m INTERVAL CONTOURS FROM LIDAR FLOWN SUMMER, 2008.
 3. BASE MAPPING OBTAINED FROM ONTARIO MINISTRY OF NATURAL RESOURCES DECEMBER, 2010.
 4. WATER LEVELS DOWNSTREAM OF THE PROPOSED STRUCTURE WILL BE UNCHANGED.

- LEGEND**
- ROAD
 - UTILITY LINE
 - SECTION WITH ASSUMED BATHYMETRY
 - SECTION WITH SURVEYED BATHYMETRY

- INUNDATION EXTENTS AT:**
- LTAf (EXISTING)
 - LTAf (PROPOSED)
 - HWM FLOW (EXISTING)
 - 1:2 YEAR FLOW (EXISTING)
 - 1:2 YEAR FLOW (PROPOSED)
 - 1:100 YEAR FLOW (EXISTING)
 - 1:100 YEAR FLOW (PROPOSED)



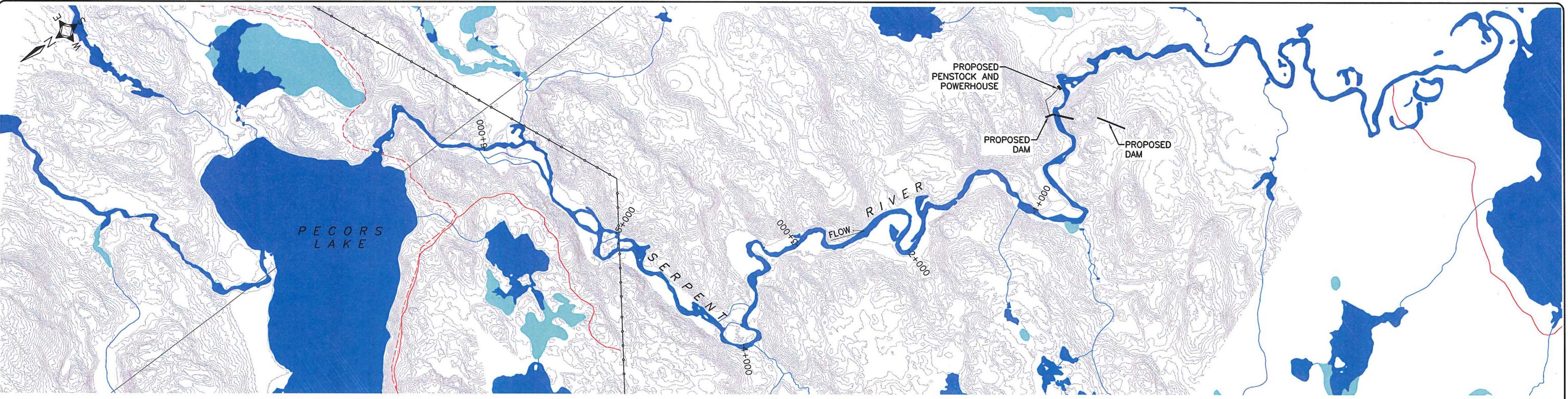
PRELIMINARY - NOT FOR CONSTRUCTION

XENECA POWER DEVELOPMENT INC.

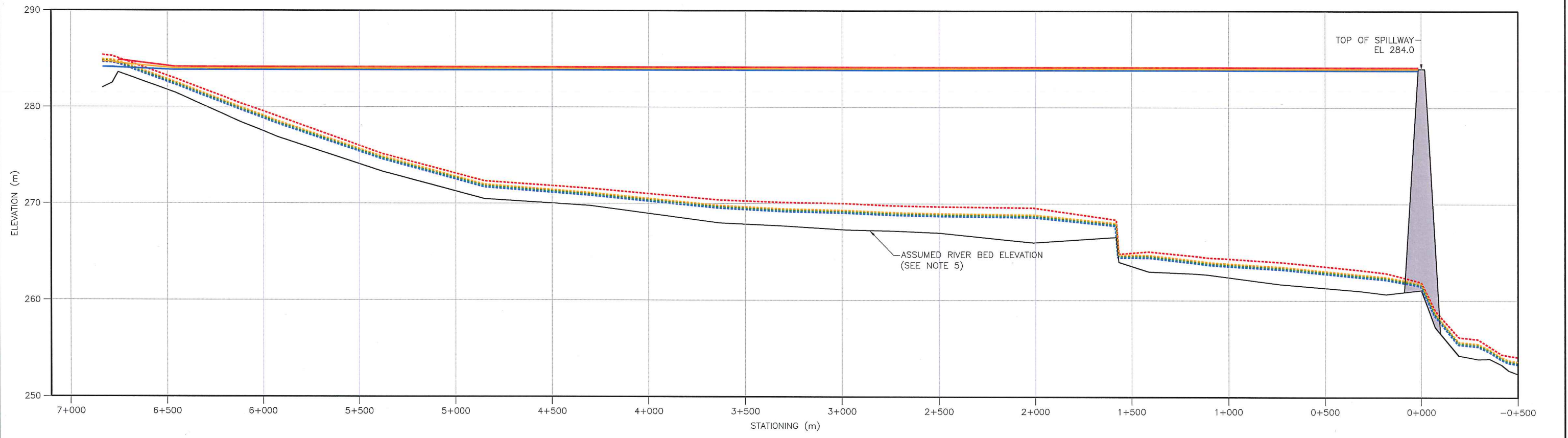
FOUR SLIDE FALLS HYDRO PROJECT
PROJECT - GENERAL
HEADPOND INUNDATION MAPPING
STATION 4+500 TO -0+851

PROJECT NUMBER	1052-001
CADD NUMBER	4.3.028
DRAWING NUMBER	10-123

THIS DRAWING SHALL NOT BE REPRODUCED IN ANY MANNER, OR FOR ANY PURPOSE, EXCEPT BY WRITTEN PERMISSION OF CANADIAN PROJECTS LIMITED AND IS PROTECTED BY COPYRIGHT LAW. © 2011 THIS DRAWING MUST BE STAMPED, SIGNED AND DATED TO BE APPROVED FOR CONSTRUCTION. VOID ALL DRAWINGS BEARING AN EARLIER DATE OR REVISION NUMBER.



PLAN
HOR 1:20 000

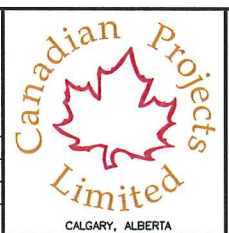


PLAN
HOR 1:20 000
VER 1:400

- NOTES**
1. ALL DIMENSIONS, ELEVATIONS AND STATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
 2. 2.5 m INTERVAL CONTOURS FROM LIDAR FLOWN JUNE, 2009.
 3. BASE MAPPING FROM ONTARIO MINISTRY OF NATURAL RESOURCES OBTAINED DECEMBER, 2010.
 4. WATER LEVELS DOWNSTREAM OF THE PROPOSED STRUCTURE WILL BE UNCHANGED.
 5. RIVER BED ELEVATION CONSISTS OF BATHYMETRIC SURVEY DATA WHERE AVAILABLE, SUPPLEMENTED BY CPL ESTIMATES WHERE NOT AVAILABLE.

LEGEND		WATER LEVELS AT:	
	WATER		LTAF (EXISTING)
	WETLAND		LTAF (PROPOSED)
	ROAD		HWM FLOW (EXISTING)
	UTILITY LINE		1:2 YEAR FLOW (EXISTING)
			1:2 YEAR FLOW (PROPOSED)
			1:100 YEAR FLOW (EXISTING)
			1:100 YEAR FLOW (PROPOSED)

0 200 400 600 800 1:20000		0 4 8 12 16 1:400						
METRES								
REV	Y	M	D	REVISION DESCRIPTION	DES	CHK	DRN	CHK
A	11	01	26	FOR REVIEW	SMS	WD	ADF	CPB



PRELIMINARY - NOT FOR CONSTRUCTION

XENECA POWER DEVELOPMENT INC.	
FOUR SLIDE FALLS HYDRO PROJECT	
PROJECT - GENERAL	
HEADPOND	
PLAN & PROFILE	
PROJECT NUMBER	1052-001
CADD NUMBER	4.3.039
DRAWING NUMBER	10-124