Attachment 1: Introduction to Initial Study Report

TABLE OF CONTENTS

List of Tables

List of Figures

1 GENERAL

This document presents Seattle City Light's (SCL) initial study report (ISR) for the Boundary Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 2144. The ISR describes SCL's overall progress in implementing its relicensing study plan and schedule and provides a summary of data collected during 2007 and an explanation of variances from the study plans and schedules outlined in the Revised Study Plan (RSP), which was filed by SCL in February 2007 and approved by FERC in its March 15, 2007 study determination letter (FERC 2007a). The ISR also includes SCL's proposed modifications to ongoing studies for the 2008 field season.

This ISR includes the results of 22 of the 24 studies identified in the RSP. Results from studies 4 and 23 are not included in this ISR for the following reasons. Consistent with FERC's October 25, 2007 determination letter (FERC 2007b)[1], the Study 4 Toxics Assessment: Evaluation of Contaminant Pathways is on a unique schedule as the result of its two-phased approach. The ISR for Study 4 will be filed with FERC on August 15, 2008. Study 23, Aesthetic/Visual Resources, is a second-year (i.e., 2008) study, and as such, its report will be included in the Updated Study Report (USR) to be filed with FERC in March 2009. Greater detail regarding the Study 4 schedule is provided in Section 4 and Attachment 2 of this ISR.

A list of studies and the resource issues(s) that each study is designed to address is provided in Section 5. The study components are organized by resource area, and indicate where one study will intersect with studies from other resource areas. Each study report provides all information specified under FERC's Integrated Licensing Process (ILP) requirements (18 CFR § 5.15) and is organized as follows:

- Introduction
  - Study background
  - Study description
- Study objectives
- Study area
- Methods
  - Subsections unique to studies
- Preliminary results
  - Subsections unique to studies
- Summary and discussion
- Variances from FERC-approved study plan and proposed 2008 methods modifications
- References
- Appendices

The process and schedule for developing and sharing information with relicensing participants are described in Section 2 of this ISR. Ultimately, the results of the relicensing studies program

[1] FERC, October 25, 2007, Study Plan Determination for Phase 2 Toxics Sampling and Analysis Plan for the Boundary Hydroelectric Project

will be synthesized in an Integrated Resource Analysis (IRA) designed to characterize Project-related resource impacts and evaluate potential Protection, Mitigation, and Enhancement (PME) measures. SCL plans to engage relicensing participants in IRA discussions (see Section 4.1) in early 2009. SCL plans to present its assessment of Project impacts in the Preliminary Licensing Proposal (PLP), which will be filed with FERC no later than April 30, 2009, and will refine its presentation of information on impacts and its licensing proposal, including PMEs, in the License Application, which must be filed no later than September 30, 2009.

2 PROCESS AND SCHEDULE OVERVIEW

2.1. FERC Determination and Study Plan Modification

Consistent with requirements under 18 CFR § 5.15, SCL will, within 15 days following the filing of this ISR, hold a meeting with relicensing participants and FERC staff to discuss the 2007 study results and proposals to modify 2008 study plans based on those results. Within 15 days following this meeting, SCL will file a meeting summary, which will include any changes or additions agreed upon at the meeting to the proposed modifications identified in the individual ISR reports.

FERC staff or any relicensing participant may file a disagreement concerning SCL's meeting summary within 30 days of its issuance. This filing must set forth the basis of any disagreement with the material content of SCL's meeting summary and propose any desired alternative modifications to ongoing studies or new studies. SCL will then have 30 days to respond to the disagreements and possibly propose revised study modifications or new studies. Within 30 days of SCL's response, any remaining disagreements will be resolved by FERC, and the study plan will be amended as appropriate. If no disagreements concerning SCL's meeting summary and request to amend the approved study plan are filed within 30 days, SCL's proposed study plan amendment will be considered approved.

Any proposal to modify an ongoing study must demonstrate that the approved study was not conducted as described in the approved RSP, that it was conducted under anomalous environmental conditions, or that environmental conditions have changed in a material way since the study plan's approval. The proposal must also explain why the study's objectives cannot be met via the approved study's methods and why the proposal for modification was not made earlier, or that significant new information has become available that affects the study.

2.2. Study Reporting Timeline through USR Meeting

The proposed timeline for study reporting, i.e., the filing of the ISR and USR, is presented in Table 2.2-1.

Table 2.2-1. Proposed study progress reporting and relicensing participant review opportunities associated with the ISR and USR.

Report / Information Sharing	Proposed Timeframe	Review Comments Due
File ISR [1]	March 2008 [3]	Approximately 60 days [5]
Hold Initial Study Report meeting (meeting on study results and any proposals to modify study plan) [1]	Within 15 days of initial study report	Disputes/requests to amend study plan due within 30 days from study report meeting summary
Hold meetings on Year 2 study results, Integrated Resource Analysis, and assessment of Project effects	1st Quarter, 2009	
File USR [2]	March 2009 [4]	Approximately 60 days [5]
Hold Updated Study Report meeting (meeting on study results and any proposals to modify study plan) [2]	Within 15 days of updated study report	Disputes/requests to amend study plan due within 30 days from study report meeting summary

Notes:

1 Required under 18 CFR section 5.15(c).

2 Required under 18 CFR section 5.15(f).

3 The ISR must be filed no later than 1 year after FERC approval of the study plan (18 CFR, section 5.15(c)(1)).

4 The USR must be filed no later than 2 year after FERC approval of the study plan (18 CFR, section 5.15(f)).

5 Applicant must hold a meeting within 15 days of issuance of the study report (18 CFR section 5.15(c)(2)) and issue a meeting summary within 15 days of the meeting (18 CFR section 5.15(c)(3)). Participants then have 30 days to file any disputes or requests to amend the study plan (18 CFR section 5.15(c)(4)).

3 ONGOING RELEVANT NON-ISR STUDIES AND ANALYSES

SCL is currently conducting some studies and analyses that are relevant to, but not incorporated into, the study program outlined in the RSP. These efforts, described below, include hydrology analyses, bathymetry and topography data collection, and temperature modeling. SCL initiated these efforts prior to the formal relicensing study program, either because they were determined to be prerequisites to other studies or, in the case of temperature modeling, were required for a parallel regulatory process, i.e., the Interstate Temperature TMDL (Total Maximum Daily Load). Beyond its application in the context of the Temperature TMDL, the temperature model of the Boundary Project area will also be used to assess the effects of current Project operations as part of FERC relicensing and the Washington Department of Ecology's (Ecology) 401 certification process.

Although the data collection and analyses described below are not part of the RSP approved by FERC, SCL did carefully consider their design and execution in light of FERC's requirements to ensure that they reflect consistency with FERC study criteria (18 CFR § 5.9(b)), such as addressing a nexus between Project operations and resource effects and using methods that are consistent with generally accepted scientific practice.

3.1. Hydrology Data and Statistics

Hydrologic conditions influence the way the Project operates. Water surface elevations in Boundary Reservoir are influenced by the operation of the Boundary Project as well as inflows to the reservoir, which are in turn influenced by flow releases from upstream projects. Analyses of existing hydrology data were undertaken by SCL to produce a reliable, hourly hydrologic record needed to conduct environmental and energy production analyses as part of relicensing. These hydrology analyses are necessary for understanding the effect of Project operations on resources and for developing potential PMEs.

The primary sources of hydrologic data for the Project are USGS gages 12396500 (Pend Oreille River below Box Canyon) and 12398600 (Pend Oreille River below Boundary Dam) and records of water surface elevations measured by SCL in the Boundary Dam forebay. Another source of hydrologic data is the record of water surface elevations measured in Seven Mile Dam forebay by British Columbia Hydro. The hydrologic analyses are being completed based on data from the aforementioned gages, hydrographic and topographic surveys, and stage recorder data (see Study 7, Mainstem Aquatic Habitat Modeling, for an explanation of the location of stage recorders and application of stage data). The analyses involve a rigorous quality assurance procedure to identify and correct errors before data are used in finalizing study results or in subsequent modeling.

The hydrologic record report, compiled by R2 Resource Consultants (R2 2008), describes the hydrologic dataset being used to support ongoing relicensing studies. The record of hourly flows between 1987 and 2005 was used to describe current operations. The report includes a variety of hydrologic statistics used to describe the 19-year period (Calendar Years 1987 through 2005) of hourly records. In addition, average daily flow records between 1912 and 2004 were reviewed to characterize the hydrologic nature of the 19-year record. The hydrologic database for the period 1987 through 2005, along with a summary report covering the same period, was submitted to relicensing participants in February 2008.

Long-term flow records are available from the USGS for the Pend Oreille River in the vicinity of the Project from Calendar Year 1913 through 2006. From Calendar Year 1913 through 1963, flows were measured by the USGS just upstream from the present location of Boundary Dam (Gage No. 12398500). When the Boundary Project was constructed, SCL assumed responsibility for measuring river flows and reporting these data to the USGS (Gage No. 12398600). Overall, flows have been measured in the vicinity of the Project from Calendar Year 1913 through 2006, with one year of overlap between the two aforementioned gages. Missing data were estimated using streamflow records from nearby watersheds with similar characteristics or from synthesized data.

Average annual flows from the 94-year period of record (1913 through 2006) were analyzed to determine historical trends in basin hydrology. The long-term average flow in the vicinity of the Project during this period was 26,370 cfs. An extended dry period was observed from 1919 through 1945 (average flow of 23,860 cfs), followed by an extended wet period from 1946 through 1976 (average flow of 30,300 cfs), followed by another extended dry period from 1977 through 2006 (average flow of 23,860 cfs). The durations of these periods were remarkably similar, ranging from 27 to 31 years. The period adopted for Boundary relicensing studies (1987

through 2005) is within the current extended dry period (average flow is about 10 percent less than the long-term average).

A flow duration curve was derived from the 94 years of average annual flow extending from 1913 through 2006, with the results shown in Figure 3.1-1. Although the period from 1987 through 2005 is somewhat drier than the long-term average, it does capture the long-term range of variability of basin hydrology. The average annual flow from 1997 ranks as the second wettest year during the 94-year period, while the average annual flow from 2001 ranks as the second driest year during the long-term record. The average annual flow from 2002 is similar to both the median and the long-term average from the 94-year period. Thus, Calendar Years 1997, 2001, and 2002 can be considered representative wet, dry, and average years, respectively.

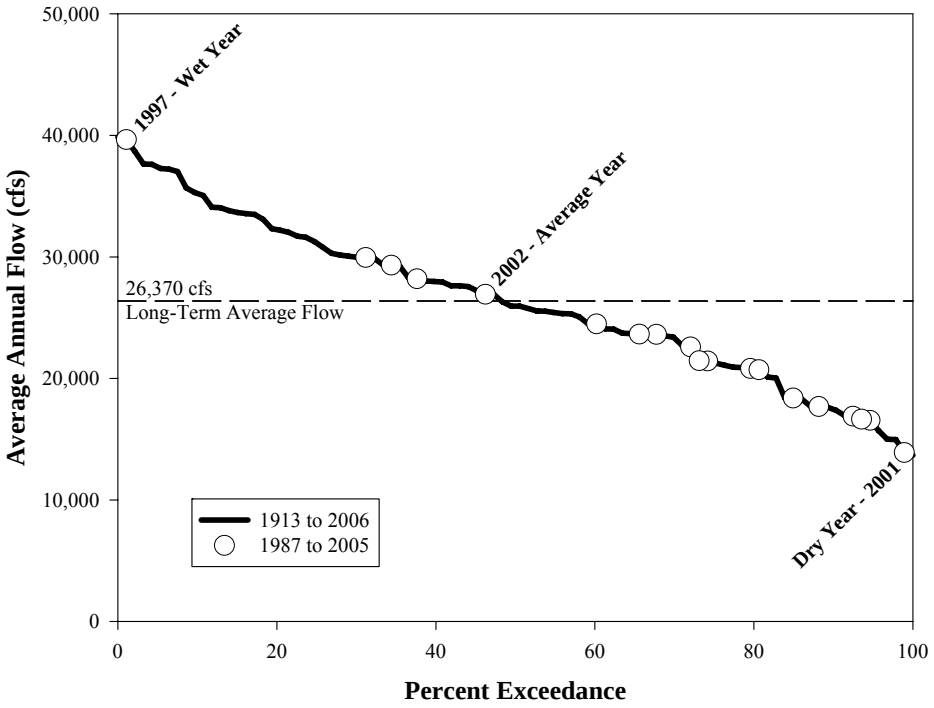

Figure 3.1-1. Flow duration for the Pend Oreille River in the vicinity of Boundary Dam, derived from average annual flows from Calendar Years 1913 through 2006. Percent exceedance of average annual flows from 1987 through 2005 is shown based on ranking these years within the 94-year period, 1913 through 2006.

3.2. Bathymetry and Upland Topography Surveys

Bathymetry and upland topography surveys were performed to chart reservoir bottom and adjacent bare earth surface features and provide detailed topographic data to 1) support biological and other resource studies, 2) support hydrologic modeling, and 3) perform quality control (QC) checks on previous survey work.

The upland topography survey was collected by Terrapoint using an airborne Light Detection and Ranging (LIDAR) sensor. These data were supplemented and checked by DeGross Aerial Mapping using aerial photogrammetry. The final upland topography survey covers a longitudinal area from 0.75 miles south of Box Canyon Dam downstream through the Project area and north across the Canada-U.S. border to downstream of the Salmo River confluence. Throughout this area the survey extends approximately 0.75 miles upland of the reservoirs' shorelines.

The original bathymetry survey was conducted by Global Remote Sensing (GRS). These survey results were supplemented and checked during subsequent bathymetric surveys performed by Tetra Tech EC, Inc. (TtEC). TtEC also conducted a bathymetric survey of BC Hydro's Seven Mile Reservoir, which was previously unsurveyed, providing full bathymetric coverage from Box Canyon Dam downstream to Boundary Dam, then across the Canada – U.S. border to Seven Mile Dam (approximately 27 miles).

Based on comparisons of the TtEC and GRS bathymetry surveys and a jointly conducted field test, GRS conducted a multibeam bathymetry survey in the lower reservoir, below Metaline Falls. The final dataset, consisting of multibeam bathymetry, scanning laser survey of the shorelines, discrete Global Positioning System (GPS) points, and LIDAR data, was merged by TtEC and R2 Resource Consultants (R2). R2 then published the data for use in the other studies.

The following is a summary of the major activities, timelines, and a list of the primary systems used in the 2005-2007 survey work.

3.2.1. Boundary Dam Upland Topographic Surveys

In August 2005, Terrapoint conducted a LIDAR survey from above Box Canyon Dam (Project river mile [PRM] 35.3) past the Salmo River confluence (PRM 12.8), plus 0.75 miles of the Salmo River. The following systems were used for this survey: Navajo twin-engine aircraft at an altitude of 3,000 feet above ground level; 36-degree full angle laser; Trimble 4700 GPS receiver; Honeywell H764 inertial measurement unit; Sokkia GSR2600 dual frequency GPS receivers.

DeGross Aerial Mapping collected supplemental aerial photogrammetric data at Project facilities, dams, shorelines, and selected upland areas and performed LiDAR QC checks during September – November 2005. The following materials and systems were used: 1 inch = 600 feet and 1 inch = 1,000 feet, 60 percent overlap, color aerial photography dated August 20, 2005; KLT & Associates digital softcopy station.

3.2.2. Boundary Project Bathymetry Surveys

The following systems were used to conduct the original multibeam bathymetry survey from Box Canyon Dam to Boundary Dam, plus survey of Boundary tailrace by GRS in 2006: EM3000 multibeam sonar; gyrocompass; TSS DMS motion sensor; real-time kinematic (RTK) GPS.

TtEC conducted a supplemental multibeam bathymetry survey in selected areas of Boundary Reservoir in May, June, and July 2007 to fill data gaps and quality-check data. The July 2007

survey included the use of scanning laser to survey selected areas of the shoreline. The following systems were used during this period: RESON SeaBat 8125 multibeam sonar; Applanix WaveMaster inertial attitude/heading sensor; Leica RTK GPS; Riegl LMS-Q120 scanning laser system.

In August 2007, TtEC conducted a multibeam/single beam survey of Seven Mile Reservoir, from the Canada-U.S. border to Seven Mile Dam (approximately 9 miles), plus approximately 1 mile of the Salmo River in Canada, upstream from the confluence with the Pend Oreille River. The following systems were used during this period: RESON SeaBat 8125 multibeam sonar; Applanix WaveMaster inertial attitude/heading sensor; Leica RTK GPS; Riegl LMS-Q120 scanning laser system; Ross Laboratories 825B dual frequency echosounder.

3.2.3. Survey Data Collection, Quality Assurance/Quality Control, Processing Steps

TtEC merged GRS bathymetry and TtEC bathymetry and scanning laser data and provided a gridded dataset to R2. Review showed fairly good correlation above Metaline Falls, but some significant discrepancies in elevation in the area between Metaline Falls and Boundary Dam were observed. R2 merged combined bathymetry/scanning laser data with previously collected upland LIDAR data.

Based on discussions between SCL, GRS, and TtEC, a field test was set up in October 2007 to address the discrepancies between the aforementioned bathymetry surveys. Immediately following the field test, GRS conducted a resurvey of the area between the north end of the Metaline Falls canyon from PRM 25.8 to the log boom in the Boundary Dam forebay located at PRM 17.1. The following systems were used during this period: EM3002D multibeam sonar; Meridian Surveyor gyrocompass; TSS DMS-03 motion sensor; RTK GPS.

During the October 2007 field testing timeframe, TtEC conducted a scanning laser survey of the full shoreline between Metaline Falls and the log boom in the Boundary forebay to provide a contiguous dataset and ensure a good correlation with the existing LIDAR data. The following systems were used for this effort: Applanix WaveMaster inertial attitude/heading sensor; Leica RTK GPS; Riegl LMS-Q120 scanning laser system.

3.2.4. Survey Post-Processing

TtEC merged GRS bathymetry, previously collected RTK GPS data from Battelle and Pacific Geomatic Solutions (PGS), and TtEC bathymetry and scanning laser data for the upper and lower reservoirs. TtEC then merged the resultant data with a subset of the LIDAR data up to 2,100 feet (provided by R2) for the upper reservoir. R2 merged the resultant bathymetry/laser data with the LiDAR data in the lower reservoir between Metaline Falls and Boundary Dam. The new GRS data showed good correlation with the bathymetry and scanning laser data collected by TtEC. R2 reviewed the combined dataset, translated it into ESRI's ArcGIS format, and distributed the data for use in the other relicensing studies.

3.3. Temperature Modeling

Temperature modeling of the Boundary Project area is needed to satisfy regulatory requirements associated with certification of the Project under Section 401 of the federal Clean Water Act (401 certification). The temperature model of the Project area is being used in conjunction with models of other segments of the Pend Oreille River to complete the Washington-Idaho Interstate Temperature TMDL plan. Although temperature modeling has been conducted outside the FERC-approved relicensing studies program, it addresses a potential nexus between Project operations and resource effects.

Temperature modeling is being conducted for SCL by Battelle, Pacific Northwest National Laboratory (Battelle). Battelle developed a predictive temperature model of the Pend Oreille River from the tailrace of Box Canyon Dam to Boundary Dam. The model, which is based on a state-of-the-art, industry-standard program (CE-QUAL-W2; Cole and Wells 2002), is being used to understand the physical processes controlling water temperature in the Project area, as well as the effects of the Project on existing water temperatures and can also be used to evaluate effects of the Project on temperatures for operations scenarios. Potential operations scenarios will be evaluated as part of SCL's IRA process (see Section 5.1) and results will be reported in SCL's PLP, Application for 401 Certification, and License Application.

Specific temperature modeling objectives addressed by SCL as of the filing of this ISR are as follows:

- Review and processing of available bathymetric, hydrologic, meteorological, and water quality data needed for setup and calibration of the model
- Setup and calibration of the model for simulation of hydrodynamics and temperature
- Conducting model application and analyses for the following scenarios:
    - Existing Condition — Linkage of individual reaches of the model for the calibration condition to simulate the entire system using inflow data
    - Without Project Condition — Simulation of temperature in the Project area in the absence of the Project but with all other existing hydrologic and land-use conditions in place

Objectives that SCL anticipates will be addressed as part of the IRA are as follows:

- Conducting model application and analyses for potential operations scenarios — Simulation of the temperature response in the Project area for potential operations scenarios identified during the relicensing and 401 certification processes

The review of available data, model setup for existing conditions, and initial calibration of the model were completed in 2006. Computed error statistics demonstrate that the model is well calibrated, i.e., correspondence between measured data and model predictions is at a level acceptable to Ecology.

Modeling of Existing Conditions in the Project area and the Without-Project scenario, both based on 2004 – 2005 hydrology, was completed in 2007. A final report documenting model

construction and calibration was also completed in 2007 (Breithaupt and Khangaonkar 2007). The report included background, objectives, results, and a summary of the calibration between modeled and measured temperature data. Data products provided in the report include:

- Graphical presentation of model inputs
- Temperature prediction time-series and vertical profiles compared to measured data
- Model calibration results and a list of model parameters
- Model results for the Existing Conditions scenario

3.3.1. Interstate Temperature TMDL

The Pend Oreille River has been identified by Washington, Idaho, and the Kalispel Tribe as being impaired for temperature due to violations of each jurisdiction's numeric water quality standards. In 2005, the three regulators partnered with EPA to coordinate development of a TMDL for shared waters by co-signing a Memorandum of Agreement (MOA, the Interstate-EPA TMDL for the Pend Oreille River). An interstate watershed advisory group was formed to better understand potential temperature impairment in the Pend Oreille River and develop this Interstate-EPA Temperature TMDL; SCL is a member of the Pend Oreille River Watershed Advisory Group (WAG).

During 2007, modeling of existing and estimated natural temperatures was completed for the Pend Oreille River from Lake Pend Oreille in Idaho to Boundary Dam, just south of the Canadian border. The CE-QUAL-W2 model developed by Battelle for SCL in the Boundary reach was linked by Ecology with upstream model segments developed by Portland State University to create a calibrated model for use in the TMDL analysis.

The temperature model was used to estimate natural temperature regimes by removing all known human heat influences within the study reach. The differences between existing conditions and natural conditions are currently being evaluated. Initial modeling results show that existing Pend Oreille River temperatures at times exceed the numeric water quality standards for all jurisdictions but that existing temperatures are frequently within the range of natural temperature conditions, or cooler. Each regulating entity has a "natural conditions provision" in its water quality standards that allows up to 0.3 ºC of human induced temperature change above estimated natural conditions. This natural conditions provision was used to model the "allowed" temperature in the river. This "allowed" temperature was compared to several model scenarios, developed by Ecology for the portion of the Pend Oreille River in Washington, to determine compliance with water quality standards.

For much of the year, existing conditions are predicted by the model to be cooler than natural conditions, due to the generally deeper water. Ecology and other regulators are currently determining the variance between existing and natural temperatures during warmer summer conditions for exceedance of the allowable 0.3 ºC above natural conditions due to human sources. TMDL allocations are expected for critical time periods when human-caused heating exceeds 0.3 ºC above natural conditions.

As a member of the WAG, SCL has contributed technical support in development of the model and extensive comments on the Draft TMDL developed by the regulators. The initial draft of the

TMDL was released for WAG review in August 2007, and is undergoing significant revision based on WAG comments. The TMDL is scheduled to be submitted for EPA approval in 2008.

The modeled allowable temperatures based upon the natural conditions provision will provide the target temperatures for the Boundary reach to evaluate compliance with water quality standards. This TMDL analysis and any temperature effects attributed to the Boundary Project will be addressed in Ecology's 401 Certification of the Project. The implementation plan for the TMDL is expected to acknowledge that any measures necessary to address temperature reduction by the Boundary Project will be included in the Project's water quality attainment plan, which is required for certification.

4 CURRENT PROJECT OPERATIONS

The Pend Oreille River system, which includes the Clark Fork River basin upstream of Lake Pend Oreille, is highly regulated, with flows controlled by dams associated with several energy production and/or storage projects. Flows into Boundary Reservoir are influenced by the operations of upstream projects, including Box Canyon Dam (Pend Oreille County PUD), Albeni Falls Dam (U.S. Army Corps of Engineers), and other projects farther upstream, such as Hungry Horse Dam (U.S. Bureau of Reclamation). Boundary Reservoir has a small active storage capacity [2] relative to average daily river flow, and as a result, instream flow releases to the Pend Oreille River from the Project on annual, seasonal, or monthly time intervals are influenced by projects upstream from the Project (R2 2008).

The Project is operated in a load-following mode that shapes available water to deliver power during peak-load hours with a total plant capability of 1,070 MW from its six (6) turbines. This operating regime allows SCL to meet continued service area load growth and provide regional system reliability. The normal maximum reservoir water surface is at elevation 1,994.03 feet NAVD 88 (1,990 feet NGVD 29) [3]. As noted above, the reservoir has little active storage, approximately 41,000 acre-feet, within the maximum drawdown of 40 feet, as authorized by the current license.

The load-following mode of the Project primarily affects instream flow releases on a daily or hourly interval. Project operations affect the hydrologic conditions in the Pend Oreille River upstream to Box Canyon Dam, as well as the Pend Oreille River downstream from the Project. Upstream effects are associated with water surface elevation fluctuations in the reservoir, while downstream effects are associated with flow release fluctuations from the Project to the Pend Oreille River/Seven Mile Reservoir.

[2] Based on new bathymetric and topographic surveys, a revised stage/capacity curve/table for the Boundary Reservoir shows approximately 41,000 acre-feet of active storage within the maximum drawdown range of 40 feet (1,994.03 feet NAVD 88 [1,990 feet NGVD 29] to 1,954.03 feet NAVD 88 [1,950 feet NGVD 29]) (R2 2008).
[3] SCL is in the process of converting all Project information from an older elevation datum (National Geodetic Vertical Datum of 1929 [NGVD 29]) to a more recent elevation datum (North American Vertical Datum of 1988 [NAVD 88]). As such, elevations are provided relative to both data throughout this document. The conversion factor between the old and new data is approximately 4 feet (e.g., the crest of the dam is 2,000 feet NGVD 29 and 2,004 feet NAVD 88). Although some relicensing studies may round the conversion to 4 feet, certain hydrologic statistics are cited based on the actual conversion factor of 4.03 feet.

During the summer recreation season, approximately Memorial Day weekend through Labor Day weekend, SCL voluntarily restricts the water surface elevation fluctuations to a 10-foot range, between elevation 1,994.03 feet NAVD 88 (1,990 feet NGVD 29) and elevation 1,984.03 feet NAVD 88 (1,980 feet NGVD 29) to facilitate reservoir access and related recreational activities during daytime hours. For the remainder of the year, the water surface elevation may fluctuate between elevations 1,994.03 feet NAVD 88 (1,990 feet NGVD 29) and 1,974.03 feet NAVD 88 (1,970 feet NGVD 29). Storage between elevation 1,974.03 feet NAVD 88 (1,970 feet NGVD 29) and elevation 1,954.03 feet NAVD 88 (1,950 feet NGVD 29) is reserved for extreme system load requirements. Flood storage is not provided, and other than the operating goals noted above, there are no seasonal or minimum flow requirements.

The storage/elevation curve derived from the new Boundary Reservoir bathymetric and topographic surveys is shown in Figure 4.0-1. There is about 15,400 acre-feet of available storage in the upper 10 feet of the reservoir (between elevations 1,984.03 and 1,994.03 feet, NAVD 88 [1,980 and 1,990 feet NGVD 29]) and about 26,900 acre-feet of available storage in the upper 20 feet of the reservoir (between elevations 1,974.03 and 1,994.03 feet, NAVD 88 [1,970 and 1,990 feet NGVD 29]), the typical ranges of operations depending on the time of year.

Hourly ramping rates for falling stages, including monthly and annual daily maximum ramping rate frequencies were determined for the Pend Oreille River in Boundary Forebay and at the USGS Primary Gage No. 12396500 below Box Canyon Dam for Calendar Years 1987 through 2005. Daily maximum ramping rate exceedance frequencies were determined for 10 percent, 20 percent, 50 percent (median), 80 percent, and 90 percent levels. Results of these calculations are summarized in the hydrologic record (R2 2008).

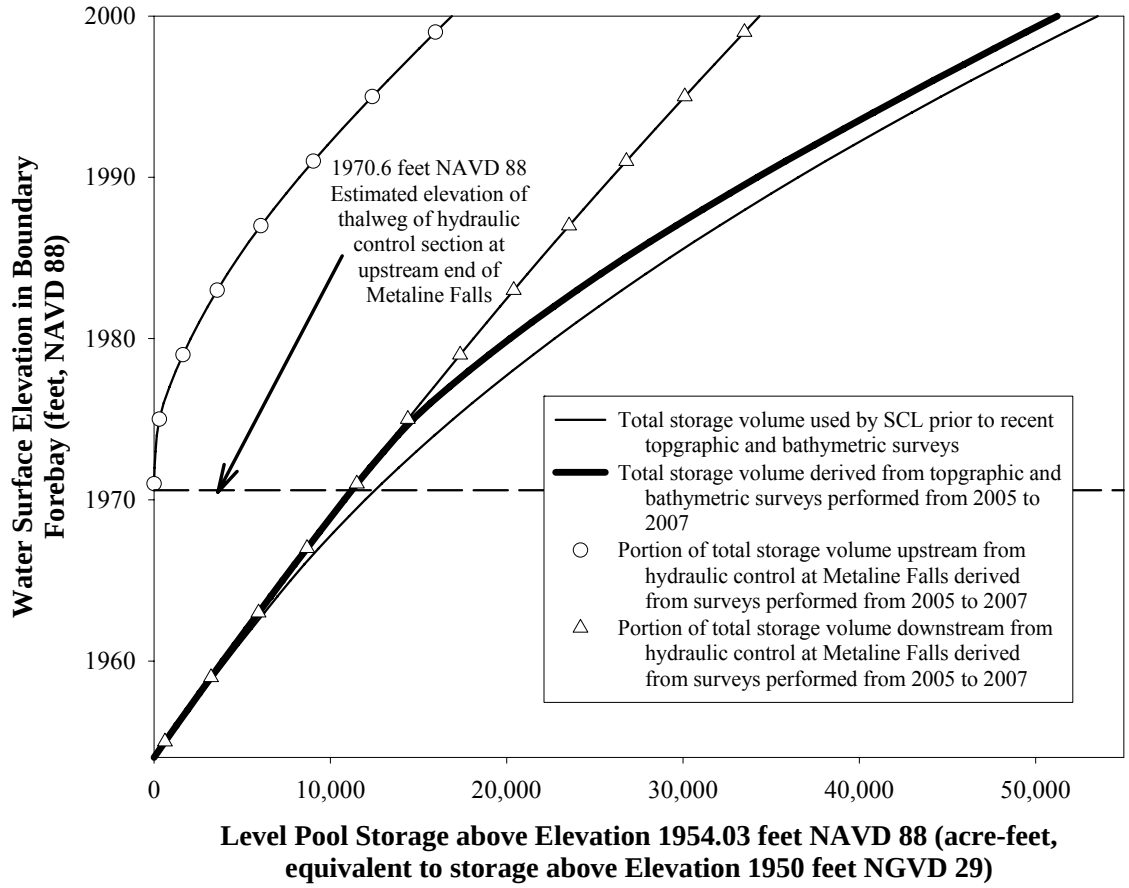

Figure 4.0-1. Level pool storage in Boundary Reservoir above elevation 1,954.03 feet NAVD 88 (lower limit of usable storage, equivalent to storage above elevation 1,950 feet NGVD 29), compared to total storage curve used by SCL prior to recent topographic and bathymetric surveys with total storage curve derived from topographic and bathymetric surveys performed from 2005 to 2007, and upstream and downstream portions of total storage curve derived from surveys performed from 2005 to 2007. (R2 2008)

5 DEVELOPMENT OF PRELIMINARY LICENSING PROPOSAL AND LICENSE APPLICATION

The relicensing studies addressed in the ISR and USR will provide much of the information necessary for determining and characterizing Project impacts and identifying appropriate PME measures relevant to those impacts. As noted above, preliminary results of SCL's IRA will be initially presented in the PLP (filed in April 2009) and later refined in the License Application (September 2009).

For any studies extending into late 2008 and 2009, final conclusions regarding Project impacts and appropriate PME measures may not be available in time for presentation in the PLP, or even in the License Application. Final proposals related to these topics may take the form of post-license application continuation of studies and/or post-license-issuance processes for continued study and consultation toward ultimate development of appropriate PME measures.

Figure 5.0-1 shows the general timeframes and relationships between the steps involved in developing the PLP and License Application. As conceptualized in Figure 5.0-1, relicensing participants have the opportunity to provide input in the areas of study interpretation and Project effects analysis to be presented in the PLP and License Application. Table 5.0-1 provides a summary of the opportunities that relicensing participants have to provide input to the ISR, USR, IRA, PLP and License Application. Additional details on the planned IRA engagement are provided below.

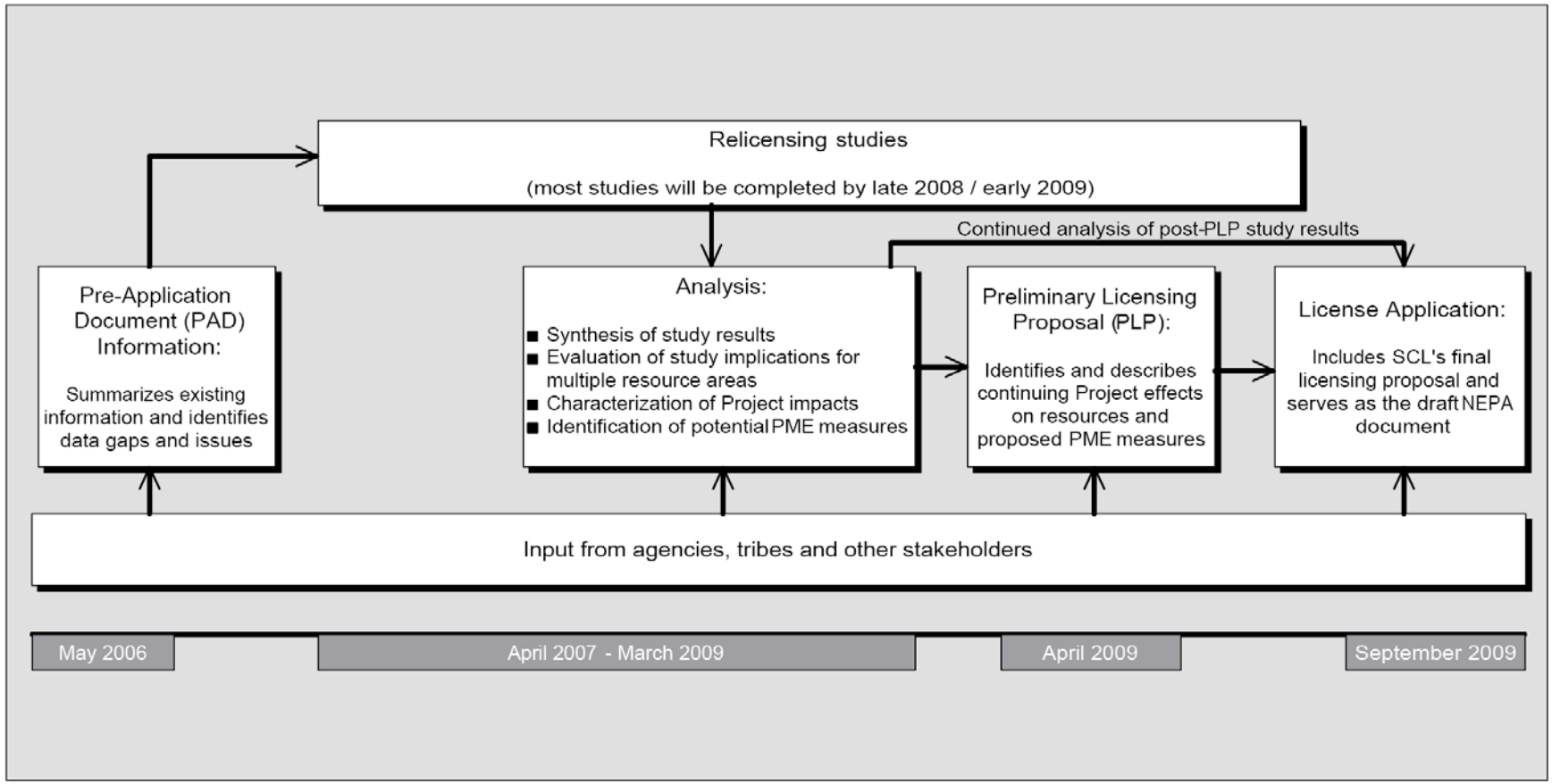

Figure 5.0-1. General sequence of steps, timeframes, and junctures for relicensing participants input related to development of the PLP and License Application.

Table 5.0-1. Steps and schedule for relicensing participant involvement in PLP and License Application development.

Timeframe	SCL Tasks	Interactions with Relicensing Participants
March 2008	File Initial Study Report with FERC	Official study report meeting and follow-up (meeting summary, etc.)
2008	Study program continues	
1st Quarter, 2009	Begin developing PLP framework: Use study results to assess cross-over issues Identify Project effects (based on information to date)	Hold meetings on Integrated Resource Analysis and assessment of Project effects
March 2009	File Updated Study Report with FERC	Official study report meeting and follow-up (meeting summary, etc.)
March–April 2009	Final drafting, reviewing, and revisions of PLP	
Late April 2009	File PLP with FERC	
April–August 2009		Continue discussions with relicensing participants regarding impact analysis for current operations and for other operations scenarios, along with potential PMEs (to be reflected in License Application)
May–August 2009	Complete all studies, to the extent possible, and address PLP comments	
August 2009	Finish preparation of License Application	
September 2009	File License Application with FERC	

5.1. Integrated Resource Analysis (IRA)

The planned IRA requires assimilation of individual study results, identification and understanding of issues and impacts across resources, and, an integrated analysis of how those impacts might be influenced by elements of other resource areas for the Project as it is currently operated and a variety of operations scenarios. The field studies performed in 2007 and 2008 will provide useful field data that will greatly increase the understanding of conditions under existing operating parameters. The IRA will include a predictive exercise that will rely on a variety of analyses and computational models, used for various study evaluations, to predict hydrologic conditions under a variety of operations scenarios to predict their associated habitat effects.

5.1.1. Relicensing Participant Engagement

The IRA will be initiated by SCL and its consultants, in conjunction with relicensing participants, during the preparation of the PLP, with the objective of synthesizing information to assess the effects of the Project as it is currently operated. Following the issuance of the PLP, SCL will continue to engage with relicensing participants in evaluating potential PMEs relative to other operations scenarios as well as non-operational PMEs.

SCL recognizes that it will be a challenge to accomplish this enhanced level of consultation on the PLP and License Application while still meeting the tight process timelines of the ILP. SCL's proposed relicensing participant involvement plan and schedule, which attempt to make the most effective use of the limited time available to interact with relicensing participants prior to issuance of the PLP and between PLP issuance and License Application filing, is summarized in Table 5.1-1.

Table 5.1-1. Summary of engagements with relicensing participants on the IRA.

Engagement with relicensing participants[1]	**Timeframe**
FERC-Initial Study Report (ISR) public meeting	March 2008
Periodic update meetings for resource workgroups	2nd & 3rd Quarters, 2008
Briefings on 2nd year study efforts	4th Quarter, 2008
Relicensing participants' input on analytical tools used in the IRA	4th Quarter, 2008
Meeting(s) to discuss effects of current operations	1st Quarter, 2009
Meeting to review SCL's licensing proposal in the PLP and other operations scenarios and PME proposals for the License Application	2nd & 3rd Quarters, 2009

Notes:

1 For all meetings with relicensing participants, SCL will make every effort to send out relevant meeting materials as far in advance of the meeting as practicable.

The purpose of meetings with relicensing participants will be to discuss the issue or issues at hand, solicit relicensing participant input, and identify areas of agreement and disagreement on effects analyses and potential PMEs. The outcome of all engagements will be documented in meeting summaries and summarized in the PLP and/or License Application.

Given the complexity of some elements of the overall study program, the fact that some data collection and modeling will continue into early 2009, and because some study areas (such as development of TDG abatement measures) are of a longer-term nature, some elements of the IRA and the resulting PME proposals will not be complete for presentation in the PLP, and in some cases may not be ready for full presentation in the License Application. In these instances, SCL will identify and explain in the PLP and/or License Application the status of relevant resource analyses, the anticipated schedule for their completion, and when PME proposals are expected to be finalized. SCL will make every effort to complete as much of the analyses and PME identification as possible during the pre-license application period, and for many resource areas, Project effects analysis and PME development are expected to be complete at the time the License Application is filed.

5.1.2. Technical Scenario Team

The Technical Scenario Team (TST) will address modeling related elements of the IRA, for example, presentations and discussions of modeling results for resource analyses to assess effects of existing Project operations. The TST will also be provided with input from resource workgroups where experts have developed conclusions related to resource-specific technical issues related to modeling.

The TST is envisioned as a group consisting of representatives from agencies, tribes and other relicensing participants, SCL, and consultants with expertise in software modeling and analyses. The intent is for the TST to ensure that requests to assess potential operations scenarios contain well-formed inputs and that subsequent results are produced with a high level of confidence and understanding among relicensing participants.

The following functions would be performed by the TST:

1. Standardize methods of communication with resource workgroups
2. Initiate and develop scenario requests
3. Coordinate modeling requests to avoid redundant analyses
4. Standardize and document modeling definitions and assumptions
5. Define and standardize model input and output formats
6. Provide quality assurance and quality control (QA/QC) on analysis requests and modeling output
7. Maintain a database of analysis results
8. Provide interpretation of model output to resource workgroups

Using standardized definitions for input parameters and operations scenarios, the TST would ensure that each modeling request contains a well-formed input set for analysis. As proposed, the TST would provide QA/QC for the Scenario Tool output, habitat analysis modeling output, and other model related resource analyses. The intent of the QA/QC effort would be to ensure

that analysis results are consistent with the input assumptions prior to the transmittal of the results to the resource workgroups.

5.2. Proposed Workflow for Study and Modeling Analyses

Computational analysis and modeling of Project operations, hydrology, habitat analyses, and biologic time series are proposed for use in the Project relicensing effort to evaluate a range of potential environmental effects associated with different hydrologic and operations scenarios. This approach is intended to provide relicensing participants and SCL with comparative information on the effects of the existing operations and potential operations scenarios for use in the evaluation of potential PME measures as part of development of the PLP and License Application.

Currently, the various models are separate and unique pieces of software. During 2008, when studies are still underway, SCL will integrate the modeling systems as conceptually illustrated in Figure 5.2-1.

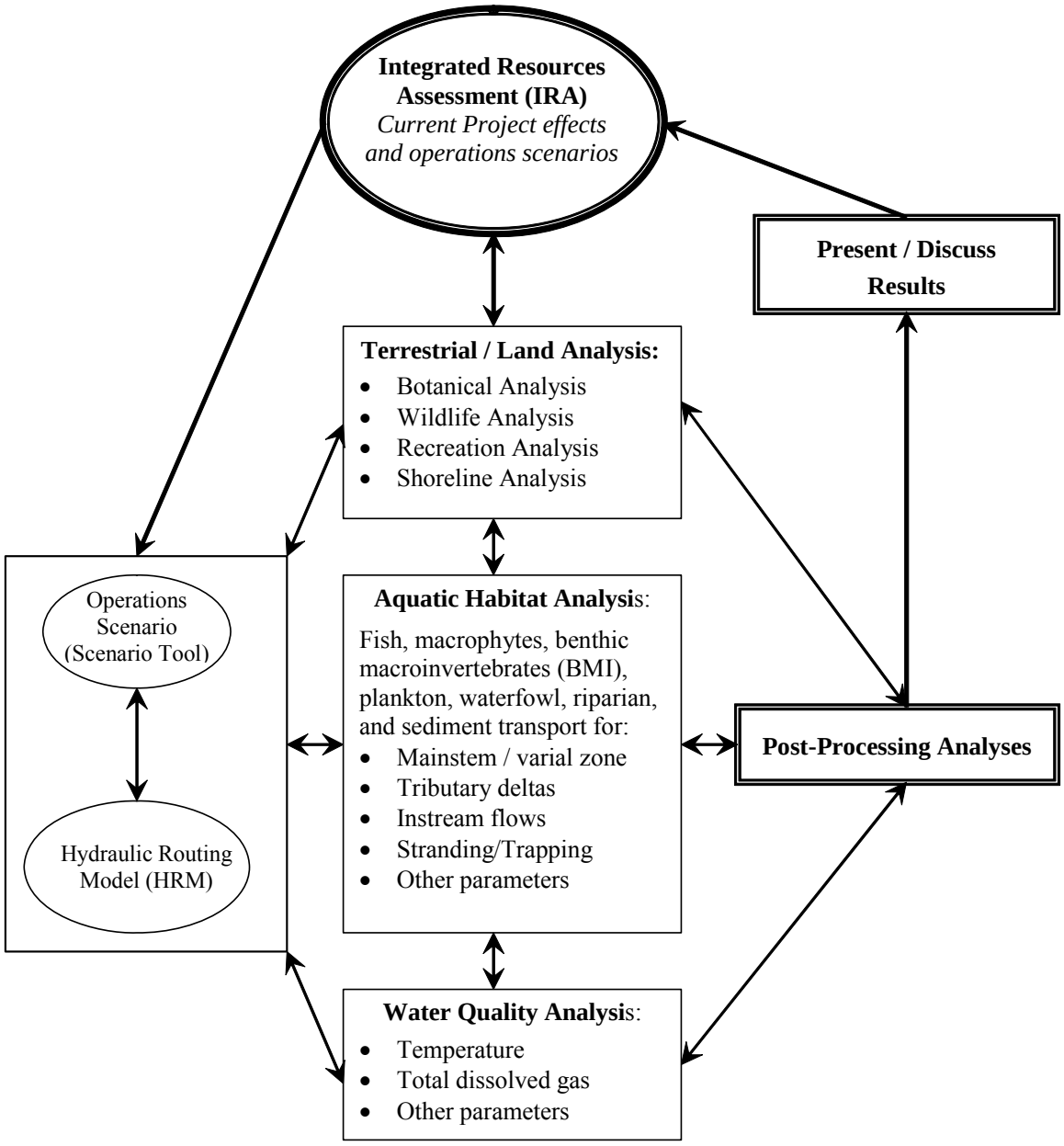

Figure 5.2-1. Conceptual workflow for integrating modeling and resource analysis.

5.3. Models that Support the Integrated Resource Analysis

Efforts have been underway to develop and apply models needed to support the evaluation of Project effects and operations scenarios. These include the scenario tool, hydraulic routing model, mainstem habitat model, trapping and stranding model, mainstem sediment transport model, and tributary habitat models. Information that supports the resource models is being developed as part of the relicensing studies and ongoing relevant non-ISR studies and analyses

(Section 3.0 of this Introduction). Together these models with post-processing analyses and the data that support them, provide the suite of tools to be used by SCL and relicensing participants to conduct the IRA for existing Project effects and subsequently comparison to operations scenarios.

The following sections provide brief descriptions of the models being developed and to be used during the IRA. More detailed information regarding each model identified below and the applicable resource analyses can be found in the appropriate study report provided in Attachment 2 of this ISR.

5.3.1. Scenario Tool and Hydraulic Routing Model

The Scenario Tool and Hydraulic Routing Model (HRM) are software models that will help predict resource impacts and benefits relative to current Project operations and operations scenarios. Using current or future operations and resource criteria, the Scenario Tool produces hourly water surface elevations and flows as input for the Hydraulic Routing Model. The Scenario Tool is a Microsoft Excel® spreadsheet with an add-in optimization engine (Solver by Frontline Systems, Inc.) that optimizes and simulates Project energy production, Project reservoir and tailwater water surface elevations, and flows.

The optimization of Project energy production by the Scenario Tool provides a consistent foundation for the relative comparison of resource impacts or benefits for various operations scenarios in conjunction with study results. Simulation by the Scenario Tool allows the output (elevations, flows, and/or energy production) to be readily used as input data to the Hydraulic Routing Model. Due to the specific application for resource evaluations, the Scenario Tool results cannot and will not directly translate to future operational changes at the Project.

Development of the Scenario Tool and Hydraulic Routing Model is continuing into 2008, using the hydrology data and statistics described in Section 3.1. Both models build on the framework for assessing resource impacts and benefits as illustrated in Figure 5.2-1.

The Hydraulic Routing Model has two components: 1) an upstream or reservoir component that addresses the Project area from Box Canyon Dam to Boundary Dam (reservoir HRM); and, 2) a tailwater or downstream component that addresses the area from Boundary Dam to Redbird Creek (a tributary to Seven Mile Reservoir) (downstream HRM), approximately 1 mile north of the Canada-US border.

Using Box Canyon inflows, Project outflows, and the initial Project forebay water surface elevations, the reservoir HRM computes water surface elevations and average velocities at cross section locations between the Boundary and Box Canyon dams. Similarly, the downstream HRM uses Project hourly outflows and Seven Mile Reservoir water surface elevations (or outflows) to determine water surface elevations and average velocities at various cross sections downstream of the Project.

5.3.2. Mainstem Habitat Model

The mainstem habitat model uses the water surface elevations and average velocities from the Hydraulic Routing Model, along with specific velocity measurements within habitat cells at various habitat transects, to determine velocities and depths for each habitat cell for each hour of simulated operation. Other cell parameters like substrate, cover, and water temperature (as appropriate) are incorporated into the habitat model and compared to Habitat Suitability Index/Criteria (HSI/HSC) for fish and other aquatic species (benthic macroinvertebrates, periphyton, and macrophytes) of interest to determine the relative amount of habitat at each transect for those species for each hour of Project operation. The transect data are then aggregated to determine Weighted Usable Area (WUA) for each hour. The hourly habitat data for each operations scenario can be analyzed using various techniques such as habitat duration curves for different species life stages. The focus of the mainstem habitat model will be the Project reservoir's varial zone.

5.3.3. Trapping and Stranding Model

Similar to the mainstem habitat model, the trapping and stranding model makes use of the Hydraulic Routing Model, physical data collected at various locations throughout the Project reservoir (e.g., pool locations), and biological responses (duration of stranding, exposure to water temperatures, cover, etc.) to estimate trapping and stranding potential in the Project reservoir.

The approach has been formulated to be similar to other analyses involving water surface elevation fluctuations in the varial zone. The stranding and trapping indices will use results of the Scenario Tool and the Hydraulic Routing Model to determine the water surface elevation on an hourly basis to evaluate conditions throughout the mainstem habitat modeling study area. The stranding and trapping analysis will track the period of dewatering to which fish are potentially exposed. Fish will be assumed to return to potential stranding and trapping areas as soon as the water surface elevation rises and once again inundates the dewatered area. Because the stranding and trapping indices can be calculated at each habitat routing model cross section, there will be a high level of spatial resolution to the indices.

5.3.4. Sediment Transport and Tributary Delta Modeling

The objective of sediment transport and tributary delta modeling is to quantify the effects of Project operations on aquatic habitats in the deltas of the tributary streams. Three modeling efforts are underway to address this objective:

- Aquatic habitat modeling to translate fluctuations in Boundary Reservoir pool elevation into estimates of habitat quantity and quality at select tributary deltas
- Tributary delta sediment modeling to assess whether delta morphologies are sensitive to Project operations and describe if, and how, delta morphologies may change over the term of a new FERC license
- Mainstem sediment transport modeling to evaluate how erosion and accumulation of mainstem sediments may affect tributary delta habitats; results of the mainstem sediment transport model will also be used to support other studies such as reservoir shoreline erosion and water quality

5.3.5. Modeling Limitations

Computational modeling as part of the Boundary Project relicensing analysis will assist in the evaluation of current Project effects and operations scenarios. However, models are inherently limited as representations of actual phenomena, and model input data, as well as modeling objectives and assumptions, involve a degree of uncertainty. Field data is required to calibrate or validate models that will be used in relicensing analyses to improve the reliability and predictive nature of the models.

6 SUMMARY LIST OF PROPOSED STUDIES

This ISR includes reports for 22 of the 24 relicensing studies.[4] These studies, along with studies 4 (Toxics) and 23 (Aesthetic/Visual Resources), are summarized in Table 6.0-1, along with the corresponding resource issue(s) that each study is designed to address. The studies are organized by resource area, and indicate in shaded text where one study will intersect with studies from other resource areas.

All Project elevations included in the ISR, unless otherwise noted, are provided relative to both the North American Vertical Datum of 1988 (NAVD 88) and the National Geodetic Vertical Datum of 1929 (NGVD 29). In rare instances when an elevation is provided relative to the NGVD 29 only—e.g., some existing Project drawings—a conversion factor for identifying the NAVD 88 is provided in a heading or legend.

[4] The Study 4, Toxics Assessment: Evaluation of Contaminant Pathways is on a unique schedule as the result of its two-phased approach (see Attachment 2). Study 23, Aesthetic/Visual Resources, is a 2008 study and will be reported on in the USR in March 2009.

Table 6.0-1. Summary of studies included in this ISR.

Identified Resource Issue	Study Title/Description[5]	Study No.
Geology and Soils		
Contribution of the Project to shoreline, hillslope, and Project road related erosion	▪ Erosion Study	1
Water Resources		
Potential Project-related flooding of private property adjacent to upper portion of Boundary Reservoir	▪ Analysis of Peak Flood Flow Conditions Above Metaline Falls	2
	Other relevant study: ▪ Mainstem Aquatic Habitat Modeling Study (hydraulic routing model component)	7
Contribution of the Project to total dissolved gas (TDG) in the Pend Oreille River below the Project	▪ Evaluation of TDG and Potential Abatement Measures	3
	Other relevant studies: ▪ Fish Distribution, Timing, and Abundance Study ▪ Fish Entrainment and Habitat Connectivity Study	9 12
Effect of the Project on toxic compounds in Boundary Reservoir	▪ Toxics Assessment: Evaluation of Contaminant Pathways, Potential Project Nexus	4
	Other relevant studies: ▪ Erosion Study ▪ Mainstem Aquatic Habitat Modeling Study (hydraulic routing model component) ▪ Sediment Transport and Boundary Reservoir Tributary Delta Habitats Study	1 7 8
General water quality in Boundary Reservoir and relation to fish and habitat	▪ Water Quality Constituent and Productivity Monitoring	5
	Other relevant study: ▪ Mainstem Aquatic Habitat Modeling Study (aquatic plant habitat suitability component)	7
pH and dissolved oxygen (DO) in Boundary Reservoir	▪ Evaluation of the Relationship of pH and DO to Macrophytes in Boundary Reservoir	6

[5] Shaded studies are being conducted under another resource area.

Table 6.0-1, continued…

Identified Resource Issue	Study Title/Description[5]	Study No.
Fish and Aquatic Resources		
Effect of load-following operations and pool-level fluctuations on fish and aquatic species and habitats	▪ Mainstem Aquatic Habitat Modeling Study; study includes the following components: ▪ Habitat mapping ▪ Hydraulic routing model ▪ Physical habitat model development ▪ Habitat suitability index (HSI) development, for: - Fish - Macrophytes - Periphyton and benthic macroinvertebrates	7
Sediment transport and effect of reservoir fluctuations on tributary delta habitat	▪ Sediment Transport and Boundary Reservoir Tributary Delta Habitats Study; study includes the following components: ▪ Tributary delta habitat modeling ▪ Evaluation of tributary delta sediment processes ▪ Evaluation of mainstem sediment transport	8
Abundance, distribution, and periodicity of fish in Boundary Reservoir	▪ Fish Distribution, Timing, and Abundance Study; study includes the following components: ▪ Passive and active sampling ▪ Biotelemetry	9
Effect of Project operations on wood recruitment and transport	▪ Large Woody Debris Management Study	10
Aquatic productivity in Boundary Reservoir	▪ Productivity Assessment	11
Fish entrainment and connectivity	▪ Fish Entrainment and Habitat Connectivity Study; study includes the following components: ▪ Evaluation of potential turbine entrainment ▪ Evaluation of potential spillway entrainment	12
Recreational fishery at the Project	▪ Recreational Fishery Study; study includes the following components: ▪ Recreational creel and angler surveys ▪ Triploid trout biotelemetry ▪ Triploid trout management	13
Effect of Project operations on habitat in Boundary Reservoir tributaries	▪ Assessment of Factors Affecting Aquatic Productivity in Tributary Habitats	14

Table 6.0-1, continued…

Identified Resource Issue	Study Title/Description[5]	Study No.
Botanical and Wildlife Resources		
Waterfowl nesting habitat and productivity at Boundary Reservoir	▪ Waterfowl/Waterbird Study	15
	Other relevant study: ▪ Mainstem Aquatic Habitat Modeling Study (hydraulic routing and aquatic plant habitat suitability components)	7
Status of cottonwood and other riparian-dependent plant species adjacent to Boundary Reservoir	▪ Inventory of Riparian Trees and Shrubs	16
	Other relevant studies: ▪ Erosion Study ▪ Mainstem Aquatic Habitat Modeling Study (hydraulic routing model component) ▪ Sediment Transport and Boundary Reservoir Tributary Delta Habitats	 1 7 8
Effect of the Project on rare, threatened, and endangered (RTE) plant species	▪ Rare, Threatened, and Endangered (RTE) Plant Species Inventory	17
Effect of the Project on RTE wildlife species	▪ RTE Wildlife Species Study	18
	Other relevant study: ▪ Big Game Study	 19
Effect of the Project on deer, elk, and other big game species	▪ Big Game Study	19
	Other relevant study: ▪ RTE Wildlife Species Study	 18
Effect of the Project on bats	▪ Bat Surveys and Habitat Inventory	20
Recreation and Land Use		
Recreational use, opportunities and demand in the Project area	▪ Recreation Resource Study; study includes the following components: ▪ Recreation surveys ▪ Regional recreation analysis ▪ Dispersed recreation use, access, and condition analysis ▪ Future recreation use analysis ▪ Recreation carrying capacity analysis	21
	Other relevant studies: ▪ Recreational Fishery Study ▪ Erosion Study	 13 1

Table 6.0-1, continued…

Identified Resource Issue	Study Title/Description[5]	Study No.
Project-related roads system (condition and needs) and public access	▪ Land and Roads Study	22
	Other relevant studies: ▪ Erosion Study ▪ Big Game Study ▪ Recreation Resource Study	 1 19 21
Aesthetic/Visual Resources		
Effect of the Project on visual character and visual quality	▪ Aesthetic/Visual Resource Study	23
	Other relevant studies: ▪ Erosion Study ▪ Recreation Resource Study (recreation surveys component)	 1 21
Cultural Resources		
Effect of the Project on cultural resources	▪ Cultural Resource Study	24
	Other relevant studies: • Erosion Study • Dispersed Recreation Use, Access, and Condition Analysis (a component of the Recreation Resources Study) • Assessment of Factors Affecting Aquatic Productivity in Tributary Habitats • Bat Surveys and Habitat Inventory	 1 21 14 20

7 REFERENCES

Breithaupt, S. A., and T. Khangaonkar. 2007. Temperature modeling of the Pend Oreille River, Boundary Hydroelectric Project, CE-QUAL-W2 Model Calibration Report. Prepared for Seattle City Light. Prepared by Battelle, Pacific Northwest Division, Richland, WA.

Bridge, B., and B. Feldpausch. 2008. Study No. 25, Bathymetry Survey, Boundary Reservoir and Tailwater to Seven Mile Dam. Prepared for Seattle City Light. Prepared by Tetra Tech EC, Inc., Bothell, WA. January 11, 2008.

Cole, T.M., and S.A. Wells. 2002. CE-Qual-W2: A Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model, Version 3.1. User Manual (Draft). Instruction Report EL-02-1. Prepared for U.S. Army Corps of Engineers, Washington, DC. August 2002.

FERC (Federal Energy Regulatory Commission). 2007a. Study Plan Determination for Boundary Hydroelectric Project. Letter dated March 15, 2007.

FERC (Federal Energy Regulatory Commission). 2007b. Study Plan Determination for Phase 2 Toxic Sampling and Analysis Plan for the Boundary Hydroelectric Project. Letter dated October 25, 2007.

R2 Resource Consultants. 2008. Compilation of Project Hydrologic Data, Preparation of Hydrologic Database and Hydrologic Statistics in Support of Relicensing Studies, Boundary Hydroelectric Project (FERC No. 2144). Prepared by R2 Resource Consultants, Inc., prepared for Seattle City Light, Seattle, WA.

SCL (Seattle City Light). 2006a. Pre-Application Document for the Boundary Hydroelectric Project (FERC No. 2144). Seattle, Washington. May 2006. Available online at http://www.seattle.gov/light/news/issues/bndryRelic/br_document.asp

Terrapoint. 2005. Project Report, Metaline Falls, Contract #2354-H. Prepared for DeGross Aerial Mapping, Inc. Prepared by Terrapoint, The Woodlands, TX. September 10, 2005.

This page is intentionally left blank.