Gorge 2nd Tunnel

Appendix B: Historical Investigation Technical Memorandum

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PROJECT MEMORANDUM

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Subject:	Gorge 2nd Tunnel—Historical Construction Records Review

1 Introduction

The purpose of this memorandum is to summarize the information obtained during the design team's literature search of existing Seattle City Light (SCL) documents related to the Gorge facilities. These documents were reviewed for data that could be incorporated into the Gorge 2nd Tunnel (G2T) optimization studies. This information is one of the deliverables listed in the Scope of Work, Task 100.

Although documents related to planning, construction, and hydraulics were reviewed, the primary focus of the investigation was to collect and review material related to the construction of the Gorge 1st Power Tunnel (G1T). Information on the construction of G1T would provide valuable insight into potential risks that could impact the construction of the G2T. Although specific G1T construction records were not available, several of the historic documents contained information that can be used in the optimization evaluations. Documents related to hydraulic performance were reviewed and incorporated into the hydraulic models as necessary.

2 Literature Review

Seattle City Light documents related to SCL construction projects in the vicinity of the G2T project area were obtained through e-mail correspondence with SCL as well as through examination of SCL archive files. Despite the fact that no G1T original construction documents were available, other pertinent information was collected. This included:

- G1T repair and inspection documents;
- Geologic investigation reports and laboratory data for nearby projects;
- Previous Gorge Companion Tunnel studies;
- Gorge Powerhouse Extension and High Dam construction reports;
- G2T preliminary studies;

- Skagit River Project feasibility studies;
- G1T and Gorge Powerhouse penstock inspection reports;
- Ross Power Plant tunnel inspection report; and
- Thunder Creek and Diablo Dam geologic reports.

Historical information collected from SCL was copied and reviewed. A list of these documents and a short summary of their contents are included in Table 1.

Information on geology included in the historical documents was reviewed and will be included in the Geologic Assessment Technical Memorandum (Subtask 102), where pertinent to characterizing anticipated ground behavior during G2T excavation.

3 Conclusions

No historical documents detailing the construction of G1T were found. Weekly construction summaries identified during the literature review provided only a general overview of construction operations and are not suitable for assessing tunneling conditions or risks.

Due to the lack of available detailed construction documentation, no construction risks were identified; however, geologic information obtained from borehole logs for the original Gorge Dam, the new High Gorge Dam, and the Gorge Powerhouse Extension provides some insight into bedrock lithology and rock quality in the project area. Historical geologic information is discussed in the Geologic Assessment Technical Memorandum.

Table 1. Summary of Available Historical Information Related to G2T Project

File Name	*Structure*	*Document*	*Author*	*Date*	*Type*	*Summary*
525L (5-68)	Gorge 1st Tunnel Invert	Inspection of Test Patches Applied in June 1960	Sheehan	6/15/1971	memo	Location and description of each test patch (all applied June 1960); description of patch condition as of June 1971.
525L (10-76)	Gorge 1st Tunnel	Gorge Power Tunnel Inspection	Bishop	10/8/1979	memo	Description of conditions observed during full length tunnel inspection.
531-L(1-83)	Gorge 1st Tunnel	Gorge Power Tunnel Inspection	Whitney	6/19/1986	memo	Description of conditions observed during full length tunnel inspection and surge tank inspection.
753	Gorge 1st Tunnel	Gorge Powerhouse Tunnel Drain October 1990	DEH	10/1/1990	report	Daily log of eleven-day tunnel drain. Summary of work completed.
525-L (7-82)	Gorge 1st Tunnel	Concrete Patches for Gorge Tunnel	Early	10/9/1990	memo	Location of patches, type and amount of grout applied. Contains photos of work progress.
531-L (1-90)	Gorge 1st Tunnel	Gorge Power Tunnel Inspection	Hastig, Davis, and Gwilym	6/16/1993	memo	Summary of partial tunnel inspection; recommendations of inspection team. Contains photos (poor quality).
N/A	Gorge Companion Tunnel	Rock Report 1862	The Robbins Company	3/5/1984	report	Laboratory test results for granodiorite sample. TBM specifications, prices, and performance.
N/A	Gorge Companion Tunnel	Rock Report 2070	The Robbins Company	9/16/1987	report	Laboratory test results for five rock samples from Diablo, Gorge, and Ross. TBM specifications, operation costs, and performance.
531-L(1-83), SCLGHPT2	Gorge Companion Tunnel	Proposed Gorge Companion Tunnel - Project Memo	Hansen	12/30/1988	memo	Complete 1988 study. Includes project scope, description of flow regime, project history, economic analysis, legal considerations, spoil characteristics, proposed spoil reuse, proposed storage sites with descriptions, construction methods, truck hauling, environmental considerations, schedule, conclusions, lab test results, summary of field investigations, tunnelling reference list, construction costs, permit and approval list.
N/A	Gorge Dam	Boring logs	N/A	4/1919 - 5/1923	field logs	Vertical bores, directional drilling, and test pits.
531-L (1-90)	Gorge 1st Tunnel, Gorge Powerhouse Extension	Record of repair work to concrete in Gorge Tunnel	Currier	4/15/1941	memo	Summary of repairs, field notes and records, plan of additional diamond drilling for Plant extenstion.
D-11615	Gorge Powerhouse Extension	Location of Diamond Drilling Holes	Schindler	11/1945	drawing	Diamond drill hole location plan.
AJT-M	Gorge Dam	Field notes	Turner	1/1922-7/1922	memo	Weekly construction field notes - original construction.
N/A	Gorge 2nd Tunnel	Gorge 2nd Power Tunnel Reference Drawings	City Light	N/A	list	Reference drawings list - penstock, intake, civil, surge tank, unit 23, powerhouse, draft tubes, unit 24, butterfly valves
B-2386	Gorge Powerhouse Extension	Diamond Drilling	HGS	11/21/1946	drawing	Diamond drilling plan.
B-2409	Gorge Powerhouse Extension	Diamond Drilling at Upstream End of Powerhouse	HGS	6/9/1947	drawing	Diamond drilling plan.
B-2449	Gorge Powerhouse Extension	Additional Diamond Drilling at Upstream End of Powerhouse	HGS	2/4/1948	drawing	Diamond drilling plan.
B-3196	Gorge Powerhouse Extension	Additional Diamond Drilling at Upstream End of Powerhouse	N/A	N/A	drawing	Site contours.
N/A	Diablo Dam Site	A Report on the Bed-Rock Foundation	Landes & Goodspeed	6/30/1928	report	Description of bedrock at Diablo Dam site. (contains photos)
N/A	Rock Point	Diamond Drilling Results	city engineer	6/19/1919	memo	Brief summary of diamond drilling results at Rock Point.
N/A	Skagit River Project	Design Considerations	Landes & Goodspeed	1/8/1921	memo	Brief discussion considering the omission of tunnel lining from the design.
N/A	Gorge 2nd Tunnel	Upstream Connection to Existing Tunnel	Hatch Mott MacDonald	10/20/2006	drawing	Plan of proposed upstream connection to existing tunnel.

Table 1. Summary of Available Historical Information Related to G2T Project (continued)

D-32715	Gorge Companion Tunnel	Topography Map from Goodell Creek Bridge to Gorge Powerhouse	SCL	11/24/1998	drawing	Topographic map.
D-32717	Gorge Companion Tunnel	Topography Map from Goodell Creek Bridge to Gorge Powerhouse	SCL	4/27/1998	drawing	Topographic map.
D-32718	Gorge Companion Tunnel	Topography Map from Goodell Creek Bridge to Gorge Powerhouse	SCL	4/27/1998	drawing	Topographic map.
D-32719	Gorge Companion Tunnel	Topography Map from Goodell Creek Bridge to Gorge Powerhouse	SCL	4/27/1998	drawing	Topographic map.
D-32721	Gorge Companion Tunnel	Topography Map from Goodell Creek Bridge to Gorge Powerhouse	SCL	4/27/1998	drawing	Topographic map.
D-42975	Gorge 2nd Tunnel	Gorge 2nd Tunnel Conceptual Plan	SCL	5/28/2008	drawing	Cover sheet.
D-42976	Gorge 2nd Tunnel	Gorge 2nd Tunnel Conceptual Plan	SCL	5/28/2008	drawing	Plan and profile.
D-42977	Gorge 2nd Tunnel	Gorge 2nd Tunnel Conceptual Plan	SCL	5/28/2008	drawing	Site plan - portal and staging area.
D-42978	Gorge 2nd Tunnel	Gorge 2nd Tunnel Conceptual Plan	SCL	5/28/2008	drawing	Wastewater pipeline and disposal area.
D-42979	Gorge 2nd Tunnel	Gorge 2nd Tunnel Conceptual Plan	SCL	5/28/2008	drawing and logs	TBM discharge water secondary treatment and disposal area plan. Test-pit logs. Grain-size distribution.
D-42980	Gorge 2nd Tunnel	Gorge 2nd Tunnel Conceptual Plan	SCL	5/28/2008	drawing	Existing conditions - portal plan and cross sections.
N/A	Gorge 2nd Tunnel	Gorge Power Surface	N/A	5/28/2008	drawing	Power surface contours.
N/A	Gorge 2nd Tunnel	Gorge Power Topo	N/A	N/A	drawing	Power surface topographic plan.
N/A	Gorge 2nd Tunnel	Gorge Power Tunnel Topo Composite	N/A	N/A	drawing	Power surface topographic composite plan.
N/A	Gorge 2nd Tunnel	SKG-Epenstocks_3D	N/A	N/A	drawing	3D penstocks.
N/A	Gorge 2nd Tunnel	SKG-Newhalem	N/A	N/A	drawing	Topographic composite plan.
N/A	Gorge 2nd Tunnel	SKG-P2nd-Tunnel	N/A	N/A	drawing	3D tunnel.
N/A	Gorge 2nd Tunnel	SKG-Siteplan	N/A	N/A	drawing	Site plan.
N/A	Gorge 2nd Tunnel	SKG-USGS-contours	N/A	N/A	drawing	USGS contours.
N/A	Gorge 2nd Tunnel	Site plan	N/A	N/A	drawing	Site plan.
D-36892	Gorge 2nd Tunnel	Gorge Power House Tunnel Two Entrance	N/A	2/13/2008	drawing	Survey plan.
D-36894	Gorge 2nd Tunnel	Gorge Power House Tunnel Two Water Dissipation Site	N/A	1/28/2008	drawing	Survey plan.
D-36913	Gorge 2nd Tunnel	Gorge Power House Tunnel Two Entrance	N/A	2/13/2008	drawing	Survey station profiles.
D-36914	Gorge 2nd Tunnel	Gorge Power House Tunnel Two Entrance	N/A	2/13/2008	drawing	Survey station profiles.

Table 1. Summary of Available Historical Information Related to G2T Project (continued)

N/A	Gorge 2nd Tunnel	Reference Documents for Hydraulic Modeling	SCL	N/A	outline	Table of contents.
N/A	Gorge 2nd Tunnel	Reference Documents Registry - Gorge 2nd Tunnel Hydraulic Modelliing	SCL	N/A	spreadsheet	Document name, document type, source, location.
N/A	Gorge 2nd Tunnel	Gorge Powerhouse Acoustic Flowmeter Installation	SCL	1/2008	report	Flowmeter test summary, procedure, results, conclusion, recommendations.
N/A	Gorge Powerhouse Extension	Gorge Plant - Tunnel Loss Tests	Shelving	3/2/1955	memo	Test proposal and results.
N/A	Gorge Powerhouse	Gorge Units 22 and 23 - Load Rejection Tests	Cornwell	12/13/1985	memo	Load rejection test results - Units 22 and 23.
N/A	Gorge Powerhouse	Gorge Powerhouse Unit 22 Relief Valve Calibration Test Data Sheet	Dexter	5/13/1984	memo	Data sheet.
N/A	Gorge Dam	Gorge Transient Analysis	multiple	1925-1955	memos	Load rejection test results (1925, 1948), surge tank stability (1948), water-hammer pressures and surge tank performance (1948).
N/A	Gorge Powerhouse	Gorge Powerhouse Units 21, 22, 23 & 24 Test Data and Preliminary Results	N/A	4/26/1986	report	Test results.
D-10974	Diablo	General Layout	Stevens	4/9/1937	drawing	General layout.
SCL Job1	Gorge Dam	Data Pertinent to the Gorge High Dam	N/A	N/A	report	Streamflow data (1937-1938)
SCL Job2	Gorge Dam	A Report on the Gorge Dam Site - Part I	N/A	8/1920	report	Review and interpretation of drilling data.
SCL Job3	Gorge Dam	List of Gorge High Dam drawings	N/A	N/A	list	Drawing list.
SCL Job4 - Job10	Gorge Dam	Gorge drawings	N/A	1920-1923	drawings and logs	Plans and profiles of possible sites, boring logs, boring location plans, bedrock contour plans.
SCL Job11 - Job12	Gorge Dam	A Report on the Gorge Dam Site - Part II	N/A	N/A	report	Report on the final location of the masonry dam at the gorge site based on existing data, data pertinent to Gorge High Dam.
SCL Job13	Gorge Dam	Memo to the Utilities Committee of the City Council	Constant Angle Co.	7/10/1929	memo	Skagit River Development considerations.
SCL Job14	Gorge Dam	Gorge Crib Dam	Constant Angle Co.	5/31/1929	drawings	Crib Dam drawings.
SCL Job15	Gorge Dam	Memo to the Utilities Committee of the City Council	Constant Angle Co.	5/8/1929	memo	Skagit River Development cost estimates
SCLCC2	Gorge High Dam	Exploration of the Gorge and Copper Creek Dam Foundations by a Seismic Refraction Survey	Conwell	6/2/1952	memo	Field trip report.
N/A	Gorge Powerhouse Extension	Diamond Drill Core Photos	N/A	5/1948	photos	Core sample photos.
D-11615	Gorge Dam	Gorge Damsite Location of Diamond Drill Holes	SCL	11/20/1929	drawing	Location plan.
SCLGR 1	Gorge High Dam	Geologic Examination of the Gorge High Dam Site, Skagit Project Seattle City Light	Coombs	1954	report	Site geology, drilling program summary, recommendations.
D-17130	Gorge Powerhouse Extension	Powerhouse Structure Plan Showing Power Plant Excavation Second Stage	Cutler	9/16/1950	drawing	Excavation plan.
SCLGRRP1	Ross	Geologic Report on Ross Powerhouse Excavation and Ross Power Tunnel No. 2	Coombs	10/2/1951	report	Fault zone descriptions, geologic report.
D-SK-MPH-18	Gorge Companion Tunnel	Geologic Examination of the Gorge High Dam Site, Skagit Project Seattle City Light	SCL	N/A	drawing	Plan and profile.

Table 1. Summary of Available Historical Information Related to G2T Project (continued)

SCLGRRP1	Gorge Companion Tunnel	Gorge Companion Study Documents	Bishop, Dyer	1977	memos	Skagit power tunnel improvement feasibility study, tunnel improvement analysis, ecomomic studies
N/A	Gorge Companion Tunnel	Gorge Powerhouse Plant Generator Output vs. Flow	TKC	11/9/1987	drawing	Plot of plant generator output vs. flow. (with and without companion tunnel)
SCLGHPT1	Gorge Companion Tunnel	Design Calculations and memos	SCL, Robbins	1987-1988	calculations, memos	Design calculations, environmental considerations, Unit 24 generator rebuild recommendations, tunnel muck gradation reports from various U.S. and Norwegian jobs.
SCLGHPT3	Gorge Companion Tunnel	Summary of Field Investigations for Tunnel Spoil Storage Sites	N/A	N/A	report	Tunnel spoil storage site summary.
SCLGHPT4	Gorge Companion Tunnel	Project Memo - Gorge Companion Tunnel	Gwilym, Davis	12/22/1988	proposal	Improvement summary, flow calculations.
SCLGHPT5	Gorge Companion Tunnel	Gorge Powerhouse Performance (w/ 14' companion tunnel)	TKC	12/16/1988	drawings	Net head vs. plant load, turbine output, unit 23 1987 design, turbine discharge
SCLGHPT6	Gorge Companion Tunnel	Various memos	Davison, Yamagiwa	1988	memos	Environmental assessment, economic analysis,
SCLGHPT7	Gorge Companion Tunnel	Preliminary Review and Comments on Proposed Gorge Companion Tunnel Project	North Cascades Conservation Council	1988	memos	Environmental assessment
SCLGPPT1	Gorge 1st Tunnel	Inspection Reports	Schultz	6/1963	report	Tunnel inspection results.
N/A	Gorge Powerhouse Extension	Gorge Powerhouse Extension Record of Constructoin	SCL	1951	report	Gorge powerhouse construction records - 7/1948 thru 6/1951. Complete summary.
SCLGPE	Gorge Powerhouse	Analysis of Hydraulic and Electrical Equipment for Units #21, 22, 23, & 24	Benson	1962	report	Summary cost analysis.
SCLPDSA-SCLPDSE	Gorge High Dam	Photos of Gorge Dam Site	N/A	1952	photos	Site photos.
A-3019	Gorge High Dam	Test Drilling for Freezing Points	Benson	8/1954	drawing	Alignment. (taken from Eastman Oil survey)
D-16352	Gorge High Dam	Proposed Drill Arrangement & Layout for Drilling Freezing Holes	Benson	1954	drawing	Site Layout.
N/A	Gorge	DOL Refraction Seismic Survey	Conwell	N/A	drawing	Plan and profile.
D-16352	Gorge High Dam	Information Accumulated in Drilling Cased Holes, Pumping Ground Water and Grouting and Freezing the River Fill Material in Connection with Water Diversion at the Gorge High Dam Site	Raver	1954	drawing	Drilling cased holes, grouting, pumping, freezing, conclusion. Contains photos, logs.
SCLSPRPP1	Ross Power Plant	Report on Inspection of Excavation for Power Plant and Tunnels	Harza Engineering	2/28/1951	drawing	Purpose, conclusions, work description, progress, equipment, safety considerations.
D-25295	Thunder Creek	Thunder Creek Diversion to Ross Lake	SCL	7/26/1967	drawing	Area map from USGS Quads.
D-25320	Thunder Creek	Mile 6 Dam Site Topograhy	SCL	12/5/1967	drawing	Topographic map.
N/A	Thunder Creek, Ross	Miscellaneous	various	1968, 1949	memos	Miscellaneous Thunder Creek correspondance, Ross Dam construction field points.
N/A	Thunder Creek	Thunder Creek Project; Preliminary Geologic Report	IECO	5/31/1968	memo	Summary report.
N/A	Thunder Creek	Thunder Creek Project; Tunneling Machine Information	IECO	8/27/1968	memo	Brief geoligic summary of tunnel alignment.