Grant Lake Engineering Feasibility

March 18, 2014

McMillen

DESIGN with Vision. BUILD with Integrity.

In Association with

HEA

Presentation Outline

- Historical review
- Itemized status of tasks
- Project configuration and operational scenarios
- Deliverables
- Next steps
- Questions/comments

Historical Review – Previous Studies

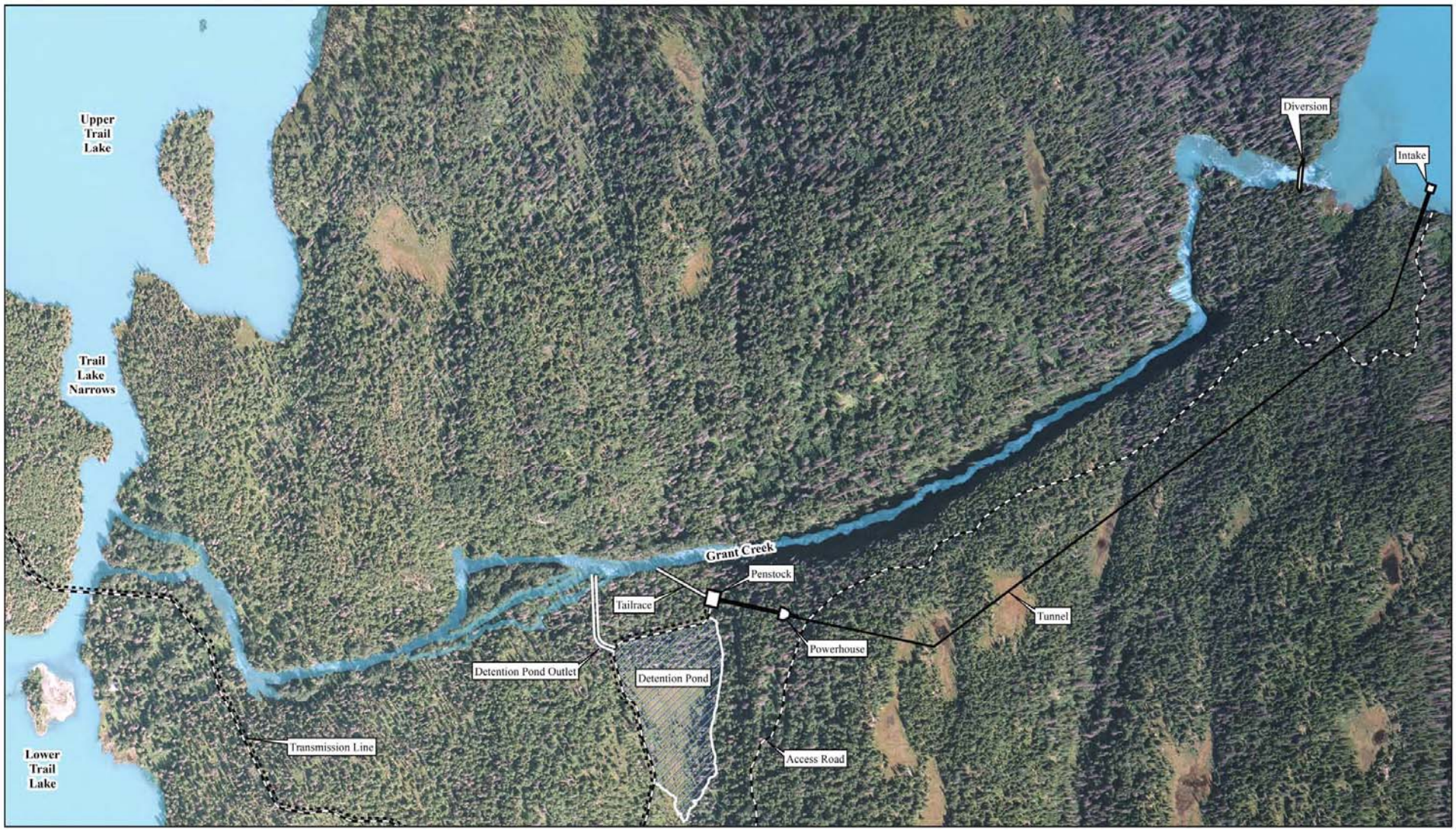
Year	Study
1954	R.W. Beck and Associates preliminary investigation
1955	U.S.G.S geological investigations of proposed power sites at Cooper, Ptarmagin, and Crescent Lake
1980	CH2M Hill pre-feasibility study
1981	USACE National Hydroelectric Power Resources Study
1984	Ebasco Services Project Feasibility Analysis
2009-10	HDR site evaluation and analysis

Itemized Status of Tasks

Task	Description	Status
1.0	Data Collection and Site Visit	Complete
2.0	Surveys and Mapping	Ongoing
3.0	Geotechnical Investigations	Internal draft review
4.0	Hydrologic Analysis	Draft TM
5.0	Hydraulic Analysis	Draft TM
6.0	Operation and Generation Analysis	Initial model complete
7.0	Alternatives Development and Evaluation	To be completed
8.0	Cost Estimates and Financial Analysis	To be completed
9.0	Project Schedule/Construction Methodology	To be completed
10.0	Preliminary Design Report	To be completed
11.0	Prepare FERC Exhibits	To be completed

Current Project Configuration and Operational Scenarios

- Lake intake
- 3200 ft long tunnel
- 8-ft diameter surge chamber near tunnel outlet
- 360 ft long steel penstock
- 45-ft by 60-ft powerhouse
- Evaluating turbine-generator options
- Powerhouse access road/intake access road
- Transmission line and substation



N

0 150 300 600 Feet

McMILLEN, LLC

Homer Electric Association, Inc.
A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Proposed Hydroelectric Project Infrastructure

DESIGNED: J. Woodbury
DRAWN: J. Woodbury
CHECKED: C. Warnock
PROJECT DATE: 3/10/2014
SCALE: 1:4,000

Current Scenarios – FERC License Application

- Use previous alternatives from Ebasco report for basis of alternatives development and evaluation
- Alternatives A, B, C involve raising the lake level and will be used for basis of comparison
- Alternatives D, E (and others) will be used for lake tap with no lake raise and various powerhouse size configurations

Current Scenarios – Example

Alt.	Description	Features
A	Intake Upstream from Saddle Dam	Two dams, penstock, surge tank, powerhouse, transmission, access roads
B	Intake at Main Dam with Tunnel and Surface Conduit	Two dams, two powerhouses, surge tank, tunnel, transmission, access roads
C	Intake at Main Dam with Surface Conduit	Similar to Alt. B
D	Lake Tap with Two Equal Size Units Powerhouse	Lake tap intake, tunnel, penstock, surge tank, powerhouse, access roads, and transmission
E	Lake Tap with One Small and One Large Unit Powerhouse	Lake tap intake, tunnel, penstock, surge tank, powerhouse, access roads, and transmission

Deliverables – Engineering Work Tasks

Task	Description	Deliverable
1.0	Data Collection and Site Visit	Bibliography
2.0	Surveys and Mapping	Boundary survey
3.0	Geotechnical Investigations	Preliminary Report
4.0	Hydrologic Analysis	Technical Memo
5.0	Hydraulic Analysis	Technical Memo
6.0	Operation and Generation Analysis	Technical Memo
7.0	Alternatives Development and Evaluation	Technical Memo
8.0	Cost Estimates and Financial Analysis	Technical Memo
9.0	Project Schedule/Construction Methodology	Technical Memo
10.0	Preliminary Design Report	Draft/Final Report
11.0	Prepare FERC Exhibits	Exhibits A thru G

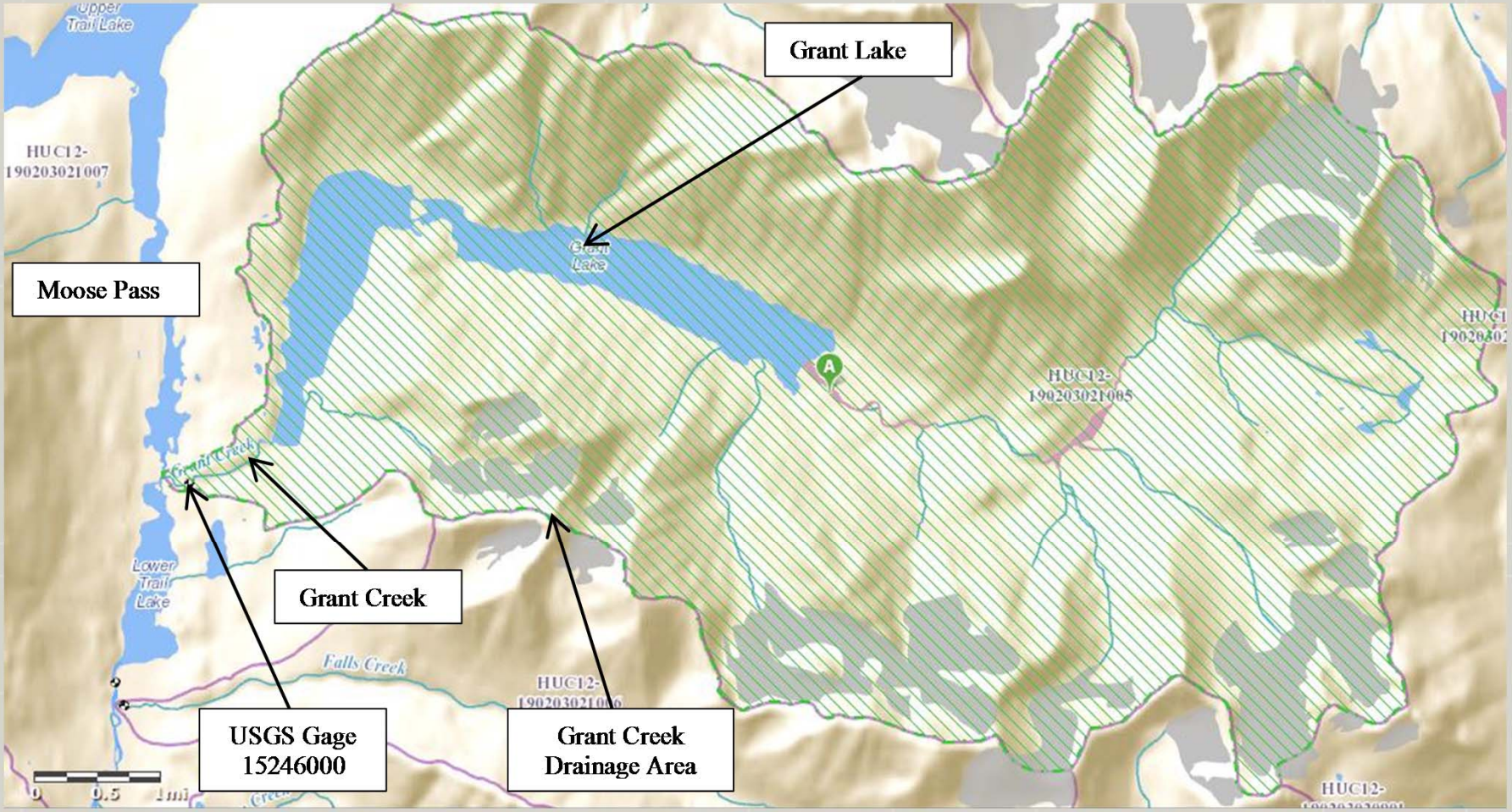
Summary - Work Completed

- Review draft Hydrology TM results
- Review draft Hydraulics TM results
- Summarize approach to geotechnical site assessment
- Outline operational/generation model
- Present next work tasks steps and schedule

Hydrologic Review – Purpose and Scope

- Complete an independent review and analysis of previous hydrologic analyses using available gage data and basin characteristics
- Determine the peak stream flow magnitude and frequency discharges
- Complete a flow duration and mean daily flow analysis to use in the Project energy production evaluation

Hydrologic Review – Basin Map



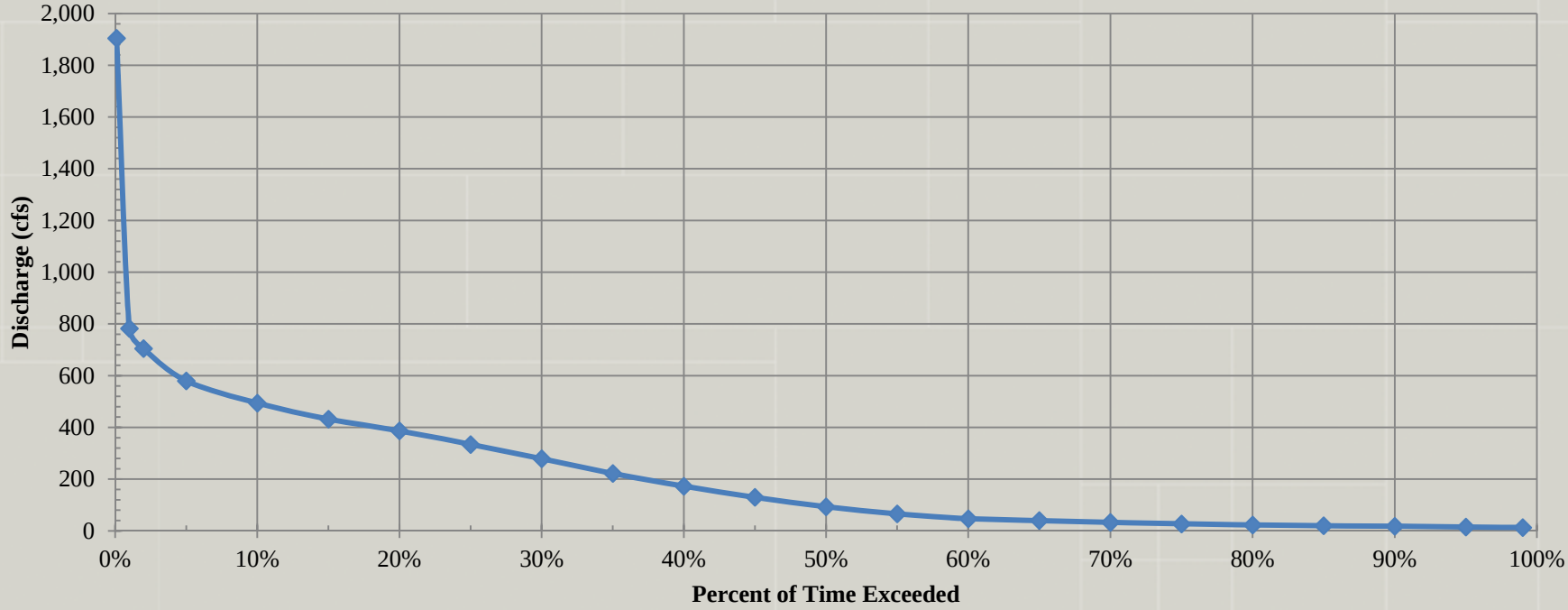
Hydrologic Review – Characteristics

Item	Value
USGS Station No.	15246000
Station Name	Grant Lake near Moose Pass, AK
Drainage Area	44.2 square miles
Mean Basin Elevation	2,900 ft
Areas of Lakes and Ponds (storage)	10%
Area of Forest	20%
Mean Annual Precipitation	90 inches
Mean Min. January Temperature	10 o F

Hydrologic Review – Flow Duration

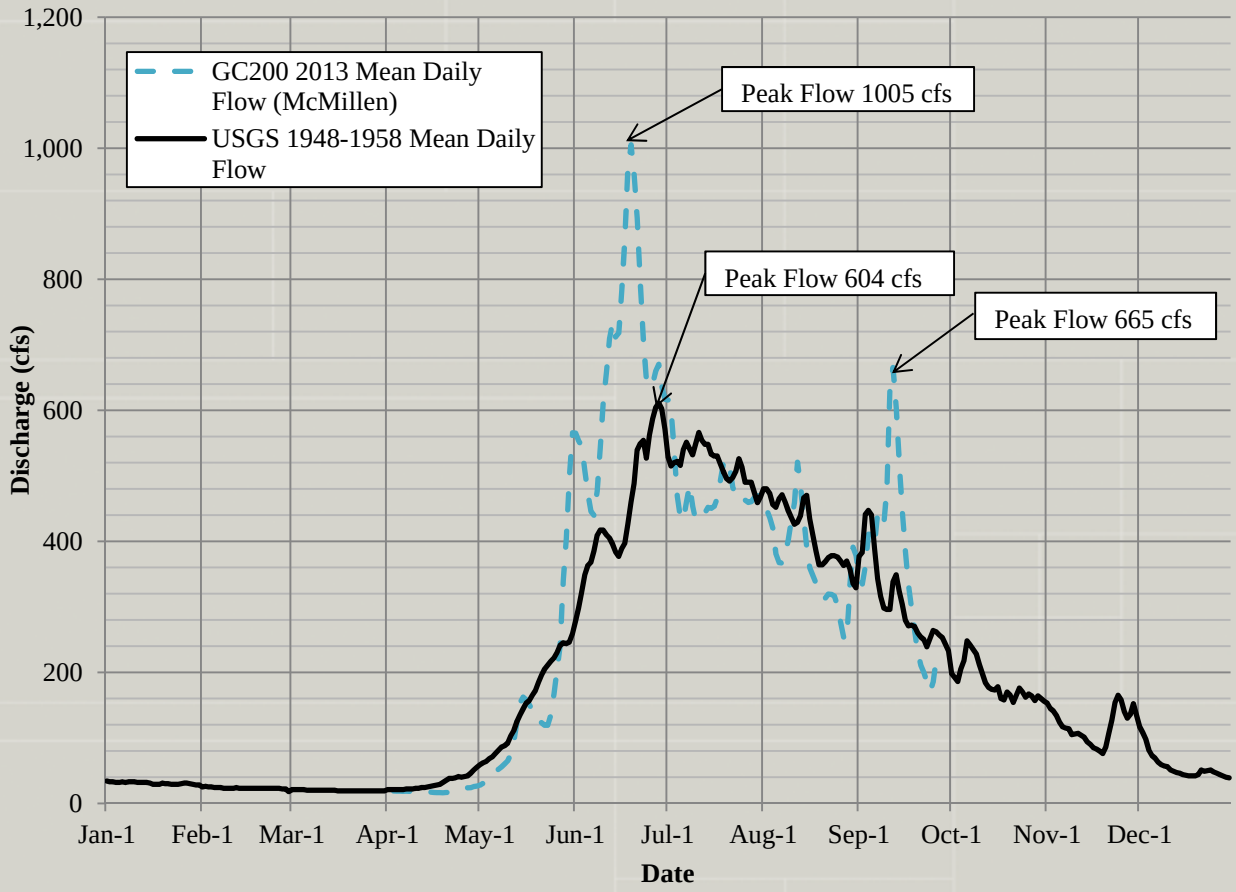
Percent of Time Exceeded	Grant Creek Discharge (cfs)
95%	15
90%	18
80%	23
70%	33
60%	47
50%	93
40%	172
30%	279
20%	387
10%	494
5%	580

Hydrologic Review – Flow Duration



Grant Creek Flow Duration Analysis

Hydrologic Review – Mean Daily Flow



Grant Creek Mean Daily Flow - 1948-1958 and 2013 (Calendar Year)

Hydrologic Review – Mean Annual Flow

Calendar Year	Grant Creek Annual Mean Discharge (cfs)	Classification Based on Long Term Kenai River Record
1948	193.9	Normal
1949	193.4	Normal
1950	181.1	Dry
1951	175.3	Dry
1952	209.5*	Dry
1953	275.1	Wet
1954	173.8	Dry
1955	162.5	Dry
1956	148.7	Dry
1957	202.3	Wet

* Outlier

Hydrologic Review – Conclusions

- Current analysis results were consistent with previous analyses
- 95% exceedance flow of 15 cfs
- 5% exceedance flow of 580 cfs
- 20% exceedance flow of 387 cfs
- 100-year flood of 3,310 cfs for powerhouse flood protection

Hydraulic Review – Purpose and Scope

- Determine the water surface profiles along Grant Creek for various flows
- Develop a tailwater rating curve for the powerhouse tailrace channel
- Determine the 100-year water surface at the powerhouse proposed location
- Provide the design flow and head assumptions for various generation scenarios/turbine-generator configurations

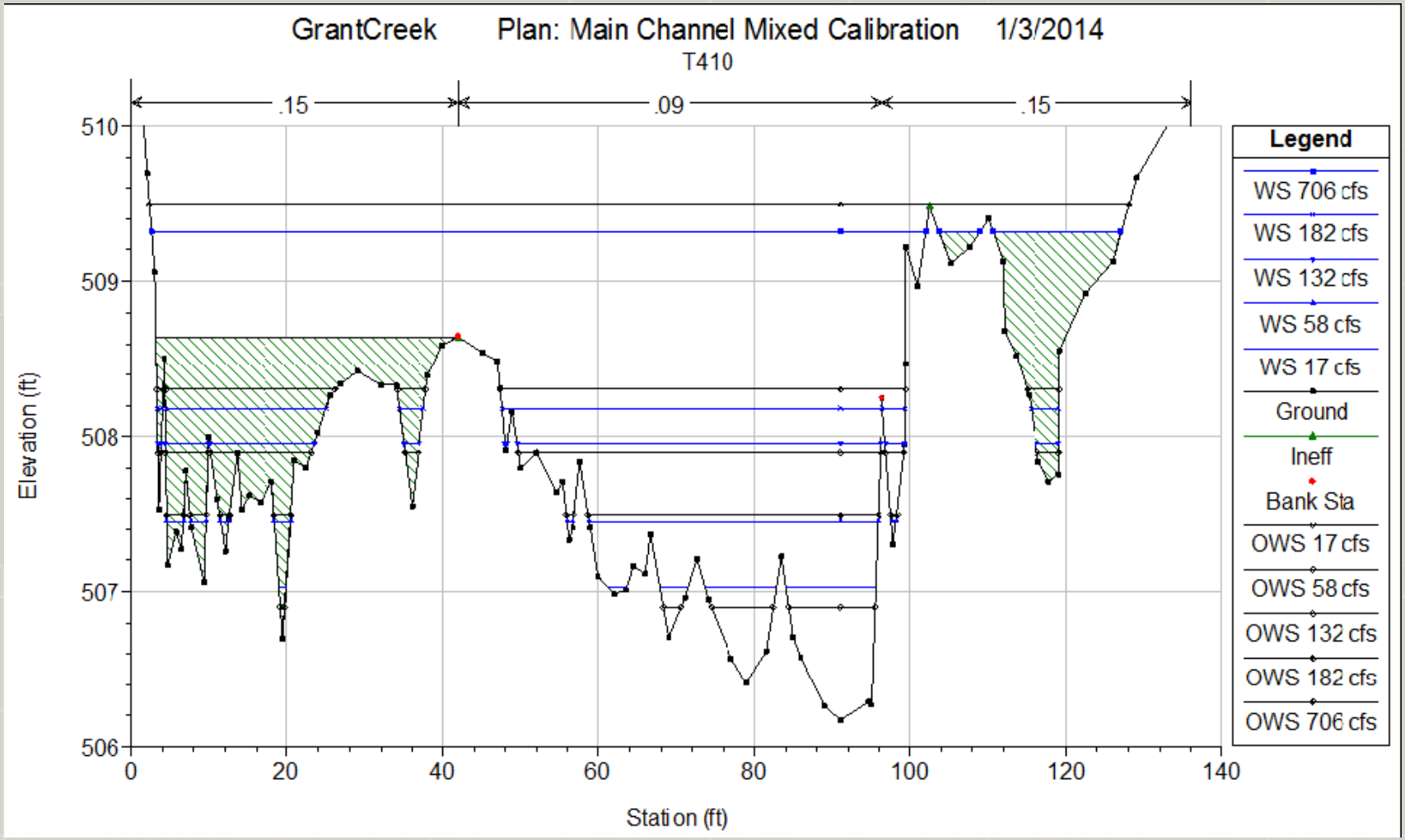
Hydraulic Review – HECRAS Model

- Purpose of the model – to fill in the gaps in the hydraulic record and perform simulation of various flow regimes
- Uses IFIM cross-sections to develop the basic model geometry
- Input hydrologic flow values determined in TM 1
- Calibrated using field measured water surfaces conducted to support the IFIM analysis

Hydraulic Review – HECRAS Model

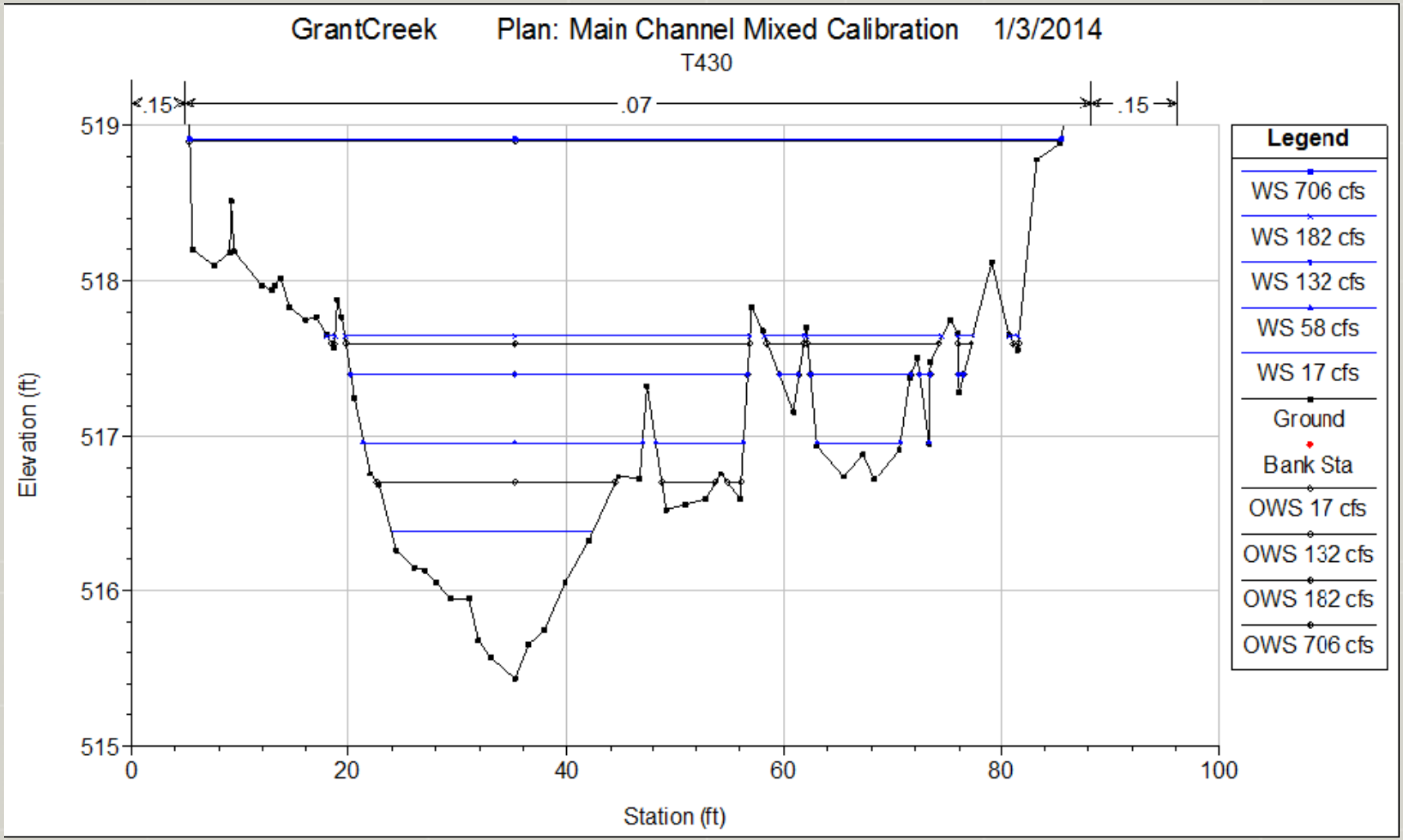
Cross Section Name (IFIM Study)	HEC-RAS Station (ft)	Main Channel Roughness (n)	Overbank Roughness (n)
T220	50	0.07	0.10
T230	82	0.07	0.10
T300	932	0.07	0.10
T310	1061	0.07	0.10
T400	1381	0.07	0.08
T410	1435	0.09	0.15
T430	1865	0.07	0.15
T510	2110	0.07	0.15

Hydraulic Review – Model Calibration



Modeled (WS) vs. Observed Water Surface (OWS) Elevations – Cross Section T410

Hydraulic Review – Model Calibration

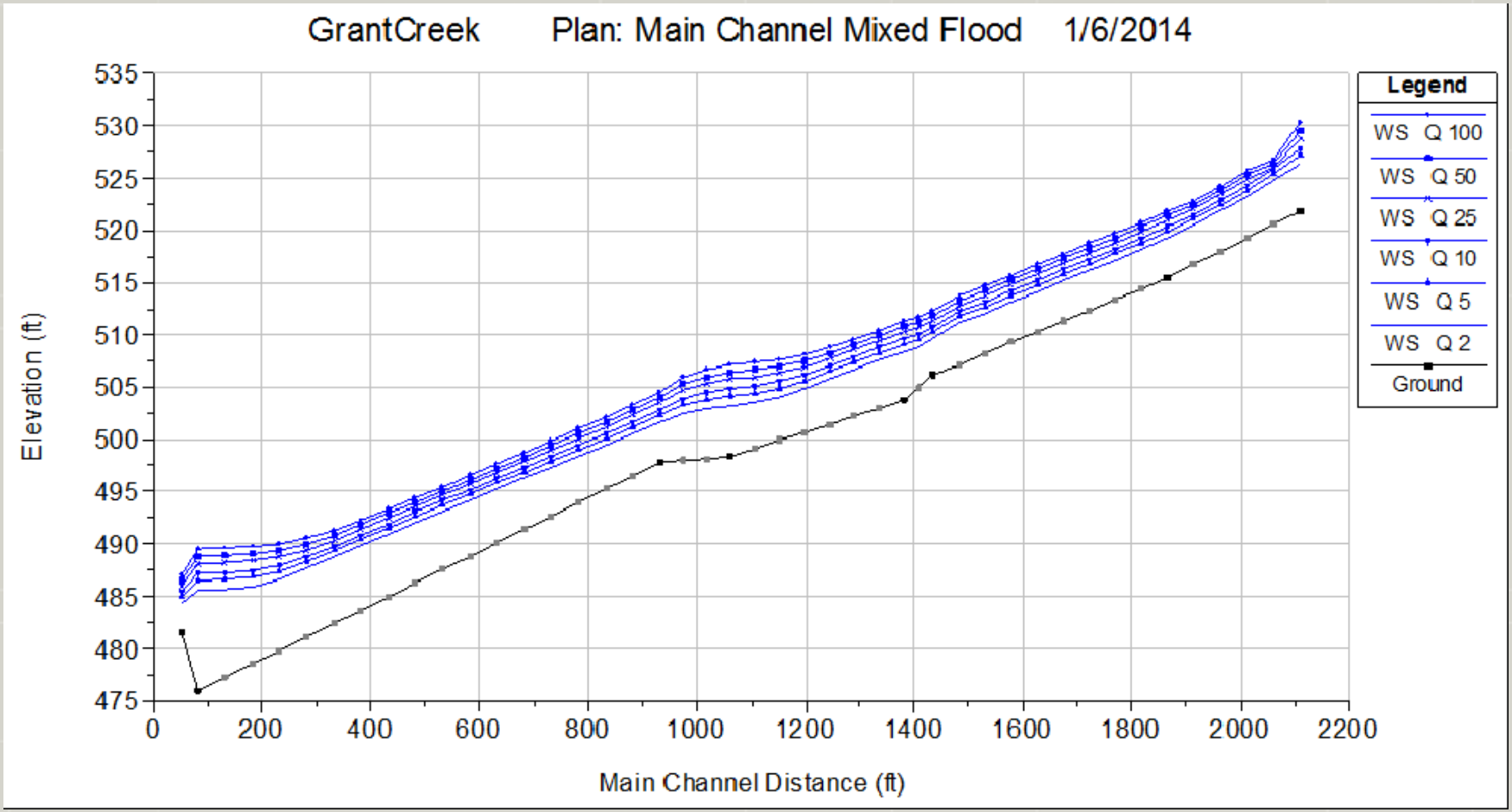


Modeled (WS) vs. Observed Water Surface (OWS) Elevations – Cross Section T430

Hydraulic Review – Model Sensitivity

	T410 (Sta. 1435)		T430 (Sta. 1865)	
	Calibration n-values	Sensitivity n-values	Calibration n-values	Sensitivity n-values
Discharge (cfs)	W.S. Elev. (ft)	W.S. Elev. (ft)	W.S. Elev. (ft)	W.S. Elev. (ft)
17	507.0	506.9	516.4	516.3
58	507.5	507.3	517.0	516.9
132	508.0	507.7	517.4	517.2
182	508.2	507.9	517.6	517.5
706	509.3	509.0	518.9	518.6
961 (2-year)	509.7	509.3	519.3	519.0
3310 (100-year)	512.3	511.4	521.8	521.2

Hydraulic Review – Profiles



Grant Creek Hydraulic Profiles – 2-year through 100-year Floods

Hydraulic Review – Flood Water Surface

Discharge (cfs)	Flood Frequency	Water Surface Elevation (ft)
961	2-year	515.1
1410	5-year	515.8
1790	10-year	516.3
2350	25-year	516.9
2810	50-year	517.3
3310	100-year	517.8

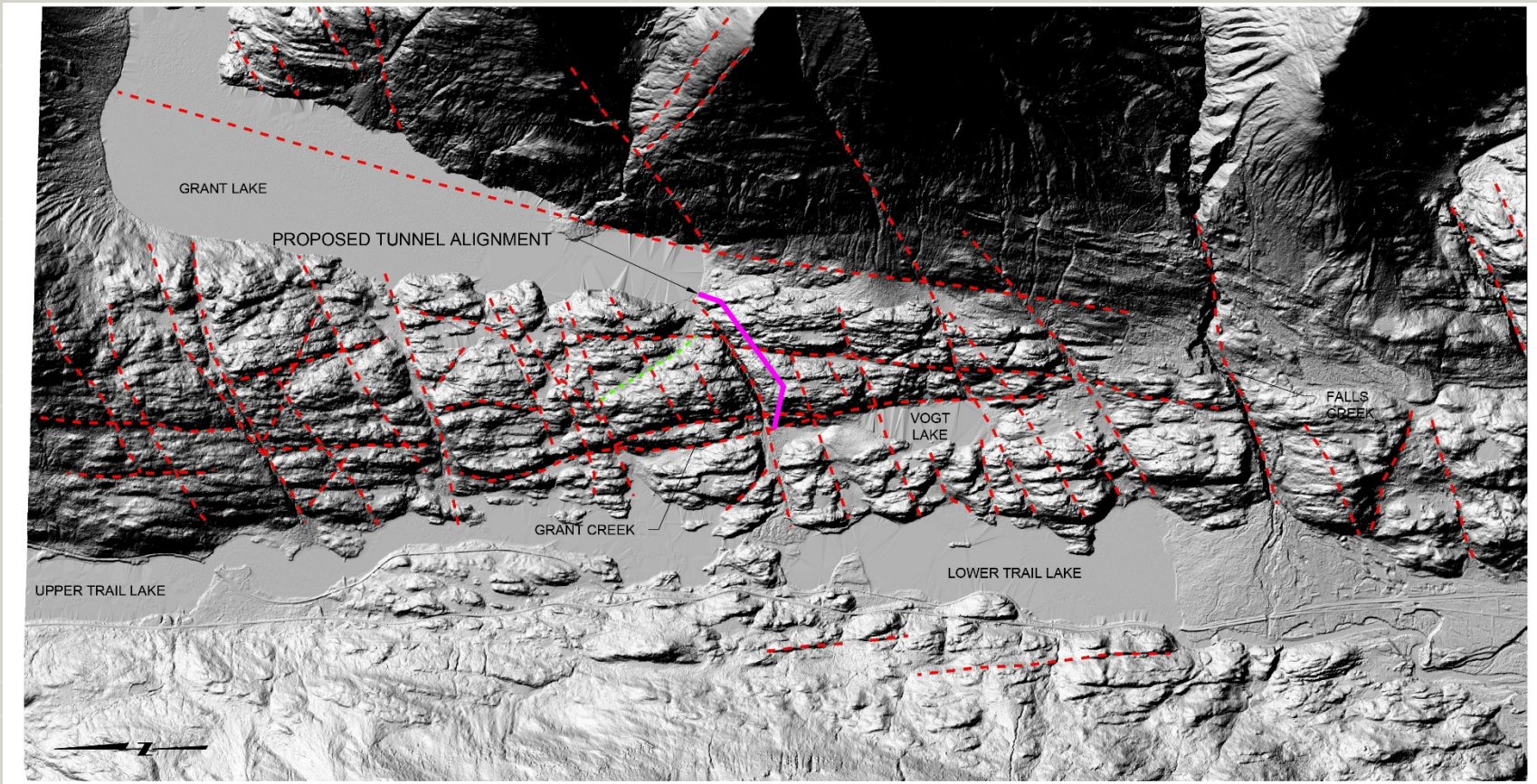
Hydraulic Review – Conclusions

- Design 100-year flood water surface elevation of 517.8 ft at a discharge of 3,310 cfs
- Significant hydraulic gradient through stream reach, evidenced by relatively small shifts in stream profile across flow regimes

Geotechnical Update

- Utilize existing data for preliminary design development
- Conducted a reconnaissance-level site investigation to determine develop basic geologic mapping
- Update the preliminary tunnel design using the field data as well as previous investigations
- Summarize in a preliminary design report

Geotechnical Update – Tunnel Plan



NOTES:

1. HILLSHADE IMAGE DEVELOPED FROM LIDAR SURVEY COMPLETED IN 2008 FOR THE KENAI WATERSHED FORUM

LEGEND:

MAPPED LINEAMENTS

MAPPED LINEAMENTS (BY PERVIOUS INVESTIGATORS)

PROPOSED TUNNEL ALIGNMENT

2000 1000 0 2000

FEET

JACOBS ASSOCIATES

Engineers/Consultants

KENAI HYDRO LLC
GRANT LAKE HYDROELECTRIC PROJECT

PRELIMINARY TUNNEL DESIGN AND REPORT
GEOLOGIC LINEAMENT MAP

PROJECT NO.	REV
5121.0	0

DATE: DEC 2014

FIGURE 3

Geotechnical Update – Downstream Portal

Geotechnical Update – Intake Access

Operational/Generation Model

- Developed to allow estimation of generation production under various operational scenarios
- Utilizes gage data with mean daily flow estimates to generate daily power production
- Allows powerhouse size and unit configuration to be varied as well as tunnel and penstock size optimization
- Can also allow for input minimum flow requirements

Operational/Generation Model

- Exit to demonstration of operation/generation model

Next Steps

Task	Description	Next Steps
1.0	Data Collection and Site Visit	Complete
2.0	Surveys and Mapping	Prepare boundary survey
3.0	Geotechnical Investigations	Issue draft report
4.0	Hydrologic Analysis	Finalize TM
5.0	Hydraulic Analysis	Finalize TM
6.0	Operation and Generation Analysis	Develop run scenarios
7.0	Alternatives Development and Evaluation	Develop/evaluate alts.
8.0	Cost Estimates and Financial Analysis	Set up templates
9.0	Project Schedule/Construction Methodology	Set up templates
10.0	Preliminary Design Report	Develop outline
11.0	Prepare FERC Exhibits	Develop templates

Next Steps – Engineering Schedule

Task	Description	Milestone Date
1.0	Data Collection and Site Visit	Complete
2.0	Surveys and Mapping	7/1/14
3.0	Geotechnical Investigations	5/1/14
4.0	Hydrologic Analysis	5/1/14
5.0	Hydraulic Analysis	5/1/14
6.0	Operation and Generation Analysis	5/1/14
7.0	Alternatives Development and Evaluation	8/1/14
8.0	Cost Estimates and Financial Analysis	8/1/14
9.0	Project Schedule/Construction Methodology	8/1/14
10.0	Preliminary Design Report	8/30/14
11.0	Prepare FERC Exhibits	9/30/14

Questions/Comments