Grant Lake Infrastructure and Operations

July 7-8, 2014

McMillen

DESIGN with Vision. BUILD with Integrity.

In Association with

HEA

Presentation Outline

- Review the Proposed Infrastructure and Layout
- Review the Updated Hydrologic Analysis
- Review the Updated Hydraulic Analysis
- Present the Operating Assumptions
- Present the Operational/Generation Model
- Review the Operational/Generation Model Results
- Discuss any Additional Engineering Questions

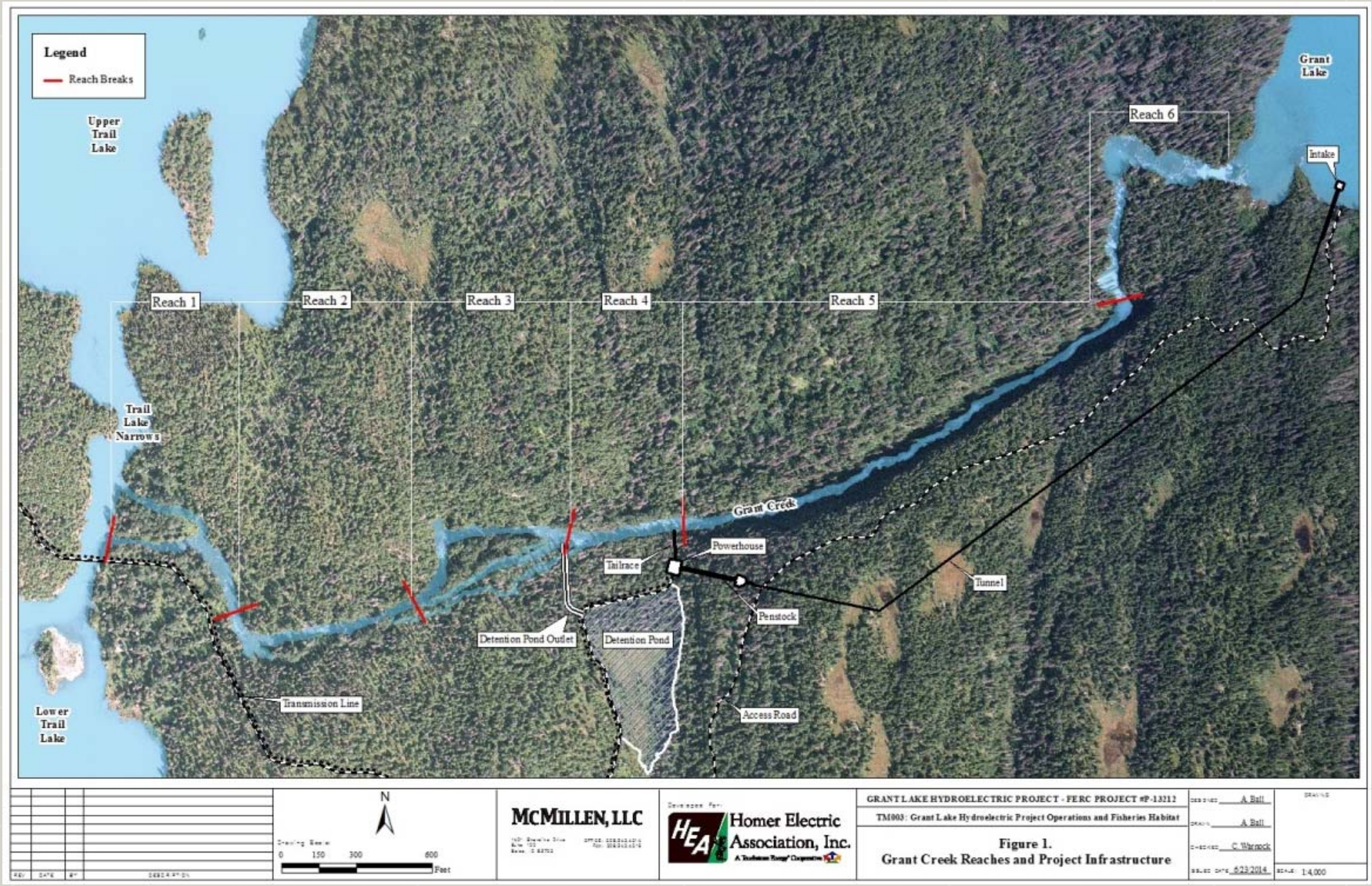
Proposed Infrastructure

- An intake structure in Grant Lake.
- A tunnel extending from the lake intake to just east of the powerhouse.
- A penstock and surge tank located at the west end of the tunnel.
- A powerhouse with two Francis turbines providing an anticipated combined 5-Megawatt output. The maximum design flow will be approximately 385 cfs.
- Tailrace channel returning powerhouse flow to Grant Creek.

Proposed Infrastructure - continued

- Tailrace detention pond and return channel.
- Switchyard with disconnect switch and step-up transformer.
- An overhead or underground transmission line.
- A pole mounted disconnect switch where the transmission line intersects the main power distribution line.
- Access road from the Seward Highway to the powerhouse and extending up to the intake structure.

Grant Creek Project Layout

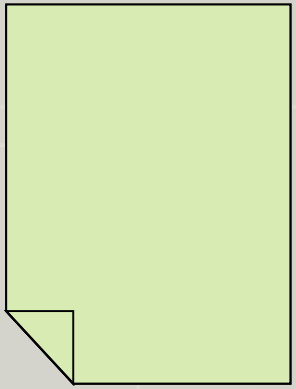


Hydrologic Analysis Review

- 66-year ‘composite’ daily streamflow record developed for Grant Creek
  - Calendar Years 1948-2013
  - USGS gage record
  - Intermittent streamflow records from engineering studies
  - Record extension based on Kenai River at Cooper Landing
- Used for Hydraulic, Generation, and Habitat Analyses
- Summarized in Technical Memo 001: Grant Creek Hydrologic Analysis

Hydrologic Analysis Review

- Technical Memo 001: Grant Creek Hydrologic Analysis

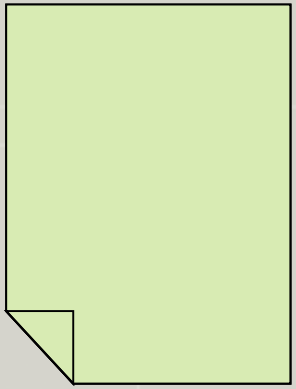


Hydraulic Analysis Review

- HEC-RAS model geometry developed based on IFIM cross sections.
- Flood flows based on from hydrologic analysis.
- Tailwater elevations computed for the tailrace location.

Hydraulic Analysis Review

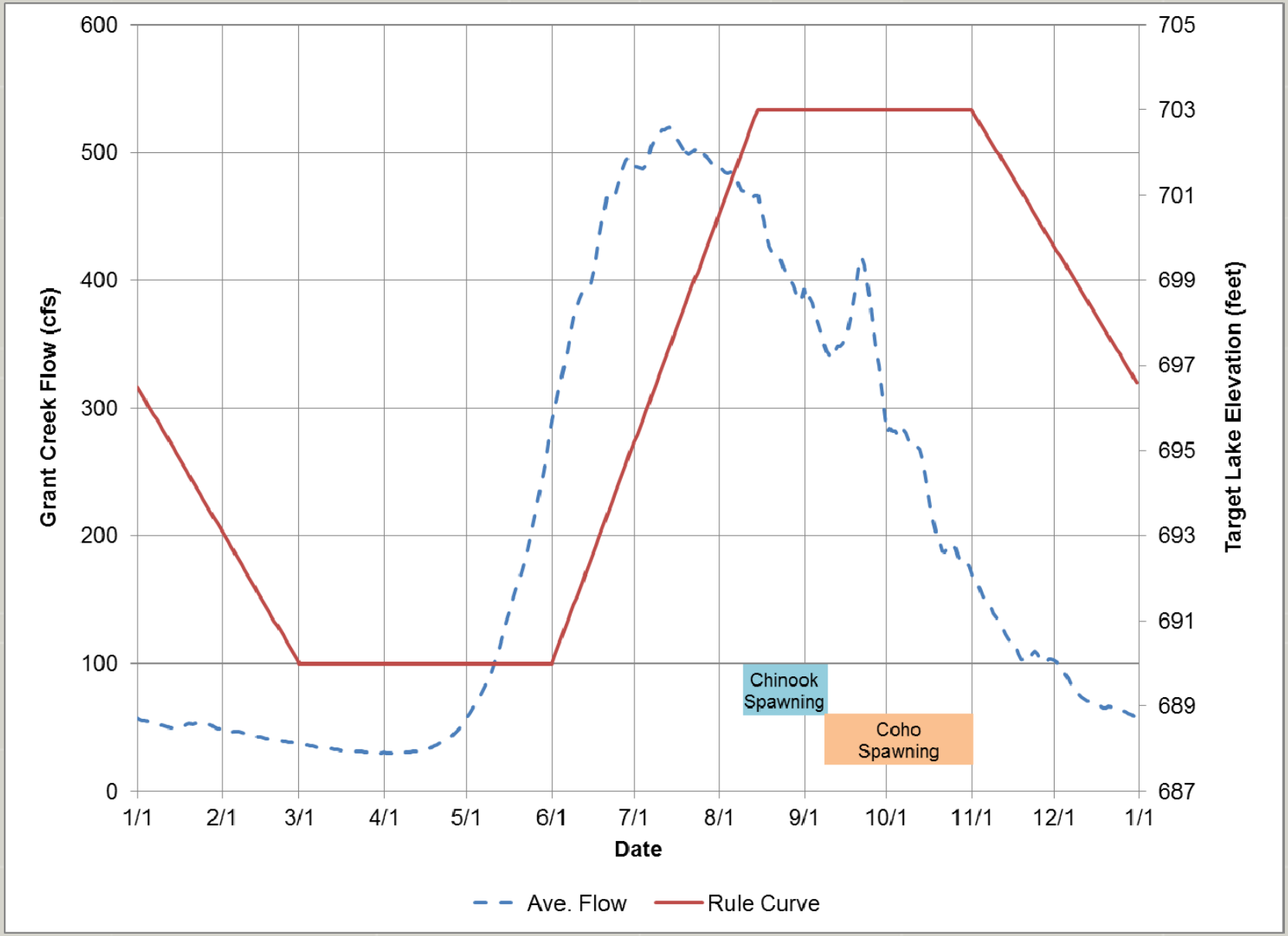
- Technical Memo 002: Grant Creek Hydraulic Analysis



Operating Assumptions

- Assuming no dam, natural storage only
- Reservoir Operating Range: 703-690 feet (13 feet)
- Approximate Tailwater Elevation: 518 feet
- Peak Powerhouse Discharge: 385 cfs
- Minimum Powerhouse Discharge: 23 cfs
- Turbines: 1 MW and 4 MW Francis Units
- Instream Flow Releases in Reach 5:
  - 10 cfs during Chinook spawning (Aug – Sept)
  - 7 cfs during Coho spawning (Sept – Oct)
  - 5 cfs for the remainder of the year

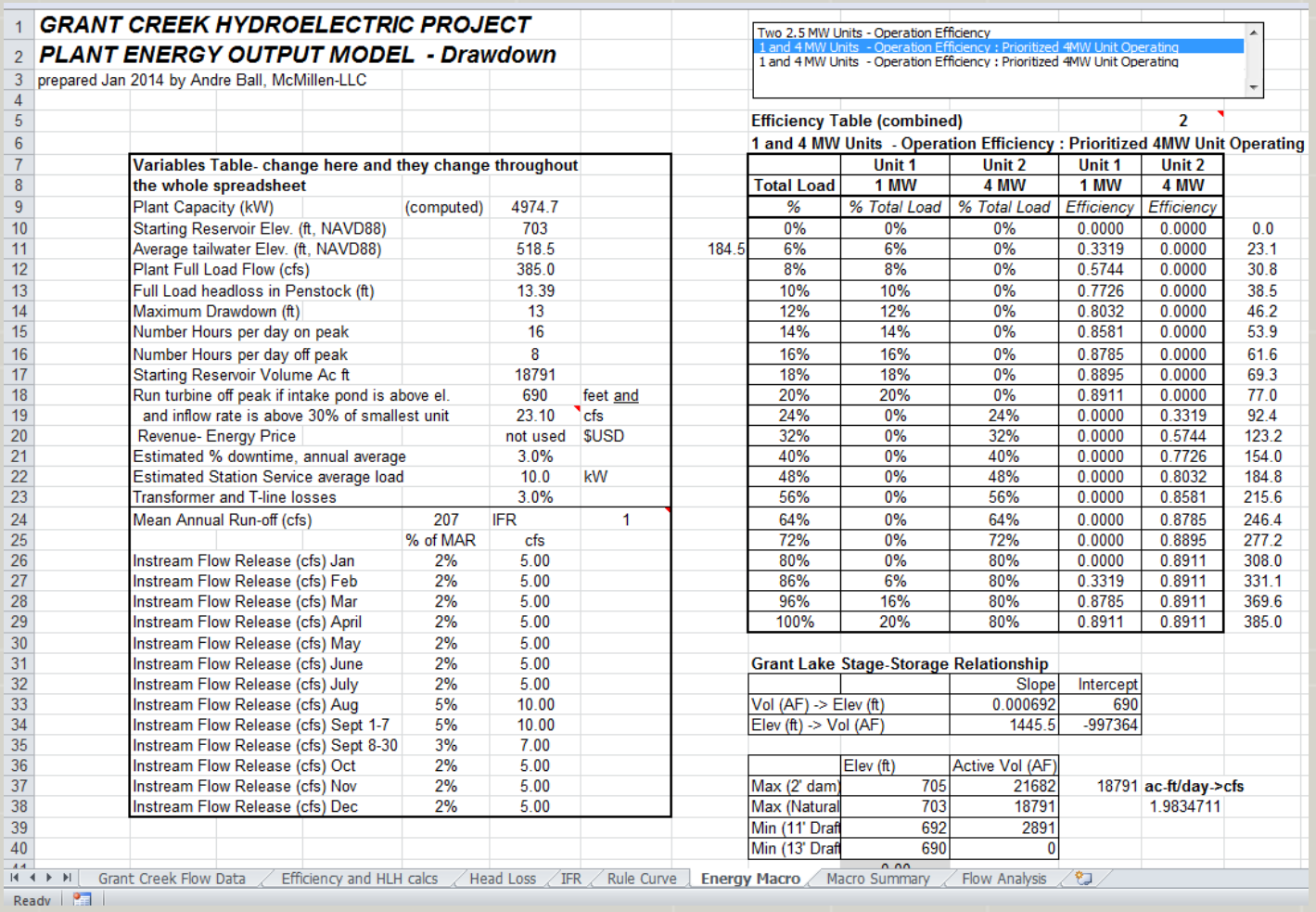
Operating Assumptions



Operational/Generation Model

- Developed to estimate energy production under various operational scenarios
- Utilizes composite streamflow record to calculate daily power production
- Includes instream flow requirements
- Allows powerhouse size and unit configuration to be varied as well as tunnel and penstock size optimization

Operational/Generation Model



GRANT CREEK HYDROELECTRIC PROJECT

PLANT ENERGY OUTPUT MODEL - Drawdown

prepared Jan 2014 by Andre Ball, McMillen-LLC

Two 2.5 MW Units - Operation Efficiency
1 and 4 MW Units - Operation Efficiency : Prioritized 4MW Unit Operating
1 and 4 MW Units - Operation Efficiency : Prioritized 4MW Unit Operating

Variables Table- change here and they change throughout the whole spreadsheet			
Plant Capacity (kW)	(computed)	4974.7	
Starting Reservoir Elev. (ft, NAVD88)		703	
Average tailwater Elev. (ft, NAVD88)		518.5	
Plant Full Load Flow (cfs)		385.0	
Full Load headloss in Penstock (ft)		13.39	
Maximum Drawdown (ft)		13	
Number Hours per day on peak		16	
Number Hours per day off peak		8	
Starting Reservoir Volume Ac ft		18791	
Run turbine off peak if intake pond is above el.		690	feet and
and inflow rate is above 30% of smallest unit		23.10	cfs
Revenue- Energy Price		not used	$USD
Estimated % downtime, annual average		3.0%	
Estimated Station Service average load		10.0	kW
Transformer and T-line losses		3.0%	
Mean Annual Run-off (cfs)	207	IFR	1
	% of MAR	cfs	
Instream Flow Release (cfs) Jan	2%	5.00	
Instream Flow Release (cfs) Feb	2%	5.00	
Instream Flow Release (cfs) Mar	2%	5.00	
Instream Flow Release (cfs) April	2%	5.00	
Instream Flow Release (cfs) May	2%	5.00	
Instream Flow Release (cfs) June	2%	5.00	
Instream Flow Release (cfs) July	2%	5.00	
Instream Flow Release (cfs) Aug	5%	10.00	
Instream Flow Release (cfs) Sept 1-7	5%	10.00	
Instream Flow Release (cfs) Sept 8-30	3%	7.00	
Instream Flow Release (cfs) Oct	2%	5.00	
Instream Flow Release (cfs) Nov	2%	5.00	
Instream Flow Release (cfs) Dec	2%	5.00	

Efficiency Table (combined) 2

1 and 4 MW Units - Operation Efficiency : Prioritized 4MW Unit Operating

	Unit 1	Unit 2	Unit 1	Unit 2	
Total Load	1 MW	4 MW	1 MW	4 MW	
%	% Total Load	% Total Load	Efficiency	Efficiency	
0%	0%	0%	0.0000	0.0000	0.0
6%	6%	0%	0.3319	0.0000	23.1
8%	8%	0%	0.5744	0.0000	30.8
10%	10%	0%	0.7726	0.0000	38.5
12%	12%	0%	0.8032	0.0000	46.2
14%	14%	0%	0.8581	0.0000	53.9
16%	16%	0%	0.8785	0.0000	61.6
18%	18%	0%	0.8895	0.0000	69.3
20%	20%	0%	0.8911	0.0000	77.0
24%	0%	24%	0.0000	0.3319	92.4
32%	0%	32%	0.0000	0.5744	123.2
40%	0%	40%	0.0000	0.7726	154.0
48%	0%	48%	0.0000	0.8032	184.8
56%	0%	56%	0.0000	0.8581	215.6
64%	0%	64%	0.0000	0.8785	246.4
72%	0%	72%	0.0000	0.8895	277.2
80%	0%	80%	0.0000	0.8911	308.0
86%	6%	80%	0.3319	0.8911	331.1
96%	16%	80%	0.8785	0.8911	369.6
100%	20%	80%	0.8911	0.8911	385.0

184.5

Grant Lake Stage-Storage Relationship

		Slope	Intercept
Vol (AF) -> Elev (ft)		0.000692	690
Elev (ft) -> Vol (AF)		1445.5	-997364

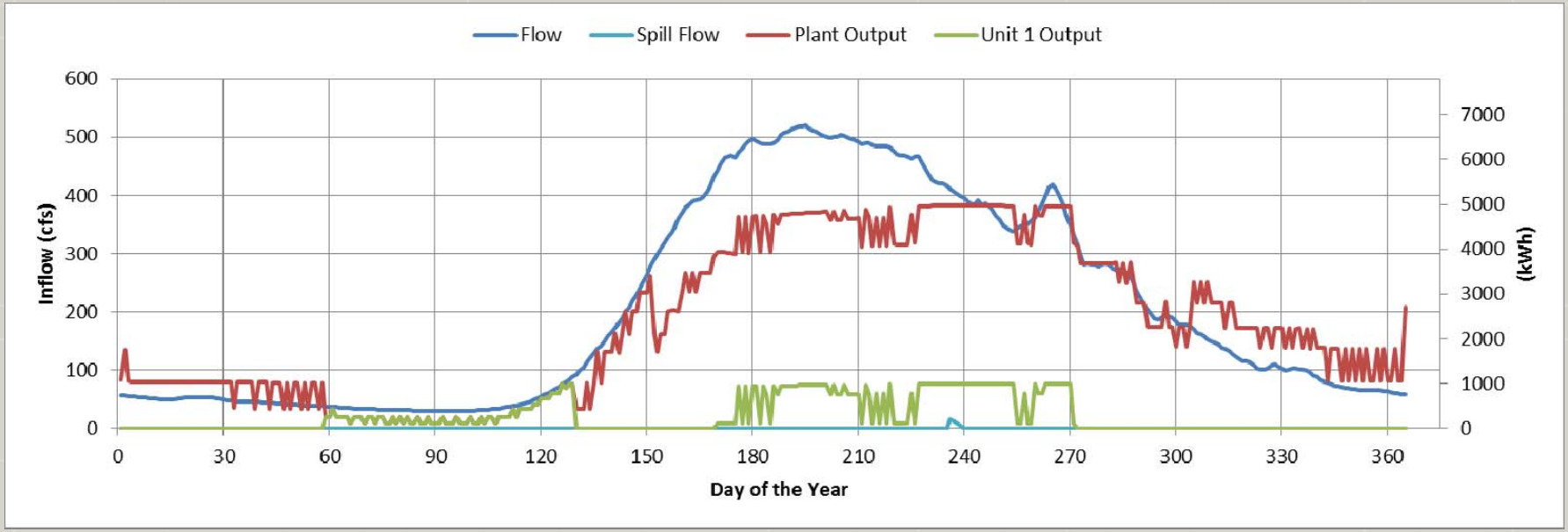
	Elev (ft)	Active Vol (AF)		
Max (2' dam)	705	21682	18791	ac-ft/day->cfs
Max (Natural	703	18791		1.9834711
Min (11' Draf	692	2891		
Min (13' Draf	690	0		

Grant Creek Flow Data | Efficiency and HLH calcs | Head Loss | IFR | Rule Curve | Energy Macro | Macro Summary | Flow Analysis

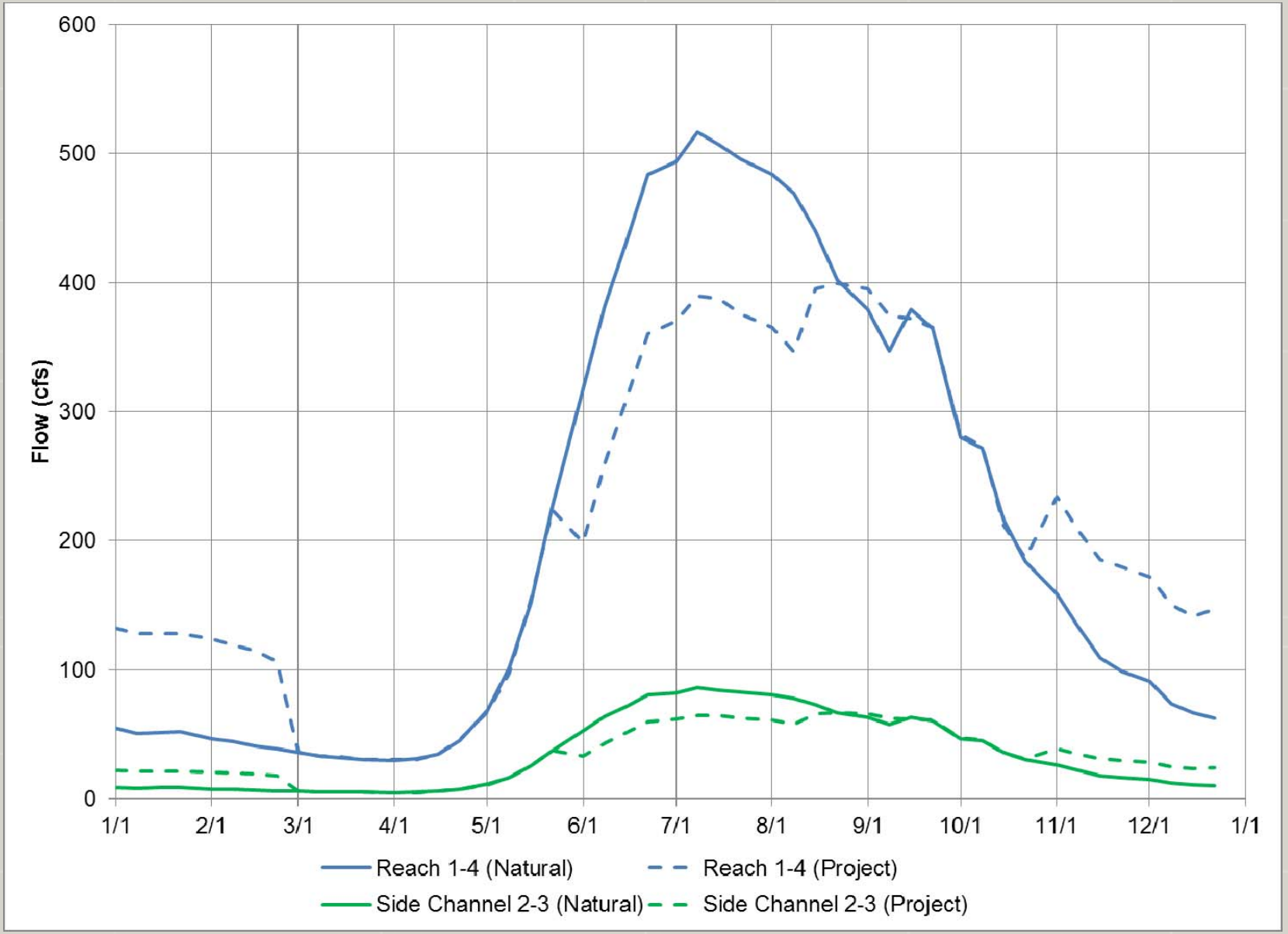
Ready

Generation Model Results

- Energy Production :19,500 MW-Hours Annually (based on Average Daily Flows)
- Plant Factor: 0.45



Project Alteration to Streamflows



Next Steps

- Refine operational model based upon dialogue today
- Continue infrastructure design tasks to support DLA submittal

Questions/Comments