

Grant Creek Fisheries Assessment Study Results

Grant Lake Hydroelectric Project (FERC No. 13212)

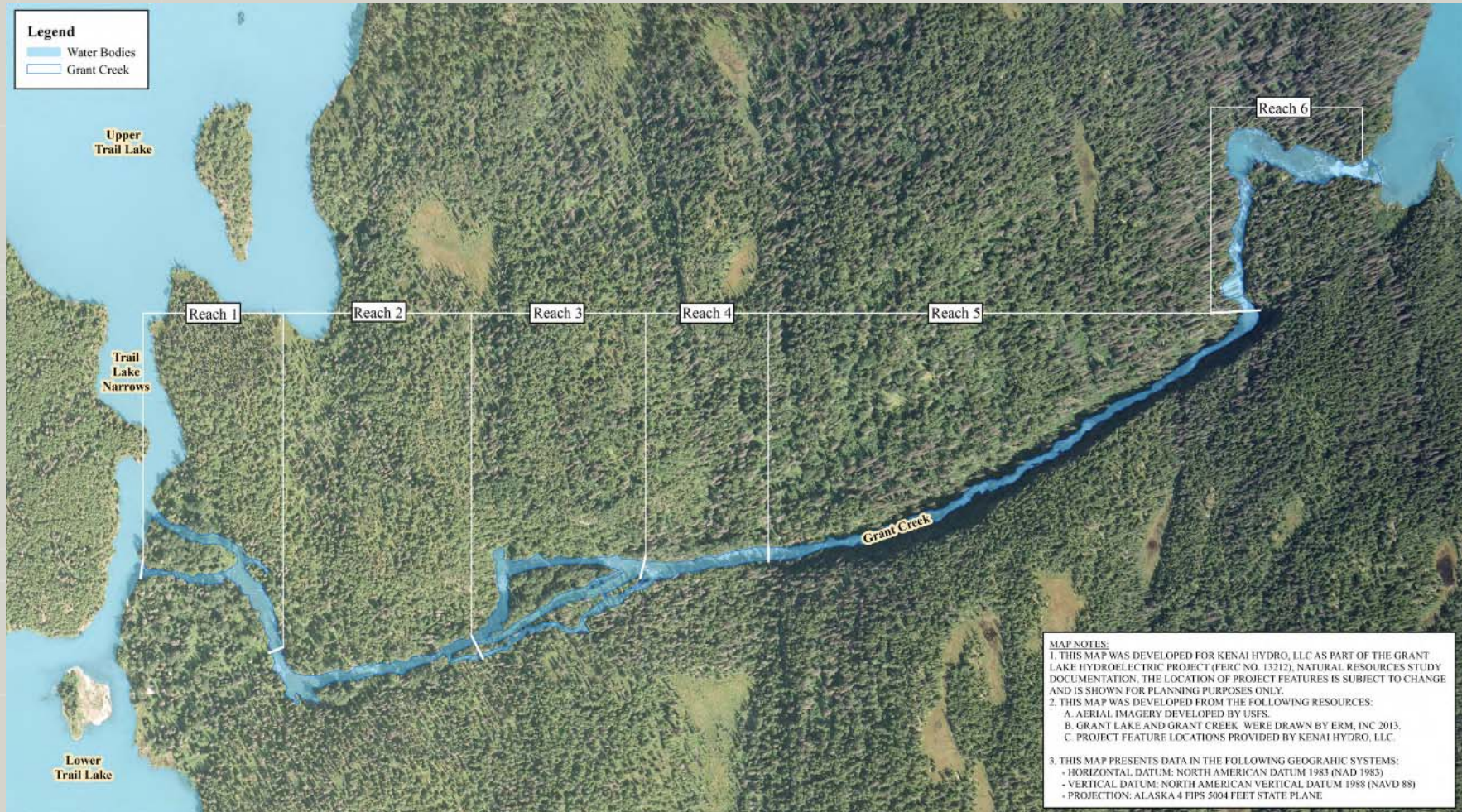
March 19-20, 2014 – Anchorage, AK



In Association with



Introduction – Study Area



Introduction – Study Objectives

- Grant Creek Salmon Spawning Distribution and Abundance
 - Salmon Escapement to Grant Creek
 - Distribution of Spawning Salmon
- Grant Creek Resident and Rearing Fish Abundance and Distribution
 - Adult Rainbow Trout Abundance, Distribution, and Spawning
 - Resident and Rearing Fish use of Reach 5
 - Resident and Rearing Fish use of Reaches 1-4
- Trail Lake Narrows Fish and Aquatic Habitats
 - Fish use in the Narrows at the Proposed Bridge Location

Methods

- Adult Weir
 - Foundation of 2013 Grant Creek Study
 - Located Approximately 200 meters Upstream of Confluence
 - Installed May 23 and Removed October 23
 - Perpendicular to Flow with Up and Downstream Trapping Facilities
 - Weir Design: Standard Steel and Aluminum A-Frame Picket Weir
 - 1.9 cm steel pickets spaced 2.54 cm apart



Methods

- Adult Weir - Continued

- Weir Function:

- Identify and Enumerate all Salmon Species Migrating Through the Weir – Up and Downstream
 - Collect Biological Samples/Data/Tagging:
 - Species
 - Sex
 - Length (Mid-Eye to Fork)
 - Weight (Grams)
 - Scales
 - Genetic Samples (Axillary Process)
 - Radio- and Floy-Tag
 - Recover and Process Carcasses
 - » Recover Radio and Floy Tags (Used to Estimate Stream Life)
 - » Document Egg Voidance in Females

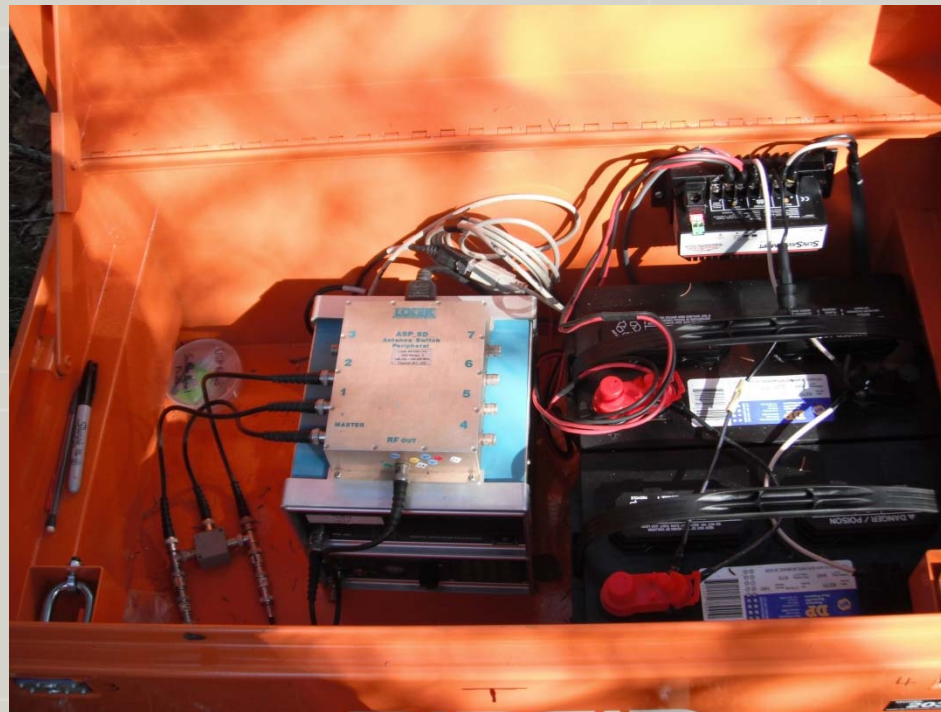
Methods

- Radio Telemetry
 - Gastrically Implanted Transmitters in Chinook (n=9), Sockeye (n=65), and Coho (n=50)
 - Surgically Implanted Transmitters in Rainbow Trout (n=20) and Dolly Varden (n=1)



Methods

- Radio Telemetry – Continued
 - Monitored Fish Movement Using Two Fixed-Site Telemetry Stations
 - Underwater Array Near Grant Creek Confluence
 - Underwater Arrays at Reach 4/5 Break and in Reach 5
 - Conducted Two Mobile Surveys per Week



Methods

- Visual Surveys (Escapement)
 - Conducted Weekly
 - Typically Two Teams of Two – Each Bank
 - Conducted Under Similar Conditions Where Possible
 - Observations Recorded on Reach Maps (Species and Location)
- Redd Surveys (Spawning Distribution)
 - Conducted Weekly
 - Typically Two Teams of Two – Each Bank
 - Observations Recorded on Reach Maps (Species and Location)
- Carcass Surveys (Biological Sampling)
 - Conducted Weekly and During Daily Activities
 - Recovered Radio and Floy Tags
 - Carcasses Recovered and Processed at the Weir

Methods

- Juvenile Incline Plane Traps
 - Used to Assess Abundance and Distribution of Juvenile Salmonids
 - Enumerated Fish by Species and Collected Weight and Length Data
 - Released Dyed Fish to Ascertain Trap Efficiency (Lower Trap Only)
 - Upper Trap Located at the Reach 4/5 Break
 - Operated April 28 to May 30, and September 19 to October 16
 - Lower Trap Located at the Reach 1/2 Break
 - Operated April 30 to October 16
 - Traps Shut Down Intermittently Due to Flow and Debris
 - Surfaces Constructed with ¼ Inch Mesh or Perforated Plate

Methods

- Minnow Trapping
 - Trapping Occurred Monthly – April through October
 - Goal was to Deploy 10 Traps per Reach – Representing all Habitat Types
 - Deployed a Total of 382 Minnow Traps During Study
 - Baited with Cured and Sterilized Salmon Eggs
 - Fished for 24 hours
 - Calculated Catch Per Unit Effort (CPUE)



Methods

- Snorkel Surveys
 - Conducted Only in April and May (Due to High Flows and Poor Visibility)
 - Surveys Conducted at Night in Reaches 1-5
 - Goal was to Sample all Potential Rearing Habitats
 - Fish Classified by Species and within 20 mm Bins
 - Calculated Fish Density by Habitat Unit



Methods

- Beach Seining
 - Used 50' Net with ¼" Mesh
 - Not Conducted in Reach 5 Due to Dominant Boulder Substrate
 - Sampled 5 Sites in Reaches 1-4; Only 3 Sites Suitable
 - Sampled the Narrows on July 23 – Three Sites
- Angling Surveys
 - Only Conducted in Narrows to Assess Species Composition and CPUE

Results

- Adult Weir Counts

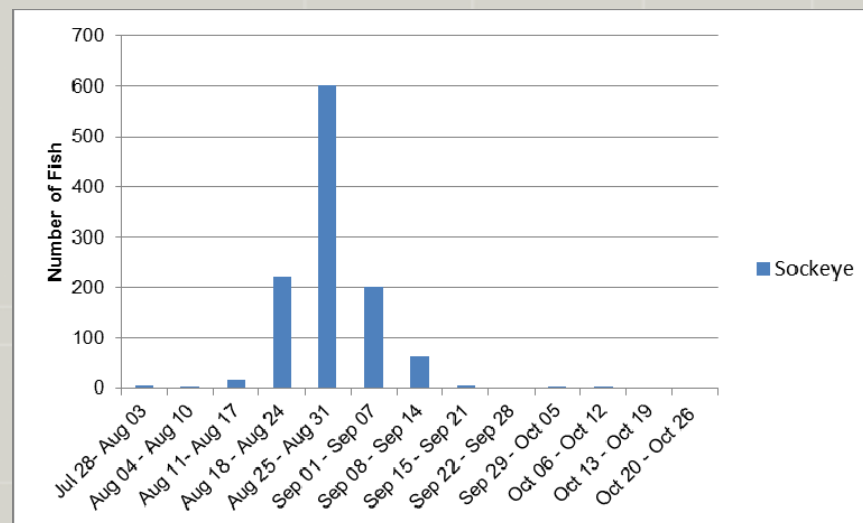
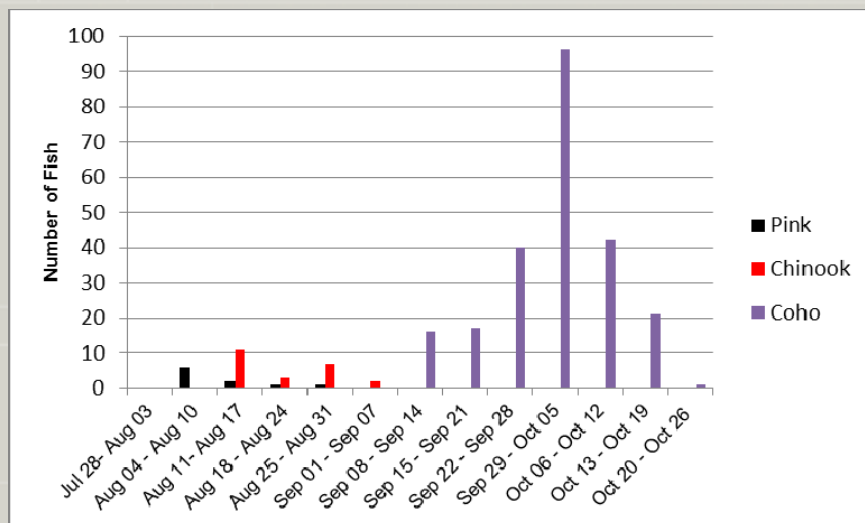
- Total of 1,439 Salmon Migrated Upstream of the Weir
 - Chinook – 35 (Floy-Tagged 33; Radio-Tagged 9)
 - Sockeye – 1,153 (Floy-Tagged 533; Radio-Tagged 65)
 - Coho – 239 (Floy-Tagged 176; Radio-Tagged 50)
 - Pink – 12 (Did Not Floy- or Radio-Tag)
- Total of 52 Salmon Migrated Back Downstream – Net 1,387 Salmon
 - Chinook – 23
 - Sockeye – 1,117
 - Coho – 237
 - Pink – 10
- Caveats
 - Does Not Include Fish Below the Weir – Spawners and Strays
 - Some Fish Migrated both Up and Downstream of the Weir Without Being Captured within the Facilities
 - Extent of Undocumented Passage Unknown

Results

- Adult Weir Counts
 - Total of 27 Resident Salmonids Migrated Upstream of the Weir
 - Rainbow Trout – 13 (Floy-Tagged 13; Radio-Tagged 4)
 - Dolly Varden – 14 (Floy-Tagged 14; Radio-Tagged 1)
 - Caveats
 - Does Not Include Fish Below the Weir – Spawners and Strays
 - Some Fish Migrated both Up and Downstream of the Weir Without Being Captured within the Facilities (Based on Radio Telemetry Observations)
 - Extent of Undocumented Passage Unknown

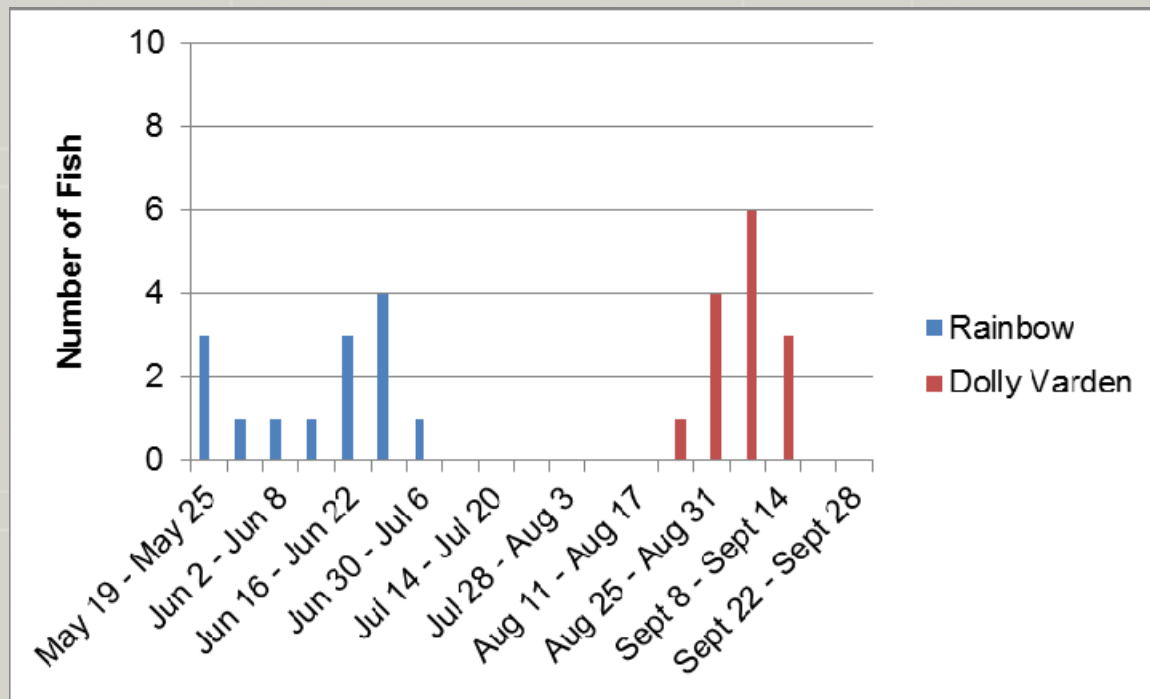
Results

- Runtimeing – Adult Anadromous Salmon
 - Pink – August 4 through August 25; Peak August 15
 - Chinook – August 11 through September 5; Peak August 16
 - Sockeye – July 29 through October 9; Peak August 29
 - Coho – September 8 through October 26; Peak October 3



Results

- Runtimeing – Adult Resident Salmonids
 - Rainbow Trout – May 24 through July 3; No Discernable Peak
 - Dolly Varden – August 24 through September 11; Peak September 5



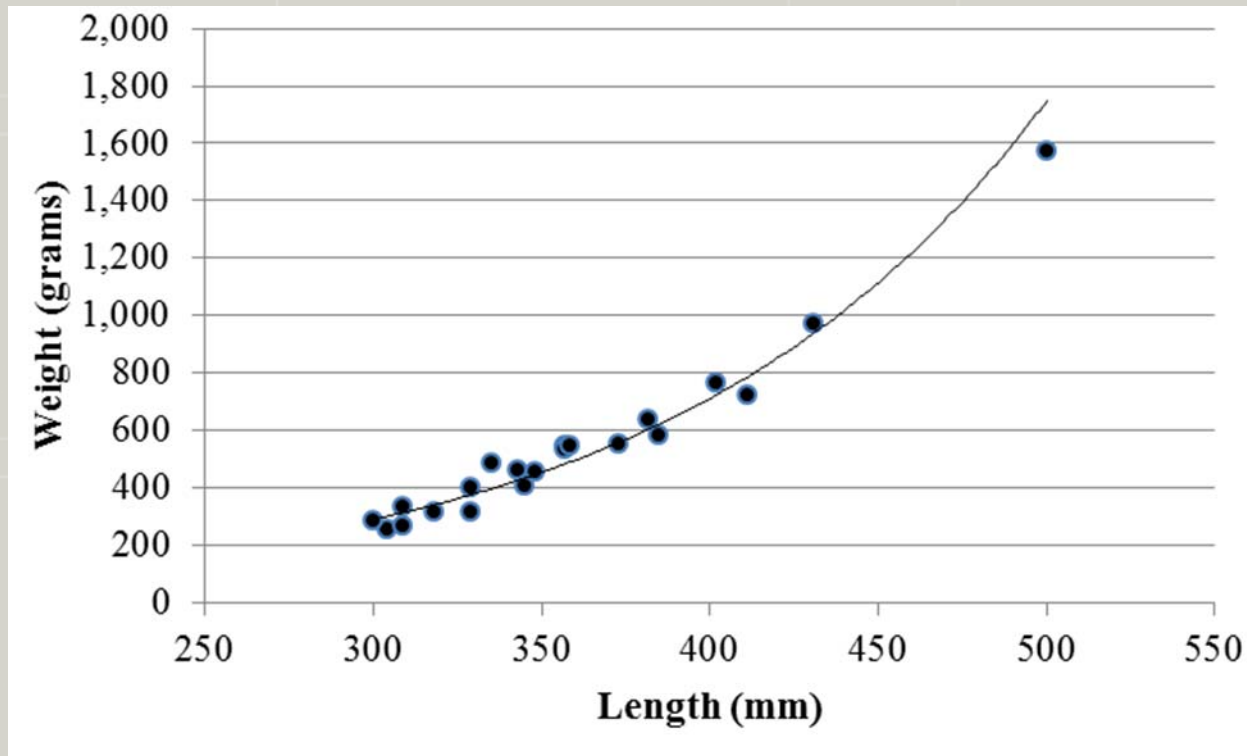
Results

- Fish Size – Anadromous Species

Species	Sex	Mean Length (cm)	Mean Weight (kg)
Chinook	Female	88	10.4
	Male	71	5.9
Coho	Female	59	3.3
	Male	58	3.5
Sockeye	Female	54	2.6
	Male	55	3.0
Pink	Female	42	1.0
	Male	45	1.3

Results

- Fish Size – Rainbow Trout
 - Mean Length – 358 mm
 - Mean Weight – 544 gm
 - Based on 4 Weir and 16 Angling Caught Trout



Results

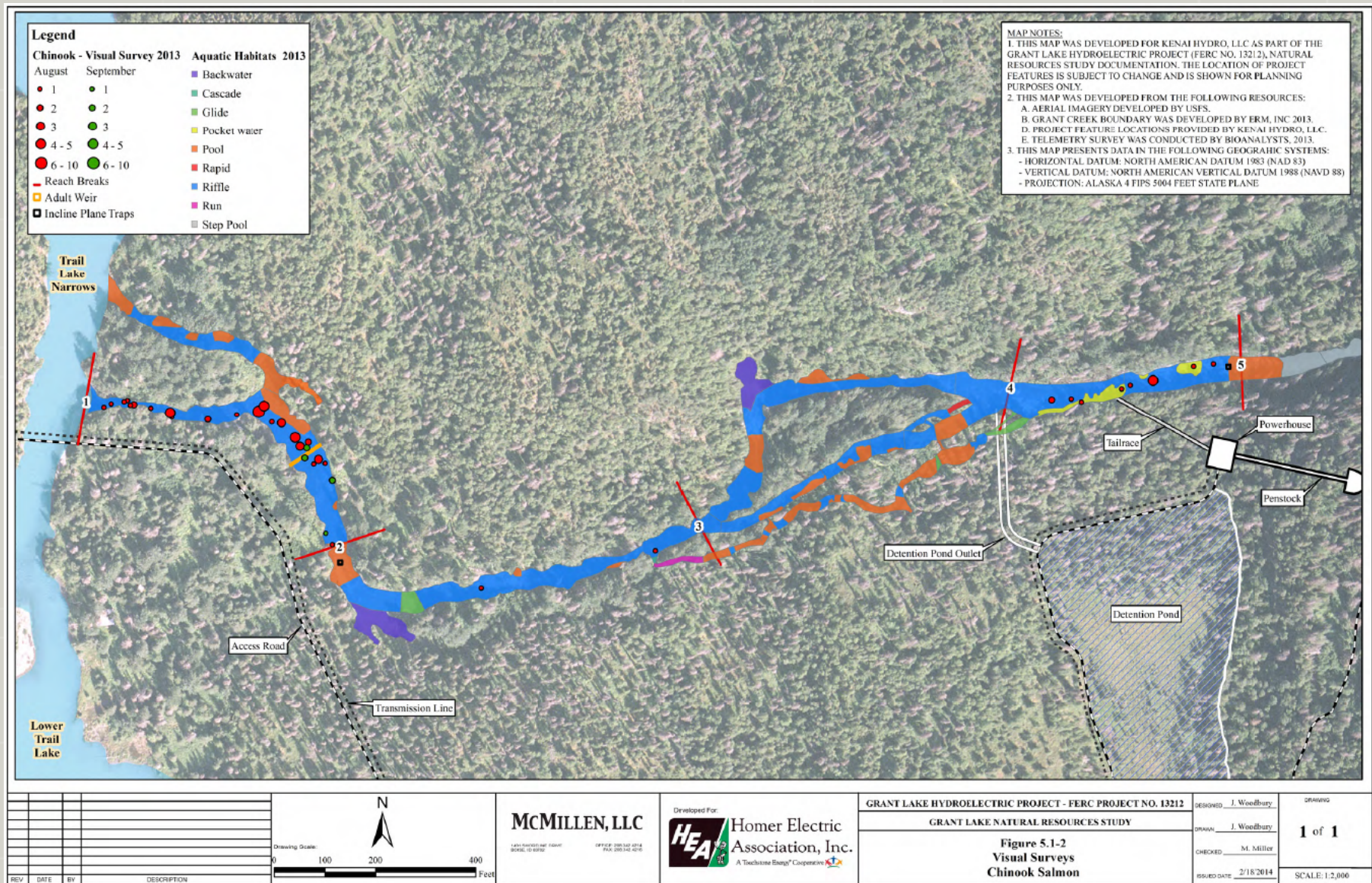
- Anadromous Salmonids - Age-at-Return – Total Age (Percent)

Species	Age-3	Age-4	Age-5	Age-6
Chinook	3.1	59.4	28.1	9.4
Coho	2.7	89.2	8.1	
Sockeye		3.0	95.0	2.0

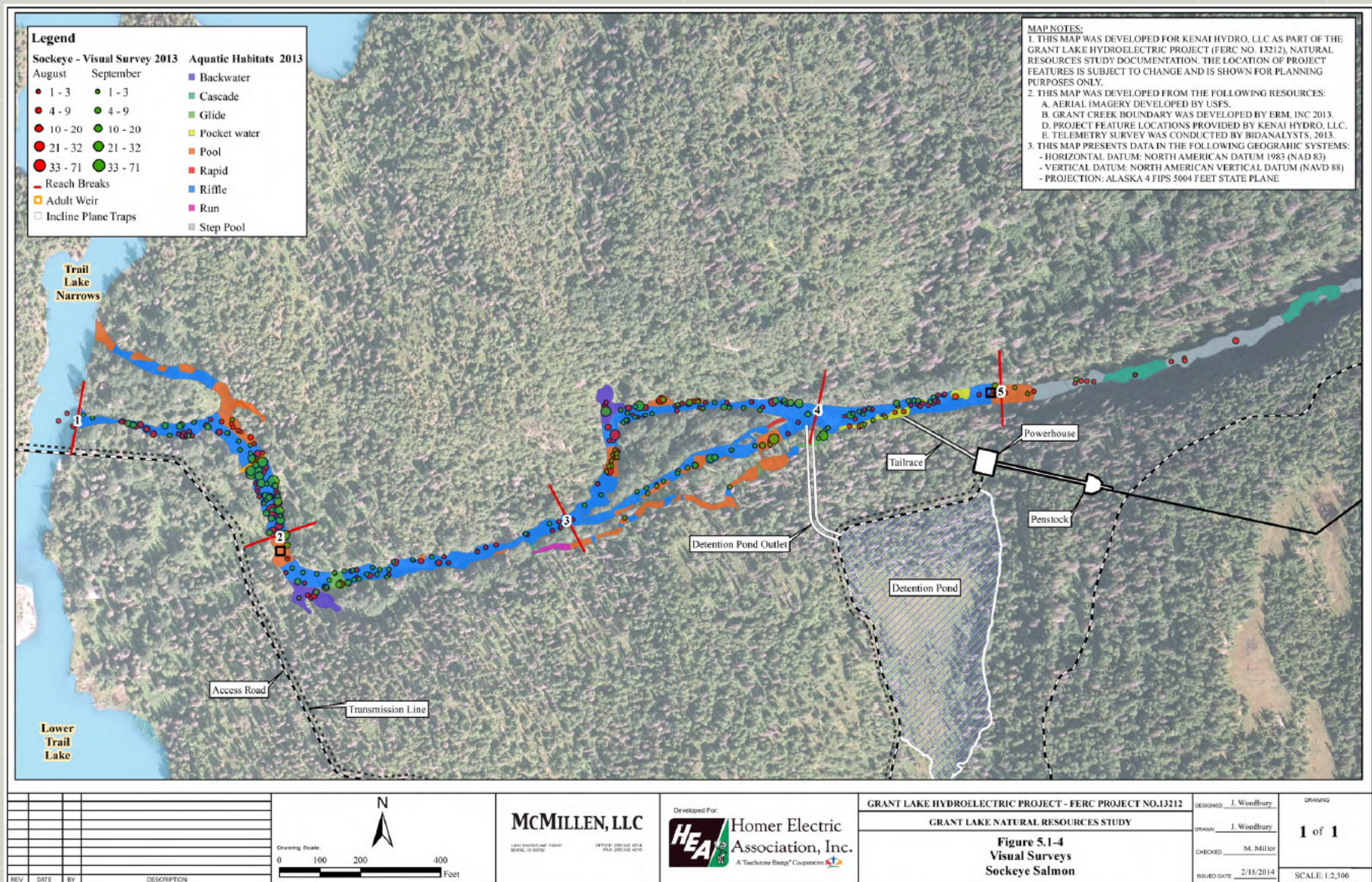
Results

- Estimate of Adult Salmonid Abundance
 - Based on Area-Under-the-Curve Calculations (Bue et al. 1998)
 - Requires an Estimate of Area-Under-the-Curve – Based on Visual Observations (English et al. 1992)
 - Requires an Estimate of Stream Life – Based on Floy and Radio Tag Data (From Telemetry and Carcass Surveys)
 - Requires an Estimate of Observer Efficiency – Based on Visual Surveys Counts Relative to Weir Counts

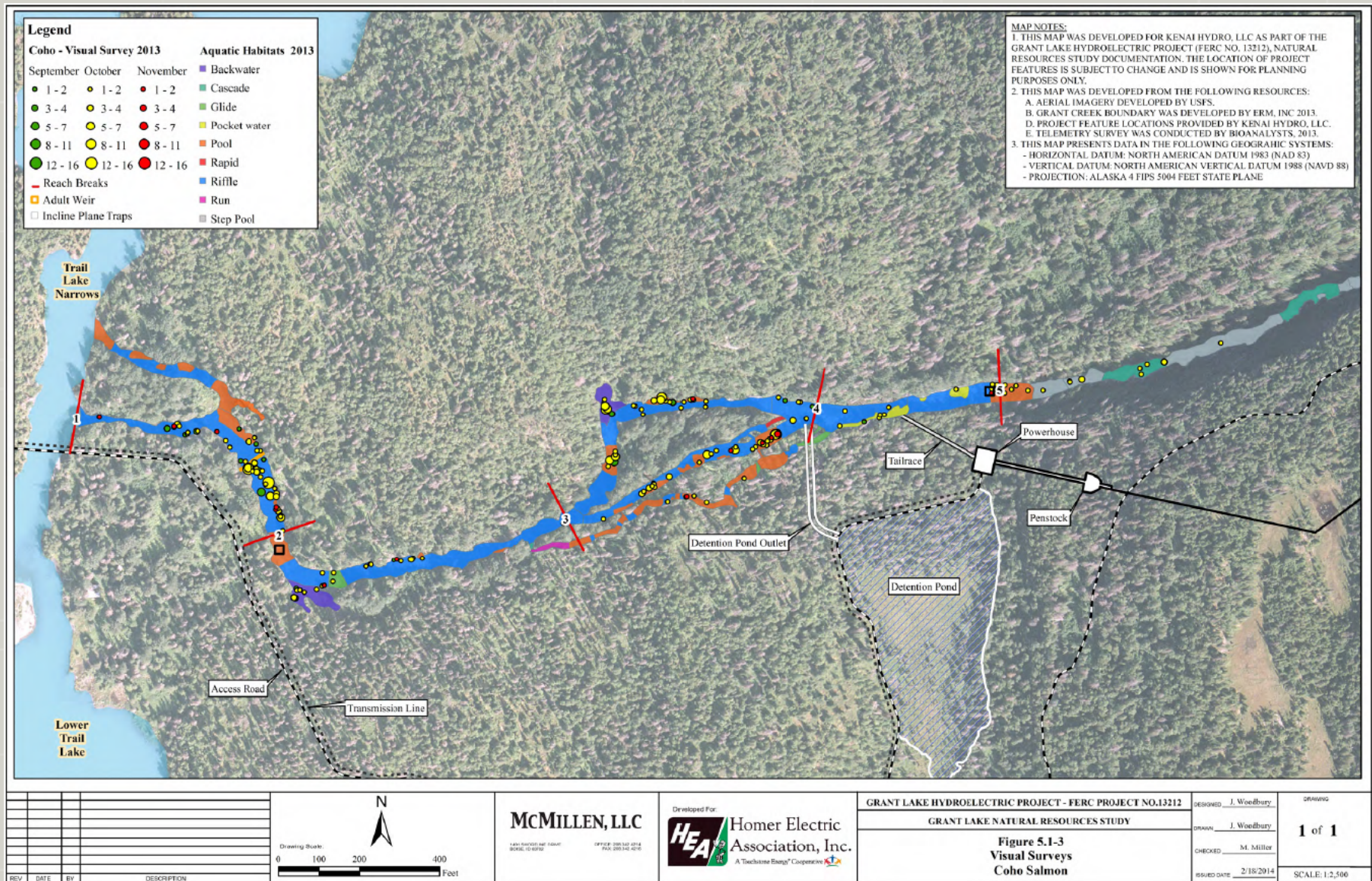
Results – Visual Surveys – Adult Chinook Distribution



Results – Visual Surveys – Adult Sockeye Distribution



Results – Visual Surveys – Adult Coho Distribution



Results

- Estimate of Adult Salmonid Abundance
 - Stream Life – Based on Both Floy and Radio Telemetry Data
 - Observer Efficiency – Based Visual Counts vs. Weir Counts

Species	AUC	Stream Life (Days)	Observer Efficiency	Estimate of Abundance		
				Above Weir	Below Weir	Grant Creek
Chinook	159	11	0.60	27	63	90
Sockeye	10,483	14	0.72	1,040	129	1,169
Coho	2,756	16	0.75	231	21	252

Results

- Adult Salmonid Abundance – Adjusted 2009 Estimates

Species	2009		2013		Estimate of Abundance		
	Stream Life (Days)	Observer Efficiency	Stream Life (Days)	Observer Efficiency	2009 Original	2009 Adjusted	2013
Chinook	14	0.30	11	0.60	231	148	90
Sockeye	9	0.50	14	0.72	6,293	2,705	1,169
Coho	---	---	16	0.75	---	---	252

Results

- Adult Salmonid Spawning – Number of Redds by Reach

Reach	Species				Total	Proportion
	Pink	Chinook	Sockeye	Coho		
1	2	4	144	18	168	0.433
2	0	0	52	7	59	0.152
3	0	1	102	38	141	0.363
4	0	1	7	7	15	0.039
5	0	0	3	2	5	0.013
Total	2	6	308	72	388	1.000

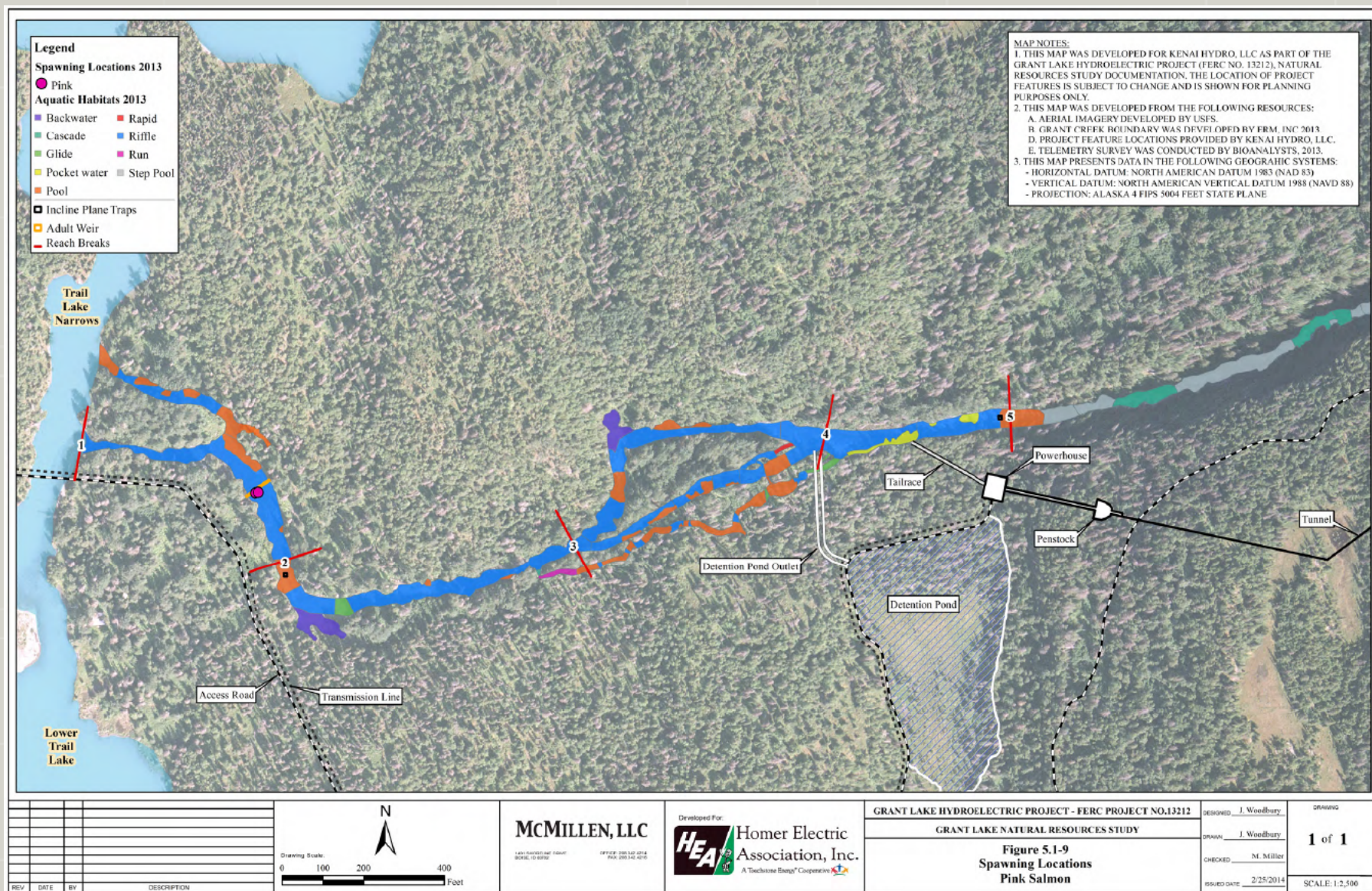
Note: No Rainbow or Dolly Varden Spawning was Observed

Results – Salmonid Spawning Locations

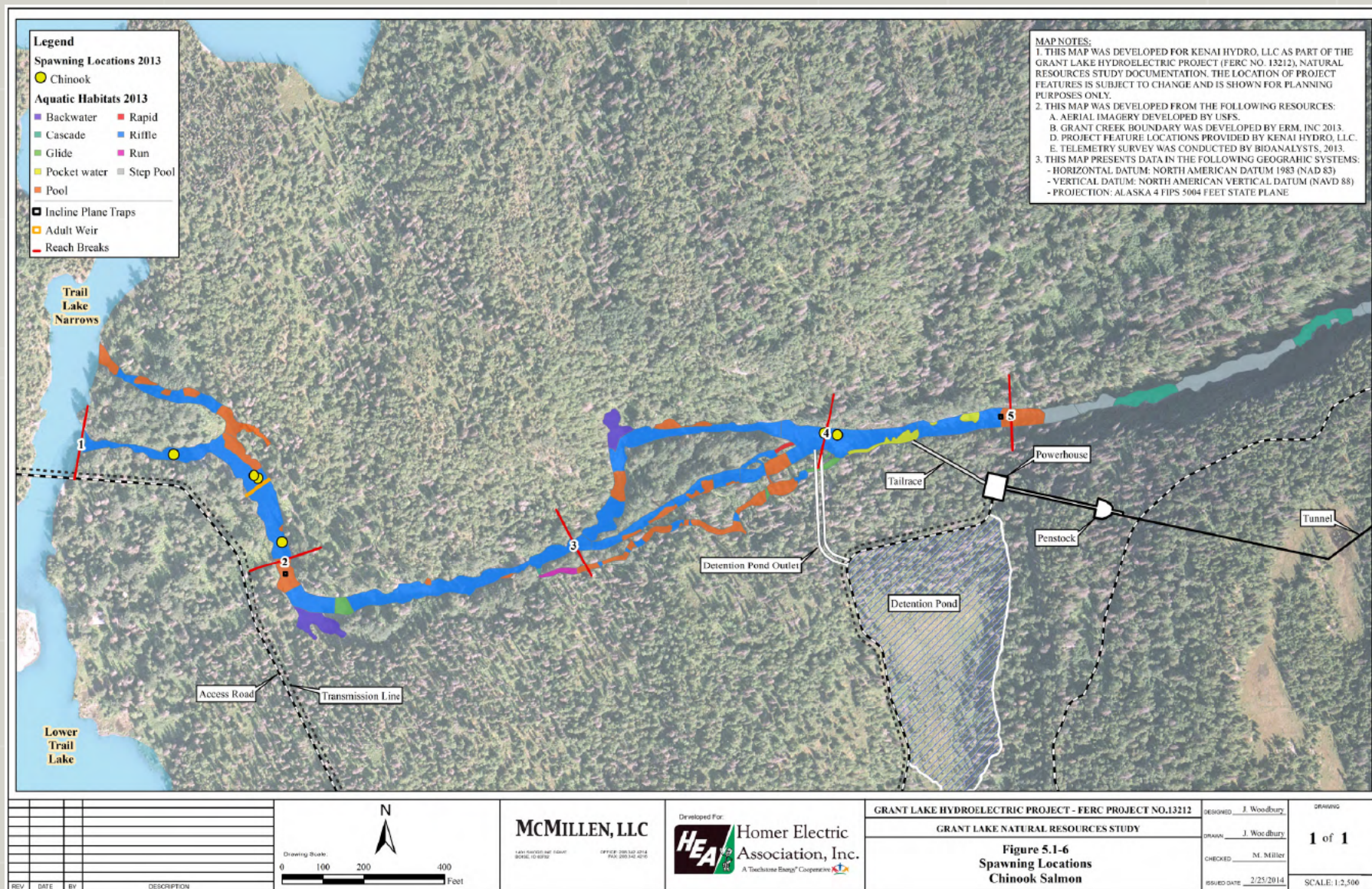
Species	Backwater Areas	Mainstem Areas	Side Channels	Total
Pink	0	2	0	2
Chinook	0	6	0	6
Sockeye	27	239	42	308
Coho	4	49	19	72
Total	31	296	61	388

Note: Primarily in Riffle (0.71) and Pool (0.19) Habitat

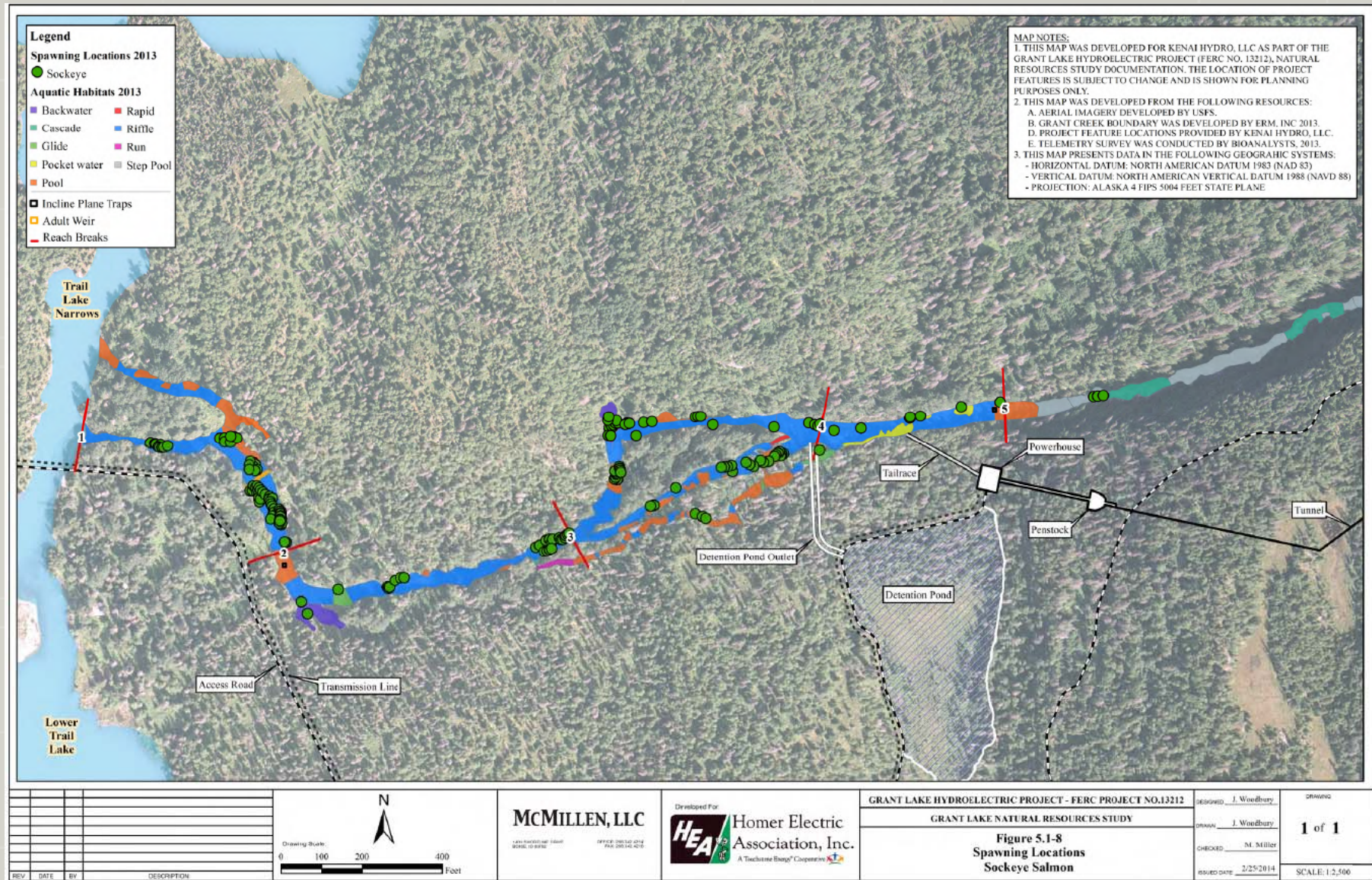
Spawning Locations – Pink Salmon



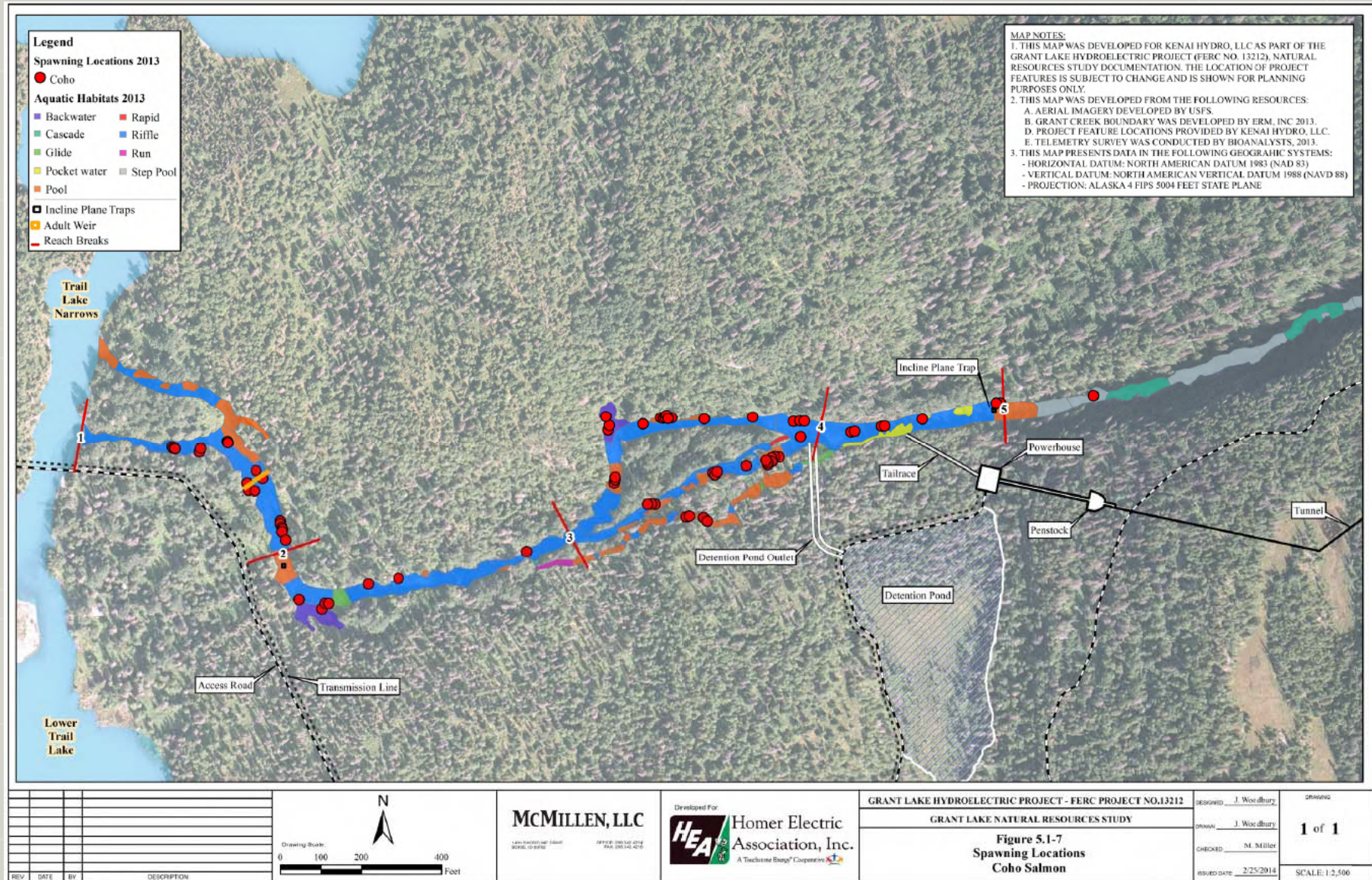
Spawning Locations – Chinook Salmon



Spawning Locations – Sockeye Salmon



Spawning Locations – Coho Salmon

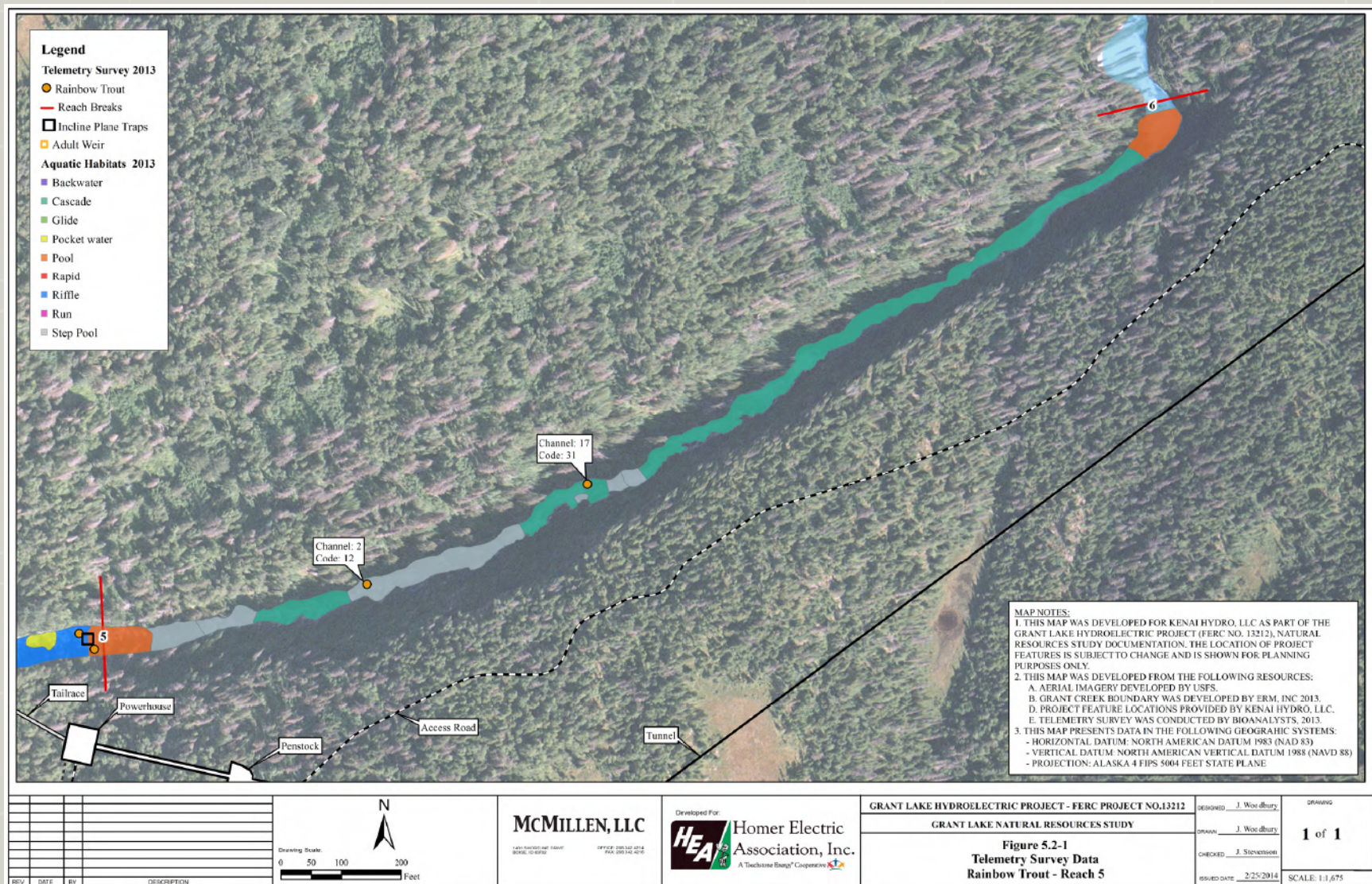


Results

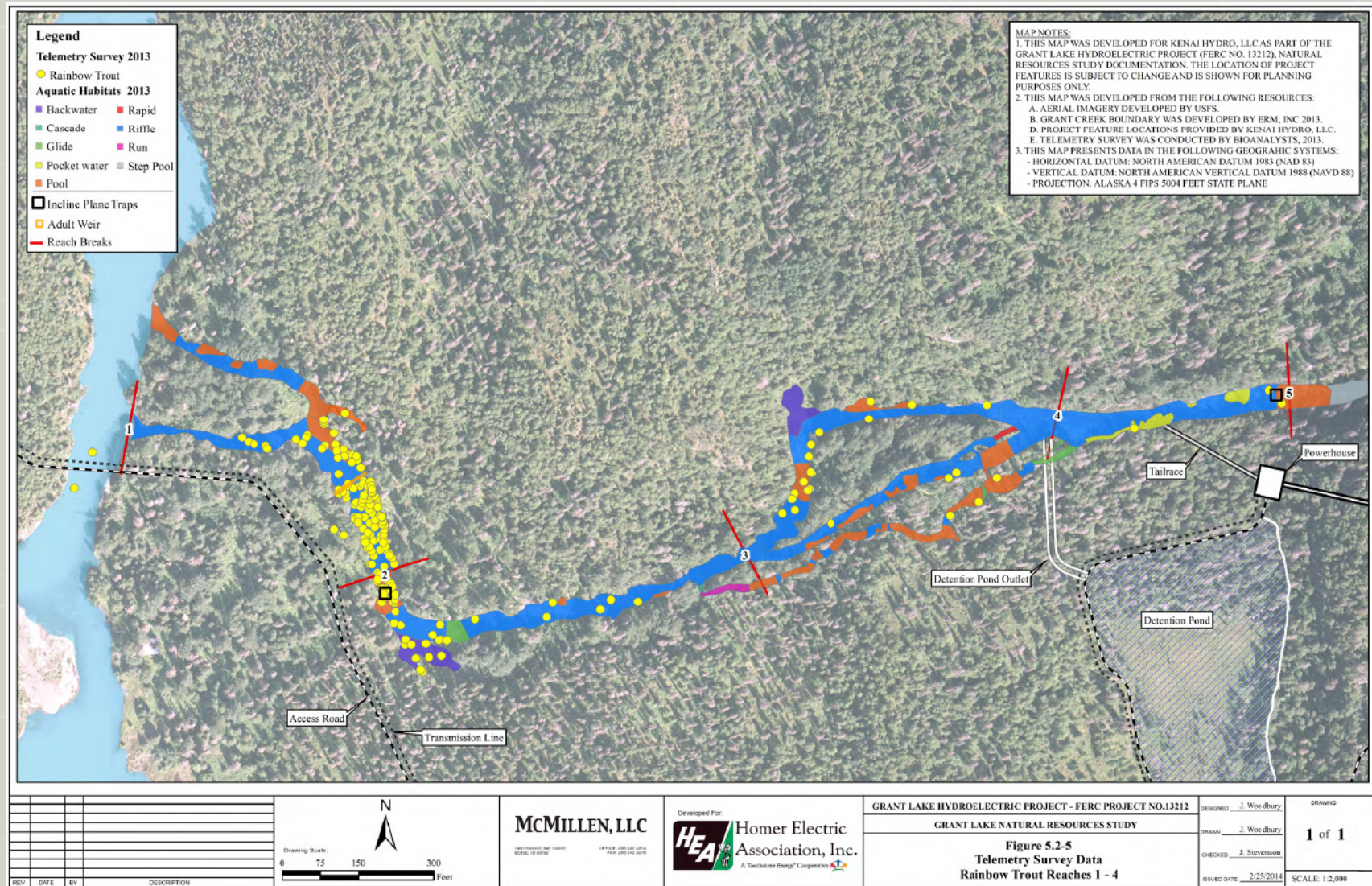
- Habitat Use by Adult Rainbow Trout – Number of Telemetry Detections by Reach and Habitat Type

Reach	Habitat Type				Total
	Pool	Riffle	Backwater	Pocket Water	
1 - Mainstem	23	101			124
2 - Mainstem	19	13	8		40
3 - Mainstem	9	11			20
3 - Predominant Side Channel	3	5			8
3 - Secondary Side Channel	3				3
4 - Mainstem	1	1		1	3
Total	58	131	8	1	198

Results – Location of Telemetry Detections for Adult Rainbow Trout – Reach 5



Results – Location of Telemetry Detections for Adult Rainbow Trout – Reaches 1-4



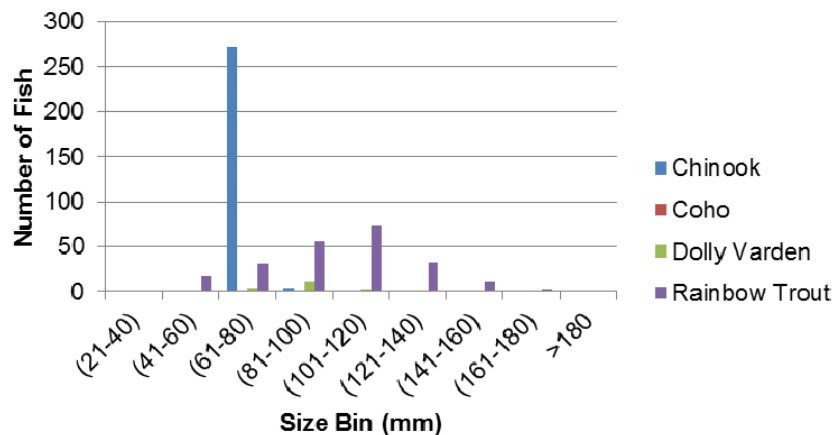
Results

- Adult Rainbow Trout Exodus from Grant Creek
 - Median Date: September 1
 - Earliest Date: June 17
 - Latest Date: October 26

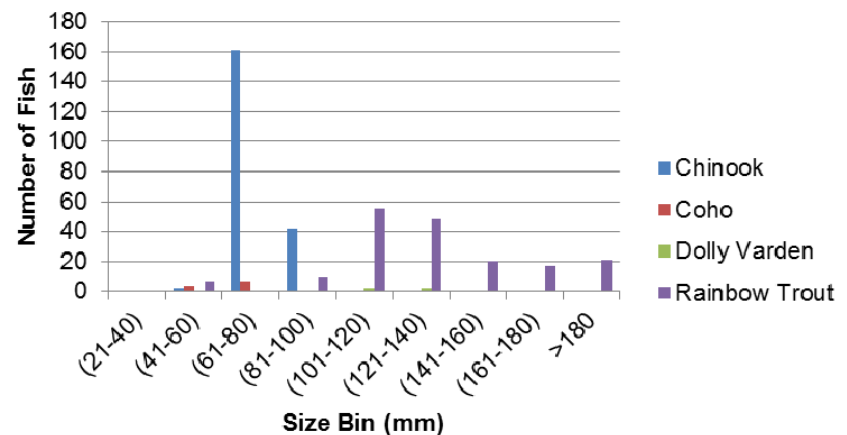
Results

- Overwintering of Juvenile Salmonids
 - Age-1 Chinook Observed in April and May
 - Few Coho Observed in April and May
 - Multiple Age Classes of Juvenile Rainbow Trout and Dolly Varden
 - Snorkel Data and Incline Plane Trap Data Confirm Overwintering

April Snorkel Survey - Reaches 1-4



May Snorkel Survey - Reaches 1-4



Results

- Juvenile Distribution in Grant Creek
 - Assessed for Reach 5
 - Snorkel Surveys
 - Incline Plane Trap
 - Minnow Traps
 - Assessed for Reaches 1-4
 - Snorkel Surveys
 - Beach Seining – Marginal Success – Not Included in Summary
 - Minnow Traps
 - Incline Plane Trap

Results

- Juvenile Distribution in Grant Creek
 - Reach 5 Snorkel Surveys – Conducted in April and May
 - Access Limited to Lower Third of Reach 5
 - Temperatures 0.5 – 4.0° C
 - Flows were 18 cfs and 150 cfs in April and May, Respectively
 - Snorkeled Three Step Pools in April; Two Step Pools in May
 - Surveys not Conducted June through October Due to Limited Visibility
 - Total of 16 Fish were Observed during the Two Surveys – All 16 were Rainbow Trout (60 – 280 mm FKL)

Results

- Juvenile Distribution in Grant Creek
 - Upper Incline Plane Trap
 - Trap Operation: April 28 – May 30; September 19 – October 16
 - Trap Down May 30 – September 19 Due to High Flows
 - No Mark/Recapture Activities Conducted – Lack of Fish
 - Therefore, No Estimate of Abundance
 - Total of 172 Juveniles Captured at Upper Incline Plane Trap:
 - 8 Chinook
 - 1 Coho
 - 7 Dolly Varden
 - 5 Rainbow Trout
 - 19 Sculpin
 - 132 Stickleback

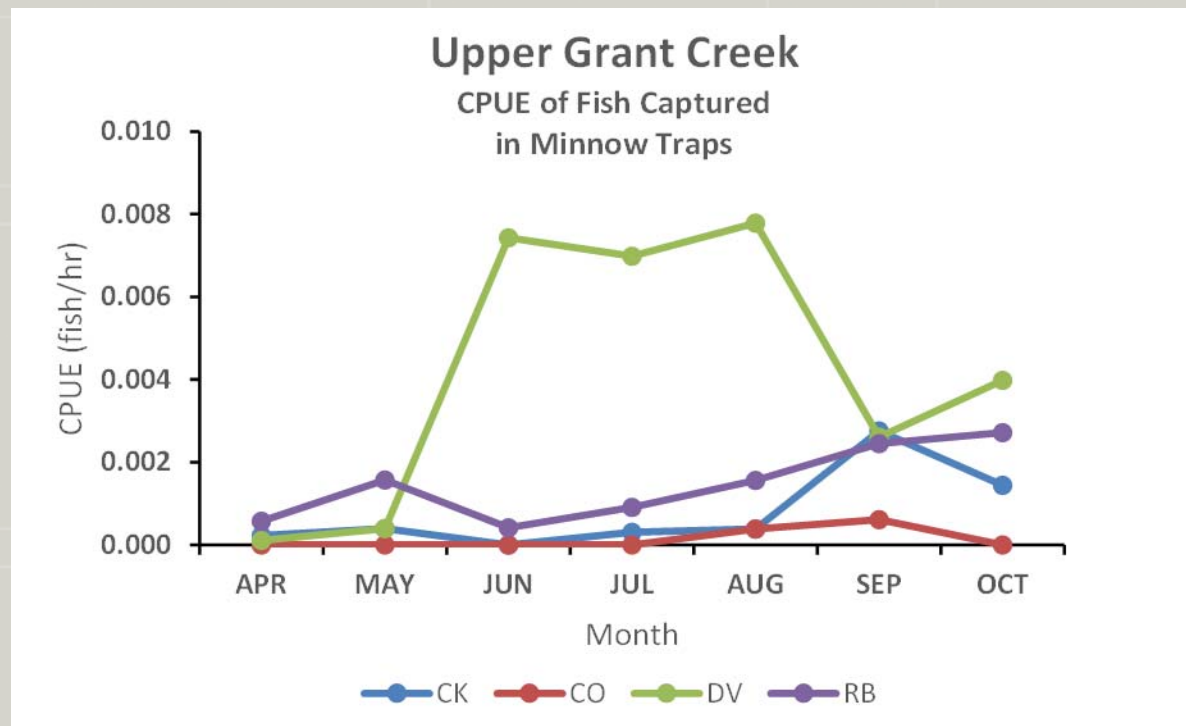
Results

- Juvenile Distribution in Grant Creek
 - Reach 5 Minnow Trapping – Conducted April through October
 - Primary Means for Assessing Juvenile Use of Reach 5
 - Seven Trapping Periods
 - Total of 57 Minnow Traps Sets
 - Total Trap Time of 1,318 Hours
 - Captured a total of 205 Fish

Species	Number	Proportion	CPUE (Fish/Hr.)
Chinook	31	0.15	0.024
Coho	5	0.02	0.004
Dolly Varden	102	0.50	0.077
Rainbow Trout	48	0.23	0.036
Sculpin	19	0.09	0.014
Total	205	1.00	0.156

Results

- Juvenile Distribution in Grant Creek – Reach 5 Minnow Trapping Cont.



Results

- Juvenile Distribution in Grant Creek
 - Reaches 1-4 Snorkel Surveys – Conducted in April and May
 - Flows were 18 cfs and 150 cfs in April and May, Respectively
 - Temperatures 0.5 – 4.0° C
 - Collectively Snorkeled 23 Sites
 - 2 Glides
 - 14 Pools
 - 7 Riffles

		April 2013 Snorkel Results		
Channel	Habitat	No. Fish	Area Sampled (m ²)	Density (Fish/100 m ²)
Mainstem	Glide	42	933	4.50
	Pool	357	7,193	4.96
	Riffle	39	8,463	0.46
Backwater	Pool	83	794	10.46
	Total	521	17,382	3.00

Results

- Juvenile Distribution in Grant Creek
 - Reaches 1-4 Snorkel Surveys – Cont.

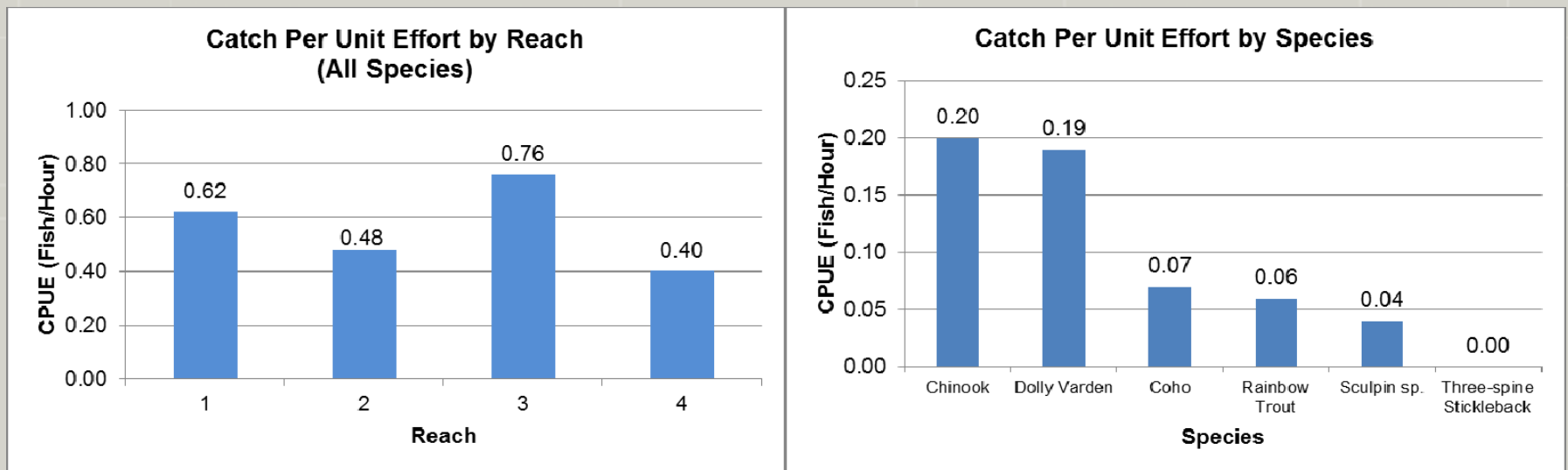
		May 2013 Snorkel Results		
Channel	Habitat	No. Fish	Area Sampled (m ²)	Density (Fish/100 m ²)
Mainstem	Pool	200	6,139	3.26
	Riffle	2	1,226	0.16
Side Channel	Pool	41	1,137	3.61
	Riffle	30	676	4.44
Backwater	Pool	127	1,111	11.43
	Total	400	10,290	3.89

Results

- Reaches 1 – 4 Minnow Trapping
 - Conducted April through October (7 Sets)
 - Goal was to Set 10 Traps per Reach per Set
 - Represent all Potential Habitat Types
 - Set Total of 273 Traps
 - Total of 6,137 Trap Hours
 - Captured a Total of 3,468 Fish

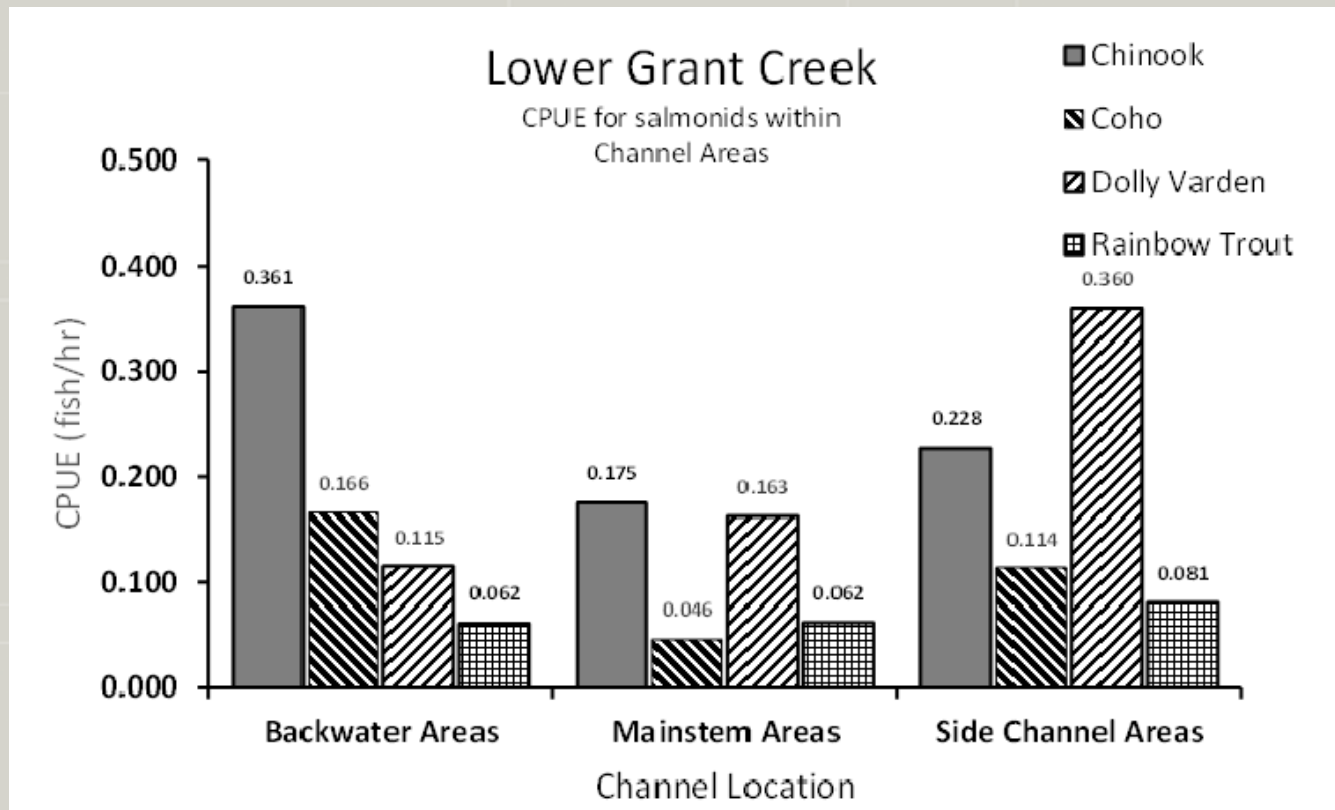
Results

- Reaches 1 – 4 Minnow Trapping – CPUE by Reach and Species



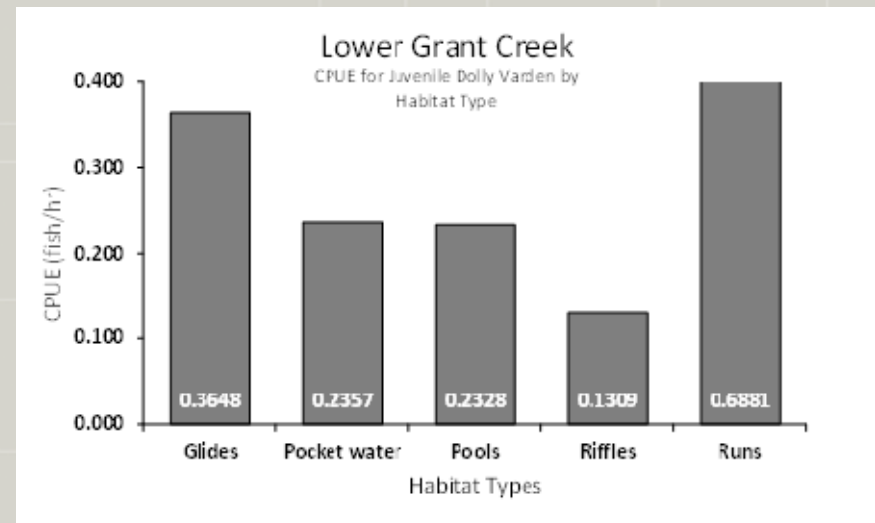
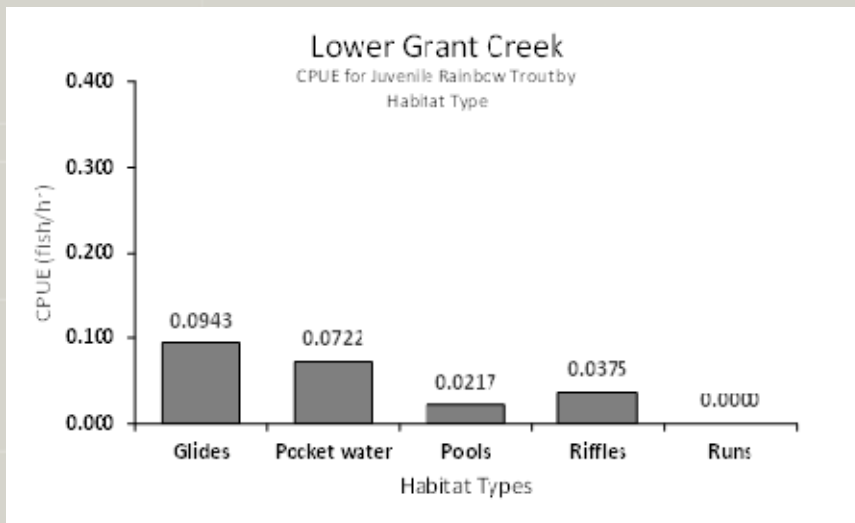
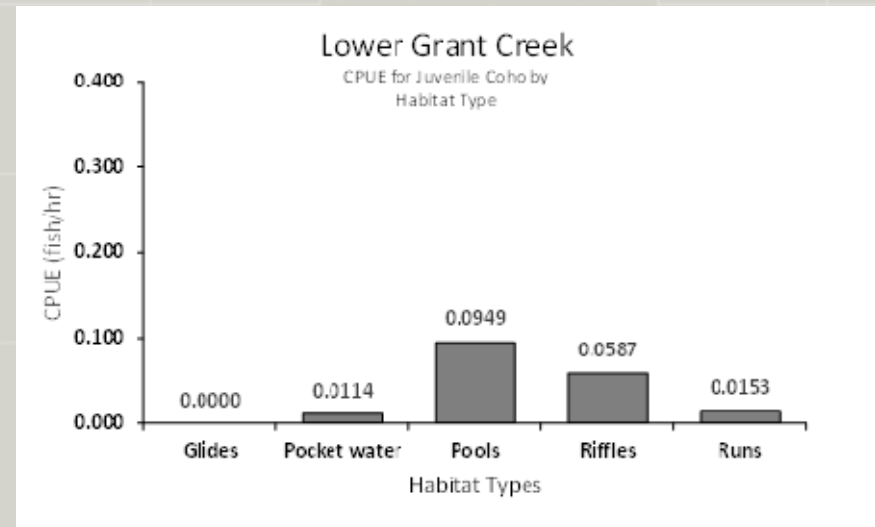
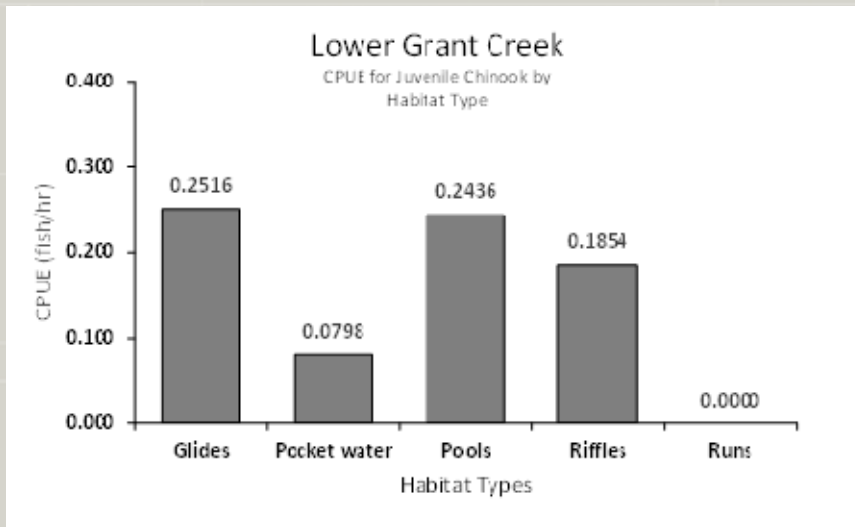
Results

- Reaches 1-4 – Minnow Trapping – CPUE by Channel Area



Results

- Reaches 1-4 – Minnow Trapping – CPUE by Habitat Types

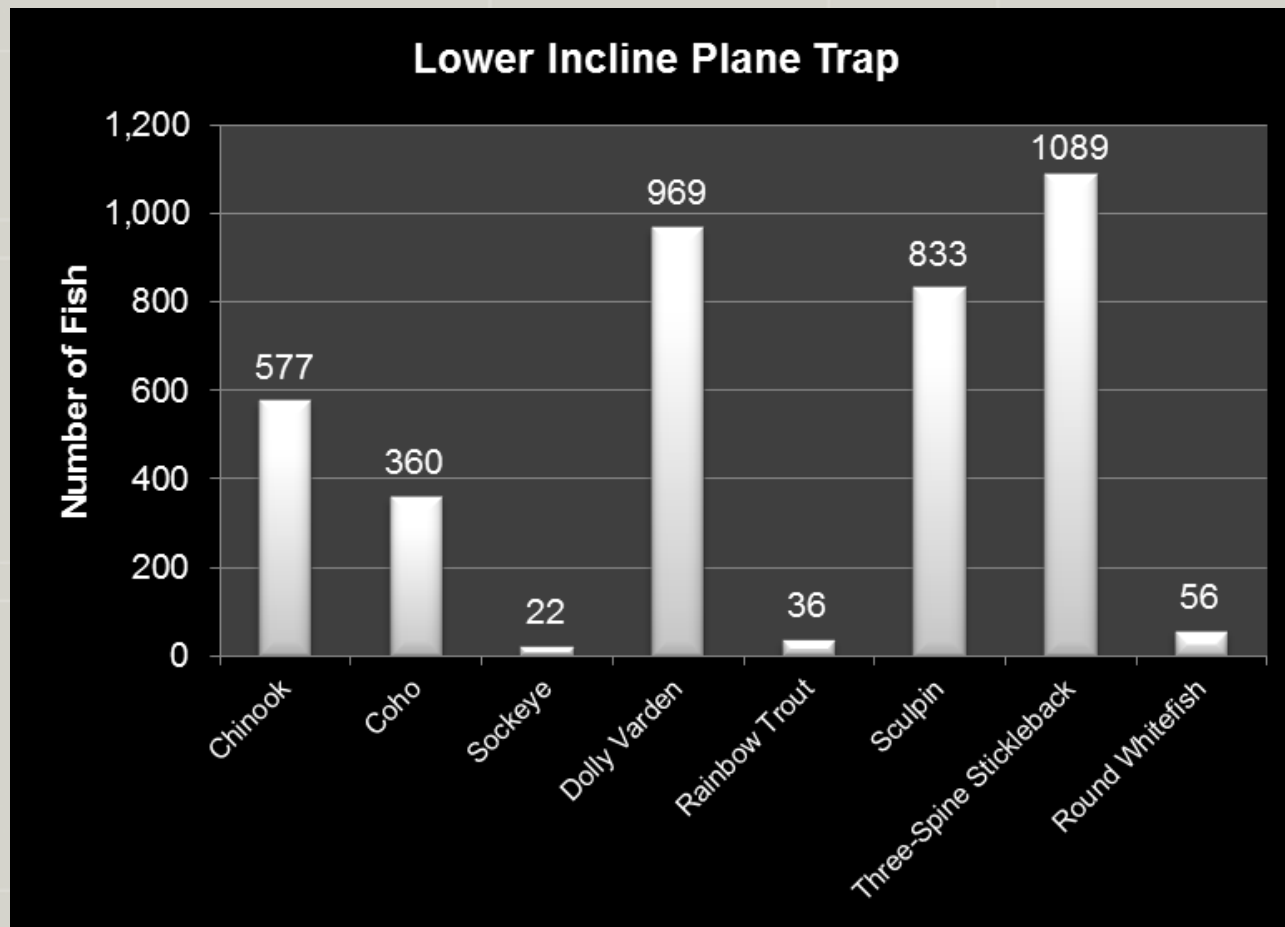


Results

- Lower Incline Plane Trap
 - Operated from April 30 – October 16
 - Operated Continuously with a Few Minor Exceptions
 - Intended to Provide Abundance for Reaches 1-4 (Assumed Continuous Operation of Upper Incline Plane Trap)
 - Due to Failure of Upper Incline Plane Trap – Abundance Estimate Represents all of Grant Creek Upstream of Lower Trap
 - Excludes Grant Creek Below Lower Trap (Area of Highest Concentration of Spawning)
 - Initially, Mesh Size Too Large – Excluded Fry-Sized Fish (< 50 mm)
 - Sockeye and Sub-Yearling Fish of all Species)
 - Abundance Estimate Represents Parr-Sized Fish and Larger

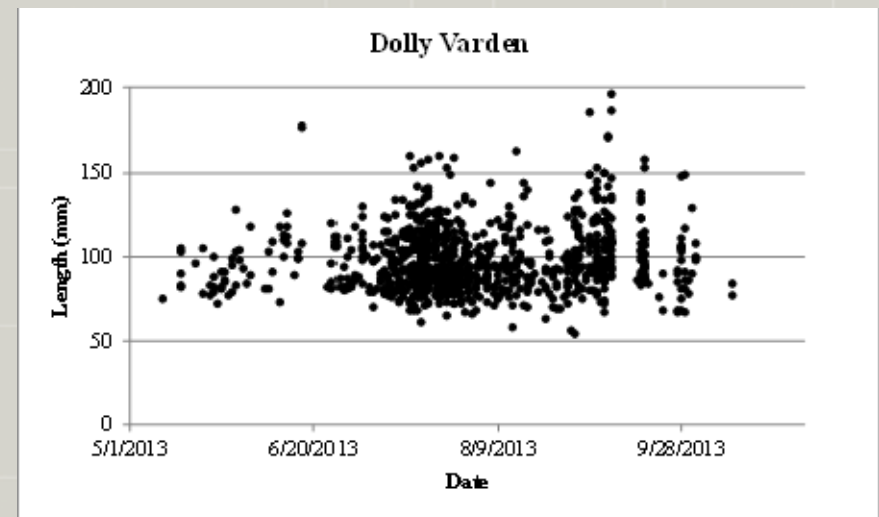
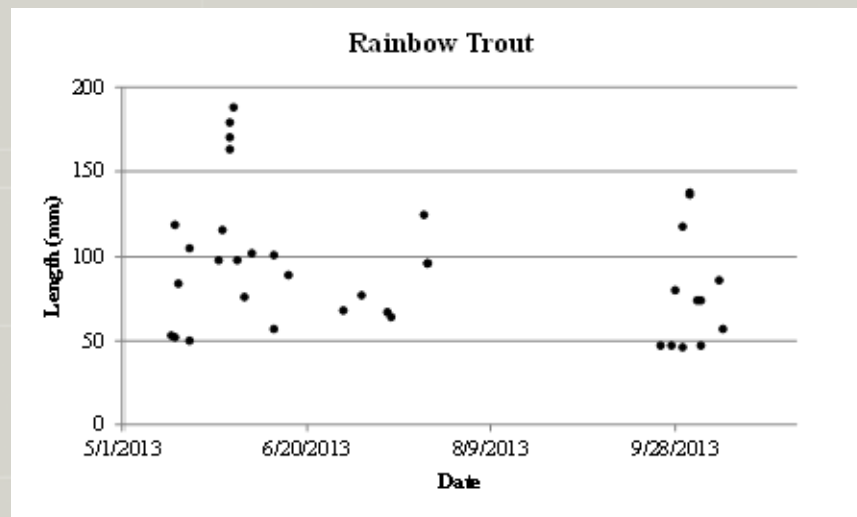
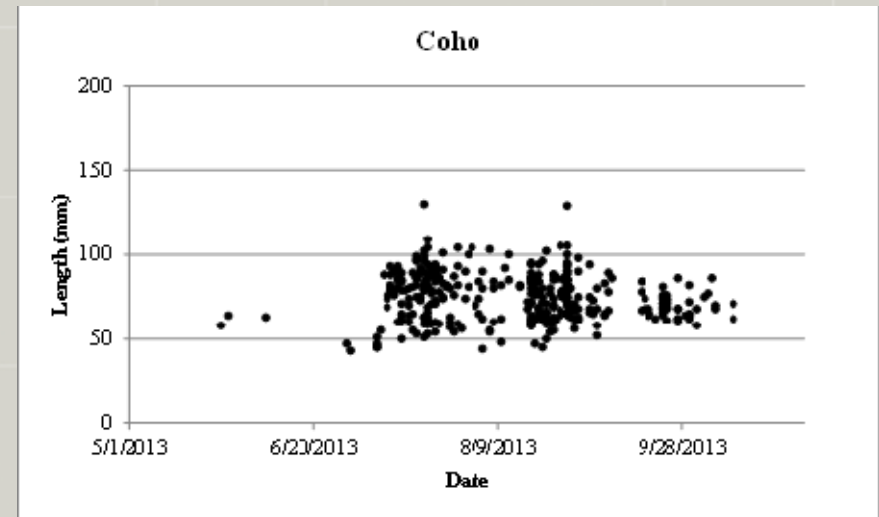
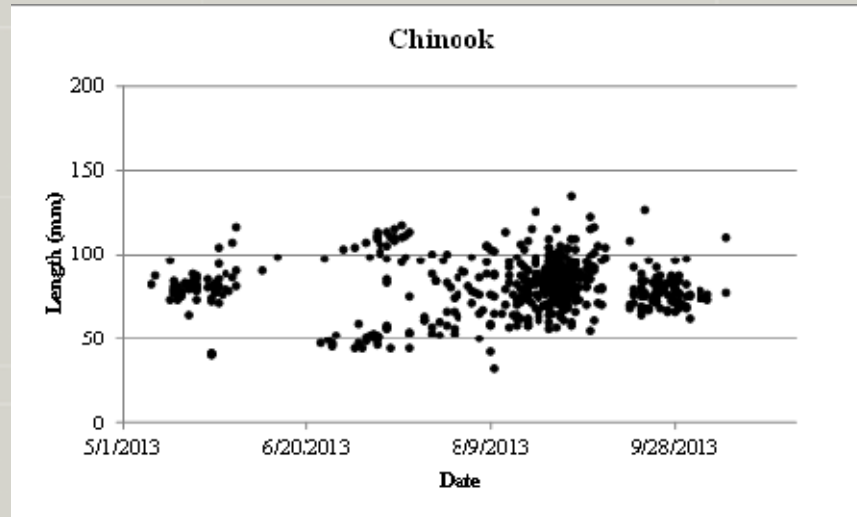
Results

- Lower Incline Plane Trap
 - Total of 3,942 Fish Captured in Trap



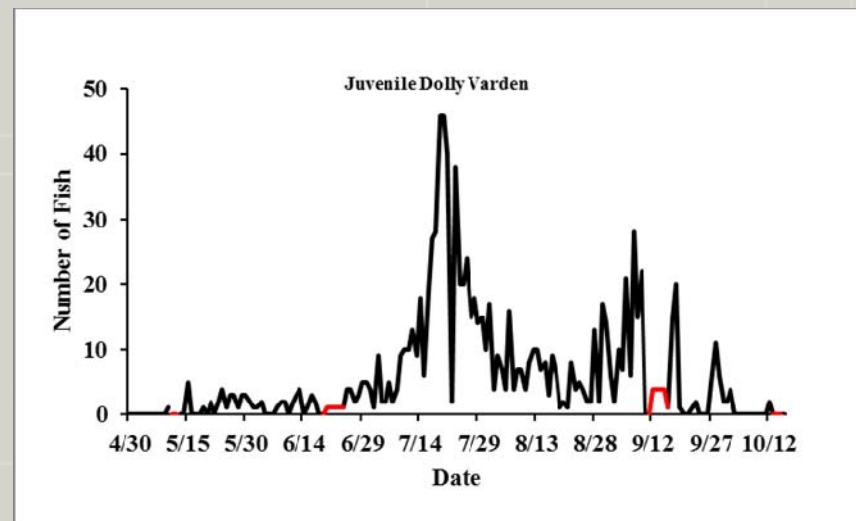
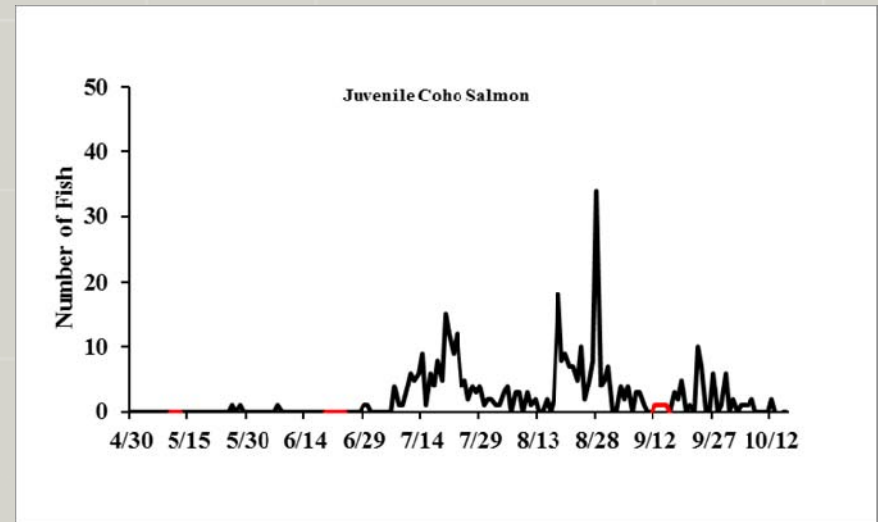
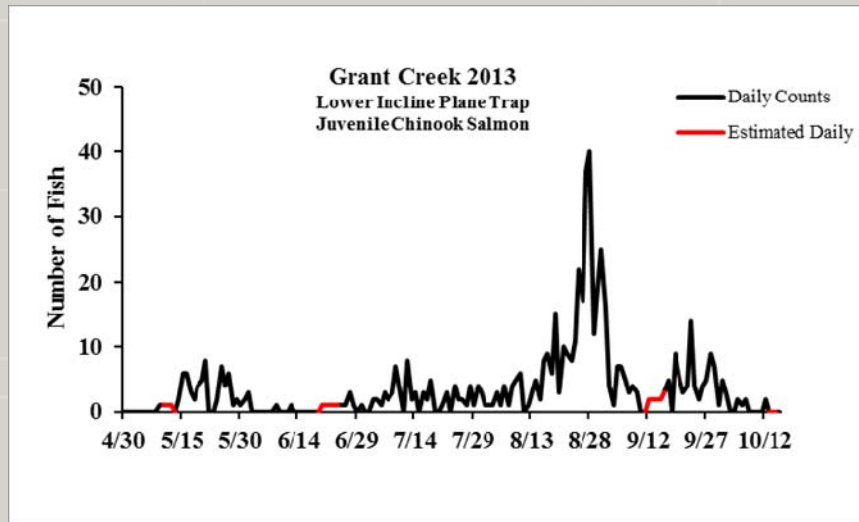
Results

- Lower Incline Plane Trap – Distribution by Size and Date



Results

- Lower Incline Plane Trap - Runtime



Results

- Lower Incline Plane Trap – Estimate of Grant Creek Abundance – Trap Efficiency Tests
 - For Parr-Sized Fish
 - Upstream of Trap – Including Reach 5
 - Excludes Major Spawning Area Below Trap

Species	Low Flow Condition		High Flow Condition		Trap Efficiency	
	Release	Recapture	Release	Recapture	Low	High
Chinook	380	45	68	10	0.118	0.147
Coho	169	19	110	13	0.112	0.118
Sockeye	3	0	9	0	0.000	0.000
D.V.	248	2	571	41	0.008	0.0725
R.B.T	8	0	5	1	0.000	0.200

Results

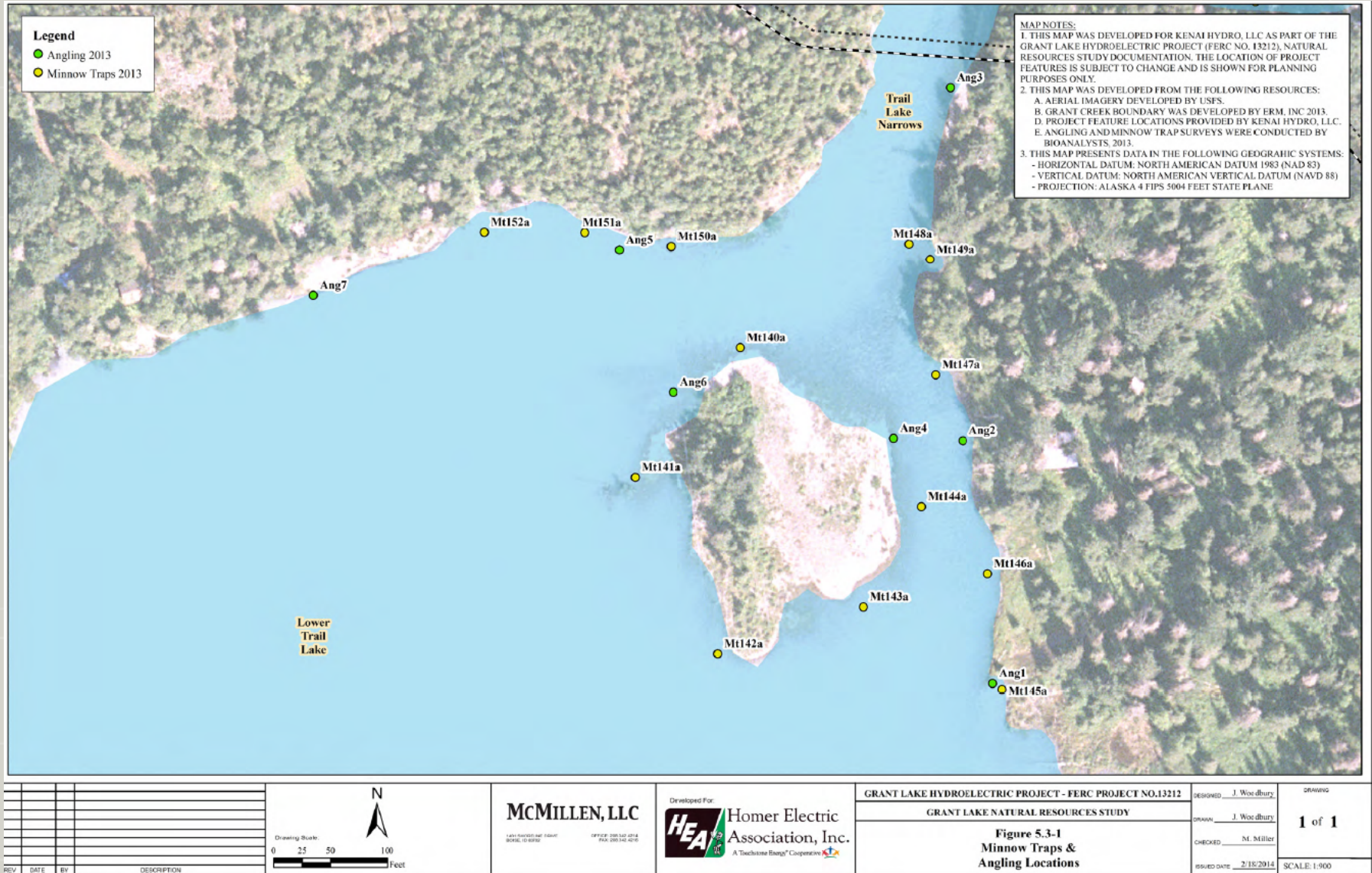
- Lower Incline Plane Trap – Estimate of Grant Creek Abundance
 - Conducted Test of Homogeneity – Chinook and Coho no Difference between High and Low Flow Conditions
 - Chinook – Used Efficiency of 0.123
 - Coho – Used Efficiency of 0.115
 - Flow Effect for Dolly Varden – Used 0.008 for Low Period; 0.072 for High Period

	Dolly Varden				
Statistic	Chinook	Coho	Low Flow	High Flow	Total
Observed n	577	360	296	673	---
Estimate of N	4,798	3,165	36,766	9,665	46,431
S.E. of N	603	546	25,980	1,471	26,021

Results

- Trail Lake Narrows – Sampled in July, and Included:
 - Minnow Trapping
 - Beach Seining
 - Angling Surveys for Adults

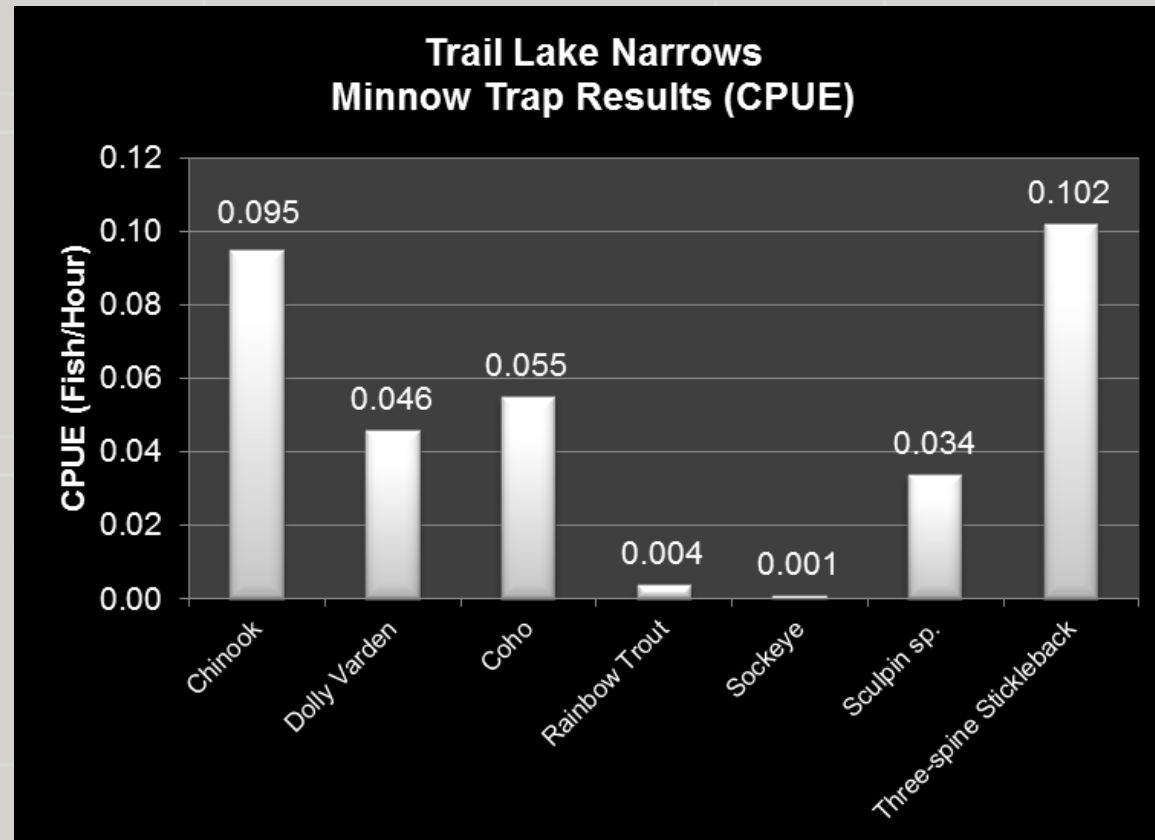
Results – Trail Lake Narrows



Results

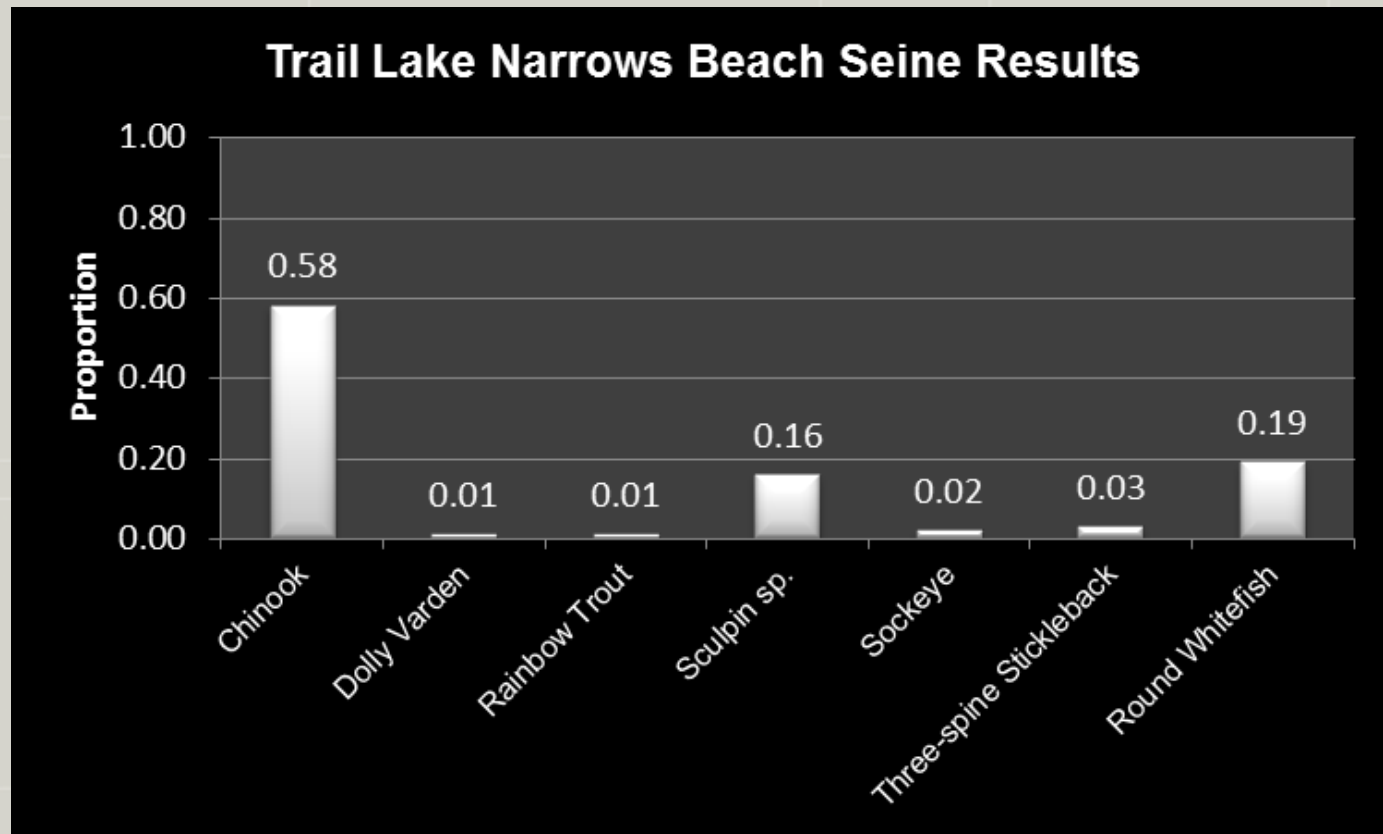
- Trail Lake Narrows – Minnow Trapping – Cont.

Reach	Number of Traps	Total Effort (Hours)	Number of Fish	CPUE (Fish/Hour)
Trail Lake Narrows	52	1,133	381	0.34



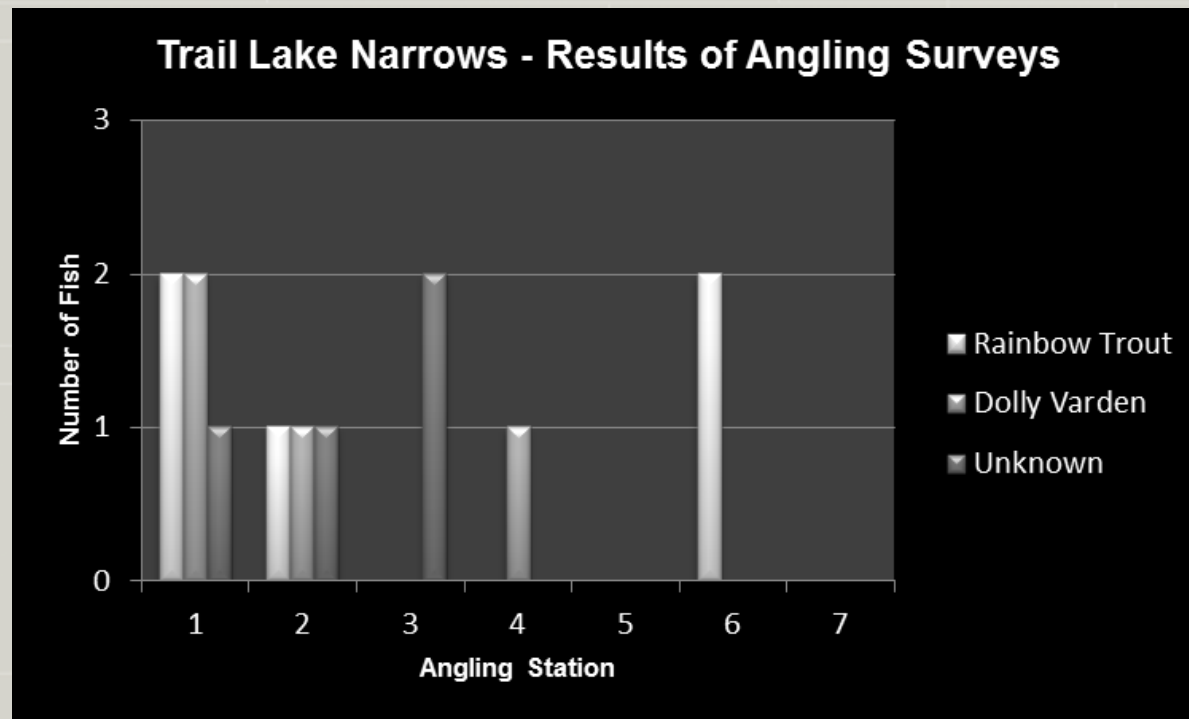
Results

- Trail Lake Narrows – Beach Seining Results
 - Conducted at Night
 - At Three Locations where Substrate and Flows were Conducive to Sampling



Results

- Angling Surveys – Conducted at 7 Angling Stations (1 Hour per Station)
 - Dominant Species was Rainbow Trout (n = 5)
 - Dolly Varden were Second Most Abundant (n = 4)
 - Four Additional Fish Could Not Be Identified (Broke Off Before Landing)



Potential Impacts

- Summary of Potential Impacts – Both Good and Bad
- Based on an Average Water Year
- Not Intended to Replace Detailed Analysis at a Later Date
- Based on Professional Judgment – Degree of Impact Unknown
- Assumptions:
 - December thru April – P.H. at Minimum Operation
 - May – Lake Level Maintained
 - June/July – Refill Grant Lake – Then P.H. Peak Capacity
 - August thru November
 - Throughout Year – Base Flow through Reach 5

Potential Impacts

- Assumed Operations would Result In:
 - Lower Flows in Reach 5 Year Round
 - December thru April In Reaches 1-4 – Higher than Historically (except December)
 - In May, and August thru November – Reaches 1-4 at Historical Levels
 - June/July – Reaches 1-4 – Less than Historical Levels Unit Grant Lake Refills

Potential Impacts

- Reach 5 – Contains 1.3% of Documented Grant Creek Spawning
 - Anadromous Spawning
 - Lower Flows = Less Spawning Habitat – Potential Negative Impact
 - Resident Spawning
 - Lower Flows = Less Spawning Habitat – Potential Negative Impact
 - May Improve Access to Upper Reach 5 Due to Lower Flows – Potential Positive Impact
 - Egg Incubation
 - Decreased Flows will Result in More Exposure of Channel Bed and Bank – Fewer Eggs Deposited but No Change in Survival
 - Decreased Flow will likely Reduce Gravel Recruitment and Increased Deposition of Fines – Potential Negative Impact
 - Lower Flow Could Result in Less Scour Events (Redds) – Potential Positive Impact
 - Juvenile Rearing
 - Winter Rearing Habitat – Plenty of Step Pool Habitat Currently Exists during Winter – Likely No Change
 - Summer Rearing Habitat – Decreased Flow = Improved Habitat – Potential Positive Impact

Potential Impacts

- Reaches 1-4
 - Anadromous and Resident Spawning
 - No Change - Run-of-River Operations During Spawning Periods (Except Early June)
 - Egg Incubation
 - Mainstem
 - Increased Flows During Incubation – No Change
 - Areas of Dewatering – Likely Some Overwinter Survival Improvement – Potential Positive Impact
 - Reach 3 Side Channels – Likely Improved Overwinter Survival of Incubating Eggs in Areas that Ice Over and/or Dewater – Extent Unknown
 - Reach 1 and 2 Distributaries – No Change (No Spawning at These Locations)
 - Juvenile Rearing
 - Mainstem
 - Higher Winter Flows = More Overwinter Habitat – Possible Overwinter Survival Increase
 - Decreased Summer Peaks (June/July) – May Maintain More Rearing Habitat – Positive Benefit – During Extreme Peak Flows – Margin Habitat Lost – Likely Negative Impact

Potential Impacts

– Juvenile Rearing – Continued

- Reach 3 Side Channels
 - Increased Winter Flows Would Increase Winter Habitat – Positive Impact
 - Spring, Summer, Fall – No Change
- Reach 2 Distributary – Flow Alteration would Decrease Time this Channel is Watered – Loss of Prime Rearing Habitat – Negative Impact
- Reach 1 Distributary – No Appreciable Change in Flow Dynamics – No Impact

– Global Issues

- Development of Flow Regimes Should Consider Ramping Rates to Minimize the Potential for Stranding
- All Construction Activities Should Follow Best Management Practices to Minimize Impacts