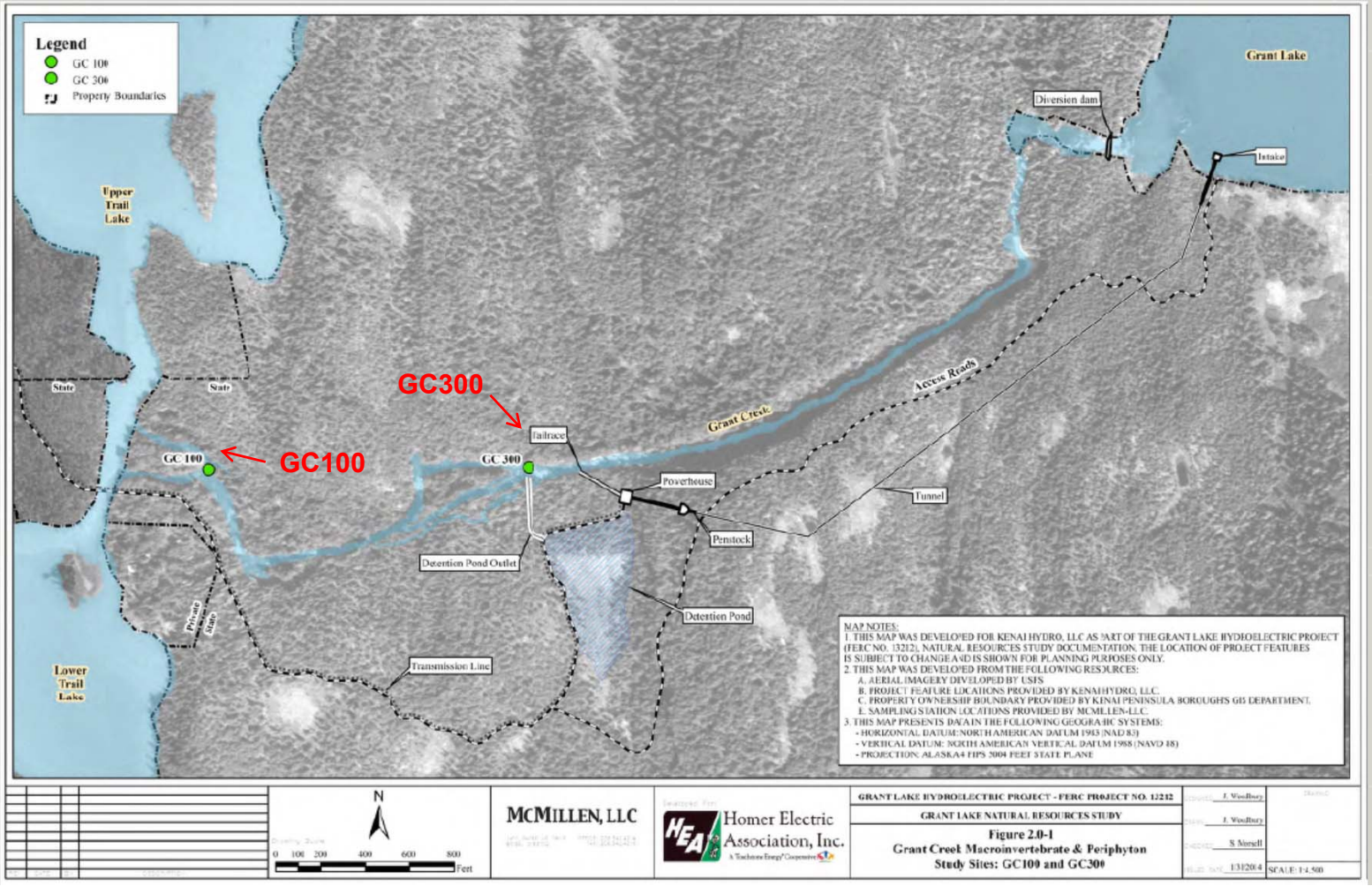
Grant Creek Macroinvertebrate and Periphyton Studies

2013 studies were conducted to complete data collection started in 2009 and to meet objectives stated in the study plan. Studies were designed to

- Provide a reliable measure of baseline stream productivity that can compared from year to year and with other stream systems.
- Provide some indication of the relative “health” of the Grant Creek ecosystem by employing standard measures that are comparable to other Alaska stream systems.

Grant Creek Macroinvertebrate and Periphyton Studies



Grant Creek Macroinvertebrate and Periphyton Studies

Sampling Site GC100: Looking cross channel from the north bank.

Grant Creek Macroinvertebrate and Periphyton Studies

Sampling Site GC300: Looking cross channel from the north bank.

Grant Creek Macroinvertebrate Study – Methods

- Sampling Methods:
  - Sampling in 2009 included both Alaska Stream Condition Index (ASCI), which is a modified EPA Rapid Bioassessment Protocol (RBP), and a quantitative method using Surber samplers
  - ASCI methods collect kick net samples from the range of habitats found in the sampling reach
  - Methods using Surber samplers in riffle habitats only, collect quantitative data that is more useful for monitoring purposes

Grant Creek Macroinvertebrate Study – Methods

- 2013 Field Work:
  - One sampling event on August 14, 2013 at GC100 and GC300
  - Employed Surber samplers in riffle habitats
  - Five replicates collected at each site
  - Samples placed in Nalgene bottles and preserved in alcohol

Grant Creek Macroinvertebrate Study – Methods

- Laboratory Work:
  - All organisms were sorted from the sample material
  - Preserved in alcohol
  - All organisms were identified to genus or next practicable taxon; Chironomidae only to family

Grant Creek Macroinvertebrate Study – Methods

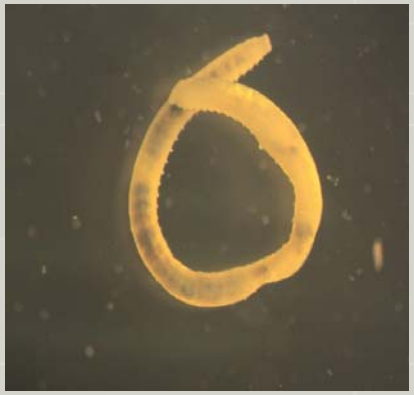
- Data Analysis – Metrics Calculated:
  - Population density as numbers/m2
  - Taxa richness metrics (overall taxa richness, Ephemeroptera taxa richness, Trichoptera taxa richness, Plecoptera taxa richness)
  - Taxonomic composition metrics (percent Ephemeroptera, percent Trichoptera, percent Plecoptera, percent Ephemeroptera/Plecoptera/Trichoptera (EPT), percent Chironomidae, percent dominant taxon)
  - Population trophic characteristics metrics (percent filterers, percent gatherers, percent predators, percent scrapers, percent shredders, filterer richness, gatherer richness, predator richness, scraper richness, shredder richness)
  - Hilsenhoff Biotic Index (HBI) scores (based on tolerance values assigned to each taxa)
  - Alaska Stream Condition Index, modified EPA RBP, (ASCI) habitat assessment scores

Grant Creek Macroinvertebrate Study – Results

Results

- 35 macroinvertebrate taxa collected in 2009 and 2013 samples
  - 26 insect taxa
  - 9 non-insect taxa (e.g. snails and oligochaetes)

Plecoptera -
genus Suwallia



Oligochaeta

Grant Creek Macroinvertebrate Study – Results

- Metrics developed from the results of macroinvertebrate identifications indicated general similarity between sites and years
- It was notable that fewer Chironomidae were identified at GC300 in 2009 than in other samples
- Apparent trends are highlighted in the following tables of macroinvertebrate metrics

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate population density and taxa richness metrics, 2009 and 2013.

Sample Site	Date	Sample Type	Density (no. / m^2)	Taxa Richness	Ephemeroptera Taxa Richness	Plecoptera Taxa Richness	Trichoptera Taxa Richness	EPT Taxa Richness
GC100	**08/06/09**	Surber[1]	12034 (4697)	19 (0.8)	6 (0.75)	3 (0.80)	3 (0.40)	12 (0.49)
GC100	**08/14/13**	Surber	19282 (7877)	20 (1.6)	6 (0.00)	3 (0.49)	2 (1.02)	12 (1.27)
GC300	**08/06/09**	Surber	2204 (1764)	15 (3.1)	4 (1.36)	3 (1.33)	3 (1.60)	10 (3.38)
GC300	**08/14/13**	Surber	12835 (3275)	22 (2.7)	6 (0.49)	4 (0.80)	3 (0.89)	12 (1.47)
GC100	**08/06/09**	ASCI[2]	2740	10	4	2	1	7
GC300	**08/06/09**	ASCI	530	12	1	2	1	4

Notes:
1. Data reported are averages (followed by + or - standard deviation in parentheses) of five replicate Surber samples.
2. Data reported are totals for composited samples.

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate population composition metrics, 2009 and 2013.

Sample Site	Date	Sample Type	% Ephemeroptera	% Plecoptera	% Trichoptera	% EPT	% Chironomidae	% Dominant Taxa
GC100	**08/06/09**	Surber[1]	3.9 (2.2)	2.6 (2.1)	1.3 (0.7)	7.7 (4.8)	84.7 (7.7)	84.7 (7.7)
GC100	**08/14/13**	Surber	2.6 (0.9)	1.4 (0.6)	0.4 (0.1)	4.4 (1.4)	88.5 (3.9)	88.5 (3.9)
GC300	**08/06/09**	Surber	18.0 (4.4)	8.9 (3.3)	4.6 (3.9)	31.5 (5.7)	41.0 (18.6)	48.4 (13.2)
GC300	**08/14/13**	Surber	6.4 (2.4)	1.8 (0.7)	0.5 (0.2)	8.7 (2.6)	83.3 (4.8)	82.3 (5.5)
GC100	**08/06/09**	ASCI	1.4	0.5	0.2	2.1	13.1	82.9
GC300	**08/06/09**	ASCI	1.3	1.6	0.7	3.6	7.5	77.8

Notes:
1. Data reported are averages (followed by + or - standard deviation in parentheses) of five replicate Surber samples.

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate functional feeding group metrics, 2009 and 2013.

Sample Site	Date	Sample Type	% Filterers	% Gatherers	% Predators	% Scrapers	% Shredders	Filterer Richness	Gatherer Richness	Predator Richness	Scraper Richness	Shredder Richness
GC100	**08/06/09**	Surber[1]	5	89	3	2	2	4	10	7	6	1
GC100	**08/14/13**	Surber	5	91	3	1	1	3	8	6	5	1
GC300	**08/06/09**	Surber	15	56	8	17	3	4	7	10	5	2
GC300	**08/14/13**	Surber	5	88	4	3	1	3	6	5	4	0
GC100	**08/06/09**	ASCI	83	14	2	1	0	1	3	4	3	1
GC300	**08/06/09**	ASCI	79	10	8	2	0	3	4	3	1	0

Notes:

1. Data reported are averages of five replicate Surber samples.

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate biotic indices and habitat assessment, 2009 and 2013.

Sample Site	Date	Sample Type	Hilsenhoff Biotic Index[1]	ASCI Habitat Assessment[2]
GC100	08/06/09	Surber	5.76	
GC100	08/14/13	Surber	5.81	
GC300	08/06/09	Surber	4.71	
GC300	08/14/13	Surber	5.61	
GC100	08/06/09	ASCI	7.5	200
GC300	08/06/09	ASCI	7.1	190

Notes:
1. Scale from 0-10, with 10 indicating greatest water body impairment.
2. Scale from 0-200, with 200 indicating most macroinvertebrate rich habitat

Grant Creek Macroinvertebrate Study – Results

- Analysis of variance calculated for several metrics
  - Comparison of variability between years and sites
  - Determine if results represent a reliable baseline condition
  - Found variance between years and sites insignificant (P> 0.05), except when comparisons were made to data collected at GC300 in 2009
  - These results may be explained by lower numbers of Chironomidae identified at GC300 in 2009 as compared to other samples
  - Variance in the metric ‘EPT taxa richness’ was insignificant both between sites and between years; this metric independent of Chironomidae data

Grant Creek Macroinvertebrate Study – Discussion

- Data useful for describing baseline:
  - Variability not significant except for metrics influenced by lower numbers of chironomids collected at GC300 in 2009
  - ANOVA indicates that GC100 could be used to monitor stream condition

Grant Creek Macroinvertebrate Study – Discussion

Predicted responses of several metrics to habitat impairment or perturbation (excerpted from EPA RBP, Barbour et al. 1999).

Metric	Definition	Predicted Response to Perturbation
Taxa Richness	Measures overall variety of the population	Decrease
EPT Taxa Richness	Number of taxa in the EPT orders	Decrease
% EPT	Percent of population in EPT orders	Decrease
% Scrapers	Percent of population that scrape or graze upon periphyton	Decrease
% Gatherers	Percent of population that “gather”	Variable
% Predators	Percent of population that are predators. Can be made restrictive to exclude omnivores.	Variable
Hilsenhoff Biotic Index	Uses tolerance values to weight abundance in an estimate of overall pollution. Originally designed to evaluate organic pollution	Increase

Grant Creek Macroinvertebrate Study – Discussion

- Data may be used for comparison to other streams in the Cook Inlet watershed and as an estimation of stream “health” and/or macroinvertebrate habitat quality
  - The challenge is to compare data collected using similar methods and stream categories
  - There is some data available for Cook Inlet and Upper Kenai where either Surber samplers or ASCI methods were used

Grant Creek Macroinvertebrate Study – Discussion

- Data collected using Surber samplers in riffle habitats
  - Grant Creek exhibits lower percent Ephemeroptera, Plecoptera, Trichoptera, shredders, scrapers, and predators, and higher percent Diptera/Chironomidae and gatherers than the mean for other Cook Inlet streams
  - Indicative of lower quality habitat or more stressful conditions: turbid water, variable flows, and flood/high velocities making substrate unstable

Grant Creek Macroinvertebrate Study – Discussion

Mean percent composition of the aquatic insect fauna in streams of the Cook Inlet Basin, Alaska [modified from Oswood and others (1995)] (excerpted from USGS 1999) and in Grant Creek, 2009 and 2013.

Fauna	Percent Composition Cook Inlet Watershed Streams	Percent Composition Grant Creek, 2009 and 2013 [1]
Taxonomic Structure		
Coleoptera	0.0	NA
Diptera	34.0	74.4 [2]
Ephemeroptera	41.3	7.7
Plecoptera	17.5	3.6
Trichoptera	7.2	1.7
Functional Group		
Shredders	11.6	1.8
Scrapers	11.2	5.8
Collector-filterers	6.6	7.5
Collector-gatherers	60.5	81.0
Predators	10.0	4.5

Notes:

1. Includes GC300 2009 which varies significantly from the other samples.
2. Chironomidae only.

Grant Creek Macroinvertebrate Study – Discussion

- Data collected using ASCI methods (employed on Grant Creek in 2009)
  - Comparison with other high gradient (> 2%) streams comprised mainly of riffle/run habitat in Kenai Peninsula Pacific Coastal Mountain Ecoregion
  - Indicates Grant Creek habitat relatively stressful for macroinvertebrate populations
  - ASCI scores based on core metrics result in a “poor” score for Grant Creek

ASCI scores based on core metrics (excerpted from ENRI 2000), and score for Grant Creek: average of GC100 and GC300, 2009.

		Score				Grant Creek Score
Ecoregion and Stream Type	Maximum	Very Good	Good	Poor	Very Poor	
Pacific Coastal Mountains						
All Stream Types	42	>29	20-29	10-19	<10	18

Grant Creek Periphyton Study - Methods

- Field Work:
  - One sampling event in August 2013 at GC100 and GC300
  - Used a modified EPA rapid bioassessment protocol
  - Ten samples collected within a single habitat type (riffles) to provide quantitative data for monitoring purposes
- Laboratory analysis of samples to determine chlorophyll *a* concentration

Grant Creek Periphyton Study - Results

- 2009 and 2013 results varied between sites and years

Average[1] concentrations of chlorophyll *a* from periphyton collected in Grant Creek, 2009 and 2013.

Sample Site	Date	Chlorophyll a Concentration (µg/cm^2)
GC100	**08/06/09**	34.79 (23.76)
GC100	**08/14/13**	5.85 (4.92)
GC300	**08/06/09**	12.70 (9.94)
GC300	**08/14/13**	4.4 (2.84)

Notes:
1. Averages, followed by standard deviation in parentheses, are of 10 replicate samples.

Grant Creek Periphyton Study - Results

- ANOVA of the data collected on Chorophyll *a* concentrations indicates significant variability ($P < 0.05$) between years at both sites and between sites in 2009.
- The difference in concentrations between GC100 and GC300 in 2013 was not significant ($P > 0.05$).

Grant Creek Periphyton Study - Discussion

- The data collected to date on periphyton chlorophyll a concentrations at the two sites in Grant Creek exhibits too much variability to be said to describe a baseline condition
- Grant Creek presents challenging conditions for periphyton, as well as benthic macroinvertebrates: turbidity from glacial influences, variable flows, and flood/high velocity flows
- Stabilization of flows could potentially improve conditions for periphyton and benthic macroinvertebrates