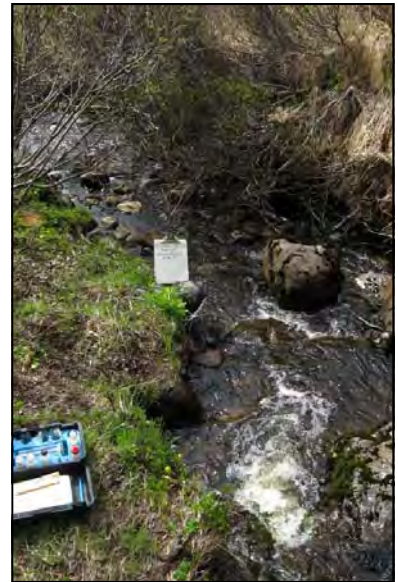
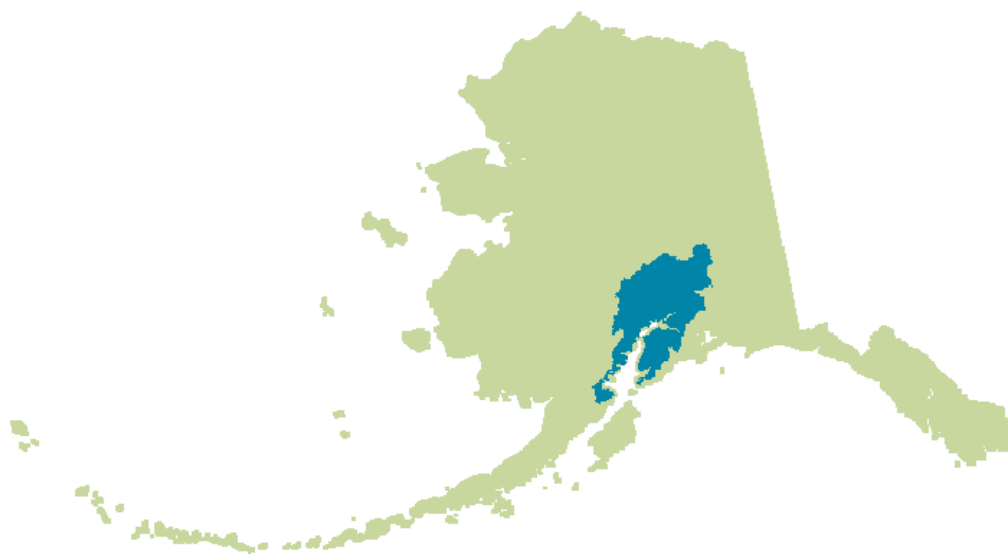




# Citizens' Environmental Monitoring Program Baseline Water Quality Report



## McNeil Creek 2000—2009



Cook Inletkeeper is a community-based nonprofit organization that combines advocacy, outreach, and science toward its mission to protect Alaska's Cook Inlet watershed and the life it sustains.

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Citizens' Environmental Monitoring Program  
Baseline Water Quality Reports  
2012: McNeil Creek

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# INTRODUCTION

## Citizens' Environmental Monitoring Program

With nearly a million miles of streams and rivers in Alaska, the lack of baseline water quality information—especially in populated regions such as Southcentral Alaska, home to the vast majority of Alaskans—may result in an inability to provide adequate oversight on future development. In response to this gap in knowledge, Cook Inletkeeper's volunteer water quality monitoring began in 1996 with the formation of the Citizens'



*Jenny and Willy Dunne sampled at McNeil Creek from 2000-2003. They are just two of over 300 volunteers that have collected baseline water quality data through Cook Inletkeeper's CEMP.*

Environmental Monitoring Program, known to many by its acronym—CEMP. The Citizens' Environmental Monitoring Program, the first of its kind in Alaska, is designed to meet the need for baseline water quality data for local watersheds around Southcentral Alaska. Baseline data collection is the primary aim of the CEMP model.

Many waterbodies in Alaska have not been pol-

luted, and we rely on these systems to support our fish, wildlife, and human communities. Inletkeeper created the CEMP to provide Alaskans with the tools needed to be active stewards of our water and watersheds for future generations. By training citizen volunteers to monitor water quality we are empowering the community to keep its eyes and ears tuned to changes that may impact and threaten Alaska's water resources.

## Baseline Reports

As we complete baseline data collection for a given waterbody, we create a baseline water quality report to compile watershed-specific information. Within these pages you will find background on the CEMP methods and quality assurance measures, GIS analyses of the individual watershed, and the water quality data we've collected through the years. Finally, each report provides suggestions for future monitoring efforts. It is our intention that these reports will become a comprehensive baseline water quality library which will provide landowners, city councils, developers, and communities with valuable information for responsible decision-making.

## What are Baseline Data?

A baseline is defined as historical or reference information from which new data can be measured or compared. The Citizens' Environmental Monitoring Program collects baseline water quality data to better understand our current environment in a changing world. Population growth, increased development, and climate change are some of the catalysts for change which can alter the quality of our waterbodies. By collecting baseline data, we can track those changes and make better decisions to protect water quality for future generations. We use the following as guidelines for defining a baseline dataset:



- 5+ years of data with at least 80 site visits
- At least 40 site visits during summer months
- At least 5 site visits during every month of the year that the site was monitored
- 3 years of continuous temperature monitoring (at select sites)
- 6 bioassessment sampling events over at least 3 years (at select sites)

For more information about these guidelines, see the CEMP Effectiveness Report (2003) available online at <http://www.inletkeeper.org/CEMP/effectiveness.htm>.

## Kachemak Bay and Anchor River Watersheds

Inletkeeper's volunteer monitoring program in Cook Inlet has focused on surface water quality monitoring in the Kachemak Bay and Anchor River watersheds. To assist with the initial phases of developing and refining its Citizens' Environmental Monitoring Program, Inletkeeper convened a Technical Advisory Committee (TAC), comprised of water quality experts from across Alaska and beyond. To translate the recommendations of the TAC into workable implementation strategies, Inletkeeper convened a Citizens Advisory Panel (CAP), comprised of residents of the Southern Kenai Peninsula concerned about water quality. Together, the TAC and CAP provided Inletkeeper with invaluable input that shaped its monitoring program. Cook Inletkeeper's CEMP has trained over 300 volunteer water quality monitors since 1996. As of January 2012, over 2,000 observations have been made in the Kachemak Bay and Anchor River watersheds.

To meet its primary goal of baseline data collection in these watersheds, CEMP monitoring is focused on obtaining 5 or more years of complete datasets at individual sites within key sub-watersheds that flow into Kachemak Bay and the



*All of the CEMP sites identified above will have baseline water quality datasets completed by 2014. Baseline reports will be developed as datasets are completed. A full baseline water quality library from the efforts of the Kachemak Bay and Anchor River CEMP is anticipated by 2015.*

Cook Inlet via the Anchor River. The CEMP annual sampling schedule includes 16 site visits; a “complete dataset” has 75%, or at least 12 site visits, during the course of the year. Alternatively, a minimum of 80 site visits over the course of monitoring at a site may be used for a baseline dataset if other criteria are met. The map above shows the location of the sites that will have completed baseline datasets by 2014. Baseline reports for these sites will make up the baseline water quality library.

# INTRODUCTION

## CEMP Partnership of Southcentral Alaska

The Citizens' Environmental Monitoring Program (CEMP) was created by Cook Inletkeeper to actively engage citizen volunteers in the collection and distribution of important habitat and water quality data. By 1997, other organizations were interested in developing similar programs and the CEMP Partnership of Southcentral Alaska was formed. The Partnership developed guiding documents that are used by all Partner monitoring programs in the region. These documents include a Quality Assurance Project Plan, Standard Operating Procedures, and data quality objectives for all parameters. Since 2000 the Partnership has held an annual meeting in Anchorage in February. All CEMP Coordinators are re-certified in testing methods, and a business meeting is held to discuss any proposed changes, challenges, or ideas for the Partnership in the coming year.

While each partner organization has a unique program, the CEMP Partnership has three priority objectives :

1. Inventory baseline water quality data in the waterways of Southcentral Alaska;
2. Detect and report significant changes and track water quality trends; and,
3. Raise public awareness of the importance of water quality through hands-on involvement.

As of 2012, the Partnership had trained over 700 citizens in water quality monitoring procedures described in the CEMP Quality Assurance Project Plan. Nearly 5,000 observations have been made at over 250 stream, wetland, lake, and estuarine sites in South central Alaska. Volunteers

have contributed well over \$550,000 of in-kind donations in helping the CEMP Partnership meet its objectives. In the coming years the Partnership will build its Baseline Water Quality Library with reports from around Southcentral Alaska. A contact list for current Partners can be found on the Inletkeeper website (<http://www.inletkeeper.org>) 🌱



*Top: Jukes Lake, monitored through the Mat-Su Lake Monitoring Program. Bottom: CEMP monitoring with the Wasilla Soil and Water Conservation District.*



## Past and Present CEMP Partnership Partners (on the right from north to south):

Upper Susitna Soil and Water Conservation District (Talkeetna)

Wasilla Soil and Water Conservation District (Wasilla)

Mat-Su Borough Lake Monitoring Program (Palmer)

Anchorage Waterways Council (Anchorage)

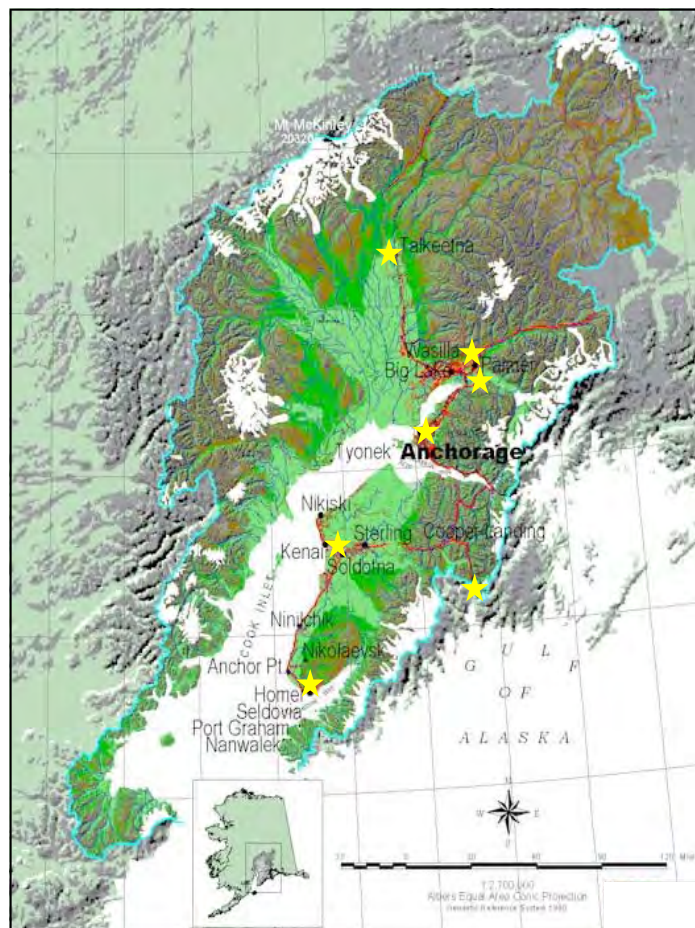
University of Alaska Anchorage Environment and Natural Resources Institute (Anchorage)

Kenai Watershed Forum (Soldotna)

Resurrection Bay Conservation Society (Seward)

Homer Soil and Water Conservation District (Homer)

Cook Inletkeeper (Homer)



Top: The Cook Inlet watershed is highlighted, with CEMP Partners represented with yellow stars. Bottom: Water quality monitoring and environmental education with the Anchorage Waterways Council.

## METHODS

To ensure adequate quality assurance oversight and consistency of volunteer-collected data, Cook Inletkeeper staff follow the Quality Assurance Project Plan for Inletkeeper's CEMP. The Quality Assurance Project Plan (version 2002, updated in 2010) has been reviewed and approved by the Alaska Department of Environmental Conservation, the Environmental Protection Agency, and the project's Technical Advisory Committee. A Field Procedure booklet and Standard Operating Procedures outline detailed methods for sampling and data management. In accordance with the Quality Assurance Project Plan, many quality assurance and quality control measures are taken to validate the volunteer collected data, including training, Partnership-wide data quality objectives, and data management.

### Training

Volunteers are required to complete Phase I through III of training to be eligible to collect data for CEMP. Phase I is an introduction to the watershed concept and monitoring procedures. Phase II is designed to teach the volunteers to use the monitoring kits and equipment. This phase involves both laboratory and field training. Phase III is an on-site training. Volunteers may begin monitoring on their own after successful completion of Phases I-III. Volunteer monitors must also attend an annual re-certification (Phase IV) training where they analyze blind performance evaluation standards and review monitoring procedures. Volunteers must complete a separate training in order to participate in biological monitoring. Trainings are offered once a year by University of Alaska Anchorage Environment and Natural Resources Institute-certified trainers.

### Data Quality Objectives

Volunteer monitors perform analysis on dupli-



*Volunteers learn how to follow protocols for collecting water quality data in the Inletkeeper lab during Phase II of CEMP training.*

cate samples during each site visit. Replicate measurements are also taken for samples analyzed in the lab. Measurements must meet predetermined data quality objectives for sensitivity, precision, and accuracy. Data Quality Objectives for CEMP parameters used by Inletkeeper are included on the following page.

### Data Management

The CEMP Coordinator reviews all data sheets for completeness. Volunteers are contacted if there are questions regarding the data sheet and monitoring event. The CEMP Coordinator enters all of the data into an MS Access database. This database was developed in 2000 in coordination with the Anchorage Waterways Council. It provides quality assurance checks on data entry and is used to review and summarize data for annual and baseline reports. As we complete baseline datasets, we are working with the Alaska Department of Environmental Conservation to migrate data into STORET—the Environmental Protection Agency's online repository for water quality monitoring data. ❄️



# DATA QUALITY OBJECTIVES

Parameter	Method/Range	Units	Sensitivity (a)	Precision	Accuracy	Calibration Method
Air Temperature	Thermometer -40 to 120°F	Degree Fahrenheit (°F)	1.0°F	±1.0°F	±1.0°F	NIST Certified Thermometer
Water Temperature	Thermometer -5.0 to +50.0°C	Degrees Celsius (°C)	0.5°C	±0.5°C	±0.5°C	NIST Certified Thermometer
	Hanna Meter HI 98129 0.0 to 60.0°C; 32.0 to 140.0°F	(°C) (°F)	0.1°C 0.1°F	±0.5°C ±1.0°F	±0.5°C ±1.0°F	NIST Certified Thermometer
	Stowaway Tidbit (Onset Computer Corp.)	(°C) (°F)	0.16°C	5%	0.2 @ 20°C	NIST Certified Thermometer
pH	pH Octet Comparator (Wide-Range) Lamotte 5858 3.0 to 10.0 units	Standard pH units	0.25 units	±0.6 units	±0.4 units	Checked against Hanna Meter HI 98129
	Hanna pH Tester Combo HI98129 0.0 to 14.0	Standard pH units	0.01	±0.02 units	±0.01 units	Standard Solutions Method
Dissolved Oxygen	Micro Winkler Titration Lamotte 5856 0 to 20 mg/l	Milligrams per liter (mg/l)	0.1 mg/l	±0.6 mg/l	±0.3 mg/l	Checked against DO Meter
Turbidity	LaMotte Model 2020 Turbidity Meter 0.00 to 100 NTUs	Nephelometric Turbidity Units	<u>NTU Report to Nearest</u> 0 to 1.0 then 0.05 NTU 10 to 40 then 1 NTU 40 to 100 then 5 NTU 100 to 400 then 10 NTU 400 to 1000 then 50 NTU over 1000 then 100 NTU	±2% for readings below 100 NTUs ±3% above 100 NTUs	±2% or 0.05 for readings below 100 NTUs (whichever is greater) +3% above 100 NTUs	Standard Solutions Method
Specific Conductance	Hanna TDS Meter 0 to 3999 microS/cm	Micro- Siemens/cm (µS/cm) (converted to 25°C)	1.0 µS/cm	±2 µS/cm	±2% of the standard	Standard Solutions Method
E. Coli	EasyGel Coliscan 0 to 60 CFU	Number of colony forming units (CFU) per 100 ml	1 CFU/100 ml	Control checks of sterility, temperature	Control checks of sterility, temperature	Send water sample split to EPA/ADEC Certified Lab

# WATER QUALITY PARAMETERS

Primary parameters (water temperature, dissolved oxygen, pH, specific conductance, turbidity, and bacteria) were measured using standard Environmental Protection Agency approved procedures and/or methods which are used by established citizens' volunteer monitoring programs (e.g., Friends of Casco Bay's Citizens' Water Quality Monitoring Program and Texas Watch's Volunteer Environmental Monitoring Program). Each of these procedures, as well as those used in measuring secondary parameters, is taken from the Volunteer Estuary/Lake/River/Stream Monitoring: A Method's Manual (EPA 1997). All methods used are consistent with those recommended by the test kit manufacturers (LaMotte, Hanna, Hach and Micrology Laboratories). 🌱



*CEMP monitors measure pH and specific conductance using waterproof Hanna combo meters. Monitors calibrate their meters before every sampling event. In addition, Inletkeeper's CEMP Coordinator collects all meters quarterly to clean and calibrate them in the laboratory. The meters automatically correct pH and conductivity values for the stream temperature.*



*Site photos from McNeil Creek Top: looking downstream, fall of 2001, Middle: looking upstream, winter of 2007, Bottom: looking downstream, summer 2009.*

# WATER QUALITY STANDARDS

Results from sampling are referenced against state (Alaska Department of Environmental Conservation) and federal (Environmental Protection Agency) water quality standards. These standards are listed in the table below. McNeil Creek is held to standards for water supply: growth and propagation of fish, shellfish, aquatic life, and wildlife. It is not listed as an anadromous (salmon-bearing) stream. 🌊



*Right: CEMP monitors go through a 3-day training to become certified for water quality sampling at Cook Inletkeeper's laboratory in Homer.*

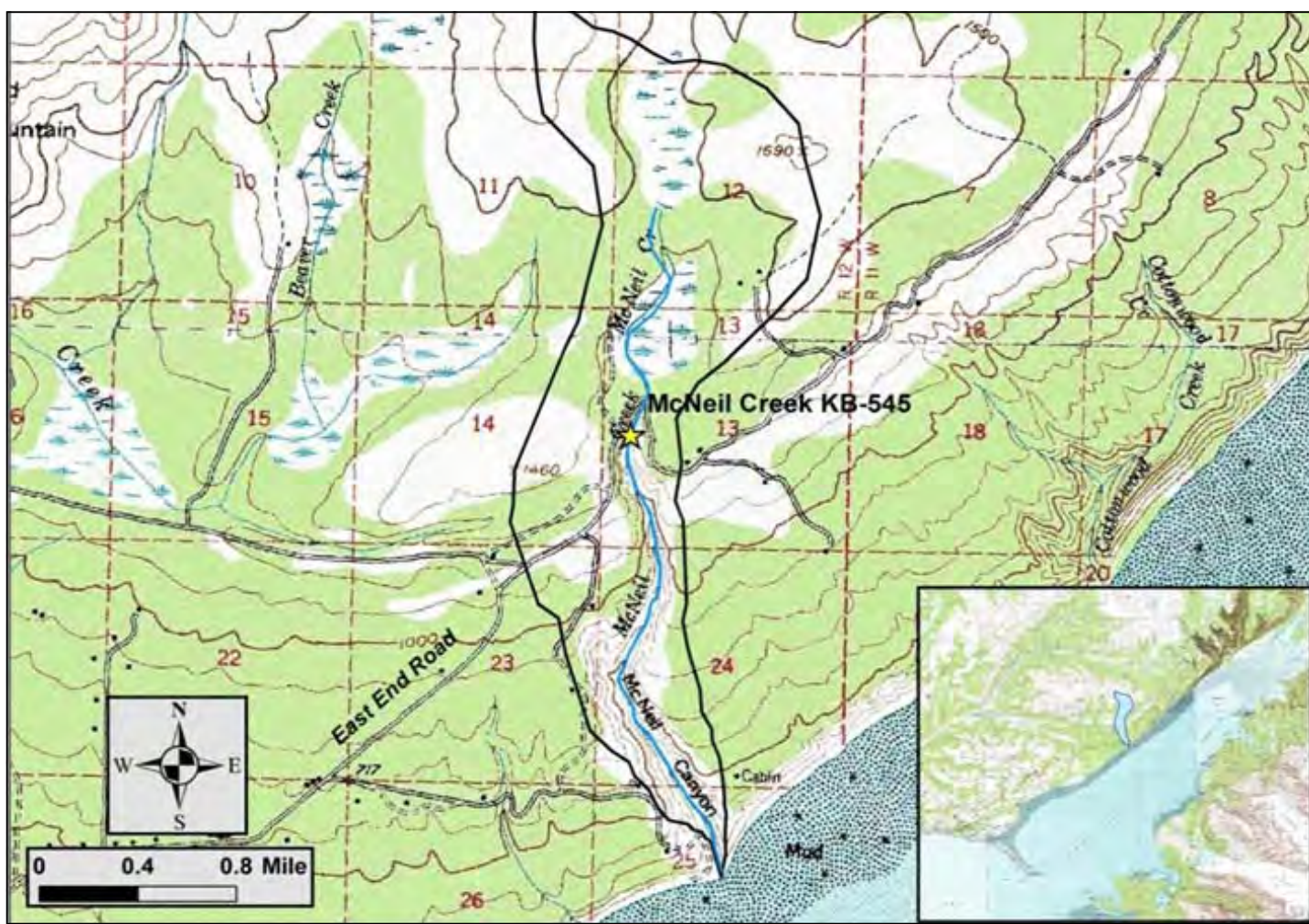
Department of Environmental Conservation Alaska Statewide Water Quality Standards 18AAC 70					
Water Use	Water Temperature	Dissolved Oxygen	pH	Fecal Coliform Bacteria (FC)	Turbidity
Water Supply: drinking, culinary, and food processing	May not exceed 15°C	Dissolved Oxygen (DO) must be > or = 4.0 mg/l	May not be < 6.0 or > 8.5	In a 30-day period, the geometric mean may not exceed 20 FC/100 ml, and not more than 10% of the samples may exceed 40 FC/100 ml	Not to exceed 5 NTU above natural conditions when the turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU
Water Supply: Growth and propagation of fish, shellfish, aquatic life, and wildlife	May not exceed 20°C. May not exceed where applicable: Fish migration routes: 15°C Fish spawning areas: 13°C Fish rearing areas: 15°C Egg & fry incubation: 13°C	DO must be > or = 7.0 mg/l. The concentration of DO may not exceed 110% of saturation in any samples collected	May not be < 6.5 or > 8.5	Not applicable	Not to exceed 25 NTU above natural conditions
Water recreation: contact recreation (freshwater)	May not exceed 30°C	DO must be > or = 4.0 mg/l	May not be < 6.5 or > 8.5	In a 30-day period, the geometric mean may not exceed 100 FC/100 ml, and not more than one sample, or more than 10% of the samples if there are more than 10 samples, may exceed 200 FC/100 ml	Not to exceed 5 NTU above natural conditions when the turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU



## McNEIL CREEK: OVERVIEW

The McNeil Creek watershed drains approximately 2.3 square miles (15,500 acres) directly into Kachemak Bay. The creek runs under East End Road, just past the McNeil Canyon Elementary School. Monitoring for McNeil Creek began in 1997 with a partnership between Cook Inletkeeper and the University of Alaska Anchorage Environmental and Natural Resource Institute (UAA ENRI) as part of a regional Cook Inlet water quality assessment. Since the upper reaches of the McNeil Creek watershed were relatively undeveloped, a site on the upstream side of the East End Road culvert was chosen as a study control for sampling. CEMP monitoring began in

2000 and continued until late 2009. From 2000 to 2006, data were collected upstream of East End Road, just above the culvert. Beginning in late 2006, the site was moved to just below East End Road, just downstream of the culvert. CEMP monitoring occurred until 2009, with a total of 81 site visits. Because of its remote location and lack of fish habitat, this site was classified as a 'low priority' for Cook Inletkeeper's CEMP. Data collected do not meet all of the goals for a complete baseline water quality dataset, however with a long and consistent timeline of monitoring we believe this dataset provides a good picture of water quality at McNeil Creek.



*McNeil Creek is located approximately 12 miles out East End Road. The inset map shows its location within the Kachemak Bay watershed. Topographic maps from the United States Geologic Survey.*



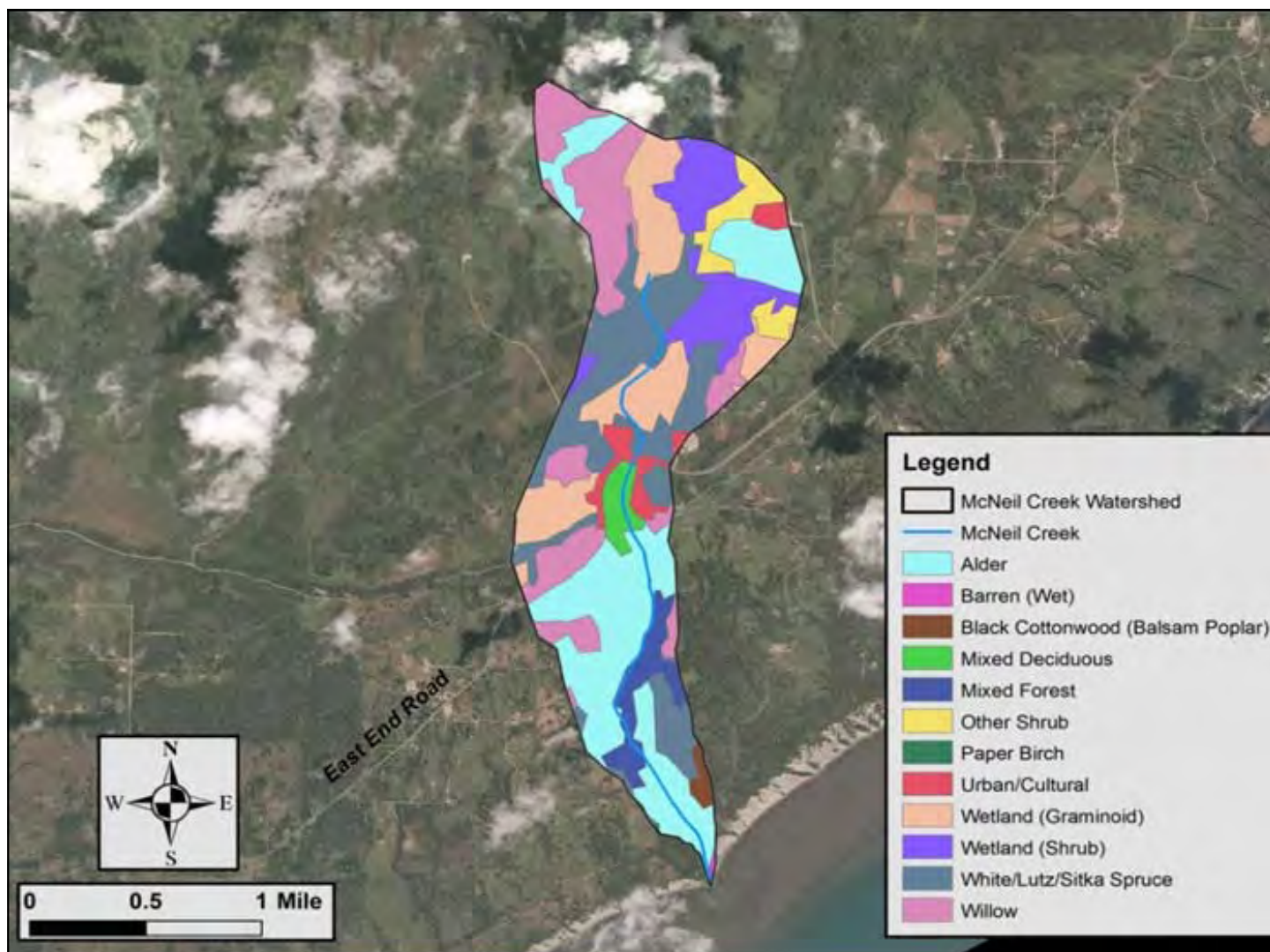
## Vegetation Types

The McNeil Creek watershed has large areas dominated by alder and spruce stands, along with areas of wetland habitat and willow. The headwaters region is mostly composed of spruce, willow, and wetland habitats, while the lower region has large areas of alder stands. There is a small region of cottonwoods in the lower reaches and small areas of mixed forest types are scattered throughout the watershed.

Developed areas are limited to the elementary

school, the Dept. of Transportation storage area, and the Kenai Peninsula Borough's solid waste transfer station. There is another small and private developed parcel in the NE section of the watershed.

Most of the upper half of the McNeil Creek watershed is wetlands, making up about 39% of the watershed. To learn more about the wetland mapping project on the Kenai Peninsula, visit: <http://www.kenaiwetlands.net/index.htm>. ❄



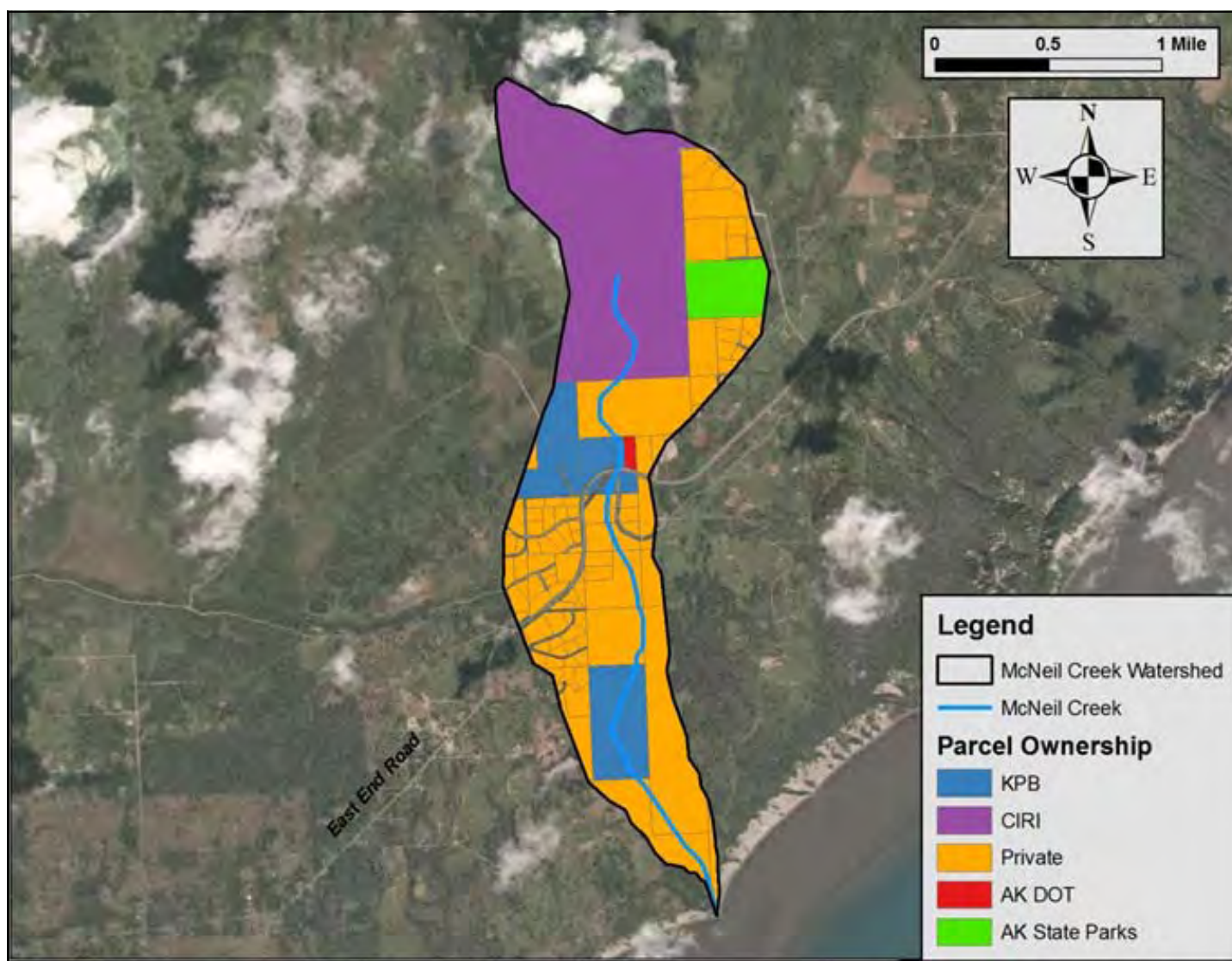
*Watershed boundary: National Resources Conservation Service Watershed Boundary Database, 2010; Basemap: ArcGIS Server Service, Quickbird 2003; Landcover: Alaska Landcover, Kenai Fish and Wildlife Service 2010.*

# McNEIL CREEK: OVERVIEW

## Land Ownership

About 50% of the 15,500 acres in the McNeil Creek watershed are privately owned, with a large mix of residential and undeveloped land parcels. Cook Inlet Region, Incorporated (CIRI) owns a large parcel in the headwaters of the watershed, covering about 34% of the entire watershed. Alaska State Parks Division makes up about 4% of the ownership with a parcel in the eastern headwaters—this is the Eveline Trail system. The Kenai Peninsula Borough (KPB) owns

approximately 12% of the land, including the McNeil Canyon Elementary School property, the solid waste transfer site, some surrounding undeveloped areas and a large parcel in the lower reaches of the watershed. The Alaska Department of Transportation (DOT) owns a small parcel just off of East End Road near the left bank of McNeil Creek. ❄



*Watershed boundary: National Resources Conservation Service Watershed Boundary Database, 2010; Basemap: ArcGIS Server Service, Quickbird satellite imagery, 2003; Ownership parcels: Kenai Peninsula Borough GIS Division, 2010*



## Invasive Species

Three invasive species have been detected and reported within the McNeil Creek watershed. The common dandelion (*Taraxacum officinale*) is a ubiquitous invasive plant throughout the state. This species was documented in the McNeil Creek watershed in 2000. Invasive species fall dandelion (*Leontodon autumnalis*) and orange hawkweed (*Hieracium aurantiacum*) have been identified and reported within the last

couple of years. Orange hawkweed was documented in 2010, and fall dandelion in 2011. Fall dandelion was observed off of Fireweed Road near the lookout, and orange hawkweed was observed at the solid waste transfer site.

For more information on Alaskan invasives, see: <http://aknhp.uaa.alaska.edu/botany/akepic> 🌱



Watershed boundary: National Resources Conservation Service Watershed Boundary Database, 2010; Basemap: ArcGIS Server Service, Quickbird satellite imagery, 2003; Invasive species: Alaska Exotic Plants Information Clearinghouse Data Portal, accessed July 2012

# McNEIL CREEK: OVERVIEW

## Human Use

The wastewater treatment system at McNeil Canyon Elementary School began to fail in 1995 and showed signs of impending failure in 2000. The effluent drains directly into McNeil Canyon, and failure would have an impact on McNeil Creek and downstream on Kachemak Bay. With this looming issue, the Kenai Peninsula Borough (KPB) awarded a contract with private wastewater treatment business BioCycle to install a new system in 2001. CEMP visits did not show any preliminary exceedences of state water quality standards for bacteria during this time;

however, after 2003 CEMP data does suggest decreased levels of *E. coli* bacteria in McNeil Creek (see page 24 for more on bacteria data at this site).

The Alaska Department of Transportation (DOT) keeps a sand pile on their small property adjacent to McNeil Creek (see McNeil Creek land ownership map on page 14). In 2001, CEMP Volunteer Willy Dunne observed sand from the pile sloughing into McNeil Canyon (see the photo on the facing page). Willy notified DOT and the pile was moved further away from the slope, silt fences were erected, and the road bank was adjusted to prevent further erosion. This issue was detected through visual inspection and familiarity with the site, as pertinent water quality CEMP data were not collected to provide quantitative results from the sedimentation. No issues in either elevated turbidity or specific conductance have been observed since. There is an identified sand pit in the northeastern corner of the watershed that, according to local residents, has been there for many years. Through our sampling we did not see evidence of impacts from this sandpit on water quality in the middle reach of the creek.

A KPB solid waste transfer site is located on Old East End Road at the corner of the intersection with East End Road. There is no direct pollution from the transfer site into McNeil Creek, but trash from this site can be found, carried by wind and birds, in the canyon and creek. In 2009 Cook Inletkeeper staff communicated with the Kenai Peninsula Borough Solid Waste Department regarding the large amounts of trash from the transfer site in McNeil Canyon. Since this time, Borough staff have increased their frequency of site visits and have worked with contractors to improve and increase garbage pick-ups. This issue is ongoing. 🌱



*McNeil Creek sewage effluent warning sign from 2001.*





Left: Department of Transportation salted sand pile with failing erosion control upstream from McNeil Creek. Photo taken on Sept. 30, 2001.

From Willy Dunne's datasheet on September 30, 2001:

*"New pile of salted sand at road at top of gully. Erosion controls failing"*

As a result of this photograph and notification by Willy, DOT moved their pile further away from the slope, better silt fences were erected, and the road bank was expanded to prevent further erosion.



Right: Photographs taken that document the overflow of trash from the transfer station at the corner of East End Road and Old East End Road. The top photograph is looking towards McNeil Canyon. Overflow trash becomes windblown or scattered by birds, ending up in the canyon and in McNeil Creek.

As a result of these and other pictures, and conversations with the Kenai Peninsula Borough Solid Waste Department, on-site contractors come on a more regular schedule to pick up trash in the surrounding area and Borough staff increased the frequency of their site visits.

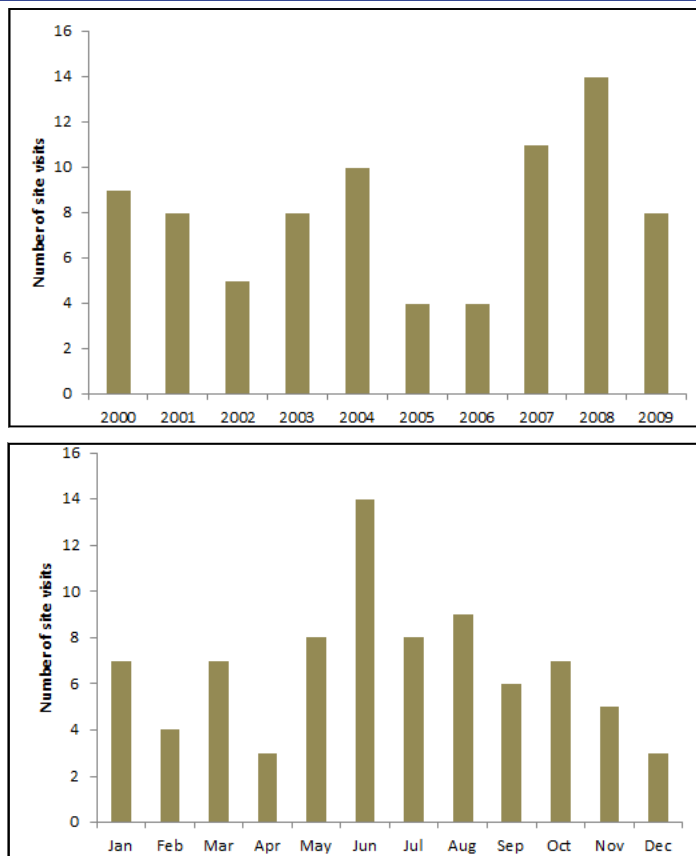




# McNEIL CREEK: VOLUNTEER MONITORS

Between 2000 and 2009, volunteer water quality monitors spent nearly 200 hours documenting baseline water quality at McNeil Creek during 81 site visits. Willy Dunne began monitoring this site on June 13, 2000 with help from Jenny Dunne. Willy and Jenny monitored McNeil Creek until February 23, 2003, respectively putting in 57 and 25 hours of monitoring. Abbey Kucera, with occasional assistance from CEMP Coordinator Dale Banks, then monitored until September 26, 2004, putting in 22 hours of monitoring time. Through 2005 and 2006 McNeil Creek was monitored primarily by CEMP Coordinators Dale Banks or Ingrid Harrauld. Scott Miller began monitoring on May 27, 2007. Scott dedicated 72 hours to monitoring at McNeil Creek, and completed the baseline water quality data collection at this site on June 28, 2009. One additional sampling visit was made by CEMP Coordinator Rachel Lord on October 27, 2009.

Thank you to Willy, Jenny, Abbey and Scott for all of their hard work and dedication over the years! 🌱



*Top: Number of site visits to McNeil Creek by year, from 2000—2009. Bottom: Number of site visits to McNeil Creek by month from 2000-2009. This dataset does not meet our baseline criteria for at least 5 years with more than 12 site visits ( $n=1$ ), and not all 12 months are represented by at least 5 site visits ( $n=9$ ). Despite this, with a long and consistent timeline of monitoring we believe this dataset provides a good picture of water quality at McNeil Creek.*



*Right: Jenny and Willy Dunne sampled McNeil Creek for three years, from 2000 to 2003.*

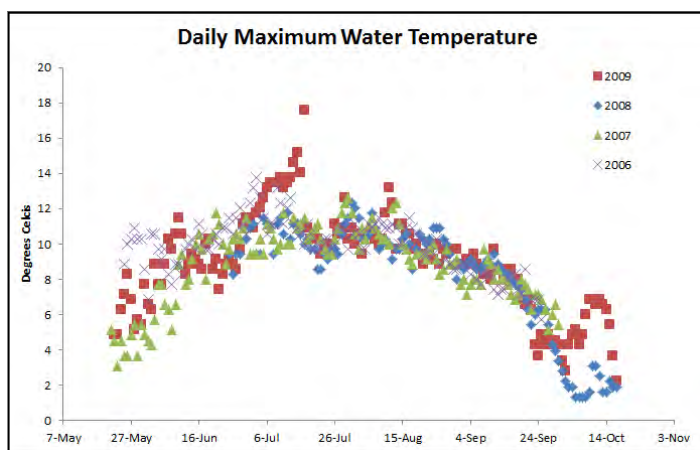
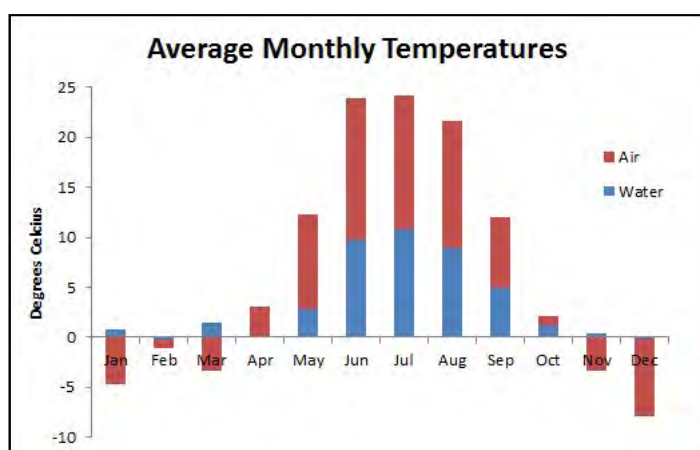
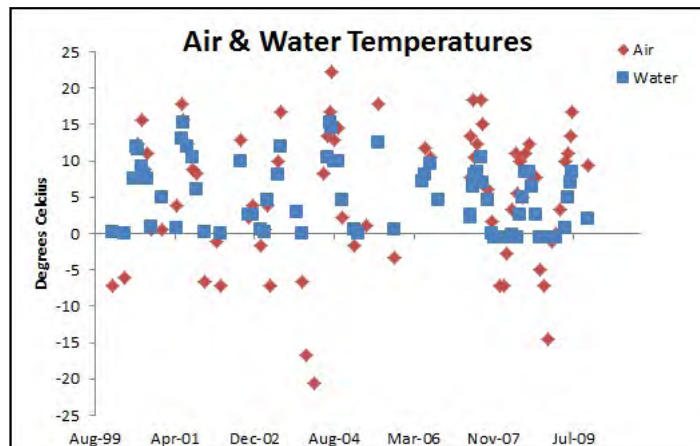
# McNEIL CREEK: TEMPERATURE

During CEMP site visits, monitors record water and air temperatures using alcohol-filled thermometers. Fish and other aquatic organisms are adapted to living within a certain temperature range. Changes in riparian (or streamside) vegetation, groundwater inputs, weather, and climate patterns can all affect water temperatures.

CEMP volunteers took 74 water temperature measurements at McNeil Creek between 2000 and 2009. The average water temperature was 5.0°C, and ranged from -0.5°C to 15.3°C. Average water temperatures were lowest during December (-0.2°C), February (-0.3°C) and April (0.1°C). The warmest average water temperatures occurred during July (10.8°C), June (9.8°C) and August (8.9°C). CEMP sampling never documented water temperatures exceeding the state water quality standard for aquatic life (20.0°C).

Air temperature was recorded during 76 site visits to McNeil Creek. Average air temperature was 5.4°C (42°F). Air temperature ranged from -0.6°C (-5°F) to 22.2°C (72°F). Air temperature was lowest during the winter months of December (-7.8°C), January (-4.7°C) and March (-3.3°C) and warmest during June (14.1°C), July (13.3°C) and August (12.7°C).

Cook Inletkeeper staff placed continuous temperature data loggers in McNeil Creek, just downstream from the CEMP sampling site, from 2006 to 2009. Data loggers were in-stream from late-May through September. In 2008 and 2009 the loggers were in place until October 17. Daily maximum temperatures indicate similar yearly trends throughout the season. 2009 and 2006 were slightly warmer than 2007 and 2008, and fall stream temperatures in 2009 rose abruptly prior to falling again during the second week of October. ❄️



Top: All water (blue) and air (red) temperatures taken with the alcohol-filled thermometers by CEMP monitors during site visits at McNeil Creek. Middle: Average water and air temperatures by month from CEMP site visits between 2000 and 2009. Bottom: Daily maximum temperatures from continuous monitoring in May through September, 2006—2009.



# McNEIL CREEK: DISSOLVED OXYGEN

CEMP monitors the levels of dissolved oxygen (DO) in our streams. Oxygen is needed by fish and other aquatic organisms to live. We measure DO using a chemical titration, and express it as a concentration of milligrams of oxygen per liter of



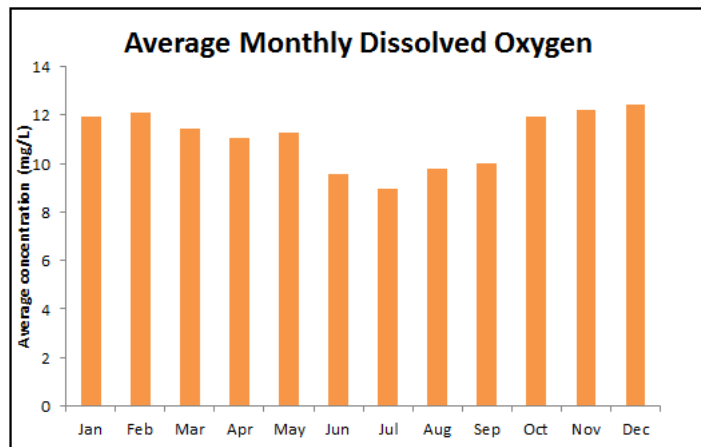
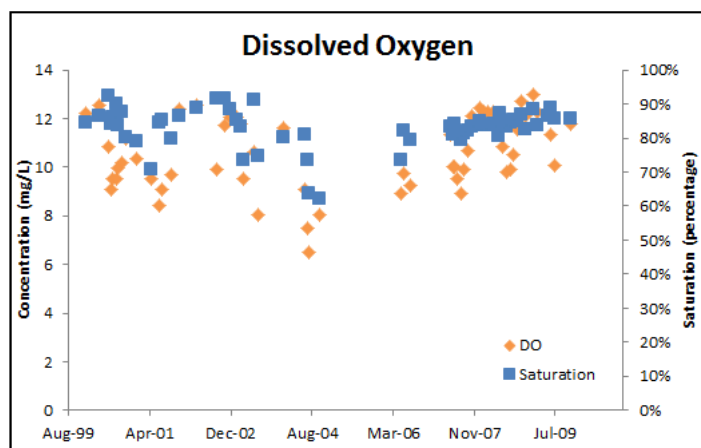
*CEMP monitors measure dissolved oxygen using the Winkler Titration. Most of the chemical reagents in their monitoring kits are for this test.*

water. The amount of oxygen that can be dissolved in water is temperature dependent; colder water can hold more oxygen. Therefore we also look at how saturated the water is with oxygen (i.e. how much oxygen does it hold compared to what it could hold at that temperature). Saturation is expressed as a percent.

Changes in dissolved oxygen can be caused by turbulence and interactions with the air (like in a waterfall), decaying plant matter, sewage, and wastewater inputs. High levels of photosynthesis and increased mixing with the air through riffles and small waterfalls could increase saturation levels above 100%, creating a condition of supersaturation.

Dissolved oxygen was successfully measured during 59 site visits to McNeil Creek. The con-

centration of DO ranged from 6.5 mg/L to 13.0 mg/L, and was 10.6 mg/L on average across all years. The lowest DO concentrations at McNeil Creek occur during the summer months of June, July and August. We see a similar trend at other local streams, with warmer summer water temperature leading to lower concentrations of DO. On July 11, 2004 McNeil Creek exceed Alaska water quality standards for supporting aquatic life with only 6.5 mg/L of DO measured. DO saturation ranged from 62% to 93%; average DO saturation was 83%. ❁



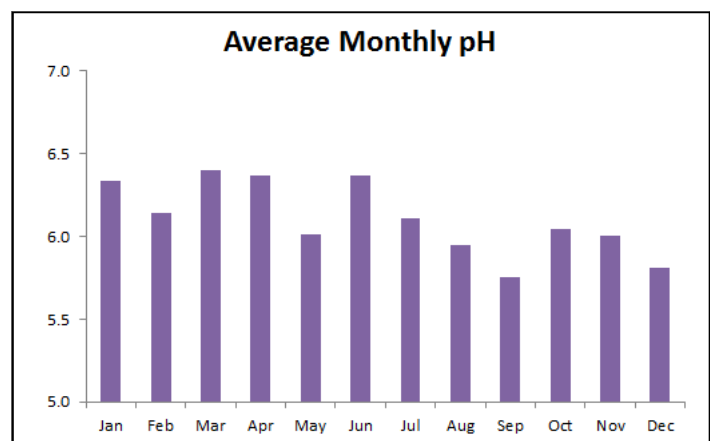
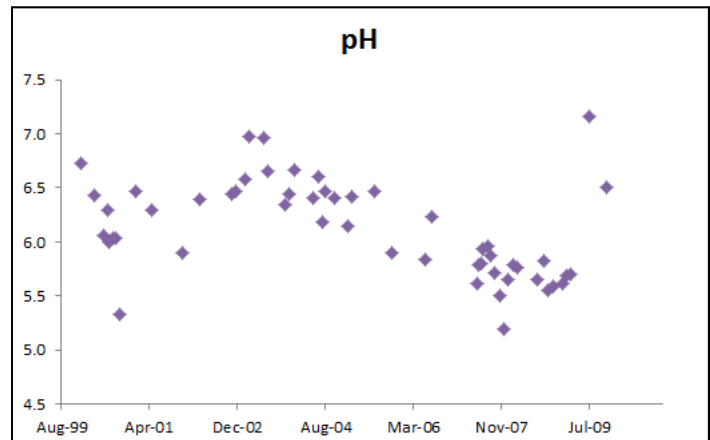
*Top: All dissolved oxygen concentration levels (mg/L, orange) and saturation (% , blue) measured by CEMP monitors during site visits at McNeil Creek from 2000 to 2009. Bottom: Average dissolved oxygen concentration levels by month from CEMP site visits between 2000 and 2009.*

## McNEIL CREEK: pH

pH is a measure of the level of activity of hydrogen atoms in the water. It is expressed on a logarithmic scale and ranges from 0 (acidic) to 14 (basic). Most streams naturally range between 6.5 to 8.0 pH units. Differences in pH can result from rain and groundwater inputs, decaying plant material, and inputs from runoff. Rain water tends to have a lower pH, ranging from 5.6 to 5.8.

pH averaged 6.1 at McNeil Creek. The range of pH values was 5.2 (in November 2007) to 7.2 (in June 2009). Monthly averages fluctuated from 5.8 in September and December to 6.4 in March, April and June. Lower pH levels were found in the winter, these winter months can see higher inputs of melted snow and rain water from upstream parking lots at the school, McNeil Canyon Elementary. Rain and snow inputs can lower pH in streams, as the average pH of rain is slightly acidic.

Over all years the pH was consistently below 7.0 at McNeil Creek. We recognize the apparent drop in pH beginning in 2007, as well the two higher readings in 2009. We have closely looked at data collected during this time. We have no reason to doubt the data collected, and the results are consistent with the more acidic pH readings taken at McNeil Creek throughout the sampling history at this site. The wetland-dominated headwaters of McNeil Creek may contribute to the lower pH, as wetlands are typically more acidic. ❁



*Top: All pH taken by the Hanna Meter (HI 98129) by CEMP monitors during site visits at McNeil Creek from 2000 to 2009. Bottom: Average pH by month from CEMP site visits between 2000 and 2009.*

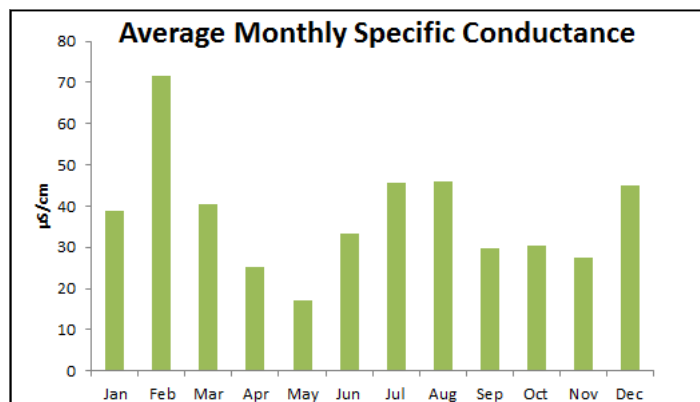
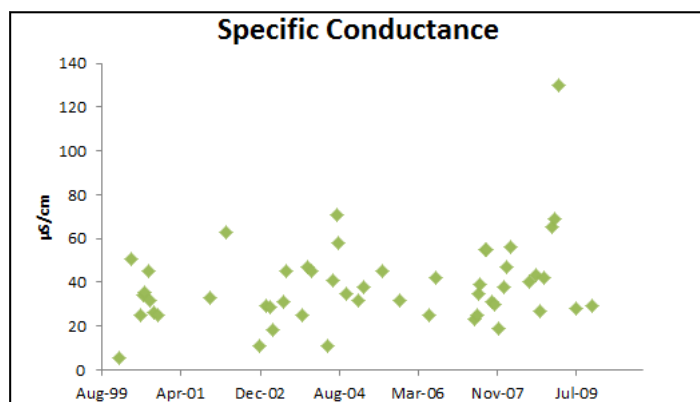


# McNEIL CREEK: SPECIFIC CONDUCTANCE

Specific conductance measures the ability of water to conduct an electrical current at a given temperature. It is recorded as micro Siemens per centimeter ( $\mu\text{S}/\text{cm}$ ). The presence of ions, or salts, in water increases the ability to conduct electricity; thus, specific conductance is a way to measure the dissolved solids in a stream. Specific conductance is influenced by groundwater (increasing conductance) and rainwater inputs (decreasing conductance) as well as road and other runoff (which tends to increase conductance).

CEMP volunteers measured specific conductance during 52 site visits to McNeil Creek. Average specific conductance was  $39 \mu\text{S}/\text{cm}$  and ranged from  $5 \mu\text{S}/\text{cm}$  to  $130 \mu\text{S}/\text{cm}$ . That maximum specific conductance level measured at McNeil Creek was on February 22, 2009. The measurement was taken through thick ice and from a very small pool of water. In such conditions, dissolved solids that increase specific conductance can be concentrated, leading to elevated levels as seen on this date.

Conductance levels across all years are similar to streams in the Anchor River watershed and more remote sites outside of the City of Homer. CEMP sites from within Homer and running off of the Homer bench (such as Woodard and Palmer Creeks) typically have specific conductance levels consistently over  $100 \mu\text{S}/\text{cm}$ . 🌱



*Top: All specific conductance data ( $\mu\text{S}/\text{cm}$ ) were taken with a Hanna Meter (HI 98129) by CEMP monitors during site visits to McNeil Creek from 2000 to 2009. Bottom: Average specific conductance ( $\mu\text{S}/\text{cm}$ ) by month from CEMP site visits between 2000 to 2009.*

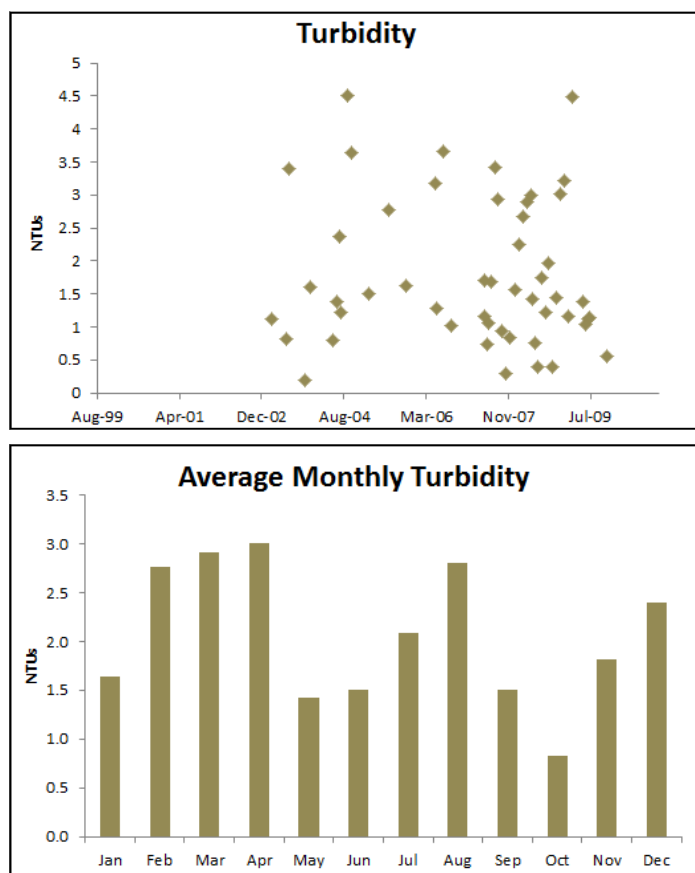
## McNEIL CREEK: TURBIDITY

Turbidity is a measure of water clarity and describes the amount of light scattered or absorbed by water. Turbidity is measured in Nephelometric Turbidity Units (NTUs). Lower NTU values correspond to clearer water. Between 1999 and 2003 CEMP volunteers measured turbidity using a turbidity column method. Starting in 2003, measurements were done by bringing samples from the field into the lab and measuring turbidity using a nephelometer. Because these two methods are not comparable, and the nephelometer is more accurate in its measurements, only these data are presented as part of this baseline dataset.

Silt, clay, organic material and colored organic compounds can all influence turbidity. Natural and human caused erosion, as well as storm water runoff can increase turbidity. Negative impacts from increased turbidity may include increased water temperatures, decreased habitat for aquatic organisms, and more opportunities for the growth of potentially harmful bacteria. The State water quality standard for turbidity is related to natural conditions. CEMP data provide valuable information to establish what the natural turbidity conditions are for McNeil Creek.

Between 2003 and 2009, CEMP volunteers took turbidity samples during 50 site visits to McNeil Creek. Turbidity averaged 1.8 NTUs, with higher levels during the months of March, April and August, when the average turbidity was 2.91, 3.01 and 2.81 NTUs respectively.

Minimum turbidity at McNeil Creek was 0.2 NTUs; turbidity was under 5 NTUs during much of the summer months of May and June, as well as during the early-winter month of October. Overall, turbidity at McNeil Creek is remarkably low, with the stream well-protected by its ripari-



*Top: All turbidity data (NTU) were collected by CEMP monitors during site visits to McNeil Creek from 2000 to 2009. Water samples for turbidity analysis are collected in the field and analyzed in the lab using a LaMotte Turbidimeter. Bottom: Average turbidity (NTU) by month from CEMP site visits between 2000 to 2009.*

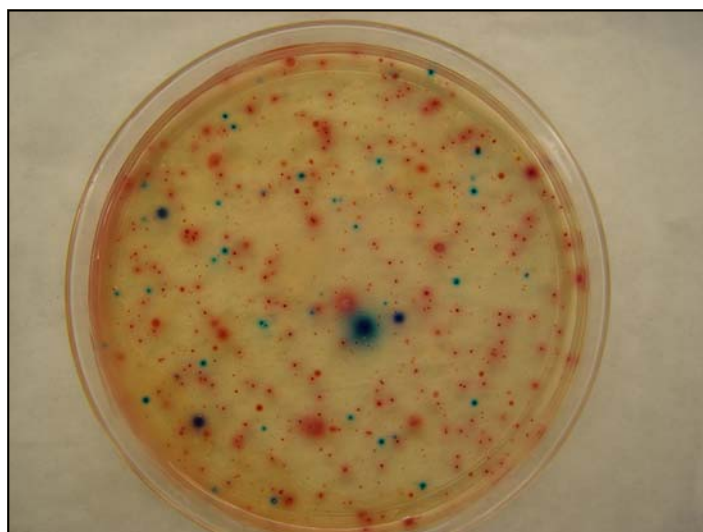
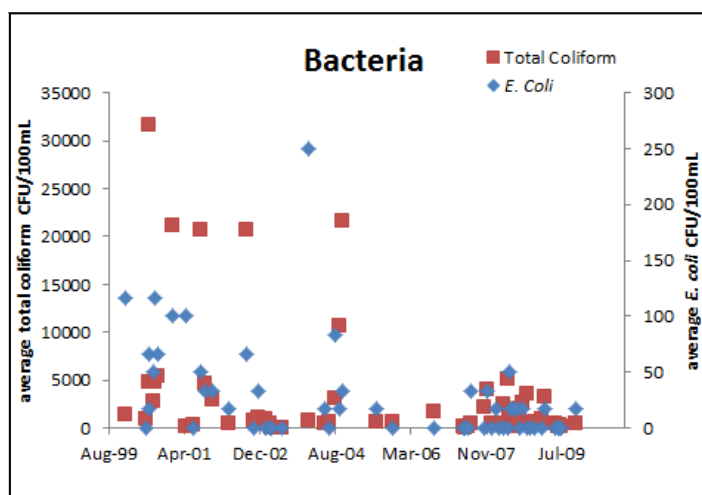
an habitat. The riparian vegetation throughout the length of the creek is intact, including through the Elementary School property upstream of the sampling site. This intact riparian zone helps to buffer the stream from increased turbidity, especially during storm events and seasonal runoff during spring break-up. 🌱



## McNEIL CREEK: BACTERIA

CEMP volunteers monitor for total coliforms and *E. coli* at all sites throughout the year. Many types of coliform bacteria are normally found in soil and water. Alaska's water quality standards are for fecal coliforms. *E. coli* is an indicator of fecal bacteria that is found in the intestines of human and other warm-blooded animals. CEMP tests reveal the number of colony forming units (CFUs) of *E. coli*, which we utilize as a preliminary indicator of fecal coliforms. In the event of a persistent exceedence through both high and low stream flows, the CEMP Coordinator would send samples to a state-certified lab in Anchorage for official fecal coliform testing. Finding *E. coli* levels that are above water quality standards may be indicative of contamination by runoff from animal waste, decaying animals, or human waste from sewage or leaking septic tanks.

CEMP monitors collected water samples for bacteria testing that were successfully plated and incubated during 57 site visits. *E. coli* colonies were detected in 27 of these samples (47%), and colony counts ranged from 17 CFUs/100mL to 250 CFUs/100mL on January 4, 2004. It is unclear what caused this elevated mid-winter bacteria level at McNeil Creek, and subsequent sampling showed reduced levels of bacteria. The septic system at McNeil Canyon Elementary School was shown to be failing in 2000, and was replaced in 2001/2002. Our bacteria data show a general decrease in *E. coli* colonies from an average of 41 CFU/100mL from 2000 to 2003, to an average of 11 CFU/100mL from 2004 to 2009. 🌱



Top: Bacteria levels at McNeil Creek from 2000-2009. *E. coli* colonies are in blue, and total coliform colonies in red. Both data sets show the average colony forming units (CFU) per 100mL. Bottom: Water samples are mixed with a bacteria-growing medium and incubated on a petri dish for 48 hours.

# McNEIL CREEK: HABITAT ASSESSMENT

On June 6, 2012, Cook Inletkeeper summer interns Kelly Barber and Greg Goforth performed a habitat assessment over a 50-meter (164 feet) reach of McNeil Creek at CEMP site KB-545.



*Top: Looking south down McNeil Canyon from East End Road. Bottom: Looking north from East End Road up McNeil Creek. (June 6, 2012)*

The 'Stream Walk' habitat assessment is performed to provide the community with a snapshot of the physical environment surrounding a CEMP sampling site. This physical assessment compliments the chemical monitoring done by volunteers. Stream Walks can be incorporated

into future monitoring plans on a regular basis and can provide qualitative information on the surrounding stream habitat in a cost- and time-effective manner.

The upstream boundary of the reach began at the CEMP site, located just after the outflow of the culvert at East End Road, and continued 50-meters downstream, following the curves of the creek. The stream was estimated at 90% bank full, with clear water. Bed composition was split between boulders and cobbles (50 and 40%, respectively), with some gravel (10%) dispersed along the reach. Stream width ranged from 3.1 to 9.8 feet, with an average width of 7.4 feet. Stream depth ranged from 0.5 feet to 1.25 feet, with an average depth of 0.67 feet.

Bank stability along the reach was rated as 'stable' for both banks. Though the reach area is bounded by East End Road and Old East End Road, the riparian zone extended to over 60 feet up both banks. Riparian vegetation was composed mostly of willow and grasses, with several spruce trees. The impact of the spruce bark beetle was apparent, as the area was littered with fallen spruce trees and several standing dead. The downstream end of the culvert under East End Road appeared to be in good condition.

The stream reach is located within a Kenai Peninsula Borough parcel. The entirety of McNeil Creek, within a 60ft buffer along the left and right banks, is classified as undeveloped and unprotected. Human use was not detected apart from some felled spruce trees and escaped trash from the transfer site on Old East End Road (see photo on page 6). The steep slope down to the reach is a likely deterrent. 🌲



# McNEIL CREEK: FUTURE MONITORING

Through CEMP, volunteers monitored McNeil Creek from 2000 to 2009. This baseline report summarizes the chemical and physical data collected at McNeil Creek over these years. Our monitoring efforts have shown overall high water quality at this stream. Turbidity was notably low for creeks in this area, consistently below 5 NTUs across all seasons and years of sampling.

The discovery of the Alaska Dept. of Transportation's salted sand pile too close to the stream-bank is a great example of the value of citizen monitoring and the importance of active hands-on stewardship by members of the community.

## Future monitoring recommendations

- Habitat assessments and photo point monitoring should occur every other year, as close to the same date each time as possible. If change is occurring more rapidly at the site, assessments should be more frequent.
- During future site visits, a culvert assessment for the culvert under East End Road should be made to monitor for any damage, blockages or other evident issues.
- GIS analysis on impervious cover in the watershed should be performed when new satellite imagery becomes available.
- If there is substantial development or increases in impervious cover in the watershed, consider landowner outreach to maintain riparian habitat and ensure continued high water quality.



*Top: Springtime high flow at the downstream CEMP site, below the East End Road culvert. This photo was taken on May 11, 2008. Bottom: The same site during summertime low flow at the McNeil Creek CEMP site downstream of East End Road. This photo was taken on August 10, 2008. Both pictures were taken by CEMP volunteer Scott Miller.*

## ACKNOWLEDGEMENTS

Many thanks go out to Willy, Jenny, Abbey and Scott, as well as to the other 300+ CEMP volunteers throughout the years! Without their dedication and continued support, we would be unable to do this work. They have taken time to attend training sessions, yearly recertifications, and have gone into the field in all weather conditions to collect these water quality data. We would like to thank Joel Cooper, whose invaluable insight and previous involvement with CEMP helped to piece together some of the CEMP history with McNeil Creek.

Cook Inletkeeper would like to especially thank Dan Bogan of the University of Alaska Anchorage's Environment and Natural Resources Institute for his ongoing support and training. Dan has volunteered many hours to CEMP and the CEMP Partnership—our program is stronger and the data are better because of his time and efforts.

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## Thank You Volunteers!

