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Alaska Section
AMERICAN WATER RESOURCES ASSOCIATION

2013 American Water Resources Association-Alaska Section Annual Conference

March 4-7, 2013
B P Energy Center
Anchorage Alaska

Conference Sponsors:

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Conference Schedule

Monday March 3, 2013			
9:00 AM	***WELTS workshop***		
12:00 PM	**LUNCH (on your own)**		
1:00 PM	Welcome - Terry		
Session 1: Alaskan water data overview and legislative update (T. Schwarz)			
1:10 PM	David Schade	ADNR/MLW	2013 Review of Water Resources Related Legislation
1:30 AM	Jeff Conaway	U.S. Geological Survey	An overview of the U.S. Geological Survey stream gaging program in Alaska
1:50 PM	Jessica Cherry	UAF/IARC/WERC	The Impacts of Historical Observational Network Coverage on Our Understanding of Arctic Hydrology and Climate
2:10 AM	Christopher Estes	Chalk Board Enterprises	A Cost Effective Solution to Improve and Facilitate Local, State, and Federal Permitting Processes and Achieve Better Short- and Long-term Natural Resources Management Decisions and Associated Socioeconomic Benefits
2:30 PM	**BREAK**		
Session 2: Water Quality (L. Lynn)			
3:00 PM	Rebecca Shaftel	University of Alaska Anchorage	Persistence and stability of macroinvertebrates and diatoms in two regions of Alaska
3:20 PM	Allen Bondurant	University of Alaska Fairbanks	Lake ice blocks as time lapse evidence of methane ebullition events
3:40 PM	Abhijit Chatterjee	University of Alaska Fairbanks	Dynamic biosorption of Cd onto immobilized orange peels in packed bed columns: Prediction of breakthrough curves by the constant pattern model
4:00 PM	***POSTER SESSION (snacks provided)***		

Tuesday March 5, 2013			
Session 3: Hydropower/Susitna Watana (T. Schwarz)			
9:00 AM	Michael Lilly	GW Scientific	An Overview of the 2012 Susitna River Surface-Water Hydrology Program in Support of Susistna-Watana Hydroelectric Evaluations.
9:20 AM	Anna Liljedahl	UAF/IARC/WERC	Susitna-Watana Hydroelectric Project: Hydrologic modeling and field measurements of the upper Susitna basin
9:40 AM	Dudley Riser	R2 Resource Consultants	Integrated Resource Approach to Susitna-Watana Hydro

10:00 AM	**BREAK**		
Session 4: Hydropower/ Instrumentation (T. Schwarz)			
10:30 AM	Patrick J. Driscoll, PE	Doyon Utilities, Inc	History, use, renovation and rehabilitation and assessment for hydroelectric generation of Ship Creek Dam
10:50 AM	Michael Lilly	GW Scientific	Winter Hydrology Characteristics of the Kogoluktuk River and Nearby Streams to Support Hydropower Evaluations for Local Villages
11:10 AM	Bill Mann	In-Situ	Design and Measurement Differences of Absolute and Gauged Water Level Sensors
11:30 AM	Dirk Baker	Campbell Scientific	Updates from Campbell Scientific
12:00 PM	**LUNCH (on your own)**		
Session 5: North Slope Hydrology (M. Lilly)			
1:00 PM	Marielle Remillard	GW Scientific	Past and Present Active Layer Temperature and Unfrozen Moisture Content Profiles Related to Winter Tundra Travel on the North Slope, Alaska
1:20 PM	Nathan Stephan	UAF/IARC/WERC	Dye Tracers for Characterizing Breakup in Arctic Rivers: An Old School Solution for a Modern Conundrum
1:40 PM	Joshua Koch	USGS	Morphology-dependent water budgets and nutrient cycling in ponds near the Chipp River, Arctic Coastal Plain, Alaska
2:00 PM	Ann Olsson	University of Alaska Fairbanks	Wildfire and permafrost: Post-fire changes in flowpaths of water
2:20 AM	Michael Lilly	GW Scientific	Long-Term Trends in Water Use of Arctic Lakes and Reservoirs
2:40 PM	**BREAK**		
Session 6: Groundwater (M. Hill)			
3:00 PM	James A. Munter	J. A. Munter Consulting, Inc.	Nitrates in Well Water on the Anchorage Hillside
3:20 PM	Melissa E. Hill	Alaska Hydrologic Survey, DNR	Shallow groundwater in the Matanuska-Susitna Valley, Alaska: Conceptualization and Simulation of Flow
3:40 PM	Chas Jones	University of Alaska Fairbanks	Can groundwater springs control river ice thickness?
4:00 PM	Michelle L. Barnes	UAF/WERC	Macrodispersion of Groundwater Contaminants in Discontinuous Permafrost
4:20 PM	Wayne Westberg	MW Drilling	Groundwater Well Drilling 101

Wednesday March 6, 2013			
Session 7: Surface Water 1 (A. Liljedahl)			
9:00 AM	Emily Youcha	UAF/WERC	The Hydrology of Rivers Draining the Central Brooks Range, Alaska
9:20 AM	Terry Schwarz	AHS/MLW/ DNR	Physical Susceptibility of Navigable Waters
9:40 AM	Becci Anderson	USGS	National Hydrography Dataset in Alaska: an Update
10:00 AM	J. Brock Freyer	UNCC/3PPI	Braided River Management: observations from Pool 6 of the Upper Mississippi River System
10:20 AM	**BREAK**		
Session 8: Surface Water Hydrology/Flood Hazards (A. Liljedahl)			
10:40 AM	Janet Curran	USGS	Updates to geospatial site information and basin characteristics for Alaska's USGS stream gages
11:00 AM	Celine van Breukelen	NWS/NOAA	Flood Inundation Mapping of the Lower Kenai River using HEC-RAS
11:20 AM	Katrina E. Bennett	UAF IARC/WERC	Historical changes and future projections of extreme hydro-climate streamflow events in Interior Alaskan watersheds using trends, extreme value analysis and the ClimdEx archive
11:40 AM	Jennifer Davis	UAF	Assessment of Flood Hazard Potential in the Valdez Glacier Watershed in Future Climate
12:00 PM	**AWRA-AK Membership meeting (Lunch provided)**		
Session 9: Stream Restoration and Protection I (W. Rice)			
1:00 PM	Bill Spencer	HDR Inc.	Fish at Zoo: Passage Restoration on Little Campbell Creek
1:20 PM	Richard Pribyl	DOWL HKM	Challenges of Fish Passage Design in Gustavus, Alaska
1:40 PM	Tim Terry	Shannon and Wilson	Vander Court Stream Restoration
2:00 PM	Dan Billman	HDR Inc.	Little Campbell Creek Box Culverts
2:20 PM	William Rice	USFWS	Perspectives of Stream Restoration in South Central Alaska and Beyond
2:40 PM	**BREAK**		
Session 10:Stream Restoration and Protection II (W. Rice)			
3:00 PM	Chandra McGee	DEC	Community Watershed Planning in Interior Alaska
3:20 PM	Branden Bornemann	Kenai Watershed Forum	Anchor River Restoration
3:40 PM	Harold Shepard	Laoch Consulting	Setting up Watershed Councils for Resource Protection
4:00 PM	Closing of conference		

Abstracts

Session 1: Alaskan water data overview and legislative update

Monday March 4 1:30-2:40

2013 Review of Water Resources Related Legislation

David Schade[1], david.w.schade@alaska.gov
[1] ADNR/MLW

Currently the Alaska Legislature is considering a number of bills that may have impacts on the use of water resources within the state: House Bill 77 (and the companion bill SB26) Act relating to the Alaska Land Act, including certain authorizations, contracts, leases, permits, or other disposals of state land, resources, property, or interests; relating to authorization for the use of state land by general permit; relating to exchange of state land; relating to procedures for certain administrative appeals and requests for reconsideration to the commissioner of natural resources; relating to the Alaska Water Use Act; and providing for an effective date." This bill proposes several changes to the Alaska Water Use AS 46.15, including reservation of water, bulk water export, and the review and appeal processes. SB27 (and the companion HB78), "An Act establishing authority for the state to evaluate and seek primacy for administering the regulatory program for dredge and fill activities allowed to individual states under federal law and relating to the authority; and providing for an effective date." This bill authorizes a takeover administration of some activities regulated under Section 404 of the Clean Water Act. Senate Bill 32 "An Act stating that the development and operation of a hydroelectric site at Chikuminuk Lake is not an incompatible use in the Wood-Tikchik State Park." This bill would allow the study of and operation of a hydroelectric site at Chikuminuk Lake. An overview of these and other bills with water resource management implications will be highlighted and discussed.

An overview of the U.S. Geological Survey stream gaging program in Alaska

Jeff Conaway[1]**,** jconaway@usgs.gov
[1]U.S. Geological Survey

The U.S. Geological Survey Alaska Science Center operated a network of 122 streamflow gages and 47 crest-stage gages in Alaska during the 2012 water year. The network is dynamic and fluctuates annually based on cooperator data needs and federal funding levels. The overall number of active streamflow gages decreased from the previous water year: ten gages were discontinued and seven gages were added. Funding for the network is split between federally appropriated dollars and funding from 16 different federal, state, borough, and native corporations. The basic piece of data collected at each site is stage, which is converted to discharge using a stage-discharge relationship for the site. Additional environmental parameters such as water temperature, air temperature, and precipitation are also collected at some sites. Data from active stations, as well as from discontinued stations, are stored in a publically accessible database. Daily data are accessible for 506 stations and the annual maximum flows are available for 667 stations. Data can be queried by site name, number, hydrologic unit code, and location or can be accessed graphically with the National Water Information System Mapper (maps.waterdata.usgs.gov). The length of record for gages in Alaska ranges from a single open-water season to 94 years with the average being 13 years of daily discharge data. WaterWatch (waterwatch.usgs.gov) is a tool for viewing the real-time and historic streamflow conditions. WaterWatch uses streamgage-based maps to show current streamflow conditions compared to historical conditions for sites with 30 years or more of quality assured and approved streamflow data. WaterWatch tools for visualizing and analyzing data include streamflow-duration hydrographs, basic summary statistics for individual stations or geographic areas, stage-discharge rating curves, flood and drought maps, and comparison maps of historical streamflow.

The Impacts of Historical Observational Network Coverage on Our Understanding of Arctic Hydrology and Climate

Jessica Cherry[1,2,3] jcherry@iarc.uaf.edu
A. Jacobs[2]
[1]University of Alaska Fairbanks,
[2]International Arctic Research Center
[3]Water and Environmental Research Center

The Arctic Landscape Conservation Cooperative commissioned the authors to construct a database of historical hydro-climate measurements and then use it to analyze the coverage of the current observational network. This database-called Imiq, the Inupiat Eskimo word for freshwater—was used in turn to study the impacts of network coverage on our state of knowledge about the climate in arctic Alaska. Some of these datasets date back to 1900 and long-term trends are calculated for temperature, precipitation, river discharge, and other variables. The magnitude, and in some cases the direction, of these trends is highly dependent on which stations were operating in the network at any given time. While the Imiq database provides new accessibility to several very long- term data records, the results of the analysis are a cautionary note on the use of disparate station data for trend detection.

A Cost Effective Solution to Improve and Facilitate Local, State, and Federal Permitting Processes and Achieve Better Short- and Long-term Natural Resources Management Decisions and Associated Socioeconomic Benefits

Christopher Estes[1], christopher@chalkboardllc.com
[1]Chalk Board Enterprises LLC

We opened the meeting reviewing the status, use, and importance of hydrologic data required for achieving cost effective and wise natural resource management, conservation, development and research as it relates to present and future Alaskans: what data are needed and examples of actions underway to address data gaps and needs. This presentation will review highlights from those discussions, subsequent follow-up actions, and make the argument for increased state, federal, industrial, academic, tribal and other private investments in strategic hydrologic data collection and reporting to improve and facilitate local, state, and federal permitting processes. It will be explained why and how this investment will benefit all Alaska's water users and result in better natural resources management decision and contribute to socioeconomic benefits for all Alaskans. . ,Alaska's vast surface and subsurface water resources provide a variety of essential purposes and benefits by supporting water demands for human consumption, environmental, industrial and other uses. Natural resource management, conservation, and water related development decisions and research are all dependent on the acquisition and analyses of sufficient amounts of geographic based, site specific and regional hydrologic data such as precipitation, river flows in lotic (flowing water environments), groundwater availability from subsurface locations, and water level and volumes in lake/reservoir type (lentic) water sources on a year-round basis (open water and ice covered seasons). Adequate amounts of hydrologic data are required to contribute to the overall socioeconomic well-being of Alaskans. Alaskans can proudly boast Alaska represents ~20% of the nation's land area, ~50% of the nation's coastline, and ~40% of the nation's flowing surface waters. Alaskans can also brag the current quality and availability of Alaska water sources and usages differ significantly from the majority of other locations in the United States and other countries. For example, less than 1% of Alaska's water bodies have been modified. Despite our unique status, the ability to make better short and long-term water use decisions is limited because less than 1% of Alaska's water bodies have site specific flow and water level data collected specific those water bodies. And, most don't have water quality information corresponding to changes in seasonal flow variability and climatic conditions. The challenges and arguments for expending additional resources required to improve flow and water level data collection to facilitate and benefit permitting will be the primary focus of this presentation. Present and projected water management uses and issues in Alaska are typically associated with the impact of increased demand and competition for water use associated with human population growth, energy production, recreation, industrial growth, and maintenance of fish and wildlife and other natural resources. Another growing use of water is based on demands by other parts of the country and planet to import water of good quality from Alaska (water export from Alaska). For the short-term Alaskans are fortunate because the majority of most of existing Alaskan water bodies that have been altered and used for supply water have been capable of supporting the majority of present competing water demands for various human needs and at the same time to sustain fish and wildlife production and other ecological functions. On the other hand, the steady increase in the growth of competing water uses associated with the desire to increase water demands to support natural resource and energy developments and support socioeconomic growth should encourage Alaskans to closely evaluate the adequacy and availability of hydrologic and other water related information needed to make water allocation decisions that effectively balance and serve all competing water demands in the best public interest. Last year we observed there are a variety of insufficient site specific and regional hydrologic data gaps, especially a dearth of significant data required to document baseline historical seasonal water availability of surface and subsurface water supplies in most locations throughout Alaska. Regardless of their intended purposes for using water, 2012 AWRA presenters (water managers, other stakeholders, and competing water users) agreed that not knowing how much water naturally exists within a water supply source at any given time of the year (and not being able to project how water availability changes over multiple years during wet and dry periods) can result in inadvertent errors in determining and predicting how much water can or should be removed and left within rivers, lakes, and wells in the overall best public interest. Natural resource management decisions based on inadequate hydrologic can hamper natural resource development, industrial and population growth and result in long and costly permit delays. Water allocation decisions based on limited hydrologic data can also be detrimental to fish and wildlife, recreations and other types of socioeconomic benefits. Similarly, costs associated with the time and equipment and measurements required to collect one to five years of essential continuous hydrologic data needed to better inform a water allocation or reservation of water use permit decision by the Alaska Department of Natural Resources and other government entities is steep. Even if permits weren't required, adequate hydrologic data are required to plan the proper location and scale of a private or commercial development that will be water dependent. An assessment of economic viability is also dependent on adequate water availability data. Last year, it was explained that some equate Alaska's current stage of water availability knowledge and uses with that experienced by the western United States approximately 170 years ago. Completion for water hydrologic information was extremely limited and over time has unfortunately resulted in expensive and long-term efforts to meet human and other water demands in part because water use decisions were based on inadequate data and limited comprehension how to balance water uses and needs. Unfortunately past water management actions and policies implemented in the lower 48 states over the past 100 years ultimately resulted in over-appropriation (over allocation) of water from most surface-water bodies. That means more water was allocated for diversions, withdrawals, and impoundments versus amounts of water needed and retained within rivers and lakes to sustain all types of water uses including human consumption, industrialization, and fish and wildlife habitat and other ecological processes and services. These are all situations that Alaskans have an opportunity to avoid and it's in their best socioeconomic interest to do so. In summary, this discussion will focus on local, regional and statewide permitting process and other socioeconomic benefits that can be achieved by expanding the expenditure of state and private resources to strategically collect long-term surface and subsurface hydrologic data and other components associated with the hydrologic cycle.

Session 2: Water Quality
Monday March 4, 3:00-4:00

Persistence and stability of macroinvertebrates and diatoms in two regions of Alaska

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Dan Rinella[1], Dan Bogan[1]
[1]University of Alaska Anchorage

We compared the interannual persistence and stability of lotic macroinvertebrate and diatom assemblages in two regions of Alaska, U.S.A. Comparisons were based on 3 streams in the interior and 5 streams in the Bristol Bay region sampled during overlapping four-year periods (2007-2010 and 2008-2011, respectively). We calculated persistence as between-year Jaccard similarity, which captures taxa presence, and we calculated stability as between-year Bray-Curtis distance, which captures community composition (taxa presence and abundance). In both regions, diatoms exhibited higher interannual stability and persistence than did macroinvertebrates. Streams in the interior had lower mean stability and persistence than those in the Bristol Bay region. This pattern may be due to the cold winters and greater disturbance associated with ice breakup in the interior's continental climate zone relative to Bristol Bay's more moderate transitional climate zone. Persistence and stability have important implications for establishing baseline conditions and detecting the effects of climate change and watershed development on stream communities, such as in salmon streams of the Bristol Bay region where large-scale mineral deposits are under exploration.

Lake ice blocks as time lapse evidence of methane ebullition events

Allen Bondurant*[1]*, acbondurant@alaska.edu
Katey Walter Anthony[1]
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Methane bubbles originating from decomposition of organic matter in lake bottom sediments are trapped by lake ice cover in winter and become enclosed within the ice as the ice thickens downward. Repeated bubbling from discrete locations results in bubbles stacking vertically in the lake ice column. Because of the discrete nature of these methane ebullition seeps, it is possible to cut a block of ice from the lake and observe the pockets of gas layered through time as the ice grows through the winter season. By keeping track of the ice growth rate, we are able to use ice blocks as time lapse evidence to estimate the timing of ebullition events and relate them to environmental factors such as changes in atmospheric pressure and temperature. When pressure drops, the stress on conduits connected to free-phase gas in lake sediments is increased as gas expands, until a point where the expanding gas bubbles break out, flowing to the sediment surface through bubble tubes. These relatively large expulsions of gas driven by atmospheric pressure drops are recorded as big bubble pockets in the surface lake ice. During periods of high pressure, relatively few bubbles are released from sediments to lake ice, resulting in bubble-poor or bubble-free layers in lake ice. We compare careful estimates of the accumulation of gas volume over time in the ice blocks to data sets of bubbling recorded by automated flux traps installed beneath the ice. These automated traps include a tipping apparatus that registers a time event after a known volume of gas passes through the trap. We also relate seasonal patterns of seep bubbling rates recorded by ice blocks (winter months) and bubble-trap data loggers (year-round) to temperature fluctuations in order to explain observations of higher bubble fluxes in summer and lower bubble fluxes in winter. Use of these methods together allows for higher accuracy in estimating total and seasonal methane production.

Dynamic biosorption of Cd onto immobilized orange peels in packed bed columns: Prediction of breakthrough curves by the constant pattern model

Abhijit Chatterjee [1]**,** achatterjee@alaska.edu
Silke Schiewer[1]
[1]University of Alaska Fairbanks

Mining is a major economic activity in Alaska. Mining wastewater may cause surface and groundwater contamination if not treated properly. Since metals are toxic even at low concentration, conventional waste treatment methods (chemical precipitation, membrane filtration) become either expensive or fail to meet discharge criteria for metal-contaminated water. Biosorption, i.e., passive uptake of metals by biomass, is a cost-effective alternative. Past research showed that orange peels waste obtained from fruit processing industries can be used to remove cadmium from synthetic and real mining effluent in a packed bed column. It was also found that raw peels can be immobilized in alginate to form a better defined material with increased mechanical strength and higher uptake capacity. To contribute towards an eventual commercialization of biosorption, this study focuses on predictive mechanistic modeling of breakthrough curves (Cd concentration in treated effluent vs. time). The corresponding model parameters (external (kf) and intra-particle (ks) mass transfer coefficients) are essential for industrial scale-up. Fixed-bed experiments were conducted using alginate immobilized orange peels by varying influent Cd concentration (C0) (5-12 mg/L) and bed height (L) (40-54 cm) at a constant flow rate of 2 ml/min. breakthrough and saturation times decreased with increase in C0 and decrease in L. Uptake at equilibrium (saturation) varied within a limited range (55 to 68 mg/g). The model assumed that a stable mass transfer zone was established within the column (‘constant pattern’ behavior) and that the Langmuir isotherm is valid at the liquid/solid interface. The ks optimized from one fixed-bed experiment (0.004 cm/min) was used for the prediction of breakthrough curves obtained from other experiments. The kf was estimated from an engineering correlation which was a function of Reynolds number, Sherwood number and Schmidt number.

Session 3: Hydropower/ Susitna-Watana Project
Tuesday March 5, 9:00-10:00

An Overview of the 2012 Susitna River Surface-Water Hydrology Program in Support of Susistna-Watana Hydroelectric Evaluations

***Michael Lilly*[1], mlilly@gwscientific.com**
David Brailey[2], Stuart Beck[3]
[1]GW Scientific, [2]Brailey Hydrologic, [3]R2 Resource Consultants

An intensive campaign of comprehensive hydrologic data collection was initiated in the Susitna River basin in the spring of 2012. This effort was performed to support the multi-year Susitna environmental and engineering feasibility studies required for Federal Energy Commission Licensing of the proposed Susitna-Watana hydroelectric project.

The comprehensive series of field campaigns consisted of measuring bathymetric cross sections with discharge, water level and slope measurements, and continuous water level and water temperature monitoring stations with remote data telemetry access. These cross section and discharge measurements were primarily located within the middle river study segment from approximately project river mile 80 (about eight miles downstream of Parks Highway Bridge) upstream to river mile 187 (the proposed Watana Dam location). The establishment of the surface water hydrologic network was designed to support a wide array of summer (ice-free) and winter (ice-cover) river flow routing models (such as HEC-RAS) for simulating unsteady water-surface elevations, instream flow and water level assessments, fisheries studies, and many other hydrologic and natural resource evaluations associated with the current project assessment. The data network will help characterize the Susitna River hydrology processes for summer, winter and the fall and spring transition periods.

Using a Sontek M9 acoustic Doppler current profiler (ADCP), 214 discharges were measured between June and October at 89 cross sections to characterize a range of flow conditions. 178 loop moving-bed tests were performed to quantify discharge during both stationary and moving-bed conditions. Eleven gaging stations and two water-level stations were installed to measure water-levels, water temperature, air temperature, and collect hourly images of river conditions. Gaging stations were included in the discharge measurement program to develop rating curves for each station. Stations transmit data and images hourly through a radio telemetry network.

The Susitna-Watana surface water hydrologic network data-collection programs will also contribute to improving the understanding of winter flow and ice conditions associated with the winter aquatic habitat environment. Similar to prior hydropower generation assessments of the Susitna River watershed during the 1980s, the establishment of the current comprehensive hydrologic network and multi-year surface-water collection program represent one of the state's largest concentrated hydrologic collection campaigns conducted within the same watershed.

This information will provide significant contributions to understanding long-term seasonal water availability and other water resource and ice processes within the Susitna River watershed. It will also provide information for a multitude of other water management related decisions for 77% of the state's population along the Railbelt. Additionally, state-of-the-art data collection protocols and associated results will further contribute to an improved understanding of hydrologic data collection and water resources in remote and harsh cold glacial environments for all regions in Alaska.

Susitna-Watana Hydroelectric Project: Hydrologic modeling and field measurements of the upper Susitna basin

Anna Liljedahl[1], akliljedahl@alaska.edu
J. Braun[2], R. Daanen[1], A. Gusmeroli[3], R. Hock[2], J. Schulla[4], G. Wolken[5,6]
[1]Water and Environmental Research Center, University of Alaska Fairbanks; [2]Geophysical Institute, University of Alaska Fairbanks; [3]International Arctic Research Center, University of Alaska Fairbanks; [4]Hydrologic Software Consultant, Zurich; [5]Division of Geology and Geophysical Surveys; [6]Alaska Department of Natural Resources

The proposed Susitna-Watana Hydroelectric Project has the potential to provide renewable energy to nearly 80% of Alaska's population, which would allow the State of Alaska to meet its renewable energy goal by year 2025. With a projected life-span of 100+ years, the dam would promote a long-term energy source. Critical to any effective hydroelectric development is a firm understanding of the basin-wide controls on river runoff and how seasonal and long-term reservoir recharge may change over the course of the structure's life-span. The upper Susitna basin includes permafrost and glaciers, both which play a major role in controlling watershed hydrology and therefore stream flow. The region's glaciers and permafrost are projected to decrease during the 21st century. Currently, glaciers provide a significant portion of the runoff despite the relatively low coverage (4%) of the upper Susitna watershed area (13,279 km²). Changes in glacier extent and volume, in response to climate warming and/or altered precipitation regimes, have the potential to substantially alter the quantity and seasonality of runoff. Further, a decrease in permafrost extent would modify the seasonal flow regime by increasing groundwater recharge and winter runoff. Therefore, it is crucial to account for the integrated glacier-permafrost-hydrology system in order to properly evaluate Susitna-Watana's operational longevity and to assess potential protection, mitigation and enhancement measures. In April 2012, the Alaska Division of Geological & Geophysical Surveys and the University of Alaska Fairbanks, began a multi-year hydrology study of the upper Susitna drainage basin. The focus is on modeling the effects of future climate variability and change, permafrost thaw, and glacier wastage and retreat on runoff. The study combines field measurements of glacier mass balance, runoff, snow accumulation, precipitation and computational modeling to provide estimates of recent historical and future runoff into the proposed 81 km2 and 63 km-long reservoir of the Susitna-Watana Hydroelectric Project. We are currently initializing and calibrating the thermal, hydrology and glacier modules in WaSiM, which is a physically-based and spatially distributed hydrology model that couples mass and heat transfer. Forced by a combination of fine resolution (2 km) climate simulations and measured air temperature and precipitation, the preliminary simulations suggest a large sensitivity of simulated runoff to high-elevation glacier melt and precipitation. Like much of Alaska, effective and refined understanding of the runoff regime is constrained to the extremely limited hydrometeorological monitoring at higher elevations.

Integrated Resource Approach to Susitna-Watana Hydro Instream Flow Studies

Dudley Reiser[1], dreiser@r2usa.com
Betsy McGregor[2], Phil Hilgert[1], Kevin Fetherston[1], MaryLou Keefe[1], Bill Fullerton[3], Michael Lilly[4], Paul Dworian[5], Robin Beebe[6]
[1]R2 Resource Consultants; [2]Alaska Energy Authority; [3]Tetra Tech; [4]GW Scientific; [5]URS; [6]HDR

Construction and operation of the Susitna-Watana Hydroelectric Project will affect Susitna River flows downstream of the dam; the degree of these effects will ultimately depend on final Project design and operating characteristics. The Project is proposed to be operated in a load-following mode. Project operations will cause seasonal, daily, and hourly changes in Susitna River flows compared to existing conditions. The potential alteration in flows will influence downstream resources/processes, including fish and aquatic biota and their habitats, channel form and function including sediment transport, water quality, groundwater/surface water interactions, ice dynamics, and riparian and wildlife communities (AEA 2011). The potential operational flow-induced effects of the Project on these resources/processes will need to be carefully evaluated as part of the licensing process. This paper describes an integrated resource approach that will be used to characterize and evaluate these effects.

Session 4: Hydropower/Instrumentation
Tuesday March 4, 10:30:00-11:50

History, use, renovation and rehabilitation and assessment for hydroelectric generation of Ship Creek Dam

Patrick J. Driscoll[1], pdriscoll@doyonutilities.com
Douglas W. Johnson[2], Skip Koch[2]
[1]Doyon Utilities, Inc
[2]Weston Solutions, Inc

A presentation regarding the history, use, renovation and rehabilitation and assessment for hydroelectric generation of Ship Creek Dam, Joint Base Elmendorf Richardson, Alaska. The presentation provides a history of military constructed water impoundment structure that became operational in 1954 as the primary water supply point for Fort Richardson, Elmendorf AFB and the City of Anchorage. Additionally, the presentation reveals the level of effort that took place between 2009 and 2012 to rehabilitate and renovate the 60 year old structure to bring it into compliance to current standards and requirements to operate under State of Alaska regulations. Lastly, the presentation will discuss the findings of the evaluation to install hydroelectric generation capabilities.

Winter Hydrology Characteristics of the Kogoluktuk River and Nearby Streams to Support Hydropower Evaluations for Local Villages

Michael Lilly[1]**,** mlilly@gwscientific.com
[2]Dave Brailey, Ron Paetzold[1], Demi Mixon[1], Marielle Remillard[1]
[1]GW Scientific, [2] Brailey Hydrologic

Communities in the Kobuk River Valley currently rely on diesel-fuel for electricity generation; however, this can be both costly and inefficient due to the remote location of these villages. In an effort to reduce energy costs and promote renewable technologies, the Alaska Village Electric Cooperative (AVEC) and NANA Regional Corporation initiated a series of studies to determine the hydroelectric potential in the region. A network of hydrologic stations was installed on three creeks (Cosmos Creek, Wesley Creek, Dahl Creek) and the Kogoluktuk River with the objective of monitoring air and water temperature, water level, and ice conditions. Since energy demands are expected to be highest during winter season, the understanding of winter hydrology processes is more critical. End of Winter hydrological conditions were evaluated during site visits in March 2012. The information is improving the understanding the surface water resources to help evaluate how to best use them for hydropower resource planning and development.

Design and Measurement Differences of Absolute and Gauged Water Level Sensors

Bill Mann, billmann@in-situ.com
In-Situ

An absolute (non-vented) pressure sensor measures all pressure forces detected by the strain gauge, including atmospheric pressure. Its units are psia (pounds per square inch "absolute"), measured with respect to zero pressure. The back of an absolute pressure sensor is sealed from the atmosphere. Therefore, the front of the absolute pressure sensor responds to both atmospheric pressure and the pressure head of water above the sensor. A gauged (vented) sensor eliminates the effects of atmospheric pressure because the vent tube in the cable allows atmospheric pressure to be applied to the back of the sensor. The basic unit for vented measurements is psig (pounds per square inch "gauge"), measured with respect to atmospheric pressure. Barometric pressure applies a direct stress on open wells and surface water. Barometric effects can change dramatically from location to location as a result of topography and micro-meteorological changes. In confined aquifers, these atmospheric pressure fluctuations will cause dramatic water level changes if the monitoring well is open to the atmosphere. While an absolute sensor will work in this application, documentation of barometric data for the duration of the test will be needed to correct absolute measurements for barometric pressure effects. Such post-test processing can introduce cumulative error of two to three times the stated accuracy specification of the pressure sensor alone. Barometric effects typically do not have as great an impact on water levels of unconfined aquifers or surface water. However, when testing groundwater or surface water in such an application, barometric fluctuations cause a direct effect on any one absolute sensor, requiring the sensor to be corrected with barometric data to obtain the most accurate water level elevations. Gauged sensors eliminate the effect of varying barometric pressure on the measurement and the need for post-logging data compensation. In addition, gauged sensors yield the most accurate water level results. Absolute sensors work for all applications—provided that a barometric record is kept for applications requiring correction for barometric fluxes. Post processing of absolute sensor data results in cumulative error greater than the sensor's accuracy specification

Updates from Campbell Scientific

Dirk Baker, dbaker@campbellsci.com
Campbell Scientific, Inc.

Campbell Scientific is a leading manufacturer of high quality, versatile, rugged data acquisition systems used around the world for decades. I will present an overview of equipment used in water resources applications with an emphasis on updates and new products. These include software, pressure transducers, turbidity, pH, and automatic samplers.

Session 5: North Slope Hydrology
Tuesday March 4, 1:00-2:40

Past and Present Active Layer Temperature and Unfrozen Moisture Content Profiles Related to Winter Tundra Travel on the North Slope, Alaska

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Arctic transportation networks are extensively used by the oil and gas industry for supporting drilling and maintenance activities. The Alaska Department of Natural Resources (ADNR) is the agency currently responsible for authorizing winter tundra travel on Alaska state lands. The criteria are a soil temperature colder than -5°C at the 30-cm depth and, in the coastal plain region, a snow depth greater than 15 cm, and in the foothills region a snow depth greater than 23 cm (Bader, 2005a, Bader, 2005b). While the number of companies working on the North Slope is increasing, the number of days available for tundra travel, and thus the winter-work season, has been steadily decreasing. This study examines the thermal state of the active layer, with a focus on the soil temperature characteristics at the 30 cm tundra travel management depth. Soil properties and soil water content are examined as they affect the freezing and thawing process and resulting soil strength. Several different networks of weather and permafrost stations have been in place on the coastal plain and northern foothills of the Brooks Range in northern Alaska. Comparative analysis of recent and historical data for multiple stations using the current tundra travel criteria shows a significant decrease in a typical winter-work season of approximately 29.9%. This analysis of historical soil temperature data shows a significant decrease in the winter-work season lengths under the current travel management criteria as well as providing a more accurate overall areal average and better understanding of areal spatial variability. Unfrozen soil moisture content is a second physical property of soils important for assessing soil strength. This data is collected less often. When measured, it is commonly for soil moisture analysis in watershed hydrology projects. Selected data will be shown demonstrating the application of the data towards tundra travel management. Water frozen in soil adds strength by decreasing slippage and cementing particles together. Soil water influences the rate that soil freezes. It is important to understand the soil-strength requirements when choosing temperature management levels. Slight changes in temperature management levels could help lengthen tundra travel seasons, but need to be carefully evaluated.

Dye Tracers for Characterizing Breakup in Arctic Rivers: An Old School Solution for a Modern Conundrum

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Discharge in Arctic rivers is often near its annual maximum during spring breakup. However, the presence of swiftly moving ice at this time of year leads to unsafe boating conditions, thus complicating the collection of discharge information through modern methods such as acoustic Doppler current profiling (ADCP). Our study is designed to evaluate the breakup discharge of Alaska's Itkillik River using Rhodamine WT, a fluorescent dye. Notable advantages of the method included the ability to inject and collect the dye without entering the water. A disadvantage of the method was the confounding effects of turbidity and/or suspended solids. In our second field season, a second fluorescent dye, Uranine, was utilized. With improvements made to our sampling techniques and the addition of Uranine, we were able to see a vast improvement in our discharge results resembling those recorded by the ADCP.

Morphology-dependent water budgets and nutrient cycling in ponds near the Chipp River, Arctic Coastal Plain, Alaska

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Small ponds on the Arctic Coastal Plain of Alaska are productive ecosystems that provide critical habitat for migrating waterfowl, and invertebrate food resources for birds and fish. Little is known regarding how the shape and sizes of these ponds affect their water and nutrient budgets, and subsequently aquatic ecosystem productivity. These ponds are replenished by snowmelt each spring, and generally desiccate over the dry summer until the advent of late-summer precipitation. Ponds form in topographic depressions related to the presence and thawing of patterned ground, which leads to large differences in pond volume and morphology. We sampled solute, nutrient, and water isotopes from twelve randomly-selected ponds near the Chipp River. These ponds represented four dominant size classes (deep troughs, and shallower low-centered polygons, small thaw ponds, and large thaw ponds), and our sampling aimed to quantify how the pond shape and size affected water temperature and desiccation, phosphorus (P) loading, and biogeochemical cycling. We hypothesized that morphology matters because shallower ponds may be warmer and more susceptible to desiccation, while trough ponds are colder and bolstered by subsurface inflows. Evaporation was found to be the largest source of water loss, affecting smaller ponds disproportionately due to their high surface area to volume ratios. Troughs deviated from this relationship, which may be related to their colder temperatures, steep banks that buffer the water from evaporation, and early summer subsurface inflows. Inflows accounted for 6 to 27 % of the trough pond volume, were solute-rich, and may partially explain higher phosphorus (P) concentrations in the troughs relative to other pond types. Low-centered polygons were most susceptible to desiccation and also displayed the highest assimilation rates of P and ammonium. Nitrogen to P ratios correlated to pond volume, suggesting that larger thaw ponds are less likely to derive P from inflows or thawing margins, potentially explaining their decreased ecosystem productivity. Climate change is expected to affect the Arctic by increasing winter precipitation and summer temperatures, which may lead to increased spring runoff and faster rates of mid-summer desiccation. Given their unique morphology, trough ponds are likely to persist throughout the summer while the other pond types may dry. Therefore, warming arctic temperatures may shift the dominant location of aquatic ecosystem production to trough ponds.

Wildfire and permafrost: post-fire changes in flowpaths of water

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Wildfire frequency and severity in the boreal forest is predicted to increase due to climate warming. In the boreal forest of Alaska, the impacts of climate warming and increase in fire frequency are unique because of complex hydrological flowpaths resulting from permafrost distribution. Increased fire frequency will likely influence carbon and nutrient fluxes in streams due to loss of vegetation, combustion of soil, thawing of permafrost, alteration of watershed flowpaths, and changes in stream hydrology (e.g. surface water-ground water interactions and changes in flowpaths). At high latitudes, permafrost constrains watershed flowpaths to shallow soils and consequently influences stream nutrient inputs. Shallow flowpaths, in which water flows above permafrost, have high dissolved organic carbon (DOC) concentration and low inorganic nitrogen concentration, compared to water moving through deeper flowpaths. The objective of our research was to quantify how wildfire in the boreal forest influences dissolved organic matter concentration and export and nutrient concentrations in headwater streams. Specifically, we investigated 1) how wildfire influenced carbon and nitrogen exports, and 2) how wildfire affected watershed hydrology in a burned watershed underlain by discontinuous permafrost? The research was conducted in the Caribou-Poker Creeks Research Watershed (CPCRW), which is underlain by discontinuous permafrost. Following a 2004 wildfire, stream DOC concentration declined and nitrate concentration increased. Declining nitrate was potentially caused by the combustion of soil organic carbon stocks, alteration of hydrologic flows from shallow to deeper flowpaths, or decreased plant productivity and nutrient uptake. We used an end-member mixing analysis to describe the major sources of water contributing to stream flow. We found that post-fire, the contribution of a shallow watershed flowpath to stream flow declined over 50% with flow shifting to a deeper flowpath. This change in watershed hydrology was correlated with the decrease in stream water DOC concentration and increase in inorganic nitrogen concentration we observed post-fire. Increases in fire frequency and severity will likely hasten the rate of permafrost loss across the boreal landscape. Our results suggest that such changes will increase the contribution of deeper versus shallow flowpaths and alter streamwater chemistry with decreased carbon export and increased nitrogen export.

Long-Term Trends in Water Use of Arctic Lakes and Reservoirs

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Lakes and reservoirs on the North Slope support a number of industrial water use requirements including arctic transportation, work camps and facilities, dust control and well and drilling activities. Water use is regulated by the Alaska Department of Natural Resources. The Alaska Department of Fish & Game and Bureau of Land Management also manage water use were habitat protection is needed, such as wintering fish habitat. Permitting and water management are based on generalized assumptions due to the lack of empirical data on lake ice, spring snowmelt and summer precipitation recharge and other hydrological conditions in the region. Over the past ten years, study efforts have been made to improve understanding of hydrology, water-use trends, and water quality on the North Slope with the objective of improving management practices and developing analysis tools to help field managers and agency staff. The data, tools and improved management methods will help addressing creasing future needs for water, while maintaining the high level of environmental protection that has been maintained. This talk will focus on significant water use trends for arctic lakes and reservoirs on the North Slope between 2001 and 2012.

Session 6: Groundwater Hydrology
Tuesday March 5, 3:00 to 4:40

Nitrates in Well Water on the Anchorage Hillside

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The results of the analyses of nitrates in well water from samples collected from over 2,900 wells on the Anchorage Hillside between 1989 and 2010 are publicly available. These data were examined to: (1) identify areas with elevated nitrates; (2) determine nitrate trends over time, and (3) correlate nitrate concentrations with physical characteristics of the well or site. Observed nitrate concentrations vary significantly across the Hillside, sometimes within a very short distance. The nitrate levels from most Hillside wells are below levels commonly attributable to human activities; however some wells have nitrate levels approaching nationally accepted Maximum Contaminant Levels (MCLs) of 10 mg/l. Nitrate levels in many wells on the Hillside are increasing, but at generally low and varying rates. For example, 38% of 47 public water system wells on the Hillside have low but increasing trends of nitrates that are statistically significant, i.e the trends are not likely the result of randomness. Examination of data from 144 private wells with 4 or more nitrate analyses shows a similar pattern of significant numbers of wells with increasing nitrate trends while many other wells are virtually nitrate-free. The underlying report of this work was commissioned by the Home and Landowner's Organization, Inc. (HALO), as part of its Hillside District Plan Implementation Program, and the report is available on their website. The study also examined existing data to evaluate potential sources of nitrate contamination and avenues for elevated nitrates to get into drinking water aquifers and/or directly into wells. There appears to be some statistically significant correlation between shallower aquifers and elevated nitrates. Recently-enacted changes that require well grouting and bedrock sealing during well construction may be having positive benefits in reducing nitrate levels in wells. There does not appear to be any simple correlation between septic system usage and nitrates; many areas with relatively dense septic system usage exhibit lower nitrate patterns than other areas with larger lots and lower septic system densities. The report concludes that the long-term viability of on-site well and wastewater systems on the Anchorage Hillside is not significantly diminished on the basis of existing nitrate trends and concentrations. The current practice of letting the tiny number of individual well owners with elevated nitrate levels develop solutions best suited to their unique situation seems to be the best practical approach.

Shallow groundwater in the Matanuska-Susitna Valley, Alaska: Conceptualization and Simulation of Flow

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The Matanuska-Susitna Valley is currently undergoing rapid population growth outside of municipal water and sewer service areas. Consequently, a study was initiated between the Alaska Department of Natural Resources (ADNR) and the U.S. Geological Survey in response to concerns about the hydrologic effects of increasing demands on groundwater resources. The objectives of the study were (1) to compile existing data and collect new data to support hydrogeologic conceptualization – including characterization of surface and groundwater interaction – in the study area, and (2) to develop a steady-state, regional scale numerical groundwater flow model. To address the first study objective, lithologic data from the ADNR Well Log Tracking System were used to construct a three-dimensional model depicting the distribution of different hydrogeologic units. Furthermore, groundwater budget components – including in-place recharge and groundwater-surface water interaction – were quantified using both measurement and modeling techniques. Finally, groundwater and surface-water monitoring stations were established to provide both continuous and periodic water-level data. To address the second study objective, a steady-state numerical model was developed to simulate regional groundwater flow. The groundwater flow model boundaries were specified by physically meaningful hydrologic features based upon conceptualization of the groundwater system. Comparison of simulated and observed water levels and flows showed that the model adequately simulates the regional groundwater flow system. This model is therefore appropriate for studying regional-scale groundwater availability.

Can groundwater springs control river ice thickness?

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We modeled the thermal balance between groundwater discharge and ice-free areas in the Tanana River near Fairbanks, Alaska, a region characterized by discontinuous permafrost. Under degrading permafrost conditions, these areas have been hypothesized to have increased winter discharge due to increasing contributions from groundwater flow. In the winter, interior Alaskan rivers are fed almost entirely by groundwater, which also serves as an external source of heat energy to the system. Several reaches of the river fed by groundwater springs remain ice-free or have dangerously thin ice throughout the winter despite air temperatures that dip below -40°C. These areas are dangerous for winter travelers that regularly use Alaskan rivers for wintertime travel. We developed a model to explore how fluctuations in groundwater discharge act as a control on river ice thickness under changing atmospheric conditions. Specifically, the model examines how local and regional changes in groundwater flow affect ice dynamics (growth or thinning) in the context of two primary research questions: 1) What are the dominant factors in the interactions of air temperature, groundwater upwelling rates, groundwater temperature, snow cover, and ice thickness in controlling the seasonal ice dynamics on the Tanana River? 2) What are the rates of change in ice thickness resulting from observed and projected changes in these parameters? Our results indicate that under a particular scenario, heat flux due to upwelling may degrade river ice at up to 17 mm/day, but the potential ice melt is reduced by increased air temperature and water depth, but increased by increased hydraulic conductivity, groundwater upwelling, ice thickness, or snow depth. Increased air temperatures associated with climate change is expected to increase upwelling rates, decrease the temperature gradient, increase snow depths, and decrease ice thickness. Estimated future changes estimate that potential ice melt rates may increase by up to 18% under an altered climate. These results provide additional evidence that changing hydrologic conditions may affect inhabitants of northern latitudes under potential hydrologic scenarios in a changing climate.

Macrodispersion of Groundwater Contaminants in Discontinuous Permafrost

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Understanding dispersion of groundwater contaminants is crucial in the development of conceptual and numerical contaminant transport models. For this reason, the objective of this study is to characterize the macrodispersion processes of groundwater contaminants in discontinuous permafrost. Permafrost acts as an impermeable barrier that impedes flow of groundwater and influences contaminant transport. Discontinuities in the permafrost yield the potential for interaction between the subpermafrost and the suprapermafrost waters such as upward and downward flow. Upwelling of clean subpermafrost water has the potential disperse and dilute the contaminant plume. Conversely, if downward gradients occur contaminant may be introduced deeper into the aquifer. Hinzman et al. (2000) and Carlson et al. (2011) identified the ability of permafrost topography to channelize groundwater contaminants. Groundwater-surface water interactions can increase dispersion of groundwater contaminants, through surface water recharge. The sulfolane plume site in North Pole, Alaska, a region characterized by discontinuous permafrost, has been selected as a case study. Sulfolane is a slightly polar, highly soluble compound with very low sorption properties. The preliminary findings of this study have aided regulatory and private agencies in understanding contaminant transport of the sulfolane plume and configuring contaminant transport models. The atypical aspect ratio of the plume and the detection of sulfolane concentrations below the permafrost layer at depths up to 305 feet are indicative of macrodispersion processes. Data is collected from monitoring wells in the North Pole region and from the USGS Tanana River at Fairbanks, AK gauge station. The data currently consists of sulfolane concentrations, groundwater elevation and temperature. A variety of methods have been used to analyze the data including both horizontal and vertical gradient analysis, temperature as a tracer, and the development of a conceptual model. Horizontal gradient analysis identifies the possibility for radial flow pattern characteristics, while a vertical gradient analysis identifies well nests where upward or downward gradients may occur. Fluctuations in groundwater elevations appear to correlate with fluctuations in the Tanana River stage, indicating strong groundwater-surface water interaction. Except monitoring wells along Badger Slough, which maintain relatively constant groundwater elevations. Groundwater temperatures vary throughout the extent of the sulfolane plume indicating areas of surface water interactions and high permafrost regions. In areas where top of permafrost was found at depths greater than 120 feet or not found at the limit of the suprapermafrost monitoring well installations (150 feet), water temperatures measured in nested wells that are not trending towards zero Celsius, as would be expected where continuous permafrost is present, indicate possible discontinuities in the permafrost. Relatively warmer water from the subpermafrost portion of the aquifer is flowing into the suprapermafrost portion through these discontinuities resulting in relatively warm water in these zones. Stable isotopes will be used to further identify groundwater-surface water interactions as well as sub and suprapermafrost water interactions.

Groundwater Drilling 101

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MW Drilling

This talk will cover groundwater well design, construction and devolvement, specifically focused on the challenges of work statewide in Alaska. Several examples will be given of challenging projects from around the state; groundwater wells on the North Slope, production and injection wells in the Anchorage Basin, and drinking water wells in Southeast Alaska.

Session 7: Surface Water Hydrology I
Wednesday March 6, 9-10:20 am

The Hydrology of Rivers Draining the Central Brooks Range, Alaska

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Both sides of the Central Brooks Range are sparsely populated regions of the state with limited environmental data. A team of researchers from the University of Alaska Fairbanks, Water and Environmental Research Center, has recently started collecting hydrological and meteorological data in both south and north draining watersheds of the Central Brooks Range. Measured meteorological variables include air temperature, wind speed and direction, relative humidity, net radiation, rainfall, snow depth and active layer soil moisture and temperature (if not too rocky). The intent is to develop a basic understanding of the hydrology of this region which includes: end-of-winter snow surveys and warm season rainfall to quantify the regional precipitation patterns, the rate of snowmelt and the hydrologic runoff response, observations of river ice conditions prior and during breakup, summer runoff response, post breakup sediment dynamics, and a modeling program. A description of the program and some preliminary results will be shown.

Physical Susceptibility of Navigable Waters

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Title navigability of a inland waterbody is judged by two criteria, historic use and physical susceptibility, set forth in The Daniel Ball, 77 U.S. (19 Wall.) 557, 563, (1870) US Supreme Court case. Because of Alaska's sparse population and lack of development, there are many inland waterbodies with little or no evidence of actual use. Because of their physical characteristics, however, many of these remote waterbodies could be used for transporting people or goods if there was a need. Under these circumstances, they are considered legally navigable. First, a brief synopsis of historic use criteria will be covered, and then a more comprehensive overview of the field and analytical methods used by the State of Alaska to determine the physical susceptibility to navigation for a waterbody will be discussed.

National Hydrography Dataset in Alaska: An Update

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The National Hydrography Dataset (NHD) in Alaska was mapped at 1:63,360 scale from USGS Historical Topographic Maps, and the data contains errors including streams outside of their channels, misrepresentations of flowlines in braided streams and incorrectly disconnected streams. There is a strong need in the state to correct these issues and improve the NHD in Alaska. There is no state agency or office in Alaska directly responsible for hydrography mapping in the state. The most successful method of upgrading NHD in Alaska has been to work with partner entities in their local areas to make data improvements where they are the most knowledgeable, have the highest investment and have committed and established coordination relationships. Currently, there are several efforts underway to update the NHD and increase coordination throughout the state.

Braided River Management: observations from Pool 6 of the Upper Mississippi River System

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Braided rivers are dynamic systems and ever- changing in nature, making each system unique (Nanson et al., 1996; van den Berg, 1995). For centuries braided rivers have been managed for the purposes of navigation, hydropower, and flood control. The history and effects of such management practices are well documented (Bettis et al., 2008; Jiongxin, 1997; Petts et al., 1989). With the advent of large river restoration, challenges maintaining balance between the interwoven elements of ecology and social needs have emerged (Buijse et al., 2002; O'Donnell et al., 2007; USACE, 2012). Due to the complexity of objectives, scale, and cost of such projects, understanding which management practices have negatively or positively altered the natural system is essential (Piégay et al., 2009). Possibly the most dynamic part of braided rivers are the sensitive and ecologically diverse mid-channel bars and islands. The associated aquatic and terrestrial habitats with these features make degraded mid-channel land features key candidates for restoration (Johnson et al., 1995). The U.S. Army Corps of Engineers has begun the task of restoring over a century of negative effects caused by river management practices in the Upper Mississippi River System (UMRS) (Dettmers et al., 2001; USFWS, 2006; USGS, 2003). Pool 6 of the UMRS, near Winona, Minnesota, is an exception within this generally degraded system. Local conditions within Pool 6 have stimulated the natural system to begin developing mid-channel features without the aid of restoration efforts. To better understand where and why these changes have occurred, chronological data sets spanning from 1895 to 2010 were analyzed. Observations identified in this analysis can be applied to enhance similar projects within previously managed reaches. If the conditions observed within Pool 6 prove replicable in other locations, restoration efforts can be less invasive, self-sustaining, and more cost effective.

Session 8: Surface water Hydrology/ Flood Hazards

Wednesday March 6 10:40 12:00

Updates to geospatial site information and basin characteristics for Alaska's USGS stream gages

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An ongoing update of statewide flood frequency estimation equations required a systematic upgrade of geospatial and basin data for USGS streamgages in Alaska. Digital gaging basin boundaries outlining the drainage area for each gage are used in the study to obtain basin characteristics likely correlated with streamflow statistics, which serve as variables in estimation equations. Streamgage locations, which often represented the location of the gaging infrastructure, were relocated to a flowline in the National Hydrography Dataset (NHD). Local versions of gaging basin boundaries were reconciled with the Watershed Boundary Dataset (WBD), a national database of hydrologic unit code (HUC) designations. Edits were made directly in the WBD, which was then used to build a geodatabase of revised USGS gaging basin boundaries. A new ArcGIS tool developed for the project expedited the process of obtaining new basin characteristics, which will replace drainage areas in the National Water Information System (NWIS) and other variables in the USGS basin characteristics file. These local streamgage site information updates align with national-level NHD, WBD, and NWIS revisions and are serving as test cases for new procedures.

Flood Inundation Mapping of the Lower Kenai River using HEC-RAS

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Flooding is the cause of the majority of Presidential disaster declarations and results in greater U.S. economic loss than any other type of weather related natural disaster. The availability of flood inundation maps for planning and forecasting will improve our capacity to identify, quantify and communicate the risk and impacts associated with flooding, thereby facilitating more effective response, mitigation and recovery efforts at the regional, state and community levels. The National Weather Service (NWS) has 77 gages which have flood inundation maps available to the public, but currently none exist for Alaska. Each gage has a library of static flood inundation maps for a range of stages. The Alaska Pacific River Forecast Center (APRFC) is building a library of flood inundation maps for the area downstream of Soldotna using the HEC-RAS hydraulic model. The cities of Soldotna and Kenai on the lower river are home to more than 11,500 full-time residents and welcome thousands of fishermen, recreationalists and tourists each summer. The economic vitality, availability of LiDAR (high resolution elevation data), river cross-section data, and high tidal range make the Kenai a perfect candidate to be modeled in HEC-RAS. The most downstream river gage, operated by the US Geological Survey (USGS), is at the Soldotna Bridge, 20 river miles upstream of the mouth. There is a significant amount of infrastructure in the flood plain in this ungauged section of river. With a tidal range of 20 feet, the tides have a large effect on river stage over the 12 mile stretch of tidally influenced river. A tide gage is located at Seldovia, but a correction factor can be applied to estimate the tide at the mouth of the Kenai, which provides the downstream boundary condition for the HEC-RAS model. To implement this project, we have worked with the Army Corps of Engineers (COE) Alaska Region Office as well as our partners on the Kenai River. The COE had a pre-existing steady-state HEC-RAS model and we modified it to run in the unsteady-state environment. We extended the cross sections to include over- bank areas, generated in GIS from recently acquired LiDAR data. To calibrate the model, we first verified that the steady and unsteady state solutions to the model were identical. We are currently extending overbank cross sections to calibrate the model to two floods; the flood of record, a >100 year event which happened in Septemberof 1995 and reached a peak flow of 42,300 cfs; and the most current event, which occurred in September 2012 and reached a peak flow of 30,000 cfs. After the model has been calibrated and is fully functional, we will use it to develop a library of static maps utilizing the LiDAR data to show the expect extent of flooding at different levels.This project presents a great opportunity for collaboration between the USGS, NWS, COE and the Kenai Borough to deliver a timely, accurate and valuable product to the communities we serve.

Historical changes and future projections of extreme hydro-climate streamflow events in Interior Alaskan watersheds using trends, extreme value analysis and the ClimdEx archive

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Climate change will shift the frequency, intensity, duration and persistence of extreme hydro-climate events and may have particularly disastrous consequences in vulnerable systems such as the warm- permafrost-dominated Interior region of Alaska. This work focuses on recent research results from trends and generalized extreme value (GEV) analyses at several Interior Alaskan river basins for 1951-2010. Trends analysis of maximum streamflow for the Chena River at Fairbanks indicates a strong (61 %) and statistically significant (99% confidence interval) increase in 12-day flow events during the snowmelt period (late April), followed by a strong (69%) and significant (99%) decrease in the 12-day flow events during the post-snowmelt period (mid to late-May). The annual trend however, illustrates significant (95%) decreases (50%) in maximum streamflow events in this watershed. Most stations in the broader Interior region of Alaska follow similar patterns, particularly in terms of the April streamflow increases, with varying degrees of magnitude and significance (Salcha, Susitna at Gold Creek, Upper Chena, Yukon at Eagle, Nuyakuk, Kuskokwim, and Talkeetna). Almost all of these stations show declining trends in streamflow after the snowmelt peak although at most stations the decreases are not significant. GEV analysis, based on flow records from 1951-2010, shows that in April the Chena and Salcha River basins have experienced an increase in maximum flow events occurring above the 10-year flood return interval post-1979. Nine events greater than the 10-year flood return interval have occurred in the 30-year period at both sites, more than three-fold the expected. The flow volume amounts for these events are closer to the 20-year return period level in the Salcha and the 40-year return period for the Chena, as indicated by the fitted GEV distributions for these sites. Exploration based on a study of Environment Canada's CMIP-5 ClimdEX indices of temperature and precipitation for Alaska suggest that these driving climate factors are projected by a subset of 'best performing' global climate models to increase by the 2080s, indicative of increasing extreme patterns in hydro-climate for Alaska's Interior basins. Adequate representation of extremes is required in hydrologic modeling frameworks to accurately reflect these changing patterns, and provide adequate warning to Alaskan communities of such events.

Assessment of Flood Hazard Potential in the Valdez Glacier Watershed in Future Climate

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Few glaciological studies have addressed the effect of glacial runoff on watershed hydrology. Glaciers in Alaska's Prince William Sound region are losing volume in response to recent changes in climate. Valdez Glacier is one of the most rapidly thinning and retreating alpine glaciers in the Western Chugach Mountains of the Prince William Sound region. Melt water from glaciers contribute to runoff in lower elevations, which in combination with heavy precipitation events, can result in dramatic flooding. Downstream of the Valdez Glacier is the Valdez Airport and popular recreational and gravel mining areas - all which could be threatened in a large flooding event of the Valdez Glacier Stream. The hydrology of the Valdez Glacier watershed is less known, and it is challenging to predict how the watershed will respond as the glacier continues to lose volume. The study utilizes field measurements of meteorological, glacier mass balance, streamflow, and lake water level to inform and refine hydrologic simulations using the physically-based Water Balance Simulation Model (WaSiM). Computational simulations in combination with our field measurements can help identify areas that may be subject to flooding and provide guidance to the City of Valdez on decisions about infrastructure development and recreation. Measurements from the 2012 field season show that the stream water level varied up to 1.2 m from May 31 to November 17, with maximum water levels occurring during the last week of June and end of September. Lowest stream water levels were in mid-July and mid-September. The water level of Valdez Glacier Lake varied up to 3.2 m throughout the summer season. The stream drains the lake. Accordingly, maximum and minimum lake water levels coincided with the levels changes observed in the stream. The stream response lagged about 30 minutes behind the lake response during the seasonal peak, which was recorded in late September.

Session 9: Stream Restoration and Protection I
Wednesday March 6 1:00-2:40

Fish at Zoo: Passage Restoration on Little Campbell Cr

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HDR Inc.

An early homestead era dam on Little Campbell Creek and a mismanaged water intake for a local golf course have combined to sever fish passage on LCC where it transits the Alaska Zoo north of O'Malley Road. As part of a continued effort to return LCC to biological viability and with USFWS funding HDR studied the restoration of fish pass through the Alaska Zoo. This presentation will examine the problems and solutions to this fish passage conundrum.

Restoration Challenges of Fish Passage Design in Gustavus, Alaska

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The distinctive geologic characteristics of the Gustavus flatlands present several challenges for restoration efforts aimed at improving access to fish habitat in area streams. The flatlands are experiencing substantial uplift, reported at up to one inch per year, due to post-glacial rebound in Glacier Bay; this uplift is resulting in trenching of streams maintaining their gradient to Icy Strait. The resultant glacial landscape is poorly drained with a high water table, generally located within a few feet of the surface. Historic road building practices consisted of trenching material to procure fill for constructing roads above the high water table and to promote drainage away from the road prism. Groundwater collecting in the roadside ditches has subsequently formed defined stream channels supporting populations of anadromous and resident fish species. The City of Gustavus and United States Fish and Wildlife Service recently partnered with engineers at DOWL HKM to improve fish passage at multiple road-stream crossings in Gustavus, Alaska, where existing culverts have become barriers to fish migration. The success of embedded / stream simulation culverts relies heavily on the ability to incorporate natural sediment transport and channel function into the design. Practical design solutions must account for highly mobile stream beds consisting primarily of glacial sands and silts, remnants of marine mudflats and glacial outwash. Intermittent layers of marine clays and established vegetative mats provide limited stability in riparian systems otherwise prone to scour and rapid channel response. The artificial origin of roadside streams, which are highly linear with little channel diversity, requires reconsideration of traditional restoration goals; large scour pools that would often be filled to restore natural channel continuity are widely believed to be some of the most beneficial habitat features. Culvert replacement designs must provide hydraulic conditions sufficient to flush out bed material to prevent filling existing pools while maintaining favorable conditions for fish migration. Design alternatives must also consider long-term effects of post-glacial uplift and the anticipated change between stream bed and bank elevations over the design life of the project. Dewatering and constructability challenges encountered during installation of an embedded culvert on the Rink Creek tributary have raised questions regarding the feasibility of installing larger embedded culverts at Mountain View Drainage crossings. Restoration efforts are now reconsidering the use of bridges in conjunction with stream channel reconstruction of impacted reaches.

Vander Court Stream Restoration

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The Vander Court at Lore Road stream restoration project will enhance the fish and wildlife habitat in a disturbed area of the South Branch of the North Fork of Little Campbell Creek. Restoring this segment of Little Campbell Creek to its natural conditions was recommended by the US Fish and Wildlife Service. Primary elements of the restoration consist of reconstructing a straightened channel to serve as backwater habitat for fish and insects, constructing new streambed channels to match natural conditions, restoring appropriate vegetation, and diverting creek waters into the new channel. The general design criteria are to: impart sinuosity to reflect the natural "pre-disturbed" condition of Little Campbell Creek; accommodate flow characteristics observed in the model reference reach; retain the existing topographic slope, including the end-point elevations of the straightened reach; and, maintain the Base Flood Elevations in a "no rise" condition. The proposed channel section for the restored creek channel alignment consists of a stepped channel. The stepped channel is designed to have a main channel section that models the reference reach and provides adequate habitat for fish. The upper step of the channel is provided to allow adequate flow while not producing a rise in flood elevation. A distinct element of the project adding to its complexity was obtaining a Conditional Letter of Map Revision. When performing the hydraulic analysis it was found that the floodplain conditions on this section of Little Campbell Creek differed from the conditions used in the existing Flood Insurance Study. The existing hydraulic model, generated more than 30 years ago, included a split flow which no longer exists, a stream location which may have moved due to natural meandering, and a downstream road under crossing which has undergone multiple configurations.

D&S Concrete Culvert Replacement

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HDR Alaska, Inc.

The South Fork of Little Campbell Creek culvert through the D&S Concrete property increased flooding risk and limited fish passage. The process of replacing the culvert with a better operating structure was long and involved many different analyses and negotiations. This presentation will summarize the project history and the design considerations that yielded the creative culvert solution constructed through the site.

Perspectives of Stream Restoration in South Central Alaska and Beyond

William Rice[1]**,** william_rice@fws.gov
US Fish and Wildlife Service[1]

Despite a robust suite of channel restoration projects in Alaska over the last decade, new practitioners may not know many of the projects, methods applied or lessons learned. This presentation will primarily focus on discussing the state of the practice of stream restoration over the last decade, primarily in South Central Alaska. An emphasis will be placed on recent projects in urban and rural environments, no-wood to large-wood applications, single and multi-thread channel restorations, large and small stream projects. A short history of streambank restoration techniques will also be presented. Through this overview of key projects and methods we can develop a better understanding of the successes and challenges faced and hopefully improve future restoration projects.

Session 10: Stream Habitat and Restoration II
Wednesday March 6, 3:00 to 4:00

Community Watershed Planning in Interior Alaska

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Fairbanks, Alaska's second largest city, was incorporated in 1903, with the core downtown area centered on the lower Chena River and its side branch, Noyes Slough. The lower Chena River and Noyes Slough are both listed as polluted from sediment on Alaska's impaired waters list. The main source of pollution is urban runoff. Despite the pollution, the Chena River supports the second largest spawning population of Chinook (king) salmon in the Yukon River drainage. Many Alaskans, including thousands of rural indigenous village residents, are dependent on the Yukon River for subsistence fishing. In response to water quality and other concerns, a multi-agency Fairbanks Green Infrastructure Working Group convened in July 2011 and began collaborating to more efficiently address restoration and planning within the Fairbanks area. Members of the Fairbanks Green Infrastructure Working Group are looking to efficiently pool resources to reduce run-off pollution to the Chena River especially in high priority areas, and apply green infrastructure applications where they will have the most benefit. This presentation provides additional background information on the Chena watershed and a description of the workgroup's accomplishments to date.

Kenai Watershed Forum Anchor River Restoration

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Kenai Watershed Forum

In 2005 and 2006, with support from the Alaska Coastal Conservation Program, the Kenai Watershed Forum (KWF) conducted a reconnaissance level assessment of the South Fork of the Anchor River to assess reaches of the river that had been altered by anthropogenic influence. During the course of this work, it was discovered that an abandoned gravel pit had captured the river channel during a flood event in 2002, resulting in an unnatural braided stream with an overburden levee (a relic of the gravel pit) acting as an island between the two most active channels. The property where the gravel extraction had previously occurred was purchased for the State of Alaska prior to the 2002 flood and is managed for the conservation of exceptional stream and riparian habitat value. Upon completion of the assessment work this site was identified as a high priority for restoration.

Thanks to Stimulus funding through the National Oceanic and Atmospheric Administration, KWF was able to restore natural stream morphology and reduce known sources of turbidity on this section of the Anchor River, directly benefiting anadromous fish and their habitat. During the summer of 2011 KWF restored a single channel to a 1,600 ft. reach of the Anchor River while also flattening the floodplain to allow future unimpeded flood flows, re-establishing a historic meander, stabilizing the channel by reinforcing banks with rock, vegetation, root wads, and log jams, and removing abandoned debris. This presentation will discuss stream restoration techniques utilized during this project, the success of the project post-construction, and plans for continuation of project monitoring.

Using Watershed Assessments to Protect Resources & Subsistence Uses in Alaska

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Laoch Consulting

Development of Watershed Assessments (Assessment) provide a means for better understanding of the potential impacts of development in the watershed and to the community. Ultimately, using Assessments, Watershed Council will develop a Watershed Management Plan addressing water quality and quantity protection activities. Watershed Management Plans developed by Native Alaskan Tribal Governments support the continued pursuit of a centuries old subsistence lifestyle of the Native Villages which are dependent on fish and wildlife resources. Also, because the native communities area, often, at a higher risk from the impacts of development in Watersheds, they are at the same time, the ones with the most knowledge as to what these impacts are and how to address them. The research, planning and application of Indigenous Knowledge combined with Tribal sovereign status, the federal trust relationship, and state and federal environmental justice policies, therefore, provides native vi Additional Info: Power point presentation.

Poster Session

Simulation the effect of wave action on fate of crude oil spilled at Alaskan shores

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The U.S Department of Energy states that the United States currently relies on foreign countries for 45% of the oil we use today. The recent prospect of drilling in the Beaufort Sea indicates that the Off-Shore oil production along Alaskan coasts is expected to increase in coming decades. Low temperatures present during most of the year in Alaska affect the physical properties (e.g. viscosity) as well as biodegradability of crude oil. Historic oil spills such as the Exxon Valdez show that long term effects can be seen on ecosystems as a result of oil spills. A number of studies have been performed in the past to evaluate different response strategies of a spill if it were to occur in the ocean. However, very little research has been done on the fate of crude oil once it reaches the shore. It is common practice after such spills to enhance microbial degradation of petroleum hydrocarbons by nutrient addition after preliminary soil clean-up by mechanical means, as done for the Exxon Valdez oil spill. However, the efficiency of nutrient addition may be reduced on a shoreline due to wash-out resulting from tidal and wave action. Similarly, flushing has an impact on the transport of hydrocarbons both within the soil/sediment matrix and into the sea. The present project's aim is to investigate the fate of nutrients and crude oil in a laboratory setting using a wave simulation tank. The parameters of the experiment to be varied include the dosage and type of fertilizer added, soil matrix and intensity of wave action. If time permits the study will examine how these different parameters vary as a function of temperature. By measuring concentrations of fertilizer and hydrocarbons across different soil profiles and describing the observed results with mathematical models, the interrelation of transport of contaminant and nutrients, hydrocarbons biodegradation, nutrient consumption and biomass growth will be described. The completion of this project will help lead to a better understanding of processes occurring in a shore environment after a spill occurs and aid in developing remediation strategies if such a spill occurs in the future.

Active layer soil thermal and hydrologic regime: From ice wedge polygon to landscape scale

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Ice wedge polygons, which are common to the low-gradient Arctic tundra, give rise to several microtopographical units and a diverse range of miniature ecosystems. The rims, troughs, and center mounds or basins result in a somewhat systematic mosaic of vegetation and hydrology across the Arctic wetlands. We argue that effective assessments of larger-scale (> km2) and pan-Arctic fluxes of energy, water and carbon require a fundamental understanding of processes at the ice wedge polygon scale and how they affect landscape scale fluxes. Here, we present field measurements of snow depth and active layer hydrologic and thermal regime across a low-centered polygon with well-developed troughs and we show the importance of snow distribution and ice wedge polygon type on watershed-scale hydrology. The ice wedge polygon was instrumented in fall 2007 within the Barrow Environmental Observatory, Barrow, Alaska. Hourly measurements included soil temperature and near-surface soil moisture at 29 sites. Snow and active layer depth was measured manually in April/May and September, respectively. The results present large variability in snow depth, active layer depth, time of freeze-up, and near-surface soil temperature that are correlated to feature type (trough, rim and low center). For example, end-of-winter snow depth is about twice as deep in the troughs as on the rims, resulting in an >10 ºC soil temperature difference during cold spells. Further, a complete freeze up, defined as the rapid soil cooling that follows the end of phase change, occurs about a month later in the troughs than the exposed and dry rims. The field measurements informed a modeling exercise of schematic ice wedge polygon landscapes, which highlight the effects of troughs on snow accumulation and lateral export of water. The identified fine-scale spatial variability in active layer and surface characteristics of ice wedge polygon landscapes impose important controls on watershed-scale water fluxes, and should therefore be represented in regional scale ecosystem assessments.

The Use of Salix alaxensis for the Rhizoremediation of Soil Contaminated by Diesel Range Organics and 1-Chlorooctadecane

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The Yukon Koyukuk Tank Farm was established in Kaltag, Alaska, in the early 1960's. Since that time there have been multiple heating oil spills. Thus, the soil in the area has been found to be contaminated with diesel range organics and in certain locations 1-chlorooctadecane. Due to the presence of weathered diesel, the remote location and the costs of ex-situ remediation, the use of Salix alaxensis (felt leaf willow) for rhizoremediation of the site will be studied. The willow Salix alaxensis is commonly found throughout interior Alaska and contains the compound salicylic acid, which it releases through the roots. Microcosm studies will be performed with crushed Salix alaxensis root, mimicking root turnover, to determine the effects of salicylic acid on the remediation of weathered diesel and 1-chlorooctadecane. With cold weather dominating much of the year, half of the microcosms will be kept at 4ºC and the rest at 20ºC. The microbial community development will be tracked with DNA fingerprinting to determine if the presence of salicylic acid will influence the microbes present. If found to be effective, the use of Salix alaxensis would be advantageous as cuttings could be taken directly from the local population, less maintenance would be required and overall costs reduced.

Biodegradation of crude oil in cold climate terrestrial environments

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Oil is the most important energy source and an environment pollutant as well. Alaska, a large producer of crude oil, has experienced both marine and terrestrial crude oil spills in the past. As crude oil contamination of the environment is harmful for ecosystems, it is important to develop approaches to remove spilled oil. For oil spills at remote terrestrial sites, in situ bioremediation will be the best solution to degrade the crude oil. However, it is known that all metabolic activities slowdown in cold conditions as generally prevailing in Alaska. Therefore, the rate of biodegradation of crude oil by micro-organisms under different environmental parameters has to be studied. One parameter that has so far not been studied systematically is the effect of salinity, which is important for the bioremediation potential of sea shores compared to inland sites. This study will focus on the biostimulation method for bioremediation. Laboratory microcosms will be set up with varying temperatures, salinity, fertilizer concentration, crude oil concentration and soil type. The relationship between the nutrient consumption, biomass growth and fuel degradation will be investigated. Investigating biodegradation under various circumstances will help in determining suitable conditions for degradation of crude oil at low temperatures. The fate of crude oil percolating through snow and ice covering soil will also be determined in another set of experiments. It is important to study the behaviour and degradation of crude oil in the presence of snow and ice because the majority of Alaska is covered by snow or ice for most of the year. This aspect has not received much scientific attention in the past. Therefore, the project will overall focus on determining the rate of biodegradation of crude oil in different conditions, as a proxy for oil spills in cold terrestrial areas including seashores.

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