Hydrology Technical Working Group
Pebble Project
January 10, 2008
Minutes recorded by Charlotte MacCay/Bristol

Present:
Jim Vohden/ADNR
David Johnson/ADEC
Scott Maclean/ADNR-OHMP
Doug Limpinsel/NOAA-NMFS
Jason Mouw/ADF&G
Tammy Massie/ADF&G
Phil North/EPA
Andrea Meyer/ADNR
Leslie Tose/USACE
Shawn Florio/HDR
Robin Beebee/HDR
Dennis Deans/PLP
Charlotte MacCay/Bristol

Public Observers

None

As with all Technical Working Group (TWG) Meetings, the minutes reflect discussion of suggestions and concerns raised by individuals. Discussion does not reflect any decision making or consensus from the group (with the exception of choosing a lead).

Administrative Issues

- Scott Maclean was chosen as TWG lead.
- U.S. Geological Survey (USGS) data related to the project area is available at any time on their website. The 2007 winter data has not been entered yet.
- The next meeting will involve the groundwater hydrology team and the snow survey team.
- The meteorological consultant will also be requested to attend the next meeting.
- It would be useful to have all surface and groundwater hydrology consultants at all future meetings.
- There is an upcoming conference in Juneau (American Water Resource Association – Alaska Section). Topics include the impact of climate change on hydrography and methods for estimating flow in gaged and ungaged streams.

Data Requests

- Agencies would like to see the hydrology results;
- Instream Flow was taken out of this TWG, as it refers to a specific and complex fish habitat instream flow model that requires specific expertise. The term "Instream Flow" was not meant as a substitute for stream flow measurements, which are still very much an important part of the hydrology TWG;
- The team would like to have a correlation of base flow data to groundwater well data;
- The correlation of surface flow runoff data to the Iliamna precipitation record;
- The correlation between groundwater and surface water interchange;
- Mean daily flows (not the individual 15-minute readings, but the daily average flow), preferably for all stations, but a subset of stations of interest could work. A mean monthly or mean annual flow could suffice if necessary. This could be used for independent analysis of instream flow and seasonal flow analysis;
- A map of the gaining and losing reaches and a line graph with percent gain or loss during base flow would be useful; and
- Hydrographs to evaluate if there is a delay in runoff, indicating a lag where water from precipitation is not infiltrating.

Pebble Limited Partnership (PLP) Hydrology Study Review

- CH2M Hill started the hydrology studies in 2004, now HDR conducts the hydrology studies. Knight Piesold (KP) reduces the field data into hydrographs for project use. The data is provided to Water Management Consultants (WMC) primarily for use in developing water balance models. The data is also provided to the fisheries and water quality disciplines for use in their environmental studies.
- The study area is approximately 360 square miles – the study area has not changed since the inception of the program in 2004.
- Instantaneous discharge (IQ) is recorded by HDR at all sites, including sites where continuous flow meters are installed.
- In 2005, a program to take flow exchange measurements was implemented in an effort to take measurements of gaining and losing stretches. A cut-off barrel with an attached bag holding a known volume of water was pushed into the sediments for a set time. Then, the water volume in the bag is re-measured. This was designed for lakes with silty sediments. Placement in a gravel streambed likely led to inadvertent measurement of intra-gravel flow detracting from the accuracy of the program. The program was discontinued.
- Attempts to use piezometers or thermistors in the streambed were problematic. The devices did not remain in place. Also, when thermistors were inserted greater

than 10 feet into the water column, it was difficult to discern local from regional effects. The program was replaced by a fisheries program that includes thermistors at the sediment/water interface for the instream flow program. WMC may also have some thermistors installed. Details of this program are scheduled for clarification when WMC attends the next TWG meeting.

- Winter data
  - There was no base flow data sampling design for 2004. However, there was no rain for 2 months that late summer/fall and data collected in September 2004 is representative of base flow conditions.
  - A base flow program was added in 2005.
  - Two to three hydrology teams take IQ readings such that a single drainage (e.g., South Fork Koktuli River) is measured within a single day . This is done for each drainage every spring during low flow conditions prior to breakup.
  - Based on the very dry 2004 summer, a base flow measurement event was originally scheduled for late summer each year, but since 2004, baseflow conditions have not been sufficiently present to measure. Therefore, summer base flow events have been eliminated from the program.
  - Data is fed into a site-wide water balance that can provide flow estimates at any point along the stream.
  - HDR also uses pressure transducer continuous flow meters that are removed in the winter. Only IQ measurements are collected in winter.
  - USGS keeps continuous flow meters installed year-round. However, the USGS winter measurements are estimated since continuous stage measurements are not valid under ice-covered conditions. The USGS estimates the winter hydrographs using periodic IQ measurements in conjunction with local meteorological data.
  - HDR/KP correlates their gages to the USGS hydrographs and sees a close correlation the rest of the year.
  - Lowest flows are in early April.
- Hydrographs – specifically unit runoff values – from the various continuous stations show a high degree of correlation through the year.
- Flow apportionment can be determined based on drainage area using the data collected to date.
- IQ measurements at each stream station are collected coincidentally with the collection of water quality samples. These IQ data are used by the water quality group to estimate mass flow of various water quality sample analytes.
- Salt- dilution Sampling Method
  - This USGS method is currently typically used at a couple of stations: typically NK119A, UT119A, and UT100E. These sites tend to be higher up

in the drainage system where the creeks are steep and turbulent. The purpose of using the salt dilution method is to increase the accuracy of these IQ measurements in turbulent streams where velocity meter measurement may not be as appropriate.

- Downstream field conductivity and other samples are typically taken before the salt-dilution method is employed, so that added conductivity from the test will not affect downstream readings, although, realistically dilution would probably lead to undetectable downstream changes in conductivity.
- This is a conservation of mass method. A known concentration of common table salt is injected into the stream. Conductivity is measured downstream, at a point where the injected salt is expected to be thoroughly mixed with a constant concentration across the streambed. Conductivity is measured and used to produce a curve of concentration over time. The discharge rate is calculated using the area under the curve.
- Both flow meters and salt dilution were conducted at several stations with moderate turbulence, and the two methods compared well.

Sampling Stations

- The hydrology study used the same sampling stations as the surface water quality team.
- Some stations have been added or dropped over the years.
  - 2005 - added 2 stations in the South Fork Koktuli to provide data related to mine design concepts.
  - 2006 - one station at North Fork Koktuli related to a mine feature was dropped and then added back in during 2007.
  - 2007 - stations were added in the Upper Talarik in response to the discovery of the East Zone. Also, Alaska Peninsula Corporation (APC) added 3 stations on their property on the lower reaches of the Upper Talarik. One of the stations replaced UT100A, which was an IQ station operated by HDR. Another APC station was installed on the Newhalen River on APC lands. This is an independent effort by APC, with assistance in training and protocol by HDR. Data is shared between APC and PLP. APC also has hired an independent hydrologist.
- There is no USGS gage in the Nushugak River, which is an area that will be considered as an affected area within the National Environmental Policy Act (NEPA) process.
- Agency request was made for monitoring in the Mulchatna River, which is an area that will be considered as an affected area within the NEPA process.
- Stations were set up in 2004 relative to the ore-body knowledge available in 2004. Preliminary calculations showed that outside of the study area, there was less than

a 10 percent change in the flow. It is difficult to precisely measure any flow change at this level.

- It's important to the fishery instream flow modeling to have sufficient sampling stations to determine changes in flow on a reach-to-reach basis. It is not necessary to have a gage for every 10 percent change in flow, but enough flow data is needed to understand how changes in hydrology upstream can affect flow downstream.
- Overall unit runoff is fairly consistent with some exceptions. There are some gaining and losing stretches in the streams.
- Outside of base-flow periods, flow is affected by storm runoff – this holds true regionally.
- Seeps are measured by the surface water quality team. There are 4,145 inventoried seeps throughout this area. Approximately 100 seeps are being sampled.
- Fish spawning sites are controlled by strong upwelling and down welling. The hydrology study needs to cover this network sufficiently to be able to relate fish spawning areas and the hydraulic influences.
- The PLP fish team does integrate hydraulic information on gaining and losing stretches and upwelling in the streams with the design of the fish study program.

Water Balance Model

- No long-term river gages exist nearby that contain similar drainage characteristics to the drainages in the project study area. This makes it difficult to develop a long-term hydrologic record via correlation. Other modeling methods are currently being investigated.
  - This was discussed with the USGS at the onset of the program, but there was no good long-term gage in existence to use. This is why modeling is also being conducted.
  - Iliamna River gage goes back to 1996. It's also not a similar river.
  - The Nushugak River had a gage from the 1960s to the 1980s at one site, and another gage from the 1970s to the 1990s at another, but there was no overlap between these two stations to develop a long-term record.
  - Developing a correlation with the Anchorage Bowl may be a possible method to determine mean annual flow for the long-term.
- The current thought is to develop a correlation between the on-site surface runoff data and the Iliamna precipitation data over the sampling time-period. The correlation allows the water balance to use and adjust the long-term Iliamna precipitation data for application in long-term projections for the site.
- Iliamna has approximately 50 years of weather data.
- Climate change will be considered.

Snow Survey

- The snow survey is to be covered next meeting
- Precipitation data suggests more precipitation should be showing up in the hydrograph, indicating there may be significant loss of snow due to drifting.
- The snow survey is to address the drifting of snow.

Future Meeting Agenda Items

a) model for predicting water balance
b) climate change considerations with respect to models
c) groundwater/surface water interchange
d) met station overview and correlation between precipitation and flow