SUSITNA-WATANA HYDRO

Meeting Notes
IFS-TT: Riverine Modeling Proof of Concept
Technical Team Meeting
April 15, 16, and 17, 2014

LOCATION: Alaska Energy Authority – Board Room
813 West Northern Lights Blvd.
Anchorage, AK 99503

SUBJECT: Riverine Modeling – Proof of Concept Technical Team Meeting Notes

GOAL: *The IFS-TT Proof of Concept (POC) meeting was a follow-up to the November 13-15, 2013 Riverine Modelers Meeting that provided a forum to review and discuss the riverine models and describe model linkages (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/02/2013.11.13Modelers_Notes.pdf). The POC meeting was designed to advance the understanding of these models and how Project operations that influence riverine processes and fish habitats will be evaluated. This was accomplished by demonstrating the application of the models specific to two key biological metrics (effective spawning/incubation habitat, and juvenile rearing habitat) at one Middle River Segment Focus Area (FA), FA-128 (Slough 8A). Modeling included two scenarios –Existing Conditions and Operational Scenario (OS) – 1. Emphasis was placed on demonstrating the model process and example model results. The overall goal of the meeting was to PROVE via demonstration that the modeling process is CONCEPTUALLY sound (Proof of Concept) and can be broadly applied to other areas of the Middle River Segment. The meeting also briefly reviewed the analytical approach being applied to the Lower River segment. See Handout on Meeting Goals, Structure and Outcome.*

ATTENDEES: **William Ashton** DEC, **Greg Auble** USGS, **Martin Bozeman** AEA, **Jeff Davis** ARRI, **Mark Doner** HDR, **Wayne Dyok** AEA, **Stephen Ertman** HDR, **Bill Fullerton** TT, **Hal Geiger** St. Hubert Research Group, **Dara Glass** CIRI, **Domoni Glass** Environ, **John Hamrick** TT, **Bob Henszey** USFWS, **Phil Hilgert** R2, **Melissa Hill** ADNR, **Colin Kikuchi** USGS, **Joe Klein** ADF&G, **Felix Kristanovich** Environ, **Betsy McGregor** AEA, **Bill Miller** Miller Ecological, **Doug Ott** AEA, **Rob Plotnikoff** TT, **Dudley Reiser** R2, **Eric Rothwell** NMFS (Day 1), **Corinne Smith** TNC, **Gary VanDerVinne** NHC, **Jose Vasquez** NHC, **Lori Verbrugge** USFWS, **Sue Walker** NMFS, **Charlie Wisdom** Environ, **Lyle Zevenbergen** TT, **Jon Zufelt** HDR

ON PHONE: **Laura Arendall** R2, **Woohee Choi** FERC, **Kasey Clipperton** Golder, **Matt Cutlip** FERC, **Kevin Fetherston** R2, **Peter Foote** Louis Berger, **Solomon Gbondo-Tugbawa** Louis Berger, **John Haapala** MWH, **Dan Healy** NHC, **Sharon Kramer** Harvey Ecology, **Michael Lilly** GW Scientific, **Becky Long** Susitna River Coalition, **Matt Love** VNF, **Paul Makowski** FERC, **Sara O'Neal** Trout Unlimited, **Steve Padula** McMillen, **Dirk Pedersen** Stillwater, **Timothy Ruga** AKRF, **Hal Shepherd** UCI, **Wayne Swaney** Stillwater, **Fred Winchell** Louis Berger

This three day Technical Team (TT) Proof of Concept (POC) meeting was a follow-up to the November 13-15, 2013 Riverine Modelers TT meeting and provided a forum to update the progress and status of the riverine fish habitat modeling efforts and demonstrate via example, how the different models will be applied in evaluating flow related Project effects on fish habitats. Clarification requests or questions resulting after this meeting are to be communicated to Betsy McGregor at BMcGregor@aidea.org. Additional materials related to the instream flow modeling may be discussed in future TT communications.

It should be noted that all data and model results provided in the meeting presentation materials and/or discussed during the meeting are preliminary and subject to revision. Much of the data that were presented have not been fully QA/QC'd and the models used in generating the examples presented in the meeting have not been fully calibrated or validated; model outputs were for demonstration purposes only. The model results should not be cited or used in any way to describe Project effects.

The following meeting notes are intended to capture major discussion points, and questions and comments raised during the POC meeting. These notes are supplemental to the presentation materials provided on the Project website (http://www.susitna-watanahydro.org/). The meeting agenda and meeting materials including all of the presentations made during the meetings are available under the "Past Meetings" tab (link provided under the "Meetings" tab) on the Project website.

April 15 POC APPROACH AND MODELING INPUTS

Review of Agenda and Meeting Objectives – Dudley Reiser

Dudley Reiser opened the meeting and noted that the POC meeting was a follow-up to the November 13-15, 2013 Riverine Modelers meeting that provided a forum for discussing each of the different models, including model inputs and outputs and linkages to other models. The POC meeting was designed to demonstrate how the different models would be used in evaluating fish habitats within the different Focus Areas in the Middle River. In this case, FA-128 (Slough 8A) was selected and each of the modelers would be presenting information and preliminary model results specific to FA-128. He briefly reviewed the agenda and noted that the majority of the first day would be spent on reviewing model inputs and reach-scale drivers of the POC analysis, which would then lead to detailed discussion concerning model results specific to FA-128. The second day was scheduled to continue the more detailed discussion of the FA-128 modeling that would include specific examples of model output resulting from effective spawning and incubation analysis and salmonid rearing habitat analysis. The third day would present information on options for spatial extrapolation of model results, provide a summary of the habitat modeling being conducted on the Lower River segment, and allow for open discussion of the overall POC meeting. The following notes are presented chronologically by day and generally follow the same format provided in the Riverine Modelers notes. Annotations generally include brief descriptions of what was presented followed by bulleted (●) Discussion Points and (○) Comments/Questions (C/Q).

Brief Review of November 13-15, 2013 Riverine Modelers Meeting and Issues Identified – Dudley Reiser (R2)

Dudley Reiser displayed the meeting notes from the Riverine Modelers meeting and indicated that the notes had been used by the modelers for identifying resource issues that had been mentioned during the first meeting that served as key points to address in the POC meeting. He didn't expect all issues to be addressed by the end of the POC meetings, but a large number of them.

POC COMPONENTS – DUDLEY REISER AND PHIL HILGERT (R2)

Dudley Reiser then provided some background information related to the POC including the rationale for the selection of FA-128 (Slough 8A) (http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_FA128SelectionBasis.pdf). He stepped through each of the ten Focus Areas progressing from upstream to downstream and noted the different levels of complexity in each. FA-128 was selected for demonstration purposes because it contained the full complement of habitat types present, the habitats are highly complex, areas of groundwater-surface water interactions are known, and the 1980 studies indicated that this location was biologically important and supported salmonid spawning and juvenile rearing. Because of the complexity of habitats within FA-128, it was one of the more intensely studied of the seven FAs that had been measured to date. He demonstrated this through a series of slides that layered in the locations of different resource studies within the FA. It was felt that the selection of FA-128 for POC would provide the best example of the linkages between all of the models and how they will be used to evaluate flow-habitat relationships.

Some of the major points from the presentation and discussion:

- General comments
    - C/Q – The question of model validation came up and Charlie Wisdom indicated he would like to have a validation data set in addition to a calibration data set for each model.
    - C/Q – Lori Verbrugge reminded group about the question of uncertainty and how that will affect outputs of models feeding into one another. Dudley Reiser responded that uncertainty was briefly discussed during the November 13-15, 2013 TT Decision Support System presentation and that it would receive further attention.
    - C/Q – Because one of the PPT slides showed HSC data collection sites, Jeff Davis asked whether the HSC measurements would be further evaluated relative to FDA. Dudley Reiser noted that the FDA data will be reviewed and may be used as one means to check the HSC/HSI model predictions.
- Complexity of Focus Areas as a basis for determining Level of Study Intensity
    - C/Q – Eric Rothwell commented that his view of the Study Plan indicated that "each of the Focus Areas would be subject to intense study". His interpretation of this was that every Focus Area would receive the same level of study for all of the resource disciplines. As an example, not having groundwater wells at each site seems to be contradictory to this. Dudley Reiser noted that all of the Focus Areas are being or will be intensively studied, but that doesn't mean that the studies at a given Focus Area will necessarily include the same level of effort across all resource disciplines. As an example, he cited to FA-115 (Slough 6A) and noted that although that site contains abundant salmonid rearing habitat, it does not contain spawning habitats and therefore there is no need to install groundwater wells to monitor sources of groundwater upwelling related to spawning and incubation habitats. He also cited Indian River FA (FA-141) noting it consisted largely of a tributary and that again, groundwater monitoring was not warranted. Michael Lilly added that there were discussions related to all of the FAs across all disciplines that identified key issues/questions that considered the specific characteristics of each FA. This led to a determination of whether certain study elements (e.g., groundwater) would need to be included in all Focus Areas.
    - Dudley Reiser then briefly discussed the two biological metrics that would be the subject of the POC discussions including: 1) Effective spawning and incubation habitat; and 2) Salmonid rearing habitat. He referred to the earlier set of biological metrics discussed during the November 13-15, 2013 meeting (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_BiologicalMetricsTable.pdf) and noted these two metrics captured a number of individual metrics and both are important relative to understanding Project effects on fish habitats.

- C/O – Jeff Davis asked about whether barrier analysis or flow fluctuations/varial zone analysis would be discussed as part of this. Dudley Reiser indicated those would not be covered in these meetings but are important and are being considered.

He also presented a few slides excerpted from the March 21, 2014 TT meeting that provided an update on the Habitat Suitability Index (HSC)/Habitat Suitability Index (HSI) development process (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014-03-21TT_IFS_Presentation-HSC.pdf). These served to highlight the locations of HSC measurements and identified the species and life stages (chum spawning and coho fry) that were used in the POC habitat analysis. Phil Hilgert noted that the objective of the HSC studies is to collect two years of data from within each Focus Area as well as other areas. Data have been collected using a stratified random sampling design that included measurements of both habitat utilization and habitat availability.

Dudley Reiser also briefly described the two scenarios that were the subject of the POC analysis including Existing Conditions and what is termed Operational Scenario 1 (OS-1). He mentioned that John Haapala would be providing more information on these.

MODELING INPUTS AND REACH-SCALE DRIVERS OF THE POC ANALYSIS

The next discussion centered on describing the various inputs that were used in the POC analysis.

Representative Years – Lyle Zevenbergen (TT) / Phil Hilgert (R2) / Jon Zufelt (HDR)

Lyle Zevenbergen began the discussion of representative years and stepped through a series of slides that described the selection process applied from the fluvial geomorphology (FGM) perspective for analysis (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014_04_15_TT_Riverine_RepresentativeYears.pdf). The representative years are those that will be the focus of the modeling efforts to include a wide range of climatic conditions in addition to average conditions. He mentioned the objectives were to identify representative years for wet, average and dry conditions as well as years representative of warm and cool Pacific Decadal Oscillation (PDO) periods. He noted that fluvial geomorphology was concerned with open-water period, ice processes concerned with ice covered period, and instream flow concerned with both. He described the processes he used in sorting and ranking the years that lead to identification of several candidate years for the open water period, as well as the procedure for screening the PDO periods. The initial recommendation for representative years was 1950 (dry year), 1985 (average), and 1981 (wet).

Phil Hilgert then explained the selection process from the instream flow habitat perspective and noted that there was agreement on the 1981 (wet) and 1985 (average) years. However, for the dry years, instream flow preferred 1970.

Jon Zufelt discussed the approach from the ice processes perspective and was likewise ok with the selection of 1985 and 1981. However, dry, average and wet designations do not work well for winter period and would rather use categories of cold, average, and warm. A review of data suggested that the cold (dry) year should be 1976 instead of 1970. Thus, final representative years are 1981 (wet/warm), 1985 (average), and 1976 (dry/cold).

Some of the major points from the presentation and discussion:

- C/Q – Joe Klein suggested that if Fluvial Geomorphology Modeling (FGM) predicts channel change at Years 0, 25, and 50, then the 50 years will include the entire cycle of PDO. Joe suggested that FGM consider the influence of PDO when looking at future channel change.
- C/Q – Domoni Glass (Environ) wondered whether the timing of higher flows was an issue that should be looked at. Lyle responded that the timing is not an issue for the geomorphology as the time of the flow during the open water period does not influence the geomorphic response.

- C/Q – Joe Klein asked why not 2 or 3 years for each wet, dry, average year to be more representative. Lyle responded that if parsed finer and finer then the representative year concept is really being applied anymore. The analysis will start with representative years but others can be run through the models if warranted.
- C/Q –Joe Klein brought up the idea of taking an average of, for example, wet years rather than selecting one specific year – e.g., create a hypothetical wet year. Lyle Zevenbergen responded that this would result in a year without good peak flows as well as low flows and could mask variability. Joe Klein countered that you may be picking a year that may or may not be representative – have to better understand what the results would be used for in thinking about this. Phil Hilgert noted that the use of a synthesized year would require a separate model run and it would not have any associated meteorological conditions and tributary inflows; this could be a problem.
- C/Q – Greg Auble said beyond representative years, he is more concerned from a biological perspective in the habitat season. That high flows occur is an important qualitative aspect of the hydrologic regime for both fish and plants and that naturally there's a little bit of variation within this. He noted that this is a qualitative aspect of the flow regime that is not specifically included in dry, wet, cold, warm year designations. He further noted that Project operations would likely have a pretty strong effect on the variability and magnitude of the high flows and going to see big shift in the proportion of years with late occurring high flows. He indicated it was important that this not be missed, but also acknowledged there is a ways to go in the modeling before this can be addressed.
- C/Q – Sue Walker asked about consideration of El Nino and La Nina years. Lyle responded that they are inherent in the 50 years of record to be used for the long-term simulations.
- C/Q – Dudley Reiser noted that these were all good comments related to representative years and that the modeling effort has not finalized anything. The key objective is to select a set of years that broadly represent the range of flow and ice breakup conditions that can occur in the river that can be used in the models to reasonably characterize how riverine processes operate under natural conditions, and then compare those with different operational scenarios.
- C/Q – Wayne Dyok responded to Greg Auble's comment regarding higher flows in the spring rather than later. He noted that issues such as this should be able to be potentially managed via inflow forecasting that will allow for better reservoir management.

Operations Modeling of Existing Conditions and OS-1 – John Haapala (MWH)

John Haapala then provided an update on the operations modeling that was used in the POC analysis (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014_04_15-17_TT_Riverine_ReservoirOperations.pdf). He briefly reviewed the maximum load following scenario that has been termed OS-1 and noted the objective in running this scenario was that it provided an extreme case of operations. Ostensibly, the resulting seasonal, daily and hourly changes in stage would therefore represent a worst case scenario and therefore resource effects associated with this operation should likewise theoretically be the greatest. He noted that the scenario had been modified slightly from the original OS-1 in that the USGS flow extension study results were now available and therefore incorporated more than one year of operation; the scenario was therefore termed OS-1b. He described the process used in ranking flows from wettest to driest and identified the Dry – 1976, Average – 1985, and Wet – 1981 representative years. He then progressed through a series of slides depicting operational runs for each of these representative years noting Watana outflow, inflow, Gold Creek flow and the reservoir elevation.

Some of the major points from the presentation and discussion:

- Operational differences between the years were most notable during the periods from July 1 through September.
- Operations during the winter periods were generally consistent during all years with daily flow changes ranging from around 4kcfs to 12kcfs.
    - C/Q – Eric Rothwell asked about ramping rates and John Haapala indicated those were not considered in this scenario. Eric Rothwell suggested following ADFG guidance on ramping rate restrictions based on Washington State's Instream Flow guidance document (see Hunter 1992)[1]. Joe Klein mentioned that the worked described in Hunter (1992) was based on a middle sized river.
- John Haapala noted that –the operational scenario was based on limiting the spillway operations to every 50 years because of gas supersaturation and its effect on fish. He also noted that having a full reservoir was important for meeting minimum flows which for purposes of this scenario were those considered in Case E-VI of the 1985 license application.
    - C/Q – Question was asked how ramping rates would affect operations if imposed Hunter's ramping rate restrictions. John Haapala responded that it could flatten the daily fluctuations but hard to say without actually modeling. Wayne Dyok noted that these types of operational modifications are being considered and will be added as needed.
    - C/Q – Question was asked if reservoir sedimentation would have effect on operations. John Haapala responded that the OS-1b scenario contains original volume of reservoir, but can reduce this volume by an amount, as determined by other models. He noted that based on previous 1980s studies, reservoir sedimentation did not seem to be a significant factor. Bill Fullerton added that the Water Quality model will consider reservoir sedimentation to some degree.

Reservoir Water Quality Model – John Hamrick (TT)

John Hamrick then provided updates on both the reservoir and riverine water quality models that will provide inputs into the fish habitat analysis (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_ReservoirWQM.pdf). He described the objectives of the modeling and the EFDC modeling framework that included a hydrodynamic model, temperature model, nutrient cycling model, a solids and sorptive contaminant model, and a mercury cycling model. He briefly described each of these models and the spatial resolution of the reservoir model. He noted that for the POC analysis he completed two multiple year simulations of post-Project reservoir temperature corresponding to 1974-1976 which represented a dryer period with large pool drawdown, and 1979-1981, a wetter period with small pool draw down. He then displayed a series of figures that depicted inflow (into reservoir) and outflow temperatures as well as reservoir pool elevations for the two different simulations. The general patterns depicted for both series showed a general decrease in water temperatures during the summer/open-water periods and an increase in temperature during the winter time (see slides 12-16). He also displayed simulations depicting water temperature profiles at the dam location (see slides 17-20).

Some of the major points from the presentation and discussion:

- C/Q – Jeff Davis asked how the models deal with phosphorous and nitrogen and if these are preloaded, also whether field data are used to define those parameters. John Hamrick responded that it uses standard model inputs but that some can be specified by site specific parameters. Absent field data which is the case since the reservoir currently does not exist, the model inputs will use literature derived values for a range of parameters in northern climate water bodies.

[1] Hunter, M.A. 1992. Hydropower flow fluctuations and salmonids: a review of the biological effects, mechanical causes, and options for mitigation. State of Washington Department of Fisheries Technical Report No. 119. Olympia. 46 pp.

- C/Q – Felix Kristanovich asked about the status of the mercury model. John Hamrick said it is under development and estimated it should be available in the next 6 months. Right now there are no plans to simulate zooplankton in the model, but predation on algae is included to provide an indirect representation of zooplankton.
- C/Q – Wayne Dyok asked if during the winter period, you could get closer to 0 degrees by pulling from water closer to the surface. John Hamrick said possible but would have to give this some thought. He noted this relates to the use of "shuttering" which could be used to select withdrawal depths. Dara Glass asked about lower levels of the reservoir, if aerobic or anaerobic conditions would dominate the colder and lower you go. John Hamrick noted he would expect most of the deeper waters to have low DO in the model.
- C/Q – Question was asked if the reservoir would be stratified or have seasonal turnover and how does ice and inflow affect the stratification? John Hamrick responded that the fall turnover is most dramatic and that this would be affected by the operation of the outlet. If you take water off the surface this would allow higher DO saturation at the surface, so might be favorable to re-aeration. During ice cover, temperature ranging from zero under the ice to as high as 4 ºC in very deep location could be expected.
- C/Q – Wayne Dyok asked whether it would ultimately be possible to compare results of the temperature model with those of the 1-D model developed in the 1980s? John Hamrick indicated that everything is included in the model to estimate a bulk thermal budget so this should be possible.

Open-water Flow Routing Model – Version 2 – Stuart Beck (R2)

Stuart Beck presented an update on the OWFRM noting that Version 2 had been completed (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17_TT_Riverine-V2OWFRM.pdf). He noted that new cross-sections had been added in the Middle and Lower River, the domain had been extended down to PRM 29.9, and the coverage within the floodplain had been extended with LiDAR. Version 1 of the model was based on 88 cross-sections while Version 2 was based on 167 cross-sections. He also noted that the calibration had been refined, new cross-section rating curves had been developed, and tributary flows had been synthesized. He then showed a series of figures that displayed simulated WSEs versus USGS measured at Gold Creek gage, Sunshine gage, and Susitna gage. He explained the outputs from the model will include hourly flow and stage hydrographs at different locations in the river including Focus Areas and showed examples for PRM 187.2 and at FA-128 for dry (1976) and wet (1981) under existing and OS-1b conditions. He also discussed the limitations of the model and noted it was not applicable during ice-covered conditions, the model is one-dimensional, the bathymetry within Devils Canyon was estimated, and that there are no water surface elevations at locations in between the cross-sections. Stuart Beck indicated that the 2-D hydraulic model within the Focus Areas would rely on input from the OWFRM to determine WSEs. The output from the OWFRM combined with LiDAR will also be used for determining areas of inundation in riparian floodplain zones.

Some of the major points from the presentation and discussion:

- C/Q – Colin Kikuchi suggested including a few figures in the ISR simulating stage instead of flow at FA-128 (Slough 8A) in addition to flow for OS-1b. Stuart Beck indicated those will be included.
- C/Q – Felix Kristanovich asked about the calibration process, specifically is channel width part of the calibration for interpolated data? Stuart Beck noted that the interpolation process used 2 steps. The first employs a process where a synthesized transect is placed downstream from an existing transect, with the synthesized transect based on existing information, with the dimensions of the transect capable of being adjusted. The second is based on an option in HEC-RAS that allows for the interpolation of transects between measured transects. HEC-RAS employs an algorithm that provides a smooth transition with the interpolated transects between cross-sections.

- C/Q – Greg Auble expressed some confusion between the different models. He asked whether the cross-sections in this one would be modified by 25 and 50 year geometries. Stuart Beck noted that initially this will be run with existing topography, and then can be modified based on altered geometries provided by 1-D bed elevation model. Stuart Beck indicated he expected changes in bed elevations and width resulting from riparian encroachment. Greg Auble indicated there was no reason one couldn't do linear interpolation between cross-sections to get sense of overall area. Stuart Beck agreed and indicated this application will be discussed at the Riparian POC meeting.
- C/Q – Dan Healy raised several questions, the first whether there had been checks for correlation between the OWFRM and the 1-D ice process model? Stuart Beck and Steve Ertman both indicated there had been a comparison made between Version 1 of the OWFRM and the open-water version of the River1D ice model and both were behaving similarly. Dan Healy also requested that if adjustments were made in width/elevations resulting in changes in slope to match simulated water levels, this should be discussed in the reporting, as well as how that might affect ice process modeling where water surface width is important to heat transfer and jam stability relationships. The transference of geometry between 2 models is something of concern. Stuart Beck noted that a detailed description of the calibration process would be included in a Technical Memorandum/Appendix to the ISR. Dan Healy also suggested consideration be given to HEC-RAS capabilities to handle the influence of lateral habitats on main channel WSE. Stuart Beck noted this is being incorporated into the analysis and are specifically looking at areas that only become engaged with certain WSEs.

Riverine Water Quality Model – John Hamrick (TT)

John Hamrick then proceeded to describe the status of the riverine water quality model (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_RiverWQM.pdf). He briefly reviewed some of the questions raised during the November 13-15, 2013 meetings including how would water quality be characterized in the Focus Areas. He described a series of models that are included in the analysis including; the hydrodynamic model noting there was a coarse mesh 2-D model for the entire river and finer mesh 2-D models for Focus Areas; the water temperature model which is primarily concerned with open-water conditions; the nutrient cycling models; and the solids and contaminant models. He also displayed a relationship between turbidity and TSS and Rob Plotnikoff noted this was being looked at due to the importance of turbidity as part of the HSC/HSI analysis. John Hamrick described the model domain and spatial resolution (slides 9 and 10), and then provided a series of slides to note the coarse horizontal grid for the entire river and finer grid in the Focus Area (FA-128 was shown). He described the POC simulations noting this focused on water temperature – again simulation periods were 1974-1976 (dryer periods) and 1979-1981 (wetter periods). Pre-Project analysis used historical river flow, post-Project used reservoir outflow temperature. He then showed preliminary model outputs for these two periods (slides 15 – 20). The figures showed a general pattern of warmer temperatures in the winter periods and colder temperatures in the summer months for the post-Project simulations. Slides 19-20 displayed temperatures at different locations (dam site, PRM 131, PRM 88.1) and indicated a tempering of the temperature differential in a downstream direction. John Hamrick then displayed a series of plots showing pre-post temperature comparisons in the general vicinity of FA-128 for both the 1976 and 1981 time periods. He discussed the lateral variation in temperatures in Focus Areas and noted that thermal imagery indicated differences (1-3 ºC) in temperatures between sloughs and creeks and mainstem river. He ended the presentation with an update of the river modeling effort.

Some of the major points from the presentation and discussion:

- C/Q – Jeff Davis asked what WQ parameters were linked directly to HSC? Dudley Reiser noted that HSC is considering turbidity, DO, and temperature – these are the 3 parameters brought in from WQ model.

- C/Q – Question asked about integration of reservoir and riverine water quality models? John Hamrick noted the models do not run simultaneously, but the reservoir model provides post-Project upstream boundary conditions for the post-Project river model.
- C/Q – Jeff Davis asked about the TSS/turbidity relationship. Rob Plotnikoff noted it was developed from data from both glacial fed and clear water tributaries; data comes from all transect locations for a variety of depths; it represents four months of data. Jeff Davis noted that the TSS vs. turbidity graph (slide 9) ranges from 0 to 1,400 NTUs; however, fish use will be influenced by changes of NTUs in the 0 to 200 NTU range. While the relationship appears strong from 1 to 1,400 NTUs, it appears that the 0 to 200 range may be biased by the higher values. He suggested that AEA consider re-partitioning the turbidity data to see if a better relationship is available for the lower NTUs – and HSC should double-check that turbidity is or is not correlated to fish distribution. Dudley Reiser indicated the relationship between fish distribution and turbidity was being evaluated; he referenced statistical analysis being completed by Alice Shelly of R2.
- C/Q – Sue Walker referred to slide 14 and asked whether the simulations relied upon air temperatures. John Hamrick noted the temperatures based on atmospheric temperature records at Talkeetna. Sue Walker asked a number of follow-on questions related to climate change and specifics of the data sources and John Hamrick addressed.
- C/Q – Jeff Davis asked about links between mainstem and side channels/sloughs? If main channel gets colder will side areas also or will they respond independently? John Hamrick noted that the data suggest temperature differences in some areas can be up to 2 degrees. Jeff also asked about model calibration and determining if the model results are reliable. John Hamrick noted that the standard strategy that will be applied here is to calibrate and then validate the model with data.
- C/Q – Colin Kikuchi noted it would be useful to have a good description of parameters used in validation process and calibration parameters presented in the ISR; perhaps in tabular format. John Hamrick noted that the reservoir model can't be calibrated, but that based on his professional judgment and experience, he believes it looks reasonable. For the riverine model, the hydrodynamic part is just like the HEC-RAS or River1D where adjustments are made to roughness. He noted there will be a more explicit explanation in the ISR.
- C/Q – Joe Klein agreed that a better description of the calibration and validation process is needed in the ISR. He believes this is important across all models.
- C/Q – Greg Auble asked how upwelling/hyporheic flow is input into the fine grid in the WQ model. John Hamrick noted that the current model addresses this as a thermal sink; Greg Auble – added – as if there was no upwelling or hyporheic flow? Dudley Reiser noted that upwelling is not explicitly in the model yet and but will need to come in; same with the 2-D hydraulic model that will be described. Modelers are still considering how the groundwater elements will be brought into the 2-D models. Colin Kikuchi noted there were some estimates of groundwater upwelling sources from the 1980s data that could be used in the analysis. John Hamrick noted that groundwater inflow and temperature can be readily included in the model after that information is assembled in a spatial-temporal format.

River1D – Ice Processes Model – Jon Zufelt (HDR)

Jon Zufelt began the ice processes presentation by revisiting issues raised during November 13-15, 2013 meetings (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_River1D-IceProcesses.pdf) (slide 2). He noted that Steve Ertman would be describing the River2D model development on Day

2 of the meetings. Jon described the River1D ice model components including frazil ice formation and transport and ice accumulation (slides 3-4). He presented a figure (slide 5) that displayed Accumulated Freezing Degree Days (AFDD) versus time for the three representative years – 1976 – cold, 1981 – warm, and 1985 – average; the figure displayed periods of freeze-up, ice growth, and breakup. This was followed by a figure depicting flows during the winter periods under pre and post (OS-1) conditions. He noted that River1D model is not yet completed (due in June) and stepped through a number of caveats relevant to the POC discussion at FA-128 (slide 7). He showed several slides depicting cross-sections at PRM 128.1 and 129.7 and photographs of freeze-up. He then stepped through a series of slides that provided examples of River1D modeling under 6,000 cfs for different freeze-up periods, 2,000 cfs with freeze-up cover, and the progression of freeze-up at FA-128 under 6,000 cfs.

Some of the major points from the presentation and discussion:

- C/Q – Eric Rothwell – It's not clear the process of how 1-D model results that represent average conditions and will be brought into the 2-D framework at specific Focus Areas. Jon Zufelt noted this will be discussed during Day 2 meeting; he confirmed that the 1-D represents average values for each cross section and cannot be expected to represent different thicknesses of ice in the main channel and side channel. He noted that a separate little model up a single channel, based on 2-D model velocities could be ran to obtain estimates of ice thickness in the side channels.
- C/Q – Eric Rothwell asked how ice progression might occur under load following conditions. Jon Zufelt indicated that it may be possible to run River2D and determine velocities at all nodes, as a means to determine how ice formation may occur in the side channels and sloughs; Steve will discuss how velocities were used to determine where to place ice in the 2-D model tomorrow.
- C/Q – Greg Auble asked if the ice modeling is going to handle breakup. Jon Zufelt – yes.

Jon Zufelt then provided a short presentation that described the process for ice breakup forecasting and what the latest breakup forecast is for 2014.

Geomorphology – Lyle Zevenbergen (TT)

Lyle Zevenbergen presented an update on the reach scale fluvial geomorphology modeling (FGM) (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014_04_15_TT_Riverine_FGM-1D.pdf). He described the linkages between the 1-D and 2-D models and noted that the 2-D hydraulic model would serve as input to the habitat modeling analysis. The reach-scale model extends from PRM 187.2 to PRM 29.9 and includes the Chulitna and Talkeetna rivers up to the USGS gages. The model will also provide inputs to Focus Areas for future (25 and 50 year) conditions, including downstream boundary conditions, upstream flow and sediment boundary conditions, and main channel change. He also discussed some preliminary aspects of the POC FGM analysis that will be presented on Day 2; year zero conditions, no sediment transport inputs included, habitat inputs provided by 2-D hydraulic model, and modeling consisted of series of steady state models at different flow conditions.

Some of the major points from the presentation and discussion:

- C/Q – Question asked about how FGM will be validated. Lyle Zevenbergen noted that the 1-D model will be tested against 1980 to 2012 data as a test of reasonableness rather than validation. Complete 1980s data sets are not available to complete an independent validation/calibration process. Will also be running models for sediment rating curves for upstream end, and see how well the model matches sediment rating curves for other locations. Largely it's a test if model is producing reasonable results that we have faith in but not true validation/calibration.
- C/Q – Question raised about the armor layer and how that will be handled. Lyle indicated the model will be ran without the armor layer and the model will build it using different grain sizes as input. Results look promising but nothing to report yet. Bill Fullerton noted that video had been

taken through the ice as a means to discern bed material sizes in the deep areas that could not be sampled during turbid open water conditions.

- C/Q – Question raised regarding how changes in width will be handled. Lyle noted width change would be included in both 1-D and 2-D models and will be based mainly on sediment supply and change in the frequency of the 2 year (or slightly less) frequency flows. This will be used to come up with effective long term change.
- C/Q – Question raised regarding sediment sources post-Project. Lyle noted the reservoir will capture virtually all sediment and that virtually clear water will be coming out of the reservoir. Only a small fraction of the wash load (silt and clay, but mostly clay) will be transported through the reservoir. Therefore, only banks and tributaries will provide sources of sediment below the dam, particularly bed material load (sand, gravel and cobble).
- C/Q – Question regarding loss of high flows and therefore river unable to move coarse sediments delivered by the tributaries after dam is constructed. Lyle noted that some tributaries currently have large fans and if less of this sediment can be transported, after dam construction, this may result in further building of the fan until the river is sufficiently constricted to provide hydraulic conditions that do transport the tributary sediments. Sediment deposition at tributary mouths will be assessed with the 2-D model in Focus Area and with a mass balance and 1-D modeling approach at selected tributaries outside the Focus Areas.
- C/Q – Jeff Davis asked about sediment sources as being episodic? Lyle acknowledged this noting it certainly happened in 2012 at Gold Creek and upper tributaries. Since the 1-D model will be working with a 50-year period of record large events will be contained within the record.

FA-128 (SLOUGH 8A) RESOURCE MODELS/ANALYTICAL TOOLS

Dudley Reiser noted that the presentations would now shift to discussions of Focus Area FA-128 (Slough 8A) and how the different models are being used to provide inputs into the habitat modeling analysis. Time considerations resulted in shifting the presentation on groundwater ahead of geomorphology.

Groundwater – Michael Lilly (GWS)

Michael Lilly provided a description of groundwater related activities that are occurring at FA-128 (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15TT_Riverine_Presentation-Groundwater.pdf). He stepped through a series of slides that illustrated the analytical approach and process being applied and types of data being collected at FA-128 (Slough 8A). He then presented slides that described the importance of modeling and illustrated general habitat types and groundwater/surface water interactions. Slides 8-15 provided images of FA-128 (Slough 8A) that depicted a variety of hydrological features, boundaries, and data collection and monitoring points, including groundwater wells. He highlighted locations that were selected for aquatic transects (slide 16). He also provided several examples of water temperature and water level relationships that have been recorded for different monitoring stations within FA-128 (see slides 20-33). Areas of groundwater upwelling were depicted in two figures (slide 33 and 34), the latter illustrating areas influenced by riverine and upland groundwater sources. Michael then provided a table illustrating groundwater upwelling trends that will be provided as inputs into the habitat modeling analysis.

Some of the major points from the presentation and discussion:

- C/Q – Colin Kikuchi asked about the delineation of certain small channel features north of Slough 8A. Michael Lilly noted those were old swales that act like French drains; they have not been identified as major features. Fish habitat HSC has conducted some sampling in these areas.
- C/Q – Bob Henszey noted that for riparian, those are uncommon habitats; can they be quantified? Michael Lilly noted this would be addressed in Riparian POC meetings. He does not

think these features have a significant influence on hydrology. Bob Henszey voiced concern that he has not seen any data to support Michael's interpretation of these features. Michael noted that data are being collected but some professional opinion will be needed in terms of interpretation.

- C/Q – Melissa Hill asked if staff are currently collecting data. Michael Lilly indicated crews are visiting the following Focus Areas: FA-138, FA-128, FA-113, FA-115, and FA-104. The data collection is to maintain camera sets, discharge measurement sets including paired measurements to monitor groundwater inflow, and some water quality measurements; crews are capturing end of winter period.
- C/Q – Colin Kikuchi asked for definition of upland dominated. Michael Lilly indicated that definition does not mean that there is no influence by stage changes in main channel, but the primary source of groundwater exchange relates to upland hydrology processes that are not influenced by riverine hydrology. Colin suggested changing definition to mean magnitude of susceptibility of influence from main channel; i.e., riverine is most susceptible.
- C/Q – Jeff Davis does not see how this relates to HSC (slide 36) relative to upwelling and downwelling. Dudley Reiser indicated it does not relate directly to that slide; will also need temperature component of the groundwater to bring this into egg incubation and fry emergence. Bill Miller noted he would be looking at time periods. Michael Lilly noted he will be working with Bill Miller in determining data needs; mapping out zones and determining whether that zone will change with flow and defining its characteristics. Bill Miller noted the process of figuring out that interface and the ability to transfer the data to the river segment scale is ongoing.
- C/Q – Melissa Hill stressed importance of obtaining groundwater fluxes in these areas, not just qualitative data. Phil suggested the need to identify the reference flow associated with the classification as that will allow for work in a more quantitative fashion.

- Dudley Reiser noted that IFS is still working heavily on groundwater as it is a significant issue. The preliminary designations of groundwater dominance provided in slide 34 may be useful for considering how these could be used in other areas.

April 16 FA-128 (SLOUGH 8A) RESOURCE MODELS (continued) AND ADDRESSING BIOLOGICAL QUESTIONS AT FA-128

Dudley Reiser provided a brief overview of day two activities, noting that the focus of discussion would be on presenting preliminary modeling and analytical results specific to FA-128 (Slough 8A) as a means to demonstrate the integration of resource studies in evaluating potential Project effects on fish habitats.

FA-128 (SLOUGH 8A) RESOURCE MODELS/ANALYTICAL TOOLS (CONTINUED)

Geomorphology – Lyle Zevenbergen (TT)/Bill Fullerton (TT)

Lyle Zevenbergen began the discussion with a presentation on the geomorphology modeling that has occurred at FA-128 (Slough 8A) (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15TT_Riverine_Presentation-Geomorph.pdf). He briefly summarized some of the issues that had been raised at the November 13-15, 2013 meetings and discussed the selection of the 2-D model, SRH-2D for the geomorphology modeling. He also reviewed status of the 1-D modeling noting that HEC-6T was initially preferred but that HEC-RAS Vs 4.2 was being evaluated. He then discussed the interdependencies of the studies and specifically highlighted data needs for the IFS habitat analysis (see Slide 6). The next series of slides presented depicted the steps used in developing the bathymetric data and the TIN for FA-128 (Slough 8A) and

including screen shots of contours and coarse and fine mesh patterns (slides 10-11), and geomorphic mapping. He then described the calibration process noting adjustments in Manning's n and calibration of WSE, discharge and velocity (slides 14-23). He then presented some preliminary results and noted there were a number of issues that warranted further consideration, including integration of subsurface flows that is not explicitly addressed in SRH-2D. Lyle presented a series of slides that showed how those issues were addressed for the POC (slide 28) and noted that the model is capable of including point source inputs such as would occur via groundwater-surface water exchange (slides 28-37). He then stepped through a series of model output slides that depicted depths for flows from 2,000 cfs to 50,000 cfs, and then a series of slides at 30,000 cfs that depicted WSE, velocity, shear stress, Dcrit-mm, and Froude # (slides 38-51). He noted that one of the next steps would be in formalizing an approach that considers groundwater and hyporheic flows.

Some of the major points from the presentation and discussion:

- C/Q – Jeff Davis asked about the range of depths in probability curves in (juvenile rearing?) and how that relates to the FGM output. Dudley Reiser noted the depths depicted are included in the range of depth in HSC functions. Jeff Davis also asked whether as part of the calibration (slide 22) comparisons are made by macrohabitat type. Lyle Zevenbergen noted calibration was done as a whole and not per macrohabitat type.
- C/Q – Question asked whether there is going to be enough data to use this in a predictive sense. Lyle responded yes, for instance in Slough 8A, data has been collected over a range of conditions.
- C/Q – Greg Auble thought the modeling could get weird if there is a lag in hyporheic flows; i.e., may be putting a wave through the model. Lyle noted that these are steady state models, and need to be aiming for the average condition. Lyle indicated there is the same issue with Skull Creek; there will be a range of flows in Skull Creek when the mainstem is at 12kcfs but will need to run the model for the average condition (flow) in Skull Creek.
- C/Q – Jeff Davis asked whether discharge at Slough 8A would remain constant. Lyle noted that for POC, 4 cfs was added at the upstream end, but this can be adjusted based on further information. It will be possible to put this flow in as a line source that accumulates in a downstream direction.
- C/Q – Joe Klein asked whether that process will be applied at other Focus Areas. Lyle – yes. Joe also asked whether the rate of influx from groundwater can be adjusted under different flow conditions. Lyle noted that for the POC, Stuart Beck provided input estimates that were fixed, but that with varying flows the rates could be adjusted.
- C/Q – Question asked if groundwater capabilities of River2D were considered? Lyle Zevenbergen noted that the groundwater component of River2D is really just a numerical method to accommodate wetting and drying of mesh elements, to keep the model stable. In theory, it might be able to be fine-tuned to get something that might work along this line. However, River2D does not use point sources. He noted that Steve Ertman will address River2D later on. Phil Hilgert commented that the initial run of River2D does visually appear to do a much better job of modeling groundwater-fed habitats than the initial run of the SRH-2D; but the River2D has limited ability to make adjustments. SRH-2D allows up to 10 inputs per FA which allows macrohabitat-specific groundwater rating curves to be incorporated.
- C/Q – Jeff Davis asked if salmonids had been caught in the cross-channels noted earlier. Phil Hilgert – yes but he does not have data at hand showing how many and what sizes.
- C/Q – Sue Walker asked if the model outputs had been validated. Lyle Zevenbergen – no, this is preliminary modeled data.
- C/Q – Question raised – are there plans to do a comparison of shear stress between 1-D and 2-D? Lyle Zevenbergen – yes, will look at shear stress distribution in the channel. May not use entire

channel as being mobile, so will look at an effective width to account for fact that 1-D is using average condition so want to get average; lean more towards areas that will actively transport sediment.

- C/Q – Melissa Hill commented she was pleased with the way groundwater had been added as a quantitative amount. She is not advocating 3D groundwater modeling but feels that having this represented in a quantitative manner is important.
- C/Q – Dudley Reiser noted that from a fish habitat analysis perspective still continuing to look at River2D as a possibility since it does have the pseudo – groundwater component and it does have a bit more history with fish habitat analysis. However, SRH-2D has more flexibility in receiving inputs such as tributary and groundwater sources. Both models will work and the team is giving both careful consideration.

2-D Ice Processes – Stephen Ertman (HDR)

Stephen Ertman presented 2-D ice processes modeling examples for FA-128 (Slough 8A) (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_Presentation-2D-IceProcesses.pdf). He discussed several of the issues that had been brought up in the November 13-15, 2013 meetings and then described the conditions he was concerned with for the POC (slide 3). He then presented a series of slides depicting the River2D model layout including bed elevation, roughness length, and computational grid (slides 5-7), followed by River2D open-water results for FA-128 at 6,000 cfs (Gold Creek). He noted that River2D uses a pseudo-groundwater model that tracks surface/subsurface WSE and will place water in depressions even if they are disconnected from surface flows. He showed model output and ice formation based on open-water conditions at 6,000 cfs flow where V<1 fps and D< 1 ft. (slide 9) and then showed a progression of ice buildup. He repeated this for 2,000 cfs and 10,000 cfs flow conditions (slides 17-20). Steve noted that because River2D has a pseudo groundwater component, it tracks changes in elevation of the water surface throughout the model domain. For the winter period, River2D will have to deal with the same groundwater issues as SRH-2D, but the approach might be different for how those issues are resolved. For example, if hyporheic seepage is creating water ponding in topographic depressions, River2D might depict that adequately without further adjustment. At Slough 8A, even when the model represents disconnected channel sections, River2D will show groundwater flow coming in. If the sections were connected, the hyporheic seepage could generate a very small down-gradient surface flow.

Some of the major points from the presentation and discussion:

- C/Q – Felix Kristanovich asked where groundwater comes in for River2D. Steve Ertman noted that the only model input is coming from the River1D HEC-RAS simulant. The 1-D model gives surface-water inflow at the upstream channel boundary and stage at the downstream channel boundary. An initial condition is also required for stage at the upstream boundary. The initial stage at the upstream boundary and the specified stage at the downstream boundary defines an initial gradient for groundwater head, which then changes with time in accordance with a 2-D groundwater transport equation for an isotropic, homogenous aquifer. If groundwater flow changes with surface flow, it may be possible to simulate additional groundwater flow as a specified boundary condition, but the procedure would not be as simple as with SRH-2D. This would be even more difficult for an area such as Half-Moon Slough, which is not adjacent to a model border.
- C/Q – Bob Henszey asked if water surface contours can be shown. Steve Ertman – yes, the water surface contour for the entire model domain can be shown. Lyle Zevenbergen noted that in River2D, both groundwater and surface water are being conveyed through the Focus Area, so some of the flow is going through island areas.

- C/Q – Jeff Davis asked how the examples align with reality. Steve Ertman noted that the models are preliminary and do not reflect reality – yet. Jeff asked whether empirical data will be brought into this. Steve – yes, photographic data and ice thickness measurements during winter. Also have discharge measurements at selected locations during the winter. Dudley Reiser noted that during the last winter studies field efforts, specific locations were identified that were important from both a fish habitat and ice processes perspective in which to take measurements of ice thickness, WSE, and discharge.
- C/Q – Question – are there plans to do 2-D map of ice thickness? Jon Zufelt – no. Phil Hilgert added that River1D would be run and then could be calibrated with ice measurements. Will have mainstem transects with thickness and cover for ice process model. In addition, winter discharge at significant tributaries.
- C/Q – Question – are ice measurements taken at entrances to side channels? Jon Zufelt noted that the winter studies efforts involved collecting ice thickness at selected side channels.
- C/Q – Greg Auble noted that from perspective of getting to fish habitat, haven't talked about how geomorphic change is going to play into all this. Currently operating in current topography. How will the actual mechanic break up including knocking down trees, depositing sediment, scouring, creating side channel etc. be handled? Steve Ertman noted that most of that probably occurs in main channel and edges, and that River1D does have dynamic break up capabilities. Greg asked how will "dirt" be moved around. Lyle Zevenbergen noted that the sediment transport model for this area will be run dynamically with a very intense hydrograph, high back water, and suspended loads, and to see what kind of sediment accumulates up in those islands. By high condition, the hydrographs can easily hit 60-70k cfs for short periods.
- C/Q – Wayne Dyok noted that the reservoir has a very large storage capacity and can manage flows effectively during spring. Question is how do we want to manage it? If you want a major break up every few years for moving sediment, the flexibility with the dam would allow you to do that. Once we understand how all models work together and have identified management goals for riparian and fish, then it should be possible to think collectively on how we want to manage it.
- C/Q – Greg Auble asked about the physics of gouging out bed, ice blocks knocking trees over, lifting of gravel, etc. Jon Zufelt noted that River1D is a dynamic ice processes model which includes ice generation, ice transport, ice accumulation and growth but also jam failure and ice transport downstream. While the model can indicate areas of overbank flooding and potential ice and sediment deposition, it assumes that the ice floats hydrostatically so bed gouging by ice pieces, lateral shoving of trees or soil/gravel are beyond the physics of this model. Dudley Reiser noted that ice scar mapping has been done as part of the riparian field studies and should be able to relate scars to particular ice flow condition. Kevin Fetherston noted he had posted preliminary results of ice scar mapping that will be discussed during the Riparian POC meetings the end of April. He noted that ice is definitely affecting the flood plain. He noted he has evidence of surfaces where cottonwood trees are growing in areas that currently wouldn't flood for 500 years but have 150 year old trees growing there, so something is occurring (e.g., ice movement) to deposit sediment at these locations.
- C/Q – Question raised regarding how ice effects will be evaluated on beluga whales? Steve Ertman noted they have basic ice processes studies going on down there; but no detailed modeling.
- C/Q – Greg Auble felt that the modeling examples presented (e.g., SRH-2D and River2D) were good and it will be important to see how hyporheic and upland sources of groundwater will be

added to them. He asked about how temperature would be brought into this. Steve noted that this would be addressed in water quality discussion.

- C/Q – Dan Healy noted the model output is essentially depth and velocity, but does not output anything about the nature of the ice. Does this meet needs of other studies? Steve Ertman – yes to depth and velocity, can also estimate total bed shear stress. Bill Miller will discuss use of the data in habitat modeling discussion.

Water Quality – John Hamrick (TT)/Rob Plotnikoff (TT)

John Hamrick proceeded with the water quality modeling discussion for FA-128 (Slough 8A) and noted it was centered on water temperature (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17_TT_Riverine_Presentation-FA128WQM.pdf). He described the process used in developing the temperature simulation and noted the simulations were done for May through October for 1976 and 1981 and for Pre- and Post-Project conditions (slide 2). He displayed the model grid for FA-128 (Slough 8A) and then showed the temperature simulations Pre-and Post-Project over the May-October 1976 period followed by Pre-and Post-Project temperature depictions within the FA-128 (Slough 8A) area (slides 3-5). This was followed by a similar series of slides for May-October 1981 Pre- and Post-Project.

Some of the major points from the presentation and discussion:

- C/Q – Dudley Reiser noted that more work is occurring on the water quality elements within the Focus Areas. For example, we know that groundwater upwelling temperatures are at times different from surface temperatures and this will need to be factored into this model. John Hamrick noted that the model will allow for the input of inflows and temperatures and there are no limits on the number of these. He can overlay the groundwater contours on the map and import into the water quality grid.
- C/Q – Greg Auble asked whether the 2-D model is able to have hyporheic flow added from top to bottom of channel so can account for warm or cool water as it moves beneath islands and mixes with groundwater. John Hamrick indicated that this is not currently possible but mentioned River2D. Steve Ertman noted River2D considers a single aquifer.
- C/Q – Jeff Davis asked about calibration. John Hamrick noted its performance will be evaluated against empirical data. Dudley Reiser noted there are lots of temperature data that have and are continuing to be collected in the river that can be used for calibration and validation purposes. This includes both surface water, and in the Focus Areas, intergravel temperatures. In addition, Michael Lilly has temperature recorders in his surface-water sites, groundwater wells, and streambed temperature profile measurements. Rob Plotnikoff concurred and added that many of the water quality temperature recorders are in or at the boundaries of the Focus Areas, but also have some point measurements in the lateral habitats including along a longitudinal survey line that extends upstream and downstream from the groundwater wells located at fish habitat sites.
- C/Q – Question raised about the use of TIR data sets. Rob Plotnikoff acknowledged this data set and indicated it was for a specific date and time and flow condition. However, it will be reviewed and evaluated. Dudley Reiser noted it will definitely be used in identifying locations of groundwater both in and outside of the Focus Areas. John Hamrick noted that the water quality model could be run for the same temporal period the TIR data were collected to check correspondence.
- C/Q – Question about other biologically important parameters that will be considered in the modeling. John Hamrick noted that TSS/turbidity will be modeled, as well as DO, although data suggest for the most part DO in the system is saturated. Dudley Reiser noted that intergravel DO

may vary as it is influenced by groundwater. Mentioned that intergravel DO measurements are being collected at two Focus Areas.

John Hamrick then showed two temperature animations, one showing Pre-Project daily average temperatures during May-October 1981 and the other Post-Project temperatures for the same time period.

Biological Inputs (HSC/HSI; Periodicity) – Phil Hilgert (R2)/Dudley Reiser (R2)

Dudley Reiser noted that the discussion is now shifting over to providing a demonstration of how the inputs provided from the above models will be used in evaluating Project effects on fish habitats in FA-128 (Slough 8A). For this, want to first discuss some of the biological data that were collected in FA-128 (Slough 8A) during the 1980s. Phil Hilgert stepped through a series of 8 slides that provided useful background data on the studies completed in the 1980s (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17_TT_Riverine_Presentation-1980sSlough8A.pdf). Phil noted the similarities and differences between current habitat features and conditions in the 1980s. For instance, the inlet to Slough 8A does not appear to be breached until mainstem flows exceed about 30,000 cfs under open-water conditions. In early 2014, even though winter flows were only several thousand cfs, the inlet to Slough 8A had been breached due to an ice jam in the mainstem channel. This same pattern of Slough 8A breaching at 30,000 cfs during open-water conditions and breaching due ice jam breaching during winter low flows had been observed during the 1980s. Dudley Reiser then briefly touched on the HSC/HSI data and periodicity information that served as inputs into the habitat modeling (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_HSC-HSI-EffSpawn.pdf). He noted that the HSC/HSI models had been presented at the March 21, 2014 TWG meeting (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014-03-21TT_IFS_Presentation-HSC.pdf) and referred Licensing Participants to that presentation for more details on how the models were developed.

ADDRESSING BIOLOGICAL QUESTIONS AT FA-128 (SLOUGH 8A)

Review of Biological Metrics – Dudley Reiser (R2)

Dudley Reiser displayed the biological questions and metrics matrix that had been presented at the November 13-15, 2013 meetings (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15-17TT_Riverine_BiologicalMetricsTable.pdf). He noted that for the POC, two metrics had been selected – effective spawning and incubation habitat, and salmonid rearing habitat. These were presented for illustrative purposes only and are not the only metrics that will be evaluated.

Effective Spawning/Incubation Habitat: Open-water and Ice Covered – Bill Miller (MEC)/Phil Hilgert (R2)/et al.

Bill Miller proceeded with the discussion of effective spawning and incubation analysis at FA-128 (Slough 8A) (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15_TT-POC-meeting-2D-fish-habitat_effective-spawning_incubation.pdf). He stepped through a series of slides that provided an overview of the presentation and objectives of the POC noting that both Pre- and Post-Project conditions were considered. He reviewed the 2-D habitat based model and noted that data dependencies included hydraulic models for open-water and ice processes, substrate data and cover data, groundwater data, water quality data and HSC/HSI analysis (slide 4-5). Bill explained the steps used in the effective spawning and incubation analysis (slides 6-17) noting that the analysis centered on chum salmon spawning and tracking the spawning areas through the spawning and incubation period (slide 6). He divided the discussion into data needs for the spawning period and those for the incubation period that factored in dewatering, freezing, breaching flows, redd scour, and DO. Bill described the computational steps involved in completing the habitat analysis and provided example screen-shots of Visual Basic (VB) interfaces and linkages with GIS analysis (slides 18-22). Various data layers were displayed including those related to substrate, cover, and groundwater (slides 23-27). Data flow through the process was depicted in a series of flow charts (slides 28-33). He then provided a series of habitat simulations of chum salmon spawning under different flow conditions

(50kcfs, 30kcfs, 22kcfs, 16kcfs, 12kcfs, 8kcfs, 6kcfs, 4kcfs, and 2kcfs) (slides 34 to 42), followed by a series depicting incubation habitats under flows of 12kcfs, 10kcfs, 8kcfs, 6kcfs, and 2kcfs. The combined results of this analysis were depicted on slide 51 that displayed Habitat Area versus discharge with a distinction made between open-water and ice covered periods. Bill also described the process that would be used for breaching analysis using Side Channel 8A (slide 52-53) and then showed figures that demonstrated hourly habitat changes for a dry (1976) and wet (1981) condition, expressed as both habitat and percentage change from existing conditions. Bill summarized the process used and noted that a similar approach would be used for other species and life stages and for other Focus Areas.

Some of the major points from the presentation and discussion:

- C/Q – Question asked why temperature and DO were not considered in the HSC model. Greg Auble provided an extreme example suggesting that HSC should consider temperature even if there is no correlation observed under current conditions. Dudley Reiser reminded everyone the HSC models were preliminary and based on available information; models may change when additional data are included. Phil followed-up and agreed that if spawning were observed under a range of temperatures for Existing Conditions and Post-Project conditions greatly altered the range of temperatures, HSC without a temperature component would not detect the change in habitats. Jeff Davis asked about incubation and Bill Miller noted incubation was different since for the incubation analysis intergravel temperatures would be included. Greg Auble commented the need to make sure the variables that are subject to change from flow changes and that are biologically relevant are included in the analysis, otherwise cannot have confidence in the analysis.
- C/Q – Wayne Dyok asked why the condition of <1C temperatures resulted in loss of spawning area? Bill Miller noted this was based on freezing potential. Phil Hilgert suggested another way to consider this may be to look at cumulative degree days. Dudley Reiser noted some egg stages more susceptible to cold water mortality more than others – could factor that into the analysis.
- C/Q – Question raised about scouring and suggested a better way than Dcrit to consider scouring would be with bed shear stress ratio (actual/critical). Lyle Zevenbergen agreed and indicated he would collaborate with Bill Miller.
- C/Q – Dara Glass raised concern about the number of factors that were coming in to play in the modeling and worried that model outputs will not reflect reality. Phil Hilgert noted that the number of parameters is important and will help zero in on those habitat areas actually used. Dara asked whether habitats can move over time. Phil Hilgert – yes.
- C/Q – Jeff Davis asked if looking at all permutations. Bill Miller indicated that for the POC, selected a couple of years for examples. However, the analysis could also be considered on a seasonal basis or other time steps, as well as different years. Phil Hilgert thinks will be important to consider timing of spawning; e.g., what percent of population was spawning during a particular hour or day and then assess that time step in terms of flows from beginning of spawning to emergence. Bill Miller noted this can be done but entails a different type of analysis. Same thing can be done for scouring and dewatering – i.e., track locations over time, relationships over time with respect to flow fluctuations. Bill Miller also noted that the analysis would need to consider HSC data for upwelling gravel/cobble. Joe Klein concurred about the importance of this type of analysis.
- C/Q – Bob Henszey suggested that we consider using a non-linear Curve fitting software package for the HSC analysis (such as Table Curve 2D) rather than the 4th order polynomial. Bob will send information to Dudley.
- C/Q – Hal Geiger asked a lot of questions about the multivariate equation applied in the HSC analysis. What is the sample size n? Are we dividing the fish observations by the habitat availability or does the n equal fish observations and availability? Dudley Reiser and Phil Hilgert

suggested that more information was available on this in the March 21, 2014 HSC presentation referenced above. Also noted that it may be good to have a discussion with Alice Shelly who completed the HSC statistical analysis.

- C/Q – Joe Klein mentioned the Cooper Lake relicensing as one example where temperature problems were addressed via comparisons with criteria. Joe will send link to report to Dudley.
- C/Q – Sharon Kramer asked about the binomial distributions for characterizing depths and velocities. Suggested consideration be given to whether fish are concentrated within a specific area versus just noting whether they are there or not there. Dudley Reiser noted that the field crews did not double count fish; i.e., if observed a location that contained 5-10 juvenile fish all using the same location, the crews considered this a single observation. This approach treats one fish the same as multiple fish and could lead to other biases. The HSC crews recorded the number of fish at each observation and the database can be queried to assess how many observations consisted of groups of fish. Phil noted that for spawning, individual redds were counted. Will be looking at FDA data for further information on this.

Salmonid Rearing Habitat: Open-water and Ice Covered – Bill Miller (MEC)/Phil Hilgert (R2)/et al.

Bill Miller then shifted over to a discussion on Salmonid Rearing Habitat analysis (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15TT_2D_fishhabitat_salmonidrearing.pdf). Bill stepped through a number of the same process and modeling slides that were presented in the effective spawning presentation (slides 2-7) and noted that the analysis was focused on potential rearing habitats as defined by dewatering, cover, depths and velocities. Data needs and inputs were defined (slide 7) and the preliminary "best fit" HSC model described which included three models – not turbid/cover; not turbid/no cover; and turbid (>50 NTU). He also presented information on periodicity. For the POC, the rearing habitat analysis was focused on coho fry, although slide 9 depicted chum fry. Slides 12-18 depicted the model steps and GIS flow chart components. Bill then presented a series of slides depicting salmonid rearing habitats under ice conditions for flows of 2 – 12kcfs and then for open-water conditions for the range of flows from 2 – 50kcfs (slides 19-32). These results were displayed graphically as a Habitat Area versus flow curve (slide 33). Hourly changes in rearing habitat were depicted as well as percentage changes for a dry (1976) and wet (1981) year (slides 33-37). He noted that a similar approach would be used for other species and life stages.

Some of the major points from the presentation and discussion:

- C/Q – Jeff Davis noted that for juvenile fish, seems like relative abundance and growth rate could factor into HSC. Don't see a parameter for site score. If there's a large abundance of fish and are growing good in one area, wonder how that could be captured in HSC. Bill Miller noted that the data were collected in a random sampling process whereby transects are snorkeled and both utilization and availability data are collected (see slide 12 of March 21, 2014 HSC presentation that illustrates sampling points across 10 transects). Jeff Davis suggested that fish growth be considered as part of HSC; currently it is not.
- C/Q – Joe Klein noted that Alice Shelly had indicated she was preparing a write-up of the HSC analysis. Dudley Reiser concurred and noted this would be in an appendix to the ISR.
- C/Q – Question asked whether we have a reference chart that lists the different studies and where the data are coming from. Dudley Reiser noted that the best source for this would be the RSP interdependencies chart. The November 13-15, 2013 Riverine Modelers meeting had a set of charts that displayed different sources of information and how the models are tied together.
- C/Q – Dara Glass commented that her concern is that not only scientists and engineers but also the general public will be reading and trying to understand the modeling results. The analysis needs to be understandable at a level that scientists and engineers are not used to talking in.

Wayne Dyok noted there were four levels of understanding that are needed; 1) modelers talking amongst themselves; 2) modelers interfacing with Licensing Participants; 3) the written materials presented in the ISR which is primarily for the technical person; and 4) then ultimately translating for the public.

April 17 LOWER RIVER APPROACH AND OTHER CONSIDERATIONS

Dudley Reiser briefly reviewed the meeting schedule and the topics for discussion on Day 3. But first, Jon Zufelt provided an update regarding his breakup forecast.

Options for Spatial Expansion of FA Results to Other Areas – Dudley Reiser (R2)/Phil Hilgert (R2)

Dudley Reiser then discussed some options for consideration related to the spatial extrapolation of information from the Focus Area to other areas in the Middle River segment (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_17TT_Riverine_SpatialExtrapolation.pdf). Four options were presented that ranged from the simplest to the more complex. These included extrapolation by linear distance, macrohabitat linear distance, macrohabitat area, and macrohabitat weighted by fish use. He stepped through a series of slides for each of the options that showed how the determination of habitat, defined by weighted usable area (WUA) would be calculated first within FA-128 (Slough 8A) and then expanded to areas outside the Focus Area (slides 4-13). For each option, assumptions and uncertainties were presented. For the macrohabitat area example, he noted that a sub-reach of MR-6 had been evaluated by GIS and area calculations made based on bankfull width as determined from orthophotos. He stressed that a final method has not been selected and that feedback on the options as well as others will be appreciated. Phil Hilgert noted that it will be important to make a decision on how the analysis will be extrapolated before final analysis is completed.
Some of the major points from the presentation and discussion:

- C/Q – Question rose regarding status of the habitat mapping analysis, when would it be available? Dudley Reiser noted he will check with MaryLouise Keefe on this.
- C/Q – Greg Auble raised concern about how the habitat types may change over time and what that would do to the extrapolation process. His general recommendation was to not be too concerned about fine-tuning the habitat types. Need them to be adjustable to new conditions and if you make them too complex will not be applicable given new geometry. He noted that if you're worrying about analyzing impacts, the analysis will be no better than your ability to predict the change in habitat types. Lyle Zevenbergen noted that if main channel degrades, lateral features will breach less frequently. In theory without even changing their geometry, they could get reclassified. Some features are more dynamic than others. Greg suggested that we don't try to make it as well as can today, but rather try to make it robust in thinking what it will be. Dudley Reiser thought that if bed elevation changes do occur, should be able to draw inference as to the habitat types that would exist for that topographic setting. He agreed that having too refined a classification would make this problematic.
- C/Q – Jeff Davis acknowledged this but also mentioned there could be some disconnect between the habitat types and FDA results; i.e., there may be reasons that fall outside of the habitat classification for fish congregating within a particular area. Is concerned how that would be addressed in future model runs. Jeff also asked about features that were identified in the field that weren't included in the original mapping – that is also a concern. Dudley Reiser noted that the field mapping was initiated last year and that surveys were conducted outside of the Focus Areas so further evaluations related to this should be possible.

- C/Q – Colin Kikuchi asked whether it is part of the plan to look at geomorphology at years 25 and 50 and reclassify habitat and recalculate WUA. Greg Auble thought this would be tricky since the macrohabitat types in the entire geomorphic reach would have to be known. Lyle Zevenbergen noted that the 1-D model would need to inform the 2-D model and then go back to the 1-D model. As changes are identified the iterative process will help to extrapolate that back to the habitat types. Dudley Reiser suggested drawing inferences about the scale of the change based on 1-D model results and apply some type of adjustment factor to the 2-D model and then use that to assess macrohabitat types. Greg Auble and Lyle Zevenbergen thought this could be handled via considering the proportion of area change in the FA; complete a weighting based on current habitat proportions and then whatever happens in FAs in terms of bed elevation changes can be used to extrapolate. Phil Hilgert noted that at year 25 and 50 you could calculate inlet elevations of side channels/etc. through the Middle River. GIS can calculate linear distance associated with those and then you can check how those compare with existing conditions; gives you a check.
- C/Q – Wayne Dyok asked whether this type of analysis was really warranted. Can inferences simply be drawn by looking at the Focus Areas? Colin Kikuchi noted this would assume FAs are representative of other areas. Sue Walker asked what the reclassification of habitat types at the 25 and 50 year points be used for?; assume it is for measuring impacts but concerned how the FDA information would factor in to this. Also wondered about representativeness of the FAs. Dudley Reiser mentioned that the representativeness of the FAs in terms of macrohabitats had been initially evaluated and was presented in two TMs. In terms of FDA, he stressed that none of the habitat models should be viewed as predictive of fish abundance or distribution. As to why it is important to evaluate macrohabitat changes in the future, it relates to mitigation planning; i.e., need some estimate of the quantity of habitat now and then compare with the future so can develop appropriate mitigation plans. Wayne Dyok noted there would be some flexibility in the operations related to temperature and flow releases and that AEA is open to working under an adaptive management framework.
- C/Q – Sue Walker suggested that AEA run an operational scenario that is more realistic and reasonable rather than the worst case scenario exemplified in OS-1. She thinks this would be a better approach and would serve more in identifying what are the most significant Project effects.
- C/Q – Lori Verbrugge asked about climate change and whether that was being considered in the planning? Wondered if had done sensitivity analysis to see if SNAP model predictions encompass conditions predicted in next 50 years. Wayne Dyok referenced the DGGS studies. As part of that AEA should get results of their first year modeling in early 2015.
- C/Q – Hal Geiger shifted discussion to the fourth option for extrapolation related to "fish weighting" and indicated he did not think this was warranted or statistically correct since the HSC analysis already captures fish preferences in the calculations. He thinks the extrapolation should be based on "space" not fish distribution. Phil Hilgert explained that the use of a fish weighting factor has been used on other relicensing studies – he personally is not an advocate of it – just letting everyone know it has been used. The logic is to identify those areas with greatest effect on fish. He characterized it as a fudge factor in which you adjust the outcome based on expectations. He noted this is not easy to defend and doesn't stand up in court well. Greg Auble agreed with Hal and that the HSC has the fish term already in it, but indicated that professional judgment would also need to be applied.

Lower River Fish Habitat Modeling Approach – Kasey Clipperton (Golder)/Phil Hilgert (R2)

Kasey Clipperton then provided an update on the habitat modeling analysis that is ongoing in the Lower River (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014_04_15TT_Riverine_1D-lowerriver-fishhabitat.pdf). He noted that for this POC discussion the analysis focused on coho salmon spawning and juvenile rearing. In contrast to the 2-D modeling being conducted in the Middle River, the Lower River approach represents a transect-based, PHABSIM type analysis in which weighted usable area (WUA) is computed on a square feet/1,000 ft. basis. The analysis was done for open-water conditions for Existing Conditions and the OS-1 scenario. He discussed the basic tenets and elements of the model and data dependencies (slides 4-5) and showed a depiction of the two PHABSIM sites that were used for the POC analysis – one located at PRM 97 and one in Birch Creek (slide 6). Results of the HEC-RAS were shown for both sites (slides 7-8); HSC and periodicity information were also discussed noting that the current analysis relied upon the 1980s data (slides 9-10). Kasey then stepped through a series of slides that provided an example of WUA-flow relationships and then various figures that displayed a time series of habitats under dry (1976) and wet (1981) year conditions (slides 11-20). He also reviewed the evaluation metrics noting there was a wide range of metrics for the time series analysis, and that the breaching analysis would consider frequency, duration, timing, as well as connectivity to and flow depth at tributary mouths. He mentioned that a similar series of habitat analysis would be completed for each of the study sites measured in 2013 in Geomorphic Reach LR-1. Future study efforts will involve collection and analysis of cross-sectional and 1-D PHABSIM data at mainstem and lateral habitats and the lower portions of Sheep and Caswell creeks within Geomorphic Reach LR-2, and collection of cross-sectional and 1-D PHABSIM data within the lower portion of the Deshka River in LR-3. These Lower River study areas include the lower portions of five tributaries which will focus on the connectivity of tributary mouths.

Some of the major points from the presentation and discussion:

- C/Q – Jeff Davis asked if there is documented coho spawning in Birch Creek? Kasey Clipperton noted the analysis was based on suitability of habitat conditions using HSI curves and is an indication of spawning habitat potential based on depth, velocity and substrate only and is not weighted by actual or documented use. Kasey notes that what is termed Birch Creek slough is actually a side channel that has water flowing through it all times they were in the field. Water was clear in Birch Creek proper. Jeff Davis expressed concern that the Project may influence temperature in that system. Birch Creek receives runoff from Fish Lake and Birch Creek water is already warm; if Project operations reduce water volume in lower Birch Creek, the creek may absorb more heat.
- C/Q – Dudley Reiser summarized the overall approach in the Lower River noting it was not as detailed as in Middle River due in part to the complexity in the Lower River, but also because of flow attenuation so that Project effects in terms of stage changes are less than in Middle River. Focus was on selecting specific areas that had been identified in the past as important fish habitats and also concentrated on the connectivity of tributaries.
- C/Q – Question raised regarding salinity in the intertidal zone? Wayne Dyok noted this was looked at in the 1980 in terms of volume and tides. Suggested looking at the 1980s reports.
- C/Q – Jeff Davis asked about the representativeness of the sites selected in the Lower River. Phil Hilgert noted the sites are indicative of how other sites might behave; they are not necessarily representative. Joe Klein suggested that the Lower River sites could serve as a barometer as to how habitats are responding to flows.
- C/Q – Question raised about eulachon. Betsy McGregor indicated that the eulachon study (Study 9.16) was being deferred until 2015. The IFS team is coordinating with Fish Program.
- C/Q – Question asked about recreational flows. Dudley Reiser noted that ERM is working on this and they will be relying upon the OWFRM output.
- C/Q – Dara Glass asked whether the studies are considering the human factor in the analysis in terms of local information and knowledge. Dudley Reiser – yes – as we conduct field studies our

field crews often engage in discussions with local boat operators and land owners regarding the river. To date, this has proven to be a great source of local information regarding where fish have been found and as well as observations on ice processes and flooding. Wayne Dyok noted that AEA is going to be conducting a series of public meetings on the Project.

Open Discussion and Questions Regarding Day 1 and Day 2

During the final session, Dudley Reiser encouraged feedback from the meeting participants.

- C/Q – Colin Kikuchi – This is a complicated study. Points to consider: suggest the need for formalizing system for estimating groundwater discharge; further discussion of HSC is warranted; need more explanation regarding the study implementation schedule and how the delay will affect overall schedule; and need more discussion on the Decision Support System (DSS); Betsy McGregor referenced a table that was filed with FERC in March which indicates activities planned for 2014, tentative activities depending upon CIRWG access and the final budget, and activities deferred to 2015 (http://elibrary.ferc.gov/idmws/file_list.asp?accession_num=20140128-3147). Dudley Reiser acknowledged the need for more DSS discussion which will be forthcoming.
- C/Q – Felix Kristanovich – Noted he was eager to see the results of the geomorphic model (1-D bed evolution model). Bill Fullerton noted that is being worked on and will be able to discuss in a TWG meeting, most likely in the fall.
- C/Q – Question regarding uncertainty. Dudley Reiser mentioned this was part of DSS discussion during November 13-15, 2013 meetings and will be discussed further.
- C/Q – Colin Kikuchi noted he was impressed with the data documentation that was provided for the studies; especially impressed with groundwater data.
- C/Q – Jeff Davis had a number of comments, including the level of effort being expended in each Focus Area, what occurs in the winter period, and that temperature needs to be brought into the analysis.
- C/Q – Greg Auble thought it was a great meeting and that the studies are making good progress. Feels that there has been a tremendous amount of focus on where the problem areas are and are a lot further along than in November 2013.
- C/Q – Charlie Wisdom echoed the need for further HSC discussion and inclusion of temperature. Also concerned about downstream transport of toxins into Lower River and impacts on fish. Also thinks consideration needs to be given in determining what things can be done to mitigate for the impacts.
- C/Q – Bob Henszey indicated his comfort level has been raised in certain areas but in others still concerned. He cited the groundwater studies as an area that he had additional question. Michael Lilly indicated additional information would be covered in the upcoming Riparian POC meeting. He would like to see the level of effort planned for the upper three Focus Areas outlined soon so Licensing Participants have an opportunity to review.
- C/Q – Hal Geiger felt the meetings were very worthwhile, acknowledging that he has a ways to go to get caught up with everyone's understanding of the Project, as he has just started.
- C/Q – Wayne Dyok noted that from AEA's perspective, they very much appreciate receiving informal feedback from the Licensing Participants. He acknowledged there is a formal mechanism but stressed value of informal feedback and that AEA is open to that.
- C/Q – Dara Glass suggested that instead of referencing the Services, it should be Stakeholders to be more inclusive of all licensing participants. Wayne Dyok acknowledged this. Dara noted there

is still a Plan of Operations that needs to be submitted by AEA to CIRWG for approval before access is provided to CIRWG lands. She also raised concern about climate change and that should be considered in the analysis. Wayne noted the DGGS models should be completed in February 2015 but these will be based on one year of modeling data. The SNAP model information was used in the development of the DGGS models.

- C/Q – Phil Hilgert reviewed action items. Dudley Reiser noted that the meeting notes would be compiled and made available as soon as possible.

- The meeting was adjourned.

Summary of Modeling Issues, Action Items and Next Steps

Action Items	Responsibility
When presenting model results, modelers need to describe the calibration procedures, describe the validation procedures, and identify validation data sets (separate from calibration).	All Modelers
The TSS vs. turbidity graph (Riverine WQ Modeling Slide 9) ranges from 0 to 1,400 NTUs; however, fish use will be influenced by changes of NTUs in the 0 to 200 NTU range. Check whether the correlation would change if we only consider data in the 0 to 200 range.	TT
HSC used a best-fit analysis and some parameters were not included (such as temperature) based on the pre-Project database – however, need to consider how to address post-Project conditions when developing HSC curves.	R2
The 2-D Fish Habitat Model to use bottom shear instead of total shear to better indicate sediment particle movement.	MEC/TT
ADF&G provide Cooper Lake relicensing project reports with temperature-related data comparison graphics.	ADF&G – done
Provide write-up of methods for HSC/HSI curve development.	R2
AEA to provide more details on DGGS modeling-related to climate change.	AEA
Develop a schedule for future TT/TWG meetings.	AEA
The potential influence of Project operations on water temperature should be looked at as part of the analysis at Birch Creek.	TT/R2/Golder
Consider developing a more realistic post-Project flow regime as a starting point-instead of OS-1 (maximum load following).	AEA

Presentations, IFS-TT Riverine Modelers Proof of Concept Meeting April 15-17, 2014 (listed in order presented)

April 15th

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