

ESHMC Meeting Notes January 23rd, 2012

Item 1 - Introductions were made, and an attendance list was circulated. The following were present at the meeting:

- Rick Raymondi
- Allan Wylie
- Sean Vincent
- Jennifer Sukow
- Chuck Brockway
- David Blew
- Jae Ryu
- David Hoekema
- Greg Sullivan
- Mike McVay
- Bryce Contor
- Chuck Brendecke
- Dave Colvin
- Harvey Walker
- Mat Weaver*

***Present at meeting but did not sign attendance sheet.**

Willem Schreuder, Lyle Swank, Jim Brannon, Stacey Taylor, Jennifer Johnson, Gary Johnson, and John Koreny joined the meeting via polycom.

Mat Weaver (IDWR) was introduced to the committee.

Item 2 – Stacey Taylor began the meeting with a progress report regarding the data that she is assimilating for model validation. She went through the diversion data that had been collected and indicated what pieces were still missing. Data from the Northside Canal Company, Reno Ditch, and Southwest Irrigation District were mentioned as incomplete, and she said that she intends to use averages in place of missing data. Stacey said she is still exploring the suitability of using of Agrimet data for 2009/2010 because ET Idaho data have not been completed for these years, and she had begun a comparison of ET Idaho vs. Agrimet. Stacey stressed that the ET data are important because of its use in numerous water budget files including the ETI, FPT, and OFF files. She also said the final step is to create ALL official files using the newest version of the ESPAM recharge tool, version 1.2.

Chuck Brockway asked what was missing with respect to Reno Ditch, and Stacey said she still needs several more years. She said she would send Chuck an email containing what were still missing. Stacey briefly discussed her work to assess the suitability of using Agrimet data. She said that her analysis shows that there is not a linear comparison between the Agrimet and the ET Idaho data and that it is a challenge to correlate the data even using a scaling or correction factor. Bryce asked

what kind of a scaling factor was being contemplated, and Stacey said she was looking at month-to-month changes for scaling. Chuck Brockway asked if she was shaping the ET Idaho data to get corresponding Agriment values, and Stacey said yes. Stacey went on to say that her analyses are preliminary, the shaping is better than directly using Agriment, and that the results vary with different sites.

Chuck Brockway asked when Stacey's effort would be finished. She said sometime during February and added that the results need to be reasonable because so many files depend on ET data. Chuck Brendecke was interested in how the results would be used, and Allan said that IDWR will plug the last two years of water budget data into the model and then see how the model generated values compare with observed values.

Chuck Brendecke then asked about the 1902 validation effort. Allan Wylie said IDWR has looked at estimates of irrigated acres in the early 1900's as well as estimates on crop mix, but he was not sure about the temperature and precipitation data. He said he might use average data to plug into the model to determine a steady state condition. Jennifer Sukow said the PRISM data goes back to 1895 and that there are monthly rasters for Idaho. She added that she was not sure how the data were derived. Bryce said PRISM is based on weather station data, so it may be suitable for use. Jennifer said that the American Falls station has records back to 1891 or 1892. Jennifer Sukow summarized that the early validation effort had not been pursued in a while.

Chuck Brockway asked what the purpose of the early validation is. Allan responded that Israel Russell published a report in 1902 that contained data between 1898 into the early part of 1900. He added that the exercise would allow us to evaluate the ability of the model to reproduce the early 1900 conditions. Chuck Brockway said that Garabedian tried to do this but was not successful, and then he asked if the committee is trying to redo what Garabedian attempted. Allan said we would limit the validation effort to the early 1900's.

Greg Sullivan said that the aquifer was not in a steady state condition in the 1900 time frame. Allan agreed, but he said there was no development in the lower valley. Bryce Contor said only a small fraction of the impact in the upper valley makes it to the lower valley. Allan said that overall, there is a small amount of land that had been put into agriculture at this time, and he thought it would be useful to compare the model results to the records that we have. David Hoekema said that the aquifer is almost in a natural condition. Allan agreed and said that impacts in the Idaho Falls area have a minimal effect lower on the plain, and he added that we are not trying to replicate the entire period since 1900, just a snapshot of 1902.

Chuck Brockway commented that this analysis is not really validation. Willem said he disagreed and added that we are giving the model something it has not seen to evaluate how well it replicates earlier conditions. Chuck Brockway asked the question what if we miss. Willem said then the model will not be validated to the

earlier conditions, and we could not use the model for earlier periods. Chuck Brockway asked what if we replicate the 2009 and 2010 conditions well. Bryce said if we do this, there are possible outcomes. He went on to say that we will learn if the validation works or not, and we will learn how the model works in a large variety of stresses. Willem responded that if the validation doesn't work, it won't necessarily tell us what to do to fix the problem, and that otherwise he agreed with Bryce.

Chuck Brockway said that the 1900 data are not the same quality as what is in the model. Allan responded that if it were the same quality, we would have used that period in the model. Then Chuck said he was concerned if the validation matches, he would not be sure it is a good validation. John Koreny said he agreed with Chuck, and he added that the early data are not used because they are not good. He concluded that this validation effort is not worth doing. John then went on to say that we don't know the crops and water levels, the spring flows are sketchy, and he said he read the reports, and he concluded that the data are not well controlled. Greg Sullivan said there are data of value. Allan said that he believed the data are adequate for validation.

Willem asked if you run the validation what is expected. Allan said he would be looking at spring flows and water levels and that he expects the water levels to be lower and more constant with less seasonal variability. Chuck Brendecke commented that the validation effort would not be a calibration, rather a determination if the model can approximate early conditions. John Koreny questioned whether you could be confident in the model even if the results were very close. Allan summarized what the objective is by saying that we would populate the model with 1902 data and then determine how well it represents early spring discharges and water levels. He added that we could determine if the model steers water to the right springs.

Bryce said that he thought the deficiency was in terms of quantity of data not quality of data around 1900. John Koreny asked how validation can be done without reach gains, crop types and locations, etc. He added that normally if the results are off, you would look at the data. Greg Sullivan responded that if the answer is off, you would look for reasons, and one place to look is the data. Jennifer Sukow said we know where the irrigated acres are, and we have more information than we initially thought.

Chuck Brockway recommended that the other validation exercise, the uncertainty analyses, and the calibration should have priority over the back cast validation. Greg Sullivan said we will learn from the back cast. Jennifer Sukow said the validation work won't impact the uncertainty effort. Chuck Brockway said it takes time. Bryce Contor said if we are nominating things to drop, he recommended dropping the comparison of ESPAM version 1.1 to ESPAM version 2.0. Chuck Brockway said that the Director should know that the concerned water users want the comparison of ESPAM version 1.1 to ESPAM version 2.0. Allan Wylie said that neither the comparison nor the validation will slow the uncertainty analyses.

David Hoekema asked if it would be a worthwhile validation effort to compare the model to the measured flows when the springs hit peak flows. Allan said it might be. Chuck Brockway said if we performed both back casts, we would be looking at the high and low spring flows. Dave Blew asked if any springs were higher in 1900 than they were in 1980. Jennifer said some were about the same, possibly the Malad Springs. Dave Blew said he thought that the historic flows at the Curren Tunnel were higher in 1900. Jennifer said that for the most part, there is not a lot of useful data in the Hagerman area. Dave responded that he thought there was older data on the Curren Tunnel. Allan said he was not sure that the tunnel flows mentioned in old records are actually collected at Curren Tunnel, and he said that the flows might be other spring discharges. Chuck Brockway said the water right on the Curren Tunnel was approximately 45 cfs. He added that there must be some information to base the water right on, maybe measured flows. Dave said he was sure that there were historical measurements on the tunnel, and he said that he would provide the data to IDWR.

Item 3 – Allan Wylie presented the representation of ground water underflow in the model which resulted in a correction/adjustment to the ESPAM version 2.0 calibration dataset. He began his discussion with a conceptual diagram of the mechanisms by which water discharges from the aquifer to springs and directly into the river. Then he explained the general head boundary and its application to ESPAM version 2.0, as well as how the underflow is calculated and assigned to gauged river reaches (Kimberly – Buhl, Buhl – Lower Salmon Falls, and Lower Salmon Falls – King Hill). Allan indicated the underflow in the Kimberly to Buhl reach averages 264.5 cfs, and within that total, the Crystal underflow is 116 cfs; the Buhl to Lower Salmon Falls underflow averages 907.5 cfs, and within that total, the Thousand Springs and Magic underflow averages 494 cfs, and the flow from Blue Heart spring that discharges directly to the river is 63.3 cfs; and finally, the Lower Salmon falls to King Hill discharge averages 365.4 cfs.

Chuck Brockway asked where the 116 cfs at Crystal Springs was measured, and Allan said the USGS gaged the Snake River above and below the Crystal Spring complex. Chuck also asked if it was one measurement, and Allan said yes, and that IDWR will ask them to repeat the measurement this coming spring. Chuck then asked how the gains were calculated, and Allan said by differencing Snake River gages and subtracting out the gains from the south side and returns from both Northside Canal Co and Southside Canal Co. Chuck summarized the underflow representation as a re-distribution of reach gains, and we are calibrating the model to reach gains. Allan agreed and said we are no longer assigning all the ungauged aquifer discharge to the C springs.

Sean Vincent asked Allan to show how the general head boundary was done, and Allan showed the assignment of cells on a map. Chuck Brendecke asked if some cells have drains and a general head boundary, and Allan said yes. Chuck Brendecke asked if the underflow was assigned a weight for PEST to consider in calibration, and Allan said yes the underflow is weighted similar to the C target springs. Allan then

said he is confident that the underflow occurs, but less confident regarding the actual quantities per reach. Chuck Brockway asked if there are differences in the algorithm regarding how MODFLOW addresses underflow and the C target springs. Allan said there are differences, if the aquifer goes dry, water could into the aquifer from the river via a general head boundary. Chuck Brockway asked Allan if he ran the underflow re-distribution though the PEST calibration process. Allan said yes and that it seemed that it could improve calibration.

Item 4 - Jennifer Sukow presented the changes made to reach gains below Milner to accommodate underflow in ESPAM version 2.0. She began by discussing the previous targets (Kimberly to King Hill, and Kimberly to Lower Salmon Falls). She indicated that the targets incorporated the deduction for the south side groundwater contributions between Kimberly and Lower Salmon Falls. Then she summarized the new targets for the assignment of underflow (Kimberly to King Hill, Kimberly to Buhl, Buhl to Lower Salmon Falls) and indicated that the deduction for south side groundwater contributions was subdivided between Kimberly-Lower Salmon Falls and Lower Salmon Falls-King Hill.

Next Jennifer discussed the deduction of south side ground water contributions in more detail. She said that for the previous targets, the south side groundwater contribution was calculated using water budget method. It was assumed to equal the annual recharge from Twin Falls tract plus underflow from the Salmon Falls Creek basin and Salmon Falls Creek tract, and that approximately 52% of the contribution was assigned to Milner to Kimberly reach, and 48% was deducted from the Kimberly to Lower Salmon Falls reach gain. Jennifer then said that for the new targets, she must split the south side contribution to Kimberly-Lower Salmon Falls between Kimberly-Buhl and Buhl-Lower Salmon Falls.

Jennifer added that between Kimberly and Lower Salmon Falls, the groundwater base flow in measured return flow channels and creeks is a significant portion of south side groundwater discharge. She showed the hydrographs from 2005 through 2010 for Deep Creek with the base flow separated out as an example. Then she showed a comparison of the water budget calculation for the south side contribution to the base flow measured in return flows and creek flows. Jennifer said that the Kimberly-LSF south side contribution that was calculated by the water budget method for 2002-2008 averages approximately 2,000 AF/yr (1%) less than the base flow calculated from measured returns and creeks. She added that the base flow contributions in the Kimberly to Buhl reach average 42.5% of total base flow contribution, and the base flow contributions in the Buhl to LSF reach average 57.5% of the total base flow contribution. Jennifer said that for the new targets, deductions for south side contribution to the Kimberly-LSF reach calculated by water budget method (1980-2008) were apportioned to Kimberly-Buhl and Buhl-LSF reaches using the 42.5%/57.5% split.

In conclusion, Jennifer showed a summary hydrograph that included the new reach gain targets. She said that an e-mail had been sent out to the committee with a link to

the updated spreadsheet and design document. Chuck Brockway asked what the cause was for the bulge in the Buhl to LSF reach gains. Jennifer said she was not sure but it could be the reading at the Buhl gauge. Bryce asked if the red hydrograph representing the gains from Kimberly to King Hill was the sum of the three other hydrographs (Kimberly to Buhl, Buhl to Lower Salmon Falls, and Lower Salmon Falls to King Hill), and Jennifer said yes. Chuck Brockway asked if the Kimberly to King Hill reach gains are similar to the north side spring discharge estimate, and Jennifer said the reach gains are a little higher. She added that the spring discharge estimate, assuming that Chuck was referring to the Kjelstrom calculation, might not include underflow. Chuck said that it would be interesting to compare the reach gains to the USGS graph (Kjelstrom). IDWR agreed to make this comparison.

Item 5 - Stacey Taylor presented the changes/updates/corrections that have been made to the diversion spreadsheet and perched river seepage spreadsheet. With respect to perched river seepage, Stacey indicated that changes were made to the data for Big Lost Reach 2, the Little Wood from Carey to Richfield, the Malad River flows, Birch Creek, the Birch Creek Hydropower Plant, Camas Creek, Medicine Lodge Creek, the Little Lost River, and the Big Lost River Flood Control.

For the diversion spreadsheet, Stacey said errors were found in entities IESW058 and IESW019. She said that this prompted a check of all entity diversions for anomalous highs and lows. She said that she plotted annual water year diversions and checked each entity. Stacey showed a before and after comparison of the corrections in the diversions for Milner – Gooding, Fort Hall, Mud Lake, Basin 31, the Big and Little Wood, Harrison, New Sweden, Southwest, and Henrys Fork.

Bryce said that he thought that the Henrys Fork graph look odd with respect to the drop off (approximately 500,000 down to 300,000 acre-feet) in diversions starting in 2000. Stacey said that she checked the data and was satisfied that her numbers were correct. She said it would be interesting to know what happened. Bryce asked Tony and Lyle if that had any insight, and Lyle said he did not know. Lyle then said that 2001 – 2005 were drought years, and he thought that climate could explain the drop in diversions, but he was not confident in this explanation.

Chuck Brockway questioned why there was no data for Southwest between 2001 and 2009. Stacey said she was having trouble obtaining the data from the secretary (Marilyn). Chuck thought that this should be under the responsibility of Brian Higgs. Bryce suggested that Stacey call Cindy Yenter. Rick Raymondi offered to help Stacey with contacting Brian Higgs.

Greg Sullivan asked if Stacey had checked all the diversions and perched river seepage values or just the sites that appeared anomalous. Stacey said she had sent out a memo to the committee with details regarding her procedure, and she said that she check all sites, even ones that appeared normal. Dave Blew said that in 1984, the stream below Goose Creek Reservoir flooded, and the high flows might have been recorded but not really diverted to agriculture. Bryce said the extra water would have

gone straight to the river, and that using an average diversion would be acceptable for Southwest. Most of the committee members voiced agreement with using the average flow until actual diversions could be obtained.

Item 6 - Jennifer Sukow discussed raster snapping as a GIS adjustment to raster files. Jennifer indicated that IDWR GIS specialists had pointed out that raster files could be better aligned using a procedure via ARC Map. She said that when rasters are produced, it is considered good practice to align the pixels to a common pixel grid, and she explained the procedure. Bryce said that water budget raster data sets had been developed in the past before there was an option for raster snapping in the version of GIS that he was using. Jennifer conceded that there may not be a great difference between snapped files and those that have not been snapped, but she said by snapping, edge effects will come out consistently. She added that a new version (V1.2) of the recharge tools (IAR tool and the PRISM utility) had recently been published to incorporate the use of snap rasters. Bryce said it is a good procedure to implement even if it is cosmetic. Jennifer said she looked at the changes that occurred in the datasets surface water entities, and she said they were minor and would not result in significant changes to the water budget.

Item 7 - Allan Wylie discussed his most recent model calibration run using water budget version E120116A001. He said that it includes all the corrections, adjustments, and changes to the water budget discussed earlier in the meeting, including the revised perched river seepage and diversion numbers. When Allan showed the slide containing the comparison of the transmissivity distribution (Version 1.1 vs. Version 2.0), Chuck Brendecke asked if the color scales were the same, and Allan said no. Allan pointed out that there is a difference in the color shading near the springs because we are no longer targeting reaches, rather individual springs. He also said that lots of pilot points have been added near the springs to steer the water. Chuck Brockway said the Rexburg Bench shows a lower T in the current output, and Allan agreed and said there are now more targets in that area.

Allan moved to the S_y slide and said that he is using the same scale but the Version 1.1 values extend lower. He said the lower values are represented in the Lower Malad area. Chuck Brendecke noted that the Big Wood values are opposite. Allan said that Stacey made an adjustment the diversion and perched river seepage files that changed the seasonality in Malad gains and that the Glens Ferry Formation under the basalt in the Hagerman area has an impact on the S_y values. Chuck Brockway asked if the low point below American Falls Reservoir was new, and Allan said yes it is new compared to ESAPAM version 1.1. Greg Sullivan said that the values could have dropped just below the color line and maybe there is not that big of a change. Bryce asked why the S_y values are lower in the Big Lost area. At this point, Allan said that the version 1.1 color ramp for S_y values needed to be fixed, and he agreed to do this.

Chuck Brendecke asked if the river bed conductance values shown on the slide were pegged or hitting the upper or lower bounds. Allan said no, the values could have

gone lower or higher. Greg Sullivan asked if the low at American Falls was a natural feature, and Allan said yes, that at one time, there was a natural basalt or lava dam near the site of the current dam and lacustrine sediments were deposited in the general area of American Falls Reservoir. He added that there is a small area near the dam that does not have the lacustrine deposits and has better hydraulic communication with the aquifer.

Allan showed the comparison for drain conductance, and he reminded the committee that there are high and low elevation drains for cells containing more than one spring. Chuck Brendecke asked if any of the values were pegged. Allan said yes, the Thousand Springs drain conductance is pegged which is a new development. He said it might be pegged because we now recognize underflow. Chuck asked if the upper drain was pegged, and Allan said yes. Jennifer Sukow said that other contributing factor was the fact that the upper drain was moved up maybe ten or fifteen feet higher.

Allan showed the perched river seepage comparison slides and said for version 2.0, the scale adjustment at Mud Lake was pegged on the high end, and the factor had increased by 20%. On the tributary underflow slide, Allan said the Henrys Fork scaling factor was about 14X, and the Camas factor was near 0. Bryce asked if the color scale was the same on the two slides, and Allan said yes. Chuck Brendecke asked if there was a change in total tributary underflow volume. Allan said he was not sure and that he would need a comparison model run with and without adjustments. Chuck Brockway asked what changes were noted in the new version with the Big Lost. Allan said the Big Lost and Little Lost demonstrated some increase in the scaling factors, and that in general, PEST increased the north side ESPA underflows except for Beaver and Camas Creeks.

For non-irrigated recharge, Bryce said that the values did not hit the stops on either end of the scale, and Allan agreed. Allan said that the ET adjustment factor for surface water sprinkler irrigation at Northside showed an increase of 5%, which is near the maximum. Bryce commented that the constraint is not binding. Allan said the ET for surface water gravity irrigation at Northside decreased by 2%, and the canal seepage at Mud Lake decreased. In regard to the transient head results, Allan indicated there was a high mean residual in the area of American Falls Reservoir, and he said that will get fixed with modeling the gains in the Portneuf in the next model version. Allan added there is a good match on the heads in the INEL area. Chuck Brockway asked if the phasing issue was still present in the gains in the Shelley to Near Blackfoot reach. Allan said the observed appears to be out of phase with the modeled values after about year 2000. Allan went on to say that he doesn't know what to think, and he has asked Lyle Swank (Water District 01) about the gages and was told that the gages do not appear to be the issue.

Greg Sullivan asked why the modeled values are so dampened vs. the measured gains. Allan said that the modeled values were dampened before this calibration run, but there is more dampening now in the spring reaches after incorporating the

underflow, because the underflow comes off the bottom of the aquifer and is therefore more flat. Allan said the model matches the seasonality of the springs much better than the seasonality of the reach gains. He added that the model is underestimating the underflow in some reaches, and gave the example that from Kimberly to Buhl, the model predicts 247 cfs in underflow, whereas the modeled underflow is 265 cfs. Allan indicated the difference is less than 10%, and he said he has applied low weights on the underflow targets.

Chuck Brockway summed up the calibration run by indicating the biggest changes appeared to be in the tributary underflow. Bryce said that he would like the committee to say that the model is calibrated. Chuck Brendecke asked if we have improved the overall sum of squared residuals. Allan said no, but added that it was hard to compare the sum to that of previous runs because there are newly added targets. Allan said the residuals had increased, but there is an improved fit with the revised diversions for AFRD2 and entity 55. Greg Sullivan said that the model under-predicts the amplitude for most every target and suggested that the committee should discuss this issue in terms of how the model is used. Chuck Brockway said it is a fact that the model is not “hitting” the amplitude but it does reflect the seasonality aspect of the aquifer which is good. Chuck offered that the model is better used for planning rather than for items that require accurate seasonal variability. Chuck went on to say that there might be a concern for the ability of the model to predict certain seasons, and there might be an under-prediction in certain seasons.

Chuck Brockway said that the simulated water levels always appear to be high. Allan said the average bias is 1.3, and he agreed the model is high. Greg Sullivan said that we want a model that better predicts seasonal variability, and he said that the calibration is not complete. Bryce said that we have to be cautious for predictions that depend on seasonality. Chuck Brockway said he has a bigger concern if the model is used to predict absolute reach gains in a season. Greg Sullivan asked why Chuck felt this way. Chuck said the pattern is that predicted reach gains are below measured values. Greg expressed the concern that the model might indicate that a reach is not receiving sufficient gains in July, but in reality, the gains may be OK.

Chuck Brockway said that the mitigation plans are developed using a steady state analysis. Bryce responded that Chuck’s statement is not true because the coalition needs to be satisfied in the season of use. Chuck agreed with Bryce and said that if the Director asks for a transient run, we would have to deal with that in the ESHMC.

Greg Sullivan asked whether the committee can characterize the calibration beyond a yes or no statement. Chuck Brockway said that members of the committee have been chastised for offering policy during meetings, and at the same time, some members still say ESPAM version 2 should not be used for analyzing individual springs, yet the model is calibrated to individual springs. Greg said that if we don’t qualify the calibration, we would be saying that the model can be used for everything. Chuck Brockway agreed saying the committee should qualify how the model should be used. Allan Wylie said that in the Final Report (2004), it is stated that the model cannot be

used to model individual springs, so for the upcoming final report, the committee should avoid over-restricting how the model can and cannot be used. Greg said that there could be some dissension among the committee members. Chuck Brendecke said he thought it would be helpful to give nuance to whether the model is calibrated. He said the committee should discuss whether there is a way to discuss the calibration that would give it richness.

Greg Sullivan said that the model calibration demonstrates spatial and seasonal variability. Bryce thought that the statements made by Greg could be part of the model report. Chuck Brendecke asked what did the Final Report (2004) on ESPAM version 1.1 say about limitations. Bryce said that there have been lots of changes to the model and that it would be better to develop a new section on model limitations for the upcoming final report.

Chuck Brockway said there should be a statement regarding the ability of the model to simulate individual springs. Then he asked what the Director should do to provide mitigation to individual springs other than use Covington and Weaver as a basis. Greg Sullivan said the model is better for some springs than it is for others. Chuck Brockway then said that generally, the model simulates individual springs well, although it misses the amplitude on some. He added that the Director has to deal with that and maybe find a way to adjust the model to develop a better depiction of the amplitude.

Chuck Brendecke asked if the importance of local amplitude is related to geology or what is being done in the aquifer immediately above the spring or is it a function of the system. Bryce said the spatial distribution of data could explain the seasonality issue. Willem Schreuder said he doesn't agree with the spatial distribution explanation offered by Bryce. He added that if we are averaging the data, it should be OK. He then said that we are doing something to the model to dampen the seasonality. Bryce said there is a spatial distribution of stress that we cannot capture. Chuck Brockway said maybe we don't have the right algorithm to simulate spring outflow. Willem said the concern is not so much whether we are over or under in the fluctuations, and he added that the slope is important as long as we get the change in head correct.

Bryce said the seasonality issue in his way of thinking is not trying to use the model for very short time frames. Chuck Brendecke said the model simplifies the representation of geology, and it is inevitable that it will dampen the seasonality. He then said the closer we look at specific locations, the more peculiar the model output will seem, and it will not conform to measured data. Chuck Brendecke concluded that we should not use the model look too closely at specific locations.

Willem said the monthly stress period should get us a long way to replicating seasonality, and he asked the question, why does the spatial average causes a dampening of seasonality? Chuck Brendecke responded that the aquifer demonstrates preferential flow, there are leaky laterals on a local scale, and there are impacts

caused by specific wells. Willem asked if those factors always dampen the model output and could they sometimes amplify the output. Chuck Brendecke said regression models amplify the seasonality. Willem responded that if spatial variability amplifies the output in one location, it has to dampen the effect in other locations, but in our case the output is always dampened. Jim Brannon asked that since we calibrate to fluctuations, should we both under and over predict. Bryce said he thinks that since we cannot capture true heterogeneity and we have linearity, so we can't get the correct amplitude and have a chronic representation of less amplitude in the model signal.

Willem suggested that we could be giving PEST contradictory signals, i.e., we say we want to match signals but we apply constraints to the model and apply weights to constrain the model. Allan said that matching the seasonality was made worse with adding the underflow as a target. He said that the underflow comes out in the river at an artificially low elevation which is partly responsible for the lower amplitude, and another factor is the artificially high S_y . Greg said a graph or map could be used to show how the calibration was affected. Chuck Brockway said the underflow is constant throughout the year and is driven by the same head in the aquifer. Allan added that it is driven by the aquifer head in the cell from which the underflow discharges. Chuck Brockway said that the head varies during the season. Allan responded that there is a lower seasonal change in underflow because it discharges from the bottom of the aquifer. Jim Brannon suggested that there is not a monthly target for the underflow.

Chuck Brendecke asked if any of the upper drains are dewatered or dry throughout the year. Allan said yes, the second sand spring drain went dry. He said that he tried a new elevation, but it was still dry. Willem said we may want to think about the elevation and conductance of the lower drain, and let PEST hunt up and down while adjusting the drain conductance. Chuck Brendecke said that as we try to sensitize the discharge to elevation, it becomes more important to match the aquifer head in the cells "right on".

The committee changed the subject and agreed that the presentations related to the Updated White Paper would be given at the next meeting. The committee then agreed that the next meeting would be held on Monday, February 27th. IDWR agreed to invite the Director to the presentations. Finally, the committee agreed to develop an outline of issues as part of the executive summary for the Final Report. The outline would be developed after the next meeting.

Item 8 - Allan began a discussion of predictive uncertainty starting with providing reasons to conduct the analysis. The reasons he provided were to: establish the precision (not accuracy) for key model predictions; identify where more data can reduce predictive uncertainty; and document the limitations of the model. Then Allan discussed how the current procedure was selected. He said that in 2007, an uncertainty analysis was ranked the third most important improvement to undertake in developing ESPAM2. Then he said that in November 2009, the ESHMC chose to

evaluate predictive uncertainty using PEST, and in March 2011, the ESHMC unanimously agreed to proceed with a predictive uncertainty analysis immediately after calibration of ESPAM2. Finally, he said that in June 2011, the committee limited the scope of the predictive uncertainty analysis to the impact of stress applied at the centroids of each of eight Water Districts on each of four reaches.

Then Allan described the procedure that he has been following which includes running MKMOD, running MODFLOW, comparing the model output with field observations, comparing the sum of the squared residuals (ϕ) with PDO [Allan said that PDO is a value of the objective function (ϕ) that is considered calibrated], conducting the prediction, and saving the value if it is a new maximum (or minimum) is found and ϕ is low enough. He said that under this approach, the contribution to predictive uncertainty can be evaluated from the adjustable components of the water budget, the adjustable physical parameters (transmissivity, specific yield, and conductance), and measurement uncertainty to the extent that it is taken into account by the weighting scheme. He added that PEST is allowed to adjust many components of the water budget mostly through scalars, and he described the adjustable components.

Allan proceeded to discuss the results noting that the uncertainty analyses thus far are based on calibration run E110712A001, and the most recent calibration run is E120116A001, thus the results are all preliminary. He said the predictive uncertainty analyses establish the precision for key model predictions, and he showed a table of the percentages for the calibrated impact, the maximized impact, and the minimized impact from the stress applied at the WD 110, WD120, WD 130, and WD 34 centroids. Chuck Brendecke asked what the % means, and Allan said it is the percent of stress realized at Clear Lakes. Jim Brannon asked is the % of calibrated impact, and Allan said no – it's the percent of impact.

Chuck Brockway asked what PEST did to get a maximum impact. Allan said PEST adjusted the parameters that impacted the prediction but did not adversely impact calibration. Chuck asked if PEST had a routine to do this analysis, and Allan said yes. Dave Colvin asked if the calibration quality was ever improved, and Allan said that sometimes he noticed a well or wells or springs that fit better. He added that sometimes the fit on C target springs was worse, but the fit on other springs was better. Greg Sullivan asked if Allan allowed the objective function to vary 1 or 2% from optimum, and Allan said yes per Doherty. Greg then asked if you could allow 5% to see the sensitivity to the 1 to 2% variance. Allan said yes, but the runs take days. Willem said the problem is trying to boil the calibration down to 1 number, and 5% is arbitrary. Chuck Brockway said we will have difficulty with any number, because we all don't understand this process.

Chuck Brendecke said he doesn't have a sense of how much change there is in the objective function in these runs. Allan said the R^2 on all of the runs is 0.9993, and it was much smaller in ESPAM version 1 because there were fewer observations. Willem asked if Allan had used John Doherty's satanic utility, and Allan said yes.

Dave Colvin asked if the committee could see the objective function for these runs, and Allan said yes.

Chuck Brockway asked why the stress was applied to Water District 110, and Allan said there were concerns that the model would be used for transfers. He added that if the footprint of the stress was big enough, it would limit the flexibility of the analysis. As a compromise, a 3 x 3 cell cluster was used. Jim Brannon said that the range where the model stays calibrated is scale-dependent, and he asked what if the target was larger. Allan said he is testing the WD 34 impact on the Near Blackfoot to Minidoka reach, and since it is a longer target, the uncertainty might be lower. Willem said that because Clear Lakes Springs is a target with a good calibration, we are able to maximize the impact to the target without compromising the calibration. He concluded that it has less to do with the length of the target than whether there is a good calibration dataset that is controlled by observations. Jim responded that it is about weighting rather than size, and Willem agreed.

Dave Colvin asked if the procedure for reporting was always the same, and Allan said it has evolved. He said that for Clear Lakes Springs, the total discharge of 2 cells was reported, but the total does not include underflow. Jim Brannon said he was surprised how constrained the WD 34 minimal impact was. Allan said PEST minimized the Big Lost underflow, and maximized the Henry's Fork underflow to get the 0.44% minimized impact for WD 34.

Chuck Brendecke said that the predictive uncertainty analysis as it is being run is a sensitivity analysis. Allan said it is a sensitivity analysis where the model stays calibrated. Chuck Brendecke asked if there is a possibility that when PEST is trying to maximize a prediction that there are many solutions that are the same, and Allan said yes. Willem said that it would be useful to look at one parameter and see how it changes with different stresses. Willem recommended that Allan show the calibrated maximum and minimum on the same screen, and Allan agreed. Chuck Brendecke said he would like to see more interpretation as to what we get out of the predictive uncertainty analyses.

Jim Brannon said that the non-uniqueness that Chuck Brendecke and Allan discussed now bothers him. Willem said that the solution is at least one of many ways to come up with the maximized prediction, and it shows what was violated, what data components could be collected to improve the model, and how/what was adjusted to maximize a prediction. Allan said that to simulate the impact of knowing underflow in a location, we could fix the underflow and force it to adjust something else, and Willem expressed a concern that we would over-constrain the model. He said that we don't have good observations on the underflow, and that we don't weight parameters, rather we weight observations.

Chuck Brockway said that he didn't understand this issue and that the committee has the responsibility to tell what the analyses mean for water right administration, and it should be something the Director can use. Greg Sullivan said that the committee is

looking at one part of the uncertainty universe. Chuck Brockway said the Director wants an analysis of uncertainty. Bryce agreed and said that we should provide the Director something useful in terms of an uncertainty analysis. Chuck Brendecke said it would be helpful for everyone to look at the table and interpret it in a few sentences and explain what it means. Chuck Brockway thought that we should also include what changed the most. Chuck Brendecke said this doesn't explain the whole uncertainty world, but it has to be made an understandable, clear, and useful exercise. Bryce said that another column should be added to Allan's table (impacts expressed as a % realized at a selected location) that would include 2 or 3 items that changed the most. Allan said it could be the parameter values that changed the most.

Chuck Brockway said that all this results in a strong justification for more powerful computers for the Department. Willem said that with the Monte Carlo approach, you can express true probability distributions better. Allan said with more powerful computers, he could have 8 to 9 runs done.

DECISION POINT SUMMARY

The following was agreed upon:

- 1) Stacey Taylor said she would send Chuck Brockway an email containing what was still missing from the Reno Ditch diversion data.
- 2) Dave Blew from Idaho Power Company agreed to provide the historical measurements on the Curren Tunnel to IDWR.
- 3) IDWR agreed to compare the reach gains from Milner to King Hill to the USGS graph (Kjelstrom calculation).
- 4) IDWR agreed to fix the version 1.1 color ranges of S_y values on the slide.
- 5) The committee agreed that the next meeting would be held on Monday, February 27th, 2012.
- 6) The committee agreed that the presentations related to the Updated White Paper would be given at the next meeting. IDWR agreed to invite the Director to the presentations.
- 7) The committee agreed to develop an outline of issues as part of the executive summary for the Final Report. The outline would be developed after the next meeting.
- 8) IDWR agreed to provide the objective function for the predictive uncertainty PEST runs.
- 9) IDWR agreed to show the calibrated maximum and minimum on the same screen.
- 10) IDWR agreed that another column would be added to the predictive uncertainty summary table that would include 2 or 3 parameters that changed the most during the uncertainty analysis.
- 11) IDWR agreed to contact the committee regarding what runs should be analyzed for consideration as to whether calibration is sufficient to begin validation. IDWR asked that the committee provide input by February 15th, 2012.