FIRO WORKSHOP JUNE 27-JUNE 29, 2016
SUMMARY NOTES & ACTION ITEMS

Participants

Jay Jasperse, SCWA, co-chair	Ann DuBay, SCWA	Brad Moore, USACE
Marty Ralph, CW3E, co-chair	Joe Forbis, USACE	Ken Nowak, USBR
Courtney Black, NOAA	David Ford, Ford Consulting	Arleen O'Donnell, ERG
Marchia Bond, USACE	Joshua Fuller, NOAA	Leila Ostadrahimi. ISACE
David Boughton, NOAA	Reno Harnish, CW3E	Chandra Pathak, USACE
Barry Bunch, USACE	Rob Hartman, NOAA	Dave Reynolds, NOAA
Rob Cifelli, NOAA	Julie Kalansky, CW3E	Patrick Rutten, NOAA
Katherine Dahm, USBR	Janice Lera-Chan, USACE	Scott Sellars, CW3E
Chris Delaney, SCWA	Cuong Ly, USACE	Patrick Sing, USACE
Pat Deliman, USACE	Alicia Marrs, NOAA	Cary Talbot, USACE
Mike Dettinger, USGA	Andy Martin, CW3E	Christa Woodley, USACE
Michael Dillabough, USACE	Matthew McPherson, USACE	Sean White, City of Ukiah
Gabrielle Dorr, NOAA	John Mendoza, SCWA	Jeff Zimmerman, NOAA
Chuck Downer, USACE	George Modini, USACE	

By WebEx:

- Tamara Alaniz Mendocino County
- Alan Flint USGS
- Lorraine Flint USGS
- Lynn Johnson NOAA OAR
- Robin Webb NOAA OAR

UCSD Grad Students and Post-Docs:

- Reuben Demirdjian
- Meredith Fish
- Mike Sierks
- Anna Wilson
- Brian Kuwzenuk

WORKSHOP ACTION ITEMS

- ANN DUBAY: Work with J.D. Hardesty to post all presentations on Corps blog, http://usacesanfrancisco.armylive.dodlive.mil/
- ANN DUBAY: Update steering committee names on one-pagers and in lists.
- MIKE DILLABOUGH: Research basis for 8,000 cfs flow limit at Hopland Bridge.
- CHRIS DELANEY: If flows can increase at Hopland, extend model to Guerneville to see how higher flows could affect flood scenario.
- SCOTT SELLARS: Work with CNRFC on additional bookend scenarios.
- KATHERINE DAHM: Will share links from BOR on forecast-informed reservoir projects (see below): SECURE Water Act Report and Data Visualization Tool www.usbr.gov/climate/SECURE

  Reclamation Reservoir Operations Pilot Initiative Website
  http://www.usbr.gov/watersmart/wcra/reservoirpilot.html

  Reclamation Climate Change Adaptation Strategy
  http://www.usbr.gov/climate/

- JOE FORBIS: Will share spreadsheet with reservoir ratings for potential FIRO transferability. (Done, attached)
- MARTY RALPH: Team will add 1995-96 Monterey storms to data set on Meso-scale frontal waves.
- JOSH FULLER: Will share water quality data set with Jeff Church, at SCWA.
- DAVE REYNOLDS: Will follow-up with Rob's group to look at December 2015 dry-weather "miss."
- MARTY RALPH/ARLEEN ODONNELL: Ask participants to complete summaries of science projects, by sending out a template and asking people to think about 5-year horizon.
- MARTY RALPH: Will initiate discussion with Cary Talbot and Pat Rutten, conference co-chairs, about a March 2017 FIRO conference.
- ARLEEN O'DONNELL: Will solicit from steering committee members a short list of names of technical experts to conduct outside review of Preliminary Viability Assessment.

SUMMARY NOTES

FIRO Updates and Information Sharing

Current Lake Mendocino Conditions: Jay Jasperse discussed Lake Mendocino current water conditions. Point: Deviation for the last year implemented by Corps resulted in having water in the lake currently.

Josh Fuller noted that the fall-run Chinook return in 2015 was more robust than in 2014. Hatchery return for steelhead were higher, too. Real drought impacts will be seen in coming years. Wild steelhead and coho residing in tributaries will be hardest hit by the drought.

NOAA Habitat Blueprint: Pat Rutten discussed the NOAA habitat blueprint for the Russian River, which is consistently identified as the poster child for collaboration. What will NOAA be doing with blueprint in next generation? Going forward, will likely start focusing on FIRO as one of the main outcomes (along with estuary habitat restoration). Blueprint keeps FIRO in forefront for fisheries.

Discussion of banked storage and benefits to fish. FIRO is a water delivery program, but tributaries are critical. If don't have water in tributaries, coho can't survive the summer. Conservation, groundwater recharge and reclamation will help.

California-Nevada River Forecast Center 2015/16 Winter. Rob Hartman noted that March rain was a big help. The rainy season was typical of west coast rain, with storms in fits and starts. Lake Mendocino releases were very low until we got into March event. Noted that there is an 8000 cfs flow limit at Hopland, which limits releases from CVD. Guerneville is one of highest repetitive loss locations in US, but only got close to flood stage once in 2016.

Discussed CNRC forecasts: Very close on forecast of Lake Mendocino inflows. There was tendency to over-forecast for 10-day accumulated flows. There was no occasion when storm snuck up. Models are getting better. Not sure why, but could be better AR information.

Overview of NOAA OAR FIRO Science activities. Rob Cifelli reported that there are five new soil moisture sites in upper Russian River watershed.Will be taking a microscopic look at the model to determine how it is doing. Lynn Johnson is working on cooperative project with Colorado State University, NMFS and SCWA. NOAA took

advantage of El Niño; did flights in tropics to see if clues on breeding grounds of El Ninos can help with AR forecasts. Rob discussed whether they are expanding on national water model assessment.

Overview of USACE FIRO Science activities. Cary Talbot reported that there is a lot going on on Corps side. There are 15 Corps people in attendance, including regulars plus others, including coastal and ERDC. Christy Jones left the Corps. Joe Forbis is her replacement. PIO from SF District is working with PR office at HQ on FIRO messaging. Corps is being asked about FIRO on a regular basis. Coordinating messaging to make sure that we are all on the same page. New people from ERDC: Chuck Downer is leading effort on distributed model on RR; ERDC also doing WQ model that links reservoirs/flows. New Lt General for Corps has started. Request for FIRO briefing is on the way.

On July 13, there will be a House briefing on FIRO with NOAA, Corps, Western States Water Council, SCWA. The topic is western water issues, including FIRO, ARs, sub-seasonal issues.

FIRO Preliminary Viability Assessment
Chris Delaney: Reviewed SCWA model which utilizes CNRFC ensemble hindcast. Compared modeling results of current operations, perfect forecast, risk-based approach, and hydrid scenario (modified rule curve and risk based).
Showed how perfect forecast could impact storage. Noted that having more days in forecast only impacts frequency of spills and impacts downstream. Doesn't affect water supply.
Spills were eliminated with 10-day perfect forecast. No benefit to using perfect forecast past 13 days. If forecasts were on an hourly timestep, the spills might not show up.

Discussed whether the scaling of storms might shape impact and concerns regarding scaling for a 25-year sample size; flow regimes in relation to fish needs -- whether release schedule could improve water quality (by increasing flows during flood releases to shorten the time period that turbid water is released); whether hybrid model was necessary (debate about whether hybrid represents an interim step that could be helpful in pursuing a major deviation); concerns about model's ability to deal with extremes given time range of CNRFC of 1985-2010, like an extreme drought period followed by extreme flooding; ramping rates.

QUESTIONS FOR FURTHER STUDY:

- 8,000 cfs limit at Hopland.
- Use of sensitivity analysis.
- Extending model to Guerneville to determine whether higher releases from CVD would impact flooding in lower river.
- Adding bookends, which will be done by Scott Sellars.
- Conducting a hindcast in a short time frame.

Matt McPherson: Reviewed process and results of HEC modeling. Results were similar to SCWA model. Both results find that using forecast information could potentially result in improved water supply storage while maintaining flood protection. HEC will be using hindcast data to fine-tune analysis, using tools, etc, that Corps would require. There was a lot of discussion about additional modeling. Concerns were raised regarding adding too much onto this project before Preliminary Viability Assessment is done. It was noted that it was a positive development that the HEC and SCWA approaches both have similar outcomes.

David Ford: Showed outline of Preliminary Viability Assessment; about 40 pages written (David is writing the body of the report). The body will be the HEC report and SCWA report. Aiming toward report release at end of October. Everyone will have a chance to weigh in. Discussion about external review of report. It was noted that lots of agencies will be reviewing. The report will be a work product of the steering committee, which will discuss the review question at its June 29 meeting.

Day Two

FIRO Transferability

Katherine Dahm: Provided overview of the USBR Secure Reservoir Operations pilot initiatives. Climate change adaptation strategy guides reservoir ops pilot. Guidance to science capacity to pilot to implementation.

- Step 1: Developed team that represents western areas/policy (SECURE team, est in 2014)
- Step 2: Conducted a reclamation-wide survey on current operations.
- Step 3: Identified 5 pilot study sites
- 2016-17: Conducting pilots

Sites are in Central Oregon, Klamath, Colorado, Southwestern OK. Oregon pilot is most similar to LM FIRO, with a project jointly operated by USBR and Corps. Update rule curve; forecast optimization; flood control rule curves. Developing guidance. Goal of pilot: When there are continual dry years, can there be an "off the shelf" deviation?

Discussion about whether reservoirs support urban supplies; volume of transfer; projects shared with USACE.

Joe Forbis: Discussed the development of a matrix for updating WC manuals. The Sacramento District created list of reservoirs and ranked them based on 16 questions. Totaled scores and categorized. Weighted questions to assign value. The lower the number, the easier it would be to implement; higher is harder to implement.

Result: 31 total reservoirs: 5 are don't need to be updated; 2 will be easy to update; 8 will be medium difficulty; 16 will be hard but not impossible to update.

Discussion about why the choice of the exercise was the ease of implementation versus benefits to community. "The Matrix" was created for the purpose of prioritizing water control manual updates based on the level of difficulty to update them. The Corps recognizes and values non-flood control benefits, the matrix doesn't explicitly include what benefits might come from implementing forecast-based/forecast-informed operations. The Matrix is Step 1, and Step 2 would be answering the question "Now that we have an idea of how hard it would be to implement forecast-based/forecast-informed operations at project X, what potential benefits can be realized?" It was noted that ranking was partly based on the rankers experience with reservoir operations.

Joe Forbis: Presentation on bands and Buffer zones for WC manuals. Band/buffer: variable or conditional flood space. The space in the reservoir where the top of conservation pool can vary. Flood control pool can vary by date (LM and 22 others in Sac district); basin wetness; snowmelt parameter; upstream storage credit. Six reservoirs combine variety of factors. Example: For Lake Oroville, date and basin wetness (factor of accumulated rainfall). Multiple rain gauges. Restarts on Sept 1. But decreases if don't get rain; creates index. Noted that soil moisture sensor being used at Martis Creek. Testing it, but haven't changed ops off of this. Forecasts come into calculation in "forecasted inflows."

Discussion about buffer zone calculations and whether, as science progresses, we should use hydro-model. It was noted that in the RR, have 12 soil moisture settings. Great opportunity to look at basin wetness factor in calculation.

Brad Moore: Lake Folsom. Much larger than Lake Mendo. Joint federal project, new additional gate. Can release more water without being so high in the pool. Congress mandated that Corps LOOK at forecast-based operation. Looking at two components:

1. Top of conservation pool, based on forecasted inflow volume. Releases were empirical/trial and error. Use 300K AF trigger based on forecasted inflows (stepped releases) if storage is above TOC. From CNRFC.
2. Upstream storage.

What is downstream flow release based upon? 115K, capacity when Folsom was constructed. Can go up to 160K, if levees hold, OK. But don't want to keep it there forever.

Scott Sellars: Forecast verification analysis. When forecasts go past 115 hours, not so accurate.
Can use this simple tool to develop certainty measure. Can transfer to any basin. The tool is very sensitive to number of forecasts available. Extreme events were left out, because of scatter. Also, sliding 24-hours would increase sample size.

Discussion about continuing this work. Probabilistic versus deterministic forecast. Noted that Corps cares about dots above the line; not dots below the line. Most worried about flood predictions. Noted that weather prediction skill for West Coast storms is much better. Four times better here than in other areas.

Dave Reynolds: Requirements and Options for FIRO Decision Support Tools – Benefits and Challenges Ahead. Discussed skill of mean of MEFP; limitations/benefits of SCWA model. Bottom line: Ability to predict no rain is bearing out hypothesis.

Discussion about whether project should be discussing specific water supply benefits as a result of FIRP (19,000 AF was discussed as an amount that could have been preserved). It was noted that only 58 times out of more than 4,000 events did significant precipitation events occur that were greater than 1 inch, when predicted to be less than 1 inch and only a handful of events were over two inches.

Science Presentations & Discussions, Part II

Andy Martin: Verification of West-WRF during AR Conditions at Lake Mendocino. West-WRF is a CW3E product that has the goal of creating the best possible forecasts of extreme western precipitation events. Benefit FIRO with high resolution, greater than 5 day forecasts. The temporal resolution for the model is every six hours, but it can do more.

Marty Ralph: Meso-scale frontal waves & AR recon campaign. Discussed role of Meso-scale frontal waves on AR direction and productivity. Air flight in February 2016 provided large amounts of data. Discussion of how much do mesoscale frontal waves affect flows vs affect of releases. During the AR season, its mainly natural flow in river. Question regarding how do ARs affect LM (a mountain range over)? Using data sondes to measure information in LM area.
Need to get better measurement of mesoscale front waves to get timing and location of AR better. Important for peak flows. Discussion of 1995-96 storms in Monterey.

Lake Mendocino Storage and FIRO: Meeting Water Quality Objectives for Salmonids

Josh Fuller: How will FIRO benefit fisheries? Discussed three salmonids of concerns in Russian River:

1. Chinook (fall run only in RR). Big problem is low water in tributaries; low water in fall for upstream migration. Real opportunity to meet recovery target in RR.
2. Steelhead: Winter run; important that we get adults back out of river, as they can spawn multiple times. Target pop is 19K; with 8.5K in upper RR.
3. Coho salmon: Endangered. Winter run. All below Dry Creek. Lake Mendocino operation doesn't affect coho.

RR BiOP and Potter Valley BiOP both affect Lake Mendocino releases and operations. Turbidity is a problem identified in RR BiOP – can't really be affected by FIRO. Seems to be getting worse. Ramping is another problem. Ramping down too fast can strand young steelhead. The March-May ramp down is critical, because stranding can happen.

Discussion of how the 100 cfs ramp-down limit (when flows less than 2,500 cfs) creates problems for Corps (trying to get to minimum flows); water temperature destratification and loss of cold water pool for Chinook migration; and groundwater flows into RR/tribs.

David Boughton: Using life-cycle modeling to think about response of Chinook salmon to FIRO. Extreme flow events rework gravel and loosen it up. This needs to occur frequently enough so that gravels don't become embedded. But FIRO releases could go either way for velocity. It's a naturally flashy system. Only 10% is regulated. This may take modeling.Release limitations of BO may have more impact than FIRO.

BREAKOUT GROUPS

Preliminary Viability Assessment: Same outline as presented last year. Some slight schedule slip. Steering committee will review the final draft and will determine if outside review is needed. Identified some other issues/questions for steering committee to decide.

Science Task Group: Discussed graphics that show science growing better as time goes on.

Lake Mendo ideal place to do this because precip forecasting science is really good. Discussed transferabilty and concern that FIRO idea will go viral and people will try it and there will be problems, which could result in backlash. Goal is for FIRO to spread – but based on sound methodology and science.

Discussion of whether this project could be a test bed for FIRO and whether the graph showing why LM is good spot and why other areas aren't, might create political problems.

Communications & Outreach Task Group: Group discussed key FIRO messaging and the launch of the Preliminary Viability Assessment. The task group will flesh out a launch plan to be shared with the Steering Committee at its September 8 meeting.

CLOSING

Marty Ralph assessed interest in hold a FIRO conference for a community of interested people to come together and share ideas In March 2017. Goal is to discuss studies, etc, for LM FIRO, Folsom and BOR pilots. Invite ACWA, water managers. Sponsored by Scripps, Corps, ACWA and DWR. Could potentially start getting the message out to communities ASAP.