M & T / Llano Seco Fish Screen Facility
Short-Term/Long-Term Protection Project

Project Alternatives and Feasibility Workshop
Technical Review of Proposed Off-stream and In-stream Alternatives

February 16 – 18, 2005
Llano Seco Ranch Headquarters
Chico, CA

M I N U T E S

Wednesday
February 16, 2005

Site visit along river to evaluate changes over the winter months. The following individuals conducted the site visit:

Yantao Cui, Research Scientist, Hydrology/Geomorphology
Michael Harvey, Principal Geomorphologist, Mussetter Engineering, Inc
Eric Larsen, Research Scientist Geology
Kelley Moroney, Refuge Manager, Sacramento Valley National Wildlife Refuge Complex
Robert Mussetter, Principal Engineer, Mussetter Engineering, Inc.
David Sieperda, Manager, Rancho Llano Seco
Paul Ward, Association Fishery Biologist, Region 2, California Department of Fish and Game
Olen Zirkle, Manager, Conservation Programs, Ducks Unlimited, Inc.

Following the site visit, the workshop was held at the Llano Seco Ranch headquarters.

Introductions

Beverley Anderson-Abbs, Env. Specialist, , Sacramento River Conservation Area Forum
Howard Brown, Fishery Biologist, National Oceanic & Atmospheric Agency
Burt Bundy, Manager, Sacramento River Conservation Area Forum
Stephen Caswell, Project Engineer, Carolla Engineers
Stacy Cepello, Environmental Scientist, California Dept. of Water Resources
Yantao Cui, Research Scientist, Hydrology/Geomorphology
Dennis Dorratcague, MWH Americas
Dan Efseaft, River Partners
Michael Harvey, Principal Geomorphologist, Mussetter Engineering, Inc.
Les Heringer, Manager, M&T Chico Ranch
Eric Larsen, Research Scientist Geology
Chris Leininger, Project Development, Ducks Unlimited, Inc.
Friz McKinley, Director City of Chico – Public Works Dept.
Tamara Miller, PE, City of Chico

Kelley Moroney, Refuge Manager, Sacramento Valley National Wildlife Refuge Complex
Robert Mussetter, Principal Engineer, Mussetter Engineering, Inc.
Vickie Newlin, Sacramento Valley Regional Coordinator, California Bay-Delta Authority
Scott Parker, Project Manager, Carollo Engineers
Matt Reed, Project Manager, Reynolds, Inc.
Bruce Ross, Engineer Geologist, California Dept. of Water Resources
Neil Schild, Principal Engineer, MWH Americas
David Sieperda, Manager, Rancho Llano Seco
Paul Ward, Association Fishery Biologist, Region 2, California Department of Fish and Game
Olen Zirkle, Manager, Conservation Programs, Ducks Unlimited, Inc.

Project Review: Olen reviewed the Steering Committee Charge, Goals and Objectives, Progress to Date. He described the existing conditions of the gravel bar as increasing and reviewed the Steering Committee recommendations regarding the two viable alternatives (in-river (potential spur dikes) and off-river (potential Ranney Collectors). Olen explained an amendment request was initiated to provide for support to study each of these alternatives. This workshop will evaluate and discuss the information presented in these studies. (See enclosed studies.) Olen explained that the workshop information would develop answers to the fundamental questions addressed in the Steering Committee Charge.

FUNDAMENTAL QUESTIONS TO BE ADDRESSED

1. What is the rate and uncertainty associated with river meander and sediment deposition at the project site?

   The project has two detailed studies to assist in answering this questions.

2. What is the realm of possible alternative means to meet the water requirements of the beneficiaries?

   The last workshop discussions laid out a list of possible alternatives appropriate to the project that initiated a test well to study groundwater characteristics and supply.

3. What is the current fish screen criteria and can that criteria be changed to accommodate innovative solutions?

   Paul Ward, Howard Brown and Dennis Dorratcague have been working together as a subcommittee to advise the Steering Committee. There was consensus at the last workshop that the state and federal fish screen criteria had some flexible.

4. What are the uncertainties associated with the simultaneous interaction between river meander, pumping plant capacity and fish screen protection?

   This is the Steering Committee main charge and represents the project hypothesis. It presents the question that there is a solution that could design a scenario where not only satisfy the screen criteria, satisfy water needs, and satisfy the river meander.

Tomorrow's discussions will look at the conceptual model to guide the decisions process in trying to satisfy the goals and objective of the project, as well as, meeting engineering and economic feasibility and beyond the realm of the project.

This were the project is to date. This is the final round of information gathering and presentations. This afternoon discussions will be dedicated to developing a recommendation to CBDA and moving to the next steps. Olen explained that the City of Chico was working in collaboration with this project to protect the wastewater outfall and has just completed a Draft EIR/EIS to address this issue.

City of Chico Wastewater Treatment Plant Outfall Proposed Alternatives

Friz McKinley, Director City of Chico – Public Works Dept.
Stephen Caswell, Principal Engineer, Carollo Engineers

Fritz McKinley explained that the City of Chico was looking at an expansion project slated for 2007 and the outfall will be increased in size. Like M&T and Llano Seco, the city is unsure about the gravel bar. He then turned the discussion over to Stephen Caswell to present the details.

Stephen Caswell explained that as the City of Chico continues to expand as they bring the current outlying communities that are septic systems, there is a need to expand the treatment plant capacity from an average dry-weather flow capacity of 9mgd, as it exists today, to 12 mgd. Correspondingly, is a peak wet-weather flow component and the outfall will be sized to meet this requirement at 30 mgd. The preliminary assessments have found existing outfall capacity is about 27.5 mgd and there is a shortfall. Coupled with the expansion issue is the problem of the gravel bar encroachment. The existing outfall was constructed between 1974-75 and during a 1986 storm event the diffuser section detached a moved downstream. The city shortened the outfall toward the left bank. Since that time the outfall has remained in place and worked well with the exception of a couple years ago when the gravel began to settle around the diffusers. At that point there was a joint project with the M&T to remove the gravel bar so that both the function of the outfall and the pumping facility would be returned.

Changes in the water quality standards now require a higher level of initial dilution and the existing outfall is not designed to meet those requirements. The new diffuser will completely optimize the design to achieve a superior level of dilution of the secondary affluent of the treatment plant. The criteria for the new design of the outfall is set to meet the build-out capacity of the treatment plant and minimize the number of times of getting out into the river.

Slides were presented that depicted the gravel bar encroachment over time (aerial photos).

The geomorphologists working with Carollo Engineers developed six alternatives for the city to meet the duel demands dealing with the gravel bar encroachment as well as the larger diffuser to support higher flows. The list includes (1) continued dredging as was done in 2002; (2) spur dikes; (3) relocation of the gravel bar; (4) cutting a pilot channel through the state parks area and redirecting the river; (5) creating a movable diffuser design (easily detached and relocated as

needed to accommodate the river movement); and, (6) a relocation of the outfall pipe further downstream.

The first alternative is really not a permanent solution, both noted in the Steering Committee report and the geomorphologists reports. In any wet weather season, the gravel bar could completely rebuild and therefore, continued dredging is not a long-term solution to maintaining the outfall. It is an expensive cost for continued dredging and the permitting requirements are quite extensive.

Preliminary evaluations of the spur dike options show that this action could limit the growth of the gravel bar. The city will still need to deal with the capacity issue of the outfall pipe to at least reach the 12 mgd capacity. It's been determined that this can be reached in the diffuser section by itself. However, there would need to be a future project through the M&T property to upgrade the transition main to meet the ultimate 15 mgd capacity. The other benefit of the spur dike option is the that it would provide the opportunity for a joint project if that is the alternative selected by the Steering Committee.

Another alternative presented by the geomorphologists was a relocation of the gravel bar by physically moving the bar to the right bank of the river and installing some protective spur dikes upstream to fix the gravel bar position. In concept, this option did not seem practical.

The next option was a pilot channel from Big Chico Creek to the river in an attempt to mitigate some of the bank erosion on the right bank. This was again determined not likely to be feasible from a regulatory standpoint.

The fifth alternative considered was a moveable diffuser anchored on piles driven along the toe of the levee and essentially having segments of pipe that could be stretched upstream and downstream as required and lateral piles driven across the river to anchor the diffuser pipe. This would be a flexible design in order to provide the ability to cope with river movement. However, it proves to be a very expensive alternative and requires several instances of getting in and out of the river and from a regulatory standpoint did not seem too desirable.

The last alternative considered was a relocation of the existing diffuser from its present position to a location about 300 feet downstream of the pumping plant. This location is approximately 1,500 feet from the treatment facility. The geomorphologists have assessed the entire upstream stretch of the river from the existing outfall and the downstream stretch of the river. From that assessment the downstream location was determined a suitable site that had a reasonable chance of meeting the design life of 15 to 20 years of the existing outfall. Slides were presented to illustrate the constraints associated with the downstream location (i.e. riparian area and river cutback issue). One of the downsides is the lack of permanence based on the current rates of erosion and deposition verified by both the Steering Committee and the geomorphologists working with Carollo. The downstream location seems to only have a 20-year life.

There is a conceptual evaluation prepared looking at the various options presented to the city. The two options that stood out as being a potentially feasible were the spur dikes and the diffuser relocation. The spur dike option has the benefit of the shared project cost between the city and

M&T/Llano Seco. However, the city is in a position to preselect an alternative to meet the environmental documentation required to move ahead on the issue. As the Steering Committee has not reached a consensus on which alternative to more forward, either with a stand along project like the Ranney Well that does not have any benefit to the city or a joint project like the spur dikes it was decided that at that point that the environmental documentation needed to proceed with an option that the city could support on their own. At that point the recommended alternative is to move the diffuser downstream. The city has certainly taken into account the possibility that the city could proceed with a joint project if the Steering Committee determines that is the appropriate recommendation for the M&T/Llano Seco.

Currently, EIR/EIS document will go to public comment next week and is almost ready to wrap up. In order to meet the city's needs in terms of capacity of the plant for the nitrate action plan as well as growth in the community, the city had to move on treatment plant project. This gives the Steering Committee an idea of the timeline that the city has to meet those demands. The public review period begins next week. The important step for the city was to initiate and complete the environmental documentation to begin meeting the capacity increase.

In response to questions, Stephen further explained that the diffuser would be designed for a 15 mgd condition which is essentially the build out of the community of Chico and the treatment plant. The outfall itself is hydraulically designed for 37.5 mgd which supports an average treatment plant capacity of 15 mgd. He explained that treatment plants are rated on their dry-weather flow capacity and then there is also a hydraulic peak factor that is applied to that rate. The design will treat and discharge the entire 37.5 mgd. The actual rating of the plant for a growth perspective is based on the 15 mgd rating.

Stephen explained that the city does not have the same groundwater option as the M&T/Llano Seco. They city must have a surface water discharge.

More discussions were held regarding the extension of the main through the M&T Ranch.

It was concluded that if the river could be fixed in the location of the current outfall or downstream relocation by spur dikes it would significantly increase the life-time of the outfall.

The question was raised about moving the outfall to Little Chico Creek. Stephen responded by explaining that this would require a treatment to meet the Title 22 standards for an affluent dominated water body at a substantial cost (a $20 to $30 million plant upgrade).

More discussions were held regarding the spur dike solution and possible response by the river. All agreed that there was no easy answer.

Stephen responded that the city is faced with having to preselect an alternative to proceed with their process. The city is in a position to have some reasonable alternatives to move ahead. Stephen explained that the spur dikes could benefit both the city and M&T/Llano Seco and would be supported by the city. However, if a mutually viable alternative never comes to the table, the city would have no option but to proceed on their own. The benefit of moving the diffuser downstream is to take advantage of river movement to the east and the river's tendency

to move due south from the relocation site. The site follows the edge of the levee down and hydraulics a gain back towards the river in terms of gradient. This seems to provide a greater capacity to move downstream in the future. This contingency helped support the relocation.

A question was raised about how inclusive is the EIR/EIS of the project site. Does it include the possibility of spur dikes. Stephen explained that the report only refers to the option as identified by the Steering Committee and identify the potential of a joint project. But in order to have an EIR/EIS certified there must be an identified alternative. If it turns out that a position along the river as it is now, the city will address it at that point. The city needed to include the downstream alternative to move the EIR/EIS forward.

The question was raised about amending the existing EIR/EIS if the spur dike option is recommended. It is possible to utilize the city EIR/EIS for this project? It was felt that the previous EIR/EIS was conducted by the same consultant, Jones and Stokes. It might be easier to just amend both reports.

The question was asked about a possible implementation schedule. Stephen responded by explaining the city will proceed with a preliminary design of the outfall to the point it will support the permitting documents. However, the city has gone into this knowing that there may be a detour if the Steering Committee puts forth a recommendation that has a joint project opportunity.

Olen concluded by reiterating that there is a possibility of a partnership that could share mutual needs and benefits associated with a joint project that has the potential to extend the life of both facilities. Both entities are faced with the same problems and constraints associated with the river. It would seem that the joint partnership benefits should be given weighted consideration in the decision-making process associated with the spur dike alternative, especially when one partner is faced with a long-term solution regarding public health and safety concerns. This would bring an economic benefit as well as a social benefit.

Fritz McKinley reiterated that the city is very willing to be a cost-sharing partner in the M&T/Llano Seco project. The long-term solution would also help meet the growth demands on the treatment facility. Stephen also explained that city has yet to decide on how to proceed with the project but certainly as mentioned earlier in the presentation, the existing outfall hydraulic capacity will support up to approximately 11 mgd, an average dry-weather flow. That is in excess of the current 9 mgd rating of the plant. He explained that the EIR must be document a comprehensive project. The city must have a plan to meet the criteria and with that in mind, there is a desire not to do a plant upgrade at 11 mdg and then another upgrade at 12. It makes sense to plan the project all at once.

The question was raised about any modeling conducted to provide information to the EIR/EIS? Stephen replied by explaining that the information was a literature review of previous river modeling conducted in the project area (i.e., The Nature Conservancy). It was mainly a technical review of the existing conditions.

The comment was made about the added value of spur dike option to the relocation alternative proposed by the city. Stephen explained that there are two ways to proceed. With the decision to add 2,000 feet of additional piping and the increased costs -- if there is an opportunity to continue to maintain the diffuser at the same time that the Steering Committee decides to implement the spur dike alternative; and, the project will roll out; then within the next short period of time, the city can go back and reassess the outfall decision.

The question was raised about implementing the spur dike option and future impacts to the relocation project? Stephen responded by stating that the city would like to be a part of the design of the spur dikes and regardless of the number of spur dikes the city would prefer to implement all at one time. Once the decision is made by the Steering Committee to proceed with the spur dikes, the city can reevaluate their position at that point.

The question was raised about replacing the old pipe or just replacing the outfall? Stephen suggested, from the permitting aspect, the old pipe would have to be abandoned. Whether or not it would be demolished and/or removed could not be determined at this point. It has been determined, that in the future, it will not be used.

The question was raised regarding environmental mitigation associated with the diffuser relocation? Stephen suggested that there are bank swallow considerations, however, no associated permanent mitigation is proposed.

The question was asked if the city conducted in any technical review of spur dikes and/or gravel bar removal? Stephen confirmed that the alternatives were based on conceptual options and assessed on the feasibility of attaining regulatory approvals for the various conceptual projects. He explained that the options are supported and preferred by economics. From a cost standpoint, the additional transmission main compared to the cost of implementing a spur dike alternative on was not economical.

The city used the spur dike assessment developed by the Steering Committee in their evaluation. The Steering Committee reminded the group that the estimated costs for the spur dike alternative did not include mitigation.

More discussions were held regarding the costs, characteristics and possible river response to spur dikes in the project area. No conclusions were reached. The presentation was brought to a close.

Presentations of Off-Stream and In-Stream Alternatives

Aquifer Text DRAFT Report, January 21, 2005

Neil Schild, Principal Engineer, MWH Americas
Chris Petersen, Hydrogeologist, MWH Americas
Matt Reed, Project Manager, Reynolds, Inc.

Neil Schild opened the presentations by reviewing the previous technical reviews conducted by the Steering Committee that have led to the Draft Aquifer Study (i.e., scattered ground water wells, another intake across the river, lineal groundwater collector, Ranney wells, and spur dikes). The findings from these investigations substantiated the collection of data associated with hydrogeologic conditions to support a Ranney System.

Chris Petersen presented the study objectives of collecting the data, field methodology, the results of the testing, and the conclusions that were reached and documented in the report.

Primary Objective: Confirm that shallow groundwater in the aquifer next to the Sacramento River that was being tested was actually connected to the Sacramento River.

Secondary Objective: Assess the impact of pumping the shallow aquifer on groundwater levels at various locations away from the river.

Methodology: The test pumping wells were located as closed to the river as possible and then located a series of monitoring wells perpendicular and parallel to the river in an attempt to accurately assess the draw down of the aquifer.

Chris explained the installation of river staff gauges to assess possible river draw down during pumping of the test well.

Chris explained the construction of the wells, cutting logs, measurement tools and data collection. He presented the layers found in the gravels in all the wells and how this information was used to design the test wells.

He presented the test results that can be found in the Draft Aquifer Test Report. In conclusion the test results showed that the project area was homogeneous and transmissive sand and gravels. He explained that data collected from the spinner log test showed that the project area is productive especially below the clay unit described in the report.

Chris explained data collected from river levels and how these levels corresponded to aquifer levels before and after pumping. He explained that the stretch of the river along the project area appears to be a gaining stream where groundwater flows into the river. When the river level goes up quickly and higher than the groundwater, the data shows that the river migrates toward the groundwater system.

Chris explained the results of the 48-hour continuous pumping tests. Results can be found in the report that illustrate the draw downs levels of the surrounding monitoring wells dropped significantly relative to the river level during that period. However, the change is not that high in comparison. Chris gave a detailed overview of the data results at various pumping rates.

Chris further explained the determination of pumping rates to use for long-term continuous pumping tests. He explained that a step test was used to step production initially at 562 gpm and then analyzed the draw down in the test well. This was tested in one-hour steps. Then the pumping was stepped up to 1,000 gpm for one hour. The draw down was evident, however, it

stabilized very quickly. Then the pumping was stepped up to 1,500 gpm and finally up to 1,882 gpm. More turbulent flows occurred at this point of the testing and the test was halted.

During the tests, the river levels were going down as shown in the graphs. The same trend shows up in each of the monitoring wells. This data shows that the wells are connected and influenced by what's happening in the river.

The river affect was calculated and the corrected data was used to calculate the aquifer parameter, transmissivity, storictivity and hydraulic conductivity. Three different methods were used to determine the values. This data was used to determined the potential yield of a Ranney-type well system.

Chris reviewed the data associated with changes in water levels during each phase of the testing. Chris explained that water quality samples were also collected before the testing was conducted to establish pretest conditions. All resulted were reviewed. All groundwater looks similar, total dissolved solids concentrations are higher than the river. This provides more evidence that the aquifer is flowing from the groundwater system to the river rather than the river flowing naturally to the groundwater. Chris explained that a reverse flow would eventually occur with continuous pumping.

Chris explained that a temperature profile was also conducted in the test well and two monitoring wells. The results may indicate that the river water is moving across the shallow portion of the sand and gravel zone past the monitoring wells and into the test well. More discussions were held regarding temperature data.

Chris further explained that baseline surface water groundwater levels tend to suggest an interconnection between the river and the shallow aquifer. The spinner log also supported this conclusion. Chris noted that the whole area is very transmissive.

Chris concluded that draw down impacts in the project area are really minimal. There is draw down in the test well, which is what was expected. However, moving out to the two nearest monitoring wells and the far wells, and there is hardly any draw down. Chris suggested that the transmissive envelop spreads out a long way and he concluded that the cone of depression is very small and goes out a long way.

Chris concluded from the data that the baseline temperature readings in groundwater and in the river indicate that the river is a gaining stream under a natural unstressed condition. The water quality results seemed to indicate the same conclusion. This condition seems to change with changes with rapid increases in the river level, then the river starts feeding back into the groundwater system. The aquifer yield that was calculated was very typical for a semi-confined aquifer of these soil textures. It appears that the conditions are suitable for a Ranney-size well system.

Question: If the river moves away from the present location, what sort of potential impacts on the water supply? Chris suggested that since the aquifer is 80' thick and it is very porous gravel and sand, there doesn't appear to be a significant draw down which indicates that the aquifer is a

very broad unit, that even if the river moves away you would still get the type of yields that the are suggested because the aquifer itself is so transmissive.

Question: Describe the river water surface compared to the groundwater level. Yantao questioned the relationships and gradients between the river level and the groundwater level in comparison to the river moving away from that stretch of the river. More discussions held regarding this question.

Question: Yantao still unsure about the sufficiency of the data to draw a reliable conclusion about groundwater levels if the river meanders away from the well site and argued that the draw down in the well will increase once the river moves away from the well.

Question: What did the data show at a pumping rate higher than 1,892 gpm?
Answer: The efficiency of the well went way down. Chris explained the draw down data tends to be linear to a certain point and then it reaches a break point where it becomes nonlinear and that's when the flow from the formation into the well becomes more turbulent and the information is plotted. A point is chosen at the top along the linear portion and that becomes the rate chosen for the long-term test. It doesn't mean that the well cannot be operated at the higher rate but the lift costs will be higher since it becomes necessary to lift that water up from a much greater depth. It's a function of the pumps trying to pull the water out of the well. There is 40 to 50 feet of strain. The well was built primarily for the purposes of the test. Many agricultural production wells will strain at 100, 200, 300 feet. There is a much larger area that water can flow into on those wells and with more production is available before you pump off. The flow rates tested out of 50' of screen are very good which indicates that this formation is very transmissive.

Please see complete data sets in the Draft Aquifer Test Report.

Neil Schild introduced Matt Reed.

Matt Reed presented (slide show) an explanation of the design, construction phases of a Ranney Collector System and its operation. He explained that the function of the system is to lower the groundwater surface by pumping a groundwater-to-subsurface water flows from high elevation to low elevation. Lower the head under a strain and then cause that strain to recharge the aquifer.

Matt presented information about a Ranney System constructed for Sonomo County Water Agency. The well was pumped May 31, 2002, 26 million gallons/day (40 cfs). The well was built in an aquifer very similar in terms of transmissity that appears from the data is in the project area. This Sonoma system easily achieved the 40 cfs flow with 13 feet of draw down and had another 60 feet available. The construction of the well and pumps is a function of the need and configuration required.

Matt presented methodologies, data and structure requirements used to determine potential yield for the project using the data collected from the Draft Aquifer Text Report. Matt explained that smaller numbers were used in the calculations as a result of looking at the total saturated thickness. He referred to the test well data and believed that if the upper zone was dewatered,

which is a highly transmissive zone, it would impact the well yield. He explained that his evaluation did not include the benefit of that extra transmissive zone. The approach only took into consideration the lower zone. Stoictivity number is entirely appropriate for this setting. The permeability is just the 482 divided by 86 feet of thickness. It was assumed a recharge distance of 700 feet to a hydraulic boundary which would essentially be the effect of the river. That is a little different than the actual geographic distance -- it is a theoretical hydraulic boundary that takes into account the flux difference across the river bed so it is not a perfect boundary. The calculations are actual further at the far side of the river. Other considerations: the depths of the lateral floor of the static water level; the central well design; 10 to 12 laterals 250 feet in length 12 inch diameter or ½ foot radius; 16 ft diameter casson; yield calculations were assumed to have pumping level of 15 feet above the center line of the laterals; two tiers or elevations; six laterals in each tier.

If we were in a static water level, we would calculate how much water can be pumped by drawing down to 15 feet above the laterals. If the yield at the recharge boundary located at 700 feet is calculated, there is a projected draw down in feet zero down to 70 – 60 in the design pumping level; and, that is 15 feet above the lateral and an estimated yield in gallons per minute. At 62 to draw down, the projected pumping of roughly 42,000 gallons per minute is 49 cfs. Knowing that the issue of the river is moving, the yield was evaluated if there were no returns from the river. In an extreme condition, if the river moves 1 mile to the west, the well is dried up. At a draw down at 180 days of continuous pumping, the design pumping level at 60 feet was at 14,000 gpm (31 cfs). There is a range in respect to yield. Worst case scenario is roughly 31 cfs. In summary, three to four wells and pipeline and pumps would cost $12.5 to $16 million as a range.

Matt explained that one of the benefits to the Ranney system was a high percent of the construction and maintenance is on shore and it would not be necessary to go back into the river to do work pre or post construction.

Matt further explained that the evaluation of the system yield was high even if the river moves away from the wells. In reviewing the data with MWH, it was Matt's recommendation that before investing in a big system, that the project construct one well and collect data one year. This valuable information could then be used to optimize spacing, number of wells, and costs for future well development.

Question(s): If there is a 60 ft draw down for almost 50 cfs and the project requires 150 cfs, how is it that we only need three wells?
Answer(s): It may only require three. Top more accurately understand future well capacity, Matt recommended constructing one well. He stated that 50 cfs is a big well. He explained that there are not that many operating wells pumping that capacity in the country. He commented that only five in the entire US that are that large. He believed that the project may not find three sites available within the existing ½ mile riverfront necessary to accommodate the spacing of large capacity collectors. He recommended, thatfor economical reasons, the project should initially consider four to five collectors.

Question(s): How far apart should the collectors be spaced?

Answer(s): The collectors should be from 800 to 1,000 feet apart. Matt stated that spacing tries to optimize the costs of the pipeline versus the yield. Distance could have a huge impact on construction costs.

Neil Schild provided an estimate sheet. He explained that the costs were estimated by placing the first collector 600 feet north of the existing pumping plant and placing the second collector in the same location of the test well. Two other collectors were placed 1,000 feet south of the test well. Neil explained that in the location 2,500 feet south of the existing pumping plant, the river migrates west away from the levee. Placing the wells at 2,000 was not feasible.

Neil further explained that the pumping energy was estimated across a 50 ft pipeline conveyance out from the casson. The conveyance design down to the wet well still has to use the natural gas pumps and motors to lift the water from the wet well up to the canal. The energy costs were calculated at 10 cents a kilowatt hour. However, Les corrected the calculated to the more accurate number of 20 cents per kilowatt hour. The 20 cents was calculated at 20,000 ac/ft/yr, 30,000 ac/ft/yr and 40,000 ac/ft/yr. If the maximum of 20 cents per kilowatt hour was used to calculate the operation costs of four Ranney Collectors, the annual cost would be a little over a $1 million. That cost is just energy alone - lifting the water 100 feet out of the casson and keeping enough pressure in the pipeline just a little lower than the wet well. M&T will still have to use natural gas pumps and motors to move water all the way up to the canal. The cost only brings the water over and dumps it into the wet well. There is still a cost to lifting the water to the canal. The water elevation may vary between the wet well and the river.

The presentation concluded and the Steering Committee took the discussion into the following agenda item integrating each of the bullets within the discussions:

Steering Committee Discussions – Ground Water Alternative as a Long-Term Solution Cumulative Costs and Expected Impacts

- Engineering
- Environmental
- Economic (operations & maintenance, life-time expectancy, legal authorities)

It was noted that the option to keep a wet well full or provide storage to keep the canals full was not included in the above estimate.

Question(s): Is it possible to look at putting a well closer to the canal in order to pump into the canal and alternate pumping?
Answer(s): The life would probably be the same amount, however, the lift would be contained to just one operation. If a Ranney Collector was located near the canal, there would be additional lift to extract the lower level groundwater.

Question(s): Are there any opportunities adjacent to the river located on the map.
Answer(s): It's necessary to put the water in the canal and integrate with all the other flows - a smaller contribution would be easier to integrate. This could be reconsidered. Currently, the ranch must pump water from one side of the ranch to the other. The goal is to keep the Ranney Collectors close to the river in order to maintain the water rights.

Question(s): It has been conservatively estimated that it might take small Ranney Collectors to meet capacity. It has been estimated that four collectors may be required (3 X 50cfs = 150cfs). The fourth collector was recommended to be conservative. Is the fourth collector warranted? Is there another alternative to pump an extra 20 to 30 cfs and the rely on the three Ranney Collectors? It seems like having a whole fourth collector to protect 10 cfs might not be feasible.
Answer(s): The cost per collector is approximately $3 million. All the wells have operating costs and the water must be integrated into the water conveyance system. It may be feasible if something is located next to the canal.

Question(s): There is a 30% loss in capacity due to the delivery system. Would it make sense to put one or two collectors at the end of the system so that you eliminate the loss? Is there an available and adequate aquifer?
Answer: In order to make that determination a boring would have to be made. To relocate the collectors will result in a loss of river connection and the diversion is basically out of the river. There is also the a loss of operational flexibility. The water rights would be an issue for the M&T Chico Ranch and Rancho Llano Seco. The Steering Committee would have to investigate the water rights.
Answer(s): There is a good aquifer in the upper zone it just depends on the trade off. If there is not a lot of groundwater currently being used, there may be an opportunity to use groundwater with little impacts due to the availability of a deeper aquifer. A 30% loss over that length of conveyance may mean a larger well to make up the difference. It may required a channel pump. The groundwater is generally high due to all the surface water application in the area and the general gradient towards the river. It should be noted that the two ranches are linked together with one pumping facility

Question(s): Would it be prudent to run some numbers to see what kind of savings can be obtained by not having water loss and by pumping in different locations and compare the expenses. In addition, assess water use efficiency by lining the canal?
Answer(s): Previous calculations: 30,000 ac/ft annually @ 20 cents per kilowatt hour = $850,000. The Ranney Collectors maintain the supply at the upper end of the system. It is certainly possible to scatter wells along the canal and line the canal. It may reduce the costs from $16 million to $9 million.

The issue was discussed regarding relocating the collector system in one location at the upper-end of the system or scattered along the canal.

Comments:

- There is approximately a 20-foot lift out of the river from the existing pumping facility. M&T would like to maintain the lift for efficiency purposes.
- As pumping is located get further away from the river, there is more lift, in addition to draw down if you have wells.
- Reconfiguring the system may result in an expense that exceeds the productivity of the ranch. Maybe water users in Los Angeles can afford to pay for these expenses but these numbers are beyond the ability to use water for agriculture.
- USFWS could not afford that price for water.

- There is a significant amount of private wetlands within the project area that do not provide any financial return. Overpriced water will result in drying up the wetlands.
- Current manageable costs are approximately less than $7 to $8.

Olen concluded the discussion. He explained that each issue will be reevaluated for risks and benefits, in addition to an assessment of data gaps.

LUNCH

Two-dimensional Modeling to Evaluate Potential River Training Works at M&T Pumping Plan Sacramento River, RM 192.5

Bob Mussetter, Principal Geomorphologist, Mussetter Engineering, Inc.
Michael Harvey, Principal Geomorphologist, Mussetter Engineering, Inc.

Bob Mussetter reviewed previous information that set the stage for the presentation of the 2-D model. He explained that some 1-D step backwater modeling using the Army Corps of Engineers (ACOE) was available from the comprehensive study. It was agreed at previous workshops that the river issue was more than a one-dimensional problem and more detail was required regarding the hydraulics - that is the nature of the report.

Bob reviewed the cross sections that were used in the one-dimensional model (192.75 - closest to the pump intake just slightly upstream from the City of Chico's outfall; 193.0 - the mouth of Big Chico Creek; 193.5 - the top of the gravel bar). The 1-D model tried to understand the water surface elevations and what fall level is necessary to spread out into the over banks. Basically, the model determined the average bank full discharge in this reach. The results showed that the discharge will overtop the right bank at about 90,000 cfs. As a basis for analysis in the bulk of the 2-D modeling runs, 90,000 cfs was used as the discharge.

As a background on the hydrology, Bob presented the historical flow numbers at the Hamilton City gauge, the peak discharges going back to the mid 1940's. He explained that if a flood frequency analysis is performed, the results point to a two-year event (Standard Leopold type dynamic channel theory.). If the results are assessed on the mean daily for duration curves that discharge happens a few days a year. It is the discharge that is in the range of flows that would probably have the most effect on the dynamics of the channel in that reach.

One analysis made by the 1-D model at various discharge levels from fairly low flow around 20,000 cfs p to very high flow, was the look at the variation in the main channel top width. The model shows that sediment dumping occurs at the pumping station intake right at the narrowest area in the entire 10-mile reach. The sediment dumping is occurring at the gravel bar upstream from that location in a very wide area. A site visit this morning verified that the problem has gotten worse.

If the average channel velocity is cross sectionally averaged, it would be expected that the narrow section around the pump intake would have a high average channel velocity for at least the high range of flows; and, then around the gravel bar it is a low average channel velocity. If you look at the sediment transport, typical bed material sizes and the flow, the TD4 is about 1 ½

- 38 millimeters. What does it take to move those sizes of particles based on those one dimensional hydraulics? What you see is mobilization at about 20,000 cfs right at the pump intake, however, if you go to 193 a ¼ mile upstream across the bar, the model shows that, based on the cross sectional averages, that size of material cannot be mobilized.

If you look at the up-river sediment transport rates coming downstream, at the head of the bar there is a fairly substantial transport rate. The sediment dumps out right through the bar and then there is a higher transport capacity as move downstream. Bob explained that was conclusion from the 1-D model.

The model suggests that, if you can find a way to narrow the river up where the gravel is located, the dynamics of the river will erode away at the bar; transport rates will be up; and, a better continuity through the system will be achieved. At the same time, it would be keep the right bank from migrating. The river is wider at that location and as a result there will be better sediment continuity through the reach.

Two dimensional models have been developed to look at the hydraulics through the smaller reach in more detail to understand the dynamics of the proposed dike field (a series of spur dikes along the right bank) that would narrow the river up and hold the right bank in place. The initial 2-D model went from about river mile 191.5 as the downstream boundary. The boundary was set to ensure that anything modeled with out boundary condition doesn't propagate up to the area of interest. The model used river mile 194.5 at the top.

Bob presented a diagram illustrating the two dimensional mesh that was used to set up the model. There are three different versions of the model. The real surveyed topography is based on mapping that was done in 1996. That mapping was utilized and 2003 topography was estimated based on the bank line alignments apparent in the 2003 aerial photographs. Once the 2003 model was completed, the model estimated the hydraulic behavior of the river prior to the bank starting to erode (when the bank was narrow over against the site). The model estimated again from the 1979 aerial photography and other additional sets of rough topography values for that condition.

In the channel, there are no high-flow water surface elevations. The 2-D model was validated by comparing the water surface elevations by what was predicted from the calibrated 1-D model that the ACOE had put together -- that is the basis for the validation. It isn't real water surface data. At least there was consistency between the two models. The end value is .023 in the main channel, the over banks are quite a bit rougher, and the model used .12 in that area. The side channels are a little bit more open, not as heavily vegetated, and the model used .06. In addition, a downstream boundary condition must be used for the model. That was delineated by developing rating curve from the 1-D model - for any given discharge, there is a known starting water surface elevation at the downstream boundary and that is the basis for the calculations.

Bob described the first set of results for the 1996 mapping at the bank full 90,000 cfs. The model shows that the water surface elevation along the bank is just right at the top of the bank under this condition. The left side is the velocity distribution through the reach (bright red) at the top is 12 feet per second and then blue is 0. The gravel bar is right in the area where the colors

start changing right over the edge of the bar. This is the eddy there is a zone right around the mouth of Big Chico Creek. The pumping plant is right in this area, so are fairly high velocities in that area.

By combining the hydraulics at each of the nodes in the mesh with the information about the average bed material grain size in the reach, the model can compute a normalized grain sheer for distribution over the reach. The information results in a dimensionless number. That is, if the number is less than one, it means that that average bed material size would not be mole. You would not expect to see transport of those sizes. When the number is greater than one, you would see varying rates of transport. The model shows that critical sheer stresses exist all the way through and all along the right side of the gravel bar. There are hydraulics exceeding the incipient conditions all the way down through the reach. Under these conditions, the gravel will continued to move and a depositional zone will exist.

Bob explained the technical aspects of the model resolution and boundaries. In addition, he explained how the topography was developed. He informed the group that the real topography was not available and explained that the model was pieced together with the best available information provided to MEI. He described the model as a combination of the hydraulics on the sediment side, the normalized grain sheer force and sheer stress distribution for the 2003. The resulted in a best estimate of the 2003 at 90,000 cfs. The interesting piece of information is that as the channel widened out the velocities lowered under the 2003 conditions.

There were two conditions the model analyzed in terms of possible solutions to the problem.

(1) Realign the bank upstream the other is the spur dike.

Bob gave a brief overview. The model concluded that if you do fairly minor changes and look at the hydraulics in the short-term, not considering the effect of that on future river meandering, and so on the hydraulic effect, velocity and depth only occurs right in the vicinity of the bank realignment and it doesn't propagate very far down stream. This certainly doesn't do anything to change the dynamics in the project area. After modeling this conclusion, MEI moved on to the next step which was the spur field.

(2) Spur Dike Field.

Bob explained the model looked at a series of eight spur dikes. The most downstream spur dike would be just a short distances upstream from the pumping plant and would extend on up past the head of the gravel bar. Basically, the idea is to try to constrict and move the river back to a location similar to where is was under the 1996 condition. Bob presented a three-dimensional oblique view of what the spur dikes would look like on the bank. He explained that the Butte City dikes would not be suggested as an optimal way to build a spur dike.

As one of the design criteria, the spur dike design did not go all the way to the top of the bank. Bob presented a diagram of his explanation and explained the conditions that were considered. The earlier presented figure described the dikes basically coming out to the existing bank line and then having the root of the dike going about 30 feet back into the bank. To get the hydraulic

conditions to behave similar to what it would have been in 1996, the top of the bank must be pushed far out as well. So in reality, the it would probably require at least 30 to 60 feet of higher spur out to where the 1996 bank line was and then drop it down to that lower level. This requirement has a significant effect on the cost. It's probably would be necessary if you wanted to this option to behave right hydraulically.

The model set two of the dikes at about 2/3 of the bank height. The model set the downstream dike at 2/3 the bank height and then calculated what discharge it took to overtop the dike. An upstream profile was run and that became the basis for the top elevations of the upstream dikes – the dikes would all start to overtop at about the same discharge.

This first comparison of the two models predicts the west side shows the grain sheer stress at the same plot before 2003 without the dikes. In the area where it doesn't appear to move the sediment, there is enough sheet stress to mobilize some of the material along the side, but the build of the bar is below. If you look at the condition with the dikes in place, the model suggests that the proposed dike design would probably cause the gravel bar to shrink in size and certainly erode the end of the bar to shorten it back in the upstream direction. From that standpoint it would be quite helpful in controlling the continued growth of that bar.

The unfortunate thing at this discharge level, we really haven't helped the situation around the M&T location. The cross section goes right across the intake level. Push the sheer a little bit closer and over, raises the energy a bit but probably not enough at least when considering the movement of the coarser grained gravels - not enough to do a whole lot of good at this higher discharge.

If we estimate the bed material, gravel transport capacity section by section down is fairly high upstream and then along the bar it becomes very low; and, then it jump up again as it comes through the area of the pumping intake. The reason it's higher now is we've basically increased the energy grading up across that riffle along the area upstream from the bar, but it's very low along where the area of the intake is. This again was for the gravel size range.

The model also considered the effects of the Big Chico Creek flows. MEI conducted a concurrent flow analysis and concluded that flow varies all over the place but the common discharge in Big Chico Creek when you have 90,000 cfs flow in river is about 1,000 cfs. That number was used to see how the value affected the model. The spur dikes crank the energy up along the bottom not really performing for the intake for the gravel size.

It was discouraging after seeing those results. MEI decided to model the historic conditions before the problem existed. The model again utilized the 1979 mapping and estimated the topography for that condition. MEI had available topography for this particular model. Bob presented a 1979 photo. It is now possible to compare the grain sheer results with that condition. This comparison provided a very marked difference. The results show that through the area along the gravel bar and on past the pump intake, the hydraulics are lot more uniform. Bob further explained the transport rates through the reach.

MEI was curious to understand the sedimentation issues surrounding the pumps. The dive reports described the biggest problem was associated with sands at the intake and not gravels. MEI was curious to know what would the dikes do during the low-flow period in terms of moving the sands through the reach and if it would benefit the pumps. The model was run at 8,000 cfs with the note that generally pumping is between the 4,000 and 12,000 cfs in the river (typical low-flow period). The model compared the difference between the baseline model and the west dike model at 8,000 cfs difference in velocity in this case. What the model suggests is by putting these dikes particularly in the lower end (the upstream dikes are necessary to hold the bank in place) the dikes actually ratchet the velocity up along that bank and particularly around the area of the intake.

Under the baseline conditions along that side velocities are less than a 1 ½ ft/second and the higher velocities are out closer to the middle of the river. Bob further described the position of the dikes and the results that can be found in the report. He concluded by stated that the dikes would provide enough additional energy to keep that intake fairly clean of sand.

Steering Committee Discussions –Installation of Rock Groins Alternative as a Long-Term Solution

Cumulative Costs and Expected Impacts

- Engineering
- Environmental
- Economic (operations & maintenance, life-time expectancy, legal authorities)

Question(s): Would the gravel bar still move down?
Answer(s): No. The dike field creates high enough energy high to "chew off" the end of the bar and actually decrease the size of gravel bar. The becomes stabilized and will not continue to grow. The problem is really not gravel, it's the sand under low-flow conditions. The model suggests that the dikes could operate under a range of flows. It will keep the sand out of there at low flows but there should be enough energy to move whatever goes off the bar will be moved on through the reach.

More discussions were held and questions debated.

Bob further commented that you have to consider the sediment supply to understand the growth of the gravel bar. There is a wide separation zone area so the sediment that comes down dumps out and builds the bar. Whether the bar grows under those conditions is a function of how much sediment is coming to it. Just because the bar is mobile doesn't mean that it won't grow. What allowed the bar to continue to grow is the erosion of the bank. The argument is that if the bank is trained and the energy increased, the bar will at least be stabilized. It may reduce the bar and keep it in that location.

Concern(s): That the 2003 conditions, with dikes, are so similar to 1996 and under the1996 conditions the bar was growing. There is fear that under the 2003 conditions with the dikes, the bar will continue to grow in a downstream direction. The south and east side of the bar are low

enough to allow deposition and so there is fear that all that will be mobilized is the upstream edge of the bar and it will grow in the downstream direction.

Comment(s): If you don't allow the river to widen in this area, and historically there has been enough energy to move that gravel through there with the channel narrowed up, it would not allow the bar to grow. What made the bar grow was the process that was just described – pressure was caused on the other bank and the other bank eroded then the problem just compounded itself.

More discussions held.

Comment(s): Yantao commented that he cautioned that the group should be careful in trying to read too much into the sheer stress. The most important part here is probably the flow pattern and also the planform. Basically, if the proposed dikes are built at the west bank, they will push the flow toward the east, which will erode sediment from the bar and gradually get the pump intake into a better situation. In principle, a river cross section has to maintain certain flow area, and if the area is reduced on the west bank, it has to get back from somewhere else, and that somewhere is by eroding the bar because the east bank is not erodible. If you look at Eric's meander model, it uses this same principal, the river will erode on one bank and deposit to the other bank so that the river will maintain the same width. In our case, we are reducing the effective channel width by building dikes on the west bank, and the channel will no have not other way to go but erode the gravel bar.

Comment: MEI looked at the cost of rock and installing the rock no other costs for the two types of dikes were performed. One would have the root of the dike start right at the 2003 bank line and the other would be to take a full bank height out to the 1996 bank line before it was dropped down to the two thirds. The rock costs about $35 / ton ($1.3 million). If you went back to the existing bank line, or about $2.3 million, if you took it all the way out to the 1996 bank line. Mitigation costs are not calculated and are anyone's guess at this point. Other: Approximately $12.50 / ton for the rock at the quarry, about $7 / ton to truck to site and Andersen Drag Line gave a cost about $8 - $10 / ton to push it out into the river. Note: Andersen Drag Line contracted the dikes at Butte City.

More discussions held about construction costs.

Costs were compared to the Butte City dikes. Mike Harvey commented that the sheet piles placed in the dikes are antithetical to whole design concept of a dike. A dike is supposed to be a flexible structure and to ram a sheet pile right down through middle of the dike eliminates that attribute. The Butte City Dikes are nonflexible structures and CALTRANS called it a dike. The advantage of a spur dike as opposed to a full-bank revetment is to support environmental issues. Enough rock is placed it will self adjust as a result of scouring. There is enough rock mass to take local scour and it will still function. So by ramming a sheet pile down the middle of the dike that self-adjusting attribute cannot take place. The history of dikes has shown that they don't need to be maintained. There are no hard and fast designs for dikes.

A key component to successful dikes is a sufficient sediment load in the river in order to get deposition between the dikes (sand and fine gravels). This action forms a buttress to the

unprotected portion. There is a good example of that unintended effect down by the Kummulshue Bend. Due to the scour action at the end of the rock, there is a big sand bar covered willows.

The comparison was made to Woodson Bridge dikes. Mike commented that those were not the same kind of dikes. This project is talking about permeable dikes.

Mike further commented that rock has a bad rap in the Sacramento system for a number of reasons. Part of the reason is that rock has always been full-bank revetment. The Sacramento district has not, for some reason or another, installed dikes other than a low-water navigation channel down below Verona where they had some wing dikes. If you look at some work that has been done around the country spur dikes actually are not the same as full-bank revetment. Up on the Willamette, studies have shown that they actually have some environmental benefits that provide a substrate for invertebrates, they provide various low velocities for younger fish. There is no experience here on the Sacramento River with spur dikes.

Mike brought articles reporting from the environmental perspective that show real benefits to the environment. The information shows that spur dikes are a better treatment from an environmental viewpoint than full-bank revetment. It is important to realize that the dikes aren't as environmental unfriendly as a lot of the revetments along the Sacramento River system. There is still the argument of reducing river meander and associated ecological impacts.

More discussions about environmental benefits.

Bob summarized by saying if we are going to fix this problem in a way that allows the pump intake to function and meet the operation criteria, it is absolutely clear you have to figure out some way of holding the river where it is or pushing it back over on that side. He questioned if the arguments met with the reality of the situation. He stated that from purely a technical standpoint, the modeling providing reasonable assurance that spur dikes are a viable option. It may warrant some additional modeling to refine some other scenarios and ultimately there is a need to for a physical model.

Eric Larsen suggested that the question should be answered how the river will change in the next 25 years. The model shows what the river is now and there may be the need for another spur dike downstream.

Bob commented that there is merit in the 25-year model, the question is centered around a time frame. No matter what is done in the river, the river is going to go somewhere else again. The question is, given the situation that the project is in today, where the protections exist, where the inflections in the bends are located, how those bends are moving, is it in the design life of this project realistic to think that the bends are going to just migrate down through this area and completely change the game at this location within that 30 to 50 year timeframe?

The question was raised that discussions in a previous workshop regarding river predictions modeled by Eric showing the movement over 100 years will cover the pumping plant.

Bob reiterated that it isn't a question of whether the river will move ten years from now, it's can we do something to solve the problem?

Eric stated that he is involved in a number of projects where the whole dilemma resulted in not looking at the long-range movement of the river. We're here today because that was not done.

It was suggested that to control costs, extraction of the gravel bar on a regular basis becomes a viable option.

Bob remarked that be doing that you release the pressure on the west bank so it may not migrate as fast, however, the problem that river will continue to want to migrate to the west is still going to be there, whether you take that bar out of there or not.

Les commented that over time moving the gravel bar would no longer be a problem because the river will be so far west.

Mike questioned if the concern was looking at the up-stream revetment on River Road? He questioned if there was concern related to removing the revetment or leaving that in place?

Eric replied that either way there will be a problem in the future. If it is taken out there will be more serious problems.

Mike – everybody agrees that if you pull the revetment and the river shifts over then the approach is steepened and the spur dikes are flanked. If you put dikes in, then there is a passive commitment that you preserve the alignment. Especially when there is an existing revetment upstream.

Discussions were held regarding on-going commitments to existing bank protections and how the existing revetments influence project solutions.

Eric Larsen commented that it is an exciting possibility of a feasible off-channel collector as a solution and therefore removing the issues of continuous bank protections.

Discussions were held regarding how far off-site would river dynamics impact a project solution.

Stacy Cepello commented on historical river conditions, e.g., the river has stayed in that corridor for 100 years -- the left bank is hard. He commented that finding an in-river solution is dependent on the river corridor dynamics at the project location and the protection of the pumping facility if it stays in the river.

The comment was made that CBDA charged the Steering Committee with looking at the river as a system and how a solution to the M&T/Llano Seco problem might impact or improve the system.

More discussions were held about the construction and placement of spur dikes.

Mike Harvey commented that he had compiled some qualified research regarding environmental considerations and micro and macro scale associated with spur dikes that is worth reading. He suggested that the committee review the findings rather than take the position that all revetment is unacceptable. He explained that the papers clearly describe environmental benefits. [Documents made available to all Steering Committee members.]

Eric reviewed information regarding river dynamics for 1997 and 1896 surrounding the project site in a power point presentation. He described the evolution and progressive migration of the river over time. With the strong possibility of wing dikes as a solution, the following question was raised: Would there be a possibility of considering movement in other parts of the river and allowing other parts of the river to move that are not constrained as a type of mitigation? What might be gained?

As a beginning Eric modeled what would occur if this particular bank constraint were removed (edit: identify location on the river). And downstream from the site, other sites were removed. Eric described the river dynamics at the pine creek bend, the M&T bend, Phalen Island, and Golden State Island. It was pointed out that the placement of existing rock in the illustration was incorrect. Eric explained that his report was based on a map provided to him for the modeling. Les Heringer described the accurate location of the rocked bank (farther upstream). It was also pointed out that what may have appeared as a rock revetment is actually a built up levee. Eric explained that his study looked at the river without present structures or revetments. He explained that after the last workshop he walked the river at the park site and talked to Koll Buer about current conditions. He explained that he put together the presentation hat rather quickly and it is not been written up.

Eric moved on to explain six different scenarios where the first four took out four bank constraints one-by-one to predict the results. The last took a few combinations out to see what might happen. Eric presented a map of the results. Eric explained that the map showed a crude location of where the groins might be placed. He experimented with different locations. Eric explained that the modeling seemed to agree with the MEI study. Eric pointed out the river movement with each removal and how the river would expect to migrate with everything in place in the next 50 years in five-year increments particularly in 1997 upon which the modeling was based. He illustrated movement away from the groins. Eric explained that the river seemed to move one hector every five years or 2 ½ acres every five years are being reworked in those areas.

Eric explained that he was working on modeling individual flows. Eric continued to explain the significant changes when some constraints are removed and how little the river moves in other removal areas (little mitigation). Finally, if all constraints were not in place, which means that Phalen and Golden State were removed, the model would get these kinds of changes. The model removed the constraints at the park with and without the hypothetical groins in place at 50 and 100 years. Eric provided slides illustrating the scenarios. Eric commented the river is naturally pulling away from the proposed groins. More discussions were held regarding the information presented. Eric commented that it's his hunch and the modeling suggests even with the groins in place the river apex is tending to move down. Over 50 years it appears that the river has moved away from the groin site naturally.

However, it was noted that Eric's suggestion was based on the upstream removal of rock on River Road. Eric agreed and explained that he did not have the scenario with the rock. Eric commented, that in his mind, a model is a tool to use help the group think and not to say this is what's going to happen. A model tells you what could happen, what are the tendencies, what do I really need to think about. Eric believes that the committee should think about the facts with or without the rock at River Road, the apex is going to migrate downstream and maybe come around the revetment at the park (Eric referred to the 100-year tendency in the presentation).

More discussions were held regarding the movement of the river apex over time based on the modeling information, background data and previous modeling efforts conducted on the river.

Mike suggested that if the premise is accepted and the rock on river road stays in place and nothing is done in the area of the proposed groins at this time, then it can be said with certainty that the pumping plant cannot withdraw water from the river. The river has already gone down another 30 to 40 feet and there have been higher flows at about 40,000 cfs this year. If the curvature on the bend increases the erosion rate will increase with time. And so, effectively if nothing is done on the west bank the pumping plant is uncertain. So if that premise is accepted, then the discussion comes back to what was said early on. Is there another way to get water? What the group found is that alternative may be cost prohibitive in terms of those who need to use the water. So then is there a compromise somewhere between? What we see on the slide presentation that there is some point between where the current river alignment is and will be in X years. It doesn't appear to be an either or if you want to maintain the pumping plant as a pump station. Let's set the premise, that if you put the groins in, then you can rectify the existing situation at the pumps. So, you can utilize the river as a tool. Ultimately, things will change and if they change there is a relatively short-term fix because we don't know what X is and if it does occur then we are in no worse position. All it's done is preserve that period X for using the pumps. Mike asked the group if that was a reasonable interpretation of the presented information.

Eric replied that the economics – when you cite the groins at $2.5 million at the top end what is the cost for upstream activities. Mike responded by saying that he was basing his response on not doing anything upstream.

Yantao replied with some concerns that the river might migrate away from the pump station even with the proposed dikes. Basically, what the dikes do is to fix the river at this particular location and leave no room for migration. Under the worst-case scenario, if the river does meander away downstream of the proposed dikes, we can always add an additional dike, in the future (not now) to further restrict the river course. Even if this occurs, it would have to be many years away from now and from an engineering and economic point of view there is no need to add another dike at this point.

Bob Mussetter commented a difference is a result of looking at this at two difference scales. He commented that Eric's model shows the river dynamics occurs at multiple bends over a long period of time; and, and the MEI model shows that in the life-time of this project if the upstream revetment is protected, the solution should it hold for reasonable amount of time. In the bigger

picture it might be argued that the problem is bigger than the solution – one cannot control the river and it shouldn't even be tried – it should be recognized that eventually the upstream bends are going to migrate, the inflexion of the river is going to change and we are going to lose the benefit of what we put here. And so the real question is, when you consider all the costs (construction and environmental) is it better to take this short-term fix on the assumption or with the risk that we can hold it for 30 to 40 years here and make it work long enough to get the benefit out of that money or is it better to spend $14 or $20 million to construct the Ranney Collectors and eventually the river will just move away from them. He felt encouraged by Eric's model–he wasn't sure that the scenario would be that bad in the 30 to 50 year timeframe even if the worse case assumptions were wrong.

Eric reiterated that the river is going away from the pumps.

Mike commented that if the prediction is correct it will actually develop a condition that is better for the pumps in the long term.
Eric commented these conditions would be created in the long-long term.
Bob commented that this only happens if the inflexion of that bend changes and so we need to ask – What is the mechanism that would cause the inflexion of that bend to change? This has to start way upstream and it's not going to happen in the timeframe.

Eric commented that the project site has been a stable area and stayed true for 80 years, however, the river shows movement.

Bruce Ross commented that the model seems to be focused more on reducing the size of the gravel bar. What we really need to do is maintain a fall way against the bank in front of the pumps. Watching how the gravel bar migrates, it looks like eventually Chico Creek may be on top of the pumps. It appears that it may migrate down in front of the pumps before it was dredged. He wondered rather than concentrating on diking the upstream maybe the dikes should be moved downstream to hold the a width to maintain adequate velocities to prevent deposition?

Mike replied that this approach was considered. Mike explained that the two upstream dikes from the point of view of forcing erosion on the gravel bar is somewhat ineffective. They are an insurance policy because the one thing the project can't afford is have the river cut across the top behind the downstream dikes. The hydraulics show that the revetment on River Road actually kicks the river over to the west bank. The upper dikes are essentially blocker dikes. There is no disagreement. However, you run into a construction problem and maintenance problem. To ensure that the dikes are not flanked you need to extend the dikes. They be can be buried and not sit out as piles of rock. There will be some issues regarding under what flows will these dikes be effective because you can't build them high. From a purely construction point of view and maintenance, the dikes will have to be very long features landward. A detailed study concerning these issues was not described in the report because it was important to first analyze the feasibility of the dikes.

Mike explained that historically dikes fail on the landward side at the root.

Burt Bundy commented and the committee discussed similar issues surrounding Kopta Slough and Chico Landing.

Mike commented that precedence already concerning relaxing ACOE standards in the Butte Basin. The Corp suspended the Title 33 requirements for maintenance. It allows vegetation to grow on the rock. Mike explained that the above-mentioned sites were rocked after 1986 with the idea that the river alignment in the Butte Basin had to be maintained by the channel geometry. The existing channel geometry controlled the state discharge curve for the overflow. The overflow at the M&T and then down below the Kimmelshue Bend is the 3-Bs overflow and then eventually down to Parrot Ranch was a good place. It was believed that those three overflows had safe discharge and how quickly the flows traveled down into the levee and into the Butte Basin were dependent on the geometry of the river. And that's why so many of those sites were wrong. The 2-D modeling that is being done tend to suggest that there is a self-balancing phenomenon as more water goes down the river. This gives a higher backwater and tail water and forces more flow into the Butte Basin. The reason for the rock may have actually diminished somewhat and the Corp might be more interested in allowing rock to be removed. The ACOE was funded to support and comprehensively model the County Road 29 break. The reason they modeled it was because was to test the premise that the overflows into the Butte Basin were dependent on the existing geometry. However, the modeling did not support that premise. There is the possibility that the ACOE will be more flexible.

Stacy commented that the Corp might be very reticent to remove the rock at this site.

Discussions were held concerning potential project mitigation, e.g., removal of existing rock revetments and potential mitigation sites and possible downstream riverine changes attributes to such removal.

There is concern that if there is a sizeable storm event, access to the pumping plant could be lost in one storm. If that should happen, it would be necessary to move quickly to in order to restore the interrupted water supply which would also mean that a rock removal project should be identified as soon as possible to provide some level of assurance that the project will not be jeopardized due to environmental requirements. A solution to the problem should not be delayed.

It was noted that the field reconnaissance verified rapid changes in the river since 1996. It was also noted that a viable solution becomes more difficult the longer the river has to dynamically change at the project site.

Les also emphasized that downstream landowners are significantly concerned about impacts to their properties as upstream rock is removed. It would be necessary to model each scenario to alleviate third party impacts. Les wanted the committee to be sure that full consideration is given to potential delays associated with any proposed alternative that may put the pumping facility at risk.

Discussions were held regarding the state and federal resource agencies position on river management principals. These agencies find themselves in a dilemma between being a water users and natural resource managers.

More discussions were held regarding dredging. The question was raised about the estimated cost s for dredging. Les reported the figure at $400,000 (included permits).

Discussions were held regarding a potential extension of the pumping plant intake to accommodate riverine changes. It was agreed that a continual movement would be necessary to adapt to the river changes.

Olen posed the following scenarios: Let the river meander over to the state park, this tends to move the river toward the pumping plant. Is there a way to pull the revetment out upstream, let the river start to migrate above back to the east and then setting up six pumping plants by moving farther out into the channel. Is there a cross over point that there is going to be secure over time. Olen referred to the modeling depicting old and new channels crossing over upstream from the pumping plant. Is there a point where a redesign of the intake and moved it out farther into the channel and thereby provide a safe location for the fish screens?

Bob commented that the deflection point tends to move downstream overtime.

Mike Harvey commented that because the time it will take to get to the cross over point is unknown and you leave the river where it is, not do anything, there will be a problem

Bruce suggested that if the cost is $400,000 to dredge the channel is it possible to dredge every 3 to 4 years while the river is pushed out up above and let it migrate naturally to where it is back in front? It was agreed that more modeling would be necessary to answer that question.

Les commented that for over 20 years the SB 1086 process has designed and approved (including agency adoption) the guiding principal to limit the meander where appropriate to protect public infrastructure. Les reminded the committee that this project fits this scenario without question. Now, some of the agencies are changing the rules after the fact and is disconcerting for those of us who have worked on this for the last 20 years to have to live through this again.

Chris L. explained that a handout has been prepared for the following day's discussions regarding the guiding principals established by the stakeholders of the SB 1086 process.

The question was raised about the past participation by any of the landowners along the west bank in the SB 1086 process. Les commented that Stu Stiles cane to one meeting, Butte County did not participate because they felt it was not an issue for them.

The meeting was brought to a close due to the lack of time.

Steering Committee Summary Discussions - Set Next Day Priorities
This item was carried over to the next day.

Thursday
February 17, 2005

Meet at **Llano Seco Ranch Headquarters**

Beverley Anderson-Abbs, Env. Specialist, , Sacramento River Conservation Area Forum
Howard Brown, Fishery Biologist, National Oceanic & Atmospheric Agency
Burt Bundy, Manager, Sacramento River Conservation Area Forum
Stacy Cepello, Environmental Scientist, California Dept. of Water Resources
Yantao Cui, Research Scientist, Hydrology/Geomorphology
Dennis Dorratcague, MWH Americas
Jim Gaumer, Engineer, M&T Chico Ranch
Michael Harvey, Principal Geomorphologist, Mussetter Engineering, Inc.
Les Heringer, Manager, M&T Chico Ranch
Eric Larsen, Research Scientist Geology
Chris Leininger, Project Development, Ducks Unlimited, Inc.
Kelley Moroney, Refuge Manager, Sacramento Valley National Wildlife Refuge Complex
Dan McManus, Hydrogeologist, Calif. Dept. of Water Resources
Tamara Miller, PE, City of Chico
Robert Mussetter, Principal Engineer, Mussetter Engineering, Inc.
Bruce Ross, Engineer Geologist, California Dept. of Water Resources
Neil Schild, Principal Engineer, MWH Americas
David Sieperda, Manager, Rancho Llano Seco
Ken Walters, Supervisor Resource and Planning, Calif. Dept. of Parks and Recreation
Paul Ward, Association Fishery Biologist, Region 2, California Department of Fish and Game
Olen Zirkle, Manager, Conservation Programs, Ducks Unlimited, Inc.

Olen Zirkle - Opening Remarks – Introductions

Olen opened the meeting with a round of introductions. He explained that the workshop would be initiated with stakeholder presentations addressing the body of knowledge that has been compiled thus far in order to thoroughly understand stakeholder issues and concerns and any information gaps. After the presentations, Olen explained that the group would move meeting into a roundtable discussion to review all the information and develop a decision-making matrix for the purpose of refining and weighting the risks and benefits of the potential solutions. He requested that the committee be fully committed to thoroughly discussing all possible scenarios so that the group could deliberate overnight and come back on Friday with a clear direction to recommend to CBDA on Friday.

> **M&T Chico Ranch / Llano Seco Ranch** - Challenges, Uncertainties and Risks (Long-Term Solution Alternatives)
> Les Heringer, Manager, M & T Chico Ranch

Les presented a 1935 aerial photograph that depicted the river along the project area, particularly the area 1,200 feet downstream from the present location of the pumps (preferred site for the

City of Chico to move the outfall). Les also presented copies of the basic principals and management guidelines of the Sacramento River Conservation Area Forum Handbook that started in 1986 (SB 1086) that brought all the interests along the Sacramento River together to develop conclusions on how to deal with the river that would benefit all the stakeholders.

Les explained that he has been involved with the process since 1986. He stated that Senate Bill 1086 Program considers bank stabilization as an implementation tool that, when used carefully, can further the goal of the program. Specifically, there are places along the river where bank stabilization will be necessary to limit the meander to the inner river zone. This limitation will take into account the potential need to protect existing land uses including agricultural and structural hard points such as buildings, bridges, pumping plants, flood management control structures and levees from bank erosion. Structural hard point is defined as a structure or a group of structures within the area of recent river meander that because of various attributes including the limit to historic locations public and private infrastructure and government commitment is deemed necessary to be protected from the river movement. It is intent and goal of the Senate Bill 1086 Program to expedite this permit process for protection of these structural hard points as discussed further in the handbook.

When the process has identified a preferred solution and other alternatives have been considered, the most effective, economically feasible and least environmentally damaging techniques should be used.

Les explained that this language represented the charge of the conservation area that all the stakeholders worked on for twenty years, and there are certainly people in this room that worked a lot harder on putting this together than himself, however, he was been an active participant for for 20 years. Some of the signatories to this handbook are the U.S. Forest Service, California Dept. of Fish and Game, California Dept. of Water Resources, National Marine Fisheries Service, State Water Resource Control Board, California Dept. of Forestry and Fire Protection, Army Corp of Engineers, State Reclamation Board, California Dept. of Food and Agriculture, State Lands, Bureau of Reclamation, Wildlife Conservation Board, U.S. Bureau of Reclamation, and Natural Resource Conservation Service.

Les explained that he went into this study project with an open mind and continues to take that position. However, with the information that has been presented it felt it was important to make it clear about the direction that the information is leading the M&T Ranch. The recent improvements to the river to protect hard points would be the Butte City Bridge. Some of the committee members made a site visit of the new construction. Folks in this room have worked for years in Hamilton City to come up with a solution that provides the city with long-term protection and that includes Hamilton City's sewage treatment plant that is on the river-side of the city. It is intended to widen out the flood way and build a levee along the east side of the town that protects the town from the river. Everyone knows that the river north of Hamilton City is trying to get through a levee that would flood the town. Glenn Colusa Irrigation District also found it necessary to harden a point to protect the pumping plant north of Hamilton City. The Woodson Bridge State Park and Corning's outfall that is on the west-side of the Sacramento River located near the west footing of the Woodson Bridge and the State Park located across the

river and the river is right now aiming right at the west side of the Woodson Bridge and they are trying to come with a solution to the problem.

Les explained that when the ranch started working on this pumping plant project in the early 1990's shortly after USFWS and CDFG purchased the land through easements or fee title part of the Llano Seco Ranch here for a refuge, the ranches were able to sit down with the different interests to come up with a solution for the old pumping plant. The Big Chico Creek location of the plant defied screening. It was originally built in the early 1900's and provided the ranch with a very reliable economically feasible source of water. There was a remnant salmon run on Big Chico Creek and we wanted to protect the resources. The ranch sat with the different interests that were part of the Llano Seco Ranch, because they also needed a fish-friendly supply of water, and after a feasibility analysis determined that the best place for the pumping plant is the present location. Part of the ranch's contribution was 40cfs of water that we gave up in perpetuity in Butte Creek. Paul Ward was instrumental and behind that effort. The ranches have a very good water right on Butte Creek also. Some of that water includes foreign water that PGE brings over from the west branch of the Feather River and the ranch back in the early 1900 worked a deal with PGE where after they used the water to generate power we have a right to pick that water up and use it for agriculture. It is now also used for the refuges. That 40 cfs contribution adds up to about 21,000 acre ft of water per year that we have given to Butte Creek for the new pumping plant on the Sacramento. That water gravity flows to the ranch. There is no lift -- it just gravity flows through the south part of Chico on the out to the ranches where we use or send it south to the Llano Seco Ranch and refuge. Prior to moving to the river, we also met with the agencies and built the first fish screen on Butte Creek.

Les believed that the ranch set the standard for what needed to be done on Butte Creek. After the construction of the fish screen, with a lot of help of different folks and agencies, other farmers, duck clubs and water users on Butte Creek followed suit. He felt that the project was an example of how to do things on the Sacramento River with the use of the pumping plant and fish screens. M&T/Llano Seco are one of the first ones to agree to move the pumping plant out to the river and since then there has been a lot of other good examples of water users working with the agencies, making the river better for fish.

As the river continues to move away from the pumping plant, very soon dredging will cease to be an option as the river moves further west. With that river movement, rock groins will also cease to be a long-term option.

Les stated that he sees the whole process as one that is on borrowed time.

Les explained that the ranch cannot go without water – not even for a day, much less a year or two. It would be like shutting the water off in your house or in your yard. You would know very quickly that it would not work. Les stated that he thought that the ducks in the refuge would be in the same position.

Les continued by saying that one option that was discussed by the committee yesterday could conceivably cost three times more than the original pumping plant cost which was $5 million (Ranney Collectors). It's capital cost could be seven times higher than the other options we

heard about - $2 to $3 million versus $15 million. It could also produce water that is 5 times more expensive than the water that we are currently able to pump. This cost would be beyond the ranch's means to utilize the water for agriculture. He understood that the refuge also similar limits to what they can pay for water.

Les felt that it was an unknown regarding how the productive capacity of the Ranney Wells would be impacted if the river moves to the west and away from the collectors. If that would be altered?

Les believed that limiting the meander of the river in this stretch of the river is a win win not only for the ranches and the refuge but also for the City of Chico who serves over 100,000 residents. The city had to go forward with a plan because they don't know what this project is going to end up with – they are also seeking a long-term solution. They could move down river and, if this river continues to move west, the city could be moving again. They could spend $2 million here for a fix with really no reasonable security for their future. Also, the city would cut a swath right through the middle of our walnut orchards to relocate the outfall downriver. If they have to move the outfall again, they would have to cut another swath in another location of the orchard. Les stated that the ranch is very proud of those orchards. He was concerned that time was critical and more studies were recommended that will take more time. He explained that the project has been studied for more than two years and within that time period successfully flused out some sensible options to the problem. He was concerned that the right solution may be hinge on one opinion rather that the collective opinion of the committee and the stakeholders.

Les explained that he felt that there is no "magic solution to this problem of river meander when you have hard points along the river." "There is no magic bullet here." He felt that the project should project the current investment of the pumping plant and protect and protect the public health of the people in the city of Chico. Because of the work that done with the Sacramento River Conservation Area, the river is now allowed to meander within roughly 90% of its reach. He believed that the remaining 10% should have the ability to limit the meander to protect important and necessary infrastructure. He gave the following examples of limited river meander: Hamilton City, GCID, Butte City Bridge, and Woodson Bridge. He explained that those projects conducted the same studies as the Steering Committee and have come to the conclusion that every mile of the river should not be allowed freely meander. There are people to protect and an economy to protect. It's not feasible to let the river meander throughout the whole reach of the river.

Les explained that it appeared that the rock groins have environmental benefits - they fill with materials and grow willows, trees and they allow fish an area to rest. Matt Reid also stated that the Ranney Collectors are not maintenance free. He stated that the collectors will silt in and you do have to go in when that happens and do very expensive pressure cleaning. The committee was not comfortable with the option of building one collector, using it for a year and if the performance was acceptable, build the rest of them. Les stated that the ranch cannot afford to be part of an experiment, the solution must be based well-defined. Les explained that, from what he heard yesterday, he was not sure that the committee will come up with a consensus decision that everybody is comfortable due to philosophical reasons. He felt that the committee must ultimately make a decision as directed by CBDA who funded the studies.

Les continued by stated that the process should move on to the next phase of investigations which includes the environmental work. He felt that action would ensure that the refuges and the ranches a dependable and affordable supply of water and it will also ensure the City of Chico that they don't encounter a public health issue down the road. The City of Chico would be happy to partner with this group to come up with a solution that benefits not only the stakeholders in this project but also the county. Les ended his presentation.

Question(s): How does the ranch manage the seasonable water supply?
Answer(s): Les explained that the ranch also gets water from the diversion on Butte Creek. Water users: M&T Chico Ranch, Rancho Llano Seco, the Dayton Mutual Ranch, the Genetic Tree Improvement Center along the skyway, the Mendecino National Forest, and two or three smaller diverters between Butte Creek and the ranch. When there is plenty of water in Butte Creek, the ranch gets 110 cfs after the 40 cfs. Typically in the spring, there is quite a bit of water in Butte Creek. Butte Creek is not damned, there is no reservoir so much of what is diverted is natural flow. So as spring wears on and summer approaches typically Butte Creek water supplies diminishes greatly and that's when we have to utilize the pumping plant more than we do earlier in the year.

Les described on the map where the Butte Creek water flows to the ranch and how the ranch hydrology dictates irrigation flows from either the Butte Creek diversion or the river water. There are dry years when the ranch diverts very little water from Butte Creek period. In 1996, Butte Creek changed coarse in a big flood and the ranch completely lost the diversion. We the help of the Natural Resources Conservation Service and about $1 million the diversion was entirely reconstructed. Butte Creek is not a guaranteed water supply either.

Question(s): What is the history on the pumping plant capacity?
Answer(s): Les explained that the pumps can pump 120 cfs as it is currently designed. The facility including the pumps and pipelines are designed for 150 cfs, however, due to cost constraints at the time of construction, one pump and one motor was not put in place in order to complete the project on time. So there are four holes and three pumps. The ranch has the ability to drop a pump in the fourth hole at any time to meet demand at 150 cfs.

Question(s): Is there monthly diversion records.
Answer(s): Les explained that both the Bureau and the ranch have the records, since the ranch is a settlement contractor.

Question(s): Is there some kind of agreement between the Rancho Llano Seco and the M&T Chico Ranch on the split of the water?
Answer(s): Les explained that it has always been 50/50 split if water is short. Typically we don't have that issue, unless it's a real dry year and we don't have any water in Butte Creek and then it becomes a big issue.

Question(s): On the north part of the ranch, what percentage of ground water compared to surface water is utilized?

Answer(s): Les explained that the new orchards at the north end will be serviced by surface water. Les described on the map the ranch irrigation system that distributes either ground water or surface water. Les explained that Butte Creek water requires a lift.

Question(s): Does the ranch purchase water from the Bureau?
Answer(s): Les explained that the ranch does not purchase. The ranch has a right to 7% project water and 93% is base water. In a dry year the ranch is cut back. In a critically dry year when there is less that 3.2 million ac/ft of inflows to Shasta, the ranch is limited to 75% of our contract. That did happen in the late 80's early 90's and back in 1976 and 1977. That's when water becomes really critical to the ranch because on dry years there is very little water in Butte Creek.

Question(s): Is there a large percentage of water in Butte Creek is actually out of the basin?
Answer(s): Les explained that not a lot of water comes from out of the basin. About 20% - 40,000 ac/ft on average comes out of the west branch of the Feather River. Early in the 1900's PGE put in some power plants up above Paradise. Water was diverted out of the West Branch of the Feather River and brought over and run through Honey Creek Power Plant and then dumped into Butte Creek. This helps the Butte Creek flows in dry years. However, PGE is unpredictable in their flow management. They are trying to more precisely management flows to help spring-run salmon in Butte Creek that over-summer and to keep the water cool in the upper reaches. However, even in a dry year, PGE would be limited by what is available in the West Branch of the Feather River. That's when we give up the 40 cfs from October 1 to June 30.

Question(s): Over what period of the year is the ranch operating the pumps?
Answer(s): Les explained that the pumps are operated when frost protection begins in February – first of March all the way through to the middle of December. The power costs for this study were not calculated on this schedule. The costs were calculated on the quantity of water at 100 feet. No timing was calculated. An estimate was arrived based on pumping 20,000 cfs, 30,000 cfs and 40,000 cfs. Les explained that the ranch diverted 30,000 cfs this last year. In a dry year, it could be up to 40,000 cfs. In a dry year, the ranch is supplying water out of the river that wouldn't be available in Butte Creek for refuge, wetlands and decomp that is also not included in the calculation. Les further explained that the plant is still pumping in early December and the reason we shut it off then because normally by that time we have enough water in river overflow and Butte Creek to supply our needs. In the fall, Butte Creek goes just about dry and the ranch water right in creek is no longer good because of the flows. Typically, we get enough water and rain water so that we're able to shut the pumping plant off early December and divert water from Butte Creek for rice straw decomposition and for the refuge. But in a dry year, and I've been through them, the pumping plant could run year round.

Discussions were held regarding the lack of available information to reasonably quantify any negative impacts from constructed hard points in the river. In addition, the group discussed the difficulties of managing complex habitats for complex species.

Question(s): Is maintain river meander critical to winter-run salmon?
Answer(s): Paul Ward commented that river meander was probably not critical, however, he commented that it was absolutely beneficial. He explained that the meander provides rearing habitat.

Burt Bundy commented that the 1997 emergency work done on the river between DWR, BOR and the Reclamation Board still has not implemented a mitigation for those sites to date.

Stacy Cepello commented that the river meander should be put in a broader context and how it would play out in an environmental document. On the Sacramento there is roughly 300 miles of river from Keswick. Of that 300 miles, the lower 200 miles is basically the heart of the Sacramento River flood control project. There are very close levees and setback levees from the Delta up to Ord Ferry. And there is 100 miles from there up to Keswick. From Keswick to the mouth of Cottonwood Creek you have essentially a sediment starved, highly regulated system which is reasonably good for raising fish through temperatures, gravels and so forth. It 's geologically controlled and highly regulated. So roughly between Red Bluff and the M&T, you have 50 miles left of a 300 mile system that actually has flood plain and sort of meanders in places and functions somewhat like a large alluvial river. You have large bows out of tributaries, erodible banks, and of that roughly 50 miles, half of it has been lost and that half is virtually every outside zone that could be worked on as a restoration project. So, of the 50 miles, roughly 25 miles that is not directly affected by rock that's where we are. Roughly, Chico Landing to Red Bluff, 100 miles, 50 miles rock. Chico Landing to Red Bluff is OK. Chico Landing to Colusa, roughly 100 miles, 50 miles of that is rock. In the biological opinion, what they said is the levees are there and we understand we need the levees and the levees should be protected as a matter of public safety. So the levees will be protected when they need to be protected. However, you have to recognize that cumulatively it turns the river into a canal rather than allowing it to function like a river. This gets back to the question, the fact that the policy of the state is that if you are going to have current and future water supplies that are reliable, you have to take care of the fish and the fish habitat, that's what the CALFED framework and policy tried to accommodate, that's why I can be here. The question is, how are those fish populations, productivity and sustainability of those native populations maintained. To the degree that we can have natural functioning processes in the system, we believe that this is the most sustainable, most productive, most likely to engender the native populations persistent through time. If you move towards rocking the river for the purposes of protecting fish, you have to understand the balance and the consequences of that. That's kind of where we are.

Burt Bundy commented that the reality, as seen by the Reclamation Board and the Resources Agency, is if rock is placed, then rock is removed in like amount. It has not been determined if it's one to one. It's on a case-by-case basis depending on where the rock is located. That's one reason why there is frustration surrounding Kopta Slough. It was agreed upon by the Resources Agencies that the rock removal would qualify for mitigation for river mile 149.0 which was done under emergency situation in 1997. That was a big step - they are a lot of river miles apart. They did agreed to allow rock removal at Woodson Bridge for that mitigation at RM 149.0. Now we can't get approval from the ACOE. I believe that if we can put groins in here and use Kopta Slough as mitigation it would certainly be something to pursue.

More discussions were held regarding other possible potential mitigation sites and the feasibility of possible mitigation projects.

Les commented that he agrees with Stacy about enhancing the river for fish. We've done that. We gave up 40 cfs of our water on Butte Creek to help the fish Butte Creek, we moved off of Chico Creek to help the fish, we built the fish screens on the river to help the fish and here we are.

Eric Larsen commented that 50% of the river rocked on the outside bend, what that means is that 80 to 90% of the moveable river is rock because the outside bend is what moves. You don't rock the inside of a bend. So, you really have a situation that is 80 to 90% rock. So that's why it's critical to keep looking at places where we can continue to allow natural processes to occur.

Les pointed out that the M&T Ranch owns all of Golden State and explained the reasoning behind the placement of rock. In 1980, the area was rocked to protect the integrity of the M&T flood release structure. He explained the Butte Basin Overflow Area originated in this area. The water reaches flood stage, it builds in this area and flows through the Rancho Llano Seco and ends up at Angel's Slough and then flows down into the Butte Sink. Les pointed out all the flood control structures on the map. He explained that this is a real volatile part of the river right there so they have done some rocking to help protect the integrity of the Butte Basin Overflow Area.

Discussions were held regarding the County Road 29 project. The modeling showed this is a sub-balancing system and so some of the previous concerns that the flow split was controlled by planform of the river showed not to be accurate. So they are not as important for that purpose any longer.

Bob Mussetter commented on the SB 1086 process. He asked the group what the stakeholders were contemplating by the statement that hard points might be necessary. Did that mean that they really meant that there are certain existing hard spots that needs to be protected or that there could be additional ones in the future that might need to be fixed? What was the mind-set of the decision-makers?

Les commented that he felt that the state thought at the time when they put the handbook together that there were public and private infrastructure on the river that needed to be protected. That's hard points. Les deferred to Paul.

Paul commented that he felt this approach was not aimed at existing hard points and it could be those in the future; it was those hard points that were publicly valuable to be considered for hard points without ever defining exactly which each of those were on the river. The process spent considerable time in developing how this would be defined.

Bob commented that when you look at the project in the big picture, we have to evaluate whether the in-river option is viable or not. Don't we have to answer that question? Stacy described the existing conditions of the river very well and where does this project fit in the big picture of the priorities of the things that the people were thinking when the SB 1086 was designed. Does it make the cut or not?

Stacy commented that the agencies have asked the question, what is a hard point? Even to this day it's hard to define. But if you continue on, the question that bank protections could be made on a site-specific basis in cooperation with participating landowners.

When it comes to a hard point, what purpose, what function is that hard point preserving and are there alternatives which can reasonably meet the needs. In the case of a bridge, there are not a lot of alternatives. It's necessary to protect the bridge. The function is to get people from one side to the other. In other instances, we have to look at it is feasibility, how much does it cost, are we using public money wisely, and in this case I see it very similar to GCID. You have to go through the process, you have to look at the alternatives. If it turns out that rock in the river is the only choice, what is the purpose and the need. That is what the project is based on and that's what the people will look at outside this room. It's to get water to agriculture and to the refuges and to do so without harming the fish. Basically, the same purpose and statement we had for GCID.

In that process, we looked at all the different ways of getting water from the river. One of the alternatives that was looked at was wells (75 or more). It cost too much. Ultimately, we came to conclude that if you are going to put it in the river and if you are going to live with the river you are going to try to minimize the risk and there is going to be a lot of rock. And, not only is it important to know what the river will do at that site, but what the river will do upstream and downstream as well. And that's what we are trying to figure out here. If rock is ultimately the only alternative that the ranch can get it's water, the only feasible alternative, then ultimately the refuge will get what they need then you bite the bullet and you've got rock and you deal with the river.

If there is a reasonable alternative in the broader scale of things, precedent, CALFED, public funds, is this the right thing to do? And, it makes sense and no one is willing to step up to the plate and cover these additional costs, which otherwise makes groundwater integral, then we're stuck with dealing with the river. Personally, I would rather not have to deal with the river if someone is willing to pay for that. But, if the alternative is something that I can't afford, it's not really a choice. I think we are doing exactly what needs to be done, even better than before. We have some of the best minds and river people in the world in this room. If we can't come up with more alternatives, then we go with what works and what's feasible and let the public pay for it.

Burt commented that he agreed with Stacy. He stated that he was part of the group that helped write the language in the SB 1086. We really wanted to protect a continued function in the river. How we do it – we just have to pour over all the options and take a good hard look at a solution. If it takes rock, that's what it takes. We need to look at everything thoroughly. I think this is a great process.

Question(s): There is another issue surrounding the activity of diverting the water directly out of a river, there is a value and it's been known to be used recently since the sale of river water is on the rise. If this diversion is put on a groundwater supply, through the Ranney Collectors or any other option, Les should ask the first question – Has the ranch lost the water right to the river and can the ranch ever sell any water?

Answer(s): Dan McManus commented that to answer that question, it would have to be identified what is the percentage of river water and ground water that is being pumped. And, if turns out that you are only pumping 70% surface water, that actually brings you an opportunity to sell water and recoup costs for operations and maintenance. It would be similar to a groundwater substitution program. Everyone is looking for in-stream water to flood the Delta and it would be considered high priority water. However, it adds another layer to the process and it's important to find people to step up to the plate willing support that option on a long-term basis.

Les commented that it may a complicated process through the Bureau and that process has not been finalized to the point that you could go and do something today. You would need a ground water pumping permit and sell surface water and I don't want to lose my riparian water right out of the river. We heard from the folks from Montgomery Watson yesterday that the Ranney Collectors will be getting some ground water not all surface water. That will always be argumentative.

Les commented that his is not a water seller, that he is a farmer and the ranch has not even contemplated this issue.

Question(s): Yantao – Does the mitigation have to be removal of rock or can it be something else.
Answer(s): Paul commented that you're talking about several different authorizations. The first perspective would be rock to rock. From the fish wildlife habitat perspective it could be something else or it could be both.

Burt commented that the biological opinion seems to be fairly specific as to what is acceptable as far as mitigation for the rock placement. He thought there is an allowance, however, it is still narrow.

Stacy commented that a working group has developed a fish habitat value model where they look at a bank and evaluate it for a certain number of unit values for the particularly listed species and then they look at reveted rock and then they say that it has a certain value for the species and determine various ways of compensating of which a more direct way of doing it is wrong but there are other habitat types that can be built so that it all adds to the value of the equation for the model that has been developed.

Dan Mc Manus commented that to look at things on a level playing field, the group should discuss these costs – the placement of rock and the cost of the removal of rock. It certainly will be considerably less than a Ranney System. However, when we look at this realistically, it would be nice to have those costs at least estimated into the figures.

Mike Harvey commented that it is difficult to define the costs. Mike strongly agreed that those figures should be part of the in-channel alternative and it must be part of the real cost. He felt there were two elements to deal with regarding the mitigation. The on-site mitigation, essentially what is done on the site when the rock is put in and, what is impacted on the site. That is somewhat quantifiable in terms of the equation. However, what we're talking about is the

cumulative impact of rock revetment and it's ecological impacts and this is where we must assign a cost. We really don't have an ability to assign a cost to that approach. Because as it was stated, in the 300 miles of river you have 200 miles that are rocked. We have a very short piece of river – the Butte Basin section is one of the most potentially dynamic portions left in the Sacramento River system. How do we get a value for that in terms of a dollar value for this project? I'm not sure we can, but we are being held to that standard. We are not talking mitigation just for on-site mitigation here. And so, although I agree that you that we need to get a mitigation cost, how do we develop a mitigation cost?

Stacy commented that the group should take a look at what is needed, what fits and that becomes the reality. He explained that the only practical and functional model available is based on potentially critical habitat for endangered species and the cumulative effect of rock in the bigger picture. That's the model that's out there. Roughly, for every foot or mile of rock that is placed, there is an obligation to mitigate in kind by taking out rock or doing something that has functional equivalency.

Mike commented that there are on-site costs and,in order to get some idea of the other costs, it would be necessary to add in the cost equivalent to the length of the bank of rock removal? Is that a fair assessment?

Stacy agreed with that assessment.

Burt commented that there could be a set back levee cost as well.

Eric Larsen commented that he was involved with the Princton-Cordora project. He explained that question was asked – what is the economic value to allowing the river meander. OK we are going to pay "up-teen million dollars" – part of that money is paid for the value of ecological purposes so that when we say one has this much cost and this much value, part of the value could for these ecological things. He felt that the science panel is pretty supportive of that approach.

Bob commented that this was the reason that he raised the first question. It seems, that in order for the committee to make the decision and there is consensus, maybe there is room to argue that there are really two options: (1) Out-of-river - Ranney System; and (2) in-river. From a purely technical point of view, there is some room to argue that maybe the dikes may not be the right conclusion on its own, however, he asked the group to consider the option for the moment and consider the two options in general. He felt that in order to make a decision the questions raised are dealing with the trade out between the cost of the solution and the ecological value. He felt is necessary to "come to grips with the true cost including the ecological cost of putting hard points in the river (in-river option) and the cost of the Ranney System. There is a differential there."

Bob further stated that the next question - Where does the money come from? Who receives the benefit? For the sake of argument, is it reasonable to expect the ranch to pay even all of the power costs that the ranch would not have otherwise had o pay because they are not the ones that benefit – they partly benefit from ecological values – "but all the rest of us do too." Is there some way to come to grips with that question?

The comment was made that the person who ended up with the last mile of rock - their costs are huge but whoever rocked first - their costs are small. This then brings the discussion back to the costs are born by only one.

Stacy commented that he felt the discussion should be reframed and move toward an environmental document. Right now there are two options - in river and out of river – No action does not mean no consequences. No action clearly indicates action needs to be taken. You can make the river work the way you want it to – there are risks and some unknown costs in trying to hold the river there. He commented that GCID held advantages, but was not sure that those same advantages can be applied to this project. He felt the Ranney Collector alternative really has to do with eliminating risk of being in the river, as well as, move closer to the CALFED program. He felt that the alternatives should be laid out for CALFED and see if they would be willing to make the investment.

Discussions were held regarding the committee charge. It was agreed that the project is directed to provide CALFED with all alternatives with a justification of all useful information and expanded thinking.

Mike commented that if the committee wants to preserve the options, this is not an open-end process because if we go another one to two years, we do not have an in-river option. At the moment, the river can be engineered to hold an alignment that can make the pumps work. You may have to do some work up at river road and put the dikes in. If that bank erodes much more, the dikes won't work. There would have to be structures that are so massive that it would warrant a totally different fix to bring the river back. Mike did not believe that this was an open-ended process - it's a time-limited problem. There is a window at the moment where there are two options – a in-river option and an out-of-river option and time is of the essence.

Neil commented that an EIR/EIS would take a minimum of two years. Mike agreed.

Eric commented that if the recommendation is the in-river process, it would take two years. He believed waiting for two years was not feasible, and therefore, should not be pursues as an option.

More discussions were held regarding actually time constraints and environmental documentation.

Paul commented that the driving force here is probably fish screen standards. There is an ability through the two agencies that administer the regulations to relax those standards. And conceivably, nothing could be done and just keep cutting the channel over for the water and still meet fish screen standards and pumping capacity. Obviously, it may not be favorable to the ranch, however, other diverters are doing the same thing. If you want to look at the problem strictly economically, that might be the most efficacious way to go. And, if there is a two-year wait, the other options are still available.

In addition, Paul felt that this is not just a site-specific issue regarding fish screen standards. There are at least three other pumping facilities facing the same question. This project is a prime

place to start forcing that exact question to some sort of resolution. It may be that there is a dead-end fish screen – out of channel – and the Resources Agency must accept that fact as a result of weighing the benefits and the cost of compliance. Paul further detailed fish screen requirements and passing velocity requirements. Paul stated that when the environmental values were weighed, this option should not be dismissed.

Olen commented that he felt this issue was resolved earlier. The issue was impacts from Big Chico Creek. In addition, the availability of water back to the ranch. Due to the permitting processes keeping the channel dredged. If you had a high water event, the channel would be filled again and require dredging again. And during that process, you would dry the ranch up. The environmental documentation is a lengthy process and in the meantime the ranch has no water.

Paul commented that this is an up front cost that would be built to the approach. However, this is a generic problem with other diverters who have used dredging as an option. Paul felt that the permits could be put in place up front as part of the project costs (5-year permits). He reiterated that this option should not be dismissed.

More discussions were held regarding the influence of Big Chico Creek, the State Park, and maintenance on a yearly dredging effort.

Discussions were held regarding the "Family Water Alliance" (probably meant GCID) in Colusa that their continual effort to keep a ¼ mile of channel open. It looks like the river is going to change coarse again and move back towards their pumps which were initially in the water just as the M&T pumps. Currently, they dredge ¼ of a mile at a cost of between $50,000 and $100,000 per year. Not sure the capacity of the pumps. The gravel is divided among the farmers.

More discussions were held regarding potential dredging area, spoils and costs.

Olen moved the meeting on to the next agenda item.

Dave Sieperda, Manager, Llano Seco Ranch

Dave began his presentation by confirming that the Llano Seco Ranch must have a reliable water supply, especially to service mainly the wetlands on the ranch. David reiterated that the DFG wetland operators were under the same budget constraints as the ranch to ensure operation and maintenance of any water supply.

Dave explained that in the fall the ranch needs a water supply between 80 and 90 cfs, especially during flood-up time. He asked the group to weigh the small fix option against this large water demand. Small fixes may never accommodate that amount of supply needs. Dave further explained the wetland management responsibilities and water supply needs. He detailed the ranch water delivery system on the map. He said there are close to 300 acres of private wetlands that do not generate any income.

Paul commented that the DFG wetlands located on the ranch has the potential to receive water out of Thermalito Bay. DFG would much rather use the gravity flow ranch water than bear the cost of lifting the water from Thermalito Bay. The wetland area totals about 1,500 acres. Dave also confirmed the necessity of river water during low water years for the Llano Seco Ranch and reiterated that the ranch is a similar year-round system as the M&T.

Dave explained that the ranch has 450 acres of permanent crops (orchards) and about 1,600 acres in annual production. About 800 acres on the east side of the ranch (USFWS easement, irrigated pasture) is supplied by a well. Dave explained that the ranch would like to improve the land in the future and plant additional production crops. Dave described where flood waters flow over the ranch in high water years and the location of rocked areas on the ranch. He explained that he was not knowledgeable about any other areas of bank stabilization areas and concluded his presentation.

Olen asked the group for comments.

Mike commented that historical data shows that the river is straighter from Ord Ferry to Kimmulshue Bend in the last 100 years.

More discussions were held regarding the changes along the river in the project area.

U.S. Fish & Wildlife / Calif. Dept. of Fish & Game / Calif. Dept. of Water Resources
Challenges, Uncertainties, and Risks (Long-Term Solution Alternatives)
Kevin Foerster, Project Leader, Sacramento National Wildlife Refuge

Kelley Moreney represented Sacramento National Wildlife Refuge and began the presentation by explaining the wetland management responsibilities on the Llano Seco Ranch and the Sacramento River Refuge along the river. He described the wetland locations on the map - 4,500 plus that receive water for conservation habitat on the ranch, and as Dave mentioned, there is no income produced from that wetland area. Kelly explained that a couple years ago, due to budget constraints, the refuge was unable to flood the refuge wetlands at the current water cost. Kelley explained that increases of 3 to 4 times the current cost is not economical for the refuge and the agency will not be able to flood or manage the wetlands to meet the goals of migratory birds, large populations of giant garter snake and other species under those circumstances. An inexpensive source of water is critical to the continued management of both the federal easement lands and federal refuge and wildlife lands and to meet the goals of all three conservation areas.

Kelley explained like others, he was very enthusiastic about the Ranney Collectors until the associated costs were detailed. He said there is no way that the agency could meet the demands. He suggested that the group more closely look at some identified concerns regarding the Ranney Collectors. He would like to see a more detailed look at the actual costs and an increase in the efficiency of the system already in place. That is, look at the water use efficiency once the water gets to the delivery system. He mentioned the comment about a 30% ditch loss earlier in the meeting and felt that is should be a priority concern. Siphons along Ord Ferry have been identified as having major problems and could actually go at any time. To replace the system would cost upwards of $1 million. If the pumps and the water system did have to be shut down

for any long period of time and the water from Butte Creek was eliminated from the system, these 100 year-old redwood siphons that would fall apart. The water is probably the only thing holding them together right now. If the water dropped, we would have some major problems. Kelley stressed that a replacement of the siphons should definitely be added to the scenario of options.

Kelley continued by explaining that another interest the agency has is the Sacramento River Refuge. He explained that the authorization made by Congress to purchase part the land was to support SB 1086, in addition to responding to the number of conservation and environmental groups that were concerned about river restoration and their opposition to rip rapping. Kelley felt that there is scientific evidence to show that rip rapping is not a positive activity for ecosystems.

Kelley stated that the Sacramento River Refuge is an endangered species refuge for winter-run Chinook salmon, valley elderberry long-horn beetle, and number of other species including migratory birds. One of the objectives that the agency has included in the CPC, where possible, provides areas for the river to meander and acquire available properties areas really not suitable for agriculture to allow flood frequency and the potential for the river to move. Right across from the M&T Pumps is property that is part of the Sacramento River Refuge. Contiguous to the property is private property owned by Val Shaw under a The Nature Conservancy easement. Walter Stiles has another property located in the same area.

Kelley explained that one of the goals of the refuge is to allow river processes. In fact, the agency has removed rock on properties upstream and realized immediate bank swallow re-colonization. Fall-run began to spawn right where the levee was removed and the river had eroded it away. Kelley felt that putting rock on refuge land is not something that the agency is really excited about, however, the agency is willing to consider the alternative. He explained that the agency is working on a similar process at the Princeton-Glenn-Cordora Irrigation District and Provident Irrigation District pumps, in addition to the Llano Seco Riparian Sanctuary. Kelley detailed the circumstances of the project and compared them to the M&T/Llano Seco project. Kelley reiterated that the refuge is willing to consider all the alternatives and the most likely alternative on that site that we will be partnering up with the irrigation district to place rock on the refuge. He explained that the alternative can be acceptable, however, the final authority does not come from the refuge.

Kelley explained that the Princeton-Glenn-Cordora project is looking at restoring approximately 500 acres of riparian habitat that is currently fallowed. This action makes the project a little more attractive. The project is also looking at removing rip rap upstream. Kelley explained that liability issues and potential impacts on the split would determine if rock removal is feasible.

Kelley felt that the refuge is not comfortable moving forward with a preferred alternative that considers rock at this point until the issues and concerns are more settled. He stated that there didn't seem to be agreement among the experts on the technical information presented the day before. DWR and Eric Larsen were fully agreeable to some of the conclusions as far as the rock project being the best solution. Until there is consensus from the experts whether or not rock is the best solution, Kelley didn't think that the refuge would be able to move forward on that type

of solution. From an environmental standpoint, there is the Ranney Collection System and the possibility of dredging. The question is feasibility and cost. None of the three water users are making enough money off the water. Kelley stated that he is not sure where to go from this point.

Paul brought up another option that is a difficult approach as well. If the river continues to meander to the west, how far are we going to go? The other issue that we haven't really looked at that closely in the past is the Chico Outfall. There facility is in jeopardy as well as the river continues to migrate and it's not something this group has really focused on. Kelley felt it is a major issue.

Les commented that there was some rock below the M&T and asked Kelley if USFWS would consider rock removal.

Kelley commented that the modeling didn't show that the river would move too far to the west. That would be his first concern. The project should take in account the downstream impacts. Anytime you take out that much rock, you will be affecting someone somewhere else. There needs to be more investigation of the potential impacts.

Kelley suggested that there might be some other opportunities to remove rock nearby. Les mentioned the Hamilton City project that is part protection and part restoration. This project would provide for 1,200 acres, of what is now orchard, to be restored to habitat and opening up much more of the flood plain. He felt that was a positive effort. The proposal identified levee removal, however, Kelley did know if it would potentially impact the M&T project. The old J levee is identified as being removed. The flows being addressed for that project would not be affected by the levee removal but at a higher flow rate there would be significantly more water coming to this side of the river – just over 90,000 cfs. – and significantly more water on the west side of the river. Kelly was not sure how that would impact the river hydrology especially whether or not is would cause more deposition.

More discussions will be held regarding the J levee removal.

Eric suggested that since the price of the water is a key issue, it might be something that the committee could brainstorm about in the afternoon session of the workshop. There might be other ways that are outside the box to deal with that type of water to get to a workable compromise and identify beneficiaries.

Kelley agreed and felt that there was not a clear alternative identified to qualify as the best long-term solution. Kelley agreed that is was necessary to look at options for meeting cost requirements. He felt that meeting a two-year deadline for environmental documentation to place rock in the river was not feasible. Kelley strongly suggested that this would take longer than two years – not because of the Refuge – it's just not feasible to complete those processes in two years. The funding to conduct those investigations will be considerable – maybe $200,000 to $250,000 for the environmental compliance. Kelley did not believe that CALFED will have another funding opportunity for quite some time unless the project was able to get an amendment.

Les asked if the USFWS project across the river might be used for mitigation for the M&T project similar to what USFWS is doing across the river for Princeton-Cordora?

Kelley thought it could be a possibility, however, he felt it the project had different circumstances. The restoration for that project is funded by CALFED and there is a connection.

The question was raised about any water use efficiency improvements to the water delivery to the refuge.

Kelley reported that improvements have been made to water delivery on the refuge. All the canals and water control structures for water delivering have been improved as part of the NAWCA project years back. The lower portion of canal on Ranco Llano Seco has been rehabilitated but there are still considerable upgrades that need to be done. The siphons that are on Rancho Llano Seco are privately owned so the USFWS can't directly pay for the system improvements. At this time, discussions are being held with DU and the ranch to come up with some possible funding sources. They are looking at BOR, WCB, and CALFED to do some work on the system.

More discussions were held regarding potential system losses, water measurement and potential improvements.

The question was raised about what cost could the Refuge bear?

Kelley replied that the Refuge could probably get by with twice the current price which is less than $20. The Refuge is not buying water – the water is part of the Rancho Llano Seco water right. He explained that the costs currently range from $45,000 to $50,000. The refuge would have to change the way they manage the wetland if the cost reached $100,000. The Refuge could not afford that cost. The wetlands would not be flooded well, a permanent pond would be eliminated, a definite management change would occur on the property. It would not be the quality habitat that the Refuge would hope to provide.

More discussions were held regarding the uncertainties associated with higher costs of water deliveries and the expected life of a long-term solution. The comment was made regarding a 30-year life for the pumping plant and the undetermined life expectancy of the Ranney Collector.

Neil commented that the existing stainless steel screens should last between 30 to 40 years. The pumping plant should last at a minimum 50 years even up to 80 years. Concrete has historically lasted over 100 years. Neil suggested that the concrete caissons on the Ranney Wells would have the same expectancy unless there is an earthquake. You might have to vibrate and clean the screens every 25 years and water quality would determine the corrosive life of the underground screens. Good stainless steel screens last up to 40 years.

Kelley commented that it would be unreasonable to expect a project to last in perpetuity without modifications. He felt the he and his colleagues would agree that a life span of 30 years is reasonable.

Les commented that to replace the fish screens would cost $300,000 today (7 sections @$50,000 a section).

More discussions were held regarding the economic issues associated with replacement costs.

Kelley further commented that there is concern about the cost of operations of the Ranney Collectors. He felt that reduction in capital costs may be accomplished by looking at other strategies of improving water delivery. He felt that other production wells are not a feasible option. He felt that rock groins have an undetermined life expectancy.

Mike commented that based on past experience with this type of structure, rock groins have proven a 50-year life expectancy. The questions is, where will the river be in 50 years? This would not be an isolated project. If the decision is made to implement rock dikes, a decision has to be made to allow the flows to get there. It's not an either or. If that decision is made, the dikes are good for more 50 years.

Kelley commented that discussion regarding the rock near the J levee has lasted over 25 years with no maintenance.

More discussions were held regarding project life expectancy, maintenance, operation and failures of rock in the river.
Mike commented that the term failure means that it fails to function as holding the river there. Mike referred to the upstream rock and that it would not fail within the period of time of life expectancy. Where that rock is having its problems, is that initially is hooked up farther. They tried to hold the bend that wasn't going to get held and so the pile of rock in the middle was because the river flanked and went over the top and cut back. But the rest of the rock is pretty sound through there. Mike explained that the ends of the revetments are most vulnerable. However, the rest of the rock is pretty sound. He granted that if the site is not maintained that with time it works it's way backwards. However, this would be at a very slow rate. He felt that you could pretty safely say that the life of the rock dikes would definitely extend between 30 to 50 years.

Kelley further commented that there is additional concerns about impacts on conservation lands, e.g., state parks, DFG, USFWS properties, as well as the easement lands, resulting from the rock dikes. He didn't believe that the committee has been able to fully evaluate the rock groin project because of the complex associated costs, e.g., habitat costs, mitigation, etc.. Kelley referred back to Les' suggestion for restoration similar to the Princeton-Cordora project that doesn't include removing rock that would be a concern. Whereas on one site there is an increase in the amount of workable ground and in this project there would be a reduction. Kelley felt that this may be difficult for USFWS. He explained that there is concern about the long-term cost of the rock. There is concern about the Butte City rock groins. It is felt that if the river continues to erode upstream and the river potentially end runs the rock groins, CALTRANS will want to come back in and re-rock the rest of the channel. The concern is that as the river migrates west, the project will continue to follow the river with rock.

Kelley was also concerned, that in the future, twice as much rock would be ultimately placed at the project site than originally identified due to the continued upstream and downstream dynamics over time. Maybe that may not be a viable or reasonable concern with more information.

More discussions were held regarding this issue.

The question was raised about the dike design and if the river flow changes will that affect the way the dikes are designed to work?

Mike replied that if the river gets away from the dikes it would have an affect. If the river comes in at a very acute angle or if the river turns straight into the dikes, then the dikes will be ineffective.

Kelley asked at what point would the dikes become ineffective? Eric's model showed that the river is kicking to the east right at the site where the rock groins are proposed. Will the dikes be as effective against that angle at which the river hits those dikes and continue to prevent deposition at the pumps?

Mike commented that the problem becomes flipped. If the dikes are in trouble then the problem the committee is dealing with isn't the problem at the M&T Pumps now.

More discussions were held regarding future changes in the river at that location, dike responses future issues and continued modeling to answer the questions raised.

Mike and Eric agreed that a model was important to understand the river and to provide useful information for decision-making. If the predictions are correct and the tendencies are there then that knowledge is built into the model. The results may mean that something may need to be incorporated at River Road. There was agreement.

Mike reiterated that you can't have one without the other. You can't let River Road go and put dikes in. Eric commented that this issue should be cost out immediately.

Mike commented that an extra dike should be put in effectively at the end of River Road to kick the flow out with a bull-head dike. Mike described the location on the map and explained the flow alignment and potential changes by the dike.

Kelley further concluded his concerns by raising the question of potential navigation hazards. He commented that he understood that the proposed groins would be covered over 20 days per year and was unsure of the depth of coverage. It would vary with the flow rates.

More discussions were held regarding the conclusions at Princeton-Cordora and how they might apply to M&T.

Kelley concluded by stating, from a personal point of view, traditional rip rap may be a better choice than the groins. Kelley stated he would be very interested in reading the articles regarding the environmental benefits of the groins since he needed to be convinced. He commented that the large woody debris that was cabled at the Butte City groins was not meaningful. That happens every day with the walnut trees falling into the river with erosion.

Paul Ward cautioned that the committee should not use the Butte City rock groins as a prime example of this type of structure or how the structure would be revegetated.

More discussions were held regarding the possible alternatives at Butte City other than dikes.

Bob commented that the argument for the ecological value of the dikes versus full bank is the habitat and hydrologic diversity and topographic diversity you get around the dikes. You get a scour hold off the end of the dike, you get an eddy in the backside, you get deposition between the groins. And it does allow for the potential of regrowth.

Mike commented that there are some rock dikes on the Yuba River. It's actually quite difficult to see the dikes due to the vegetation. These were big dikes that went to the top of the bank. One of the benefits is great habitat for vertebrates. It provides substrate that is not available on the south banks. The assessment of the dikes was done with a biological view.

Kelley agreed that there seems to be an obvious diverse habitat associated with a rock groin as opposed to the traditional rock.

There was a request to see a picture of a rock groins in a long-time setting. A picture was made available.

Kelley commented that USFWS has had discussion about traditional types of bank stabilization. He gave the example of the millions of dollars spent on environmentally-friendly rip rapping along the Columbia River. He stated that it does work and it does provide habitat so there are options available to look at. However, the Columbia is not a nice meandering river – there are some differences.

Olen asked the committee to recognize the time and suggested that a lunch break be taken and then continue the discussions after lunch.

> **PLEASE NOTE:** Due to the required time that was necessary to thoroughly discuss each contributor's issues and concerns, not enough time was available to complete the morning agenda. To ensure that all comments are presented and recorded, Olen is requesting that Paul Ward and Stacy Cepello present written statements of the "challenges, uncertainties, and risks (Long-Term Solution Alternatives)" to be included in these workshop minutes in addition to their comments stated above.

[LUNCH]

Please note that the following agenda items were not formally referred to in the previous discussions. However, both individuals took the opportunity throughout the workshop to provide substantial feedback throughout the discussions.

Paul Ward, Fishery Biologist, Region 2, Calif. Dept. of Fish & Game

Stacy Cepello, Chief Environmental Services Section

Olen adjourned for Lunch – Steering Committee Comments and Discuss resumed after lunch.

Adjourn Meeting for Collaborative Study - Lunch

Steering Committee Comments and Discussions

> **Collaborative Study Evaluation of Project Alternatives**
> For the rest of the day, available members of the Steering Committee are requested to informally meet together to discuss major findings, conclusions and a preliminary recommendation for the next steps of this project. This preliminary recommendation will be presented by an agreed upon Steering Committee member the following day.

Olen opened the discussions by appointing Mike Harvey to lead the discussions who will step the committee through charts designed to organize the previous discussions. He explained that what came out of the morning discussions were more than one alternatives and a no action. The Ranney Collector is an off-channel alternative, the spur dikes are an in-channel alternative, and dredging with fish screen flexibility is in-channel. Olen referred the committee to a copy of the conceptual model and the first three things for consideration: (1) river meander; (2) water requirements; (3) fish screen requirements. In addition, there is economic) and engineering feasibility, and broke down a little farther and there is feasibility from an environmental mitigation feasibility together with engineering feasibility (can we do it) and an economic analysis which deals with the up front capital costs and then there is a long-term operations and maintenance cost and a column for other costs.

By the end of the afternoon, the goal is to complete the matrix, then overnight the committee can think about how to winnow the information down to reach a consensus on the next steps.

Discussions on Alternative #1 – No Action

Mike asked the committee if the discussion could start off with the presumption that current conditions are unacceptable? Can we satisfy the water requirements under the no action requirement? Can we do it today? Yes – but there is no certainty.

Paul argued that it could be done in perpetuity if 150,000 cubic yards were removed in timely intervals - that is different than dredging.

Mike asked if we do absolutely nothing in the river or out of the river, can we actually meet the water requirements – all agreed that it could not.

Mike then moved on to fish criteria. If the pumping is continued, it fish criteria met? Paul commented that short-term no and long-term yes because there is no flows.

Les also commented that as far as the fish are concerned we could go back to Butte Creek then that fishery would be impacted.

Les commented that portion of our needs would be lost at the river.

Comment was made that a no action alternative would meet the meander alternative.

Mike commented that environmental feasibility and engineering feasibility are not applicable to no action.

If nothing is done, water will have to be found somewhere.

Burt commented that an economic impact would be to stop farming.

Mike asked the question – Is there another source of water?

Discussions were held regarding water source alternatives.

Eric commented that he thought that by tomorrow the committee may be combining different actions. There might be combinations with no action for a year.

Consensus on Decision Matix Criteria

Alternative #1 – No Action

Water Requirement – NO
Fish Screen – NO
Meander – YES
Feasibility – Environment – N/A
Economic – Capital Cost – N/A
Economic – O&M – N/A
Gaps – Return to Butte Creek for water needs – Loss of agricultural productions and wildlife values. No city benefit.

Please see Decision Matrix Table at the end of Thursday, February 17, 2005 Workshop Minutes.

Discussions for Alternative #2 – Ranney / Off-Channel

Mike began the discussion by stating water requirement, fish screen and meander could be met with this alternative. The question was raised about Butte County groundwater ordinance may have to be met. There are some questions and uncertainties about the number of wells.

Neil commented that it was reported that if the river moves away from the wells, more wells would be necessary.

Stacy stated that the river moving away does not have a great affect because they are not really counting on the Sacramento River as being the primary source.

Dan McManus replied that it goes both ways.

Yantao commented that the difference seems to be 3 wells or 5 wells. Dan commented he thought it was 3 or 4. Yantao commented that it is 30 cfs against 49 cfs.

More discussions were held concerning the Ranney Well capacity.

Mike commented that one of the issues that became apparent was the requirement for a double lift.

Neil commented that the well should be plumbed right into the manifold and take it right on up the canal. It could go either way. Neil thought it might be more economical manifold it into the existing the transmission line and push it right on up the hill.

Mike commented that part of the issue is that the existing pumps and fish screens would not be used. Neil agreed. Mike asked what would be salvageable from the existing pumping plant. Neil stated that there were eight valves on all the pumps and there is a valve on the wet well now. The plant can always restart pumping, if water was available. Neil suggested that it be left in place.

It was agreed that a bigger engine would be necessary due to more lift. Neil stated that it probably would be necessary to abandon the entire pumping plant.

Mike asked if there are any technical issues that haven't been looked at?

Bob asked the question about the manifold issue. The operating costs (approx. $1 million) assumed that the existing pumping costs for the existing plant would stay the same. You could get some savings by eliminating that pumping cost – What are the current annual pumping costs?

Les stated that right now the ranch is pumping from about 20 to 22 feet and he thought that the new estimated lift would be 75 to 80 feet. Les stated previously the costs were at $8.00 ac/ft.

Neil stated that there is 60 feet of draw down in the wells (60+22=82 ft) at all times.

Les reminded the group that the test was done along the river not up by the ditch.

Neil described the location of the potential Ranney Wells on an aerial. Neil explained that a spacing of 2,000 feet apart was estimated.

Discussions were held regarding line loss and potential new configuration of a delivery system to accommodate the proposed Ranney System.

Mike asked the group if the matrix should rank each column as either positive or negative in respect to the City of Chico? Les agreed and explained that their input was vital in the short-term fix.

Tamara explained that the city listed the alternatives in the present EIR. She explained the cities evaluation of alternatives in regards to the timing issues for the city and the life expectancy of any new outfall. She further explained that the EIR is out for comment and a preferred alternative will be selected and construction would begin in 2007. Outfall construction may be delayed 1 ½ year or 2 years.

More discussions were held regarding the alternatives in regards to the City of Chico.

Mike asked the question whether the environmental considerations meet the concerns of the State Parks and are there any separate issues?

Ken replied that he believe that State Parks was probably the least impacted. He thought the visual impact may have some merit. As far as the environmental concerns, the park supports the river meander and is prepared to let some of the land go back to the river. He did not believe that the County would let River Road go back to the river or move the road. He sees the lands being fallowed as the river moves over.

Mike moved the discussions on to economical capital costs.

Bob commented that he made a quick calculation regarding the O&M for the Ranney – If you calculate the present value of $1 million per year operating costs, maybe that's high, $1 million at 5% rate of return – present value is $15 million of the just the operating costs for 30 years. This is just to clarify the comparisons.

Dan commented that for a more accurate assessment, the annual average water use should be used to make the comparison. The annual average water use is 20,000 or 30,000 af.

Bob commented that a maybe a better figure would then be $570,000 at 20,000 af?

Neil commented that it would be necessary to add 5% on to the amount for existing pumping costs.

Dan commented that if you "moth-ball" the current system and you could get away with more than one Ranney Collector. The cost of the Ranney System should be more detailed. Matt Reed was going to talk with the Sonoma County Water Agency engineer to discuss more accurate costs to the a Ranney Collector.

Neil commented that Sonoma County Water Agency is an M&I producer and they are pushing their water 250 feet uphill. The comparison is apples and oranges.

Bob commented that he did not have a basis to know the actual number, but the idea of putting a number like that down is a relevant issue – it's a real cost. Bob was not sure how to weigh that against the environmental issues.

Neil commented that at 20 cents a kilowatt hour, by going to natural gas may buy some savings.

Les reiterated that the ranch spends about $8.00 to pump an ac/ft and last year the ranch pumped 30,000 ac/ft at $250,000. That $1 million is a credible figure.

Neil commented that it would be about $32 an ac/ft. The head is what dictates the cost – the lift.

Olen commented that he had knowledge of a program through BOR where they offered low-cost power for environmental projects. Would something like that work here? Could we get at-cost power out of Shasta?

Neil was not confident that the BOR could offer that opportunity since they have to buy power on the lines just like everybody else. M&T is not with WAPA. GCID, TC Canal, RD 2035 have preference power.

Stacy commented that there are considerations made for environmental power. He found that there must be a project that the BOR is willing to embrace and get benefit and then will give out project power. He stated that a current proposal to the BOR did not get anywhere.

Dan commented that if there are three separate facilities, they all don't have to be on the same meter. One could be dedicated for off peak. There is an opportunity to savings there. Maybe two to go off peak. If the pumping rate is five hours a day or sometimes 24 hours per day – then the natural gas has benefits. The project number may be accurate. Dan stated he would have to do some detailed calculations to come to a more definitive answer.

Eric commented that he didn't think the committee would come to a conclusion on that issue here.

Dan commented that he believed that this is the breaking point on the Ranney System. Capital costs you can deal with but you have to eat this annual cost of operating the system and then paying for it – "that's a killer - that puts it under."

Yantoa asked if even half the costs would work?

More discussions were held regarding capitalization and savings in pumping costs through water use efficiency measures. It was agreed that a more accurate assessment of water savings would need to be calculated to understand the true savings.

Dan commented that lining ditches doesn't always provide water savings. Flood up takes longer because the upper aquifer has not been recharged from the water losses in the canal. It's hard to really quantify – it may be considerable less than what you think.

Please see the Decisions Matrix Table.

Discussions for Alternative #3 – Spur Dikes / In-Channel

Mike commented that its not that the bank cannot be stopped. He said that we have to remember what the purpose of the dike. You actually use fairly short dikes just to hold in the location that is the time of the time of construction. That's not the point. The point is that we have to get the sheer stress distribution back to where it was close to approximately 2003 conditions or 1999-96 conditions. It's not just a question of holding the bank.

Bob commented that he thought the spacing of the dikes could be relaxed. It's about a 1 on 3 – 20 degrees for every 30 feet on the dike in theory you could increase the spacing by 90 feet. May eliminate one dike. He compared the costs of the Ranney System at approximately $150 million to the cost of the spur dikes of approximately $5 million.

Eric commented there is somewhere on the order of magnitude of 2 to 3 to 1.

More discussions were held regarding the location and purpose of the dikes.

Mike commented that the best that can be said at this stage -- if this element of the project moves forward it must be decided if the project can be done? Mike added to the matrix – time sensitive and effectiveness limited by distance of bank retreat.

More discussions were held regarding the dikes.

Please see Decision Matrix Table for final rankings on Alternative #2.

Discussions for Alternative #4 – Dredging / Fish Screen Flexibility

Mike commented that it can be assumed that this alternative meets all the requirements. Is the technology available? Can it be permitted?

Paul commented that there are standards and examples available that point to the answer being yes.

Discussions were held regarding the replacement of the fish screen.

Paul commented that if the screen is replaced with a flat plate screen it has six times the surface area.

Mike asked for consensus about environmental feasibility.

Dennis commented that a permit to dredge the channel every year is required. That may be difficult.

Discussions were regarding the permitting process, multi-year permits and the spoils.

Paul commented that the spoils may be a different issue. He suggested that the spoils could be located upstream and be recaptured by the system.

Mike commented that GCID stacks it on the island and lets the river manage it.

Paul commented that approach could be taken with this project. When we looked at the removal of the gravel bar – one of the options was actually to take it down the Golden State Hwy and let the river recapture it down there. The cost of hauling it down there was the problem. But in fact all that is being done is dredging the channel. Whatever size that may be is in the flood plain, stack it downstream in the floodplain and let it go. DFG issues permits for that activity.

Mike commented that the City of Chico may not be as supportive of this alternative.

Dennis commented that the channel is being re-dredged and would be mainly comprised of silt. Would DFG still allow dredging if the bulk of the material was silt rather than gravel?

Paul commented that if it's stacked in the dry and the water quality is not increased, the result is similar to natural erosion. The spoils would be stockpiled below the diversion where it is recaptured under high flows.

Discussions were held regarding the dredging locations and potential results.

Mike asked how do you go with the intermediate time frame with this alternative, because the dredging option only becomes a reality when the full diversion is unavailable. The question remains when does it become necessary to dredge?

Paul replied by saying that he supposed that what ever this limit of amount of dredging is – whether it is to maintain Les' pumping success – we've already been in a situation for a week now of not meeting the screen criteria for fish approach. And there is nothing happening. Even if you went out today to measure the bypass that situation is already in existence.

Dennis suggested that what you have to do is essentially predict where the bar is going to be, what the depth will be and at various time essentially design what to do in each of those scenarios. And then you have to get a permit right away to be able to go out and do that. Then the question is how is the permit obtained in a timely manner. Is there a case where you have to go out in the water to dredge it?

Question(s): Should a channel be dredged toward the intake instead of dredging the gravel bar as was done in the past?
Answer(s): Yantao commented that his issued was discussed in the Stillwater memorandum and agreed upon over the first workshop that dredging a channel will likely not succeed, and poses a greater risk to the intake. Instead, dredging the gravel bar should still be the best option when dredging becomes necessary.

More discussions were held regarding the dredging options and Yantao offered to present more evidence to demonstrate that dredging a channel will likely not be successful.

Discussions were held regarding the following issues:

- bypass flows
- timing of dredging
- types of dredging equipment
- spur dikes versus dredging
- existing dredging operations
- locations for dredge spoils
- periodic dredging versus Ranney System costs
- fish screen criteria and size
- relaxation of fish screen criteria
- current pumping plant capacity versus Ranney System capacity
- combination of water sources
- Western Canal and Termalito Bay water sources
- alternative combinations
- availability of old pumping plant in Big Chico Creek
- renovation costs of the old pumping plant
- water rights issues
- risk of existing pumping plant to deposition in a big storm event
- depositional zone in the river near the pumps

DECISION MATRIX

PROJECT LIFE EXPECTANCY 30 YEARS?

Alternative	Water Requirement	Fish Screen	Meander	Feasibility Environment	Feasibility Engineering	Economic Capital Cost	Economic O&M	Gaps
1. No Action	NO	NO	YES	N/A	N/A	N/A	N/A	Return to Butte Creek for water needs. Loss of agricultural production and wildlife values. No city benefit.
2. Ranney / Off-Channel	YES	YES	YES	N/A	YES 3 – 5 wells	~$4 m / well unknown	4X pump costs PU$15m / 30yr Refine Costs Need a long-term subsidy Ground water Saving for sale	Butte Co. GW Ordinance Abandon existing pumps Look @cost savings – operational Reduce water demand (25%) i.e., inc. efficiency Thermalito source Legal issues (SW vs GW) No city benefit
3. Spur Dikes / In-Channel	YES	YES	NO	YES w/ unknown Mitigation costs or requirements	YES	$300K / dike + access points 9 + off-site improvements $3m $1.5 m removal 2,500’		Time sensitive & effectiveness limited by distance of bank retreat. State Parks ownership @ River Road Timing for City of Chico
4. Dredging / Fish Screen Flexibility	YES	YES	YES	YES (?)	YES	New fish screen – flat plate $5m - $6m	? Dredge Costs Call Dutra	Annual / multi- year permits for dredging Disposal issues Annual cost of dredging No City benefit
*Back Up – have capacity to re-use old ____ Chico Creek pump site					YES	$1.5m + screen		Insurance policy NeedS refurbishing

Friday
February 18, 2005

Meet at **Llano Seco Ranch Headquarters**

Beverley Anderson-Abbs, Env. Specialist, , Sacramento River Conservation Area Forum
Howard Brown, Fishery Biologist, National Oceanic & Atmospheric Agency
Burt Bundy, Manager, Sacramento River Conservation Area Forum
Yantao Cui, Research Scientist, Hydrology/Geomorphology
Dennis Dorratcague, MWH Americas
Rebecca Fris, Restoration Coordinator, Calif. Bay-Delta Authority
Michael Harvey, Principal Geomorphologist, Mussetter Engineering, Inc.
Les Heringer, Manager, M&T Chico Ranch
Eric Larsen, Research Scientist Geology
Chris Leininger, Project Development, Ducks Unlimited, Inc.
Kelley Moroney, Refuge Manager, Sacramento Valley National Wildlife Refuge Complex
Friz McKinley, Director City of Chico – Public Works Dept.
Tamara Miller, PE, City of Chico
Robert Mussetter, Principal Engineer, Mussetter Engineering, Inc.
Bruce Ross, Engineer Geologist, California Dept. of Water Resources
Neil Schild, Principal Engineer, MWH Americas
David Sieperda, Manager, Rancho Llano Seco
Paul Ward, Association Fishery Biologist, Region 2, California Department of Fish and Game
Olen Zirkle, Manager, Conservation Programs, Ducks Unlimited, Inc.

Olen Zirkle, Opening Remarks – Introductions

Presentation of Major Findings, Conclusions and Preliminary Recommendations

Steering Committee Discussions –
Refine recommendation, Final Consensus and Next Steps to prepare and submit Project Recommendation to CBDA.

Note: Both agenda items were combined into one discussion. Olen took the lead in summarizing the previous day's discussions.

Olen opened the meeting with introductions and began the discussion by referring the Steering Committee back to the conceptual model. He stated that the previous discussions and concluded that there were two alternatives that concurrently met the first three criteria, (1) meander / sediment; (2) fish screen, and, (3) pumping requirements. He explained that the next step is to start looking at the feasibility of each of these alternatives regarding environmental implementation and financial implementation.

Olen concluded that the Ranney System was associated with high costs in the range of $11 million to $16 million capital costs and then an annual $1million cost in additional pumping

costs to run those systems. He summarized that the committee determined that, if the landowner had to pick those costs up, it would not be a viable alternative. He explained that if the costs to operate the Ranney System could be solved, the Ranney System would meet all the project requirements.

Olen continued by explaining that the next alternative that met the criteria, however, this option has some real technical problems trying to maintain a channel through the advancing gravel bar. The dredging alternative would require a very large fish screen to meet the requirements. This alternative also has some economic considerations and engineering feasibility issues.

Olen explained that the Steering Committee must consider a non-goal alternative that does not successfully meet all the project goals of river meander, pumping capacity and fish screens, as well as engineering feasibility and cost.

Neil commented that the group should talk more about the City of Chico and how they could participate in the spur dike alternative and that the long-term solution would double the lifetime of the city outfall.

More discussions were held regarding the circumstances surrounding the City of Chico outfall.

Comment were made regarding how the out-of-river alternative or the no action alternative will fiscally impact the City of Chico, in addition to the impact from river meander. The river will migrate and that is bad news for the City of Chico. Discussions were held regarding the opportunities and benefits for the city to hold the river in place.

Les reiterated that the importance of working with the city in a partnership project. He commented that the city understands that there is no secure relocation site on the river without river protection and each time the city relocates the outfall, M&T will lose more orchards.

Olen moved the discussion to give Dennis Dorratcague time to present a flow chart describing his analysis of the issues. (See Flow Chart at the end of Friday, February 18, 2005 Workshop Minutes)

Dennis explained that it appeared no one alternative met all the project criteria and because of the critical time constraints that the project was under, it was prudent to simultaneously fill information gaps for each alternative rather than sequentially study each alternative. He believed that if the committee clarified their understanding about each alternative one at a time, it might be 2007 before a reasonable assessment may be complete. Under the current river conditions, he felt that the ability to train the river with the dikes was time sensitive.

Eric reiterated that that the spur dike action would be impossible to accomplish because of the political situation in the river.

Mike commented that there is no doubt that putting rock on Sacramento River is a problem, however, the problem should be viewed with a realist approach. Realistically, there are locations on the river where infrastructure must be protected, and traditionally, on the Sacramento River

people have just used full-bank rock revetment. In many other places around the nation dikes are used instead. Mike stated that in keeping with the spirit and intent of the CALFED approach of experimental and adaptive management, one of the things that the experts don't know anything about is dikes on the Sacramento River. He asked the question, if it requires a rock treatment, would it not be better to utilize a spur dike option rather than a traditionally bank revetment? Mike suggested that one element of the project might be to use the interim action as an adaptive management experiment and to monitor the biological and physical aspects of the spur dikes to validate the environmental benefits and/or impacts. He also suggested looking at similar sites where the river is being held that may provide valuable information to help the committee come to a decisions (RM 192 and RM 172). Mike agreed that the committee was committed to try to find an out-of-the river alternative, however, the cost and the feasibility may be unacceptable.

The question was posed to Rebecca regarding the ability of CALFED to meet the annual energy costs of the Ranney System?

Rebecca commented that it would not be feasible for CALFED to support an annual energy cost. She explained that CALFED was trying to put together a long-term finance plan because money is actually running out in the bonds. CALFED generally does not fund O&M costs for any project. She gave as an example the willingness of CALFED to finance fish screens, however, the entity that owns the screens will assume operations costs. She stated that there are no annual funds available to support any O&M -- CALFED operates on bond dollars and there is no way to establish long-term assurances. There is no annual CALFED budget. Until the finance plan is up and running and can provide some stability over the next several years, there is no way that CALFED could commit to any long-term funding.

Discussion were again held regarding the inability of the ranches and refuges to bear the burden of the costs. Mike commented that the M&T and the refuges cannot afford that cost of water.

Comparisons were made between the Ranney system at approximately $16 million (initial cost) and about $1 million a year to pump; and, the spur dike option at approximately $7 to 8 million capital costs and somewhat minimal O&M costs. Additional discussion was held regarding potential sediment deposition, modeling predictions, and dredging frequency and costs.

Bruce commented that the modeling shows that there is still a depositional environment right by the pumps; and, the historic analysis using the 1997 flood events which was superimposed on the 1996 river geometry, showed that the gravel bar moved and subsequently required dredging so it wouldn't encroach on the pumps.

Dennis commented that to adapt to a dredging alternative would essentially modify the fish screen operations. It would require a variation from fish screen criteria. He stated that the unknowns would be the cost to modify the fish screens, the unknown length of the fish screens, how much dredging would be required to meet the flow requirements, and how far will the river move each year? He felt that after 30 years it would be a "dead-end situation." He explained that to meet the DFG criteria for a dead-end screen, the screen would have to be very large. Probably five times the existing screen length. It would probably require a flat plat screen that

would be the most economical to construct. Relaxation of fish screen criteria would decrease the cost. How much it could be relaxed is undetermined and up to the agencies.

Discussions were held regarding the significant unknowns associated with the dredging alternative, how unpredictable the variables were over the long-term, the environmental impacts, the potential for long-term open-water dredging permits, and continued policy support for the option. In addition, the issue of cost to meet present fish screen criteria during the life expectancy of the project and the need to relax the criteria.

The questions were raised – does the fish screen really need to meet the criteria? The discussion was held regarding the basis for the criteria. Dennis explained that the criteria ensures the safety of the fish in the presence of the screen and ensures that the hydraulic criteria are met. He explained that the criteria were set for the weakest swimmers and the smallest size that is not present in the system at all times. He felt that there was room for a relaxation of the standard. He commented that the fish screen improvements may exceed the cost of the Ranney System. (Rough calculations – 24,000 sq ft about ½ acre)

More discussion were held about the stricter fish screen standards held by NOAA Fisheries and the associated costs that became prohibitive, in addition to the lack of biological justification. Paul believed that issue needed resolution and this may be the project to find the answer.

Discussions where held regarding the similar issues that faced GCID, e.g., fish screens would not be operational without a gradient facility, relaxation of fish screen criteria (NOA relaxed exposure time between bypasses), etc.

Paul commented regarding the issues surrounding the present need to demonstrate a definitive level of take at every site. He felt that the ability to meet that criterion was not physically possible at the 3,000 unscreened diversions identify through the DFG survey. Paul stated that if the economic costs and biological justification were added up, the policy makers may need to step back and find another approach to this issue. Paul continued by explaining that one approach under both federal and state law is to permit an incidental take for a listed species as long as it doesn't jeopardize existence and, under state law, as long as it's mitigated. Paul believed that the future held this approach since there the capital costs are prohibitive.

Rebecca commented that she encouraged the committee to follow Paul's approach. She stated that CALFED gave direction to the committee "to think outside the box," especially since the state and federal agencies sat together on the ERP Committee for the purpose of melding state and federal requirements.

More discussions were held regarding mitigation for incidental take and possible mitigation strategies;

Les commented that he had some serious reservations about the implementation of annual dredging out in the Sacramento River for the life of that pumping plant. He stated that the ranch is seriously afraid to commit to that approach with such significant unknowns. He stated that dredging would require a serious commitment from the State Parks since the river is constantly

moving to the west. He reiterated that the ranch is dealing with a large fish screen pinned against the bank that may not survive the winters. He cited the examples of how the river creates significant debris problems. Over the past winters, is has been necessary to pull huge trees off the large H beams protecting the existing screens. He felt that the dredging alternative did not provide a long-term solution, but only an emergency fix. He did not feel that annual dredging was thinking "outside of the box." He also expressed concern about how annual dredging might impact the Spring-run Salmon Big Chico Creek. The dredging might have to be done across Big Chico Creek which may once again reverse it's flows.

Dennis suggested that the committee may need to present a suite of alternatives to CALFED with an investigation schedule that leads to information that will finalize and preferred alternative. He felt that each alternative tended to be the best under certain circumstances, however, each had major constraints, e.g., Ranney System – O&M constraints; water sale opportunities.

Dave stated that there were serious constraints associated with potential water sales and the ability to sell groundwater versus surface water.

Eric reiterated the potential for water sales based on potential pumping withdrawal of 70% river water and 30% groundwater estimates.

Discussions were held regarding the allocation of water to the ranches versus the state and federal refuges and their associated costs. The question was raised regarding the true reality of water available for sale and the ability of the ranches to subsidize the public refuges costs.

Dave commented that Rancho Llano Seco has riparian water rights and cannot legally sell riparian water.

Les stated that the ranch is under a BOR contract and that the Rancho Llano Seco is totoally riparian with no BOR contract.

More discussions were held regarding water right authorities, true water availability, potential buyers, and the true availability of funds and assurances.

Les also stated that looking to the BOR for preferred power is not an alternative because the system runs on natural gas and will continue to use natural gas as the best alternative. He reminded the group that his costs are $8.00/AF at $240,000 per year and with the Ranney System there is four times the lift and that's where the $1 million costs originated.

Discussions were held regarding the spur dike alternative and the associated concerns regarding the near-term probability of river migration. Concerns were raised regarding the feasibility of spur dikes if not implemented in a timely manner and if there would be a potential need to increase the size of the spur dike alternative over time.

Discussions were held regarding the change in construction of spur dikes if the river significantly migrates; economic concerns surrounding changes in construction; what conditions would trigger

the changes in dike construction; predictability of river dynamics and impacts to proposed spur dike alternative; and, protection strategies for the pumping plant until major questions are answered.

More discussions were held that referred to the org chart and the need to work simultaneously to work through the unknowns because time was of the essence due to river dynamics. It was agreed by the committee that a strategy was necessary to protect the operations of the pumping facility until the committee had completed efforts to refine the proposed alternatives in order to select a preferred alternative. The committee agreed that an additional excavation of the gravel bar would be necessary until a final long-term solution was determined.
Les commented that the ranch would have to reapply for all permits to conduct another gravel bar extraction project.

Olen suggested that the next recommendation from the committee to CALFED should be to move ahead and get the permitting started. He stated that the first permit for dredging was conditioned upon the dive report. If the annual dive report indicates gravel bar encroachment, then the project needs to move forward and request a CALFED subcommittee amendment for dredging. The project would request authorization to initiate environmental documentation for an ultimate gravel bar reduction and dredging at the pumps.

Olen asked for consensus – all agreed.

Discussions were held regarding the cost increases of permits, associated costs of spoils removal, dredging approaches, impact of in-channel dredge spoil disposal on City of Chico outfall, and constraints associated with issuance of permits.

Dennis continued with the discussions regarding the last step in the org chart - the proposal to CALFED. He felt that the committee should continue a simultaneous scope of investigation for each alternative and explain to CALFED during the amendment process the urgency of the need to take an interim action since the project is under a time constraint as a result of river dynamics.

More discussions were held regarding the following information needs:

- a more definitive cost analysis of lift requirements, energy costs, ground water versus surface water and capacity to more clearly define number of Ranney Collectors;
- expedient collection of accurate river survey data to more definitively analyze the spur dike alternative; and,
- assessment of water sources to more definitively analyze water sales potential.

Olen then directed the group to discuss the information gaps for each alternative and record these action on flip charts. (See list of information gaps for each alternative at the end of Friday, February 18, 2005 Workshop Minutes)

The following is an additional list of comments associated with outline of information needs for each of the alternatives as recommended by the Steering Committee:

RANNEY

- analyze Ranney System O&M costs and potential number of wells, well spacing and the impacts of river migration on water yields;
- analyze fish screen criteria and recommendations to relax criteria; and
- determine the appropriate approach to gravel bar extraction and short-term protection of the pumping plant.

WINDROW ROCK

- to protect the spur dike option, windrow rock was recommended to keep the river from migrating away to a point that the spur dike alternative would not be feasible;
- the windrow rock was suggested as a temporary action just to slow the river process until a final alternative was selected;
- the apex of the river where the windrow rock would be proposed is on FWS lands and would need approval from Sacramento;
- the windrow rock treatment, as a temporary option, would save the project a significant amount of cost associated with the spur dike option, as well as, ensuring the river connection to the Ranney System;
- approvals for such an interim action would have constraints on such a short timeline;
- removing the windrow rock would be feasible and similar to removing rock for mitigation;
- the City of Chico would be in favor of an interim action to protect the outfall;
- the interim action would need an EIS;
- there is probability that the agency would be sued for this interim action, as well as, a spur dike option;
- emphasis should be given to the windrow rock as a temporary action;

Olen moved the discussion to Spur Dikes.

SPUR DIKES

- questions raised regarding the future movement of the upstream bend apex over time;
- migration of the apex of the upstream river bend would be prevented by maintaining the existing revetment and hardening along River Road;
- the apex of the upstream river bend will continue to migrate no matter what is done in the river;
- the river bank is migrating because there is an expansion zone near the west bank and it "kicks off of River Road" the bar builds and the bank migrates – to stop the bank from migrating, bar must be prevented from building;
- the gravel bar will probably be shaved as a result of the proposed river treatment;
- there is no engineering basis to assume the river will migrate past a river treatment intended to hold the river at the west bank within the timescale of the project if the Rive Road revetment is maintained;

- debate regarding the movement of the river thalwag at River Road near term and long term;
- as an example of how the river may react to spur dikes, it is suspected and predicted that the river is going to migrate through the Butte City Bridge project;
- fixing the river is comparable to canyon walls that prevent river migrate;
- it was argued that the pumps should not have been placed in the current location and a more thorough examination of river dynamics should be conducted to ensure that the same mistake is not made;
- reiteration that a no action alternative was not acceptable;
- there are numerous existing down-river installations that have held river migration for longer than 30 years;
- there are existing 75 year-old river revetments that have not been flanked;
- due to river dynamics, it is not possible to implement a river treatment on the west side without maintaining the existing river revetment at River Road;
- it was argued that rip rapping for one pumping plant set the precedent for rip rapping for other pumping plants along the river;
- it was argued that if the river is rip rapped in one location and that is not effective, another location will need to be treated to compensate for the mistake;
- more than likely there will be major shifts of the river upstream within the project life resulting in major changes to the project location – probably to the east side;
- questions were raised regarding impacts of major river migration away from the proposed Ranney System and how that would impact the river connection to the system and Ranney Well yields;
- questions were raised regarding the prediction of river movement with a hard point at River Road; [Note: Current modeling by Eric Larsen was only a "quick prediction," a more accurate modeling effort should be conducted at this point in the project.]

Olen commented that it would be important to know where the river would migrate once the Ranney System was constructed with no change at River Road.

Eric commented that the model was not calibrated with a variable erosion field. He explained that the next modeling effort would include a variable erosion field with the additional run to correct the location of existing rock and include the proposed Ranney System, as well as, the alteration at the State Park and the spur dikes.

More discussions were held regarding in-stream alternatives, environmental documentation and feasibility of actions.

DREDGING

- changing the screen may lead to a dead-end situation and perpetual annual dredging;
- incidental take would be an issue;
- in order to get the volume of water necessary to meet fish screen criteria, the size of the dredged channel would be an unknown if the river keeps moving west;
- the question was raised regarding the dredging costs associated with gravel bar movement if the river goes farther west;

[Note: Eric commented that once his model is calibrated with the variable erosion field, the model can predict an annual rate. He will oversee the calibrations to predict the movement with individual flows. He stated that this has not been done before, however, he would take the responsibility for the effort.]

- questions were raised regarding the gravel bar width and rate of movement at defined intervals with a recommendation for a transport analysis;
- the question was raised regarding how Big Chico Creek impacts the river and the potential to dredge a channel to move the creek flows to the pumps (shortest route);
- the question was raised about the potential of a dredge channel to confuse returning salmon;
- the question was raised concerning the estimate of how much material must be moved to get water to the pumps;
  [Note: Eric was not sure that his modeling would help answer that question, however, it would give some idea how the bank would move.
  Bob commented that Eric's model could help if the results were used to know the bend preformed if you don't put spur dikes in the river and then you assume that the bar will migrate down like a typical point bar (the topography of the bar is known). As the model evolves, the bar, is just shifted down and predicts the impacts to the pumping location.]
- the question was raised concerning the possibility if River Road is not hardened and ultimately the river moves over in 30 to 40 years, what happens to Big Chico Creek;
- the question was raised concerning the possibility of dredging the head of the bar and allowing the river to meet the flow of Big Chico Creek to continue past the pumps

Action Items:

Eric will take pictures at the site and make adjustments to the current modeling effort.

Mike commented that the environmental issues associated with a long-term solution should be given a priority for evaluation.

Bruce commented on the potential sediment issues depending on alignment with the dredge channel and recommended evaluation.

More discussions were held regarding the dredge channel approaches, access to the dredge channels, equipment needs, dredge requirements and re-sedimentation issues, channel widths, initial costs and long-term annual dredging costs, costs associated with changing fish screen criteria, movement and location of dredge materials.

Olen concluded the discussion by stating that it would be necessary to capture the needs assessment of all the alternatives into a proposal to CALFED. He asked the group to discuss assignments for accomplishing this task. Olen commented that DU would take the lead in organizing and preparing the proposal.

The group discussed the information gaps of each alternative and assigned experts to develop a preliminary scope of work to conduct more refined investigations that will lead to a final solution.

Olen moved the discussion to stepping out the process for the next level of decision-making. It was agreed to coordinate with Rebecca to ensure that CALFED science reviews are incorporated into the next steps of the Steering Committee. Olen confirmed that discussions would be held with Rebecca to determine a schedule of meetings and then Olen would circulate the schedule among the committee members. It was also agreed that time is of the essence and that the process needed to move ahead quickly due to the timing of the year and river flows. It was agreed that the deadlines should be established.

It was agreed that the schedule was tentative and may be changed according to the CALFED schedule.

It was agreed that M&T would begin the permit process immediately and those activities would become part of the proposed contract amendment.

Olen explained that under the current contract, the dive report was the trigger requirement to initiate dredging to reduce the gravel bar. It would be necessary to go back to the CALFED Contracts Amendment Subcommittee for approval to change that requirement and begin environmental documentation prior to the dive report. It was agreed that DU should took the lead in preparing the documents for CALFED.

It was agreed that the City of Chico should be brought in throughout the process.

Olen concluded the workshop by thanking everyone for all their hard work to review all the information and commitment to great discussions in trying to determine the best solution.

Workshop Adjourned.

PROCESS

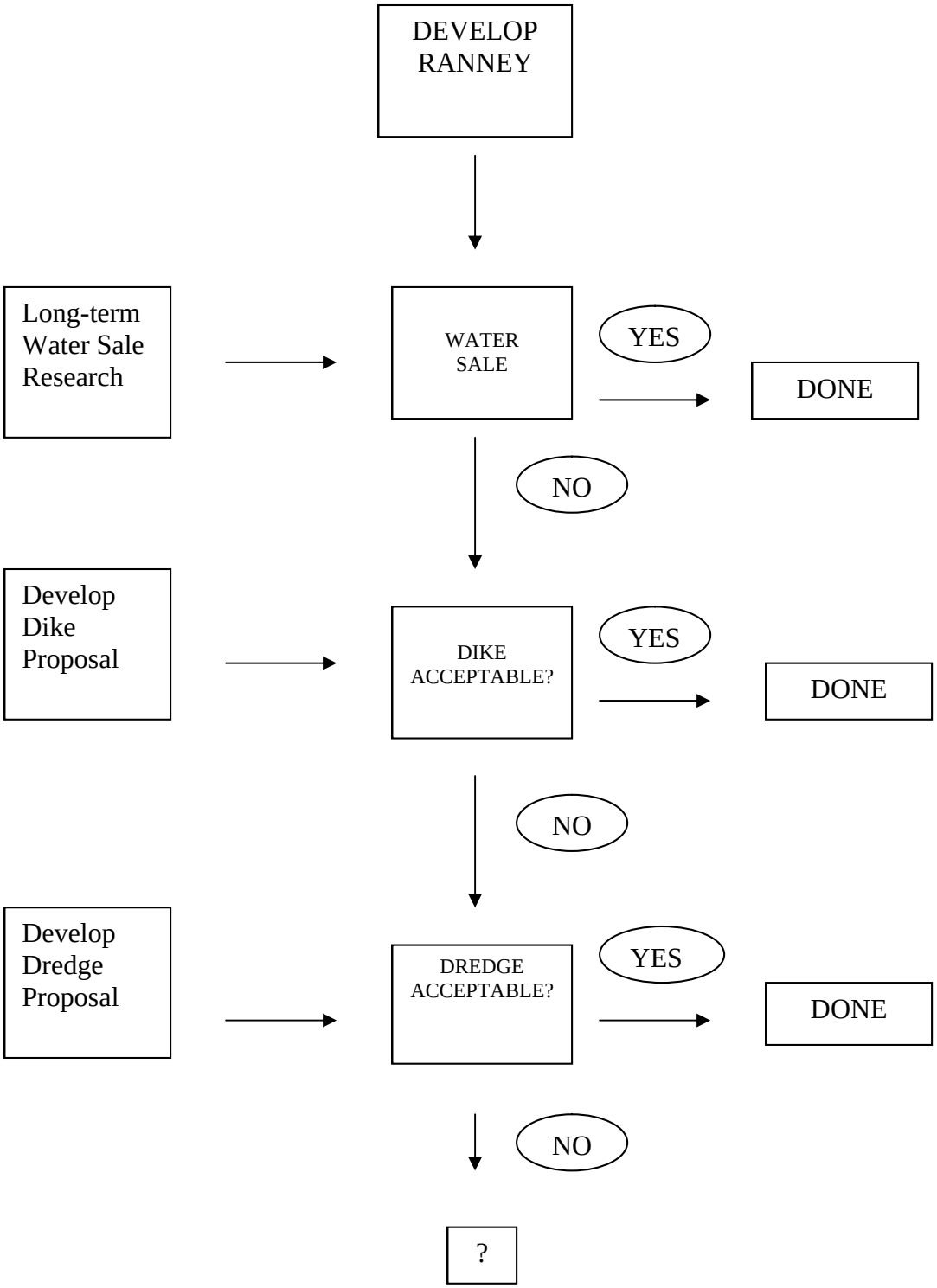
Coordinate proposal components

Scope of Work

Write Proposal / Review

Deadline – March 10

Note: Develop alternatives simultaneously until information/implementation supports elimination.



RANNEY

MWH Americas – Ranney, Inc.

Refine energy / capital costs

- Range of transmissivity(s)
- Power costs (data)
- Refine lift / head loss (configurations)

Recovery / reduce O & M costs

- Water sales
- Water use efficiency / reduce diversion
- Alternate source

Diversion – Quantity

- Timing
- Water year type

Location

Long-term maintenance (refine costs)

Long-term efficiencies

Project life / depreciation schedule

Understand Yield (Where is the river flow? – Eric w/Neil)

Economic Feasibility

- EWP
- EWA
- Finance (lower power $ for environmental?)

  Note: 30-year life expectancy.

WINDROW ROCK (temporary)
Mussetter Engineering

No Engineering

No environmental (policy issues)

- On-bank / EIR/EIS

Reduces river impact

- Buys time – would be removed?

Apex on refuge – Stiles property

Saves $$

May eliminate dredging

City of Chico benefits

Conduct preliminary discussions (Les H. Neil S., Dave S., Kevin F., & Kelley M.)

SPUR DIKES

Mussetter Engineering / Yantao Cui / MWH Americas

Need existing topographics

Model existing conditions

River Road modeling

Model additional “Yantao” dike

Model DS boundary

Frame adaptive management experiment

Environmental feasibility / System-wide (SRCA) – MWH Americas

Physical Model (Preferred)

Priority: Cutoff point when size makes dikes not feasible.

Note: 30-year life expectancy – 600 feet

DREDGING

MWH Americas

Screen criteria relaxation/modification

- Costs (capital / annual)

Incidental Take Permit

Dredging costs (initial / long-term)

- How much material to excavate that will ensure flow to pumps?

Environmental Issues

- Lon-term permitting
- Mining vs. environmental solution

Dredge

- Location
- Access points
- Equipment

Discuss dredging constraints / opportunities

Disposal Issues

Priority: Obtain permits right away.

RIVER MODEL

Eric Larsen

Variable erosion field

1. W/correct rock (re: Ranney)

2. W/alteration at State Parks with dikes

    - Calibrated
    - Variable flow
    - Step yearly intervals (5 years?)
    - Dredging (input to MWH – 5 yr intervals to 50 yrs)

3. Proposal to refine model

    - State Parks
    - Cartoons

PROPOSED SCHEDULE

March 2005	Proposal Due
May 2005	Approval
July 2005	Start (1 year project)
November 2005	Reconvene Steering Committee
December – January 2006	CBDA Discussions
February 2006	Bay-Delta Authority Approval

Action Items:

Permits: M&T – Butte County (Groundwater)

Letter - City of Chico

Change Language in existing Scope of Work to advance environmental documentation and approvals for gravel bar extraction.

Adjourn – Box Lunch