

Navajo Dam EIS Hydrology Committee

June 12, 2000

Attendees:

Rick Cox of Parson's Engineering has replaced Ron Christensen as the San Juan Water Commission representative. Pat Turney represented John Whipple. See attached attendance list for those present.

Low Flow Test:

Reclamation will be conducting a 250 cfs flow test July 10 - 14 to examine impacts to irrigators and habitat between Navajo Dam and Farmington on the San Juan River. A public hearing will be held tonight to review the issues.

Review of Hydrology Runs:

John Simons distributed the model output statistical and depletion summaries for the no-action, 250/5000 cfs, 250-400/5000 cfs and 500/5000 cfs model runs. Flow recommendations are met only by the 250/5000 cfs configuration. These results include all corrections and updates to the model and are posted on the Keller-Bliesner Engineering Website (kelbli.com). Using presently available hydrology and modeling tools, it appears that there is limited opportunity for future water development or flexibility in increases in minimum releases.

Future Model Runs:

The following additional runs were requested:

1. 400 cfs year-around minimum run for power plant impacts.
2. Scheduled depletion run (level of depletion allowed before moving from 500 cfs to 250 cfs minimum)
3. Scheduled depletion run (level of depletion allowed before moving from 250/400 cfs to 250 cfs minimum)
4. Efficiency sensitivity on ALP at 40% and 60% (requested by Jicarilla. Priority to be reviewed by Reclamation)
5. Scheduled depletion run (level of depletion allowed before moving from 400 cfs to 250 cfs minimum)

Later in the meeting it was decided that all runs for Navajo EIS should be based on a configuration with all the ALP diversions and depletions being taken in Colorado. This is to deal with New Mexico's concern that interstate transfers that are described in the ALP EIS are not presently allowed by law. Reclamation will work out this project description and develop the foundation such that it is supportable in the EIS. They will have a version ready by the next meeting.

Mini-Model of the San Juan from Navajo Dam to Farmington:

John Simons presented the concept of developing a small model of the San Juan River from the Navajo Dam to the confluence with the Animas. The model would be driven by Navajo Dam releases and include natural channel losses along the route. Diversions and return flows will be based on acreages irrigated and ground-truthed return flow volumes and locations. Diversions and main spills will be measured during this summer at 500 cfs and during the 250 cfs test. John will lead development of this model. It is anticipated that it would be completed by sometime in September.

Model Review:

As a part of the biological opinion for ALP, FWS is requiring an independent review of the San Juan hydrology in order to sure the accuracy of the model. Reclamation will take the responsibility for this review and coordinate with FWS on results. The review is to be completed in the first of next year.

Review of assignments from past meetings:

Dave Fricke distributed a summary of the comparison of the San Juan model natural flows and those used in CRDSS. The natural flows agree quite well for most stations. There are a few exceptions, mainly in tributaries. The greatest differences occur on Spring Creek, La Plata River and McElmo Creek. In general, however, there is not a large disagreement. Dave will forward there spreadsheet to Brian for closer analysis to assess impact.

There was some discussion of running the model with this natural flow as a sensitivity test, at least for key mainstem gages. The decision was postponed pending model configuration and issue prioritization by Reclamation.

Dave King discussed sensitivity to bypass flow setting. He has completed runs with bypass flows set at calibrated levels and then +10% and -10%. Results are attached. John Simons distributed documents presenting a comparison of the San Juan natural flow input data and those provided in the CRSS consumptive use and loss reports that he and John Whipple reviewed. The review focused on the non-ag depletions, the largest of which is Navajo Reservoir evaporation. Since these values affect both natural flow and model, the net affect to mainstem modeling is small. It was decided that no changes would be made to the current model to address the differences, but that values would be corrected if and when natural flows are re-computed

Natural Flow Assessment and Model Enhancement:

Given the number of concerns with the nature of the natural flows and the way the model must handle historic flows to match the natural flow process, some feel that it is important to update and improve the natural flow calculations. Since CRDSS natural flows are well documented, this would be a possible starting point. John presented a series of steps that would be necessary to recompute the natural flows and update the model. A discussion concerning scope, schedule and budget ensued. It was decided that the committee needed to work out the approach to take and the tasks to be completed, along with any optional approaches that may be acceptable but less costly, before the scope, schedule and budget could be completed. John Simons will draft and circulate a list of tasks to complete the work for all to review and comment upon. This will be edited with comments included and a meeting held on July 31-Aug 1 to work out the approach. Presently there is a relatively broad range of opinion on what should be done. The discussion needs to be well focused and well developed, for which there was inadequate time at this meeting. The long-term objective of the model must be well defined to best set the framework. Reclamation will review these issues and establish their view of what they need in terms of an operational and planning model that may be complimentary to the requirements of the RIP.

Schedule:

Model runs cannot be completed until Reclamation provides a configuration of ALP with all-Colorado depletions as this will be the base configuration. It will take about 2 weeks to complete model runs after receipt of the configuration. The new configuration is expected on or before July 31.

In the intervening time, the small model of the river below Navajo dam will be developed and tested. Completion is expected by some time in September. Field data will be collected during the low-flow test July 10-14 as well as at 500 cfs either before or after the 250 cfs test.

Model documentation will proceed but has been delayed for the completion of ALP hydrology for the EIS. A number felt it was important to proceed even if the model is modified in the future to document the process used for ALP. Reclamation is examining priorities for completion of this work along with the other tasks. The present schedule calls for completion of a revised outline for review by the group and then completion of the documentation by October, 2000. The next meeting was scheduled for 1:00 - 5:00 pm, July 31 and 8:00 am - 3:00 pm on August 1 in Farmington, NM.

Hydrology Group Meeting Attendees - 6/12/00

| Name | Organization | Telephone | e-Mail |
|-------------------|--|------------------------------|----------------------------------|
| Dave King | BOR-TSC | 303-445-2471 | dking@do.usbr.gov |
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| C. Nancy LaMascus | City of Farmington | 505-324-0738 | nlamascus@fmtl.org |
| Ernie Teller | BIA-NIIP | 505-325-1864 | eteller@cyberport.com |
| Dick Kreiner | Corps. of Engineers - Albuquerque | 505-342-3383 | richard.d.kreiner@usace.army.mil |
| Rick J. Cox | San Juan Water Com. | 801-553-3308 | rick.cox@parsons.com |
| Dave Frick | Ayres Associates | 970-223-5556 | dfrick@ayresfc.com |
| John Simons | BOR-Durango | 970-385-6571 | jsimons@uc.usbr.gov |
| Tom Pitts | Water Consultant for San Juan Water Comm. | 970-667-8690 | h2orus@waterconsult.com |
| Brent Uilenberg | USBR | 970-248-0641 | builenberg@uc.usbr.gov |
| Ed Warner | USBR | 970-248-0654 | EWARWCR@uc.usbr.gov |
| Steve Harris | SWCD | 970-259-5322 | scharris@frontier.net |
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| Susan Jordan | Nordhaus Law Firm for Jicarilla Apache Tr. | 505-982-3622 303-866-3441 | sjordan@nordhauslaw.com |
| Randy Seaholm | CWCB | x314 | randy.seaholm@state.co.us |
| Ray Alvarado | CWCB | 303-986-3441 x307 | ray.Alvarado@state.co.us |
| Jack Utter | Nav. Nat. | 520-729-4004 | |
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| Mike Hamman | Jicarilla Apache Tribe | 505-983-7694 | mhamman@dellnet.com |
| Bill Miller | WJMENG, Inc./PNM | 505-827-6160 | wjmiller@trail.com |
| Patricia Turney | NMISC | 505-827-6160 | pturney@seo.state.mn.us |

San Juan RIP Naturalized Flows

Recommendations For Addressing Problems

June 14, 2000

Background:

Development of a San Juan River Basin hydrology model to be used in developing flow recommendations and analyzing impacts of water development on the ability of the system to meet the flow recommendations was begun in 1996. It was necessary to complete the model by December 1997 to complete the flow recommendations in 1998. Reclamation developed natural flow estimates existed for 1970-93 at 23 gages in the San Juan Basin (special study) and at 2 gages from 1906-1985 (Colorado River Storage System (CRSS)). These flows were developed using consistent techniques although not entirely consistent input data. It was thought at the time that these flows would be the most appropriate to use because of the long history of their use. Therefore, Reclamation natural flow estimates for the period 1929 - 1993 were utilized.

Several problems were identified with the naturalized flows during the decision model process. Prior to 1970, the natural flow estimates were only available for the San Juan River at Archuleta, NM and near Bluff, UT, for which a spatial dis-aggregation was employed to provide flow at the other required points. The pre-1970 process was not well documented and some problems existed in completing the McElmo Basin, complicated by imports from the Dolores River. In addition, the method used for estimating shortages in water-short drainages has limitations and the handling of return flows followed methods developed prior to the use of computer models, whereby return flow lagging was not considered. Even though these were identified as problems, it was felt that the accuracy would be sufficient for the immediate purpose of developing flow recommendations and assessing impacts. In the process of model development and implementation several other problems have been discovered and the implications of the previously identified limitations better understood. The following problems have been identified:

- Type I shortage computations are difficult to replicate and may not accurately reflect true shortages.
- Some areas which should have been shorted were not, especially in the New Mexico portion of the La Plata Drainage.
- Use of data inconsistent with the consumptive use and losses (CU&L) studies was used in the 1970-93 period, particularly New Mexico non irrigation data.
- Net reservoir evaporation procedures use a constant rate from year to year for each month, resulting in estimating errors.
- Return flows are not lagged, resulting in flow timing errors.
- Large unexplainable losses in some reaches resulting from gage error underestimate flows in some critical months.
- The lack of documentation on off-stream depletions makes their inclusion difficult to represent, with either under or over estimation of available flows depending on assumptions used, with no way of resolving the uncertainty.
- Depletion sources are unknown in some of the CRSS data set prior to 1970.
- Numerous adjustments in the natural flows are presently employed in the San Juan RiverWare model to correct for known deficiencies, making

documentation and tracking difficult.

- The need to handle future projects appropriately results in configuration inconsistencies between the natural flow estimation process and the San Juan model in some cases, for which corrections and approximations are necessary for calibration.

Planned future development has now reached the level that a more accurate representation of natural flows and the assumptions behind them are necessary to assess with accuracy the ability to meet natural flows at increasing levels of development. Furthermore, a more accurate assessment tool is needed as the flow recommendations are reviewed through the adaptive management process. This proposal outlines an approach to correct the deficiencies in the natural flow process and to incorporate into the San Juan model more appropriate approaches to issues such as shortage assessment, lagged return flows and reservoir evaporation, made possible by improvements in the natural flow estimation process.

Coordination with Other Reclamation Processes:

Given the use of natural flows in the CRSS modeling process, it was originally thought that the CRSS and CU&L teams would be interested in participating in this activity. However, Reclamation CRSS and CU&L personnel have stated that Type I shortages will be used until the states provide an alternative method that is applicable and acceptable to the entire upper basin of Colorado. Reclamation operating personnel do not wish to change reservoir calculation procedures at this time. Reclamation has stated that the existing naturalized flows will be used for ALP SEIS and Navajo Reservoir Operation EIS because they were the best available data at the time of the respective analyses. These positions do not preclude an improved process for use in the San Juan Basin, with future potential benefits to these other programs if acceptance by other participants is gained. It appears, therefore, that the SJRIP Hydrology Committee, if formally approved, may need to explore other funding options if this is a recommended course for the SJRIP

Objectives:

Review of the modeling process over the past four years by the ad-hoc hydrology group has indicated discomfort by some members in the modeling process, approach and results. Many of the concerns deal with modeling approached taken to replicate the calculations made in estimated natural flows and documentation of processes. Addressing natural flows must, therefore, address the concerns of the group.

Furthermore, identification of more flexibility in the water supply is desirable, including an allowance for further development while meeting the flow recommendations. While development of improved estimates of natural flows is no guarantee of an increased water supply, it will certainly increase the confidence in the estimates made.

To address these concerns and provide for better buy-in by the stake holders, the following objectives are proposed:

- Improve confidence in model results through improved data consistency, quality, exchange, maintenance, and management.
- Provide review and input from stakeholders during the development process.
- Incorporate existing data (Colorado Decision Support System (CDSS), State, Tribal and Federal Agency data) to the maximum extent possible.

- Provide a cleaner process with more straightforward documentation that is understandable to a broader audience.
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Approach Options:

Three options have been examined for redefining natural flows in the San Juan Basin. They are:

- Use existing CDSS natural flows without modification and reconfigure the model to match methodologies employed.
- Recompute naturalized flows to address known problems and meet objectives and reconfigure the model to accommodate the changes.
- Blending options 1 and 2.

Option 1. Implementation of option 1 would require reconfiguration of the San Juan model to match the approach utilized in CDSS. Adoption of the CDSS model is also possible, but would require extensive modification to CDSS to incorporate fish rules and operate on a daily time step for certain functions (reservoir releases and ALP pumping limits). Since RiverWare includes these features presently and can handle issues such as return flow lagging similar to CDSS, it is deemed more appropriate to continue with RiverWare. The model would require reconstruction to match RiverWare nodes, inclusion of shortage rules and return flow lagging would be required, although these features are needed regardless of the option selected.

The CDSS natural flow process and resulting flows have been reviewed in some detail. While some minor corrections are necessary to deal with gage error which would be required in any process, the values and approach seem reasonable. Some unresolved issues exist that must be addressed dealing with matching of gage flows in the calibration, but they do not appear to be difficult to overcome.

The biggest limitation to the CDSS natural flows are the basis of the data in New Mexico. Since the flows are based on data Reclamation is presently using, corrections would be required to incorporate New Mexico concerns in the process.

With these limitations, Option 1 will not address all the objectives as a stand-alone approach

Option 2. Implementation of option 2 will require several steps, since the existing data varies depending on time period. The following steps are envisioned:

- Correction of the 1970-1993 database to address concerns of the stake holders
- Extension of the database back to 1929. This would involve locating as much CRSS data as possible and supplementing as required.
- Add return flow lagging and a process for computing shortages within the natural flow model.
- Analyze gage errors and adjust accordingly.
- Fill and extend data records as required.
- Create a data storage, analysis and retrieval system with appropriate analysis and extraction tools to improve data maintenance capabilities.
- Create a consolidated model to compute naturalized flows. This may actually be implemented in RiverWare.
- Update the San Juan Basin RiverWare simulation model to address the techniques employed in the natural flow model (e.g. return flow lagging, new evaporation estimates, appropriate shortage computation, etc.)

While option 2 addresses all objectives, it is not the most efficient approach, in that it does not rely on the extensive database utilized in the CDSS natural flows. A significant savings in time and cost could be achieved by utilizing the best of the CDSS information and approach, with improvement in the areas where there may still be deficiencies. Therefore, Option 3, the hybrid approach, is the recommended course of action.

Recommended Approach:

Combining the first two options will require the following tasks:

- Evaluate CDSS database, approach and documentation and develop interface approach. (It may be possible and expedient to use CDSS as the natural flow generator, with improved data for the non-Colorado demands).
- Develop data storage, analysis and retrieval system, including an interface to CDSS database (This could also be incorporated into the CDSS structure to allow database sharing with CDSS).
- Correct 1970-1993 database to address concerns.
- Extend data sets that does not exist to 1929. Utilize CDSS data where appropriate.
- Extend data sets forward through WY2000
- Analyze gage errors and correct gage record as required for reasonable water balance.
- Create a consolidated model to compute naturalized flows. This could be CDSS, RiverWare or another model construction. First priority should be on using CDSS to simplify implementation and allow consistency with Colorado modeling.
- Evaluate disaggregation of monthly to daily flows to establish the appropriate approach for modeling and implement the disaggregation procedure. (This could be the process used presently for post-processing the model, or could be incorporated into the natural flows and modeled as pseudo-daily flows. Only flows downstream of Navajo dam will be analyzed on a pseudo-daily basis.)
- Update the San Juan Basin RiverWare simulation model to address the techniques employed in the natural flow model (e.g. return flow lagging, new evaporation estimates, appropriate shortage computation, etc.)
- Coordinate development with stake-holders.
- Develop complete documentation.

Data consistency between CRSS, CDSS, CU&L, and SJRIP data sets will be attempted to the extent possible. Any deviations will be documented

Schedule and Cost:

Research funds are being used to improve RiverWare's ability to predict diversion response to water supply, to add recognition of lagging to downstream demand computations to RiverWare, to design a data centered system, and to implement a prototype of a data centered system. CRSS personnel will assist in location of pre 1970 CRSS data. Funding sources have to be determined for remaining work.

Some work may be most appropriately handled by consultants or other agencies with specific experience with certain data sets. For example, the state of Colorado or a designated consultant familiar with CDSS may be appropriate for inclusion and use of the CDSS database, and possibly the full model in the natural flow estimation process. An independent consultant could be retained to analyze and correct gage records. Daily dis-aggregation may be most efficiently handled by the consultant that has developed the approach presently used and is familiar with the data. Therefore, a team approach is envisioned with the involvement of several individuals to accomplish the work. The approach has proven to be effective in the past and is recommended here.

Table 1 tabulates the estimated man power, cost and schedule expected to complete the study. Some savings will result if the CDSS database and model can be used rather than development of a new stand-alone system, but the amount of savings cannot be determined until the system is better understood. This would also shift cost and time from Reclamation to a consultant or state agency.

The schedule shown assumes funding in FY2001, with work beginning October 1. Completion is expected to take one year.

Table 1. Estimated schedule, labor requirement and cost for completion of natural flow analysis and model development

| | Task Expected Schedule | --Professional time - Man-days -- | | | -----Estimated Cost----- | | |
|---------------------------------------|---------------------------|-----------------------------------|------------|-------|--------------------------|----------|---------|
| | | Reclamation | Consultant | Total | Labor | Expenses | Total |
| a. CDSS interface | Nov-00 | 5 | 30 | 35 | 24,500 | 1,000 | 25,500 |
| b. Data system development | Jan-00 | 55 | 20 | 75 | 52,500 | 1,000 | 53,500 |
| c. Correct 1970-1993 database | Mar-01 | 20 | 20 | 40 | 28,000 | 1,000 | 29,000 |
| d. Extend data sets to 1929 | Apr-01 | 55 | 20 | 75 | 52,500 | 1,000 | 53,500 |
| e. Extend data sets from 1993 - 2000 | May-01 | 20 | 10 | 30 | 21,000 | 500 | 21,500 |
| f. Analyze and correct gage errors. | Nov-00 | | 15 | 15 | 10,500 | | 10,500 |
| g. Create natural flow model | Jun-01 | 55 | 20 | 75 | 52,500 | 5,000 | 57,500 |
| h. Daily disaggregation | Aug-01 | 5 | 25 | 30 | 21,000 | 1,000 | 22,000 |
| i. San Juan Model upgrade/calibration | Aug-01 | 50 | 40 | 90 | 63,000 | 4,000 | 67,000 |
| j. Coordination with stakeholders | Throughout | 10 | 10 | 20 | 14,000 | 3,000 | 17,000 |
| k. Develop complete documentation. | 1-Oct | 30 | 30 | 60 | 42,000 | 1,000 | 43,000 |
| | Total | 305 | 240 | 545 | 381,500 | 18,500 | 400,000 |