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STORAGE DISCUSSION
January 23, 1997

1. WHY DEVELOP STORAGE?

Storage is a way of turning water which has low value -- or even negative value -- into water of high value. Thus, storage can be used to:

- Attenuate flood flows.
- Capture flows during periods when the environmental impacts of the diversions are low for later use by the economy or the environment.
- Divert water when the entrainment impacts are relatively low for later user by the economy or to allow reductions in diversions when entrainment impacts are high.
- Improve water quality

2. STORAGE CHARACTERISTICS

CALFED is looking at different types of storage in different areas. By area:

- Sacramento Valley

  - Onstream storage. Onstream storage can be filled quickly and discharged easily. It is highly versatile and can be operated to provide environmental water, out-of-stream supplies, flood control, temperature control, and hydropower. An example would be possible enlargement of Shasta Reservoir. Enlargement of Shasta would allow for greater regulation of the Sacramento River for all the purposes mentioned. Of particular importance would be a larger cold water reservoir for protection of winter run salmon, and increased carryover storage for use during drought.

  - Offstream surface storage. Offstream storage has operational limitations compared to onstream storage. The rate at which it can fill and empty is limited by the capacity of its intakes. Also, there can be entrainment problems when water is diverted to fill the storage and temperature or water quality problems when it is emptied. However, Sacramento Valley offstream storage would be operated to avoid or minimize these problems. To give an example, Sites Reservoir could be filled during periods when salmon entrainment is not a problem (e.g., during periods of high flow). The stored water could then be used to supply western Sacramento Valley agriculture the following summer. This mode of operation would reduce agricultural diversions off the Sacramento River during periods critical for salmon and allow more water to be held upstream behind Shasta dam. Thus, Sites Reservoir would provide entrainment, yield, temperature, and hydropower benefits.

  - Groundwater storage. Groundwater storage is a form of offstream storage and has

characteristics similar to those described above. However, the integration of groundwater into the water system would be more complex in the Sacramento Valley for several reasons:

- Groundwater-surface water interactions. Groundwater in the Sacramento Valley cannot be treated in isolation. If water is placed into storage under the ground, it may have the effect of reducing natural recharge from the rivers. If so, then actual amounts of new storage are lower than they might seem. Conversely, if water is taken from groundwater to supply uses, this may accelerate the rate at which recharge takes place, reducing instream flows and reducing the actual benefit. Groundwater-surface water effects are most evident where groundwater is close to the surface such as the Sacramento Valley. The effect is less of a factor in areas where groundwater tables have been lowered, such as in much of the San Joaquin Valley.
- Local impacts. Since groundwater is a common pool with many users, the use of groundwater on a large scale can have impacts on other users as groundwater tables are drawn down and filled up.

- San Joaquin Valley Upstream of the Delta.

  - Onstream storage. The operation of onstream storage in the San Joaquin tributaries would be very similar to the use of onstream storage on the Sacramento River. Water would be captured during periods of surplus flow for other purposes, including greater deliveries to water users and increased environmental flows during critical periods. An example would be the possible enlargement of Friant Dam on the mainstem San Joaquin River.

  - Offstream surface storage. Several sites are available in the Sierra foothills. The reservoirs would divert water from the San Joaquin tributaries during periods of surplus flow for use during critical periods. An example is Montgomery Reservoir. Montgomery would divert water from the Merced or Tuolumne Rivers for rerelease at a later time. Unlike Sites Reservoir on the Sacramento River, Montgomery would not help with entrainment problems. It would, however, generate more water for use by water users or the environment.

  - Groundwater storage. Some areas of the San Joaquin tributary areas have high water tables and a great deal of surface-groundwater interaction. In these areas, groundwater storage is possible, but complex. However, there are a large number of areas where groundwater overdrafts have created large empty areas which can be used to store groundwater. An example is the Stockton East Water District. In these areas, groundwater storage can be treated like offstream storage. However, the rates at which water can be moved in and out of the ground are relatively low compared to surface storage. This implies a need to operate groundwater and surface water storage in tandem.

- Off Aqueduct Storage

  - Onstream storage. Natural runoff is very low along west side of the San Joaquin Valley. There are no opportunities for significant onstream storage there.

  - Off aqueduct surface storage. There are a number of possible offstream storage sites in the export aqueduct area. The proposal which has received the most attention and study is the proposed Los Banos Reservoir site. Los Banos would be filled via the state and federal export canals during low impact and high flow periods. The stored water would then be used for one of the following purposes: (1) increased supplies for export agriculture and export urban areas; (2) decreased exports during period of high environmental sensitivity; (3) San Joaquin Valley wetlands; (4) increased San Joaquin River flows (via release at the Mendota Pool); (5) improved water quality in the export areas; and (6) increased security against major outages in the Delta.

  - Groundwater storage. There are large areas in the western San Joaquin Valley where groundwater overdrafts have created large empty areas which can be used to store groundwater. There are also extensive areas where groundwater percolation rates are high (e.g., the Kern fan). Thus, there is a great opportunity for groundwater storage in this area, whether through conjunctive use or direct recharge. The major constraints are (1) the ability of the export canals to move water to the areas with groundwater storage potential; and (2) limits on the ability of local distribution systems to allow in lieu conjunctive use. Groundwater storage would be used in the same way that off aqueduct storage would be used. However, the generally lower rates of deposition and withdrawal would mean groundwater storage would work best in tandem with surface storage. For example, without dedicated offstream storage to act as a forebay, water may be unavailable during large parts of the year to deposit into the Kern Fan. When water is available, the groundwater may not be able to absorb the available water fast enough to fill up. Similarly, it may not be possible to extract groundwater fast enough to meet demands during peak periods without surface storage as a backup.

- Near Delta storage.

  Offstream storage. Near-Delta storage is a form of off-aqueduct storage, but it has some special characteristics. By near-Delta storage, we mean storage which can draw water directly out of the Delta, but delivers that storage directly to the export system. Near Delta storage has one major advantage over off aqueduct storage farther south. Because near-Delta storage can draw directly from the Delta, it can be filled more easily during high flow and low impact periods. That is, the storage is not dependant upon using surplus capacity in the export canals.

WHY IS STORAGE IN EVERY CALFED ALTERNATIVE?

The IDT recommended that up to 5 MAF of storage be considered in each of the three alternatives. There are a number of reasons for this conclusion:

- o Sometimes there is no acceptable substitute to storage. For example, major changes in diversion patterns to reduce entrainment are very difficult to achieve without increased local storage. Thus, Sites or some other local reservoir is needed if diversion patterns in the western Sacramento Valley are to be shifted to reduce entrainment. Similarly, without new offstream storage in the export areas, it will be very difficult to make additional shifts in export patterns to reduce the impacts of the export pumps.
- o Storage provides operational benefits for environmental flows. Many environmental needs exist in real time. Water must be released at a certain time with little notice. Diversions must be reduced due to the presence of fish. The existence of real environmental water to deal with these needs greatly simplifies meeting these needs.
- o Storage is an assurance issue. Without new storage, what happens during the next drought? The fear of many is that unacceptable amounts of water would be extracted either from the environment or from agriculture to meet urban needs. New storage reduces the stress on the system.
- o Alternatives exist to storage in some cases, but the degree to which these alternatives can replace storage is unclear. Water transfers and water efficiency measures can provide similar benefits to storage in many cases. For example, efficiency measures on the west side of the Sacramento Valley can reduce diversions from the river and thereby reduce entrainment. Water to meet at least some of the ERPP flows can probably be acquired on the market. The IDT recommended that implementation of these kinds of measures should be maximized, thereby minimizing the need for new storage. However, at present, it is unclear just what the potential is from these measures. Active water markets do not yet exist in California. Moreover, it is unclear whether all needed water can be met through markets without causing unacceptable local impacts. CALFED has already ruled out the option of pursuing major land fallowing programs in order to allow reduction in diversions and shifts in diversion patterns.
- o The IDT recommendation for storage represented a maximum volume for planning purposes, not a storage target. It is important to understand that the IDT storage figures represented the maximum amount of storage that should remain under consideration. The IDT did not represent that this level of storage is absolutely necessary for a successful CALFED program. The actual level of storage will be a function of: (1) how badly the storage is needed to meet CALFED goals; (2) support for or opposition to the storage; and (3) the ability to fund the storage.

PHASING/ SEQUENCING ALTERNATIVES

It may be possible to sequence the development of storage in order to assure that the appropriate amount of storage is ultimately developed. The following is an example of how such a sequence might proceed:

1. Acquire easements to all sites that might be needed in the future for storage.
2. Develop storage to meet needs that cannot reasonably be met without storage. For

example, Sites Reservoir might be constructed because it is a prerequisite to greatly reducing salmon entrainment problems on the Sacramento River. If alternatives 1 or 2 are chosen, maximize export area groundwater storage and either enlarge Los Vaqueros Reservoir or build Los Banos Reservoir in order to allow for significant shifts in export diversion patterns.

3. Set reasonable limits on the transferability of water in order to protect local areas. These limits could be monetary (a water tax that becomes more severe as more water is moved out of a local area) or physical (only a certain percentage of water may leave one area).
4. If additional water needs remain, pursue acquisition of additional storage, either immediately or in the future.