

7.0 DEVELOPMENT OF INITIAL ALTERNATIVE CONCEPTS

Initial alternatives are formulated using retained resource management measures. During the development of the initial alternatives, different strategies to address the primary planning objectives, constraints, and criteria will be explored. This section will further review the measures retained in Section 6 and develop a strategy for developing a range of initial alternatives that will be used in the next stage of planning.

7.1 STRATEGY FOR DEVELOPMENT OF INITIAL ACTION ALTERNATIVES

The strategy of this section is to identify how potential action alternatives will be developed using the range of retained measures that fully address the primary planning objectives and, to the extent possible, the secondary planning objectives.

To facilitate the development of initial action alternatives for the NODOS investigation, three project formulation elements will be combined. First, retained measures from the screening described in Section 6 of this IAIR will be combined to achieve planning objectives. With one remaining surface storage measure, a groundwater measure¹, and five anadromous fish survival measures, alternatives could include anywhere between one and seven measures. Second, the operational benefit mix of alternatives must be identified. Water supply and reliability can provide operational benefits for agriculture, municipal and industrial, and environmental uses. Beyond these traditional categories, CALFED has identified more specific needs, including Delta water quality, the Environmental Water Account, and new instream flows, to support restoration associated with specific streams. Selecting and prioritizing the supply, reliability, and operational elements for a NODOS project is part of the ongoing plan formulation for this investigation. The types of operations selected will significantly affect not only operation of NODOS, but the CVP, SWP and local systems as well. The third major element to refine for the Sites Reservoir measure (with or without a groundwater measure) in this initial alternative phase is conveyance. The NODOS Investigation has considered a range of sources, diversion locations, and capacities. Source, diversion location, and capacity will affect both environmental effects and the efficiency of providing specific benefits.

Each of the three formulation element categories (measures, operations, and conveyance) can generate numerous alternatives. The one offstream surface storage and five anadromous fish survival measures can be combined to determine the best combinations of measures to meet the planning objectives. To facilitate understanding of formulating alternatives for NODOS, this report will describe three illustrative initial alternatives. These three are obviously not comprehensive, but the alternatives were chosen to illustrate the formulation decisions that lie ahead for the investigation.

As a result of the initial screening of the three potential offstream storage sites in Section 6, Sites Reservoir is carried forward as the surface storage measure that addresses the NODOS Investigation primary objectives of increasing water supply, water supply reliability, operational flexibility, and anadromous fish survival. In addition, development of groundwater storage downstream of Shasta Dam has been retained as a general measure for inclusion in initial alternative formulation. In the PFR, the study team will refine this measure so that a more specific assessment of this measure's ability to meet NODOS objectives can be made. This section will focus on combining the Sites Reservoir measure and/or the groundwater storage measure with other measures retained earlier in the initial screening process that further address the primary objective of anadromous fish survival. In addition, conveyance features will be added to the Sites Reservoir package and possibly the groundwater measure. The

¹ Specific groundwater measure(s) have not yet been identified, but will be identified in the plan formulation phase.

measures will be coupled with different conveyance types and operational scenarios to create initial action alternatives that will satisfy all the primary objectives. This will facilitate analysis of the benefits and costs for alternative plans formulated in the PFR.

Conveyance types or methods involve (1) using existing canals and associated infrastructure, (2) a new pipeline and intake from the Sacramento River, (3) a new pipeline or canal from Black Butte Afterbay to TC Canal (referred to as “Stony Creek”), (4) a new Colusa Basin Drain pipeline, (5) conveyance to and from a groundwater storage measure, and (6) a combination of the above. Existing versus new facilities, as well as sizing (capacity), will be investigated with respect to meeting the primary objectives of NODOS in the Plan Formulation phase. For this IAIR, conveyance costs are not included because complete alternatives were not developed. The plan formulation study will develop complete alternatives and include conveyance costs as part of each plan.

The combination of operations, measures, and conveyance together provide a stable base to perform an analysis of benefits. The combination of measures, conveyance, and system operations will significantly determine the total benefit available for an offstream surface storage facility. NODOS can be managed with an emphasis on water quality, the environment, and/or water supply. Depending on how NODOS and the system are operated, different combinations of measures and conveyance will yield different benefits. The Plan Formulation phase will analyze integrating NODOS operations into the existing system as an integral part of the alternatives analysis.

Subsequent sections begin with a recap of the measures retained and packaged with the Sites Reservoir measure and groundwater storage measure, followed by discussions of the conveyance types and preliminary modeling studies of conceptual operation scenarios. Finally, three illustrative initial alternatives are identified and the No-Action alternative is described.

7.2 RETAINED RESOURCE MANAGEMENT MEASURES

To recap previous sections of this IAIR, the primary planning objectives for the NODOS Investigation are:

- ❖ Increasing water supplies, water supply reliability, and Sacramento Valley water management flexibility for agricultural, M&I, and environmental purposes, including CALFED programs such as Delta water quality, EWA, and ERP, to help meet California’s current and future water demands, with a focus on offstream storage; and
- ❖ Increasing the survival of anadromous fish populations in the Sacramento River during critical fish migration periods by affecting flow, passage, habitat, and water quality as well as the health and survivability of other aquatic species.

The secondary objectives are:

- ❖ Providing ancillary hydropower generations benefits to the statewide power grid;
- ❖ Developing additional recreational opportunities in the study area; and
- ❖ Providing incremental flood control storage to support major northern California flood control reservoirs.

The measures listed in Table 7-1 were retained following the screening described in Section 6. They will be screened further and used to develop initial alternatives.

**Table 7-1
Summary of Measures Retained Through Screening Process**

Measure	Primary Objective: Water Supply & Reliability	Primary Objective: Anadromous Fish Survivability	Secondary Objective: Hydropower (Ancillary Benefits)	Secondary Objective: Recreation Potential	Secondary Objective: Incremental Flood Control Storage
Construct new conservation offstream surface storage at the Sites Reservoir site	☑	☑	☑	☑	☑
Develop groundwater storage near the Sacramento River, downstream from Shasta Dam	☑	☑			
Restore abandoned gravel mines along the Sacramento River		☑			
Construct instream aquatic habitat downstream from Keswick Dam		☑			
Replenish spawning gravel in the Sacramento River		☑			
Improve fish passage at RBDD		☑			

As illustrated in Table 7-2, Sites Reservoir can satisfactorily provide benefits for the elements of the planning objectives, with the exception of the habitat element of anadromous fish survival. Based on the ability of Sites Reservoir to address the elements of the primary and secondary objectives, it may be considered a standalone project. However, additional measures could be incorporated to improve the habitat element of the anadromous fish survival objective.

7.3 CONVEYANCE METHODS FOR INITIAL ALTERNATIVES

A second important project formulation element associated with a NODOS action alternative is conveyance. Since Sites Reservoir is offstream, both water sources and conveyance will be required. The NODOS Investigation team has studied a number of source and conveyance options that could provide water supply for storage in Sites Reservoir. Operations, engineering, and environmental studies associated with the conveyance options are ongoing. Potential sources include the Sacramento River, Stony Creek, and Colusa Basin Drain. All conveyance options will deliver water to Funks Reservoir, which will act as a forebay to Sites Reservoir. Funks Reservoir is currently used as a regulating reservoir on the Tehama-Colusa Canal. The range of conveyance options are identified below, and are organized by source:

Sacramento River:

- ❖ Existing or expansion of TC Canal;
- ❖ Existing or expansion of Glenn-Colusa Irrigation District Main Canal; and
- ❖ New pipeline from opposite Moulton Weir.

Stony Creek:

- ❖ New pipeline or canal from Black Butte Afterbay to TC Canal.

Colusa Basin Drain:

- ❖ New pipeline in the same alignment as the Sacramento River new pipeline.

Each option above has a range of conveyance capacities so that the conveyance package selected could include anywhere from one to five of the options described. Conceptually, each conveyance option also possesses unique characteristics in its ability to provide the range of benefits and project objectives that will be described in the following section. Ultimately, an assessment of costs, benefits, and environmental effects will determine the selection of conveyance options for the Sites Reservoir project formulation.

Groundwater conveyance to and/or from a groundwater storage facility is yet to be identified. Groundwater storage sites will be evaluated in detail when the Common Assumptions Feasibility Module is developed and groundwater storage can be more fully studied and evaluated. During the plan formulation phase, studies will focus on identification of local and regional alternatives that would be acceptable to local partnerships, and would meet the NODOS objectives either conjunctively with Sites Reservoir or as a groundwater alternative without surface storage. For this report, it is assumed that groundwater storage will connect to the Sacramento River either to fill the groundwater storage and/or to release water from groundwater storage.

7.4 OPERATIONS/BENEFITS SCENARIOS

The next step in the planning process is to define a specific set of operational objectives to formulate detailed alternatives. The alternatives will be evaluated with CALSIM II, the water resources system operations model developed jointly and used by DWR and Reclamation, and DSM2, the Delta hydrodynamics and water quality model developed by DWR. The NODOS Investigation team has developed and completed preliminary operations studies of four conceptual scenarios based on general operational objectives to estimate the potential benefits of NODOS surface storage only. The four conceptual operations scenarios meet all of the four operational objectives: (1) increasing water supply and water supply reliability for the Sacramento Valley and statewide, (2) improving Delta water quality, (3) contributing to the CALFED Ecosystem Restoration Program objectives, and (4) providing storage and water supply for the EWA. However, each scenario has a different emphasis and priority in meeting each of the objectives.

Preliminary CALSIM II modeling results of the four conceptual operations scenarios showed that NODOS has the potential to provide an average annual total water supply benefit of 310 to 470 TAF/year over the long term and 315 to 440 TAF/year during the driest periods. The total water supply is the quantity of water that can be used toward meeting all of the above objectives. The quantity of water provided for the objectives varies, depending on the priority given to each objective.

7.5 NODOS INITIAL ACTION ALTERNATIVE CONFIGURATIONS

Table 7-3 lays out three initial action alternatives, each with a specified operations focus along with a configuration of the elements discussed above. It must be emphasized that these three action alternatives are just an illustrative range for alternative formulation.

Table 7-2
Ability of Retained Measures to Address Elements of the Planning Objectives

Measure	Water Supply and Reliability							Anadromous Fish Survival					Hydropower	Recreation	Incremental Flood Control
	Water Supply	Supply Reliability	Operational Flexibility	Delta Water Quality	Environmental Water Account	Ecosystem Restoration Program	Focus on Off-Stream Storage	Flow (volume, timing and location)	Fish Passage (amount of flow and location)	Habitat	Water Quality (temp and flow)	Benefits to Other Aquatic Species			
Construct new conservation offstream surface storage at the Sites Reservoir	H	H	H	H	H	H	H	H	H	L	H	M	M	H	H
Develop groundwater storage near the Sacramento River, downstream from Shasta Dam	M	M	M	L	H	H	H	M	M	L	L	L	L	L	L
Restore abandoned gravel mines along the Sacramento River	L	L	L	L	L	H	NA	L	L	H	L	H	L	L	NA
Construct instream aquatic habitat downstream from Keswick Dam	L	L	L	L	L	H	NA	L	L	H	L	H	L	L	NA
Replenish spawning gravel in the Sacramento River	L	L	L	L	L	H	NA	L	L	H	L	H	L	L	NA
Improve fish passage at Red Bluff Diversion Dam	L	L	L	L	L	H	NA	L	H	M	M	H	L	L	NA

H = high
 L = low
 M = medium
 NA = not applicable

This page intentionally
left blank.

**Table 7-3
Conceptual Scenarios for Initial Action Alternatives**

Initial Alternative Features	Initial Alternative A Environmental Focus	Initial Alternative B Water Quality Focus	Initial Alternative C Water Supply Focus
Measures			
Construct new conservation offstream surface storage at Sites Reservoir (up to 1.8 MAF)	X	X	X
Improve fish passage RBDD	X	X	
Restore abandoned gravel mines along the Sacramento River	X	X	
Construct instream aquatic habitat downstream of Keswick Dam	X		
Replenish spawning gravel in the Sacramento River	X		
Develop conservation groundwater storage near the Sacramento River downstream from Shasta Dam	X		X
Conveyance			
TC Canal		X	
GCID Canal		X	
New Pipeline	X	X	
Stony Creek Diversion	X		
Colusa Basin Drain Diversion	X		
Groundwater storage conveyance to/from Sacramento River	X		X
Operational Priorities			
Environmental	1	3	2
Water Supply	3	2	1
Water Quality	2	1	3

This page intentionally
left blank.

Initial Alternative A has a conceptual environmental focus and includes the following measures: Sites Reservoir generation of up to 1.8 MAF, Red Bluff Diversion Dam passage improvement, restoration of abandoned gravel mines along the Sacramento River, construction of instream aquatic habitat downstream of Keswick Dam, and replenishment of spawning gravel in the Sacramento River. The conveyance formulation for Sites Reservoir would include the new pipeline from the Sacramento River, Stony Creek diversion and conveyance, and Colusa Basin Drain diversion and conveyance. Operational benefit priorities would list environmental first, water quality second, and water supply third.

Initial Alternative B has a conceptual water quality focus and includes the following measures: Sites Reservoir generation of up to 1.8 MAF, Red Bluff Diversion Dam passage improvement, and restoration of abandoned gravel mines along the river. The Initial Alternative B conveyance for Sites includes TC Canal, Glenn-Colusa Irrigation District (GCID) Main Canal, and the new pipeline from the Sacramento River opposite Moulton Weir. Operational benefit priorities would be water quality first, water supply second, and environmental third.

Initial Alternative C focuses on water supply and includes the following measures: develop groundwater storage near the Sacramento River, downstream from Shasta Dam, replenish spawning gravel in the Sacramento River and construct instream aquatic habitat on river tributaries. Conveyance for Initial Alternative C includes TC Canal, GCID Canal, and Stony Creek diversion and conveyance. Operational benefit priorities would list water supply first, environmental second, and water quality third.

As indicated in Sections 3 and 6, all alternatives will include the CALFED complementary actions WUE and Transfers. These CALFED program commitments are reflected in the Common Assumptions process so that the CALFED complementary actions are included implicitly in each alternative, including the No-Action and initial alternatives described here.

7.6 NO-ACTION ALTERNATIVE

In addition to the initial alternative configurations identified above and consistent with the federal P&Gs, the NODOS Investigation will carry the No-Action alternative through the FS for comparative purposes. Under the No-Action alternative, neither the federal government nor a willing and capable non-federal partner will take any action toward implementing a specific plan north of the Delta to improve water supply reliability for a significant portion of the Sacramento Valley, nor help to increase the sustainability of anadromous fish in the upper Sacramento River, nor help to provide storage and operational benefits to other CALFED programs. However, as noted above, this investigation will assume that WUE and Transfers will be implemented in the No-Action alternative.

Anticipated increases in population growth in the Central Valley will increase demands on water resources systems for additional and reliable water supplies. As discussed in Section 3, it is estimated that the demand for water in the future will significantly exceed available supplies and intensify competition for available water. If new water supplies are not developed, more reliance will be placed on shifting water use away from agricultural use for urban use.

Basic physical conditions in the study area are expected to remain relatively unchanged in the future. From a geomorphic perspective, ongoing restoration efforts along rivers are expected to improve natural riverine processes marginally. Without major physical changes to the river systems, hydrologic conditions will probably remain unchanged. Programs and projects in the Sacramento Valley are being pursued to help restore fisheries resources. Although significant increases in anadromous and resident fish populations in the Sacramento River are likely to continue through implementation of these projects and programs, these gains may be offset by other actions, such as the reduction in Sacramento River flows,

and resulting elevated water temperatures, because of reduced diversions of cooler water from the Trinity River. Accordingly, populations of anadromous fish are expected to remain generally similar to the current populations. In addition, significant efforts of federal and state wildlife agencies supporting populations of special-status species in the riverine and nearby areas will generally remain similar to current efforts.

In the future, regardless of efforts to better manage runoff from urban and agricultural environments, water quality conditions are expected to remain generally unchanged and similar to existing conditions.

7.7 PLAN FORMULATION RANGE FOR INITIAL ALTERNATIVES

The following initial alternatives illustrate the plan formulation decisions described above that must be made to develop NODOS alternatives. As noted previously, the CALFED complementary actions (WUE and Transfers) are implicitly included in all alternatives through the Common Assumptions process. In summary, the following initial alternative scenarios will be carried forward into the PFR for further development into detailed initial alternatives:

- ❖ Initial Alternative A – Environmental Focus;
- ❖ Initial Alternative B – Water Quality Focus;
- ❖ Initial Alternative C – Water Supply Focus; and
- ❖ No-Action Alternative.