ASGSA
Advisory Committee Meeting
Greenfield Civic Center
599 El Camino Real
Greenfield, CA 93927

Meeting Agenda
June 12, 2019
1:00 P.M.

Your courtesy is requested to help our meeting run smoothly.

Please follow the following rules of conduct for public participation in the meetings:

- Refraining from public displays or outbursts such as unsolicited applause, comments or cheering.
- Any disruptive activities that substantially interfere with the ability of the Agency to carry out its meeting will not be permitted, and offenders will be requested to leave the meeting.

PLEASE TURN OFF CELL PHONES AND PAGERS

1. **PUBLIC COMMENTS REGARDING ITEMS ON THE AGENDA –** A three-minute time limit may be imposed on all speakers.

2. **APPROVAL OF MINUTES OF THE MAY 17, 2019**

3. **RECEIVE GROUNDWATER SUSTAINABILITY PLAN UPDATE AND PRESENTATION FROM TODD GROUNDWATER**
    ATTACHMENTS
    a. Alternative minimum thresholds for groundwater levels (2015 instead of 2016)
    b. Groundwater salinity patterns
    c. Reservoir operations model demonstration
    d. Comments on SVBGSA draft Chapter 8 “Sustainable Management Criteria”
    e. Communication with DWR SGMA staff–status
    f. Groundwater modeling–status
    - **a. Report**
    - **b. Public Comments**
    - **c. Committee – Review / Comments / Action**

4. **RECEIVE SALINAS VALLEY BASIN GSA AND ARROYO SECO COORDINATION AGREEMENT AND MANAGEMENT AREA UPDATE**
    - **a. Oral Report**
    - **b. Public Comments**
    - **c. Committee – Review / Comments / Action**

5. **RECEIVE SALINAS BASIN AG WATER ASSOCIATION MEETING UPDATE**
    - **a. Oral Report**
    - **b. Public Comments**
    - **c. Committee – Review / Comments / Action**

6. **RECEIVE GENERAL MANAGER'S REPORT AND OTHER ITEMS**
   a. **Oral Report**
   b. **Public Comments**
   c. **Committee – Review / Comments / Action**

7. **ADJOURNMENT**

In compliance with the American With Disabilities Act, if you need special assistance to participate in this meeting, please contact the City Clerk at (831) 674-5591. Notification 48 hours prior to the meeting will enable the City to make reasonable arrangements to ensure accessibility to the meeting (CFR 35.102-35.104 ADA Title II).

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This agenda is duly posted outside City Hall and on the City of Greenfield web site

ASGSA
Advisory Committee Meeting Minutes

May 17, 2019

Committee Members Present: Alan Panziera, Nancy Isakson, Jim Thorp, Tammy Massa, Mary Lerner, Jerry Lohr, John Huerta, Tim Frahm, Roger Moitoso, and Michael Griva

1. **Public Comment -**
    a. No public comments were presented.
2. **Approval of April 10, 2019 Minutes**
    a. Minutes were approved.
3. **Receive SVBGSA/ASGSA Coordination Agreement and Management area Update**
    a. Advisory Committee was updated regarding the most recent (May 16, 2019) Subcommittee Meeting regarding the status of the Coordination Agreement and Management Area negotiations. The Agreement is very close to being complete and each organization committed to reviewing the document one last time prior to going before the SVBGSA Board of Directors. The outstanding issue is the Management Area boundary and the "holes" in the boundary presented to DWR. The SVBGSA desires the management area to be complete without holes. We Subcommittee suggested the next meeting be held with property owners that have not been included in the set of properties presented to DWR. The Advisory Committee supported this in concept, but wanted to ensure that principle property owners were the parties that came to the meeting and not just client representatives. The boundary was proposed to include the entire area previously submitted to DWR plus the parcels that represented the holes in the ASGSA Management Area boundary.
4. **Receive SBAWA Meeting Update**
    a. The Committee briefly discussed the most recent SBAWA meeting in May, no action was taken.
5. **Consider General Managers Report**
    a. The committee received an update via teleconference from Gus Yates on the minimum threshold values and modeling efforts. The discussion of the modeling performance and uses followed with staff being directed to bring additional information forward in the June Advisory Committee meeting.
6. **Adjourn**
    a. Meeting was adjourned at 3:30 pm, next meeting is scheduled for May 17, 2019 pending approval by the Board of directors.

Appendix N. Documentation of Reservoir Operations Model

Gus Yates

May 10, 2019

Overview

The reservoir operations model consists of two major components. The first is an Excel workbook that simulates daily reservoir operation over the water year 1950-2015 hydrologic period. It produces Salinas River flows at Bradley, which are passed to the second component, which is a FEMFLOW3D finite-element groundwater flow model called FFM18. The FFM18 model simulates groundwater flow throughout the Salinas Valley on a monthly basis during 1950-2015 and produces simulated flows at downstream locations along the Salinas River that are compliance locations for steelhead flows and target locations for conservation releases. The monthly net flow changes from Bradley to each downstream compliance/target location are then passed back to the reservoir operations model to determine the releases needed to meet the target flows at the downstream locations. This iterative exchange between the reservoir model and groundwater model is repeated until no adjustments to releases are necessary.

Reservoir Operations Model

The reservoir operations model simulates daily operations of Nacimiento and San Antonio Reservoirs, including releases needed for fish flows and conservation releases (note that in this discussion releases for diversion at the Salinas River Diversion Facility [SRDF] and releases for groundwater recharge along the Salinas River are both considered “conservation releases”). Each of the reservoir inflow and outflow terms are described below, with an expanded discussion of implementation of the steelhead flow criteria specified in the Flow Prescription included in the NMFS Biological Opinion. Each variable or calculation is contained in a column in the workbook, with time extending down the rows. Thus, daily simulation of water years 1950-2015 occupies 24,106 rows in each column.

Reservoir Water Balance Terms Other than Releases

Storage, Elevation and Surface Area

Storage is calculated as the storage on the previous day plus the current day precipitation and inflow, minus the current day evaporation, releases and spills. For each reservoir, storage is related to water surface elevation and surface area by area-capacity curves obtained from MCWRA and used as lookup tables in the workbook.

Rainfall

Daily rainfall was obtained from the Nacimiento Dam station for its period of record (May 1957 – June 1978). Prior to and after that date, rainfall at the reservoir was estimated based on the correlation between Nacimiento Dam rainfall with rainfall at King City (x 1.22) or Paso Robles (x 1.07) during their overlapping periods of record.

Based on a digital isohyetal map downloaded from the Monterey County Open Data GIS server, average annual precipitation at San Antonio and Nacimiento Reservoirs is similar, so the same precipitation time series was used for both reservoirs.

Rainfall in inches is multiplied by the current daily reservoir surface area to obtain a rainfall inflow rate in cubic feet per second (cfs).

Evaporation

Daily pan evaporation at Nacimiento Dam is available for 1949-1978. For years after that period of record, each day was assigned the average evaporation rate for that month of the year from the period of record. Compared to rainfall, evaporation is relatively uniform from year to year (generally within +/- 15% of the long-term average), so the use of long-term average values is reasonable.

The evaporation rate is assumed to be the same at both reservoirs, and for each reservoir the rate is multiplied by the current water surface area to obtain a flow in cubic feet per second.

Inflow

As with most reservoirs, reservoir inflow is not measured because there are multiple streams that enter the reservoir, plus possibly some subsurface inflow. Instead, it is estimated as the residual in the water balance. That is, inflow = (change in storage) – precipitation + evaporation + releases + spills. When this equation is applied on a daily basis using MCWRA records of storage, releases and spills along with the above estimates of precipitation and evaporation, many days with negative inflow values result. Part of this is due to mismatches in timing. For example, a large rain event one day might register as a storage increase on the following day. Another contributing factor is the low precision in measuring storage change, which is calculated as the change in water surface elevation multiplied by the current reservoir surface area. Elevation is recorded to the nearest 0.05 foot. A change in elevation of 0.05 foot in one day when the reservoir has a surface area of 6,000 acres is equivalent to a flow of 151 cfs.

Negative values of inflow are not simply clipped off, but rather averaged with excessively positive values on prior or later days. This concept was implemented by first estimating the reservoir water balance on a monthly basis—which is less affected by daily event timing and the precision of storage measurement—and then clipping the monthly inflows to positive-only values. Negative values proved to be rare in the monthly calculations and occurred mostly in summer when evaporation is high and inflow is small. The monthly ratio of average inflows to average positive-only inflows was then applied to each positive daily inflow to obtain a total daily inflow for the month that equaled the monthly estimate. This procedure preserves the relative magnitudes of daily fluctuations while maintaining a correct monthly mass balance. The remaining discrepancy over the month was generally less than a few percent. This monthly mass balance correction procedure was applied to a number of flows in the model.

Reservoir Releases

Reservoir releases can be grouped into three general categories: fish flows, conservation releases and spills. Fish and conservation releases are mostly restricted to certain date windows during the year. The date criteria are applied in the model by entering the appropriate release equation in the lines corresponding to the date window of each year. Many of the steelhead flow criteria extend to June 30, to allow for a smolt block flow lasting 25 days triggered on the last day of its date window (May 31).

Some of the release criteria depend on reservoir storage. To avoid circular references in the workbook, the formulas implementing those criteria reference the ending storage on the preceding day.

Flood Pool Releases

San Antonio Reservoir has a flood pool of 30,000 AF, which is the minimum amount of vacant storage capacity that must be maintained in the reservoir during winter. The operations model assumes this requirement applies during December through March. If simulated storage creeps above the flood pool threshold (305,000 AF), a user-specified flood release (currently 1,300 cfs) is initiated and continued until storage drops back below the threshold.

Nacimiento Reservoir no longer has a flood pool because the inflatable-dam spillway modification provides the necessary operational flexibility to safely pass floods through the reservoir.

Fish Flows

To maintain fish living in the reach immediately below the dam, there is a year-round minimum release requirement of 60 cfs from Nacimiento Dam and 10 cfs from San Antonio Dam. The release from Nacimiento is no made if storage drops below the conservation pool (elevation 687.8 ft, corresponding to 22,300 AF, or about 6 percent of reservoir capacity). If releases for steelhead, conservation or spills do not exceed these minimum flows, then the minimum flow requirement applies.

Releases for steelhead migration and rearing are in accord with a complex set of criteria crafted by the National Marine Fisheries Service as part of its Biological Opinion regarding effects of Salinas Valley Water Project operation on steelhead. These rules are often referred to as the "Flow Prescription" and are represented diagrammatically in **Figures N-1, N-2 and N-3**, which are for adult upstream migration, smolt downstream migration (block flows) and lagoon rearing, respectively. The decision rules are based in part on hydrologic year type, current reservoir storage and current flows at various locations in the watershed. To apply the rules in the operations model, complete daily time series of each of these factors were constructed, as follows:

Hydrologic Year Type. Some of the steelhead flow criteria are based on hydrologic year type as of March 15 or April 1. Year type is based on cumulative flow at the Arroyo Seco near Soledad gauge from October 1 to each of those dates. Historical year-to-date flow amounts were ranked and divided into five year types based on the percentage of years in each category. The categories are dry (0 to 25th percentile), dry-normal (25th to 41.7th percentile), normal (41.7th to 58.3rd percentile), wet-normal (58.3rd to 75th percentile) and wet (75th to 100th percentile). This scheme is consistent with the method specified in the Biological Opinion and divides the inter-quartile range into three equal intervals for the dry-normal, normal and wet-normal categories. **Table N-1** lists the year type identified as of March 15 and April 1 for each year during 1950-2015.

Combined reservoir storage. Simulated storage is updated separately for Nacimiento and San Antonio Reservoirs using the equation described above (change in storage = inflows – outflows). Current-day storage in the two reservoirs is summed to obtain the combined reservoir storage.

Nacimiento River below Sapaque Creek. This stream gauge is on the Nacimiento River upstream of Nacimiento Reservoir. Runoff above the gauge is unregulated. Gauged flows are available for water years 1972-present. For water years 1950-1965, daily flows were estimated as 1.265 x Arroyo Seco near Soledad flows, based on a regression of post-1972 flows. For water years 1966-1971, flows were similarly estimated as 1.698 x San Antonio River near Lockwood flows.

Arroyo Seco near Soledad (upper gauge). Gauged daily flows are available for this gauge throughout the water year 1950-2015 simulation period.

Arroyo Seco below Reliz Creek (lower gauge). This gauge began operating in water year 1995. For prior years, flow was estimated as flow at the upper Arroyo Seco gauge (near Soledad) minus 130 cfs. This average loss rate was based on an analysis of the 1995-2018 overlapping period of record for the two gauges. Net flow loss averaged 131 cfs when flow at the lower gauge was above 173 cfs and flow at the upper gauge was less than 800 cfs (median loss was 126 cfs). When flow at the lower gauge was above 70 cfs and flow at the upper gauge was less than 800 cfs, average net loss was 144 cfs (median was 132 cfs). Note that the net flow loss between the gauges reflects any concurrent inflows from Reliz Creek and diversions by Clark Colony Water Company. An average loss of 130 cfs was selected as a reasonable average to use for this operations model.

Salinas River near Bradley. In the operations model, releases from the reservoirs are added to runoff from the rest of the Salinas River watershed upstream of the gauge near Bradley to estimate flow at the gauge location. This flow is subtotaled to monthly values to become input to the groundwater model. The operations model currently assumes that runoff from the below-dam watershed is the same as historical runoff, which means it reflects historical operation of Santa Margarita Lake and historical depletion of river flow as it crosses the Paso Robles Subbasin. Historical below-dam runoff during water years 1967-2015 was set equal to gauged flow at Bradley minus the combined releases from Nacimiento and San Antonio Reservoirs. For water years 1949-1965 it was estimated by linear regression against gauged flows in the Salinas River near Paso Robles (Bradley = 1.6057 * max[Paso Robles, 10] - 35.94), based on 1970-2016 data. For water year 1966, below-dam runoff at Bradley was set equal to 10 cfs during 10/1/65-11/19/65, to total historical Bradley flow during 11/20/65-4/15/66, and back to 10 cfs for 4/16/66-9/30/66, based on a comparison of Nacimiento releases and Bradley flows during that water year.

Salinas River at Soledad. Daily flow at Soledad equals daily flow at Bradley minus the monthly net flow loss between Bradley and Soledad simulated by the groundwater model.

Salinas River near Chualar. Daily flow at Chualar equals daily flow at Bradley minus the monthly net flow loss between Bradley and Chualar simulated by the groundwater model.

Salinas River near Spreckels. Daily flow at Spreeckels equals daily flow at Bradley minus the monthly net flow loss between Bradley and Spreckels simulated by the groundwater model.

Salinas River at the Lagoon. Daily flow at the Salinas River lagoon equals daily flow at Bradley minus the monthly net flow loss between Bradley and the lagoon simulated by the groundwater model.

Lagoon Open/Closed to the Ocean. Records of dates when the Salinas River lagoon was open to the ocean during 1965-2009 were obtained from MCWRA (Criollo, 2019). The initial opening of the beach berm often coincided with a large flow event that was more than large enough to breach the sand berm. The reservoir operations model allows the user to adjust that flow threshold, which currently is a 3-day average flow of at least 250 CFS at Spreckels. The minimum flow required to maintain an opening between the lagoon and ocean was also not perfectly correlated with observed berm closure dates. The user-adjustable value in the operations model currently assumes the berm closes after 3 consecutive days of flow at Spreckels less than 80 cfs, which is the same value presently being used in the U.S. Geological Survey operations model that is under development.

Identifying the Controlling Release. The steelhead flow criteria include target flows at Soledad, Chualar, Spreckels and the lagoon. In some cases, different criteria apply for adults, smolts or rearing at a given location. Accordingly, the model evaluates all criteria applicable to each of the locations on each day of the simulation to determine which requirement results in the largest reservoir release. That becomes the "controlling" release for that location on that day. After identifying the controlling release for steelhead at each location, the model calculates the conservation flow target and associated release for that day. The larger of the fish flow release and conservation flow release becomes the actual reservoir release for that day.

The steelhead flow criteria involve multiple variables and various durations of flow. The numerous criteria are applied one or two at a time in adjacent columns of the workbook to obtain the required flow. The required flow at a downstream location is translated to a corresponding reservoir release by adding the simulated percolation loss for that month between the reservoirs and the downstream location.

The Flow Prescription decision rules shown in the diagrams (**Figures N-1, N-2 and N-3**) are ambiguous or redundant on a couple of points. These are addressed in the model as follows:

- **Multiple adult migration releases.** The diagram does not state whether only one adult migration release needs to be made in any given year, or whether multiple events could be triggered during the February 1-March 31 date window. If natural flows remain high for weeks, back-to-back releases could theoretically be required. The operations model currently assumes that multiple release events are required if the flow criteria are met, but with a minimum of 2 weeks between events.
- **Delay in release arrival at downstream location.** The adult up-migration flow objective and the initial pulse of the smolt flow objective both seek to achieve five consecutive days of a target flow. However, there is a delay of 3-4 days between the time a release is initiated at the reservoir and the time the flow arrives at the compliance location (Soledad or Chualar). Natural flows could drop below the target flow between the day the release was triggered and the day the release arrives, resulting in less than five consecutive days of the target flow. Also, the release needs to anticipate the amount of natural flow at the downstream location 3-4 days after the trigger date, because the release only needs to make up the difference between the natural flow and the target flow. There is considerable variation in the rate of recession following peak flow events, which are what trigger the releases. The operations model includes a user-specified "flow recession buffer" for each downstream location that represents the average amount of flow recession that occurs during the 3-4 day arrival time of the released water. If the buffer is set too high, more water is released than is necessary to meet the downstream flow requirement. If the buffer is set too low, the 5-day pulse might drop below the target amount for one or more days. A flow recession buffer of 400 cfs obtained a reasonably balanced mix of those two errors.
- **Number of smolt block flow events.** The trigger criteria for smolt block flow releases (flow thresholds at Sapaque and Reliz) could occur more than once during the March 15 – May 31

date window. However, the operations model assumes than only one block flow release is needed in any given year.

- **Post-block smolt flows.** The final "and" criterion in the central rectangles in the smolt flow decision rule diagram (**Figure N-2**) appears to be repeated in the steps immediately below (the diamond and two smaller rectangles). This relates to whether Arroyo Seco flow at the "near Reliz" gauge is still high enough following the block flow to allow smolt passage (i.e. greater than 1 cfs). This criterion is applied only once in the operations model, per the rules in the diamond and two smaller rectangles.

Conservation Releases

Conservation releases serve two objectives: to recharge groundwater all along the Salinas Valley and to supply diversions from the SRDF at the downstream end of the valley. The Flow Prescription mandates that a minimum flow of 2 cfs be supplied to the lagoon whenever conservation releases are being made. The operations model assumes that this lagoon flow must be supplied by a reservoir release large enough to provide continuous flow all the way to the SRDF with enough flow at that point to supply the SRDF diversion and the 2 cfs inflow to the lagoon. The maximum SRDF diversion is 36 cfs (by means of three 12-cfs pumps). During water years 2010-2018 there were six years with substantial diversions. During those years, the average diversion rate during May-August was about 18 cfs, with smaller amounts in April and September and infrequent small flows in October.

This requirement means that conservation releases operate on essentially an on/off basis. The magnitude of the release varies slightly depending on the target diversion at the SRDF and the current percolation rate, but those variations are typically small relative to the total percolation rate. Thus, the decision variable for conservation releases is primarily the number of days during a given irrigation season that conservation releases are made. Because the groundwater model operates on a monthly time step, the duration of conservation releases in the operations model is in increments of one month. The season for conservation releases is usually May through October (although the model allows them in any month). To facilitate simulation of planned multi-year carryover storage in the reservoirs—as a drought contingency—the operations model includes a lookup table that specifies which months during the current year conservation releases are made based on the April 1 combined reservoir storage. The table presently includes eight increments of reservoir storage. By setting the conservation releases to zero in all months for the smallest storage increment, the user can simulate the occurrence of years with discontinued conservation releases, such as happened historically in 1990 and 2013-2015. By adjusting the storage thresholds and corresponding durations of releases, the user can simulate a variety of reservoir operation scenarios.

In April-June fish flow requirements can coincide with conservation releases. In that case, the released water can be serving both purposes. For example, a smolt block flow release achieving 300 cfs at Spreckels would be more than sufficient to supply diversions at the SRDF plus the required 2 cfs of lagoon inflow.

Spills

After identifying the required release on a given day (the largest of the below-dam fish flow, steelhead flow and conservation release), the model starts to spill water from the reservoir if storage exceeds the reservoir capacity. The daily release is set to 10 percent of the excess storage each day, which provides a more realistic spill duration than assuming all of the excess is spilled in one day.

Allocation of Releases between Reservoirs

Nacimiento and San Antonio Reservoirs are similar in capacity, but the Nacimiento watershed is much wetter and generates roughly twice as much runoff as the San Antonio watershed. Accordingly, MCWRA generally provides two-thirds of the steelhead and conservation release requirements from Nacimiento and one-third from San Antonio. In the operations model, the user can adjust the proportion so that both reservoirs are drained to similarly low levels during droughts, which maximizes the reliable yield.

Lake Level Criteria

The Nacimiento Dam Operation Policy (MCWRA, 2018) includes guidelines for rates of water-level decline in Nacimiento Reservoir to benefit recreational users of the lake and minimize impacts on bass spawning. These generally involve temporary adjustments in release rates or shifting the balance of releases between the reservoirs over periods of a few days to a few weeks. These adjustments do not materially affect the yield available for conservation releases and are not included in the operations model.

Salinas River Flow near Bradley

Any change in reservoir operation alters flows in the Salinas River near Bradley, which is the location used to set Salinas River surface inflow to the groundwater model. Daily flows near Bradley are constructed by adding the releases and spills from both reservoirs to the runoff from the rest of the watershed (the “below-dam” runoff). The method for estimating below-dam runoff was described above (in section “Salinas River near Bradley” under “Fish Flows”). Historically, there was usually a slight gain in flow between the reservoirs and Bradley. In recent years, however, there is more commonly a 20 cfs loss (Franklin, 2018). The operations model assumes the 20 cfs was observed under steady flow conditions in summer when conservation releases were occurring and that the loss decreases to 10 cfs in winter when pumping along the river and in the Paso Robles Subbasin is seasonally low.

Groundwater Flow Model

The groundwater flow model is a finite-element model that uses the FEMFLOW3D computer program developed by Tim Durbin and Linda Bond for the U.S. Geological Survey (Durbin and Bond, 1998). Mr. Durbin prepared the Salinas Valley application of the model—called the FFM18—in 2018 for the Salinas Valley Water Coalition (Durbin, 2018). Minor additional calibration has been done since 2018 to improve simulation of drought drawdown in wells near the Salinas River in the Upper Valley and Forebay subbasins and to more accurately simulate average annual percolation losses along the Arroyo Seco.

Model structure, inputs, output and calibration were thoroughly documented by Durbin (2018). Briefly, the model grid covers the entire 180/400 Foot Aquifer, Eastside, Forebay and Upper Valley Subbasins, and extends offshore beneath Monterey Bay to approximately the location of the Monterey submarine canyon. The model grid contains five layers of nodes defining the tops and bottoms of four layers of elements. There are 10,920 nodes and 14,560 elements in total. Node spacing increases in the transverse direction from about 250 feet near the Salinas River and Arroyo Seco to more than 3,000 feet near the valley margins. Layers similarly increase in thickness from 5 percent of total Basin thickness for layer 1 to 50 percent for layer 4. The Salinas River and Arroyo Seco interact dynamically with groundwater, which means that the direction and rate of seepage across the river bed depends on the relative elevation of the river surface and underlying groundwater, as well as on wetted area and permeability. Because of this interaction, flow gains and losses along the two rivers are influenced by groundwater pumping and other terms in the groundwater balance. The model simulates mass balance in the rivers as well as in the groundwater system. Surface water is routed in the downstream direction from the model boundary to Monterey Bay. Simulated monthly flows at any location can be extracted from the model results.

The groundwater model uses monthly time steps and simulates water years 1950-2015. An initial time step representing average conditions during water year 1949 is included at the start of each simulation. To facilitate matching model output with the reservoir operations model, the initial time step is assumed to represent September 1949 in the reservoir operations model.

To enable simulation of scenarios involving changes in future land use or groundwater pumping, historical groundwater pumping and dispersed recharge (from deep percolation of rainfall and irrigation water) throughout the Forebay Subbasin are replaced with simulated values. Those are obtained from a rainfall-runoff-recharge model that simulates the 1950-2015 hydrologic period on a daily basis, tracking rainfall, runoff, interception, infiltration, soil moisture storage, evapotranspiration, irrigation, deep percolation and groundwater recharge in 317 geographic regions representing unique combinations of land use, soil, rainfall and other parameters (see GSP Appendix L). The rainfall-runoff-recharge model ensures consistency between pumping and recharge values.

The groundwater model receives estimated Salinas River flows near Bradley (daily values averaged to monthly values) as input from the reservoir operations model. The groundwater model simulates monthly flows in the Salinas River at Soledad, Chualar, Spreckels and the lagoon, and in the Arroyo Seco at the lower gauge. Those flows are extracted from the model output and converted to monthly flow changes from Bradley to each downstream location. In months when flow is present at Bradley and the downstream location, the net percolation is calculated as the net decrease in flow. If there is no flow at the downstream location, the average percolation loss for that calendar month over all years is used as the estimated percolation capacity. Those monthly changes are then passed to the reservoir operations model to recalculate release requirements for steelhead and conservation. This iterative process is continued until no further adjustments are needed in the reservoir releases, which in practice usually occurs by the second or third iteration.

Table N-1. Hydrologic Year Types based on Arroyo Seco Near Soledad Flow-to-Date

	Evaluation Date			
	March 15		April 1	
Water Year	Flow-to-Date (cfs-days)	Year Type	Flow-to-Date (cfs-days)	Year Type
1950	18,123	Dry Normal	20,044	Dry Normal
1951	40,099	Wet Normal	41,528	Wet Normal
1952	79,587	Wet	93,200	Wet
1953	25,735	Normal	28,992	Normal
1954	11,480	Dry	16,344	Dry Normal
1955	13,319	Dry Normal	14,303	Dry
1956	78,881	Wet	81,433	Wet
1957	14,423	Dry Normal	15,802	Dry Normal
1958	46,157	Wet Normal	81,572	Wet
1959	24,531	Normal	25,942	Normal
1960	15,046	Dry Normal	16,020	Dry Normal
1961	6,062	Dry	7,042	Dry
1962	41,827	Wet Normal	45,806	Wet Normal
1963	60,325	Wet	66,988	Wet Normal
1964	14,572	Dry Normal	15,553	Dry
1965	33,905	Normal	35,788	Normal
1966	24,149	Normal	25,068	Dry Normal
1967	57,954	Wet	73,942	Wet
1968	8,522	Dry	10,304	Dry
1969	130,556	Wet	137,047	Wet
1970	39,186	Wet Normal	42,676	Wet Normal
1971	26,203	Normal	27,707	Normal
1972	11,705	Dry	12,090	Dry
1973	95,971	Wet	105,063	Wet
1974	44,941	Wet Normal	53,165	Wet Normal
1975	56,715	Wet	68,872	Wet Normal
1976	4,044	Dry	4,470	Dry
1977	1,670	Dry	2,093	Dry
1978	114,540	Wet	125,450	Wet
1979	33,970	Normal	41,979	Wet Normal
1980	121,445	Wet	129,080	Wet
1981	23,862	Normal	33,421	Normal
1982	55,768	Wet Normal	69,333	Wet Normal
1983	178,265	Wet	204,405	Wet
1984	39,402	Wet Normal	41,055	Wet Normal
1985	14,572	Dry Normal	18,194	Dry Normal
1986	82,986	Wet	103,824	Wet
1987	11,248	Dry	13,259	Dry
1988	9,649	Dry	10,080	Dry
1989	6,514	Dry	8,717	Dry
1990	5,946	Dry	6,464	Dry
1991	7,001	Dry	18,773	Dry Normal
1992	29,422	Normal	32,992	Normal
1993	93,709	Wet	98,766	Wet
1994	12,767	Dry	13,664	Dry
1995	96,411	Wet	117,454	Wet
1996	47,024	Wet Normal	52,610	Wet Normal
1997	78,510	Wet	80,522	Wet
1998	111,586	Wet	121,252	Wet
1999	19,823	Dry Normal	25,146	Normal
2000	43,509	Wet Normal	47,711	Wet Normal
2001	30,516	Normal	33,595	Normal
2002	22,584	Dry Normal	24,323	Dry Normal
2003	36,926	Normal	39,766	Normal
2004	22,821	Dry Normal	24,463	Dry Normal
2005	83,483	Wet	97,912	Wet
2006	38,551	Wet Normal	49,523	Wet Normal
2007	7,541	Dry	8,196	Dry
2008	37,546	Wet Normal	39,290	Normal
2009	27,789	Normal	30,899	Normal
2010	70,851	Wet	75,923	Wet
2011	43,636	Wet Normal	75,945	Wet
2012	8,180	Dry	11,330	Dry
2013	24,441	Normal	25,115	Dry Normal
2014	4,240	Dry	4,743	Dry
2015	13,513	Dry Normal	14,011	Dry

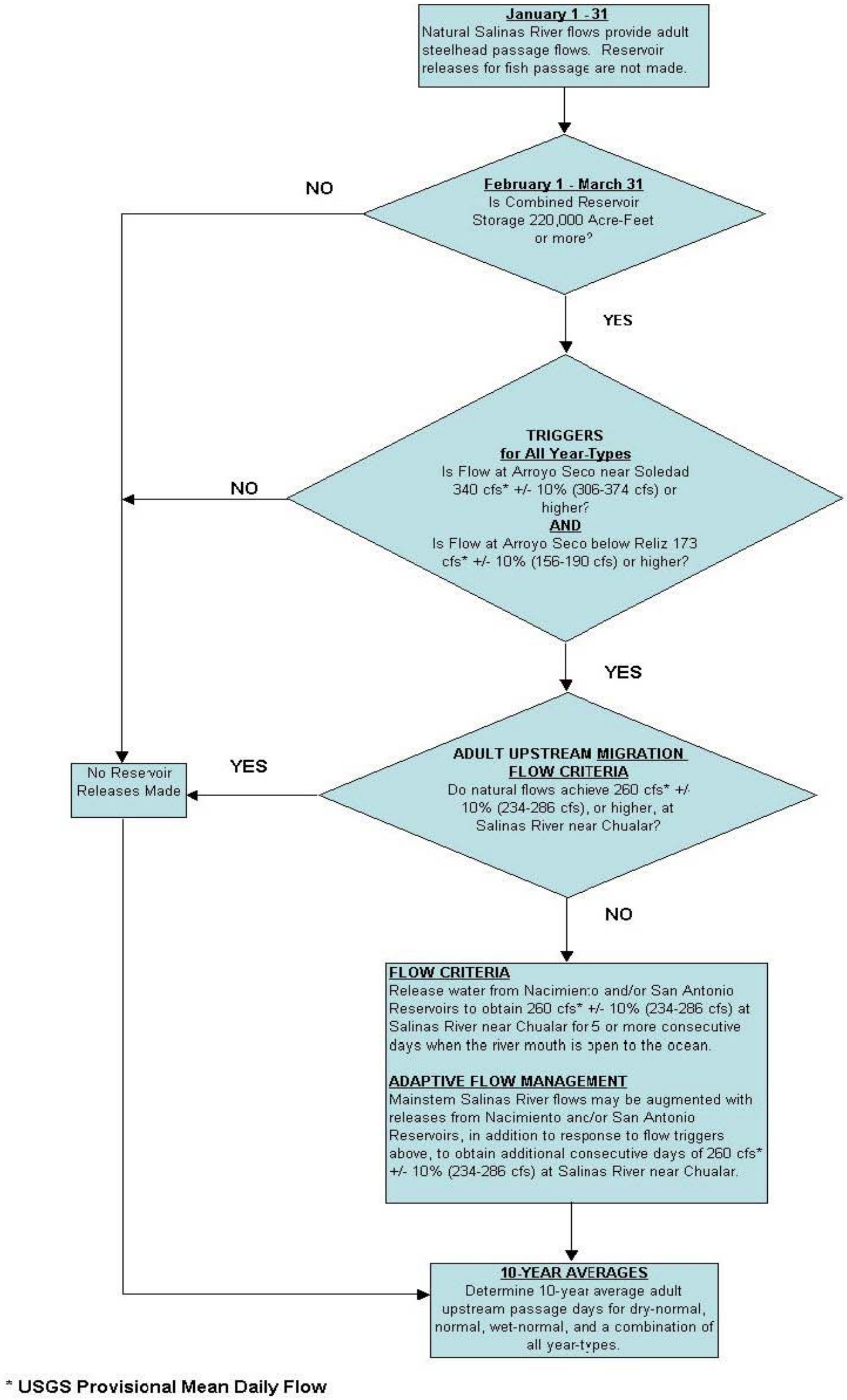

Figure N-1. Release Schedule for Adult Steelhead Upstream Migration

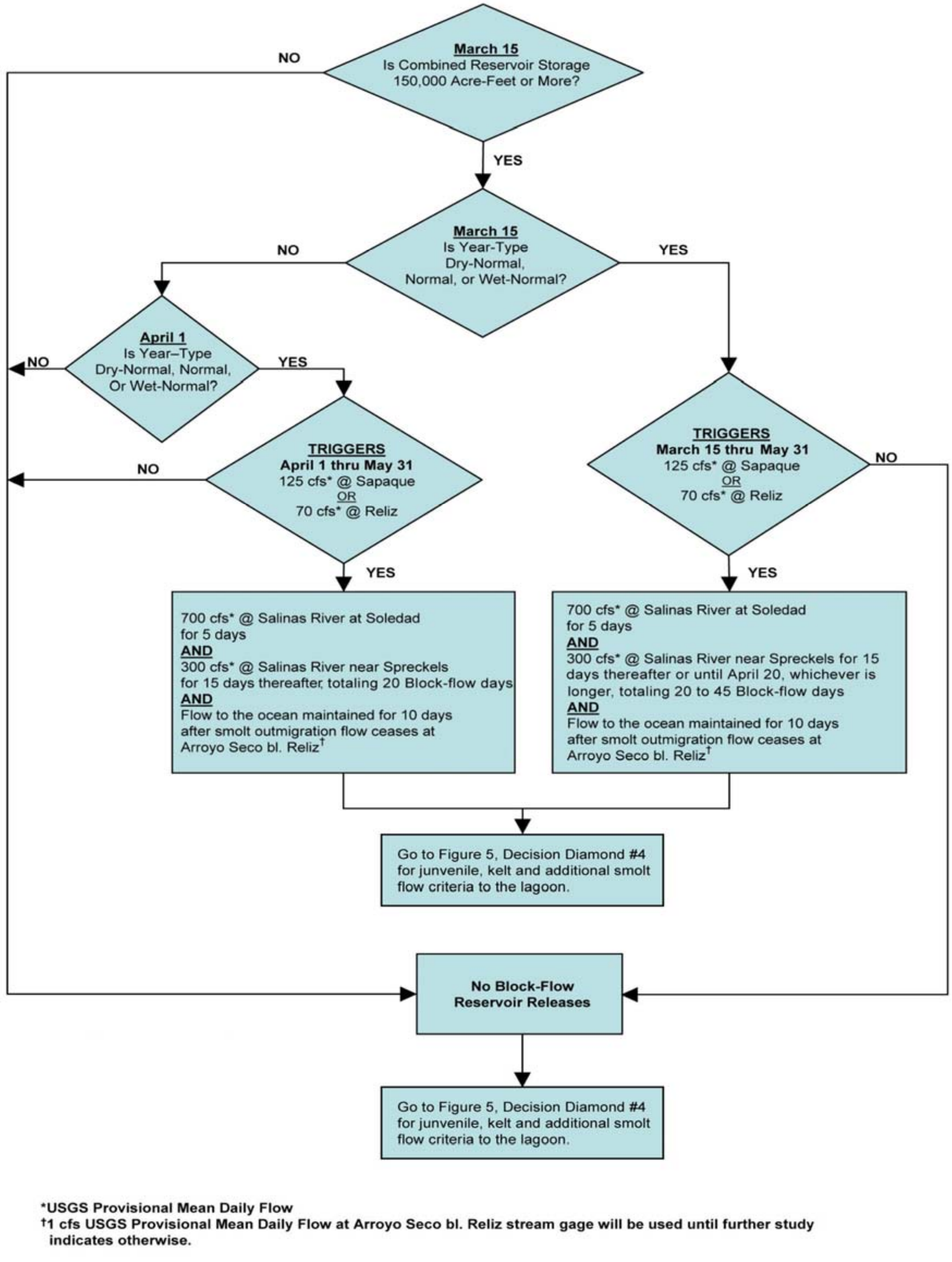

Figure N-2. Release Schedule for Steelhead Smolt Block Flows

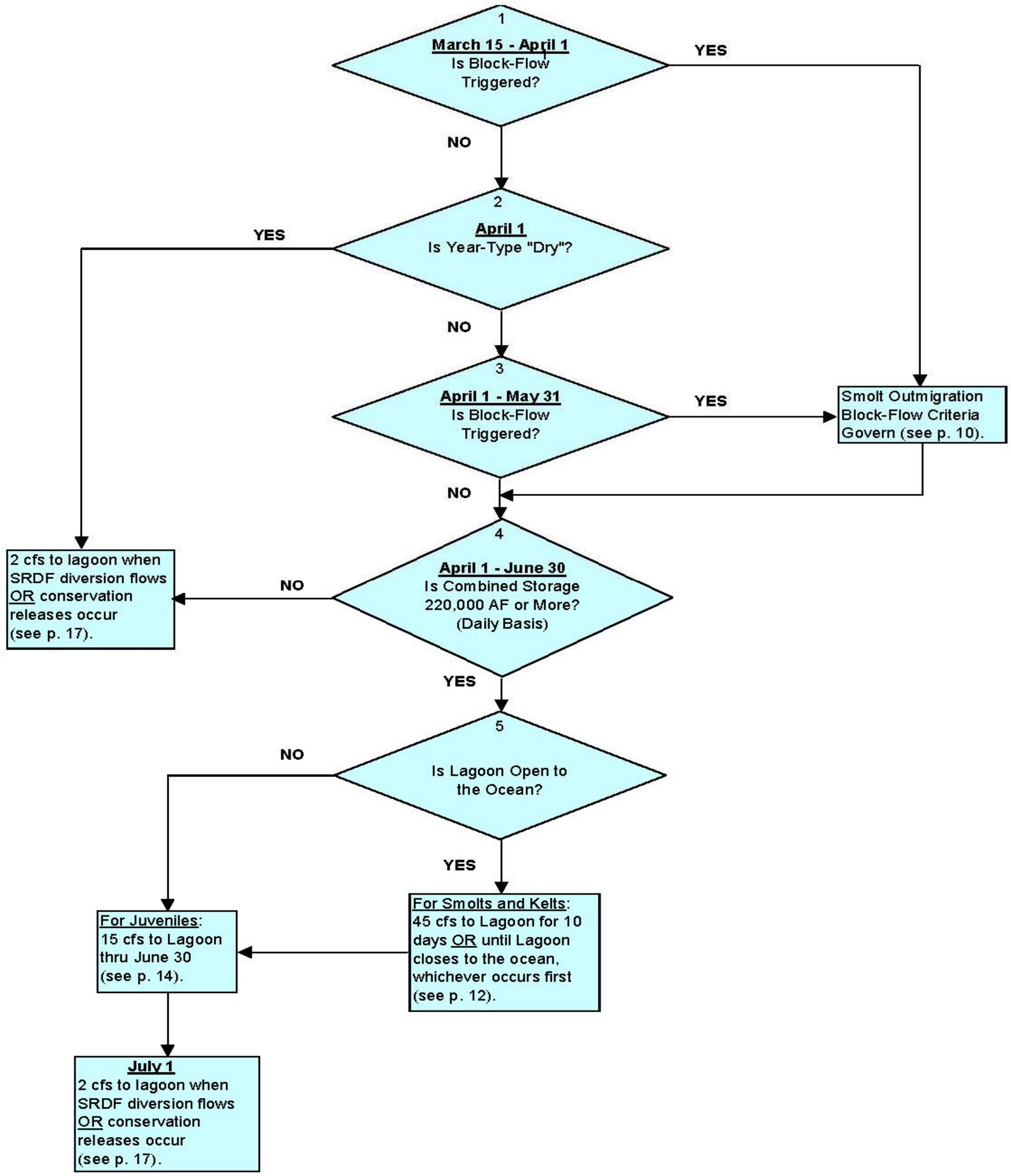

Figure N-3. Release Schedule for Steelhead Juvenile/Kelt Migration