

## VII - WATER CONTROL PLAN

### 7-01. General Objectives

The primary purposes of Alamo Dam and Lake are (1) to provide protection for the lower Colorado River from floods originating within the Bill Williams River watershed; (2) to prevent flooding along the Bill Williams River below Alamo Dam from flows greater than 7,000 cfs (198.2 cms); (3) to provide storage for lake recreation; (4) to provide storage for water conservation; and (5) to provide storage and appropriate releases for environmental objectives. Plate 7-01 is a diagram of Alamo Lake storage allocations for the aforementioned purposes.

### 7-02. Operational Constraints

There are several issues that present operational constraints in the regulation of Alamo Dam and Lake. These issues are briefly described herein:

a. Lower Colorado River. Releases from Alamo Lake ultimately enter Lake Havasu, which is formed by Parker Dam on the lower Colorado River. Parker Dam is one of three Bureau of Reclamation (USBR) dams on the lower Colorado River with the necessary storage space for regulating streamflow. The other two dams are Davis and Hoover Dams, both located upstream from Parker Dam in respective order. Hoover Dam is operated mainly for water supply with hourly adjustments for power generation and, as such, is normally committed to specific releases scheduled on a monthly basis. Both Davis and Parker Dams serve to re-regulate the power releases from Hoover Dam, to ensure that excess amounts of water are not sent to the Gulf of California. Additionally, the two downstream dams have hydroelectric power facilities of their own, and Parker Dam serves as the forebay structure for the Colorado River Aqueduct (Metropolitan Water District of Southern California) and the Granite Reef Aqueduct (Central Arizona Project). Most of the time Lake Havasu (formed by Parker Dam) and Lake Mohave (formed by Davis Dam) are at least 90 percent full, which means that any significant

releases from Alamo Dam will cause Parker Dam to spill unless coordinated with the USBR in advance.

**b. Channel Capacity.** Under a 1963 Arizona State Senate resolution, the Arizona State Department of Water Resources was tasked with precluding any development along the Bill Williams River corridor within the floodway defined by a 7,000 cfs (198.2 cms) release from Alamo Dam. Although major development has not taken place, some existing facilities, such as the Planet Ranch Road and landowner river crossings have been damaged by releases less than 2,000 cfs (56.6 cms).

**c. Streambed Crossings.** Several crossings of the Bill Williams River streambed become inundated and impassable at flows as little as 300 to 500 cfs (8.5 – 14.2 cms). These crossings are used primarily by ranchers who have lands on both sides of the river. However, every rancher and other party have alternate routes for ingress/egress to their property, when usage of the aforementioned crossings is interrupted by releases from Alamo Dam.

**d. Hydrogen-Sulfide in Outlet Works Gate Chamber.** Excessively high concentrations of hydrogen-sulfide (H<sub>2</sub>S) gas in the outlet works gate chamber are hazardous and potentially lethal to operating personnel. Consequently, operating personnel may not be able to enter the chamber and make scheduled or requested adjustment to riparian releases, since these releases are made through the low-flow butterfly valve, which can only be operated from inside the gate chamber.

### **7-03. Overall Plan for Water Control**

Alamo Dam is operated to conform with the objectives and specific provisions of the authorizing legislation, along with the stipulations of subsequent Congressional acts that are applicable to the operation of Federal facilities. The original authorizing legislation specified that Alamo Dam would be operated for flood control, water conservation, recreation, and water rights. Subsequent legislation has stipulated that

Alamo Dam will also be operated for endangered species, water quality, and other environmental objectives, such as riparian habitat and wildlife. Operation for these objectives and stipulations requires that the U.S. Army Corps of Engineers coordinate with other Federal, State and local agencies, and with local individuals.

a. **Bill Williams River Corridor Technical Committee.** The Bill Williams River Corridor Technical Committee (BWRCTC) was an interagency committee formed in 1991 for the purpose of cooperatively developing a revised water management operations proposal for Alamo Lake and the Bill Williams River. The BWRCTC was comprised of the following agencies: Arizona Game and Fish Department, Arizona State Parks, Arizona Department of Water Resources, the Bureau of Reclamation, the Fish and Wildlife Service, the Bureau of Land Management, and the Corps of Engineers. The BWRCTC ultimately developed a recommended plan for re-operation of Alamo Dam and Lake by the process described herein.

1) The BWRCTC was divided into subcommittees, whose purpose was to develop independent water management prescriptions for each of the following resource categories: riparian corridor, fisheries, wildlife, recreation, and reservoir operations.

2) The aforementioned prescriptions were blended together to create alternative operating plans for Alamo Dam and Lake that balanced all of the prescriptions' objectives.

3) Based on subcommittee recommendations, evaluation criteria were developed for each resource category to determine how each of the re-operation alternatives maximized benefits to the categories as a whole. The recommended alternative -- the one with the 1125-foot (342.9 m) target elevation -- provided the optimum overall resource benefits.

**b. Alamo Lake Feasibility Study.** The Alamo Dam and Lake Feasibility Study was authorized under Section 216 of Public Law 91-611 (Flood Control Act of 1970) and Section 301(b)(1) of the Water Resources Development Act of 1996. The study was authorized to investigate the feasibility of implementing environmental restoration activities with recreational benefits at Alamo Lake and along the Bill Williams River. The study's primary purpose was to complete the planning process of formulating and evaluating the array of alternative operating plans that were identified in the BWRCTC studies, as well as previous studies, rather than formulate additional alternatives. The Reconnaissance Guidance Memorandum, dated 18 December 1996, recognized the extensive formulation activities of the previous studies and determined that no additional alternatives need be formulated. The study and accompanying Environmental Impact statement are contained in a July 1999 report. The Record of Decision for the study (Exhibit C) was executed on 12 May 2000.

**c. Adopted Operation Plan.** The adopted Water Control Plan was based on the BWRCTC's recommended alternative. The concept of operation is based on keeping Alamo Lake at or near elevation 1125 feet (342.9 m) for as long as possible to maximize downstream benefits. This elevation is considered optimal for the benefit of all project purposes and is consistent with the objectives of the authorizing legislation. A schematic of the storage allocations is shown on Plate 7-01 and the Water Control Plan is presented in tabular format on Plate 7-02. The maximum controlled outflow from the dam is 7,000 cfs (198.2 cms). Also provided on this plate is the "maximum rate of release increase" schedule, which must be followed when making releases corresponding to lake elevations that exceed 1125 feet (342.9 m). When Alamo Lake is at or below elevation 1125 feet (342.9 m) releases will vary between 10 and 50 cfs (0.28 and 1.4 cms) depending upon specific lake elevation, time of year, and other factors. If necessary, the lake elevation will be drawn down to elevation 1110 feet (338.3 m) in order to facilitate inspection and maintenance of the upstream side of the outlet tunnel. Refer to section 7-15.b(2) for further details regarding inspection/maintenance of the upstream tunnel.

#### **7-04. Standing Instructions**

Exhibit A contains the Standing Instructions to the Project Operator for Water Control for the regulation of Alamo Dam and Lake. It includes instructions to the Project Operator for normal conditions, during communication outages and during unforeseen emergency events requiring deviation from the Water Control Plan. Because of the remoteness of Alamo Dam and the inherent difficulty in communications with the District Office, it is essential that the operators thoroughly understand all facets of the Standing Instructions.

#### **7-05. Flood Control**

Alamo Dam flood control operations are coordinated with USBR's Lower Colorado River Regional Office, which has operational responsibility over Hoover, Davis, and Parker Dams on the Colorado River. The objective of the coordination is to limit flows along the Parker Strip of the Colorado River mainstem to 19,000 cfs (538 cms), which is the maximum non-damaging capacity for this reach. In a similar manner, Alamo Dam flood operations are coordinated with other Federal, State, and local agencies that have interests and concerns along the Bill Williams River. Normally when any significant release changes are to be made, 24-hour notification is made to downstream entities, and the scheduling of these release changes is coordinated in advance with these entities. Although the maximum allowable Alamo Dam flood control release is 7,000 cfs (198.2 cms), this release may be curtailed to permit flood control releases from other dams within the lower Colorado River system, or to enable repairs to downstream channel improvements to restore hydraulic conveyance capacity. Plate 7-02 provides the elevation-release schedule for releases commencing at the top of the target elevation of 1125 feet (342.9 m). The "maximum rate of release increase" schedule provided on Plate 7-02 must be followed when making releases corresponding to lake elevations that exceed 1125 feet (342.9 m).

If the Alamo Lake water surface rises above elevation 1235 feet (376.4 m, spillway crest), floodwaters pass through the uncontrolled spillway. When the reservoir water surface elevation reaches 1244.3 feet (379.3 m), uncontrolled spillway outflow equals the maximum scheduled release of 7,000 cfs (198.2 cms).

In the case where forecasts of reservoir inflow indicate that the reservoir water surface may exceed the maximum surcharge elevation of 1259.6 feet (383.9 m), and the outlet works should remain at 80% gate opening throughout spillway flow (the “non-spillway flow transfer option” schedule). If extended streamflow forecasts of reservoir inflow indicate that there is a high degree of confidence in not exceeding the maximum design surcharge elevation of 1259.6 ft (383.9 m), then outflows may be transferred from the outlet works to the spillway, maintaining the maximum scheduled outflow of 7,000 cfs (198.2 cms) up to elevation 1244.3 feet (379.3 m), (the “spillway flow transfer option”). Plate 7-02 shows the gate schedule for transfer of flow to the spillway. If the water surface elevation rises above 1250 feet (381 m), the three outlet gates are opened to the maximum 6.8-foot (2.1 m) setting, and releases are strictly for dam safety. Should the lake water surface rise above 1259.6 feet (383.9 m), the dam operator(s) shall leave the dam site for their own safety.

#### **7-06. Recreation**

The authorized top of recreation pool is elevation 1070 feet (326.1 m) however, due to the revamping of the original recreation facilities (reference Section 3-05) to take advantage of the higher pool elevation maintained for endangered species, the current defacto top of recreation pool elevation is 1100 feet (335.3 m). This elevation is within the lower range of lake elevations where boat ramp accessibility to the lake is possible. The Water Control Plan does not require specific operational releases from Alamo Dam for recreation; however, the releases made within the authorized recreational pool between El 990 to El 1070 (301.8 to 326.1 m) are those necessary to satisfy water rights, defined as an average release of 10 cfs (reference Section 7-14). Releases from elevation 1070 feet (326.1 m) up to elevation 1125 feet (342.9 m) benefits the fish and wildlife

objectives described in Section 7-08. These releases benefit recreational objectives in that lake fluctuations are kept minimal and promote recreational aesthetics such as preventing the "bathtub ring" effect around the lake shoreline.

The recreation facilities can function within an elevation range from 1094 to 1144 feet (333.5 to 348.7 m), which includes the optimal 1115 to 1125-foot (339.9 to 342.9 m) operating range for boat access and overall recreational benefits. The highest range of lake elevations affording boat ramp accessibility is from 1154 to 1178 feet (351.7 to 359.1 m). Recreational facilities at Alamo Lake consist of boat launching ramps, campgrounds, and appurtenant structures. All recreational facilities are operated and maintained by the Arizona State Parks Department.

#### **7-07. Water Quality**

Alamo Dam is not operated specifically for water quality enhancement. The relative contribution to the Colorado River by the Bill Williams River releases is low, however, Alamo Dam can be operated in coordination with the Colorado River Project to benefit overall water quality in the Colorado River.

#### **7-08. Fish and Wildlife**

**a. Riparian Releases.** The Water Control Plan was derived in accordance with the USFWS' Biological Opinion (Exhibit D) to achieve adequate long-term water to support riparian habitat along the Bill Williams River. Reservoir releases provided on Plate 7-02 are the result of adjustments based on the water needs of the riparian habitat, in coordination with the natural resource agencies (USFWS, AGF, and BLM). Riparian releases range from 25 – 50 cfs (0.71 – 1.4 cms), up to the maximum outlet capacity of 7,000 cfs (198.2 cms). Releases made within the higher reservoir elevations have the desired effect of "high flushing" flows which also fosters cottonwood-willow habitat regeneration rehabilitating and sustaining the riparian corridor resources downstream from Alamo Dam.

**b. Fisheries.** Part of the continuing benefits derived from the prescribed Water Control Plan is that sport fishery resources at Alamo Lake are maintained, as well as provide a possible secondary fishery in the Bill Williams River below the dam for warm water fish and native fish. Alamo Lake contains a variety of warm water sport fish, including largemouth bass, which has made Alamo Lake one of the premier warm water fishing lakes in Arizona. Other non-native fish downstream of the dam include channel catfish, carp, green sunfish, and red shiners; however, the emphasis of maintenance through the Water Control Plan is largely in support of the existing warm water fishery or establishing a native fish fishery.

**c. Wildlife.** In general, all species within its assigned scope of concern benefits from the prescribed Water Control Plan. The Wildlife Subcommittee determined that all threatened and endangered species, neotropical migratory birds, other sensitive species, waterfowl, and other wildlife best benefit from the creation and maintenance of a healthy, diverse riparian ecosystem along the Bill Williams River corridor below Alamo Dam. It was determined that only under extreme, prolonged drought conditions would water management needs of the species at Alamo Lake conflict with maintenance of a healthy riparian ecosystem downstream.

Since the early 1980's specific efforts have been made to sustain the population of the Bald Eagles. Pairs of Bald Eagles, an endangered species, have been observed within the Alamo Lake area. The regulation of Alamo Lake provides a minimum pool for sufficient foraging area for nesting eagles all year round. In addition to the habitat for the Bald Eagles, favorable nesting areas are also provided for the Southwestern Willow Flycatchers, which were recently declared endangered without critical habitat in February 1995. The Corps, USFWS, and the Arizona Game and Fish Department (AGF), as necessary, will continue to coordinate efforts to minimize adverse impacts to bald eagle and Southwestern Willow Flycatchers' nests within the reservoir area.

#### **7-09. Water Conservation**

The water conservation pool is between elevations 1070 and 1160.4 feet (326.1 and 353.7 m), regulated to enhance the Colorado River water supply. The schedule of normal releases for the water conservation pool is shown on Plate 7-02. These releases are designed to balance water conservation, wildlife enhancement and water rights objectives. Actual releases may be modified with the agreement between Corps and the other agencies that have an interest in Alamo Dam operations. The goal is to at all times manage the water conservation pool to maximize project benefits. SPL will coordinate all water conservation releases with USBR reservoir operations, as well as coordinate with other Federal agencies and State agencies that have interests and concerns along the Bill Williams River and lower Colorado River.

#### **7-10. Hydroelectric Power**

There are no hydroelectric facilities at Alamo Dam. Consequently, there is no operation for hydroelectric power.

#### **7-11. Navigation Operation**

There are no operational releases made from Alamo Dam for navigation purposes.

#### **7-12. Drought Contingency Plans**

The Drought Contingency Plan for Alamo Dam and Lake was completed in June 1992 under the authority of ER 1110-2-1941, dated 15 September 1981. This plan is designed to alleviate water shortages for the following entities: Central Arizona Project; Metropolitan Water District of Southern California; Mexico; Gila Gravity Main Canal; the All American Canal System; and Arizona Department of Water Resources. Copies of the plan are located in the Reservoir Regulation Section of SPL.

### **7-13. Flood Emergency Action Plan**

A flood emergency action plan for Alamo Dam was prepared in accordance with ER 1130-2-419 (Dam Operations Management, dated 18 May 1978) and ER 1110-2-1802 (Reporting Earthquake Effects, dated 25 July 1979). The plan, entitled "Emergency Action and Notification Subplan -- Alamo Dam", dated July 1986, covers identification of impending and existing emergencies, emergency operations and repairs, and post earthquake response procedures. Downstream areas potentially subject to inundation are identified for the case of dam failure with reservoir at full capacity, spillway crest elevation of 1235 feet (376.4 m). Copies of this plan are in the Reservoir Operations Center (ROC) and the Emergency Operations Center (EOC) of SPL and at the dam site.

### **7-14. Water Rights**

The original (August 1970) edition of the Alamo Dam Water Control Manual indicates that no vested water rights had been determined at the time that the manual was published, but that a study of past records indicated that releasing inflow up to a maximum of 10 cfs would satisfy water rights. While there are a few large water right claims downstream of Alamo Dam (which are well in excess of 10 cfs), none of these rights have undergone an adjudication, and hence, have some uncertainties associated with them. At present, water rights remain unadjudicated. The 10 cfs release specified in the original water control manual served as a starting point for formulating alternative operation plans during the Bill Williams River Corridor Technical Committee Study and is a basic feature of the adopted water control plan. Except during flood events, inflows are normally 1 to 3 cfs. In the absence of any other releases, an average minimum release of 10 cfs will be made at all times. If it is necessary to shut off all releases due to inspection, maintenance, or repair activities, subsequent releases will be increased, if necessary, to maintain a daily 10 cfs average outflow.

## 7-15. Inspection and Maintenance

a. **Monthly Gate Exercise.** In order to ensure that the outlet works gates remain functional throughout the year, a monthly gate exercise is performed on the first Monday of each month. The exercise may be postponed, if conditions so warrant. The monthly gate exercise is accomplished as follows:

- 1) The dam tender checks with the ROC for permission to perform the exercise.
- 2) The dam tender checks the downstream channel from the dam to the USGS streamgage immediately downstream to ensure no one is in the area.
- 3) All service gates and the low-flow butterfly valve are closed.
- 4) Each emergency gate is fully closed.
- 5) Each service gate is fully opened and then closed. The low-flow butterfly valve is also fully opened and closed.
- 6) Each emergency gate is fully opened.
- 7) Releases prior to the gate exercise are resumed.

### b. **Outlet Tunnel Inspection and Maintenance Operation.**

(1) **Lower Portion of Outlet Tunnel.** When inspections or short-term repairs are to be conducted on the outlet tunnel downstream from the emergency gates, releases are shut off, as necessary, in order to accomplish these tasks. Compensating releases to satisfy downstream water requirements will be coordinated with the other agencies, as appropriate, once the inspection/repairs are completed.

**(2) Upper Portion of Outlet Tunnel**. The opportunity for inspecting the upper portion of the outlet tunnel would not be scheduled until the lake level recedes low enough, through normal operation of the dam, to allow installation of the bulkhead. The elevation at which the bulkhead can be installed is at, or below, 1110 feet (338.3 m). Should an emergency situation arise where inspection/maintenance of the upstream tunnel is required, and the lake level is above elevation 1110 feet (338.3 m), then the lake level will be drawn down in order to facilitate emergency inspection/maintenance activities. Once the bulkhead is in place, the Corps will receive daily inflow forecasts from the National Weather Service's Colorado Basin River Forecast Center (CRFC) in Salt Lake City. If the CRFC forecasts that inflows from a storm event are large enough to cause the lake water surface elevation to rise above 1110 feet (338.3 m), the Corps will immediately commence removing the bulkhead and placing Alamo Dam back into operation.

Removing the bulkhead is a two-step process. The first step is to equalize hydrostatic pressure on both sides of the bulkhead by opening the 6-inch (15.24 cm) filling line. The filling process takes about 10 hours. The second step is the removal of the bulkhead using divers and cables from barges in the lake. The barges are positioned in a manner such that there is a minimal angle of pull between the orientation of the gate guides and the barge cable winch. This requirement is to minimize lateral stresses on the gate guide A-frame structure, which, if significant enough, could result in a structure failure. However, if there is an extreme exigency for removal of the bulkhead wherein mobilization of the barges would take an inordinate amount of time, an alternate procedure can be followed. This procedure calls for the lifting of the bulkhead by using winches located on the operation and maintenance access road. Details of this procedure are contained in the following document: "Bulkhead Gate Instructions for Placing and Removing, Alamo Dam Outlet Gate Rehabilitation, Mohave and Yuma Counties, Arizona, DACW09-90-C-0027."

**7-16. Deviation from Normal Regulation**

Deviations from normal operation inevitably occur, because every possible circumstance affecting the operation of the dam cannot be covered in the water control plan. Guidance for covering deviations from approved water control plans within the South Pacific Division (SPD) is contained in Regulation CESP R 1110-2-8, dated 12 September 2002 (Exhibit E). This guidance describes the types of deviations and the procedures for implementing these deviations.

Approval for all deviations must be obtained from the SPD Commander. An emergency deviation situation may warrant an immediate action, rendering prior approval impossible. All planned deviations, however, must be approved by the SPD commander or delegated representative prior to their implementation. SPD approval authority for deviations is delegated to the Chief of the Water Management Team or his/her designated representative. The Chief, Water Management Team shall consult with the Chief, Technical Engineering and Construction Division, and appropriate CESP Staff. The Director of Military and Technical Services shall be advised by Division staff of the temporary change to the Water Control Plan. Approval may be made by telephone, E-mail, or FAX.

The preparation and funding for processing the deviation request is provided by the agency requesting the deviation. The deviation request must undergo an independent technical review (ITR) process by an independent technical review team (ITRT) within the LA District. Upon completion of the ITR process, a District certification is prepared, and sent to SPD with the deviation request package for acceptance and approval of the deviation request. Processing a deviation request can be costly and time consuming, and because an incomplete or inadequate package can delay approval, SPL personnel are encouraged to coordinate any questions or concerns about potential deviations and to discuss any atypical situations with their SPD counterparts early in the process.

#### **7-17. Rate of Release Change**

The maximum rates of release change are listed in Plate 7-02. These rates of release change values were selected to prevent rapid changes in downstream flows and river stages that would pose a safety hazard to the public.