GZA
GeoEnvironmental, Inc.

Engineers and Scientists

December 2, 2009
GZA File No. 01.0170142.10

Lockheed Martin Services Inc.
REAC Program
2890 Woodbridge Avenue
Edison, New Jersey 08837-3679

Attention: Mr. Dennis Miller

Re: Task 3 Dam Assessment - Final Report
Project #0-381
SRP Coronado Generating Station Evaporation Pond Dam
Apache County, Arizona

One Edgewater Drive
Norwood, MA 02062
781-278-3700
FAX 781-278-5701
www.gza.com

Dear Mr. Miller:

In accordance with our proposal 01.P0000018.10, dated May 8, 2009, and Lockheed Martin P.O. 7100051898 dated June 1, 2009, GZA GeoEnvironmental, Inc. (GZA) has completed our inspection of the Salt River Project Coronado Generating Station Evaporation Pond Dam located in Apache County, Arizona. The site visit was conducted on September 9 and 10, 2009. The purpose of our efforts was to provide Lockheed Martin and the U.S. Environmental Protection Agency (EPA) with a site specific inspection of the dam to assist EPA in assessing the structural stability of the dam under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e). The Final Report addresses comments received from the EPA and from dam owner, Salt River Project Coronado Generating Station. We are submitting one hard copy and one CD-ROM copy of this Final Report directly to Lockheed Martin and the EPA.

Based on our visual inspection, and in accordance with the EPA's criteria, the dam is currently in **SATISFACTORY** condition, in our opinion. Further discussion of our evaluation and recommended actions are presented in the Task 3 Dam Assessment Report. The report includes: (a) a completed Coal Combustion Dam Inspection Checklist Form; (b) a field sketch; and (c) selected photographs with captions. Our services and report are subject to the Limitations found in **Appendix A** and the Terms and Conditions of our contract agreement.

We are happy to have been able to assist you with this inspection and appreciate the opportunity to continue to provide you with dam engineering consulting services. Please contact the undersigned if you have any questions or comments regarding the content of this Task 3 Dam Assessment Report.

Sincerely,

GZA GeoEnvironmental, Inc.

Walter Kosinski, P.E. (AZ)
Principal

Chad W. Cox, P.E. (MA)
Consultant/Reviewer

Peter H, Baril, P.E. (MA)
Project Director

EXECUTIVE SUMMARY

This Phase I Inspection/Evaluation Report presents the results of a visual dam inspection of the Salt River Project – Coronado Generating Station (SRP/CGS) Evaporation Pond Dam located off U.S. Highway 191 in Apache County, Arizona. The inspection was performed on September 9 and 10, 2009 by representatives of GZA GeoEnvironmental, Inc (GZA), accompanied by representatives of SRP/CGS the U.S. Environmental Protection Agency (EPA).

The SRP/CGS Evaporation Pond Dam, in its current configuration, has a maximum height of approximately 53 feet above the natural ground surface, and an original maximum storage volume of approximately 5,900 acre-feet at the Spillway Design Flood elevation of 5821.9 feet. Under U.S. Army Corps of Engineers and State of Arizona guidelines, the dam is classified as an **Intermediate** size structure.

The Hazard Potential Classification for the SRP/CGS Evaporation Pond Dam is **Significant** under both the EPA and State of Arizona hazard rating criteria due to the potential flooding of the SRP/CGS plant access road, U.S. Highway 191, potential interruption of power generation, and environmental mitigation requirements which might result from a sudden release of impounded Coal Combustion Waste (CCW).

GZA also observed that secondary settling ponds have been and are being constructed upstream of the dam, within the drainage area of the dam. The settling ponds are formed by earthfill embankment structures, and are located immediately east of the Evaporation Pond adjacent to a dry landfill that is used for disposal of dry CCW.

Based on the results of the visual inspection, discussions with SRP/CGS personnel, and a review of available design documentation, the following deficiencies were noted at the dam:

1. Significant erosion of the unlined emergency spillway side slopes;
2. Surface crack adjacent to the left slope of the emergency spillway channel;
3. Presence of vegetation in the emergency spillway channel approach area;
4. Presence of erosion gullies along the left and right downstream abutment groins, along the left upstream abutment groin, and near the downstream toe of the dam at the secondary containment structure;
5. Presence of roots within, and thick brush around, left toe drain manhole;
6. PVC piping connecting the left toe drain manhole to the sump is leaking;
7. Unknown operability of embankment piezometers;
8. Unknown condition of left toe drain collection pipe; and
9. Lower markings on the staff gage are difficult to read.

GZA recommends that the owner arrange for the following to be performed at the dam:

Studies and Analyses:

1. Confirm and update the hydrologic and hydraulic analysis for the dam using updated methodology and the as-built configuration of the dam. The analysis should consider

flooding up to the Probable Maximum Flood (PMF), and should verify the maximum operating pool for the Pond with respect to the regulatory Spillway Design Flood (SDF), which is currently defined as the ½ PMF using U.S Army Corps of Engineers criteria. The analysis should also consider the construction of a fixed weir in the spillway channel and the armoring of the spillway side slopes.

2. Evaluate the surface crack on top of the left slope of the emergency spillway channel (along the dam axis by surface settlement monument #10). Monitor the surface crack for signs of additional movement or enlargement.

3. Conduct a camera survey of the interior of the left and right toe drain seepage collection pipes to evaluate the condition of the pipe section alignment, joints, and any potential blockage.

4. Investigate operability of the six embankment piezometers. If the piezometers are found to be operable, then make baseline readings and implement an annual monitoring program. If the piezometers are found to be inoperable, then attempt to make repairs. If repairs are not possible, GZA recommends decommissioning and abandoning the piezometers and installing new open tube piezometers in the embankment.

5. Monitor toe drain seepage clarity at the toe drain manhole (rather than sump), including visual observations of water clarity and monthly measurements of turbidity. A contingency plan should also be prepared if high flow rates or increased turbidity are observed in the seepage water.

6. Evaluate the impacts of the new flue gas desulfurization system (under construction) on SO_2 slurry discharge rates to the Evaporation Pond, including an evaluation of the long-term filling rate of the Pond and the potential for future Stage 2 dam construction.

7. Collect/develop documentation of the "As-Built" configuration of the two settling pond embankments and appurtenant structures.

8. Investigate the potential impacts of an embankment failure of the two settling pond embankments, including an evaluation of the resulting flood wave impact to the Evaporation Pond Dam.

Operations and Maintenance Activities:

1. Develop a formal, written Operations and Maintenance Plan. The Plan should combine Arizona Department of Environmental Quality (ADEQ) Aquifer Protection Permit (APP), Arizona Department of Water Resources (ADWR), and other regulatory requirements with routine operations and maintenance procedures and record-keeping activities for the Dam.

2. Make monthly measurements of Pond water surface elevation and wastewater/slurry flow to Pond.

3. If operable, take annual readings at the embankment piezometers.

4. Monitor left toe drain discharge channel and downstream secondary containment area for presence of wet, soggy soil or unusual vegetative growth.

5. Clear vegetation from emergency spillway approach channel area, and remove sediment as it accumulates.

6. Repair/replace staff gage markers so that Pond water surface elevation can be easily read from the upstream slope of the dam. A distinct marking should be provided at the maximum operating level.

7. Investigate operability of the meteorological instruments on top of the dam. Remove instruments if inoperable.

Minor Repairs:

1. Repair erosion gullies along the left and right downstream abutment groins, the left upstream abutment groin, and near the downstream toe of the dam at the secondary containment structure. Repair eroded upstream slope at the left abutment and reset any displaced riprap stones. Implement erosion control measures (riprap lining, check dams, vegetative barriers, etc.) to prevent further channel erosion and headcutting.

2. Remove roots from left toe drain manhole and repair any damage from shrub growth and/or root penetration.

3. Repair/replace leaking PVC piping connecting left toe drain manhole to sump. Minimizing leakage from this pipe will help eliminate a potential source of saturated soil in downstream secondary containment area.

Remedial Measures:

1. In conjunction with the results of the updated hydrologic and hydraulic analyses, repair the emergency spillway side slopes along the length of the channel. Provide grading and/or other means to direct surface runoff away from the channel slopes, especially along the axis of the dam. Repairs must address the area along the dam axis where a longitudinal crack at the top of the left spillway side slope was observed. Consider improvements, as needed, to stabilize the spillway side slopes and invert control elevation.

With respect to the Environmental Protection Agency's (EPA's) inquiry concerning whether any portion of the embankment was constructed upon coal ash slimes (known to GZA as TDF-5 and containing three specific questions), GZA provides the following response:

Question 1. "Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? - Based on available information, the Evaporation Pond Dam ("Dam") was built on natural ground that was reportedly stripped of unsuitable materials prior to placement of the embankment materials. The Dam was constructed in conjunction with the construction of the Coronado Generating Station, and no Coal Combustion Wastes (CCW) were being generated at the time of Dam construction. The Dam was designed and

constructed by Bechtel Corporation, and as-built design drawings are available along with documentation of materials used in the embankment construction. A typical section of the embankment and foundation is provided as Figure 10. It is, therefore, believed that the embankment was not built over wet ash, slag, or other unsuitable materials.

Question 2. "Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?" - The inspection team did not meet with the original designer, Bechtel Engineering, or the Engineer-of-Record William Page Ehinger (AZ P.E. 7420). GZA did have the opportunity to review the design documentation that was on file with SRP/CGS, and obtained copies of the design report, as-built drawings, selected geotechnical exploration and testing data, and selected construction correspondence. The design report and as-built drawings include detailed information about the site geology, preparation of foundation materials, and construction of the cutoff trench.

Question 3. "From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dam?" - Based on our visual inspection, and a review of available aerial photography, GZA did not observe evidence of prior releases, failures, or patchwork at the dam.

PREFACE

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection, along with data available to the inspection team. In cases where an impoundment is lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions, which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is critical to note that the condition of the dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Prepared by:

GZA GeoEnvironmental, Inc.

Walter Kosinski, P.E.
Arizona License No.: 44849

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\Report\SRP Preface.doc

EVAPORATION POND DAM
SALT RIVER PROJECT – CORONADO GENERATING STATION
APACHE COUNTY, ARIZONA

TABLE OF CONTENTS

1.0 DESCRIPTION OF PROJECT 1

1.1 Genera1 1
1.1.1 Authority 1
1.1.2 Scope of Work 1
1.1.3 Definitions 1
1.2 Description of Project 2
1.2.1 Location 2
1.2.2 Owner/Caretaker 2
1.2.3 Purpose of the Dam & Dikes 2
1.2.4 Description of the Dam and Appurtenances 3
1.2.5 Operations and Maintenance 6
1.2.6 Size Classification 7
1.2.7 Hazard Potential Classification 7
1.3 Pertinent Engineering Data 8
1.3.1 Drainage Area 8
1.3.2 Reservoir 9
1.3.3 Discharges at the Dam Site 9
1.3.4 General Elevations 10
1.3.5 Spillway Data 10
1.3.6 Design and Construction Records and History 11
1.3.7 Operating Records 12
1.3.8 Previous Inspection Reports 12

2.0 INSPECTION 14

2.1 Visual Inspection 14
2.1.1 General Findings 14
2.1.2 Upstream Slope 14
2.1.3 Top of Dam 14
2.1.4 Downstream Slope 15
2.1.5 Emergency Spillway 15
2.1.6 Seepage Collection System 16
2.2 Caretaker Interview 17
2.3 Operation and Maintenance Procedures 17
2.4 Emergency Action Plan 17
2.5 Hydrologic/Hydraulic Data 17
2.6 Structural and Seepage Stability 19
2.6.1 Slope Stability Analysis 19
2.6.2 Seepage Analysis 19
2.6.3 Foundation Liquefaction and Settlement Analyses 20

TABLE OF CONTENTS (Cont'd)

3.0 ASSESSMENTS AND RECOMMENDATIONS 20

3.1 Assessments 20
3.2 Studies and Analyses 21
3.3 Recurrent Operations & Maintenance Recommendations 22
3.4 Repair Recommendations 22
3.5 Remedial Modifications Recommendations 23
3.6 Alternatives 23

4.0 ENGINEER'S CERTIFICATION 23

FIGURES

Figure 1 Site Location Map
Figure 2 Orthophoto Location Map
Figure 3 Downstream Area Map
Figure 4 Drainage Area Map
Figure 5 Overall Site Plan
Figure 6 Evaporation Pond Dam Plan
Figure 7 Evaporation Pond Dam Photo Plan
Figure 8 Spillway Release Inundation Map
Figure 9 Dam Break - Release Inundation Map
Figure 10 Evaporation Reservoir Dam Plan and Typical Section (As-Built Drawing)

APPENDICES

Appendix A Limitations
Appendix B Photographs
Appendix C Inspection Checklists
Appendix D Definitions
Appendix E EPA Reference Document List
Appendix F Draft Report Comments and GZA Response to Comments

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The United States Environmental Protection Agency (EPA), through Lockheed Martin Corporation (LM), has retained GZA GeoEnvironmental, Inc. (GZA) to perform a visual inspection and develop a report of conditions for the Salt River Project Agricultural Improvement and Power District (SRP, Owner) Coronado Generating Station (CGS) Evaporation Pond Dam in Apache County, Arizona. This inspection was authorized by the EPA under the authority of the Comprehensive Environmental response, Compensation, and Liability Act (CERCLA) Section 104(e). This inspection and report were performed in accordance with Task 3 of Lockheed Martin Competitive RFP for Assessment of Dam Safety of Coal Combustion Surface Impoundments, EAC-0381, dated March 17, 2009. The inspection generally conformed to the requirements of the Federal Guidelines for Dam Safety[1], and this report is subject to the limitations contained in **Appendix A** and the Terms and Conditions of our Contract Agreement. A Draft of this report was issued by GZA on October 9, 2009. Comments from the EPA, SRP, and the Arizona Department of Water Resources (ADWR) were received by GZA on November 20, 2009. Copies of these comments and GZA's responses are included in **Appendix F**.

1.1.2 Purpose of Work

The purpose of this investigation was to visually inspect and evaluate the present condition of the dam and appurtenant structures (the management unit) to attempt to identify conditions that may adversely affect their structural stability and functionality, to note the extent of any deterioration that may be observed, review the status of maintenance and needed repairs, and to evaluate the conformity with current design and construction standards of care.

The investigation was divided into four parts: 1) obtain and review available reports, investigations, and data from the Owner pertaining to the dam and appurtenant structures; 2) perform an on site review with the Owner of available design, inspection, and maintenance data and procedures for the management unit; 3) perform a visual inspection of the site; and 4) prepare and submit a draft and a final report presenting the evaluation of the structure, including recommendations and proposed remedial actions.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in **Appendix D**. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; 5) general; and 6) condition rating.

[1] FEMA/ICODS, April 2004: http://www.ferc.gov/industries/hydropower/safety/guidelines/fema-93.pdf

1.2 Description of Project

1.2.1 Location

The Salt River Project Coronado Generating Station (SRP/CGS) is located about six miles northeast of the Town of Saint Johns in Apache County, Arizona. The entrance to the site is on State Route 61/U.S. Highway 191. The SRP/CGS Evaporation Pond Dam is located about two miles southwest of the power plant, at latitude 34 ˚ 33' 30" North - longitude 109 ˚ 17' 43" West. A site locus of the dam and surrounding area is shown in **Figure 1**. An aerial photograph of the dam and surrounding area is provided as **Figure 2**. The dam can be accessed by vehicles from two earthen access roads off the main SRP/CGS plant access road.

1.2.2 Owner/Caretaker

The dam is owned by the Salt River Project Agricultural Improvement and Power District, a political subdivision of the State of Arizona. The dam is operated by the Salt River Project Coronado Generating Station.

	Dam Owner/Caretaker
Name	Salt River Project Agricultural Improvement and Power District, Coronado Generating Station
Mailing Address	Mail Station CGS600 P.O. Box 1018
City, State, Zip	St. Johns, AZ 85936
Contact	William D. Beck, P.E
Title	Plant Manager
E-Mail	bill.beck@srpnet.com
Daytime Phone	928-337-5501
Emergency Phone	911 / 928-337-2211 (CGS Shift Supervisor)

1.2.3 Purpose of the Dam

The SRP/CGS is a two-unit coal-fired power plant, with a maximum generating capacity of approximately 912 Megawatts. Commercial operation of the facility began in 1979. The Evaporation Pond Dam was constructed in conjunction with the CGS facility for the purpose of storing and disposing non-recyclable plant wastewater and Coal Combustion Wastes (CCW) from the CGS facility. The wastewater is permitted to include discharge from the plant wastewater reservoir, the sulfur dioxide (SO_2) scrubber sludge/fly ash slurry mixture, ash process water, area rinse water, and stormwater runoff including that from the ash disposal area.[2] Plant operations staff have indicated that due to the characteristics of the coal currently being used, coal ash products are now primarily disposed of by dry trucking to a landfill area adjacent to the Evaporation Pond. The wastewater and scrubber slurry are pumped from the

[2] Final Aquifer Protection Permit (APP) No. P-101449-4477-31312, Salt River Project (SRP) Coronado Generating Station, Arizona Department of Environmental Quality, August 24, 2004.

plant to the Evaporation Pond via two 10-inch diameter high-density polyethylene (HDPE) pipelines.[3] The dam was designed so that wastewater and scrubber slurry liquids are lost to evaporation, and the maximum operating level is maintained such that the dam can contain runoff from floods up to the 100-year return period without discharge from the spillway. Fly ash and bottom ash from the CGS facility are disposed of in a dry landfill within the Evaporation Pond Dam drainage area, to the east of the impoundment. Fly ash and bottom ash are transported to the landfill by truck.

1.2.4 Description of the Dam and Appurtenances

The design and construction of the embankment dam is described in the August 1976 "Report on Investigation and Design of Proposed Evaporation Reservoir Dam" and the August 1977 "Supplementary Report on Investigation and Design of Evaporation Reservoir Dam", and also shown in the September 1980 "Final Issue As-Built Configuration" Drawings, by Bechtel of Los Angeles, California. The following description of the dam is based on the design reports, as-built drawings, and field observations by GZA.

The Evaporation Pond Dam is located at the northern end of the Evaporation Pond, and spans a broad, dry wash with intermittent streams. The dam was designed to provide for an initial embankment and for a planned Stage 2 expansion which would raise the dam by 30 feet by adding fill on the top of dam and the downstream slope. The Stage 2 expansion has not been constructed, and is not anticipated at this time. Note that the Stage 2 dam profile is shown with a dashed line on the "Typical Dam Section" provided in **Figure 10**.

The dam consists of a zoned earthfill embankment with a crest length of approximately 3,300 feet and a general height (from the lowest toe elevation to the top of dam) of approximately 53 feet. Arizona dam safety statutes define dam height as the "hydraulic height", or the distance from the lowest toe elevation to the spillway crest. Using this criteria, the dam height is approximately 44.7 feet. The maximum structural height of the dam is 75 feet, which is measured as the vertical distance between the lowest elevation of the cutoff trench and the top of dam elevation. The top of the dam has a width of approximately 60 feet and an elevation of approximately 5825 feet, Mean Sea Level (MSL). The top of the dam has a surface cover of gravel, and was graded with a minor crown to promote upstream and downstream drainage. Based on the latest top of dam survey by SRP on October 22, 2008, , the top of dam elevation varies from about 5824.9 feet MSL to about 5826.0 feet MSL.[4]

The upstream slope of the dam has a slope of approximately 2.5 horizontal to 1 vertical (2.5H:1V), and an approximately 47-foot wide bench at elevation 5810 feet MSL. Below the berm, the upstream slope is reportedly covered with a soil cement layer with a thickness of approximately two feet nine inches. Above the berm, the upstream slope is covered with an approximately 18-inch layer of riprap over an approximately 15-inch bedding layer. According to the design report, the upstream berm was constructed to provide adequate factors of safety in the event that the dam was to be raised to the "Stage 2" dam crest elevation of 5855 feet MSL. The downstream slope of the dam has a slope of approximately 2.5H:1V and a surface cover of gravel/crushed stone.

[3] Coal Combustion Waste Disposal Overview Presentation by SRP Coronado Generating Station, presented to EPA Region 9 and GZA, September 9, 2009.
[4] "Generating Station Evaporation Ponds Monitoring Report, by Salt River Project, October 22, 2008..

The zoned embankment is comprised of an outer shell, an inner core, a cutoff trench, and a drainage collection system consisting of a vertical chimney drain and horizontal drainage blanket. The outer shell of the embankment consists of sandy soils excavated from borrow areas adjacent to the dam. The inner core consists of silty and clayey sands excavated from borrow areas on site. The inner core has a 1H:1V slope on the upstream side, and a vertical downstream slope. At the top of the dam, the inner core has a cover of approximately 1.5 feet.

The cutoff trench consists of recompacted material from the Chinle Formation, described as a bentonitic clay shale formation underlying the dam and impoundment area. Along the majority of the dam, the cutoff trench was excavated through a layer of alluvium sand and approximately 15 feet into the underlying Chinle Formation. At the left and right abutments, the cutoff trench was excavated through the alluvium and/or the Bidahochi Formation and approximately 20 feet into the underlying Chinle Formation. The Bidahochi Formation is described as a poorly cemented sandstone with gravel, ash beds, and some travertine, and is exposed in upland areas adjacent to the right and left abutment of the dam.

The cutoff trench was constructed along the entire length of the dam, and the excavation proceeded into the Chinle Formation to a depth below the desiccated and weathered upper surface of the formation. The cutoff trench was constructed with 1.5H:1V side slopes through the alluvium sand and/or Bidahochi formation,. In the Chinle Formation, the cutoff trench was reportedly constructed with 1H:1V side slopes, and the trench has a minimum bottom width of approximately 25 feet. On the downstream side of the cutoff, the trench has an approximately 5-foot wide graded sand filter that separates the recompacted Chinle Formation material and the undisturbed Chinle Formation. The original ground surface under the embankment shells was reported to have been stripped of topsoil and unsuitable material to a depth of one foot.

Along the downstream edge of the inner core, the embankment has a 4 to 8-foot wide vertical chimney drain constructed of “clean” sand and gravel (i.e. sand and gravel with little or no fine-grained soil). The design drawings show an 8-foot wide chimney drain, however, the chimney drain was reportedly constructed with a width of 4 feet in areas where the outer shell materials were physically separated (by boards) from the chimney drain material during placement and compaction. A horizontal drainage blanket was constructed along the base of the downstream embankment shell to collect seepage form the chimney drain and adjacent areas. The drainage blanket extends from the base of the chimney drain downstream to the toe of the embankment. The drainage blanket consists of an approximately 1.5-foot thick layer of clean sand and gravel overlain by a 2-foot thick layer of gravel or crushed rock, both of which are overlain by a 1.5 to 1-foot thick layer of clean sand and gravel. The drainage blanket was constructed directly on the prepared subgrade of alluvium sand and is overlain by the downstream outer shell of the dam.

The drainage blanket ends at a toe drain collection pipe approximately 25 feet upstream of the downstream toe of the dam. The toe drain collection pipe carries drainage to two manholes located at the toe of the dam. The pipe size and material are not known, however based on the visible portion of the toe drain collection pipes at the manholes, the drain pipes appear to be constructed of corrugated metal pipe (CMP). Each toe drain manhole has a vitrified clay overflow pipe to discharge water to the downstream dry wash channel. Surrounding each of the two toe drain manholes are secondary containment berms that have been constructed to contain discharge from the manholes. The secondary containment berms

were constructed in accordance with the Arizona Department of Environmental Quality (ADEQ) Aquifer Protection Permit (APP). Following construction of the dam, the right toe drain has remained dry, and the left toe drain has been observed to discharge on the order of 1 gallon per minute (gpm). In order to more effectively contain the left toe drain discharge, SRP/CGS personnel constructed a sump well adjacent to the left toe drain manhole, and connected the manhole discharge pipe to the sump well with PVC piping. The sump well consists of a buried, vertical corrugated metal pipe (CMP) with a concrete bottom and a steel plate covering the opening. A gas-powered pump is located on the steel plate, with an intake line into the sump well, and a discharge/recirculation line that carries collected seepage water back into the Evaporation Pond. The recirculation line is buried along the downstream slope and top of dam, and is exposed on the upstream riprap slope.

Under normal operating conditions, the only means for "discharging" liquids from the Evaporation Pond is via evaporation. The only outlet for the dam is an approximately 1,290-foot long, 10-foot wide unlined, trapezoidal earthen channel cut into natural ground at the right abutment. The outlet is considered an emergency spillway, and is designed to pass flow only during floods exceeding the 100-year return period provided that the initial water surface in the Pond does not exceed the maximum operating level. The emergency spillway was designed to pass the ½ Probable Maximum Flood (½ PMF) with adequate freeboard at the dam. A further discussion of the hydrology and hydraulics of the dam and emergency spillway are provided in Section 2.5.

The emergency spillway channel was excavated into the underlying Chinle and Bidahochi formations along the right abutment of the dam. The channel has a trapezoidal cross-section, a minimum 10-foot wide bottom width and 1.5H:1V side slopes. Based on the current inspection, the spillway channel has an average bottom width of approximately 12 feet. Upstream of the control section, the approach channel has a bottom width of 25 feet. At the downstream end, the channel has a 75-foot long transition from an approximately 10-foot bottom width to an approximately 50-foot bottom width, where the channel ties into a broad, flat dry wash channel. Based on the as-built configuration of the dam[5], in areas where the channel was excavated a minimum of 10 feet into natural ground, the channel was constructed with a 1.5H:1V lower slope and 1.5H:1V upper slope, divided by a 1-foot wide berm six feet above the invert of the channel. In areas where the channel was excavated less than 10 feet into natural ground, the upper slope was constructed at 2.5H:1V. Near the downstream end of the channel, a portion of the side slopes were built above the natural ground surface,

Original instrumentation at the dam includes ten surface settlement markers installed along the top of the dam, six piezometers installed in the embankment, a staff gage on the upstream embankment slope, and several observation wells in the downstream area. Additional survey monuments have also been installed on the downstream slope of the dam and around the Pond as part of a groundwater study conducted in the 1990s. Meteorological instruments were also installed on the top of the dam, and include instruments for measuring rainfall, evaporation, and wind speed. The ten surface settlement markers were constructed with bronze caps placed on bases of concrete along the top of the dam. The six piezometers were installed in two groups of three, with three piezometers installed along the left downstream embankment and three installed along the right downstream embankment. The piezometers were located so that

[5] Evaporation Reservoir Emergency Spillway Plan, Profile, and Sections, Drawing No. 13-C-ZHC-015, Final Issue As-Built Configuration, Bechtel Corporation, September 30, 1980.

readings could be taken within the embankment inner core, downstream of the chimney drain in the downstream embankment outer shell, and in the underlying alluvium and Chinle Formation.

More information on the construction and performance history of the dam is provided in Sections 1.3.6, 1.3.8, and 2.5 of this report.

1.2.5 Operations and Maintenance

The dam and its impoundment are operated and maintained by SRP/CGS personnel. Operations of the dam are limited to the operation of the pumps and supply line through which wastewater is supplied to the Evaporation Pond, and operation of the toe drain sump pump to pump accumulated left toe drain discharge back into the Evaporation Pond. Maintenance of the dam includes annual herbicide application and deep-rooted vegetation removal, and occasional maintenance of the spillway channel and abutment areas to repair areas of erosion and sediment deposition.

Operation and maintenance of the SRP/CGS facility, including the Evaporation Pond Dam, is regulated by the EPA under the National Pollutant Discharge Elimination System (NPDES) Permit No. AZMSG-8526. Operation and maintenance of the dam is also regulated by the ADWR Office of Water Engineering – Dam Safety Section, and the ADEQ. The dam and its impoundment are a regulated by ADEQ as part of the SRP/CGS Aquifer Protection Permit (APP No. P-101449-4477-31312). The current maximum operating pool elevation is 5815.5 feet MSL, which is condition of the ADWR License of Approval for the dam. According to SRP, the maximum operating pool elevation of 5815.5 feet MSL is based on the maximum operating pool at which the 100-year return period flood can be contained within the impoundment without discharge from the emergency spillway. Note that the "final as-built" drawings for the dam show a maximum operating level of 5812.5 feet MSL, however it appears that the maximum operating pool was changed to its current level some time after construction of the dam.

As part of the ADEQ APP, SRP/CGS personnel monitor the dam according to a series of performance standards. These performance standards include:

- Bi-weekly pumping of collected toe drain seepage water from the left toe drain sump back into the Evaporation Pond.
- Monthly visual observations of the condition of the dam, condition of the wastewater/slurry pipeline, condition of the toe drain sump and pump, and monthly measurements of the toe drain seepage flow rate.
- Annual monitoring for movement of the survey monuments, and annual reporting of all monitoring results to ADEQ. Copies of the annual survey monument monitoring reports are also required by ADWR.

Based on our discussions with SRP/CGS, the weekly and monthly monitoring of the dam and pumping of water from the seepage collection sump is performed by SRP/CGS personnel, and the annual monitoring of the survey monuments on the dam is performed by SRP Engineering Personnel. SRP/CGS personnel also indicated that as part of their operations, they had constructed two secondary containment embankments to serve as settling ponds prior to

discharge into the Evaporation Pond. The settling ponds were designed and maintained to limit the normal pool volume of the ponds to less than 50 acre-feet. SRP/CGS reports that the two settling ponds are no longer operational.

As part of the ADWR Division of Safety of Dams program, the Evaporation Pond Dam is inspected every 3 years by ADWR Dam Safety personnel. A report of the ADWR visual inspection, including recommended actions to correct any deficiencies, is sent to SRP/CGS personnel following each inspection. In order to maintain the ADWR License of Approval, SRP/CGS is required to address any deficiencies noted in the inspection, and provide ADWR with documentation that the noted deficiencies have been addressed.

Based on our discussions with SRP/CGS personnel, the operations and maintenance of the dam is consistent with the performance requirements under the ADEQ APP and the ADWR License of Approval.

1.2.6 Size Classification

For the purposes of this EPA-mandated inspection, the size of the dam and its impoundment will be based on U. S. Army Corps of Engineers (COE) criteria. Based on the maximum height of 53 feet and the original design maximum storage volume of 5,900 acre-feet (at the maximum SDF elevation of 5821.9 feet MSL), the dam is classified as an **Intermediate** sized structure. According to guidelines established by the U.S. Army Corps of Engineers, dams with a storage volume between 1,000 and 50,000 acre-feet and/or a height between 40 and 100 feet are classified as Intermediate sized structures. It is noted that the State of Arizona uses the same size classification guidelines as the Corps of Engineers, and under State of Arizona Administrative Code section R12-15-1206, the dam is also classified as an **Intermediate** sized structure. Note that this size classification is based on the current dam configuration without Stage 2 expansion.

The maximum dam height of approximately 53 feet is based on the height of the dam above the natural ground surface. Based on the as-built design drawings for the dam, the top of the dam has an elevation of approximately 5825 feet, and the low point along the toe of the dam has an elevation of approximately 5772 feet. This dam height is consistent with the dam height of 53 feet reported by ADWR in the 2008 Inspection Checklist. Also note that the dam height of 53 feet does not include the depth of the cutoff trench that was excavated into natural ground. Including the depth of the cutoff trench, the maximum structural height of the dam is approximately 75 feet, which is consistent with the structural height reported by ADWR in the 2008 Inspection Checklist.

1.2.7 Hazard Potential Classification

The Evaporation Pond Dam has been classified as a **Significant** hazard potential structure by the ADWR Dam Safety Section, in accordance with the hazard rating system defined in the State of Arizona Administrative Code section R12-15-1206. Under Arizona Code, Significant hazard potential is defined as follows:

> *Significant Hazard Potential. Failure or improper operation of a dam would be unlikely to result in loss of human life but may cause significant or high economic loss, intangible damage requiring major mitigation, and disruption or*

impact on lifeline facilities. Property losses would occur in a predominantly rural or agricultural area with a transient population but significant infrastructure.

Under the EPA classification system, as presented on page 2 of the EPA check list (**Appendix C**) and Definitions section (**Appendix D**), it is GZA's opinion that the Evaporation Pond Dam would also be considered as having a **Significant** hazard potential. The hazard potential rating is based on the lack of human habitation within the anticipated dam break inundation area[6], the presence of the CGS plant access road and electrical transmission lines downstream of the dam, and the potential environmental impacts and interruption of power generation due to a failure of the dam and subsequent loss of impoundment capacity. The area downstream of the dam is shown in **Figure 3**, and the dam break inundation area from the Evaporation Pond Dam Emergency Action Plan is shown in **Figure 9**.

1.3 Pertinent Engineering Data

1.3.1 Drainage Area

Based on the original design documents and as estimated by GZA, the Evaporation Pond Dam has a contributory drainage area of approximately 2.98 square miles[7]. The drainage area is undeveloped, and consists of low rolling hills and broad, flat washes. Elevations within the drainage area range from approximately 6013 feet to 5775 feet MSL.

A small earthen embankment is located within the maximum pool area. The embankment was reportedly constructed to provide a watering location for cattle, and forms a small pond noted as "Alejandro Tank" on the USGS Saint Johns North Quadrangle Map. The small embankment is located within the maximum operating pool of the Evaporation Pond, and no longer impounds water above the elevation of the Evaporation Pond under normal condition. The drainage area has a sparse vegetative cover. Along the eastern limit of the drainage area is a landfill operated by SRP/CGS that receives bottom ash and fly ash from plant operations. The ash is transported to the landfill by truck from the plant.

In addition to the landfill, two settling ponds have been constructed within the drainage area, adjacent to the Evaporation Pond (See **Figure 5**). Under current operating procedures, the wastewater and SO_2 scrubber slurry pumped from the plant discharges either to the active (southern) settling pond or directly into the Evaporation Pond. SRP/CGS personnel operate valves along the HPDE wastewater/slurry pipeline to direct discharges to the active settling pond, or directly into the Evaporation Pond. The larger of the two settling ponds also receives surface stormwater runoff from the adjacent Coal Ash Landfill. The settling ponds were not visited by GZA during the Evaporation Pond Dam inspection; however the ponds were visible from the adjacent Coal Ash Landfill (See Photos 39 and 40).

At the time of inspection, wastewater/slurry was being discharged directly to the Evaporation Pond. Based on discussions with SRP/CGS, the settling ponds have been constructed to provide some level of sedimentation for the pumped wastewater and slurry prior

[6] Coronado Generating Station Evaporation Pond Dam Break – Release Inundation Map, Revised December 9, 2008

[7] Evaporation Reservoir Hydrologic Data, Drawing No. 13-C-ZHC-012/1, Bechtel Corporation, April 1981

to discharge to the Evaporation Pond Dam. SRP/CGS reported that the embankment berms/dams that impound the ponds are not regulated under State of Arizona dam safety regulations. Based on GZA's limited observations, it appeared that two main settling ponds had previously been used by SRP/CGS. SRP/CGS reports that the two settling ponds are no longer used in CCW operations. The smaller settling pond is located near the northern end of the Coal Ash Landfill, and consists of a small U-shaped earthen embankment with a side-hill configuration. During GZA's site inspection, the smaller (northern) settling pond was not in use, and the level of sediment in the smaller pond was up to about 3 feet below the top of the containment berm. Based on available aerial photographs, the smaller pond has a surface area of approximately 6 acres and is formed by an embankment with a length of approximately 1,500 feet. The larger (southern) settling pond and embankment is actively impounding previously-discharged wastewater/slurry from the plant as well as runoff from the Coal Ash Landfill. Based on available aerial photographs, the larger pond has a surface area of approximately 21 acres and is formed by an embankment with a length of approximately 1,300 feet[8]. SRP/CGS personnel indicated that water control in the larger settling pond is via a riser pipe outlet. The two settling ponds have been constructed adjacent to the Evaporation Pond, and are situated such that all discharge or flows from an embankment failure would flow to the Evaporation Pond and be contained by the dam

1.3.2 Reservoir

The Evaporation Pond is located within a broad, dry wash area that is underlain by the naturally-impervious Chinle Formation. The location of the dam and impoundment were selected based on the low permeability of the underlying Chinle Formation, which is an integral part of the design to keep wastewaters out of the surrounding groundwater. The reservoir is surrounded by low, rolling hills, and the shoreline is sparsely vegetated.

Aerial surveys of the impoundment area were conducted on October 21, 1980 by SRP and on March 1, 2009 by Isaacson Engineering, Inc. of Saint Johns, Arizona for SRP. Based on the results of the initial 1980 survey, at the spillway crest elevation of 5816.7 feet MSL, the pond was estimated to have a surface area of 290 acres and a storage volume of 3,365 acre-feet. At the time of the 2009 survey, the pond had a surface area of approximately 172 acres and an estimated total storage volume (including sludge/solids and open water) of 2,264 acre-feet. At the time of the survey the water surface elevation in the Pond was approximately 5,812.0 feet MSL, or 4.7 feet below the spillway crest. Using the 2009 survey, Isaacson Engineering estimated the volume of accumulated sludge/solids to be approximately 1,519 acre-feet, or approximately 45-percent of the storage volume of the pond at the spillway crest elevation. Note that the current maximum operating pool elevation for the dam is elevation 5815.5 feet MSL, or 1.2 feet below the spillway crest.

1.3.3 Discharges at the Dam Site

Under normal conditions, and in accordance with the ADEQ APP, no discharges occur from the dam. The emergency spillway at the dam is designed to pass floods greater in magnitude than the 100-year return period flood. Based on discussions with SRP/CGS personnel, in the 30 years of continuous operation, the Pond has never reached the level of the emergency spillway.

[8] USDA Farm Service Agency, National Agriculture Imagery Program (NAIP), 2007.

Seepage from the dam is collected in two toe drain collection pipes, which discharge at two manholes at the toe of the dam. SRP/CGS personnel report that a flow on the order of 1 gpm has consistently been observed discharging from the left toe drain collection pipe. In order to prevent toe drain discharge to the downstream area (and potentially reach the underlying groundwater), secondary containment berms have been constructed around the left and right toe drain manholes, and an overflow pipe and sump well have been constructed to collect seepage from the left toe drain. In accordance with the performance standards of the ADEQ APP, SRP/CGS personnel operate a gas-powered pump to pump accumulated seepage water from the left toe drain sump back into the Evaporation Pond.

Evaporation Pond water level measurements and wastewater/slurry pumping rates were provided by SRP/CGS. The measurements cover a time range from 1986 through 2006, and are based on approximately monthly measurements. Based on discussions with SRP/CGS personnel, since 2006 records of water level and pumping rates have not been recorded, however personnel routinely make visual observations of the Evaporation Pond to verify that the water level is below the current maximum operating level of 5815.5 feet MSL.

1.3.4 General Elevations (feet – MSL)

Elevations are taken from design drawings, reports, and survey monument monitoring data provided by SRP. Elevations are based upon the USGS topographic map MSL vertical datum.

A.	Top of Dam (Minimum)	5824.9 feet[9]
B.	Spillway Design Flood Pool (Design)	5821.9 feet
C.	Normal Pool (Maximum Operating Pool)	5815.5 feet[10]
D.	Spillway Crest	5816.7 feet
E.	Upstream Water at Time of Inspection	± 5810.0 feet
F.	Downstream Tail Water at Time of Inspection	None (No tailwater)
G.	Low Point along Toe of Dam	± 5772 feet
H.	Low Point of Cutoff Trench	± 5750 feet

1.3.5 Spillway Data[11]

A.	Type	Trapezoidal, unlined earthen open channel
B.	Weir Length	No fixed weir, ± 10 foot bottom width (minimum)
C.	Weir Crest/Control Elevation	5816.7 feet (No hard control)
D.	Upstream Channel	5815.5 feet
E.	Downstream Channel	5815.5 feet

[9] Based on lowest elevation of dam crest survey monuments, as surveyed on October 22, 2008 by Salt River Project, Coronado Generating Station Evaporation Ponds Monitoring Report.
[10] Based on License of Approval, State of Arizona Department of Water Resources Division of Safety of Dams, July 24, 1981.
[11] Spillway Elevations based on "Final Issue As-Built Configuration" Drawing 13-C-ZHC-015, Bechtel Corporation, September 30, 1980

1.3.6 Design and Construction Records and History

The dam was designed and constructed by Bechtel Corporation of Los Angeles, California in the late 1970s. Geotechnical investigation and laboratory testing was performed by Sergent, Hauskins, and Beckwith of Phoenix, Arizona. Additional geotechnical laboratory testing was performed by Geo-Testing, Incorporated of San Rafael, California. SRP/CGS maintains a file of design and construction records for the dam, the contents of which were made available to GZA.

The primary design records for the dam include the August 1976 "Report on Investigation and Design of Proposed Evaporation Reservoir Dam", the September 1977 "Addendum to Report on Investigation and Design of Proposed Evaporation Reservoir Dam", and the August 1977 "Supplementary Report on Investigation and Design of Evaporation Reservoir Dam". Construction records for the dam include extensive geotechnical exploration data, materials testing data, embankment construction and compaction data, and construction correspondence. The design records include extensive geologic and geotechnical information about the existing site geology, geotechnical and hydrologic properties of the underlying geologic formations and materials testing data for the on-site borrow materials used in construction of the embankment. Included in the original investigation and design of the dam was the potential addition of a second embankment section that would raise the height of the dam by approximately 30 feet, if required due to filling of the initial impoundment area or construction of additional units at the plant. In the as-built drawings, the dam as constructed is noted as the "Stage 1" dam, and the raised dam is noted as "Stage 2" dam.

Construction of the dam began in September of 1977 and was completed in March of 1979. Based on the as-built drawings of the dam and construction records, the foundation of the embankment was prepared by stripping a minimum 1-foot layer of topsoil and unconsolidated alluvium sand. Underlying the thin layer of alluvium is the Chinle Formation, which was noted to have a desiccated and "fluffy" upper layer approximately six inches to one foot thick. The Chinle Formation was noted to have surface cracks up to 1 inch wide. The cutoff trench for the embankment was excavated through the alluvium sand and into the Chinle Formation a minimum of one foot below any open joints. In order to avoid drying and subsequent cracking of the Chinle Formation, final excavation/grading of the cutoff trench surfaces was delayed until immediately prior to placement of fill material.

Initial design records indicated that the entire upstream slope of the dam (above and below the berm) was to be constructed with an outer layer of stone riprap. Based on construction correspondence, the embankment slope cover located below the berm was changed from riprap to a compacted soil cement mixture. It appears that the decision to use soil cement was made due to the lack of adequate local sources of stone. Other design changes of note involve the design and construction of the emergency spillway. Based on design records, the emergency spillway was originally designed to have a fixed weir with a crest elevation of 5817 feet MSL, and the channel bottom and side slopes were to be armored with asphalt. A design change was made to delete the fixed crest weir and spillway lining from the design, and the spillway was constructed as an unlined channel with no fixed weir section. Based on available construction correspondence, it appears that the design engineers had concerns that a fixed weir constructed on the highly plastic Chinle formation would have the potential to move (rise) due to swelling of the Chinle clay. The as-built drawing of the emergency spillway reflects the design change, and shows a spot elevation of 5816.7 feet MSL, apparently the spillway invert

elevation. It is unclear if the design invert elevation was changed from 5817 feet to 5816.7 feet MSL, or if the omitted fixed weir was to extend 0.3 feet above the channel, but never built.

1.3.7 Operating Records

Some operations records were provided to GZA by SRP/CGS. It appears that SRP/CGS personnel previously made monthly measurements of Evaporation Pond water surface elevations and monthly average wastewater/slurry flow rates to the Pond. A graph of this data was made available to GZA, and shows the Pond level and average flow rate from 1986 through 2006. Evaporation Pond water level measurements were also provided for the period from December 1981 to April 1983. Based on conversations with SRP/CGS, visual observations of the Pond level are made during the bi-weekly visits to the dam required under the ADEQ APP, however written records of Pond elevation have not been kept since early 2006. Based on the available water level and wastewater flow data, the Evaporation Pond rose to the maximum recorded level of approximately 5814.2 feet MSL in early 2003, corresponding to the maximum recorded flow rate into the Pond of approximately 1,250 GPM. Since early 2003, the Pond level has generally decreased to its present level of approximately 5810 feet MSL, corresponding to lowering flow rates into the Pond. SRP/CGS reports that, in recent years, changes have been made to increase the efficiency of plant water recycling and subsequently reduce the flow of plant wastewater to the Evaporation Pond. These changes have been made in order to prolong the service life of the dam.

Written records for the piezometers in the embankment were not available to GZA, and SRP/CGS reports that the piezometers have not been routinely read for several years and their condition is unknown. As part of the ADEQ APP, SRP/CGS personnel monitor an observation well downstream of the dam for the presence of water. SRP/CGS reports that the observation well has been dry at the time of each measurement. A number of additional observation wells are located in the area of the dam and Evaporation Pond. These observation wells were used during an extensive hydrogeological monitoring program that was performed from 1992 to 1994 to evaluate the impact of the Evaporation Pond on the surrounding groundwater[12].

1.3.8 Previous Inspection Reports

Visual inspections of the Evaporation Pond Dam are conducted by the ADWR Office of Water Engineering – Dam Safety Section every 3 years. Visual inspections have also been conducted by SRP personnel, including a 1979 Summary Inspection of the dam following completion of construction, and several annual SRP Safety of Dams inspections from the 1980s.

In September 1979, SRP Civil Engineering conducted a summary inspection of the dam. Based on the results of the 1979 inspection, SRP considered the dam to be "structurally adequate and safe for continued operation". Key recommendations in the report included:

- Repair erosion in emergency spillway channel, and address drainage of stormwater from right abutment into channel;

[12] "SRP/EPRI Coronado Generating Station FGD Pond Project Review Meeting", John Goodrich-Mahoney, Electric Power Research Institute, Larry Holcombe, Radian Corporation, and Jim Erickson, GeoTrans, Inc., June 7, 1994.

- Measure Pond level at staff gage, and inflow rate weekly, and develop a monthly maximum working level for Pond; and,
- Evaluate the need for lining the emergency spillway or constructing the Stage 2 dam before Pond reaches elevation 5806.5 feet (level at which the Pond can contain the ½ PMF without spillway discharge).

On May 8, 1984, SRP Safety of Dams conducted a visual inspection of the dam. Based on the results of the 1984 inspection, the key SRP recommendations were to fine-grade the emergency spillway channel to address channel erosion, and to conduct semi-annual analyses of toe drain seepage water, including analysis of suspended solids, total dissolved solids, and turbidity. On May 30, 1989, SRP Safety of Dams conducted a visual inspection of the dam. Based on the results of the 1989 inspection, SRP recommended modifying the fence across the emergency spillway channel so that it would break away with spillway flow, and backfilling around the toe drain seepage recirculation line and the right piezometer standpipe.

The two most recent inspections of the dam by the ADWR Dam Safety Section were conducted on September 27, 2005 and on September 12, 2008. In the 2005 ADWR report, key recommendations include:

- Repair the erosion gully in along the right downstream groin;
- Repair the erosion of side slopes and deposition of sediment in the emergency spillway channel, and clear channel on an annual basis unless slopes are armored;
- Address emergency spillway channel erosion from the right abutment area; and,
- Clear trees and vegetation from the emergency spillway approach channel.

In the 2008 ADWR report, key recommendations included:

- Clear emergency spillway channel and regrade to maintain crest at elevation 5816.7 feet MSL, and seed side slopes to prevent erosion;
- Preparation of an Operations and Maintenance plan recommended;
- Update Emergency Action Plan (EAP) contact information;
- Repair erosion gullies at the left and right downstream groin areas; and,
- Measure seepage from left toe drain and investigate condition of right toe drain.

Following the 2008 ADWR Report, SRP/CGS operations and maintenance personnel performed work and conducted investigations based on the ADWR recommendations. SRP/CGS provided GZA with documentation of the action items and dates that various items were completed[13]. Based on the SRP/CGS summary, the EAP contact information was completed in December 2008, the left toe drain seepage was measured and checked for the presence of fine sediment in December 2008, the emergency spillway channel was regraded in March 2009, and dead branches were added to the downstream abutment groin erosion gullies to "reduce water velocity and stabilize gulley bottom" in March 2009.

[13] Table Summary of Action Items for CGS Evaporation Pond Dam (01.46) – ADWR Dam Safety Inspection Report, SRP/CGS, December 5, 2008.

2.0 INSPECTION

2.1 Visual Inspection

The SRP/CGS Evaporation Pond Dam was inspected on September 9 and 10, 2009 by Walter Kosinski, P.E., Chad W. Cox, P.E. (Massachusetts), and Gregory W. Hunt of GZA GeoEnvironmental, Inc., accompanied by John Schofield of the EPA. The inspection was conducted over the course of two days. For both days, the weather was clear with temperatures in the 70°s to 80°s Fahrenheit. Photographs to document the current conditions of the dam were taken during the inspection and are included in **Appendix B**. At the time of the inspection, the water level in the Pond was approximately 5810 feet MSL, based on the staff gage located on the upstream embankment slope. Underwater areas were not inspected, as this level of investigation was beyond of GZA's scope of services. A copy of the EPA Checklist and a separate copy of the GZA inspection checklist are included in **Appendix C**.

With respect to our visual inspection, there was no evidence of prior releases, failures, or patchwork observed by GZA.

2.1.1 General Findings

In general, the SRP/CGS Evaporation Pond Dam was found to be in **SATISFACTORY** condition. The specific concerns are identified in more detail in the sections below. An overall site plan showing the Evaporation Pond Dam, settling ponds, and Coal Ash Landfill is provided as **Figure 5**. A site plan showing key features of the Evaporation Pond Dam, including deficiencies observed during the current inspection, is provided as **Figure 6**. The location and orientation of photographs provided in **Appendix B** is shown on the Photo Plan in **Figure 7**. The location of photographs of the two settling ponds is shown on the Overall Site Plan in **Figure 5**.

2.1.2 Upstream Slope (Photos 1, 2, 3, 23 through 27)

The Pond water surface elevation at the time of inspection was approximately equal to the upstream berm at elevation 5810 feet MSL. Therefore, the lower portion of the upstream slope was underwater and not visible. The upstream slope above the berm was in good condition. Minor shrub growth is present between riprap stones, especially near the right abutment contact. No unusual movement or sloughing was observed in the slope. At the left abutment contact, runoff from the left abutment area had eroded a gully along the left upstream abutment groin. The left edge of the upstream riprap slope has been degraded by the erosion, and several riprap stones have been undermined and displaced (Photos 26 and 27). The erosion gully appears to have cut approximately 2 to 3 feet into the edge of the riprap slope.

2.1.3 Top of Dam (Photos 1, 4, 21, 25)

The top of the dam has a gravel cover, with some grasses and small shrubs. The top of dam has minor ruts along the entire length from vehicular traffic. The alignment of the top of dam appeared generally level, with no depressions or irregularities observed. The ten survey

markers along the top of the dam are intact and are surveyed annually by SRP personnel. As-built drawings of the dam indicate that the top of dam elevation ranges from elevation 5825.0 feet to elevation 5825.8 feet MSL (Surface settlement monuments 2 – 10). Based on the most recent survey of the monuments in October 2008, the maximum settlement along the top of the dam was approximately 2 inches. Some small areas of dead vegetation were observed on top of the dam, which should be removed to allow for better visual inspection of the surface.

2.1.4 Downstream Slope (Photos 5 through 8, 20, 28)

The downstream slope of the dam is generally in good condition. The surface cover of the slope is gravel, with some grasses and small shrubs. Some minor erosion rills were observed along several areas of the slope. No unusual movement or sloughing was observed in the slope. A gravel access road runs along the toe of the downstream slope. The access road is in good condition, with minor rutting on the surface. As noted in two most recent ADWR inspections conducted in 2005 and 2008, erosion gullies are present along the right and left downstream abutment contacts/groins. In both left and right erosion gullies, SRP/CGS personnel have placed some dead branches in an effort to stabilize the channels and prevent further erosion. Based on the current inspection, it appeared that additional erosion protection of the channels may be necessary to prevent further channel cutting.

Additional erosion was observed at the toe of the downstream slope, especially to the right of the left toe drain manhole, where surface runoff appears to be eroding a channel in the secondary containment berm. Some minor to moderate erosion was observed on the slopes adjacent to the left and right toe drain manhole (Photos 9 and 10) and on the containment berm.

2.1.5 Emergency Spillway (Photos 29 through 35)

The water level in the Pond is controlled by the rate of pumped wastewater into the Pond, surface runoff from the drainage area, and evaporation. At the time of inspection, the water level in the Pond was approximately seven feet below the emergency spillway crest. Since the Dam was put into service in 1979, the Pond has never reached the level of the emergency spillway. The emergency spillway has, however, required continual maintenance due to the unlined earthen channel bottom and side slopes. Prior to the current inspection, and following the ADWR 2008 inspection, SRP/CGS personnel regraded the bottom of the spillway channel and repaired some of the side slope erosion. SRP/CGS reports that the channel bottom was surveyed, and was graded to restore the channel invert elevation of 5816.7 feet MSL.

At the time of inspection, the channel bottom was generally clear and no additional accumulation of sediment was observed. In the approach area where the Chinle formation clay is exposed, the channel bottom had several desiccation cracks. The channel side slopes were in fair to poor condition, with erosion channels cut into the slopes along the entire channel length. The most severe erosion was observed in line with the dam axis, where excavation for the proposed Stage 2 dam appears to channel runoff into the spillway channel. An earthen berm was constructed in this area to control the erosion (Photo 34), however the spillway channel continues to receive runoff from the surrounding area, and the side slopes continue to experience significant erosion (Photo 35).

A surface crack was observed on natural ground adjacent to the emergency spillway channel. The surface crack was located near the top of the left channel slope, transverse to the

axis of the dam, where a cut appears to have been made into natural ground to the top of dam elevation. The surface crack was visible along the width of the cut (Photos 36 though 38). The surface crack appeared to be a tension crack, and is located above a steep section of the left channel slope. At its widest point, the crack was about 6 inches wide, and was manually probed with a ruler to a depth of about 28 inches. The surface crack passes underneath the concrete base of survey monument #10, which was surveyed by SRP on October 22, 2008. Based on the SRP survey, the survey monument (BC 10) has moved 0.01 feet to the North and 0.15 feet to the East since the previous year's reading (date unknown). This movement of approximately 2 inches to the East is consistent with the observed crack alignment—the east side of the crack appears to be moving towards the emergency spillway. Previous annual survey reports were not provided to GZA; therefore, long-term movement of the survey monument #10 was not able to be evaluated.

Upstream of the excavated emergency spillway channel, in the channel approach area, is an area of vegetative growth including thick brush and tall shrubs. The presence of this vegetation was noted in the 2005 ADWR Inspection Report, which recommended that the vegetation be removed. The vegetation observed during the current inspection appears to be consistent to that shown in the 2005 ADWR Report photos.

2.1.6 Seepage Collection System (Photos 9 through 18)

The seepage collection system in the embankment consists of a vertical chimney drain, a horizontal seepage blanket, and two seepage collection pipes that discharge to two manholes at the toe of the dam. Based on conversations with SRP, and a review of available documentation, the left (west) toe drain has discharged at a fairly constant rate of about 1 gpm since the dam was put into service. Flow has never been observed discharging from the right (east) toe drain manhole.

During the current inspection, the left toe drain was discharging to the manhole, and subsequently the sump, at a rate on the order of 1 gallon per minute (gpm). SRP reported that the latest flow measurement of the left drain was approximately 0.6 gpm. The left toe drain manhole was opened, and was filled with water up to the level of the discharge/overflow pipe. The water within the manhole appeared to be clear, with no visible suspended solids. The area immediately around the left manhole is covered with thick brush, and roots from the surrounding brush have penetrated into the manhole. Within the manhole, roots were visible below the water line.

The left manhole discharge/overflow pipe is connected to a PVC pipeline that connects the manhole to the sump. The PVC piping is visible above ground at the upstream end, and buried closer to the sump. Some leakage was visible in the above-ground section of PVC pipe, especially at the pipe connections. The bottom of the discharge channel had a dry surface crust; however, the underlying soil was soft and wet. Further downstream of the manhole, the discharge channel enters into an oval-shaped secondary containment area formed by earthen berms. Within this containment area, the ground was soft and wet; however, there were no visible signs of seepage. On the upstream side of the containment area (at the downstream toe of the dam), an erosion gully was observed on the downstream slope of the ground between the containment area and the dam embankment. The erosion gully appeared to be headcutting upstream in the direction of the toe of the dam.

2.2 Caretaker Interview

Maintenance of the dam is the responsibility of SRP/CGS personnel. GZA met with SRP/CGS personnel and discussed the current operations and maintenance procedures, regulatory requirements, and the history of the dam since its construction in 1979. Ken Isaacson, formerly of SRP/CGS, was present during the construction of the dam, and provided valuable information about current and past operations and maintenance procedures at the dam.

2.3 Operation and Maintenance Procedures

As discussed in Section 1.2.5, SRP/CGS personnel are responsible for the regular operations and maintenance of the dam. Routine maintenance procedures include an annual vegetative maintenance program, consisting of the removal of deep-rooted vegetation from the embankment and application of herbicides. In order to mitigate the continued erosion along the left and right downstream abutment groins, SRP/CPS personnel have placed woody debris removed from the dam into the erosion gullies. Routine operations of the dam includes the daily operation of wastewater/slurry pumps at the CGS plant to discharge wastewater to the Pond, and weekly visits to the dam to pump accumulated toe drain seepage from the left toe drain sump back into the Pond. On a monthly basis, SRP/CGS personnel make visual observations of the dam to look for signs of deterioration or damage. On an annual basis, the SRP Survey Department visits the dam to take position and elevation readings of the survey monuments on the dam.

2.4 Emergency Action Plan

An Emergency Action Plan (EAP) was originally developed for the dam on September 20, 2005, and later revised on December 9, 2008. The EAP includes a description of potential emergency situations at the dam, emergency remedial actions, a description of available emergency resources, and a description and map of the estimated spillway release and dam break inundation areas (**Figures 8 and 9**). Based on the EAP, no inhabited structures are located within the estimated spillway release or dam break inundation areas, however, in the event of discharge from the dam, traffic may need to be stopped on the CGS Access Road and U.S. Highway 191 downstream of the dam as sections of both roads are within the projected inundation area which could result in flow over the road surfaces and/or damage to the road Note that the hazard potential classification for the dam is discussed in Section 1.2.7 on Page 7.

2.5 Hydrologic/Hydraulic Data

GZA did not perform an independent assessment of the hydraulics and hydrology for the dam as this was beyond our scope of services. However, we did review available design documentation for the dam and emergency spillway.

A summary of the hydrologic and hydraulic analyses prepared for the design of the dam and emergency spillway are presented in the August 1976 Report on Investigation and Design of Proposed Evaporation Reservoir Dam, and the September 1976 Addendum to the same report. According to the design reports, the Spillway Design Flood (SDF) for the dam was chosen to be one-half the Probable Maximum Flood (½ PMF). The SDF was selected based on the U.S.

Army Corps of Engineers guidelines for an intermediate size, low hazard potential dam (note that the U.S. Army Corps of Engineers hazard potential rating system is different than that used by the State of Arizona and the EPA). In addition, due to the nature of the impoundment, the dam and emergency spillway were designed so that the 24-hour, 100-year flood would be stored in the impoundment without discharge from the emergency spillway provided that the initial water surface elevation in the pond did not exceed the maximum operating level.

The SDF was estimated by Bechtel using the 24-hour Probable Maximum Precipitation (PMP) amount of 20.4 inches[14]. The PMP precipitation was distributed into 15 minute time increments using procedures suggested by the National Weather Service[15]. The ½ PMF hydrograph was estimated using one-half of the runoff from the PMP, and assuming that the rainfall would instantly runoff to the dam site (i.e. Time of Concentration being zero). The ½ PMF was estimated to have a peak inflow of 21,300 cubic feet per second (cfs) and a runoff volume of 1,560 acre-feet. The ½ PMF hydrograph was routed through the reservoir with a starting water surface elevation of 5818 feet MSL, and results in a reported maximum water surface elevation of 5,821.9 feet MSL, and a maximum discharge of 450 cfs from the emergency spillway. Note that this routing assumes that the emergency spillway has a bottom width of 18 feet, and the analysis appears to be based on the assumption that the spillway invert is at an elevation of 5818 feet.

Bechtel also analyzed the dam under 100-year flood conditions, the results of which were used to determine the invert elevation of the emergency spillway. Based on the results of the analysis, the 24-hour, 100-year flood was estimated to result in 320 acre-feet of runoff. With a starting water surface elevation of 5817 feet MSL, the 100-year flood would result in a maximum water surface elevation of 5818 feet MSL—the proposed elevation of the emergency spillway invert during the design phase. It appears that the dam and emergency spillway were designed under the conservative assumption that the water surface in the Pond would start at elevation 5817 feet MSL (proposed maximum operating level), then a 100-year flood would raise the Pond to the spillway crest elevation of 5818 feet MSL, and then the ½ PMF would result in a maximum pool of 5821.9 feet MSL. Under this scenario, the maximum ½ PMF flood pool would leave about 3.0 feet of minimum freeboard at the dam, which allows for wave action on the embankment.

Based on the available as-built documentation of the dam, there appears to have been a number of design changes that were made following the 1976 design report. The main changes affecting the emergency spillway include the omission of a fixed weir from the spillway channel, the final invert elevation of the channel, and the final channel bottom width. It appears that the fixed weir was eliminated from the construction of the emergency spillway, and the channel was constructed with a bottom width of 10 feet and a control invert elevation of 5816.7 feet MSL. Note that during the current inspection, the bottom width of the emergency spillway channel was measured to be approximately 12 feet near the apparent spillway crest. It was noted that re-grading of the spillway channel and removal of accumulated sediment may have widened the spillway from 10 feet to 12 feet. In addition, the maximum operating pool appears to have changed from an elevation of 5817 feet MSL in the 1976 design report, to an elevation of 5812.5

[14] "Generalized Estimates of Probably Maximum Precipitation for the United States West of the 105th Meridian," Technical Paper No. 38, U.S. Weather Bureau, Washington, D.C., 1960.
[15] "Probable Maximum Thunderstorm Precipitation Estimates, Southwest States," Preliminary Draft, John T. Ridel and E. Marshall Hanson, National Weather Service, March 1973.

feet MSL shown in the as-built drawings, and to the current maximum operating elevation of 5815.5 feet MSL.

Based on the aforementioned design and construction documents, and discussions with SRP, there appears to be some potentially contradictory information as to the final configuration of the emergency spillway and the maximum operating level for the Pond. Based on our limited review of project data, it appears that changes were made during the construction of the dam that may not have been well documented, and it is unknown if an updated hydrologic and hydraulic analysis of the dam was performed using the as-built configuration of the emergency spillway. GZA recommends that SRP review all available hydrologic and hydraulic data for the dam to determine the as-built design values for the spillway crest, maximum operating level, and the maximum spillway design flood pool. In addition, an updated hydrologic and hydraulic analysis of the dam is recommended using updated methodology and current hydrologic data. It is noted that the incremental storage volume available in the Pond between elevation 5815.5 feet MSL and the spillway crest at elevation 5816.7 feet MSL is approximately 500 acre-feet based on the Volume versus Elevation graph provided in the April 1981 Bechtel as-built drawing 13-C-ZHC-012/1. This incremental volume is greater than the effective runoff volume for the 100-year flood described in the design documents. This may have been the rationale for raising the maximum operating pool level to elevation 5815.5 feet MSL, but this should be confirmed.

2.6 Structural and Seepage Stability

As part of the original design, Bechtel analyzed the dam for slope stability, foundation liquefaction, foundation settlement, and embankment seepage. The structural and seepage stability analyses are presented in the August 1976 Report and the August 1977 Supplemental Report by Bechtel.

2.6.1 Slope Stability Analyses

For the embankment slope stability analyses, Bechtel analyzed the embankment under normal loading, steady state seepage loading, and steady state seepage loading combined with a seismic horizontal acceleration of 0.1 g. For all loading conditions, the dam was found to have satisfactory factors of safety. In addition, Bechtel analyzed the Stage 2 dam under the same conditions, and noted that the upstream berm constructed as part of the Stage 1 dam is only needed to provide adequate factors of safety for the Stage 2 dam (and was conservatively not used in the Stage 1 dam analysis). It is noted that the slope stability analysis did not include an analysis of the embankment under SDF (maximum pool) loading; however the steady state pool that was analyzed by Bechtel reflects a Pond elevation of 5817 feet MSL, which is above the current (as-built) spillway invert elevation. The flow through the uncontrolled spillway would serve to lower the pond and limit the duration over which the Pond would remain at maximum pool.

2.6.2 Seepage Analysis

In order to control seepage, the embankment was designed with a compacted clay core. Based on laboratory tests, the core material was estimated to have a permeability ranging from 0.4 to 500 feet per year (3.9×10^{-7} to 4.8×10^{-4} centimeters/second). Bechtel performed a seepage analysis using a coefficient of permeability of 300 feet per year (2.98×10^{-4} centimeters/second). Based on the results of the analysis, Bechtel estimated a seepage loss

through the dam of approximately 200 gpm, using a water surface elevation in the Pond of 5817 feet MSL (maximum operating level during design stage). SRP/CGS reports that seepage rates observed have been significantly less.

2.6.3 Foundation Liquefaction and Settlement Analyses

Bechtel evaluated the potential for soil liquefaction in the foundation alluvium layer. The liquefaction potential of the granular materials in the foundation was analyzed using the Seed and Idriss method, and assuming an acceleration of 0.1g and 10 stress cycles. Based on the results of the analysis, Bechtel concluded that the granular foundation materials are not susceptible to liquefaction under design earthquake loading conditions.

Bechtel also evaluated the settlement potential of the foundation materials due to embankment loading. The settlement analysis was performed using computer modeling methods, using estimated values for the undrained modulus for the foundation materials and laboratory values for the consolidation characteristics of the Chinle clay. Based on the results of the analysis, Bechtel estimated that the total maximum foundation settlement for the embankment is on the order of 7 inches; including 4 inches of (short-term) elastic settlement following embankment loading and 3 inches of (long-term) consolidation settlement. Settlement from the compression of embankment materials was found to be insignificant.

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

In general, the overall condition of SRP/CGS Evaporation Pond Dam is judged to be **SATISFACTORY**. The dam was found to have the following deficiencies:

1. Significant erosion of the unlined emergency spillway side slopes;
2. Surface crack adjacent to the left slope of the emergency spillway channel;
3. Presence of vegetation in the emergency spillway channel approach area;
4. Presence of erosion gullies along the left and right downstream abutment groins, along the left upstream abutment groin, and near the downstream toe of the dam at the secondary containment structure;
5. Presence of roots within, and thick brush around, left toe drain manhole;
6. PVC piping connecting the left toe drain manhole to the sump is leaking;
7. Unknown operability of embankment piezometers;
8. Unknown condition of left toe drain collection pipe; and
9. Lower markings on the staff gage are difficult to read.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of the appropriate regulatory agencies.

3.2 Studies and Analyses

GZA recommends the following studies and analyses:

1. Confirm and update the hydrologic and hydraulic analysis for the dam using updated methodology and the as-built configuration of the dam. The analysis should consider flooding up to the Probable Maximum Flood (PMF), and should verify the maximum operating pool for the Pond with respect to the regulatory Spillway Design Flood (SDF), which is currently defined as the ½ PMF using U.S Army Corps of Engineers criteria. The analysis should also consider the construction of a fixed weir in the spillway channel and the armoring of the spillway side slopes.

2. Evaluate the surface crack on top of the left slope of the emergency spillway channel (along the dam axis by surface settlement monument #10). Monitor the surface crack for signs of additional movement or enlargement.

3. Conduct a camera survey of the interior of the left and right toe drain seepage collection pipes to evaluate the condition of the pipe section alignment, joints, and any potential blockage.

4. Investigate operability of the six embankment piezometers. If the piezometers are found to be operable, then make baseline readings and implement an annual monitoring program. If the piezometers are found to be inoperable, then attempt to make repairs. If repairs are not possible, GZA recommends decommissioning and abandoning the piezometers and installing new open tube piezometers in the embankment.

5. Monitor toe drain seepage clarity at the toe drain manhole (rather than sump), including visual observations of water clarity and monthly measurements of turbidity. A contingency plan should also be prepared if high flow rates or increased turbidity is observed in the seepage water.

6. Evaluate the impacts of the new flue gas desulfurization system (under construction) on SO_2 slurry discharge rates to the Evaporation Pond, including an evaluation of the long-term filling rate of the Evaporation Pond and the potential for future Stage 2 dam construction.

7. Collect/develop documentation of the “As-Built” configuration of the two settling pond embankments and appurtenant structures.

8. Investigate the potential impacts of an embankment failure of the two settling pond embankments, including an evaluation of the resulting flood wave impact to the Evaporation Pond Dam.

3.3 Recurrent Operation & Maintenance Recommendations

GZA recommends the following operation and maintenance level activities:

1. Develop a formal, written Operations and Maintenance Plan. The Plan should combine ADEQ APP, ADWR, and other regulatory requirements with routine operations and maintenance procedures and record-keeping activities for the Dam.

2. Make monthly measurements of Pond water surface elevation and wastewater/slurry flow to Pond.

3. If operable, take annual readings at the embankment piezometers.

4. Monitor left toe drain discharge channel and downstream secondary containment area for presence of wet, soggy soil or unusual vegetative growth.

5. Clear vegetation from emergency spillway approach channel area, and remove sediment as it accumulates.

6. Repair/replace staff gage markers so that Pond water surface elevation can be easily read from the upstream slope of the dam. A distinct marking should be provided at the maximum operating level.

7. Investigate operability of the meteorological instruments on top of the dam. Remove instruments if inoperable.

3.4 Repair Recommendations

GZA recommends the following <u>minor</u> repairs which may improve the overall condition of the dam, but do not alter the current design of the dam. The recommendations may require design by a professional engineer and construction contractor experienced in dam construction.

1. Repair erosion gullies along the left and right downstream abutment groins, the left upstream abutment groin, and near the downstream toe of the dam at the secondary containment structure. Repair eroded upstream slope at the left abutment and reset any displaced riprap stones. Implement erosion control measures (riprap lining, check dams, vegetative barriers, etc.) to prevent further channel erosion and headcutting.

2. Remove roots from left toe drain manhole and repair any damage from shrub growth and/or root penetration.

3. Repair/replace leaking PVC piping connecting left toe drain manhole to sump. Minimizing leakage from this pipe will help eliminate a potential source of saturated soil in downstream secondary containment area.

3.5 Remedial Modifications Recommendations

GZA recommends the following major repairs which may improve the overall condition of the dam, and may alter the current design of the dam. The recommendations may require design by a professional engineer and construction contractor experienced in dam construction.

1. In conjunction with the results of the updated hydrologic and hydraulic analyses, repair the emergency spillway side slopes along the length of the channel. Provide grading and/or other means to direct surface runoff away from the channel slopes, especially along the axis of the dam. Repairs must address the area along the dam axis where a longitudinal crack at the top of the left spillway side slope was observed. Consider improvements, as needed, to stabilize the spillway side slopes and invert control elevation.

3.6 Alternatives

There are no practical alternatives to the repairs itemized above.

4.0 ENGINEER'S CERTIFICATION

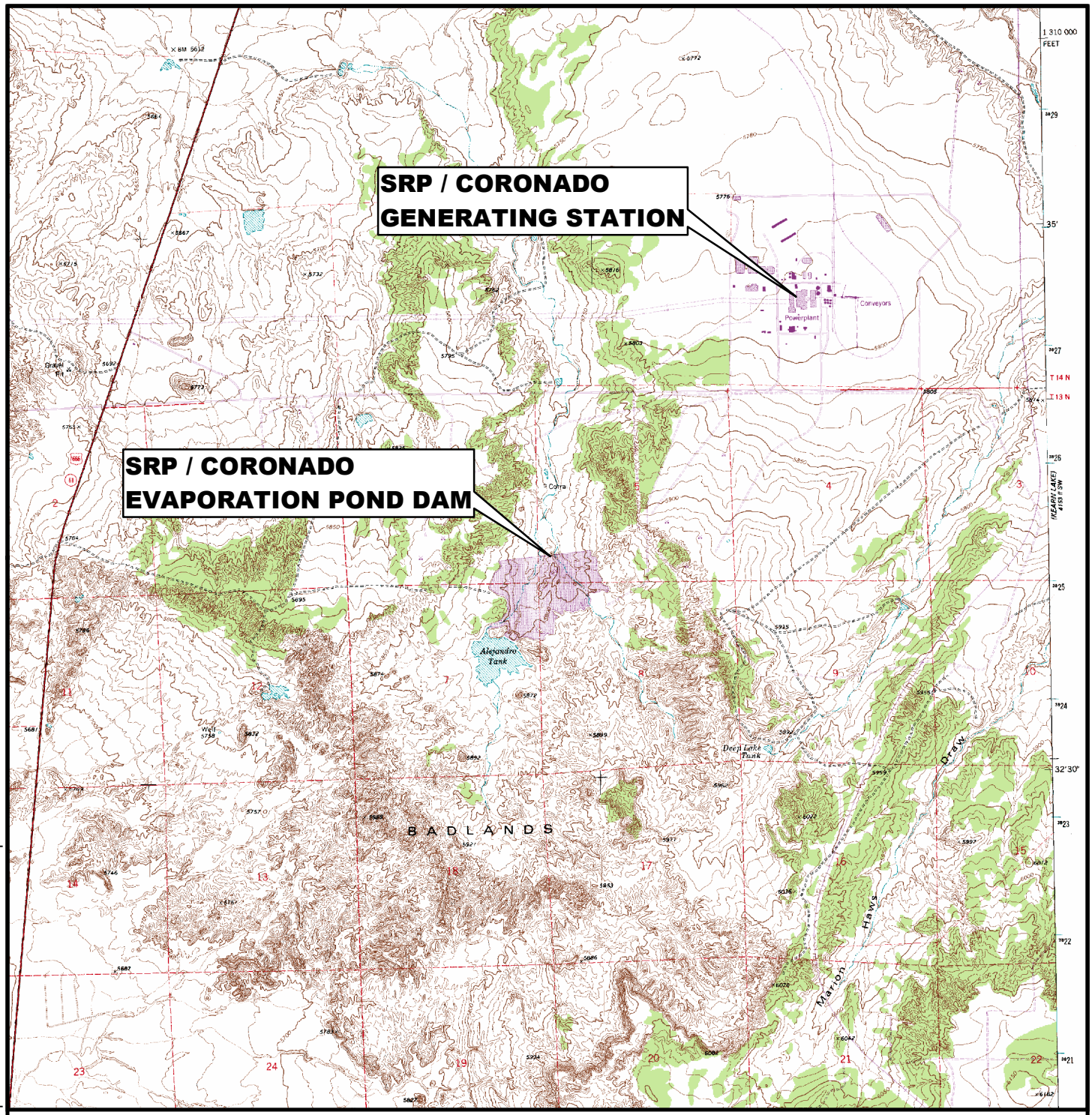
I acknowledge that the management unit referenced herein, the SRP/CGS Evaporation Pond Dam, has been assessed to be in **SATISFACTORY** condition on September 10, 2009.

Walter Kosinski, P.E. (AZ)
Senior Principal

Chad W. Cox, P.E. (MA)
Consultant/Reviewer

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\Report\SRP Coronado - Evaporation Pond Dam Report.doc

FIGURES



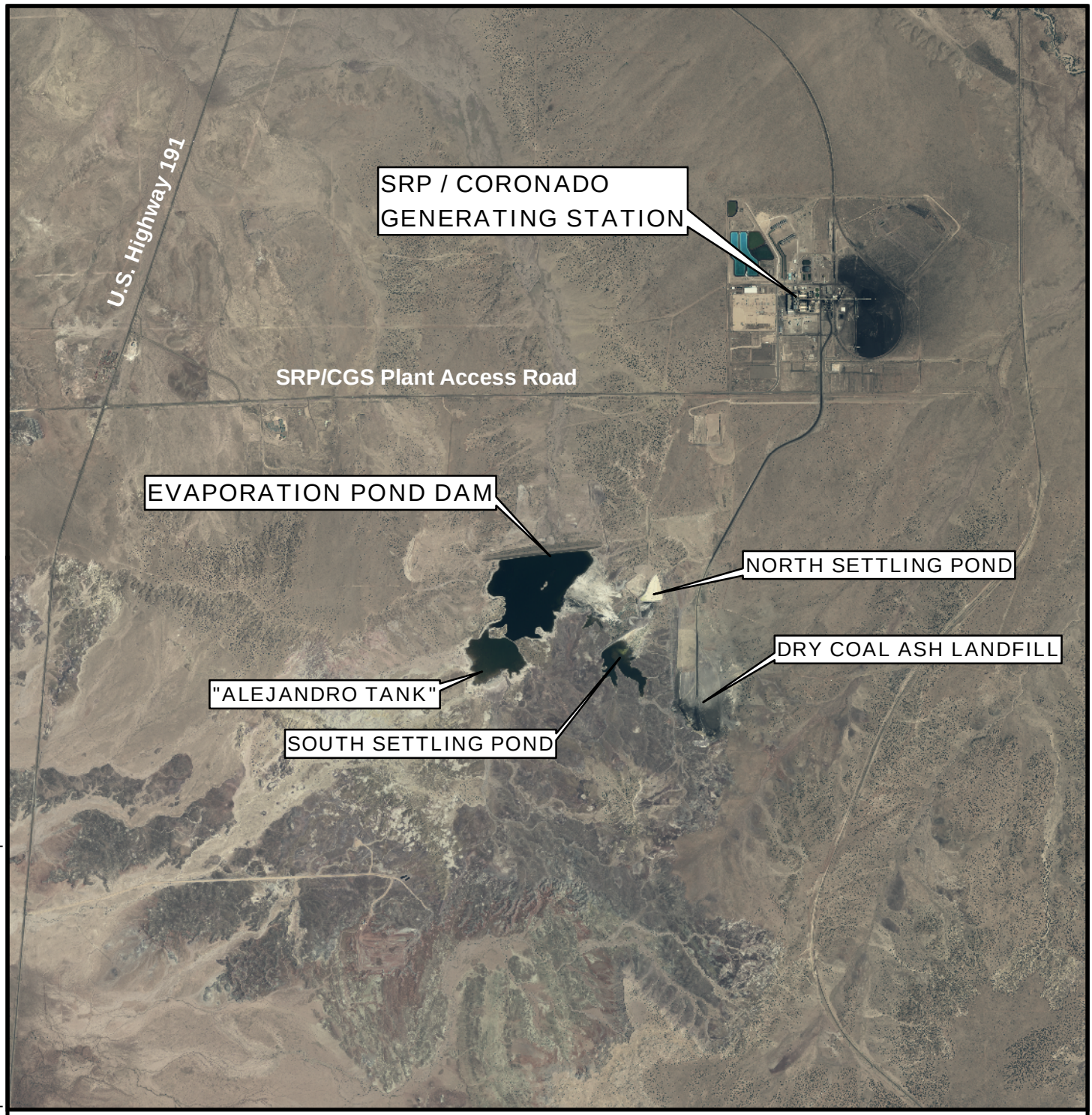
SOURCE : SCANNED USGS TOPOGRAPHIC QUADRANGLES
PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA
REGIONAL IMAGE ARCHIVE. DATA ACCESSED SEPTEMBER 2009.

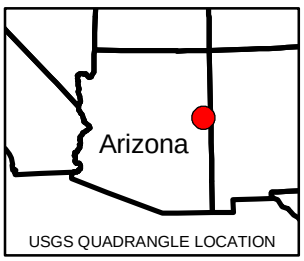
0 2,000 4,000 8,000 Feet

N
W E
S

GZA	PROJ. MGR.: JPG DESIGNED BY: GWH REVIEWED BY: PHB OPERATOR: GWH DATE: 09-02-2009	LOCUS MAP (USGS 7.5-MINUTE TOPOGRAPHIC QUAD.) SRP / CORONADO GENERATING STATION EVAPORATION POND DAM	JOB NO. 170142.10 FIG. NO. 1

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\GIS - Maps





SOURCE : USDA FARM SERVICE AGENCY NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), 2007. PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA REGIONAL IMAGE ARCHIVE. DATA ACCESSED SEPTEMBER 2009.

0 2,000 4,000 8,000 Feet

®

GZA

PROJ. MGR.: JPG
DESIGNED BY: GWH
REVIEWED BY: CWC
OPERATOR: GWH

DATE: 09-30-2009

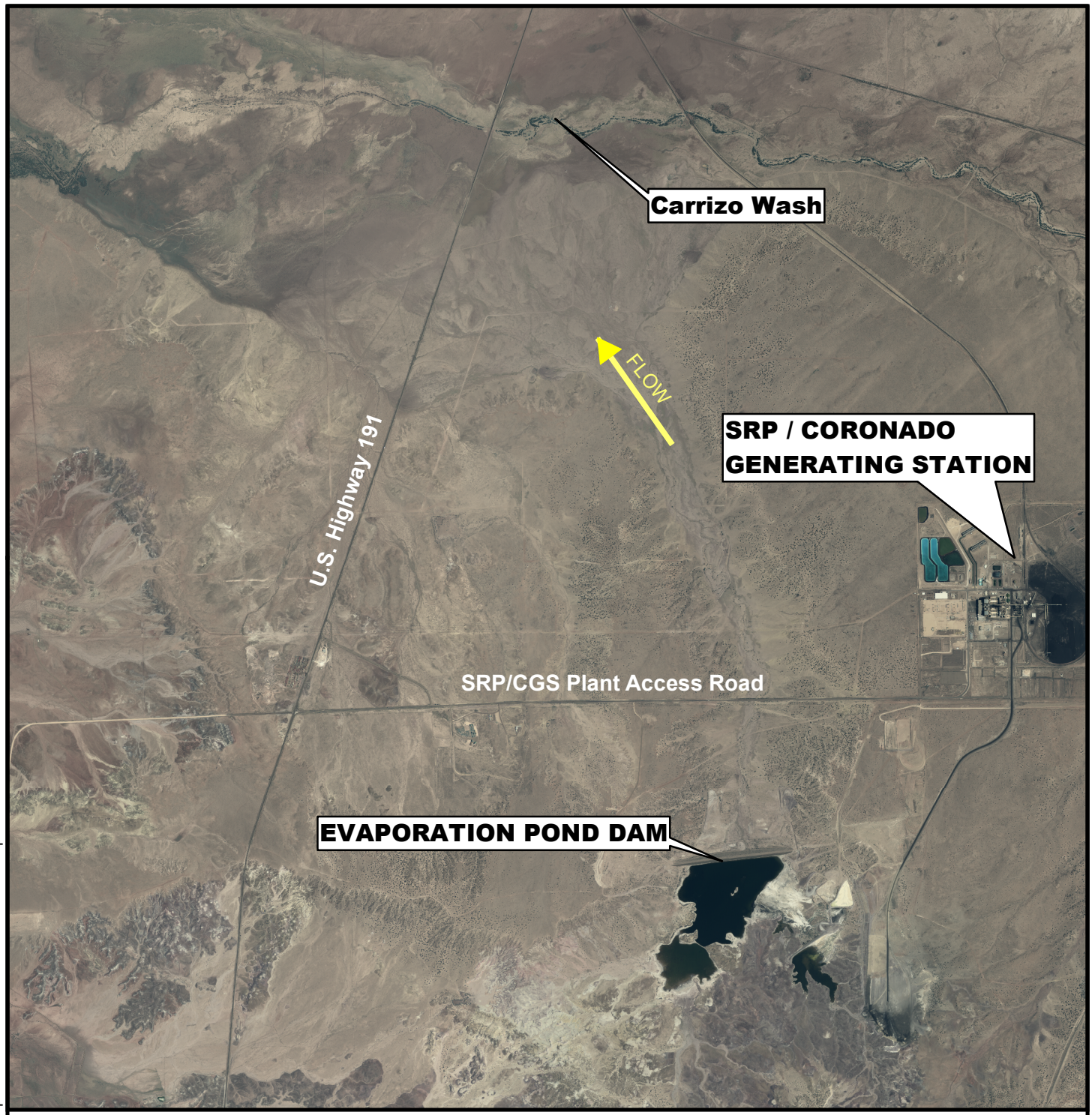
LOCUS MAP
(DIGITAL ORTHOPHOTO/AERIAL IMAGERY)

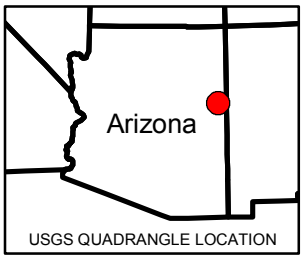
SRP / CORONADO GENERATING STATION
EVAPORATION POND DAM

JOB NO. 170142.10

FIG. NO. 2

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\GIS - Maps





SOURCE : USDA FARM SERVICE AGENCY NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), 2007. PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA REGIONAL IMAGE ARCHIVE. DATA ACCESSED SEPTEMBER 2009.

0 1,950 3,900 7,800 Feet

N W E S

GZA

PROJ. MGR.: JPG
DESIGNED BY: GWH
REVIEWED BY: CWC
OPERATOR: GWH

DATE: 09-30-2009

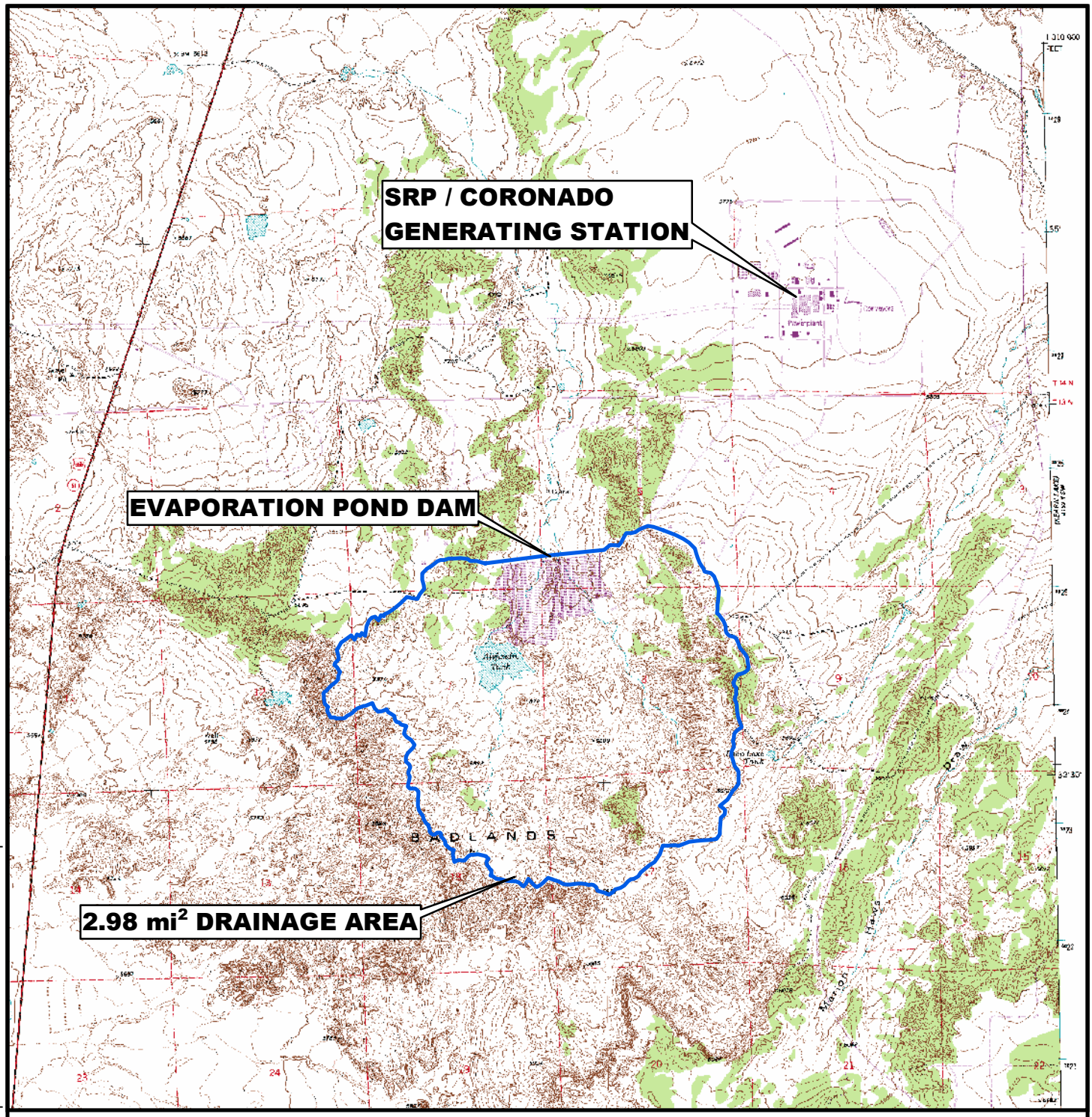
DOWNSTREAM AREA MAP (DIGITAL ORTHOPHOTO/AERIAL IMAGERY)

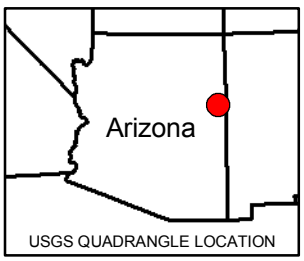
SRP / CORONADO GENERATING STATION
EVAPORATION POND DAM

JOB NO. 170142.10

FIG. NO. 3

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\GIS - Maps





SOURCE : SCANNED USGS TOPOGRAPHIC QUADRANGLES
PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA
REGIONAL IMAGE ARCHIVE. DATA ACCESSED SEPTEMBER 2009.

0 2,000 4,000 8,000 Feet

N
W E
S

GZA	PROJ. MGR.: JPG DESIGNED BY: GWH REVIEWED BY: CWC OPERATOR: GWH DATE: 09-30-2009	CONTRIBUTORY DRAINAGE AREA MAP (USGS 7.5-MINUTE TOPOGRAPHIC QUAD.) SRP / CORONADO GENERATING STATION EVAPORATION POND DAM	JOB NO. 170142.10 FIG. NO. 4

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\GIS - Maps

Dam Access Road

Evaporation Pond Dam

Evaporation Pond

Dam Access Road

SOURCE : USDA FARM SERVICE AGENCY NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), 2007.
PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA REGIONAL IMAGE ARCHIVE.
DATA ACCESSED SEPTEMBER 2009.

ORIGINAL SCALE: 1" = 300'

N
W E
S

0 500 1,000 2,000 Feet

Wastewater/Slurry Discharge

39

40

Coal Ash Haul Road

Wastewater/Slurry Settling Pond

Small Embankment Constructed for Cattle Pond (Alejandro Tank)

Landfill Runoff & Wastewater/Slurry Setltling Pond

Coal Ash Landfill

39 9/09/2009 GZA Photo Location/Direction

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\Figures - SRP Coronado

GZA GeoEnvironmental, Inc.
One Edgewater Drive
Norwood, MA 02062
Phone: (781) 278-3700 Fax: (781) 278-5701

SALT RIVER PROJECT
CORONADO GENERATING STATION
APACHE COUNTY, AZ

OVERALL SITE PLAN

Proj. Mgr.: JPG
Designed By: GWH
Reviewed By: CWC
Operator: GWH

Dwg. Date: 09-30-2009

Job No.: 01.0170142.10

Figure No.: 5

SOURCE : USDA FARM SERVICE AGENCY NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), 2007. PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA REGIONAL IMAGE ARCHIVE. DATA ACCESSED SEPTEMBER 2009.

N
W E
S

0 300 600 1,200 Feet

Emergency Spillway Discharge Area

Erosion Along Containment Area Berm

Secondary Containment Area

Left Toe Drain Manhole

Site Access Road

Erosion along Left Downstream Abutment

Emergency Spillway Channel with Eroded Side Slopes

Erosion Along Right Downstream Abutment

Right Toe Drain Manhole

Berm for Control of Runoff to Spillway

Surface Crack Observed

Evaporation Pond Dam

Left Toe Drain Recirculation Pipe

Site Access Road

Erosion of Upstream Riprap Slope

Vegetation in Emergency Spillway Approach Area

Evaporation Pond

Accumulated Sludge/Solids

GZA GeoEnvironmental, Inc.
One Edgewater Drive
Norwood, MA 02062
Phone: (781) 278-3700 Fax: (781) 278-5701

SALT RIVER PROJECT
CORONADO GENERATING STATION
APACHE COUNTY, AZ

EVAPORATION POND DAM PLAN

Proj. Mgr.: JPG
Designed By: GWH
Reviewed By: CWC
Operator: GWH

Dwg. Date: 09-30-2009

Job No.: 01.0170142.10

Figure No.: 6

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\Figures - SRP Coronado

SOURCE : USDA FARM SERVICE AGENCY NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), 2007. PROVIDED BY THE UNIVERSITY OF ARIZONA, ARIZONA REGIONAL IMAGE ARCHIVE. DATA ACCESSED SEPTEMBER 2009.

N
W E
S

0 300 600 1,200 Feet

Evaporation Pond Dam

Evaporation Pond

13 9/09/2009 & 9/10/2009 GZA Photo Location/Direction

J:\170,000-179,999\170142\170142-00.JPG\Inspections\Salt River round 2\Figures - SRP Coronado

GZA GeoEnvironmental, Inc.
One Edgewater Drive
Norwood, MA 02062
Phone: (781) 278-3700 Fax: (781) 278-5701

SALT RIVER PROJECT
CORONADO GENERATING STATION
APACHE COUNTY, AZ

EVAPORATION POND DAM
PHOTO PLAN

Proj. Mgr.: JPG
Designed By: GWH
Reviewed By: CWC
Operator: GWH

Dwg. Date: 10-02-2009
Job No.: 01.0170142.10

Figure No.: 7

FIGURE 8

SPILLWAY RELEASE INUNDATION MAP

SRP/CGS EVAPORATION POND DAM
EMERGENCY ACTION PLAN
Updated December 2008

CORONADO GENERATING STATION
EVAPORATION POND
SPILLWAY RELEASE INUNDATION MAP

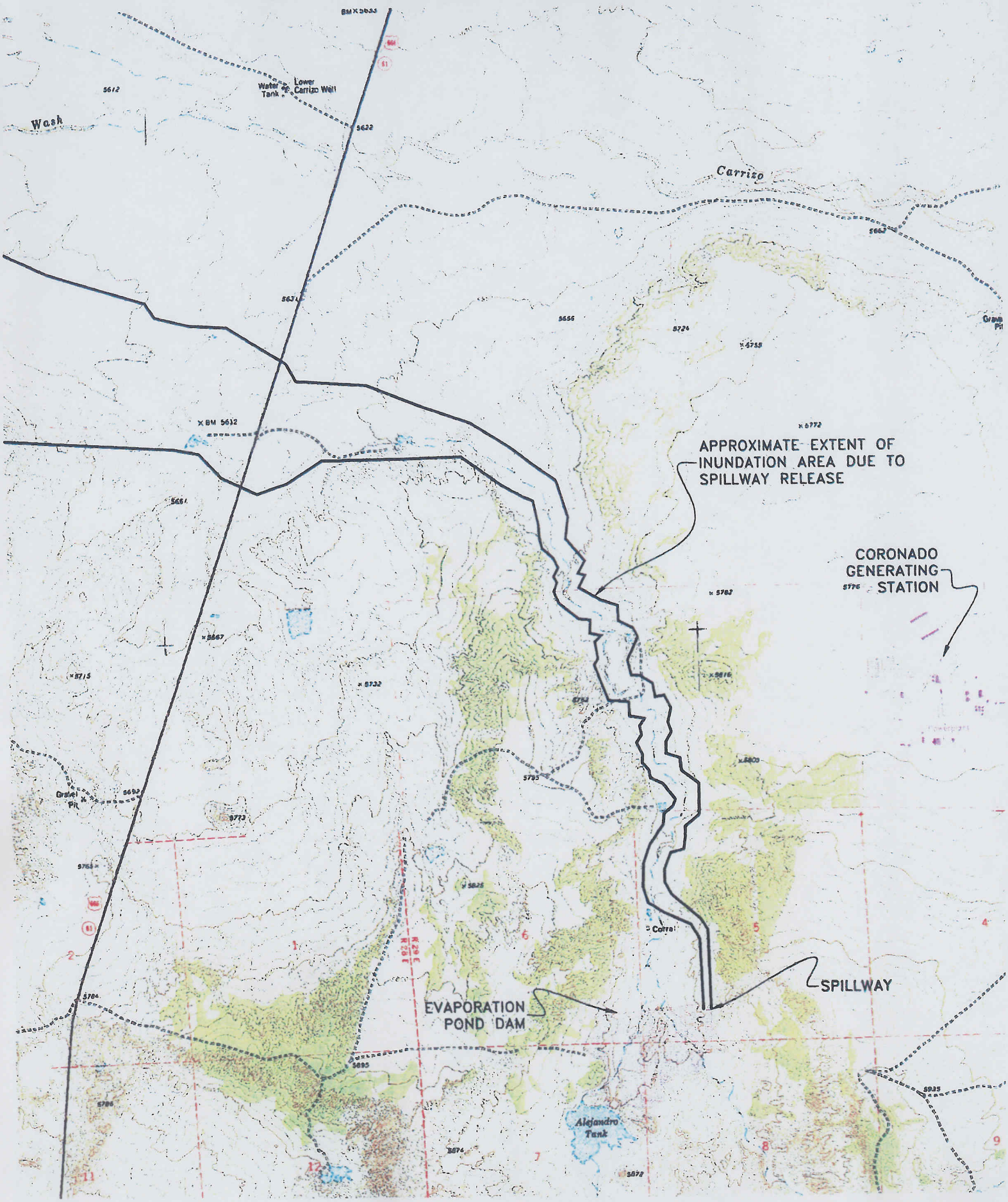


FIGURE 9

DAM BREAK - RELEASE INUNDATION MAP

SRP/CGS EVAPORATION POND DAM
EMERGENCY ACTION PLAN
Updated December 2008

CORONADO GENERATING STATION
EVAPORATION POND
DAM BREAK –RELEASE INUNDATION MAP

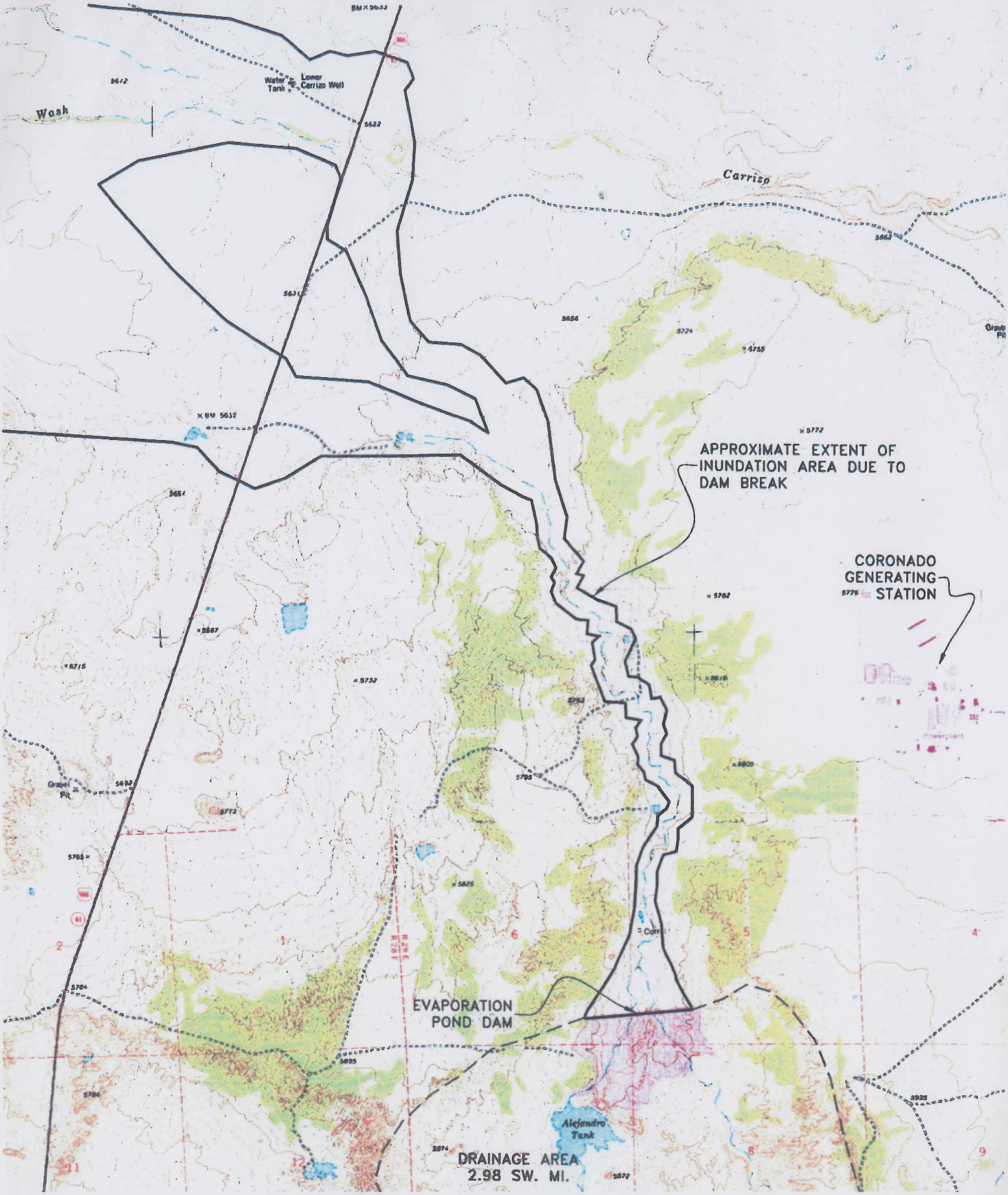


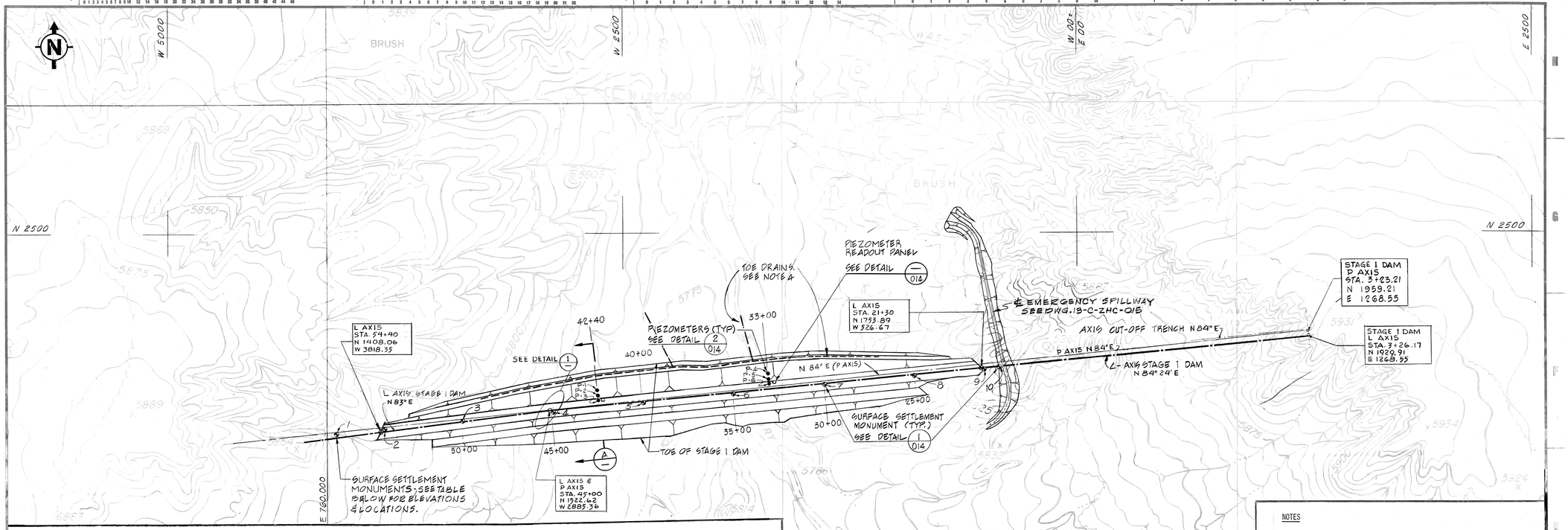
FIGURE 10

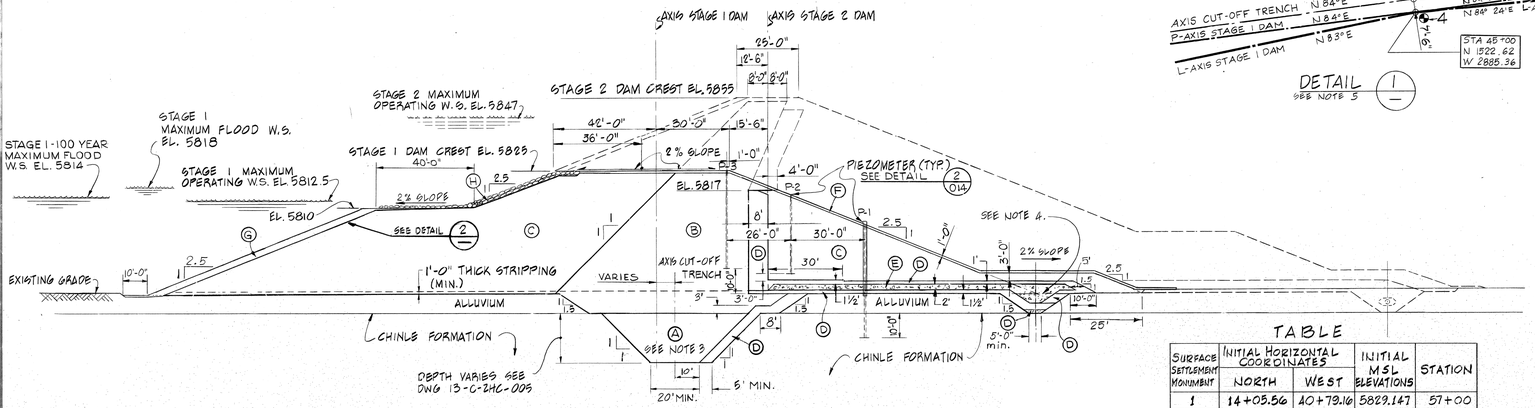
EVAPORATION RESERVOIR DAM PLAN AND TYPICAL SECTION

"FINAL ISSUE AS-BUILT CONFIGURATION", BECHTEL DRAWING NO. 013-C-ZHC-004, SEPTEMBER 30, 1980

This drawing and the design it conveys are the property of BECHTEL. They are issued strictly for information and shall not be reproduced, copied, loaned, exhibited, or used except in the Bechtel corporation's express authorization. Work will not be performed, completed, fabricated, constructed, or assembled from these drawings unless authorized by any written agreement between the Owner and Bechtel.

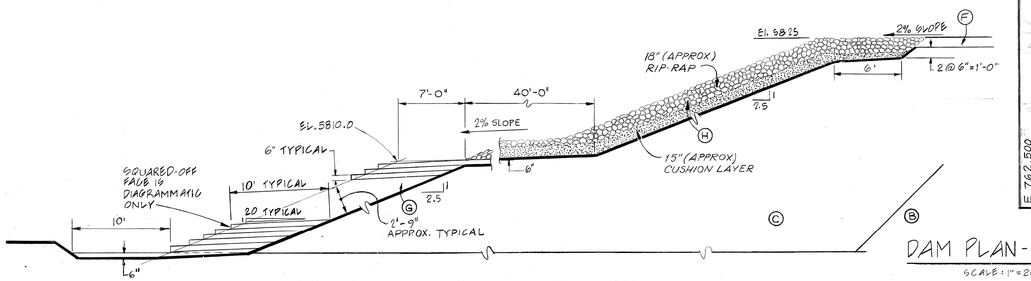
SCALING RULES





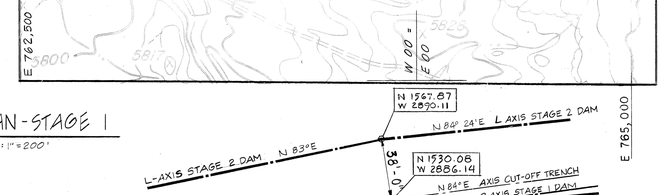
TYPICAL DAM SECTION (A)

SCALE 1" = 20'



SOIL CEMENT-RIPRAP DETAIL (2)

SCALE: 1" = 5'



DETAIL (1)

SEE NOTE 5

DAM PLAN-STAGE 1

SCALE: 1" = 200'

TABLE

SURFACE SETTLEMENT MONUMENT	INITIAL HORIZONTAL COORDINATES NORTH	WEST	INITIAL MSL ELEVATIONS	STATION
1	14+05.56	40+79.16	5829.147	57+00
2	14+31.92	38+10.35	5825.846	54+30
3	14+78.86	33+82.65	5825.682	50+00
4	15+22.07	28+84.84	5825.700	45+00
5	15+71.43	23+87.53	5826.157	40+00
6	16+20.20	18+90.12	5825.959	35+00
7	16+68.03	13+92.11	5825.757	30+00
8	17+17.80	8+94.70	5825.666	25+00
9	17+54.86	5+16.72	5825.005	21+40
10	17+63.65	4+27.15	5825.364	20+30

NOTES

1. ZONE-MATERIAL FILL IN SITU

	TYPE OF SOIL
(A) — CUT-OFF BACKFILL	CHINLE FORMATION - RECOMPACTED
(B) — CORE	CLAYEY SAND OR SILTY SAND
(C) — SHELLS	RANDOM SANDY MATERIAL
(D) — CHIMNEY DRAIN, BLANKET DRAIN AND CUT-OFF TRANSITION MATERIAL	CLEAN SAND AND GRAVEL
(E) — ROCK DRAIN	GRAVEL OR CRUSHED ROCK
(F) — DOWNSTREAM SLOPE AND CREST PROTECTION	QUARRY WASTE OR EQUAL
(G) — UPSTREAM SLOPE PROTECTION (BELOW EL. 5810)	SOIL CEMENT
(H) — UPSTREAM SLOPE PROTECTION (ABOVE EL. 5810)	RIP RAP

2. NO MATERIAL SHALL BE PLACED ON ANY FOUNDATION WHICH HAS NOT BEEN APPROVED BY THE STATE AND THE ENGINEER.
3. FOR DETAILS OF REQUIREMENTS FOR CUT-OFF EXCAVATION CLEANUP, PROTECTION AND BACKFILLING, SEE SECTION 6.8 OF THE TECHNICAL SPECIFICATIONS.
4. FOR DETAILS OF TOE DRAINAGE SYSTEM SEE DWG. 13-C-ZHC-013.
5. THE STAGE 1 DAM AXIS PRIOR TO REVISION 2 OF THIS DWG. IS DESIGNATED AS THE P-AXIS. THE STAGE 1 AND STAGE 2 DAM AXES ADJUSTED IN REVISION 2 OF THIS DWG. ARE DESIGNATED AS THE L-AXES.

NO.	DATE	REVISIONS	DRN BY	CHK	GS	ENGR	PROJ ENGR	APPR
4	11/30/78	FINAL ISSUE AS-BUILT CONFIGURATION	MAK			BND	RLC	
3	7/30/80	ADDED SPILLWAY & SURFACE SETTLEMENT TABLE	YL	BKY	BKY	BND	RLC	
2	3/30/80	REVISED AS-BUILT	TW	BKY	BKY	BND	RLC	
1	6/7/77	NOTE ADDED TO 3RD SENTENCE OF GENERAL NOTE 1 AND NOTE 2 ADDED	Y.N.	CJH	CJH	WRF	JFR	
0	10/5/76	REMOVED PLACEMENT LIMITS RESTRICTION AT UPSTREAM TOE	Y.N.	CJH	CJH			
D	10-27-76	ADDED DOWNSTREAM TOE "FILLET" CUT-OFF MATERIAL & ELIMINATED "HORIZ. WEIR" SECTION. ISSUED FOR CONSTRUCTION	Y.N.	CJH	CJH	WJC		
C	10-15-76	REVISED CUTOFF DETAILS AND SEDIMENTARY POSITIONS, SPILLWAY STRUCTURE LOCATION & NOTES	Y.N.	CJH	CJH			
B	9-22-76	ISSUED FOR PERMIT APPLICATION	RLN	CJH	CJH			
A	8-11-76	REDRAWN, REISSUED FOR REPORT	RLN	CJH	CJH			
B	4-19-76	ISSUED FOR REVISED REPORT	EV					
A	3-15-76	ISSUED FOR REPORT	RAZ					

DRAWING CODE

BECHTEL LOS ANGELES

CORONADO GENERATING STATION
SALT RIVER PROJECT

EVAPORATION RESERVOIR
DAM PLAN AND TYPICAL SECTION

SCALE	JOB NO.	DRAWING NO
1" = 200'	10507	13-C-ZHC-004

200' 0 200' 400'
SCALE IN FEET

EM 10507

8 7 6 5 4 3 2 1

5 4 3 2 1 0 E D C B A

APPENDIX A

LIMITATIONS

DAM ENGINEERING & VISUAL INSPECTION LIMITATIONS

1. The observations described in this report were made under the conditions stated herein. The conclusions presented in the report were based solely on the services described therein, and not on scientific tasks or procedures beyond the scope of described services or the time and budgetary constraints imposed by Lockheed Martin.

2. In preparing this report, GZA GeoEnvironmental, Inc. (GZA) has relied on certain information provided by Lockheed Martin, Salt River Project (and their affiliates) as well as Federal, state, and local officials and other parties referenced therein. GZA has also relied on certain information contained on the State of Arizona's Dam Safety Program website as well as Federal, state, and local officials and other parties which were available to GZA at the time of the inspection. Although there may have been some degree of overlap in the information provided by these various sources, GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this work.

3. In reviewing this Report, it should be noted that the reported condition of the dam is based on observations of field conditions during the course of this study along with data made available to GZA. The observations of conditions at the dam reflect only the situation present at the specific moment in time the observations were made, under the specific conditions present. It may be necessary to reevaluate the recommendations of this report when subsequent phases of evaluation or repair and improvement provide more data.

4. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions may be detected.

5. Water level readings have been reviewed and interpretations have been made in the text of this report. Fluctuations in the level of the groundwater and surface water may occur due to variations in rainfall, temperature, and other factors different than at the time measurements were made.

6. GZA's comments on the hydrology, hydraulics, and embankment stability for the dam are based on a limited review of available design documentation prepared by Bechtel Corporation for Salt River Project. Calculations and computer modeling used by Bechtel Corporation in these analyses were not available and were not independently reviewed by GZA.

7. This report has been prepared for the exclusive use of Lockheed Martin for specific application to the existing dam facilities, in accordance with generally accepted dam engineering practices. No other warranty, express or implied, is made.

8. This dam inspection verification report has been prepared for this project by GZA. This report is for broad evaluation and management purposes only and is not sufficient, in and of itself, to prepare construction documents or an accurate bid.

APPENDIX B

PHOTOGRAPHS

Photo 1: Overview of Evaporation Pond and Dam from right abutment. Note emergency spillway cut in foreground.

Photo 2: Overview of upstream slope of dam from right abutment contact. Note moderate brush growth on riprap slope.

Photo 3: View along upstream riprap slope from right side of dam. Note upstream berm and lower portion of upstream slope submerged by Pond.

Photo 4: View along top of dam from right abutment area. Note grass and brush vegetative cover and minor rutting from vehicular traffic.

Photo 5: View along downstream slope of dam from right side of dam. Note gravel surface, and grass and brush vegetative cover.

Photo 6: View along downstream slope of dam from right side of dam.

Photo 7: View along downstream slope of dam looking towards right abutment, taken from access road along downstream toe. Note minor rutting of access road.

Photo 8: View along downstream slope of dam looking towards left abutment, taken from access road along downstream toe. Note minor rutting of access road

Photo 9: View of right toe drain manhole at downstream toe of dam. Note dry discharge channel surrounded by secondary containment berms

Photo 10: View of right toe drain manhole from downstream dry channel. Note minor erosion adjacent to concrete cover (circled).

Photo 11: View inside right toe drain manhole. Note standing water at bottom of manhole, and dry inlet and outlet pipes.

Photo 12: View through vitrified clay outlet pipe from downstream. Right toe drain manhole and toe drain collection pipe visible in background.

Photo 13: Overview of left toe drain collection system. Toe drain manhole (left) is connected by PVC piping to sump well (right). Note wet soil around PVC pipe.

Photo 14: View of left toe drain manhole from downstream. Note heavy brush and vegetative cover around manhole.

Photo 15: View inside left toe drain manhole. Note standing water and roots within manhole. Toe drain collection pipe flowing at right.

Photo 16: View of seepage water taken from left toe drain manhole.

Photo 17: View of left toe drain sump, with gas pump, recirculation piping, and bucket used for flow measurement and seepage observations.

Photo 18: View inside left toe drain sump. Note seepage discharge from inlet pipe, and hanging pipe for pumping collected seepage back to Pond.

Photo 19: Overview of downstream area, with secondary containment berms visible for containment of seepage discharge.

Photo 20: View of erosion gulley near left downstream toe of dam. Note woody debris placed in channel by SRP/CGS to control erosion.

Photo 21: View of meteorological instruments on top of dam, left side.

Photo 22: View of staff gage on upstream berm. Note lower markings difficult to read. Pond level at time of inspection was approximately 5810 feet.

Photo 23: View along upstream slope of dam from left side. Note upstream berm partially visible above water line.

Photo 24: View along upstream slope of dam looking towards left abutment.

Photo 25: View along top of dam from left abutment. Note minor rutting from vehicle traffic.

Photo 26: View of erosion channel along left upstream abutment groin. Note undercutting and displacement of riprap slope at right.

Photo 27: View of undercutting and displacement of riprap at left abutment contact. Hard hat shown for scale.

Photo 28: View of erosion channel along right downstream abutment contact.

Photo 29: View of emergency spillway approach channel and pond from top of right channel slope. Note slope erosion in foreground.

Photo 30: Overview of emergency spillway channel from top of right channel slope. Channel invert in foreground, discharge area in background.

Photo 31: View within emergency spillway channel looking upstream from break-away cattle gate. Note accumulation of tumbleweeds.

Photo 32: View within emergency spillway channel, looking downstream towards discharge area. Note recent grading of spillway channel bottom.

Photo 33: View of emergency spillway discharge area from downstream.

Photo 34: View of excavated area at right abutment, with earthen berm constructed to prevent stormwater runoff from eroding spillway slopes.

Photo 35: View of emergency spillway near channel control section. Note eroded channel slope. Surface crack observed at top of left slope (see following photos).

Photo 36: View of surface crack near top of left slope of emergency spillway channel, near control section of channel and axis of dam.

Photo 37: Detail view of surface crack near top of left slope of emergency spillway channel. Note ruler inserted approximately 30 inches into crack.

Photo 38: Overview of top of slope area where surface crack was observed. Approximate alignment of surface crack shown with dashed line.

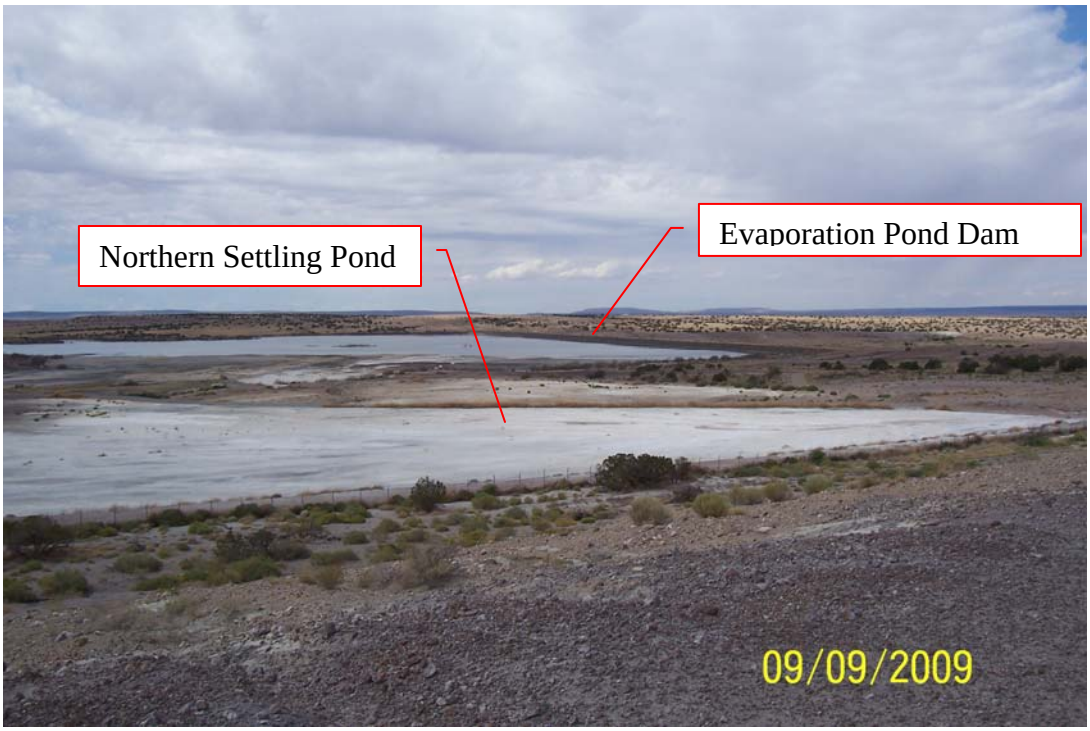


Photo 39: View from Ash Landfill area towards settling pond and Evaporation Pond Dam. Note small earthen berm around northern settling pond.

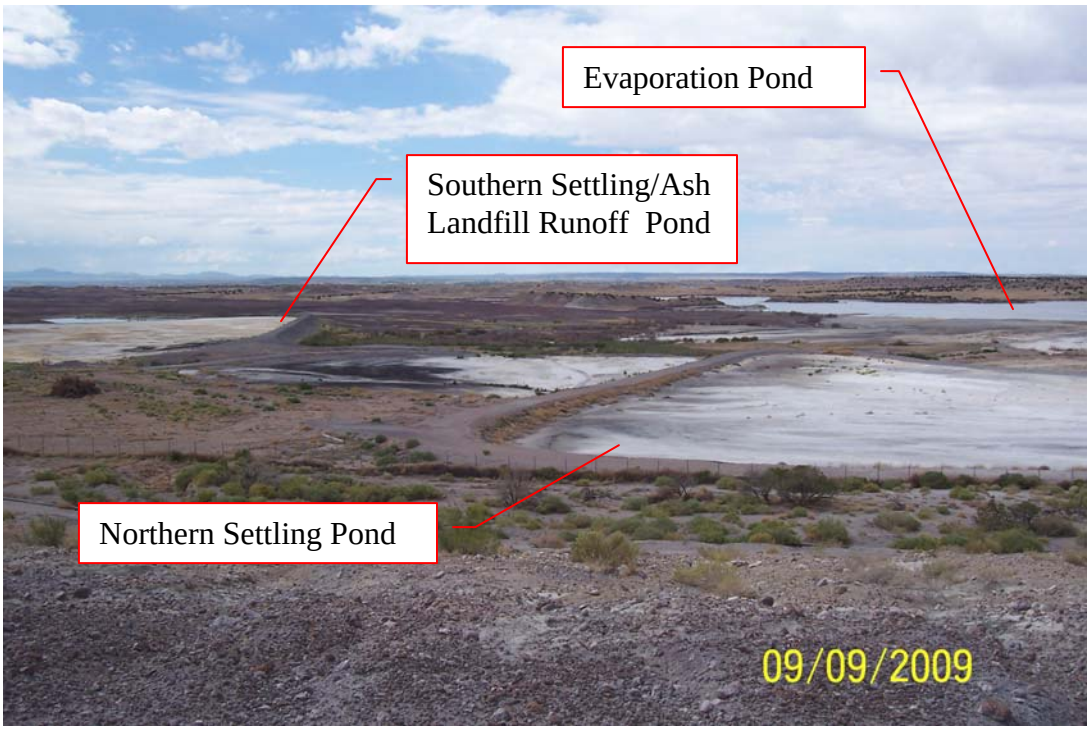


Photo 40: View from Ash Landfill area towards settling ponds and Evaporation Pond.

APPENDIX C

EPA & GZA INSPECTION CHECKLISTS

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Coronado Generating Station	Date:	September 10, 2009
Unit Name:	CGS Evaporation Pond Dam	Operator's Name:	Salt River Project
Unit I.D.:	01.46	Hazard Potential Classification:	High **Significant** Low
Inspector's Name:	Walter Kosinski, P.E. & Chad Cox		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?		✔
2. Pool elevation (operator records)?	5810 ft +/-		19. Major erosion or slope deterioration?		✔
3. Decant inlet elevation (operator records)?	N/A		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	5816.7 ft		Is water entering inlet, but not exiting outlet?	N/A	
5. Lowest dam crest elevation (operator records)?	5825.0 ft		Is water exiting outlet, but not entering inlet?	N/A	
6. If instrumentation is present, are readings recorded (operator records)?	✔		Is water exiting outlet flowing clear?	N/A	
7. Is the embankment currently under construction?		✔	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	✔		From underdrain?	✔	
9. Trees growing on embankment? (If so, indicate largest diameter below)		✔	At isolated points on embankment slopes?		✔
10. Cracks or scarps on crest?		✔	At natural hillside in the embankment area?		✔
11. Is there significant settlement along the crest?		✔	Over widespread areas?		✔
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?		✔
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✔	"Boils" beneath stream or ponded water?		✔
14. Clogged spillways, groin or diversion ditches?		✔	Around the outside of the decant pipe?	N/A	
15. Are spillway or ditch linings deteriorated?	✔		22. Surface movements in valley bottom or on hillside?		✔
16. Are outlets of decant or underdrains blocked?		✔	23. Water against downstream toe?		✔
17. Cracks or scarps on slopes?		✔	24. Were Photos taken during the dam inspection?	✔	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

1) State ADWR Dam Safety section inspects every 3 years. SRP Dam Safety personnel read measurements annually; Observations monthly; Plant submits self monitoring annually as part of AZ Aquifer Protection Permit.
6) Piezometers not read. Water level not recorded. Seepage measured and recorded. Settlement/alignment movements surveyed annually.
8) Plans indicate foundation was stripped prior to embankment construction.
14) Fence across spillway has potential to accumulate debris.
15) Spillway channel unlined, side slope erosion present. Groin ditches unlined & erosion present.
16) No flow from right toe drain.
21) Clear seepage from left toe drain at ~ 1 gpm. Seepage recirculated to pond via pump.
22) Small hillside containment berms have been constructed on east side of impoundment apparently above top of dam.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # AZMSG-8526 INSPECTOR Walter Kosinski, P.E. & Chad Cox

Date September 10, 2009

Impoundment Name Coronado Generating Station Evaporation Pond
Impoundment Company Salt River Project
EPA Region 9
State Agency (Field Office) Addresss ADWR - Dam Safety Section
3550 N. Central Ave., Phoenix, AZ 85012
Name of Impoundment CGS Evaporation Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update X

	Yes	No
Is impoundment currently under construction?	_____	X
Is water or ccw currently being pumped into the impoundment?	X	_____

IMPOUNDMENT FUNCTION: Containment of coal combustion waste (primarily scrubber waste product)

Nearest Downstream Town : Name Hunt & Woodruff
Distance from the impoundment 2.4 miles & 53 miles
Impoundment Location: Longitude 109 Degrees 17 Minutes 43 Seconds
Latitude 34 Degrees 33 Minutes 30.0 Seconds
State AZ County Apache

Does a state agency regulate this impoundment? YES X NO _____

If So Which State Agency? Arizona Department of Water Resources

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

__X__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

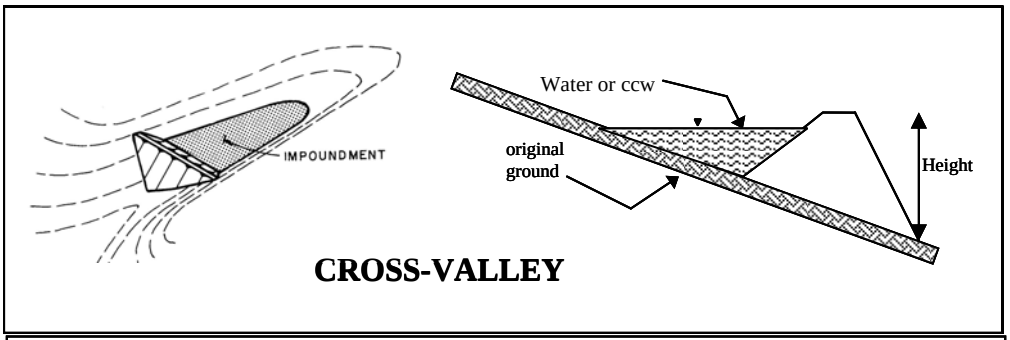
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

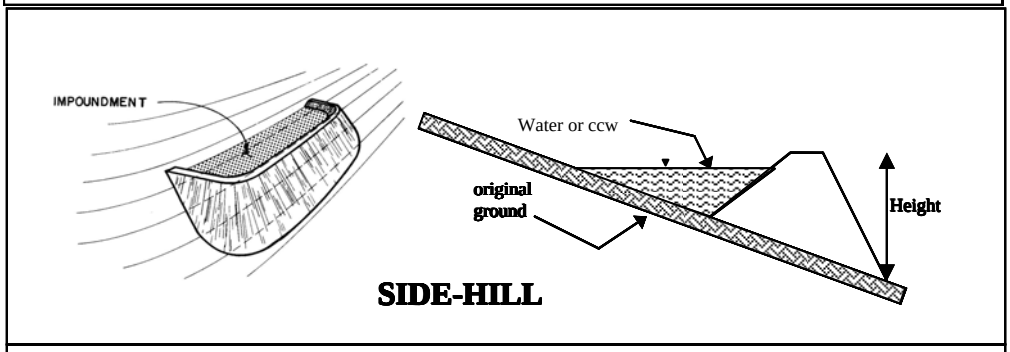
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

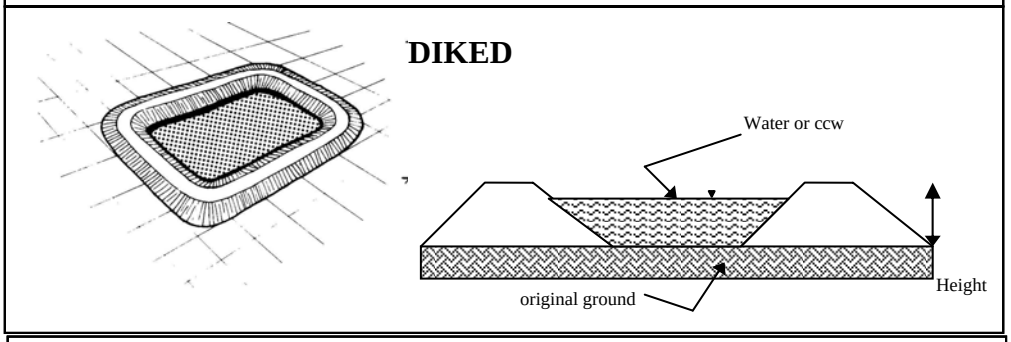
No permanent human habitation downstream of dam in expected dam break inundation area. Failure will affect road to power plant and, potentially high voltage transmission line towers. Failure could lead to interruption of power generation. Failure would cause discharge of accumulated CCW, requiring mitigation.

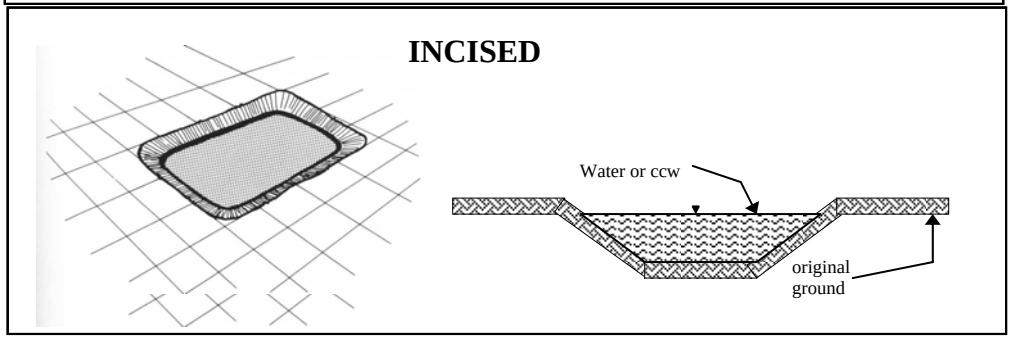
West Bottom Slag

CONFIGURATION:









__X__ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

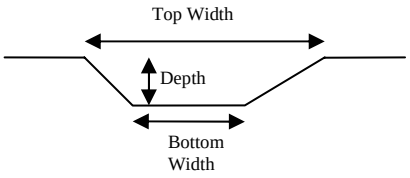
Embankment Height 53 feet
Pool Area 290 acres*
Current Freeboard 15 feet**
Embankment Material Zoned earthfill
Liner None-natural clay formation under impoundment
Liner Permeability 1×10^{-8} cm/sec remolded permeability

*At spillway crest
**With pool at current elevation

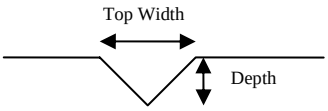
TYPE OF OUTLET (Mark all that apply)

__X__ **Open Channel Spillway**
__X__ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

TRAPEZOIDAL

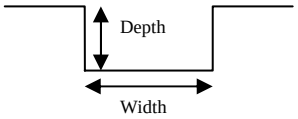


TRIANGULAR

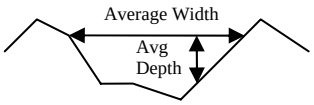


__10'__ depth (min)
__12'__ bottom (or average) width
__~40'__ top width

RECTANGULAR

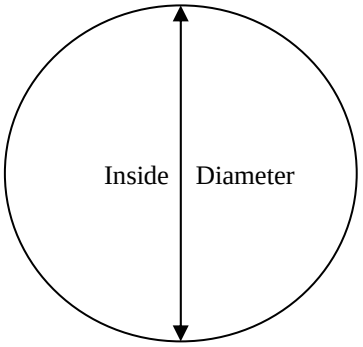


IRREGULAR



__N/A__ **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____

Is water flowing through the outlet? YES _____ NO _____

__N/A__ **No Outlet**

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By __Bechtel Corporation_____
_____

Has there ever been a failure at this site? YES _____ NO ___X_____

If So When? _____

If So Please Describe : _____

Has there ever been significant seepages at this site? YES _____ NO __X__

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO ___X____

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe : _____

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: Evaporation Pond Dam

STATE ID #: 01.46 - Arizona Dept. of Water Resources

REGISTERED: ☑ YES ☐ NO (with ADWR & ADEQ)

NID ID #: AZ00155

STATE SIZE CLASSIFICATION: Intermediate

STATE HAZARD CLASSIFICATION: Significant

CHANGE IN HAZARD CLASSIFICATION REQUESTED?: No

DAM LOCATION INFORMATION

CITY/TOWN: Near Saint Johns, Arizona

COUNTY: Apache County

DAM LOCATION: (street address if known) south of SRP plant entrance road off SR 61/US 191

ALTERNATE DAM NAME: Evaporation Reservoir Dam

USGS QUAD.: Saint Johns North

LAT.: 34 ˚ 33' 30" N

LONG.: 109 ˚ 17' 43" W

DRAINAGE BASIN: Little Colorado River

RIVER: Unnamed Tributary to Carrizo Wash

IMPOUNDMENT NAME(S): Evaporation Pond, Evaporation Reservoir (contiguous with *Alejandro Tank* on USGS Quad)

GENERAL DAM INFORMATION

TYPE OF DAM: Zoned Earthfill Embankment

OVERALL LENGTH (FT): 3,300

PURPOSE OF DAM: Power Plant/Combustion Waste Impoundment

NORMAL POOL STORAGE (ACRE-FT): ±3,800 acre-ft at 5815.5 ft

YEAR BUILT: 1979

MAXIMUM POOL STORAGE (ACRE-FT): ±5,900 acre-ft at 5821.9 ft

STRUCTURAL HEIGHT (FT): 53 ft (to toe of dam), 75 ft (with cutoff trench)

EL. NORMAL POOL (FT): 5,815.5 (Current Max. Operating Level)

HYDRAULIC HEIGHT (FT): 44.7 (top of dam to toe of dam)

EL. MAXIMUM POOL (FT): 5,821.9 feet (1/2 PMF pool)

NAME OF DAM: Evaporation Pond Dam | STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 | NID ID #: AZ00155

INSPECTION SUMMARY

DATE OF INSPECTION: September 9 & 10, 2009 | DATE OF PREVIOUS INSPECTION: 9/12/2008 by AZ Dept. of Water Resources

TEMPERATURE/WEATHER: Clear, 80s F | ARMY CORPS PHASE I: ☐ YES ☑ NO | If YES, date (No known Phase I)

CONSULTANT: GZA GeoEnvironmental, Inc. | PREVIOUS ADWR REPORT: ☑ YES ☐ NO | If YES, date 9/12/2008

BENCHMARK/DATUM: Vertical Datum - MSL

OVERALL PHYSICAL CONDITION OF DAM: SATISFACTORY | DATE OF LAST REHABILITATION: N/A, Built 1979

SPILLWAY CAPACITY: 450 cfs @ 5821.9 ft (original design)

EL. POOL DURING INSP.: Approximately 5,810 ft | EL. TAILWATER DURING INSP.: None, downstream channel dry

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
Walter Kosinski, P.E.	Senior Principal	GZA GeoEnvironmental, Inc.
Chad Cox, P.E.(Massachusetts)	Associate Principal	GZA GeoEnvironmental, Inc.
Gregory Hunt	Staff Engineer	GZA GeoEnvironmental, Inc.
John Schofield	Environmental Scientist	U.S. Environmental Protection Agency (EPA), Region 9
Prabhat Bhargava	O&M Manager	Salt River Project (SRP) / Coronado Generating Station (CGS)
Kent Liesemeyer	Sr. Environmental Engineer	Salt River Project (SRP) / Coronado Generating Station (CGS)
Ken Isaacson	Civil Engineer	Salt River Project (SRP) / Coronado Generating Station (CGS)
Karol Wolf	Environmental Scientist	Salt River Project (SRP)
Dan Casiraro	Mgr. Environ. Compliance	Salt River Project (SRP)

NAME OF INSPECTING ENGINEER: | SIGNATURE:

NAME OF DAM:	Evaporation Pond Dam	STATE ID #:	01.46 - Arizona Dept. of Water Resources
INSPECTION DATE:	September 9 & 10, 2009	NID ID #:	AZ00155

OWNER:		CARETAKER:	
ORGANIZATION	Salt River Project (SRP)	ORGANIZATION	SRP Coronado Generating Station
NAME/TITLE	John M. Williams Jr., President	NAME/TITLE	Bill Beck, P.E. / Plant Manager
STREET	1521 N. Project Drive	STREET	Mail Station CGS600, PO Box 1018
TOWN, STATE, ZIP	Tempe, AZ 85281-1298	TOWN, STATE, ZIP	St. Johns, Arizona 85936
PHONE	602-236-5900	PHONE	928-337-5501
EMERGENCY PH. #	602-236-3333	EMERGENCY PH. #	928-245-0264
FAX		FAX	928-337-2961
EMAIL		EMAIL	bill.beck@srpnet.com
OWNER TYPE	public (state political subdivision)		

PRIMARY SPILLWAY TYPE	Earthen Open Channel (unlined)		
SPILLWAY LENGTH (FT)	10-ft bottom width	SPILLWAY CAPACITY (CFS)	450 cfs @ 5,821.9 feet
AUXILIARY SPILLWAY TYPE	None	AUX. SPILLWAY CAPACITY (CFS)	N/A
NUMBER OF OUTLETS	None (Evaporation Only)	OUTLET(S) CAPACITY (CFS)	(Evaporation rate of ± 50 in/yr)
TYPE OF OUTLETS	N/A	TOTAL DISCHARGE CAPACITY (CFS)	450 cfs @ 5,821.9 feet (original design)
DRAINAGE AREA (SQ MI)	2.98	SPILLWAY DESIGN FLOOD (PERIOD/CFS)	1/2 PMF / 450 cfs outflow

HAS DAM BEEN BREACHED OR OVERTOPPED ☐ YES ☑ NO IF YES, PROVIDE DATE(S)

FISH LADDER (LIST TYPE IF PRESENT) None

DOES CREST SUPPORT PUBLIC ROAD? ☐ YES ☑ NO IF YES, ROAD NAME:

PUBLIC BRIDGE WITHIN 50' OF DAM? ☐ YES ☑ NO IF YES, ROAD/BRIDGE NAME:

MHD BRIDGE NO. (IF APPLICABLE)

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

EMBANKMENT (TOP OF DAM / CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
TOP OF DAM	1. SURFACE TYPE	Gravel, with some grasses and shallow-rooted vegetation. Some dead brush (1)			X
	2. SURFACE CRACKING	None observed	X		
	3. SINKHOLES, ANIMAL BURROWS	Some small burrow holes observed, no sinkholes observed		X	
	4. VERTICAL ALIGNMENT (DEPRESSIONS	Appears level, no depressions observed	X		
	5. HORIZONTAL ALIGNMENT	Alignment appears true	X		
	6. RUTS AND/OR PUDDLES	Minor ruts along vehicle access road on top of dam		X	
	7. VEGETATION (PRESENCE/CONDITION)	Some low grass and shrubs, no deep-rooted vegetation		X	
	8. ABUTMENT CONTACT	At right abutment: natural high ground between dam and spillway contact appeared	X		
		to be in good condition.			
	ABUTMENT CONTACT (CONT.)	At left abutment: some limited erosion along upstream edge of dam crest,			X
		apparently from uphill runoff.			

ADDITIONAL COMMENTS: 1) is present along the top of dam and should be removed.

PVC Sump recirculation line is buried across top of dam - not visible during inspection.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None observed	X		
	2. SEEPAGE	None observed	X		
	3. SLIDE, SLOUGH, SCARP	None observed	X		
	4. EMB.-ABUTMENT CONTACT	Erosion gullies at groins on both sides.			X
	5. SINKHOLE/ANIMAL BURROWS	Some small burrows observed, no sinkholes observed		X	
	6. EROSION	Minor rills on slope		X	
	7. UNUSUAL MOVEMENT	None observed	X		
	8. VEGETATION (PRESENCE/CONDITION)	Light cover of grass and sparse shrubs. Vegetation controlled with herbicides		X	
		annually, and deep-rooted vegatation is removed. Surface generally gravel covered.			

ADDITIONAL COMMENTS:

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	None observed	X		
	2. SLOPE PROTECTION TYPE AND COND.	Approximately 24-inch diameter basaltic riprap on and above bench in (1)	X		
	3. SINKHOLE/ANIMAL BURROWS	None observed	X		
	4. EMB.-ABUTMENT CONTACT	Right contact okay. Left contact eroded, with limited area of undercutting (2)			X
	5. EROSION	None observed on slope, see (4) for erosion at abutment.	X		
	6. UNUSUAL MOVEMENT	None observed	X		
	7. VEGETATION (PRESENCE/CONDITION)	Very minor shrub growth.		X	

ADDITIONAL COMMENTS: 1) good condition. Soil cement shown on design plans on slope below bench, but not visible during inspection.
2) of riprap. Erosion along upstream edge of slope at abutment, apparently from upland runoff.

Approximately 2-inch diameter PVC toe drain recirculation line present along top of riprap.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	6 piezometers in embankment, connected to 2 readout points. Piezometers not (1)			X
	2. OBSERVATION WELLS	None on embankment, several wells in downstream area for aquifer protection (2)		X	
	3. STAFF GAGE AND RECORDER	Staff Gage in pond, lower numbers difficult to read.			X
	4. WEIRS	None	X		
	5. INCLINOMETERS	None	X		
	6. SURVEY MONUMENTS	10 survey monuments located along top of dam. Monuments are surveyed (3)		X	
	7. DRAINS	Left and right toe drains, discharge to respective manholes. (4)		X	X
	8. FREQUENCY OF READINGS	Occaisional readings of flow rate and observations of water clarity.		X	
	9. LOCATION OF READINGS	Readings taken at left drain sump; kept on record at plant.		X	

ADDITIONAL COMMENTS: 1) currently being read, operability unknown

2) program. Wells reportedly dry.

3) annually for elevation and alignment.

4) Right toe drain manhole - no flow. Some standing water in manhole, however no indication of flow in drain pipe.

Left toe drain flowing at approximately 1 gpm clear flow. Manhole was full to outlet pipe, with some roots within manhole.

PVC piping connected to left manhole to discharge seepage to sump, which is weekly pumped back to reservoir

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

DOWNSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE				
	2. WALL ALIGNMENT				
	3. WALL CONDITION				
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:			
	5. SEEPAGE OR LEAKAGE				
	6. ABUTMENT CONTACT				
	7. EROSION/SINKHOLES BEHIND WALL				
	8. ANIMAL BURROWS				
	9. UNUSUAL MOVEMENT				
	10. WET AREAS AT TOE OF WALL				

N/A

ADDITIONAL COMMENTS: Not applicable to this dam.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

UPSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S WALLS	1. WALL TYPE				
	2. WALL ALIGNMENT				
	3. WALL CONDITION				
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:			
	5. ABUTMENT CONTACT				
	6. EROSION/SINKHOLES BEHIND WALL				
	7. ANIMAL BURROWS				
	8. UNUSUAL MOVEMENT				

N/A

ADDITIONAL COMMENTS: Not applicable to this dam.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	None observed	X		
	2. FOUNDATION SEEPAGE	None observed	X		
	3. SLIDE, SLOUGH, SCARP	Erosion gulley on bench upstream of toe drain containment area.			X
	4. WEIRS	None	X		
	5. DRAINAGE SYSTEM	None (Berms downstream of dam to contain toe drain discharge)	X		
	6. INSTRUMENTATION	Several monitoring wells in the downstream area, one well is monitored (1)		X	
	7. VEGETATION	Sparse shrubs and salt cedar	X		
	8. ACCESSIBILITY	Good - by foot or vehicle access from plant access roads	X		
	DOWNSTREAM CONTAINMENT AREA:	Bottom of containment area is soft and moist, possible from leakage from left toe		X	
		drain line downstream of manhole or from sump. Some erosion observed on (2)			
	9. DOWNSTREAM HAZARD DESCRIPTION	SRP/CGS plant access road 0.8 miles downstream, transmission line towers 1.2 miles	X		
		downstream, SR 61/US 191 crossing 4.2 miles downstream (no residences)			
	10. DATE OF LAST EAP UPDATE	December 2008	X		

ADDITIONAL COMMENTS: 1) Annually under ADEQ permit requirement. Well has reportedly been dry during each observation.
2) slopes of containment berms.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS
MISC.	1. RESERVOIR DEPTH (AVG)	Varies with sediment/sludge deposition. Average approxiamtely 25 feet including sediment/sludge.
	2. RESERVOIR SHORELINE	Undeveloped, sparse vegetation. Located within SRP-owned land.
	3. RESERVOIR SLOPES	Moderate slopes, some minor erosion gullies from upland runoff. (1)
	4. ACCESS ROADS	Several plant access roads to dam and surrounding area.
	5. SECURITY DEVICES	Locked gates at access roads, wire gate in spillway to keep livestock out of pond.
	6. VANDALISM OR TRESPASS	☐ YES ☑ NO WHAT:
	7. AVAILABILITY OF PLANS	☑ YES ☐ NO DATE: 9/30/1980 As-Built Drawings (Bechtel)
	8. AVAILABILITY OF DESIGN CALCS	☑ YES ☐ NO DATE: August 1976 (Bechtel)
	9. AVAILABILITY OF EAP/LAST UPDATE	☑ YES ☐ NO DATE: December 2008
	10. AVAILABILITY OF O&M MANUAL	☐ YES ☑ NO DATE:
	11. CARETAKER/OWNER AVAILABLE	☑ YES ☐ NO DATE: 9/9/09 - 9/10/09
	12. CONFINED SPACE ENTRY REQUIRED	☑ YES ☐ NO PURPOSE: For toe drain manhole/sump access

ADDITIONAL COMMENTS: 1) Two diked settling ponds and a dry coal ash landfill are located uphill of the reservoir on the eastern side.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Earthen open channel, unlined, excavated into natural soil	X		
	WEIR TYPE	Open channel spillway, no hard control.		X	
	SPILLWAY CONDITION	Fair - significant side slope erosion, dessication cracking along channel floor, (1)			X
	TRAINING WALLS	None (earthen side slopes originally at 1.5H:1V, steeper in some areas apparently (2)			X
	SPILLWAY CONTROLS AND CONDITION	No fixed control surface. Channel was surveyed and regraded to design elev. (3)		X	
	UNUSUAL MOVEMENT	Some cracking at tops of side slopes, posible scarps		X	X
	APPROACH AREA	Vegetative growth upstream of channel in approach area, should be cleared.			X
	DISCHARGE AREA	Clear, channel widens into low wash area, some erosion gullies downstream		X	
	DEBRIS	Some tumbleweeds accumulated against cattle fence in spillway, some shrubs (4)		X	X
	WATER LEVEL AT TIME OF INSPECTION	Reservoir 6 - 7 feet below spillway invert, spillway dry (has never discharged)	X		
		Note: operating pool intended to be maintained so that 100-year flood is contained			
		within impoundment without discharge from spillway (per Aquifer			
		Protection Permit)			

ADDITIONAL COMMENTS: 1) and some possible movement observed of side slopes near axis of dam. Crack at top of left side slope at dam axis runs full length from upstream high ground to downstream high ground.

2) due to erosion of the side slopes.

3) in March 2008 due to accumulation of eroded sediment (ADWR 2008 Inspection Report)

4) in spillway approach area.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE				
	WEIR TYPE				
	SPILLWAY CONDITION				
	TRAINING WALLS				
	SPILLWAY CONTROLS AND CONDITION				
	UNUSUAL MOVEMENT				
	APPROACH AREA				
	DISCHARGE AREA				
	DEBRIS				
	WATER LEVEL AT TIME OF INSPECTION				

N/A

ADDITIONAL COMMENTS: Not applicable to this dam.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE				
	INTAKE STRUCTURE				
	TRASHRACK				
	PRIMARY CLOSURE				
	SECONDARY CLOSURE				
	CONDUIT				
	OUTLET STRUCTURE/HEADWALL				
	EROSION ALONG TOE OF DAM				
	SEEPAGE/LEAKAGE				
	DEBRIS/BLOCKAGE				
	UNUSUAL MOVEMENT				
	DOWNSTREAM AREA				
	MISCELLANEOUS				

N/A

ADDITIONAL COMMENTS: Not applicable to this dam. Inflow is balanced by evaporation.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

CONCRETE/MASONRY DAMS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE				
	AVAILABILITY OF PLANS				
	AVAILABILITY OF DESIGN CALCS				
	PIEZOMETERS				
	OBSERVATION WELLS				
	INCLINOMETERS				
	SEEPAGE GALLERY				
	UNUSUAL MOVEMENT				

N/A

ADDITIONAL COMMENTS: Not applicable to this dam.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

CONCRETE/MASONRY DAMS (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	N/A			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	HORIZONTAL ALIGNMENT				
	VERTICAL ALIGNMENT				

ADDITIONAL COMMENTS: Not applicable to this dam.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE	N/A			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACT				
	LEAKAGE				

ADDITIONAL COMMENTS: Not applicable to this dam.

NAME OF DAM: Evaporation Pond Dam STATE ID #: 01.46 - Arizona Dept. of Water Resources

INSPECTION DATE: September 9 & 10, 2009 NID ID #: AZ00155

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	N/A			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACTS				

ADDITIONAL COMMENTS: Not applicable to this dam.

APPENDIX D

DEFINITIONS

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to references published by the U.S. Army Corps of Engineers, the Federal Energy Regulatory Commission, the Department of the Interior Bureau of Reclamation, or the Federal Emergency Management Agency.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate there from, including but not be limited to, spillways; reservoirs and their rims; low level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

General

EAP – Emergency Action Plan - Shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.068 acre feet.

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Condition Rating

SATISFACTORY - No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

FAIR - Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.

POOR - A management unit safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. POOR also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.

UNSATISFACTORY - Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

Hazard Potential

(In the event the impoundment should fail, the following would occur):

LESS THAN LOW HAZARD POTENTIAL: Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

LOW HAZARD POTENTIAL: Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL: Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

HIGH HAZARD POTENTIAL: Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

APPENDIX E

EPA REFERENCE DOCUMENT LIST

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

Coal Combustion Waste Surface Impoundment Assessment
Salt River Project
Coronado Generating Station
St. Johns, Arizona
Document List
September 9, 2009

1. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-004, Final Issue As Built Configuration, Bechtel, 9/30/80.
2. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-005, Final Issue As Built Configuration, Bechtel, 9/30/80.
3. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-006, Final Issue As Built Configuration, Bechtel, 9/30/80.
4. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-009, Final Issue As Built Configuration, Bechtel, 9/30/80.
5. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-010, Final Issue As Built Configuration, Bechtel, 9/30/80.
6. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-011, Final Issue As Built Configuration, Bechtel, 9/30/80.
7. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-012/1, Final Issue As Built Configuration, Bechtel, 9/30/80.
8. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-012/2, Final Issue As Built Configuration, Bechtel, 10/21/80.
9. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-014, Final Issue As Built Configuration, Bechtel, 9/30/80.
10. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-015, Final Issue As Built Configuration, Bechtel, 9/30/80.
11. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-017, Final Issue As Built Configuration, Bechtel, 9/30/80.
12. Design Drawing, Evaporation Reservoir Dam Plan and Typical Section, 13-C-ZHC-020, Final Issue As Built Configuration, Bechtel, 9/30/80.
13. Annual Discharge to Evaporation Pond from 1986 September 2002, Reporting Period: 5-16/06-8/15/07.
14. Coronado Generating Station Evaporation Dam (01.46), September 12, 2008 Dam Safety Inspection Report Finding of No Safety Deficiency, Arizona Department of Water Resources, Office of Water Engineering, October 16, 2008.
15. Aquifer Protection Permit No. P-101449, Place ID 4477, LTF 31312, dated June 3, 2003.
16. Coronado Generating Station Evaporation Dam (01.46), September 27, 2005 Inspection Report Notice of No Safety Deficiencies, Arizona Department of Water Resources, Office of Water Engineering, March 22, 2006.
17. Table Summary of Action Items for CGS Evaporation Dam (01.46) – WDWR Dam Safety Inspection Report, (Inspection date: 9/12/08) & Cover Letter (dated 10/16/08), Salt River Project, Coronado Generating Station, 12/05/08.

18. Zone 1 Soil Testing Data, 5 pages dated 3-8-77, 5 pages dated 3-7-77, 5 pages dated 3-1-77, one page dated 5-9-77, and one page 8-31-77.
19. SRP Memo, 1989 SOD Examination of CGS Evaporation and Raw Water Dams, stamped June 19, 1989.
20. Application for the Approval of the Plans and Specifications for the Construction, Enlargement, Repair, Alteration or Removal of a Dam and Reservoir, Undated.
21. Memo, Delete Lining of Spilllway, 10-19-78.
22. SRP/EPRI Coronado Generating Station, FGD Pond, Project Review Meeting, John Goodrich-Mahoney, June 7, 1994.
23. Memo and Tables, Test Borings, Bechtel Power Corporation, February 9, 1976.
24. Appendix, Coronado Evaporation Dam, Summary Inspection Report, Salt River Project, 1979.
25. Coronado Evaporation Dam, Summary Inspection Report, Salt River Project, 1979.
26. Evaporation Pond Dam, AZ Dam No. 01.46, Coronado Generating Station, St. Johns, Apache County, Salt River Project, Dam Safety Emergency Action, Revised December 9, 2008.
27. SRP, Coronado Generating Plant, Coal Combustion Waste Disposal Overview Power Point Presentation, Presented to EPA Region 9 and GZA Environmental, September 9, 2009.

APPENDIX F

DRAFT REPORT COMMENTS AND GZA RESPONSE TO COMMENTS

Comments on Coronado

EPA HQ - No comments

EPA Region -

See attached doc dated Nov. 17, 2009

State -

From: "Michael J. Johnson" <mjjohnson@azwater.gov>
To: James Kohler/DC/USEPA/US@EPA, John Schofield/R9/USEPA/US@EPA, 'Mel P.Bunkers' <Bunkers.Mel@azdeq.gov>
Cc: Stephen Hoffman/DC/USEPA/US@EPA, Ravi Murthy <rmurthy@azwater.gov>, "Karen L. Smith" <klsmith@azwater.gov>
Date: 11/09/2009 11:40 AM
Subject: RE: Comment Request on EPA's Draft Coal Ash Impoundment Assessment Reports

Jim,

Thanks for the opportunity to review the reports. ADWR has no direct comments on the reports themselves. Please be advised that following our next inspection of the state-regulated dam at the Apache site (tentatively scheduled for December 2009), we will review the current earth fissure mitigation plan in light of more recent findings related to fissure monitoring and identification at other Arizona damsites.

Mike

Michael Johnson, Ph.D., P.E.
Assistant Director, Surface Water Division
Arizona Department of Water Resources
(602) 771-8659
mjjohnson@azwater.gov

Company -

See attached doc dated Nov. 12, 2009

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

November 17, 2009

MEMORANDUM

SUBJECT: Comments to Dam Assessment Report – *Draft*, Project #01-381, SRP Coronado Generating Station Evaporation Pond Dam, Apache County, Arizona, prepared by GZA Environmental, Inc. dated October 9, 2009

FROM: John Schofield, RCRA Enforcement Office

TO: James Kohler, P.E., Office of Resource Conservation of Recovery

The following are EPA Region IX, RCRA Enforcement Office comments to the referenced report:

1. Page 17, Emergency Warning System. Recommend that title of this section be changed to "Emergency Action Plan."

2. Page 17, Emergency Warning System. Check figure references. The referenced figures should be Figures 8 and 9, and not Figures 7 and 8, as listed.

3. Page 17, Emergency Warning System. Recommend adding discussion on Hazard Potential Rating and/or reference discussion found at Page 7, Section 1.2.7. Hazard Potential Classification. Also, GZA Environmental, Inc. (GZA) should include any calculations performed by GZA to verify inundation information. What is the inundation depth at the Access Road?

Delivering More Than Power™

Mail Station CGS600
PO Box 1018
St. Johns, AZ 85936

Coronado Generating Station
Phone: (928) 337-4131
Fax: (928) 337-2961

November 12, 2009

Mr. Stephen Hoffman
US Environmental Protection Agency
Two Potomac Yard
2733 South Crystal Drive
5th Floor, N-5237
Arlington, VA 22202-2733

Re: Response to the request for comments on the Draft Report of the Coal Combustion Residuals impoundment at the Salt River Project Coronado Generating Station under the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675.

Mr. Stephen Hoffman:

Thank you for providing Salt River Project Agricultural Improvement and Power District (SRP) the opportunity to provide comments on the draft report prepared by GZA GeoEnvironmental, Inc. (GZA) for the Coronado Generating Station (CGS) facility based on the investigation conducted September 9-10, 2009 by the United States Environmental Protection Agency (USEPA) and GZA to assess the structural stability of the coal combustion residual impoundment at CGS. The report is well written and SRP has only few minor comments. SRP's specific suggested changes in the report text and rationale for the corrections are provided in Attachment A to this letter.

If you have any questions about the comments on the report please do not hesitate to call Prabhat Bhargava of my staff at (928) 337-5506.

Sincerely,

William D. Beck, Plant Manager
SRP / Coronado Generating Station

Attachments

cc: Glen Reeves
Daniel Casiraro
Prabhat Bhargava
Kent Liesemeyer
Karilee Ramaley
File: LOC 5-2-7.1

ATTACHMENT A

Suggested Changes in Task 3 Dam Assessment Report –Draft
Project #0-381,
SRP Coronado Generating Station Evaporation Pond Dam

The GZA draft report dated October 9, 2009 (GZA File No. 01.0170142.10) is well written and researched. In general, the report appears to be an accurate account based on the site specific inspection of the Evaporation Dam at the Salt River Project, Coronado Generating Station (SRP/CGS) facility on September 9 and 10, 2009. However, there are number of suggested corrections / changes that SRP/CGS requests:

Dam Height: Replace Structural Height of 53 feet with 61.3 feet (maximum or embankment height)
Executive Summary (page i, 2nd paragraph)
Section 1.2.4 (page 3, 3rd paragraph)
Section 1.2.6 (page 7, 1st paragraph)
Section 1.3.4 Corrections to General Elevations (Top of Dam minus Low Point should equal 61.3 feet)
Appendix C:
CCW Impoundment Inspection (EPA Form xxxx-xxx, Jan 09) Page 3
Dam Safety Inspection Checklist (v.3.1) Page 1
Reason: The "Statutory Dam Height" of 53 feet from Arizona Department of Water Resources (ADWR) records is the distance from the lowest point on the toe of the dam to the spillway crest. The total freeboard of 8.3 feet must be added to obtain a height to the crest of the dam which is 61.3 feet.

Settling ponds: Replace "The northern of the two settling ponds is reportedly no longer operational. The southern of the two settling ponds is operational" with "Neither settling pond is operational"
Section 1.2.5 (page 6, last paragraph on page)
Reason: SRP/CGS was not discharging into the settling ponds at the time of the GZA inspection and has no plans to discharge to these structures in the future.

Settling ponds: Replace "adjust the elevation of the discharge to limit" with "maintained"
Section 1.2.5 (page 7, 1st paragraph on page)
Reason: SRP/CGS designed the settling pond for a capacity less than 50 acre-feet (not actively adjusted).

Settling ponds: Replace "it appeared that two main settling ponds used by SRP/CGS" with "it appeared that two main settling ponds are no longer used by SRP/CGS"
Section 1.3.1 (page 8, 4th paragraph)
Reason: SRP/CGS was not discharging into the settling ponds at the time of the GZA inspection and has no plans to discharge to these structures in the future.

Vegetation: Replace "Deep-rooted vegetation that had been removed from the dam had been deposited in small piles on top of the dam, and" with "Dead vegetation"
Section 2.1.3 (page 14, 1st paragraph):
Reason: This vegetation was not deep-rooted and these dead shrubs remained in the place that they grew (not removed from elsewhere).

Typographical error: Replace "great" with "greater"
Section 2.5 (page 18, last paragraph on page)
Reason: Typographical error.

APPENDIX F

GZA Response to Comments Received on Draft Report

Comments from John Schofield, EPA Region IX:

1. GZA has changed the title of the "Emergency Warning System" section to "Emergency Action Plan", as suggested.

2. GZA has updated the Figure references as noted.

3. GZA has referenced the "Hazard Potential Classification" section of the report. GZA did not perform calculations to independently verify the inundation areas presented in the Emergency Action Plan (Figures 8 and 9). Regarding the inundation depth at the Access Road, the Emergency Action Plan did not contain detailed hydraulic information regarding downstream flow rates and flow depths. For the purposes of an Emergency Action Plan, in the event of a dam failure, the conservative assumption is typically made that downstream roadway culverts will be blocked by debris and/or sediment carried downstream by a potential flood wave, and that small roadway embankments will be damaged by overtopping flow. In GZA's opinion, roadway closures at the Access Road and U.S. Highway 191 are appropriate given an actual or potential emergency situation at the Evaporation Pond Dam.

Comments from SRP/CGS:

Dam Height: GZA has reported the general dam height as 53 feet based on information presented in the 1980 As-Built Drawings and the 1979 Summary Inspection Report (Page 1-1) by Bechtel. GZA has included additional information in the Final Report to clarify the dam height. The dam height of 53 feet is measured from the low point along the toe of the dam (Elev. 5772 feet above Mean Sea Level (MSL), based on site topography shown in As-Built Drawings 13-C-ZHC-005 and 13-C-ZHC-009) to the top of the dam (Elev. 5825 feet MSL).

Based on available as-built documentation, the hydraulic height of the dam is approximately 44.7 feet, as measured from the toe of the dam (Elev. 5772 feet MSL) to the spillway crest (Elev. 5816.7 feet MSL). It is noted that the State of Arizona, under Arizona Revised Statutes Chapter 6 Article 1 45-1201, uses the hydraulic height of the dam as the statutory "dam height". Adding 8.3 feet of freeboard height to the hydraulic height gives the general dam height of 53 feet, which is in agreement with the "dam height" listed in the ADWR Inspection Checklists, the basis for which is unknown. GZA believes the height referenced in the ADWR Inspection Checklists is the general dam height (toe of dam to top of dam), rather than the hydraulic height.

The U.S. Bureau of Reclamation (USBR) defines structural height in the text "Dams and Public Safety" as the distance between the lowest point in the excavated foundation and the top of the dam. Under this definition, the structural height of the dam is 75 feet, which accounts for the 53 feet of embankment above the toe and an additional 22 feet of cutoff trench.

Settling Ponds: The comments regarding the design and operation of the settling ponds have been incorporated into the Final Report. GZA confirms that SRP/CGS was not discharging into the settling ponds at the time of the inspection.

Vegetation: GZA has addressed the comment in the Final Report text and Inspection Checklist.

Typographical Error: GZA has corrected the error in the Final Report.

Comments from ADWR:

(No specific comments to address)