CHOLLA POWER PLANT BOTTOM ASH POND

Periodic Inflow Design Flood Control System Plan

October 2021
AECOM Project 60664605

Delivering a better world

Prepared for:

Arizona Public Service
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Prepared by:

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Table of Contents

Attachment

1. Introduction

This Periodic Inflow Design Flood Control System Plan for the Bottom Ash Pond at Cholla Power Plant, operated by Arizona Public Service (APS), has been prepared in accordance with the requirements of Title 40 of the Code of Federal Regulations Part 257 (40 CFR 257) (“the Coal Combustion Residuals [CCR] Rule”, or “the Rule”) and the specific requirement of 40 CFR § 257.82(c)(4) that “(t)he owner or operator of the CCR unit must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years.”

2. Methodology

The methodology used to prepare this 2021 Periodic Inflow Design Flood Control System Plan for the Bottom Ash Pond (BAP) at the Cholla Power Plant is for the certifying Qualified Professional Engineer (QPE) to:

1. Identify and review the hydrologic design basis references used for the 2016 Plan and verify applicability for use in 2021.
2. Perform a documented review of each major component of the contributing technical information from:
    a. AECOM, 2016, Cholla Power Plant, Bottom Ash Pond, Inflow Design Flood Control System Plan, CH_Inflowflood_003_20161017, September 28, 2016 (hereafter referred to as the “2016 Plan” and incorporated and referenced directly as Attachment A to this document).
3. Consider and document whether the 2016 Plan and its conclusions:
    a. Meet the current reporting requirements of the Rule;
    b. Reflect the current condition of the structure, as known to the QPE and documented in the annual inspections;
    c. Are compromised by any identified issues of concern; and
    d. Are consistent with the standard of care of professionals performing similar evaluations in this region of the country; and
4. Identify any additional analyses, investigations, inspections, and/or repairs that should be completed in order to complete this 2021 Recertification.

This report documents the results of these considerations, incorporates the 2016 Plan as an Appendix, identifies any additional technical investigation or evaluations (if needed), and presents an updated certification by the QPE.

3. Applicability of 2016 Plan Hydrologic Design Basis

The 2016 Plan relied on then-current methodology for estimation of Probable Maximum Precipitation (PMP) depth that are prescribed by the Arizona Department of Water Resources (ADWR) and developed by Applied Weather Associates (AWA 2013). This PMP tool evaluates precipitation for the 72-hour general, 72-hour tropical, and the 6-hour local distribution. At the BAP site, the 6-hour local storm yields the largest runoff volume of the three distributions. The methodology yields a rainfall depth of 7.74 inches.

The relevant page of the ADWR website (https://new.azwater.gov/dam-safety/az-pmp) provides hyperlinks to the technical studies supporting the PMP tool, and the PMP tool itself, and includes a statement that "(t)he most recent version of the Statewide Probable Maximum Precipitation Study was published in 2013."

AECOM concludes that the details presented in this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4. 2016 Plan – Review by Section

Other than as described in the remainder of this section, the details presented in this section of the 2016 Report adequately represent current conditions and satisfy the requirements of the Rule.

4.1 "§257.82 Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The details presented in this section of the 2016 Plan accurately describe the requirements of the Rule.

4.2 "Overview"

The details presented in this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4.3 "§257.82 (a)(1)(2)(3) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

A separate 2021 Periodic Hazard Potential Study confirms the assignment of the most severe classification, High Hazard, to the BAP. Therefore, this aspect of the 2016 Plan adequately represents current conditions and satisfies the requirements of the Rule.

As described in Section "3. Applicability of 2016 Plan Hydrologic Design Basis" of this 2021 Plan, the methodology used in the 2016 Plan for estimation of the PMP depth is the same as the ADWR advice for use in 2021.Therefore, this aspect of the 2016 Plan adequately represents current conditions and satisfies the requirements of the Rule.

APS had reported no change in the operational procedures and maximum operating levels for the BAP. The dredge solids removal program continues, though less frequently because the Plant is operated only seasonally. The characterization of the flood storage volume capacity available within the BAP that was reported in the 2016 Plan is unchanged and therefore adequately represents current conditions and satisfies the requirements of the Rule.

4.4 "§257.82 (b) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The details presented in this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4.5 "§257.82 (c)(1)(2)(3)(4)(5) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The owner or operator continues to acknowledge and will comply with these requirements.

Per the requirement of §257.82 (c)(4), this document constitutes the "every five years" Periodic Inflow Design Flood Control System Plan.

A certification of this Periodic Inflow Design Flood Control System Plan by a QPE is included in this document per the requirement of §257.82(c)(5).

4.6 "§257.82 (d) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The owner or operator continues to acknowledge and will comply with these requirements.

5. Recommended Additional Technical Investigations or Evaluations

None identified and none recommended.

6. Conclusion

The 2016 Plan and its conclusions meet the current reporting requirements of the Rule, reflect the current condition of the structure as known to the QPE and documented in the annual inspections, are not compromised by any identified issues of concern, and are consistent with the standard of care of professionals performing similar evaluations in this region of the country.

7. Limitations

This document is for the sole use of APS on this project only and is not to be used for other projects. In the event that conclusions based upon the data presented in this document are made by others, such conclusions are the responsibility of others.

The Periodic Inflow Design Flood Control System Plan presented in this report is based on the 2016 Plan and relies and incorporates any Limitations expressed in that document.

The Certification of Professional Opinion in this report is limited to the information available to AECOM at the time this Assessment was performed in accordance with current practice and the standard of care. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this area performing the same services under similar circumstances during the same period. Professional judgments presented herein are primarily based on information from previous reports that have been assumed to be accurate, knowledge of the site, and partly on our general experience with dam safety evaluations performed on other dams.

No warranty or guarantee, either written or implied, is applicable to this work. The use of the word “certification” and/or “certify” in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

8. Certification Statement

Certification Statement for:

- Certification Statement 40 CFR § 257.82(c)(5) – Periodic Inflow Design Flood Control System Plan for an Existing CCR Surface Impoundment.
- CCR Unit: Arizona Public Service; Cholla Power Plant; Bottom Ash Pond

I, Alexander W. Gourlay, being a Registered Professional Engineer in good standing in the State of Arizona, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the information contained in this Periodic Inflow Design Flood Control System Plan dated October 2021, including the technical content in Attachment A, meets the requirements of 40 CFR § 257.81.

Alexander W. Gourlay, P.E.
Printed Name

October 11, 2021
Date

Attachment A:

AECOM, 2016, *Cholla Power Plant, Bottom Ash Pond, Inflow Design Flood Control System Plan, CH_Inflowflood_003_20161017,* September 28, 2016.

ATTACHMENT A

AECOM, 2016. ***Cholla Power Plant, Bottom Ash Pond, Inflow Design Flood Control System Plan, CH_Inflowflood_003_20161017,*** **September 28, 2016.**

CHOLLA POWER PLANT
BOTTOM ASH POND
INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
CH_Inflowflood_003_20161017

This *Inflow Design Flood Control System Plan* (Plan) document has been prepared specifically for the Bottom Ash Pond (BAP) at the Cholla Power Plant. This Plan has been prepared in accordance with our understanding of the requirements prescribed in §257.82 of the Federal Register, Volume 80, Number 74, dated April 17, 2015 (U. S. Government, 2015) for hydrologic and hydraulic capacity requirements for CCR surface impoundments associated with existing Coal Combustion Residual (CCR) surface impoundments. Section §257.82 is reproduced below for reference purposes. This document serves as the initial plan described in §257.82.

The BAP is an existing CCR surface impoundment facility. Calculations prepared previously in support of the facility operation have been referenced and reproduced herein to address the requirements listed.

§257.82 Hydrologic and Hydraulic capacity requirements for CCR surface impoundments

(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.

(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.

(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.

(3) The inflow design flood is:

(i) For a high hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the probable maximum flood;

(ii) For a significant hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the 1,000-year flood;

(iii) For a low hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the 100-year flood; or

(iv) For an incised CCR surface impoundment, the 25-year flood.

(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.

(c) *Inflow design flood control system plan* –

(1) *Content of the Plan*. The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by

appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).

(2) *Amendment of the Plan*. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

(3) *Timeframes for preparing the initial plan -*

(i) *Existing CCR surface impoundments*. The owner or operator must prepare the initial inflow design flood control system plan no later than October 17, 2016.

(ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner of operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR unit.

(4) *Frequency for revising the plan.* The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).

(5) The owner or operator must obtain a certification from a qualified engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.

(d) The owner or operator of the CCR unit must comply with the record keeping requirements specified in §257.105(g), the notification requirements specified in §257.106(g), and the internet requirements specified in §257.107(g).

SITE INFORMATION	
Site Name / Address	Cholla Power Plant / 4801 Frontage Road, Joseph City, AZ 86032
Owner Name / Address	Arizona Public Service / 400 North 5th Street, Phoenix, AZ 85004
CCR Unit	Bottom Ash Pond (BAP)

OVERVIEW

The Bottom Ash Pond (BAP) located at the Cholla Power Plant is an existing facility that receives bottom ash produced as a waste product from the operation of the electric generating units at the Cholla Site. The pond was formed by the construction of an embankment across a low lying area.

This inflow/flood control plan describes the contributing Inflow Design Flood (IDF) precipitation event, flood runoff volumes, and available/required storage capacity for the pond. The BAP embankment is classified as a high hazard dam (AECOM 2016) and is therefore required to accommodate the IDF resulting from a Probable Maximum Precipitation (PMP) event. The BAP does provide sufficient flood storage for the PMP runoff volume.

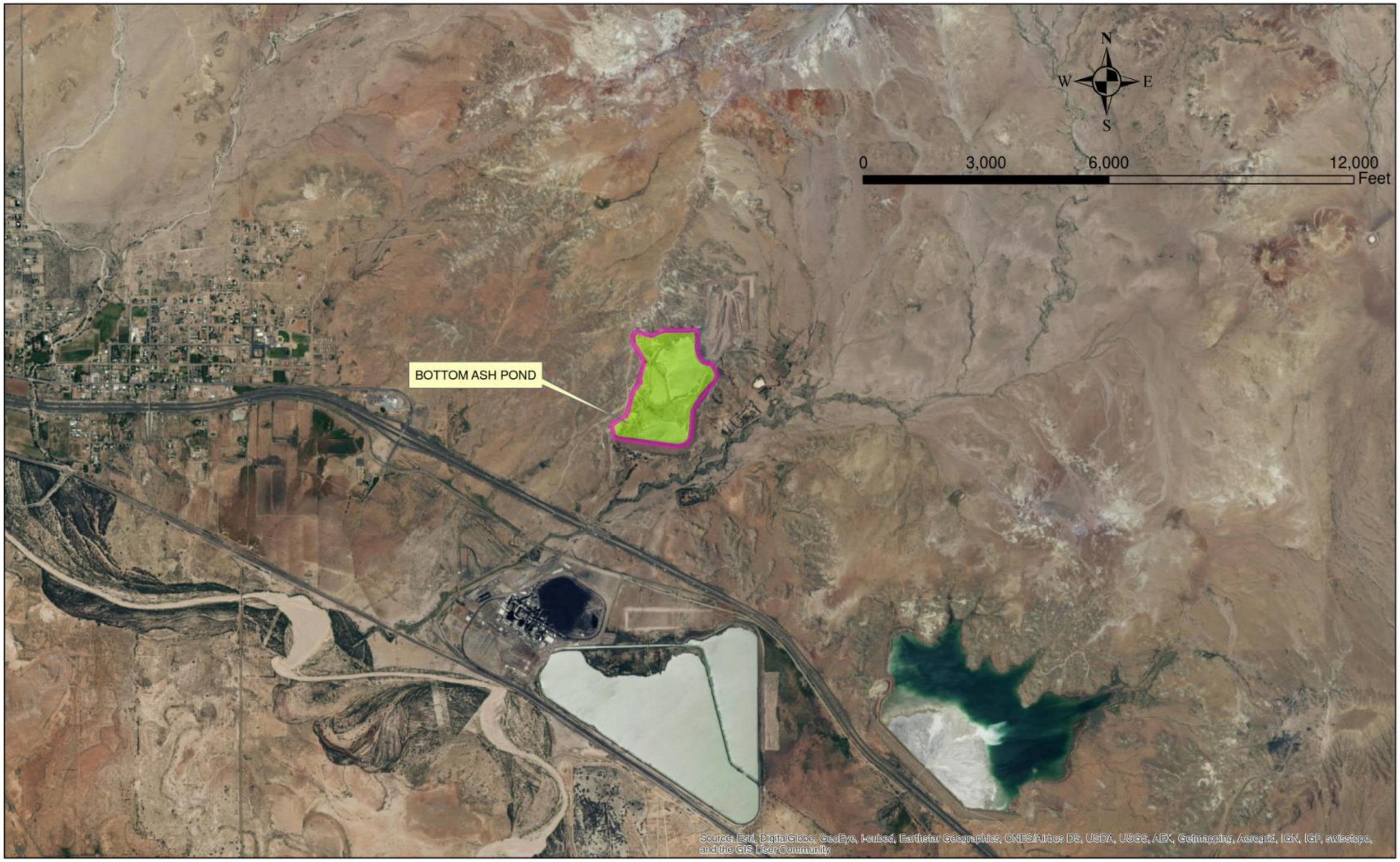


Exhibit 1 – Bottom Ash Pond (BAP) at Cholla Power Plant Facility

§257.82 (a)(1)(2)(3) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section. (1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.	The Bottom Ash Pond has a high hazard classification (AECOM, 2016) which requires accommodation (storage and/or safe discharge) of the Probable Maximum Precipitation (PMP) inflow runoff volume. In order to compare elevations specified in the original construction, raise, permitting, and survey documents for the BAP, it is necessary to consider the different vertical datums referenced for "elevation above mean sea level". All elevations identified in the original 1975 engineering design, the 1993 dam raise, and all ADWR permitting documents are referenced to the older NGVD 29 vertical datum. All current topographic mapping and land surveying are referenced to the more recent NAVD 88 vertical dam. The difference in datums in estimated to be an average of 2.4 feet in the general location of the BAP. The effect is, for example, that the 1993 raise documentation identifies the raised main dam crest elevation as 5123.3 feet (NGVD 29), which translates to 5125.7 feet (NAVD 88). All calculations in this Certification are referenced to the current NAVD 88 datum and, for clarity, a datum is referenced for all elevation values. Ebasco (1976) documented the original design basis in **Flood Routing Studies for Bottom Ash and Fly Ash Ponds** (Ebasco 1976). The original design basis identified a Probable Maximum Thunderstorm Precipitation runoff volume of 107.7 acre–feet based on a rainfall depth of 10.1 inches. In 1993, APS raised the elevation of the crest of the embankment in order to increase the storage of the impoundment. APS (1991) documented the design basis for the raise in **Design Report for Cholla S.E.S. Units 1-4, Raising Bottom Ash Dam to Elevation 5123.3 feet MSL**

	(NVGD 29) (APS 1991). The revised design basis identified a Probable Maximum Precipitation runoff volume of 99 acre-feet based on a rainfall depth of 10.5 inches. Subsequent to the 1993 crest raise, APS improved the operational characteristics of the impoundment by dividing the northern portion into a smaller ("west") and larger ("east") decant cell, separated from each other and the free water pond in the southern portion of the impoundment by internal ash embankments with stop-logged water discharge conduits to the free water pond. By rotating the bottom ash slurry discharge between the two decant cells, each could be allowed to drain sufficiently to allow subsequent mechanical excavation and transport of impounded ash to an adjacent, permitted ash landfill cell, the Bottom Ash Monofill. In order to document the current capacity of the impoundment to contain runoff from the IDF, AECOM has performed new precipitation depth, runoff volume, and storage volume calculations, which are attached as Appendices 1 and 2 to this demonstration, for the current configuration of the impoundment and its three cells. AECOM used current methodology for estimation of Probable Maximum Precipitation depth that are prescribed by the Arizona Department of Water Resources (ADWR) and developed by Applied Weather Associates (AWA 2013). This PMP tool evaluates precipitation for the 72-hour general, 72-hour tropical, and the 6-hour local distribution. At the BAP site, the 6-hour local storm yields the largest runoff volume of the three distributions. The methodology yields a rainfall depth of 7.74 inches. Based on a measured contributing watershed area of 131 acres and an assumed

	runoff curve number of 90 (assessed to be unchanged from those values documented by APS, 1991), the calculated runoff volume for the PMP is 71 acre-feet (see Appendix 1). For simplicity, the flood storage volume capacity provided within the free water pond alone was compared to the PMP runoff volume. The free water pond is bounded laterally by the main dam embankment to the south and east, native ground to the west, and the intermediate divider dike to the north. The flood storage volume is estimated from the elevation–storage volume relationship for the free water pond area between the maximum operating water surface elevation of 5120.2 feet (NAVD88) and the maximum flood pool elevation of 5122.4 feet (NAVD88). The calculated flood storage volume capacity in the free water pond alone, estimated based on 1-foot as-built topographic contour data provided by APS in 2014 (APS, 2014), is 72.5 acre-feet (see Appendix 2). Therefore, the free water pond flood storage capacity of 72.5 acre-feet exceeds the PMP runoff volume of 71 acre-feet. The BAP embankment is constructed to elevation 5125.7 feet (NAVD 88), which provides 3.3 feet of freeboard above the maximum flood pool elevation. AECOM notes that this demonstration of capacity conservatively neglects additional storage that would be available in portions of the two decant cells in which the impounded ash elevation is less than the maximum flood pool elevation.
(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in	The U.S. Army Corps of Engineer's HEC-1 flood hydrograph model was used to estimate runoff volume of 71 acre-feet based on a Probable Maximum Precipitation rainfall depth of 7.74 inches. A contributing drainage area of 131 acres,

paragraphs (a)(1) and (2) of this section. (2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.	SCS Curve Number of 90, PMP rainfall depth of 7.74 inches, and rainfall distribution were incorporated into the HEC-1 model. The 71 acre-feet runoff volume is accommodated within the flood pool bound by the BAP embankment and interior divider embankment and within the vertical segment above the maximum operating water surface elevation and below the embankment crest elevation of 5125.7 feet (NAVD 88) with over 3.3 feet of freeboard. No outflow from the BAP is anticipated and no emergency spillways are provided as part of the BAP.
(a)(3) The inflow design flood is: (i) For a high hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the probable maximum flood; (ii) For a significant hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2) , the 1,000-year flood; (iii) For a low hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the 100-year flood; or (iv) For an incised CCR surface impoundment, the 25-year flood.	The hazard classification for the Bottom Ash Pond is high based on the **Final Summary Report Structural Integrity Assessment, Bottom Ash Pond, Cholla Power Plant**, prepared by AECOM in August 2016 (AECOM, 2016).
§257.82 (b) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.	The BAP is designed and operated as a disposal facility and is intended for use as an impoundment with storage volume in excess of the probable maximum thunderstorm runoff volume.

§257.82 (c)(1)(2)(3)(4)(5) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(c)(1) *Content of the plan.* The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).	This *Inflow Design Flood Control System Plan* serves as the initial plan prescribed herein.
(c)(2) *Amendment of the Plan*. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.	The owner or operator acknowledges and will comply with this requirement.
(c)(3*) Timeframes for preparing the initial plan* – (i) Existing CCR impoundments. The owner or operator must prepare the initial inflow design flood control system plan no later than October 17, 2016. (ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR Unit	The BAP is an existing CCR impoundment at Cholla Power Plant. This document constitutes the Inflow Design Flood Control System Plan.

(c)(4) *Frequency for revising the plan*. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).	The owner or operator acknowledges and will comply with this requirement.
(c)(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.	Certification by a professional engineer is included as an attachment to this document.
§257.82 (d) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in §257.105(g), the notification requirements specified in §257.106(g), and the internet requirements specified in §257.107(g).	The owner or operator acknowledges and will comply with this requirement.

References

AECOM, August 2016, ***Final Summary Report Structural Integrity Assessment, Bottom Ash Pond, Cholla Power Plant.***

Arizona Public Service, 2014, ***1-Foot Contour Mapping from As-Built Topographic Data.***

Applied Weather Associates, 2013, **Probable Maximum Precipitation Study for Arizona, prepared for the Arizona Department of Water Resources.**

Arizona Public Service, July 1991, ***Design Report for Cholla S.E.S. Units 1-4, Raising Bottom Ash Dam to Elevation 5123.3 Feet MSL***.

Ebasco Services Incorporated, May 1976, ***Flood Routing Studies for Bottom Ash and Fly Ash Ponds***.

Ebasco Services Incorporated, September 1975, ***Arizona Public Service Company, Cholla Generating Station, Ash Disposal Sites, Seepage and Foundation Studies Engineering Report***.

U.S. Government, April 2015, ***Federal Register, Volume 80, Number 74, Rules and Regulations***.

Appendices

1. **Cholla Bottom Ash Pond PMP Inflow Runoff Volume**
2. **Cholla Bottom Ash Pond Storage Volume**

Certification Statement 40 CFR § 257.82(c)(5) – Initial Inflow Design Flood Control System Plan for an Existing CCR Surface Impoundment

CCR Unit: Arizona Public Service; Cholla Power Plant; Bottom Ash Pond

I, Alexander W. Gourlay, being a Registered Professional Engineer in good standing in the State of Arizona, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the information contained in the initial inflow design flood control system plan dated September 28, 2016 meets the requirements of 40 CFR § 257.82.

Alexander W. Gourlay, P.E.

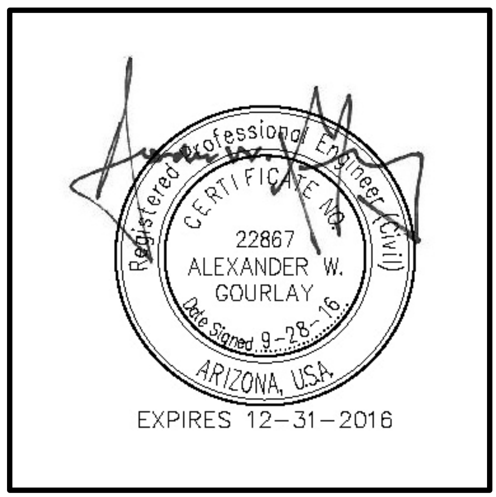
____

Printed Name

September 28, 2016

____

Date



APPENDIX 1 - CHOLLA BOTTOM ASH POND PMP INFLOW RUNOFF VOLUME

AECOM	Calculation Sheet				
Project Name:	Cholla CCR Report			**Calculation Number:**	0
Client Name:	APS			**Revision Number:**	2
Project Number:	**Job No.**	**Cost Code**	**Parent (if any)**	**Prepared By/Date:**	TB / 9-21-2016
	60492605		N/A		
Title:	Cholla BAP PMP Hydrologic Analysis – HEC-1				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the hydrologic analysis for the watershed draining toward the Bottom Ash Pond (BAP) at Cholla Power Plant.

REQUIRED DELIVERABLES:

- HEC-1 model that calculates the storm volume for the 6-Hour PMP using the AWA Methodology for PMP evaluation

DATA /ASSUMPTIONS:

- The topography used for the analysis was based on the 1-foot contour mapping provided by Arizona Public Service (APS, 2014).
- The PMP rainfall depths were calculated using the PMP Evaluation tool developed by Applied Weather Analysis (AWA, 2013) for Arizona Department of Water Resources (ADWR). The tool is used as an extension in ArcGIS.
- The PMP Evaluation tool calculates the rainfall depth for the General PMP storm event, Tropical PMP storm event and the Local PMP storm event. Table 1 shows the rainfall depth for the different PMP storm events obtained for the drainage area of the site. The model results indicate that the maximum rainfall depth was obtained for a 6-hour Local PMP storm event (7.74 inches). It was determined that the 72-hour General PMP storm event, 72- hour Tropical PMP storm event would yield a lesser runoff volume compared to the 6-hour Local PMP storm event. Figure 1 shows the 6-Hour Local PMP rainfall depth for site drainage area.
- The PMP rainfall was distributed as per the AWA methodology. The rainfall distribution for the 6-hour PMP is shown in Figure 2. Table 2 shows the rainfall distribution.
- The drainage area for the BAP was calculated to be 131 acres based on drainage delineation as shown in Figure 3.
- Curve number method was used evaluate the rainfall losses. A curve number of 90 were used for the site as per the Design Report for Cholla S.E.S. (APS, 1991). The reference is attached in Attachment A.

- The longest flow path, Lca, and slope were calculated in ArcGIS to estimate the Time of Concentration and Storage Co-efficient (R). The Calculation is attached in Attachment A.
- The inputs were entered into the HEC-1 model to calculate the runoff volume for the drainage area.

RESULTS:

The results from the HEC-1 analysis indicate that the runoff volume for the 6-hour Local PMP storm event using the AWA methodology was calculated to be 71 acre-feet. The HEC-1 Results are shown in Attachment A.

Project Name:	Cholla CCR Report			**Calculation Number:**	0
Client Name:	APS			**Revision Number:**	2
Project Number:	**Job No.**	**Cost Code**	**Parent (if any)**	**Prepared By/Date:**	TB / 9-21-2016
	60492605		N/A		
Title:	Cholla BAP PMP Hydrologic Analysis – HEC-1				

Calculation Sheet

Figure 1 PMP Evaluation Tool – Site

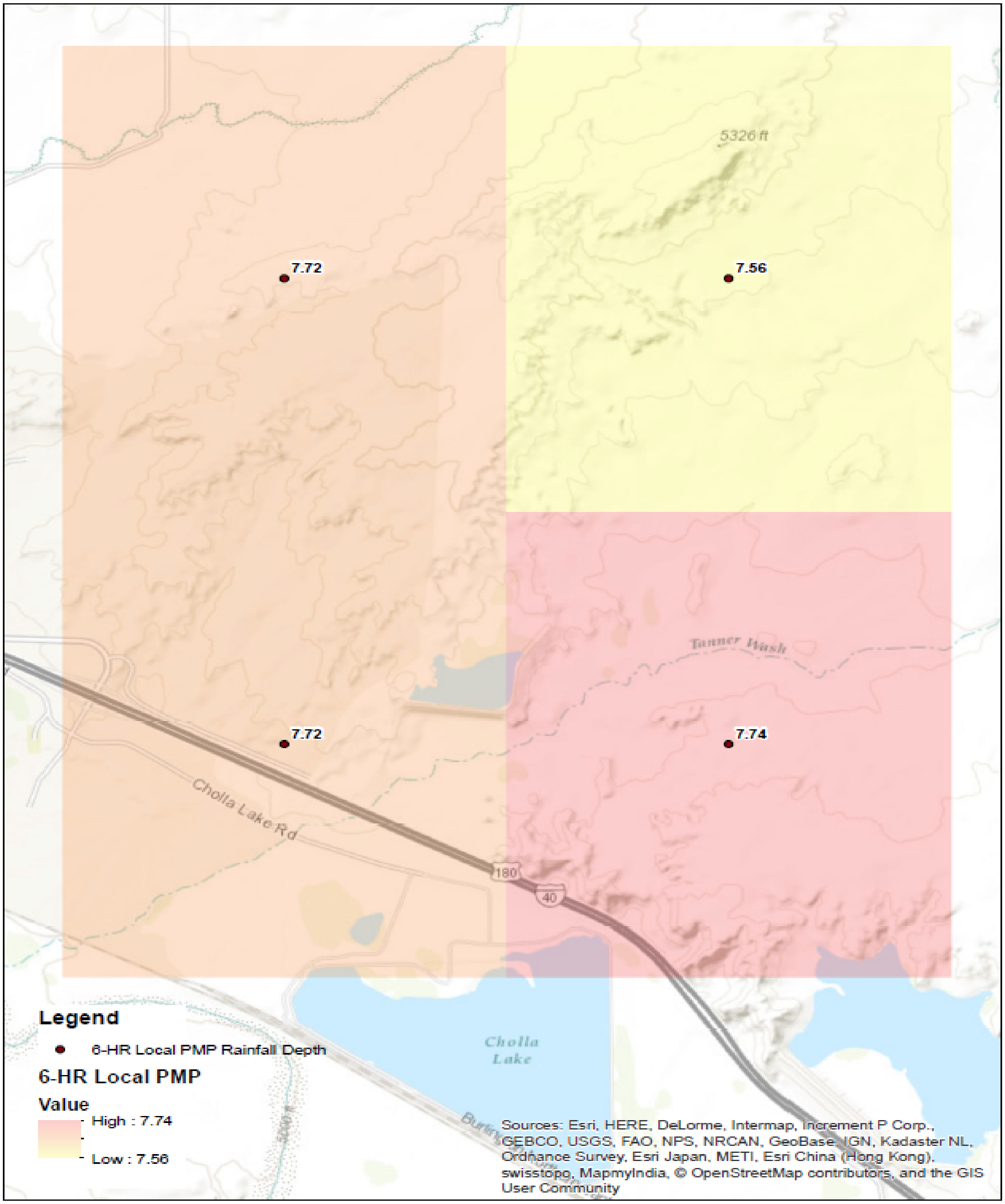


Figure 2 6-Hour PMP Rainfall Distribution

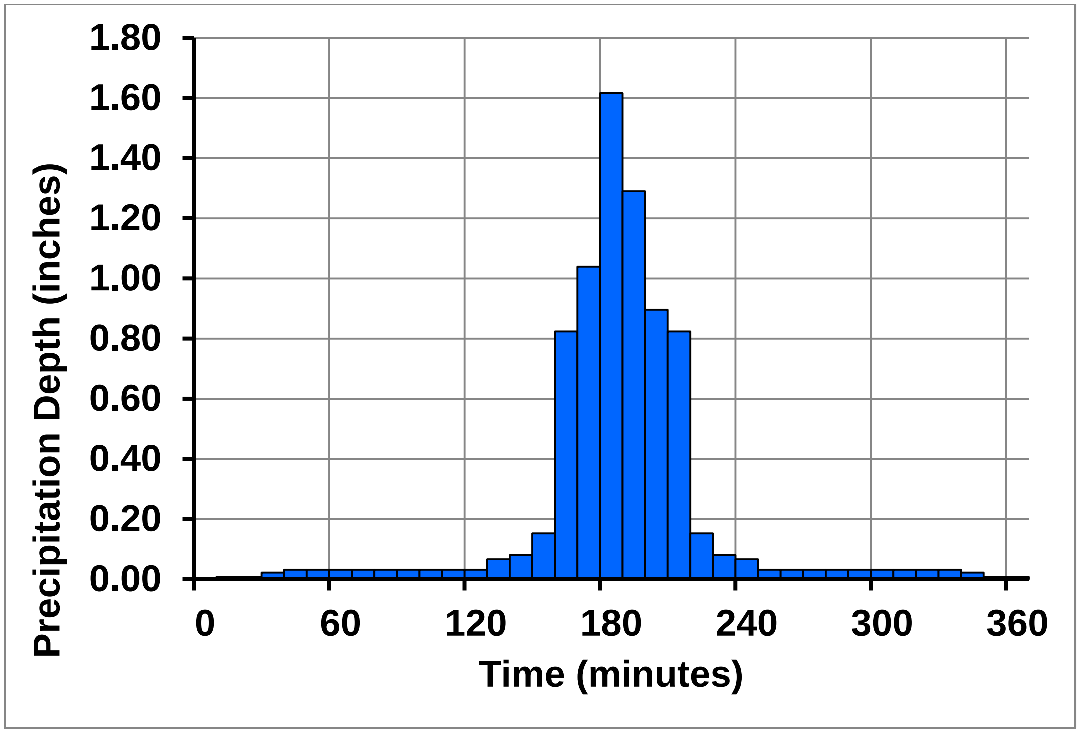


Figure 3 – Bottom Ash Monofill Drainage Map

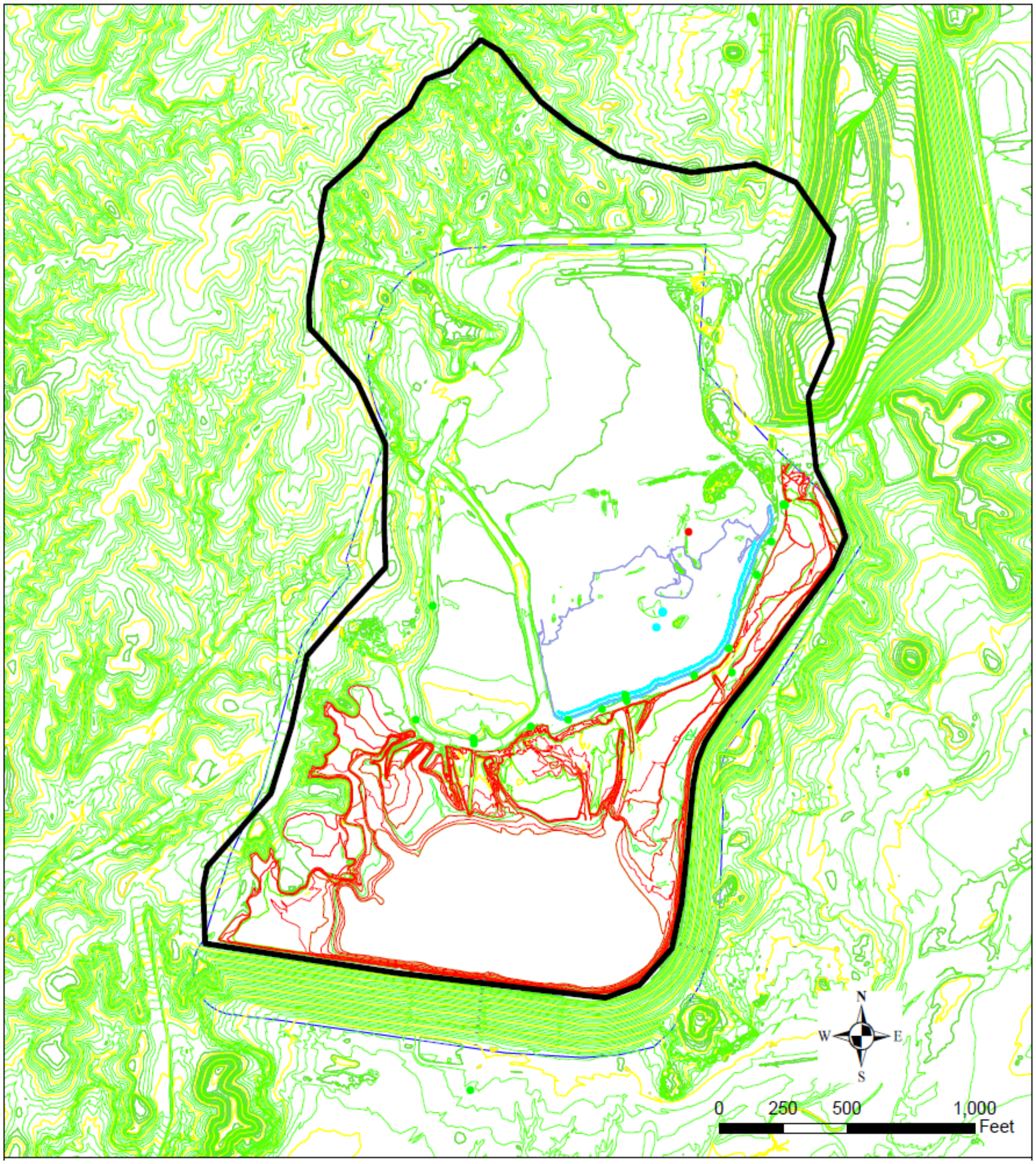


Table 1 - PMP Rainfall Depth Values from the PMP Evaluation Tool

PMP Rainfall Depth	Grid 1	Grid 2	Grid 3	Grid 4
6-hour Tropical PMP Storm	4.7	4.77	4.72	4.66
72-hour Tropical PMP Storm	7.38	7.49	7.41	7.32
6-hour General Winter PMP Storm	1.82	1.84	1.82	1.8
72-hour General Winter PMP Storm	5.96	6.01	5.97	5.92
6-hour Local PMP Storm	7.72	7.56	**7.74**	7.72

Note:
The PMP rainfall depths for the various grids in the vicinity of the BAP drainage area were obtained from the PMP Evaluation tool provided by the Arizona Department of Water Resources.

Table 2 - 6-Hour PMP Rainfall Distribution

Time (mins)	Cumulative PMP (in)	Incremental PMP (in)	Percent Distribution
0	0.000	0.00	0.000
10	0.008	0.01	0.001
20	0.015	0.01	0.002
30	0.038	0.02	0.005
40	0.070	0.03	0.009
50	0.101	0.03	0.013
60	0.133	0.03	0.017
70	0.165	0.03	0.021
80	0.197	0.03	0.025
90	0.228	0.03	0.030
100	0.260	0.03	0.034
110	0.292	0.03	0.038
120	0.324	0.03	0.042
130	0.390	0.07	0.050
140	0.471	0.08	0.061
150	0.623	0.15	0.081
160	1.447	0.82	0.187
170	2.487	1.04	0.321
180	4.103	1.62	0.530
190	5.393	1.29	0.697
200	6.290	0.90	0.813
210	7.114	0.82	0.919
220	7.266	0.15	0.939
230	7.347	0.08	0.949
240	7.413	0.07	0.958
250	7.445	0.03	0.962
260	7.477	0.03	0.966
270	7.509	0.03	0.970
280	7.540	0.03	0.974
290	7.572	0.03	0.978
300	7.604	0.03	0.982
310	7.636	0.03	0.987
320	7.667	0.03	0.991
330	7.699	0.03	0.995
340	7.721	0.02	0.998
350	7.729	0.01	0.999
360	7.737	0.01	1.000

REFERENCES:

1. APS 1991, Arizona Public Service, Design Report for Cholla S.E.S. Units 1-4, Raising Bottom Ash Dam to Elevation 5123.3 Feet MSL, July 1991.

2. APS 2014, Arizona Public Service, 1-foot Contour mapping from as-builts, obtained in February 2015.

3. AWA 2013, Applied Weather Associates, *Probable Maximum Precipitation Study for Arizona*, prepared for the Arizona Department of Water Resources, 2013.

Attachment A

```
1*****************************************
**************************************
 *                                       *                                                   *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                   *    U.S. ARMY CORPS OF ENGINEERS
*
 *             JUN   1998                *                                                   *    HYDROLOGIC ENGINEERING CENTER
*
 *           VERSION 4.1                 *                                                   *          609 SECOND STREET
*
 *                                       *                                                   *       DAVIS, CALIFORNIA 95616
*
 *  RUN DATE   23SEP16  TIME  15:57:53   *                                                   *           (916) 756-1104
*
 *                                       *                                                   *
*
 *****************************************
**************************************



                                                  X     X  XXXXXXX   XXXXX          X
                                                  X     X  X        X     X        XX
                                                  X     X  X        X               X
                                                  XXXXXXX  XXXX     X       XXXXX   X
                                                  X     X  X        X               X
                                                  X     X  X        X     X         X
                                                  X     X  XXXXXXX   XXXXX         XXX


            THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

            THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
            THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
            NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
            DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
            KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                        HEC-1 INPUT                                         PAGE  1

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1           ID
             2           ID  ***************************************************************************
             3           ID  **                                                                       **
             4           ID  **                    BOTTOM ASH POND HYDROLOGY MODEL                    **
             5           ID  **                                                                       **
             6           ID  ***************************************************************************
             7           ID  ***************************************************************************
             8           ID  PROJECT:                Cholla - BAP 6- HR Local PMP Model
             9           ID  CLIENT:                 Arizona Public Service
            10           ID  PREPARED BY:            AECOM
            11           ID  PROJECT No:             60492605
            12           ID  FILE NAME:  6-HR PMP Local.dat             CREATED DATE: Sep 21, 2016
            13           ID
            14           ID  STORM:                  6-hour Local PMP
            15           ID
                         *DIAGRAM
            16           IT      15  1JAN94       0    1500
            17           IO       3
                         *
                         *
                         *

            18           KK     BAP
            19           KO       0       0     0.0       1      21
            20           BA  0.205
            21           IN      10  1JAN94
            22           PB  7.737
            23           PC  0.000   0.001   0.002   0.005   0.009   0.013   0.017   0.021   0.025   0.030
            24           PC  0.034   0.038   0.042   0.050   0.061   0.081   0.187   0.321   0.530   0.697
            25           PC  0.813   0.919   0.939   0.949   0.958   0.962   0.966   0.970   0.974   0.978
            26           PC  0.982   0.987   0.991   0.995   0.998   0.999   1.000
            27           LS       0      90       0
            28           UC     0.6    0.40
                         *
            29           ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    18         BAP

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
```

```
***************************************
 *                                        *                                                            *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                                                            *    U.S. ARMY CORPS OF ENGINEERS
*
 *              JUN   1998                *                                                            *    HYDROLOGIC ENGINEERING CENTER
*
 *           VERSION 4.1                  *                                                            *          609 SECOND STREET
*
 *                                        *                                                            *       DAVIS, CALIFORNIA 95616
*
 *  RUN DATE   23SEP16  TIME  15:57:53    *                                                            *           (916) 756-1104
*
 *                                        *                                                            *
*
 *****************************************
***************************************



                            ***************************************************************************
                            **                                                                       **
                            **                     BOTTOM ASH POND HYDROLOGY MODEL                   **
                            **                                                                       **
                            ***************************************************************************
                            ***************************************************************************
                            PROJECT:                Cholla - BAP 6- HR Local PMP Model
                            CLIENT:                 Arizona Public Service
                            PREPARED BY:            AECOM
                            PROJECT No:             60492605
                            FILE NAME:  6-HR PMP Local.dat              CREATED DATE: Sep 21, 2016

                            STORM:                  6-hour Local PMP

   17 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          15  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1JAN94  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ        1500  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     16JAN94  ENDING DATE
                       NDTIME        1445  ENDING TIME
                        ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL     .25 HOURS
                        TOTAL TIME BASE  374.75 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
***


             **************
             *            *
   18 KK     *      BAP   *
             *            *
             **************

   19 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        1500  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .250  TIME INTERVAL IN HOURS


   21 IN          TIME DATA FOR INPUT TIME SERIES
                        JXMIN          10  TIME INTERVAL IN MINUTES
                       JXDATE      1JAN94  STARTING DATE
                       JXTIME           0  STARTING TIME

                SUBBASIN RUNOFF DATA
```

```
  20 BA         SUBBASIN CHARACTERISTICS
                      TAREA         .20  SUBBASIN AREA

                PRECIPITATION DATA

  22 PB               STORM        7.74  BASIN TOTAL PRECIPITATION

  23 PI           INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .01       .01       .01       .01       .01       .01       .01       .03
                      .17       .28       .23       .16       .02       .01       .01       .01       .01       .01
                      .01       .01       .00       .00

  27 LS         SCS LOSS RATE
                      STRTL         .22  INITIAL ABSTRACTION
                     CRVNBR       90.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  28 UC         CLARK UNITGRAPH
                         TC         .60  TIME OF CONCENTRATION
                          R         .40  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED                                       ,

                                                           ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .60 HR,       R=   .40 HR
                                         SNYDER   TP=   .48 HR,      CP=   .60

                                                     UNIT HYDROGRAPH
                                                10 END-OF-PERIOD ORDINATES
               48.      139.      151.       91.       48.       25.       13.        7.        4.        2.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      BAP

    TOTAL RAINFALL =    7.74, TOTAL LOSS =    1.19, TOTAL EXCESS =    6.55

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR    374.75-HR
+   (CFS)       (HR)
                             (CFS)
+     678.      3.50                  144.         36.         12.           2.
                           (INCHES)  6.521       6.521       6.521        6.521
                            (AC-FT)    71.         71.         71.          71.

                          CUMULATIVE AREA =     .20 SQ MI

1
                                                      RUNOFF SUMMARY
                                                  FLOW IN CUBIC FEET PER SECOND
                                               TIME IN HOURS,  AREA IN SQUARE MILES

                                          PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION         FLOW     PEAK                                            AREA      STAGE    MAX STAGE
+                                                               6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                             BAP         678.    3.50         144.         36.         12.        .20

 *** NORMAL END OF HEC-1 ***
```

Project
Subject **Unit hydrograph**
Designed by Date Job No.
Checked by Date Client Ref. No.

Time of Concentration and Storage Coefficient

Basin ID	Basin Area[1] [sf]	Basin Area[1] [mi^2]	Top Elev.[1] [ft]	Bottom Elev.[1] [ft]	Travel Length[1] [ft]	Travel Length [mi]	Basin Slope [ft/mi]	Lca[1] [ft]	Lca [mi]	Impervious Area [%]	Type of Watershed[2]	Time of Concen. [hr]	Storage Coefficient [hr]
BAP		0.205	5198	5123	4,095	0.78	96	1,522	0.29		1	0.6	0.40

Notes:

Methodology from *ADOT Highway Drainage Design Manual, Hydrology* , March 1993.

[1] Information obtained from GIS calculations.

[2] Three types of watersheds can be selected based on the type that contains the greatest portion of the travel length and are represented by the following numbers:

1 desert/mountain
2 agricultural fields
3 urban

"FILE COPY"

09.27

P.O. BOX 53999 PHOENIX, ARIZONA

GENERATION ENGINEERING

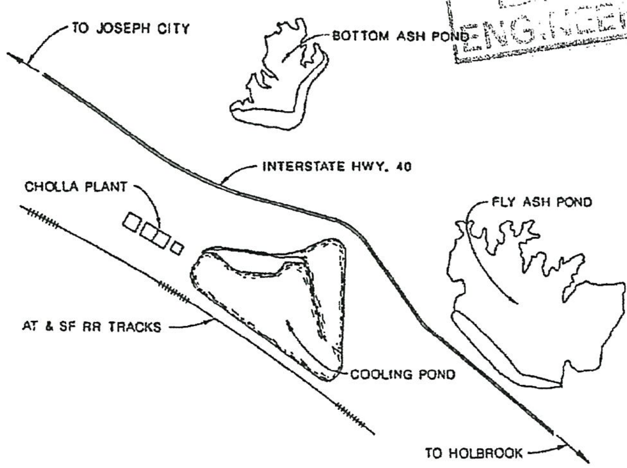
APS.

DESIGN REPORT FOR CHOLLA S.E.S. UNITS 1 — 4 RAISING BOTTOM ASH DAM TO ELEVATION 5123.3 FEET MSL

JULY 1991

Registered Professional Engineer
CERTIFICATE NO. 15284
MARTA M. SANTOS
Date Signed 07/18/91
ARIZONA, U.S.A.

RECEIVED
JUL 19 1991
ENGINEERING DIV.



ARIZONA PUBLIC SERVICE COMPANY

Civil and Structural Engineering

maximum height of the dam extensions is approximately 56 feet, factors of safety similar to or better than those for the stability analysis evaluated in Alternative 1 should be expected provided the strength parameters and foundation materials and preparation are similar. A more detailed stability analysis should be performed during final design for the most critical section of the dam extensions. The original design indicates that the downstream and upstream slopes will be at 3:1 with components of the embankment consisting of a clay core with granular shells. The side slopes of the extended dam will tie into the existing contours.

4.3 HYDROLOGICAL/HYDRAULIC ANALYSES

4.3.1 Hydrologic Evaluation

Runoff estimates have been made assuming a runoff curve number[a] of 90 for all three alternatives. With the present dam configuration and all three proposed alternatives, the design storm must be fully retained because the dam has no emergency spillway. The minimum acceptable freeboard for an earthen embankment with no emergency spillway is 3.0 feet according to the Dam Safety Branch of the Arizona Department of Water Resources. Design storm runoff volumes were calculated for the sub-basins of Alternatives 2 and 3 using the 6-hour PMP of 10.5 inches used in previous studies at this site (Dames & Moore, 1990). The design storm runoff volume for Alternative 1 was previously developed (99 acre-feet). The drainage areas for Alternatives 2, 3A and 3B were estimated with the intermediate dike 50-feet, 100-feet and 100-feet, respectively, from the present water line and included the area contributed by the intermediate dike crest and upstream face.

4.3.2 Flood Pool Evaluation

With the design storm storage volumes calculated, the next step was evaluating how the required flood storage should be allocated in the existing reservoir. For Alternative 1

[a]An index of runoff based on data developed by the U.S. Soil Conservation Service and U.S. Bureau of Reclamation.

APPENDIX 2 - CHOLLA BOTTOM ASH POND STORAGE VOLUME

AECOM

Calculation Sheet

Project Name:	Cholla CCR Report			Calculation Number:	0
Client Name:	APS			Revision Number:	0
Project Number:	Job No.	Cost Code	Parent (if any)	Prepared By/Date:	GP / 9-21-2016
	60492605		N/A		
Title:	Cholla BAP Stage Storage Volume Calculation				

PROBLEM STATEMENT:

The purpose of this calculation package is to estimate the storage capacity of the BAP and how the required flood storage should be allocated in the existing reservoir.

BACKGROUND:

The impoundment was constructed in 1975 and the main dam crest was raised to its current elevation (5125.7 feet, NAVD 88) in 1993. Subsequent to the 1993 crest raise, APS improved the operational characteristics of the impoundment by dividing the northern portion into a smaller ("west") and larger ("east") decant cell, separated from each other and the free water pond by internal ash embankments with stop-logged water discharge conduits to the free water pond. By rotating the bottom ash slurry discharge between the two decant cells, each could be allowed to drain sufficiently to allow subsequent mechanical excavation and transport of impounded ash to an adjacent, permitted ash landfill cell, the Bottom Ash Monofill.

For simplicity, the flood storage volume capacity provided within the free water pond alone was compared to the PMP runoff volume. The free water pond is bounded laterally by the main dam embankment to the south and east, native ground to the west, and the intermediate divider dike to the north. The flood storage volume is estimated from the elevation–storage volume relation for the free water pond area between the maximum operating water surface elevation of 5120.2 feet (NAVD88) and the maximum flood pool elevation of 5122.4 feet (NAVD88).

REQUIRED DELIVERABLES:

- Stage storage curve that illustrates the cumulative volume storage per surface elevation within the BAP limits.
- Calculation of approximate volume capacity of the BAP at the maximum operating elevation and maximum flood pool elevation.

DATA /ASSUMPTIONS:

- The 1-ft surface topography used for the analysis was based on the as-builts contour mapping provided by Arizona Public Service in 2014 (APS, 2014). The surface contours are only visible above the water surface at the time of the mapping. The contours and aerial topography used in the calculation can be found in Figure 1.
- All elevations referenced in this document are on the NAVD 88 datum unless otherwise noted.
- Previous studies utilized the NGVD 29 datum, so a conversion to NAVD 88 was estimated using the Corpscon6 software and the results can be found as an attachment. The average conversion in the vicinity of the BAP is raising the elevation 2.4 feet when converting from NGVD 29 to NAVD 88.
- The HEC-1 analysis calculation package dated September 2016 estimated a runoff volume of 71 acre-feet to be stored in the BAP.
- The 'minimum' freeboard requirement is 3 feet (per ADWR guidelines), however the pond was designed to have a freeboard of 3.3 feet (APS, 1991), therefore the design freeboard was maintained to generate the maximum flood pool elevation of 5122.4 ft. NAVD 88 (EL 5120 ft. on NGVD 29 Datum).
- A linear interpolation using the stage storage curve numbers was performed to approximate the volumes at the max operating level (EL 5120.2 ft. NAVD 88) and the max flood pool elevation (EL 5122.4 ft. NAVD 88).
- This demonstration of capacity conservatively neglects additional storage that would be available in portions of the two decant cells in which the impounded ash elevation is less than the maximum flood pool elevation.

RESULTS:

The results from stage storage calculation indicate that the free water pond of the BAP has sufficient storage capacity to collect the runoff volume. There is additional storage capacity in the East decant cell if needed.

REFERENCES:

1. APS 1991, Arizona Public Service, Design Report for Cholla S.E.S. Units 1-4, Raising Bottom Ash Dam to Elevation 5123.3 Feet MSL, July 1991

2. APS 2014, Arizona Public Service, 1-foot Contour mapping from as-builts, obtained in February 2015.

AECOM	Calculation Sheet		
Project Name:	Cholla CCR Report	Calculation Number:	0
Client Name:	APS	Revision Number:	0
Project Number:	Job No.: 60492605; Cost Code: ; Parent (if any): N/A	Prepared By/Date:	GP / 9-21-2016
Title:	Cholla BAP Stage Storage Volume Calculation		

Table 1 – Stage Storage Curve Data

Contour Elevation (NAVD88)	Contour Area	Depth	Incremental Volume	Cumulative Volume	Incremental Volume	Cumulative Volume
	(sq. ft.)	(ft.)	Avg. End (cu. ft.)	Avg. End (cu. ft.)	Conic (cu. ft.)	Conic (cu. ft.)
5,112.00	581,932.09	N/A	N/A	0	N/A	0
5,113.00	628,706.36	1	605319.22	605319.22	605168.57	605168.57
5,114.00	691,433.35	1	660069.85	1265389.08	659821.34	1264989.91
5,115.00	771,710.84	1	731572.09	1996961.17	731204.77	1996194.68
5,116.00	841,278.29	1	806494.56	2803455.74	806244.41	2802439.09
5,117.00	896,556.77	1	868917.53	3672373.27	868770.97	3671210.06
5,118.00	969,608.22	1	933082.5	4605455.76	932844.1	4604054.16
5,119.00	1,064,714.94	1	1017161.58	5622617.34	1016790.85	5620845.01
5,120.00	1,276,071.94	1	1170393.44	6793010.79	1168799.85	6789644.86
5,121.00	1,423,616.16	1	1349844.05	8142844.05	1349171.58	8138816.44
5,122.00	1,500,156.83	1	1461886.49	9604741.33	1461719.49	9600535.93
5,123.00	1,582,724.93	1	1541440.88	111146182	1541256.56	11141792.5

Table 2 – Stage Storage Volume

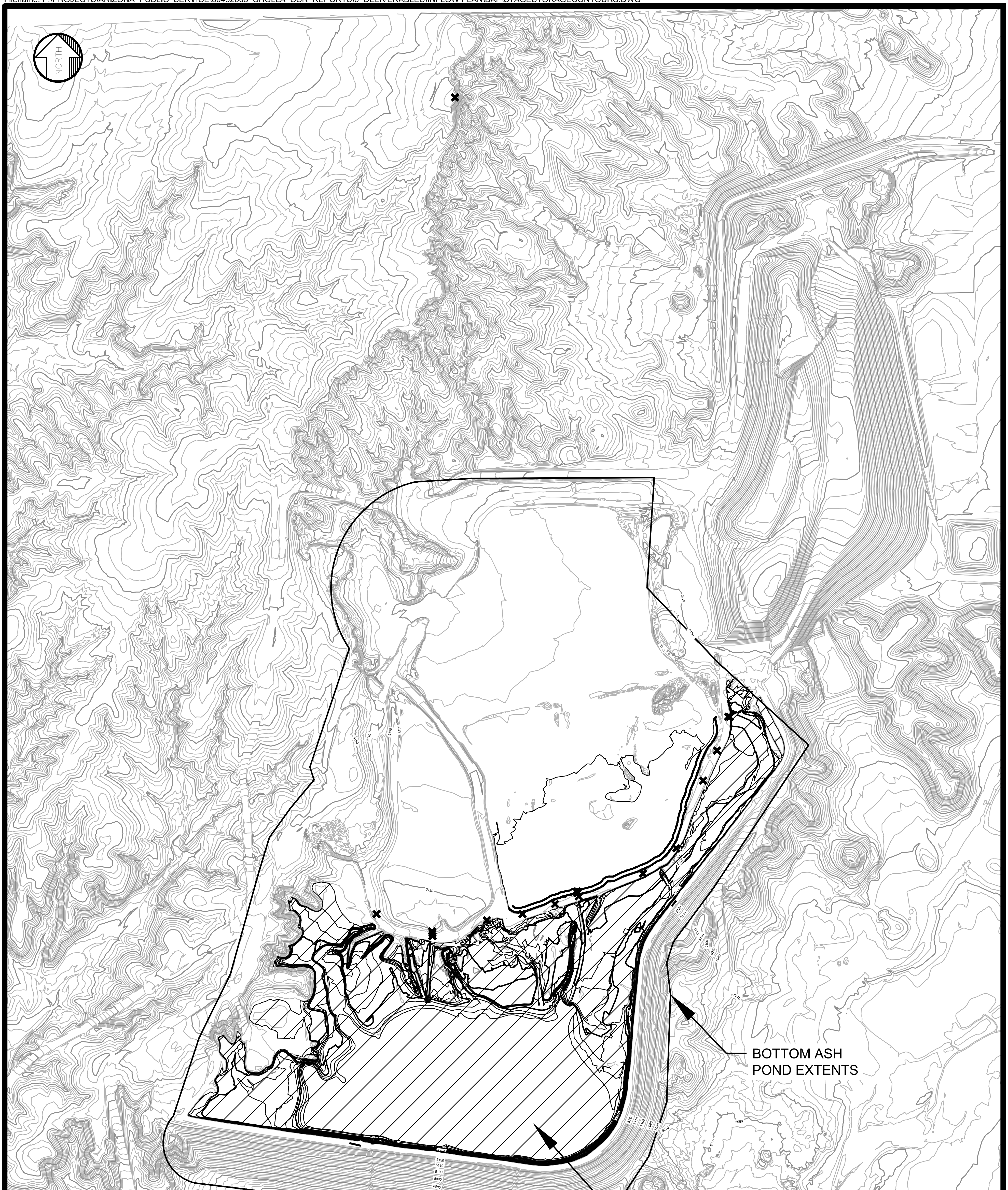
TARGET STORAGE CAPACITY (HEC-1) 71 AC-FT = 3,092,760 FT^3		
Elevation (FT) (NAVD88)	Volume (FT^3)	
5120.2	7,059,479	Max Op. Elev.
5122.4	10,217,039	Max Flood Pool Elev.
ESTIMATED STORAGE CAPACITY IN BAP	3,157,559	72.5 AC-FT

Calculation Sheet

Project Name:	Cholla CCR Report			Calculation Number:	0
Client Name:	APS			Revision Number:	0
Project Number:	Job No.	Cost Code	Parent (if any)	Prepared By/Date:	GP / 9-21-2016
	60492605		N/A		
Title:	Cholla BAP Stage Storage Volume Calculation				

FIGURES

Last saved by: PANDITG(2016-09-21) Last Plotted: 2016-09-21 Project Management Initials: Designer: SDU Checked: JBH Approved: AWG ANSI B 11" x 17"
Filename: P:\PROJECTS\ARIZONA_PUBLIC_SERVICE\60492605_CHOLLA_CCR_REPORTS\6_DELIVERABLES\INFLOW PLAN\BAP\STAGESTORAGECONTOURS.DWG



Cholla Power Plant
Arizona Public Service
Cholla Power Plant, Joseph City, AZ
60492605 Date: 2016-09

Cholla Power Plant
Bottom Ash Pond

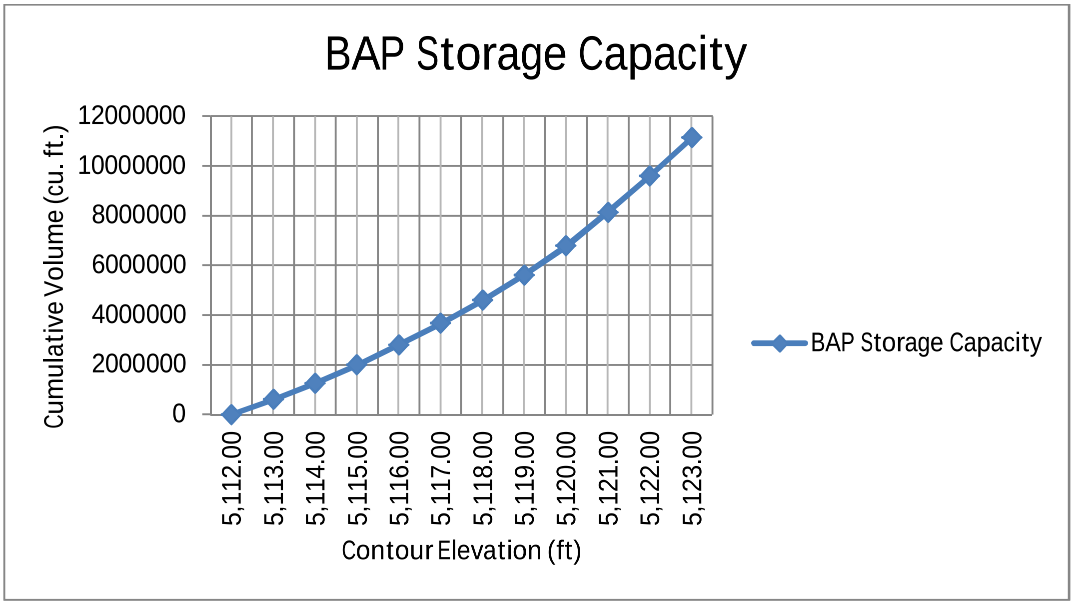
AECOM

Figure: 1

Calculation Sheet

Project Name:	Cholla CCR Report			Calculation Number:	0
Client Name:	APS			Revision Number:	0
Project Number:	Job No.	Cost Code	Parent (if any)	Prepared By/Date:	GP / 9-21-2016
	60492605		N/A		
Title:	Cholla BAP Stage Storage Volume Calculation				

FIGURE 2 – Stage Storage Curve



Vertical Datum Conversion Sheet

Cholla

BAP Volume Check

20 September 2016

INPUT	OUTPUT
State Plane, NAD83 0201 - Arizona East, U.S. Feet Vertical - NAVD88, U.S. Feet	State Plane, NAD83 0201 - Arizona East, U.S. Feet Vertical - NGVD29 (Vertcon94), U.S. Feet

Arbitrary Point 1

1/3

	Input		Output
Northing/Y:	1439114.7780	**Northing/Y:**	1439114.778
Easting/X:	663385.6446	**Easting/X:**	663385.645
Elevation/Z:	5122	**Elevation/Z:**	5119.402
Convergence:	-0 04 12.03242	**Convergence:**	-0 04 12.03242
Scale Factor:	0.999901534	**Scale Factor:**	0.999901534
Combined Factor:	0.999660407	**Combined Factor:**	0.999660531

Grid Shift (U.S. ft.): X/Easting = 0.0, Y/Northing = 0.0

Arbitrary Point 2

2/3

	Input		Output
Northing/Y:	1438676.9504	**Northing/Y:**	1438676.950
Easting/X:	662847.1542	**Easting/X:**	662847.154
Elevation/Z:	5116	**Elevation/Z:**	5113.405
Convergence:	-0 04 15.72779	**Convergence:**	-0 04 15.72779
Scale Factor:	0.999901580	**Scale Factor:**	0.999901580
Combined Factor:	0.999660740	**Combined Factor:**	0.999660864

Grid Shift (U.S. ft.): X/Easting = 0.0, Y/Northing = 0.0

Arbitrary Point 3

3/3

	Input		Output
Northing/Y:	1438411.6727	**Northing/Y:**	1438411.673
Easting/X:	663187.3106	**Easting/X:**	663187.311
Elevation/Z:	5112	**Elevation/Z:**	5109.402
Convergence:	-0 04 13.37952	**Convergence:**	-0 04 13.37952
Scale Factor:	0.999901551	**Scale Factor:**	0.999901551
Combined Factor:	0.999660902	**Combined Factor:**	0.999661027

Grid Shift (U.S. ft.): X/Easting = 0.0, Y/Northing = 0.0

Remark:

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