BONANZA POWER PLANT
COAL COMBUSTION RESIDUAL (CCR) UNIT
RUN ON / RUN OFF CONTROL PLAN

VERSION 3 (REVISED 9/30/21)

PREPARED BY: DESERET POWER ENGINEERING

September 2021

Deseret Generation and Transmission Co-operative
10714 S. Jordan Gateway St. 300
South Jordan, UT 84095

Qualified Professional Engineer Certificate

I, Tyler S. Esplin, a registered Professional Engineer (PE) in the State of Utah, certify under penalty of law that this CCR Run On / Run Off Control Plan meets the requirements of Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments pursuant to 40 CFR 257.81. It is my opinion that the information within this report is true and accurate according to the guidelines outlined in the said rule.

Dated this 30 day of September 2021

Registered Professional Engineer
Number 323799-2202
State of Utah

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I. SITE INFORMATION

Deseret Generation and Transmission Co-operative
Bonanza Power Plant
12500 East 25500 South
Vernal, Utah 84078
Phone: 435-789-9000

Title V Permit Number: V-UO-000004-00.02
Responsible Official: Eric Olsen, PE (Plant Manager)
Company Contact: Tyler Esplin, PE (Environmental Superintendent)

Bonanza is operated by Deseret Generation and Transmission Cooperative (Deseret) and is located approximately 35 miles southeast of Vernal, Utah. Bonanza is a 500 MW gross coal fired steam turbine and generator.

II. INTRODUCTION

In accordance with 40 CFR 257.81, this document fulfills the *Run-On / Run-Off Control Plan* for the Bonanza Power Plant's (Bonanza) existing coal combustion residual (CCR) units. This plan documents the control systems that are designed, constructed, operated, and maintained to:

- Prevent storm water run-on flow onto the active portion of the CCR unit during peak discharge from a 24-hour, 25-year storm; and
- Prevent storm water run-off flow from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

III. LANDFILL INFORMATION

Deseret Power maintains the following two CCR landfill units, classified as existing landfills under 40 CFR 257.53, at the Bonanza Power Plant site:

A. Bottom Ash Landfill
B. Fly Ash / Flue Gas Desulfurization (FGD) Sludge Landfill

These landfills contain fly ash, bottom ash, boiler slag, and flue gas desulfurization materials. All of these materials can be found in either landfill. However, the landfill title represents its primary constituent(s).

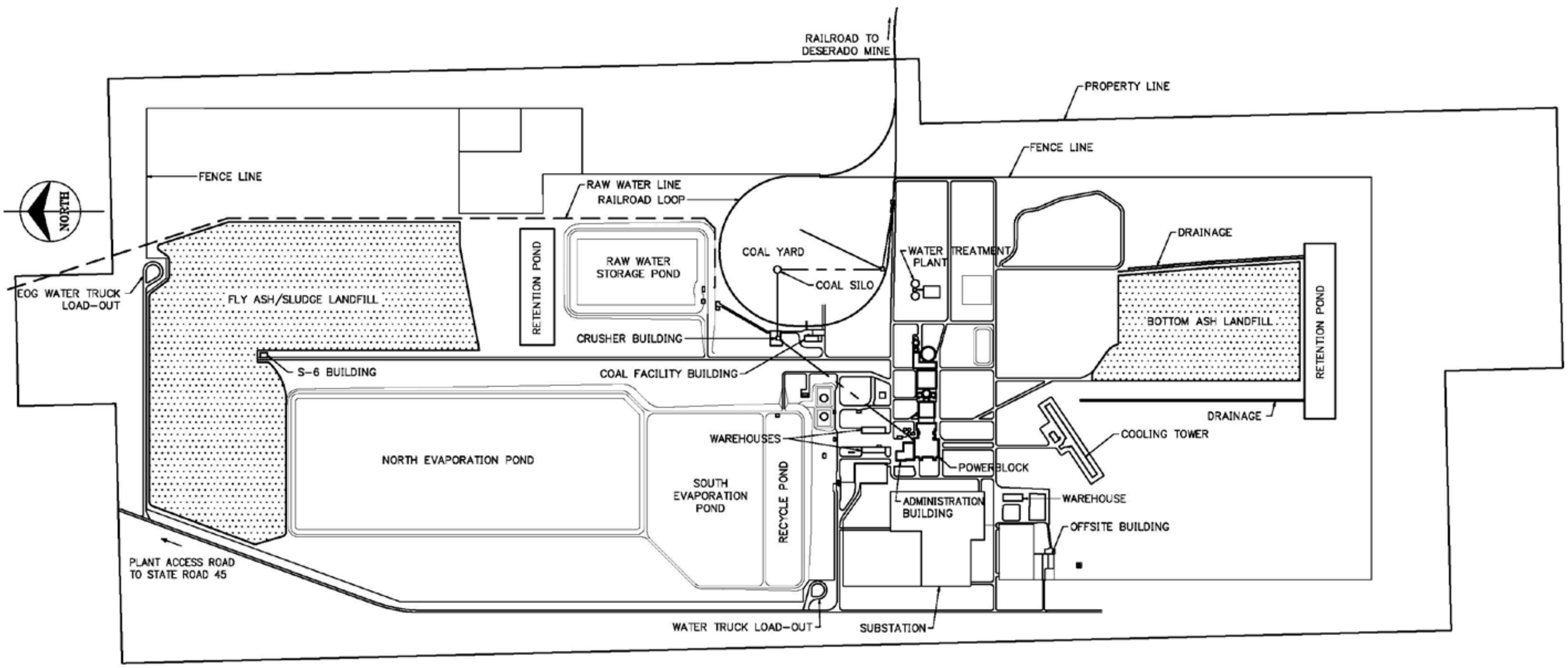
Refer to Figure 1 for relative landfill locations.

A. Bottom Ash Landfill

Located on the southern end of the plant and primarily consisting of bottom ash and boiler slag. CCR is hauled from the boiler area and deposited off an existing plateau where native soils gradually slope to elevations approximately 30-feet lower. The landfill is built out as an extension of the existing plateau with an approximate elevation of 5030 feet above Mean Sea Level (MSL). The existing footprint measures approximately 53 acres, however only portions of the landfill have reached final plateau elevation.

B. Fly Ash / FGD Sludge Landfill

Located on the northern end of the plant and primarily consisting of a dried mixture of processed fly ash and flue gas desulfurization (FGD) sludge material. The landfill consists of CCR that is built up from native soil elevations to an approximate elevation of 5160 feet above MSL. The existing footprint area measures approximately 152 acres, however only portions of the landfill have reached final elevation.



RAILROAD TO
DESERADO MINE
PROPERTY LINE
FENCE LINE
FENCE LINE
NORTH
RAW WATER LINE
RAILROAD LOOP
DRAINAGE
COAL YARD
WATER TREATMENT
PLANT
RETENTION POND
RAW WATER
STORAGE POND
COAL SILO
EOG WATER TRUCK
LOAD-OUT
FLY ASH/SLUDGE LANDFILL
BOTTOM ASH LANDFILL
RETENTION POND
CRUSHER BUILDING
S-6 BUILDING
COAL FACILITY BUILDING
DRAINAGE
COOLING TOWER
WAREHOUSES
NORTH EVAPORATION POND
SOUTH
EVAPORATION
POND
RECYCLE POND
POWERBLOCK
ADMINISTRATION
BUILDING
WAREHOUSE
OFFSITE BUILDING
PLANT ACCESS ROAD
TO STATE ROAD 45
WATER TRUCK LOAD-OUT
SUBSTATION

Figure 1

IV. RUN-ON CONTROL SYSTEMS

Each CCR landfill is protected from storm water run-on by storm water channels, elevated roads, berms, culverts and grading that divert potential run-on around the landfills to lower elevations. The locations of these features are depicted on Figures 2 and 3.

Peak storm water flows have been calculated using hydrologic calculations. The capacity of storm water control features, such as ditches and storm water channels, have been calculated using Manning's equations and designed to exceed potential run-on from outside locations.

A. Bottom Ash Landfill

Storm water at the Bottom Ash Landfill is controlled by the following features:

North Boundary:	The topography on the northern boundary is relatively flat with mild grades sloping toward the landfill. Storm water channel 1-1 runs along the northern landfill boundary with an elevated berm on the landfill side. Storm water is diverted around the landfill and directed downgradient to storm water channel 1-2. Culvert 1-1 conveys potential run-on under the north-east access road.
East Boundary:	Storm channel 1-2 receives water from areas up gradient of the landfill and conveys storm water flow away from the Eastern base of the landfill to Retention Pond 1.
West Boundary:	The area west of the landfill primarily slopes to the south and toward the retention pond. Storm water channel 1-3 conveys water away from the western base of the landfill to Retention Pond 1 immediately down gradient of the landfill. A low berm has been constructed on the western edge of the channel and diverts small drainages away from the channel.
Northwest Boundary:	Storm water channel 1-4 conveys water collected on the north-eastern landfill access roadway and other potential run-on areas to storm water channel 1-3.
South Boundary:	Retention Pond 1 is located on the south side of the landfill and is down gradient of the landfill with no potential for storm water run on.


North Boundary Storm channel
East Boundary Storm Water Channel 1-2
Culvert 1-1
East Boundary Storm Water Channel 1-3
BOTTOM ASH LANDFILL
Retention Pond 1

Figure 2

B. Fly Ash / FGD Sludge Landfill

The Fly Ash / FGD Sludge Landfill is protected from storm water run-on by the following features:

North Boundary:	The Kennedy Wash Diversion Canal located along the northern and north-eastern plant boundaries. Starting at the north-west corner of the plant and running east, the canal diverts storm water from the Kennedy wash and other tributaries around the facility to reconnect to the natural wash down gradient of the facility.
West Boundary:	The west boundary is protected from storm water run-on by a storm water diversion ditch constructed adjacent to the Deseret Power Plant Road. Storm water is conveyed parallel to the plant to the Kennedy Wash Diversion Canal and to lower elevations to the south. The southern extension of the landfill is protected from storm water run-on by the landfill access road and storm water channel 1-2.
East Boundary:	Areas East of the landfill are down gradient from the landfill, hence they pose no run-on potential.
South Boundary:	Areas South of the landfill are down gradient from the landfill, hence they pose no run-on potential.

All of these run-on control features can be seen on Figure 3.

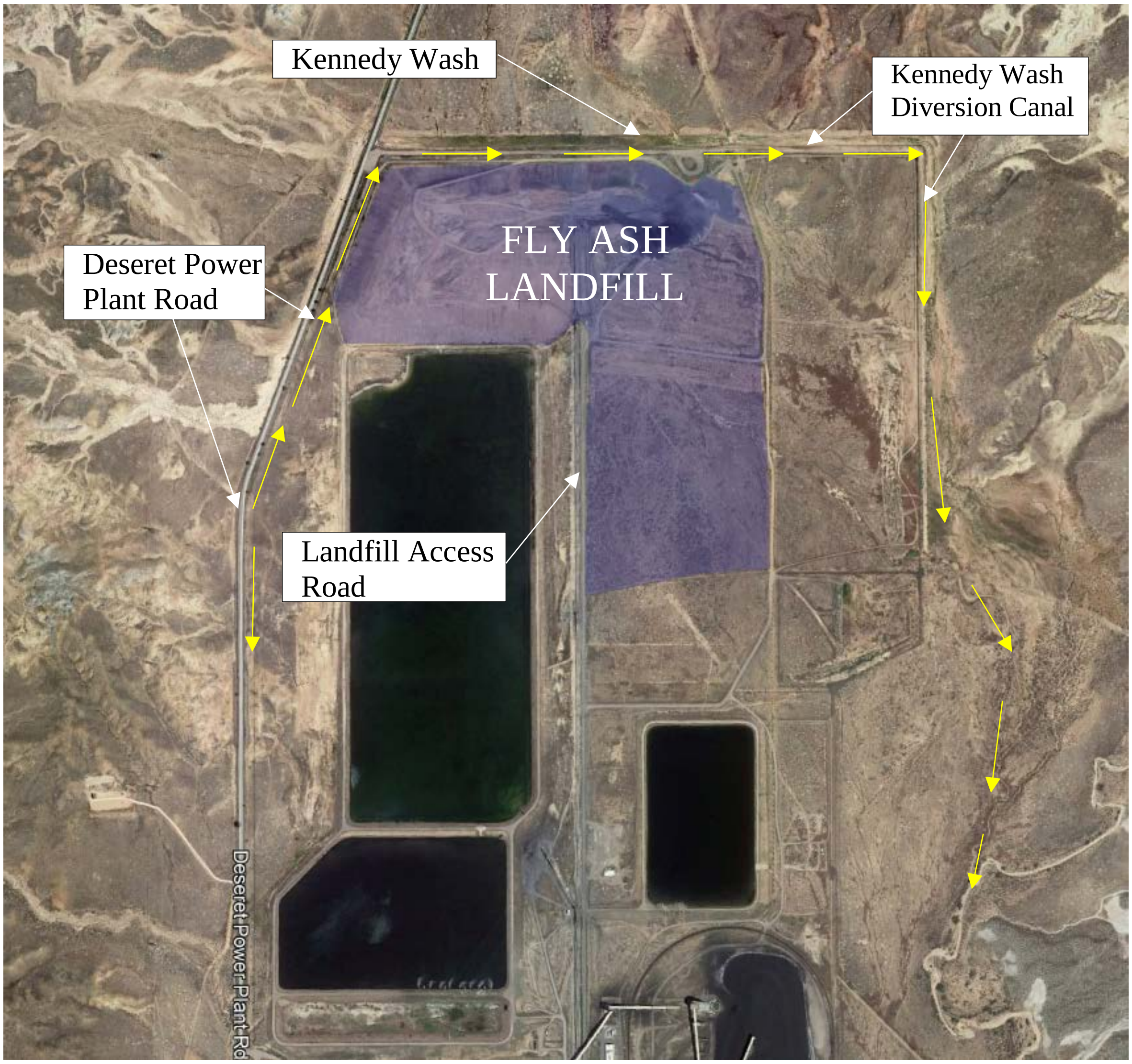

Kennedy Wash
Kennedy Wash
Diversion Canal
FLY ASH
LANDFILL
Deseret Power
Plant Road
Landfill Access
Road
Deseret Power Plant Rd

Figure 3

V. RUN-OFF CONTROL SYSTEM

Storm water retention ponds collect run-off from each CCR landfill and adjacent water shed areas. Each retention pond has been designed and constructed to retain at least the volume anticipated by a 24-hour, 25-year storm event. The run-off control system has been designed such that no run-off shall leave the plant site and no pollutants shall be discharged into waters of the United States pursuant to 40 CFR 257.3-3.

A. Bottom Ash Landfill (Drainage Basin 1)

The Bottom Ash Landfill is completely encompassed inside an existing drainage basin that is run off protected by retention pond 1 and adjacent dikes. This pond was originally built during plant construction and is still in use today. Dikes divert storm water from the landfill and surrounding drainage basin into the retention pond. Figure 5 depicts the approximate drainage basin area and calculations are shown in the appendix.

Retention Pond	Capacity (ft^3)	Calculated 24 hour 25-year Storm Event (ft^3)
#1	1,100,000	420,000

The following design features protect storm water run-off from leaving the retention pond 1 drainage basin:

North Boundary:	The northern boundary in up gradient from the landfill, hence no run-off is anticipated.
East Boundary:	Storm water channel 1-2 runs along the landfill eastern boundary and slopes to retention pond 1. The landfill sets approximately three feet above the channel and has been conservatively designed to accommodate run off from the eastern half of the land fill and areas up gradient in the water shed.
West Boundary:	Storm water channels 1-3 and 1-4 run along the landfill western boundary and slopes to retention pond 1. The channels have been conservatively designed to accommodate all potential run-off from the western half of the landfill.
South Boundary:	Areas south of the landfill are down gradient from the landfill, hence they pose no run-on potential.

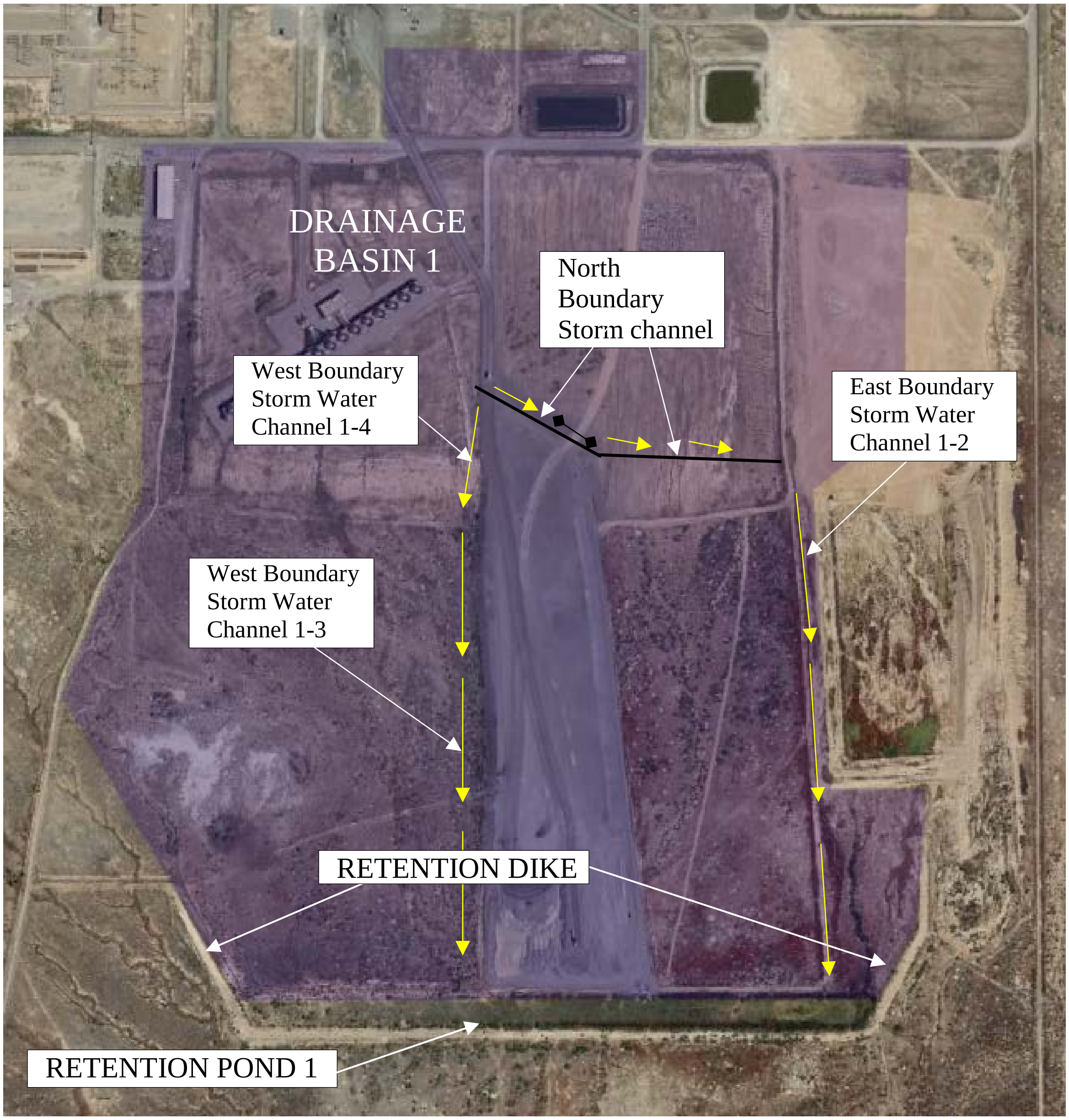

DRAINAGE BASIN 1
North Boundary Storm channel
West Boundary Storm Water Channel 1-4
East Boundary Storm Water Channel 1-2
West Boundary Storm Water Channel 1-3
RETENTION DIKE
RETENTION POND 1

Figure 4

B. Fly Ash / FGD Sludge Landfill

The landfill is graded into four drainage basins, numbered 2 through 5, and each drainage basin features a correspondingly numbered retention pond; See Figure 5.

Retention Pond	Capacity (ft^3)	Calculated 24 hour 25-year Storm Event (ft^3)
#2	750,000	185,000
#3 (North Evap. Pond)	75,000,000	809,000
#4	35,000	20,000
#5	43,000	32,000

i. Drainage Basin 2

Bounded by storm water channels 2-1 and 2-2 on the east and west side; respectively. These channels carry storm water to retention pond 2. Additional run off will be collected from the area east of the north evaporation pond and routed through culvert 2-2.

ii. Drainage Basin 3

Includes the western landfill area and southern slopes immediately North of the North Evaporation Pond. A constructed berm prevents storm water from collecting in low areas and concentrating into erosion channels. The North Evaporation Pond serves as the retention pond (3) for this drainage basin.

iii. Drainage Basin 4

Includes the landfill western slopes and northwest slopes. Retention Pond 4 has been constructed to capture storm water run-off from these areas. A storm water channel (4-1) and culvert (4-1) have been installed to divert storm water to the Retention Pond 4.

iv. Drainage Basin 5

Includes the landfill northern and northeast slopes. Retention Pond 5 has been constructed to capture storm water run-off. A storm water channel (5-1) and culvert (5-1) have been installed to divert storm water to the Retention Pond 5.


RETENTION POND #4
STORM CHANNEL 5-1
CULVERT 4-1
Retention Pond #5
CULVERT 5-1
DRAINAGE BASIN #4
DRAINAGE BASIN 5
CULVERT 2-4
STORM CHANNEL 4-1
DRAINAGE BASIN 3
STORM CHANNEL 2-1
CULVERT 2-3
BERM
CULVERT 2-1
DRAINAGE BASIN 2
STORM CHANNEL 2-2
NORTH EVAP. POND (RETENTION POND #3)
CULVERT 2-2
CULVERT 2-4
Retention Pond #2

Figure 5

VI. AMMENDMENT OF THE PLAN

This plan has been prepared and certified by a professional engineer (see cover page) and will be reviewed periodically to update any conditions that may arise. The owner or operator may amend the written run-on and run-cuff control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(3). The owner or operator will amend the written plan whenever there is a change in conditions that would substantially affect the written plan in effect.

VII. TIMEFRAMES FOR PREPARING INITIAL PLAN

The initial plan for the existing CCR landfills must be prepared no later than October 17, 2016. Any new CCR landfills and any lateral expansion of an existing CCR landfill must prepare an initial run-on and run-off control plan no later than the date of initial receipt of CCR in the CCR unit.

VIII. PLAN REVISIONS

A periodic revision of this plan will be prepared every five-years. A revised plan may be completed earlier than the prescribed five-years, however the five-year deadline for the subsequent revision will be based on the date of placement to the facility's operating record.

IX. PLAN CERTIFICATION

The initial and all subsequent periodic plans will obtain a certification from a qualified professional engineer stating that the plans meet the requirements of §257.81. Refer to beginning of this plan for the PE certification.

X. RECORD KEEPING

This plan must comply with the recordkeeping, notification, and website requirements pursuant to 40 CFR 257.105(g). Copies of records in electronic and paper formats will be kept at the facility in a written operating record. Records will be retained for at least five years from the date of occurrence, measurement, maintenance, corrective action, report, record, or study.

When the initial or subsequent plans are posted to the operating record, notifications will be made within 30 days to the appropriate Tribal Authority:

Ute Indian Tribe
EPA Contact - Title V Permit
P.O. Box 190
Ft. Duchesne, UT 84026

This plan is available on a publicly accessible internet website at:
https://apps.deseretpower.com/apex/f?p=107:1:8421128017314:::::

Appendix A
CALCULATIONS

NOAA Atlas 14, Volume 1, Version 5
Location name: Jensen, Utah, US*
Latitude: 40.0167°, Longitude: -109.1833°
Elevation: 5514 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.106** (0.091-0.125)	**0.136** (0.117-0.162)	**0.187** (0.160-0.223)	**0.235** (0.199-0.280)	**0.311** (0.258-0.370)	**0.381** (0.308-0.455)	**0.464** (0.365-0.557)	**0.559** (0.426-0.680)	**0.713** (0.515-0.881)	**0.851** (0.592-1.07)
10-min	**0.161** (0.138-0.190)	**0.207** (0.178-0.247)	**0.284** (0.243-0.339)	**0.357** (0.303-0.425)	**0.473** (0.393-0.563)	**0.580** (0.469-0.693)	**0.705** (0.556-0.847)	**0.852** (0.648-1.03)	**1.08** (0.784-1.34)	**1.30** (0.901-1.63)
15-min	**0.199** (0.172-0.235)	**0.256** (0.221-0.306)	**0.352** (0.302-0.420)	**0.443** (0.376-0.527)	**0.587** (0.487-0.698)	**0.719** (0.582-0.859)	**0.874** (0.689-1.05)	**1.06** (0.803-1.28)	**1.34** (0.972-1.66)	**1.61** (1.12-2.02)
30-min	**0.268** (0.231-0.317)	**0.345** (0.297-0.412)	**0.474** (0.406-0.565)	**0.596** (0.507-0.709)	**0.791** (0.656-0.940)	**0.968** (0.783-1.16)	**1.18** (0.928-1.41)	**1.42** (1.08-1.73)	**1.81** (1.31-2.24)	**2.16** (1.50-2.72)
60-min	**0.332** (0.286-0.392)	**0.427** (0.368-0.510)	**0.587** (0.503-0.699)	**0.738** (0.627-0.878)	**0.978** (0.812-1.16)	**1.20** (0.969-1.43)	**1.46** (1.15-1.75)	**1.76** (1.34-2.14)	**2.24** (1.62-2.77)	**2.68** (1.86-3.37)
2-hr	**0.395** (0.344-0.465)	**0.496** (0.430-0.586)	**0.664** (0.573-0.785)	**0.820** (0.700-0.970)	**1.08** (0.894-1.27)	**1.31** (1.06-1.56)	**1.59** (1.25-1.91)	**1.93** (1.46-2.34)	**2.48** (1.78-3.08)	**2.98** (2.05-3.77)
3-hr	**0.446** (0.391-0.521)	**0.561** (0.490-0.653)	**0.736** (0.639-0.859)	**0.896** (0.770-1.04)	**1.15** (0.965-1.34)	**1.37** (1.13-1.61)	**1.64** (1.31-1.95)	**1.97** (1.53-2.37)	**2.50** (1.86-3.11)	**3.01** (2.15-3.81)
6-hr	**0.567** (0.503-0.646)	**0.706** (0.630-0.809)	**0.897** (0.796-1.02)	**1.06** (0.936-1.22)	**1.31** (1.13-1.49)	**1.51** (1.28-1.73)	**1.75** (1.45-2.02)	**2.05** (1.67-2.40)	**2.58** (2.03-3.14)	**3.08** (2.36-3.85)
12-hr	**0.694** (0.627-0.778)	**0.859** (0.778-0.964)	**1.07** (0.959-1.20)	**1.25** (1.11-1.40)	**1.50** (1.33-1.70)	**1.71** (1.49-1.95)	**1.94** (1.66-2.23)	**2.20** (1.85-2.57)	**2.68** (2.19-3.18)	**3.15** (2.51-3.89)
24-hr	**0.809** (0.754-0.879)	**1.01** (0.936-1.10)	**1.25** (1.16-1.36)	**1.46** (1.35-1.58)	**1.76** (1.62-1.90)	**2.00** (1.82-2.17)	**2.25** (2.03-2.43)	**2.53** (2.27-2.73)	**2.92** (2.58-3.21)	**3.22** (2.82-3.92)
2-day	**0.903** (0.832-0.982)	**1.12** (1.03-1.22)	**1.40** (1.28-1.51)	**1.62** (1.49-1.76)	**1.95** (1.77-2.10)	**2.19** (1.99-2.38)	**2.46** (2.22-2.65)	**2.75** (2.47-2.97)	**3.14** (2.79-3.40)	**3.45** (3.04-3.96)
3-day	**0.980** (0.902-1.07)	**1.22** (1.12-1.33)	**1.51** (1.39-1.64)	**1.75** (1.61-1.90)	**2.09** (1.91-2.26)	**2.35** (2.14-2.55)	**2.63** (2.38-2.85)	**2.92** (2.63-3.17)	**3.33** (2.96-3.61)	**3.64** (3.22-4.07)
4-day	**1.06** (0.971-1.15)	**1.31** (1.22-1.43)	**1.62** (1.49-1.77)	**1.88** (1.73-2.05)	**2.23** (2.05-2.43)	**2.51** (2.29-2.72)	**2.81** (2.54-3.05)	**3.10** (2.79-3.37)	**3.52** (3.13-3.82)	**3.84** (3.40-4.18)
7-day	**1.21** (1.10-1.32)	**1.50** (1.37-1.64)	**1.84** (1.68-2.02)	**2.14** (1.95-2.35)	**2.54** (2.29-2.78)	**2.85** (2.57-3.12)	**3.19** (2.85-3.49)	**3.53** (3.13-3.87)	**4.00** (3.51-4.41)	**4.38** (3.80-4.83)
10-day	**1.34** (1.23-1.48)	**1.67** (1.53-1.83)	**2.06** (1.89-2.26)	**2.37** (2.17-2.59)	**2.79** (2.54-3.04)	**3.12** (2.81-3.39)	**3.45** (3.11-3.75)	**3.78** (3.39-4.11)	**4.24** (3.76-4.61)	**4.58** (4.04-5.00)
20-day	**1.75** (1.60-1.90)	**2.17** (1.99-2.37)	**2.66** (2.43-2.89)	**3.04** (2.77-3.30)	**3.54** (3.23-3.85)	**3.92** (3.56-4.26)	**4.29** (3.89-4.67)	**4.67** (4.20-5.08)	**5.16** (4.62-5.62)	**5.53** (4.93-6.04)
30-day	**2.05** (1.90-2.21)	**2.54** (2.35-2.75)	**3.08** (2.85-3.33)	**3.50** (3.23-3.78)	**4.03** (3.72-4.36)	**4.42** (4.07-4.78)	**4.80** (4.40-5.20)	**5.18** (4.73-5.62)	**5.66** (5.14-6.14)	**6.01** (5.43-6.53)
45-day	**2.46** (2.29-2.66)	**3.05** (2.85-3.30)	**3.68** (3.43-3.98)	**4.16** (3.87-4.49)	**4.77** (4.42-5.15)	**5.21** (4.82-5.63)	**5.63** (5.19-6.08)	**6.05** (5.56-6.54)	**6.57** (6.00-7.12)	**6.94** (6.32-7.54)
60-day	**2.85** (2.64-3.06)	**3.53** (3.28-3.78)	**4.22** (3.93-4.53)	**4.73** (4.39-5.07)	**5.36** (4.96-5.74)	**5.81** (5.37-6.22)	**6.23** (5.75-6.68)	**6.61** (6.09-7.10)	**7.09** (6.49-7.63)	**7.41** (6.78-8.00)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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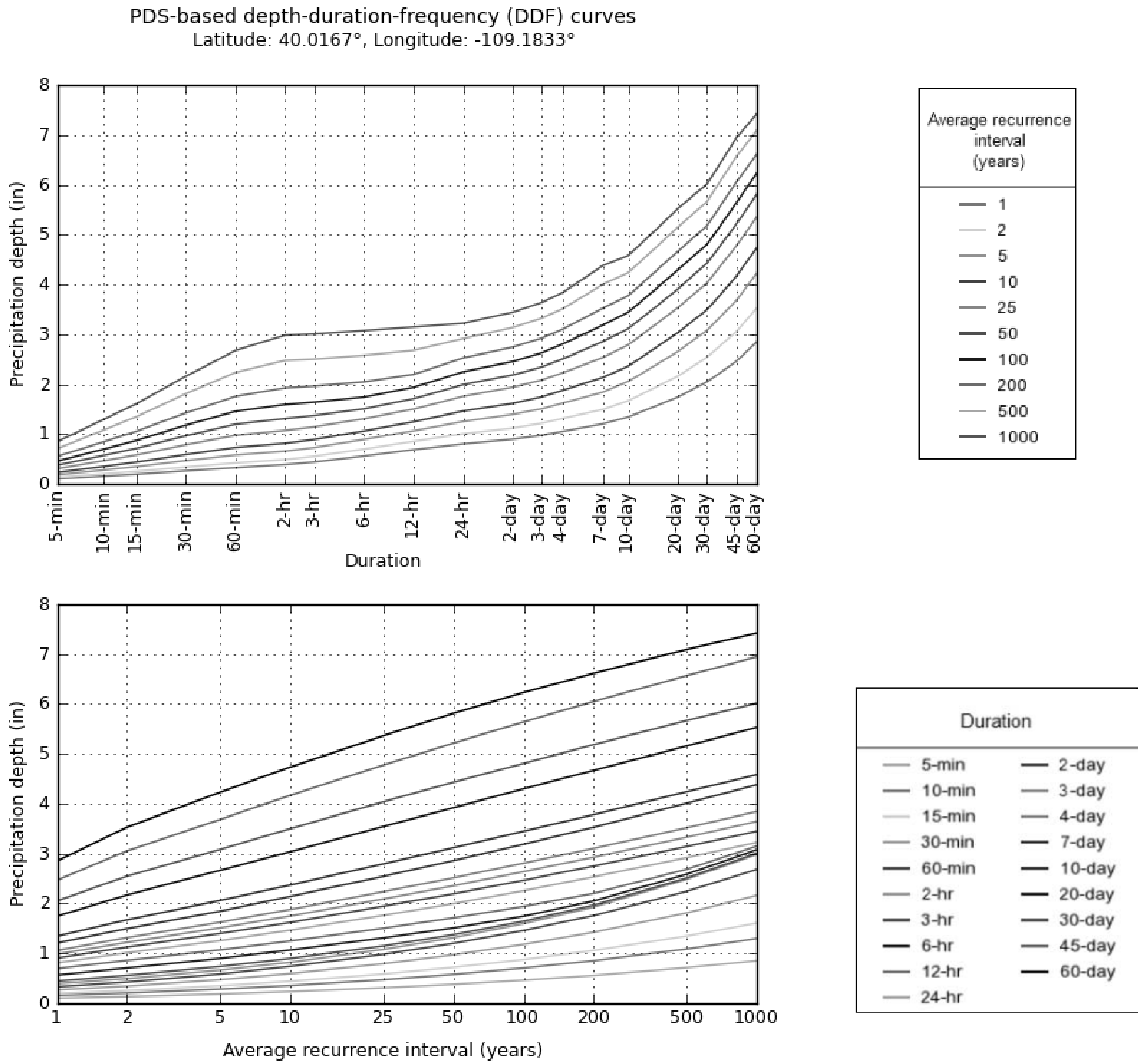
PF graphical



NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Mon Jun 20 17:08:40 2016

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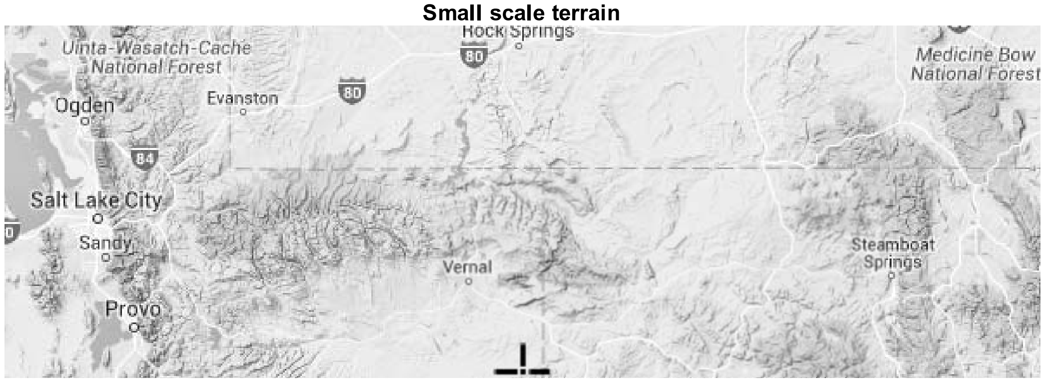
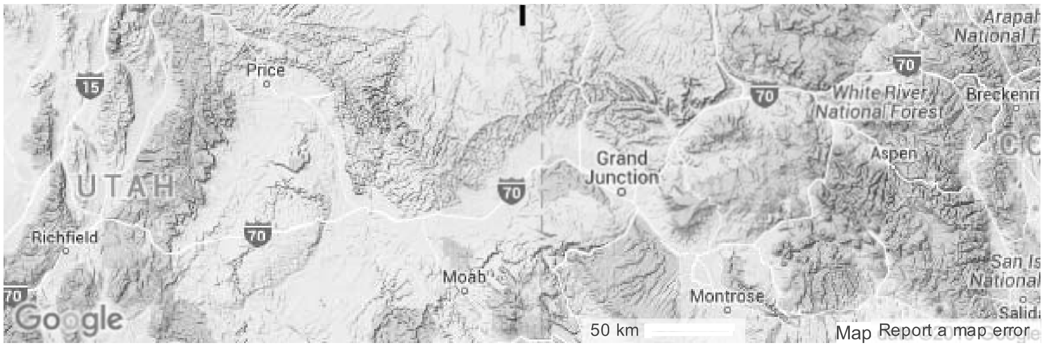
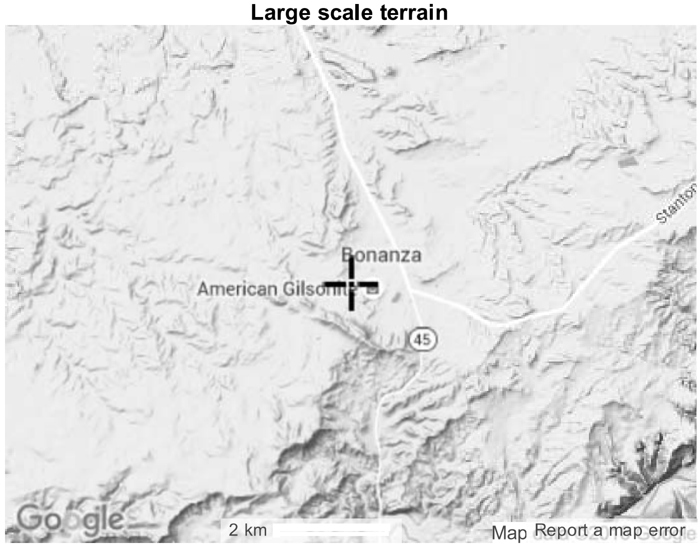
Maps & aerials

Small scale terrain

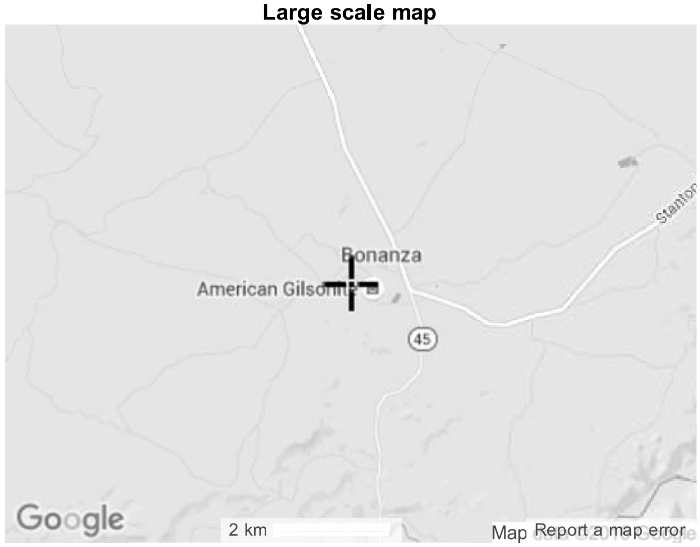




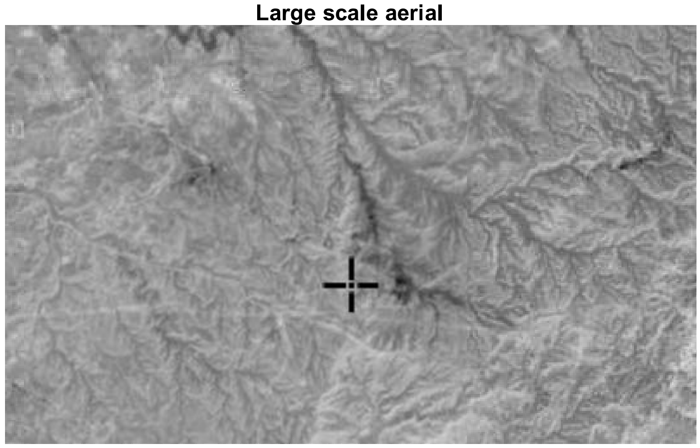
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Retention Pond 1 - Bottom Ash Landfill

Design Rainfall: 25-Year, 24 Hour

Pond Volume: 1,100,000 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Native Soils*	143	80	11440	Turzo, B	Herbaceous, Poor
Land Fill Area	58	85	4930		Ash
Blow Down Pond	-1				
CT Area /Roads	5	98	490		Impervious
Total	205		16860		
Calc'd CN		82			

SCS Storm Distribution			
Precipitation	P=	1.76	in
Curve Number	CN=	82	
Potential Ret.	S=	2.16	in
Run Off	Q=	0.51	in

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Capacities		
Run Off Volume	376,463	cu.ft
Pond Surface Area	300,000	sq.ft
Direct Precip to Pond	44,000	cu.ft
Pond Volume:	1,100,000	cu.ft
Pond Free Board	679,537	cu.ft

$$V_{pond} = A_{db} \frac{Q}{12}$$

Retention Pond 2 - Fly Ash Landfill

Design Rainfall:	25-Year, 24 Hour	
Pond Volume:	750,000	cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Native Soils*	37	71	2627	Turzo, B	Herbaceous, Fair
Covered Landfill	82	80	6560	Turzo, B	Herbaceous, Poor
Ash Landfill	20	85	1700		Ash
Total	139		10887		
Calc'd CN		78			

SCS Storm Distribution

Precipitation	P=	1.76	in
Curve Number	CN=	78	
Potential Ret.	S=	2.77	in
Run Off	Q=	0.37	in

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Capacities

Run Off Volume	184,818	cu.ft
Pond Surface Area	156,000	sq.ft
Direct Precip to Pond	22,880	cu.ft
Pond Volume:	750,000	cu.ft
Pond Free Board	542,302	cu.ft

$$V_{pond} = A_{db}\frac{Q}{12}$$

Retention Pond 3 - Fly Ash Landfill

Design Rainfall: 25-Year, 24 Hour

Pond Volume: 75,000,000 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Covered Landfill	30	80	2400	Turzo, B	Herbaceous, Poor
Total	30		2400		
Calc'd CN		80			

SCS Storm Distribution

Precipitation	P=	1.76	in
Curve Number	CN=	80	
Potential Ret.	S=	2.50	in
Run Off	Q=	0.42	in

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Capacities

Run Off Volume	45,981	cu.ft
Pond Surface Area	5,200,000	sq.ft
Direct Precip to Pond	762,667	cu.ft
Pond Volume:	75,000,000	cu.ft
Pond Free Board*	74,191,352	cu.ft

$$V_{pond} = A_{db}\frac{Q}{12}$$

* Empty Capacity - Requires approximately 0.2 inches of freeboard to accommodate

Retention Pond 4 - Fly Ash Landfill

Design Rainfall:	25-Year, 24 Hour	
Pond Volume:	35,100	cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Land Fill Area	11	80	880	Turzo, B	Herbaceous, Poor
Total	11		880		
Calc'd CN		80			

SCS Storm Distribution

Precipitation	P=	1.76	in
Curve Number	CN=	80	
Potential Ret.	S=	2.50	in
Run Off	Q=	0.42	in

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Capacities

Run Off Volume	16,860	cu.ft
Pond Surface Area	19,800	sq.ft
Direct Precip to Pond	2,904	cu.ft
Pond Volume:	35,100	cu.ft
Pond Free Board*	15,336	cu.ft

$$V_{pond} = A_{db} \frac{Q}{12}$$

Retention Pond 5 - Fly Ash Landfill

Design Rainfall: 25-Year, 24 Hour

Pond Volume: 43,400 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Land Fill Area	15.8	80	1442	Topping Soil + Roads	
Roads	2	89			
Total	17.8		1442		
Calc'd CN		81			

SCS Storm Distribution

Precipitation	P=	1.76 in
Curve Number	CN=	81
Potential Ret.	S=	2.34 in
Run Off	Q=	0.46 in

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Capacities

Run Off Volume	29,634	cu.ft
Pond Surface Area	12,650	sq.ft
Direct Precip to Pond	1,855	cu.ft
Pond Volume:	43,400	cu.ft
Pond Free Board*	11,910.36	cu.ft

$$V_{pond} = A_{db}\frac{Q}{12}$$

Retention Pond 1 - Storm Water Channel 1-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlass 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.5	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	1200	feet	
Ave. Slope	Y=	0.70	%	
Time of Concentration	Tc=	0.73	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	401	csm/in	
Area	Am	0.017	sq mi	
Run Off Flow Rate	qp	2.9	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Retention Pond 1 - Storm Water Channel 1-1

Trapezoid-Ditch

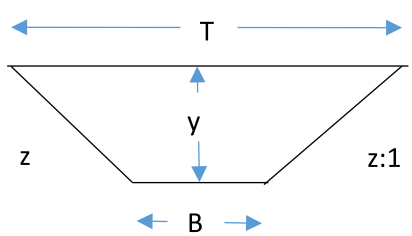
Depth	y=	1	ft
Bottom Width	B=	2	ft
Top Width	T=	8	ft
Side Slope	z=	3	
Slope of channel	S=	0.01	ft/ft
area	A=	5	ft2
Wetted Perimeter	P=	8.3	ft
Ratio, Area/W.P.	R=	0.60	
Manning n	n=	0.035	
Flow Velocity	V=	3.0	ft/sec
Flow Volumetric Rate	Q=	15.2	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

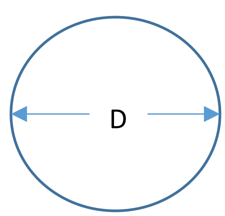
$$A = \frac{y}{2}(b + T)$$



Culvert 1-1

Manning n	n=	0.012	
Culvert Slope	S=	0.02	ft/ft
Diameter, Req'd	D=	0.8	ft
Diameter Installed	Di=	1.0	ft

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 1 - Storm Water Channel 1-1

Runoff Curve Number Calculation

Area	acres	CN	CN x Area	Soil Type	Description
Native Soils*	11	80	880	Turzo, B	Herbaceous, Poor
Total	11		880		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 1 - Storm Water Channel 1-2

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	83		
Potential Ret.	S=	2.10	inches	
Run Off	Q=	0.52	inches	
Hydraulic Length	L=	4000	feet	
Ave. Slope	Y=	0.72	%	
Time of Concentration	Tc=	1.74	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	232	csm/in	
Area	Am	0.12	sq mi	
Run Off Flow Rate	qp	14.6	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Trapezoid-Ditch

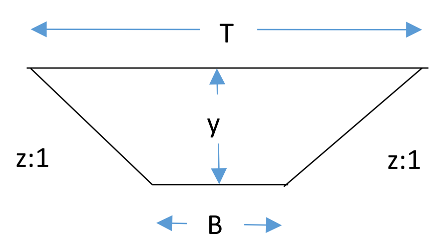
Depth	y=	1.5	ft
Bottom Width	B=	8	ft
Top Width	T=	14	ft
Side Slope	z=	2	
Slope of channel	S=	0.0072	ft/ft
area	A=	16.5	ft2
Wetted Perimeter	P=	14.7	ft
Ratio, Area/W.P.	R=	1.12	
Manning n	n=	0.035	
Flow Velocity	V=	3.9	ft/sec
Flow Volumetric Rate	Q=	64.4	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

$$A = \frac{y}{2}(b + T)$$



Retention Pond 1 - Storm Water Channel 1-2

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Native Soils*	53	80	4240	Turzo, B	Herbaceous, Poor
Landfill Area	25	85	2125		Ash
Blow Down Pond	-1				Pond - Does not contribute
Total	77		6365		
Calc'd CN		83			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 1 - Storm Water Channel 1-3

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	85		
Potential Ret.	S=	1.76	inches	
Run Off	Q=	0.62	inches	
Hydraulic Length	L=	2100	feet	
Ave. Slope	Y=	0.72	%	
Time of Concentration	Tc=	0.96	hrs	
Initial Abstraction	Ia=	0.353	in	
	Ia/p=	0.20		
unit peak discharge	qu=	332	csm/in	
Area	Am	0.052	sq mi	
Run Off Flow Rate	qp	10.7	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Retention Pond 1 - Storm Water Channel 1-3

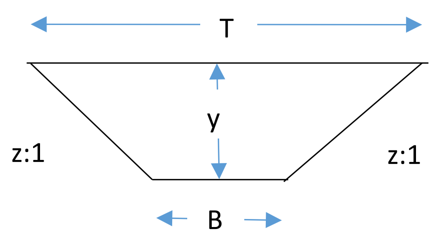
Trapezoid-Ditch			
Depth	y=	1.5	ft
Bottom Width	B=	8	ft
Top Width	T=	14	ft
Side Slope	z=	2	
Slope of channel	S=	0.0072	ft/ft
area	A=	16.5	ft2
Wetted Perimeter	P=	14.7	ft
Ratio, Area/W.P.	R=	1.12	
Manning n	n=	0.035	
Flow Velocity	V=	3.9	ft/sec
Flow Volumetric Rate	Q=	64.4	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

$$A = \frac{y}{2}(b + T)$$



Retention Pond 1 - Storm Water Channel 1-3

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	33	85	2805		Ash
Total	33		2805		
Calc'd CN		85			

Retention Pond 1 - Storm Water Channel 1-4

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	82		
Potential Ret.	S=	2.26	inches	
Run Off	Q=	0.48	inches	
Hydraulic Length	L=	1200	feet	
Ave. Slope	Y=	0.50	%	
Time of Concentration	Tc=	0.83	hrs	
Initial Abstraction	Ia=	0.273	in	
	Ia/p=	0.16		
unit peak discharge	qu=	380	csm/in	
Area	Am	0.011	sq mi	
Run Off Flow Rate	qp	2.0	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

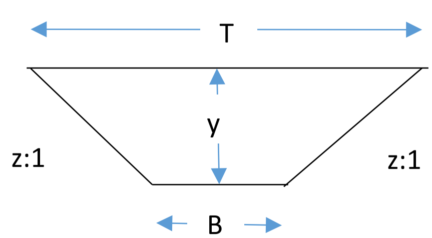
Trapezoid-Ditch			
Depth	y=	1	ft
Bottom Width	B=	1	ft
Top Width	T=	7	ft
Side Slope	z=	2	
Slope of channel	S=	0.008	ft/ft
area	A=	4	ft2
Wetted Perimeter	P=	5.5	ft
Ratio, Area/W.P.	R=	0.73	
Manning n	n=	0.035	
Flow Velocity	V=	3.1	ft/sec
Flow Volumetric Rate	Q=	12.4	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

$$A = \frac{y}{2}(b + T)$$



Retention Pond 1 - Storm Water Channel 1-4

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Native Soils*	6.4	80	512	Turzo, B	Herbaceous, Poor
Asphalt	0.6	98	58.8		Impervious
Total	7		571		
Calc'd CN		82			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	3300	feet	
Ave. Slope	Y=	18.5	%	
Time of Concentration	Tc=	0.32	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	620	csm/in	
Area	Am	0.074	sq mi	
Run Off Flow Rate	qp	19.3	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Trapezoid-Ditch

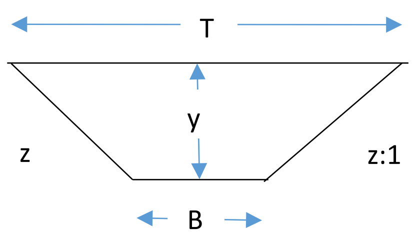
Depth	y=	2	ft
Bottom Width	B=	2	ft
Top Width	T=	14	ft
Side Slope	z=	3	
Slope of channel	S=	0.005	ft/ft
area	A=	16	ft2
Wetted Perimeter	P=	14.6	ft
Ratio, Area/W.P.	R=	1.09	
Manning n	n=	0.035	
Flow Velocity	V=	3.2	ft/sec
Flow Volumetric Rate	Q=	51.1	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

$$A = \frac{y}{2}(b + T)$$



Retention Pond 2 - Storm Water Channel 2-1

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	47.1	80	3768	Turzo, B	Herbaceous, Poor
Total	47.1		3768		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-2

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	3250	feet	
Ave. Slope	Y=	19.3	%	
Time of Concentration	Tc=	0.31	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	629	csm/in	
Area	Am	0.079	sq mi	
Run Off Flow Rate	qp	21.0	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_C = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Retention Pond 2 - Storm Water Channel 2-2

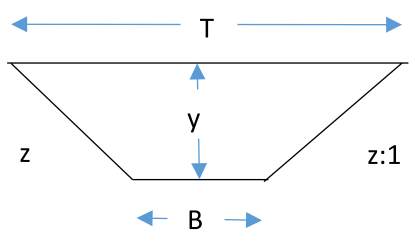
Trapezoid-Ditch			
Depth	y=	2	ft
Bottom Width	B=	2	ft
Top Width	T=	14	ft
Side Slope	z=	3	
Slope of channel	S=	0.0074	ft/ft
area	A=	16	ft2
Wetted Perimeter	P=	14.6	ft
Ratio, Area/W.P.	R=	1.09	
Manning n	n=	0.035	
Flow Velocity	V=	3.9	ft/sec
Flow Volumetric Rate	Q=	62.1	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

$$A = \frac{y}{2}(b + T)$$



Retention Pond 2 - Storm Water Channel 2-2

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area*	50.5	80	4040	Turzo, B	Herbaceous, Poor
Total	50.5		4040		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1 and 2-4

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	1500	feet	
Ave. Slope	Y=	18.5	%	
Time of Concentration	Tc=	0.17	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	813	csm/in	
Area	Am	0.028	sq mi	
Run Off Flow Rate	qp	9.4	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Trapezoid-Ditch

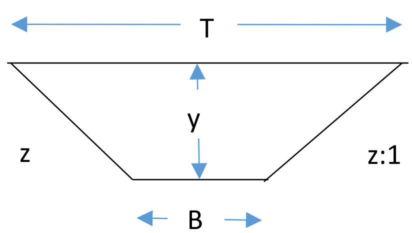
Depth	y=	2	ft
Bottom Width	B=	2	ft
Top Width	T=	14	ft
Side Slope	z=	3	
Slope of channel	S=	0.005	ft/ft
area	A=	16	ft2
Wetted Perimeter	P=	14.6	ft
Ratio, Area/W.P.	R=	1.09	
Manning n	n=	0.035	
Flow Velocity	V=	3.2	ft/sec
Flow Volumetric Rate	Q=	51.1	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

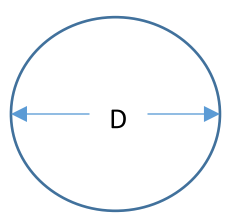
$$A = \frac{y}{2}(b + T)$$



Culvert 2-1 / 2-4

Manning n	n=	0.012	
Culvert Slope	S=	0.005	ft/ft
Diameter, Req'd	D=	1.6	ft
Diameter Installed	Di=	2.0	ft

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1 / 2-4

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	18	80	1440	Turzo, B	Herbaceous, Poor
Total	18		1440		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-2 : POI Culvert 2-2

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlass 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	1600	feet	
Ave. Slope	Y=	5.6	%	
Time of Concentration	Tc=	0.33	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	614	csm/in	
Area	Am	0.026	sq mi	
Run Off Flow Rate	qp	6.7	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

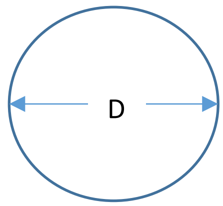
$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Culvert 2-2			
Manning n	n=	0.012	
Culvert Slope	S=	0.021	ft/ft
Diameter, Req'd	D=	1.1	ft
Diameter Installed	Di=	1.5	ft

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 2 - Storm Water Channel 2-2 : POI Culvert 2-2

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area*	16.5	80	1320	Turzo, B	Herbaceous, Poor
Total	16.5		1320		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water : POI Culvert 2-3

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches
Curve Number	CN=	80	
Potential Ret.	S=	2.50	inches
Run Off	Q=	0.42	inches
Hydraulic Length	L=	3320	feet
Ave. Slope	Y=	4.7	%
Time of Concentration	Tc=	0.64	hrs
Initial Abstraction	Ia=	0.299	in
	Ia/p=	0.17	
unit peak discharge	qu=	434	csm/in
Area	Am	0.039	sq mi
Run Off Flow Rate	qp	7.2	ft3/sec

(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_C = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

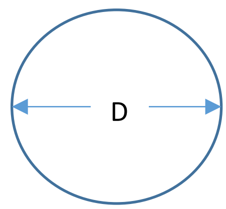
$$q_p = q_u A_m Q$$

b Culvert 2-3

Manning n	n=	0.012	
Culvert Slope	S=	0.01	ft/ft
Diameter, Req'd	D=	0.97	ft
Diameter Installed*	Di=	1.0	ft

*(2) Culverts installed (1/2 qp)

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 2 - Storm Water : POI Culvert 2-3

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	25	80	2000	Turzo, B	Herbaceous, Poor
Total	25		2000		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-4

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlass 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	5636	feet	
Ave. Slope	Y=	18.5	%	
Time of Concentration	Tc=	0.49	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	500	csm/in	
Area	Am	0.061	sq mi	
Run Off Flow Rate	qp	12.9	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

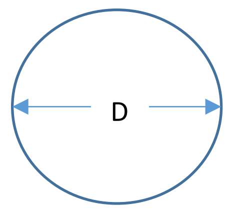
$$q_p = q_u A_m Q$$

Culvert 2-3

Manning n	n=	0.012	
Culvert Slope	S=	0.0075	ft/ft
Diameter, Req'd*	D=	1.3	ft
Diameter Installed	Di=	1.5	ft

*(2) Culverts installed (1/2 qp)

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-4

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	39	80	3120	Turzo, B	Herbaceous, Poor
Total	39		3120		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 5 - Storm Water Channel 5-1 : POI Culvert 5-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	73		
Potential Ret.	S=	3.74	inches	
Run Off	Q=	0.22	inches	
Hydraulic Length	L=	2500	feet	
Ave. Slope	Y=	33.0	%	
Time of Concentration	Tc=	0.24	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	709	csm/in	
Area	Am	0.028	sq mi	
Run Off Flow Rate	qp	4.3	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1

Trapezoid-Ditch

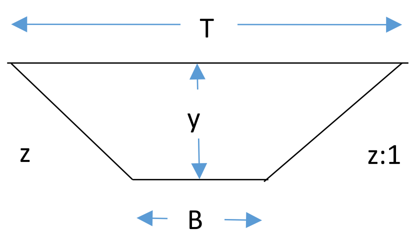
Depth	y=	1.25	ft
Bottom Width	B=	2	ft
Top Width	T=	7	ft
Side Slope	z=	2	
Slope of channel	S=	0.01	ft/ft
area	A=	5.625	ft2
Wetted Perimeter	P=	7.6	ft
Ratio, Area/W.P.	R=	0.74	
Manning n	n=	0.035	
Flow Velocity	V=	3.5	ft/sec
Flow Volumetric Rate	Q=	19.6	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

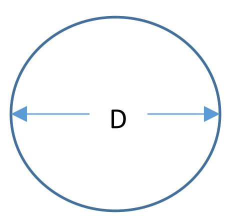
$$A = \frac{y}{2}(b + T)$$



Culvert 2-1

Manning n	n=	0.012	
Culvert Slope	S=	0.02	ft/ft
Diameter, Req'd	D=	0.91	ft
Diameter Installed	Di=	1.50	ft

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	15.8	82	1296	Turzo, B	Herbaceous, Poor
Roads	2	89			
Total	17.8		1296		
Calc'd CN		73			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 3

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	3250	feet	
Ave. Slope	Y=	3.00	%	
Time of Concentration	Tc=	0.79	hrs	
Initial Abstraction	Ia=	0.299	in	
	Ia/p=	0.17		
unit peak discharge	qu=	385	csm/in	
Area	Am	0.087	sq mi	
Run Off Flow Rate	qp	14.1	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Retention Pond 3

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area*	55.4	80	4432	Turzo, B	Herbaceous, Poor
Total	55.4		4432		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 4 - Storm Water Channel 4-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.50	inches	
Run Off	Q=	0.42	inches	
Hydraulic Length	L=	1530	feet	
Ave. Slope	Y=	33.30	%	
Time of Concentration	Tc=	0.13	hrs	
Initial Abstraction	Ia=	0.299		
	Ia/p=	0.17		
unit peak discharge	qu=	902	csm/in	
Area	Am	0.017	sq mi	
Run Off Flow Rate	qp	6.5	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_C = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$

Trapezoid-Ditch

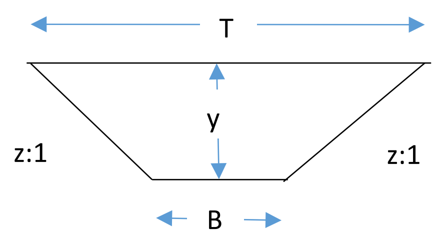
Depth	y=	1.5	ft
Bottom Width	B=	2	ft
Top Width	T=	11	ft
Side Slope	z=	3	
Slope of channel	S=	0.011	ft/ft
area	A=	9.75	ft2
Wetted Perimeter	P=	11.5	ft
Ratio, Area/W.P.	R=	0.85	
Manning n	n=	0.035	
Flow Velocity	V=	4.0	ft/sec
Flow Volumetric Rate	Q=	39.5	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

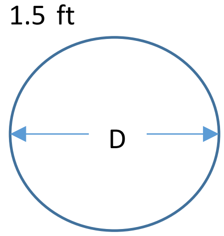
$$A = \frac{y}{2}(b + T)$$



Culvert 4-1

Manning n	n=	0.012	
Culvert Slope	S=	0.011	ft/ft
Diameter, Req'd	D=	1.2	ft
Diameter Installed	Di=	1.5	ft

$$D = \left[\frac{2.15\, q_p n}{S^{0.5}}\right]^{0.375}$$



Retention Pond 4 - Storm Water Channel 4-1

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	11	80	880	Turzo, B	Herbaceous, Poor
Total	11		880		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Kennedy Wash - Storm Water Channel

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

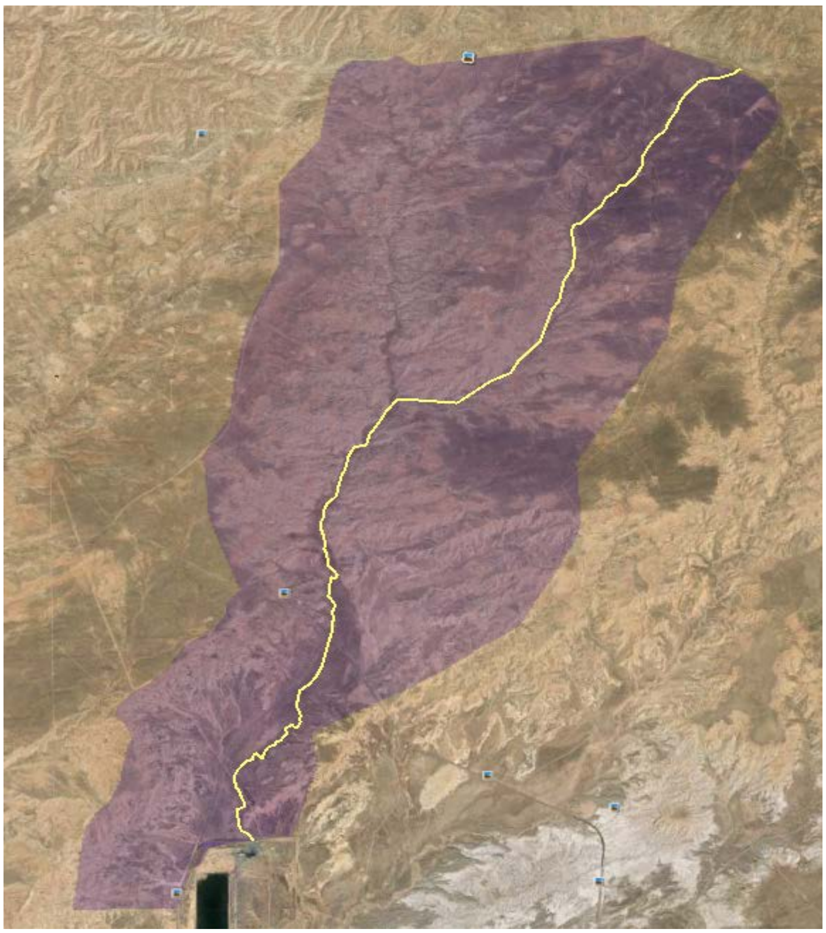
Precipitation	P=	1.76	inches	(NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)
Curve Number	CN=	80		
Potential Ret.	S=	2.55	inches	
Run Off	Q=	0.41	inches	
Hydraulic Length	L=	53937	feet	
Ave. Slope	Y=	3.80	%	
Time of Concentration	Tc=	6.67	hrs	
Initial Abstraction	Ia=	0.5		
	Ia/p=	0.28		
unit peak discharge	qu=	75	csm/in	
Area	Am	23.1	sq mi	
Run Off Flow Rate	qp	716	ft3/sec	

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8}\left(\left(\frac{1000}{CN}\right) - 9\right)^{0.7}}{1140\ Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Trapezoid-Ditch

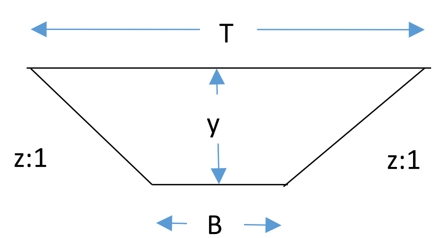
Depth	y=	3.5	ft
Bottom Width	B=	85	ft
Top Width	T=	106	ft
Side Slope	z=	3	
Slope of channel	S=	0.0077	ft/ft
area	A=	334.25	ft2
Wetted Perimeter	P=	107.1	ft
Ratio, Area/W.P.	R=	3.12	
Manning n	n=	0.035	
Flow Velocity	V=	8.0	ft/sec
Flow Volumetric Rate	Q=	2,666	ft3/sec

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

$$A = \frac{y}{2}(b + T)$$



Kennedy Wash - Storm Water Channel

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Drainage	6184	89	550376	D	Denco-Gerst Complex, 66
Drainage	4515	67	302505	B	Solirec-Abracon-Begay Complex, 213
Drainage	1412	80	112960	B	Turzo Complex, 241
Drainage	997.4	88	87771.2	D	Badland-Denco Complex, 8
Drainage	538.8	67	36099.6	B	Abracon Loam, 2
Drainage	464.6	89	41349.4	D	Badland-Rock Outcrop, 12
Drainage	361.1	67	24193.7	B	Shotnick Sandy Loam, 206
Drainage	140.9	67	9440.3	B	Shotnick-Ioka Complex, 208
Drainage	105	67	7035	B	Milok Fine Sandy Loam, 141
Drainage	76.1	88	6696.8	D	Denco Silty Clay Loam, 65
Total	14795		1178427		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Appendix B

REQUIREMENT / COMPLIANCE TABLE

Section	Requirement	Compliance Section
§257.81(a)	*The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:*	
	(1) A run-on control system to prevent flow onto the active portion of the CCR unit during peak discharge from a 24-hour, 25-year storm; and	IV
	(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.	V
§257.81(b)	*Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under §257.3-3*	V
§257.81(c)	*Run-on and run-off control system plan -*	
	(1) Content of the plan. The owner or operator must prepare initial and periodic run-on and run-off 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 run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3).	IV,V, Appendix A
	(2) Amendment of the plan. The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(3). The owner or operator must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.	VI
	(3) Timeframes for preparing the initial plan - *(i) Existing CCR landfills. The owner or operator of the CCR unit must prepare the initial run-on and run-off control system plan no later than October 17, 2016.* *(ii) New CCR landfills and any lateral expansion of a CCR landfill. The owner or operator must prepare the initial run-on and run-off control system plan no later than the date of initial receipt of CCR in the CCR unit.*	VII
	(4) Frequency for revising the plan. The owner or operator of the CCR unit must prepare periodic run-on and run-off 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 subsequent 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 a periodic run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3).	VIII
	(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.	IX
§257.81(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).*	X