Sunnyside Cogeneration Associates

SCA #2 Ash Landfill
Run-on and Run-off Control Plan

September 2016

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1.0 Introduction

The Sunnyside Cogeneration Associates (SCA) power plant burns waste fuel left behind by other mines through the past decades of mining in the area and results in an efficient use of natural resources and reclamation of the existing refuse piles. Operations occur in a manner which protects air quality, surface waters and groundwater in the region. Ash is a byproduct of the SCA power plant and SCA has been disposing of this ash in existing landfills a short distance from the power plant since plant began operations in the early 1990's. The SCA#1 Ash Landfill was closed in 2015 when the SCA #2 Ash Landfill began operations.

The existing SCA #2 Ash Landfill is located in unincorporated Carbon County (Portions of Sections 7 & 8, Township 14 South, Range 14 East, SLB&M) just south of the city of Sunnyside / East Carbon. (Approximately Latitude 39° 32' 24" North and Longitude 110° 22' 50" West). Carbon County granted a Conditional Use Permit for the SCA #2 Ash Landfill. The Utah State Department of Environmental Quality also granted a construction permit for the landfill. The Utah State Engineer granted a permit to build Sediment Pond #018.

This plan identifies the Run-on Controls and Run-off Controls in place at the existing SCA #2 Ash Landfill. The controls described in this plan prevent flow onto the active portion of the landfill and also collect and control water running off from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm. This plan has been prepared to meet the requirements of 40CFR 257.81 and 40CFR 257.3-3 and the proposed Utah State regulations R315-319-81.

2.0 Executive Summary

The existing SCA #2 Ash Landfill encompasses a footprint of approximately 30-40 acres resting against and into a small side hill with existing elevations ranging from approximately 6400 to 6775. This location was chosen because there is no surface water flowing in the vicinity and it is up above the valley floor and has minimal potential for ground water.

Intermittent flows from precipitation events in this area are smaller and short term because there is not a significant collection area that would flow to this location.

Potential precipitation run-on flows are diverted away from the active portion of the landfill by a combination of ditches, berms and site construction slopes.

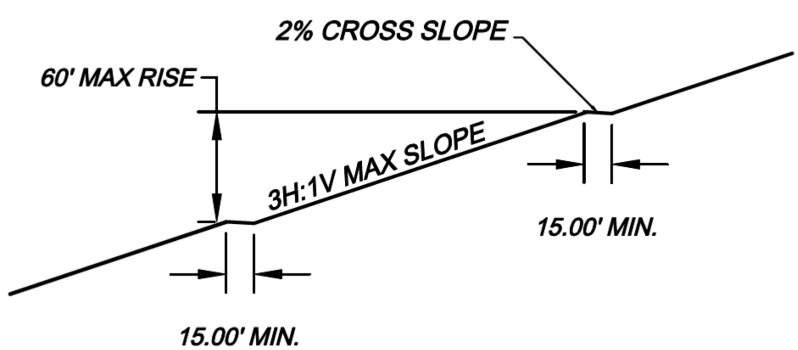
Precipitation run-off flows are collected in a series of ditches, detained in sediment traps and contained in a clay-lined sediment pond (#018). In the event that any discharge ever comes from this sediment pond, the discharge will be monitored in accordance with the requirements of the state UPDES permit.

Closure plans for the landfill will cover the ash material and revegetate the surface to reduce potential runoff and erosion from the site.

3.0 Landfill Design and Closure Parameters

The design parameters for the SCA #2 Ash Landfill include the following:

- 3H:1V slope on the face of the landfill
- Benches/Terraces 15 feet wide at a maximum vertical spacing of 60 feet
- Drainage Collection ditches on each bench/terrace with the ditch profile slope generally in the range of 1-2%. Drainage will be directed to perimeter collection ditches, through erosion control BMP's and sediment traps and then into a clay-lined sediment pond.



TYPICAL FILL SECTION

- Cap the landfill with a low permeability soil (clay) layer
- Cover the cap with a vegetative growth layer (18 to 24 inch) with fertilizer and organic material mixed in and leave the surface in a roughened condition to reduce runoff and erosion potential.
- Seed and re-establish vegetation on the covered surface.

4.0 Surface Water Controls

This section presents the analysis and design of the surface water control features for the SCA #2 Ash Landfill. The governing principals behind the surface water controls for this landfill are to prevent off site water from running onto the landfill area and to collect and divert runoff from the landfill via terrace ditches to the perimeter collection ditches. This water is detained briefly in sediment traps to slow the flow rate and drop sediments prior to reaching the lined sediment pond #018. Straw bales or other bmp's will be placed periodically in the perimeter collection ditch to further assist in slowing the flow velocity and reducing the potential erosion.

Runoff calculations are based on the concept that the ash terraces will be covered as described above on a periodic basis such that the entire ash landfill is not exposed at the same time. This will allow the re-vegetation efforts to establish a reasonable ground cover and minimize runoff and erosion for the project.

4.1 Existing Surface Water Features

As previously stated, the location for the SCA #2 Ash Landfill was selected in part due to the absence of water sources in the area. This site is not located in a 100 year flood plain and only small ephemeral surface water features exist in the near vicinity. The site is located in the upper headwaters area of Icelander Creek. Icelander Creek is normally dry near the site but often has extended seasonal flows below Whitmore Springs located approximately 1.5 miles to the west / northwest of the site. Water Canyon is located approximately 0.5 miles to the south of the site and typically only sees storm related or snow melt related runoff. Grassy Trail Creek is located approximately 0.8 miles to the north / northwest and usually experiences flow during seasonal runoff conditions and releases from the upstream dam.

4.2 Hydrologic Data

The rainfall point values for the Sunnyside and East Carbon, Utah area were obtained from the NOAA Atlas 14, Volume 1, Version 5. The 24-hour rainfall value of 2.32 inches for the 25-year event was used in modeling for this design.

Runoff was estimated using the Rational method and hand computations. Assuming Type I antecedent moisture conditions for the site, the runoff coefficient was estimated at 0.65 for exposed ash conditions, 0.25 for surfaces that have been recently covered with soil and roughened, and 0.15 for surfaces that have been re-vegetated in a roughened condition.

The direct tributary drainage area to Sedimentation Pond #018 is approximately 55 acres. The designed sediment traps 1 and 2 together with straw bales and other bmp's will slow the peak flow velocities in the ditches and reduce the sediment load, but overall, the total volume of water delivered to #018 is the same. These sediment traps have been factored into the hydrologic modeling.

Pond and sediment trap design details, watershed boundaries, flow paths, pond connectivity, diversions, ditches, and calculations are shown in the Appendix A to this report and the accompanying drawing package (Appendix B).

Potential run-on from most areas outside the landfill footprint will be diverted away from the sediment pond using diversion berms and ditches on the landfill perimeter combined with sloping of the active surface of the landfill.

4.3 Design Assumptions

When the SCA #2 Ash Landfill development is in progress, the tributary drainage area to the sedimentation pond #018 will consist of a combination of existing ground in undeveloped areas, exposed ash on active terraces and benches of the active cell, and cover soil on closed benches. Existing ground in undeveloped areas of the site consists of a coarse alluvium in a relatively dry condition. Runoff from these areas not yet covered with ash material will generally either be diverted away from the landfill or be collected with the landfill runoff and flow to the sediment pond.

Ash surfaces in the active cell tend to be in a somewhat dry condition after exposure to the evaporative conditions typical of the area. Benches in the cell will be sloped inward as an erosion-prevention measure to prevent run-off from cascading down the terrace faces. Runoff from the top of the terrace will drain to perimeter ditches or terraces and be conveyed to the sediment traps and pond. Cover soil on closed portions of the landfill will also tend to be in a relatively dry condition, and will be sloped and roughened as described in the reclamation section above.

As expected, runoff computations indicate that the greatest runoff volume is generated from exposed ash surfaces. In order to produce a conservative pond design volume (on the side of oversizing), the pond was design to contain the runoff volume projected and then the two main sediment traps were added as increased volume capacity in the system. While it is anticipated that the sediment traps will remain open and drain slowly through the discharge pipe, it is possible to temporarily close the discharge pipe valve and hold the storm water to avoid a discharge from sediment pond #018. The UPDES permit will allow a discharge from #018 as long as the discharge is tested and meets the required water quality standards.

4.4 Hydrologic Modeling Analysis Results

Based upon computations using the Rational method, the 25-year 24-hour event will produce approximately 1.5 to 2.0 acre feet of runoff in a final reclaimed condition. The 25-year 24-hour event will produce between approximately 1.0 and 3.3 acre feet, depending on the condition of the landfill construction at the time of the storm (amount of the landfill constructed, extent of exposed ash surface, amount of reclamation / revegetation completed, sediment traps, etc.). Calculation summaries are included in Appendix A.

Sediment Pond #018 is designed with a capacity of approximately 2.5 acre feet, below the 18" overflow discharge standpipe. Discharge capacity through the standpipe is as much as 13 cfs. While it is possible to envision two major storms occurring in a short time period (with a combined total precipitation greater than the design storm and hence a potential discharge from pond #018), it is expected that there will be no discharge during most years.

Sediment Trap #1 is designed with a capacity of approximately 1.6 acre feet below the 24" overflow discharge standpipe. Discharge capacity through the standpipe is as much as 18 cfs, but it is expected that most storms will be smaller than 1.6 acre feet and will therefore simply drain this sediment trap through the 2" drain pipe at flow rates less than 0.3 cfs. Discharge from Sediment Trap #1 will flow directly to Sediment Pond #018.

Sediment Trap #2 is designed with a capacity of approximately 1.4 acre feet below the overflow discharge spillway ditch. Discharge capacity over the spillway can be as much as 15 cfs, but it is expected that most storms will be smaller than 1.4 acre feet and will therefore simply drain this sediment trap through the 2" drain pipe at flow rates less than 0.3 cfs. Discharge from the Sediment Trap #2 drain pipe will flow to a terrace ditch and into the south perimeter collection ditch which will flow to Sediment Trap #1 and then to Sediment Pond #018. If Sediment Trap #2 fills and discharges through the overflow spillway, it will follow ditches on SCA property into SCA's Borrow Area Pond #016 which, if it ever discharges, would end up into Sediment Trap #1 and then Sediment Pond #018.

4.5 Run-on Ditch and Berm Sizes

This section discusses the minimum design size for run-on prevention ditches and berms.

Run-on prevention is intended to minimize the amount of water coming into contact with the exposed ash materials. This effort is accomplished first by selecting a site with minimal potential for surface waters. The constructed means for preventing run-on includes berms or ditches around the perimeter of the landfill and or out beyond the perimeter. These berms or ditches deflect and or convey storm flows away from the landfill to natural drainage ways that will not contribute to the water volumes being treated in the sediment traps or sediment pond #018. In some areas around the landfill, topographic conditions are such that run-on is collected in the landfill perimeter ditch and conveyed to the sediment trap and pond #018.

The minimum size for a run-on prevention berm is 2 feet high with side slopes minimum 2H:1V if the berm is placed parallel to the contours of the natural slope of the hill above it. The berm must be a minimum of 1 foot high with side slopes minimum 2H:1V if it is placed perpendicular to the contours of the natural slope of the hill.

The minimum size for a run-on collection ditch is a cross section of 5 square feet with minimum side slopes of 2H:1V.

In addition to run-on prevention berms and ditches, the top perimeter surface of the active ash terrace will be sloped to the perimeter at a minimum of 1% such that precipitation from outside the ash surface will stay at the perimeter and not run across the ash surface.

4.6 Run-off Collection and Conveyance Ditch Sizes

This section discusses the minimum design size for landfill run-off collection and conveyance ditches.

Run-off collection is intended to collect and treat water that has potentially come into contact with the landfill ash materials. This water is treated in the sediment traps and sediment pond #018. This treatment effort is accomplished long term by capping the ash materials and covering with soil to minimize the potential that precipitation directly on the landfill will come into contact with the ash materials. During the active construction period for the landfill, ash material is exposed to precipitation and the focus will be on collecting and treating the run-off.

Terrace ditches will be constructed on the inside edge of each of the terraces. These ditches will be a minimum of 3 square feet cross section and will have a minimum of 1% profile slope. The terrace ditches will collect runoff from the landfill slopes above the terrace and convey the water to the perimeter ditch.

Perimeter ditches will have a minimum cross section of 8 square feet and will generally have a much greater profile slope (generally 2% to 8%). Steeper sections of the perimeter ditches will have BMPs and or rock armoring to minimize erosion in the ditch.

4.7 Ditch Conveyance and Erosion Control

This section discusses erosion control for runoff control ditches at the SCA #2 Ash Landfill. Ditches flowing across the terraces and around the perimeter of the landfill will not generally be lined. The minimum ditch grade at the landfill is approximately 1 percent—there is little chance that excess ponding will occur in any ditches. The ponding area of the sediment pond #018 will be 100-percent lined, as described above. Ash contact runoff may wet the soil in the ditch invert, but will tend to quickly evaporate in the arid climate rather than infiltrate.

Flow velocities in the terrace ditches will generally be high enough that little sediment deposition will occur. Therefore any ash which may erode from the landfill will be deposited in the sediment traps or the lined sediment pond. Ash and sediment will be routinely excavated from the traps and pond and placed into the active ash cell.

The The north and south perimeter ditches are sloped much greater than terrace ditches. They will have periodic bmp's (such as straw bales, silt fences or other check dams) to reduce the risk of serious bed erosion in the ditch. If significant amounts of sediment build up behind the bmp's, maintenance will be required to ensure the continued functionality of the ditch and bmp.

As an alternate to bmp's described above, SCA may determine that it is more efficient to place rock armoring in the ditches to control erosion. Gravel and cobbles obtained from screening cover soil can be placed along the ditch invert. Some fines will initially wash away (to the sedimentation trap), leaving a natural graded armor layer. SCA may also choose to install additional small sediment traps, or other bmp's, at the site to manage flow rates.

4.8 Run-off Water Treatment

Run-off water collected from the landfill will be detained in the sediment traps to drop the majority of the sediments and then evaporated in pond #018. The sediment traps are intended to hold peak flows temporarily and release slowly to pond #018. The sediment traps are not lined in an effort to facilitate a simpler effort in sediment cleaning without risking damage to a liner below the sediments.

Sediment Pond #018 is lined with a low-permeability barrier layer to minimize infiltration of ash-contact runoff which is captured in the pond. The native clay material liner consists of screened import material (2-inch minus), spread and compacted in place. The liner is 12 inches thick, compacted in two 6-inch lifts to 95% with a resultant hydraulic conductivity less than or equal to $1x10^{-5}$ cm/s.

Given the sediment traps up from the Sediment Pond #018, the sediment accumulation in #018 is significantly reduced and regular sediment cleaning occurs more in the sediment traps and less in #018.

It is anticipated that most years will not see any discharge from pond #018. However, in the event of multiple large storms, any discharge from pond #018 will be monitored in accordance with the UPDES permit.

APPENDIX A

HYDROLOGIC CALCULATIONS

SCA#2 Ash Landfill
Storm Drainage Calculations

Landfill Complete and Revegetated

Rational Formula Q = CiA

	Acres	Area (sqft)	Coefficient	C*A (sqft)
Terraces U1-3 Revegetated flow to Sed Trap 2	25.3	1100000	0.15	165000
Terraces L1-4, M1-2 Revegetated flow to Sed Trap 1	39.2	1707000	0.15	256050

25 Year 24 Hour Storm Analysis **Terraces U1-3 Revegetated flow to Sed Trap 2**

Interval (min)	Rate (in/hr)	Cumulative Precip (in)	C*A (sqft)	Peak Ditch Flow (cfs)	Storm Volume (cuft)	Storm Volume (acft)
60	1.13	1.13	165000	4.28	15538	0.4
120	0.64	1.27	165000	2.41	17463	0.4
180	0.45	1.34	165000	1.69	18425	0.4
720	0.13	1.51	165000	0.48	20763	0.5
1440	0.10	2.32	165000	0.37	31900	0.7

25 Year 24 Hour Storm Analysis **Terraces L1-4, M1-2 Revegetated flow to Sed Trap 1**

Interval (min)	Rate (in/hr)	Cumulative Precip (in)	C*A (sqft)	Peak Ditch Flow (cfs)	Storm Volume (cuft)	Storm Volume (acft)
60	1.13	1.13	256050	6.64	24111	0.6
120	0.64	1.27	256050	3.73	27099	0.6
180	0.45	1.34	256050	2.63	28592	0.7
720	0.13	1.51	256050	0.74	32220	0.7
1440	0.10	2.32	256050	0.57	49503	1.1

Summary: Under a fully revegeted condition, relatively little runoff is expected

Sediment Trap #2 would capture all runoff from upper terraces 1-3 and discharge at a slow rate.
Sediment Trap #1 plus Sediment Pond #018 are adequate to treat and control the expected runoff under the described condition

Terrace ditches are expected to experience flows in the range of up to 1-2 cfs
The perimeter collection ditches could experience flows up to 4-8 cfs, depending on conditions

SCA#2 Ash Landfill
Storm Drainage Calculations

Upper Phase condition
(landfill under construction up to elev 6775 with lower terraces reclaimed)

Rational Formula Q = CiA

	Acres	Area (sqft)	Coefficient	C*A (sqft)
Terrace U3 Exposed Ash Surface	16.5	720000	0.65	468000
Terrace U2 Covered and Roughened	7.0	307000	0.25	76750
Terraces L1-4, M1-2 & U1 Revegetated	32.1	1400000	0.15	210000

25 Year 24 Hour Storm Analysis **Terrace U3 Exposed Ash Surface**

Interval (min)	Rate (in/hr)	Cumulative Precip (in)	C*A (sqft)	Peak Ditch Flow (cfs)	Storm Volume (cuft)	Storm Volume (acft)
60	1.13	1.13	468000	**12.14**	44070	1.0
120	0.64	1.27	468000	6.82	49530	1.1
180	0.45	1.34	468000	4.80	52260	1.2
720	0.13	1.51	468000	1.35	58890	1.4
1440	0.10	2.32	468000	1.04	90480	**2.1**

25 Year 24 Hour Storm Analysis **Terrace U2 Covered and Roughened**

Interval (min)	Rate (in/hr)	Cumulative Precip (in)	C*A (sqft)	Peak Ditch Flow (cfs)	Storm Volume (cuft)	Storm Volume (acft)
60	1.13	1.13	76750	**1.99**	7227	0.2
120	0.64	1.27	76750	1.12	8123	0.2
180	0.45	1.34	76750	0.79	8570	0.2
720	0.13	1.51	76750	0.22	9658	0.2
1440	0.10	2.32	76750	0.17	14838	**0.3**

25 Year 24 Hour Storm Analysis **Terraces L1-4, M1-2 & U1 Revegetated**

Interval (min)	Rate (in/hr)	Cumulative Precip (in)	C*A (sqft)	Peak Ditch Flow (cfs)	Storm Volume (cuft)	Storm Volume (acft)
60	1.13	1.13	210000	**5.45**	19775	0.5
120	0.64	1.27	210000	3.06	22225	0.5
180	0.45	1.34	210000	2.15	23450	0.5
720	0.13	1.51	210000	0.61	26425	0.6
1440	0.10	2.32	210000	0.47	40600	**0.9**

Summary: Terrace under construction is expected to have highest runoff rates at up to 7-12 cfs
Upper (north) perimeter ditch should include straw bale check dams to reduce velocity
Sediment Trap #2 would capture all runoff from upper terraces 1-3 and discharge at a slow rate.
Sediment Trap #1 plus Sediment Pond #018 are adequate to treat and control the expected runoff under the described condition (with a total estimated runoff volume estimated at approx 3.3 acft)
Discharge valves from the two sediment traps may be closed for a time to reduce discharge from #018
South Perimeter collection ditch could experience flows up to 5-9 cfs with straw bales to reduce velocity

NOAA Atlas 14, Volume 1, Version 5
Location name: East Carbon, Utah, US*
Coordinates: 39.5395, -110.3822
Elevation: 6466ft*
* 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

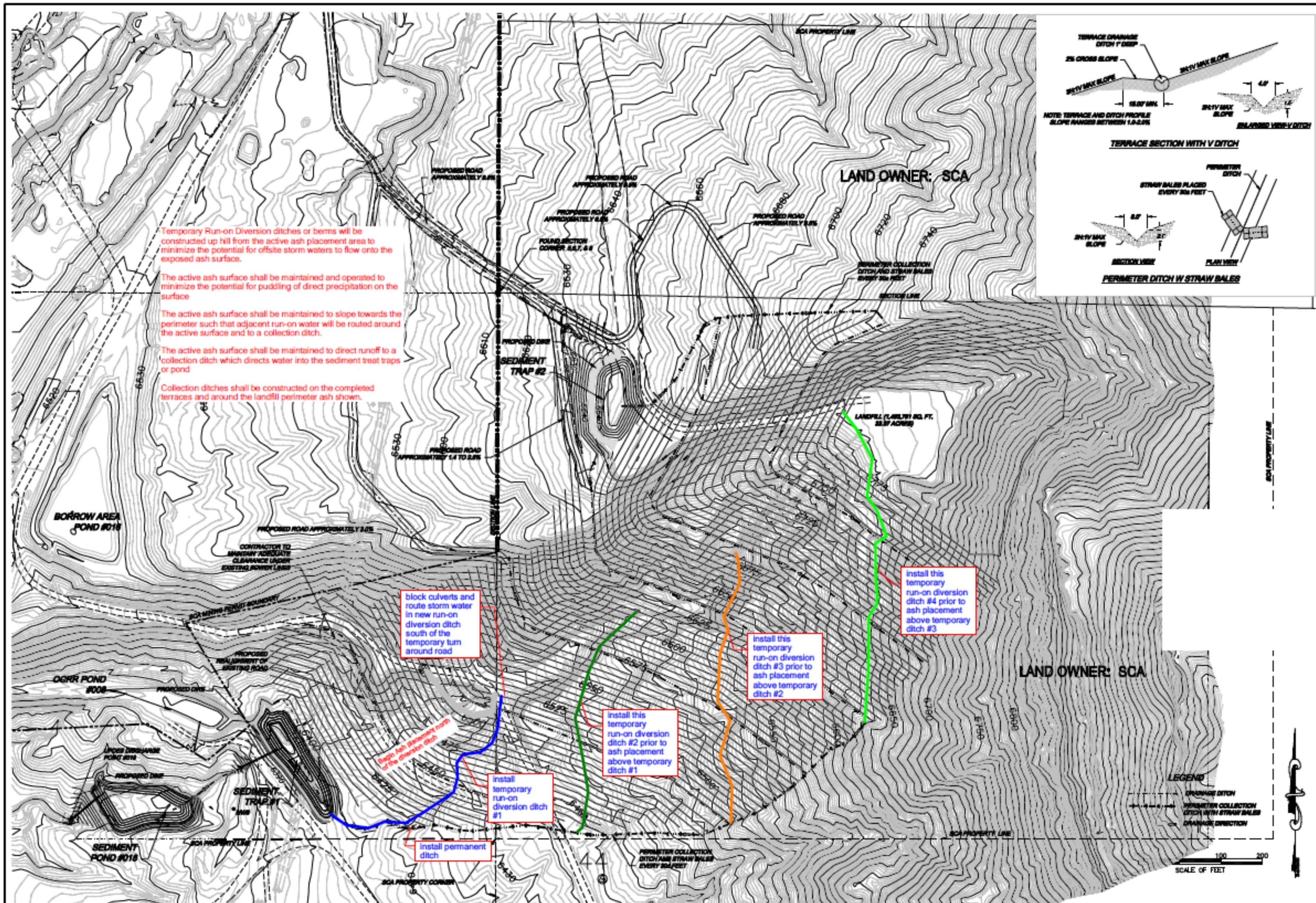
PF tabular

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	0.127 (0.109-0.150)	0.163 (0.141-0.195)	0.223 (0.191-0.265)	0.276 (0.236-0.330)	0.359 (0.300-0.431)	0.434 (0.355-0.522)	0.521 (0.417-0.631)	0.622 (0.484-0.764)	0.783 (0.583-0.983)	0.930 (0.669-1.19)
10-min	0.193 (0.166-0.229)	0.247 (0.215-0.296)	0.339 (0.291-0.404)	0.420 (0.359-0.502)	0.547 (0.456-0.655)	0.660 (0.540-0.795)	0.792 (0.635-0.960)	0.946 (0.737-1.16)	1.19 (0.887-1.50)	1.42 (1.02-1.82)
15-min	0.239 (0.206-0.284)	0.307 (0.267-0.368)	0.420 (0.361-0.500)	0.521 (0.445-0.623)	0.678 (0.565-0.813)	0.818 (0.669-0.985)	0.982 (0.787-1.19)	1.17 (0.913-1.44)	1.48 (1.10-1.85)	1.76 (1.26-2.25)
30-min	0.321 (0.277-0.383)	0.413 (0.359-0.495)	0.566 (0.486-0.674)	0.701 (0.599-0.839)	0.912 (0.761-1.09)	1.10 (0.901-1.33)	1.32 (1.06-1.60)	1.58 (1.23-1.94)	1.99 (1.48-2.50)	2.36 (1.70-3.04)
60-min	0.398 (0.343-0.473)	0.511 (0.444-0.612)	0.700 (0.601-0.834)	0.868 (0.742-1.04)	1.13 (0.942-1.35)	1.36 (1.12-1.64)	1.64 (1.31-1.98)	1.95 (1.52-2.40)	2.46 (1.83-3.09)	2.93 (2.10-3.76)
2-hr	0.476 (0.415-0.557)	0.600 (0.523-0.704)	0.799 (0.693-0.938)	0.979 (0.842-1.15)	1.27 (1.07-1.49)	1.54 (1.26-1.81)	1.85 (1.48-2.19)	2.21 (1.72-2.65)	2.80 (2.07-3.43)	3.35 (2.38-4.18)
3-hr	0.537 (0.474-0.621)	0.674 (0.593-0.781)	0.870 (0.764-1.01)	1.05 (0.915-1.22)	1.34 (1.14-1.55)	1.59 (1.33-1.85)	1.90 (1.56-2.23)	2.27 (1.81-2.69)	2.87 (2.20-3.47)	3.43 (2.53-4.22)
6-hr	0.683 (0.607-0.776)	0.847 (0.756-0.965)	1.06 (0.941-1.20)	1.24 (1.10-1.41)	1.51 (1.31-1.72)	1.74 (1.49-1.99)	2.02 (1.71-2.34)	2.37 (1.97-2.77)	2.96 (2.39-3.52)	3.51 (2.76-4.24)
12-hr	0.853 (0.770-0.954)	1.06 (0.953-1.18)	1.30 (1.16-1.45)	1.50 (1.34-1.68)	1.79 (1.58-2.02)	2.03 (1.77-2.29)	2.28 (1.97-2.59)	2.58 (2.19-2.96)	3.15 (2.63-3.67)	3.70 (3.03-4.36)
24-hr	1.15 (1.06-1.25)	1.43 (1.32-1.55)	1.73 (1.61-1.89)	1.99 (1.83-2.16)	2.32 (2.12-2.53)	2.57 (2.35-2.81)	2.83 (2.56-3.10)	3.09 (2.77-3.39)	3.43 (3.03-3.78)	3.72 (3.23-4.40)

APPENDIX B

DESIGN DRAWINGS



SUNNYSIDE COGENERATION ASSOC.

SCA #2 ASH LANDFILL CONSTRUCTION DRAWINGS

PROPOSED DRAINAGE PLAN

Carbon County, Utah

TWIN PEAKS
Engineering & Land Surveying
2264 NORTH 1450 EAST LEHI, UTAH 84043
(801) 450-3511, (801) 439-0700 FAX

AUGUST 2013

17 March 2014

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