DRAINAGE CALCULATIONS & NOTES

1.0 RAINFALL

The average annual rainfall in the site area is 14.81 inches according to the U.S. Climate Normals data from the National Oceanic and Atmospheric Administration (N.O.A.A.). The rainfall intensity and depth data was obtained from the NOAA Atlas 14, Volume 1, Version 5. All drainage calculations were completed using the SCS Unit Hydrograph Method as outlined in the NMDOT Drainage Design Manual 2018 with the 100-year, 24-hour frequency storm event used for the design storm. The design storm rainfall depth is 3.23 inches. To utilize the intensity as a principal factor of peak flows on a small watershed, the Natural Resources Conservation Service (NRCS) has related the percent of daily rainfall with an intensity position at 25% (6th hour for the 24-hour storm) of the design storm. The 25% intensity transformation is used for this analysis.

2.0 HYDROLOGIC SOIL CLASSIFICATION

The hydrologic soil classification was determined from soil survey information available from the Natural Resources Conservation Services (NCRS) Web Soil Survey accessed on April 10th, 2023. Data from the Soil Survey of Santa Fe County Area, New Mexico and the Soil Survey of Sandoval County Area, New Mexico published by the NCRS was used for this drainage study. The hydrologic soil group (HSG) breakdown within each individual basin is as follows:

Hydrologic Soil Group Summary

Basin	% HSG "A"	% HSG "B"	% HSG "C"	% HSG "D"
B1	0%	0%	100%	0%
B2	0%	0%	100%	0%
B3	0%	0%	96.7%	3.3%
B4	0%	23.1%	32.3%	44.6%
B5	0%	4.9%	11.4%	83.7%
B6	0%	2.7%	34.7%	62.6%
B7	0%	2.0%	56.2%	41.8%
B8	0%	0.8%	97.7%	1.5%
B9	0%	0%	100%	0%
B10	0%	0%	100%	0%
B11	0%	0%	100%	0%
B12	0%	0%	100%	0%
OS-1	0%	0%	100%	0%
OS-2	0%	0.4%	99.6%	0%
OS-3	0%	1.0%	99.0%	0%
OS-4	0%	0%	100%	0%
OS-5	0%	1.3%	98.7%	0%
OS-6	0%	0%	100%	0%
OS-7	0%	0%	100%	0%

3.0 LAND USE

The land use within each basin has been determined based on aerial imagery provided by Google Earth and imagery from Google Street View. The following table provides a summary of the land use in the site for the pre-development condition.

Pre-Development Basin Land Uses

Basin	Mountain Brush (Poor)	Desert Shrub (Good)	Desert Shrub (Fair)	Total Area (ac.)
B1	100%	0%	0%	173.5
B2	46%	54%	0%	205.8
B3	54%	64%	0%	147.7
B4	67%	33%	0%	261.3
B5	89%	11%	0%	109.0
B6	76%	24%	0%	107.6
B7	0%	67%	33%	47.5
B8	0%	5%	95%	403.5
B9	0%	0%	100%	431.0
B10	0%	0%	100%	260.6
B11	0%	0%	100%	115.8
B12	0%	0%	100%	310.0
OS-1	0%	0%	100%	233.3
OS-2	0%	0%	100%	299.4
OS-3	0%	0%	100%	425.3
OS-4	0%	0%	100%	154.9
OS-5	0%	0%	100%	231.4
OS-6	0%	0%	100%	111.3
OS-7	0%	0%	100%	121.2

4.0 RUNOFF CURVE NUMBERS

From the hydrologic soil groups and land uses listed above, Runoff Curve Numbers have been selected from Table 2-2 of Technical Release 55, "Urban Hydrology for Small Watersheds". The following is a summary of the Runoff Curve Numbers (CN) used in this study:

Curve Numbers - Soil Type Summary

Land Use	CN for HSG B	CN for HSG C	CN for HSG D
Impervious	98	98	98
Gravel Road	85	89	91
Mountain Brush (Poor)	66	74	79
Desert Shrub (Good)	68	79	84
Desert Shrub (Fair)	72	81	86

The percentage of each land use and HSG within a basin is used to calculate a Weighted Curve Number for each basin. The weighted CN will be used in section 5.0 to determine the peak runoff volume and discharge produced by each basin. The weighted curve numbers for each basin are summarized in the following table:

Pre-Development Weighted Curve Numbers

Basin	Weighted CN
B1	74
B2	77
B3	77
B4	76
B5	78
B6	78
B7	82
B8	81
B9	81
B10	81
B11	81
B12	81
OS-1	81
OS-2	81
OS-3	81
OS-4	81
OS-5	81
OS-6	81
OS-7	81

5.0 HYDROLOGY

In accordance with the NMDOT Drainage Design Manual 2018, the SCS Unit Hydrograph Method was used to determine the peak volume and discharge produced by the site. Hydrologic calculations were computed using the U.S. Army Corps of Engineers' HEC-HMS Software Version 4.10. Input data for the hydrologic calculations were determined from the following:

- The 100-year, 24-hour precipitation data was obtained from the NOAA Atlas 14-point Precipitation Frequency Data Server, Volume 1, Version 5.
- Time of concentration (Tc) values were calculated in accordance with Chapter 4 of the NMDOT Drainage Design Manual. The Kirpich Method was used for the calculations.The SCS Method uses the lag time (Tlag) for hydrologic calculations. Lag time is established as the delay difference between the centroid of the excess rainfall and the maximum peak runoff of the watershed hydrograph. The lag time is estimated as 60% of Tc. Tlag was calculated for the site for use in the analysis.

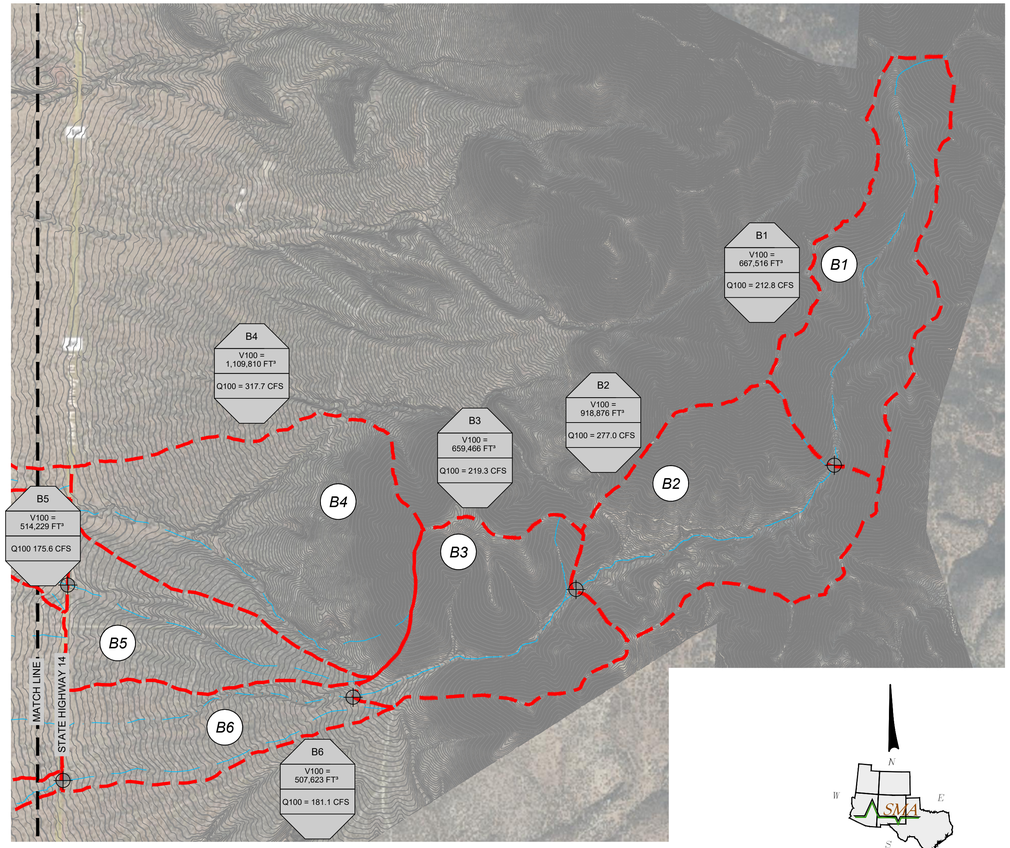
A summary of the 100-Year, 24-Hour storm water calculations are as follows.

100-Year, 24-Hour Stormwater Calculations

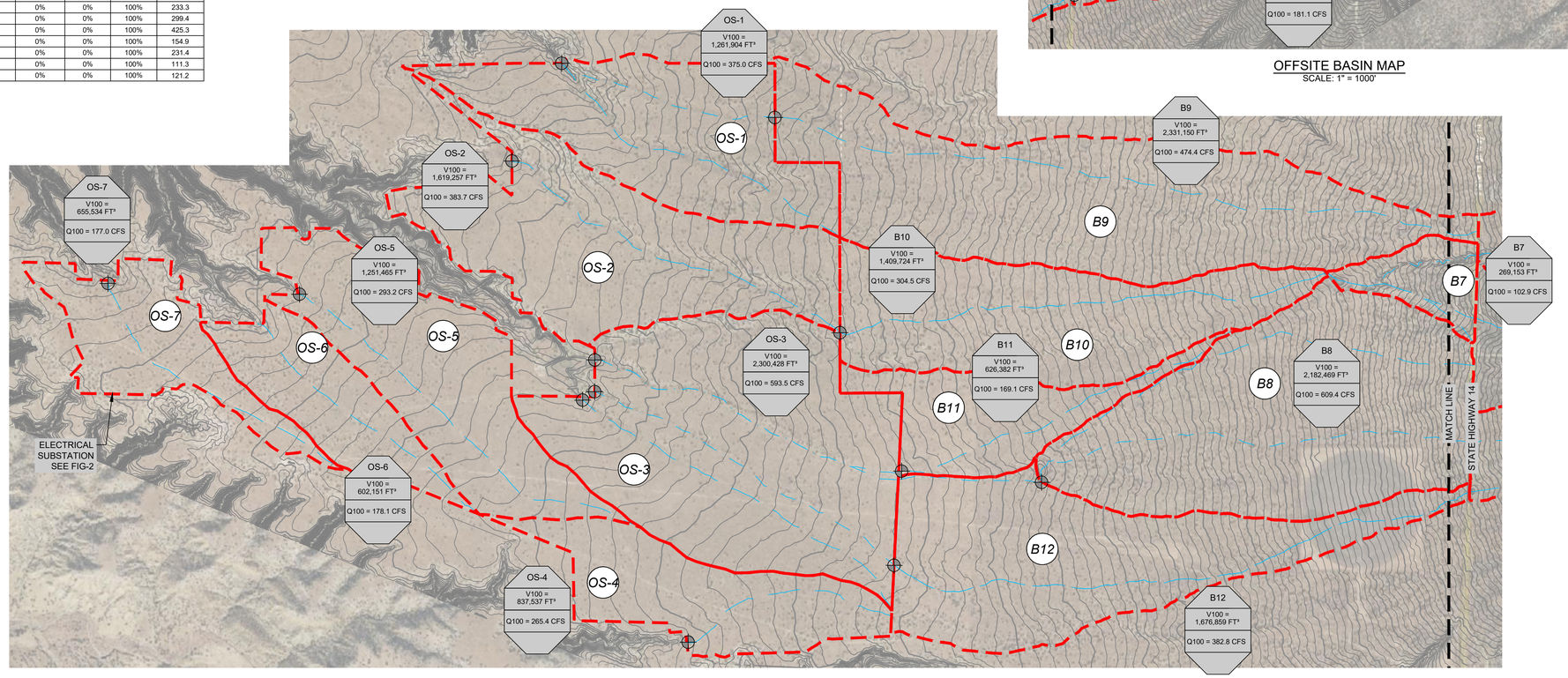
Basin	Area (ac.)	Tlag (min.)	Longest Flowpath Length (ft)	Weighted CN	Runoff Volume (ft^3)	Peak Discharge (cfs)
B1	173.5	10.6	6,812	74	667,516	212.8
B2	205.8	12.9	5,964	77	918,876	277.0
B3	147.7	10.9	4,709	77	659,466	219.3
B4	261.3	14.2	5,725	76	1,109,810	317.7
B5	109.0	10.6	4,644	78	514,229	175.6
B6	107.6	9.5	4,936	78	507,623	181.1
B7	47.5	14.1	2,699	82	269,153	102.9
B8	403.5	27.6	7,939	81	2,182,465	609.4
B9	431.0	28.3	11,500	81	2,331,150	474.4
B10	260.6	21.2	8,208	81	1,409,724	304.5
B11	115.8	17.3	6,052	81	626,382	169.1
B12	310.0	23.6	9,717	81	1,676,859	382.8
OS-1	233.3	15.1	5,462	81	1,261,904	375.0
OS-2	299.4	21.8	6,108	81	1,619,257	383.7
OS-3	425.3	19.3	6,185	81	2,300,428	593.5
OS-4	154.9	12.7	3,655	81	837,537	265.4
OS-5	231.4	22.4	6,829	81	1,251,465	293.2
OS-6	111.3	15.3	4,717	81	602,151	178.1
OS-7	121.2	17.3	5,040	81	655,534	177.0

6.0 FEMA DESIGNATED FLOODPLAINS

According to the Federal Emergency Management Agency (FEMA), the project area is located within flood Zone Designation D. Zone D indicates an area where the flood hazard is possible, but is currently undetermined or unstudied. The corresponding FIS map numbers for the area are Map #35043C1975D and Map # 35043C2000D, both effective March 18th, 2008.



OFFSITE BASIN MAP
SCALE: 1" = 1000'



ONSITE BASIN MAP
SCALE: 1" = 1000'

SCALE: 1" = 1000'

GENERAL LEGEND

BASIN HYDROLOGIC DATA	OS-1 / 100-YR VOLUME (FT^3) / 100-YR DISCHARGE (CFS)
BASIN IDENTIFICATION	B1
SUBBASIN BOUNDARY	
REACH FLOWPATH	
HYDRAULIC FLOW PATH	
MAJOR CONTOUR (25' INTERVAL)	
MINOR CONTOUR (5' INTERVAL)	
ANALYSIS POINT	

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DIAMOND TAIL SOLAR PROJECT
SANDOVAL COUNTY, NM
PRE-DEVELOPMENT DRAINAGE SHEET

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RTV	RTV	DWMJR

Date: June 2023
Scale: Horiz: 1" = 1000' Vert: N/A
Project No: 9232296
Sheet: FIG - 1

To Request a Line Locate Dial 811

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DRAINAGE CALCULATIONS & NOTES

1.0 POST-DEVELOPMENT HYDROLOGIC CONDITIONS

In the post-development condition, the land use within basins OS-1 through OS-7 will change to include solar panels, gravel access roads, and an electrical substation. For the purpose of this analysis, it is assumed that the ground cover of the substation will primarily consist of gravel with impervious concrete footings located under the individual components. It is also assumed that existing dirt roads within the site area will not be modified in a way that increases runoff. The area comprised of the solar array will be mowed leaving the root structure and stems intact 4" above ground. Trees will be removed leaving stumps in place. Solar panels will be situated above the ground surface on masts not affecting the hydrologic response. The gravel roads and the electrical substation will affect the runoff flowrate, so excess runoff must be detained to reduce the total discharge from the site to the historical rate.

2.0 REQUIRED DETENTION VOLUME FOR ACCESS ROADS

Due to the relatively small area modified by the access roads, the pre-development and post-development curve numbers of the onsite basins were calculated to be the same. This means no difference in flowrate could be calculated. The required detention volume was instead determined by modeling the proposed access roads as separate basins within HEC-HMS. The total runoff produced by each road section was used as the required detention volume for the corresponding basins. This volume was then divided by the total length of access roads within each basin to determine the required storage volume per linear foot of road. The results of these calculations can be found in the following table.

ACCESS ROAD STORAGE REQUIREMENTS			
Basin	Required Storage Volume (CU. FT)	Road Length in Basin (ft)	Storage Volume Required per Linear Foot of Road (CU. FT)
OS-1	20,259	9,601	2.11
OS-2	39,329	18,693	2.11
OS-3	41,438	19,639	2.11
OS-4	17,769	8,421	2.11
OS-5	23,329	11,056	2.11
OS-6	6,247	2,960	2.11
OS-7	12,858	6,094	2.11

Swales with check dams will be placed parallel to the proposed access roads to detain the required runoff volume. The swales will be trapezoidal with a depth of 1.25 feet, 3:1 side slopes, and a bottom width of 3 feet. The storage capacity of these swales will vary depending on the running slope and the spacing of check dams. Based on the current topography of the site, the locations of the proposed access roads have slopes ranging from 0.1% to 2%. The following table summarizes the maximum allowable check dam spacing for roadside swales of various slopes and includes the storage capacity of each.

SWALE CHECK DAM SPACING			
Running Slope of Roadside Swale (%)	Storage Volume Required per Linear Foot of Swale (CU. FT)	Storage Volume per Linear Foot Provided by Swale (CU. FT)	Maximum Required Dam Spacing (ft)
2.0%	2.11	2.13	56
1.9%	2.11	2.14	59
1.8%	2.11	2.14	62
1.7%	2.11	2.15	65
1.6%	2.11	2.15	69
1.5%	2.11	2.16	73
1.4%	2.11	2.16	77
1.3%	2.11	2.17	83
1.2%	2.11	2.17	89
1.1%	2.11	2.18	97
1.0%	2.11	2.19	106
0.9%	2.11	2.19	117
0.8%	2.11	2.20	131
0.7%	2.11	2.21	149
0.6%	2.11	2.21	173
0.5%	2.11	2.22	206
0.4%	2.11	2.22	256
0.3%	2.11	2.23	339
0.2%	2.11	2.24	506
0.1%	2.11	2.24	1,006

3.0 HYDROLOGY FOR ELECTRICAL SUBSTATION

Aside from the gravel access roads, the electrical substation located toward the southwestern corner of the site is the only area that will have a significantly different land use from the pre-development condition. To determine the required storage volume for this section of the site, it has been modeled in HEC-HMS as a separate subbasin. According to the NCRS Web Soil Survey, this area only has soils classified as hydrologic soil group C. The pre-development land cover in the area consists of desert shrub in a fair hydrologic condition. For the purposes of this analysis, it is assumed that the fenced in area of the substation will primarily contain gravel with concrete footings located under individual components. Using these land uses and the identified HSG, the Weighted Curve Numbers for the pre- and post-development basin have been calculated.

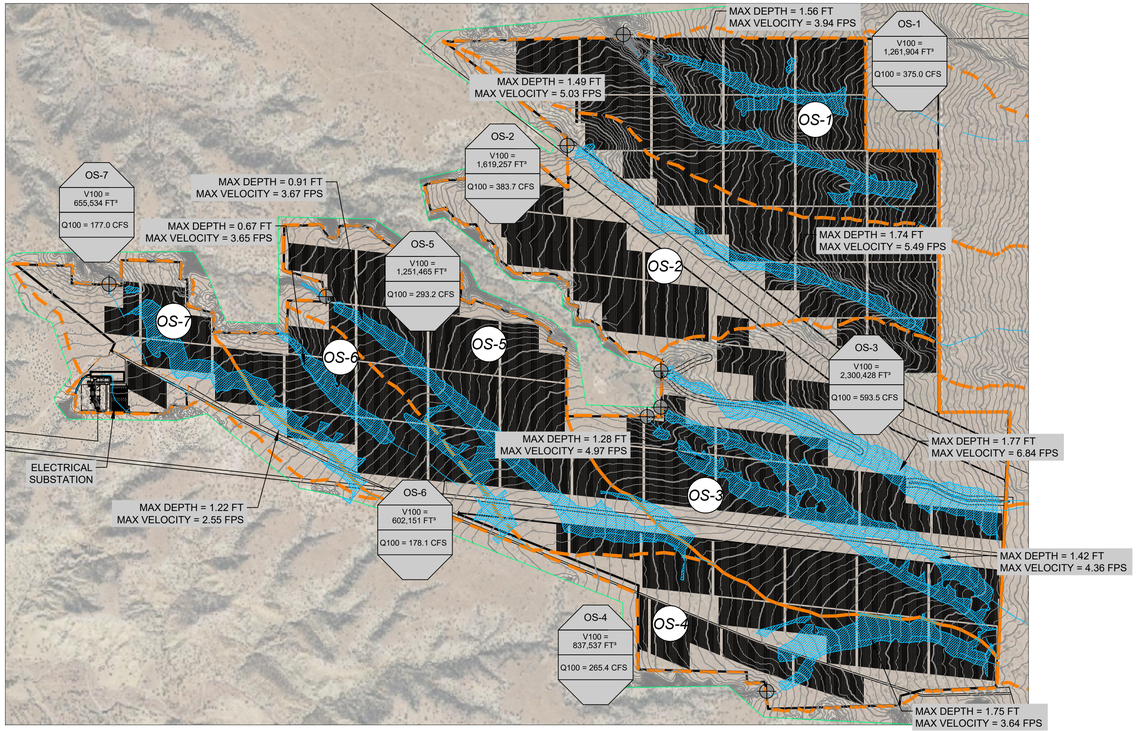
SUBSTATION CURVE NUMBER CALCULATIONS					
Condition	Total Area (ac.)	Natural Cover Area (ac.)	Impervious Area (ac.)	Gravel Area (ac.)	Weighted CN
Pre-Development	23.04	23.04	0.00	0.00	81
Post-Development	23.04	16.39	1.42	5.23	84

Using these curve numbers, HEC-HMS was used to determine the runoff volume and peak discharge rate within the substation basin for both the pre-development and post-development condition during the 100-year, 24-hour storm event.

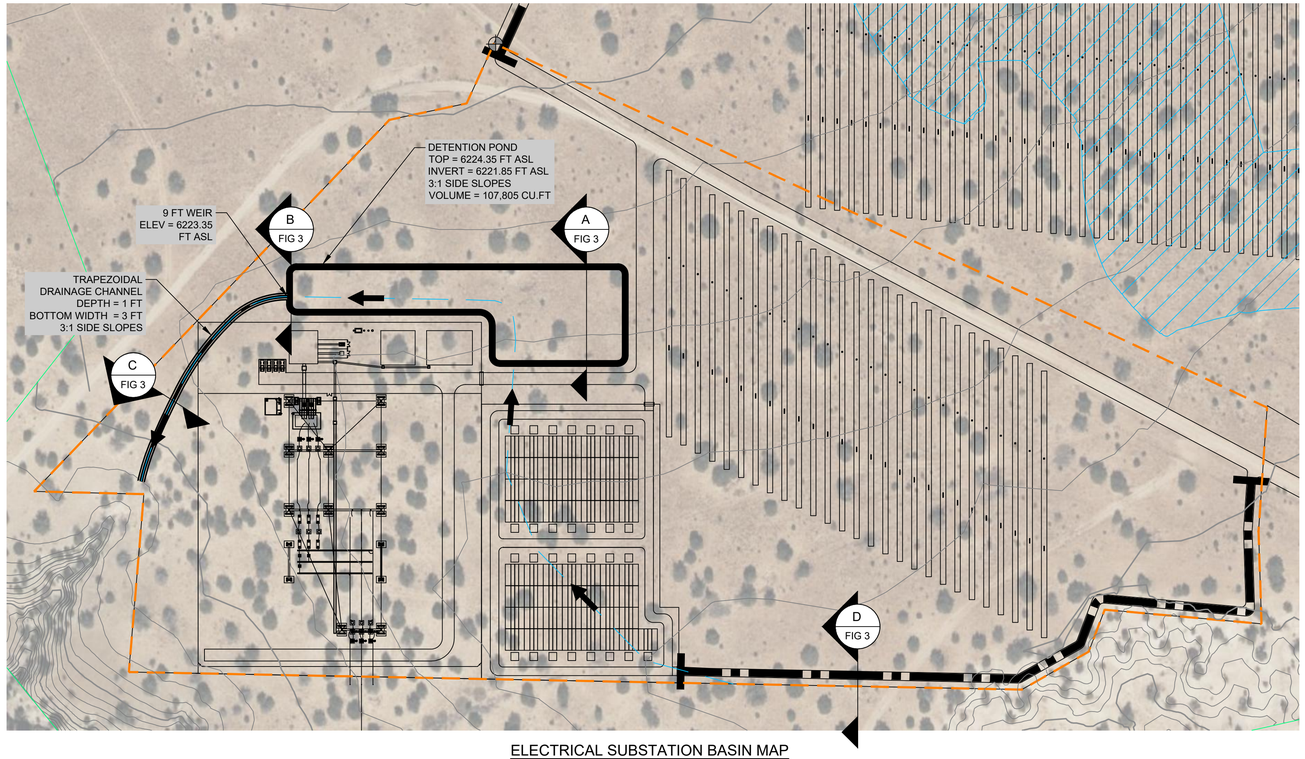
100-Year Event Substation Basin Stormwater Calculations						
Basin	Area (ac.)	Tlag (min.)	Longest Flowpath Length (ft)	Weighted CN	Runoff Volume (ft^3)	Peak Discharge (cfs)
Pre-Development	23.04	19.6	1,063	81	124,616	31.9
Post-Development	23.04	13.8	1,063	84	143,016	44.9

4.0 HYDRAULICS FOR ELECTRICAL SUBSTATION

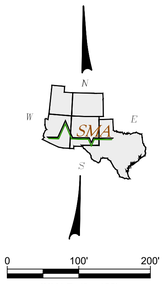
Using the stormwater calculations outlined above, the required storage volume for the proposed electrical substation was calculated to be 42,529 cubic feet. A detention pond was designed to detain the excess stormwater runoff produced by the post-development condition of the substation basin. The pond was designed using Autodesk's Hydraflow Hydrographs Extension for Civil3D version 2021. The pond is trapezoidal with 3:1 side slopes, a depth of 2.5 feet, and a total area of 47,571 square feet. The pond will have a 9 foot long weir placed 1.5 feet above the pond invert. During the 100-year storm event, the pond will detain approximately 80,813 cubic feet of stormwater and the weir will discharge at a rate of 8.13 cfs. The pond weir will connect to a trapezoidal drainage channel which will convey runoff south to the historical discharge point.



POST-DEVELOPMENT BASIN MAP
SCALE: 1" = 1000'



ELECTRICAL SUBSTATION BASIN MAP
SCALE: 1" = 100'



SCALE: 1" = 100'

GENERAL LEGEND

- BASIN HYDROLOGIC DATA (OS-1 / 100-YR VOLUME (FT^3) / 100-YR DISCHARGE (CFS))
- BASIN IDENTIFICATION (OS-1)
- APPROXIMATE 100-YR FLOOD EXTENTS
- SUBBASIN BOUNDARY
- HYDRAULIC FLOW PATH
- PROPOSED ROADSIDE SWALE
- MAJOR CONTOUR (10' INTERVAL)
- MINOR CONTOUR (2' INTERVAL)
- ANALYSIS POINT
- DIRECTION OF FLOW

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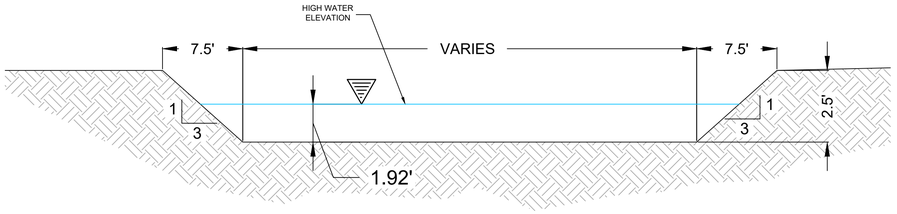
Project No: 9232296
Sheet: FIG - 2



A FIG 3 DETENTION POND
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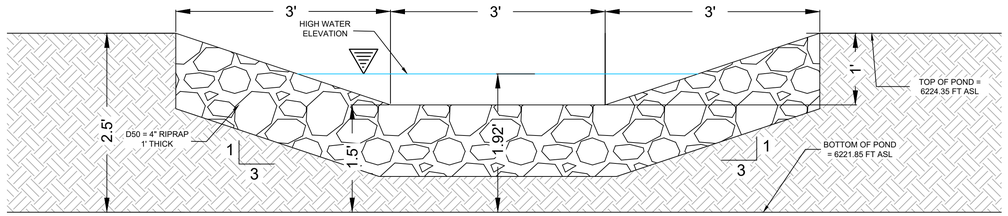
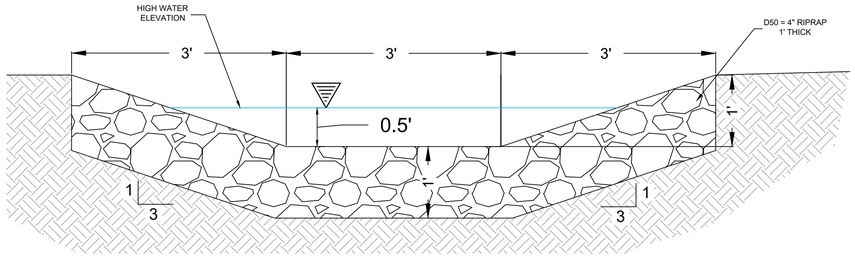


B FIG 3 WEIR
SCALE: N.T.S.



C FIG 3 TRAPEZOIDAL DRAINAGE CHANNEL
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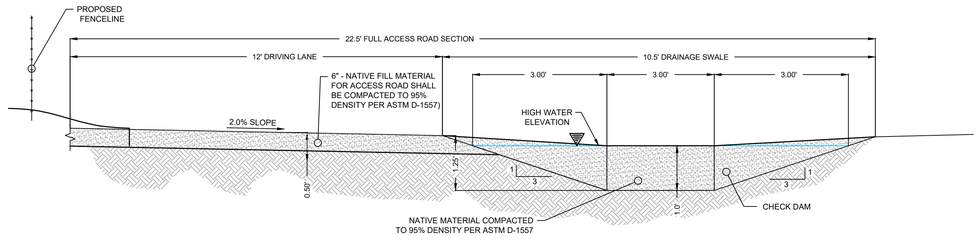
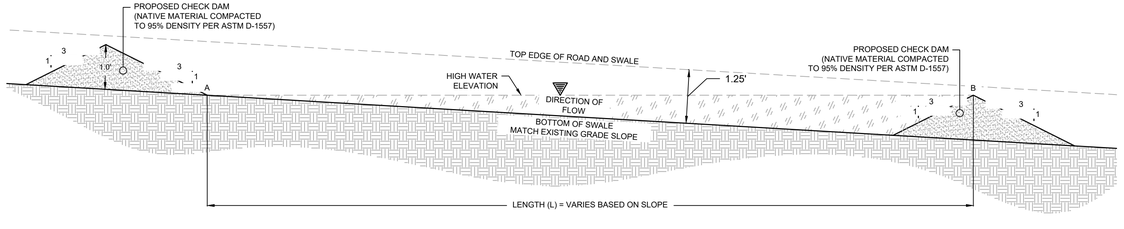


D FIG 3 ACCESS ROAD
SCALE: N.T.S.

NOTE:
1. ROADSIDE SWALE SHALL BE CLEANED OF ACCUMULATED SEDIMENT WHEN THE DEPOSITS REACH APPROXIMATELY ONE-HALF THE HEIGHT OF THE CHECK DAM.



LONGITUDINAL SWALE DETAIL
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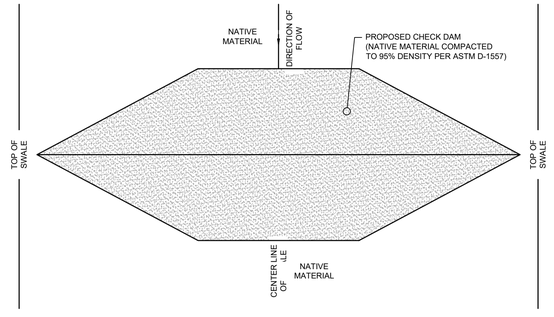

SWALE AND CHECK DAM PLAN VIEW
SCALE: N.T.S.

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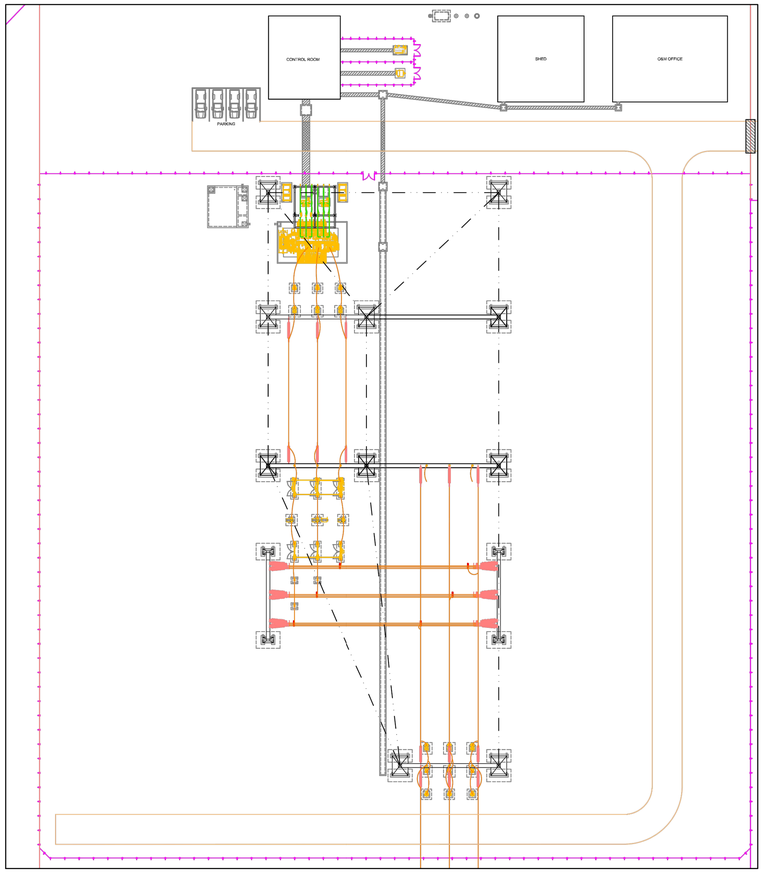
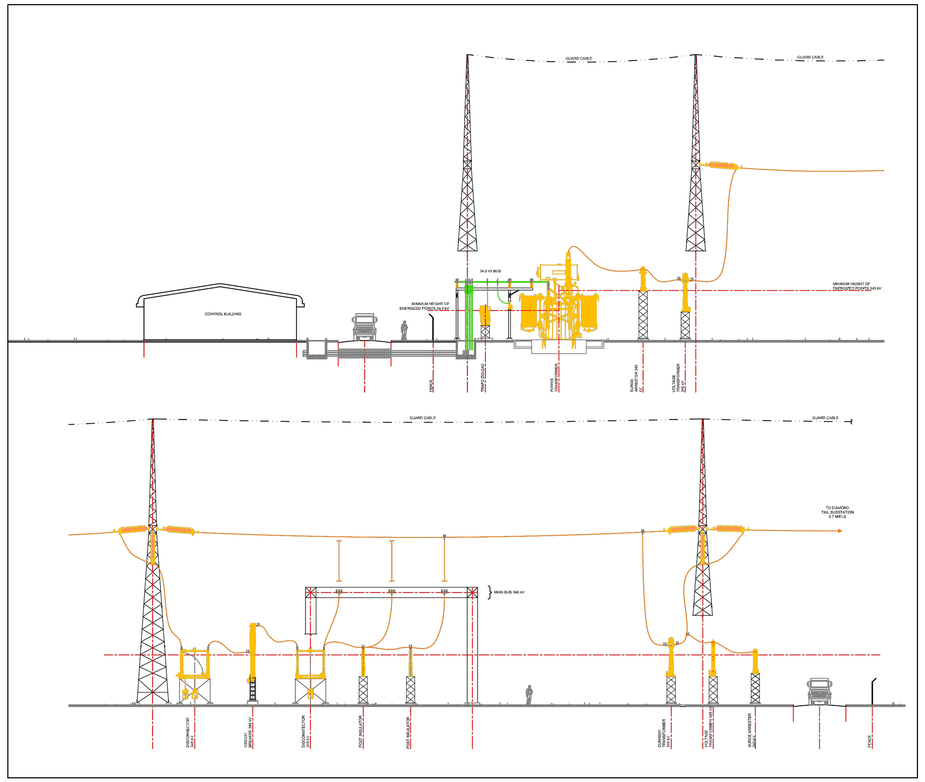


SUBSTATION PLAN
SCALE: N.T.S.



SUBSTATION DETAIL
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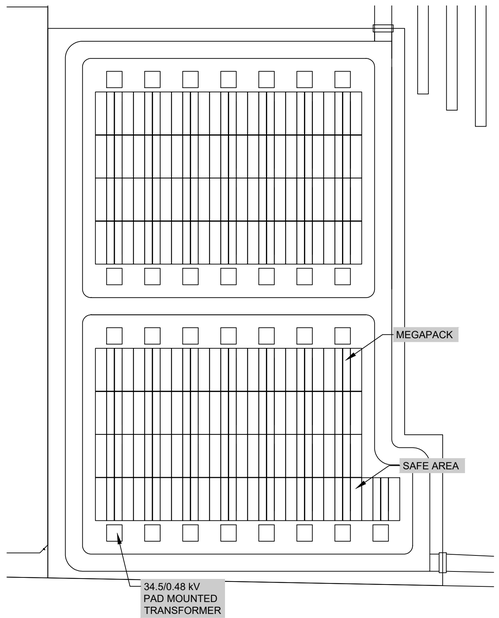

MEGAPACK DETAIL
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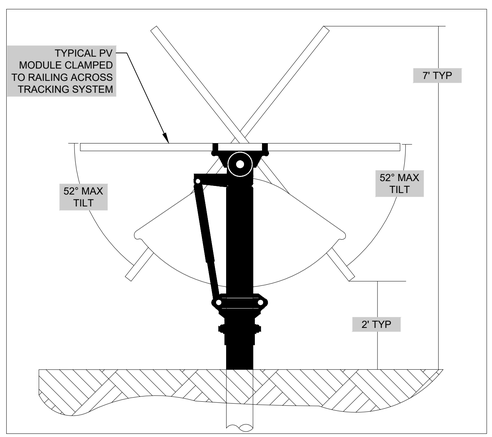

SOLAR ARRAY MOUNT DETAIL
SCALE: N.T.S.

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