APPENDIX I-1
PRELIMINARY HYDROLOGY STUDY & FLOOD ANALYSIS

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PRELIMINARY

Hydrology Study & Flood Analysis

Daggett Solar Power Facility

Unincorporated Community of Daggett, San Bernardino County, CA

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A. Introduction

1.1 Purpose & Scope

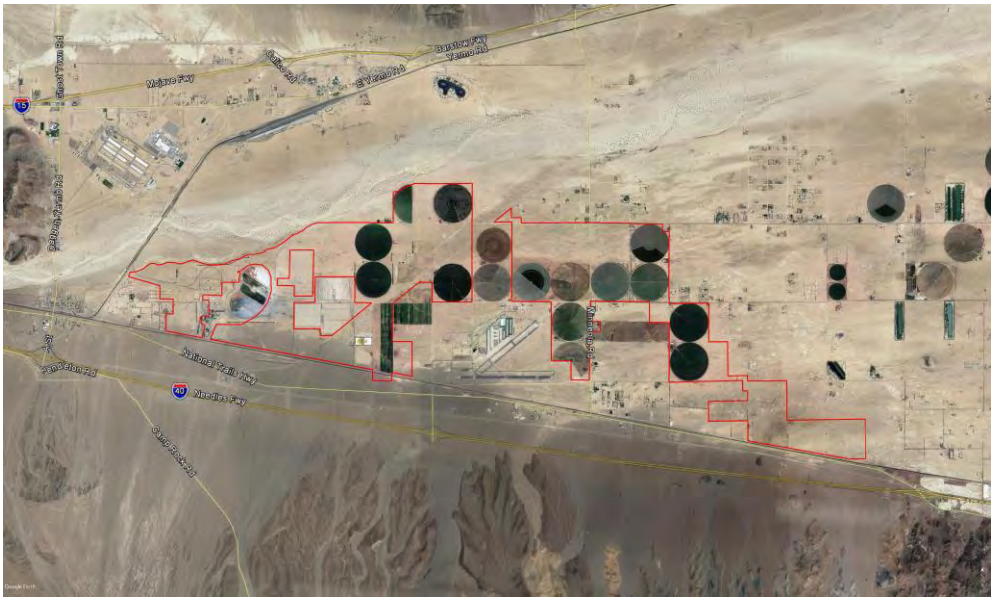
The following Preliminary Hydrology Study & Flood Analysis has been prepared by Joseph E. Bonadiman & Associates, Inc. for determination of hydrologic and flood impacts to a proposed 5,531-acre photovoltaic (PV) solar facility located in the unincorporated community of Daggett in San Bernardino County, CA.

The scope of this study is as follows:

- Identification of tributary (offsite) drainage areas impacting the project site, and calculation of peak flow rates and runoff volume for these areas.
- Identification of existing (pre-project) conditions on-site drainage areas, and calculation of peak flow rates and runoff volumes for these areas.
- Identification of developed (post-project) conditions on-site drainage areas, and calculation of peak flow rates and runoff volumes for these areas.
- Analysis of 100-year flood impacts to the project site.
- Summary of findings & conclusion.

1.2 Project Location & Watershed Description

The proposed project entails the construction of an approximately 5,531-acre photovoltaic solar facility in the unincorporated community of Daggett in San Bernardino County, CA. The project site is located approximately six miles east of the City of Barstow and 1.5 miles northwest of the unincorporated community of Newberry Springs. The project site is located approximately 0.75 miles north of the I-40 freeway, 0.1 to 0.5 miles north of National Trails Highway, and one mile east of Daggett-Yermo Road. The project site is bounded by the Union Pacific railroad to the west, Santa Fe Street and the Atchison, Topeka, and Santa Fe (A.T.S.F.) railroad to the south, and the Mojave River wash to the north.



The project site is effectively divided into a 2,899-acre eastern site and a 2,632 western site. The eastern site is bounded by rural residential properties to the southwest and the Mojave River wash to the north. An existing railroad spur and associated facilities are located within the northwestern portion of the eastern site; a large borrow pit is located within the existing railroad spur. Existing agricultural fields and facilities are located within the eastern portion of the eastern site. The decommissioned Coolwater Generating Station, a gas-fired electric generating station, and associated lined evaporation ponds are located within the eastern site but are considered "not a part" of the project. Existing Southern California Edison substations and training facilities located adjacent to the Coolwater Generating Station are within and considered part of the eastern project site. The majority of the decommissioned and demolished "Solar Two" (formerly "Solar One") concentrating PV solar generating station is located within the eastern site but is considered "not a part" of the project. The decommissioned and partially-demolished S.E.G.S. I & II PV solar generating stations are located within the eastern site but are considered "not a part" of the project.

Photo: Looking North at Coolwater Generating Station from Santa Fe Street

Photo: Looking North at S.E.G.S. I & II Solar Generating Stations from Santa Fe Road

The eastern and western sites are separated by existing agricultural fields and facilities located south of the Mojave River wash. North of the A.T.S.F. railroad and Santa Fe Street, the eastern and western sites are separated by the Barstow-Daggett Airport. The western site is comprised primarily of existing agricultural fields and facilities and undeveloped land. Existing rural residential properties are located to the north, south, and east of the western site.

Photo: Looking North at Agricultural Fields from Santa Fe Road

Refer to Exhibit "A" for an aerial orthophoto of the project site showing the existing facilities discussed in this section.

The study watershed is approximately 77.65 sq. mi. total. For the purposes of this study, the portion of the watershed south (upstream) of the A.T.S.F. railroad and associated culverts is herein referred to as "off-site", and the portion of the watershed north (downstream) of the A.T.S.F. railroad and associated culverts, which includes the 5,531-acre project site, is herein referred to as "on-site". Refer to Exhibit "B" for a U.S.G.S. quadrangle overlay of the study watershed.

1.3 References

The following documents have been made part of this study by reference:

1.) San Bernardino County Hydrology Manual, San Bernardino County Department of Public Works (August 1986).

2.) East Daggett Diversion to A.T. & S.F. Bridge (Hydraulic Calculations), San Bernardino County Flood Control District (August 18, 1967).

3.) Precipitation Atlas 14, Volume 1 Version 4.0, NOAA (2006).

4.) Soil Survey CA 698 - Mojave Desert Area, West Central Part, California, v. 9, NRCS (September 28, 2016).

5.) Soil Survey CA 671(San Bernardino County, California, Mojave River Area, v. 8), NRCS, (September 12, 2016).

6.) Flood Plain Information - Mojave River (Vicinity of Barstow), United States Army Corps of Engineers (October 1968).

7.) Flood Insurance Study (FIS) - San Bernardino County, CA & Incorporated Areas, FEMA (Revised September 2, 2016).

8.) FLO-2D Users' Manual Version 2004.10, FLO-2D (October 2004).

B. Methodology & Sources of Data

1.1 Methodology - Hydrology Calculations

The requirements and recommendations found in the San Bernardino County Hydrology Manual (August 1986) provided by the San Bernardino County Department of Public Works was used as the basis for the methodology and calculations found in this study.

Off-site flows for areas tributary to the A.T.S.F. railroad culverts and to the east Daggett interceptor channel were calculated independently of the overall watershed using the unit hydrograph method for inclusion in the FLO-2D flood model for the project site.

Existing and developed conditions hydrology calculations for the study watershed were performed using the rational hydrology method for areas less than 640 acres (1 sq. mi.) in size to establish the time of concentration (TC) for these areas, which was subsequently used to calculate lag time for the unit hydrograph calculations for these areas. For drainage areas 640 acres or greater in size, unit hydrograph calculations were performed with lag times calculated using Snyder's lag (Army Corps of Engineers method).

For the tributary (off-site) drainage areas, the USGS quadrangle topographic data indicated braiding of primary watercourses (split flow of streams). As such, it was necessary to perform hydrograph routing for these areas to split, route (using the SCS convex method), and add hydrograph flows for these areas.

The 100-year, 1-hour storm event was used for all rational hydrology method calculations. The 100-year, 24-hour storm event was used for all unit hydrograph and hydrograph routing calculations. Note that for comparison of existing and developed conditions peak flows and runoff volumes, the 100-year, 24-hour unit hydrograph calculations were used.

The San Bernardino County Rational Method (RSBC) and San Bernardino County Unit Hydrograph Method (UNSBC) software applications provided by CivilDesign® Corporation were used for the rational method and unit hydrograph method calculations included in this report. The Hydrograph Routing & Basin Analysis (ROUTE) software application provided by CivilDesign® Corporation was used for the hydrograph routing calculations included in this report.

1.2 Methodology - Mojave River Wash Hydraulic Analysis (HEC-RAS)

One-dimensional hydraulic modeling for the Mojave River wash adjacent to the project site was performed using HEC-RAS. Channel reach lengths and cross sections were based on alignment, sample line, and TIN surface data generated in AutoCAD Civil 3D and exported to HEC-RAS.

1.3 Methodology - Flood Hazard Analysis (FLO-2D)

Two-dimensional flood modeling for the on-site study watershed north (downstream) of the A.T.S.F. railroad culverts was performed using FLO-2D, per the recommendations found in the FLO-2D User's Manual (v. 2004.10, October 2004). Offsite flood impacts were modeled using hydrographs for the 12 culvert discharge locations, the east Daggett channel discharge location, and the Mojave River wash. On-site precipitation was modeled using the San Bernardino County Hydrology Manual rainfall distribution graph. On-site losses were modeled using the SCS method.

1.4 Geographic Information Systems (G.I.S.) Data

Due to the size of the study watershed, available Geographic Information System (GIS) data was utilized, as follows:

- Major watershed and major watercourse shapefile data obtained from the California Spatial Information Library (CASIL) were used for identification of major watershed(s) applicable to the project site, and to identify the major receiving waters for project site discharge.
- A Digital Elevation Model (DEM) of the National Elevation Dataset (NED) provided by USGS was used to generate the 20' topographic contours used for the tributary off-site drainage areas shown in this study. Digital Raster Graphics (DRGs) of USGS Quadrangles provide by CASIL were also used to verify elevations, blue line streams, and other topographical features.
- Property line and street centerline shapefile data obtained from the County of San Bernardino was used for base mapping and exhibits preparation.
- San Bernardino County 2013 General Plan shapefile data obtained from the County of San Bernardino was used for determination of existing watershed land use/zoning classifications.
- Satellite imagery obtained from Google Earth (August 2014) and orthorectified aerial imagery provided by DMI (October 2016) was used for verification of watershed features, including location of drainage facilities, location of impervious surfaces/structures, and pervious cover.
- NOAA Atlas 14 precipitation ASCII grid data was used for area-averaged precipitation values.
- Soils shapefile data provided by the Natural Resources Conservation Service (NRCS) Web Soils Survey (WSS) was used to identify the hydrologic soils groups.

1.5 Field Investigations & Site Photos

Field investigations were conducted by Joseph E. Bonadiman & Associates, Inc. on August 2, 2016 and August 8, 2017 to verify the drainage characteristics of the site and study watershed. The photos included in this study were taken during these investigations to substantiate the findings included in this study.

1.6 Sources of Topography

For tributary (off-site) areas, 20' topographic contours generated from USGS elevation data in addition to applicable USGS quadrangles were used for all elevation values. For existing conditions on-site areas, topographic contours generated from an aerial survey provided by DMI (October 2016) were used. For the developed conditions project site, and for the purposes of this preliminary study, it has been assumed that the general topography would remain substantially unchanged from existing conditions. Grading will be limited to general smoothing of the existing topography.

1.7 Watershed Losses

Area-averaged SCS Curve Numbers for all drainage areas and subareas were determined as follows:

1.) **Hydrologic Soil Groups** – Hydrologic soil groups for the project watershed were identified using data obtained from NRCS Soil Survey 698 (v. 9, September 28, 2016) and Soil Survey 671 (v. 8, September 12, 2016). Refer to Exhibit "D.1" for a copy of the NRCS Web Soil Survey Map with the project/tributary watershed overlay, as well as a copy of supporting materials from Soil Surveys No. CA 698 and CA 671. Data for the southern portion of the study watershed is not available from NRCS; as such, the applicable San Bernardino County Hydrology Manual soils map (see Exhibit "D.2") was used to obtain hydrologic soils groups for this portion of the study watershed. Refer to Exhibit "D.3" for the study watershed soils map with composite data from both sources, which shows groups "A", "C", and "D" to be applicable to the watershed.

2.) **Land Use** – Land use designations for the project watershed, per the 2013 San Bernardino County General Plan, are shown on Exhibit "D.4".

3.) **Pervious Fraction** – Exhibit "D.5" is a copy of San Bernardino County Hydrology Manual Figure C-4, which indicates recommended impervious percentages for common land use types. Exhibit "D.6" shows pervious percentages for the existing conditions study watershed. For areas south of the A.T.S.F. railroad zoned industrial, commercial, or open space, the recommended pervious percentages from the Hydrology Manual were used, regardless of actual conditions, to account for future development. For areas zoned Rural Residential and located outside of the project boundary, the recommended pervious percentage from the Hydrology Manual was used, regardless of actual conditions, to account for future development. For all areas north of the A.T.S.F. railroad, excluding those zoned Rural Residential, actual pervious percentages (based on aerial and satellite imagery analysis) were used, as assigning pervious percentages to these areas based on the land use designations shown on Exhibit "D.4" would result in unrealistic and unlikely conditions, due to the unique development in the area (generating stations, airport, etc.).

For developed conditions, an assumed site-wide pervious percentage of 90% was used for the entire project site area; therefore, the pervious percentages shown for existing conditions on Exhibit "D.6" were adjusted to reflect 90% pervious for the entire project site area, as shown on Exhibit "D.7".

4.) **Pervious Cover** – Exhibit "D.8" shows pervious cover types (based on Figures C-2 and C-3 of the Hydrology Manual - see Exhibit "D.10") for the existing conditions study watershed. Per aerial and satellite imagery analysis of the watershed, it was determined that "open brush, poor cover" was appropriate for all areas, with the exception of areas north of the A.T.S.F. railroad shown to be predominantly agricultural (assigned "agricultural - legumes (alfalfa) - good cover") and barren (assigned "barren"). An insignificant amount of residential/commercial landscaping exists within the study watershed; as such, this cover designation was not used.

Photo: Typical Agricultural Cover

Photo: Typical Open Brush, Poor Cover

For developed conditions, an assumed site-wide pervious cover of "barren" was used for the entire project site area; therefore, the pervious cover types shown for existing conditions on Exhibit "D.8" were adjusted to reflect "barren" cover for the entire project site area, as shown on Exhibit "D.9".

5.) **SCS Curve Numbers** – Existing conditions SCS Curve Numbers (AMC II) were calculated by intersecting the hydrologic soils groups shown on Exhibit "D.3" with the existing conditions pervious cover types shown on Exhibit "D.8", and assigning the applicable SCS Curve Numbers derived from Figures C-2 and C-3 of the SBC Hydrology Manual (see Exhibit "D.10"). These values were then area-averaged for all study areas and subareas using the ArcGIS Spatial Analyst software. Refer to Exhibit "D.11" for the existing conditions SCS Curve Numbers for the study watershed.

Developed conditions SCS Curve Numbers (AMC II) were calculated by intersecting the hydrologic soils groups shown on Exhibit "D.3" with the developed conditions pervious cover types shown on Exhibit "D.9", and assigning the applicable SCS Curve Numbers derived from Figures C-2 and C-3 of the SBC Hydrology Manual (see Exhibit "D.10"). These values were then area-averaged for all study areas and subareas using the ArcGIS Spatial Analyst software. Refer to Exhibit "D.12" for the developed conditions SCS Curve Numbers for the study watershed.

Refer to the hydrology calculation input tables found in this study for the specific SCS Curve Numbers for AMC II and AMC III for each drainage area and subarea. Note that AMC III was used for all 100-year calculations.

1.8 Watershed Precipitation

Area-averaged precipitation values for all drainage areas in this report were determined using 100-year, 1-hour, 100-year, 6-hour, and 100-year, 24-hour NOAA precipitation ASCII grid data. The ASCII grid data for these storm events was clipped to each specific drainage area and analyzed to find the average (mean) value for each area using the ArcGIS Spatial Analyst software. Refer to the hydrology calculation input tables found in this study for the specific precipitation values used for each drainage area. Refer to Exhibits "C.1", "C.2", and "C.3" for the study watershed overlays of the 100-year, 1-hour, 100-year, 6-hour, and 100-year, 24-hour precipitation grids, respectively, used in this study.

C. Offsite (Tributary) Hydrology Discussion, Calculations & Summary

1.1 Offsite (Tributary) Drainage Areas Discussion

As discussed in Section "A", the study watershed is approximately 77.65 sq. mi. total. For the purposes of this study, the portion of the watershed south (upstream) of the A.T.S.F. railroad and associated culverts, as well as the portion of watershed tributary to the east Daggett, channel, is herein referred to as "off-site", and the portion of the watershed north (downstream) of the A.T.S.F. railroad and associated culverts, which includes the 5,531-acre project site, is herein referred to as "on-site".

The off-site study watershed discussed in this section is approximately 64 sq. mi. (41,012 acres) total, and includes a.) The drainage areas tributary to railroad culverts and on-site areas (approx.. 58 sq. mi. / 37,229 acres) and b.) the 5.9 sq. mi. (3,783-acre) drainage area tributary to the existing east Daggett interceptor channel. It was necessary to analyze these off-site areas separately from the overall study watershed, to generate hydrographs at each of the 12 A.T.S.F. railroad culvert locations and the east Daggett channel discharge location for the FLO-2D flood model discussed in Section "G" of this study.

Watershed flows tributary to the on-site areas originate approximately 14 miles upstream (to the south) of the A.T.S.F. railroad in relatively steep foothills, and drain via natural braided streams and improved interceptor channels to the I-40 freeway. Drainage is conveyed under the freeway via 31 culverts, and subsequently under and over National Trails Highway via 9 culverts (in addition to other small crossings). Drainage then flows to 12 culverts located along the A.T.S.F. railroad prior to discharging to the on-site areas north of the railroad.

Photo: Looking South at Tributary Watershed Foothills from Camp Rock Road

Photo: Looking East at Earthen Interceptor Channel South of the I-40 Freeway

Photo: Looking North at Culvert along I-40 Freeway towards Project Site

Photo: Looking Northwest at Culvert along National Trails Highway (Typical)

Photo: Looking North at Channelization Downstream of National Trails Highway towards Project Site

Photo: Looking North A.T.S.F. R.R. Culvert No. 1 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 2 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 3 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 4 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 5 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 6 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 7 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 8 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 9 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 10 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 11 from Santa Fe Street

Photo: Looking North A.T.S.F. R.R. Culvert No. 12 from Santa Fe Street

Watershed flows tributary to the east Daggett interceptor channel originate approximately 10 miles upstream (to the south) of the A.T.S.F. railroad in relatively steep foothills, and drain via natural braided streams and improved interceptor channels to the I-40 freeway. Drainage is conveyed under the freeway via 4 culverts, and subsequently under National Trails Highway via 2 culverts. Drainage then flows through

culverts under the railroad and Santa Fe Street to the interceptor channel, which conveys flows in a northeasterly direction along the east side of the Union Pacific railroad before discharging under the existing on-site railroad spur via a series of 20 pipe culverts to the Mojave River wash.

Photo: Looking South at Railroad Culvert to Daggett Interceptor Channel from Santa Fe Street

Photo: Looking North at Daggett Interceptor Channel from Santa Fe Street towards Mojave River Wash

Photo: Looking North from Project Site at Mojave River Wash

Note that hydraulics calculations for the culverts located along the A.T.S.F. railroad discussed above are outside the scope of this study. Based on the hydrology calculations performed for this study, it is reasonably assumed that the majority of these culverts are not of adequate capacity to convey the calculated peak 100-year tributary flows under pressure conditions, and that overtopping of the railroad berms at the culvert locations will occur. For the purposes of this study, these flows have been continued through the culverts in question without modification, resulting in conservative calculations.

1.2 Offsite (Tributary) Unit Hydrograph Method Calculations

Input values for the offsite (tributary) 100-year, 24-hour unit hydrograph method calculations prepared for this study are tabulated as follows:

Table 1 – Offsite (Tributary) Unit Hydrograph Method Input Values

AREA	SIZE (AC)	LEN. (FT)	LCA (FT)	CHANGE (FT)	RAIN 100-1 (IN)	RAIN 100-6 (IN)	RAIN 100-24 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)
A	1,527.33	29,891	13,688	2156.00	1.29	2.13	3.17	98.50	68.50	85.80
B	2,602.41	27,687	11,420	1996.00	1.28	2.07	3.03	97.90	69.02	86.20
C	1,687.33	28,332	13,559	1988.00	1.29	2.10	3.11	99.00	65.12	83.10
D	6,665.22	57,103	29,646	2548.00	1.38	2.38	3.76	99.00	73.06	89.40
E	3,444.14	24,414	13,905	1760.00	1.45	2.64	4.24	100.00	88.00	97.60
F	4,924.59	36,355	13,280	2138.00	1.36	2.10	3.14	98.70	77.60	92.60
G	279.11	12,326	8,294	1010.00	1.39	2.19	3.29	100.00	73.70	90.00
H	512.19	14,210	5,562	473.00	1.39	1.89	2.70	81.60	62.26	80.80
I	5,065.68	36,340	20,373	2873.00	1.41	2.15	3.19	98.80	78.64	93.20
J	603.09	16,135	10,608	2030.00	1.42	2.33	3.60	100.00	87.22	97.40
K	6,161.64	39,200	25,007	2675.00	1.44	2.39	3.74	99.30	81.24	94.70
L	1,834.31	20,676	10,935	2355.00	1.41	2.19	3.29	99.90	76.82	92.10
M	108.85	4,940	2,687	164.00	1.40	1.93	2.72	98.70	63.04	81.40
N	1,657.38	14,260	7,479	1690.00	1.40	2.08	3.00	98.90	73.88	90.10
O	155.66	4,860	2,228	170.00	1.39	1.95	2.71	90.00	64.20	82.40
P	3,782.66	35,115	20,362	2044.90	1.29	2.16	3.27	98.06	87.00	97.40

Output for the offsite (tributary) 100-year, 24-hour unit hydrograph method calculations are tabulated as follows:

Table 2 – Offsite (Tributary) Unit Hydrograph Method Output Calculations

AREA	LAG (HR.)	Q_{100} (CFS)	V_{100} (AF)
A	**0.75**	**1,600.72**	**266.36**
B	**0.68**	**1,829.92**	**267.68**
C	**0.74**	**1,742.41**	**264.76**
D	**1.42**	**4,307.31**	**1,537.16**
E	**0.70**	**5,599.01**	**1,141.36**
F	**0.83**	**4,856.39**	**1,019.08**
G	**0.43**	**509.77**	**58.16**
H	**0.47**	**871.36**	**74.50**
I	**0.93**	**4,662.63**	**1,089.72**
J	**0.49**	**1,201.05**	**169.20**
K	**1.06**	**6,025.95**	**1,645.82**
L	**0.55**	**2,734.35**	**401.45**
M	**0.24**	**288.10**	**14.80**
N	**0.41**	**2,917.50**	**310.20**
O	**0.22**	**438.36**	**22.60**
P	**0.83**	**3,931.61**	**948.52**

Refer to Technical Appendix No. 1 for printouts of the offsite (tributary) 100-year, 24-hour unit hydrograph calculations. Refer to Exhibit "E" for the offsite study map.

1.3 Offsite (Tributary) Hydrograph Routing Calculations

The U.S.G.S. quadrangles for the offsite watershed indicate braided blue-line streams. Offsite area "E" is shown to split at its downstream watercourse location. The split flows of Area "E" then flow to confluence with flows from Areas "F" and "G", respectively. Area "G" is subsequently shown to split at its downstream watercourse location. The split flows of Area "G" then flow to confluence with flows from Areas "H" and "I", respectively.

Offsite area "J" is shown to split at its downstream watercourse location. The split flows of Area "J" then flow to confluence with flows from Areas "K" and "L", respectively.

Hydrograph routing was necessarily for modeling of these flow divisions and combinations. The SCS convex method of channel routing was used to route natural flows as discussed above, and tabulated below:

Table 3 – Offsite (Tributary) Hydrograph Routing Calculations

LOCATION	ROUTING ACTION	Q_{100} (CFS) AT LOCATION	V_{100} (AF) AT LOCATION
R1.0	SPLIT AREA "E" HYDROGRAPH	2,799.51	570.68
R1.0 TO R1.1	ROUTE SPLIT FLOW OF AREA "E" HYDROGRAPH TO CHANNEL TRANSITION	2,449.18	570.68
R1.1 TO R1.2	ROUTE SPLIT FLOW OF AREA "E" HYDROGRAPH TO AREA "F" DISCHARGE POINT	2,449.18	570.68
R1.2	COMBINE AREA "F" HYDROGRAPH AT AREA "F" DISCHARGE POINT	**6,592.17**	**1,589.76**
R2.0	SPLIT AREA "E" HYDROGRAPH	2,799.51	570.68
R2.0 TO R2.1	ROUTE SPLIT FLOW OF AREA "E" HYDROGRAPH TO AREA "G" DISCHARGE POINT	2,462.08	570.68
R2.1	COMBINE AREA "G" HYDROGRAPH AT AREA "G" DISCHARGE POINT	2,671.25	628.84
R2.1	SPLIT AREAS "EG" HYDROGRAPH	1,335.62	314.42
R2.1 TO R2.2	ROUTE SPLIT FLOW OF AREAS "EG" HYDROGRAPH TO AREA "H" DISCHARGE POINT	1,229.57	314.42
R2.2	COMBINE AREA "H" HYDROGRAPH AT AREA "H" DISCHARGE POINT	**1,655.64**	**388.92**
R2.0	SPLIT AREA "E" HYDROGRAPH	2,799.51	570.68
R2.0 TO R2.1	ROUTE SPLIT FLOW OF AREA "E" HYDROGRAPH TO AREA "G" DISCHARGE POINT	2,462.08	570.68
R2.1	COMBINE AREA "G" HYDROGRAPH AT AREA "G" DISCHARGE POINT	2,671.25	628.84
R2.1	SPLIT AREAS "EG" HYDROGRAPH	1,335.62	314.42
R2.1 TO R3.0	ROUTE SPLIT FLOW OF AREAS "EG" HYDROGRAPH TO AREA "I" DISCHARGE POINT	1,228.56	314.42
R3.0	COMBINE AREA "I" HYDROGRAPH AT AREA "I" DISCHARGE POINT	**5,807.39**	**1,404.14**
R4.0	SPLIT AREA J" HYDROGRAPH	600.52	84.60
R4.0 TO R4.1	ROUTE SPLIT FLOW OF AREA "J" HYDROGRAPH TO CHANNEL TRANSITION	567.01	84.60
R4.1 TO R4.2	ROUTE SPLIT FLOW OF AREA "J" HYDROGRAPH TO AREA "K" DISCHARGE POINT	567.01	84.60
R4.2	COMBINE AREA "K" HYDROGRAPH AT AREA "K" DISCHARGE POINT	**6,254.40**	**1,730.42**
R5.0	SPLIT AREA J" HYDROGRAPH	600.52	84.60
R5.0 TO R5.1	ROUTE SPLIT FLOW OF AREA "J" HYDROGRAPH TO CHANNEL TRANSITION	573.33	84.60
R5.1 TO R5.2	ROUTE SPLIT FLOW OF AREA "J" HYDROGRAPH TO AREA "L" DISCHARGE POINT	573.33	84.60
R5.2	COMBINE AREA "L" HYDROGRAPH AT AREA "L" DISCHARGE POINT	**3,106.12**	**486.05**

Refer to Technical Appendix No. 2 for printouts of the offsite (tributary) 100-year, 24-hour hydrograph routing calculations. Refer to Exhibit "E" for the offsite study map illustrating these routed flows.

Based on the unit hydrograph and hydrograph routed discussed above, the 100-year, 24-hour flow rates and volumes tributary to each of the 12 A.T.S.F. railroad culverts, as well as the east Daggett channel, are summarized below:

Table 4 – Offsite (Tributary) Hydrology Summary

CULVERT NO.	OFFSITE AREA(S)	Q_{100} (CFS) TO CULVERT	V_{100} (AF) TO CULVERT
1	A	**1,600.72**	**266.36**
2	B	**1,829.92**	**267.68**
3	C	**1,742.41**	**264.76**
4	D	**4,307.31**	**1,537.16**
5	E & F (ROUTED)	**6,592.17**	**1,589.76**
6	E, G, & H (ROUTED)	**1,655.64**	**388.92**
7	E, G, & I (ROUTED)	**5,807.39**	**1,404.14**
8	J & K (ROUTED)	**6,254.40**	**1,730.42**
9	J & L (ROUTED)	**3,106.12**	**486.05**
10	M	**288.10**	**14.80**
11	N	**2,917.50**	**310.20**
12	O	**438.36**	**22.60**
DAGGETT CHANNEL	P	**3,931.07**	**948.24**

Note: Review of the East Daggett Diversion to A.T. & S.F. Bridge hydraulics calculations summary prepared by the San Bernardino County Flood Control District (August 18, 1967) indicates an unbulked Q_{100} of 3,900 c.f.s. tributary to the East Daggett Channel. This published Q_{100} is comparable to the calculated Q_{100} for offsite Area "P" of 3,931 cf.s. Refer to Attachment No. 1 for a copy of the published Q_{100} for the channel.

D. Existing Conditions Hydrology Calculations & Summary

1.1 Existing Conditions Hydrology Discussion

After discharge through the 12 A.T.S.F. railroad culverts discussed in Section "C", on-site flows continue northerly and northeasterly before discharging to the Mojave River wash to the north and adjacent rural residential and undeveloped properties to the east. Typically, on-site drainage is conveyed as natural overland flow along very gradual slopes and relatively unconcentrated, shallow channelization, with the exception of drainage improvements associated with the existing on-site railroad spur, Coolwater Generating Station, decommissioned/removed solar facilities, and the Barstow-Daggett airport. Existing on-site paved and dirt roads do not have any associated storm drain facilities.

On-site Areas 1 through 10A are located along the northwestern edge of the project site and discharge via natural flows to confluence with the Mojave River wash.

Drainage from on-site Area 10B is the area located within the existing railroad spur that contains a large borrow pit. It is assumed that 100-year flows are contained within the pit area; therefore no discharge has been calculated for Area 10B for existing conditions.

On-site Areas 11 through 14 are located along the northwestern edge of the project site and discharge via natural flows to confluence with the Mojave River wash.

Drainage for on-site Area 15 flows northerly/northeasterly through the Coolwater Generating Station and Edison facilities and northerly/northeasterly through primarily undeveloped areas before discharging via natural flows to confluence with the Mojave River wash.

Drainage from on-site Area 16 is the Coolwater Generating Station lined detention ponds. It is assumed that 100-year flows are contained within the ponds; therefore no discharge has been calculated for Area 16.

On-site Areas 17 through 29 are located along the northern edge of the project site and discharge primarily via natural flows directly to confluence the Mojave River wash or through adjacent rural residential properties along the northeastern portion of the project site.

On-site Areas 30 through 45 (excluding Area 48, discussed below) are located at the eastern portion and along the eastern edge of the project site. Discharge from these areas flows primarily easterly and northeasterly through undeveloped, agricultural, and rural residential areas before discharging to undeveloped and rural residential properties to the east.

Drainage from the offsite portion of Area 47 discharges through railroad culverts No. 1 and 2 and flows northeasterly before ponding against existing berms running north-south along the western edge of the Coolwater Generating Station and running east-west as the bermed railroad spur. These berms are assumed to generally be of adequate height (4 ft. to 6 ft.) to prevent flows from entering these facilities. Some ponding is anticipated to occur from these flows prior to discharge through three pipe culverts located at the railroad spur to confluence with the Mojave River wash.

Drainage from on-site Area 48 flows easterly and northeasterly through existing culverts and earthen detention ponds/channels running between the runways of the Barstow Daggett Airport and through primarily agricultural and undeveloped areas prior to discharging to adjacent undeveloped properties to the east of the project site.

Drainage from the offsite portion of Area 49 discharges through railroad culverts No. 3, 4 and 5 and flows easterly and northeasterly through undeveloped and agricultural land, the decommissioned and partially-demolished S.E.G.S. I & II PV solar generating stations, and the Barstow-Daggett Airport before discharging to adjacent undeveloped and rural residential properties to the east of the project site. Culverts and earthen detention ponds/channels located between the runways of the Barstow-Daggett Airport provide some protection of the airport from Area 49 flows.

Drainage from the offsite portion of Area 51 discharges through railroad culverts No. 6, 7, 8, 9 and 10 and flows easterly through primarily undeveloped and rural residential areas prior before discharging to adjacent undeveloped properties to the east of the project site.

Drainage from the offsite portion of Area 52 discharges through railroad culverts 11 and 12 and flows northeasterly through undeveloped areas before discharging to undeveloped properties to the east of the project site.

1.2 Exiting Conditions Rational Method Calculations

For existing conditions areas less than 640 acres (1 sq. mi.), the rational hydrology method was used to generate Time of Concentration (TC) values to generate lag times for use in the unit hydrograph calculations for these areas.

Input values and output calculations for the existing conditions 100-year, 1-hour rational method calculations prepared for this study are tabulated as follows:

Table 5 – Existing Conditions Rational Method Input Values & Output Calculations

AREA	SIZE (AC)	SUBAREA REACH	LEN. (FT)	U.S. ELEV. (FT)	D.S. ELEV. (FT.)	RAIN 100-1 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	AREA TC (MIN.)	TOTAL Q_{100} (CFS)
1	1.00	1.0 TO 1.1	357	1965.4	1956.1	1.26	100.00	62.00	80.60	**18.89**	**2.22**
2	1.55	2.0 TO 2.1	285	1965.1	1955.6	1.27	100.00	62.00	80.60	**16.43**	**3.89**
3	4.92	3.0 TO 3.1	600	1963.0	1955.0	1.27	100.00	62.00	80.60	**26.58**	**8.35**
4	8.95	4.0 TO 4.1	1,000	1971.3	1953.9	1.27	100.00	62.00	80.60	**30.92**	**13.38**
5	10.00	5.0 TO 5.1	931	1971.2	1954.8	1.27	100.00	62.00	80.60		
	3.66	5.1 TO 5.2	146	1954.8	1950.6		100.00	62.00	80.60	**31.10**	**20.31**
6	9.47	6.0 TO 6.1	1,000	1970.7	1962.8	1.27	100.00	62.00	80.60		
	4.33	6.1 TO 6.2	474	1962.8	1948.8		100.00	62.00	80.60	**40.17**	**16.42**
7	9.33	7.0 TO 7.1	1,000	1970.4	1966.6	1.27	100.00	62.00	80.60		
	5.66	7.1 TO 7.2	716	1966.6	1949.6		100.00	62.00	80.60	**48.60**	**15.01**
8	8.97	8.0 T0 8.1	1,000	1966.7	1950.3	1.27	100.00	62.00	80.60	**31.28**	**13.27**
9	10.00	9.0 TO 9.1	776	1967.2	1965.2	1.27	100.00	62.00	80.60		
	6.11	9.1 TO 9.2 (CONF.)	780	1965.2	1960.4		100.00	62.00	80.60		
	9.02	9.3 TO 9.2 (CONF.)	1,000	1967.9	1960.4		100.00	62.00	80.60		
	4.84	9.2 TO 9.4	495	1960.4	1946.5		100.00	62.00	80.60	**39.79**	**30.32**
10A	6.25	10.0 TO 10.1	1,000	1967.3	1957.8	1.27	100.00	62.00	80.60		
	7.32	10.1 TO 10.2	1,280	1957.8	1957.3		100.00	62.00	80.60	**83.79**	**8.42**
10B	43.92	N/A - BORROW PIT AREA - SEE HYDROGRAPH CALCULATIONS									
11	9.20	11.0 TO 11.1	841	1957.6	1947.6	1.28	100.00	62.00	80.60	**31.13**	**13.67**
12	0.87	12.0 TO 12.1	225	1955.3	1948.8	1.28	100.00	62.00	80.60	**15.38**	**2.32**
13	8.36	13.0 TO 13.1	1,000	1959.0	1955.6	1.28	100.00	62.00	80.60		
	8.49	13.1 TO 13.2	808	1955.6	1951.6		100.00	62.00	80.60	**55.17**	**15.13**
14	10.00	14.0 TO 14.1	1,000	1955.0	1951.8	1.29	100.00	62.00	80.60		
	8.15	14.1 TO 14.2	627	1951.8	1947.4		100.00	62.00	80.60	**51.45**	**17.59**
15	10.00	15.0 TO 15.1	588	1983.2	1970.0	1.27	71.75	62.00	80.60		
	23.93	15.1 TO 15.2	891	1970.0	1964.6		45.39	62.00	80.60		
	64.34	15.2 TO 15.3	1,336	1964.6	1963.8		51.23	62.00	80.60		
	98.81	15.3 TO 15.4	6,809	1963.8	1949.3		96.60	62.00	80.60	**95.05**	**129.71**
16	158.96	N/A - LINED EVAPORATION PONDS - SEE HYDROGRAPH CALCULATIONS									
17	10.00	17.0 TO 17.1	805	1951.2	1947.6	1.30	100.00	78.00	92.80		
	138.48	17.1 TO 17.2	1,959	1947.6	1940.5		99.34	73.74	89.99	**44.88**	**187.78**
18	10.00	18.0 TO 18.1	404	1944.9	1938.1	1.33	100.00	62.00	80.60		
	21.10	18.1 TO 18.2	830	1938.1	1932.7		100.00	62.00	80.60		
	16.96	18.2 TO 18.3	590	1932.7	1926.1		100.00	62.00	80.60	**33.00**	**71.87**
19	7.87	19.0 TO 19.1	756	1933.9	1929.6	1.35	100.00	62.00	80.60	**34.57**	**11.52**
20	10.00	20.0 TO 20.1	1,000	1932.9	1925.3	1.36	100.00	58.61	77.89		
	14.41	20.1 TO 20.2	801	1925.3	1920.5		100.00	58.22	77.58	**48.93**	**25.49**
21	9.89	21.0 TO 21.1	947	1926.4	1924.8	1.36	100.00	61.58	80.26	**48.66**	**10.77**
22	3.73	22.0 TO 22.1	392	1928.1	1924.0	1.36	100.00	62.00	80.60	**23.53**	**7.58**
23	10.00	23.0 TO 23.1	770	1926.0	1922.2	1.36	100.00	62.00	80.60		
	20.75	23.1 TO 23.2	1,058	1922.2	1917.2		100.00	61.57	80.26		
	38.66	23.2 TO 23.3	2,495	1917.2	1910.2		100.00	58.95	78.16	**76.72**	**47.52**
24	10.00	24.0 TO 24.1	807	1941.9	1938.4	1.35	100.00	62.00	80.60		
	19.33	24.1 TO 24.2	1,074	1938.4	1936.3		100.00	62.00	80.60		
	44.74	24.2 TO 24.3	1,697	1936.3	1929.1		100.00	61.06	79.85		
	28.39	24.3 TO 24.4 (CONF.)	1,554	1929.1	1921.9		99.59	59.81	78.85		
	6.50	24.5 TO 24.6	1,000	1940.0	1932.2		100.00	60.62	79.50		
	14.08	24.6 TO 24.7	755	1932.2	1928.3		100.00	58.11	77.49		
	28.46	24.7 TO 24.8	1,059	1928.3	1927.3		99.39	59.72	78.78		
	21.69	24.8 TO 24.4 (CONF.)	1,788	1927.3	1921.9		99.47	61.09	79.87		
	119.87	24.4 TO 24.9	4,942	1921.9	1914.2		100.00	59.21	78.37	**131.60**	**105.13**

Table 5 – Existing Conditions Rational Method Input Values & Output Calculations (Continued)

AREA	SIZE (AC)	SUBAREA REACH	LEN. (FT)	U.S. ELEV. (FT)	D.S. ELEV. (FT.)	RAIN 100-1 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	AREA TC (MIN.)	TOTAL Q_{100} (CFS)
	10.00	25.0 TO 25.1	879	1935.0	1925.3		100.00	61.51	80.21		
	20.69	25.1 TO 25.2	1,574	1925.3	1923.0		100.00	62.00	80.60		
25	38.80	25.2 TO 25.3	1,306	1923.0	1922.9	1.36	100.00	62.00	80.60		
	84.70	25.3 TO 25.4	1,863	1922.9	1916.7		100.00	61.41	80.13		
	125.72	25.4 TO 25.5	3,934	1916.7	1906.4		99.82	61.40	80.12	**130.46**	**106.82**
	4.79	26.0 TO 26.1 (CONF.)	1,000	1912.6	1905.8		100.00	62.00	80.60		
	5.12	26.2 TO 26.1 (CONF.)	694	1906.9	1905.8		100.00	62.00	80.60		
	3.66	26.1 TO 26.3 (CONF.)	403	1905.8	1904.6		100.00	62.00	80.60		
	4.37	26.4 TO 26.3 (CONF.)	792	1913.2	1904.6		100.00	62.00	80.60		
	4.14	26.3 TO 26.5 (CONF.)	391	1904.6	1904.5		100.00	62.00	80.60		
	9.43	26.6 TO 26.7	1,000	1912.7	1908.0		100.00	60.53	79.42		
	1.91	26.7 TO 26.5 (CONF.)	534	1908.0	1904.5		100.00	62.00	80.60		
	2.51	26.5 TO 26.8 (CONF.)	369	1904.5	1904.1		100.00	62.00	80.60		
	10.00	26.9 TO 26.10	755	1911.0	1905.6		100.00	61.95	80.56		
	7.73	26.10 TO 26.8 (CONF.)	690	1905.6	1904.1		100.00	62.00	80.60		
26	29.14	26.8 TO 26.11	1,377	1904.1	1902.5	1.39	100.00	62.00	80.60		
	48.02	26.11 TO 26.12	2,640	1902.5	1897.1		100.00	62.00	80.60		
	28.21	26.12 TO 26.13 (CONF.)	1,785	1897.1	1893.1		100.00	62.00	80.60		
	8.56	26.14 TO 26.15	707	1908.1	1905.8		100.00	62.00	80.60		
	18.12	26.15 TO 26.16	1,141	1905.8	1901.6		100.00	62.00	80.60		
	43.16	26.16 TO 26.17	1,868	1901.6	1896.1		98.55	62.00	80.60		
	14.75	26.17 TO 26.13 (CONF.)	1,118	1896.1	1893.1		99.33	62.00	80.60		
	26.84	26.13 TO 26.18 (CONF.)	2,434	1893.1	1890.7		99.54	62.81	81.25		
	7.68	26.19 TO 26.20	1,000	1900.3	1894.2		100.00	62.00	80.60		
	19.58	26.20 TO 26.21	1,041	1894.2	1890.8		100.00	62.00	80.60		
	25.53	26.21 TO 26.18 (CONF.)	1,444	1890.8	1890.7		98.65	62.79	81.23		
	18.81	26.18 TO 26.22	1,942	1890.7	1887.2		100.00	59.04	78.23	**131.47**	**157.65**
27	6.15	27.0 TO 27.1	424	1908.1	1906.0	1.38	100.00	62.00	80.60	**28.20**	**10.97**
	10.00	28.0 TO 28.1	752	1892.1	1890.1		100.00	58.00	77.40		
	7.48	28.1 TO 28.2 (CONF.)	1,206	1890.1	1887.5		100.00	58.00	77.40		
28	10.00	28.3 TO 28.4	752	1890.9	1887.6	1.39	100.00	58.00	77.40		
	8.61	28.4 TO 28.2 (CONF.)	578	1887.6	1887.5		100.00	58.00	77.40		
	25.30	28.2 TO 28.5	1,132	1887.5	1884.4		99.55	59.30	78.44	**76.25**	**41.73**
29	10.00	29.0 TO 29.1	776	1889.0	1887.5	1.39	100.00	58.00	77.40		
	5.24	29.1 TO 29.2	413	1887.5	1886.4		100.00	59.40	78.52	**54.70**	**14.76**
	7.29	30.0 TO 30.1	1,000	1902.9	1896.4		85.82	73.93	90.14		
30	14.30	30.1 TO 30.2	1,043	1896.4	1893.0	1.40	100.00	78.85	93.31		
	30.30	30.2 TO 30.3	1,163	1893.0	1891.1		99.24	77.80	92.68		
	83.11	30.3 TO 30.4	2,235	1891.1	1886.0		99.10	75.86	91.52	**91.52**	**138.70**
	5.24	31.0 TO 31.1	1,000	1924.3	1920.6		67.03	62.00	80.60		
	10.93	31.1 TO 31.2	991	1920.6	1917.4		84.46	62.00	80.60		
	20.87	31.2 TO 31.3	862	1917.4	1915.8		96.69	62.00	80.60		
	40.83	31.3 TO 31.4	1,062	1915.8	1914.7		97.45	62.00	80.60		
	76.88	31.4 TO 31.5	3,431	1914.7	1905.3		95.97	63.18	81.54		
	156.96	31.5 TO 31.6	5,186	1905.3	1892.3		95.00	72.77	89.22		
31	50.34	31.6 TO 31.7 (CONF.)	2,516	1892.3	1886.8	1.40	95.00	69.92	86.94		
	10.00	31.8 TO 31.9	548	1911.9	1909.9		95.93	83.81	96.29		
	21.33	31.9 TO 31.10	1,333	1909.9	1906.6		100.00	79.18	93.51		
	38.54	31.10 TO 31.11	1,835	1906.6	1902.7		98.00	60.03	79.02		
	95.54	31.11 TO 31.12	3,382	1902.7	1893.6		90.00	62.02	80.62		
	61.48	31.12 TO 31.7 (CONF.)	2,737	1893.6	1886.8		95.00	76.19	91.71		
	45.93	31.7 TO 31.13	3,029	1886.8	1880.8		100.00	81.39	94.83	**122.15**	**302.22**

Table 5 – Existing Conditions Rational Method Input Values & Output Calculations (Continued)

AREA	SIZE (AC)	SUBAREA REACH	LEN. (FT)	U.S. ELEV. (FT)	D.S. ELEV. (FT.)	RAIN 100-1 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	AREA TC (MIN.)	TOTAL Q_{100} (CFS)
32	9.24	32.0 TO 32.1	1,000	1891.9	1884.7	1.39	100.00	81.00	94.60		
	15.12	32.1 TO 32.2	1,520	1884.7	1879.6		100.00	81.39	94.83	**43.29**	**36.04**
33	5.80	33.0 TO 33.1	1,000	1892.3	1885.7	1.39	100.00	81.00	94.60		
	11.97	33.1 TO 33.2	819	1885.7	1883.7		100.00	81.00	94.60		
	13.09	33.2 TO 33.3	871	1883.7	1881.4		100.00	81.16	94.70	**48.06**	**42.18**
34	5.20	34.0 TO 34.1	1,000	1897.6	1894.2	1.40	90.00	81.58	94.95		
	9.80	34.1 TO 34.2	570	1894.2	1893.3		90.00	81.19	94.71		
	18.50	34.2 TO 34.3	1,115	1893.3	1888.5		90.00	81.05	94.63		
	36.85	34.3 TO 34.4	1,198	1888.5	1885.5		100.00	83.00	95.80		
	36.88	34.4 TO 34.5	1,714	1885.5	1881.8		100.00	81.63	94.98	**73.07**	**108.88**
35	6.26	35.0 TO 35.1	1,000	1886.9	1882.6	1.39	100.00	83.33	96.00		
	2.06	35.1 TO 35.2 (CONF.)	378	1882.6	1880.8		100.00	84.00	96.40		
	10.00	35.3 TO 35.4	1,000	1887.0	1881.7		100.00	81.19	94.71		
	4.74	35.4 TO 35.2 (CONF.)	288	1881.7	1880.8		100.00	83.13	95.88		
	10.04	35.2 TO 35.5	686	1880.8	1879.8		100.00	84.00	96.40	**38.62**	**53.22**
36	3.57	36.0 TO 36.1	628	1883.3	1876.4	1.39	100.00	84.00	96.40	**17.53**	**10.34**
37	9.10	37.0 TO 37.1	1,000	1883.0	1878.4	1.39	100.00	84.00	96.50		
	1.32	37.1 TO 37.2	203	1878.4	1877.3		100.00	84.00	96.40	**27.57**	**21.80**
38	7.69	38.0 TO 38.1	1,000	1882.0	1879.1	1.39	100.00	84.00	96.40		
	4.61	38.1 TO 38.2	276	1879.1	1877.7		100.00	84.00	96.40	**31.03**	**23.63**
39	2.71	39.0 TO 39.1	1,000	1903.0	1897.8	1.40	90.00	62.00	80.60		
	5.97	39.1 TO 39.2	947	1897.8	1895.2		90.00	66.10	83.88		
	8.85	39.2 TO 39.3	1,225	1895.2	1893.0		90.00	84.00	96.40		
	17.12	39.3 TO 39.4 (CONF.)	1,060	1893.0	1889.2		90.00	84.00	96.40		
	9.79	39.5 TO 39.6	1,000	1897.3	1893.3		90.00	84.00	96.40		
	22.23	39.6 TO 39.7 (CONF.)	1,661	1893.3	1890.4		90.00	84.00	96.40		
	9.98	39.8 TO 39.9	1,000	1893.0	1891.0		90.00	84.00	96.40		
	4.90	39.9 TO 39.7 (CONF.)	384	1891.0	1890.4		90.00	84.00	96.40		
	6.72	39.7 TO 39.4 (CONF.)	638	1890.4	1889.2		90.00	84.00	96.40		
	5.67	39. 4 TO 39.10 (CONF.)	551	1889.2	1887.8		98.00	84.00	96.40		
	9.31	39.11 TO 39.12	1,000	1892.8	1888.2		90.00	83.86	96.40		
	2.34	39.12 TO 39.10 (CONF.)	425	1888.2	1887.8		90.00	84.00	96.40		
	16.22	39.10 TO 39.13	845	1887.8	1886.1		98.00	83.23	95.94		
	31.50	39.13 TO 39.14	1,834	1886.1	1882.0		98.00	83.30	95.98		
	31.91	39.14 TO 39.15 (CONF.)	2,287	1882.0	1876.1		98.00	84.00	96.40		
	10.00	39.16 TO 39.17	680	1888.0	1886.7		90.00	84.00	96.40		
	38.56	39.17 TO 39.18	1,765	1886.7	1882.4		90.00	83.33	96.00		
	30.62	39.18 TO 39.15 (CONF.)	2,853	1882.4	1876.1		90.00	84.00	96.40		
	13.59	39.15 TO 39.19	2,692	1876.1	1869.9		100.00	84.00	96.40	**86.75**	**228.30**
40	3.40	40.0 TO 40.1	515	1881.4	1876.5	1.40	100.00	84.00	96.40	**16.67**	**10.28**
41	2.26	41.0 TO 41.1	340	1878.4	1876.3	1.39	100.00	84.00	96.40	**15.39**	**7.18**
42	6.94	42.0 TO 42.1	1,000	1886.7	1881.5	1.39	90.00	84.00	96.40		
	20.24	42.1 TO 42.2	1,696	1881.5	1877.7		95.00	84.00	96.40		
	26.20	42.2 TO 42.3	1,288	1877.7	1875.7		100.00	84.00	96.40		
	11.90	42.3 TO 42.4 (CONF.)	781	1875.7	1872.8		100.00	84.00	96.40		
	6.25	42.5 TO 42.6	1,000	1879.9	1876.4		95.00	84.00	96.40		
	11.38	42.6 TO 42.4 (CONF.)	1,421	1876.4	1872.8		100.00	84.00	96.40		
	8.40	42.4 TO 42.7 (CONF.)	1,035	1872.8	1870.5		100.00	84.00	96.40		
	5.57	42.8 TO 42.9	1,000	1879.9	1876.1		90.00	84.00	96.40		
	9.93	42.9 TO 42.10	859	1876.1	1874.3		90.00	84.00	96.40		
	12.83	42.10 TO 42.7 (CONF.)	1,381	1874.3	1870.5		100.00	84.00	96.40		
	4.69	42.7 TO 42.11	353	1870.5	1869.2		100.00	84.00	96.40	**58.26**	**118.94**
43	5.32	43.0 TO 43.1	1,000	1877.8	1872.0	1.39	100.00	84.00	96.40		
	1.63	43.1 TO 43.2	245	1872.0	1871.0		100.00	84.00	96.40	**27.83**	**14.44**
44	6.47	44.0 TO 44.1	850	1874.3	1871.2	1.39	100.00	84.00	96.40	**24.67**	**14.66**
45	3.49	45.0 TO 45.1	439	1876.3	1872.8	1.39	100.00	84.00	96.40	**16.20**	**10.69**

Refer to Technical Appendix No. 3 for printouts of the existing conditions 100-year, 1-hour rational method calculations. Refer to Exhibit "F" for the existing conditions study map.

1.3 Existing Conditions Unit Hydrograph Calculations

As discussed above, for existing conditions areas less than 640 acres (1 sq. mi.), the rational hydrology method was used to generate Time of Concentration (TC) values to generate lag times in the unit hydrograph calculations for these areas. For all other existing conditions areas (640 acres / 1 sq. mi. or greater), the Snyder (Army Corps of Engineers) lag equation was used to establish lag times for these areas. Input values for the existing conditions 100-year, 24-hour unit hydrograph calculations prepared for this study are tabulated as follows:

AREA	SIZE (AC)	LEN. (FT)	LCA (FT)	ELEV. CHANGE (FT)	RAIN 100-1 (IN)	RAIN 100-6 (IN)	RAIN 100-24 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	TC (MIN.)	TC (HR.)
1	1.00	N/A			1.26	1.84	2.50	100.00	62.00	80.60	18.89	0.31
2	1.55	N/A			1.27	1.84	2.49	100.00	62.00	80.60	16.43	0.27
3	4.92	N/A			1.27	1.84	2.48	100.00	62.00	80.60	26.58	0.44
4	8.95	N/A			1.27	1.84	2.48	100.00	62.00	80.60	30.92	0.52
5	13.66	N/A			1.27	1.84	2.46	100.00	62.00	80.60	31.10	0.52
6	13.80	N/A			1.27	1.84	2.45	100.00	62.00	80.60	40.17	0.67
7	14.99	N/A			1.27	1.84	2.44	100.00	62.00	80.60	48.60	0.81
8	8.97	N/A			1.27	1.84	2.42	100.00	62.00	80.60	31.28	0.52
9	29.97	N/A			1.27	1.84	2.42	100.00	62.00	80.60	39.79	0.66
10A	13.57	N/A			1.27	1.84	2.40	100.00	62.00	80.60	83.79	1.40
10B	43.92	N/A			1.27	1.84	2.40	0.00	98.00	99.60	N/A	N/A
11	9.20	N/A			1.28	1.84	2.38	100.00	62.00	80.60	31.13	0.52
12	0.87	N/A			1.28	1.84	2.37	100.00	62.00	80.60	15.38	0.26
13	16.85	N/A			1.28	1.84	2.39	100.00	62.00	80.60	55.17	0.92
14	18.15	N/A			1.29	1.84	2.39	100.00	62.00	80.60	51.45	0.86
15	197.08	N/A			1.27	1.83	2.43	74.30	62.00	80.60	95.05	1.58
16	158.96	N/A			1.27	1.83	2.44	0.00	98.00	99.60	N/A	N/A
17	148.48	N/A			1.30	1.83	2.43	99.30	74.00	90.20	44.88	0.75
18	48.06	N/A			1.33	1.84	2.48	100.00	62.00	80.60	33.00	0.55
19	7.87	N/A			1.35	1.84	2.48	100.00	62.00	80.60	34.57	0.58
20	24.41	N/A			1.36	1.84	2.48	100.00	58.40	77.70	48.93	0.82
21	9.89	N/A			1.36	1.84	2.47	100.00	61.60	80.30	48.66	0.81
22	3.73	N/A			1.36	1.84	2.47	100.00	62.00	80.60	23.53	0.39
23	69.41	N/A			1.36	1.84	2.48	100.00	60.20	79.20	76.72	1.28
24	293.06	N/A			1.35	1.84	2.49	99.90	60.00	79.00	131.60	2.19
25	279.91	N/A			1.36	1.83	2.51	99.90	61.50	80.20	130.46	2.17
26	342.06	N/A			1.39	1.82	2.52	99.70	61.90	80.50	131.47	2.19
27	6.15	N/A			1.38	1.82	2.51	100.00	62.00	80.60	28.20	0.47
28	61.39	N/A			1.39	1.81	2.53	99.80	58.50	77.80	76.25	1.27
29	15.24	N/A			1.39	1.81	2.54	100.00	58.50	77.80	54.70	0.91
30	135.00	N/A			1.40	1.82	2.57	98.50	76.50	91.90	67.00	1.12
31	634.87	N/A			1.40	1.83	2.60	94.90	69.00	86.20	122.15	2.04
32	24.36	N/A			1.39	1.83	2.60	100.00	81.20	94.70	43.29	0.72
33	30.86	N/A			1.39	1.83	2.60	100.00	81.10	94.70	48.06	0.80
34	107.23	N/A			1.40	1.84	2.61	96.90	82.00	95.20	73.07	1.22
35	33.10	N/A			1.39	1.84	2.62	100.00	82.90	95.70	38.62	0.64
36	3.57	N/A			1.39	1.84	2.62	100.00	84.00	96.40	17.53	0.29
37	10.42	N/A			1.39	1.85	2.63	100.00	84.00	96.40	27.57	0.46
38	12.30	N/A			1.39	1.85	2.64	100.00	84.00	96.40	31.03	0.52
39	277.99	N/A			1.40	1.86	2.65	92.90	83.20	95.90	86.75	1.45
40	3.40	N/A			1.40	1.86	2.65	100.00	84.00	96.40	16.67	0.28
41	2.26	N/A			1.39	1.86	2.65	100.00	84.00	96.40	15.39	0.26
42	124.33	N/A			1.39	1.87	2.67	97.10	84.00	96.40	58.26	0.97
43	6.95	N/A			1.39	1.87	2.67	100.00	84.00	96.40	27.83	0.46
44	6.47	N/A			1.39	1.87	2.68	100.00	84.00	96.40	24.67	0.41
45	3.49	N/A			1.39	1.87	2.68	100.00	84.00	96.40	16.20	0.27

Table 6 – Existing Conditions Unit Hydrograph Input Values (Continued)

AREA	SIZE (AC)	LEN. (FT)	LCA (FT)	ELEV. CHANGE (FT)	RAIN 100-1 (IN)	RAIN 100-6 (IN)	RAIN 100-24 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	TC (MIN.)	TC (HR.)
46	3,782.66	35,115	20,362	2044.90	1.29	2.16	3.27	98.06	87.00	97.40	N/A	N/A
47	3,500.82	38,102	19,862	2190.20	1.29	2.07	3.03	97.95	68.25	85.60	N/A	N/A
48	764.55	20,795	10,119	58.10	1.40	1.85	2.62	89.36	70.70	87.60	N/A	N/A
49	17,446.64	81,047	39,563	2612.40	1.36	2.15	3.24	98.88	71.28	88.00	N/A	N/A
50	3,444.14	24,414	13,905	1760.00	1.45	2.64	4.24	100.00	88.00	97.60	N/A	N/A
51	15,350.45	45,387	22,710	2686.10	1.42	2.25	3.40	99.54	78.44	93.10	N/A	N/A
52	2,128.12	17,716	8,950	1680.00	1.39	2.04	2.93	98.78	73.11	89.50	N/A	N/A

Output for the existing conditions 100-year, 24-hour unit hydrograph calculations are tabulated as follows:

Table 7 – Existing Conditions Unit Hydrograph Output Calculations

AREA	LAG (HR.)	Q_{100} (CFS)	V_{100} (AF)
1	**0.25**	**2.27**	**0.12**
2	**0.22**	**3.91**	**0.18**
3	**0.35**	**9.16**	**0.57**
4	**0.42**	**14.09**	**1.03**
5	**0.42**	**21.50**	**1.56**
6	**0.54**	**18.27**	**1.57**
7	**0.65**	**17.15**	**1.70**
8	**0.42**	**14.12**	**1.01**
9	**0.53**	**39.52**	**3.37**
10A	**1.12**	**10.55**	**1.51**
10B	N/A		**8.76**
11	**0.42**	**14.60**	**1.02**
12	**0.21**	**2.24**	**0.10**
13	**0.74**	**18.40**	**1.88**
14	**0.69**	**21.03**	**2.03**
15	**1.26**	**146.52**	**26.15**
16	N/A		**32.25**
17	**0.60**	**211.40**	**22.34**
18	**0.44**	**79.26**	**5.66**
19	**0.46**	**12.94**	**0.93**
20	**0.66**	**29.32**	**2.69**

Table 7 – Existing Conditions Unit Hydrograph Output Calculations (Continued)

AREA	LAG (HR.)	Q_{100} (CFS)	V_{100} (AF)
21	**0.65**	**12.19**	**1.16**
22	**0.31**	**7.85**	**0.44**
23	**1.02**	**60.22**	**7.94**
24	**1.75**	**163.10**	**33.20**
25	**1.74**	**161.32**	**33.17**
26	**1.75**	**200.00**	**41.48**
27	**22.16**	**11.77**	**0.75**
28	**1.02**	**54.11**	**7.00**
29	**0.73**	**18.02**	**1.74**
30	**0.90**	**153.30**	**22.98**
31	**1.63**	**427.00**	**94.32**
32	**0.58**	**40.15**	**4.53**
33	**0.64**	**45.87**	**5.73**
34	**0.98**	**123.15**	**20.37**
35	**0.51**	**58.05**	**6.38**
36	**0.23**	**10.53**	**0.70**
37	**0.37**	**23.25**	**2.06**
38	**0.42**	**24.50**	**2.44**
39	**1.16**	**278.92**	**54.79**
40	**0.22**	**10.31**	**0.68**
41	**0.21**	**7.00**	**0.45**
42	**0.78**	**163.96**	**24.95**
43	**0.37**	**15.52**	**1.39**
44	**0.33**	**15.50**	**1.30**
45	**0.22**	**10.68**	**0.70**
46	**0.83**	**3,931.07**	**948.24**
47	**0.99**	**2,754.99**	**563.85**
48	**1.09**	**732.31**	**120.74**
49	**1.92**	**7,103.32**	**3,092.46**
50	**0.70**	**5,599.01**	**1,141.36**
51	**1.11**	**10,831.85**	**3,424.11**
52	**0.50**	**3,269.02**	**379.87**

Refer to Technical Appendix No. 4 for printouts of the existing conditions 100-year, 24-hour unit hydrograph calculations. Refer to Exhibit "F" for the existing conditions study map.

1.4 Existing Conditions Hydrograph Routing Calculations

The U.S.G.S. quadrangles for the offsite watershed indicate braided blue-line streams. Offsite area 50 is shown to split at its downstream watercourse location. The split flows of Area 50 then flow to confluence with flows from Areas 49 and 51, respectively.

Hydrograph routing was necessarily for modeling of these flow divisions and combinations. The SCS convex method of channel routing was used to route natural flows as discussed above, and tabulated below:

Table 8 – Existing Conditions Hydrograph Routing Calculations

LOCATION	ROUTING ACTION	Q_{100} (CFS) AT LOCATION	V_{100} (AF) AT LOCATION
R1.0	SPLIT AREA 50 HYDROGRAPH	2,799.51	570.68
R1.0 TO R1.1	ROUTE SPLIT FLOW OF AREA 50 HYDROGRAPH TO AREA 49 DISCHARGE POINT	2,461.44	570.68
R1.1	COMBINE AREA 49 HYDROGRAPH AT AREA 49 DISCHARGE POINT	**8,140.15**	**3,663.71**
R2.0	SPLIT AREA 50 HYDROGRAPH	2,799.51	570.68
R2.0 TO R2.1	ROUTE SPLIT FLOW OF AREA 50 HYDROGRAPH TO AREA 51 DISCHARGE POINT	2,460.42	570.68
R2.1	COMBINE AREA 51 HYDROGRAPH AT AREA 51 DISCHARGE POINT	**12,269.86**	**3,994.79**

Refer to Technical Appendix No. 5 for printouts of existing conditions 100-year, 24-hour hydrograph routing calculations. Refer to Exhibit "E" for the existing conditions study map illustrating these routed flows.

E. Developed Conditions Hydrology Calculations & Summary

1.1 Developed Conditions Hydrology Discussion

Due to the nature of the proposed project (PV Solar Generating Station), the overall hydrology for existing conditions will remain substantially unchanged for existing conditions (as grading will be limited to smoothing of existing topography), excepting the following:

- For the proposed 5,531 acre project site, the pervious percentage was assumed to be 90%, to account for any paved access roads, driveways, parking areas, and structures typical of this type of development. The area-averaged pervious percentage of all drainage areas/subareas within the project site limits were therefore adjusted accordingly for developed conditions.

- For the proposed 5,531 acre project site, the pervious cover was assumed to be "barren", to account for all clearing/grubbing activities and gravel areas typical of this type of development. The area-averaged pervious cover of all drainage areas/subareas within the project site limits were therefore adjusted accordingly for developed conditions.

- The existing borrow pit within the existing railroad spur is located inside the proposed project site. This pit will be filled and compacted if this area is developed as part of the project. Therefore, runoff currently contained within the borrow pit will be added to the developed conditions discharge.

1.2 Developed Conditions Rational Method Calculations

Input values and output calculations for the developed conditions 100-year, 1-hour rational method calculations prepared for this report are tabulated below:

Table 9 – Developed Conditions Rational Method Input Values & Output Calculations

AREA	SIZE (AC)	SUBAREA REACH	LEN. (FT)	U.S. ELEV. (FT)	D.S. ELEV. (FT.)	RAIN 100-1 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	AREA TC (MIN.)	TOTAL Q_{100} (CFS)
1	1.00	1.0 TO 1.1	357	1965.4	1956.1	1.26	90.00	78.00	92.80	**10.81**	**3.65**
2	1.55	2.0 TO 2.1	285	1965.1	1955.6	1.27	90.00	78.00	92.80	**9.40**	**6.31**
3	4.92	3.0 TO 3.1	600	1963.0	1955.0	1.27	90.00	78.00	92.80	**15.21**	**14.14**
4	8.95	4.0 TO 4.1	1,000	1971.3	1953.9	1.27	90.00	78.00	92.80	**17.69**	**23.04**
5	10.00	5.0 TO 5.1	931	1971.2	1954.8	1.27	90.00	78.00	92.80		
	3.66	5.1 TO 5.2	146	1954.8	1950.6		90.00	78.00	92.80	**18.06**	**34.63**
6	9.47	6.0 TO 6.1	1,000	1970.7	1962.8	1.27	90.00	78.00	92.80		
	4.33	6.1 TO 6.2	474	1962.8	1948.8		90.00	78.00	92.80	**23.90**	**28.48**
7	9.33	7.0 TO 7.1	1,000	1970.4	1966.6	1.27	90.00	78.00	92.80		
	5.66	7.1 TO 7.2	716	1966.6	1949.6		90.00	78.00	92.80	**29.30**	**26.60**
8	8.97	8.0 T0 8.1	1,000	1966.7	1950.3	1.27	90.00	78.00	92.80	**17.90**	**22.89**
9	10.00	9.0 TO 9.1	776	1967.2	1965.2	1.27	90.00	78.00	92.80		
	6.11	9.1 TO 9.2 (CONF.)	780	1965.2	1960.4		90.00	78.00	92.80		
	9.02	9.3 TO 9.2 (CONF.)	1,000	1967.9	1960.4		90.00	78.00	92.80		
	4.84	9.2 TO 9.4	495	1960.4	1946.5		90.00	78.00	92.80	**23.55**	**50.90**
10A	6.25	10.0 TO 10.1	1,000	1967.3	1957.8	1.27	90.00	78.00	92.80		
	7.32	10.1 TO 10.2	1,280	1957.8	1957.3		90.00	78.00	92.80	**59.31**	**14.72**
10B	43.92	N/A - BORROW PIT AREA - SEE HYDROGRAPH CALCULATIONS									
11	9.20	11.0 TO 11.1	841	1957.6	1947.6	1.28	90.00	78.00	92.80	**17.81**	**23.56**
12	0.87	12.0 TO 12.1	225	1955.3	1948.8	1.28	90.00	78.00	92.80	**8.80**	**3.74**
13	8.36	13.0 TO 13.1	1,000	1959.0	1955.6	1.28	90.00	78.00	92.80		
	8.49	13.1 TO 13.2	808	1955.6	1951.6		90.00	78.00	92.80	**34.34**	**26.78**
14	10.00	14.0 TO 14.1	1,000	1955.0	1951.8	1.29	90.00	78.00	92.80		
	8.15	14.1 TO 14.2	627	1951.8	1947.4		90.00	78.00	92.80	**31.25**	**31.32**
15	10.00	15.0 TO 15.1	588	1983.2	1970.0	1.27	83.79	76.19	91.71		
	23.93	15.1 TO 15.2	891	1970.0	1964.6		51.99	69.69	86.75		
	64.34	15.2 TO 15.3	1,336	1964.6	1963.8		62.82	68.48	85.78		
	98.81	15.3 TO 15.4	6,809	1963.8	1949.3		92.02	72.35	88.88	**95.72**	**131.21**
16		N/A - LINED EVAPORATION PONDS - SEE HYDROGRAPH CALCULATIONS									
17	10.00	17.0 TO 17.1	805	1951.2	1947.6	1.30	94.49	78.00	92.80		
	138.48	17.1 TO 17.2	1,959	1947.6	1940.5		94.34	77.84	92.70	**39.28**	**215.81**
18	10.00	18.0 TO 18.1	404	1944.9	1938.1	1.33	90.00	78.00	92.80		
	21.10	18.1 TO 18.2	830	1938.1	1932.7		90.88	76.60	91.96		
	16.96	18.2 TO 18.3	590	1932.7	1926.1		96.70	67.28	84.82	**21.91**	**108.39**
19	7.87	19.0 TO 19.1	756	1933.9	1929.6	1.35	100.00	62.00	80.60	**34.57**	**11.52**
20	10.00	20.0 TO 20.1	1,000	1932.9	1925.3	1.36	90.69	76.90	92.14		
	14.41	20.1 TO 20.2	801	1925.3	1920.5		90.29	77.44	92.46	**28.53**	**47.32**
21	9.89	21.0 TO 21.1	947	1926.4	1924.8	1.36	90.00	78.00	92.80	**27.60**	**19.73**
22	3.73	22.0 TO 22.1	392	1928.1	1924.0	1.36	90.00	78.00	92.80	**13.47**	**12.57**
23	10.00	23.0 TO 23.1	770	1926.0	1922.2	1.36	90.00	78.00	92.80		
	20.75	23.1 TO 23.2	1,058	1922.2	1917.2		90.00	78.00	92.80		
	38.66	23.2 TO 23.3	2,495	1917.2	1910.2		90.00	78.00	92.80	**53.62**	**84.04**
24	10.00	24.0 TO 24.1	807	1941.9	1938.4	1.35	97.49	66.02	83.82		
	19.33	24.1 TO 24.2	1,074	1938.4	1936.3		99.02	63.57	81.86		
	44.74	24.2 TO 24.3	1,697	1936.3	1929.1		99.90	62.16	80.73		
	28.39	24.3 TO 24.4 (CONF.)	1,554	1929.1	1921.9		92.56	73.58	89.86		
	6.50	24.5 TO 24.6	1,000	1940.0	1932.2		90.00	78.00	92.80		
	14.08	24.6 TO 24.7	755	1932.2	1928.3		90.00	78.00	92.80		
	28.46	24.7 TO 24.8	1,059	1928.3	1927.3		91.47	74.67	90.74		
	21.69	24.8 TO 24.4 (CONF.)	1,788	1927.3	1921.9		90.51	77.19	92.31		
	119.87	24.4 TO 24.9	4,942	1921.9	1914.2		90.00	78.00	92.80	**97.91**	**199.07**

Table 9 – Developed Conditions Rational Method Input Values & Output Calculations (Continued)

AREA	SIZE (AC)	SUBAREA REACH	LEN. (FT)	U.S. ELEV. (FT)	D.S. ELEV. (FT.)	RAIN 100-1 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	AREA TC (MIN.)	TOTAL Q_{100} (CFS)
	10.00	25.0 TO 25.1	879	1935.0	1925.3		90.00	78.00	92.80		
	20.69	25.1 TO 25.2	1,574	1925.3	1923.0		90.00	78.00	92.80		
25	38.80	25.2 TO 25.3	1,306	1923.0	1922.9	1.36	90.00	78.00	92.80		
	84.70	25.3 TO 25.4	1,863	1922.9	1916.7		90.00	78.00	92.80		
	125.72	25.4 TO 25.5	3,934	1916.7	1906.4		94.31	70.79	87.63	**97.34**	**201.55**
	4.79	26.0 TO 26.1 (CONF.)	1,000	1912.6	1905.8		90.00	78.00	92.80		
	5.12	26.2 TO 26.1 (CONF.)	694	1906.9	1905.8		90.00	78.00	92.80		
	3.66	26.1 TO 26.3 (CONF.)	403	1905.8	1904.6		90.00	78.00	92.80		
	4.37	26.4 TO 26.3 (CONF.)	792	1913.2	1904.6		90.00	78.00	92.80		
	4.14	26.3 TO 26.5 (CONF.)	391	1904.6	1904.5		90.00	78.00	92.80		
	9.43	26.6 TO 26.7	1,000	1912.7	1908.0		95.21	68.20	85.56		
	1.91	26.7 TO 26.5 (CONF.)	534	1908.0	1904.5		90.00	78.00	92.80		
	2.51	26.5 TO 26.8 (CONF.)	369	1904.5	1904.1		90.00	78.00	92.80		
	10.00	26.9 TO 26.10	755	1911.0	1905.6		90.12	77.76	92.66		
	7.73	26.10 TO 26.8 (CONF.)	690	1905.6	1904.1		90.00	78.00	92.80		
26	29.14	26.8 TO 26.11	1,377	1904.1	1902.5	1.39	90.00	78.00	92.80		
	48.02	26.11 TO 26.12	2,640	1902.5	1897.1		90.00	78.00	92.80		
	28.21	26.12 TO 26.13 (CONF.	1,785	1897.1	1893.1		90.00	78.00	92.80		
	8.56	26.14 TO 26.15	707	1908.1	1905.8		90.00	78.00	92.80		
	18.12	26.15 TO 26.16	1,141	1905.8	1901.6		90.00	78.00	92.80		
	43.16	26.16 TO 26.17	1,868	1901.6	1896.1		90.00	78.00	92.80		
	14.75	26.17 TO 26.13 (CONF.	1,118	1896.1	1893.1		90.00	78.00	92.80		
	26.84	26.13 TO 26.18 (CONF.	2,434	1893.1	1890.7		90.00	78.00	92.80		
	7.68	26.19 TO 26.20	1,000	1900.3	1894.2		90.00	78.00	92.80		
	19.58	26.20 TO 26.21	1,041	1894.2	1890.8		90.00	78.00	92.80		
	25.53	26.21 TO 26.18 (CONF.	1,444	1890.8	1890.7		90.00	78.00	92.80		
	18.81	26.18 TO 26.22	1,942	1890.7	1887.2		91.27	75.97	91.58	**98.37**	**261.95**
27	6.15	27.0 TO 27.1	424	1908.1	1906.0	1.38	90.00	78.00	92.80	**16.14**	**18.45**
	10.00	28.0 TO 28.1	752	1892.1	1890.1		90.00	78.00	92.80		
	7.48	28.1 TO 28.2 (CONF.)	1,206	1890.1	1887.5		90.00	78.00	92.80		
28	10.00	28.3 TO 28.4	752	1890.9	1887.6	1.39	90.00	78.00	92.80		
	8.61	28.4 TO 28.2 (CONF.)	578	1887.6	1887.5		90.00	78.00	92.80		
	25.30	28.2 TO 28.5	1,132	1887.5	1884.4		91.11	75.80	91.48	**49.41**	**79.27**
29	10.00	29.0 TO 29.1	776	1889.0	1887.5	1.39	90.00	78.00	92.80		
	5.24	29.1 TO 29.2	413	1887.5	1886.4		90.00	78.00	92.80	**30.52**	**28.88**
	7.29	30.0 TO 30.1	1,000	1902.9	1896.4		77.91	84.04	96.42		
30	14.30	30.1 TO 30.2	1,043	1896.4	1893.0	1.40	90.00	89.51	97.90		
	30.30	30.2 TO 30.3	1,163	1893.0	1891.1		90.00	88.11	97.62		
	83.11	30.3 TO 30.4	2,235	1891.1	1886.0		90.21	87.52	97.50	**64.58**	**156.24**
	5.24	31.0 TO 31.1	1,000	1924.3	1920.6		67.03	62.00	80.60		
	10.93	31.1 TO 31.2	991	1920.6	1917.4		84.46	62.00	80.60		
	20.87	31.2 TO 31.3	862	1917.4	1915.8		96.69	62.00	80.60		
	40.83	31.3 TO 31.4	1,062	1915.8	1914.7		97.45	62.00	80.60		
	76.88	31.4 TO 31.5	3,431	1914.7	1905.3		92.81	68.38	85.70		
	156.96	31.5 TO 31.6	5,186	1905.3	1892.3		89.32	80.26	94.16		
31	50.34	31.6 TO 31.7 (CONF.)	2,516	1892.3	1886.8	1.40	90.46	73.90	90.12		
	10.00	31.8 TO 31.9	548	1911.9	1909.9		93.90	84.94	96.96		
	21.33	31.9 TO 31.10	1,333	1909.9	1906.6		90.37	88.41	97.68		
	38.54	31.10 TO 31.11	1,835	1906.6	1902.7		89.87	75.74	91.44		
	95.54	31.11 TO 31.12	3,382	1902.7	1893.6		90.00	62.02	80.62		
	61.48	31.12 TO 31.7 (CONF.)	2,737	1893.6	1886.8		90.00	78.28	92.97		
	45.93	31.7 TO 31.13	3,029	1886.8	1880.8		90.03	89.95	97.99	**118.43**	**335.06**
32	9.24	32.0 TO 32.1	1,000	1891.9	1884.7	1.39	90.00	91.00	98.20		
	15.12	32.1 TO 32.2	1,520	1884.7	1879.6		90.00	91.00	98.20	**39.00**	**40.50**
	5.80	33.0 TO 33.1	1,000	1892.3	1885.7		90.00	91.00	98.20		
33	11.97	33.1 TO 33.2	819	1885.7	1883.7	1.39	90.00	91.00	98.20		
	13.09	33.2 TO 33.3	871	1883.7	1881.4		90.00	91.00	98.20	**43.51**	**47.45**

Table 9 – Developed Conditions Rational Method Input Values & Output Calculations (Continued)

AREA	SIZE (AC)	SUBAREA REACH	LEN. (FT)	U.S. ELEV. (FT)	D.S. ELEV. (FT.)	RAIN 100-1 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	AREA TC (MIN.)	TOTAL Q_{100} (CFS)
	5.20	34.0 TO 34.1	1,000	1897.6	1894.2		90.00	81.58	94.95		
	9.80	34.1 TO 34.2	570	1894.2	1893.3		90.00	81.19	94.71		
34	18.50	34.2 TO 34.3	1,115	1893.3	1888.5	1.40	90.00	81.60	94.96		
	36.85	34.3 TO 34.4	1,198	1888.5	1885.5		90.00	91.00	98.20		
	36.88	34.4 TO 34.5	1,714	1885.5	1881.8		90.00	91.00	98.20	**72.82**	**113.13**
	6.26	35.0 TO 35.1	1,000	1886.9	1882.6		90.00	91.00	98.20		
	2.06	35.1 TO 35.2 (CONF.)	378	1882.6	1880.8		90.00	91.00	98.20		
35	10.00	35.3 TO 35.4	1,000	1887.0	1881.7	1.39	90.00	91.00	98.20		
	4.74	35.4 TO 35.2 (CONF.)	288	1881.7	1880.8		90.00	91.00	98.20		
	10.04	35.2 TO 35.5	686	1880.8	1879.8		90.00	91.00	98.20	**34.59**	**58.58**
36	3.57	36.0 TO 36.1	628	1883.3	1876.4	1.39	90.00	91.00	98.20	**16.10**	**11.11**
37	9.10	37.0 TO 37.1	1,000	1883.0	1878.4	1.39	90.00	91.00	98.20		
	1.32	37.1 TO 37.2	203	1878.4	1877.3		90.00	91.00	98.20	**25.45**	**23.46**
38	7.69	38.0 TO 38.1	1,000	1882.0	1879.1	1.39	90.00	91.00	98.20		
	4.61	38.1 TO 38.2	276	1879.1	1877.7		90.00	91.00	98.20	**28.67**	**25.44**
	2.71	39.0 TO 39.1	1,000	1903.0	1897.8		90.00	62.00	80.60		
	5.97	39.1 TO 39.2	947	1897.8	1895.2		90.00	66.10	83.88		
	8.85	39.2 TO 39.3	1,225	1895.2	1893.0		90.00	84.00	96.40		
	17.12	39.3 TO 39.4 (CONF.)	1,060	1893.0	1889.2		90.00	84.14	96.48		
	9.79	39.5 TO 39.6	1,000	1897.3	1893.3		90.00	84.00	96.40		
	22.23	39.6 TO 39.7 (CONF.)	1,661	1893.3	1890.4		90.00	84.00	96.40		
	9.98	39.8 TO 39.9	1,000	1893.0	1891.0		90.00	84.00	96.40		
	4.90	39.9 TO 39.7 (CONF.)	384	1891.0	1890.4		90.00	84.00	96.40		
	6.72	39.7 TO 39.4 (CONF.)	638	1890.4	1889.2		90.00	84.00	96.40		
39	5.67	39. 4 TO 39.10 (CONF.)	551	1889.2	1887.8	1.40	90.00	87.25	97.45		
	9.31	39.11 TO 39.12	1,000	1892.8	1888.2		90.00	83.86	96.32		
	2.34	39.12 TO 39.10 (CONF.	425	1888.2	1887.8		90.00	84.00	96.40		
	16.22	39.10 TO 39.13	845	1887.8	1886.1		90.00	89.13	97.83		
	31.50	39.13 TO 39.14	1,834	1886.1	1882.0		90.00	88.81	97.96		
	31.91	39.14 TO 39.15 (CONF.	2,287	1882.0	1876.1		90.00	88.00	97.60		
	10.00	39.16 TO 39.17	680	1888.0	1886.7		90.00	84.00	96.40		
	38.56	39.17 TO 39.18	1,765	1886.7	1882.4		90.00	83.44	96.06		
	30.62	39.18 TO 39.15 (CONF.	2,853	1882.4	1876.1		90.00	84.40	96.64		
	13.59	39.15 TO 39.19	2,692	1876.1	1869.9		90.00	90.45	98.09	**86.66**	**230.90**
40	3.40	40.0 TO 40.1	515	1881.4	1876.5	1.40	90.00	91.00	98.20	**15.31**	**11.05**
41	2.26	41.0 TO 41.1	340	1878.4	1876.3	1.39	90.00	91.00	98.20	**14.14**	**7.71**
	6.94	42.0 TO 42.1	1,000	1886.7	1881.5		90.00	84.23	96.54		
	20.24	42.1 TO 42.2	1,696	1881.5	1877.7		90.00	86.06	97.21		
	26.20	42.2 TO 42.3	1,288	1877.7	1875.7		90.00	90.66	98.13		
	11.90	42.3 TO 42.4 (CONF.)	781	1875.7	1872.8		90.00	91.00	98.20		
	6.25	42.5 TO 42.6	1,000	1879.9	1876.4		90.00	88.34	97.67		
42	11.38	42.6 TO 42.4 (CONF.)	1,421	1876.4	1872.8	1.39	90.00	91.00	98.20		
	8.40	42.4 TO 42.7 (CONF.)	1,035	1872.8	1870.5		90.00	91.00	98.20		
	5.57	42.8 TO 42.9	1,000	1879.9	1876.1		90.00	90.04	98.01		
	9.93	42.9 TO 42.10	859	1876.1	1874.3		90.00	91.00	98.20		
	12.83	42.10 TO 42.7 (CONF.)	1,381	1874.3	1870.5		90.00	91.00	98.20		
	4.69	42.7 TO 42.11	353	1870.5	1869.2		90.00	91.00	98.20	**80.64**	**122.26**
43	5.32	43.0 TO 43.1	1,000	1877.8	1872.0	1.39	90.00	91.00	98.20		
	1.63	43.1 TO 43.2	245	1872.0	1871.0		90.00	91.00	98.20	**25.76**	**15.51**
44	6.47	44.0 TO 44.1	850	1874.3	1871.2	1.39	90.00	91.00	98.20	**22.66**	**15.82**
45	3.49	45.0 TO 45.1	439	1876.3	1872.8	1.39	90.00	91.00	98.20	**14.88**	**11.49**

Refer to Technical Appendix No. 6 for printouts of the developed conditions rational method calculations.
Refer to Exhibit "G" for the developed conditions study map.

1.3 Developed Conditions Unit Hydrograph Calculations

Input values for the developed conditions 100-year, 24-hour unit hydrograph calculations prepared for this study are tabulated as follows:

Table 10 – Developed Conditions Unit Hydrograph Input Values

AREA	SIZE (AC)	LENGTH (FT)	LCA (FT)	ELEV. CHANGE (FT)	RAIN 100-1 (IN)	RAIN 100-6 (IN)	RAIN 100-24 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	TC (MIN.)	TC (HR.)
1	1.00	N/A			1.26	1.84	2.50	90.00	78.00	92.80	10.81	0.18
2	1.55	N/A			1.27	1.84	2.49	90.00	78.00	92.80	9.40	0.16
3	4.92	N/A			1.27	1.84	2.48	90.00	78.00	92.80	15.21	0.25
4	8.95	N/A			1.27	1.84	2.48	90.00	78.00	92.80	17.69	0.29
5	13.66	N/A			1.27	1.84	2.46	90.00	78.00	92.80	18.06	0.30
6	13.80	N/A			1.27	1.84	2.45	90.00	78.00	92.80	23.90	0.40
7	14.99	N/A			1.27	1.84	2.44	90.00	78.00	92.80	29.30	0.49
8	8.97	N/A			1.27	1.84	2.42	90.00	78.00	92.80	17.90	0.30
9	29.97	N/A			1.27	1.84	2.42	90.00	78.00	92.80	23.55	0.39
10A	13.57	N/A			1.27	1.84	2.40	90.00	78.00	92.80	59.31	0.99
10B	43.92	N/A			1.27	1.84	2.40	0.00	98.00	99.60	N/A	N/A
11	9.20	N/A			1.28	1.84	2.38	90.00	78.00	92.80	17.81	0.30
12	0.87	N/A			1.28	1.84	2.37	90.00	78.00	92.80	8.80	0.15
13	16.85	N/A			1.28	1.84	2.39	90.00	78.00	92.80	34.34	0.57
14	18.15	N/A			1.29	1.84	2.39	90.00	78.00	92.80	31.25	0.52
15	197.08	N/A			1.27	1.83	2.43	77.20	71.00	87.80	95.72	1.60
16	158.96	N/A			1.27	1.83	2.44	0.00	98.00	99.60	N/A	N/A
17	148.48	N/A			1.30	1.83	2.43	94.30	77.90	92.70	39.28	0.65
18	48.06	N/A			1.33	1.84	2.48	92.80	73.60	89.90	21.91	0.37
19	7.87	N/A			1.35	1.84	2.48	100.00	62.00	80.60	34.57	0.58
20	24.41	N/A			1.36	1.84	2.48	90.50	77.20	92.30	28.53	0.48
21	9.89	N/A			1.36	1.84	2.47	90.00	78.00	92.80	27.60	0.46
22	3.73	N/A			1.36	1.84	2.47	90.00	78.00	92.80	13.47	0.22
23	69.41	N/A			1.36	1.84	2.48	90.00	78.00	82.80	53.62	0.89
24	293.06	N/A			1.35	1.84	2.49	92.80	73.40	89.70	97.91	1.63
25	279.91	N/A			1.36	1.83	2.51	91.90	74.80	90.80	97.34	1.62
26	342.06	N/A			1.39	1.82	2.52	90.20	77.60	92.60	98.37	1.64
27	6.15	N/A			1.38	1.82	2.51	90.00	78.00	92.80	16.14	0.27
28	61.39	N/A			1.39	1.81	2.53	90.50	77.10	92.30	49.41	0.82
29	15.24	N/A			1.39	1.81	2.54	90.00	78.00	92.80	30.52	0.51
30	135.00	N/A			1.40	1.82	2.57	89.50	87.70	97.50	64.58	1.08
31	634.87	N/A			1.40	1.83	2.60	90.70	73.90	90.10	118.43	1.97
32	24.36	N/A			1.39	1.83	2.60	90.00	91.00	98.20	39.00	0.65
33	30.86	N/A			1.39	1.83	2.60	90.00	91.00	98.20	43.51	0.73
34	107.23	N/A			1.40	1.84	2.61	90.00	88.00	97.60	72.82	1.21
35	33.10	N/A			1.39	1.84	2.62	90.00	91.00	98.20	34.59	0.58
36	3.57	N/A			1.39	1.84	2.62	90.00	91.00	98.20	16.10	0.27
37	10.42	N/A			1.39	1.85	2.63	90.00	91.00	98.20	25.45	0.42
38	12.30	N/A			1.39	1.85	2.64	90.00	91.00	98.20	28.67	0.48
39	277.99	N/A			1.40	1.86	2.65	90.00	85.10	97.00	86.66	1.44
40	3.40	N/A			1.40	1.86	2.65	90.00	91.00	98.20	15.31	0.26
41	2.26	N/A			1.39	1.86	2.65	90.00	91.00	98.20	14.14	0.24
42	124.33	N/A			1.39	1.87	2.67	90.00	89.60	97.90	55.82	0.93
43	6.95	N/A			1.39	1.87	2.67	90.00	91.00	98.20	25.76	0.43
44	6.47	N/A			1.39	1.87	2.68	90.00	91.00	98.20	22.66	0.38
45	3.49	N/A			1.39	1.87	2.68	90.00	91.00	98.20	14.88	0.25

Table 10 – Developed Conditions Unit Hydrograph Input Values (Continued)

AREA	SIZE (AC)	LENGTH (FT)	LCA (FT)	ELEV. CHANGE (FT)	RAIN 100-1 (IN)	RAIN 100-6 (IN)	RAIN 100-24 (IN)	PERV. %	SCS (AMC II)	SCS (AMC III)	TC (MIN.)	TC (HR.)
46	3,782.66	35,115	20,362	2044.90	1.29	2.16	3.27	98.08	87.00	97.40	N/A	N/A
47	3,500.82	38,102	19,862	2190.20	1.29	2.07	3.03	97.73	68.93	86.10	N/A	N/A
48	764.55	20,795	10,119	58.10	1.40	1.85	2.62	88.29	73.73	90.00	N/A	N/A
49	17,446.64	81,047	39,563	2612.40	1.36	2.15	3.24	97.56	73.74	90.00	N/A	N/A
50	3,444.14	24,414	13,905	1760.00	1.45	2.64	4.24	100.00	88.00	97.60	N/A	N/A
51	15,350.45	45,387	22,710	2686.10	1.42	2.25	3.40	98.68	78.58	93.10	N/A	N/A
52	2,128.12	17,716	8,950	1680.00	1.39	2.04	2.93	97.04	74.76	90.80	N/A	N/A

Output for the developed conditions 100-year, 24-hour unit hydrograph calculations are tabulated as follows:

Table 11 – Developed Conditions Unit Hydrograph Output Calculations

AREA	LAG (HR.)	Q_{100} (CFS)	V_{100} (AF)
1	**0.14**	**3.10**	**0.17**
2	**0.13**	**5.39**	**0.26**
3	**0.20**	**13.76**	**0.83**
4	**0.23**	**23.61**	**1.51**
5	**0.24**	**35.15**	**2.28**
6	**0.32**	**29.65**	**2.29**
7	**0.39**	**27.61**	**2.48**
8	**0.24**	**23.09**	**1.47**
9	**0.31**	**64.58**	**4.92**
10A	**0.79**	**15.91**	**2.21**
10B	N/A		**8.76**
11	**0.24**	**23.87**	**1.49**
12	**0.12**	**3.19**	**0.14**
13	**0.46**	**29.59**	**2.73**
14	**0.42**	**32.65**	**2.95**
15	**1.28**	**155.79**	**29.75**
16	N/A		**32.25**
17	**0.52**	**231.00**	**24.31**
18	**0.30**	**106.10**	**7.50**
19	**0.46**	**12.94**	**0.93**
20	**0.38**	**49.38**	**4.10**

Table 11 – Developed Conditions Unit Hydrograph Output Calculations (Continued)

AREA	LAG (HR.)	Q_{100} (CFS)	V_{100} (AF)
21	**0.37**	**21.10**	**1.68**
22	**0.18**	**11.15**	**0.63**
23	**0.71**	**95.46**	**11.81**
24	**1.30**	**242.92**	**45.77**
25	**1.30**	**237.71**	**45.58**
26	**1.31**	**300.53**	**58.85**
27	**0.22**	**18.35**	**1.06**
28	**0.66**	**87.71**	**10.55**
29	**0.41**	**29.53**	**2.67**
30	**0.86**	**172.53**	**26.97**
31	**1.58**	**467.11**	**105.73**
32	**0.52**	**42.85**	**5.01**
33	**0.58**	**52.22**	**6.34**
34	**0.97**	**127.68**	**21.80**
35	**0.46**	**65.27**	**6.86**
36	**0.22**	**11.06**	**0.74**
37	**0.34**	**25.11**	**2.17**
38	**0.38**	**26.59**	**2.57**
39	**1.15**	**283.08**	**56.49**
40	**0.21**	**10.74**	**0.71**
41	**0.19**	**7.17**	**0.47**
42	**0.74**	**175.86**	**26.06**
43	**0.34**	**16.57**	**1.47**
44	**0.30**	**15.91**	**1.37**
45	**0.20**	**11.04**	**0.74**
46	**0.83**	**3,931.61**	**948.52**
47	**0.99**	**2,777.99**	**574.04**
48	**1.09**	**752.60**	**128.53**
49	**1.92**	**7,461.43**	**3,317.62**
50	**0.70**	**5,599.01**	**1,141.36**
51	**1.11**	**10,858.87**	**3,438.15**
52	**0.50**	**3,316.92**	**396.52**

Refer to Technical Appendix No. 7 for printouts of the developed conditions 100-year, 24-hour unit hydrograph calculations. Refer to Exhibit "G" for the developed conditions study map.

1.4 Developed Conditions Hydrograph Routing Calculations

As with existing conditions, the U.S.G.S. quadrangles for the offsite watershed indicate braided blue-line streams. Offsite area 50 is shown to split at its downstream watercourse location. The split flows of Area 50 then flow to confluence with flows from Areas 49 and 51, respectively.

As with existing conditions, hydrograph routing was necessarily for modeling of these flow divisions and combinations. The SCS convex method of channel routing was used to route natural flows as discussed above, and tabulated below:

Table 12 – Developed Conditions Hydrograph Routing Calculations

LOCATION	ROUTING ACTION	Q_{100} (CFS) AT LOCATION	V_{100} (AF) AT LOCATION
R1.0	SPLIT AREA 50 HYDROGRAPH	2,799.51	570.68
R1.0 TO R1.1	ROUTE SPLIT FLOW OF AREA 50 HYDROGRAPH TO AREA 49 DISCHARGE POINT	2,461.44	570.68
R1.1	COMBINE AREA 49 HYDROGRAPH AT AREA 49 DISCHARGE POINT	**8,498.27**	**3,888.92**
R2.0	SPLIT AREA 50 HYDROGRAPH	2,799.51	570.68
R2.0 TO R2.1	ROUTE SPLIT FLOW OF AREA 50 HYDROGRAPH TO AREA 51 DISCHARGE POINT	2,460.42	570.68
R2.1	COMBINE AREA 51 HYDROGRAPH AT AREA 51 DISCHARGE POINT	**12,296.89**	**4,008.83**

Refer to Technical Appendix No. 8 for printouts of developed conditions 100-year, 24-hour hydrograph routing calculations. Refer to Exhibit "G" for the developed conditions study map illustrating these routed flows.

F. Existing vs. Developed Conditions Comparison & Proposed Mitigation

1.1 Existing vs. Developed Conditions Comparison

The existing and developed conditions 100-year, 24-hour hydrograph and (as appropriate) routing calculations discussed in Sections "D" and "E" are summarized as follows:

Table 13 – Existing vs. Developed Conditions Comparison

AREA	EXISTING Q_{100} (CFS)	PROPOSED Q_{100} (CFS)	Q_{100} INCREASE (CFS)	EXISTING V_{100} (AF)	PROPOSED V_{100} (AF)	V_{100} INCREASE (AF)
1	2.27	3.10	0.83	0.12	0.17	**0.05**
2	3.91	5.39	1.48	0.18	0.26	**0.08**
3	9.16	13.76	4.60	0.57	0.83	**0.26**
4	14.09	23.61	9.52	1.03	1.51	**0.48**
5	21.50	35.15	13.65	1.56	2.28	**0.72**
6	18.27	29.65	11.38	1.57	2.29	**0.72**
7	17.15	27.61	10.46	1.70	2.48	**0.78**
8	14.12	23.09	8.97	1.01	1.47	**0.46**
9	39.52	64.58	25.06	3.37	4.92	**1.55**
10A	10.55	15.91	5.36	1.51	2.21	**0.70**
10B	N/A (BORROW PIT - ASSUME REMOVAL)			8.76 (CONTAINED)	8.76	**8.76**
11	14.60	23.87	9.27	1.02	1.49	**0.47**
12	2.24	3.19	0.95	0.10	0.14	**0.04**
13	18.40	29.59	11.19	1.88	2.73	**0.85**
14	21.03	32.65	11.62	2.03	2.95	**0.92**
15	146.52	155.79	9.27	26.15	29.75	**3.60**
16	N/A (LINED EVAPORATION PONDS TO REMAIN)			32.25 (CONTAINED)	32.25 (CONTAINED)	**0.00**
17	211.40	231.00	19.60	22.34	24.31	**1.97**
18	79.26	106.10	26.84	5.66	7.50	**1.84**
19	12.94	12.94	0.00	0.93	0.93	**0.00**
20	29.32	49.38	20.06	2.69	4.10	**1.41**
21	12.19	21.10	8.91	1.16	1.68	**0.52**
22	7.85	11.15	3.30	0.44	0.63	**0.19**
23	60.22	95.46	35.24	7.94	11.81	**3.87**
24	163.10	242.92	79.82	33.20	45.77	**12.57**
25	161.32	237.71	76.39	33.17	45.58	**12.41**
26	200.00	300.53	100.53	41.48	58.85	**17.37**
27	11.77	18.35	6.58	0.75	1.06	**0.31**
28	54.11	87.71	33.60	7.00	10.55	**3.55**
29	18.02	29.53	11.51	1.74	2.67	**0.93**
30	153.30	172.53	19.23	22.98	26.97	**3.99**
31	427.00	467.11	40.11	94.32	105.73	**11.41**
32	40.15	42.85	2.70	4.53	5.01	**0.48**
33	45.87	52.22	6.35	5.73	6.34	**0.61**
34	123.15	127.68	4.53	20.37	21.80	**1.43**
35	58.05	65.27	7.22	6.38	6.86	**0.48**
36	10.53	11.06	0.53	0.70	0.74	**0.04**
37	23.25	25.11	1.86	2.06	2.17	**0.11**
38	24.50	26.59	2.09	2.44	2.57	**0.13**
39	278.92	283.08	4.16	54.79	56.49	**1.70**
40	10.31	10.74	0.43	0.68	0.71	**0.03**
41	7.00	7.17	0.17	0.45	0.47	**0.02**
42	163.96	175.86	11.90	24.95	26.06	**1.11**
43	15.52	16.57	1.05	1.39	1.47	**0.08**
44	15.50	15.91	0.41	1.30	1.37	**0.07**
45	10.68	11.04	0.36	0.70	0.74	**0.04**
46	3,931.07	3,931.61	0.54	948.24	948.52	**0.28**
47	2,754.99	2,777.99	23.00	563.85	574.04	**10.19**
48	732.31	752.60	20.29	120.74	128.53	**7.79**
49 & 50 (ROUTED)	8,140.15	8,498.27	358.12	3,663.71	3,888.92	**225.21**
50 & 51 (ROUTED)	12,269.86	12,296.89	27.03	3,994.79	4,008.83	**14.04**
52	3,269.02	3,316.92	47.90	379.87	396.52	**16.65**
TOTAL:	**33,879.92**	**35,015.89**	**1,135.97**	**10,117.27**	**10,490.54**	**373.27**

As tabulated on the previous page, the proposed project will result in an increase in total watershed 100-year, 24-hour flows of **1,135.97 c.f.s.**, **(a 3.4% increase)** and an increase in total watershed 100-year, 24-hour volume of **373.27 a.f. (a 3.7% increase).**

1.2 Proposed Mitigation

The 373.27 a.f. 100-year, 24-hour volume increase anticipated to be generated by the proposed project equates to a per-acre increase of **0.07 a.f. per-acre (3,049 cu. ft. per acre)** for the 5,531-acre project site.

This increase shall be captured in long, narrow, and shallow strip retention basins located along intermittent locations within the project site, rather than at the downstream limits of the project site. This will allow 100-year discharge (following retention of the calculated volume differential) from the basins to normalize within the project boundary prior to discharging to adjacent properties, to mimic existing drainage conditions to the absolute extent possible and prevent artificial concentration of flows at the project limits.

G. Flood Hazard Analysis

1.1 Sources of Flood Hazards

Based on the hydrologic analysis of the study watershed and field investigation of the project site, the following potential flood hazards have been identified:

- **Mojave River Wash**: Exhibit "H.1" contains copies of the relevant FEMA Flood Insurance Rate Maps (FIRMs) for the project watershed. As indicated on these maps, no published flood information is available from FEMA. The United States Army Corps of Engineers (USACoE) publication titled "Flood Plain Information – Mojave River (Vicinity of Barstow)", dated October 1968, contains estimated unbulked 100-year peak flow, velocities, and channel water surface profile and flood inundation limits for the reach of the Mojave River wash with potential to impact the project. Relevant excerpts are included as Attachment No. 2. A Q_{100} of **18,500 c.f.s.** is indicated for the wash in the vicinity of the project.

- **East Daggett Interceptor Channel**: As previously discussed and indicated in Attachment No. 1, the published unbulked Q_{100} for the East Daggett Interceptor Channel is 3,900 c.f.s. The calculated Q_{100} in this report for the drainage area tributary to the channel is **3,931.61 c.f.s.** Discharge of these flows from the channel through the 20 identified pipe culverts located under the existing on-site railroad spur at the northwestern portion of the project site flow naturally in a northeasterly direction to confluence with the Mojave River wash.

- **Tributary (Offsite) Flows:** The peak calculated Q_{100} flows through the 12 A.T.S.F. railroad culverts discharging to the project site are substantial and were therefore identified as have the potential to cause flood hazard impacts to the project site.

- **On-Site Flows:** The on-site areas north and downstream of the A.T.S.F. railroad are typically very flat with high potential to pond. Therefore, these areas were identified as have flood hazard potential resulting from a localized 100-year event.

1.2 Mojave River Wash Hydraulic Analysis

A HEC-RAS hydraulic analysis was performed for an approximately 19,900 ft. (3.77 mile) reach of the Mojave River wash beginning upstream at the existing railroad bridge crossing to the west (upstream) and ending downstream at a location slightly past the northernmost portion of the project site. This reach was identified as having the highest potential to impact the project site due to close proximity of the southern bank of the wash to the northern project site boundary. Cross sections were generated at 128 locations along the study reach using the on-site aerial topography for the project. Note that it was necessary to include 20' USGS contours along the northernmost edge of the aerial topographic survey for the northern (left) bank of the Mojave River wash and "smooth" the transition between the aerial topography and USGS topography at each the affected cross sections. However, based on the HEC-RAS results, flow within the wash did not substantially incorporate this added topography. The published Q_{100} of 18,500 for the Mojave River wash at the project location was combined with the published Q_{100} of 3,900 c.f.s. for the East Daggett Interceptor Channel for a total Q_{100} **22,400 c.f.s**. used in the HEC-RAS analysis.

Manning's "n" values were used in the hydraulic model to estimate frictional energy losses in the flow. The FEMA Flood Insurance Study (FIS) for San Bernardino County, CA & Incorporated Areas (revised September 2, 2016) indicated "n" values of 0.040-0.045 for the main channel and 0.040-0.050 for left and right overbanks of the Mojave River at Barstow. Aerial and satellite imagery indicated that the main channel and overbanks of the Mojave River at Barstow is very sandy with almost no vegetation. The main channel and overbank conditions of the Mojave River at Barstow is very similar to the main channel and overbank conditions of the Mojave River at the project location. Therefore, a main channel "n" value of 0.040 and overbank "n" values of 0.045 were used for the hydraulic analysis of the channel reach at the project location.

Refer to Attachment No. 3 for the HEC-RAS output summary table, water surface profile plot, and cross sections plots. Refer to Exhibit ""I" for the HEC-RAS study map indicated the calculated flow limits. As shown on the output summary table, the main channel depth of flow (after normalization of the hydraulic model) averages **4 to 5 ft.** These depths correlate with the 100-year water surface profiles estimated by the USACoE for the Mojave River channel for the reach in question (see Exhibit "H.2"). Attachment No. 3 also indicates that the 100-year average main channel velocities (after normalization of the hydraulic model) range from approximately **2.5 to 4 f.p.s.** As shown in Attachment No. 2, these calculated velocities correlate to the 100-year flow velocity of 4 f.p.s. estimated by the USACoE for the lower limit of their study. Note that the USACoE shows the 100-year velocity of the wash at the Daggett location to be higher (10 f.p.s.); however, this location is actually upstream of the existing railroad bridge, where significant narrowing of the channel occurs in comparison to the reach analyzed for this report.

Based on the HEC-RAS hydraulic analysis, and as shown on Exhibit "I", the 100-year flows of the Mojave River wash do not exceed the southern (right) overbank of the wash, and do not impact the project site.

1.3 FLO-2D Flood Analysis

A FLO-2D flood simulation was performed to determine potential flood hazards impacting the project site. A 12,873-acre (20.11 sq. mi.) grid model was generated from the existing aerial topographic survey of the areas north of the A.T.S.F. railroad and the Mojave River wash. Due to the size of the analyzed area, a 100-ft. grid size was selected. Note that the southeast portion of the project site was added after the aerial topographic survey was preformed and mapped; therefore, this portion of the project site was not included in the FLO-2D calculations. Also note that (as with the HEC-RAS hydraulic model) it was necessary to include 20' USGS contours along the northernmost edge of the aerial topographic survey for the northern (left) bank of the Mojave River wash; however, based on the FLO-2D results, flow within the wash did not substantially incorporate this added topography.

The 100-year, 24-hour hydrographs for each of the 12 railroad culvert locations discharging to the project site, as well as the 100-year, 24-hour hydrograph for the East Daggett Interceptor Channel, were placed at the appropriate locations on the study grid. A total simulation time of approximately 35 hours was used to match the total time of the longest hydrograph.

Generation of the hydrograph for the Mojave River wash was based on the 18,500 c.f.s. 100-year flow estimated by the USACoE. This flow was then distributed as a hydrograph based on Page 31 of the USACoE Mojave River flood study, which states that "the rise from streambed to extreme flood peak during a local storm (thunderstorm) would be approximately 2 to 3 hours and the floodwaters would remain on the floodplain for less than 1/2 day" (see Attachment No. 4 for excerpt). This description was based on the stage hydrograph illustrated as Figure 11 on Page 22 of the USACoE study, which was based on the stream gage data recorded for the January 1943 flood at River Mile 61.6 / Barstow (see Attachment No. 4). The Mojave River wash hydrograph used in the FLO-2D study was constructed by adjusting the time-discharge data of the recorded hydrograph for the 18,500 c.f.s. estimated flow (see constructed hydrograph plot included in Attachment No. 4). Note that to "spread" the flow over the width of the wash in the FLO-2D model, the 18,500 c.f.s. hydrograph was divided into four equal 4,625 c.f.s. hydrographs, to more accurately simulate flow within the wash.

Local 100-year thunderstorm precipitation over the FLO-2D model area was simulated using the FLO-2D precipitation function. Base on the 100-year, 24-hour NOAA data obtained for this study (see Exhibit "C.3"), the area-averaged precipitation for the FLO-2D model area was determined to be 2.53 in. This total rainfall was distributed based on the San Bernardino County rainfall distribution graph described in the SBC Hydrology Manual.

Losses for the FLO-2D model area were based on the SCS method in accordance with the SBC Hydrology Manual. The area-averaged SCS Curve Number (AMC III) for the FLO-2D model area was determined to be **83.45** (per the data illustrated on Exhibit "D.11"). Based on this SCS Curve Number, the initial rainfall abstraction (Ia) used in the FLO-2D model was determined to be **0.40** in., using the equation 0.2 * (1000/CN – 10).

The levee function of FLO-2D was used to simulate the bermed railroad spur and other protective berms constructed for existing facilities and the existing line evaporation ponds. For (primarily) overland desert floodplain flow with poor brush cover and minimal debris, a Manning's "n" of 0.045 was used for the entire

FLO-2D model area, with the exception of the main channel of the Mojave River wash, which was assigned an "n" value of 0.040 as discussed in Section G1.2 of this study.

The FLO-2D simulation summary is included as Attachment No. 5. Exhibit "J" shows the maximum calculated 100-year flood depths impacting the project site. Exhibit "K" shows the maximum calculated 100-year flood velocities impacting the project site.

Exhibit "J" and Exhibit "K" include overlays of the USACoE Mojave River wash flood limits (per the USACoE maps included as Exhibit "H.2") as well as the 100-year flow limits calculated in HEC-RAS for this study (per Exhibit "I").

As shown, all three flow limits for the Mojave River wash show that the 100-year flows are contained within the southern (right) bank of the wash, and therefore do not encroach into the project boundary. Variation between the USACoE, HEC-RAS, and FLO-2D flow extents can be attributed to differing topographic sources, dates of the studies performed, and methodology (approximate methods for the USACoE study vs. one-dimensional analysis for HEC-RAS vs. two-dimensional analysis for FLO-2D).

H. Summary & Conclusion

Per the hydrology and hydraulics calculations performed for this preliminary study, the proposed 5,531-acre Daggett Solar Power Facility will result in a 100-year, 24-hour volume increase of 373.27 a.f. This volume differential shall be captured and retained in strip basins distributed in a manner that will mimic existing hydrology to the maximum possible extent. The proposed project will not substantially change existing conditions topography.

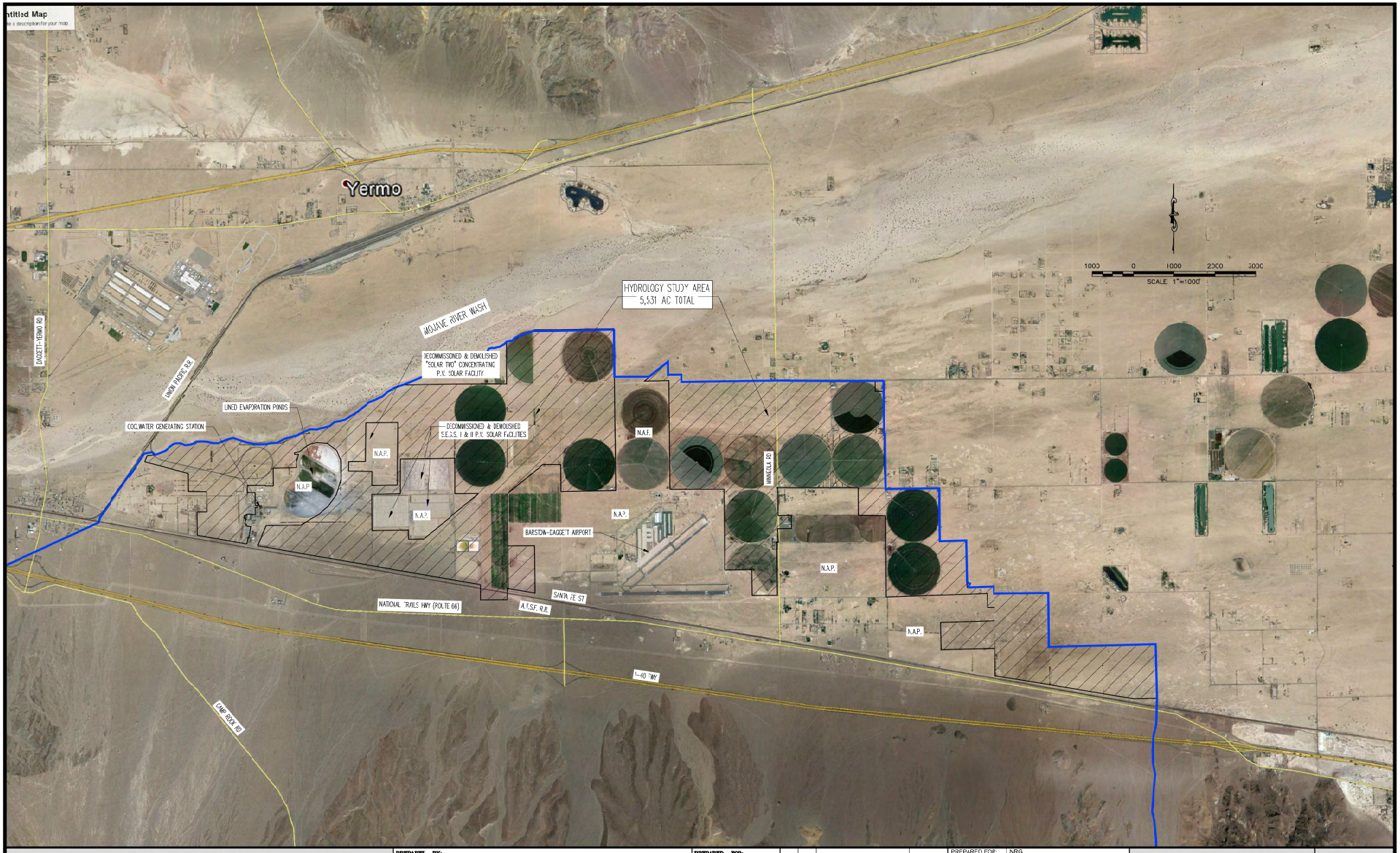
Regarding flood hazard mitigation, it is recommended that the proposed PV solar arrays be elevated one foot above the calculated 100-year max. flood depths shown on Exhibit "J", to account for freeboard. The array pilings should be of adequate design to account for scour associated with the 100-year flood velocities down on Exhibit "K".

In conclusion, development of the proposed Daggett Solar Power Facility will include necessary mitigation measures to capture the increased runoff resulting from the project, while providing adequate design measures to protect the proposed PV solar arrays.

(END)

EXHIBIT “A”

Project Site – Aerial Orthophoto



AERIAL PHOTO EXHIBIT
DAGGETT SOLAR POWER FACILITY
IN THE TOWN OF DAGGETT, COUNTY OF SAN BERNARDINO, CA

PREPARED BY:
BONADIMAN
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CIVILDESIGN

PREPARED FOR:
nrg

BY	MARK	REVISION DESCRIPTION	DATE

PREPARED FOR:	NRG
JOB NO:	154303
PREPARED BY:	JDN
CHECKED BY:	JTS

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AERIAL PHOTO EXHIBIT
DAGGETT SOLAR POWER FACILITY
IN THE TOWN OF DAGGETT, COUNTY OF SAN BERNARDINO ,CA

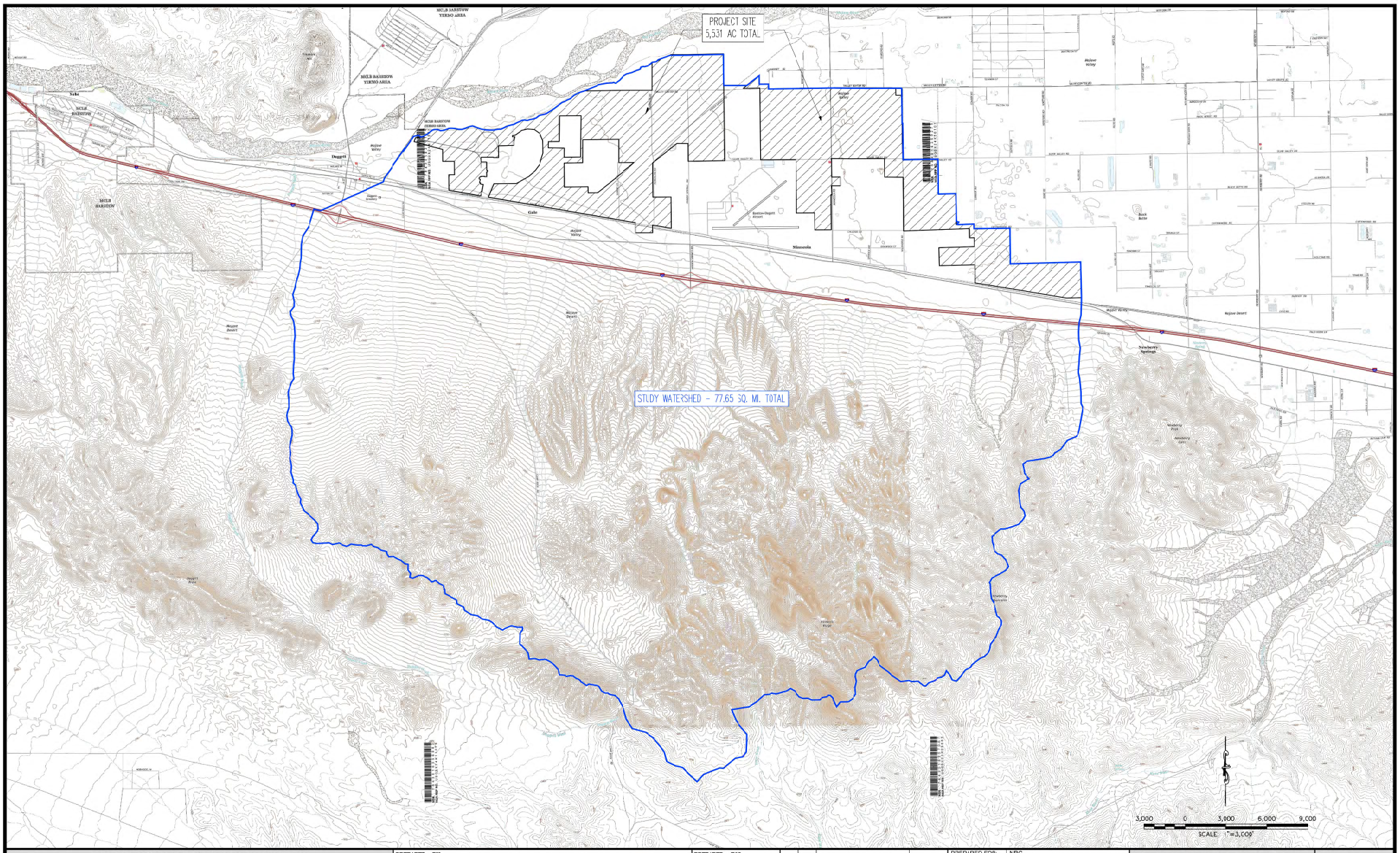
DISREGARD PRINTS BEARING EARLIER REVISION DATES! → 09-07-17

A

SHEET 1 OF 1

EXHIBIT “B”

Project Watershed – USGS Quadrangle



USGS QUADRANGLE EXHIBIT

DAGGETT SOLAR POWER FACILITY

IN THE TOWN OF DAGGETT, COUNTY OF SAN BERNARDINO, CA

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CIVILDESIGN

PREPARED FOR:

nrg

BY	MARK	REVISION DESCRIPTION	DATE

PREPARED FOR:	NRG
JOB NO:	154303
PREPARED BY:	JDN
CHECKED BY:	JTS

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USGS QUADRANGLE EXHIBIT

DAGGETT SOLAR POWER FACILITY

IN THE TOWN OF DAGGETT, COUNTY OF SAN BERNARDINO, CA

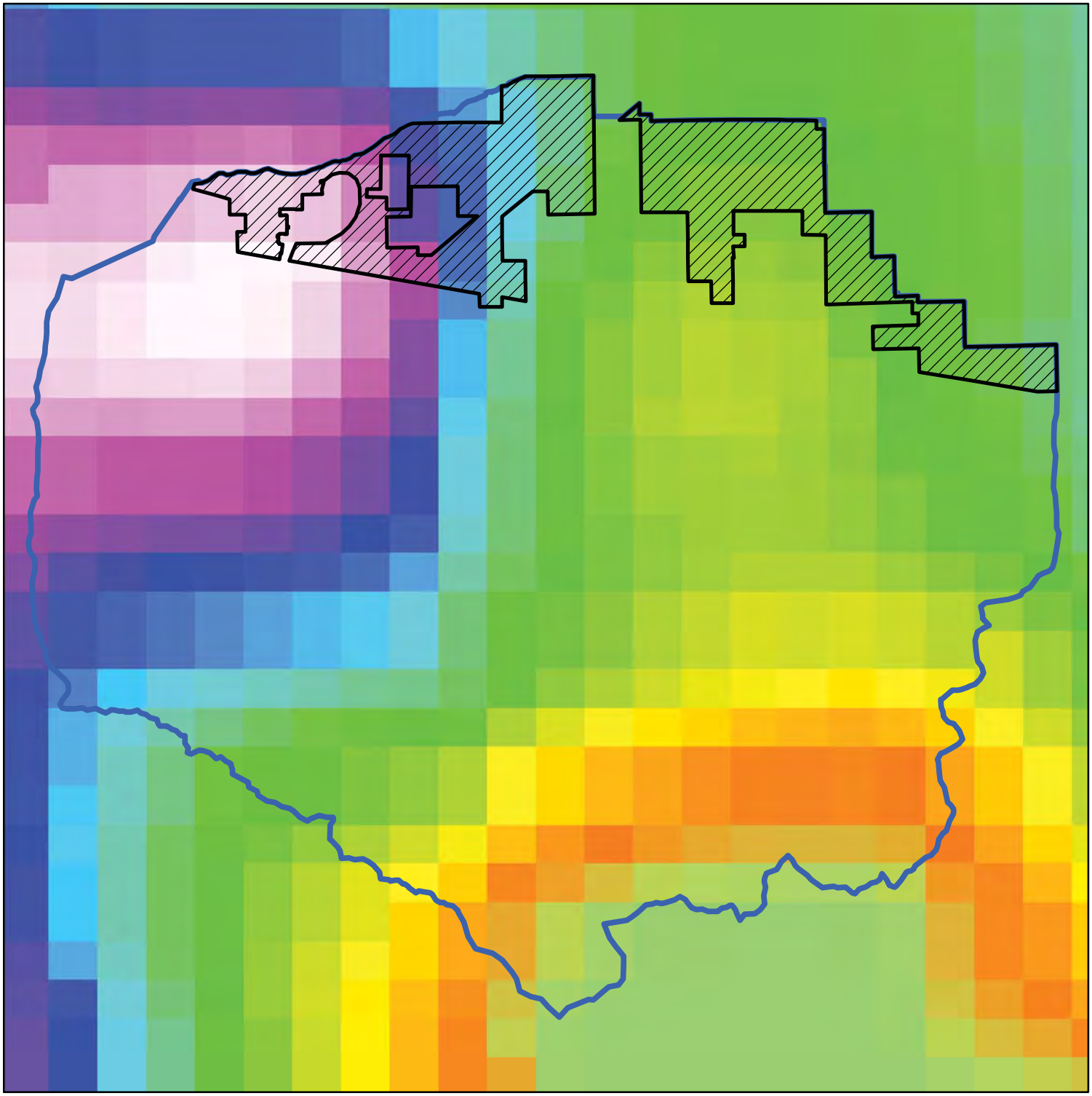
B

DISREGARD PRINTS BEARING EARLIER REVISION DATES! → 09-07-17

SHEET 1 OF 1

EXHIBIT “C.1”

Watershed Precipitation
NOAA Atlas 14 100-Year, 1-Hour Grid



PROJECT SITE

STUDY WATERSHED

PRECIPITATION (IN.)

HIGH : 1.51"

LOW : 1.23"

EXHIBIT C.1

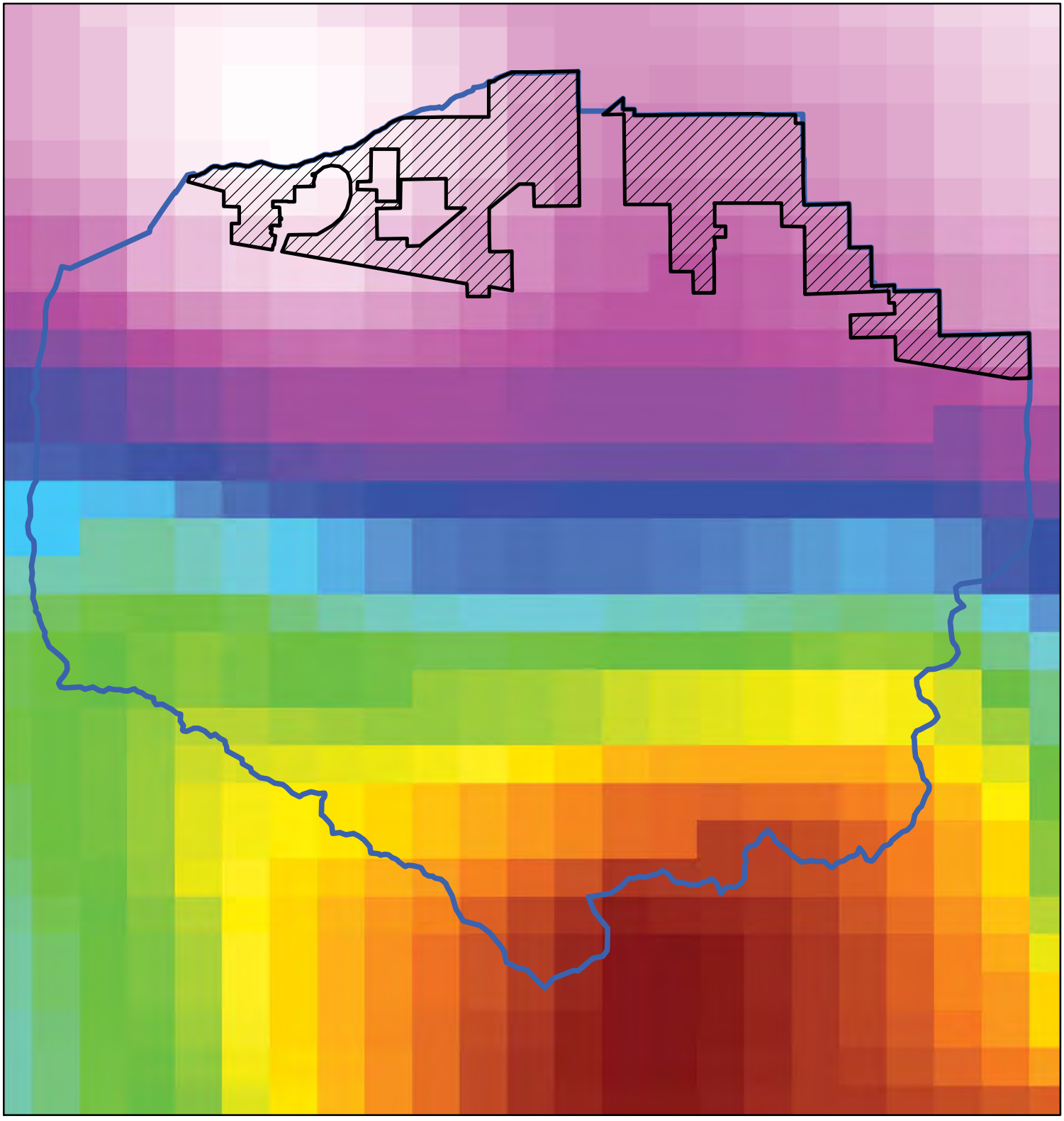
100-YEAR, 1-HOUR RAINFALL PER NOAA ATLAS 14 GRID DATA

N

0 4,500 9,000 18,000 Feet

EXHIBIT “C.2”

Watershed Precipitation
NOAA Atlas 14 100-Year, 6-Hour Grid



PROJECT SITE

STUDY WATERSHED

PRECIPITATION (IN):

HIGH: 2.87"

LOW: 1.79"

EXHIBIT C.2

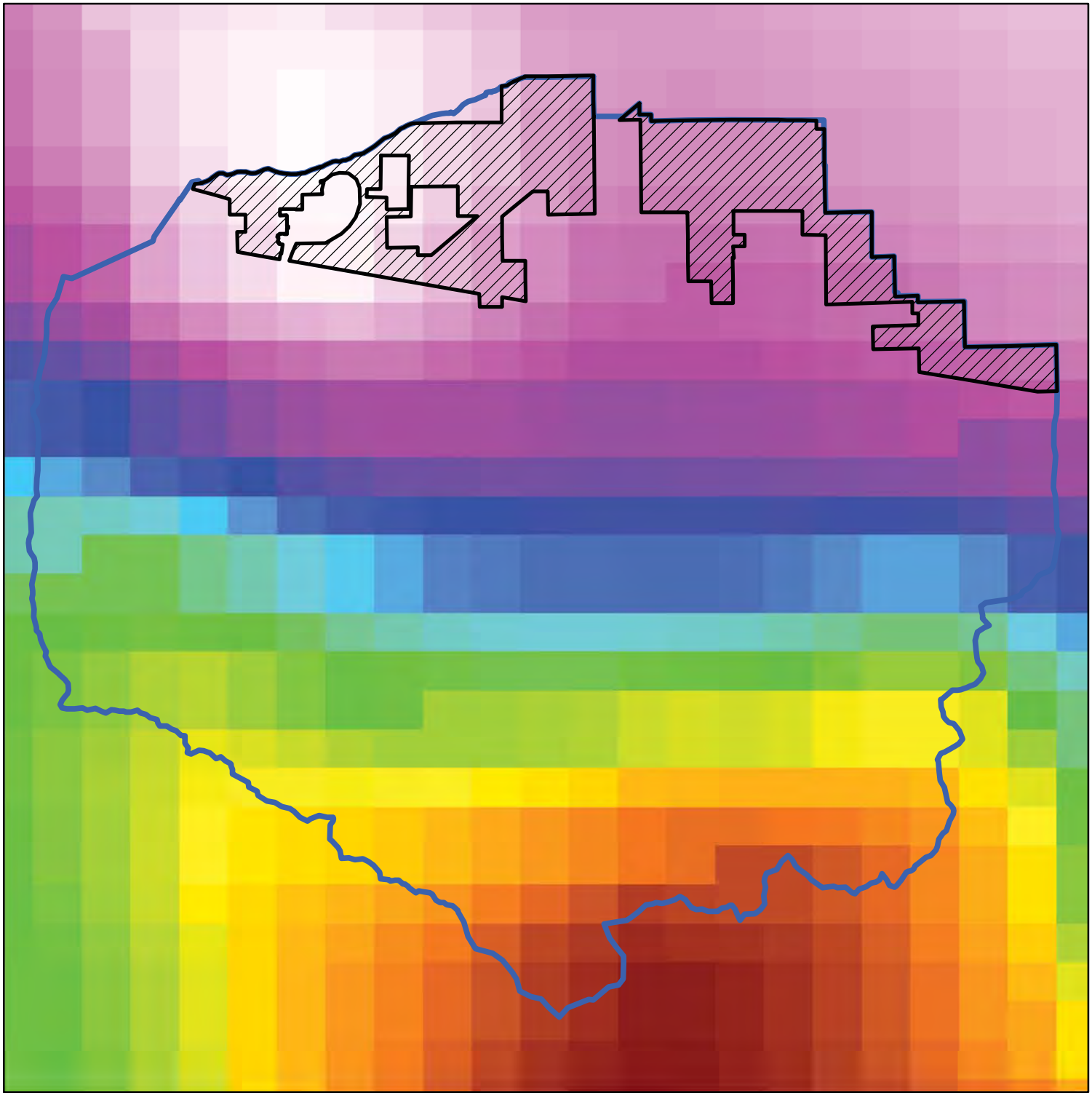
100-YEAR, 6-HOUR RAINFALL PER NOAA ATLAS 14 GRID DATA

N

0 4,500 9,000 18,000 Feet

EXHIBIT “C.3”

Watershed Precipitation
NOAA Atlas 14 100-Year, 24-Hour Grid



PROJECT SITE

STUDY WATERSHED

PRECIPITATION (IN.):

HIGH : 4.86"

LOW: 2.36"

EXHIBIT C.3

100-YEAR, 24-HOUR RAINFALL PER NOAA ATLAS 14 GRID DATA

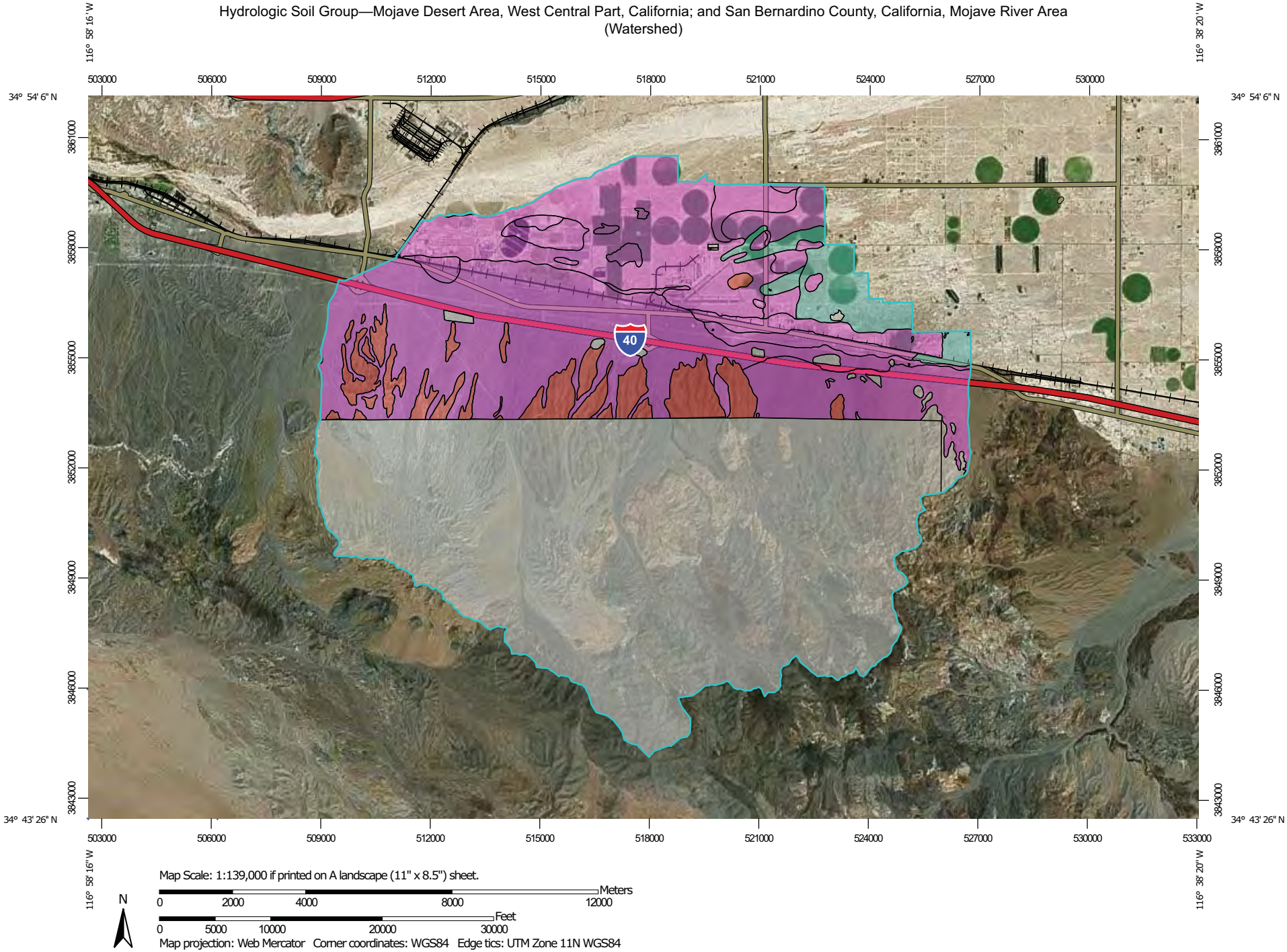
N

0 4,500 9,000 18,000 Feet

EXHIBIT “D.1”

Watershed Hydrologic Soils Groups
NRCS Web Soils Survey

Hydrologic Soil Group—Mojave Desert Area, West Central Part, California; and San Bernardino County, California, Mojave River Area (Watershed)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mojave Desert Area, West Central Part, California
Survey Area Data: Version 9, Sep 28, 2016

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 8, Sep 12, 2016

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 13, 2016—Feb 2, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Mojave Desert Area, West Central Part, California (CA698)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
NOTCOM	No Digital Data Available		26,096.4	52.5%
Subtotals for Soil Survey Area			**26,096.4**	**52.5%**
Totals for Area of Interest			**49,706.3**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — San Bernardino County, California, Mojave River Area (CA671)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
100	ARIZO GRAVELLY LOAMY SAND, 2 TO 9 PERCENT SLOPES	A	2,236.1	4.5%
112	CAJON SAND, 0 TO 2 PERCENT SLOPES	A	4,854.8	9.8%
113	CAJON SAND, 2 TO 9 PERCENT SLOPES	A	1,202.3	2.4%
115	CAJON GRAVELLY SAND, 2 TO 15 PERCENT SLOPES	A	8,375.8	16.9%
117	CAJON LOAMY SAND, LOAMY SUBSTRATUM, 0 TO 2 PERCENT SLOPES	A	811.5	1.6%
123	DUNE LAND		16.9	0.0%
127	HALLORAN SANDY LOAM	C	367.0	0.7%
128	HALLORAN-DUNELAND COMPLEX, 0 TO 15 PERCENT SLOPES*	C	1,295.4	2.6%
137	KIMBERLINA LOAMY FINE SAND, COOL, 0 TO 2 PERCENT SLOPES	A	1,241.2	2.5%
138	KIMBERLINA LOAMY FINE SAND, COOL, 2 TO 5 PERCENT SLOPES	A	30.0	0.1%
139	KIMBERLINA GRAVELLY SANDY LOAM, COOL, 2 TO 5 PERCENT SLOPES	A	89.3	0.2%
151	NEBONA-CUDDEBACK COMPLEX, 2 TO 9 PERCENT SLOPES*	D	2,643.8	5.3%
155	PITS		168.3	0.3%

Hydrologic Soil Group— Summary by Map Unit — San Bernardino County, California, Mojave River Area (CA671)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
157	RIVERWASH		7.6	0.0%
158	ROCK OUTCROP-LITHIC TORRIORTHENTS COMPLEX, 15 TO 50 PERCENT SLOPES*		250.8	0.5%
177	YERMO-KIMBERLINA, COOL, ASSOCIATION, SLOPING*	A	3.7	0.0%
178	WATER		5.6	0.0%
179	MISCELLANEOUS WATER		9.9	0.0%
Subtotals for Soil Survey Area			**23,609.8**	**47.5%**
Totals for Area of Interest			**49,706.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

EXHIBIT “D.2”

Watershed Hydrologic Soils Groups
SBC Hydrology Manual

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