July 2022
2021-196

Hesperia Spec. Industrial
Industrial Buildings
City of Hesperia, CA

Preliminary Hydrology Report

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WestLAND Group, Inc.

WestLAND Group, Inc.

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I. Purpose and Scope

The purpose of this preliminary study is to identify the mitigation measures that must be implemented during final design in order to ensure that the project does not have adverse impacts to downstream properties. The project will develop a conceptual storm drain infrastructure plan that will demonstrate how the project will flood protect the project as required by the City of Hesperia, San Bernardino County, and FEMA regulations and policies.

This study evaluates the Post-Development Hydrological Conditions and provides the criteria for the design of the on-site storm drain systems for flood protection of the proposed structures. In the design of the storm drain system, the project performed storm drain alternative assessments and evaluated the following:

1. The ultimate storm drain solution identified as part of the Victorville Master Drainage Plan prepared by the County of San Bernardino
2. A project stand-alone solution due to the timing to implement the solution from the Victorville Master Drainage Plan

When evaluating the solution identified in the Victorville Master Drainage Plan, the following challenges were identified that make it impractical:

1. Availability of Right of Ways
2. The viability of constructing the regional basin
3. Design coordination with DWR
4. Impacts to timing and financial impacts to the project

Therefore, in the case of downstream infrastructure being absent, the guidelines established in the San Bernardino County Basin Design criteria must be met for this project.

The scope of the study includes the following:

1. Evaluate three alternatives to satisfying drainage requirements.
    a. Alternative 1 is to implement the solution identified in the Victorville MDP. However, this is not feasible due to the challenges listed previously.
    b. Alternative 2 is to release runoff from the site at a rate that does not exceed the allowable flow rate, which is equivalent to the 90% of the pre-development flow rate for a 100-year storm. To obtain the allowable flow rate, the 100-year storm for pre-development conditions is modelled as a 25-year storm per the San Bernardino County Detention Basin Guidelines.
    c. Alternative 3 is to retain the entire post-development runoff volume for a 100-year storm onsite.
2. Perform 100-year rational method calculations as outlined in the San Bernardino County Flood Control Hydrology Manual.
3. Determine peak flow rates tributary to the mainline systems.
4. Size the infiltration/retention basin using the volumes determined from the unit hydrograph calculations.
5. Preparation of a report, which consists of hydrological and hydraulic results, as well as supporting exhibits.

II. Project Site and Drainage Area Overview

The proposed site is an industrial development located near the northwest corner of Palmeto Way and Amargosa Rd in Hesperia, California. The project site is bounded by roads and can be located with the provided information below:

- South of Avenal St
- East of Amargosa Rd
- North of Palmeto Way

The site consists of several parcels both irregular and rectangular in shape which approximate to 31 acres, and part of the project will include offsite street improvements along the frontage of the project on Yucca Terrace, Phelan Road, and a portion of Highway 395. The site is entirely vacant and undeveloped and surrounded by mostly paved/dirt roads. The existing natural cover consists primarily of shrubs, native bushes and trees throughout the site. The highest elevation per survey data is located on the south westerly corner of the project site. The majority of the site will sheet flow towards the northerly east corner of the project site. Overall, the site depicts slopes of approximately 2± percent towards the northerly east corner of the project site. Existing drainage patterns can be seen in the “Pre-Developed Condition Exhibit” in Appendix C.

The proposed site is considered an industrial development, and flows will be collected through nearby catch basins and conveyed to either an above ground or underground infiltration/retention basin via a storm drain system.

The project proposes to construct one building that will be used for industrial and commercial purposes. The project will have its dedicated parking areas and truck docking areas. In addition, for water quality purposes, the project proposes a storm drain system to convey stormwater to infiltration/retention basins. Since infiltration is a priority for water quality purposes and is needed to meet the WQMP hierarchy, the project will use a combination of an above ground infiltration basin and underground CMP infiltration basin to treat the stormwater runoff for water quality purposes.

As discussed previously, there are three alternatives to managing stormwater runoff. The first alternative is to follow the solution identified in the Victorville MDP and discharge to the regional basin. However, due to challenges such as the regional basin not yet being constructed along with the Right of Way issues mentioned previously, there are timing and financial impacts that makes this alternative infeasible.

Therefore, the second alternative of releasing runoff at a rate no greater than the 25-year pre-project flow rate is evaluated. However, if this alternative were to be implemented, the flow condition in the post-development conditions will be altered from sheet flow to concentrated flow. This will result in the potential for erosion downstream of the project site and will not comply with California Drainage Law which states that there cannot be a net increase in flow and velocity. In addition, there are additional challenges such as a lack of Right of Way to discharge the flows, future liability from downstream property owners that may experience flooding due to the project discharging runoff, and the creation of future environmental habitat on offsite properties due to the concentration of flows. As a result of these challenges, the project proposes to retain the entire runoff volume for up to a 100-year storm event.

III. Methodology

The San Bernardino County Hydrology Manual, was used to develop the hydrological parameters for the hydrology analysis. The rational method was used in order to perform a hydrological analysis for the proposed project conditions. The proposed development will be designed to prevent flooding for the 100-year storm.

Peak flow rate was calculated using the Rational Method calculation as outlined in the San Bernardino County Hydrology Manual (Equation D.4)

$$Q= 0.90(I-F_m)*A$$

- 100-year AMC III
- Soil Type B
- Manning's Values Used:
    - Existing Surface n=0.030
- Project is located in the "Desert" area

IV. Hydrology

The rainfall depths used in the hydrology calculations are as follows:

Storm Event & Duration	Rainfall (inches)
2-Year, 1-Hour	0.433
2-Year, 6-Hour	1.01
2-Year, 24-Hour	1.89
10-Year, 1-Hour	0.747
100-Year, 1-Hour	1.25
100-Year, 6-Hour	2.81
100-Year, 24-Hour	5.90

The rainfall depths were obtained from NOAA Atlas 14, which is included as part of Appendix F.

As discussed previously, the project evaluated three alternatives. However, the alternative to implement the solution identified in the Victorville MDP was eliminated due to the timing required to implement the solution due to the right of way constraints, regional hydrology studies, multi-agency coordination and financial burdens on the project. This resulted in the project to focus on the following alternatives:

1. Release runoff from the site at a rate that does not exceed 90% of the pre-development flow rate for a 25-year storm per the San Bernardino County Detention Basin Guidelines.
2. Retain the entire post-development runoff volume for a 100-year storm onsite.

For alternative 1 to be viable, the following needs to be met:

1. California Drainage Law which states that there cannot be a net increase in flow and velocity
2. The maximum outflow cannot be exceeded
3. The drainage infrastructures must be located within easements or right of ways

If alternative 1 were to be chosen, runoff would be released at a concentrated flow rate which increases the flow velocity and may cause erosion at the ditch downstream of the project site. This would therefore go against the California Drainage Law. In addition, since runoff would be discharged offsite into an adjacent property, there are additional concerns regarding easements and right of way that would allow us to discharge the runoff onto an adjacent property. Due to the concerns regarding the California Drainage Law and the easement and right of way issues, alternative 1 was deemed to be infeasible.

After assessing alternative 1 and the issues regarding timing, liability, and risk, alternative 2 was evaluated since it is easily demonstrated that this has lower risk and liability, and the client understands that there is a higher cost to implement. This alternative proposes to retain the entire post-development runoff onsite and is the option that the project will be using to satisfy the drainage requirements.

The proposed site was divided in subareas based on the proposed drainage patterns in order to better analyze the runoff produced throughout each area. Below is a summary of the results.

HYDROLOGY SUMMARY						
AREA ID	AREA (AC)	TC (MIN)	Q_{100} (CFS)	V_{100} (CF)	Retention Provided (CF)	Total V Provided (CF)
A	6.29	10	16.5	117,301	600,000	600,000 min
B	19.08	10	50.2	379,213		
C	6.22	10	15.9	81,068		
TOTAL	31.59		82.9	582,327		

BASIN SUMMARY TABLE		
BASIN ID	**RETENTION VOLUME**	**TOTAL VOLUME**
ABOVE GROUND BASIN	295,000 CF	295,000 CF min
UNDERGROUND INFILTRATION BASIN	305,000 CF	305,000 CF min
TOTAL	**600,000 CF**	**600,000 CF min**

Regarding the subsurface design, the project includes a CDS hydrodynamic separator to eliminate sediments, debris, and trash from entering the infiltration chambers to help ensure long term infiltration of the systems and reduce the risk of infiltration degradation. Runoff will be collected through nearby catch basins and first pretreated through inlet filters placed on each catch basin. Further downstream, the runoff will be further pretreated through the CDS hydrodynamic separator, and ultimately be discharged into either an above ground or underground infiltration system. For more information, please see the exhibit for Post-Developed conditions in Appendix C.

Per the infiltration study provided by Southern California Geotechnical, Inc, the site has sufficient infiltration rates to drawdown within 24 hours after the storm event. In particular, the infiltration rate was measured to be 17 in/hr. Applying a safety factor of 2 results in an effective infiltration rate of 8.5 in/hr which will be enough to completely drain the 144in CMP systems within 24 hours. A safety factor of 2 was selected due to in situ testing having been performed by Southern California Geotechnical, Inc. Southern California Geotechnical, Inc. has also been contacted to verify that the infiltration rates measured are accurate. For more information, please see the memo in Appendix D.

V. Conclusion

The project evaluated three alternatives to satisfying drainage requirements.

1. Alternative 1 is to implement the solution identified in the Victorville MDP. However, this is not feasible due to the challenges with timing.
2. Alternative 2 is to release runoff from the site at a rate that does not exceed the allowable flow rate, which is equivalent to the 90% of the pre-development flow rate for a 100-year storm. To obtain the allowable flow rate, the 100-year storm for pre-development conditions is modelled as a 25-year storm per the San Bernardino County Detention Basin Guidelines.
3. Alternative 3 is to retain the entire post-development runoff volume for a 100-year storm onsite.

As previously discussed, alternative 1 is not viable due to the timing of the regional basin. Therefore, only alternative 2 and 3 are considered to be viable solutions. However, for alternative 2, there are risks and impacts that also make it an inviable solution. In particular, runoff would be released at a concentrated flow rate which increases the flow velocity and may cause erosion at the ditch downstream of the project site. This would therefore go against the California Drainage Law. In addition, since runoff would be discharged offsite into an adjacent property, there are additional concerns regarding easements and right of way that would allow us to discharge the runoff onto an adjacent property.

Due to these concerns, the most viable option was evaluated to be alternative 3, which is to provide full retention onsite. Therefore, proposed development will provide enough volume to capture the entire runoff volume generated from a 100-year storm event and will not release any runoff off-site for up to a 100-year storm event. To store the volume, the development proposes a combination of above ground and underground infiltration/retention basins. Since the development will not release runoff off-site, the development will not negatively impact downstream conditions. The results demonstrate that the proposed on-site storm drain system and above ground and underground infiltration/retention basins will comply with the flood protection and WQMP requirements of the City of Hesperia and County of San Bernardino.

Appendix A

HYDROLOGY SUMMARY				
ID	**AREA A**	**AREA B**	**AREA C**	**TOTAL SITE**
AREA, SF	273992	831125	270943	1376060
ACRES	6.29	19.08	6.22	31.59
PERVIOUS	0.19	0.10	0.52	0.20
IMPERVIOUS	0.81	0.90	0.48	0.80
TIME OF CONCENTRATION, MIN	10	10	10	10
P_{24}	5.9	5.9	5.9	5.9
CN	79	84	60	78
AMC III CN	93	96	79	93
S	0.70	0.37	2.66	0.76
I_a	0.14	0.07	0.53	0.15
Y	0.87	0.93	0.61	0.86
I_{25}, IN/HR	2.21	2.21	2.21	2.21
I_{100}, IN/HR	2.93	2.93	2.93	2.93
Fp	0.04	0.02	0.16	0.05
Fm	0.01	0.00	0.08	0.01
Ybar	0.13	0.07	0.39	0.14
Q-25, CFS	12.5	38.0	11.9	62.6
Q-100, CFS	16.5	50.2	15.9	82.9
VOLUME (P=4.28IN 25YR-24HR), CF	85093	275090	58809	422434
VOLUME (P=5.90IN 100YR-24HR), CF	117301	379213	81068	582327

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005
Version 7.1

Rational Hydrology Study Date: 07/15/22

2021-196 Hesperia Spec Industrial
Rational Method
25-year

Program License Serial Number 6277

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 25.0
Computed rainfall intensity:
Storm year = 25.00 1 hour rainfall = 0.942 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station        1.100 to Point/Station
1.200
      **** INITIAL AREA EVALUATION ****
      ____________________________________________________________________
____
      Soil classification AP and SCS  values input by user
      USER INPUT of soil data for subarea
      SCS curve number for soil(AMC 2)  = 56.00
      Pervious ratio(Ap) = 0.1900     Max loss rate(Fm)=
0.139(In/Hr)
      Initial subarea data:
      Initial area flow distance =   548.000(Ft.)
      Top (of initial area) elevation =    52.200(Ft.)
      Bottom (of initial area) elevation =    44.000(Ft.)
      Difference in elevation =     8.200(Ft.)
      Slope =    0.01496  s(%)=       1.50
      TC = k(0.321)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    9.279 min.
      Rainfall intensity =      3.479(In/Hr) for a    25.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.864
      Subarea runoff =     18.908(CFS)
      Total initial stream area =        6.290(Ac.)
      Pervious area fraction = 0.190
      Initial area Fm value =    0.139(In/Hr)
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      Process from Point/Station        1.200 to Point/Station
2.200
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________
____
      Upstream point/station elevation =    44.000(Ft.)
      Downstream point/station elevation =    34.000(Ft.)
      Pipe length  =  1386.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    18.908(CFS)
      Nearest computed pipe diameter  =     24.00(In.)
      Calculated individual pipe flow  =    18.908(CFS)
      Normal flow depth in pipe =   19.31(In.)
      Flow top width inside pipe =   19.03(In.)
      Critical Depth =   18.77(In.)
      Pipe flow velocity =      6.97(Ft/s)
      Travel time through pipe =    3.31 min.
      Time of concentration (TC) =    12.59 min.
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      Process from Point/Station        2.100 to Point/Station
2.200
      **** SUBAREA FLOW ADDITION ****
      ____________________________________________________________________
____
      Soil classification AP and SCS  values input by user
      USER INPUT of soil data for subarea
      SCS curve number for soil(AMC 2)  = 56.00
      Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=
0.073(In/Hr)
      Time of concentration =    12.59 min.
      Rainfall intensity =      2.810(In/Hr) for a    25.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.871
      Subarea runoff =     43.201(CFS) for   19.080(Ac.)
      Total runoff =     62.109(CFS)
      Effective area this stream =       25.37(Ac.)
      Total Study Area (Main Stream No. 1) =       25.37(Ac.)
      Area averaged Fm value =    0.090(In/Hr)
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      Process from Point/Station        2.200 to Point/Station
3.200
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________
____
      Upstream point/station elevation =    34.100(Ft.)
      Downstream point/station elevation =    23.400(Ft.)
      Pipe length  =   675.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    62.109(CFS)
      Nearest computed pipe diameter  =     33.00(In.)
      Calculated individual pipe flow  =    62.109(CFS)
      Normal flow depth in pipe =   25.27(In.)
      Flow top width inside pipe =   27.96(In.)
      Critical Depth =   30.18(In.)
      Pipe flow velocity =     12.74(Ft/s)
      Travel time through pipe =    0.88 min.
      Time of concentration (TC) =    13.47 min.
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      Process from Point/Station        3.100 to Point/Station
3.200
      **** SUBAREA FLOW ADDITION ****
      ____________________________________________________________________
____
      Soil classification AP and SCS  values input by user
      USER INPUT of soil data for subarea
      SCS curve number for soil(AMC 2)  = 56.00
      Pervious ratio(Ap) = 0.5200     Max loss rate(Fm)=
0.382(In/Hr)
      Time of concentration =    13.47 min.
      Rainfall intensity =      2.680(In/Hr) for a    25.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.851
      Subarea runoff =      9.891(CFS) for    6.220(Ac.)
      Total runoff =     72.000(CFS)
      Effective area this stream =       31.59(Ac.)
      Total Study Area (Main Stream No. 1) =       31.59(Ac.)
      Area averaged Fm value =    0.147(In/Hr)
      End of computations, Total Study Area =           31.59 (Ac.)
      The following figures may
      be used for a unit hydrograph study of the same area.
      Note: These figures do not consider reduced effective area
      effects caused by confluences in the rational equation.

      Area averaged pervious area fraction(Ap) = 0.201
      Area averaged SCS curve number =  56.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005
Version 7.1

Rational Hydrology Study Date: 07/15/22

2021-196 Hesperia Spec Industrial
Rational Method
100-year

Program License Serial Number 6277

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.250 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

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++++
      Process from Point/Station        1.100 to Point/Station
1.200
      **** INITIAL AREA EVALUATION ****
      ____________________________________________________________________
____
      Soil classification AP and SCS  values input by user
      USER INPUT of soil data for subarea
      SCS curve number for soil(AMC 2)  = 56.00
      Adjusted SCS curve number for AMC 3 = 75.80
      Pervious ratio(Ap) = 0.1900     Max loss rate(Fm)=
0.084(In/Hr)
      Initial subarea data:
      Initial area flow distance =   548.000(Ft.)
      Top (of initial area) elevation =    52.200(Ft.)
      Bottom (of initial area) elevation =    44.000(Ft.)
      Difference in elevation =     8.200(Ft.)
      Slope =    0.01496  s(%)=       1.50
      TC = k(0.321)*[(length^3)/(elevation change)]^0.2
      Initial area time of concentration =    9.279 min.
      Rainfall intensity =      4.617(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
      Subarea runoff =     25.664(CFS)
      Total initial stream area =        6.290(Ac.)
      Pervious area fraction = 0.190
      Initial area Fm value =    0.084(In/Hr)
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      Process from Point/Station        1.200 to Point/Station
2.200
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________
____
      Upstream point/station elevation =    44.000(Ft.)
      Downstream point/station elevation =    34.000(Ft.)
      Pipe length  =  1386.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    25.664(CFS)
      Nearest computed pipe diameter  =     27.00(In.)
      Calculated individual pipe flow  =    25.664(CFS)
      Normal flow depth in pipe =   21.56(In.)
      Flow top width inside pipe =   21.66(In.)
      Critical Depth =   21.24(In.)
      Pipe flow velocity =      7.54(Ft/s)
      Travel time through pipe =    3.06 min.
      Time of concentration (TC) =    12.34 min.
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      Process from Point/Station        2.100 to Point/Station
2.200
      **** SUBAREA FLOW ADDITION ****
      ____________________________________________________________________
____
      Soil classification AP and SCS  values input by user
      USER INPUT of soil data for subarea
      SCS curve number for soil(AMC 2)  = 56.00
      Adjusted SCS curve number for AMC 3 = 75.80
      Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=
0.044(In/Hr)
      Time of concentration =    12.34 min.
      Rainfall intensity =      3.781(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.887
      Subarea runoff =     59.445(CFS) for   19.080(Ac.)
      Total runoff =     85.109(CFS)
      Effective area this stream =       25.37(Ac.)
      Total Study Area (Main Stream No. 1) =       25.37(Ac.)
      Area averaged Fm value =    0.054(In/Hr)
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      Process from Point/Station        2.200 to Point/Station
3.200
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ____________________________________________________________________
____
      Upstream point/station elevation =    34.100(Ft.)
      Downstream point/station elevation =    23.400(Ft.)
      Pipe length  =   675.00(Ft.)   Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    85.109(CFS)
      Nearest computed pipe diameter  =     39.00(In.)
      Calculated individual pipe flow  =    85.109(CFS)
      Normal flow depth in pipe =   26.86(In.)
      Flow top width inside pipe =   36.12(In.)
      Critical Depth =   34.49(In.)
      Pipe flow velocity =     13.98(Ft/s)
      Travel time through pipe =    0.80 min.
      Time of concentration (TC) =    13.15 min.
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      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station        3.100 to Point/Station
3.200
      **** SUBAREA FLOW ADDITION ****
      ____________________________________________________________________
____
      Soil classification AP and SCS  values input by user
      USER INPUT of soil data for subarea
      SCS curve number for soil(AMC 2)  = 56.00
      Adjusted SCS curve number for AMC 3 = 75.80
      Pervious ratio(Ap) = 0.5200     Max loss rate(Fm)=
0.229(In/Hr)
      Time of concentration =    13.15 min.
      Rainfall intensity =      3.618(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area,(total area with
modified
      rational method)(Q=KCIA) is C = 0.878
      Subarea runoff =     15.238(CFS) for    6.220(Ac.)
      Total runoff =    100.347(CFS)
      Effective area this stream =       31.59(Ac.)
      Total Study Area (Main Stream No. 1) =       31.59(Ac.)
      Area averaged Fm value =    0.088(In/Hr)
      End of computations, Total Study Area =           31.59 (Ac.)
      The following figures may
      be used for a unit hydrograph study of the same area.
      Note: These figures do not consider reduced effective area
      effects caused by confluences in the rational equation.

      Area averaged pervious area fraction(Ap) = 0.201
      Area averaged SCS curve number =  56.0
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U n i t H y d r o g r a p h A n a l y s i s

Study date 07/15/22

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6277

2021-196 Hesperia Spec Industrial
Unit Hydrograph
100-year

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
0.01	1	0.75
Rainfall data for year 2		
0.01	6	1.01
Rainfall data for year 2		
0.01	24	1.89

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--
      Rainfall data for year 100
                0.01            1           1.25
      ------------------------------------------------------------------
--
      Rainfall data for year 100
                0.01            6           2.81
      ------------------------------------------------------------------
--
      Rainfall data for year 100
                0.01           24           5.90
      ------------------------------------------------------------------
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      ******** Area-averaged max loss rate, Fm ********


      SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap
Fm
      No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)
(In/Hr)
       56.0      75.8         31.59      1.000     0.440    0.200
0.088

      Area-averaged adjusted loss rate Fm (In/Hr) =  0.088

      ********* Area-Averaged low loss rate fraction, Yb **********

      Area       Area          SCS CN    SCS CN      S     Pervious
       (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
           6.32   0.200         56.0      75.8       3.19     0.555
          25.27   0.800         98.0      98.0       0.20     0.960

      Area-averaged catchment yield fraction, Y =  0.879
      Area-averaged low loss fraction, Yb =  0.121
      User entry of time of concentration  =   0.227 (hours)
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      Watershed area =      31.59(Ac.)
      Catchment Lag time =   0.182 hours
      Unit interval =   5.000 minutes
      Unit interval percentage of lag time = 45.8884
      Hydrograph baseflow =     0.00(CFS)
      Average maximum watershed loss rate(Fm) =  0.088(In/Hr)
      Average low loss rate fraction (Yb) = 0.121 (decimal)
      MOUNTAIN S-Graph Selected
      Computed peak 5-minute rainfall =  0.593(In)
      Computed peak 30-minute rainfall =  1.015(In)
      Specified peak 1-hour rainfall =  1.250(In)
      Computed peak 3-hour rainfall =  2.054(In)
      Specified peak 6-hour rainfall =  2.810(In)
      Specified peak 24-hour rainfall =  5.900(In)
```

```
      Rainfall depth area reduction factors:
      Using a total area of      31.59(Ac.) (Ref: fig. E-4)

      5-minute factor = 0.999     Adjusted rainfall =  0.592(In)
      30-minute factor = 0.999    Adjusted rainfall =  1.014(In)
      1-hour factor = 0.999       Adjusted rainfall =  1.248(In)
      3-hour factor = 1.000       Adjusted rainfall =  2.054(In)
      6-hour factor = 1.000       Adjusted rainfall =  2.810(In)
      24-hour factor = 1.000      Adjusted rainfall =  5.900(In)
      ----------------------------------------------------------------
---

                     U n i t  H y d r o g r a p h
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++
      Interval          'S' Graph          Unit Hydrograph
      Number            Mean values             ((CFS))
      ----------------------------------------------------------------
---
                (K =       382.04 (CFS))

        1                 6.828                  26.086
        2                34.241                 104.729
        3                53.812                  74.769
        4                63.412                  36.675
        5                69.929                  24.899
        6                74.936                  19.129
        7                78.803                  14.773
        8                81.823                  11.537
        9                84.264                   9.327
       10                86.308                   7.807
       11                88.171                   7.119
       12                89.787                   6.173
       13                91.208                   5.430
       14                92.506                   4.960
       15                93.668                   4.438
       16                94.719                   4.017
       17                95.623                   3.454
       18                96.455                   3.176
       19                97.281                   3.156
       20                98.107                   3.156
       21                98.933                   3.156
       22               100.000                   1.578
      ----------------------------------------------------------------
---
      ----------------------------------------------------------------
--
      ----------------------------------------------------------------
--
      Total soil rain loss =      0.64(In)
      Total effective rainfall =      5.26(In)
      Peak flow rate in flood hydrograph =     81.24(CFS)
      ----------------------------------------------------------------
---
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++
```

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	22.5	45.0	67.5	90.0
0+ 5	0.0017	0.25	Q				
0+10	0.0104	1.26	Q				
0+15	0.0241	1.98	Q				
0+20	0.0402	2.34	VQ				
0+25	0.0581	2.59	VQ				
0+30	0.0772	2.78	VQ				
0+35	0.0974	2.93	VQ				
0+40	0.1184	3.05	VQ				
0+45	0.1400	3.14	VQ				
0+50	0.1622	3.23	VQ				
0+55	0.1850	3.30	VQ				
1+ 0	0.2082	3.37	VQ				
1+ 5	0.2319	3.43	VQ				
1+10	0.2559	3.49	VQ				
1+15	0.2803	3.54	VQ				
1+20	0.3050	3.59	VQ				
1+25	0.3300	3.63	VQ				
1+30	0.3553	3.67	|Q				
1+35	0.3809	3.71	|Q				
1+40	0.4067	3.75	|Q				
1+45	0.4328	3.79	|Q				
1+50	0.4591	3.82	|Q				

1+55	0.4855	3.83	|Q	|	|	|
2+ 0	0.5119	3.84	|Q	|	|	|
2+ 5	0.5384	3.85	|Q	|	|	|
2+10	0.5650	3.86	|Q	|	|	|
2+15	0.5917	3.87	|Q	|	|	|
2+20	0.6184	3.88	|Q	|	|	|
2+25	0.6452	3.89	|Q	|	|	|
2+30	0.6721	3.90	|Q	|	|	|
2+35	0.6990	3.91	|QV	|	|	|
2+40	0.7260	3.92	|QV	|	|	|
2+45	0.7531	3.93	|QV	|	|	|
2+50	0.7803	3.95	|QV	|	|	|
2+55	0.8076	3.96	|QV	|	|	|
3+ 0	0.8349	3.97	|QV	|	|	|
3+ 5	0.8623	3.98	|QV	|	|	|
3+10	0.8898	3.99	|QV	|	|	|
3+15	0.9174	4.00	|QV	|	|	|
3+20	0.9450	4.02	|QV	|	|	|
3+25	0.9728	4.03	|QV	|	|	|
3+30	1.0006	4.04	|QV	|	|	|
3+35	1.0285	4.05	|QV	|	|	|
3+40	1.0565	4.06	|Q V	|	|	|
3+45	1.0845	4.08	|Q V	|	|	|
3+50	1.1127	4.09	|Q V	|	|	|
3+55	1.1410	4.10	|Q V	|	|	|
4+ 0	1.1693	4.11	|Q V	|	|	|
4+ 5	1.1977	4.13	|Q V	|	|	|
4+10	1.2262	4.14	|Q V	|	|	|

4+15	1.2548	4.15	|Q V	|	|	|
4+20	1.2835	4.17	|Q V	|	|	|
4+25	1.3123	4.18	|Q V	|	|	|
4+30	1.3412	4.19	|Q V	|	|	|
4+35	1.3702	4.21	|Q V	|	|	|
4+40	1.3993	4.22	|Q V	|	|	|
4+45	1.4284	4.24	|Q V	|	|	|
4+50	1.4577	4.25	|Q V	|	|	|
4+55	1.4871	4.26	|Q V	|	|	|
5+ 0	1.5165	4.28	|Q V	|	|	|
5+ 5	1.5461	4.29	|Q V	|	|	|
5+10	1.5758	4.31	|Q V	|	|	|
5+15	1.6055	4.32	|Q V	|	|	|
5+20	1.6354	4.34	|Q V	|	|	|
5+25	1.6654	4.35	|Q V	|	|	|
5+30	1.6955	4.37	|Q V	|	|	|
5+35	1.7257	4.38	|Q V	|	|	|
5+40	1.7560	4.40	|Q V	|	|	|
5+45	1.7864	4.42	|Q V	|	|	|
5+50	1.8169	4.43	|Q V	|	|	|
5+55	1.8475	4.45	|Q V	|	|	|
6+ 0	1.8783	4.47	|Q V	|	|	|
6+ 5	1.9092	4.48	|Q V	|	|	|
6+10	1.9401	4.50	|Q V	|	|	|
6+15	1.9712	4.52	| Q V	|	|	|
6+20	2.0025	4.53	| Q V	|	|	|
6+25	2.0338	4.55	| Q V	|	|	|
6+30	2.0653	4.57	| Q V	|	|	|

6+35	2.0969	4.59	Q	V		
6+40	2.1286	4.60	Q	V		
6+45	2.1604	4.62	Q	V		
6+50	2.1924	4.64	Q	V		
6+55	2.2245	4.66	Q	V		
7+ 0	2.2567	4.68	Q	V		
7+ 5	2.2891	4.70	Q	V		
7+10	2.3216	4.72	Q	V		
7+15	2.3542	4.74	Q	V		
7+20	2.3870	4.76	Q	V		
7+25	2.4199	4.78	Q	V		
7+30	2.4530	4.80	Q	V		
7+35	2.4862	4.82	Q	V		
7+40	2.5195	4.84	Q	V		
7+45	2.5530	4.86	Q	V		
7+50	2.5867	4.89	Q	V		
7+55	2.6205	4.91	Q	V		
8+ 0	2.6544	4.93	Q	V		
8+ 5	2.6886	4.95	Q	V		
8+10	2.7228	4.98	Q	V		
8+15	2.7573	5.00	Q	V		
8+20	2.7919	5.03	Q	V		
8+25	2.8267	5.05	Q	V		
8+30	2.8616	5.07	Q	V		
8+35	2.8967	5.10	Q	V		
8+40	2.9320	5.12	Q	V		
8+45	2.9675	5.15	Q	V		
8+50	3.0032	5.18	Q	V		

8+55	3.0390	5.20	Q	V		
9+ 0	3.0750	5.23	Q	V		
9+ 5	3.1112	5.26	Q	V		
9+10	3.1476	5.29	Q	V		
9+15	3.1842	5.31	Q	V		
9+20	3.2211	5.34	Q	V		
9+25	3.2581	5.37	Q	V		
9+30	3.2953	5.40	Q	V		
9+35	3.3327	5.43	Q	V		
9+40	3.3704	5.47	Q	V		
9+45	3.4082	5.50	Q	V		
9+50	3.4463	5.53	Q	V		
9+55	3.4846	5.56	Q	V		
10+ 0	3.5232	5.60	Q	V		
10+ 5	3.5619	5.63	Q	V		
10+10	3.6010	5.67	Q	V		
10+15	3.6402	5.70	Q	V		
10+20	3.6797	5.74	Q	V		
10+25	3.7195	5.77	Q	V		
10+30	3.7595	5.81	Q	V		
10+35	3.7998	5.85	Q	V		
10+40	3.8404	5.89	Q	V		
10+45	3.8813	5.93	Q	V		
10+50	3.9224	5.97	Q	V		
10+55	3.9638	6.01	Q	V		
11+ 0	4.0055	6.06	Q	V		
11+ 5	4.0476	6.10	Q	V		
11+10	4.0899	6.15	Q	V		

11+15	4.1326	6.19	Q	V		
11+20	4.1755	6.24	Q	V		
11+25	4.2188	6.29	Q	V		
11+30	4.2625	6.34	Q	V		
11+35	4.3065	6.39	Q	V		
11+40	4.3509	6.44	Q	V		
11+45	4.3956	6.49	Q	V		
11+50	4.4407	6.55	Q	V		
11+55	4.4862	6.61	Q	V		
12+ 0	4.5321	6.67	Q	V		
12+ 5	4.5779	6.65	Q	V		
12+10	4.6221	6.42	Q	V		
12+15	4.6653	6.27	Q	V		
12+20	4.7082	6.23	Q	V		
12+25	4.7510	6.22	Q	V		
12+30	4.7940	6.24	Q	V		
12+35	4.8372	6.27	Q	V		
12+40	4.8806	6.31	Q	V		
12+45	4.9244	6.36	Q	V		
12+50	4.9686	6.42	Q	V		
12+55	5.0133	6.48	Q	V		
13+ 0	5.0584	6.55	Q	V		
13+ 5	5.1040	6.62	Q	V		
13+10	5.1501	6.70	Q	V		
13+15	5.1969	6.78	Q	V		
13+20	5.2442	6.88	Q	V		
13+25	5.2922	6.97	Q	V		
13+30	5.3409	7.07	Q	V		

13+35	5.3903	7.18	Q	V		
13+40	5.4406	7.29	Q	V		
13+45	5.4916	7.41	Q	V		
13+50	5.5435	7.54	Q	V		
13+55	5.5963	7.67	Q	V		
14+ 0	5.6502	7.83	Q	V		
14+ 5	5.7052	7.98	Q	V		
14+10	5.7613	8.16	Q	V		
14+15	5.8187	8.33	Q	V		
14+20	5.8774	8.53	Q	V		
14+25	5.9375	8.72	Q	V		
14+30	5.9991	8.94	Q	V		
14+35	6.0623	9.17	Q	V		
14+40	6.1272	9.43	Q	V		
14+45	6.1939	9.69	Q	V		
14+50	6.2627	9.99	Q	V		
14+55	6.3336	10.30	Q	V		
15+ 0	6.4071	10.66	Q	V		
15+ 5	6.4831	11.04	Q	V		
15+10	6.5623	11.49	Q	V		
15+15	6.6447	11.97	Q	V		
15+20	6.7311	12.54	Q	V		
15+25	6.8192	12.79	Q	V		
15+30	6.9024	12.08	Q	V		
15+35	6.9840	11.84	Q	V		
15+40	7.0691	12.36	Q	V		
15+45	7.1603	13.25	Q	V		
15+50	7.2622	14.79	Q	V		

```
   15+55       7.3815     17.32  |      Q  |         |V        |
|
   16+ 0       7.5389     22.85  |         Q         |V        |
|
   16+ 5       7.8297     42.23  |         |       Q | V       |
|
   16+10       8.3892     81.24  |         |         |   V     |     Q
|
   16+15       8.8238     63.10  |         |         |    V  Q |
|
   16+20       9.1005     40.18  |         |      Q  |     V   |
|
   16+25       9.3166     31.37  |         |  Q      |      V  |
|
   16+30       9.5058     27.48  |         | Q       |      V  |
|
   16+35       9.6734     24.33  |         Q         |       V |
|
   16+40       9.8218     21.55  |        Q|         |       V |
|
   16+45       9.9556     19.43  |       Q |         |       V |
|
   16+50      10.0782     17.80  |      Q  |         |        V|
|
   16+55      10.1930     16.67  |      Q  |         |        V|
|
   17+ 0      10.2997     15.49  |     Q   |         |        V|
|
   17+ 5      10.3993     14.47  |     Q   |         |         V
|
   17+10      10.4934     13.65  |     Q   |         |         V
|
   17+15      10.5821     12.88  |    Q    |         |         V
|
   17+20      10.6661     12.20  |    Q    |         |         |V
|
   17+25      10.7452     11.49  |    Q    |         |         |V
|
   17+30      10.8208     10.97  |   Q     |         |         |V
|
   17+35      10.8937     10.59  |   Q     |         |         |V
|
   17+40      10.9639     10.19  |   Q     |         |         |V
|
   17+45      11.0306      9.69  |   Q     |         |         | V
|
   17+50      11.0887      8.43  |  Q      |         |         | V
|
   17+55      11.1388      7.28  |  Q      |         |         | V
|
   18+ 0      11.1869      7.00  |  Q      |         |         | V
|
   18+ 5      11.2342      6.85  |  Q      |         |         | V
|
   18+10      11.2820      6.95  |  Q      |         |         | V
|
```

18+15	11.3300	6.96	Q			V	
18+20	11.3774	6.89	Q			V	
18+25	11.4242	6.80	Q			V	
18+30	11.4704	6.70	Q			V	
18+35	11.5158	6.60	Q			V	
18+40	11.5606	6.50	Q			V	
18+45	11.6048	6.41	Q			V	
18+50	11.6483	6.32	Q			V	
18+55	11.6912	6.23	Q			V	
19+ 0	11.7335	6.15	Q			V	
19+ 5	11.7753	6.06	Q			V	
19+10	11.8165	5.99	Q			V	
19+15	11.8572	5.91	Q			V	
19+20	11.8974	5.84	Q			V	
19+25	11.9372	5.77	Q			V	
19+30	11.9764	5.70	Q			V	
19+35	12.0153	5.64	Q			V	
19+40	12.0537	5.58	Q			V	
19+45	12.0917	5.52	Q			V	
19+50	12.1293	5.46	Q			V	
19+55	12.1665	5.40	Q			V	
20+ 0	12.2032	5.34	Q			V	
20+ 5	12.2396	5.28	Q			V	
20+10	12.2756	5.22	Q			V	
20+15	12.3112	5.17	Q			V	
20+20	12.3464	5.12	Q			V	
20+25	12.3813	5.07	Q			V	
20+30	12.4158	5.02	Q			V	

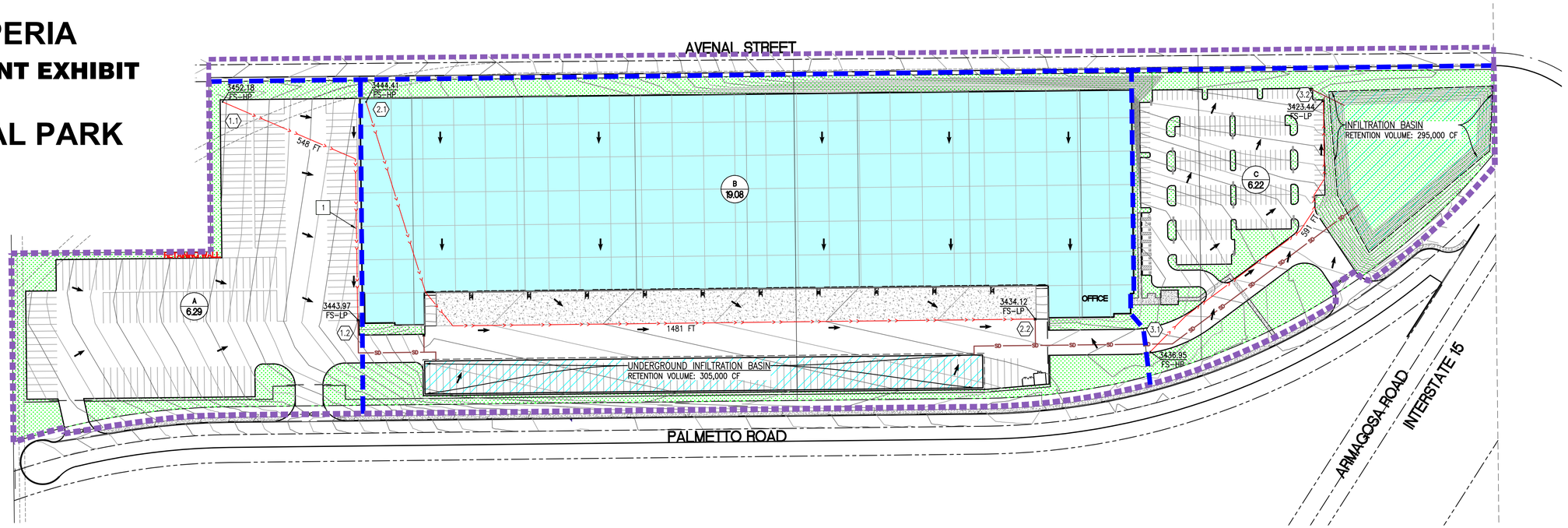
20+35	12.4500	4.97	Q				V
20+40	12.4839	4.92	Q				V
20+45	12.5175	4.88	Q				V
20+50	12.5508	4.83	Q				V
20+55	12.5838	4.79	Q				V
21+ 0	12.6165	4.75	Q				V
21+ 5	12.6490	4.71	Q				V
21+10	12.6812	4.67	Q				V
21+15	12.7131	4.63	Q				V
21+20	12.7447	4.60	Q				V
21+25	12.7761	4.56	Q				V
21+30	12.8073	4.52	Q				V
21+35	12.8382	4.49	Q				V
21+40	12.8689	4.46	Q				V
21+45	12.8994	4.42	Q				V
21+50	12.9296	4.39	Q				V
21+55	12.9596	4.36	Q				V
22+ 0	12.9894	4.33	Q				V
22+ 5	13.0191	4.30	Q				V
22+10	13.0485	4.27	Q				V
22+15	13.0777	4.24	Q				V
22+20	13.1067	4.21	Q				V
22+25	13.1355	4.19	Q				V
22+30	13.1642	4.16	Q				V
22+35	13.1926	4.13	Q				V
22+40	13.2209	4.11	Q				V
22+45	13.2490	4.08	Q				V
22+50	13.2770	4.06	Q				V

```
   22+55      13.3047      4.03  |Q        |         |         |        V
|
   23+ 0      13.3323      4.01  |Q        |         |         |        V
|
   23+ 5      13.3598      3.98  |Q        |         |         |        V
|
   23+10      13.3871      3.96  |Q        |         |         |        V
|
   23+15      13.4142      3.94  |Q        |         |         |        V
|
   23+20      13.4412      3.92  |Q        |         |         |
V|
   23+25      13.4680      3.89  |Q        |         |         |
V|
   23+30      13.4947      3.87  |Q        |         |         |
V|
   23+35      13.5212      3.85  |Q        |         |         |
V|
   23+40      13.5476      3.83  |Q        |         |         |
V|
   23+45      13.5738      3.81  |Q        |         |         |
V|
   23+50      13.5999      3.79  |Q        |         |         |
V|
   23+55      13.6259      3.77  |Q        |         |         |
V|
   24+ 0      13.6518      3.75  |Q        |         |         |
V|
   24+ 5      13.6757      3.48  |Q        |         |         |
V|
   24+10      13.6926      2.46  |Q        |         |         |
V|
   24+15      13.7045      1.72  Q         |         |         |
V|
   24+20      13.7139      1.36  Q         |         |         |
V|
   24+25      13.7216      1.12  Q         |         |         |
V|
   24+30      13.7280      0.93  Q         |         |         |
V|
   24+35      13.7333      0.78  Q         |         |         |
V|
   24+40      13.7379      0.66  Q         |         |         |
V|
   24+45      13.7418      0.57  Q         |         |         |
V|
   24+50      13.7452      0.49  Q         |         |         |
V|
   24+55      13.7481      0.42  Q         |         |         |
V|
   25+ 0      13.7506      0.36  Q         |         |         |
V|
   25+ 5      13.7527      0.31  Q         |         |         |
V|
   25+10      13.7545      0.26  Q         |         |         |
V|
```

```
   25+15      13.7559      0.21  Q          |          |          |
V|
   25+20      13.7571      0.17  Q          |          |          |
V|
   25+25      13.7581      0.14  Q          |          |          |
V|
   25+30      13.7588      0.11  Q          |          |          |
V|
   25+35      13.7594      0.08  Q          |          |          |
V|
   25+40      13.7597      0.05  Q          |          |          |
V|
   25+45      13.7598      0.02  Q          |          |          |
V
------------------------------------------------------------------------
```

Appendix B

CITY OF HESPERIA
POST DEVELOPMENT EXHIBIT
FOR
SPEC INDUSTRIAL PARK



HYDROLOGY INFORMATION

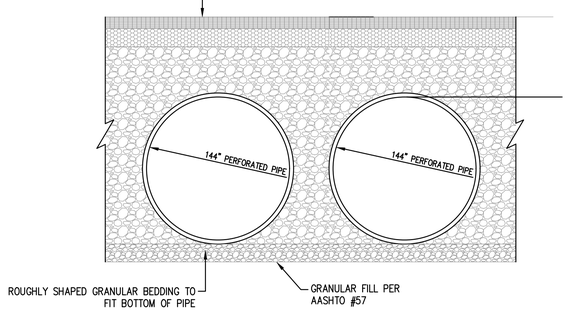
SITE AREA:	31± ACRES	
SOIL GROUP:	B	(PER USDA WEB SOIL SURVEY)
IMPERVIOUS:	80%	(PER CALCULATIONS)
ISOHYETALS:	0.433" 1.25"	(2-YEAR 1 HOUR) (100-YEAR 1 HOUR)
CN NUMBER:	78	(SOIL GROUP B)
FREQUENCY:	100 YEAR 2/10 YEAR	(FOR STORM DRAIN DESIGN) (FOR WATER QUALITY)
METHOD:	SAN BERNARDINO COUNTY HYDROLOGY MANUAL	

LEGEND:

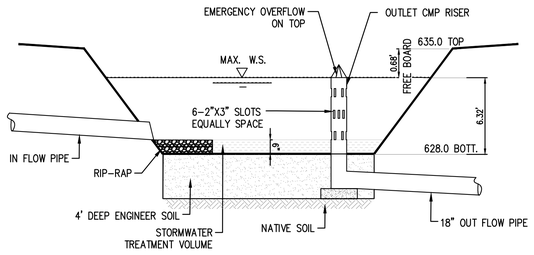
- DRAINAGE AREA/SITE BOUNDARY
- DRAINAGE SUB-AREA BOUNDARY
- STORM WATER FLOW PATH
- PROPOSED STORM DRAIN PIPE
- PROPOSED FLOW DIRECTION ARROW
- DRAINAGE AREA DESIGNATION (X / XXX) AREA(AC)
- NODE (US/DS) (X.X)
- STREAM # (3)
- PROPOSED UNDERGROUND INFILTRATION/DETENTION
- PROPOSED BUILDING
- PROPOSED LANDSCAPING

DRAINAGE NOTES:

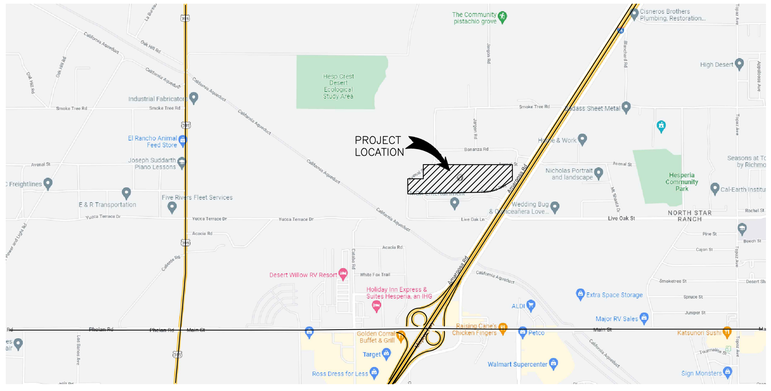
1. PROPOSED STORM DRAIN INLET
2. PROPOSED STORM DRAIN
3. PROPOSED INFILTRATION/DETENTION BASIN
4. PROPOSED UNDERGROUND INFILTRATION CMP



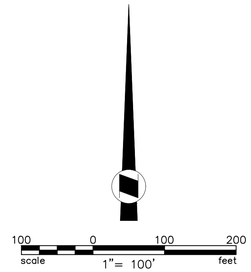
TYPICAL CMP UNDERGROUND INFILTRATION DETAIL
N.T.S



INFILTRATION/DETENTION BASIN-3 DETAIL
N.T.S



VICINITY MAP
N.T.S



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JOB NO: 2019-185

HCCII INDUSTRIAL PARK HYDROLOGY EXHIBIT

CITY OF HESPERIA

DATE: DEC 2021
SHEET 1 OF 1

Appendix C

NOAA Atlas 14, Volume 6, Version 2
Location name: Hesperia, California, USA*
Latitude: 34.4371°, Longitude: -117.3766°
Elevation: 3440.77 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.083** (0.068-0.101)	**0.118** (0.098-0.145)	**0.166** (0.136-0.203)	**0.204** (0.167-0.252)	**0.257** (0.203-0.329)	**0.299** (0.231-0.390)	**0.341** (0.257-0.456)	**0.385** (0.283-0.529)	**0.445** (0.314-0.638)	**0.493** (0.335-0.731)
10-min	**0.118** (0.098-0.145)	**0.170** (0.140-0.207)	**0.237** (0.196-0.291)	**0.293** (0.239-0.362)	**0.369** (0.292-0.471)	**0.428** (0.331-0.558)	**0.488** (0.369-0.653)	**0.552** (0.405-0.759)	**0.638** (0.449-0.915)	**0.706** (0.481-1.05)
15-min	**0.143** (0.119-0.175)	**0.205** (0.170-0.251)	**0.287** (0.236-0.352)	**0.354** (0.289-0.437)	**0.446** (0.353-0.570)	**0.517** (0.400-0.675)	**0.591** (0.446-0.790)	**0.667** (0.490-0.917)	**0.772** (0.544-1.11)	**0.854** (0.581-1.27)
30-min	**0.217** (0.180-0.265)	**0.311** (0.257-0.380)	**0.435** (0.359-0.533)	**0.537** (0.439-0.664)	**0.677** (0.535-0.865)	**0.785** (0.608-1.02)	**0.896** (0.677-1.20)	**1.01** (0.743-1.39)	**1.17** (0.824-1.68)	**1.30** (0.881-1.92)
60-min	**0.302** (0.250-0.369)	**0.433** (0.358-0.530)	**0.606** (0.499-0.743)	**0.747** (0.611-0.924)	**0.942** (0.744-1.20)	**1.09** (0.846-1.43)	**1.25** (0.942-1.67)	**1.41** (1.03-1.94)	**1.63** (1.15-2.34)	**1.80** (1.23-2.68)
2-hr	**0.434** (0.359-0.530)	**0.590** (0.488-0.722)	**0.802** (0.661-0.983)	**0.979** (0.800-1.21)	**1.23** (0.971-1.57)	**1.43** (1.11-1.86)	**1.64** (1.24-2.19)	**1.86** (1.36-2.55)	**2.17** (1.53-3.11)	**2.42** (1.64-3.58)
3-hr	**0.548** (0.453-0.669)	**0.733** (0.605-0.895)	**0.985** (0.812-1.21)	**1.20** (0.981-1.48)	**1.51** (1.19-1.92)	**1.75** (1.36-2.29)	**2.01** (1.52-2.69)	**2.29** (1.68-3.15)	**2.69** (1.89-3.85)	**3.01** (2.05-4.47)
6-hr	**0.766** (0.634-0.935)	**1.01** (0.838-1.24)	**1.36** (1.12-1.67)	**1.66** (1.35-2.05)	**2.09** (1.65-2.66)	**2.44** (1.89-3.18)	**2.81** (2.12-3.76)	**3.22** (2.37-4.43)	**3.81** (2.69-5.46)	**4.30** (2.93-6.38)
12-hr	**0.980** (0.811-1.20)	**1.34** (1.11-1.64)	**1.84** (1.51-2.25)	**2.27** (1.85-2.80)	**2.88** (2.28-3.69)	**3.39** (2.63-4.43)	**3.93** (2.97-5.26)	**4.53** (3.32-6.23)	**5.38** (3.79-7.72)	**6.09** (4.15-9.04)
24-hr	**1.34** (1.19-1.54)	**1.89** (1.68-2.18)	**2.66** (2.35-3.08)	**3.33** (2.91-3.88)	**4.28** (3.63-5.16)	**5.06** (4.20-6.22)	**5.90** (4.78-7.43)	**6.80** (5.36-8.81)	**8.11** (6.13-11.0)	**9.20** (6.72-12.8)
2-day	**1.50** (1.33-1.72)	**2.11** (1.87-2.44)	**2.98** (2.63-3.44)	**3.72** (3.26-4.34)	**4.81** (4.08-5.80)	**5.71** (4.74-7.03)	**6.69** (5.42-8.42)	**7.75** (6.10-10.0)	**9.30** (7.03-12.6)	**10.6** (7.74-14.8)
3-day	**1.60** (1.42-1.84)	**2.25** (1.99-2.60)	**3.17** (2.80-3.66)	**3.96** (3.47-4.62)	**5.13** (4.35-6.18)	**6.10** (5.06-7.50)	**7.15** (5.79-9.01)	**8.31** (6.54-10.8)	**10.00** (7.56-13.5)	**11.4** (8.34-15.9)
4-day	**1.73** (1.53-1.99)	**2.42** (2.15-2.79)	**3.40** (3.00-3.93)	**4.26** (3.73-4.96)	**5.51** (4.67-6.63)	**6.55** (5.43-8.05)	**7.67** (6.22-9.67)	**8.91** (7.02-11.5)	**10.7** (8.11-14.5)	**12.3** (8.96-17.1)
7-day	**1.92** (1.70-2.21)	**2.66** (2.36-3.07)	**3.71** (3.28-4.29)	**4.62** (4.05-5.38)	**5.95** (5.04-7.16)	**7.05** (5.85-8.66)	**8.24** (6.67-10.4)	**9.54** (7.52-12.4)	**11.4** (8.65-15.4)	**13.0** (9.53-18.2)
10-day	**2.05** (1.82-2.36)	**2.84** (2.52-3.27)	**3.94** (3.48-4.55)	**4.89** (4.28-5.70)	**6.27** (5.31-7.55)	**7.41** (6.15-9.11)	**8.64** (7.00-10.9)	**9.99** (7.87-12.9)	**12.0** (9.04-16.1)	**13.6** (9.93-19.0)
20-day	**2.49** (2.21-2.87)	**3.42** (3.03-3.94)	**4.71** (4.16-5.44)	**5.82** (5.10-6.78)	**7.43** (6.30-8.95)	**8.76** (7.27-10.8)	**10.2** (8.25-12.8)	**11.7** (9.25-15.2)	**14.0** (10.6-18.9)	**15.9** (11.6-22.2)
30-day	**2.94** (2.60-3.38)	**4.00** (3.54-4.61)	**5.48** (4.84-6.33)	**6.75** (5.91-7.87)	**8.59** (7.28-10.3)	**10.1** (8.39-12.4)	**11.7** (9.50-14.8)	**13.5** (10.6-17.5)	**16.1** (12.2-21.7)	**18.3** (13.4-25.5)
45-day	**3.48** (3.08-4.00)	**4.68** (4.14-5.39)	**6.34** (5.60-7.33)	**7.78** (6.81-9.06)	**9.85** (8.35-11.9)	**11.5** (9.59-14.2)	**13.4** (10.8-16.9)	**15.4** (12.1-20.0)	**18.3** (13.9-24.8)	**20.8** (15.2-29.1)
60-day	**3.95** (3.50-4.55)	**5.24** (4.64-6.03)	**7.01** (6.19-8.11)	**8.55** (7.48-9.96)	**10.8** (9.12-13.0)	**12.6** (10.4-15.5)	**14.6** (11.8-18.3)	**16.7** (13.2-21.7)	**19.9** (15.1-26.9)	**22.6** (16.5-31.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

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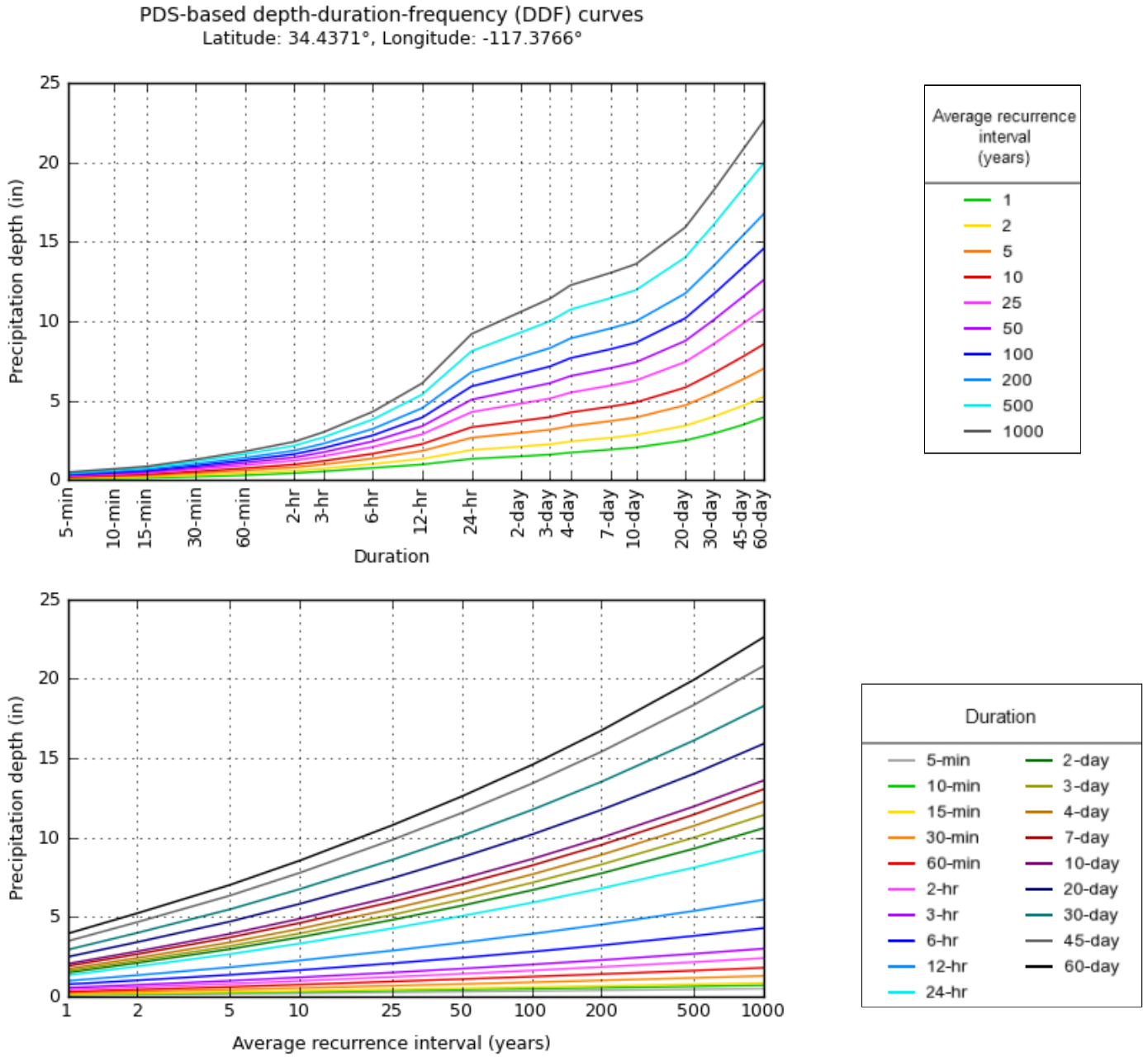
PF graphical



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Created (GMT): Wed Jul 6 18:51:42 2022

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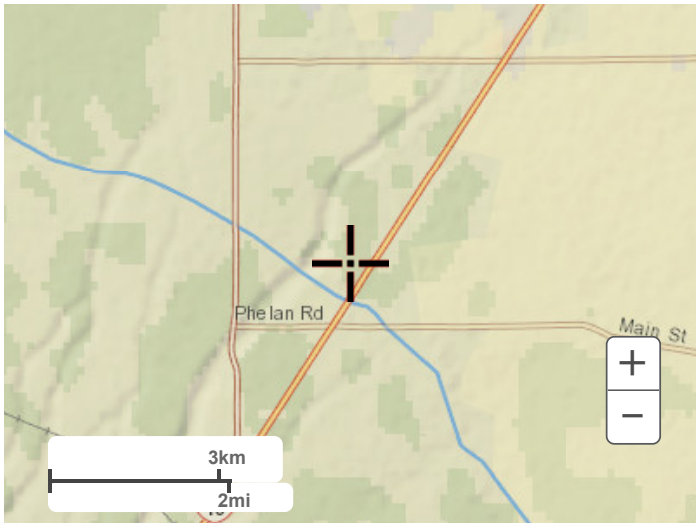
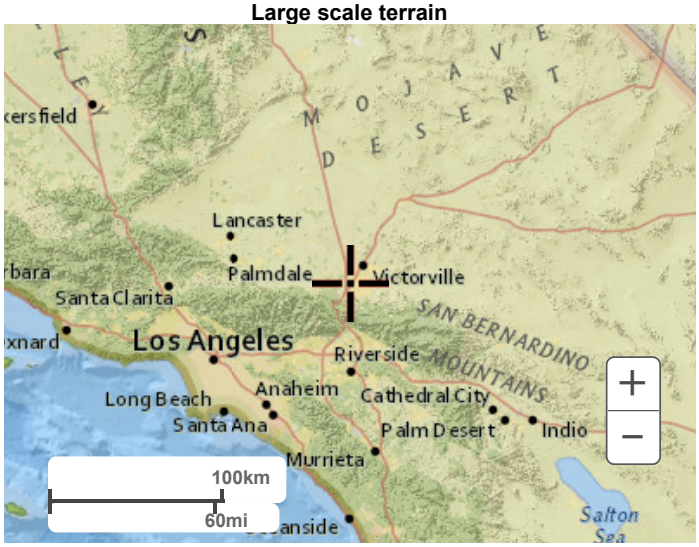
Maps & aerials

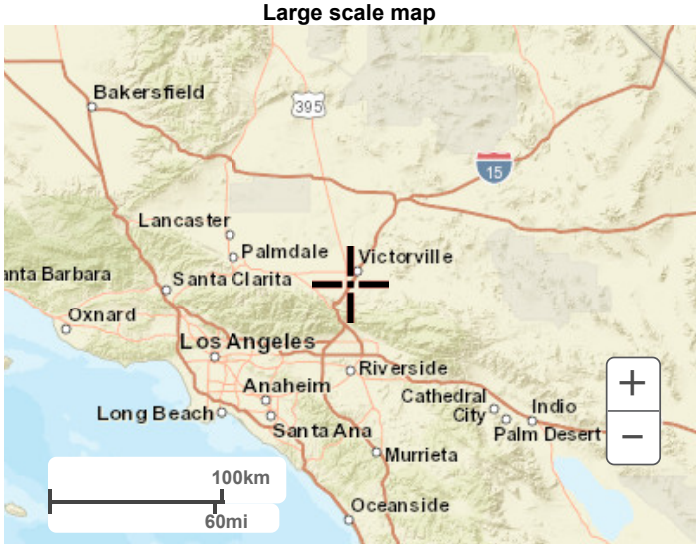
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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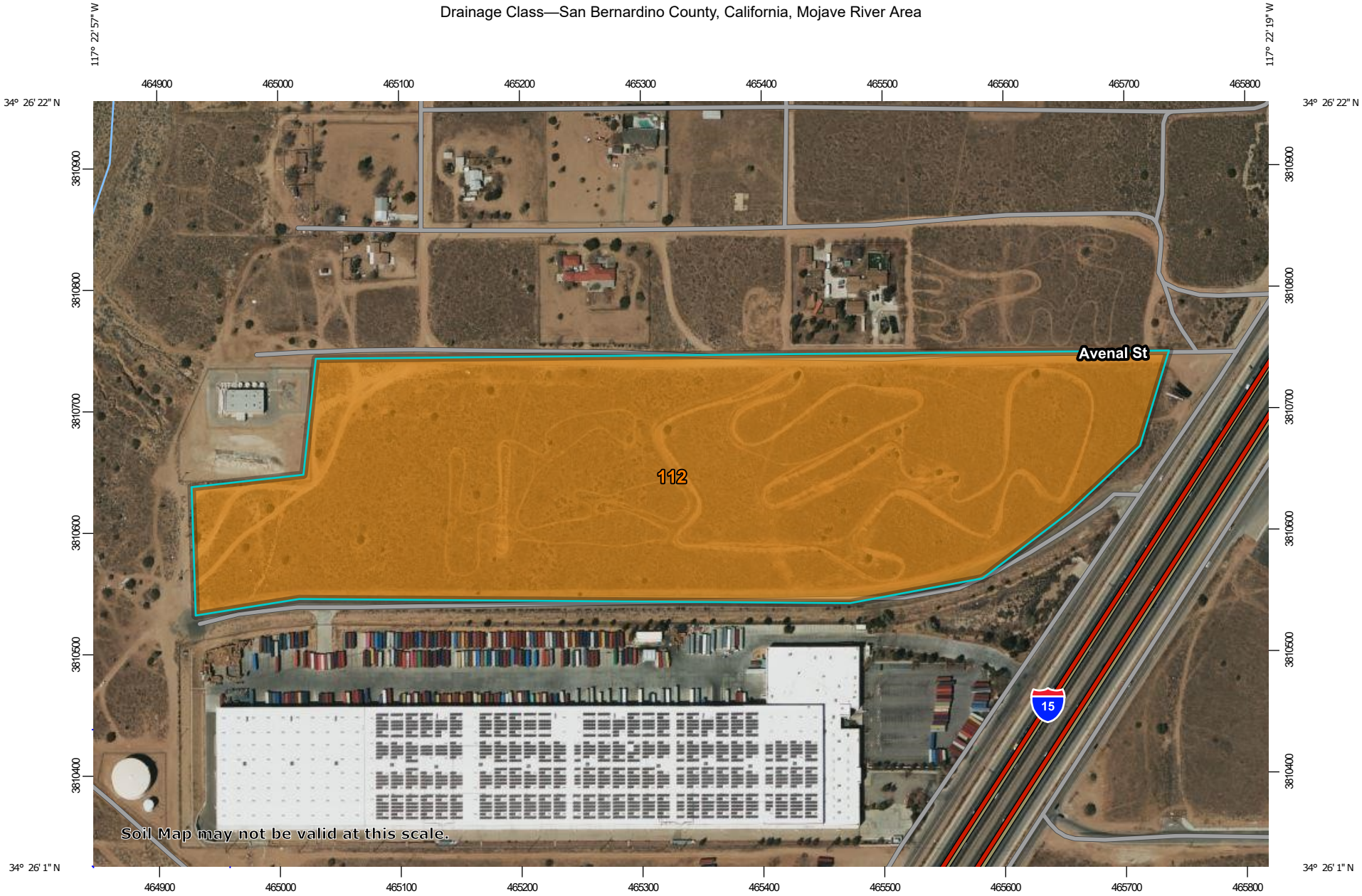
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer



Map Scale: 1:4,450 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- Not rated or not available

Soil Rating Lines

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- Not rated or not available

Soil Rating Points

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- 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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Mar 27, 2021—May 24, 2021

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.

Drainage Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
112	CAJON SAND, 0 TO 2 PERCENT SLOPES	Somewhat excessively drained	34.8	100.0%
Totals for Area of Interest			**34.8**	**100.0%**

Description

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher