Technical Drainage Study

for

The Sanctuary

Revised
July 16, 2012

Prepared By
Hansen & Associates

Job No. 07-129

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1.0 General Location and Development Description

1.1 Purpose of Report

The purpose of this technical report is to provide a detailed hydrologic and hydraulic analysis in order to establish overall drainage patterns, constraints and details for the proposed Sanctuary Subdivision and associated site in Huntsville, Utah. This report will also address onsite detention requirements and design as required by Weber County. The intent of the drainage system for the project is to minimize environmental impacts and work closely with the natural drainage patterns and conditions.

1.2 Location of Property

The project site is located at Maple Drive in Huntsville, Utah. The project site area includes land in Maple Canyon and has a latitude of 41° 17′ 16″ North and a longitude of 111° 42′ 58″ West.

1.3 Description of Property

The 520± -acre site will be developed as a single family subdivision consisting of 6 lots and all associated roads and drives. There will be a single point of ingress/egress for this project at Maple Drive. The existing site is vacant and undeveloped. The site is vegetated with native grasses, shrubs and trees. The site topography is mountainous and slopes range from 5% to greater than 30%. The entry drive and adjacent channel range in slopes from 5% to 15%.

- Roadway and Driveway slope 12% or less
- Approved pad sites 10% or less

Due to the area of the site, runoff from adjacent areas around the project site will enter the project site and drain as historically to the Maple Canyon Creek (snow melt and storm runoff). A series of check dams and detention basins are designed to detain and release runoff from the project area. Each individual lot will be responsible for detaining own runoff and having a detention plan. Ultimately, onsite and offsite runoff will drain to the Pine View Reservoir and discharge into the Willard Bay.

1.4 SCS Soils Group

The project site lies within four soil groups. Approximately 6% of the site lies within the Foxol-Rock outcrop complex (FrG) soil group. This soil group has a hydrologic soil group rating of "D". Group D soils have a very slow infiltration rate and rate of water transmission. Therefore, group D soils have a high runoff potential. An additional 14% of the site lies within the Patio

gravelly loam (PdG) soil group. This soil group has a hydrologic soil group rating of "C". Group C soils have a slow infiltration rate and rate of water transmission. Therefore, group C soils have moderate runoff potential. An additional 34% of the site lies within the Durfee stony loam (DeG) soil group. This soil group also has a hydrologic soil group rating of "C. An additional 46% of the site lies within the Smarts loam (SfG) soil group. This soil group has a hydrologic soil group rating of "B". Group B soils have a moderate infiltration rate and rate of water transmission. Therefore, group B soils have a low runoff potential.

Appropriate curve number (CN) values were established by extracting values for runoff potential based on land use and soil group types for each basin.

2.0 Drainage Basin Description

2.1 Offsite Drainage Description

Offsite flows that enter the project area have been examined briefly and included in the hydrologic analysis of the project area. Any offsite flows that enter the site will not be detained, but allowed to pass through the collection and detention system. Off site flows will drain as historically to the Maple Canyon Creek.

2.2 Onsite Drainage Description

The original roadway cut for the water reservoir was made 20 to 25 years ago. The hillside slopes have remained stable despite the absence of any retaining structures. The new roadway entrance near the reservoir has had a gravity concrete block wall installed to help stablize soil and control erosion.

Observations for the past three years by the contractor and engineers from our office observe that there is minimal runoff and no signs of erosion at the project site, indicating that the site is stabilized. Due to the extraordinary conditions of the site, Weber County Engineers allowed the project site to detain runoff that exceeds the existing, historical runoff. Each of the six lots will be required to detain their own runoff associated to their development and have not been included in this analysis. A series of check dams and detention basins are designed to detain and release runoff from the project area. While runoff is being detained and slowed by the check dams and detention basins, the water will be allowed to percolate into the ground. Percolation rates were looked at and are included in Appendix A.

The proposed roadways will cause some rerouting of historic drainage paths. This rerouting is controlled by culverts and drainage swells, under and along

the proposed road ways. Re-routing is done in a manner to return runoff to its historical paths as efficiently as possible while protecting the proposed roadway.

The area of interest was divided into 13 onsite drainage basins (labeled ON with number), 3 un-detained drainage basins (labeled UD with number), and 6 offsite basins (labeled OFF with number). The onsite drainage basins will drain to the historical drainage paths. The un-detained drainage basins are onsite basins that drain off site to surrounding canyons and are un-detainable. These areas will be left undisturbed. (Please see drainage basin map and topography for drainage patterns). The offsite basins are areas outside of the project area that will drain onto the project area. Drainage from these basins will continue to drain to the Maple Canyon Creek.

Basins ON 1, ON 2, ON 3, ON 4, ON 5, ON 6, ON 7, ON 8, ON 9, ON 10, OFF 2, and most of OFF 1 will continue to drain and be collected as done historically, into Maple Canyon Creek, without any interference from the proposed roadway. The remainder of basin OFF 1, ON 11, ON 12, and ON 13 will follow historical drainage paths until runoff approaches the proposed road. Drainage culverts and swales have been designed to protect the proposed roadway and to return runoff to historic drainage paths. Detention ponds and check dams are proposed to detain increased runoff and released at a controlled rate (See 5.0 Detention Pond Design, page 6). Basins OFF 3, OFF 4, OFF 5, and OFF 6 will continue to drain, as historically, to Maple Canyon Creek.

Onsite basins with their associated total areas, impervious and pervious areas, and CN values are itemized in Table 1. Offsite Basins with their associated attributes are itemized in Table 2.

Table 1 – Onsite Area Division and CN Values

BASIN	AREA (Acres)	IMPERVIOUS AREA (Acres)	CN VALUE	PERVIOUS AREA (Acres)	CN VALUE	WEIGHTED CN
ON 1	27.2	-	98	27.20	73	73
ON 2	26.5	-	98	26.50	66	66
ON 3	42.2	-	98	42.20	62	62
ON 4	49.1	-	98	49.10	66	66
ON 5	24.9	-	98	24.90	70	70
ON 6	11.7	-	98	11.70	66	66
ON 7	26.5	0.115	98	26.39	65	66
ON 8	11.3	0.115	98	11.19	63	64
ON 9	34.6	0.115	98	34.49	73	73
ON 10	41.4	-	98	41.40	66	66
ON 11	27.2	1.28	98	25.92	64	69
ON 12	56.4	6.14	98	50.26	54	65
ON 13	10.1	-	98	10.10	66	66
UD 1	86.4	-	98	86.40	70	70
UD 2	42.3	-	98	42.30	73	73
UD 3	4.2	0.23	98	3.97	61	66
TOTAL	**522**	**8.00**	**--**	**514.02**	**--**	**--**

Table 2 – Offsite Area Division and CN Values

Basin	Area (Acres)	Impervious Area (Acres)	CN Value	Pervious Area (Acres)	CN Value	Weighted CN Value
OFF 1	214.4	-	98	214.40	69	69
OFF 2	15.0	-	98	15.00	66	66
OFF 3	55.9	2.05	98	53.85	70	74
OFF 4	109.7	-	98	109.70	73	73
OFF 5	25.6	-	98	25.60	73	73
OFF 6	107.3	1.81	98	105.49	73	73
TOTAL	**527.9**	**3.86**	--	**524.04**	--	--

3.0 Hydrologic Analysis

3.1 Hydrologic Methodology and Criteria

Pond Pack version 8.0068 by Haestad Methods was utilized in this analysis to estimate the peak runoff values of the analyzed watersheds for the 10 year 6 hour storm event for existing and proposed conditions. This storm was determined to be the governing storm.

Input parameters used for the Pond Pack, Hydrograph SCS method, included storm hydrograph, basin areas, basin curve numbers, TR55 sheet flow parameters, TR55 shallow concentrated flow parameters, detention volume parameters, outlet parameters and other necessary data. The Pond Pack model will provide necessary CN calculations, Time of Concentration (TC) calculations, and detention and outlet calculations. Pond Pack will also calculate basin runoff, detention required, and release rates. Pond Pack calculations for proposed and existing conditions can be found in Appendix B and Appendix C, respectively, of this report.

3.2 Pond Pack Parameters

The basin areas were established based on site survey information and design

grading information. The curve numbers used were calculated by use of sub basin areas and use. Time of Concentration values were calculated within the Pond Pack program. A minimum TC value of 5 minutes was utilized. TC calculations can be found in Appendix B and Appendix C of this report. This project site is within the NOAA atlas 14 point precipitation area. The point precipitation used for this analysis is 2.42 inches for the 2 year 24 hour storm and 1.87 inches for the 10 year 6 hour storm.

4.0 Hydrologic Results

The following table summarizes proposed condition flow rates for the 10 year storm event for the concentration points relevant to the site and condition.

Table 3 - Proposed Conditions Flow Rate

Drainage Basin	Area (acres)	Peak Basin Flow (cfs)	Pond Release (cfs)	Pond Elevation (ft)	Pond Storage (cu-ft)
ON 1	27.2	2.28	--	--	--
ON 2	26.5	0.98	--	--	--
ON 3	42.2	0.93	--	--	--
ON 4	49.1	1.78	--	--	--
ON 5	24.9	1.44	--	--	--
ON 6	11.7	0.44	--	--	--
ON 7	26.5	0.99	--	--	--
ON 8	11.3	0.31	--	--	--
ON 9	34.6	2.9	--	--	--
ON 10	41.4	1.54	--	--	--
ON 11	27.2	1.42	--	--	--
ON 12	56.4	1.80	--	--	--
ON 13	10.1	0.37	--	--	--
UD 1	86.4	5.03	--	--	--
UD 2	42.3	3.55	--	--	--
UD 3	4.2	0.15	--	--	--
OFF 1	214.4	11.27	--	--	--

OFF 2	15.0	0.56	--	--	--
OFF 3	55.9	5.33	--	--	--
OFF 4	109.7	8.91	--	--	--
OFF 5	25.6	2.11	--	--	--
OFF 6	107.3	8.99			
Detention	--	--	33.27	5796.65	7,841
Total	**1,049.9**	**63.08**	**33.27**	**--**	**7,841**

The standard allowable release rate in Weber County is 0.1 cfs per acre. Due to the extraordinary conditions of the site, Weber County Engineers allowed the project site to detain runoff that exceeds the existing, historical runoff. An existing hydrologic analysis was performed to determine the existing runoff. Table 4 compares the existing, historical runoff to the proposed condition runoff for the site.

Table 4 - Existing and Proposed Flow Rates Compared

Analysis	Node	Flow Rate (cfs)
Existing	Detention	33.31
Proposed	Detention	34.72
Storage Runoff	**--**	**1.41**

Existing runoff from the project area was determined to be 33.31 cfs for the 10 year 6 hour storm event (see Appendix C for existing hydrologic analysis in Pond Pack). This runoff was then set as the allowable discharge rate from the project site. Runoff that exceeds this amount will be detained in a series of check dams and detention ponds. The designed release rate as shown in Table 3 is 33.27 cfs. This is below the allowable release of 33.31 cfs. The proposed analysis for the project site has a runoff of 34.72 cfs. The difference in runoff, and therefore the storage runoff, is 1.41 cfs (see Appendix B for proposed hydrologic analysis).

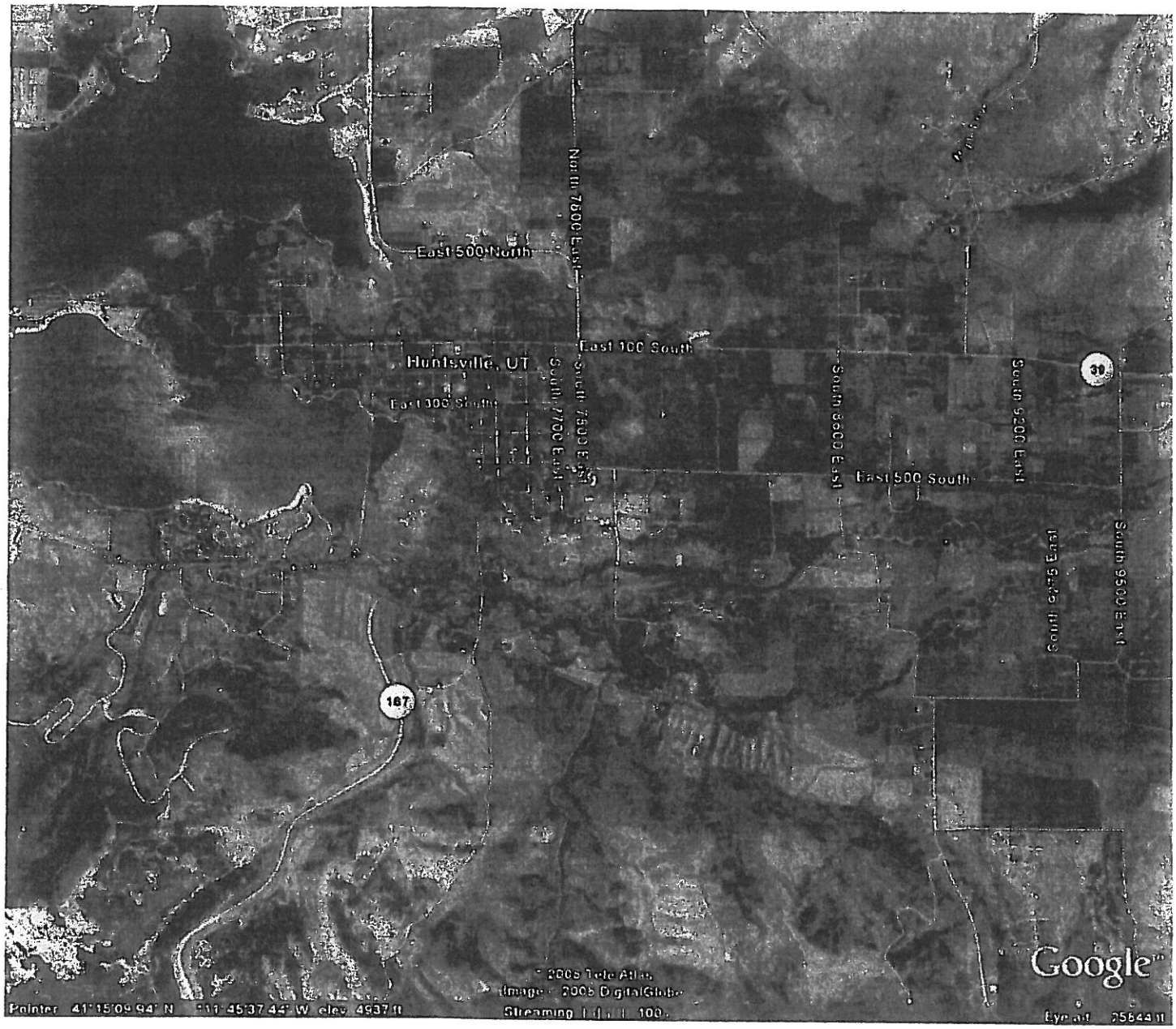
5.0 Detention Pond Design

The project site consists of steep terrain in a canyon area. Due to the existing topography, a location for a detention pond of considerable size was limited. Therefore a series of check dams and detention ponds will be used along the drainage swales paralleling the roadways (see attached Drainage Basin Map). The sites release rate is set at the historic flow rate of 33.27 cfs. The required detention volume is 7,841 cubic feet and the total provided volume is 9,801 cubic feet with 1.5' of freeboard. The release from the detention ponds will be released by means of orifice pipes. The discharge from the ponds will be released into the Maple Canyon Creek and continue to follow the drainage path to the Pine View Reservoir.

6.0 Summary

The project site is located at Maple Drive in Huntsville, Utah. The project site area includes land in Maple Canyon. The 520± -acre site will be developed as a single family subdivision consisting of 6 lots and all associated roads and drives. There will be a single point of ingress/egress for this project at Maple Drive. The site is vegetated with native grasses, shrubs and trees. The site topography is mountainous and slopes range from 5% to greater than 30%. The 10 year six hour storm event was determined to be the governing storm and used to analyze runoff associated with the site. Weber County Engineers allowed the project site to detain runoff that exceeds the existing, historical runoff for the project area. The difference in existing and proposed runoff and therefore the detained runoff is 1.41 cfs. The required detention volume is 7,841 cubic feet and the total provided volume is 9,801 cubic feet. Release from the pond will be controlled by means of orifice pipes. It discharges into the Maple Canyon Creek.

Appendix A
Hydrologic Parameters


East 500 North
North 7500 East
Huntsville, UT
East 100 South
East 300 South
South 7700 East
South 7500 East
South 8000 East
South 9200 East
East 500 South
South 9275 East
South 9500 East
39
198
Google

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 41.2878 N 111.716 W 6181 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Mar 19 2008

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.16	0.24	0.30	0.41	0.51	0.66	0.78	1.09	1.46	1.97	2.42	3.13	3.97	4.59	6.18	7.64	9.67	11.37
2	0.20	0.31	0.38	0.52	0.64	0.83	0.96	1.34	1.79	2.42	2.97	3.86	4.90	5.67	7.62	9.39	11.88	13.98
5	0.28	0.42	0.52	0.70	0.87	1.07	1.21	1.62	2.16	2.91	3.58	4.68	5.95	6.82	9.08	11.13	14.05	16.51
10	0.34	0.52	0.64	0.87	1.07	1.30	1.43	1.87	2.50	3.32	4.09	5.38	6.82	7.76	10.21	12.48	15.76	18.45
25	0.44	0.67	0.84	1.13	1.39	1.67	1.79	2.25	2.99	3.89	4.79	6.33	8.02	9.01	11.68	14.23	17.98	20.93
50	0.54	0.82	1.01	1.36	1.69	2.00	2.13	2.56	3.39	4.33	5.34	7.09	8.96	9.96	12.77	15.52	19.62	22.73
100	0.65	0.98	1.22	1.64	2.03	2.40	2.52	2.92	3.83	4.80	5.91	7.88	9.95	10.92	13.84	16.77	21.26	24.50
200	0.78	1.18	1.46	1.97	2.44	2.87	2.99	3.33	4.30	5.27	6.48	8.69	10.96	11.89	14.88	17.99	22.86	26.19
500	0.99	1.50	1.86	2.51	3.11	3.62	3.74	4.11	5.02	5.91	7.27	9.81	12.34	13.17	16.20	19.54	24.94	28.34
1000	1.19	1.81	2.24	3.02	3.74	4.33	4.44	4.82	5.61	6.42	7.88	10.68	13.42	14.14	17.19	20.68	26.48	29.91

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.18	0.28	0.35	0.47	0.58	0.75	0.87	1.20	1.61	2.19	2.69	3.47	4.47	5.17	6.89	8.49	10.69	12.48
2	0.23	0.36	0.44	0.60	0.74	0.94	1.08	1.47	1.97	2.69	3.31	4.28	5.52	6.37	8.50	10.45	13.13	15.36
5	0.32	0.48	0.60	0.81	1.00	1.22	1.35	1.78	2.39	3.24	4.00	5.20	6.71	7.67	10.13	12.39	15.53	18.14
10	0.39	0.60	0.74	0.99	1.23	1.48	1.61	2.06	2.76	3.69	4.55	5.97	7.69	8.73	11.40	13.90	17.43	20.27
25	0.51	0.78	0.97	1.30	1.61	1.91	2.03	2.50	3.33	4.33	5.33	7.03	9.04	10.14	13.04	15.85	19.90	23.02
50	0.63	0.95	1.18	1.59	1.97	2.32	2.42	2.86	3.81	4.82	5.95	7.88	10.11	11.21	14.26	17.29	21.75	25.02
100	0.76	1.16	1.44	1.94	2.40	2.81	2.92	3.30	4.35	5.33	6.58	8.78	11.23	12.31	15.47	18.72	23.60	27.00
200	0.94	1.43	1.77	2.38	2.94	3.43	3.52	3.81	4.95	5.87	7.23	9.69	12.40	13.41	16.65	20.12	25.43	28.90
500	1.23	1.87	2.32	3.12	3.87	4.45	4.53	4.81	5.91	6.60	8.13	10.97	14.03	14.92	18.19	21.91	27.82	31.37
1000	1.52	2.31	2.86	3.86	4.77	5.45	5.50	5.76	6.72	7.18	8.84	11.98	15.32	16.09	19.35	23.25	29.65	33.22

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

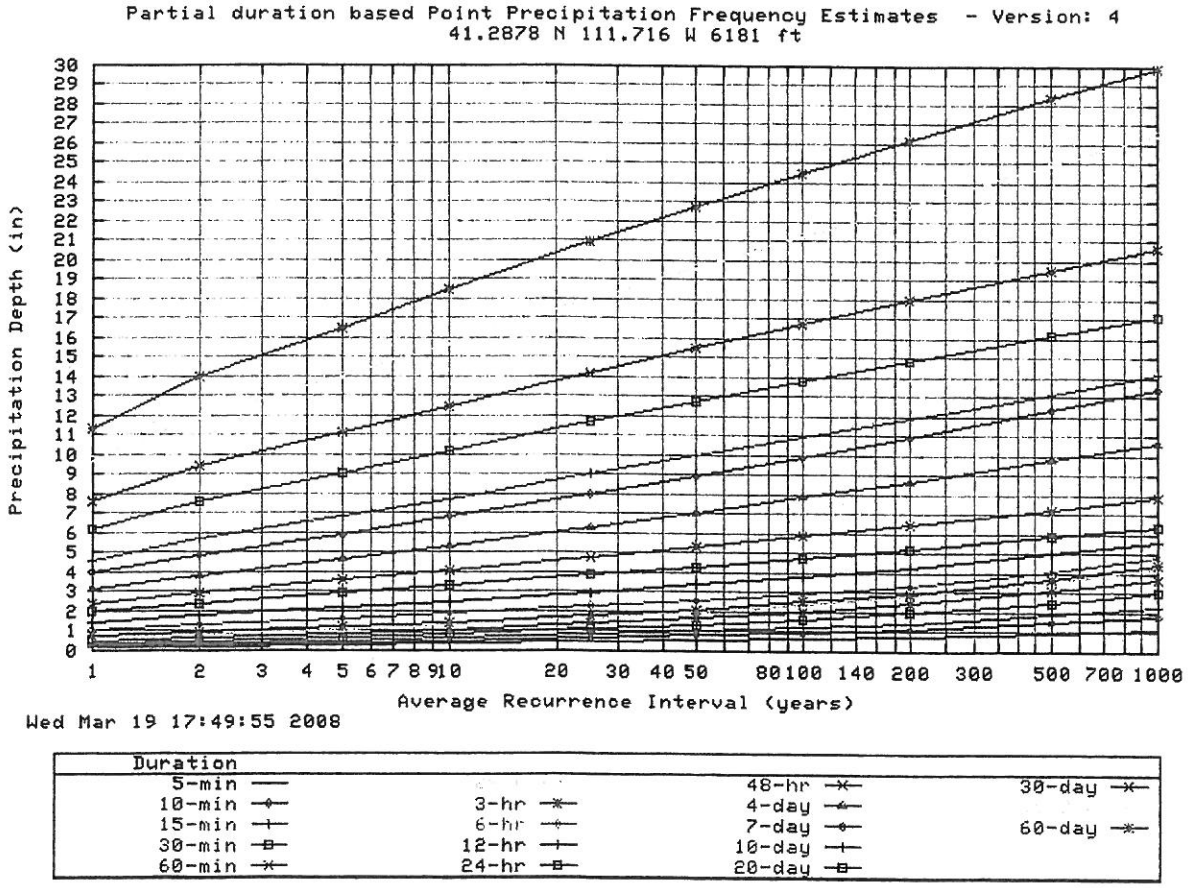
*** Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

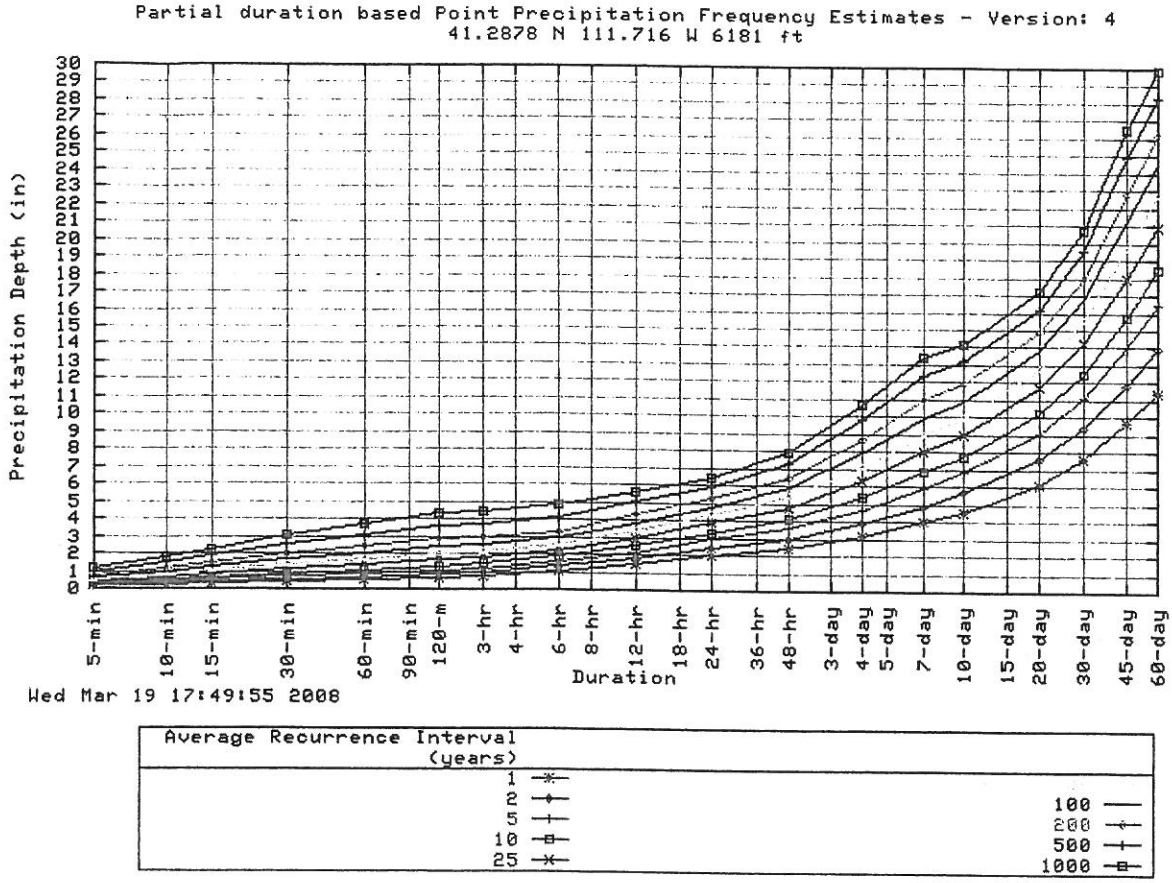
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.14	0.21	0.27	0.36	0.44	0.59	0.70	1.00	1.34	1.77	2.18	2.82	3.55	4.11	5.54	6.90	8.76	10.34

2	0.18	0.28	0.34	0.46	0.57	0.74	0.87	1.23	1.64	2.18	2.68	3.48	4.38	5.07	6.83	8.48	10.76	12.71
5	0.24	0.37	0.46	0.62	0.76	0.95	1.08	1.48	1.97	2.62	3.23	4.22	5.30	6.09	8.13	10.03	12.70	14.99
10	0.30	0.45	0.56	0.75	0.93	1.14	1.27	1.69	2.25	2.99	3.68	4.83	6.06	6.92	9.13	11.22	14.21	16.74
25	0.38	0.57	0.71	0.96	1.19	1.43	1.57	2.01	2.67	3.48	4.29	5.66	7.10	8.01	10.43	12.76	16.16	18.93
50	0.44	0.68	0.84	1.13	1.40	1.68	1.82	2.26	2.99	3.87	4.76	6.31	7.90	8.82	11.36	13.87	17.58	20.50
100	0.52	0.79	0.98	1.32	1.63	1.95	2.10	2.53	3.32	4.26	5.25	6.98	8.73	9.63	12.28	14.95	18.98	22.04
200	0.60	0.92	1.13	1.53	1.89	2.25	2.41	2.82	3.65	4.66	5.72	7.65	9.56	10.43	13.14	15.97	20.33	23.47
500	0.72	1.10	1.36	1.84	2.27	2.68	2.88	3.38	4.14	5.19	6.36	8.55	10.67	11.46	14.24	17.24	22.02	25.25
1000	0.83	1.26	1.56	2.10	2.60	3.06	3.28	3.85	4.51	5.59	6.85	9.24	11.51	12.23	15.03	18.14	23.26	26.52

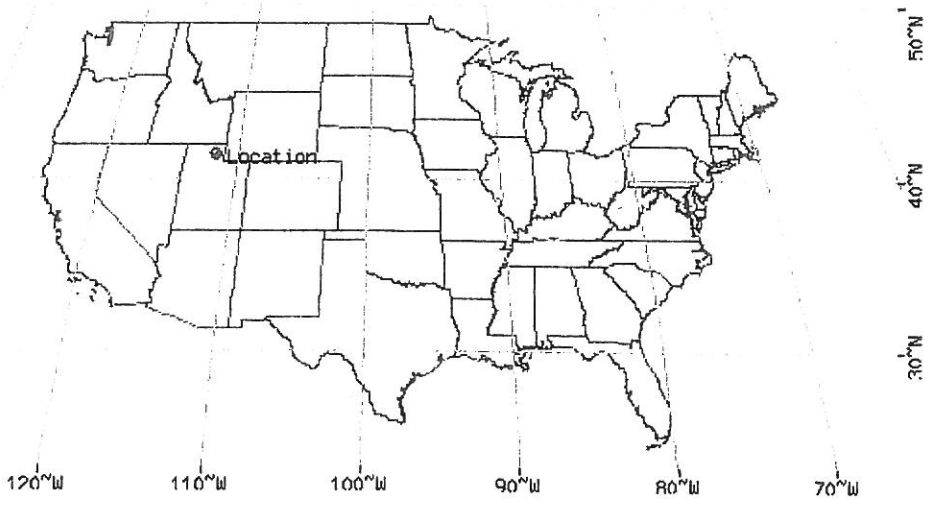
* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.



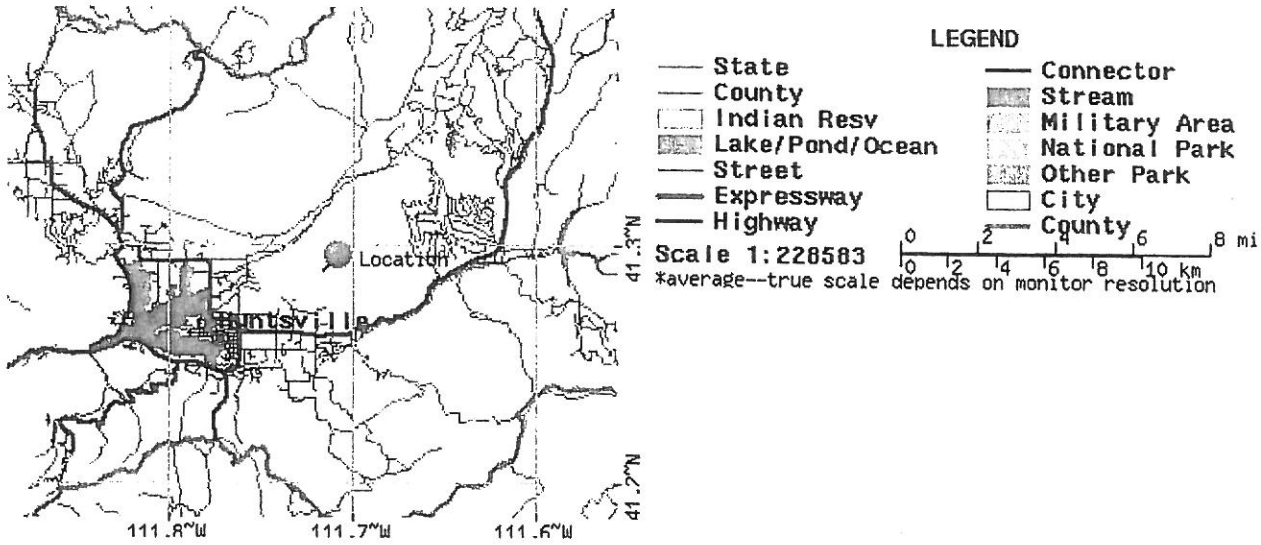


Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to our documentation.

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (41.2878/-111.716). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

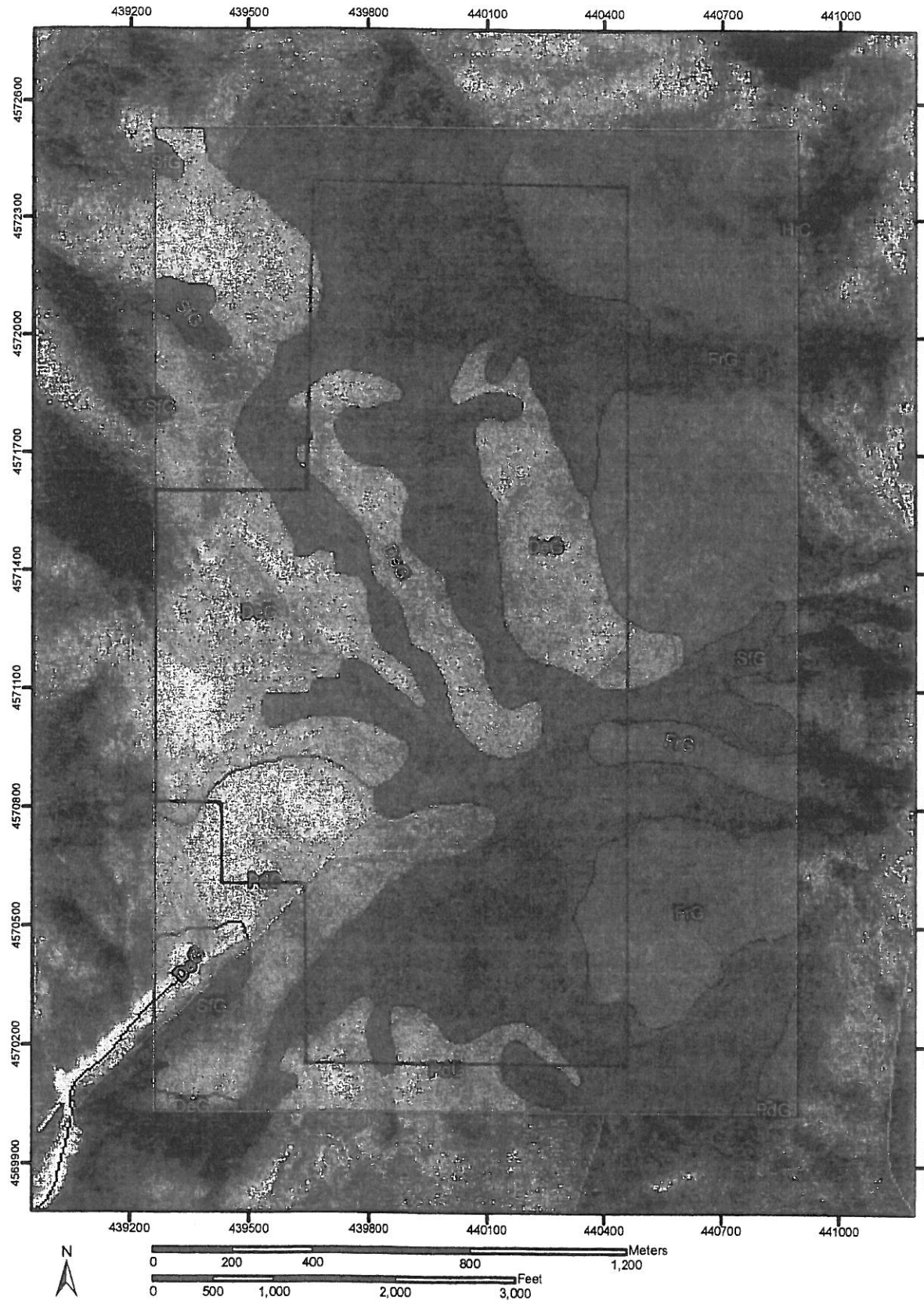
Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Yellow = C
Purple = B
Pink = D

Hydrologic Soil Group–Morgan Area, Utah - Morgan County and Part of Weber County
(Golden Eagle- The Sanctuary)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

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

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

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

Soil Survey Area: Morgan Area, Utah - Morgan County and Part of Weber County
Survey Area Data: Version 3, Dec 7, 2006

Date(s) aerial images were photographed: 10/4/1997

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.

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.

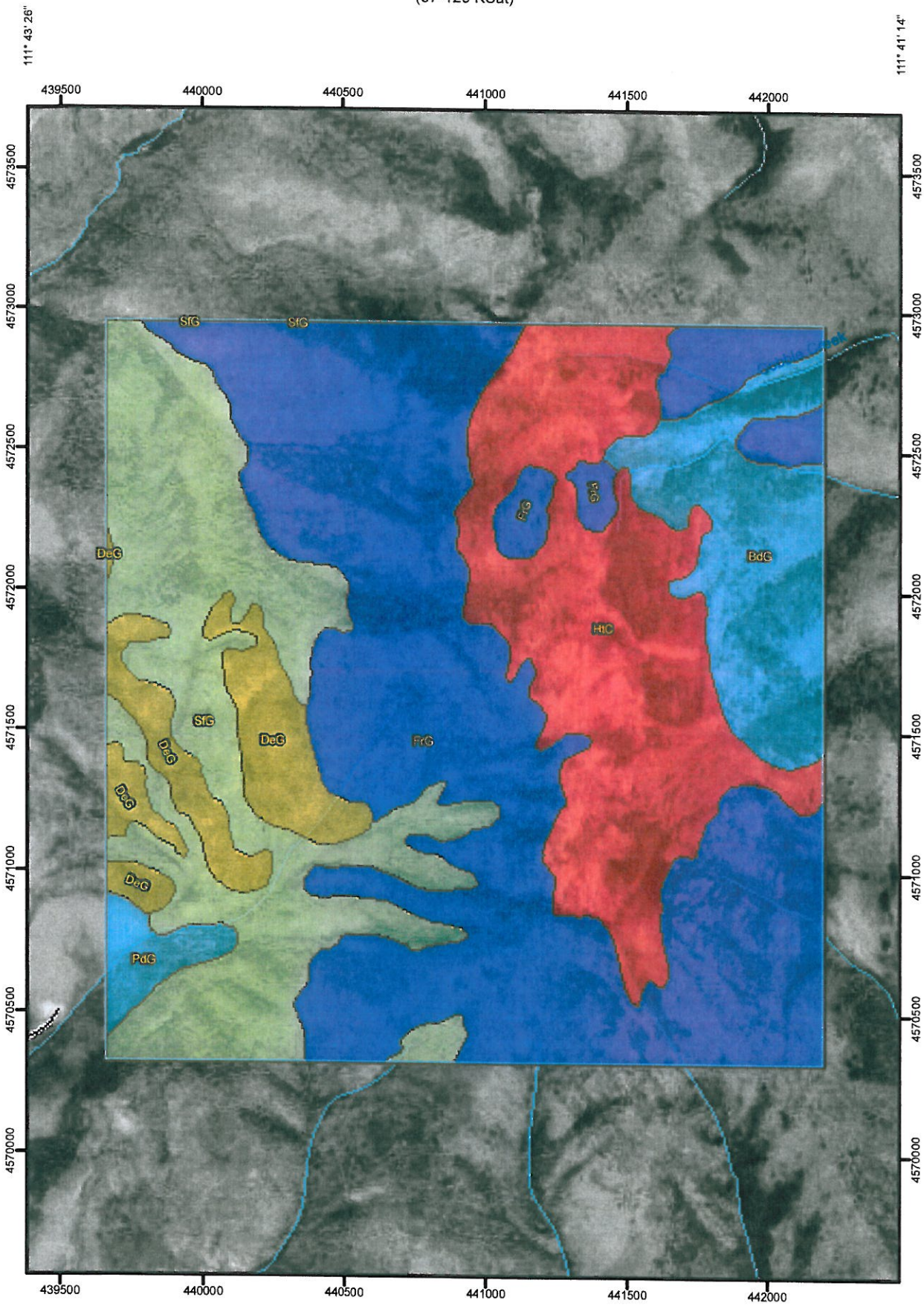
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Saturated Hydraulic Conductivity (Ksat)—Morgan Area, Utah - Morgan County and Part of Weber County
(07-129 KSat)



Map Scale: 1:19,800 if printed on A size (8.5" x 11") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1,000 2,000 3,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- <= 2.32
- > 2.32 AND <= 3.1453
- > 3.1453 AND <= 5.1102
- > 5.1102 AND <= 18.7
- > 18.7 AND <= 22.5265
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

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

MAP INFORMATION

Map Scale: 1:19,800 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

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

Soil Survey Area: Morgan Area, Utah - Morgan County and Part of Weber County
Survey Area Data: Version 5, Feb 26, 2010

Date(s) aerial images were photographed: 10/4/1997

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.

Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — Morgan Area, Utah - Morgan County and Part of Weber County				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
BdG	Broad Canyon stony loam, 30 to 70 percent	18.7000	151.7	9.2%
DeG	Durfee stony loam, 30 to 70 percent slopes	3.1453	106.2	6.4%
FrG	Foxol-Rock outcrop complex, 40 to 70 percent slopes	22.5265	699.3	42.4%
HtC	Herd-Yence complex, 3 to 15 percent slopes	2.3200	324.9	19.7%
PdG	Patio gravelly loam, 40 to 60 percent slopes	14.4970	25.6	1.6%
SfG	Smarts loam, 40 to 60 percent slopes	5.1102	340.4	20.7%
Totals for Area of Interest			**1,648.2**	**100.0%**

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

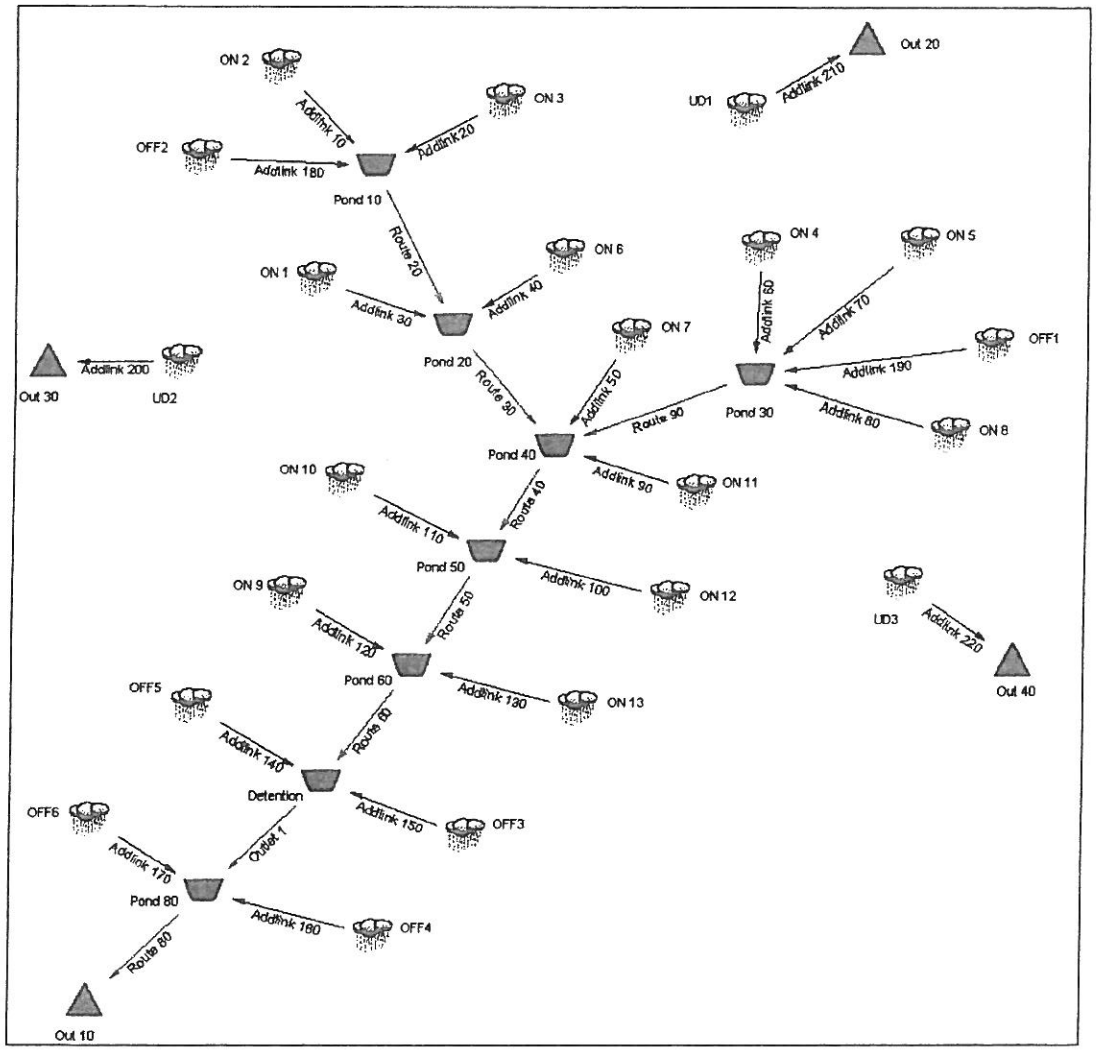
Component Percent Cutoff: *None Specified*

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options: Depth Range

Appendix B
Proposed Pond Pack Summary



POND PACK ANALYSIS: THE SANCTUARY 10 YR – 6 HR STORM EVENT

MASTER DESIGN STORM SUMMARY

Network Storm Collection: 07-129Sanctuary

Return Event	Total Depth in	Rainfall Type	RNF ID
10y6hr	1.8700	Synthetic Curve	0-10 1stQ 50%

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
DETENTION	IN	POND	10	9.706		2.7000	34.72		
DETENTION	OUT	POND	10	9.687		2.7450	33.16	96.64	.225
OFF1		AREA	10	3.086		2.7000	11.27		
OFF2		AREA	10	.147		2.7000	.56		
OFF3		AREA	10	1.356		1.5150	5.33		
OFF4		AREA	10	2.418		1.5300	8.91		
OFF5		AREA	10	.564		1.5150	2.11		
OFF6		AREA	10	2.366		1.5150	8.99		
ON 1		AREA	10	.600		1.5150	2.28		
ON 10		AREA	10	.406		2.7000	1.54		
ON 11		AREA	10	.391		2.7150	1.42		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
ON 12	AREA	10	.479		2.7150	1.80		
ON 13	AREA	10	.099		2.6850	.37		
ON 2	AREA	10	.260		2.7000	.98		
ON 3	AREA	10	.215		5.9850	.93		
ON 4	AREA	10	.482		2.7300	1.78		
ON 5	AREA	10	.402		2.7000	1.44		
ON 6	AREA	10	.115		2.7000	.44		
ON 7	AREA	10	.260		2.7000	.99		
ON 8	AREA	10	.082		2.7000	.31		
ON 9	AREA	10	.763		1.5150	2.90		
*OUT 10	JCT	10	14.471		2.7150	49.22		
*OUT 20	JCT	10	1.394		2.7000	5.03		
*OUT 30	JCT	10	.933		1.5150	3.55		
*OUT 40	JCT	10	.041		2.6700	.15		
POND 10 IN	POND	10	.622		2.7150	2.29		
POND 10 OUT	POND	10	.622		2.7150	2.29		
POND 20 IN	POND	10	1.337		2.7000	4.76		
POND 20 OUT	POND	10	1.337		2.7000	4.76		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
POND 30	IN POND	10	4.051		2.7150	14.79		
POND 30	OUT POND	10	4.051		2.7150	14.79		
POND 40	IN POND	10	6.039		2.7150	21.97		
POND 40	OUT POND	10	6.039		2.7150	21.97		
POND 50	IN POND	10	6.924		2.7150	25.30		
POND 50	OUT POND	10	6.924		2.7150	25.30		
POND 60	IN POND	10	7.786		2.7150	28.28		
POND 60	OUT POND	10	7.786		2.7150	28.28		
POND 80	IN POND	10	14.471		2.7150	49.22		
POND 80	OUT POND	10	14.471		2.7150	49.22		
UD1	AREA	10	1.394		2.7000	5.03		
UD2	AREA	10	.933		1.5150	3.55		
UD3	AREA	10	.041		2.6700	.15		

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::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0300
Hydraulic Length	300.00 ft
2yr, 24hr P	2.4200 in
Slope	.570000 ft/ft
Avg.Velocity	2.55 ft/sec

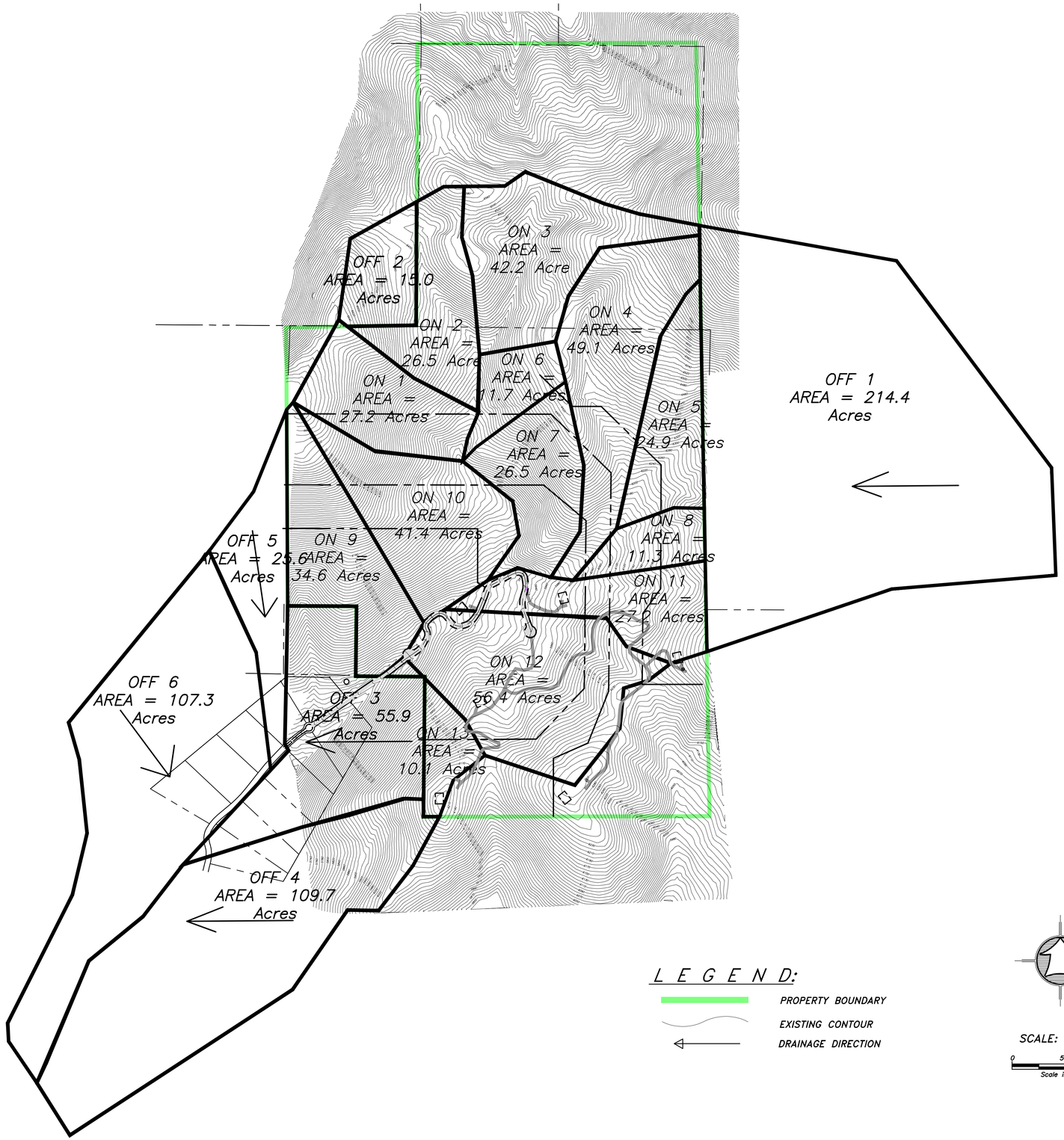
Segment #1 Time: .0327 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	2900.00 ft
Slope	.570000 ft/ft
Unpaved	
Avg.Velocity	12.18 ft/sec

Segment #2 Time: .0661 hrs

==========
Total Tc: .0988 hrs
==========



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No.	Date	By	Revision
1.	7-16-2012	MBJ	Revise drawing to match new storm drain study

HANSEN & ASSOCIATES, INC.
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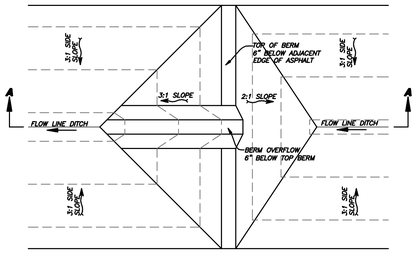
Logan (435) 752-8272

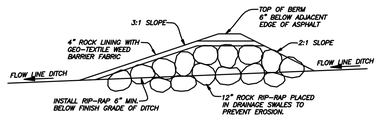
PROFESSIONAL ENGINEER
No. 276580
MATTHEW R. MEYER
STATE OF UTAH LICENSED

Drawn By: MJB Date: 9/29/10
Designed By:
Checked By:
Approved By:
Scale: 1"=500'
Drawing File: 07-129 DRAINAGE
JOB NUMBER: 07-129

DRAINAGE MAP FOR
THE SANCTUARY
A PART OF SECTION 3 & 4, T6N, R2E, AND
A PART OF SECTION 34, T7N, R2E, SLB&M
WEBER COUNTY, UTAH

SHEET
1
OF
2
SHEETS



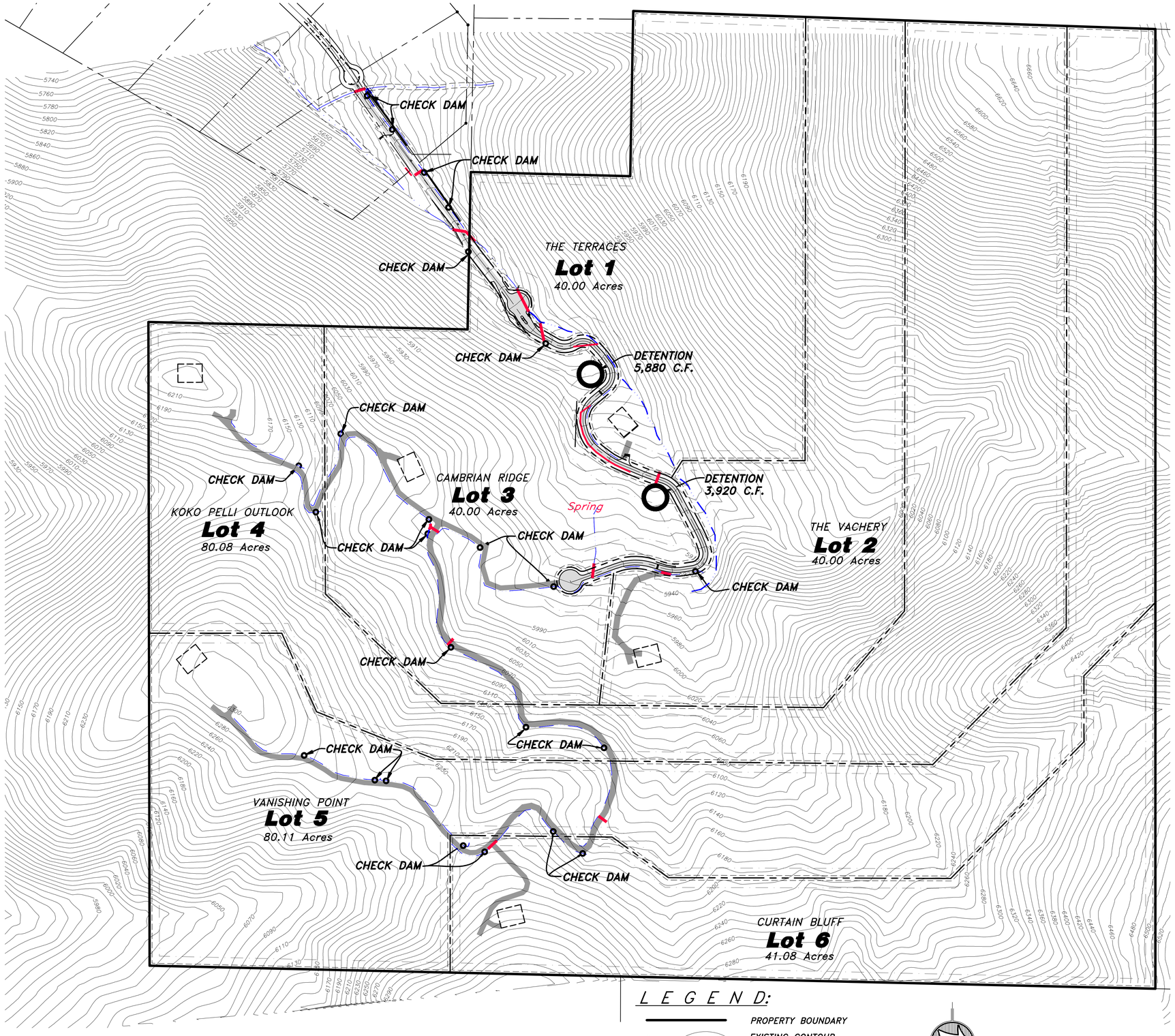


TYPICAL ROCK CHECK DAM DETAIL

SCALE: NONE

NOTE:

CONTRACTOR SHALL PROVIDE AN INTERMEDIATE CHECK DAM EVERY 400' TO 500' OR MORE FREQUENT AS SLOPE AND CONTRIBUTION AREAS DICTATE. (SEE DETAIL THIS SHEET)



LEGEND:

- PROPERTY BOUNDARY
- EXISTING CONTOUR
- CHECK DAM
- DETENTION POND

SCALE: 1"=200'

0 200 400
Scale in Feet

No.	Date	By	Revision
1.	7-16-2012	MBJ	Revise drawing to match new storm drain study

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PROFESSIONAL ENGINEER — STATE OF UTAH — No. 276548 — MATTHEW R. MEYER

Drawn By: MJB Date: 9/29/10
Designed By:
Checked By:
Approved By:
Scale: 1"=200'
Drawing File: 07-129 DRAINAGE
JOB NUMBER: 07-129

DRAINAGE MAP FOR
THE SANCTUARY
A PART OF SECTION 3 & 4, T6N, R2E, AND
A PART OF SECTION 34, T7N, R2E, SLB&M
WEBER COUNTY, UTAH

SHEET 2 OF 2 SHEETS

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