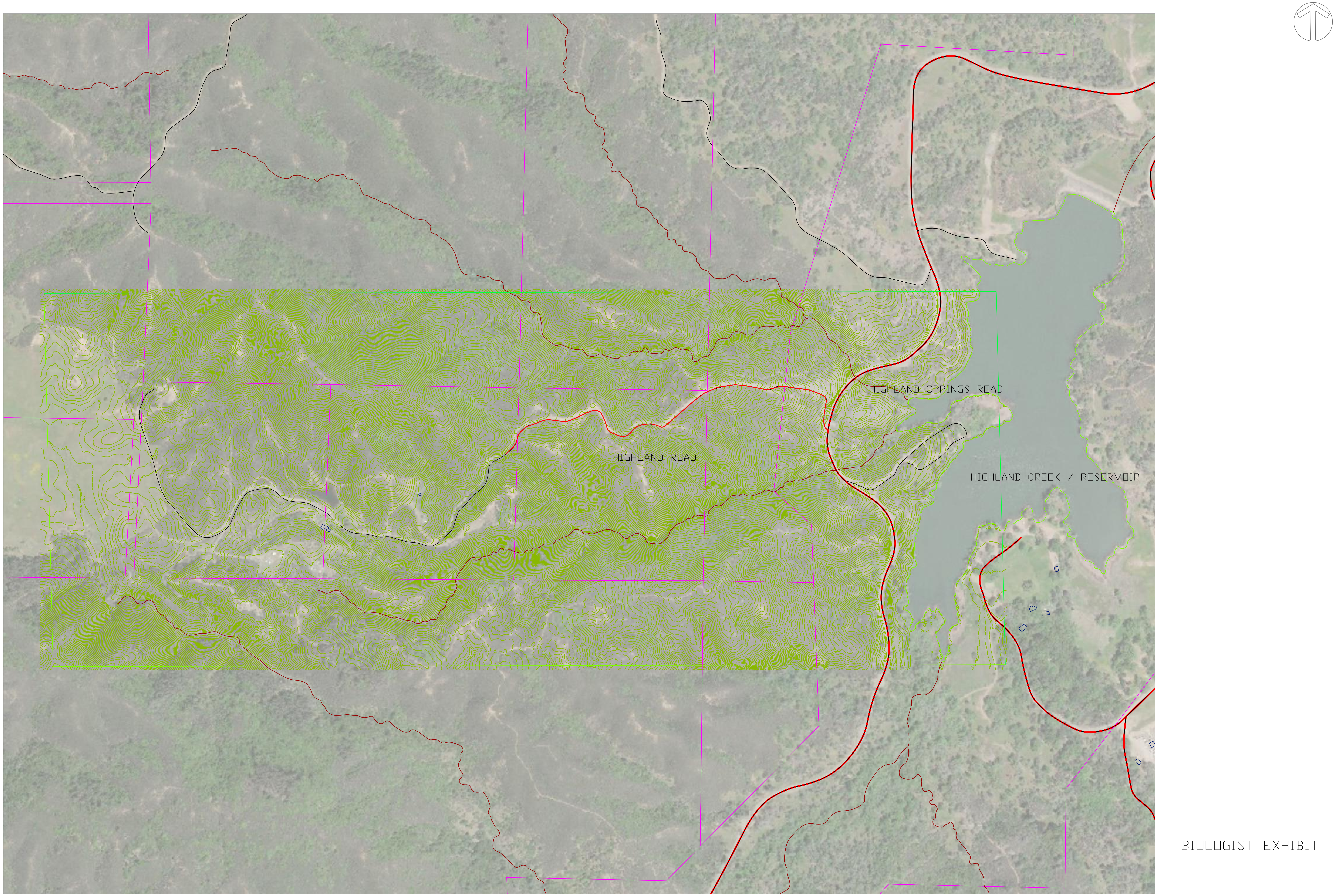
Attachment A9



BIOLOGIST EXHIBIT

Delve
Engineering
& Consulting

3111 Carriker Lane
Soquel, Ca 95073
831-295-7631
www.delveengineringandconsulting.com

REVISIONS:

SUBMITTALS	DATE:	INIT.
FIRST		
SECOND		
THIRD		
FOURTH		

-

SCALE: 1" = 300'

DRAWN BY: RSS

DESIGNED BY: RSS

CHECKED BY: DATE:

APPROVED BY: DATE:

TITLE:

LAKE CO DEVELOPMENT
VARIOUS APN'S
LAKE COUNTY, CA

ROADWAY IMPROVEMENTS

EXHIBIT

DATE: 05/22/2021

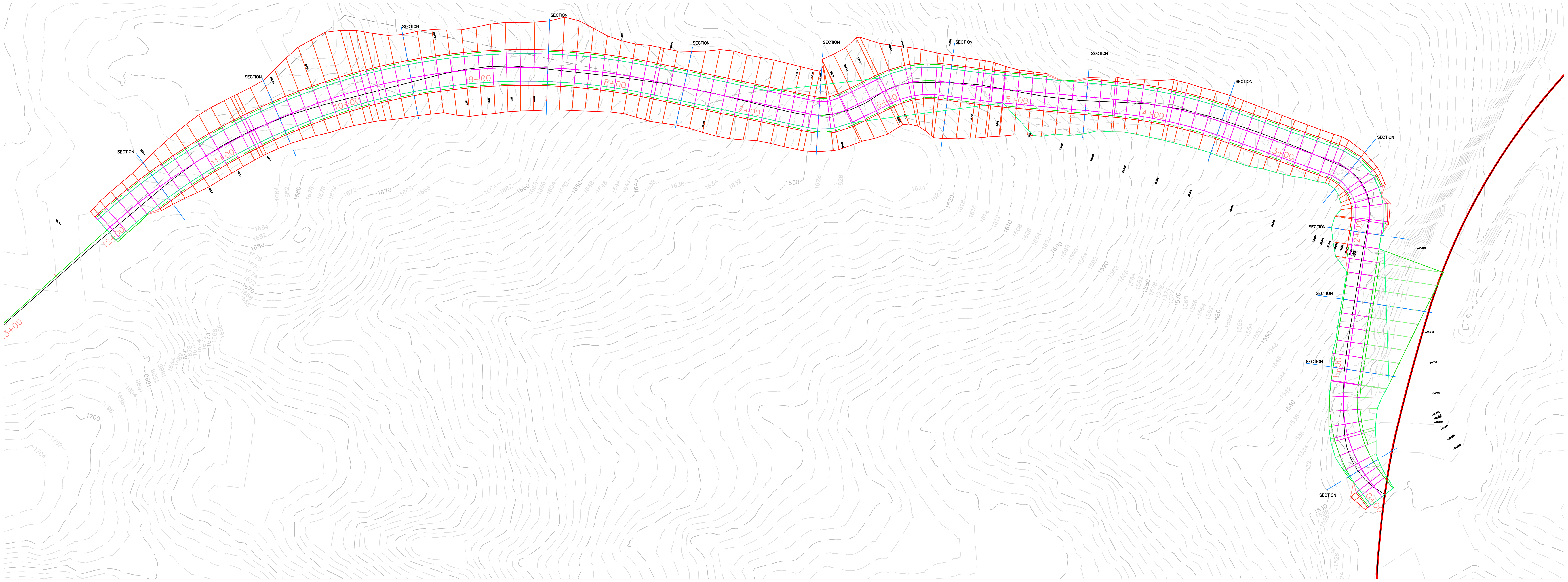
PROJECT ID.: 2021_009

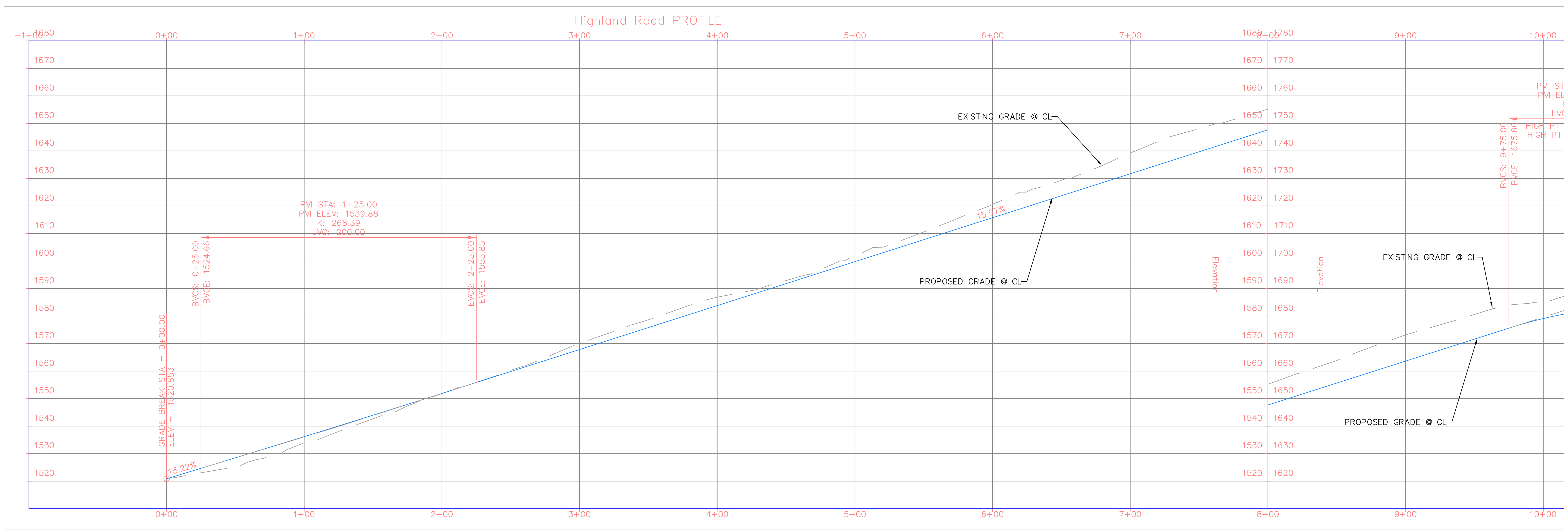
DRAWING NO.: C-1

SHT 1 OF 1

2021_009_basemap_contours roads Highland.dwg

3/19/2007





HIGHLAND ROAD

Drawing2.dwg

3/19/2007

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REVISIONS:

SUBMITTALS	DATE:	INIT.
FIRST		
SECOND		
THIRD		
FOURTH		

SCALE: 1" = 40'

DRAWN BY: RSS

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APPROVED BY: DATE:

TITLE:

LAKE CO DEVELOPMENT
VARIOUS APN'S
LAKE COUNTY, CA

ROADWAY IMPROVEMENTS

EXHIBIT

DATE: 05/08/2021

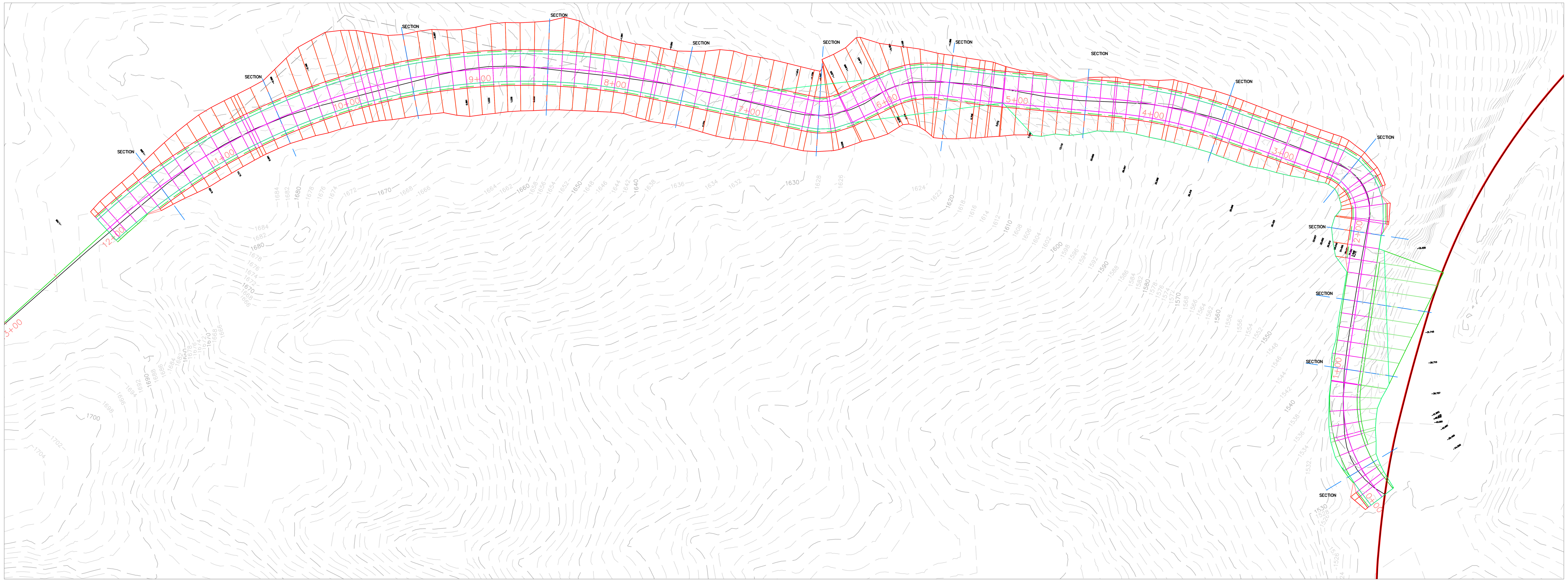
PROJECT ID.: 2021_009

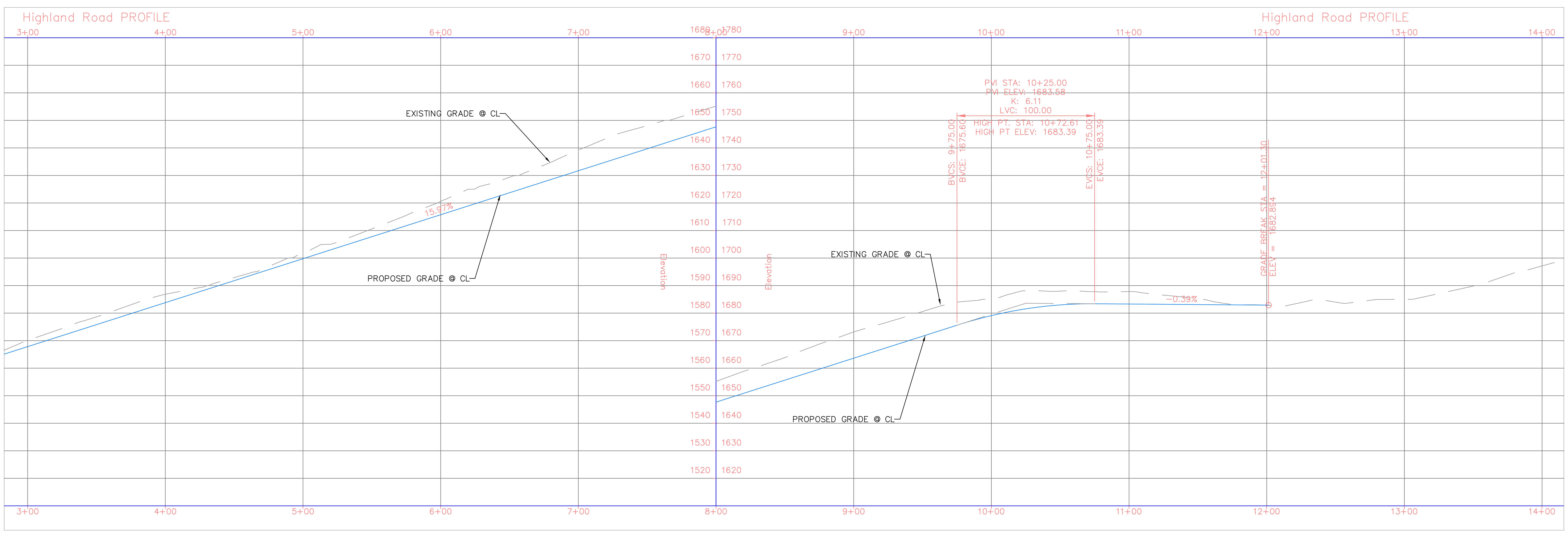
DRAWING NO.: C-1

SHT 1 OF 3

Drawing2.dwg

3/19/2007





Delve Engineering & Consulting

3111 Carriker Lane
Soquel, Ca 95073
831-295-7631

REVISIONS:

SUBMITTALS		DATE:	INIT.
FIRST	☐		
SECOND	☐		
THIRD	☐		
FOURTH	☐		

SCALE: 1" = 40'

DRAWN BY: RSS

DESIGNED BY: RSS

CHECKED BY: DATE:

APPROVED BY: DATE:

TITLE:

LAKE CO DEVELOPMENT
VARIOUS APN'S
LAKE COUNTY, CA

ROADWAY IMPROVEMENTS

EXHIBIT

DATE: 05/08/2021

PROJECT ID.: 2021_009

DRAWING NO.: C-2

SHT 2 OF 2

Cut/Fill Report

Generated: 2021-05-13 16:01:40
By user: Rider2
Drawing: D:\WORK\PROJECTS\2021_009 Lake County GIS\2_Planning\4_CAD Doc\D:\WORK\PROJECTS\2021_009 Lake County GIS\2_Planning\4_CAD Doc\Drawing2.dwg

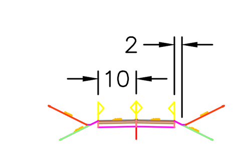
Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Highland Road_cut&fill	full	1.000	1.000	31740.54	6167.31	372.22	5795.09<Cut>

Totals

	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	31740.54	6167.31	372.22	5795.09<Cut>

* Value adjusted by cut or fill factor other than 1.0



TYPICAL SECTION

NOTES

GRADES OVER 16%
2" AC / 6" AB / 12" COMPACTED NATIVE

GRADES UNDER 16%
6" AB / 12" COMPACTED NATIVE

HIGHLAND ROAD

Delve Engineering & Consulting
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Soquel, Ca 95073
831-295-7631
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REVISIONS:

SUBMITTALS	DATE:	INIT.
FIRST		
SECOND		
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FOURTH		

SCALE: 1" = 40'
DRAWN BY: RSS
DESIGNED BY: RSS
CHECKED BY: DATE:
APPROVED BY: DATE:

TITLE:
LAKE CO DEVELOPMENT
VARIOUS APN'S
LAKE COUNTY, CA

ROADWAY IMPROVEMENTS
EXHIBIT

DATE: 05/08/2021
PROJECT ID.: 2021_009
DRAWING NO.: C-3
SHT 3 OF 3

Drawing2.dwg
3/19/2007

Lake County, CA

road

Web AppBuilder for ArcGIS

All parcel boundaries are *approximate*. Discrepancies in acerage, shape and location are common. This map is not the legal survey document to be used in single site determinations. Consult your deed for a legal parcel description.

Print Date: 11/11/2021

THE McEDWARDS GROUP
14054 Sugar Loaf Road
Grass Valley CA 95949
Phone: (707) 354-4618 License #743428 themcedwardsgroup@att.net

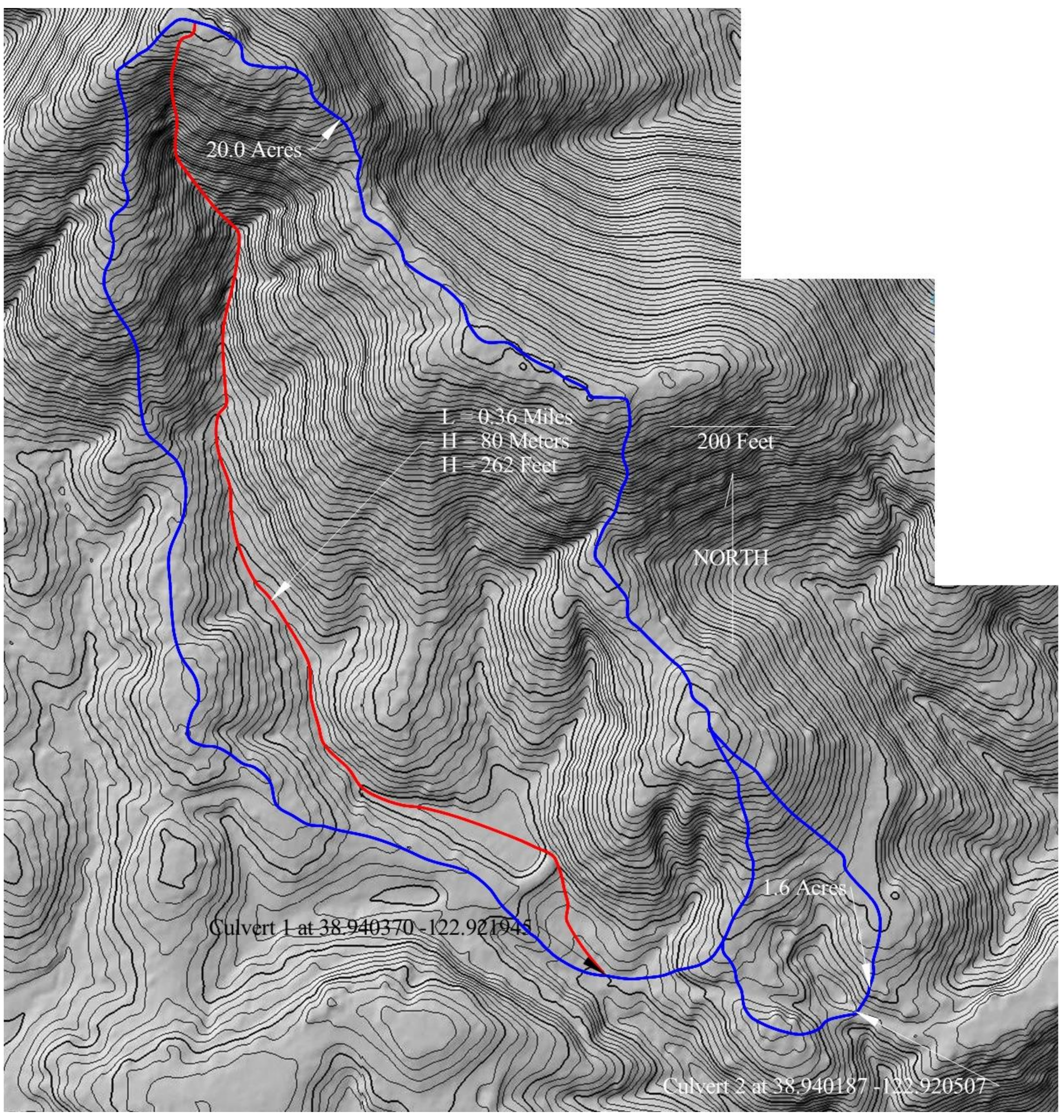
September 24, 2021
Job No. 2107.02.01

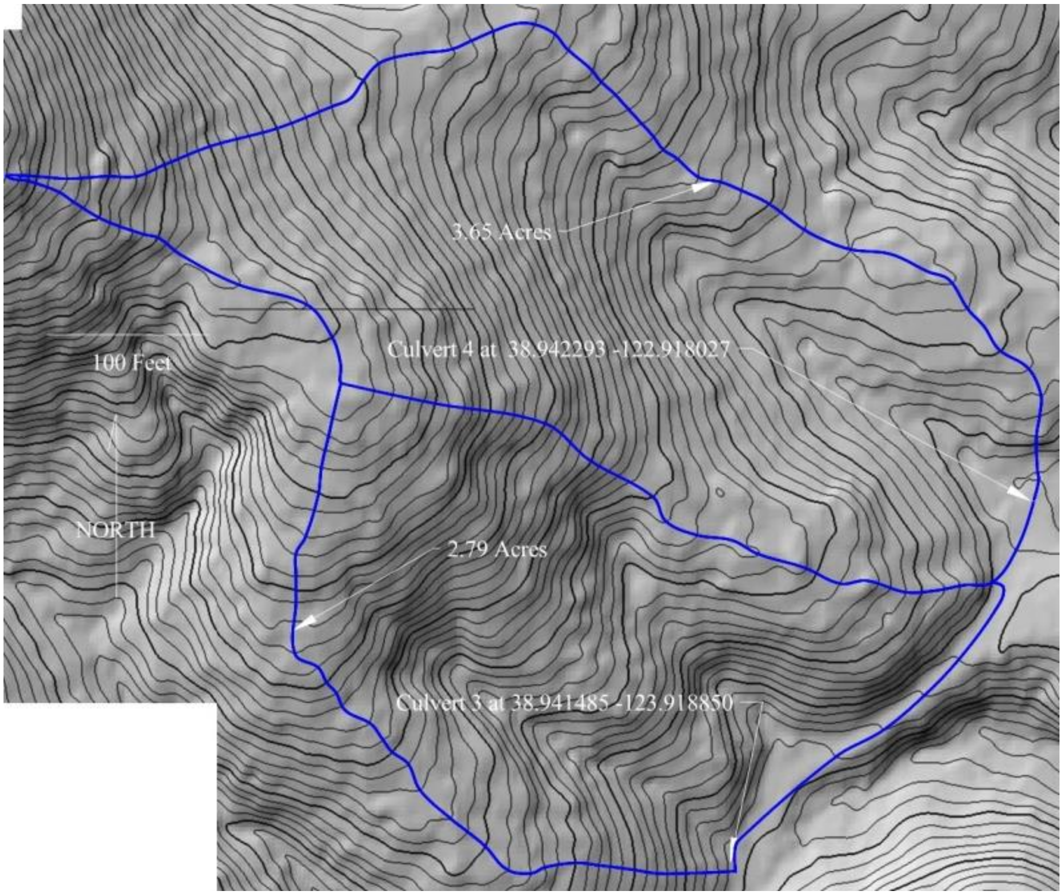
Joseph Cooper
7525 Highland Springs Road
Lakeport, CA 95453

100 Year Storm Culvert Sizing
Culverts 1 through 4
7525 Highland Springs Road
Lakeport, California

Dear Mr. Cooper,

This report describes the procedure, and results thereof, that we used to determine the diameter of four road culverts (designated at Culverts 1 through 4) at your Lakeport property to convey runoff generated by a 100-year return-interval storm. The numbered culvert locations and their watershed areas are shown on the 1 meter contour interval maps below that were obtained from https://apps.nationalmap.gov/3depdem/.





To determine the flowrate of a 100-year storm at the culvert location, we used the Rational Method described in the CalFire document *Designing Watercourse Crossings for Passage of 100-Year Flood Flows, Wood, and Sediment (Updated 2017)* found at http://calfire.ca.gov/resource_mgt/downloads/100%20yr%20revised%208-08-17%20(final-a).pdf and referenced in SWRCB Order WQ 2017-0023-DWQ.

The rational method formulae is Q = ciA where Q is the flowrate in cubic feet per second (cfs), c is a runoff coefficient (fraction of rainfall that becomes runoff), i is rainfall intensity in inches per hour, and A is the contributing watershed area in acres. The intensity of rainfall depends of the time of concentration Tc, the time it takes for runoff from the farthest point in the watershed to reach the culvert. According to the California Culvert Practice formulae, which formula is presented in the CalFire document, Tc depends on both the length (L) of the runoff path from the farthest point to the culvert, and the elevation difference (H) between the farthest point and the culvert as Tc = (11.9*L^3/H)^0.385, where L is in miles, H is in feet, and Tc is in hours. A, L, and H were measured for the Culvert 1 watershed, and these values gave a TC of less than six minutes. Because the CalFire document recommends using a Tc of 10 minutes when the calculated Tc is less than 10 minutes, we used the rainfall intensity for a time of concentration of 10 minutes for the Culvert 1 watershed and for the smaller watersheds of Culverts 2, 3, and 4.

The GPS coordinates of the culvert crossings are given below.

Culvert 1	38.940370	-122.921945	Culvert 3	38.941485	-122.918850
Culvert 2	38.940187	-122.920507	Culvert 4	38.942293	-122.918027

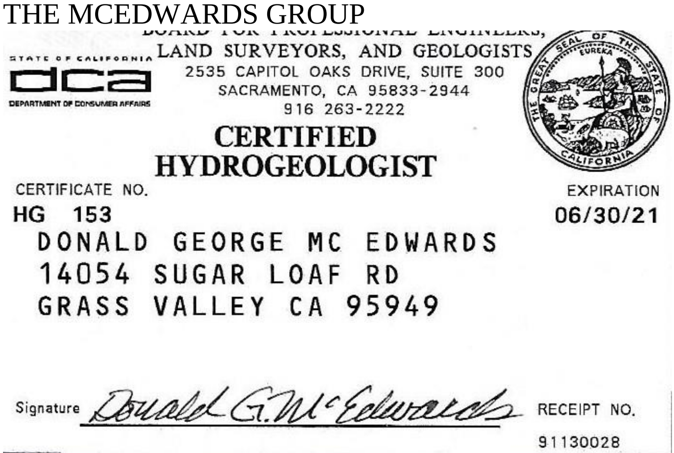
With these coordinates, we used NOAA's National Weather Service Hydrometrological Design Center Precipitation Frequency Data Server (PFDS) found at https://hdsc.nws.noaa.gov/hdsc/pfds to determine the rainfall intensity at the location of the culverts for a time of concentration of 10 minutes. The Point Precipitation Frequency Estimates data tables obtained from the NOAA server are attached. With i known, the 100-year flows for each culvert crossing were calculated. Using these flows with the Headwater Depth for C. M. Pipe Culverts with Inlet Control nomograph provided in the CalFire document, we determined the appropriate culvert sizes to handle the flows. The calculation of 100-year flows is shown on the attached spreadsheet. The determination of the culvert sizes to carry the calculated 100-year flows is shown on the attached Inlet Control nomograph.

The 100-year flows and required culverts sizes for each culvert crossing are given below.

Culvert No.	100-Year Storm Flow	Required CMP Culvert Diameter
1	18.5 cfs	36" with water depth less than 24"
2	1.5	12" with water depth less than 9"
3	2.5	18" with water depth less than 11"
4	3.3	18" with water depth less than 12"

We appreciate the opportunity to be of service. If you have any questions, please call.

Very Truly Yours,
THE MCEDWARDS GROUP



Dr. Donald G. McEdwards, CE 28088, HG 153

Attachments: Point precipitation frequency estimates
Rational method spreadsheet
Headwater Depth for C. M. Pipe Culverts with Inlet Control Nomograph

NOAA Atlas 14, Volume 6, Version 2
Location name: Lakeport, California, USA*
Latitude: 38.9404°, Longitude: -122.9219°
Elevation: 1813.84 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

Culvert 1

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	**0.130** (0.116-0.148)	**0.159** (0.141-0.181)	**0.198** (0.175-0.226)	**0.231** (0.203-0.267)	**0.279** (0.235-0.335)	**0.318** (0.261-0.390)	**0.358** (0.286-0.453)	**0.403** (0.312-0.526)	**0.466** (0.344-0.639)	**0.519** (0.368-0.739)
10-min	**0.187** (0.166-0.212)	**0.228** (0.202-0.259)	**0.284** (0.251-0.324)	**0.332** (0.291-0.383)	**0.400** (0.337-0.480)	**0.455** (0.374-0.559)	**0.514** (0.410-0.650)	**0.577** (0.447-0.754)	**0.668** (0.493-0.916)	**0.744** (0.527-1.06)
15-min	**0.226** (0.201-0.257)	**0.275** (0.244-0.314)	**0.343** (0.304-0.392)	**0.401** (0.351-0.463)	**0.484** (0.407-0.580)	**0.550** (0.452-0.677)	**0.621** (0.496-0.786)	**0.698** (0.540-0.912)	**0.808** (0.596-1.11)	**0.899** (0.638-1.28)
30-min	**0.317** (0.281-0.360)	**0.386** (0.343-0.440)	**0.482** (0.426-0.550)	**0.563** (0.493-0.649)	**0.679** (0.572-0.814)	**0.772** (0.635-0.949)	**0.872** (0.697-1.10)	**0.980** (0.758-1.28)	**1.13** (0.836-1.55)	**1.26** (0.895-1.80)
60-min	**0.448** (0.398-0.509)	**0.546** (0.484-0.622)	**0.681** (0.602-0.778)	**0.795** (0.697-0.918)	**0.959** (0.808-1.15)	**1.09** (0.897-1.34)	**1.23** (0.984-1.56)	**1.38** (1.07-1.81)	**1.60** (1.18-2.19)	**1.78** (1.26-2.54)
2-hr	**0.698** (0.620-0.793)	**0.852** (0.756-0.970)	**1.06** (0.933-1.21)	**1.22** (1.07-1.41)	**1.45** (1.22-1.74)	**1.63** (1.34-2.00)	**1.81** (1.45-2.29)	**2.00** (1.55-2.62)	**2.27** (1.67-3.10)	**2.47** (1.75-3.53)
3-hr	**0.917** (0.814-1.04)	**1.12** (0.993-1.27)	**1.38** (1.22-1.58)	**1.59** (1.40-1.84)	**1.88** (1.58-2.26)	**2.10** (1.72-2.58)	**2.32** (1.85-2.93)	**2.55** (1.97-3.32)	**2.85** (2.10-3.91)	**3.09** (2.19-4.41)
6-hr	**1.43** (1.27-1.63)	**1.75** (1.56-2.00)	**2.16** (1.91-2.47)	**2.49** (2.18-2.87)	**2.92** (2.46-3.50)	**3.24** (2.66-3.98)	**3.55** (2.84-4.49)	**3.87** (3.00-5.06)	**4.29** (3.17-5.88)	**4.61** (3.27-6.58)
12-hr	**2.12** (1.88-2.41)	**2.66** (2.36-3.03)	**3.34** (2.95-3.81)	**3.87** (3.39-4.46)	**4.55** (3.84-5.46)	**5.06** (4.16-6.22)	**5.56** (4.44-7.02)	**6.05** (4.68-7.90)	**6.69** (4.93-9.16)	**7.17** (5.08-10.2)
24-hr	**3.05** (2.74-3.47)	**3.94** (3.53-4.48)	**5.04** (4.51-5.74)	**5.89** (5.24-6.76)	**6.99** (6.04-8.26)	**7.80** (6.61-9.38)	**8.58** (7.12-10.5)	**9.36** (7.58-11.8)	**10.4** (8.10-13.5)	**11.1** (8.42-14.9)
2-day	**4.08** (3.67-4.64)	**5.26** (4.71-5.98)	**6.71** (6.01-7.65)	**7.85** (6.97-9.01)	**9.31** (8.04-11.0)	**10.4** (8.80-12.5)	**11.4** (9.48-14.0)	**12.4** (10.1-15.7)	**13.8** (10.8-18.0)	**14.8** (11.2-19.9)
3-day	**4.76** (4.27-5.41)	**6.10** (5.47-6.94)	**7.78** (6.96-8.87)	**9.08** (8.07-10.4)	**10.8** (9.30-12.7)	**12.0** (10.2-14.4)	**13.2** (11.0-16.2)	**14.4** (11.7-18.1)	**15.9** (12.5-20.8)	**17.1** (12.9-23.0)
4-day	**5.30** (4.76-6.03)	**6.80** (6.10-7.73)	**8.65** (7.74-9.87)	**10.1** (8.97-11.6)	**12.0** (10.3-14.1)	**13.3** (11.3-16.0)	**14.7** (12.2-18.0)	**16.0** (12.9-20.1)	**17.7** (13.8-23.1)	**18.9** (14.4-25.5)
7-day	**6.55** (5.88-7.44)	**8.38** (7.51-9.53)	**10.6** (9.52-12.1)	**12.4** (11.0-14.2)	**14.6** (12.6-17.3)	**16.3** (13.8-19.6)	**17.9** (14.9-22.0)	**19.5** (15.8-24.5)	**21.5** (16.8-28.1)	**23.0** (17.4-30.9)
10-day	**7.48** (6.71-8.49)	**9.55** (8.57-10.9)	**12.1** (10.8-13.8)	**14.1** (12.5-16.2)	**16.6** (14.4-19.7)	**18.5** (15.7-22.2)	**20.3** (16.8-24.9)	**22.0** (17.8-27.7)	**24.3** (19.0-31.7)	**25.9** (19.7-34.9)
20-day	**9.89** (8.88-11.2)	**12.6** (11.3-14.4)	**16.0** (14.3-18.3)	**18.6** (16.5-21.3)	**21.9** (18.9-25.8)	**24.2** (20.5-29.1)	**26.5** (22.0-32.5)	**28.7** (23.2-36.1)	**31.5** (24.6-41.1)	**33.5** (25.4-45.1)
30-day	**12.0** (10.7-13.6)	**15.3** (13.7-17.4)	**19.3** (17.3-22.0)	**22.3** (19.8-25.6)	**26.2** (22.6-30.9)	**28.9** (24.5-34.8)	**31.5** (26.2-38.8)	**34.1** (27.6-42.9)	**37.3** (29.2-48.7)	**39.7** (30.1-53.4)
45-day	**14.8** (13.3-16.9)	**18.9** (16.9-21.4)	**23.7** (21.2-27.0)	**27.3** (24.3-31.4)	**31.9** (27.5-37.7)	**35.1** (29.8-42.2)	**38.2** (31.7-46.9)	**41.1** (33.3-51.8)	**44.8** (35.0-58.5)	**47.5** (36.0-63.9)
60-day	**17.5** (15.7-19.8)	**22.0** (19.8-25.1)	**27.5** (24.6-31.4)	**31.6** (28.1-36.3)	**36.7** (31.7-43.4)	**40.3** (34.2-48.5)	**43.7** (36.3-53.7)	**47.0** (38.1-59.2)	**51.1** (39.9-66.7)	**54.0** (40.9-72.7)

[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

NOAA Atlas 14, Volume 6, Version 2
Location name: Lakeport, California, USA*
Latitude: 38.9402°, Longitude: -122.9205°
Elevation: 1813.68 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

Culverts 2, 3, and 4

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	**0.128** (0.113-0.145)	**0.156** (0.138-0.178)	**0.194** (0.172-0.222)	**0.227** (0.199-0.262)	**0.274** (0.231-0.329)	**0.312** (0.257-0.384)	**0.352** (0.282-0.446)	**0.396** (0.306-0.517)	**0.459** (0.338-0.628)	**0.510** (0.362-0.727)
10-min	**0.183** (0.163-0.208)	**0.223** (0.198-0.254)	**0.279** (0.246-0.318)	**0.326** (0.285-0.376)	**0.393** (0.331-0.471)	**0.447** (0.368-0.550)	**0.505** (0.404-0.639)	**0.568** (0.439-0.741)	**0.657** (0.485-0.900)	**0.731** (0.518-1.04)
15-min	**0.221** (0.197-0.252)	**0.270** (0.240-0.308)	**0.337** (0.298-0.385)	**0.394** (0.345-0.455)	**0.475** (0.400-0.570)	**0.541** (0.445-0.665)	**0.611** (0.488-0.772)	**0.687** (0.531-0.896)	**0.795** (0.586-1.09)	**0.884** (0.627-1.26)
30-min	**0.311** (0.276-0.354)	**0.380** (0.337-0.432)	**0.474** (0.419-0.541)	**0.554** (0.485-0.639)	**0.668** (0.562-0.801)	**0.760** (0.625-0.934)	**0.858** (0.686-1.09)	**0.965** (0.746-1.26)	**1.12** (0.824-1.53)	**1.24** (0.881-1.77)
60-min	**0.439** (0.390-0.500)	**0.536** (0.475-0.611)	**0.669** (0.591-0.764)	**0.782** (0.685-0.902)	**0.943** (0.794-1.13)	**1.07** (0.882-1.32)	**1.21** (0.968-1.53)	**1.36** (1.05-1.78)	**1.58** (1.16-2.16)	**1.75** (1.24-2.50)
2-hr	**0.684** (0.607-0.778)	**0.836** (0.741-0.952)	**1.04** (0.916-1.18)	**1.20** (1.05-1.39)	**1.43** (1.20-1.71)	**1.60** (1.32-1.97)	**1.78** (1.42-2.25)	**1.97** (1.52-2.57)	**2.23** (1.64-3.05)	**2.43** (1.72-3.46)
3-hr	**0.899** (0.798-1.02)	**1.10** (0.974-1.25)	**1.36** (1.20-1.55)	**1.57** (1.37-1.81)	**1.85** (1.56-2.21)	**2.06** (1.69-2.53)	**2.28** (1.82-2.88)	**2.50** (1.93-3.26)	**2.80** (2.07-3.84)	**3.03** (2.15-4.32)
6-hr	**1.40** (1.24-1.59)	**1.72** (1.52-1.96)	**2.12** (1.87-2.42)	**2.44** (2.13-2.81)	**2.86** (2.41-3.43)	**3.17** (2.61-3.90)	**3.48** (2.78-4.40)	**3.79** (2.93-4.95)	**4.20** (3.10-5.76)	**4.52** (3.20-6.43)
12-hr	**2.07** (1.84-2.36)	**2.60** (2.31-2.96)	**3.26** (2.88-3.73)	**3.78** (3.31-4.36)	**4.45** (3.75-5.34)	**4.95** (4.07-6.08)	**5.43** (4.34-6.86)	**5.91** (4.57-7.72)	**6.54** (4.82-8.95)	**7.01** (4.97-9.98)
24-hr	**2.99** (2.69-3.40)	**3.85** (3.45-4.38)	**4.92** (4.40-5.61)	**5.75** (5.11-6.60)	**6.82** (5.89-8.06)	**7.61** (6.45-9.15)	**8.37** (6.95-10.3)	**9.13** (7.40-11.5)	**10.1** (7.90-13.2)	**10.8** (8.22-14.6)
2-day	**4.00** (3.59-4.54)	**5.14** (4.61-5.85)	**6.56** (5.87-7.48)	**7.67** (6.81-8.80)	**9.09** (7.85-10.7)	**10.1** (8.60-12.2)	**11.2** (9.26-13.7)	**12.2** (9.85-15.3)	**13.5** (10.5-17.6)	**14.4** (10.9-19.4)
3-day	**4.65** (4.18-5.28)	**5.97** (5.35-6.79)	**7.60** (6.80-8.67)	**8.87** (7.89-10.2)	**10.5** (9.09-12.4)	**11.7** (9.95-14.1)	**12.9** (10.7-15.9)	**14.1** (11.4-17.7)	**15.6** (12.2-20.3)	**16.7** (12.6-22.4)
4-day	**5.18** (4.65-5.89)	**6.64** (5.96-7.55)	**8.45** (7.56-9.64)	**9.86** (8.77-11.3)	**11.7** (10.1-13.8)	**13.0** (11.0-15.7)	**14.3** (11.9-17.6)	**15.6** (12.6-19.6)	**17.3** (13.5-22.5)	**18.5** (14.0-24.9)
7-day	**6.40** (5.75-7.28)	**8.19** (7.34-9.31)	**10.4** (9.30-11.9)	**12.1** (10.8-13.9)	**14.3** (12.4-16.9)	**15.9** (13.5-19.2)	**17.5** (14.5-21.5)	**19.0** (15.4-23.9)	**21.0** (16.4-27.4)	**22.5** (17.0-30.2)
10-day	**7.30** (6.56-8.30)	**9.33** (8.37-10.6)	**11.8** (10.6-13.5)	**13.8** (12.2-15.8)	**16.2** (14.0-19.2)	**18.0** (15.3-21.7)	**19.8** (16.4-24.3)	**21.5** (17.4-27.1)	**23.7** (18.5-30.9)	**25.3** (19.2-34.0)
20-day	**9.66** (8.67-11.0)	**12.3** (11.1-14.0)	**15.6** (14.0-17.8)	**18.1** (16.1-20.8)	**21.3** (18.4-25.2)	**23.6** (20.0-28.4)	**25.8** (21.5-31.8)	**28.0** (22.7-35.2)	**30.7** (24.0-40.1)	**32.7** (24.8-44.0)
30-day	**11.7** (10.5-13.3)	**14.9** (13.4-16.9)	**18.8** (16.8-21.4)	**21.8** (19.4-25.0)	**25.5** (22.1-30.2)	**28.2** (23.9-34.0)	**30.8** (25.6-37.8)	**33.3** (27.0-41.9)	**36.4** (28.5-47.6)	**38.7** (29.4-52.1)
45-day	**14.5** (13.0-16.5)	**18.4** (16.5-20.9)	**23.1** (20.7-26.3)	**26.7** (23.7-30.6)	**31.1** (26.9-36.8)	**34.3** (29.1-41.2)	**37.3** (30.9-45.8)	**40.2** (32.5-50.6)	**43.8** (34.2-57.2)	**46.4** (35.2-62.4)
60-day	**17.0** (15.3-19.4)	**21.5** (19.3-24.5)	**26.9** (24.0-30.6)	**30.9** (27.4-35.5)	**35.9** (31.0-42.4)	**39.4** (33.4-47.4)	**42.7** (35.5-52.5)	**45.9** (37.2-57.8)	**49.9** (39.0-65.2)	**52.8** (40.1-71.1)

[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

RATIONAL METHOD SPREADSHEET

Q100= CiA

Q100 = predicted peak runoff from a 100-year storm (cubic feet per second, cfs)
C = runoff coefficient
i = rainfall intensity (inches per hour) for the 100-year storm
A = basin drainage area (acres)

i depends on the Time of Concentration, Tc
Tc = (11.9xL^3/H)^0.385) Kirpick Formula

Tc = time of concentration (hours)
L = length of the channel in miles from the head of the watershed to the crossing point
H = elevation difference between the highest point in the watershed and the crossing point (feet)

Values for rational runoff coefficients (Dunne and Leopold 1978).
Woodland Soils in Rural Areas
Runoff Coefficient (C)

Sandy and gravelly soils	0.1
Loams and similar soils without impeding horizons	0.3
Heavy clay soils or those with a shallow impeding horizon; shallow soils over bedrock	0.4

Use 1 meter contour interval map of site (https://apps.nationalmap.gov/3depdem/) to determne watershed area
Use hdsc.nws.noaa.gov/hdsc/pfds/ with gps and Tc to determine i for 100 year storm

Culvert 1

Latitude	38.940370		Longitude	-122.921945	
A=	20	acres			
H=	262	feet	Tc =	0.093	hours
L=	0.36	miles		5.61	minutes
C=	0.3				

Because Tc is less than 10 minutes, use Tc = 10 minutes as recommemded by CalFire document
for this and the other three smaller culvert watersheds

Tc in Minutes	Depth					
10	0.514	inches in 10 min =	0.051	in/min =	3.08	in/hour

	C	i	A	= Q	
Q100 =	0.30	3.08	20.00	18.5	cfs

From Nomograph: A 36" CMP culvert with a headwall entrance will pass 18.5 cfs
with a water depth of less than 0.66 of pipe diameter or 24 inches

Culvert 2

Latitude	38.940187			Longitude	-122.920507		
A=	1.6	acres					
C=	0.3						

Tc in Minutes	Depth						
10	0.505	inches in 10 min =		0.051	in/min =	3.03	in/hour

	C	i	A	= Q	
Q100 =	0.30	3.03	1.60	1.5	cfs

From Nomograph: A 12" CMP culvert with a headwall entrance will pass 1.5 cfs
with a water depth of less than 0.74 of pipe diameter or 9 inches

Culvert 3

Latitude	38.941485			Longitude	-122.91885		
A=	2.79	acres					
C=	0.3						

Tc in Minutes	Depth						
10	0.505	inches in 10 min =		0.051	in/min =	3.03	in/hour

	C	i	A	= Q	
Q100 =	0.30	3.03	2.79	2.5	cfs

From Nomograph: An 18" CMP culvert with a headwall entrance will pass 2.5 cfs
with a water depth of less than 0.57 of pipe diameter or 11 inches

Culvert 4

Latitude	38.942293			Longitude	-122.918027		
A=	3.65	acres					
C=	0.3						

Tc in Minutes	Depth						
10	0.505	inches in 10 min =		0.051	in/min =	3.03	in/hour

	C	i	A	= Q	
Q100 =	0.30	3.03	3.65	3.3	cfs

From Nomograph: An 18" CMP culvert with a headwall entrance will pass 3.3 cfs
with a water depth of less than 0.67 of pipe diameter or 12 inches

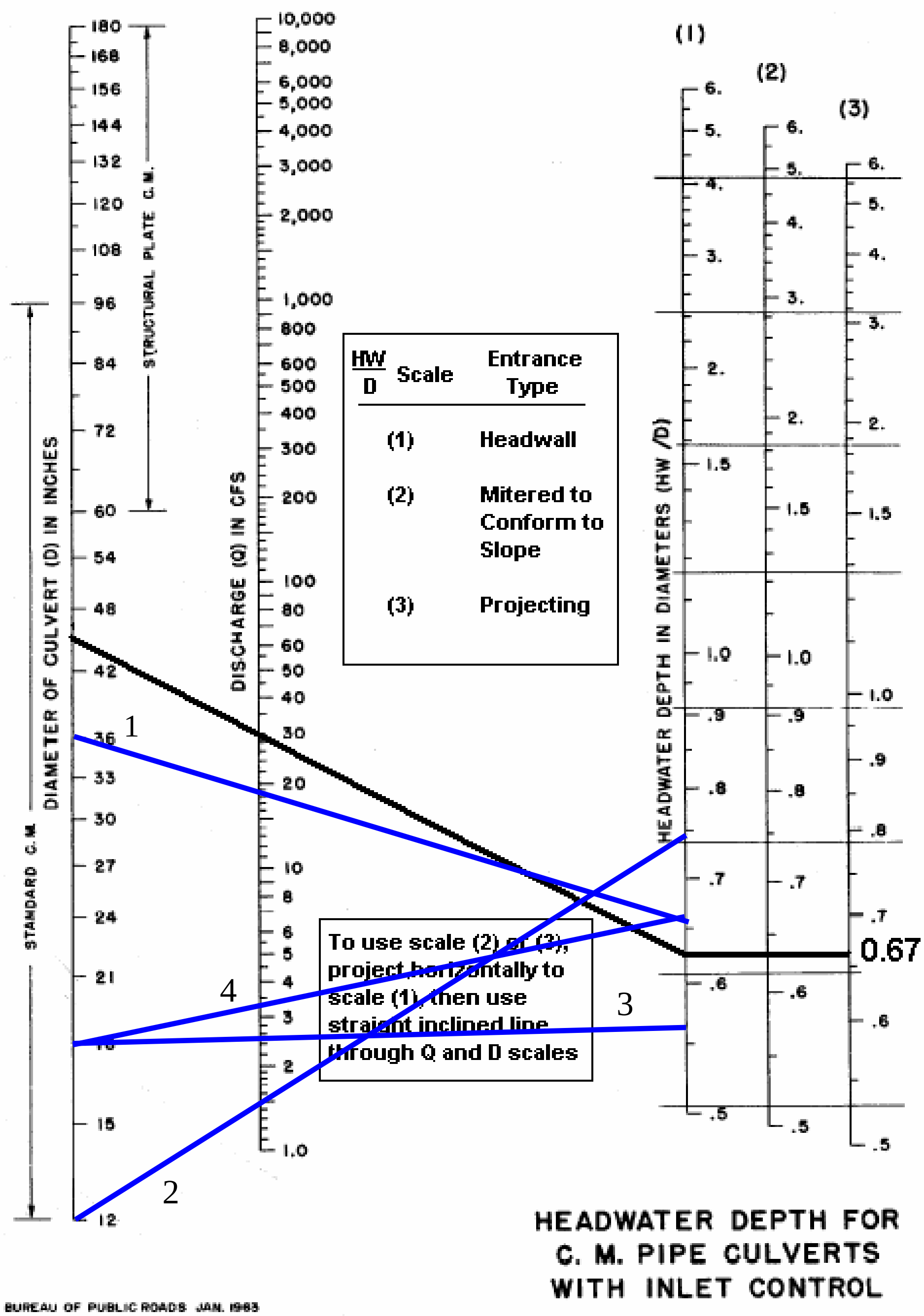
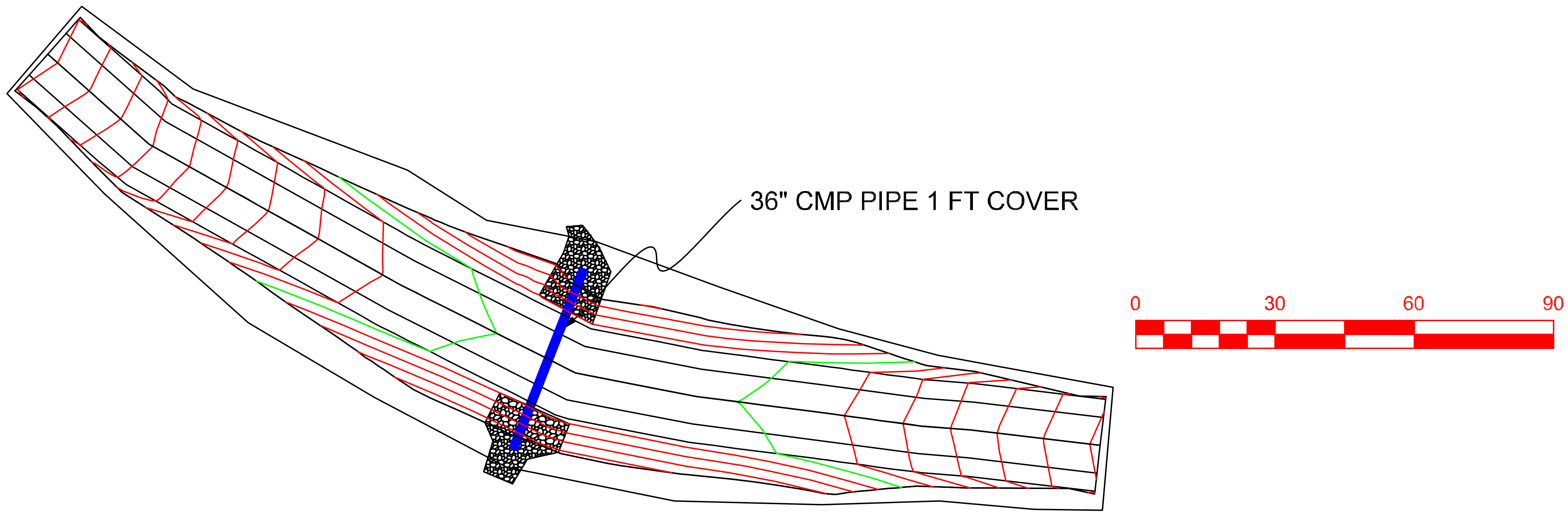
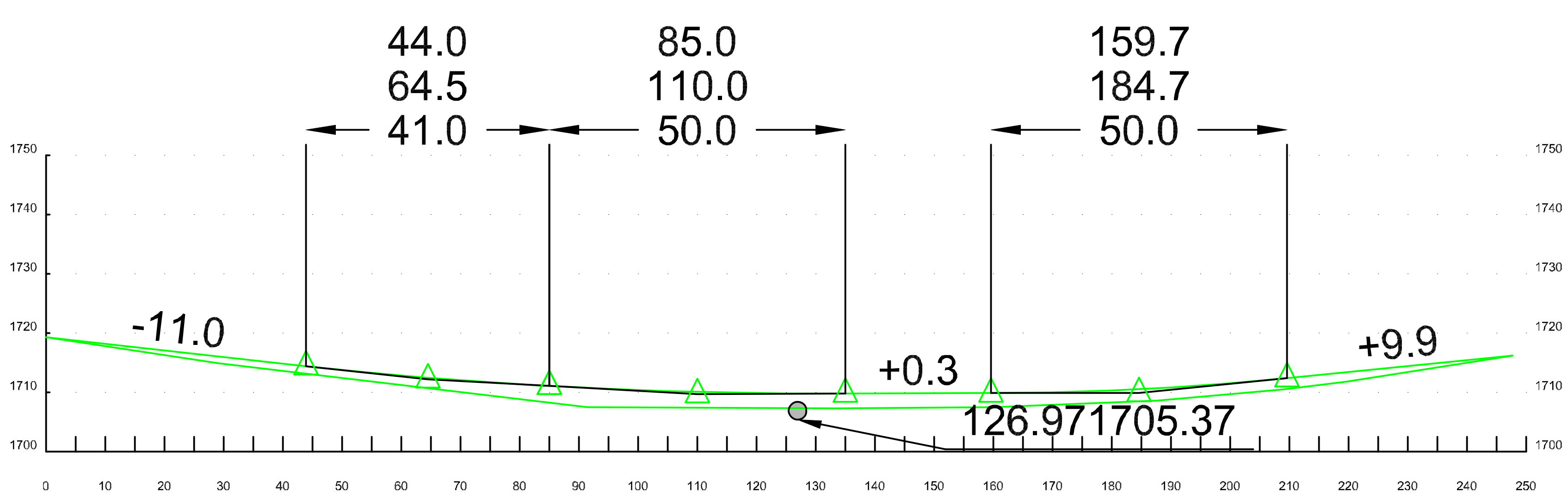


Figure 12. Normann and others (1985) culvert sizing nomograph for a round pipe with inlet control. For the watershed HEN example, using the direct transference method result of 30 cfs, a projecting pipe inlet, and a HW/D ratio of 0.67, the culvert size is 45 inches.



Tue Oct 26 08:59:48 2021



NTS

Processing 0+00.000 to 2+47.712
Total Fill: 237,622.4 C.F., 8,800.831 C.Y.
Cut to Fill Ratio: 0.00
Disturbed Area: 7,220.0 S.F.

Trench Calculator

Drawing #: Pipe 2 ... Description:

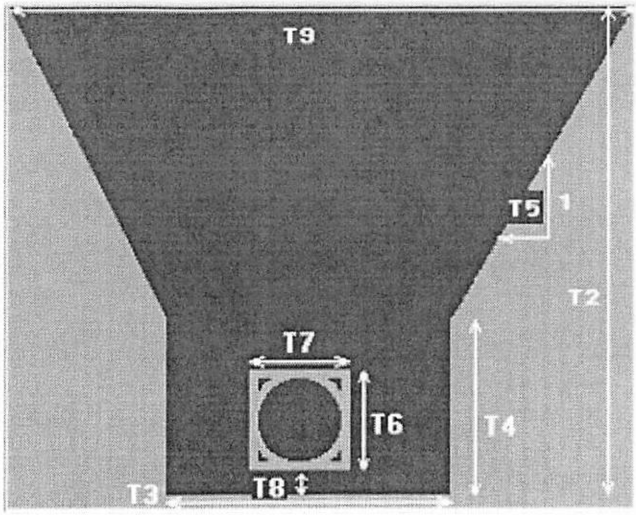
<-- New --> Print Form

Dimensions Layers

Layer 1 depth :	5.500	ft
Layer 2 depth :	0.500	ft
Layer 3 depth :	0.000	ft
Layer 4 depth :	0.000	ft

Units

English Metric



	Neat (cy)	Waste (%)	Actual (cy)	Tonnage	Weight (tons)
Total Exc	47.833	0.000	47.833	1.000	47.833
Dirt	39.292	0.000	39.292	1.000	39.292
Base	8.542	0.000	8.542	1.000	8.542
	0.000	0.000	0.000	1.000	0.000
	0.000	0.000	0.000	1.000	0.000
Total Spoil	47.833	0.000	47.833	1.000	47.833

Trench Calculator

Drawing #: Pipe #3 ... Description:

<-- New --> Print Form

Dimensions Layers

Layer 1 depth : 3.500 ft

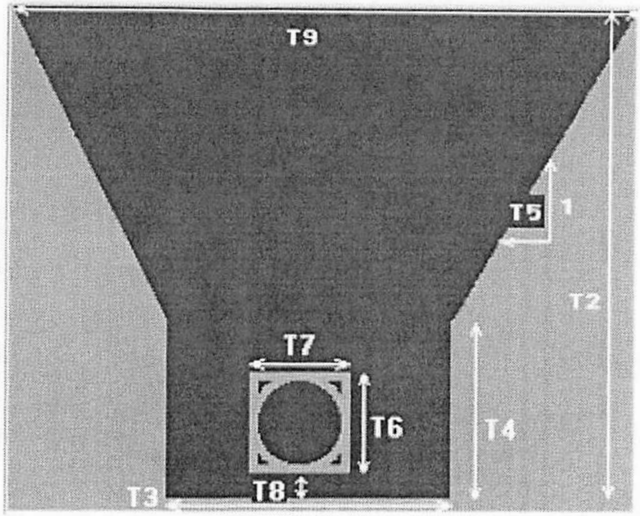
Layer 2 depth : 0.500 ft

Layer 3 depth : 0.000 ft

Layer 4 depth : 0.000 ft

Units

(•) English ( ) Metric



	Neat (cy)	Waste (%)	Actual (cy)	Tonnage	Weight (tons)
Total Exc	26.667	0.000	26.667	1.000	26.667
Dirt	20.556	0.000	20.556	1.000	20.556
Base	6.111	0.000	6.111	1.000	6.111
	0.000	0.000	0.000	1.000	0.000
	0.000	0.000	0.000	1.000	0.000
Total Spoil	26.667	0.000	26.667	1.000	26.667

Trench Calculator

Drawing #: Pipe #4 ... Description:

<-- New --> Print Form

Dimensions Layers

Layer 1 depth : 4.500 ft

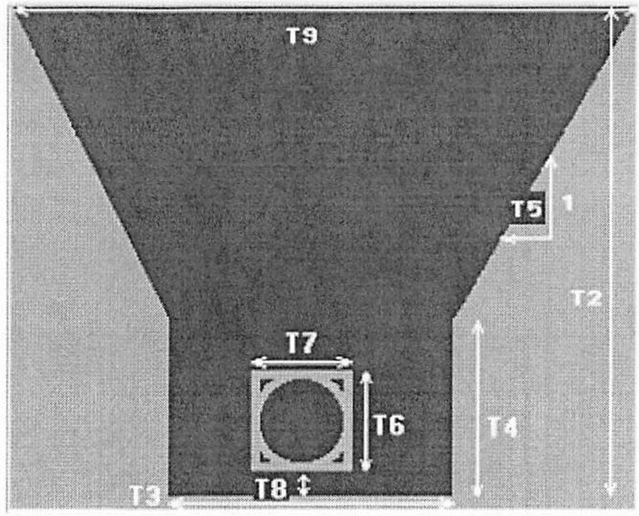
Layer 2 depth : 0.500 ft

Layer 3 depth : 0.000 ft

Layer 4 depth : 0.000 ft

Units

English Metric



	Neat (cy)	Waste (%)	Actual (cy)	Tonnage	Weight (tons)
Total Exc	45.139	0.000	45.139	1.000	45.139
Dirt	36.111	0.000	36.111	1.000	36.111
Base	9.028	0.000	9.028	1.000	9.028
	0.000	0.000	0.000	1.000	0.000
	0.000	0.000	0.000	1.000	0.000
Total Spoil	45.139	0.000	45.139	1.000	0.000