

# Virginia City/Six Mile Canyon Area Drainage Master Plan

## Final Report

NOVEMBER 2023



PREPARED FOR: STOREY COUNTY

CARSON WATER SUBCONSERVANCY DISTRICT



**Lumos & Associates, Inc.**  
950 Sandhill Drive, Suite 100  
Reno, NV 89521  
(775) 827-6111



**JE Fuller**  
8400 S Kyrene Rd, Suite 201  
Tempe, AZ 85284  
(480) 752-2124

## Table of Contents

<b>1.0 INTRODUCTION</b> .....	3
1.1 Project Purpose .....	3
1.2 Project Location.....	4
1.3 Previous Studies .....	5
1.3.1 Previous Area Drainage Master Plans .....	5
1.3.2 Flood Insurance Studies.....	5
1.4 Historical Flowpath Assessment.....	5
1.5 Carson River Mercury Superfund Site and Effects .....	5
1.6 Aerial Photography .....	6
<b>2.0 HYDROLOGIC AND HYDRAULIC MODELING</b> .....	7
2.1 Method Description .....	7
2.2 Model Development .....	7
2.2.1 Spatial Reference System.....	7
2.2.2 Model Domains and Grid Size .....	7
2.2.3 Grid Element Elevations .....	7
2.2.4 USGS LiDAR.....	10
2.2.5 Combined FLO-2D Data .....	10
2.3 Model Inflow/Outflow.....	10
2.4 Precipitation Development .....	12
2.4.1 Precipitation Depths .....	12
2.4.2 Hyetographs .....	12
2.5 Infiltration Development.....	12
2.6 Grid Element Roughness (Manning’s n and Shallow n Values).....	15
2.7 Model Control Parameters .....	17
2.8 Hydraulic Structures.....	17
2.9 Buildings (as Flow Obstructions) .....	19
2.10 Model Results .....	19
2.10.1 Floodplain Cross-Sections.....	19
2.10.2 Depth and Discharge Results.....	20
2.10.3 Animations.....	20
2.11 Verification of Results.....	30

---

2.11.1 Comparison with the Dayton Valley ADMP .....	30
2.11.2 Field Verifications and Meeting with County Employees.....	30
2.11.3 Historical Flooding Documentation .....	32
2.11.4 Summary.....	32
2.12 Sedimentation Analysis.....	33
2.12.1 Site Visit .....	33
2.12.2 Sediment Yield Analysis .....	34
2.13 Results Interpretation.....	36
<b>3.0 LOCALIZED FLOOD CONTROL MEASURES.....</b>	<b>36</b>
3.1 Introduction .....	36
3.2 Virginia City Flood Control Measures.....	37
3.2.1 Surface Flow in Streets .....	37
3.2.2 Private Driveway Runoff.....	38
3.3 Six Mile Canyon Flood Control Measures .....	40
3.3.1 Six Mile Canyon Culvert Improvements .....	40
3.3.2 Six Mile Access Road/Driveway Connections .....	41
3.3.3 Existing Culverts Inlet/Outlet Protection .....	41
3.3.4 Roadway Slope Protection.....	41
<b>4.0 PROPOSED FLOOD MITIGATION PROJECTS .....</b>	<b>44</b>
4.1 Introduction .....	44
4.2 Detention Basin/Channel/Culvert Concept Design Characteristics .....	44
4.2.1 Spanish Ravine Basin w/Outlet Pipe (SRB) – Project 1 .....	45
4.2.2 Ophir Ravine Basin w/Outlet Pipe (ORB) – Project 1 .....	46
4.2.3 Spanish to Ophir Connector Pipe (STOC) – Project 2 .....	46
4.2.4 Ophir to Six Mile Connector Pipe (OTSC) – Project 2a.....	47
4.2.5 Ophir to Cedar Connector Pipe (OTCC) – Project 2b .....	47
4.2.6 Ophir Existing Pond Improvements (OEP) – Project 3.....	47
4.2.7 Six Mile Canyon Culvert Improvements (SMC) – Project 4.....	47
4.3 Six Mile Canyon Design Characteristics .....	63
4.3.1 Six Mile Canyon Culvert Improvements (SMC) – Project 4.....	65
4.4 Basin System Flood Mitigation Conceptual 15% Design Costs & Maintenance Estimates .....	65
4.4.1 Preliminary Cost Estimates .....	65

4.4.2 Annual O&M Costs.....	65
4.4.3 Lifecycle Cost Analysis .....	66
4.5 Future Design Considerations .....	66
4.5.1 Right-of-Way Access and Easements.....	66
4.5.2 Cultural Resources .....	69
4.5.3 Carson River Mercury Superfund Site .....	69
<b>5.0 Public Outreach</b> .....	<b>71</b>
5.1 Learn and Share Meeting in Virginia City.....	71
5.2 CWSCD and Storey County .....	73
<b>6.0 References</b> .....	<b>74</b>
Appendices .....	75

### List of Figures

Figure 2.1 VC SMC Study Area in relation to the DVADMP Watershed .....	8
Figure 2.2 Limits of QL1/QL2 LiDAR Data .....	9
Figure 2.3 Inflow Hydrograph Locations.....	11
Figure 2.4 24-hour Hyetographs used in the Study.....	13
Figure 2.5 Spatial Distribution of Curve Numbers used in the FLO-2D Modeling .....	14
Figure 2.6 Surface Feature Classification .....	16
Figure 2.7 Locations of all Modeled Culverts .....	18
Figure 2.8 Floodplain Cross Section Locations.....	21
Figure 2.9 Existing Conditions 100-year, 24-hour Flow Depth Results .....	26
Figure 2.10 Existing Conditions 25-year, 24-hour Flow Depth Results .....	27
Figure 2.11 Existing Conditions 100-year, 24-hour Flow Discharge Results .....	28
Figure 2.12 Existing Conditions 25-year, 24-hour Discharge Results .....	29
Figure 2.13 100-year, 24-hour Hydrograph Comparison on Six Mile Canyon .....	31
Figure 2.14 Watersheds of Interest.....	33
Figure 2.15 Typical Examples of Surface Cover (left) and Soil Conditions (right) .....	34
Figure 2.16 NRCS soils mapping .....	35
Figure 3.1 Typical Improved Road Side Ditch.....	38
Figure 3.2 Valley Gutter W/ Road Side Ditch Transition .....	39
Figure 3.3 Rolling Dip Isometric View.....	41

Figure 3.4 Rolling Dip Driveway Sections.....	42
Figure 3.5 Typical Stabilized Road Shoulder.....	43
Figure 4.1 Project Number 1 – 25 Year, 24 Hour Max Depth (ft) .....	48
Figure 4.2 Project Number 1 – 25 Year, 24 Hour Discharge (cfs).....	49
Figure 4.3 Project Number 2a – 25 Year, 24 Hour Max Depth (ft).....	50
Figure 4.4 Project Number 2a – 25 Year, 24 Hour Discharge (cfs) .....	51
Figure 4.5 Project Number 2b – 25 Year, 24 Hour Max Depth (ft).....	52
Figure 4.6 Project Number 2b – 25 Year, 24 Hour Discharge (cfs).....	53
Figure 4.7 Project Number 1 – 100 Year, 24 Hour Max Depth (ft).....	54
Figure 4.8 Project Number 1 – 100 Year, 24 Hour Discharge (cfs) .....	55
Figure 4.9 Project Number 2a – 100 Year, 24 Hour Max Depth (ft).....	56
Figure 4.10 Project Number 2a – 100 Year, 24 Hour Discharge (cfs).....	57
Figure 4.11 Project Number 2b – 100 Year, 24 Hour Max Depth (ft) .....	58
Figure 4.12 Project Number 2b – 100 Year, 24 Hour Discharge (cfs) .....	59
Figure 4.13 Project Number 1 – 25 Year, 24 Hour Flow Reduction (%) .....	60
Figure 4.14 Project Number 2a – 25 Year, 24 Hour Flow Reduction (%) .....	61
Figure 4.15 Project Number 2b – 25 Year, 24 Hour Flow Reduction (%) .....	62
Figure 4.16 Potentially Affected Parcels Requiring Easements .....	68
Figure 4.17 Superfund Investigation Areas .....	70

### List of Tables

Table 1.1 Carson River Mercury Site Action Levels for Residential Soils .....	5
Table 2.1 LiDAR flight parameters, reproduced from DAS (2018b).....	10
Table 2.2 Maximum NOAA14 Point Rainfall Estimates (in inches).....	12
Table 2.3 Runoff Curve Numbers used in the FLO-2D Modeling.....	13
Table 2.4 Surface Features and Manning’s n Values .....	15
Table 2.5 Peak Flow and Volume Results from the FLO-2D Floodplain Cross-sections.....	22
Table 2.6 Sediment Yield Estimates (ac-ft) .....	36
Table 2.7 Peak discharge source for MUSLE analysis .....	36
Table 4.1 Project Index .....	45
Table 4.2 Desired and Provided Sediment Storage .....	45
Table 4.3 Engineers Estimate of Costs for Each Alternative .....	65

---

Table 4.4 Estimated Annual O&M for Each Alternative .....	66
Table 4.5 Life Cycle Cost Analysis .....	66
Table 4.6 Potentially Affected Parcels Requiring Easements .....	67

**List of Appendices**

Appendix A – 15% Concept Design Sheets .....	
Appendix B – Cost Estimates for Design Concepts.....	
Appendix C – NRCS Soils Data.....	
Appendix D – LiDAR Report .....	
Appendix E – Digital Data.....	

Certification

The technical material and data contained in the document were prepared under the supervision and direction of the undersigned professional engineer. The opinions contained in this document reflect Lumos & Associates professional judgment in context with the scope of work and contract. The presented opinions are based on the conditions, information, and data provided to Lumos & Associates at the time the document was published and may be subject to change based on changing conditions, information, and data. Lumos & Associates did not verify independent information, conditions, and opinions supplied by others. There is no written or implied warranty or guarantee for any damages that occur from third party use of this document.



---

Prepared under the Responsible Charge of  
Michelle Gamble, P.E.



### Authorization

This project was a collaborative effort between Storey County and the Carson Water Subconservancy District with Lumos & Associates, Inc. and JE Fuller serving as consultants to the County and Subconservancy. In the completion of this effort, both Lumos and JE Fuller had contributions to the various tasks. Below is a summary of the major tasks and identification of the consulting firm responsible for completion of each major task.

#### **Data collection – Lumos and JE Fuller**

#### **Preparation of a supplemental survey - Lumos**

#### **Development of a baseline terrain for the study area – JE Fuller**

#### **Hydrology – JE Fuller**

#### **Hydraulics**

- Existing Conditions Model Development – JE Fuller
- Sedimentation Engineering - JE Fuller
- Field Assessment and Verification – Lumos and JE Fuller
- Mitigation Alternatives Development – Lumos and JE Fuller
- Preliminary Engineering Drawings - Lumos

#### **Public Outreach - Lumos and JE Fuller**

#### **Project Report with Draft Design Alternatives – Lumos and JE Fuller**

## 1.0 INTRODUCTION

### 1.1 Project Purpose

Virginia City is located on the eastern side of the Flowery Range on a steep slope. During rain events, water and sediment from the canyons to the west of town enter the developed area. Due to the steepness of the terrain, runoff reaches high velocities, carrying sediment and eroding unpaved areas throughout the town. Throughout the town there is minimal existing storm drain infrastructure so the majority of runoff is directed onto and adjacent to streets. This not only creates hazardous road conditions but significant maintenance requirements for the County.

Runoff from the west ultimately enters Six Mile Canyon. Six Mile Canyon is a narrow two lane roadway which has become a vital connection from the Dayton Valley area to Virginia City and Reno. During large storm events, this road often becomes impassable with runoff overtopping the road and washouts and sediment impacting travel.



### O Street, Virginia City, NV

Storey County requested that an overall plan be developed to address flooding and stormwater impacts for Virginia City and Six Mile Canyon. The Virginia City and Six Mile Canyon Area Drainage Master Plan (VCADMP) identifies and evaluates sources of potential flood risk and proposes potential mitigation measures within the Virginia City and Six Mile Canyon drainage area. The VCADMP accomplishes this with three stages. The first stage identifies and quantifies flood and sedimentation risks within the project area by collecting evidence from residents,

topographic data, and field conditions through surveys. The collected information is then used to develop a hydrologic and hydraulic model to quantify hazards. The second stage will develop mitigation alternatives and phasing to partially or wholly mitigate the hazards identified. The third stage will provide stakeholder coordination and public outreach about the project through a series of public meetings to inform community members of the existing hazards and to present the mitigation alternatives.



### **R Street, Virginia City, Nevada (Looking East down Six Mile)**

Each major task of the project is presented herein and describes the technical approach, analysis, results, interpretation of results, and applicability to the overall project purpose. The results of this study can be used as a planning tool and as input to the design of potential future drainage infrastructure and flood mitigation measures that are appropriate for the physical environment for both existing and future development.

#### **1.2 Project Location**

The VCADMP study area is approximately 16.9 square miles and is located on the eastern slope of the Flowery Range. Virginia City, an unincorporated town within the study area, sits approximately 11 miles northeast of Carson City, Nevada. The entire study limits are within Storey County, with the exception of a small area of the upper portions of the watershed that extend into Washoe County. The project has two primary focus areas: Virginia City proper, and sections along Six Mile Canyon. Reference Figure 2.1 for a Vicinity Map of the project extents.

### **1.3 Previous Studies**

#### **1.3.1 Previous Area Drainage Master Plans**

The watershed encompassed by this study area was included in the Dayton Valley Area Drainage Master Plan (DVADMP), prepared by JE Fuller and Lumos & Associates in August 2019. However, the Virginia City area was not studied in detail and projects to mitigate flood did not include Virginia City and Six-Mile Canyon. This ADMP builds on the 2019 Dayton Valley Report to identify mitigations and project relevant for the Virginia City and 6-Mile Canyon area of Storey County.

#### **1.3.2 Flood Insurance Studies**

The Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Storey County was collected and reviewed. The FIS, prepared in 2009, encompassed the entire County with a focus on flooding related to the Truckee River and Long Valley Creek, both outside of the study area for this ADMP.

### **1.4 Historical Flowpath Assessment**

No analysis has been performed on historical flowpaths due to the lack of alluvial fans within the study limits. All drainages within the study limits are within steep canyons and ravines, therefore forcing runoff into consistent washes or creeks with every storm event.

### **1.5 Carson River Mercury Superfund Site and Effects**

In 1995 the U.S. Environmental Protection Agency (EPA) signed a Record of Decision (ROD) for the Carson River Mercury Superfund Site (CRMS). THE CRMS comprises a broad landscape and, to address areas not specifically investigated, the remedy included implementation of institutional controls to ensure characterization of mercury levels in surface soils in areas of residential development near known or suspected to be impacted by mercury, and addressing impacted soils, as necessary.

The Long-Term Sampling and Response Plan (LTSRP) developed by the EPA in 1995 identifies and outlines these institutional controls and provides a management plan to characterize, manage, and control impacted soils on residential properties within the CRMS.

The EPA divided the site into two Operable Units for management purposes: OU1 and OU2. OU1 includes mercury-contaminated soil at the source areas – specifically former mill sites – near Carson City, Virginia City, Dayton, and the Washoe Valley and Pleasant Valley historic mill locations. OU1 also includes the 100-year flood plain from the New Empire Mill site to the eastern edge of the Six-Mile Canyon alluvial fan.

The CRMS OU1 boundaries are defined by the location of contaminants of concern with the potential to exceed action levels. The investigative boundary map depicting areas where the contaminants have the highest likelihood of detection is presented on the Nevada Department of Environmental Protection Bureau of Corrective Actions (NDEP BCA) CRMS website and in the Map 2 series.

The CRMS, NDEP BCA and EPA established Site Action Levels for each of the contaminants of concern to reduce the risk of exposure to children under the age of six living within OU1 (Table 1.1: Carson River Mercury Site Action Levels for Residential Soils).

**TABLE 1.1 CARSON RIVER MERCURY SITE ACTION LEVELS FOR RESIDENTIAL SOILS**

Contaminant	Action Levels in milligrams per Kilogram (mg/kg)
Mercury (Hg)	80
Arsenic (As)	32
Lead (Pb)	400

To protect human health, certain properties located within the OU1 must undergo soil characterization sampling per the LTRSP Sampling and Analysis Plan (Appendix A of the LTRSP). On properties being developed for profit or speculation, the property owner must submit a remediation plan to NDEP BCA for approval when contamination is above action levels (Table 1.1). When CRMS contaminants of concern levels exceed an action level, there are generally two remediation methods for reducing exposure risk: 1. Excavating contaminated soils for appropriate disposal, and 2. Capping contaminated soils with two feet of clean fill.

Typically, Storey County has approached work in these areas by minimizing excavation and not relocating any potentially contaminated soil to any other parts of the community. Accumulated sediment from storm events is typically removed from roadways and replaced as roadside berms.

**1.6 Aerial Photography**

Historical United States Geological Survey aerial imagery from 1990 to 2020 was reviewed with particular focus on Spanish Ravine, Ophir Ravine and Six Mile Canyon for any observed changes to these areas over time. The DVADMP reviewed aerial photography dating back to 1948 which showed significant shifting of the flowpath of the channel at the eastern end of Six Mile Canyon, outside of the limits of this study area. Within the study area and in particular within the areas noted above, generally, the major flowpaths through these areas have remained fairly stable during the period reviewed, likely due to the confining nature of the narrow canyons. As a part of this effort, new aerial photography was collected for the entire study area. The aerial photography was collected in May 2023 during a period when significant thunderstorms had resulted in flooding throughout much of the study area. This aerial photography, coupled with site visits with County staff, have provided confirmation of the hydraulic modeling completed as a part of this effort.

## 2.0 HYDROLOGIC AND HYDRAULIC MODELING

### 2.1 Method Description

Since the Dayton Valley ADMP (DVADMP) (JE Fuller, 2019) modeling area covers the Virginia City and Six Mile Canyon (VC-SMC) study area (Figure 2.1), the procedures and modeling approach applied for this study are based on the DVADMP. The following hydrologic and infiltration approaches used in the overall DVADMP study were applied here:

- Infiltration was simulated using runoff Curve Number (CN) methodology.
- Rainfall depths were based on the NOAA Atlas 14 (NOAA14) precipitation estimates.
- The temporal distribution of the 6-hour storms was based on the balanced mass curve, while the 24-hour storms were based on the Nevada Department of Transportation (NDOT) GLE mass curve. Only the 24-hour storms were used in the VC-SMC ADMP.

All modeling, both hydrologic and hydraulic, was done using the FLO-2D Pro software<sup>1</sup> package, Build No. 21.08.23 with an executable dated September 17, 2021. This version has been used for multiple area drainage master studies, has substantial improvements in model runtime when compared with previous versions, and has been approved by the Flood Control District of Maricopa County through their FLO-2D version approval process. FLO-2D was selected for the current study to maintain method consistency with the DVADMP and because it is a combined rainfall-runoff model (i.e., both hydrologic and hydraulic processes are simulated within the model).

### 2.2 Model Development

#### 2.2.1 Spatial Reference System

All data that was generated for the VC-SMC ADMP used the horizontal control of the Nevada Coordinate System, West Zone, NAD83, while the vertical datum was the North American Vertical Datum of 1988 (NAVD 88). The units of measurement were U.S. Survey Feet.

#### 2.2.2 Model Domains and Grid Size

Since the VC-SMC study area is a subset of the DVADMP watershed, only one model domain was used in the current study (see **Figure 2.1**). While a 15-ft grid size was used in the DVADMP, a 10-ft grid size was used in the current study to resolve small drainage features that exist in Virginia City. The total number of cells in the VC-SMC model domain is 3,114,145 with the 10-ft grid size.

#### 2.2.3 Grid Element Elevations

The limits of all the topographic mapping sources used in the FLO-2D modeling are shown in relation to the model domains as **Figure 2.2**. There were two mapping sources:

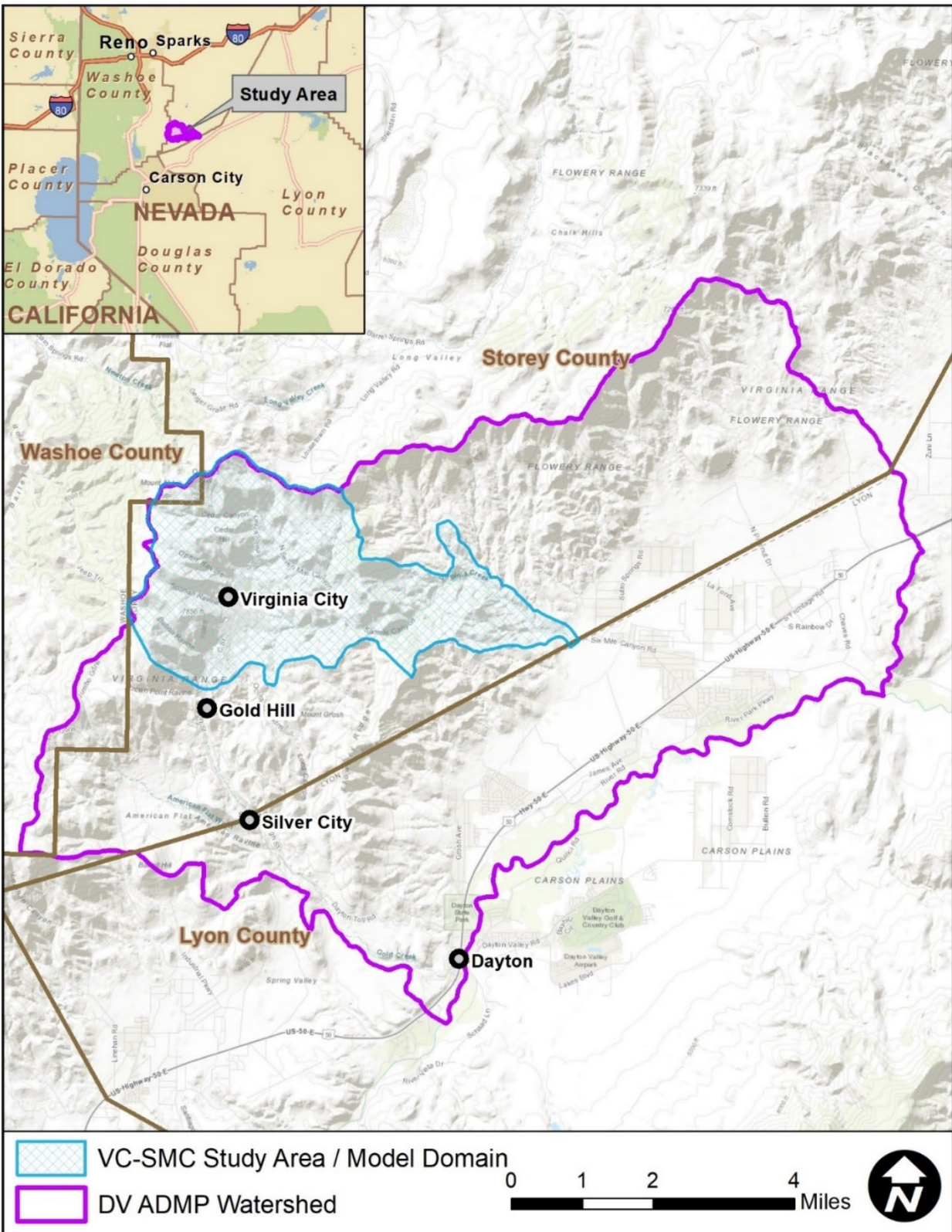
- USGS QL1 LiDAR
- USGS QL2 LiDAR

The USGS LiDAR data is discussed in more detail below.

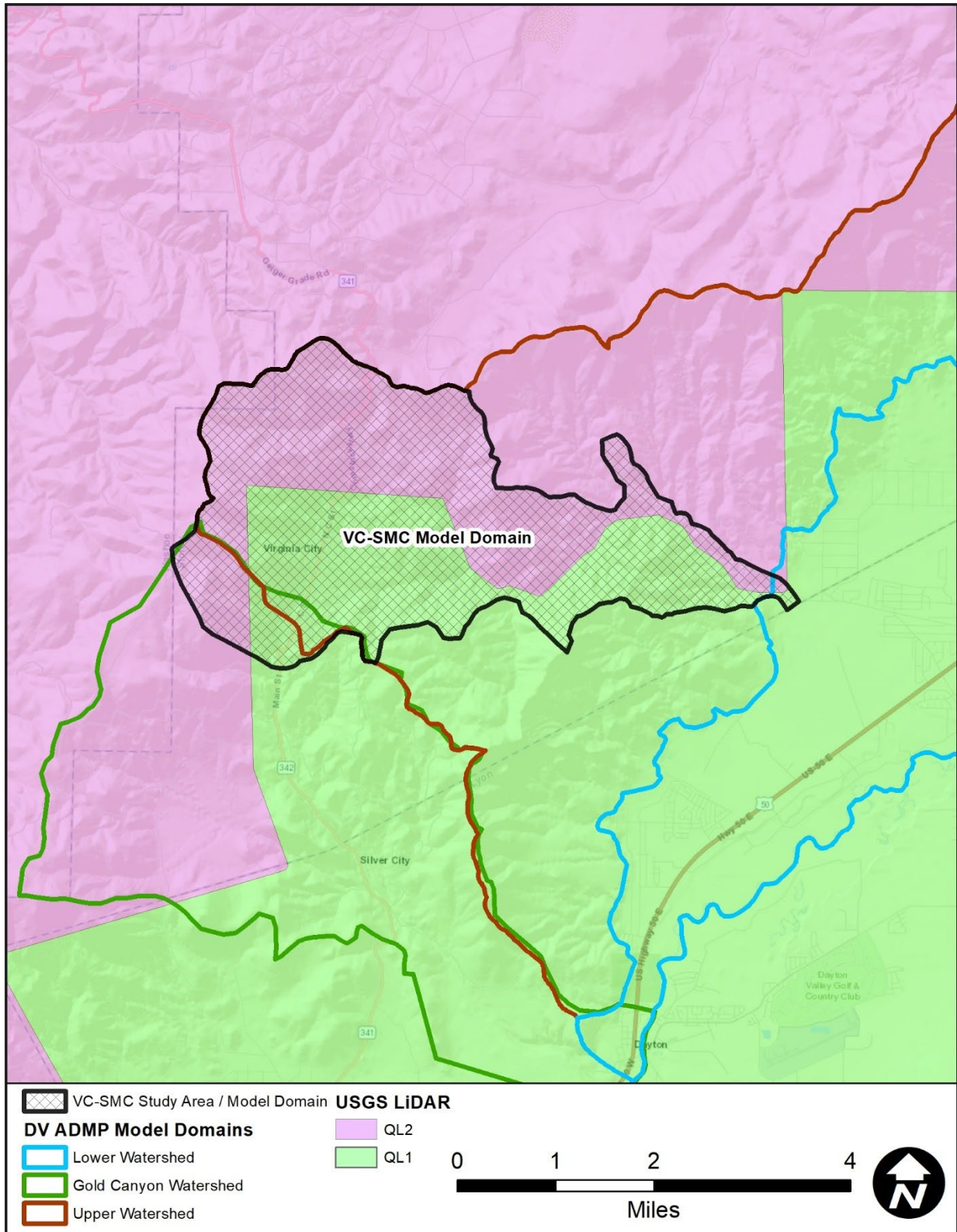
---

<sup>1</sup> <https://www.flo-2d.com/>

**FIGURE 2.1 VC SMC STUDY AREA IN RELATION TO THE DVADMP WATERSHED**



**FIGURE 2.2 LIMITS OF QL1/QL2 LIDAR DATA**



### 2.2.4 USGS LiDAR

As a part of the 3D Elevation Program<sup>2</sup>, the USGS collected high resolution LiDAR data for a large portion of Carson City and Washoe, Storey, and Lyon counties in Nevada through a contract with Digital Aerial Solutions, LLC (DAS) – Contract Number: G16PC00044. This data was collected at two specifications, QL1 and QL2. The flight parameters and point densities for both datasets are listed in Table 2.1. LiDAR collection began on September 19, 2017 and was completed on October 27, 2017 (DAS, 2018b). The original LiDAR data was collected with elevations in meters, a horizontal spatial reference of UTM Zone 11 N, Meters, NAD83, and a vertical spatial reference of NAVD 88. The DAS LiDAR reports are included in Appendix D.

**TABLE 2.1. LIDAR FLIGHT PARAMETERS, REPRODUCED FROM DAS (2018B)**

Parameter	QL1	QL2
Flying Height Above Ground Level:	8,609 feet	9,072 feet
Nominal Sidelap:	60%	30%
Nominal Speed Over Ground:	155 Knots	155 Knots
Field of View:	15°	24°
Laser Rate:	220.2 kHz	206.2 kHz
Scan Rate:	65.2 Hz	49.2 Hz
Maximum Cross Track Spacing:	1.22 meters	1.62 meters
Maximum Along Track Spacing:	0.61 meters	0.81 meters
Average point Spacing:	0.50 meters	0.67 meters

### 2.2.5 Combined FLO-2D Data

Since the LiDAR data is in meters and in a different horizontal coordinate system than the VC-SMC ADMP, the data was first converted to feet and the Nevada Coordinate System, West Zone, NAD83 and combined into a single raster. This single raster had a grid resolution of 1-foot to maintain accuracy of the LiDAR. This high-resolution raster was resampled to a 10-foot grid raster that reflects the average grid elevations that are used in the actual FLO-2D model. The topographic source and their relation to the FLO-2D model domains are shown in Figure 2.2.

### 2.3 Model Inflow/Outflow

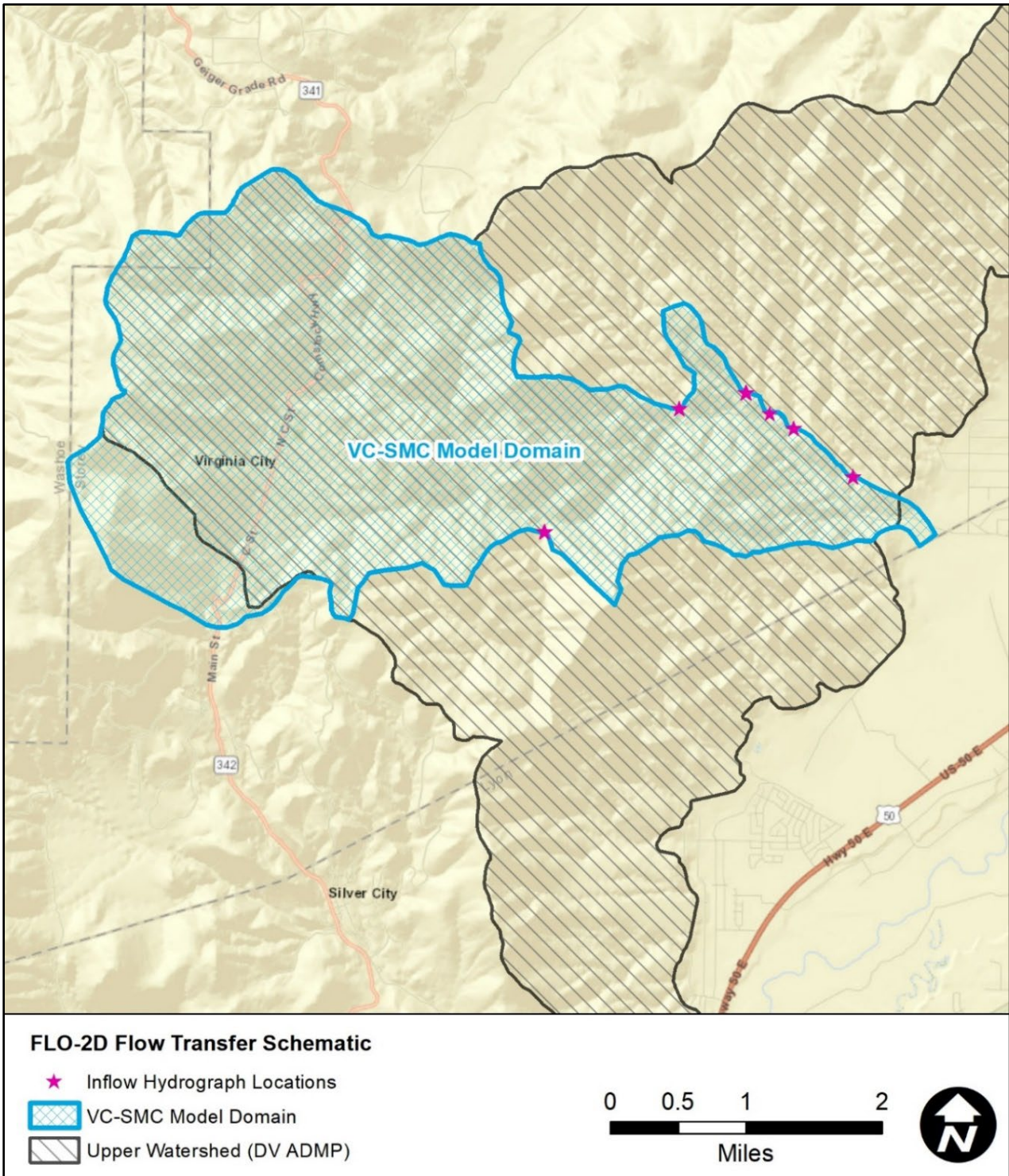
Since a 10-ft grid size is used, the model domain was set to a workable<sup>3</sup> number of cells. This required reducing the domain from the full watershed of Six Mile Canyon and reading inflow hydrographs from the larger Upper Watershed model from the DVADMP. The inflow hydrograph locations and model domain boundaries are shown Figure 2.3. Outflow cells were

<sup>2</sup> <https://www.usgs.gov/core-science-systems/ngp/3dep>

<sup>3</sup> Generally, around 3 million cells where larger number of cells can cause model runtime and PC RAM usage issues

placed along the entire VC-SMC model boundary except near the inflow hydrographs to avoid interfering with the inflow hydrographs.

**FIGURE 2.3 INFLOW HYDROGRAPH LOCATIONS**



## 2.4 Precipitation Development

As a part of the VC-SMC ADMP, two design storms were simulated:

- 25-year, 24-hour
- 100-year, 24-hour

Storey County does not have design storms identified in county regulations. The 24-hour durations were chosen to be consistent with Lyon County drainage regulations as this system eventually discharges to Lyon County.

### 2.4.1 Precipitation Depths

NOAA Atlas 14 (NOAA14) precipitation depth estimates were downloaded from the National Weather Service (NWS) website (2018) as raster images, then used to apply the spatially varied rainfall estimate for each grid element in the model. This means that the point statistics are used at each grid cell in the FLO-2D model, which is different than the typical centroid-based precipitation estimates that are used in lumped parameter (e.g., HEC-HMS or HEC-1) modeling. Point rainfall statistics were selected because:

- 1) Using point rainfall has been the general procedure for other ADMP studies in the southwest.
- 2) Using point statistics results in reasonable but conservative flow estimates.

The maximum rainfall point values for the both VC-SMC model and the Upper Watershed (from the DVADMP) are shown in Table 2.2.

**TABLE 2.2. MAXIMUM NOAA14 POINT RAINFALL ESTIMATES (IN INCHES)**

Model Domain	Storm Event	
	25Y24H	100Y24H
VC-SMC	3.595	4.607
Upper (DVADMP)	3.595	4.607

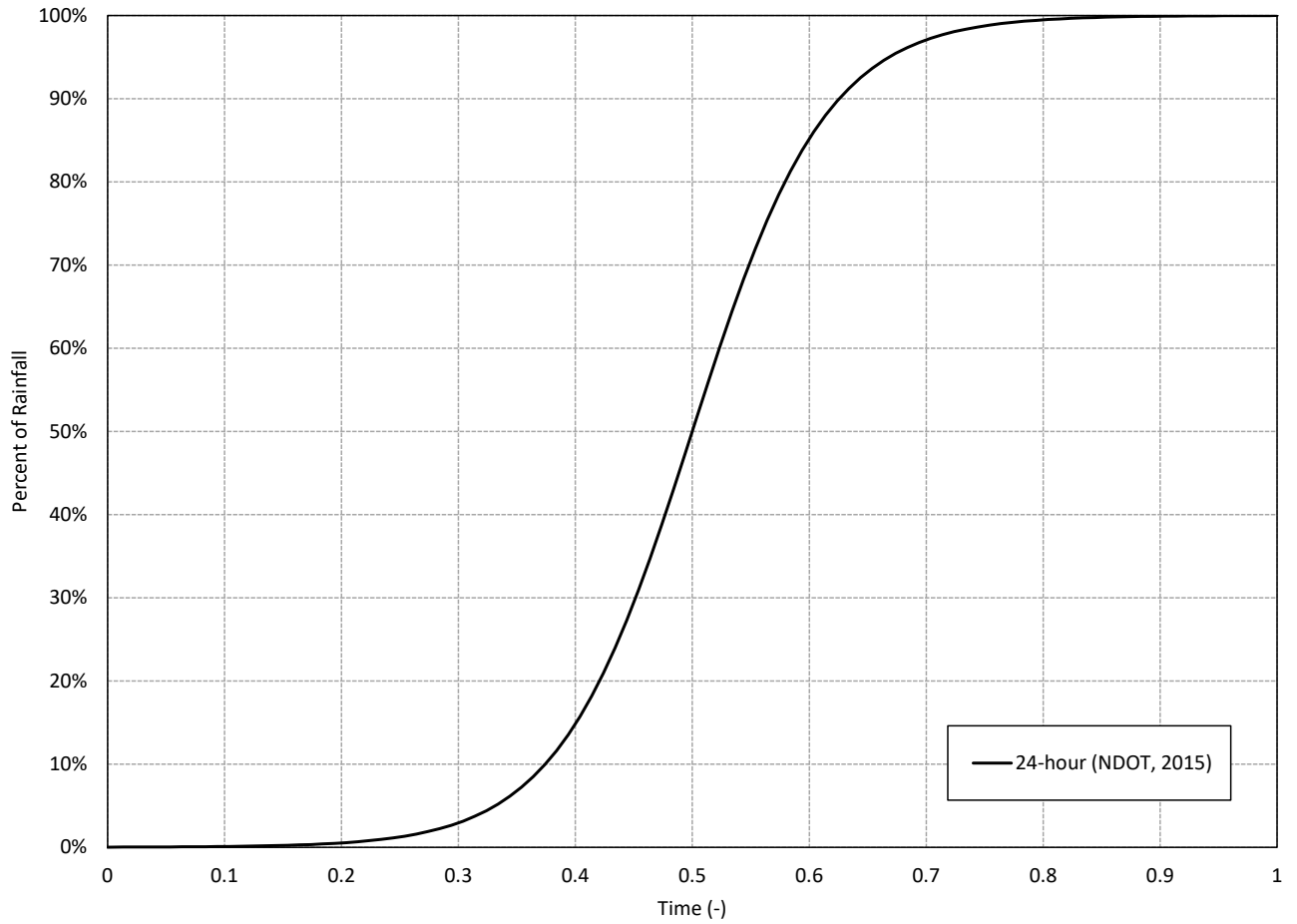
### 2.4.2 Hyetographs

The NDOT (2015) hyetograph was used for the 24-hour storms. This hyetograph was developed with the NDOT calculation spreadsheet using the 90th percentile maximum intensity (MI) from the Virginia Creek HUC-12 watershed and is shown in Figure 2.4.

## 2.5 Infiltration Development

As mentioned in Section 2.1, the CN methodology was used to calculate infiltration. CN's were extracted from the NRCS National Engineering Handbook (2004) which relates hydrologic soil group (HSG) and vegetation coverage type. Reasonable CN's were selected based on the HSG of the soils within the study area and an adjustment to account for surface imperviousness of pavement and buildings. The final, composite curve numbers selected for the FLO-2D models are listed in Table 2.3, and the spatial variation of these curve numbers is shown in Figure 2.5.

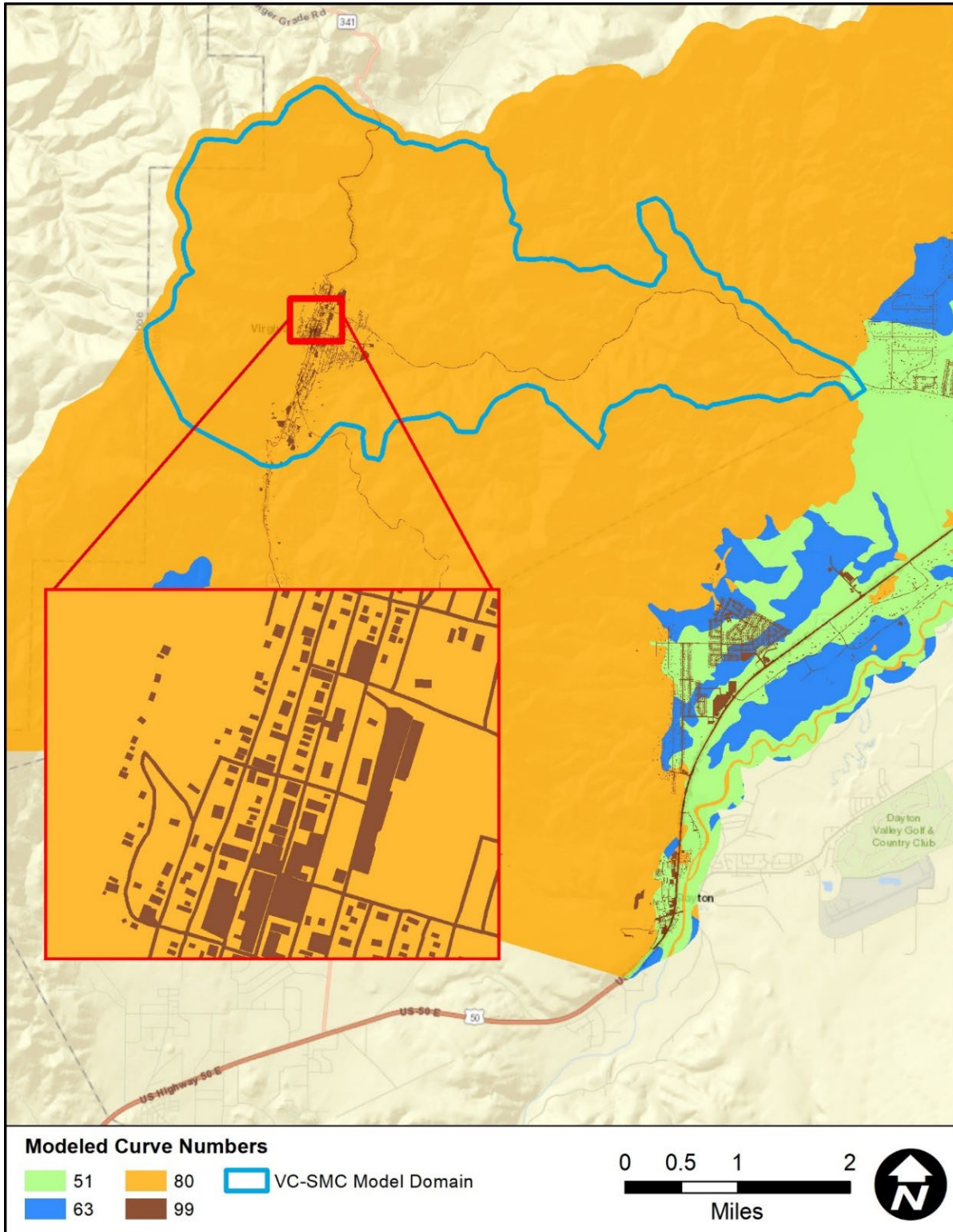
**FIGURE 2.4 24-HOUR HYETOGRAPHS USED IN THE STUDY**



**TABLE 2.3 RUNOFF CURVE NUMBERS USED IN THE FLO-2D MODELING**

Hydrologic Soil Group	Curve Number
A	51
B	51
C	63
C/D	80
D	80
Pavement/Buildings	99

**FIGURE 2.5 SPATIAL DISTRIBUTION OF CURVE NUMBERS USED IN THE FLO-2D MODELING**



## 2.6 Grid Element Roughness (Manning’s n and Shallow n Values)

The FLO-2D model uses two Manning’s n values to estimate roughness on each grid element. These consist of the base n value and the shallow n value. These two parameters allow FLO-2D to calculate a depth-varying roughness, which better approximates physical flood routing in a natural system. For depths below 0.5 feet, the model uses the shallow n or half the shallow n value. Between 0.5 feet and 3 feet, the model uses a function based on the base n value; and, at depths greater than 3 feet, the model uses the base n value. Refer to the FLO-2D Data Input Manual (FLO-2D Software, Inc., 2019) for the details about how depth-varying roughness is applied in the software.

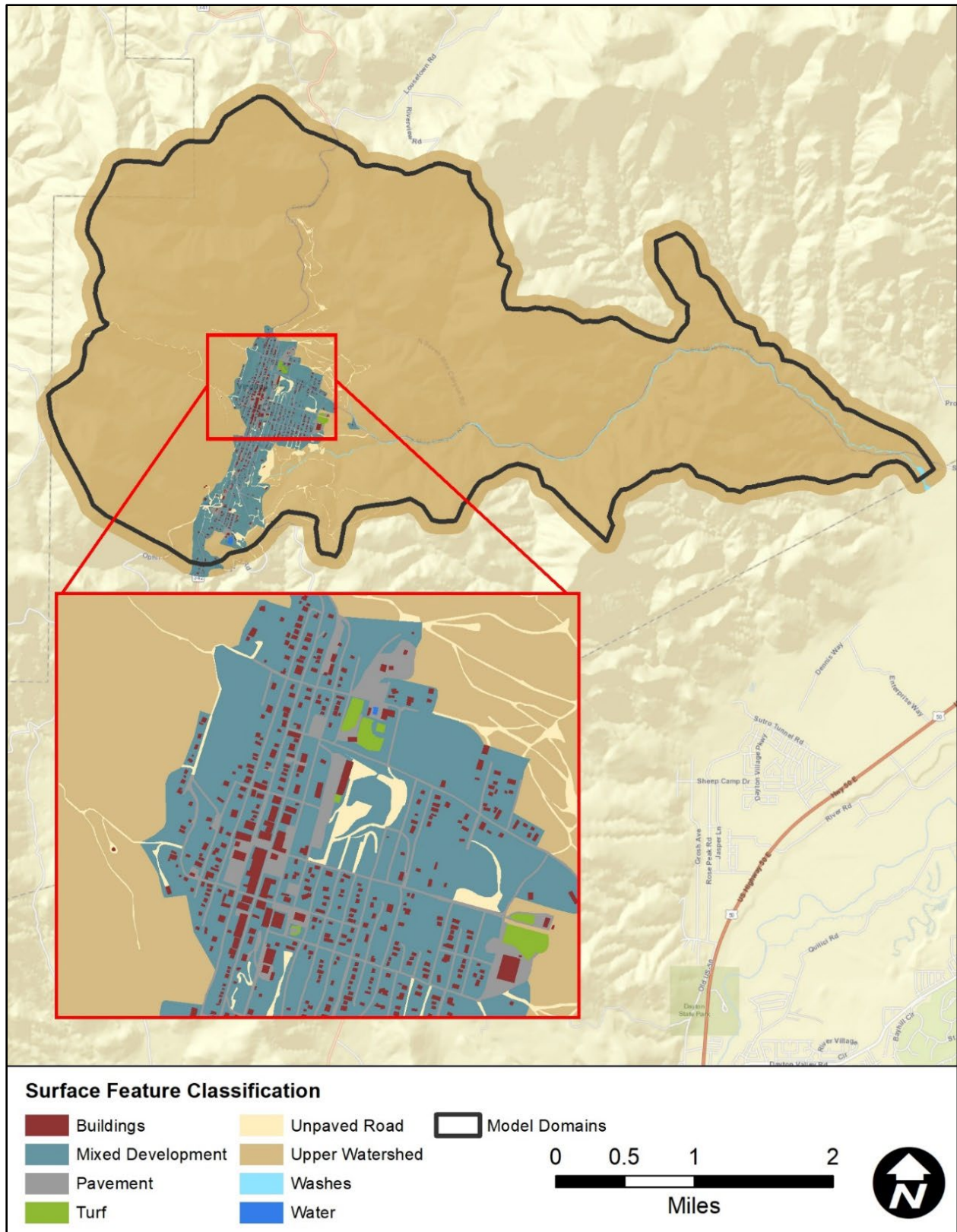
Note that the DVADMP didn’t use a spatially varied shallow n value. However, one was applied in the current study because the model uses a smaller cell size (10-ft versus the previous 15-ft) and most of the area is comprised of steep slopes, thus more refined shallow n values are appropriate.

As a part of the DVADMP, a surface feature classification GIS layer was developed to assign n values for that study. Since the DVADMP focused on the downstream Dayton area, this layer was updated by the consultant team using the latest available aerial photography (dated early 2022) to provide more detail within Virginia City and to reflect the most current conditions. The base and shallow n values for each classification were chosen based on experience on other studies, engineering judgment, and research papers, such as Yochum *et al.* (2014), Jarret (1985), and JE Fuller (2020). Table 2.4 lists the surface feature classification and the corresponding Manning’s n values used in the modeling. The spatial distribution of the surface features is shown in **Figure 2.6**.

**TABLE 2.4. SURFACE FEATURES AND MANNING’S N VALUES**

Surface Feature	Base n	Shallow n
Buildings	0.05	0.1
Mixed Development	0.045	0.15
Pavement	0.02	0.1
Turf	0.06	0.2
Unpaved Road	0.026	0.2
Upper Watershed	0.06	0.4
Washes	0.08	0.3
Water	0.04	0.2

**FIGURE 2.6 SURFACE FEATURE CLASSIFICATION**



## 2.7 Model Control Parameters

CONT.DAT and TOLER.DAT contain numerical stability and simulation controls for the FLO-2D model. The CONT.DAT file controls simulation time, output report time interval, some numerical controls and model switches, such as infiltration and rain. The total simulation time was set to 30 hours for the 24-hour simulations to allow sufficient time for the floodwave to travel through the study area.

In the CONT.DAT file, the global Manning's n value adjustment factor (AMANN) and the limiting Froude number (FROUDL) were the numerical controls that were used in the DVADMP study. For this study, these controls were set to:

- AMANN = 0 (depth integrated roughness is used with the SHALLOWN parameter)
- FROUDL = 2.0
- Global SHALLOWN = 0.2 (A global shallow n value that is applied if a spatially varied shallow n value is not used)

For the limiting Froude number, a value of 2.0 was used in the VC-SMC model domain due to the presence of mountainous areas where high flow velocities are possible since slopes can be greater than 20%.

The TOLER.DAT file contains the numerical tolerance settings specified for the model. These settings are the flow exchange tolerance (TOL), percent allowed change in flow depth (DEPTOL), and the Courant-Friedrich-Lewy numerical stability parameter for floodplain grid element flow exchange (COURANTFP). For the VC-SMC models, the settings applied were:

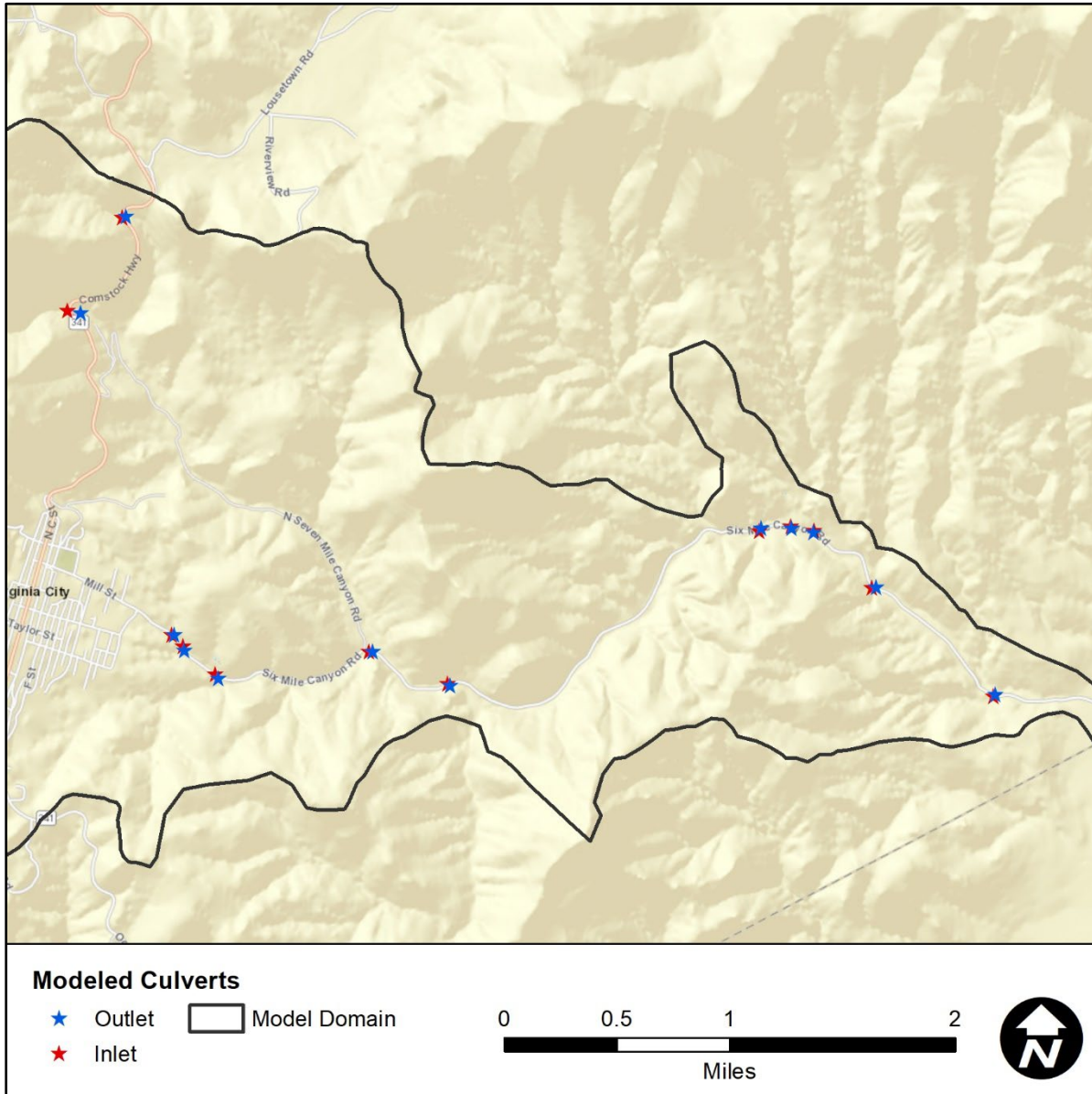
- TOL = 0.004 feet (the depth at which FLO-2D begins to route flow)
- DEPTOL = 0 (not used, model uses Courant number as stability criteria)
- COURANTFP = 0.6 (main stability criterion used by FLO-2D)

These values have been used in similar studies and yielded reasonable results. For this project, the values have produced good model stability and acceptable results.

## 2.8 Hydraulic Structures

Since no significant storm drains were observed in the field, only culverts larger than 24-inches were simulated in the FLO-2D model. Twelve culverts were modeled, and the inlet and outlet locations of these culverts are shown in Figure 2.7. NDOT provided the project team with culvert database files which included the location and size for some of the structures. JEF staff conducted multiple field verification visits to verify the database information for many of the culverts (e.g., locations, sizes, overall condition, etc.). Where field verifications did not match the database records, adjustments were made to the models to be consistent with field observations. Note that the bridge on Six Mile Canyon Road was not modeled as a hydraulic structure. Rather, the cells that showed the bridge deck elevation were smoothed to model this structure as an open channel.

**FIGURE 2.7 LOCATIONS OF ALL MODELED CULVERTS**



In 2016, the Flood Control District of Maricopa County (FCDMC) produced a comprehensive FLO-2D verification report in which recommendations on modeling hydraulic structures were provided. Per those recommendations, the generalized culvert equation option in FLO-2D was used in the VC-SMC ADMP models for single barrel box and circular culverts as a first option. If a single culvert crossing used multiple barrels (or pipes), a rating table was developed assuming inlet control for the culvert.

The modeling options that were used to simulate culverts are summarized in the list below.

- 1) Generalized culvert equations used for single barrel boxes and circular culverts with no tailwater influence (i.e., INOUTCONT parameter set to 0 because the generalized equations account for tailwater conditions). Nine culverts were simulated with this option.
- 2) If a culvert had multiple barrels (or pipes), a rating table was developed based on inlet control or the width in the generalized culvert equations was adjusted to match the equivalent area of the multiple barrels. Rating tables were used for this study. Two culverts were simulated with this methodology.
- 3) If a culvert had an irregular shape (i.e., ellipse or arch), a rating table was developed based on a simplified EPA-SWMM model (and the flow reduced if there was significant sediment blockage). One culvert was simulated with this methodology.

In general, a clogging factor (i.e., a percent reduction in flow to account for sediment blockage) was not applied. However, there were two culverts that used a clogging factor. One was a 4-ft by 4-ft box culvert that could not be field verified. This box culvert assumed an 80% clogging factor. The other was a three-barrel pipe culvert that was composed of three different pipe sizes (22-in, 36-in, and 48-in). A 30% clogging factor was applied to this culvert.

## **2.9 Buildings (as Flow Obstructions)**

Buildings were extracted from the full surface features classification shapefile to develop a separate buildings shapefile that was used to create a global area-weighted 10-foot pixel blocked obstruction raster (representing each FLO-2D grid element). The raster was then used to extract the percentage of area obstructed by buildings and assigned to area reduction factors (ARF) for each grid in the model. Cells that were 100% blocked used the FLO-2D totally blocked element routine. The buildings that were modeled with the ARF functionality are shown in **Figure 2.6**.

## **2.10 Model Results**

### **2.10.1 Floodplain Cross-Sections**

Floodplain cross-sections were developed and included in the FPXSEC.DAT file to query flow hydrographs, peak discharges, and flow volumes from the FLO-2D model at key locations, such as:

- Major flow concentration locations,
- Areas near potential mitigation sites, and
- Areas of interest to Storey County

Major floodplain cross-section locations are shown on Figure 2.8. Hydrograph plots at the floodplain-cross-sections for each storm event are included in the digital data. The peak flow

and volume for each floodplain cross-section are shown in Table 2.5. Please refer to the digital data for the detailed location of each floodplain cross-section.

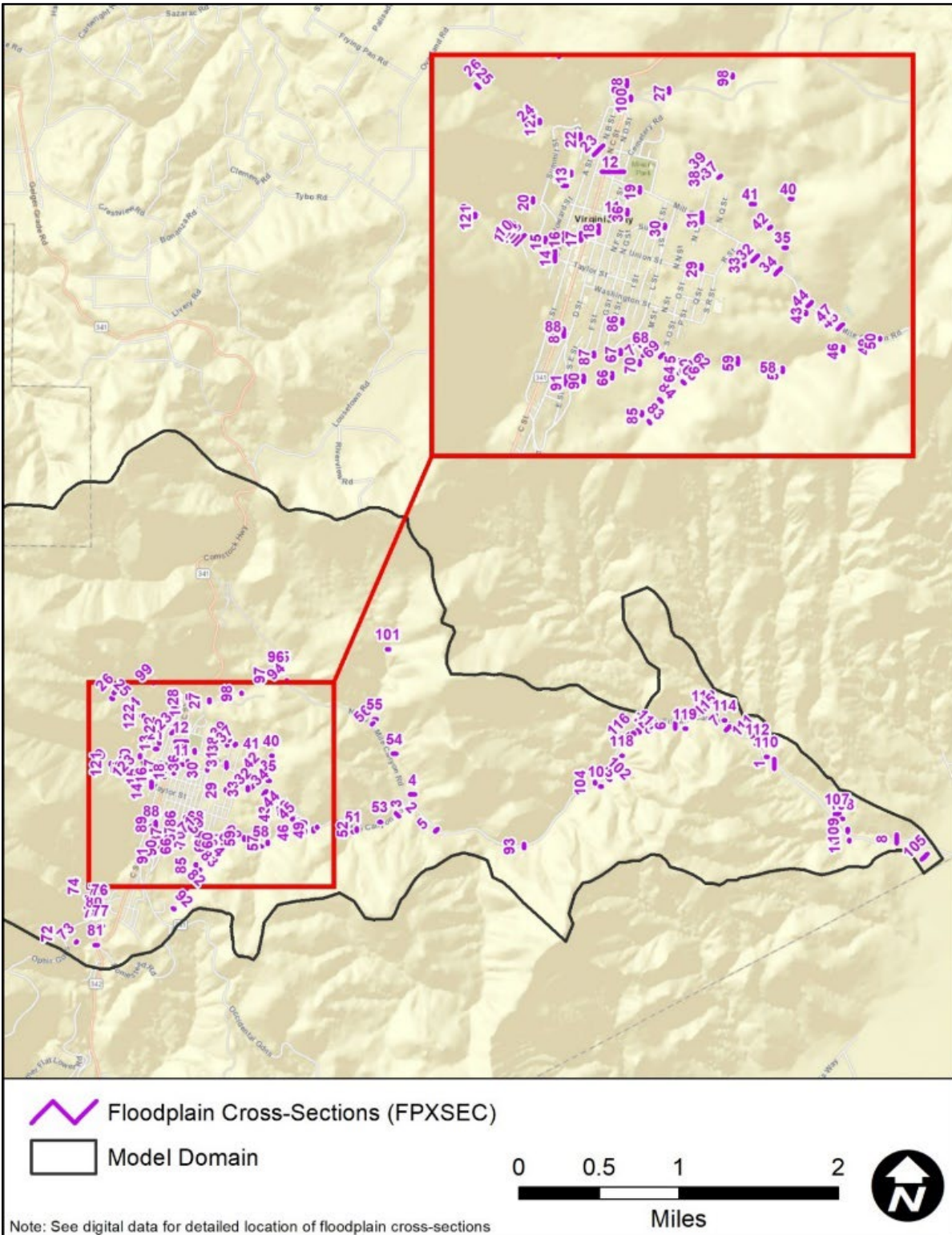
### **2.10.2 Depth and Discharge Results**

Flow depth and discharge results from the existing conditions FLO-2D modeling are shown from Figure 2.9 to Figure 2.12. Existing Conditions 25-year, 24-hour Discharge Results. These figures are for general illustrative purposes and not practical for obtaining detailed information at site-specific locations. For more detailed information, the digital data are included in Appendix E which includes the grid-based results for the maximum flow depth, maximum peak discharge, maximum velocity, and other FLO-2D results.

### **2.10.3 Animations**

Google Earth animations of the VC-SMC model results have been included with the digital data. These animations are helpful for visualizing the dynamic nature of the flooding as it moves through the study area.

**FIGURE 2.8 FLOODPLAIN CROSS SECTION LOCATIONS**



**TABLE 2.5 PEAK FLOW AND VOLUME RESULTS FROM THE FLO-2D FLOODPLAIN CROSS-SECTIONS**

ID	100Y24H		25Y24H	
	Peak Flow	Volume	Peak Flow	Volume
	cfs	ac-ft	cfs	ac-ft
1	3677.2	1300.8	2380.2	821.2
2	791.1	295	478.8	188.8
3	715.4	224.9	399	124.5
4	1173.7	419	790.4	272.2
5	2013.5	730.5	1277.7	470.8
6	3174.9	1121.2	2044.8	709.8
7	3406.4	1205.6	2200.5	761.7
8	3993.5	1409.6	2588.9	887.4
9	124.2	44.1	84.3	29.2
10	139.2	49.7	94.6	32.8
11	145.7	54.2	99.9	36.3
12	164.9	59.3	112.8	39.3
13	25.7	8.9	17.5	6
14	79.6	27.5	50.3	17.6
15	67.7	25.4	49.9	17.4
16	67	25.2	49.3	17.3
17	141.1	51.2	95.4	33.9
18	133	48	89.5	32.7
19	340.9	124	232.1	82.8
20	14.1	5	9.6	3.3
21	19.2	6.8	13	4.5
22	166.6	58.3	120.5	38.3
23	172.3	60.2	121.3	39.6
24	156.6	56.4	106	37.3
25	43.9	15.6	29.8	10.3
26	95.5	34.4	64.3	22.8
27	77.7	27	52.6	17.8
28	55.9	20	38.3	13.2
29	31.7	9.2	18.3	5.4
30	15.7	5.5	10.3	3.5
31	352.6	128.9	243	85.8
32	359.5	131.6	248.6	87.6
33	40.7	14.2	24.7	8.7
34	404.1	147.6	265.7	97.3
35	60.4	22.3	36.8	13.8

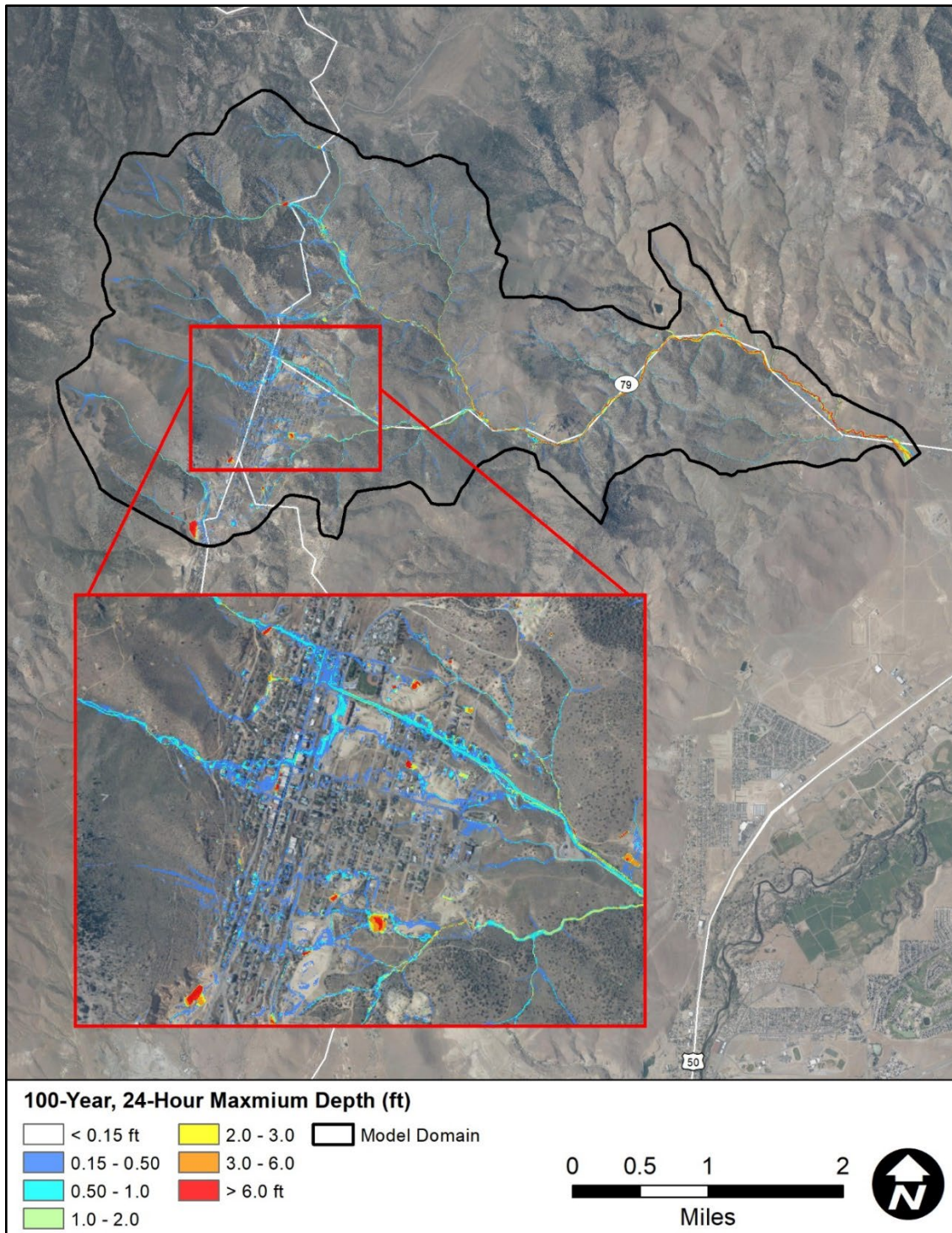
ID	100Y24H		25Y24H	
	Peak Flow	Volume	Peak Flow	Volume
	cfs	ac-ft	cfs	ac-ft
36	11.9	4	7.6	2.5
37	27.1	9.7	13.1	5.8
38	13.7	4.2	6.5	2
39	13.8	4.8	11.5	3.3
40	16.1	5.7	12.8	3.7
41	35.1	13.9	18.8	9.8
42	35	13	19.7	8
43	19.4	7.2	13.4	5
44	466.5	172.6	304.4	112.8
45	490.2	182.9	322	119.4
46	212.6	77.6	126.6	47.9
47	192.1	91.8	147.7	69.3
48	309.8	94	183.9	52
49	688.6	254.8	410	162.1
50	20.7	7.8	18.2	5.7
51	42.3	14.6	27.8	9.3
52	773.9	288.3	467.7	184.6
53	8.6	3	5.8	1.9
54	1141.8	407.1	772.2	265
55	261.4	92.6	173.7	59.6
56	835.6	298.7	568.7	195.4
57	200.3	73.2	119.7	45.1
58	49	17	32.7	10.9
59	147.6	53.8	88.9	32.6
60	14.5	4.9	7.7	2.9
61	141.1	51.3	84.4	31
62	125.4	45.5	75.7	27.6
63	68.3	25.5	39.6	15.4
64	57.5	19.7	36.6	12.1
65	12.9	4.1	6.5	2.3
66	19.4	6.8	12.9	4.5
67	17.7	6.2	11.5	3.9
68	21.7	9	13.6	6
69	60.7	21.5	39.8	13.4
70	22.6	7.9	14.8	5.1

ID	100Y24H		25Y24H	
	Peak Flow	Volume	Peak Flow	Volume
	cfs	ac-ft	cfs	ac-ft
71	35.5	14.3	23.5	9.4
72	62.6	20.1	42.1	12.7
73	68.1	21.7	47	13.8
74	165.9	59.2	112.7	39
75	61.8	23.8	45.8	16.6
76	107.3	36.4	68.6	22.9
77	134.7	39.8	93.2	22.7
78	48.9	24.8	41.3	19.6
79	8.5	3	5.9	2
80	40.9	21.8	35.5	17.6
81	78.5	23.1	47.4	13.8
82	30.1	9.8	13.2	5.4
83	34.5	12.1	16.5	6.9
84	51.9	18.9	27.7	11.2
85	18.5	6.2	11.1	3.9
86	22.3	8.8	15.4	6.1
87	15.6	5.7	10.4	3.7
88	15.2	6.1	11.2	4.2
89	26	9.7	18.1	6.6
90	21.6	8.2	14.7	5.6
91	15.5	5.9	10.7	4
92	12.9	3.7	7.3	2.3
93	2430	873	1550	559.6
94	767	274.7	523.2	180.1
95	611.2	218.5	418.4	143.3
96	32	11.7	21.3	7.8
97	116.6	41.4	79.1	27.2
98	99.2	35.2	67.1	23.1
99	45	15.4	32.2	10.2
100	10.4	3.7	7	2.4
101	206.4	73.4	137.4	47.3
102	2591.7	929.7	1657	595.1
103	17.4	5.9	11.4	3.7
104	77.6	26.8	50.8	17
105	3985.6	1408.8	2588	887.2

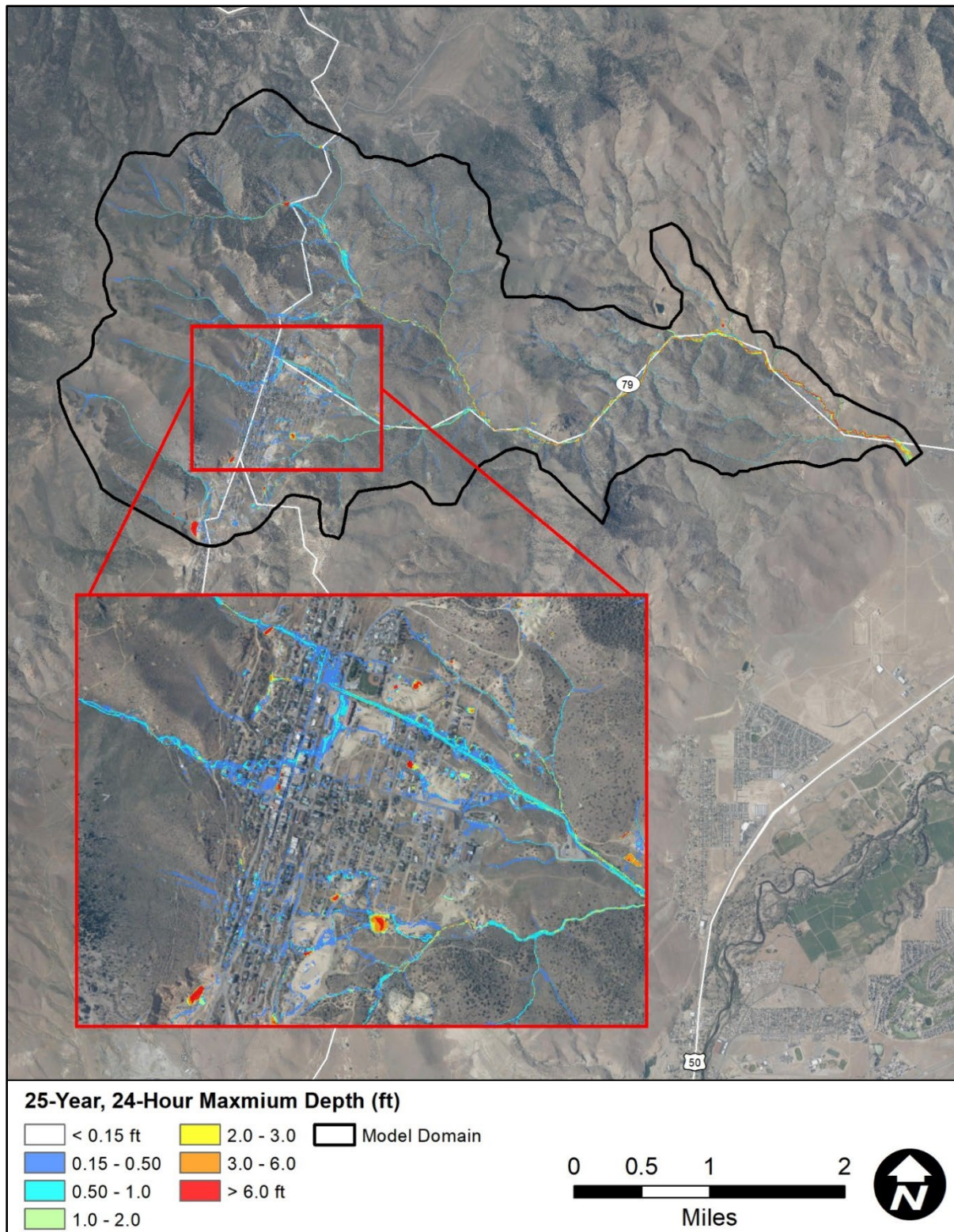
ID	100Y24H		25Y24H	
	Peak Flow	Volume	Peak Flow	Volume
	cfs	ac-ft	cfs	ac-ft
<b>106</b>	65.1	21.5	41.7	13
<b>107</b>	3703.7	1309.4	2397.6	826.1
<b>108</b>	215.2	72.4	141.2	44.9
<b>109</b>	3913	1382.9	2536.6	871.5
<b>110</b>	242.6	81.6	159.6	51.3
<b>111</b>	20.6	6.8	13.4	4.2
<b>112</b>	3434.8	1215.5	2219.3	767.7
<b>113</b>	16.5	6.2	13	4.2
<b>114</b>	185.5	65.1	125.3	40.5
<b>115</b>	6.1	1.5	0.1	0
<b>116</b>	29.3	10	19.1	6.3
<b>117</b>	2670.1	956.9	1707.5	611.8
<b>118</b>	30.4	10.2	19.6	6.3
<b>119</b>	15.5	5.2	10.7	3.2
<b>120</b>	15.2	5.3	10.5	3.4
<b>121</b>	124.3	44.2	84.5	29.2
<b>122</b>	157	56.6	106.4	37.4
<b>123</b>	142.2	50.7	96.4	33.5
<b>124</b>	141.2	50.4	96	33.3

*Note: refer to the floodplain cross-section digital data for the spatial location of each cross-section listed in this table.*

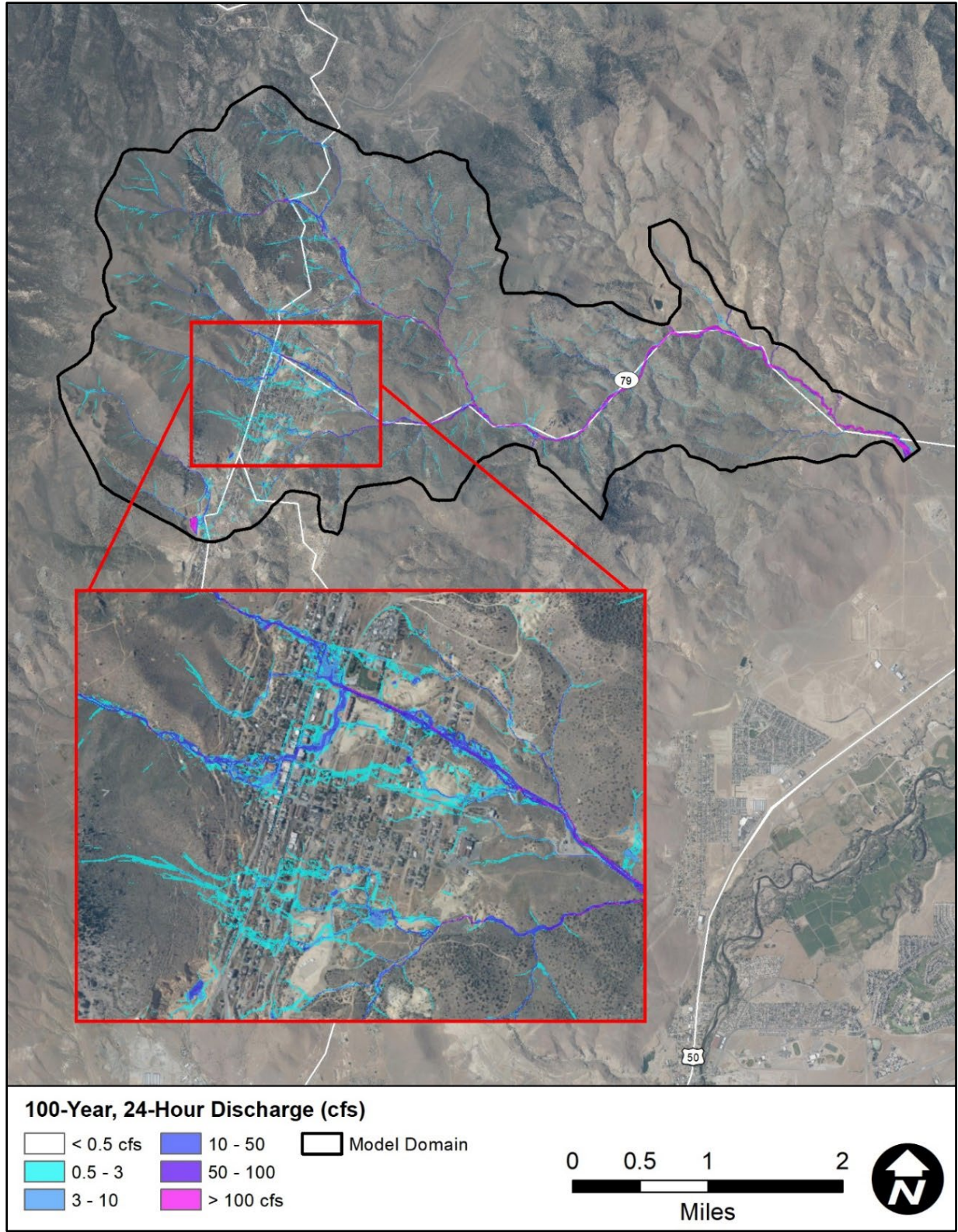
**FIGURE 2.9 EXISTING CONDITIONS 100-YEAR, 24-HOUR FLOW DEPTH RESULTS**



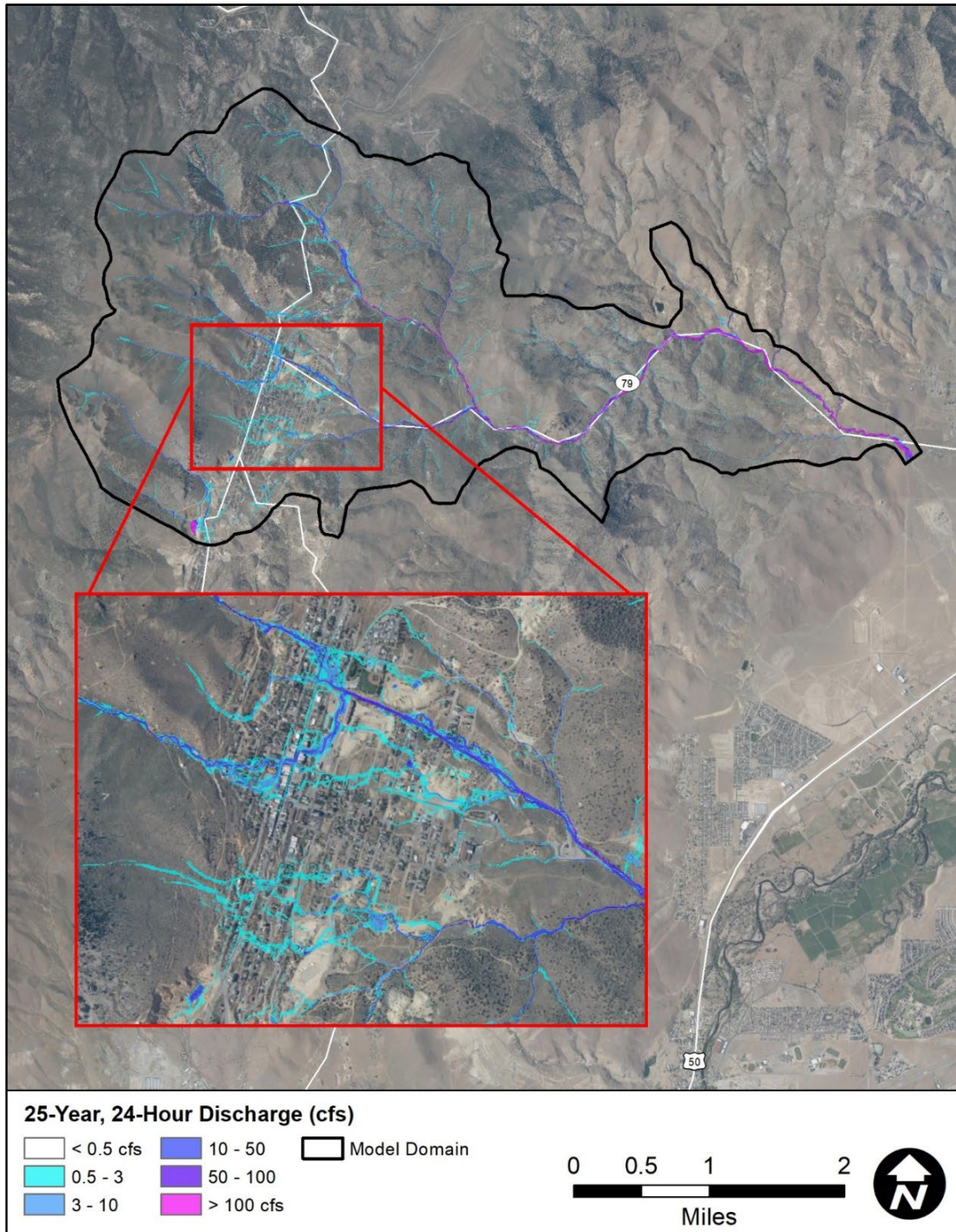
**FIGURE 2.10 EXISTING CONDITIONS 25-YEAR, 24-HOUR FLOW DEPTH RESULTS**



**FIGURE 2.11 EXISTING CONDITIONS 100-YEAR, 24-HOUR DISCHARGE RESULTS**



**FIGURE 2.12 EXISTING CONDITIONS 25-YEAR, 24-HOUR DISCHARGE RESULTS**



## **2.11 Verification of Results**

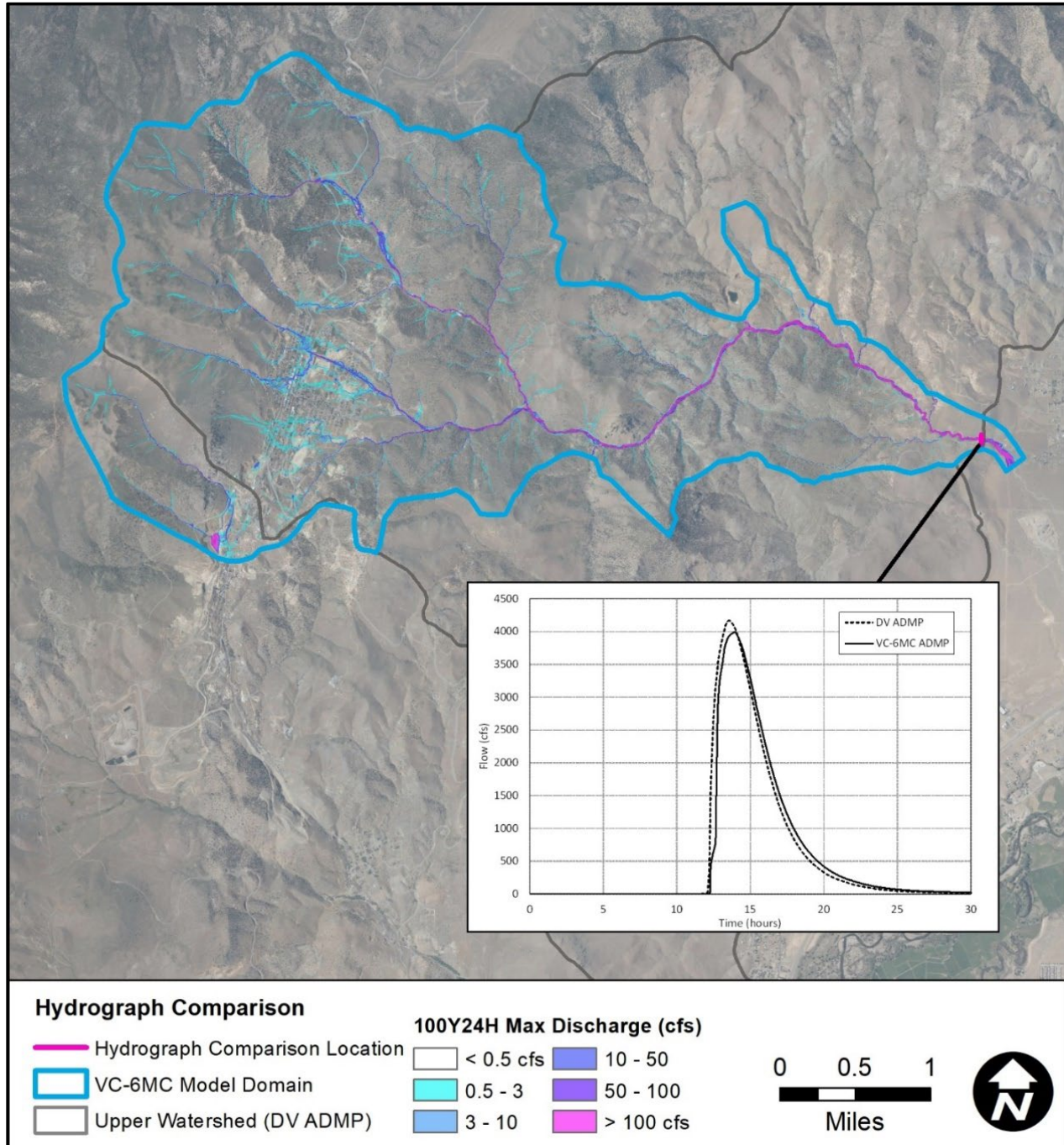
### **2.11.1 Comparison with the Dayton Valley ADMP**

Since the DVADMP results are part of an approved study that was verified with historical flooding documentation and the 100-year USGS regression equation for the Eastern Sierras Region 5 (USGS, 1997), the VC-SMC FLO-2D results were compared with DVADMP at the most downstream location of Six Mile Canyon. The comparison location and the hydrographs from the two studies are shown in Figure 2.13. The VC-SMC hydrograph is consistent with the earlier DVADMP results but shows a slightly lower peak due to Manning's n value adjustments that were discussed in Section 2.6.

### **2.11.2 Field Verifications and Meeting with County Employees**

On June 21, 2022, Lumos and JEF staff conducted a site visit and reviewed the preliminary modeling results. This information was presented to the County and public at a public meeting held that same evening. The preliminary results generally depicted what had been observed during storm events; however, observed flows were also noted in areas not indicated in the modeling results. Therefore, velocities were reviewed by running additional model outputs. It was determined that these additional areas of observed flows were areas where resultant flow depths were too shallow to show in the model animation. However, the velocity results verified flows in these areas matched the observed conditions. Lumos staff met again with County employees on September 28, 2022 with the results of the additional review described above. Lumos staff met again with County employees on June 22, 2023. The significant storm events and winter snow conditions created numerous flooding conditions within the study area throughout the previous several months. This meeting and site visit reviewed and compared the modeled flooding areas with major problem areas identified by County staff from the winter and spring storms. The flooding areas correlated well with the model results and were incorporated into the evaluation for flood mitigation potential.

**FIGURE 2.13 100-YEAR, 24-HOUR HYDROGRAPH COMPARISON ON 6 MILE CANYON**



### **2.11.3 Historical Flooding Documentation**

As a part of the public outreach effort, the project team collected flood photos from residents and County staff within the project area. Additionally, Lumos staff documented flood flows during a storm event on August 9, 2022. Residents and County staff also provided photo documentation of the severe rain events that occurred in January and June of 2023.

### **2.11.4 Summary**

The existing conditions FLO-2D models were created using the best available information for land cover, land use, topography, and hydrology. Utilizing the FLO-2D model maintained consistency with the earlier DVADMP. Like all models, the VC-SMC FLO-2D models simulate a spectrum of potential conditions during a range of storm events. The models cannot duplicate actual, observed storm events at all locations within the community due to the vast number of variables that change with each unique storm event.

The modeling results reflect the complex flooding and sedimentation hazards that exist within the VC-SMC study area. The results provide valuable, quantitative, and detailed information on which future planning and development decisions can be based. The existing conditions models also serve as a foundation on which potential mitigation alternatives can be assessed (see Section 4.0).

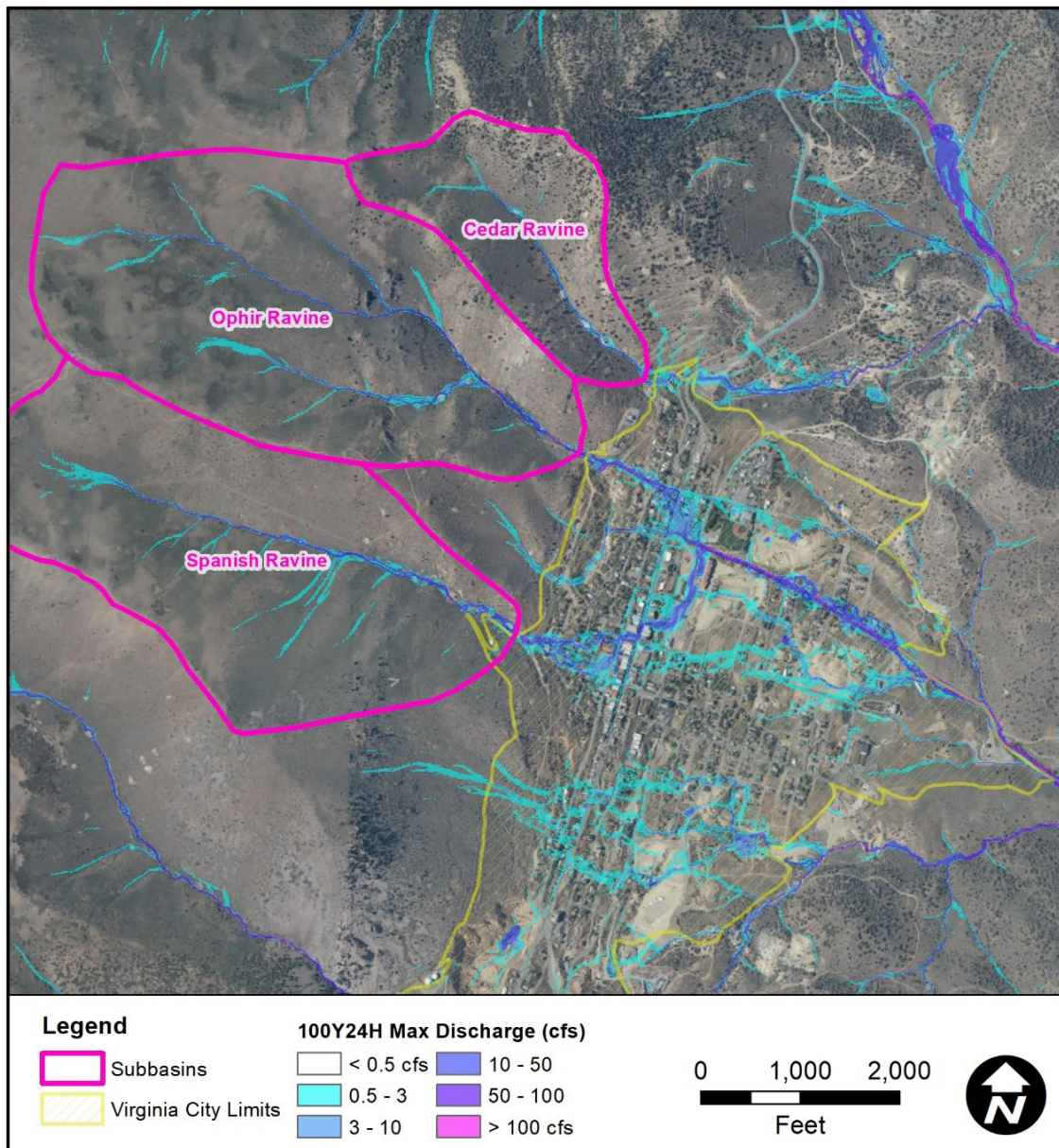
Although the ADMP FLO-2D modeling effort was not intended to replicate an actual historical flood event, the comparison of the modeling results with previous studies indicate that the results are reasonable. However, updated mapping and new FLO-2D modeling are recommended if significant changes to the topography or surface features occur in the future.

## 2.12 Sedimentation Analysis

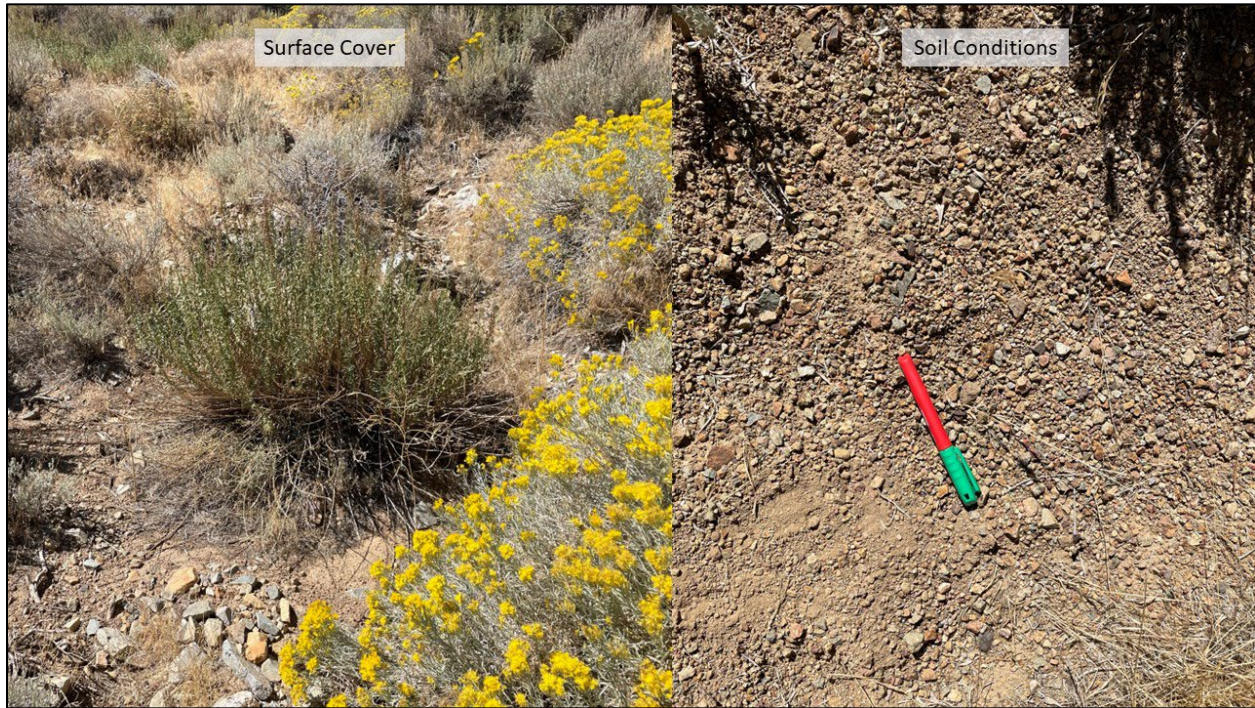
### 2.12.1 Site Visit

Lumos identified three watersheds of interest that drain to Virginia City where flood control basins may be implemented (see Figure 2.14). JE Fuller performed a site visit to verify field conditions (i.e., typical surface cover and soil conditions) in the three watersheds in September 2022. Examples of typical surface cover (left) and soil conditions (right) observed in the field are shown in **Figure 2.15**. The soil was generally gravelly sand, and these observations helped determine what methodology and parameters were used in the sediment yield analysis (see discussion below).

**FIGURE 2.14 WATERSHEDS OF INTEREST**



**FIGURE 2.15 TYPICAL EXAMPLES OF SURFACE COVER (LEFT) AND SOIL CONDITIONS (RIGHT)**



### 2.12.2 Sediment Yield Analysis

Sediment yield was computed for the three watersheds using the Modified Uniform Soil Loss Equation (MUSLE) methodology. The MUSLE approach computes soil loss for individual storm events. The following MUSLE equation, equation (FCDMC, 2018) was used in this study:

$$Y_s = \alpha(Vq_p)^\beta KLSCP$$

where:

$Y_s$  = Sediment yield

$\alpha$  = 95

$\beta$  = 0.56

K = soil erodibility factor

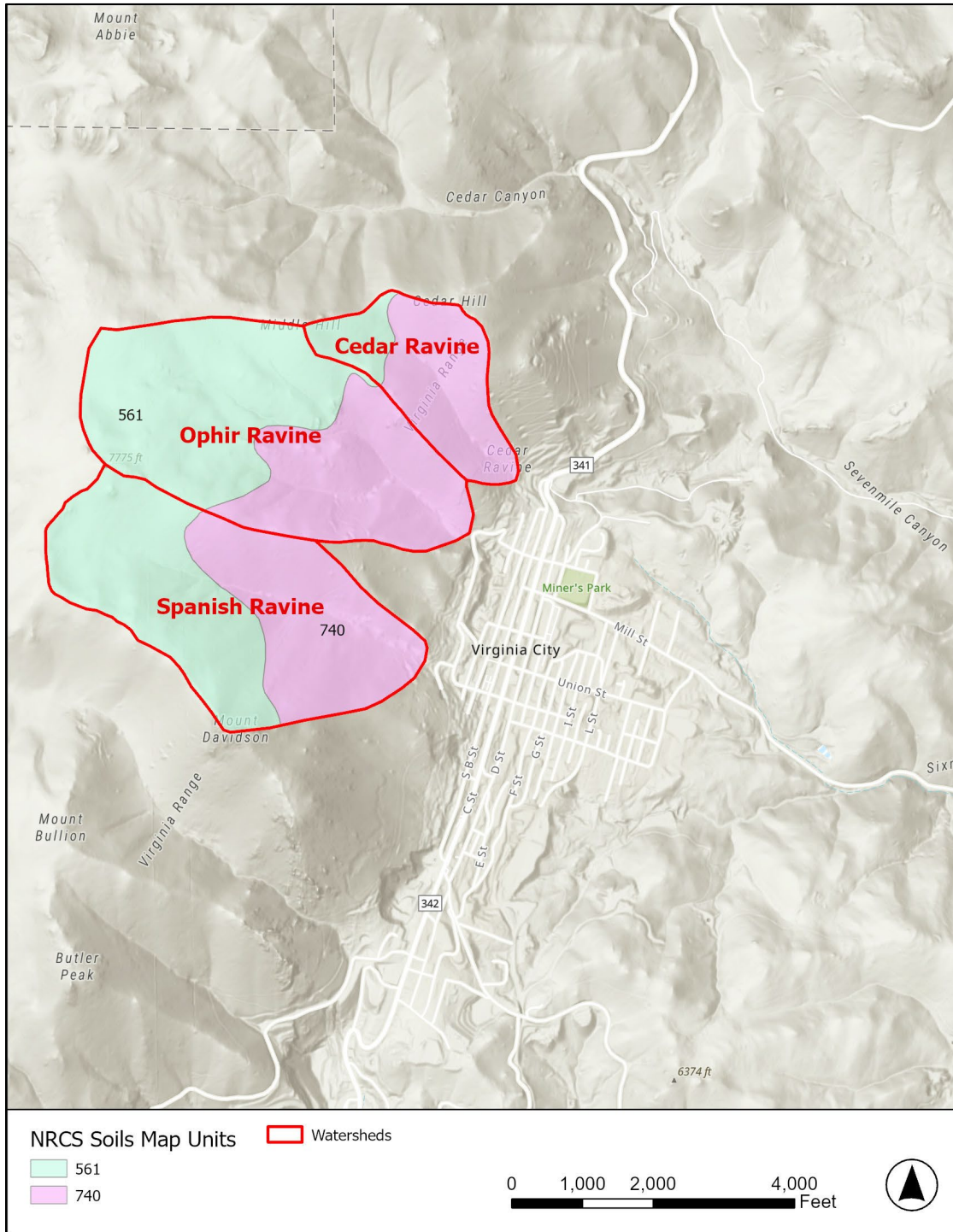
LS = topographic factor

C = cover management factor

P = erosion control practice factor

Sediment yield from a series of recurrence interval events (2-year through 100-year) was calculated, and the results were aggregated based on probability to arrive at an annualized sediment yield. Hydrologic data were taken both from FLO-2D results from this study as well as USGS regression equations to provide peak discharge and volume for all recurrence interval events (Table 2.7). The Soil Erodibility factor was estimated using NRCS mapped soil properties (Figure 2.16).

**FIGURE 2.16 NRCS SOILS MAPPING**



The NRCS soils reports used in the analysis are included in Appendix C. The Cover and Management factor (C) was determined using Table B.2 from the *Sediment Erosion and Design Guide* published by the Albuquerque Metropolitan Arroyo Flood Control Authority (Mussetter et al., 1994), aerial imagery, and field investigations. The Erosion Control Practice Factor was set to 1.0 to reflect no established erosion control in the contributing watersheds. The MUSLE methodology resulted in sediment yield estimates as shown in Table 2.6 for the recurrence interval storms listed in Table 2.7. These estimates can be used to help define a maintenance schedule for the proposed basins. Typical design volumes for other flood control basins have been 3 times the annual load plus 1 design event.

**TABLE 2.6 SEDIMENT YIELD ESTIMATES (AC-FT)**

Concentration Point	Basin Area	100-Year	50-Year	25-Year	10-Year	5-Year	2-Year	Annual
	sq. miles	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft
Cedar Ravine	0.15	0.55	0.31	0.36	0.1	0.06	0.02	0.05
Ophir Ravine	0.45	1.12	0.4	0.72	0.14	0.08	0.03	0.09
Spanish Ravine	0.4	0.28	0.55	0.17	0.19	0.12	0.04	0.07

**TABLE 2.7 PEAK DISCHARGE SOURCE FOR MUSLE ANALYSIS**

Concentration Point	100-Year*	50-Year**	25-Year*	10-Year**	5-Year*	2-Year*
	cfs	cfs	cfs	cfs	cfs	cfs
Cedar Ravine	45	36	32	30	29	28
Ophir Ravine	156	123	106	96	93	91
Spanish Ravine	31	11	19	3	2	2

### 2.13 Results Interpretation

The results displayed in Sections 2.6 and 2.7, as well as the Site Visits described in Section 2.8.1 were analyzed by Lumos to form consolidated focus-areas for the VCADMP. The modeled and mapped flow-areas, along with field-verified site observations, showed that the flood flowpaths of highest concern progressed from the Spanish Ravine to the south, and the Ophir/Cedar Ravines to the north. In addition, concentrated flows along Six Mile Canyon Road showed evidence of flooding and erosive behavior. These focus areas formed the basis for flood mitigation measures described in Section 4.0.

## 3.0 LOCALIZED FLOOD CONTROL MEASURES

### 3.1 Introduction

Within Virginia City proper and along Six Mile Canyon, several flood control measure opportunities were identified that would have a significant impact on localized flooding and the resultant maintenance requirements after a flood event. These measures are discussed in this section to provide the County with smaller, less costly measures that can be implemented in concert with the regional alternatives discussed in the previous section.

## 3.2 Virginia City Flood Control Measures

### 3.2.1 Surface Flow in Streets

Within Virginia City proper, most streets have no formal roadside conveyances. The exceptions are a few sections of AC lined roadside swales or AC berms and a few drainage culverts. Runoff from most storm events collects quickly and reaches high velocities (>8 fps). Flows typically run west to east until road cross slopes divert water to flow north or south, depending on the street. The high velocity of these discharges mobilize sediments, gravels and larger cobbles to erode from the road shoulders. As runoff slows, these materials are deposited at low points or in slope changes along the road. As a result, maintenance of public and private property is costly and challenging for County staff and residents.



**Most streets have no formal roadside conveyances.**

A potential mitigation solution would be to construct shallow, paved AC swales along primarily the east/west running streets where runoff from previous storm events have removed the existing shoulder material and created channels would benefit the community. These AC swales are proposed at existing road intersections where it may not be feasible to install culverts to convey flows beneath the existing roadways. Broad (8-ft width typically) AC or concrete valley gutters with shallow depths to flowlines should be constructed to convey flows through the intersections. By keeping the swale wide with a shallow depth to flowline, snow plowing

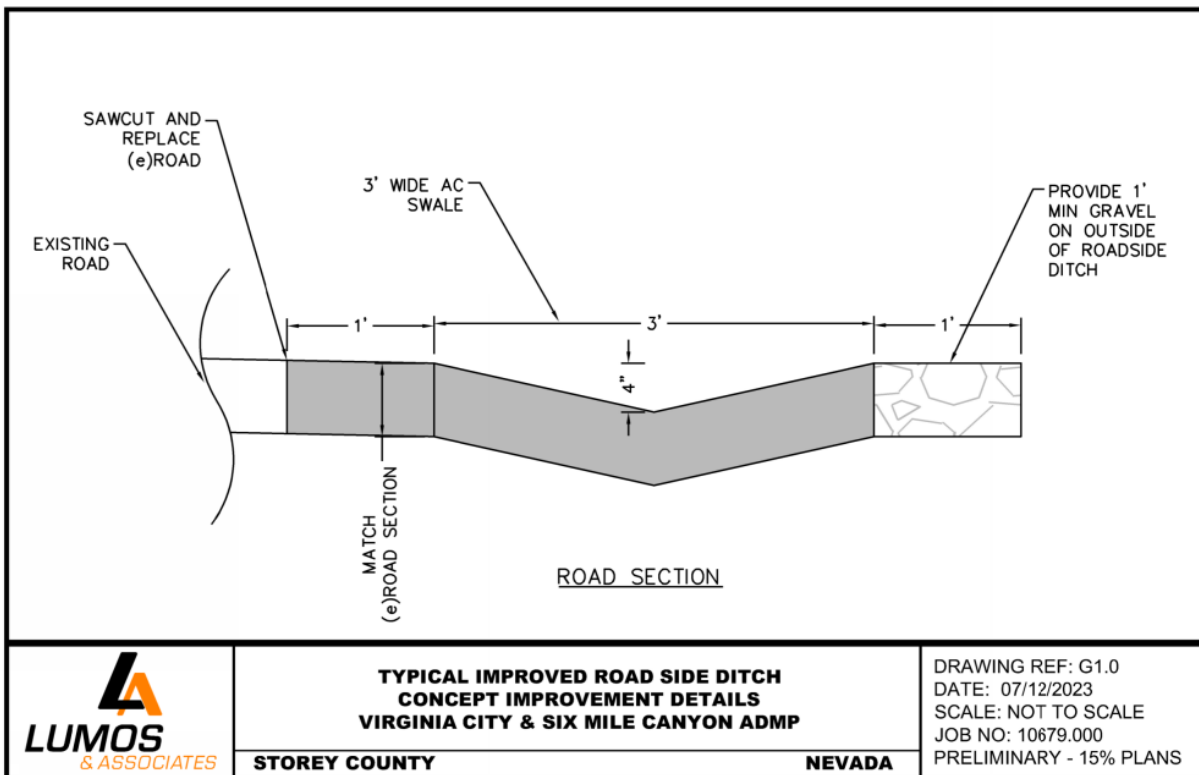
operations should not damage the swales. An example AC Swale detail and AC/Concrete Valley gutter detail is provided in Figure 3.1 through Figure 3.2.

Additionally, where there are existing catch basins and short sections of storm drain pipe, the County should review the functionality and maintenance requires of each system. Through our field visits during and after storm events, there were notable areas where existing facilities do not appropriately capture road runoff (South L Street for example) and where unstabilized discharge points create significant erosion (discharge point of existing storm drain in South L Street). Additional drop inlets or AC/paved swales across existing roads would help convey flows to existing drop inlet structures. Outlets should be stabilized with rock riprap to ensure slopes do not erode.

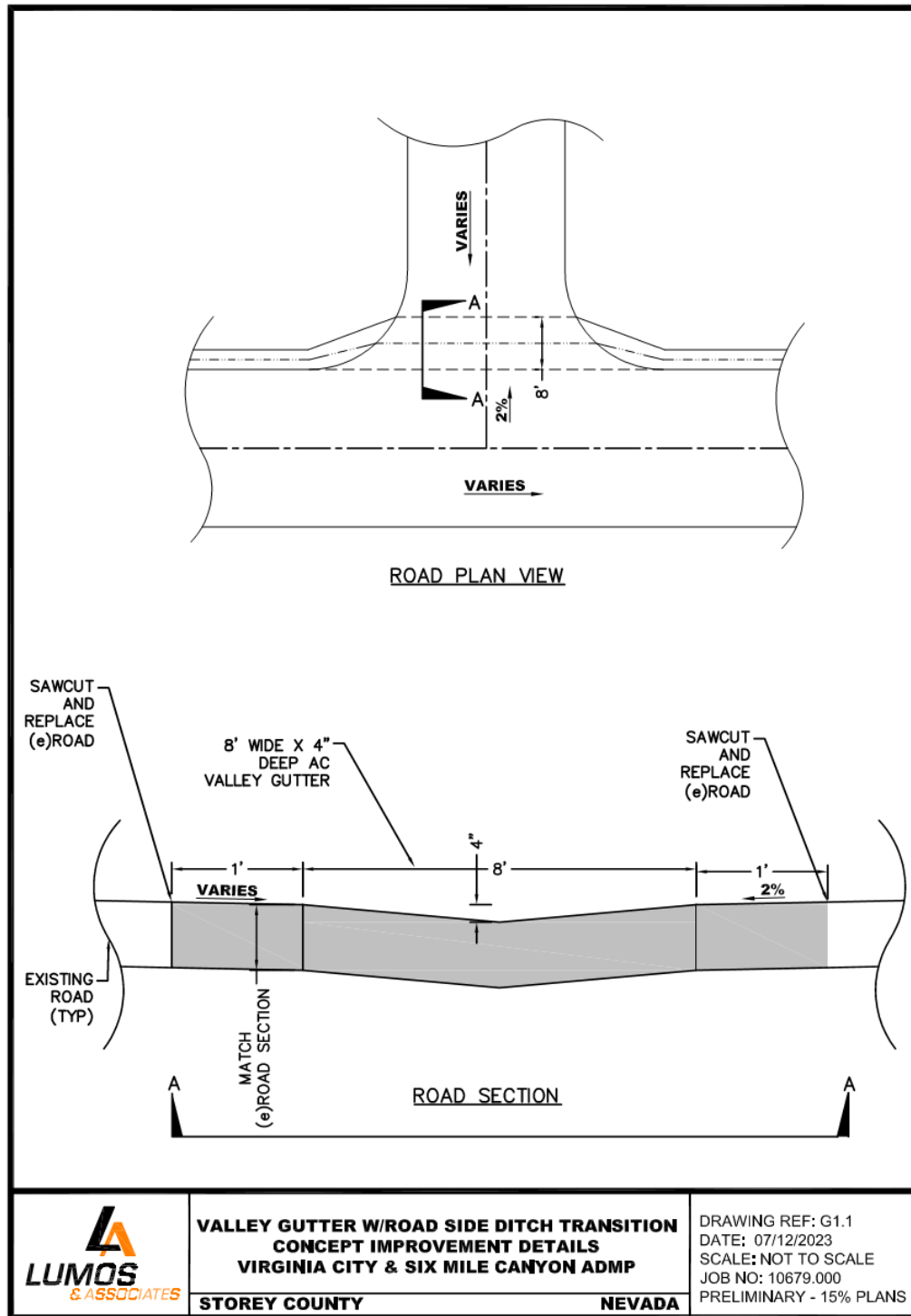
### 3.2.2 Private Driveway Runoff

All future development should be required to stabilize private driveways. Stabilization could include AC or concrete paving or placement of gravel, depending on the slope of the driveway. Driveway stabilization measures should be required to extend to the existing road, into the public Right-Of-Way. Any existing roadside conveyance channels should be propagated through the installation of culverts or swales.

**FIGURE 3.1 TYPICAL IMPROVED ROAD SIDE DITCH**



**FIGURE 3.2 VALLEY GUTTER W/ ROAD SIDE DITCH TRANSITION**



### **3.3 Six Mile Canyon Flood Control Measures**

#### **3.3.1 Six Mile Canyon Culvert Improvements**

Regular maintenance of the roadside channels should be included in the County's operations and maintenance budget. Due to the limited right of way and minimal shoulders, construction of a roadside channels along the entire roadway is not feasible without significant graded and slope stabilization. However, the County will see significant benefit by including regular maintenance of the existing channels in their operations and maintenance budget.

Along with the regular maintenance of the roadside channels, installation of new culverts at all low points in the channels to convey flows from the roadside channel to the main drainage channel will alleviate much of the roadside channel overtopping. Proposed culverts should be a minimum of 18-inch diameter smooth interior walled pipe (HDPE or PVC) to provide hydraulic efficiencies. Inlets and outlets to the pipes should be lined with rock riprap.



**The county will see significant benefit from including regular maintenance in their budget.**

### 3.3.2 Six Mile Canyon Access Road/Driveway Connections

With the increase in development in primarily the eastern portion of Six Mile Canyon, a standard for access road/driveway connections to Six Mile Canyon Road should be adopted by the County. A rolling-dip style driveway approach is suggested for all future developments. Details for a Rolling Dip Driveway can be found in Figure 3.3 and Figure 3.4. If there is an existing roadside channel that should be continued through the proposed driveway, a new culvert with a minimum diameter of 15-inches should be required to be installed.

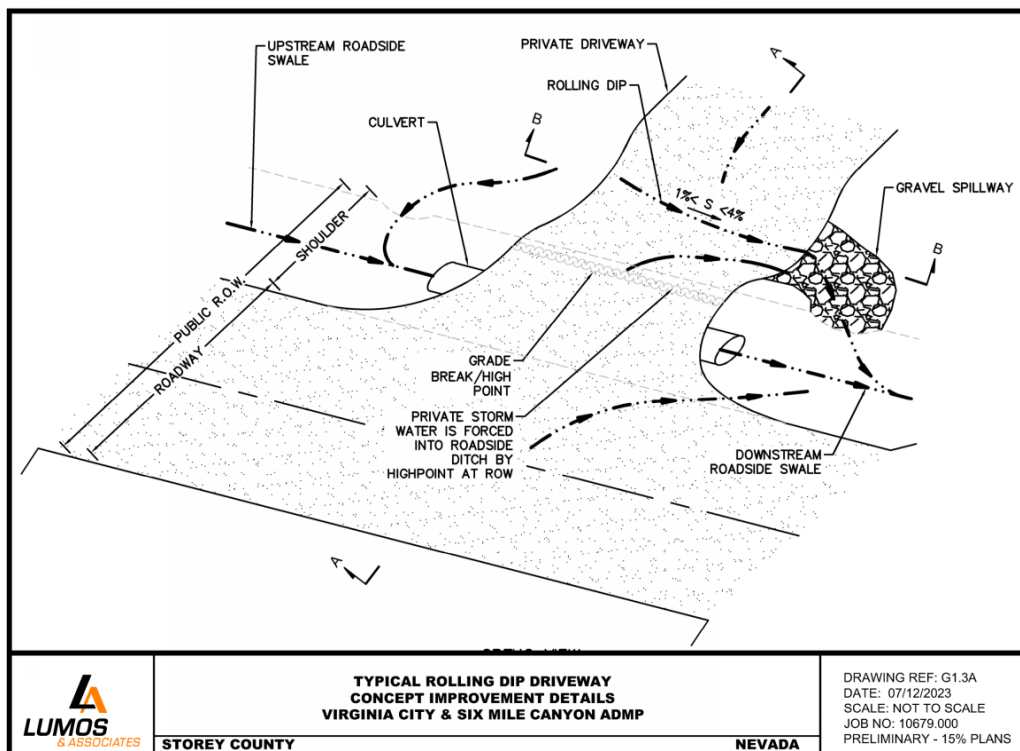
### 3.3.3 Existing Culverts Inlet/Outlet Protection

There are several smaller culverts that cross Six Mile Canyon Road and have erosion issues during small and large events. These culverts often have no flared end sections or headwalls, therefore creating inefficient and erosive hydraulics. The scour and erosion could be minimized by adding a headwall with rock riprap stabilized inlets and outlets, therefore forcing the storm water into the culvert efficiently.

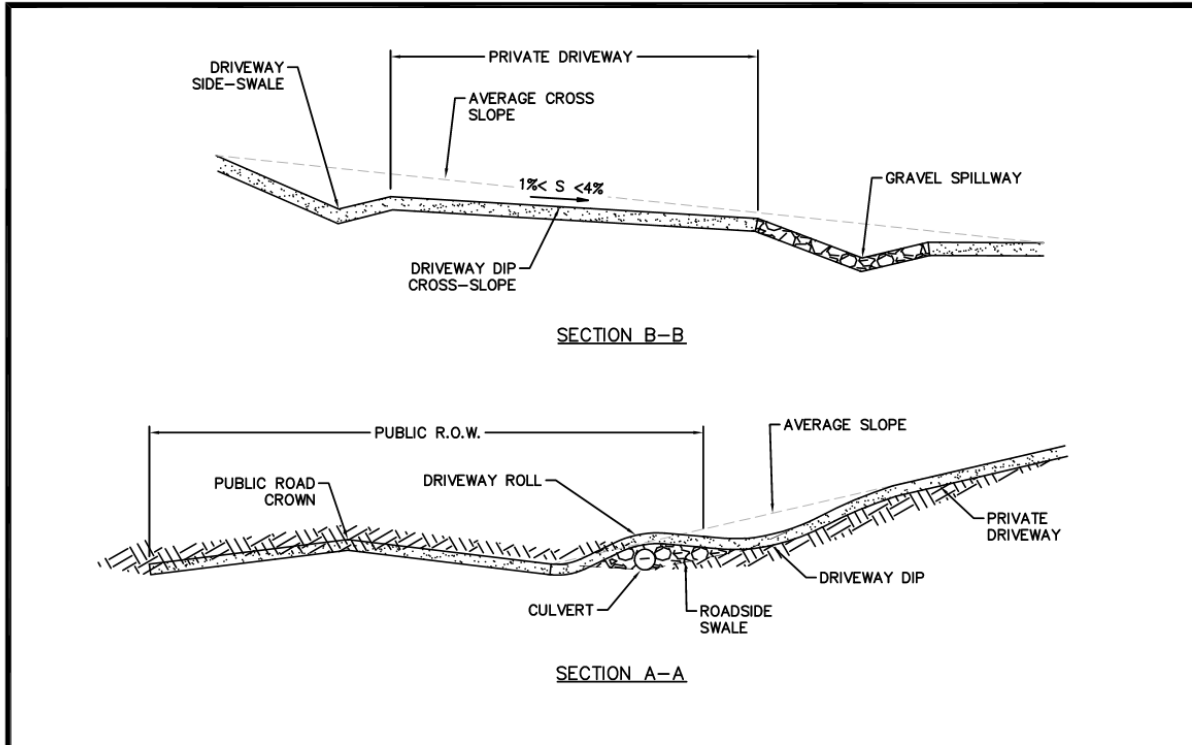
### 3.3.4 Roadway Slope Protection

Six Mile Canyon has several locations where the stream is gradually eroding closer to the existing roadway shoulder and slope. In an attempt to prevent undercutting of the slope, a typical roadway slope protection detail has been included as Figure 3.5. 4 feet minimum of shoulder is proposed to allow for the construction of a roadway barrier. The slope is proposed to be 1.5:1 maximum with a rip rap lining.

**FIGURE 3.3 ROLLING DIP ISOMETRIC VIEW**



**FIGURE 3.4 ROLLING DIP DRIVEWAY SECTIONS**



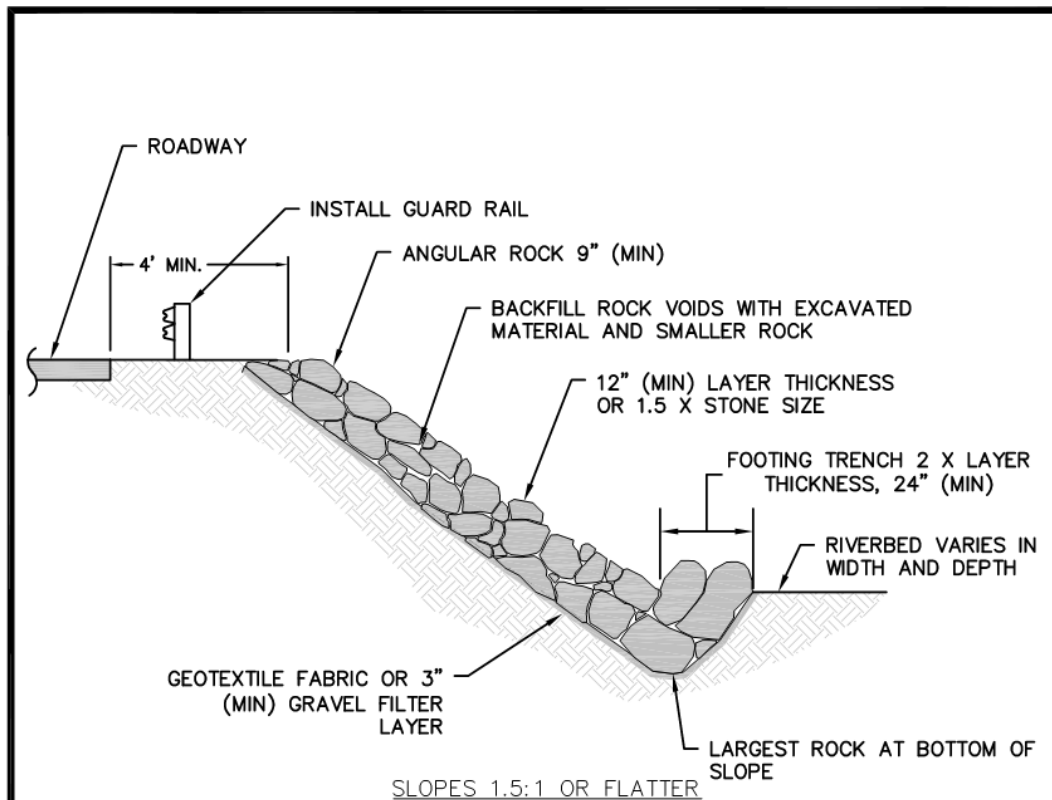
**TYPICAL ROLLING DIP DRIVEWAY SECTIONS  
 CONCEPT IMPROVEMENT DETAILS  
 VIRGINIA CITY & SIX MILE CANYON ADMP**

**STOREY COUNTY**

**NEVADA**

DRAWING REF: G1.3B  
 DATE: 07/12/2023  
 SCALE: NOT TO SCALE  
 JOB NO: 10679.000  
 PRELIMINARY - 15% PLANS

**FIGURE 3.5 TYPICAL STABILIZED ROAD SHOULDER**



**NOTES:**

1. RIPRAP SHALL BE HARD, DURABLE, ANGULAR ROCK WITH A MINIMUM SPECIFIC GRAVITY OF 2.6.
2. ROCKS SHALL BE PLACED TO FORM A STABLE STRUCTURE WITH A MINIMUM OF VOIDS AND EACH ROCK SHOULD HAVE A 3 POINT BEARING CONTACT WITH ROCKS BELOW.
3. IF A GRAVEL FILTER LAYER IS SUBSTITUTED FOR GEOTEXTILE, THEN THE MATERIAL SHALL BE A MIXTURE OF SAND AND GRAVEL, CONSISTING OF 1 1/2" IN SIZE OR LESS.
4. RIPRAP SLOPE PROTECTION SHALL BE INDIVIDUALLY DESIGNED BY A CIVIL ENGINEER FOR SLOPES GREATER THAN 6 FEET HIGHER, WHERE SEEPAGE OR OTHER INDICATIONS OF GENERAL SLOPE INSTABILITY ARE PRESENT, OR WHERE STRUCTURES ARE AFFECTED.
5. FOR NON-PERMITTED PROJECTS, REVEGETATE ADJACENT AREAS IN ACCORDANCE WITH THE TRPA BMP HANDBOOK. FOR PERMITTED PROJECTS, REVEGETATE ADJACENT AREAS TO SPECIFICATIONS OF REVEGETATION PLAN.
6. RETAIN LARGER TREES AND SHRUBS WHERE FEASIBLE.
7. APPLY GEOTEXTILE FABRIC BEFORE INSTALLING ROCKS ON SLOPES WHERE CONCENTRATED FLOW IS EXPECTED OR SEEPAGE WILL OCCUR. OTHERWISE, CONSTRUCT WITHOUT GEOTEXTILE FABRIC OR CONSULT A CIVIL ENGINEER FOR SITE SPECIFIC REQUIREMENTS.



**TYPICAL STABILIZED ROAD SHOULDER  
CONCEPT IMPROVEMENT DETAILS  
VIRGINIA CITY & SIX MILE CANYON ADMP**

**STOREY COUNTY**

**NEVADA**

DRAWING REF: G1.4  
DATE: 07/31/2023  
SCALE: NOT TO SCALE  
JOB NO: 10679.000  
PRELIMINARY - 15% PLANS

## **4.0 PROPOSED FLOOD MITIGATION PROJECTS**

### **4.1 Introduction**

Lumos was tasked with developing a series of potential flood mitigation projects based on the modeling outlined in Section 2.0 and various site visits in known problem-areas. The investigation demonstrated Virginia City is flooded by discharge water from Spanish Ravine to the south, and Ophir and Cedar Ravines to the north. In addition, known flood hazards issues along Six Mile Canyon were included as part of the flood mitigation effort.

Concept Design Plans for the 25-year, 24-hour storm events were prepared for key flood mitigation Projects. During the initial phases of this project, site limitations due to the steep topography were discussed and noted. This report built upon the 25-year, 24-hour; and the 100-year, 24-hour DVADMP hydrology for the ADMP with no substantial modifications. With the site limitations it was agreed that proposed mitigation alternatives within Virginia City proper would aim to address flows from the 25-year, 24-hour event with consideration of the 100-year, 24-hour event flows. The 100-year, 24-hour flows were the basis for proposed improvements along Six Mile Canyon.

The key Projects are described in subsequent sections. The Concept Design Plans were developed to a 15% preliminary design level and are included in Appendix A. The Plans' intended use is to capture general characteristics of the proposed improvements and provide adequate information for budgetary cost estimates, so that informed recommendations can be developed. The various design components, including detention basins extents and capacities, pipe alignments, inlet/outlet structures, are not final. The design components and full scope of work will need to be refined before each project progresses to final design. The final design will also incorporate additional considerations that are beyond the scope of the VCADMP, such as utility conflicts, construction limitations, land acquisition and other specific design considerations based on final alignments and proposed project components.

### **4.2 Detention Basin/Channel/Culvert Concept Design Characteristics**

The proposed designs were selected due to the limited existing storm drain infrastructure, available land in Virginia City and the topography of the surrounding areas. Multiple scenarios are proposed to allow for selection based on available funds and desired phasing.

The model ran three mitigation scenarios, but the projects can be phased in several orders. Projects 1, 2a and 2b were included in the model as shown in Table 4.1. As indicated above, Project 3 was not included in the model as the existing basin does not have sufficient size to meet the 25-year, 24-hour storm event design criteria.

Project 1 includes two sub-projects: the construction of a detention basin in Spanish Ravine, hereby called SRB, and the construction of a detention basin in Ophir Ravine, hereby called ORB. These basins are not interconnected and can be built separately on different timelines, as desired by the County. Each basin would have an outlet pipe and emergency overflow weir. In addition, each basin would be fenced and would have access to allow maintenance vehicles to enter the basin for removal of sediment and debris. Existing access roads would be perpetuated around the basins.

Project 2a builds upon Project 1 to provide additional flood alleviation from small and large events. Project 2a connects the SRB to the ORB (see 4.2.6) via a 48" storm drain pipe. This

project also connects ORB to Seven Mile Canyon by crossing over Highway 431 and discharging just east of the Highway via a 48" storm drain pipe. This project requires the construction of Project 1 and would need to be built as one uniform project.

Project 2b is an alternative to Project 2a and connects ORB to Six Mile Canyon via a 30" storm drain pipe, instead of Seven Mile canyon.

Project 3 is an existing basin (OEP). The history of the basin is unknown at this time. This project is a standalone project and can be implemented for a cheaper price with a large benefit for smaller storm events.

The following combination of projects can be seen in Table 4.1. The descriptions of each individual project is discussed in Sections 4.2.1 through 4.2.7.

**TABLE 4.1 PROJECT INDEX**

Project Number	Included Projects
1	SRB, ORB
2a	SRB, ORB, STOC, OTSC
2b	SRB, ORB, STOC, OTCC
3	OEP
4	SMC

Sediment loading was considered but was not a governing design feature due to limited buildable area for detention basins. Each basin was analyzed taking into consideration the sediment volume for three times the annual estimated load plus a single 100 year storm event. Reference Table 4.2 for the desired and provided sediment storage.

**TABLE 4.2 DESIRED AND PROVIDED SEDIMENT STORAGE**

Basin	3 x Annual Load*	100 Year Single*	Desired Storage*	Provided*
Ophir Ravine	0.27	1.12	1.39	2.06
Spanish Ravine	0.21	0.28	0.49	1.83

\* All values are in Acre-Feet

The basin for Spanish Ravine provides approximately 0.75 acre-feet additional usable volume. The Ophir Ravine Basin provides approximately 0.67 acre-feet additional usable volume. O&M manuals will be provided during final design.

#### **4.2.1 Spanish Ravine Basin w/ Outlet Pipe (SRB) – Project 1**

The Spanish Ravine basin (SRB), by itself, is designed to detain peak discharge for small storms, and convey flows for up to the 25-year, 24-hour storm event from Spanish Ravine contributing area. The proposed basin has a total detention capacity of 1.83 ac-ft with a

maximum berm height of 12. "The proposed SRB design criteria is below State of Nevada "dam" definition to avoid regulatory oversight and associated costs. The basin will have a low flow outlet capable of conveying 63 cfs with an emergency spillway that will convey flows in excess of the outlet. The low flow outlet will convey flows downstream to the current existing flow path. Flows over the emergency spillway will be conveyed to the current flow paths of runoff from the ravine. The detention basin is also proposed to act as a sedimentation basin to reduce the sediment deposits that currently reach the developed area of Virginia City during storm events. The ravine currently has a 25- year, 24-hour peak flow of approximately 100 cfs (taken from the addition of the peak flows of Cross Sections 14 and 15). With the basin incorporated, the peak flow is unaffected at 100 cfs at the 25 year, 24 hour storm event. Due to the limited available space and the steep nature of the canyon, this basin cannot be large enough to detain the total volume of storm water runoff from events that produce a runoff volume greater than 80,000 cubic feet. The basin will provide the City relief during smaller storm events by detaining and allowing sediment to deposit prior to being discharged downstream through town. Additionally, the benefit of the Spanish Ravine Basin is realized with Alternative 2, under Section 4.2.3. This project is located within parcel 001-291-01, as seen in Table 4.6, currently owned by the Bureau of Land Management (BLM) and Storey County.

#### **4.2.2 Ophir Ravine Basin w/ Outlet Pipe (ORB) – Project 1**

The Ophir Ravine basin (ORB), is designed to detain peak discharge for small storms, and convey flows for up to the 25-year, 24-hour storm event from the Ophir Ravine contributing area. The proposed basin has a total detention capacity of 2.06 ac-ft with a maximum berm height of 18 feet. "The proposed SRB design criteria is below State of Nevada "dam" definition to avoid regulatory oversight and associated costs. The basin will have a low-flow outlet capable of conveying 66 cfs with an emergency spillway that will convey flows greater than 66 cfs. The low flow outlet will convey flows downstream to the current existing flow path. Flows over the emergency spillway will be conveyed to the current flow paths of ravine runoff. The basin is also designed to not meet the criteria to be categorized as a dam. The ravine currently has a 25 year, 24 hour peak flow of approximately 120 cfs (Taken from Cross Section 22). With the basin incorporated, the peak flow is unaffected at 120 cfs. Due to the limited available space and the steep nature of the canyon, the basins are not proposed to be large enough to detain the storm water. The basin will provide the City relief during smaller storm events by detaining and allowing sediment to deposit prior to being discharged downstream through town. Additionally, the benefit of the basin is realized with Project 2, under Section 4.2.3-5. This basin is proposed in parcel 001-291-01, and is designed to discharge into APN 001-021-05.

Project 2 builds upon the basins proposed in Project 1 by adding a connector pipe to convey flows up to the 25-year, 24-hour event from Spanish Ravine to Ophir Ravine and then combine the flows from the two basins to discharge down Six Mile Canyon.

#### **4.2.3 Spanish to Ophir Connector Pipe (STOC) – Project 2**

The STOC project would divert the discharged flows from the Spanish Ravine Basin to the Ophir Existing Pond (OEP, see Section 4.2.6). This project would work in conjunction with the OTSC or OTCC projects. This project consists of a 48" storm drain line that runs from the Spanish Ravine pond to the OEP located in APN 001-021-05. The purpose of this project is to divert the excess flood water that typically flows through Stewart Street to the east, and direct it to the north to discharge either to a new piped system in Carson Street or a new piped system to Cedar Ravine. This connection decreases the 25 year, 24 hour peak flow from 100 cfs to 8 cfs

out of the Spanish Ravine Canyon. Coordination with affected property owners to obtain drainage easements would be required before this alternative could be implemented.

#### **4.2.4 Ophir to Six Mile Connector Pipe (OTSC) – Project 2a**

The OTSC project connects the existing Ophir pond to the Six Mile Canyon down Carson Street. The project consists of 36" storm drain that connects from the existing Ophir pond down through Carson Street and discharges on the parcel APN 001-273-01. This diverts excess storm runoff from the Ophir Ravine downstream of the densely populated areas of town. Coordination with affected property owners to obtain drainage easements would be required before this alternative could be implemented.

#### **4.2.5 Ophir to Cedar Connector Pipe (OTCC) – Project 2b**

The OTCC project is an alternative alignment for the OTSC project. This diverts flows from the existing Ophir pond to the Cedar Ravine watershed just east of State Route 341. This project would divert runoff from the Ophir Ravine to the Cedar Ravine watershed, which has no development or structures at this time, to greatly reduce the flows that run through the City. This connector pipe conveys 166 cfs at peak hour during the 25 year, 24 hour event. This diversion reduces the flows that are conveyed down Carson Street from 120 cfs to 35 cfs (found at Cross Section 22).

#### **4.2.6 Ophir Existing Pond Improvements (OEP) – Project 3**

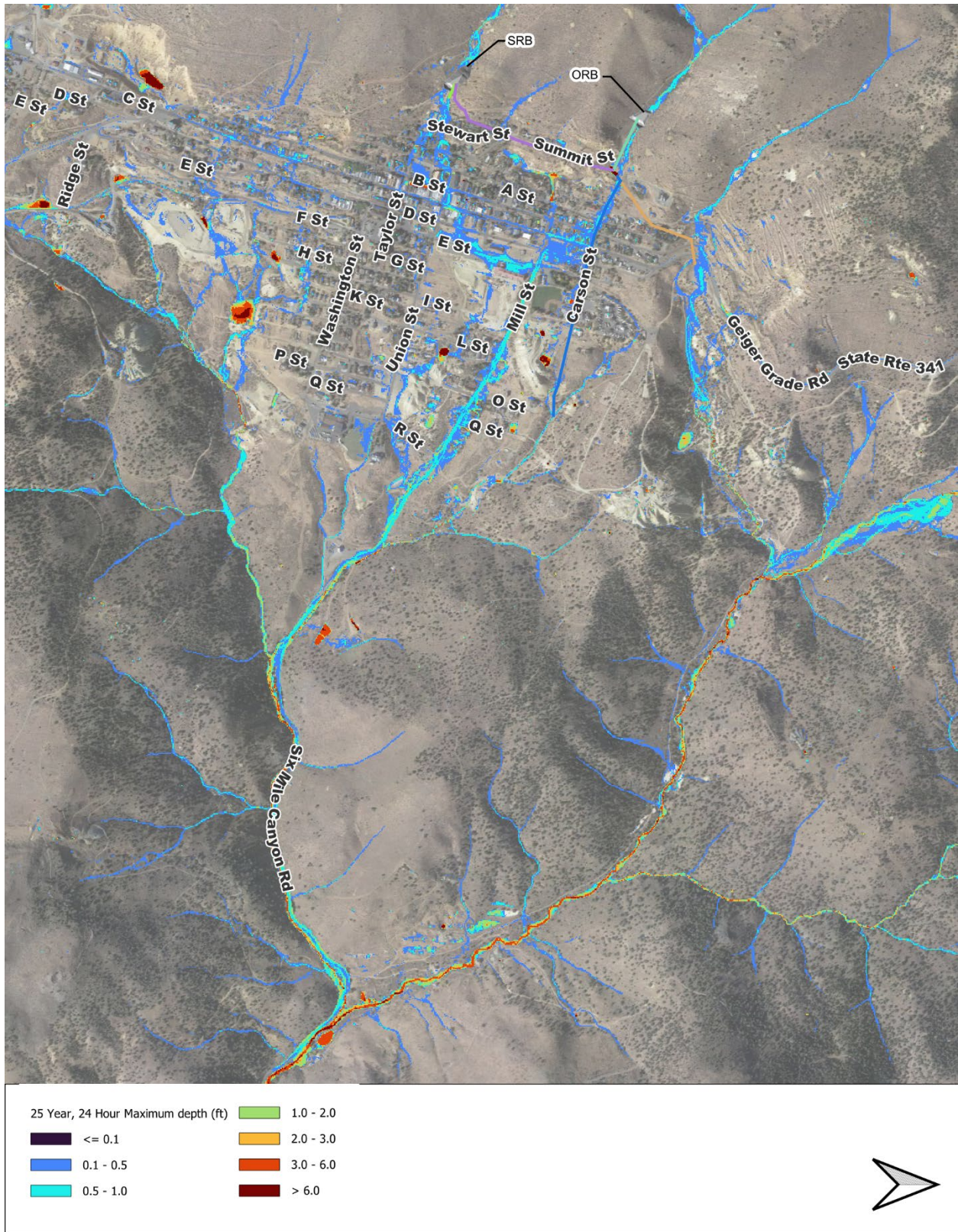
The OEP project is considered to be a less expensive interim alternative that would reduce surface flow from the Ophir Ravine and aid in the capture of sediment from this canyon using an existing small basin. An existing pond of approximately 13,000 cubic feet currently lies at the mouth of the Ophir Ravine. This pond currently has a large 48" culvert that conveys flows out of the basin without creating any detention of flows in the basin. Project 3 proposes to modify this existing basin through the construction of a new outlet structure designed to release flows at a lesser flow rate and create detention of flows from smaller storm events. The pond does not have sufficient capacity to capture and detain the volume of flow from the 25-year, 24-hour storm event but it could provide benefit during the smaller storm events, as well as spring snow melt runoff. For this reason, this project was not included in the model due to the small capacity of the pond.

#### **4.2.7 Six Mile Canyon Culvert Improvements (SMC) – Project 4**

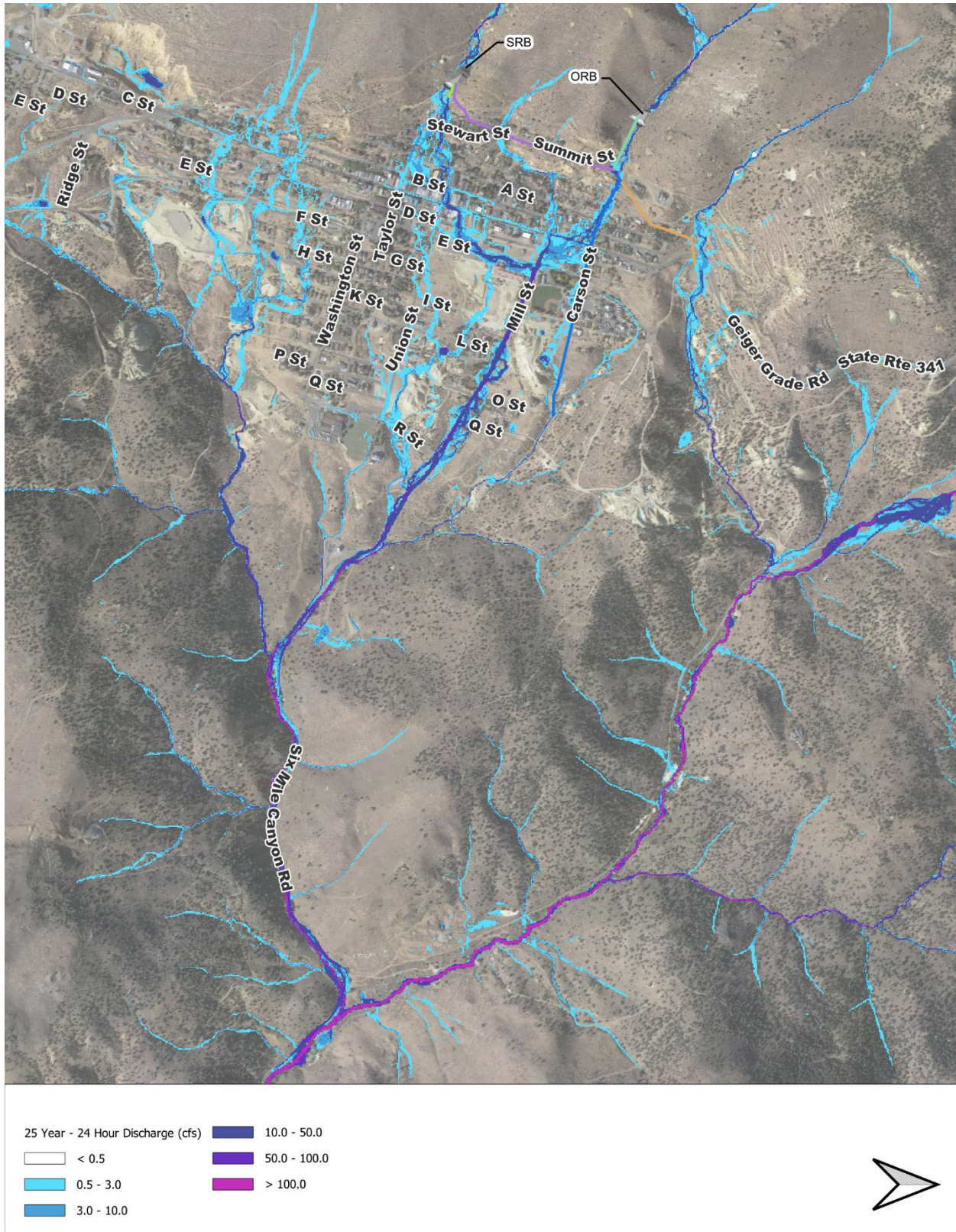
This project is discussed in the 6 Mile Canyon design characteristics section, 4.3.1.

Figures 4.1 – 4.15 show the 25 year depths, flows, and percent reduction in flows for each project number. Positive Values for the percent reduction figures indicate a decrease in flows, negative values indicate an increase in flows. Six Mile canyon is not shown in the following figures because the flows converge at Six Mile and Seven Mile canyons and equalize to existing conditions, respectively.

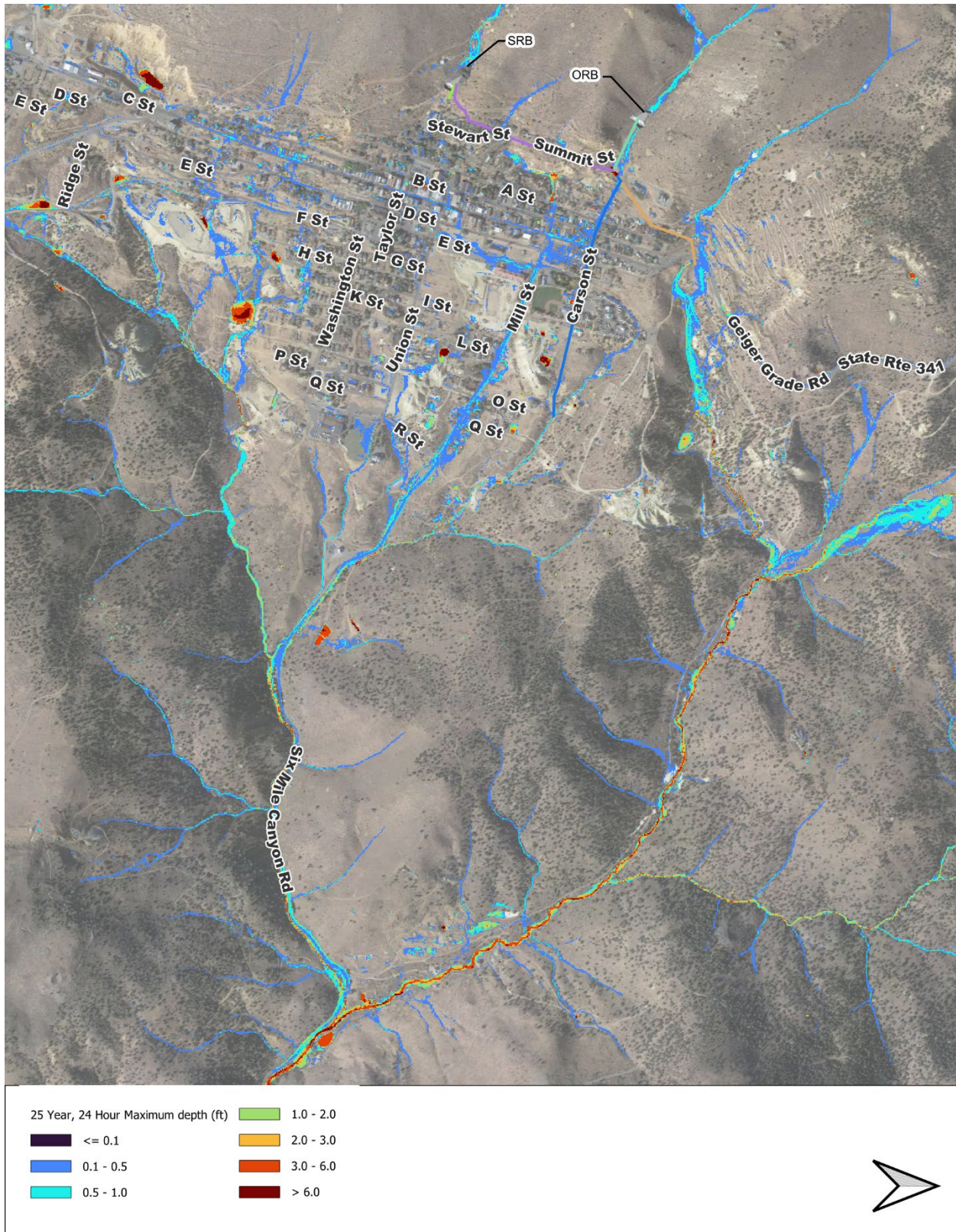
**FIGURE 4.1 PROJECT NUMBER 1 – 25 YEAR, 24 HOUR MAX DEPTH (FT)**



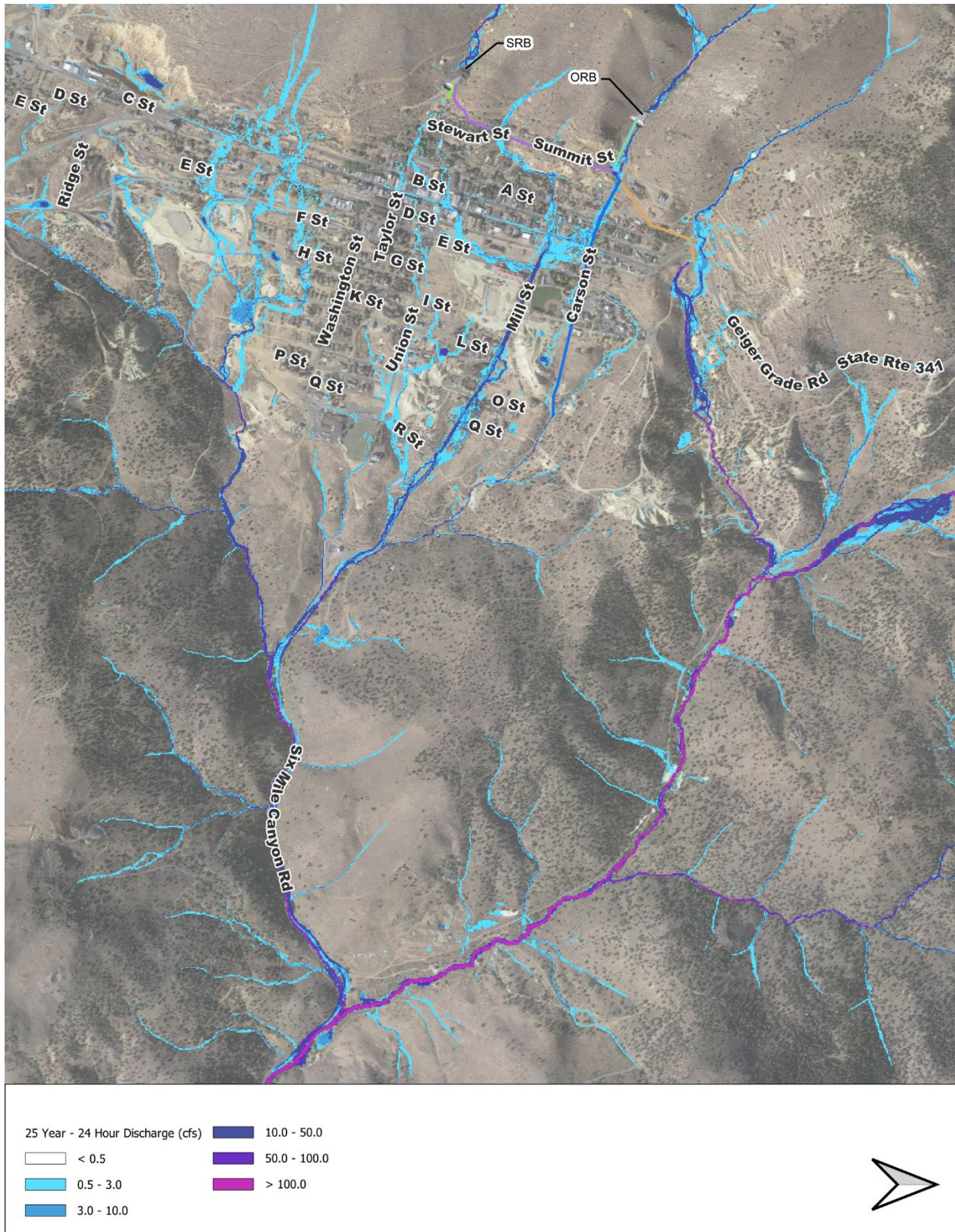
**FIGURE 4.2 PROJECT NUMBER 1 – 25 YEAR, 24 HOUR DISCHARGE (CFS)**



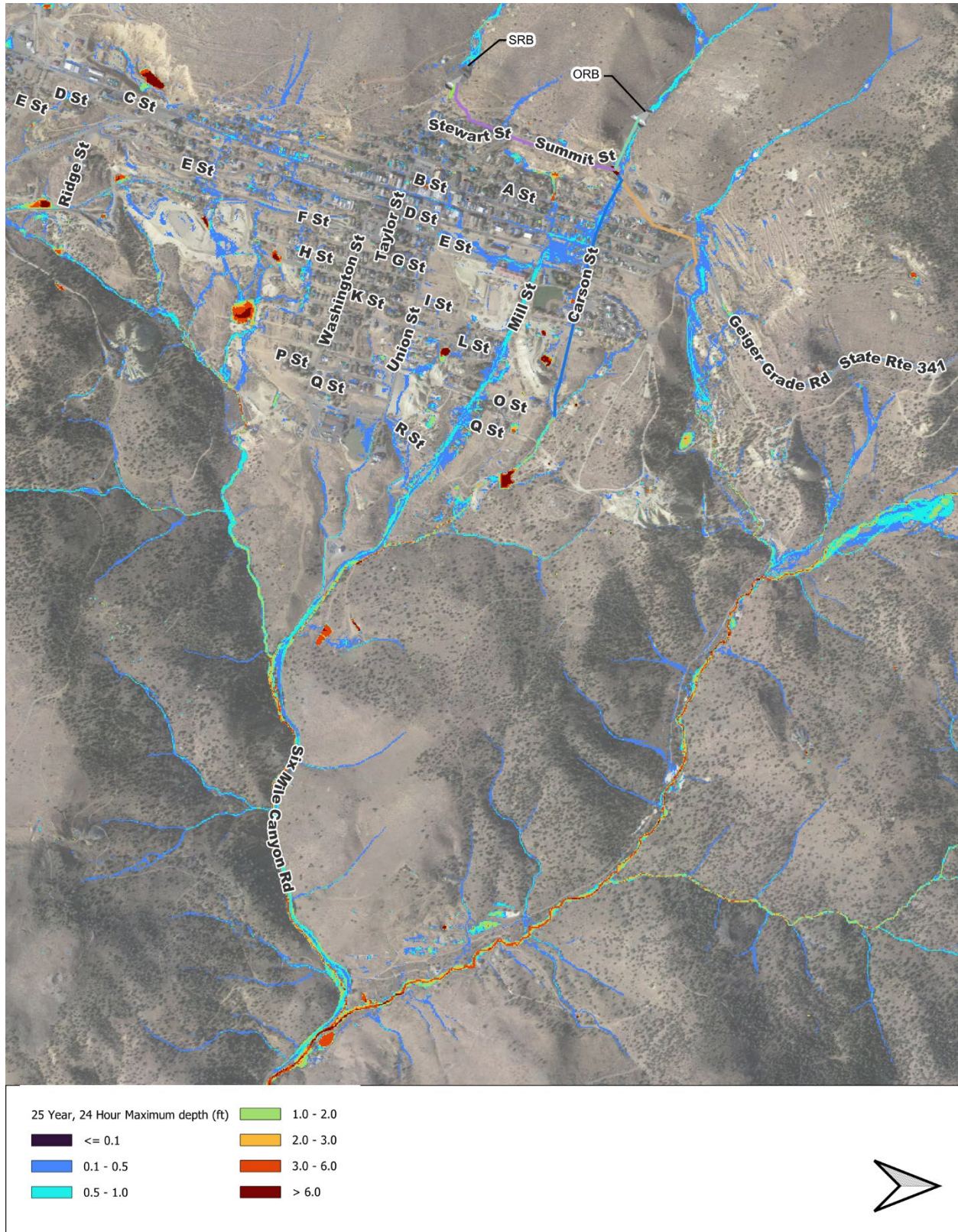
**FIGURE 4.3 PROJECT NUMBER 2A – 25 YEAR, 24 HOUR MAX DEPTH (FT)**



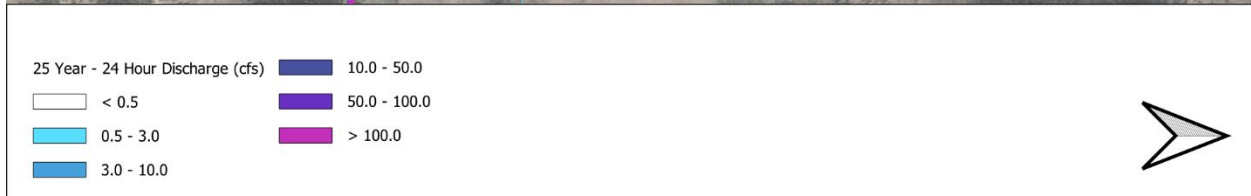
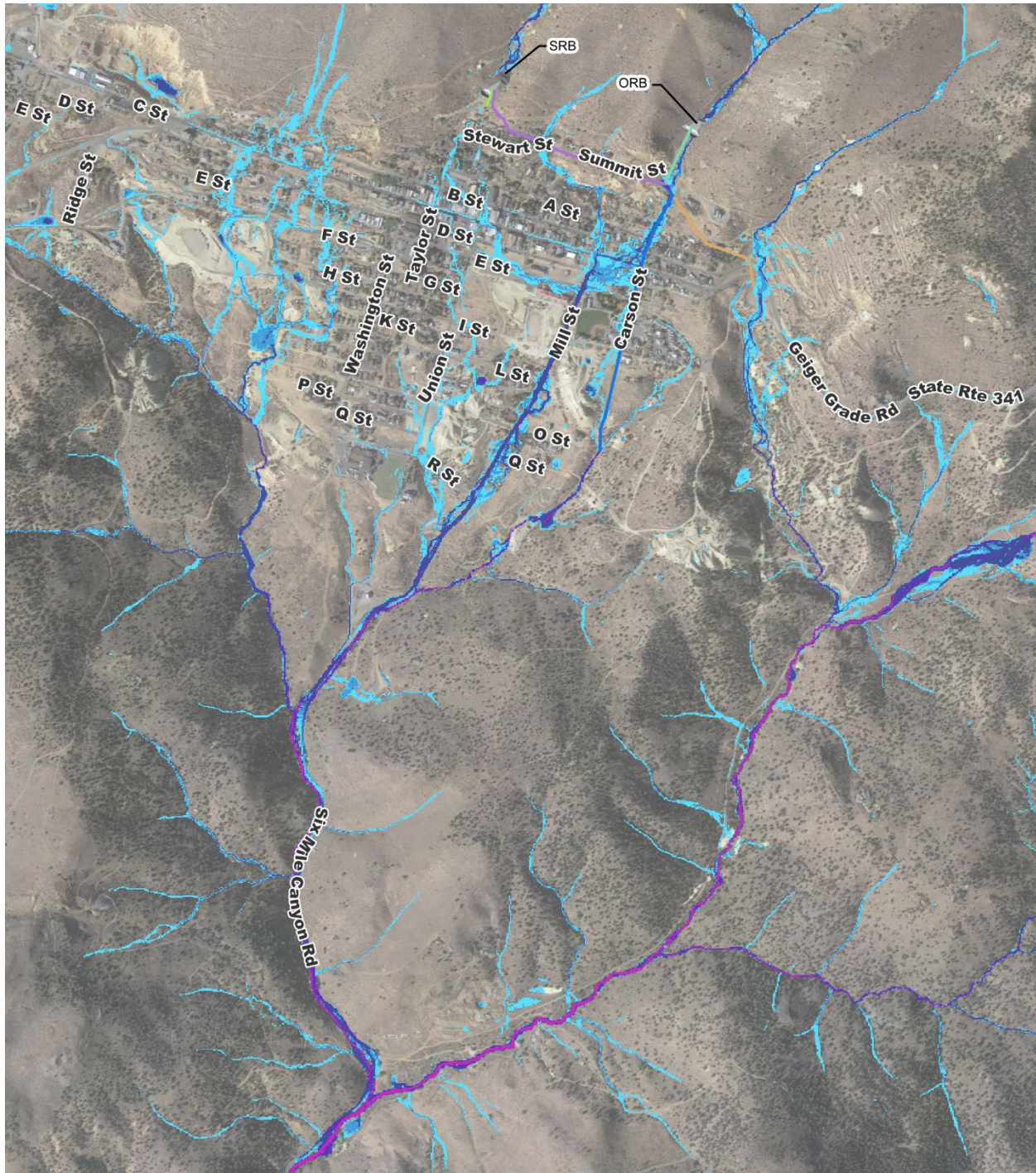
**FIGURE 4.4 PROJECT NUMBER 2A – 25 YEAR, 24 HOUR DISCHARGE (CFS)**



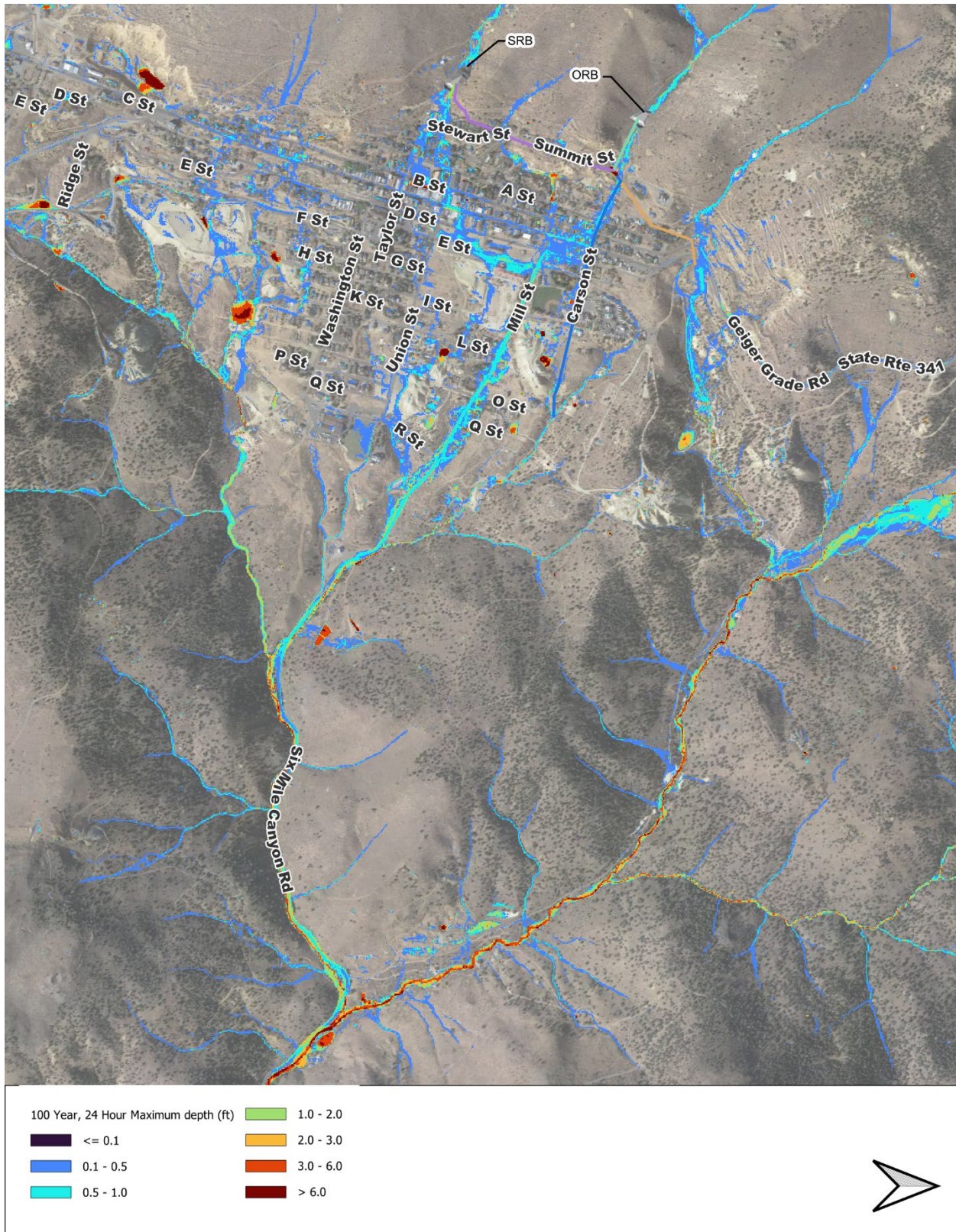
**FIGURE 4.5 PROJECT NUMBER 2B – 25 YEAR, 24 HOUR MAX DEPTH (FT)**



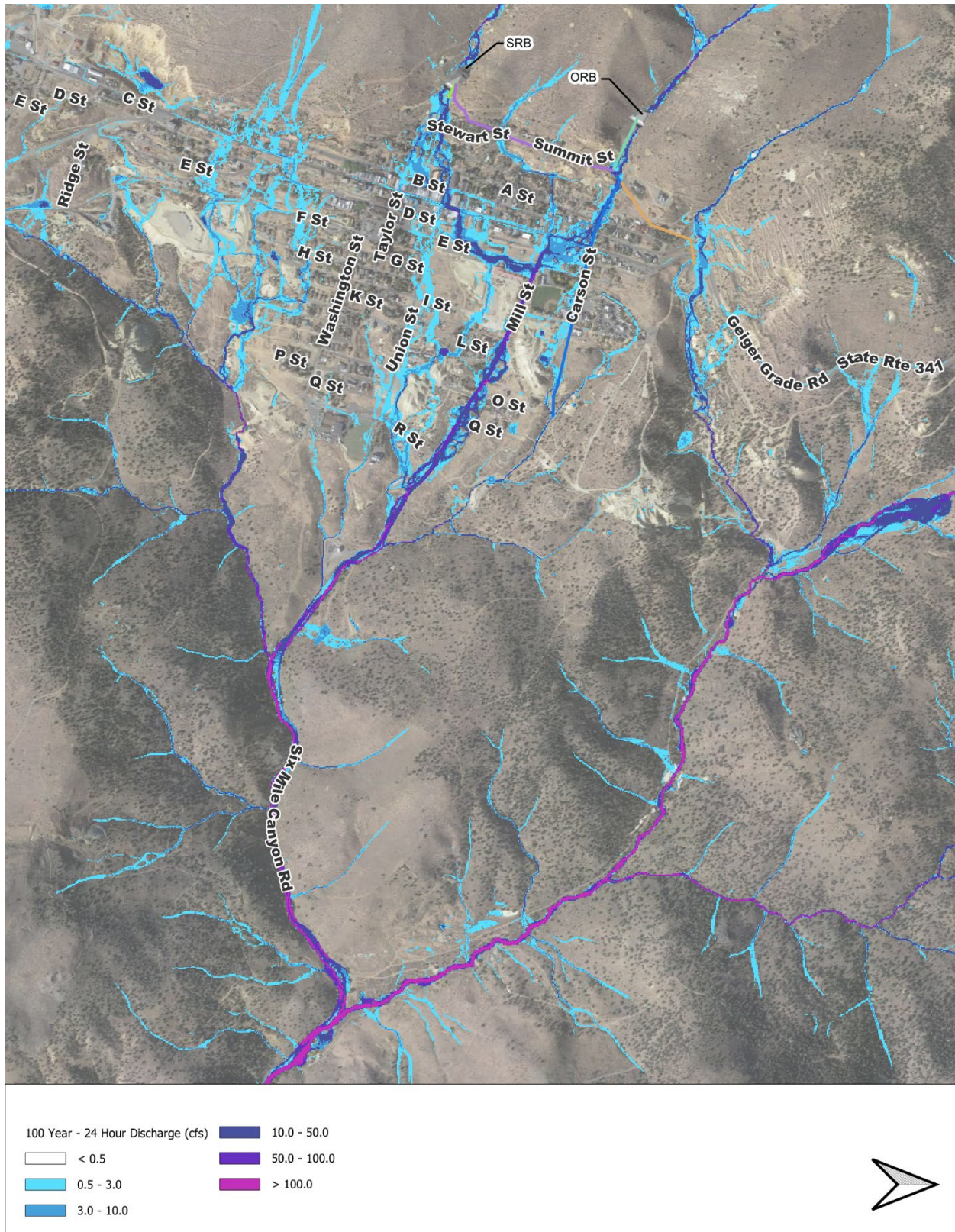
**FIGURE 4.6 PROJECT NUMBER 2B – 25 YEAR, 24 HOUR DISCHARGE (CFS)**



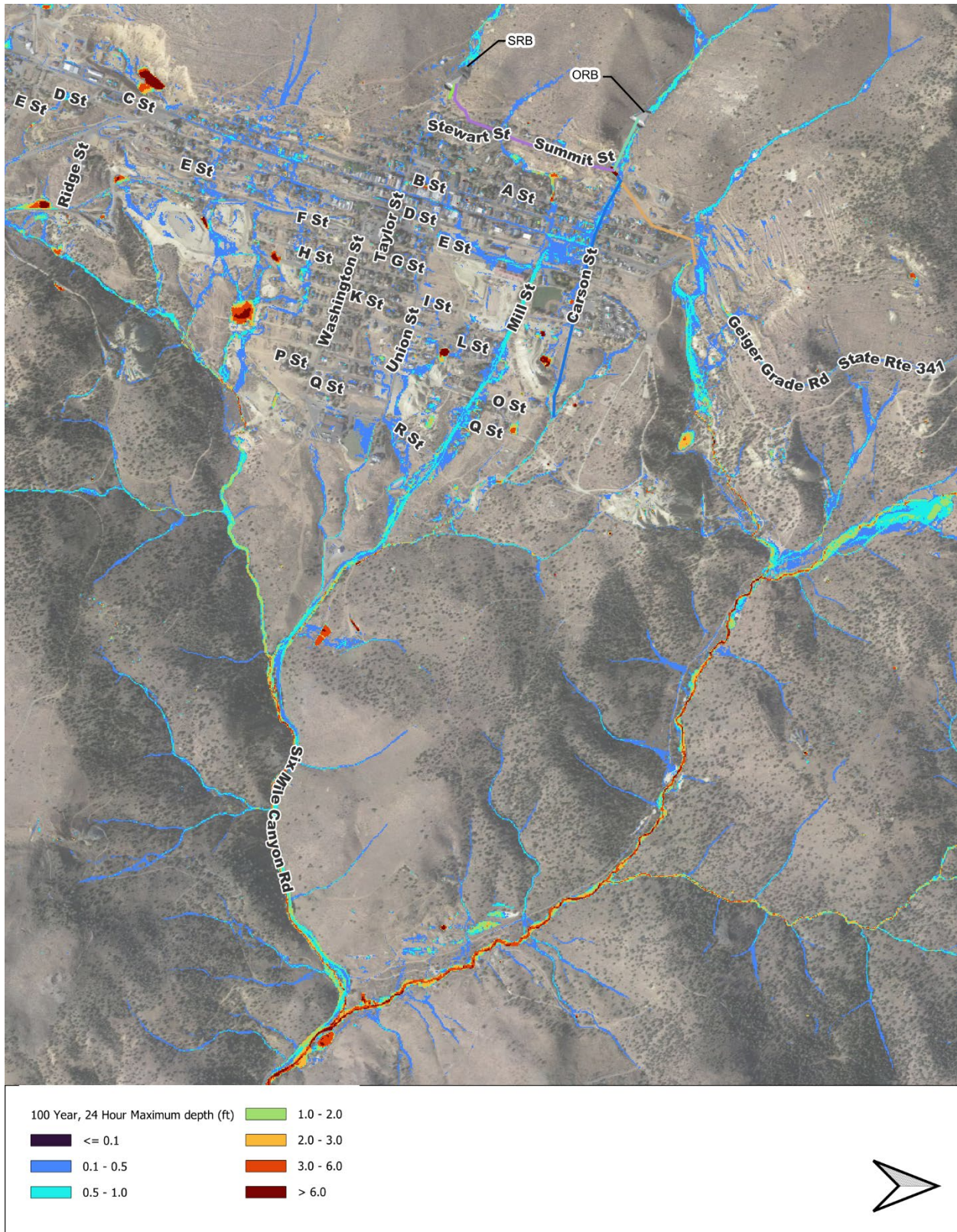
**FIGURE 4.7 PROJECT NUMBER 1 – 100 YEAR, 24 HOUR MAX DEPTH (FT)**



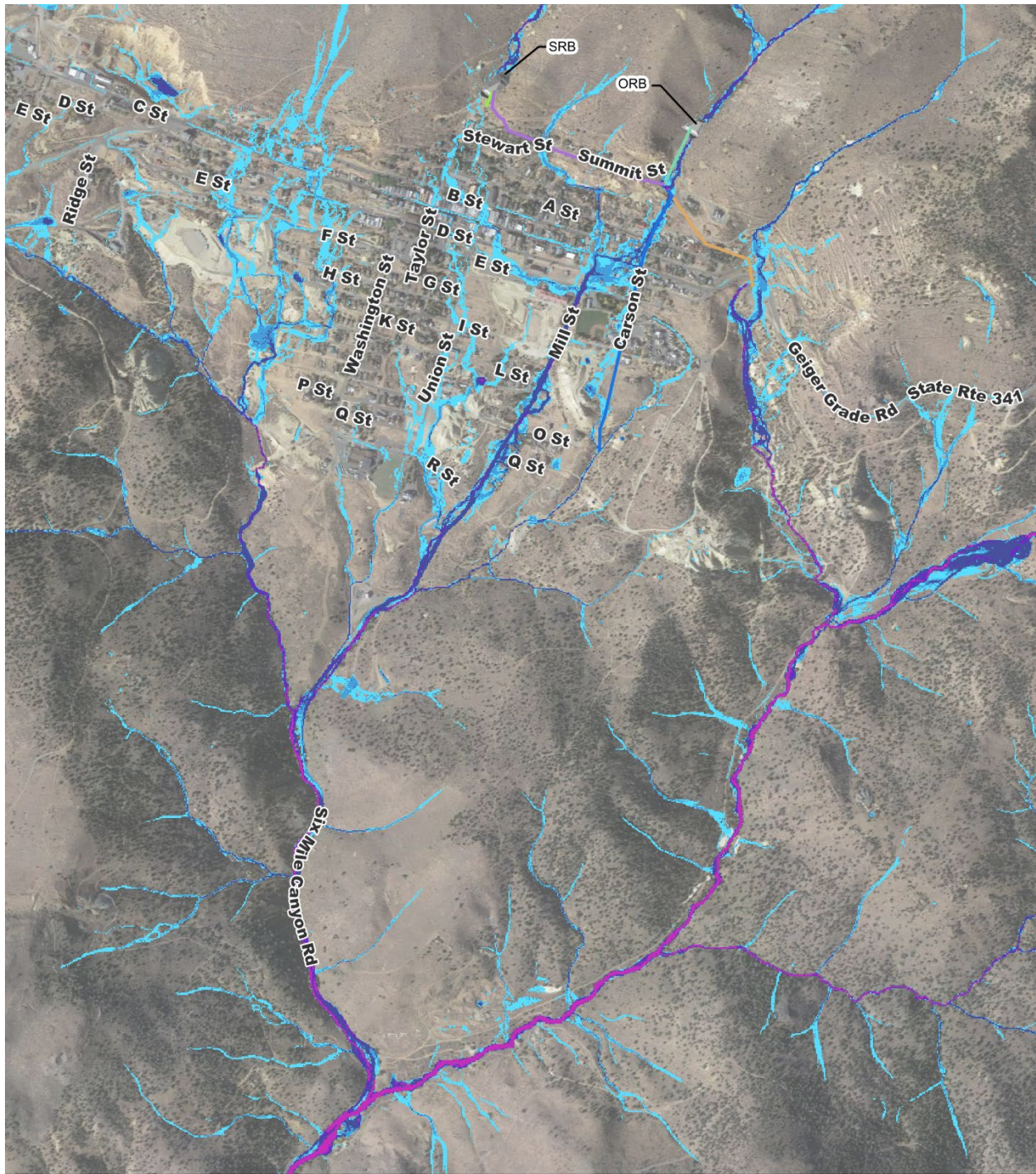
**FIGURE 4.8 PROJECT NUMBER 1 – 100 YEAR, 24 HOUR DISCHARGE (CFS)**



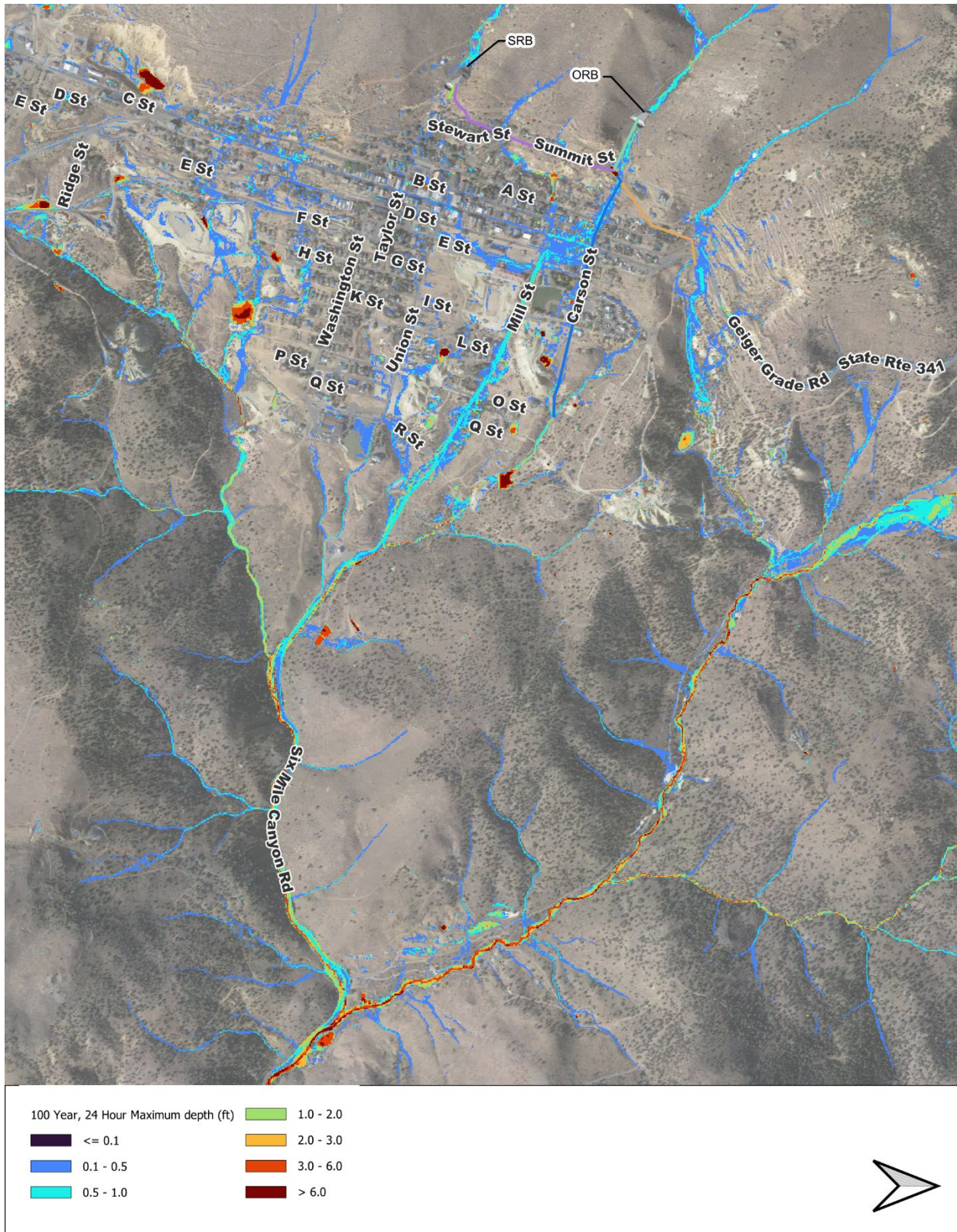
**FIGURE 4.9 PROJECT NUMBER 2A – 100 YEAR, 24 HOUR MAX DEPTH (FT)**



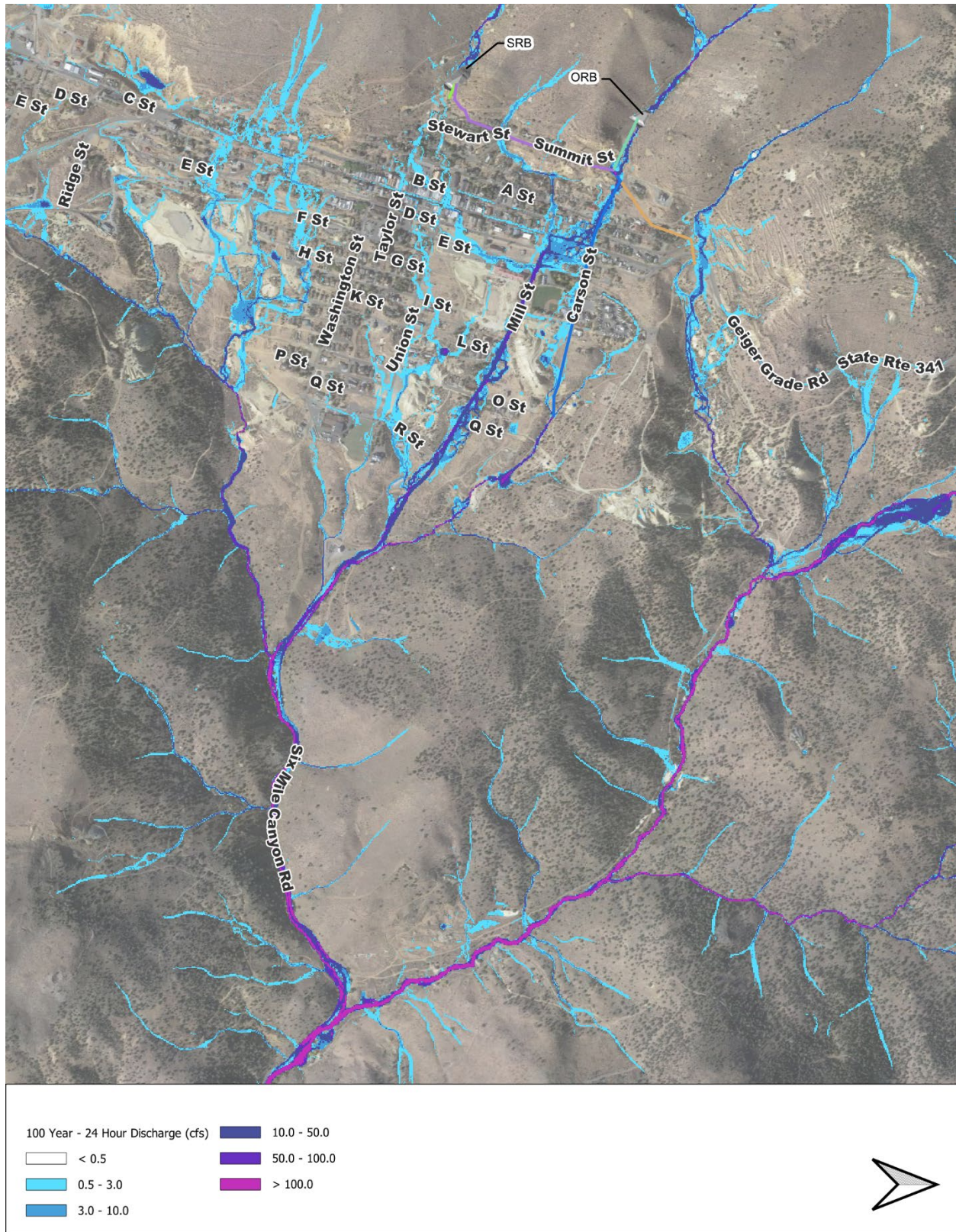
**FIGURE 4.10 PROJECT NUMBER 2A – 100 YEAR, 24 HOUR DISCHARGE (CFS)**



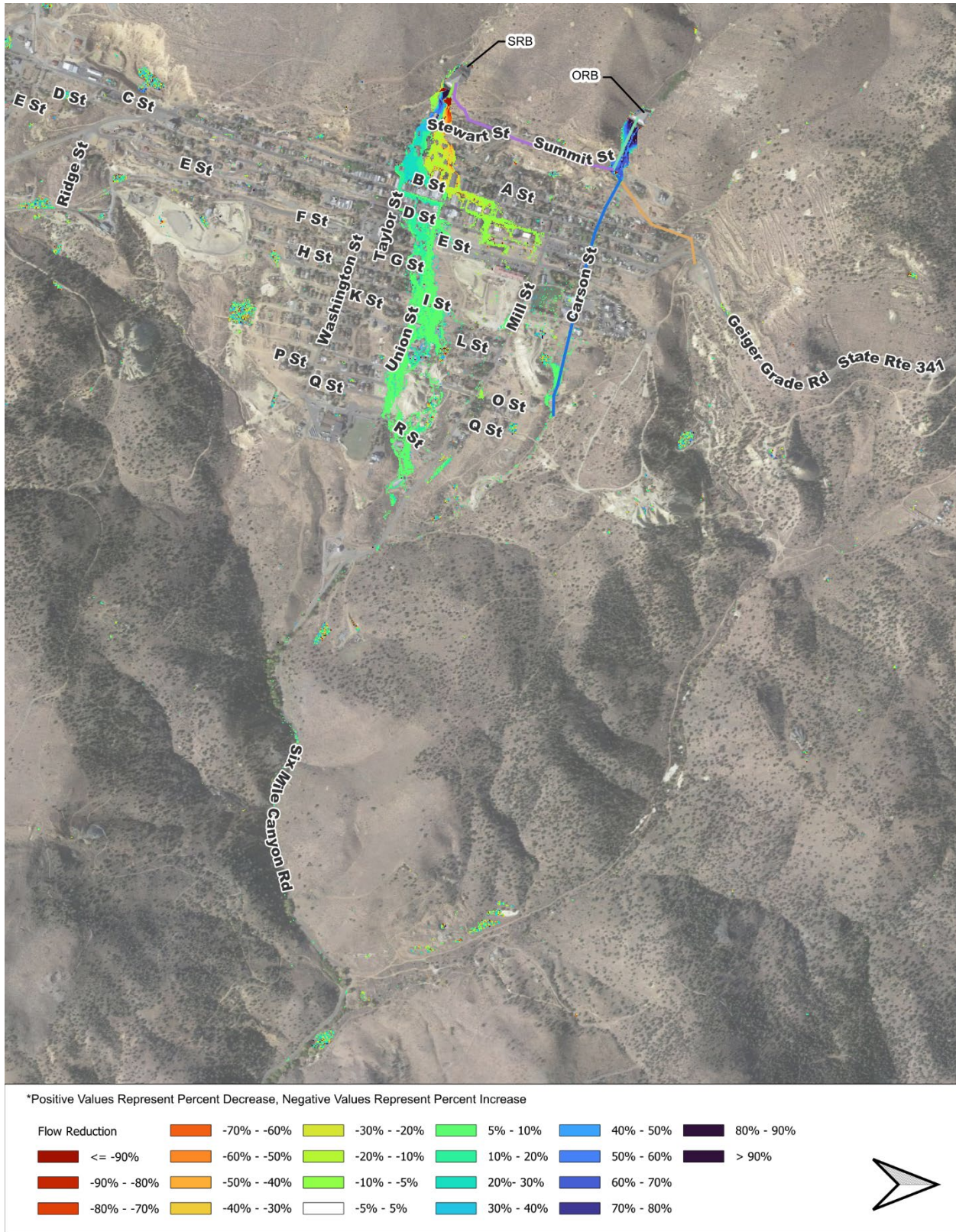
**FIGURE 4.11 PROJECT NUMBER 2B – 100 YEAR, 24 HOUR MAX DEPTH (FT)**



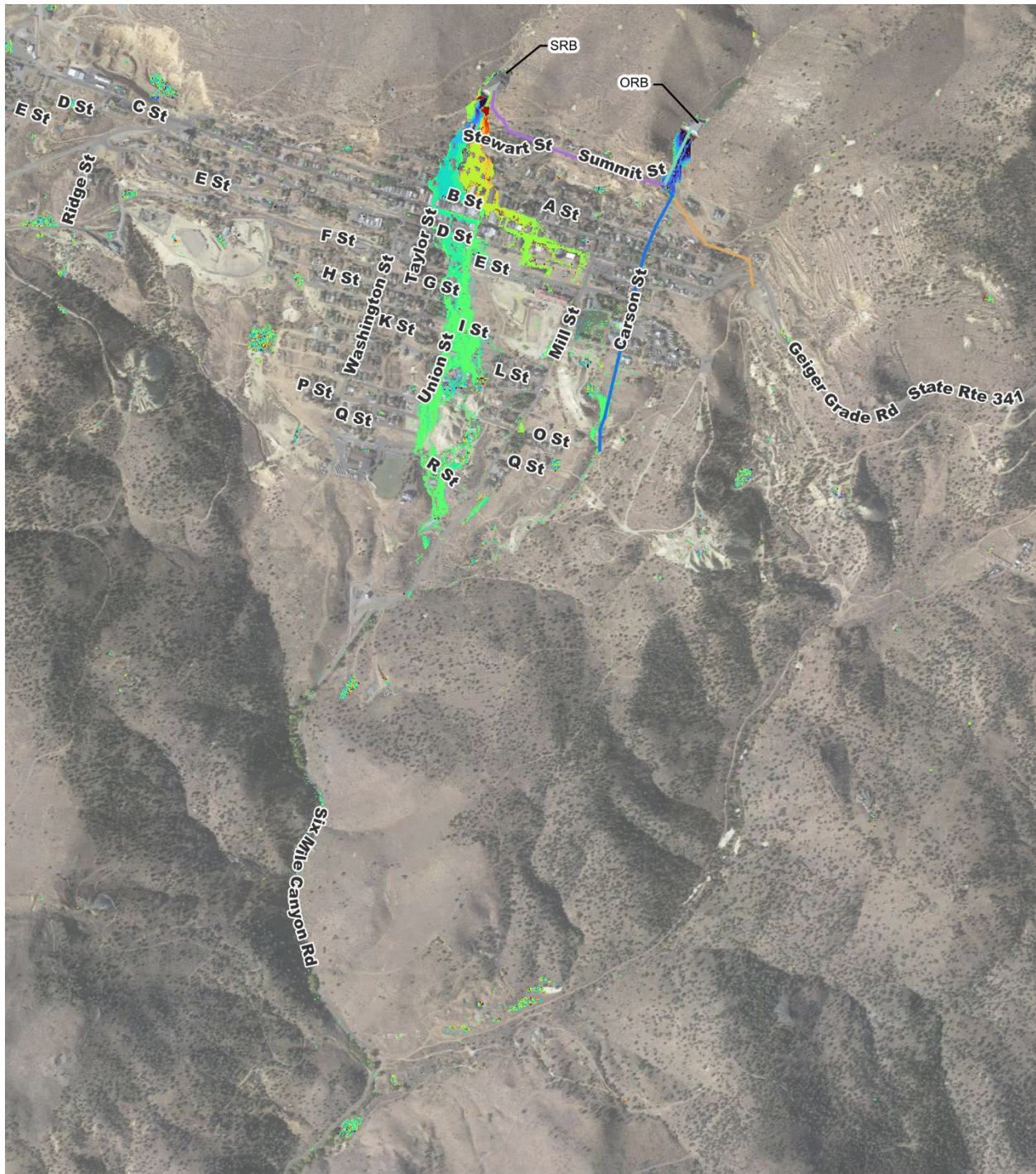
**FIGURE 4.12 PROJECT NUMBER 2B – 100 YEAR, 24 HOUR DISCHARGE (CFS)**



**FIGURE 4.13 PROJECT NUMBER 1 – 25 YEAR, 24 HOUR FLOW REDUCTION (%)**



**FIGURE 4.14 PROJECT NUMBER 2A – 25 YEAR, 24 HOUR FLOW REDUCTION (%)**

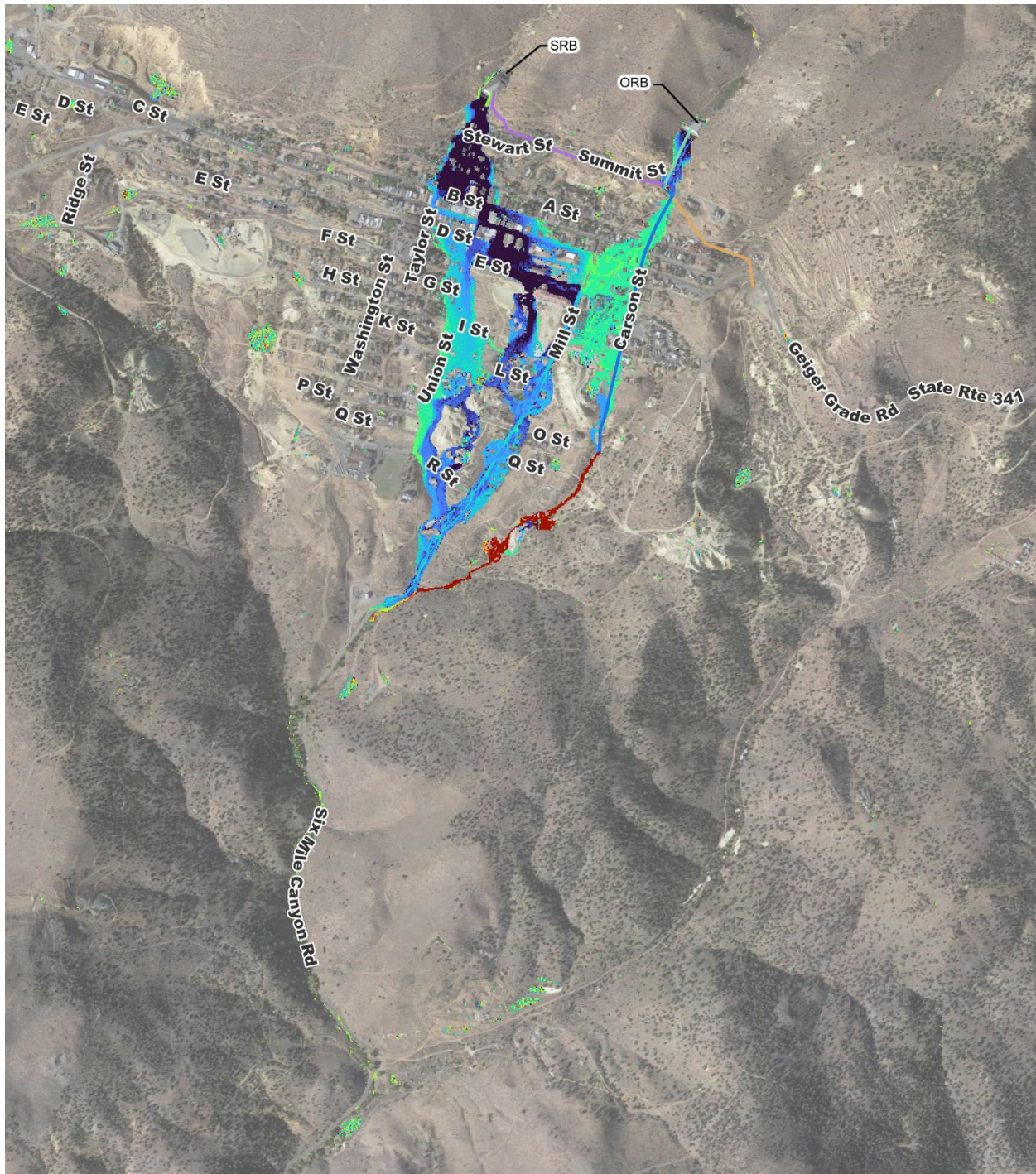


\*Positive Values Represent Percent Decrease, Negative Values Represent Percent Increase

Flow Reduction	-70% - -60%	-30% - -20%	5% - 10%	40% - 50%	80% - 90%
<= -90%	-60% - -50%	-20% - -10%	10% - 20%	50% - 60%	> 90%
-90% - -80%	-50% - -40%	-10% - -5%	20% - 30%	60% - 70%	
-80% - -70%	-40% - -30%	-5% - 5%	30% - 40%	70% - 80%	



**FIGURE 4.15 PROJECT NUMBER 2B – 25 YEAR, 24 HOUR FLOW REDUCTION (%)**



\*Positive Values Represent Percent Decrease, Negative Values Represent Percent Increase

Flow Reduction	-70% - -60%	-30% - -20%	5% - 10%	40% - 50%	80% - 90%
<= -90%	-60% - -50%	-20% - -10%	10% - 20%	50% - 60%	> 90%
-90% - -80%	-50% - -40%	-10% - -5%	20% - 30%	60% - 70%	
-80% - -70%	-40% - -30%	-5% - 5%	30% - 40%	70% - 80%	



### 4.3 Six Mile Canyon Design Characteristics

Six Mile Canyon culverts regularly overtop wash out portions of the road. The Flo-2D model coincides with field observations for the larger events. Most culvert crossings overtop and produce water depths of 1-4 feet above the crown of the road. Most locations along Six Mile Canyon show depths in the 6-8 feet range.

There are four primary types projects proposed for work along Six Mile Canyon Road to mitigate these conditions:

1. Modify two existing culverts to improve the hydraulic function of the culverts;
2. Maintain existing channel and roadside ditches;
3. Construct culverts at low points in the existing roadside channels; and,
4. Implement a County standard for driveway connections to Six Mile Canyon Road.

It was originally thought that many of the culverts were undersized, therefore forcing excess runoff to overtop the road and erode the shoulder and sometimes the actual drivable lanes. Closer investigation revealed the majority of culverts have proper capacity, but are blocked by sediment and organic debris. Many of the culverts restrict stormwater flows because they are filled halfway with sediment. Furthermore, larger storms wash dead brush, tree branches, and trees downstream to the nearest culvert, block the entrance to the culvert, and further exacerbate the blockage.



**Dead brush, tree branches, and trees washing downstream, further exacerbating the issue.**

Additionally, the majority of roadside channels that run along portions of Six Mile Canyon Road are shallow and unlined because of narrow shoulders in many locations. Significant storms quickly fill these channels with sediment and overtop, causing storm water to sheet flow across the roadway. The right-of-way width for the road is approximately 60 feet throughout the Storey County portion of the road with steep slopes and the main drainage channel immediately adjacent to the road. There is little opportunity to increase the size of any roadside channel without easement acquisition and major grading and slope stabilization measures. Within these roadside channels, there are some connections to existing culverts that allow for the runoff to be conveyed under Six Mile Canyon Road to discharge to the main channel or connected channels that convey flows to the main channel. At low points without connecting culverts or channels, water and sediment collects until the road is overtopped and the runoff eventually finds its way to the main channel. Not only does this create hazardous road conditions with water and sediment on the road, it also has created some significant erosion of the embankment of the main channel at the point the runoff joins the main channel.



**Roadside channels become filled with sediment and overtop, causing sheet flow across the roadway.**

There is increasing development along Six Mile Canyon Road. Most new driveways are unpaved roads simply bladed in to connect to Six Mile Canyon Road. Due to the steep nature of the canyon, during storm events these unpaved driveways serve as conduits for stormwater,

creating points of concentrated flows and significant sediment transport onto Six Mile Canyon Road itself. Improvements to Six Mile Canyon are discussed in Section 4.3.1.

#### 4.3.1 Six Mile Canyon Culvert Improvements (SMC) – Project 4

Two locations were identified for improvements where major overtopping has been observed in the past. These locations can be found in the 15% design plans in Appendix A. Headwalls and rip rap lining inlets and outlets are proposed to mitigate sedimentation, erosion, and capacity issues. This will allow for better hydraulics, therefore increasing the capacity and allowing for sediment flushing. Additionally, consider removing vegetation upstream and downstream whenever improvements are installed, and incorporate a periodic maintenance schedule thereafter to prevent buildup of organics and other debris.

#### 4.4 Basin System Flood Mitigation Conceptual 15% Design Costs and Maintenance Estimates

##### 4.4.1 Preliminary Cost Estimates

Preliminary cost estimates were prepared for the drainage facilities which capture storm water of the 25-year, 24-hour storm event. In addition to initial construction costs, non-construction costs were also considered which include additional environmental and BLM permitting, design, and construction services. Table 4.3 includes preliminary costs estimates for each alternative. Grant funding and loan interest calculations were not included as part of this analysis; however, the project could be phased over a period of time to reduce the financial impact. A detailed cost estimate for each alternative can be found in Attachment A. Right-of-way and/or easement acquisition costs are not included in these estimates and will need to be factored in to the overall project costs.

**TABLE 4.3 ENGINEERS ESTIMATE OF COSTS FOR EACH ALTERNATIVE**

Project	Construction Costs	Non-Construction Costs
SRB	\$1,153,000	\$230,600
ORB	\$1,158,000	\$231,600
STOC	\$1,335,000	\$267,000
OTCC	\$884,000	\$176,800
OTSC	\$1,451,000	\$290,200
OEP	\$37,000	\$7,400
SMC	\$138,000	\$27,600

##### 4.4.2 Annual O&M Costs

It is estimated that all basins will some level of debris and sediment removal, repairs to the slopes, and vegetation maintenance after the work is complete. Table 4.4 shows the estimated yearly maintenance cost for each alternative.

**TABLE 4.4 ESTIMATED ANNUAL O&M FOR EACH ALTERNATIVE**

Expense Type	SRB	ORB	OEP
<u>Additional O&amp;M Costs</u>			
Maintenance/RipRap Repairs <sup>1,2</sup>	\$32,400	\$32,400	\$32,400
Debris Removal/Disposal <sup>1,2</sup>	\$56,400	\$56,400	\$56,400
Revegetate	\$11,600	\$7,600	\$5,500
<b>Total</b>	<b>\$100,400</b>	<b>\$96,400</b>	<b>\$94,300</b>

<sup>1</sup> Assume maintenance and debris removal in each pond every 3 years (schedule one pond every 1 year).

<sup>2</sup> Costs based on 2021 FEMA Schedule of Equipment Rates.

<sup>3</sup> Average cost to reseed one pond based on vegetation costs in construction cost estimate

#### 4.4.3 Lifecycle Cost Analysis

A life cycle present worth analysis was prepared for a 20-year period considering the estimated total project costs and the annual O&M costs. Salvaged and valuable materials like sand excavated during construction and during routine maintenance were not considered in the analysis. The life cycle cost analysis and net present value (NPV) for each alternative are presented in Table 4.5.

**TABLE 4.5 LIFE CYCLE COST ANALYSIS**

Alternative	Present Value		20-Yr NPV <sup>4</sup>
	Total Project Cost <sup>1</sup>	O&M <sup>2</sup> (for 20 Yrs)	
SRB	\$1,383,600	\$1,775,800	\$3,159,400
ORB	\$1,389,600	\$1,705,100	\$3,094,700
OEP	\$44,400	\$1,667,900	\$1,712,300
<b>Total</b>	<b>\$2,817,600</b>	<b>\$5,148,800</b>	<b>\$7,966,400</b>

All improvements shown within the 15% plan set are preliminary but the volumes and quantities obtained from the designs provide an approximate estimate for the expected costs of the project.

#### 4.5 Future Design Considerations

##### 4.5.1 Right-of-Way Access and Easements

The proposed infrastructure has several right of way access intersections with existing County right of way, Bureau of Land Management managed parcels and private land. The County is currently in the process of acquiring the BLM parcel to the west of Virginia City where the Spanish Ravine and Ophir Ravine Basins would be constructed. As of the drafting of this report, that acquisition has not yet been completed.

As a part of any proposed project, coordination with affected property owners would be necessary to secure appropriate drainage and construction easements. The following Table 4.6 summarizes potential parcels that could be included in County efforts to secure required drainage and construction easements if these alternatives are furthered in design for future construction. Figure 4.16 illustrates the same information of potentially affected parcels where drainage and construction easements would be required.

**TABLE 4.6 POTENTIALLY AFFECTED PARCELS REQUIRING EASEMENTS**

APN		
001-291-01	001-273-01	001-301-10
001-033-18	001-211-01	001-163-07
001-301-05	001-033-10	001-032-06
001-213-02	001-033-15	001-212-04
001-271-02	001-021-05	001-303-01
001-272-02	001-033-16	001-011-01

**FIGURE 4.16 POTENTIALLY AFFECTED PARCELS REQUIRING EASEMENTS**



#### **4.5.2 Cultural Resources**

The Virginia City Historic District is a National Historic Landmark that includes the community of Virginia City as well as adjacent communities and open lands containing historic and archeological features associated with mining activities. According to the National Park Service, the Virginia City Historic District includes 400 buildings and covers 14,750 acres across the communities of Virginia City, Gold Hill, Silver City and Dayton.

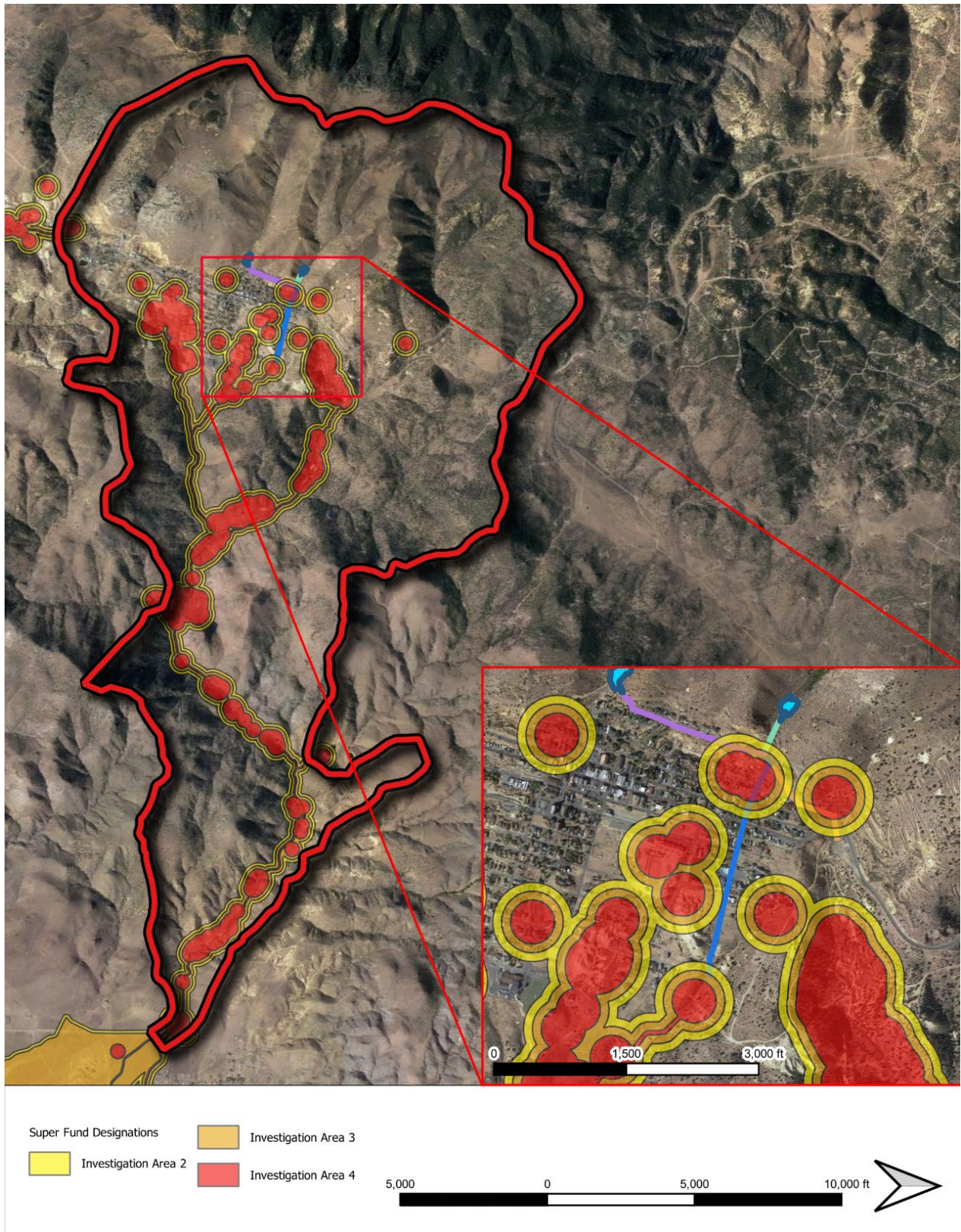
During the construction of any proposed improvements, it is likely that cultural resources may be encountered. Pursuant to Nevada Revised Statutes (NRS) 383.121, all departments, commissions, boards and other agencies of the State and its political subdivisions shall cooperate with the Nevada State Historic Preservation Office (SHPO) in order to salvage or preserve historic evidence located on property owned or controlled by the United States, the State of Nevada or its political subdivisions. Specifically, "...when any agency of the State or its political subdivisions is preparing or has contracted to excavate or perform work of any kind on property owner or controlled by the United States, the State of Nevada or its political subdivisions which may endanger historic, prehistoric or paleoenvironmental evidence found on the property, or when any artifact, site or other historic or prehistoric evidence is discovered in the course of such excavation or work, the agency or contractor hired by the agency shall notify the Office and cooperate with the Office to the fullest extent practicable...to preserve or permit study of such evidence before its destruction, displacement or removal." (NRS 383.121.2). If federal dollars are proposed for any of the projects, additional consultation for compliance with the National Environmental Policy Act (NEPA) may be required.

During construction, it may be required that an archaeological monitor be present during all ground disturbing activities. Costs for SHPO consultation, NEPA compliance and any required archaeological monitor should be taken into consideration not only for projects costs but for project timelines.

#### **4.5.3 Carson River Mercury Superfund Site**

Building proposed projects are constrained since the area in and around Virginia City falls within the Carson River Mercury Superfund Site (see Figure 3.17). For any proposed project, soil characterization sampling to detect contaminated soils should be completed during the early phase of the project. If contaminated soils are likely to be encountered, the County will need to coordinate with the Nevada Division of Environmental Protection to develop an appropriate course of action which could include avoidance of areas of contaminated soil, onsite containment of soil or removal/remediation of the contaminated soil, and /or extra BMPs on subject parcels to prevent the migration of contaminated soil.

**FIGURE 4.17 SUPERFUND INVESTIGATION AREAS**



## 5.0 PUBLIC OUTREACH

### 5.1 Learn and Share Meeting in Virginia City



A Learn and Share Meeting was held at Piper’s Opera House in Virginia City on June 21, 2022. The objective of this meeting was twofold:

1. Provide residents within the VCADMP project area an opportunity to learn about the project, meet with drainage and flood experts working on the ADMP, and ask questions about the ADMP; and,
2. Collect residents’ comments and flood experiences – particularly firsthand accounts of what occurs during precipitation/flood events, and photos depicting flooding impacts.

Invitations were mailed to over 500 addresses within the project area. 19 participants attended the Open House to learn about the project and share their experiences.

During the Open House, the project team presented an overview of the project including:

- purpose of an ADMP;
- importance of public involvement;
- study area identification;
- project element description, and
- next steps.



Following the presentation, participants were invited to provide detailed information about how drainage and flooding affects specific locations within the project area.



**Michelle Gamble, P.E.,** Lumos & Associates' Engineering Group Manager presented about the District's Master Plan and improvements outlined from the study,

**"Are the floodwaters creating hazards for pedestrians, vehicles, and buildings? That's why we're here tonight. It's important to understand what you see when it rains here in Virginia City; where does the water flow, where does the sediment accumulate?"**

**We'll be working closely with the County to make sure the alternatives presented are realistic from a constructability and long-term maintenance standpoint."**

A second public meeting will be held in fall 2023 to share the results of the VCADMP with the community.

## **5.2 CWSCD and Storey County**

Throughout the development of this ADMP, several meetings were held with the CWSCD and Storey County. The purpose of these meetings was to provide updates on the status of the analyses and design and seek input from the County staff regarding the proposed design alternatives. Formal meetings with CWSCD and/or Storey County were held on the following dates:

- January 5, 2022
- April 25, 2022
- June 9, 2022
- June 21, 2022 (First Open House)
- January 19, 2023
- February 22, 2023
- June 22, 2023
- July 12, 2023
- October 12, 2023 (Second Open House)
- December 5, 2023 (Presentation to the Board of County Commissioners – Scheduled)

## 6.0 REFERENCES

FCDMC, 2018, Drainage Design Manual for Maricopa County, Arizona – Hydraulics. Flood Control District of Maricopa County.

FLO-2D Software, Inc., 2019, FLO-2D Data Input Manual, August 2019 – Build 19.

Jarrett, R. D., 1985. Determination of Roughness Coefficients for Streams in Colorado, USGS Water Resources Investigations Report 85-4004.

JE Fuller, Inc. (JE Fuller), 2019, Dayton Valley Area Drainage Master Plan Technical Study Data Notebook. Lyon and Storey Counties, Nevada.

\_\_\_\_\_, 2020, Sun Valley ADMPU Roughness Determination. Memorandum prepared for the Flood Control District of Maricopa County, dated April 30, 2020.

National Weather Service (NWS), 2018, NOAA Atlas 14 Precipitation Frequency Estimates, retrieved from [https://hdsc.nws.noaa.gov/hdsc/pfds/pfds\\_gis.html](https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_gis.html), on June 18, 2018.

Nevada Department of Transportation (NDOT), 2015, Streamlining Hydrologic Prediction Processes Using New and More Accurate Techniques and Methods, NDOT Research Report, Report No. 530-13-803.

Mussetter, R.A., P.F. Lagasse, and M.D. Harvey, 1994, Sediment and Erosion Design Guide. Albuquerque Metropolitan Arroyo Flood Control Authority.

US Geological Survey (USGS), 1997, Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States, Water-Supply Paper 2433.

Yochum, S.E., Comiti, F., Wohl, E., David, G.C.L., Mao, L. 2014. Photographic Guidance for Selecting Flow Resistance Coefficients in High-Gradient Channels. USDA, Forest Service, Rocky Mountain Research Station, General Technical Report, RMRS-GTR-323



STOREY COUNTY

# VIRGINIA CITY AND SIX MILE CANYON AREA DRAINAGE MASTER PLAN ALTERNATIVES CONCEPT DESIGN

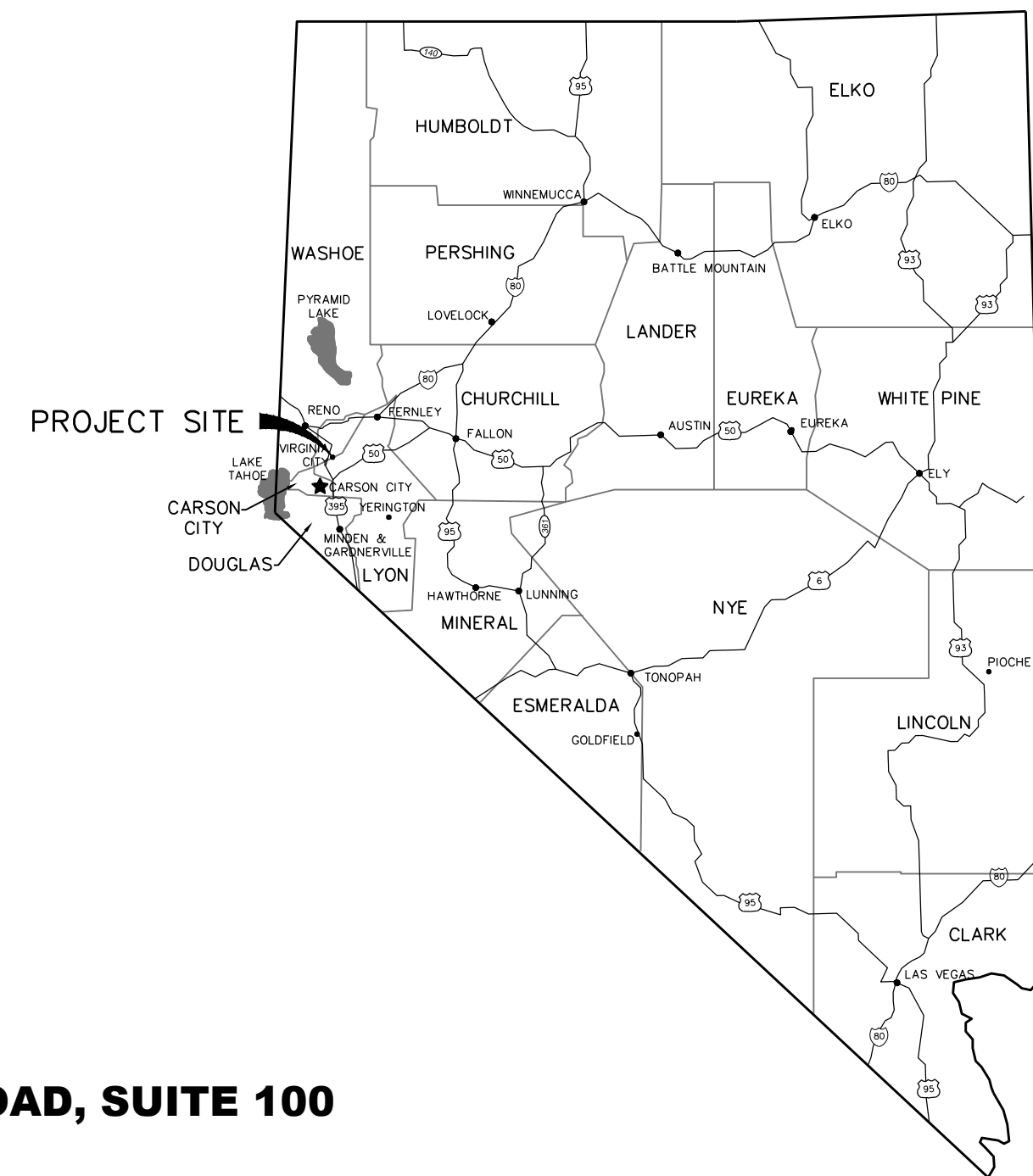


Know what's below.  
Call before you dig.

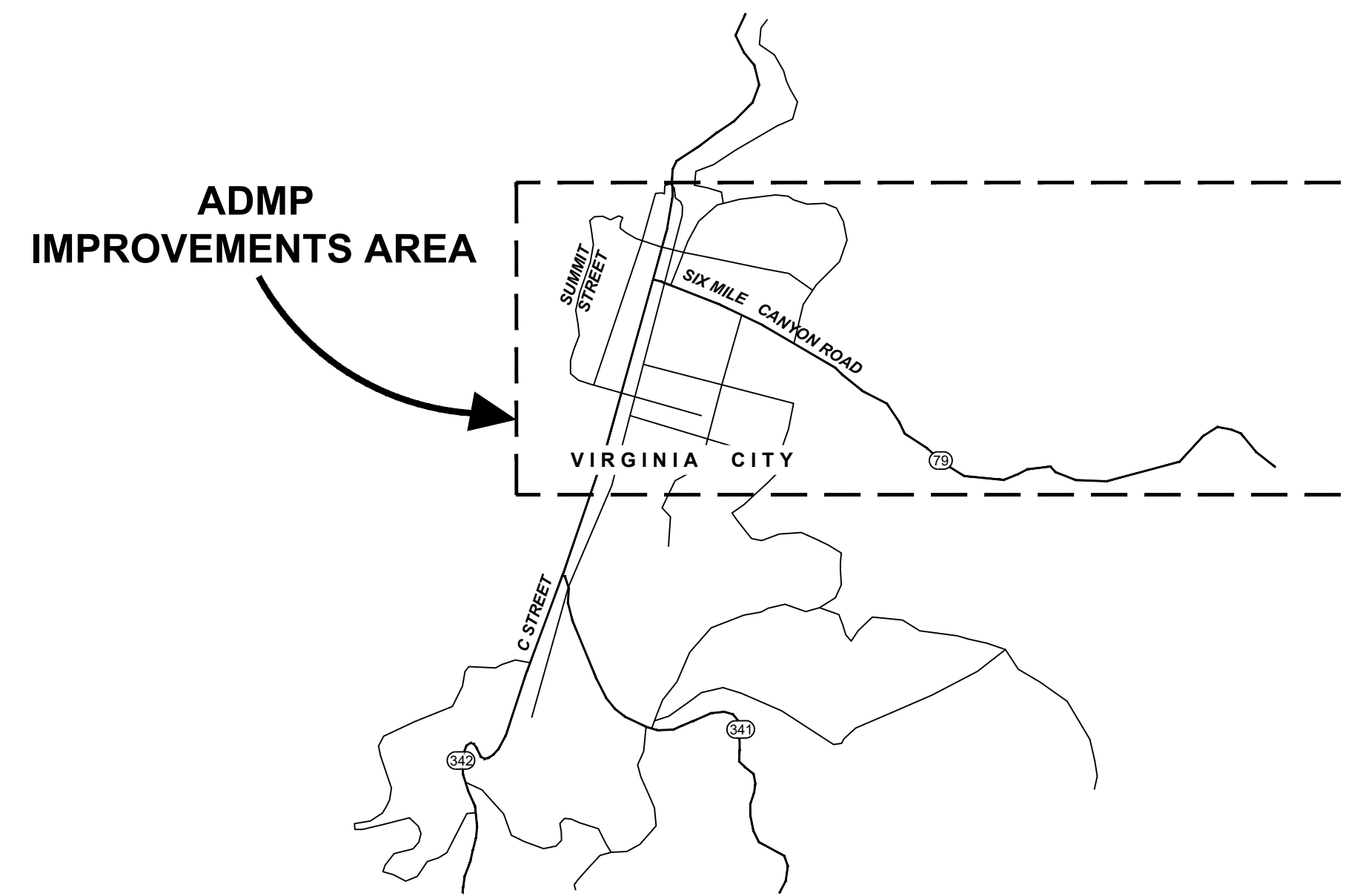


**ENGINEER**  
950 SANDHILL ROAD, SUITE 100  
RENO, NV 89521  
TEL: 775.827.6111  
INFO@LUMOSINC.COM

**OWNER**  
CARSON WATERSHED SUBCONSERVANCY DISTRICT  
ATTN: EDWIN JAMES  
777 E WILLIAM STREET, SUITE 110 A  
CARSON CITY, NV 89701  
TEL.: (775) 887-7450



**LOCATION MAP**



**VICINITY MAP**

**SHEET INDEX:**

SHEET NUMBER	SHEET TITLE
C1.0	TITLE SHEET
C1.1	NOTES SHEET
C1.2	ALTERNATIVES OVERVIEW
C1.3	ALTERNATIVE 1 OVERVIEW
C1.4	ALTERNATIVE 1A OVERVIEW
C1.5	ALTERNATIVE 2 OVERVIEW
C1.6	ALTERNATIVE 2A OVERVIEW
C1.7	SHEET INDEX
C2.0	SPANISH RAVINE SITE PLAN
C2.1	SPANISH BASIN GRADING
C2.2	SPANISH BASIN OUTLET
C3.0	OPHIR RAVINE SITE PLAN
C3.1	OPHIR BASIN GRADING
C3.2	OPHIR BASIN OUTLET
C4.0	DS OPHIR RAVINE BASIN AND OUTLET
C5.0	SPANISH DIVERSION CULVERT (ALT-2, P1)
C5.1	SPANISH DIVERSION CULVERT (ALT-2, P1)
C5.2	OPHIR DIVERSION CULVERT (ALT-2, P2)
C5.3	OPHIR DIVERSION CULVERT (ALT-2, P2)
C5.4	OPHIR DIVERSION CULVERT (ALT-2A)
C5.5	OPHIR DIVERSION CULVERT (ALT-2A)
C5.6	OPHIR DIVERSION CULVERT (ALT-2A)
D1.0	DETAILS
D1.1	DETAILS
D1.2	DETAILS
D1.3	DETAILS



950 SANDHILL ROAD, SUITE 100  
RENO, NV 89521  
TEL: 775.827.6111  
WWW.LUMOSINC.COM  
INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
ALTERNATIVES CONCEPT DESIGN  
TITLE SHEET**

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
NOT FOR CONSTRUCTION  
AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1  
IF NOT ONE INCH ON THIS SHEET,  
ADJUST SCALES ACCORDINGLY

**C1.1**  
DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: C1.1 OF 29

L:\MAPs\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - TITLE NOTES.dwg,C1.1 TITLE SHEET, 11/16/2023 12:41 pm mgroffey



PROJECTS 1-3 OVERVIEW



PROJECT 4 OVERVIEW



DRAINAGE PROJECTS OVERVIEW

- LEGEND:**
- PROJECT 1
  - PROJECT 2
  - PROJECT 2A
  - PROJECT 2B
  - PROJECT 3
  - PROJECT 4

**PROJECT 1 - ORB/SRB:**  
THIS ALTERNATIVE CREATES DETENTION/SEDIMENTATION PONDS IN SPANISH AND OPHIR RAVINES. THESE PONDS WILL HAVE OUTLET STRUCTURES AND PIPES, COUPLED WITH EMERGENCY OVERFLOW WEIRS.

**PROJECT 2A - OTCC/STOC:**  
THIS PROJECT UTILIZES THE BASINS FROM PROJECT 1, BUT CAPTURES FLOWS IN A PIPE NETWORK THAT DISCHARGE TO CEDAR RAVINE SOUTH OF HIGHWAY 341.

**PROJECT 2B - OTSC:**  
THIS ALTERNATIVE UTILIZES THE PIPES AND BASINS PROPOSED IN PROJECT 1, BUT REPLACES THE DOWNSTREAM SECTION OF PIPE (PART 2A), REDIRECTING WATER TO THE NORTH EASTERN PORTIONS OF 6 MILE CANYON, STILL REDIRECTING FLOWS FROM VIRGINIA CITY PROPER.

**PROJECT 3 - OEP:**  
THIS PROJECT CAN BE A STANDALONE IMPROVEMENT, OR COUPLED WITH OTHER PROJECTS. THE BASIN IS PROPOSED TO BE IMPROVED TO DETAIN SMALLER STORM EVENTS.

**PROJECT 4:**  
THIS PROJECT CONSISTS OF IMPROVING CULVERTS ALONG SIX MILE CANYON.



950 SANDHILL ROAD, SUITE 100  
RENO, NV 89521  
TEL: 775.827.6111  
WWW.LUMOSINC.COM  
INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
ALTERNATIVES CONCEPT DESIGN  
PROJECTS OVERVIEW**

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
NOT FOR CONSTRUCTION  
AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C1.2**

DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: C1.2 OF 29

L:\A\Proj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - TITLE NOTES.dwg,C1.2 PROJECTS OVERVIEW, 11/16/2023 12:41 pm mrdrailey

L:\AProj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - TITLE NOTES.dwg,C1.3 PROJECT 1 OVERVIEW, 11/16/2023 12:41 pm mrdofley



- LEGEND:**
- PROJECT 1
  - PROJECT 2
  - PROJECT 2A
  - PROJECT 2B
  - PROJECT 3
  - PROJECT 4

**PROJECT 1 - ORB/SRB:**  
 THIS ALTERNATIVE CREATES DETENTION/SEDIMENTATION PONDS IN SPANISH AND OPHIR RAVINES. THESE PONDS WILL HAVE OUTLET STRUCTURES AND PIPES, COUPLED WITH EMERGENCY OVERFLOW WEIRS.



950 SANDHILL ROAD, SUITE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
 VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 PROJECT 1 OVERVIEW**

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION  
 AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C1.3**

DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C1.3 OF 29

L:\A\Proj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - TILE NOTES.dwg,C1.4 PROJECT 2A OVERVIEW, 11/16/2023 12:41 pm mrdofley



- LEGEND:**
- PROJECT 1
  - PROJECT 2
  - PROJECT 2A
  - PROJECT 2B
  - PROJECT 3
  - PROJECT 4

**PROJECT 2A - OTCC/STOC:**  
 THIS PROJECT UTILIZES THE BASINS FROM PROJECT 1, BUT CAPTURES FLOWS IN A PIPE NETWORK THAT DISCHARGE TO CEDAR RAVINE SOUTH OF HIGHWAY 341.



950 SANDHILL ROAD, SUITE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
 VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 PROJECT 2A OVERVIEW**

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION  
 AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C1.4**

DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C1.4 OF 29

L:\MapProj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - TILE NOTES.dwg,C1.5 PROJECT 2B OVERVIEW, 11/16/2023 12:41 pm mrdofley



- LEGEND:**
- PROJECT 1
  - PROJECT 2
  - PROJECT 2A
  - PROJECT 2B
  - PROJECT 3

**PROJECT 2B - OTSC:**  
 THIS ALTERNATIVE UTILIZES THE PIPES AND BASINS PROPOSED IN PROJECT 1, BUT REPLACES THE DOWNSTREAM SECTION OF PIPE (PART 2A), REDIRECTING WATER TO THE NORTH EASTERN PORTIONS OF 6 MILE CANYON, STILL REDIRECTING FLOWS FROM VIRGINIA CITY PROPER.



950 SANDHILL ROAD, SUITE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
 VIRGINIA CITY STOREY COUNTY

**VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 ALTERNATIVE 2B OVERVIEW**

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION  
 AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C1.5**

DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C1.5 OF 29

L:\MAPROJ\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - TITLE NOTES.dwg,C1.6 PROJECT 3 OVERVIEW, 11/16/2023 12:41 pm mrd@lumo.com



- LEGEND:**
- PROJECT 1
  - PROJECT 2
  - PROJECT 2A
  - PROJECT 2B
  - PROJECT 3
  - PROJECT 4

**PROJECT 3 - OEP:**  
 THIS PROJECT CAN BE A STANDALONE IMPROVEMENT, OR COUPLED WITH OTHER PROJECTS. THE BASIN IS PROPOSED TO BE IMPROVED TO DETAIN SMALLER STORM EVENTS.



950 SANDHILL ROAD, SUITE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
 VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 PROJECT STOC OVERVIEW**

REV.	DATE	DESCRIPTION	BY

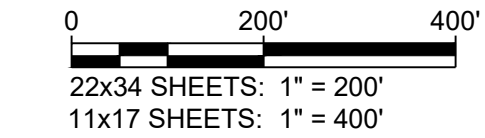
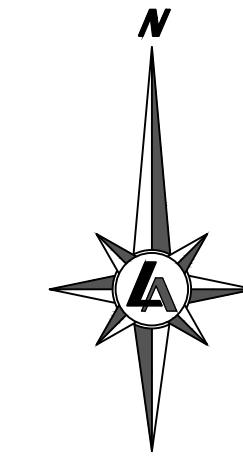
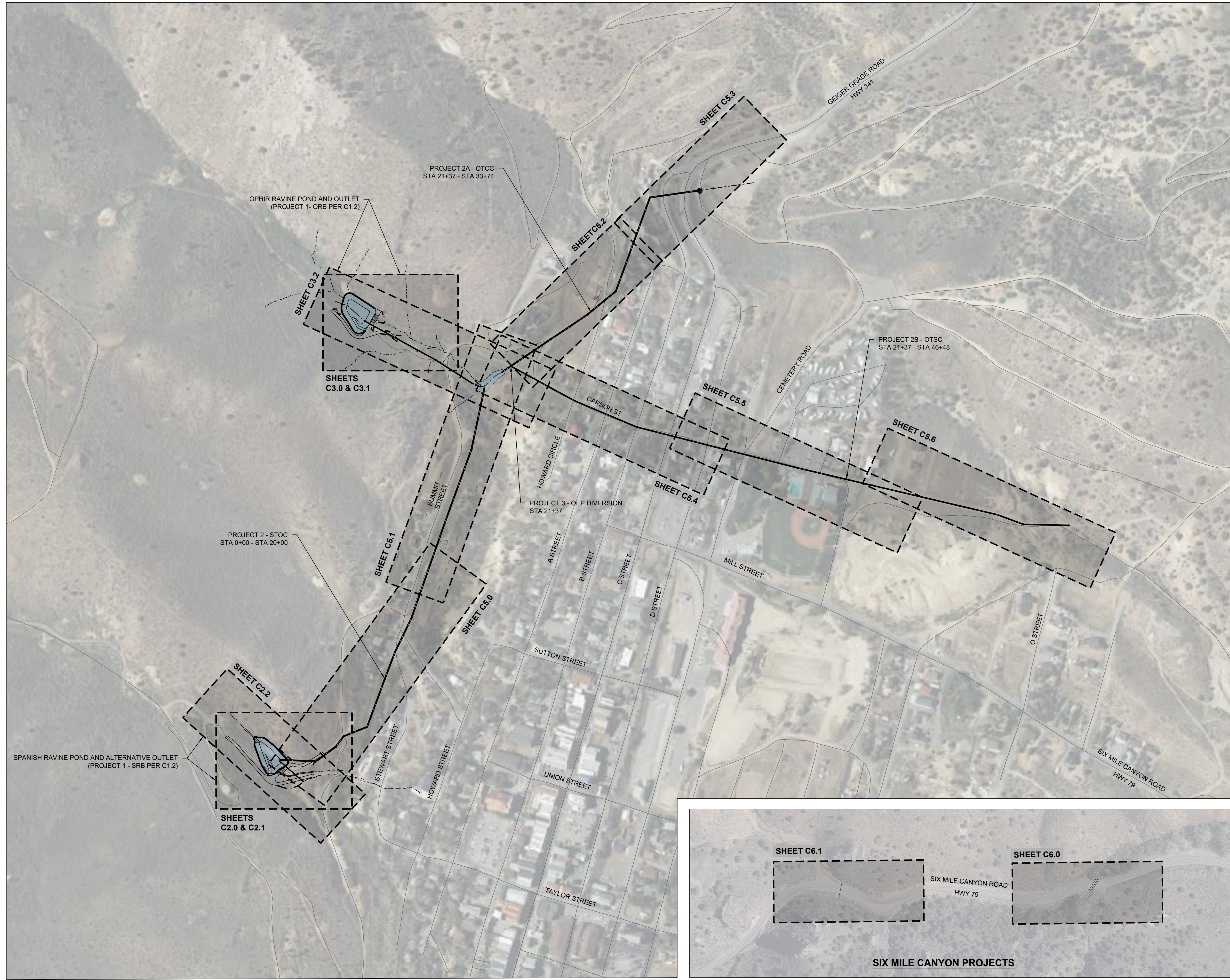
**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION  
 AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C1.6**

DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C1.6 OF 29

L:\A\Proj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - PLAN AND PROFILE.dwg,C1.7 SHEET INDEX, 11/16/2023 12:42 pm mgodfrey



NOTES:  
1. FOR AN OVERVIEW MAP REFERENCE SHEET C1.2.

**LUMOS & ASSOCIATES**  
950 SANDHILL ROAD, STE 100  
RENO, NV 89521  
TEL: 775.827.6111  
WWW.LUMOSINC.COM  
INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

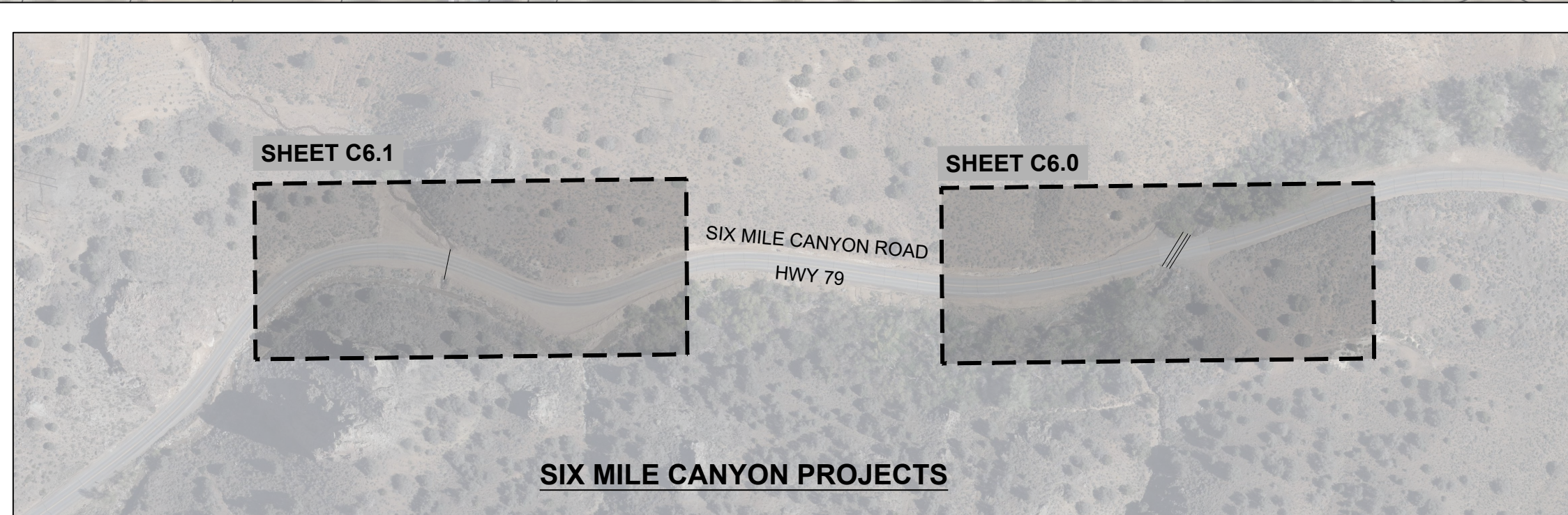
STOREY COUNTY NEVADA  
VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
ALTERNATIVES CONCEPT DESIGN  
SHEET INDEX**

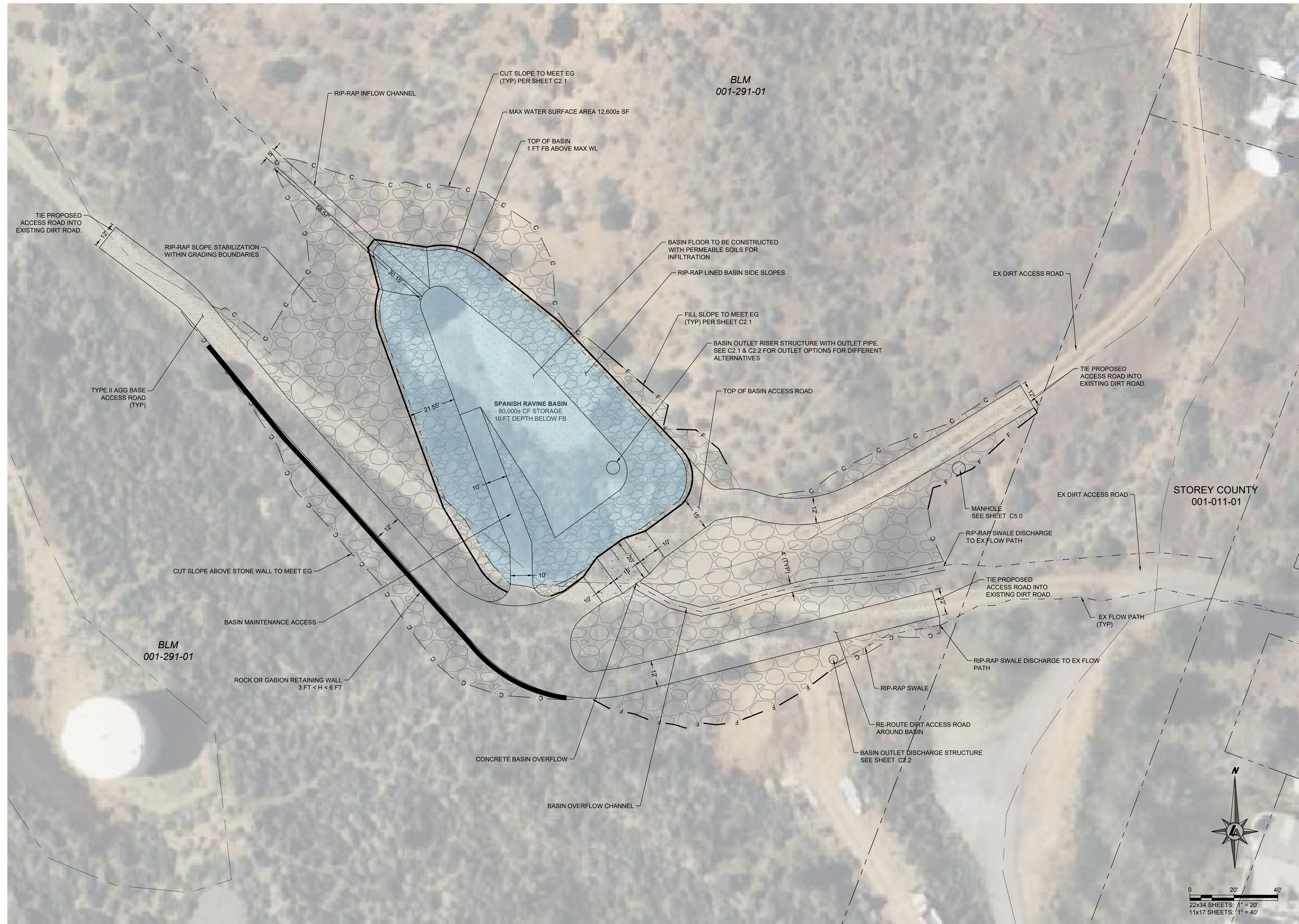
REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
NOT FOR CONSTRUCTION**  
AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1  
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C1.7**  
DRAWN BY: CE/KM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: C1.7 OF 29





STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 SPANISH RAVINE SITE PLAN**  
 STOREY COUNTY  
 VIRGINIA CITY  
 NEVADA

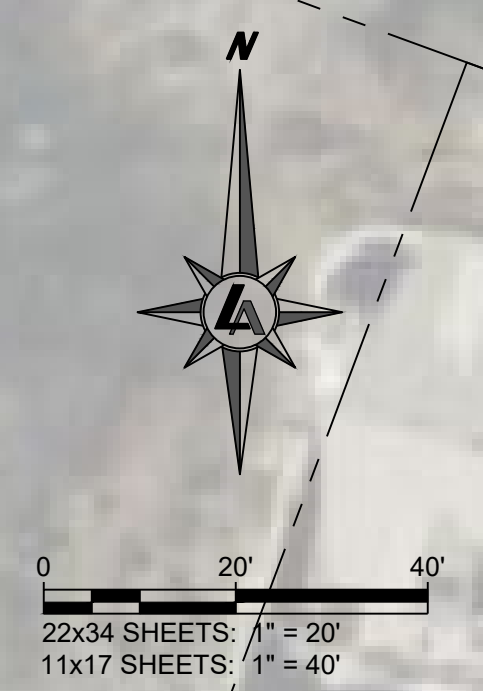
BY

REV.	DATE	DESCRIPTION

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION**  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C2.0**  
 DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C2.0 OF 29



L:\MAPROJ\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C2.0 SPANISH RAVINE SITE PLAN, 11/16/2023 12:42 pm mgodfrey

L:\AProj\10679.000 - Virginia City 6 Mi Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C2.1 SPANISH BASIN GRADING, 11/16/2023 12:42 pm mmodesty



950 SANDHILL ROAD, STE 100  
RENO, NV 89521  
TEL: 775.827.6111  
WWW.LUMOSINC.COM  
INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
VIRGINIA CITY STOREY COUNTY

## VIRGINIA CITY & SIX MILE CANYON ADMP ALTERNATIVES CONCEPT DESIGN SPANISH BASIN GRADING

REV.	DATE	DESCRIPTION

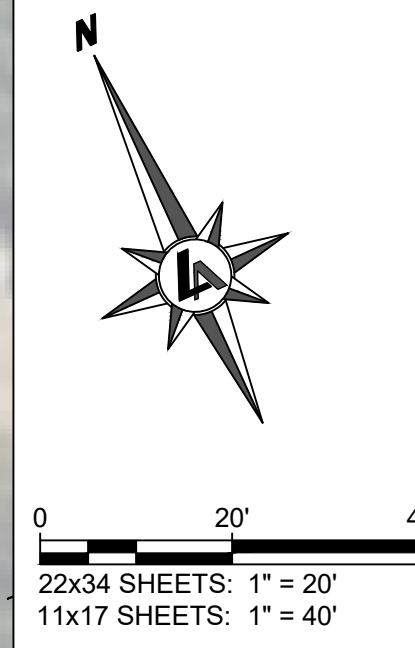
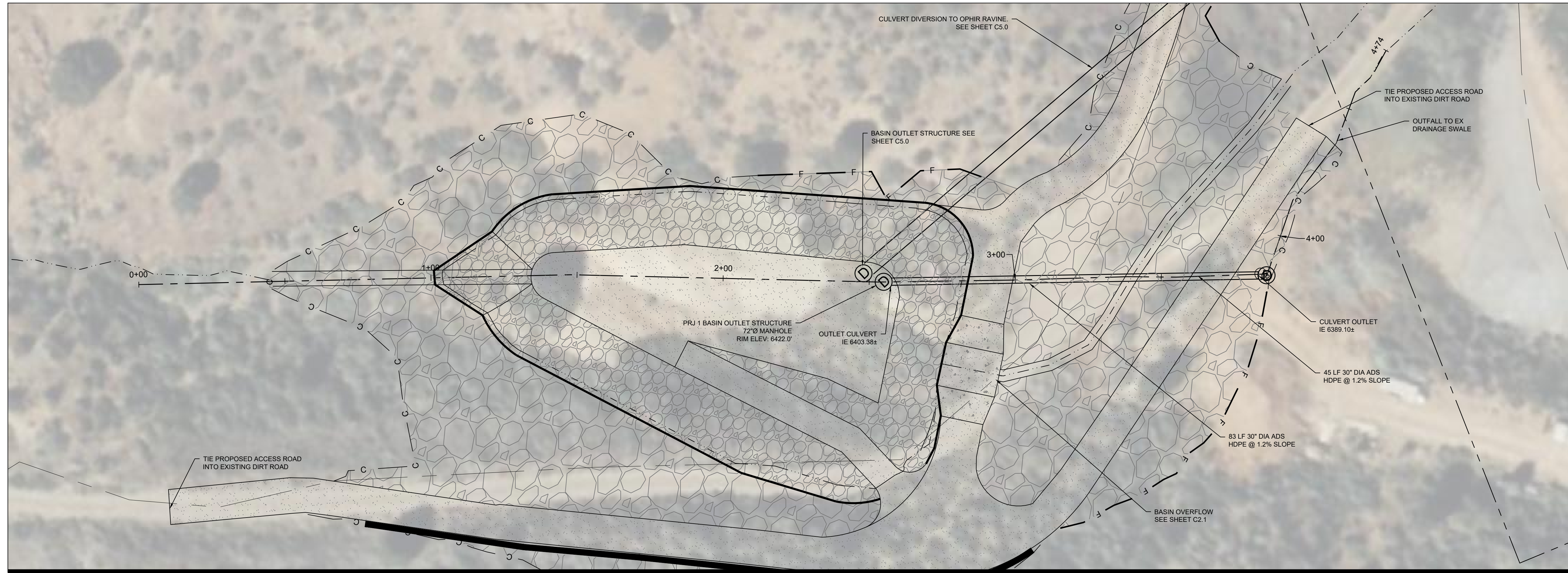
**PRELIMINARY - 15%**  
**NOT FOR CONSTRUCTION**  
AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1  
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

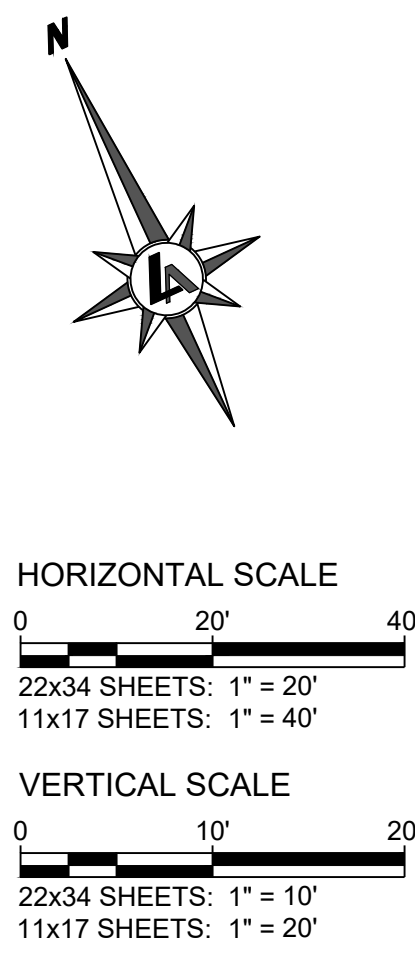
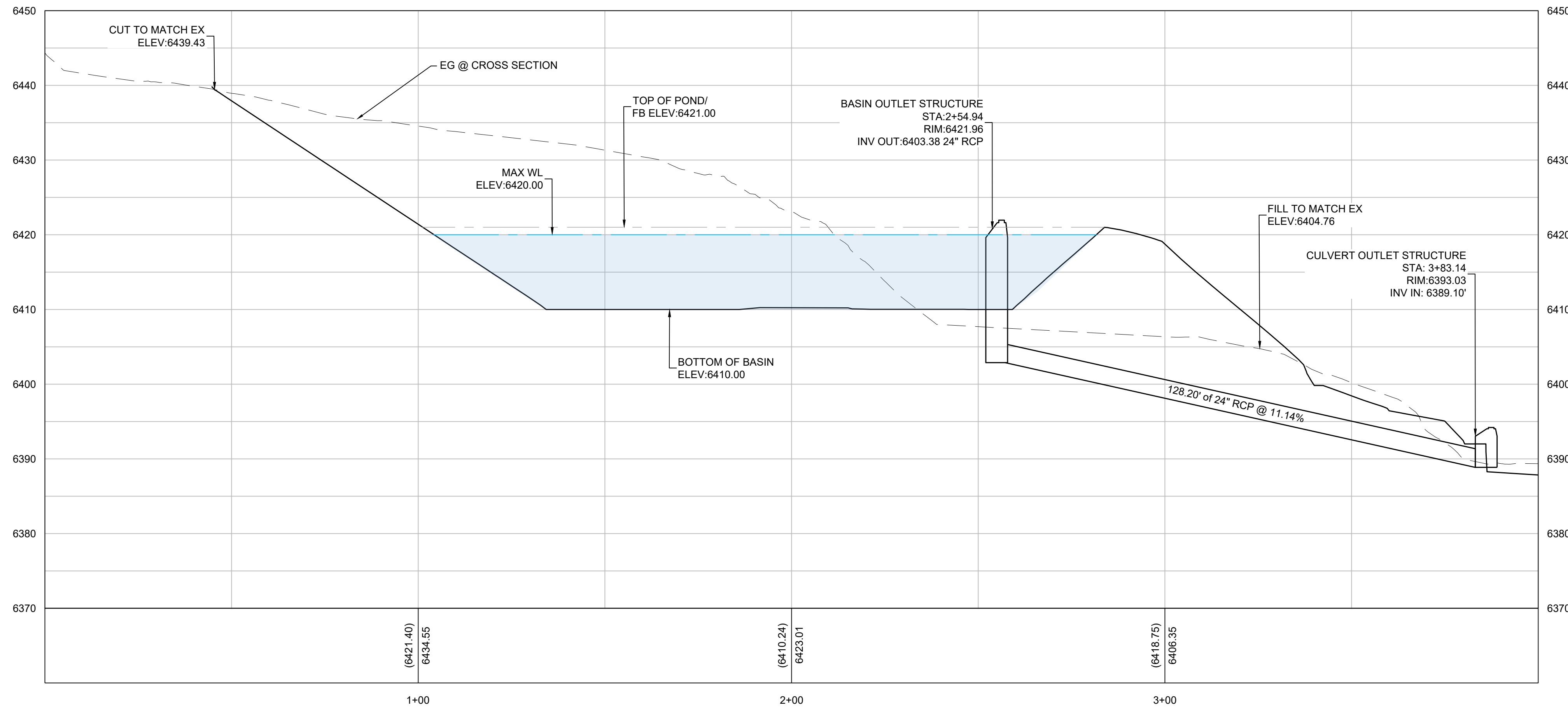
**C2.1**

DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: C2.1 OF 29





SRB OUTLET - STA:0+00 TO STA:4+00



**LUMOS & ASSOCIATES**  
 950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 SPANISH BASIN OUTLET  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

BY: \_\_\_\_\_

REV.	DATE	DESCRIPTION

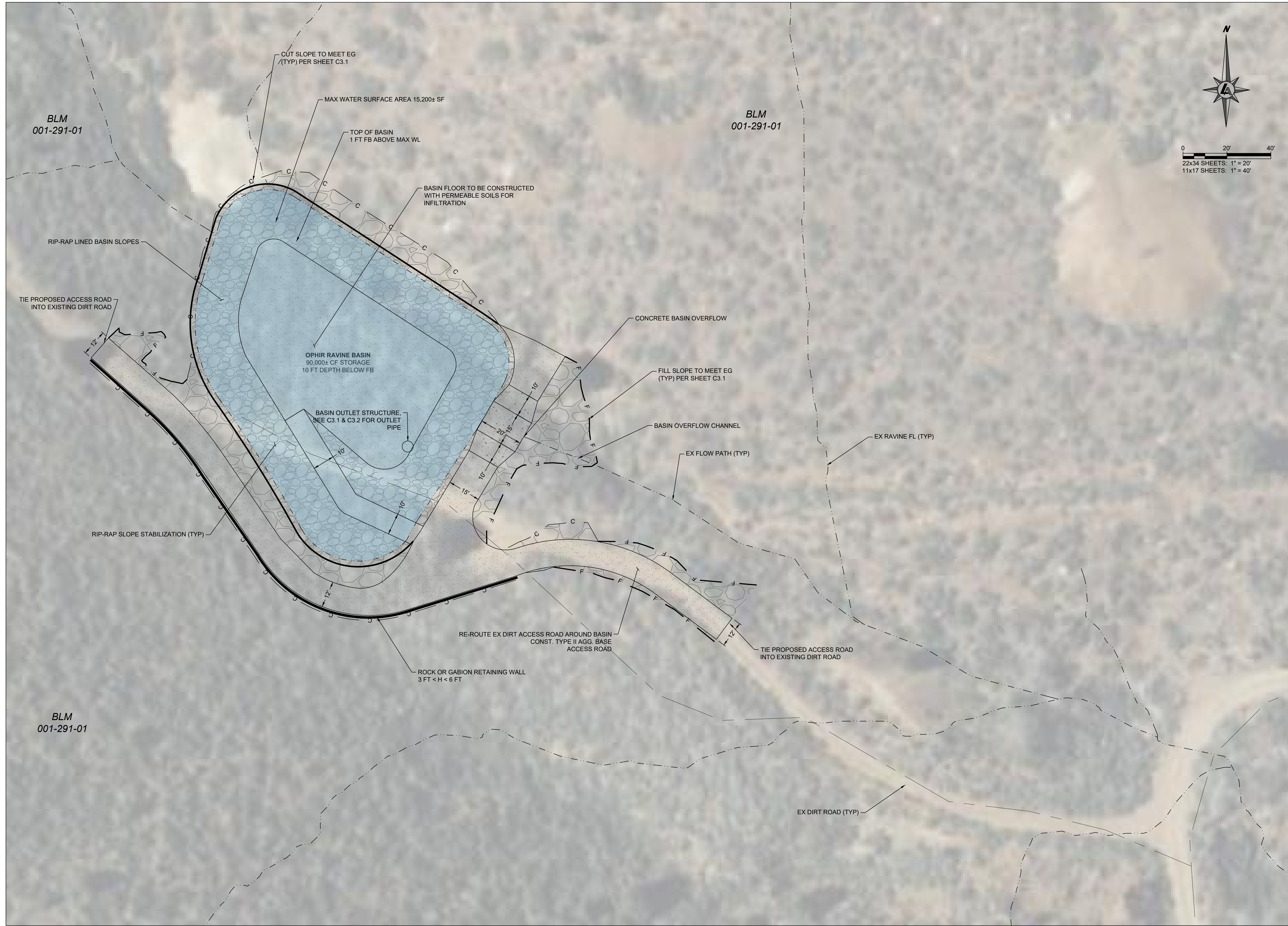
**PRELIMINARY - 15%  
NOT FOR CONSTRUCTION**  
AUGUST 2023

C2.2

DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C2.2 OF 29

L:\MAProgs\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C2.2 SPANISH BASIN OUTLET, 11/16/2023 12:42 pm mmodrifey

L:\AProj\10679.000 - Virginia City 6 Mi Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C3.0 OPHIR RAVINE SITE PLAN, 11/16/2023 12:42 pm mgodfrey



**LUMOS & ASSOCIATES**  
 950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
**VIRGINIA CITY & SIX MILE CANYON ADMP ALTERNATIVES CONCEPT DESIGN**  
**OPHIR RAVINE SITE PLAN**  
 VIRGINIA CITY STOREY COUNTY

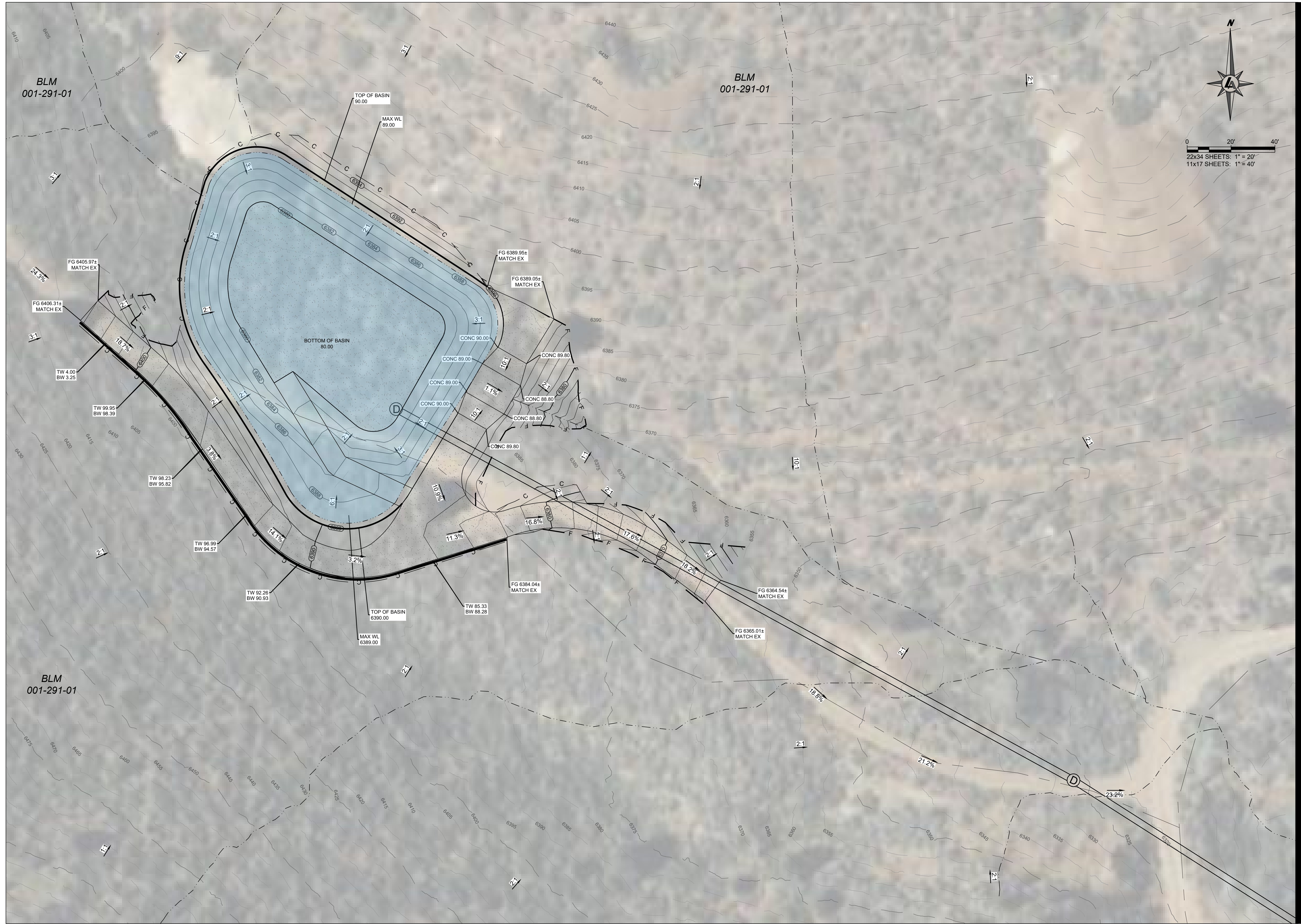
REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION**  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C3.0**  
 DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C3.0 OF 29

L:\AProj\10679.000 - Virginia City 6 Mi Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C3.1 OPHIR BASIN GRADING, 11/16/2023 12:42 pm mmodesty



22x34 SHEETS: 1" = 20'  
11x17 SHEETS: 1" = 40'



950 SANDHILL ROAD, STE 100  
RENO, NV 89521  
TEL: 775.827.6111  
WWW.LUMOSINC.COM  
INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY NEVADA  
VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
ALTERNATIVES CONCEPT DESIGN  
OPHIR BASIN GRADING**

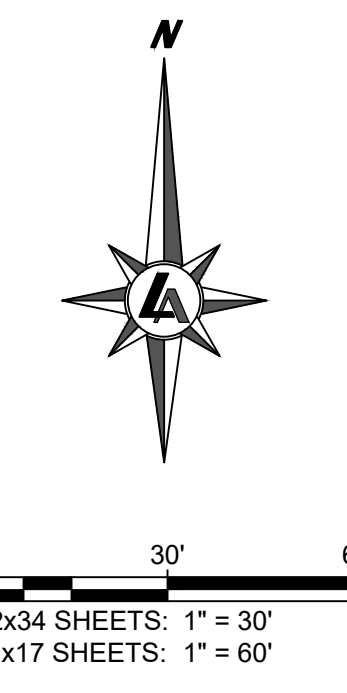
REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
NOT FOR CONSTRUCTION**  
AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1  
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C3.1**

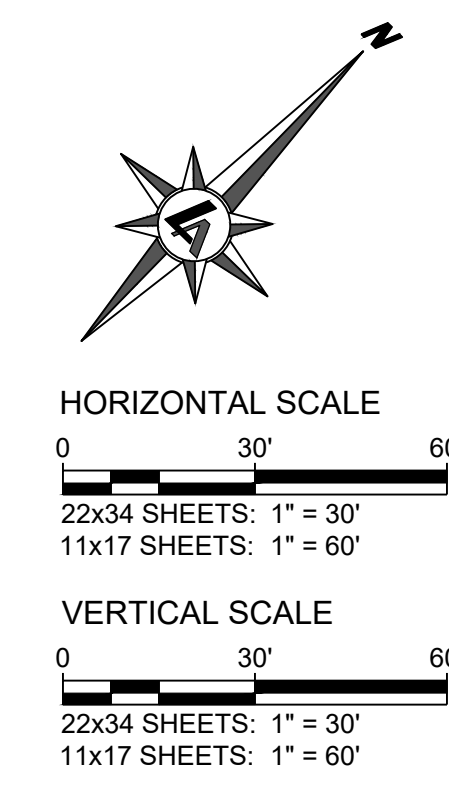
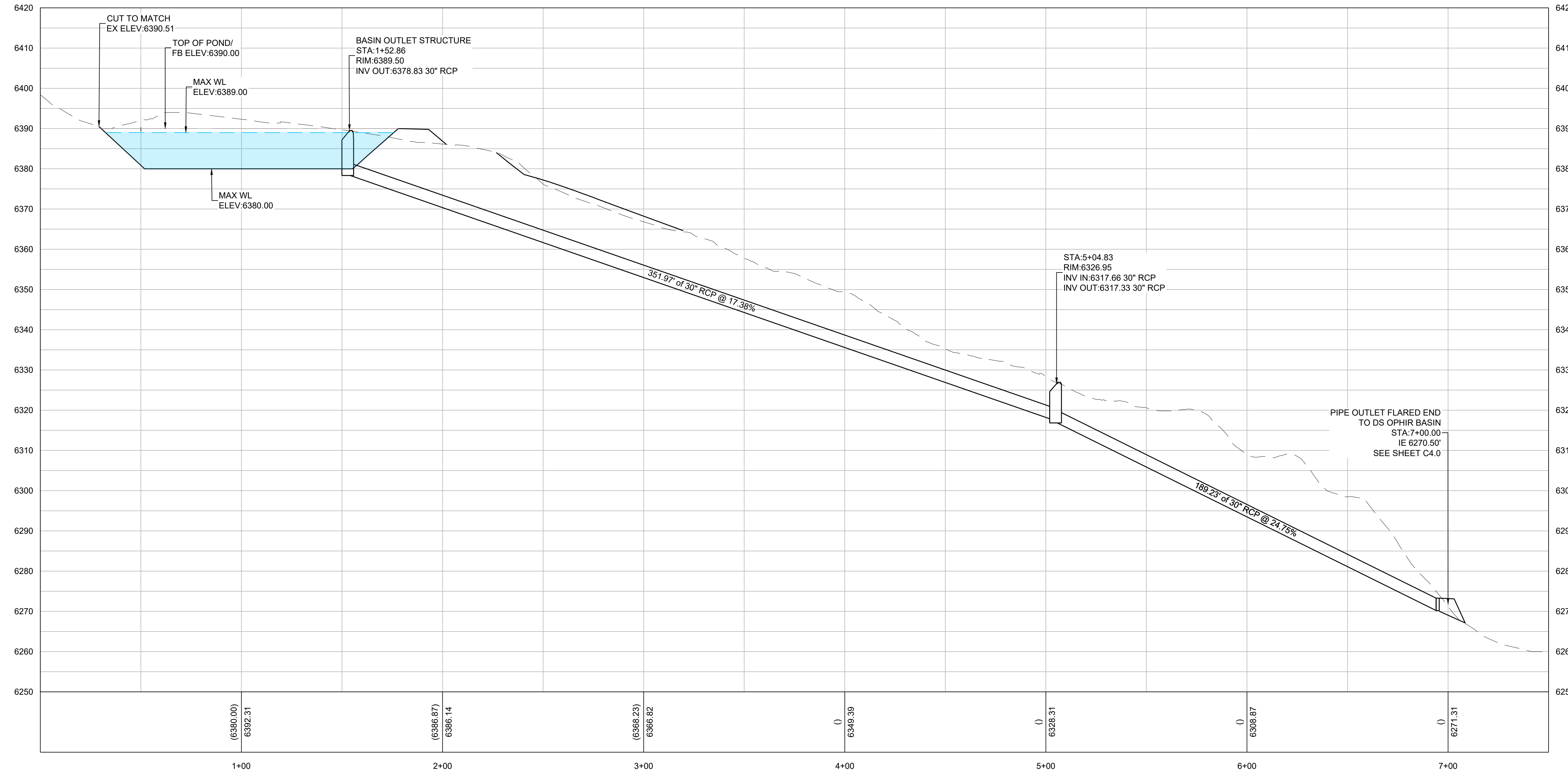
DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: C3.1 OF 29



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

ORB OUTLET - STA:0+00 TO STA:7+50



STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 OPHIR BASIN OUTLET  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV	DATE	DESCRIPTION

**PRELIMINARY - 15%**  
 NOT FOR CONSTRUCTION  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C3.2**  
 DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C3.2 OF 29

L:\A\Proj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C3.2 OPHIR BASIN, OUTLET, 11/16/2023 12:42 pm mgodfrey

L:\AProj\10679.000 - Virginia City 6 Mi Canyon Area Drainage\DWG\Sheets\10679.000 - DETENTION BASINS.dwg,C4.0 DS OPHIR RAVINE SITE PLAN, 11/16/2023 12:42 pm mgodfrey



0 20' 40'  
 22x34 SHEETS: 1" = 20'  
 11x17 SHEETS: 1" = 40'



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 DS OPHIR RAVINE BASIN AND OUTLET  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

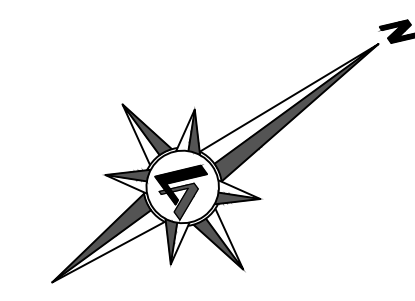
REV	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%**  
 NOT FOR CONSTRUCTION  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C4.0**

DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C4.0 OF 29



HORIZONTAL SCALE  
 0 40' 80'  
 22x34 SHEETS: 1" = 40'  
 11x17 SHEETS: 1" = 80'

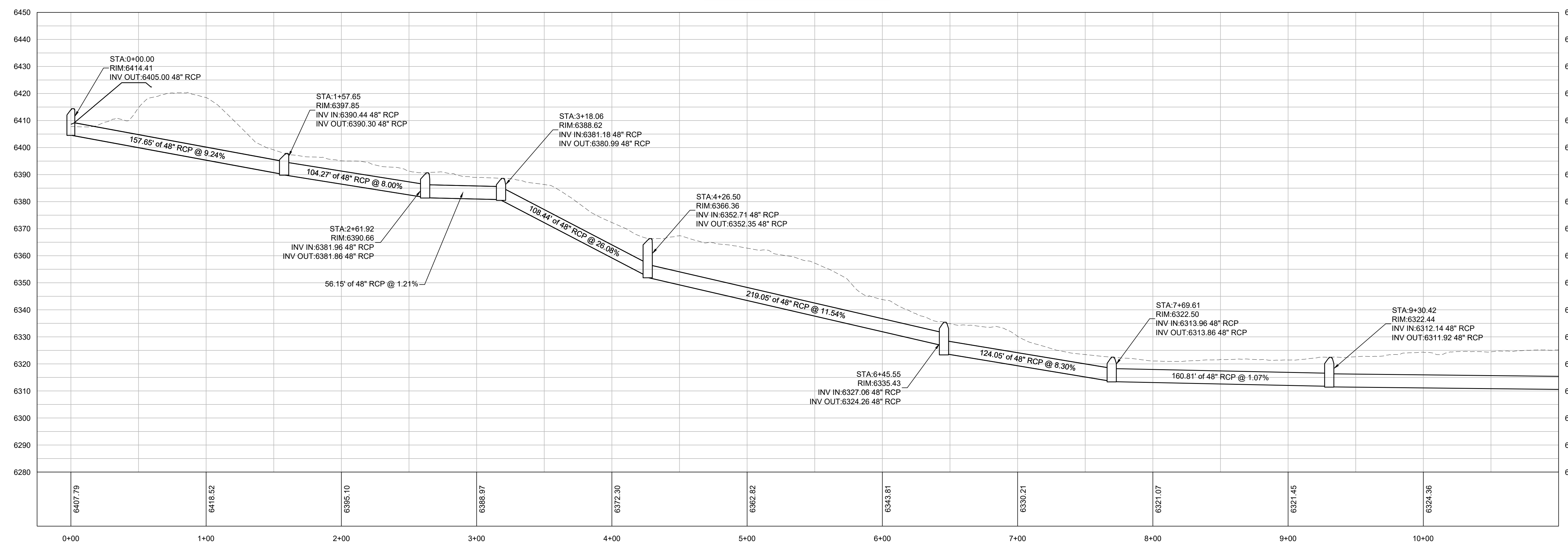
VERTICAL SCALE  
 0 20' 40'  
 22x34 SHEETS: 1" = 20'  
 11x17 SHEETS: 1" = 40'



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOC - STA:-0+25 TO STA:11+00



STORY COUNTY

VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 SPANISH DIVERSION CULVERT (ALT-2, P1)

NEVADA

STORY COUNTY

VIRGINIA CITY

REV	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION**  
 AUGUST 2023

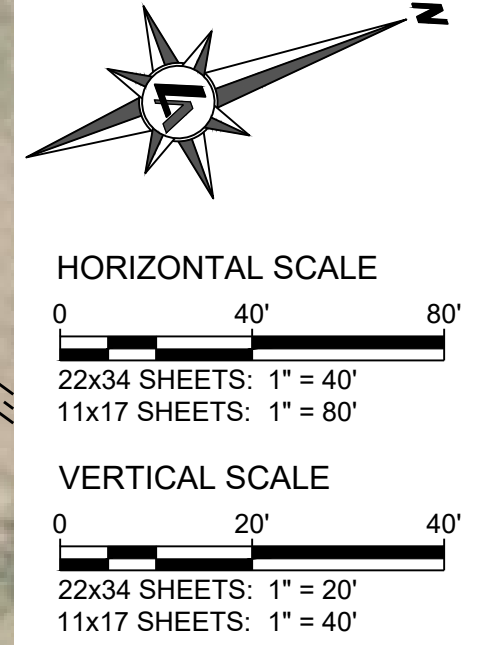
BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1

IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C5.0**

DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.0 OF 29

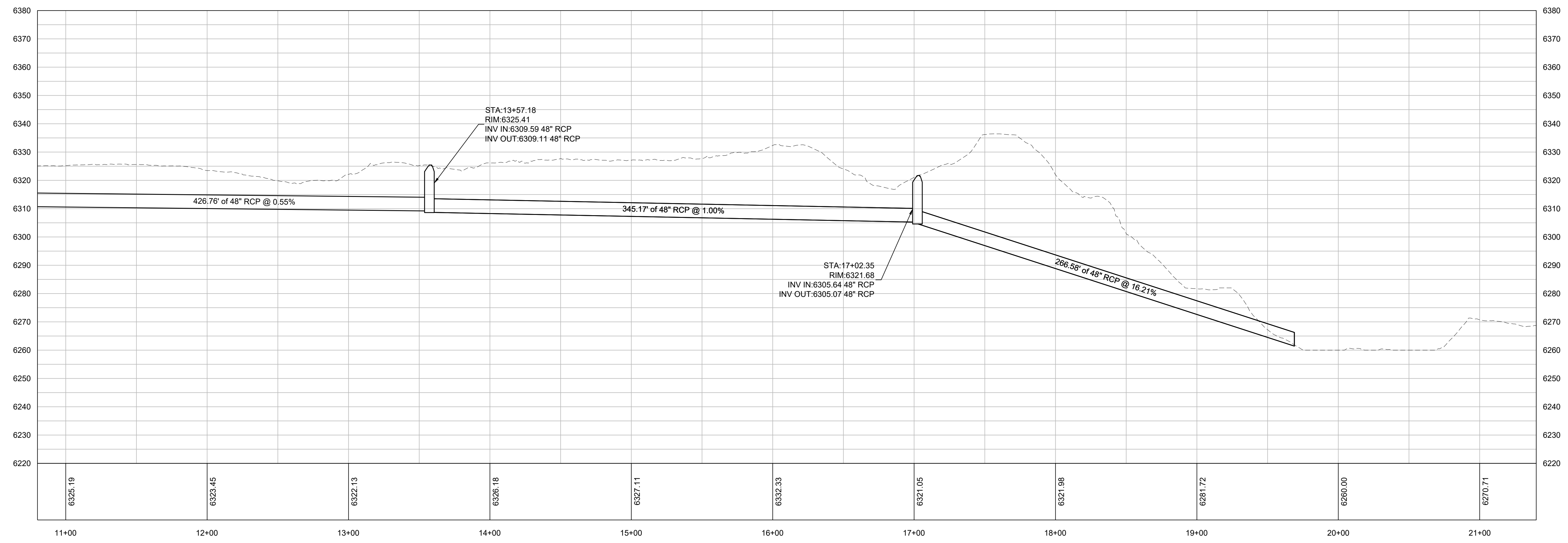
L:\A\Proj\10679.000 - Virginia City 6 Mi Canyon Area Drainage\DWG\Sheets\10679.000 - PLAN AND PROFILE.dwg,C5.0 SPANISH DIVERSION CULVERT (P1-2),  
 11/16/2023 12:43 pm mgodfrey



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOC - STA:10+80 TO STA:21+40



STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 SPANISH DIVERSION CULVERT (ALT-2, P1)  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION  
 AUGUST 2023**

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C5.1**  
 DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.1 OF 29

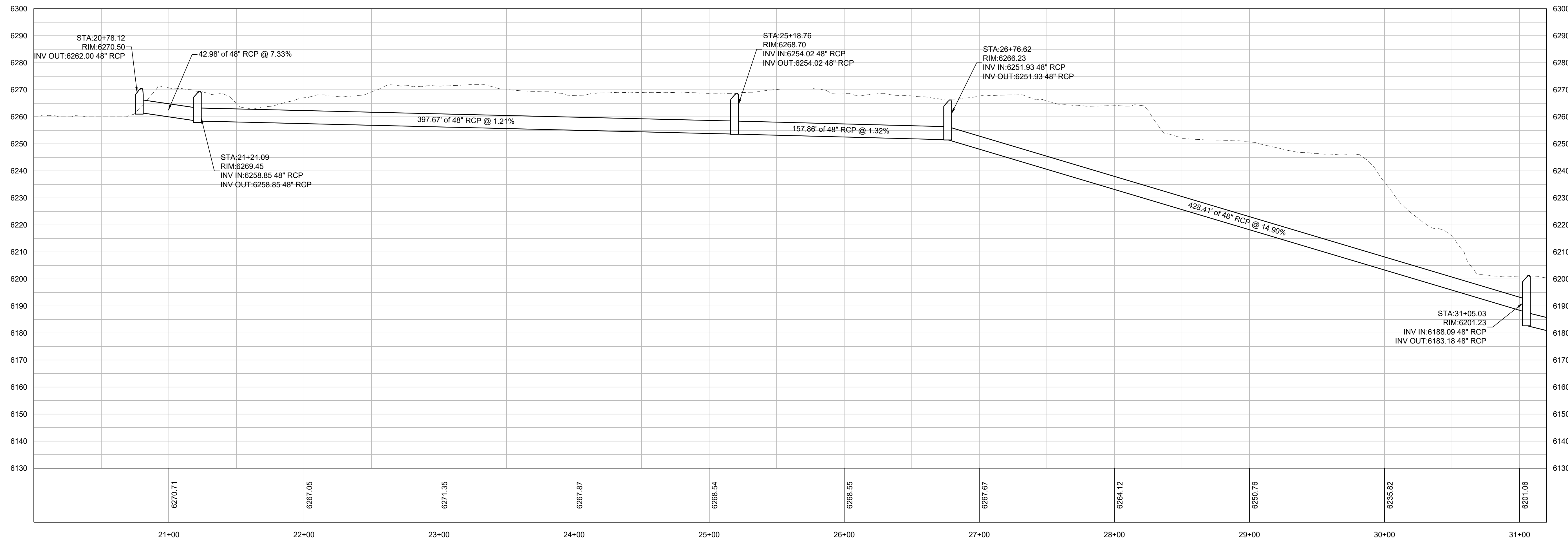
L:\A\Proj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - PLAN AND PROFILE.dwg,C5.1 SPANISH DIVERSION CULVERT (PRJ 2), 11/16/2023 12:43 pm mmodley



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

OTCC - 1 - STA:20+00 TO STA:31+20



STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 OPHIR DIVERSION CULVERT (ALT-2, P2)  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV	DATE	DESCRIPTION

BY: \_\_\_\_\_

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION**  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C5.2**

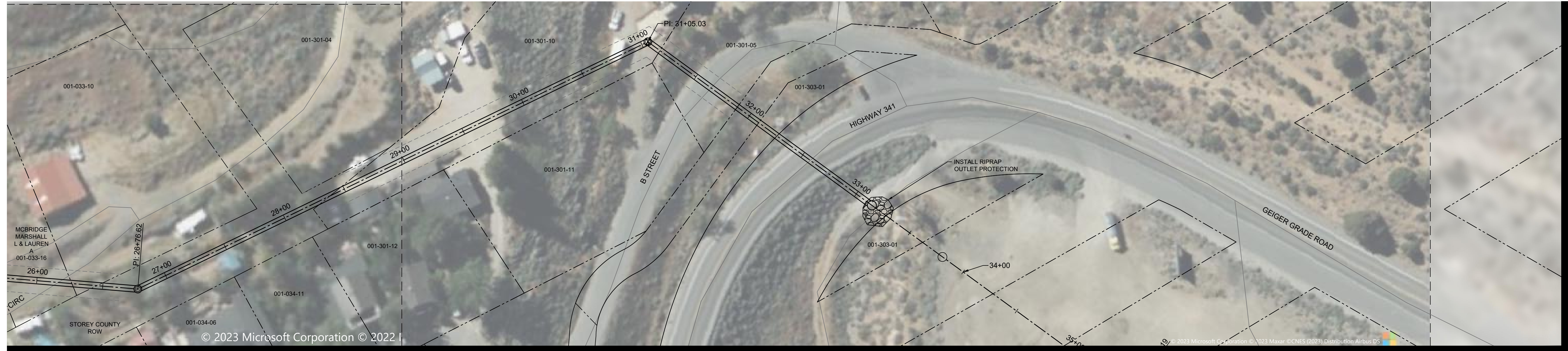
DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.2 OF 29

HORIZONTAL SCALE  
 0 40' 80'

22x34 SHEETS: 1" = 40'  
 11x17 SHEETS: 1" = 80'

VERTICAL SCALE  
 0 20' 40'

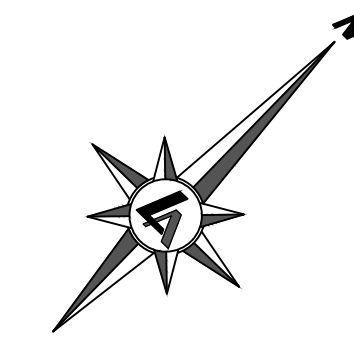
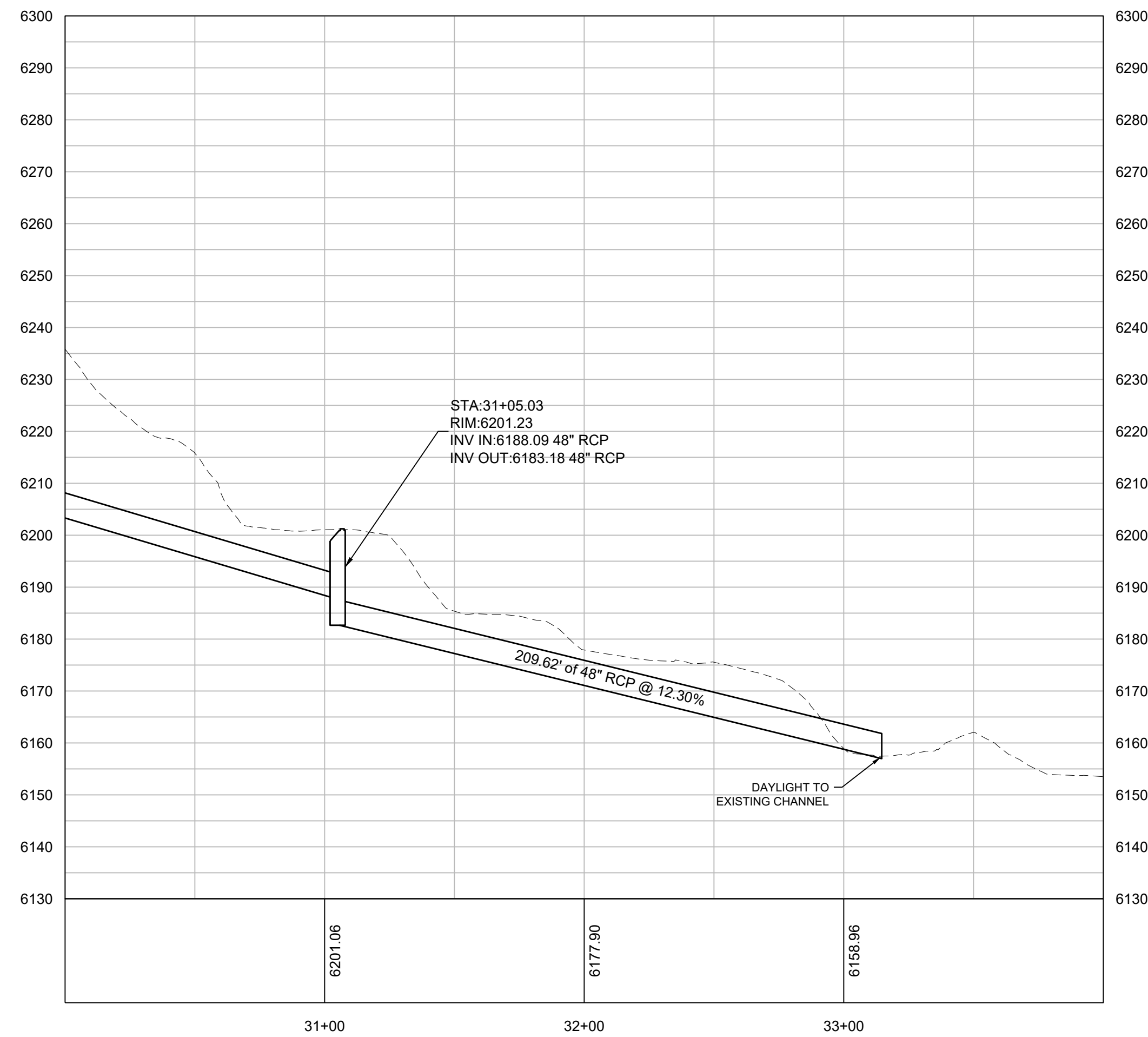
22x34 SHEETS: 1" = 20'  
 11x17 SHEETS: 1" = 40'



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

OTCC - 2 - STA:30+00 TO STA:34+00



HORIZONTAL SCALE  
 0 40' 80'  
 22x34 SHEETS: 1" = 40'  
 11x17 SHEETS: 1" = 80'

VERTICAL SCALE  
 0 20' 40'  
 22x34 SHEETS: 1" = 20'  
 11x17 SHEETS: 1" = 40'

STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 OPHIR DIVERSION CULVERT (ALT-2, P2)  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%**  
**NOT FOR CONSTRUCTION**  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C5.3**

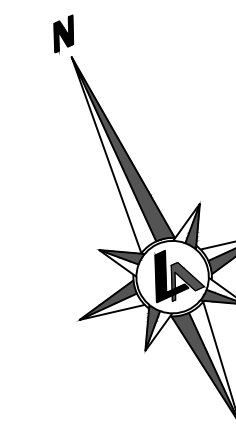
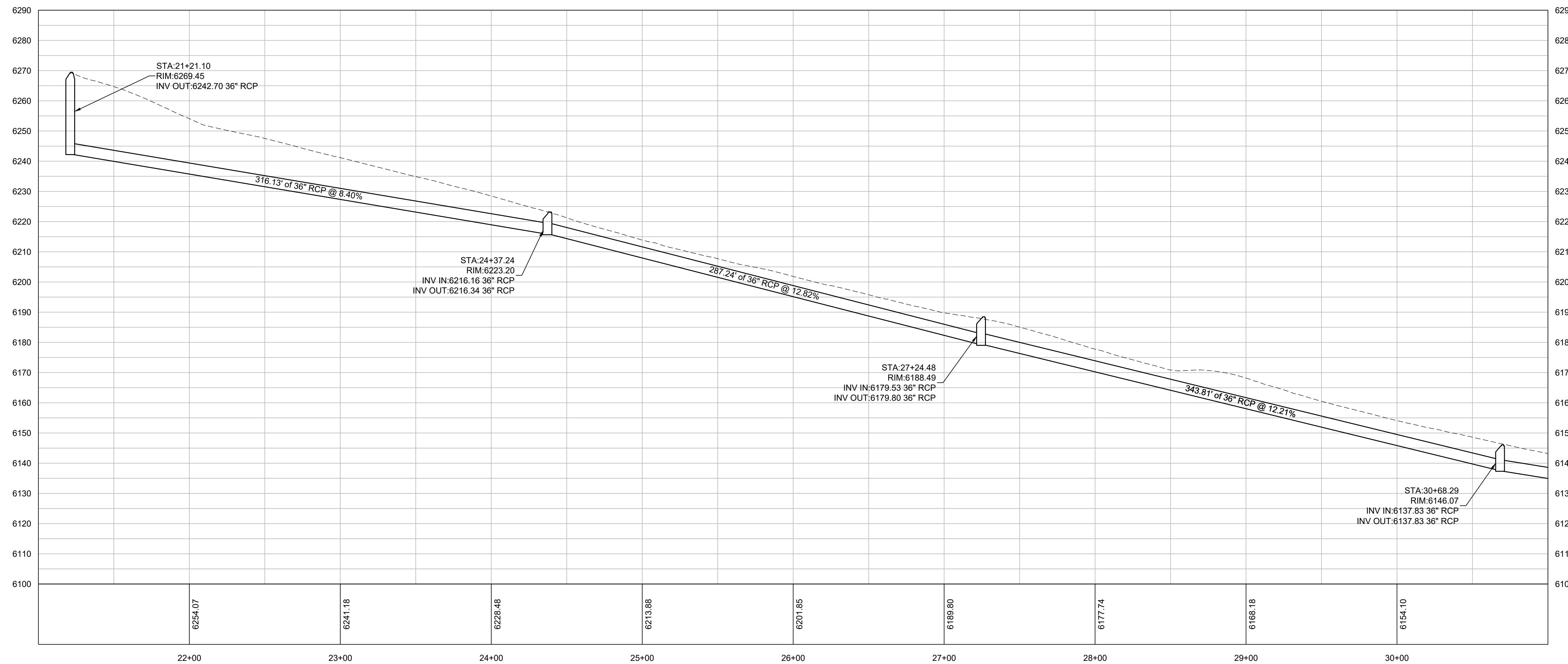
DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.3 OF 29



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

OTSC - STA:21+00 TO STA:31+00



HORIZONTAL SCALE  
 0 40' 80'  
 22x34 SHEETS: 1" = 40'  
 11x17 SHEETS: 1" = 80'

VERTICAL SCALE  
 0 20' 40'  
 22x34 SHEETS: 1" = 20'  
 11x17 SHEETS: 1" = 40'

STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 OPHIR DIVERSION CULVERT (ALT-2A)  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV.	DATE	DESCRIPTION

**PRELIMINARY - 15%**  
 NOT FOR CONSTRUCTION  
 AUGUST 2023

**C5.4**

DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.4 OF 29

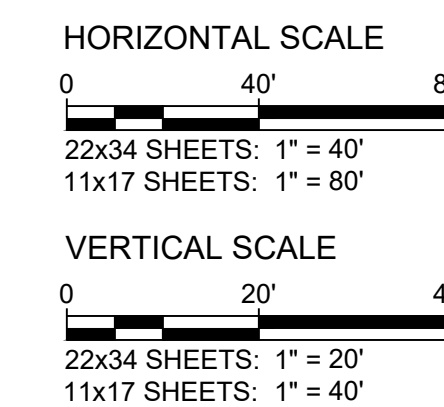
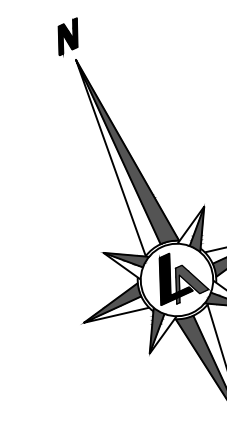
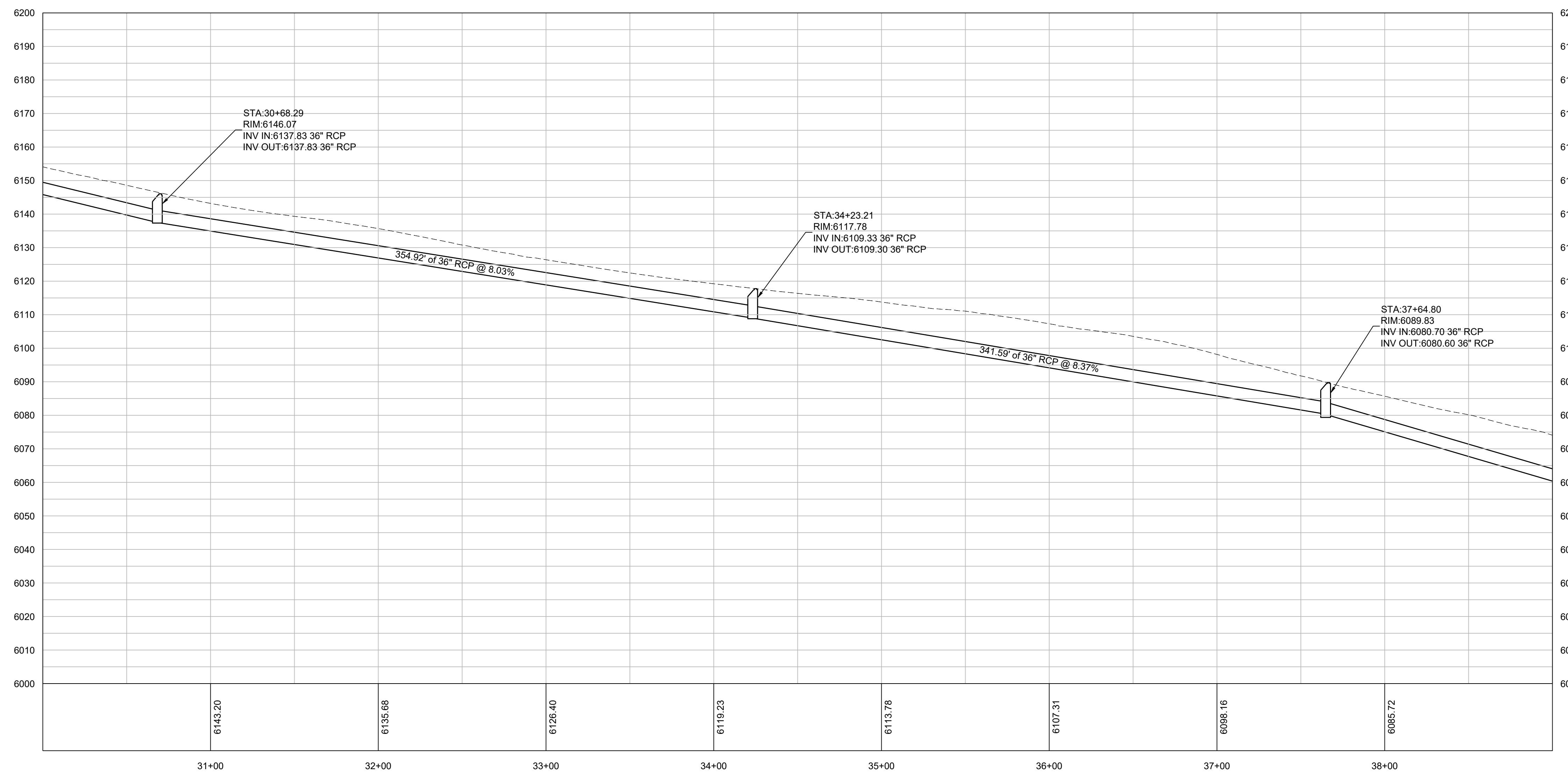


950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

© 2023 Microsoft Corporation © 2022 Maxar © CNES (2022) Distribution Airbus DS

OTSC - STA:30+00 TO STA:39+00



STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 OPHIR DIVERSION CULVERT (ALT-2A)  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV	DATE	DESCRIPTION

**PRELIMINARY - 15%**  
 NOT FOR CONSTRUCTION  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**C5.5**

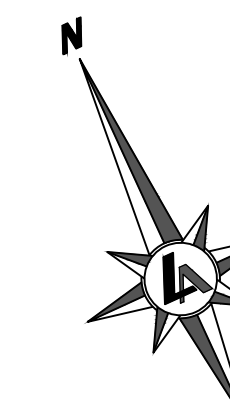
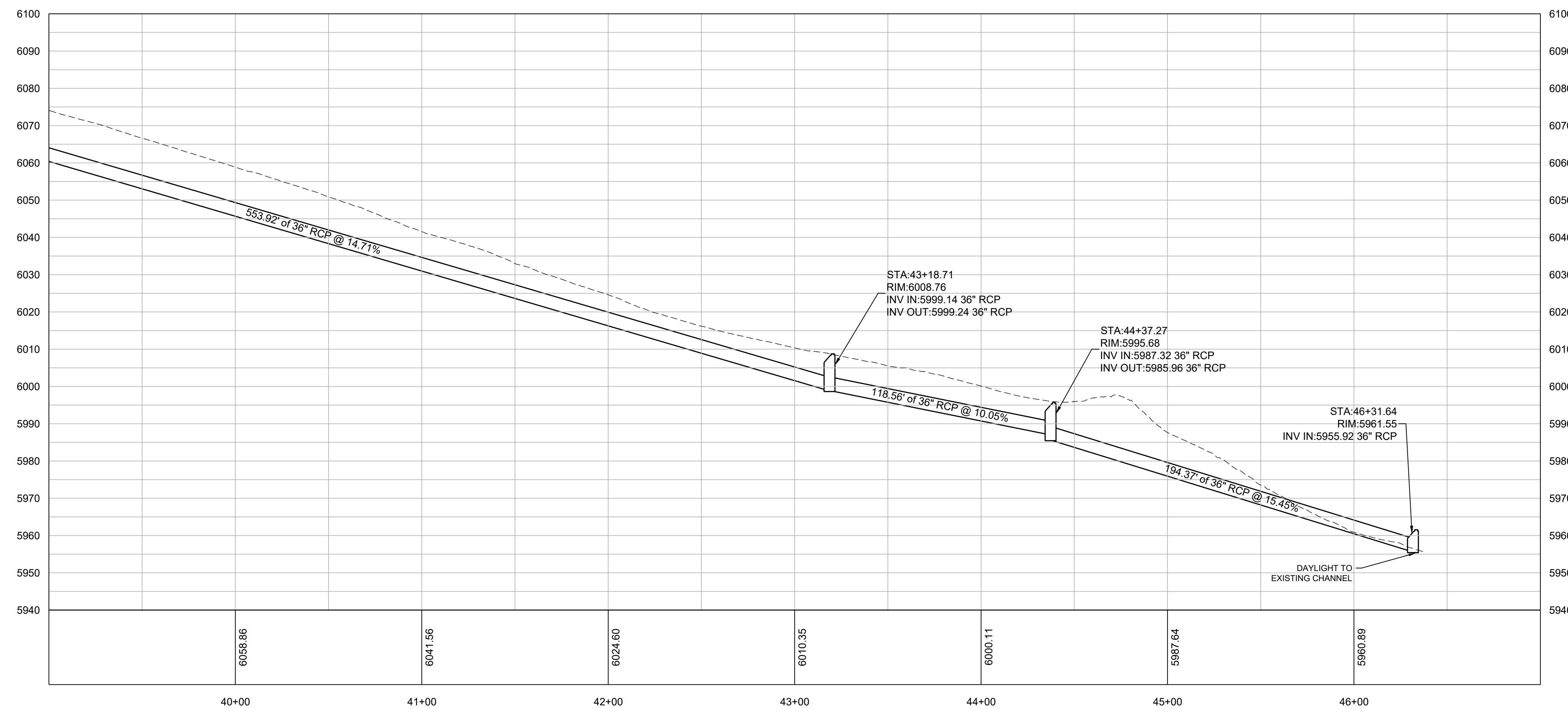
DRAWN BY: CE/KM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.5 OF 29



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

OTSC - STA:39+00 TO STA:47+00



HORIZONTAL SCALE  
 0 40' 80'  
 22x34 SHEETS: 1" = 40'  
 11x17 SHEETS: 1" = 80'

VERTICAL SCALE  
 0 20' 40'  
 22x34 SHEETS: 1" = 20'  
 11x17 SHEETS: 1" = 40'

STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 OPHIR DIVERSION CULVERT (ALT-2A)  
 VIRGINIA CITY  
 STOREY COUNTY  
 NEVADA

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%**  
**NOT FOR CONSTRUCTION**  
 AUGUST 2023

**C5.6**

DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C5.6 OF 29

L:\MapProj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - PLAN AND PROFILE.dwg,C5.6 OPHIR DIVERSION CULVERT (PRJ\_2B).  
 11/16/2023 12:44 pm mmodrifej



950 SANDHILL ROAD, STE 100  
 RENO, NV 89521  
 TEL: 775.827.6111  
 WWW.LUMOSINC.COM  
 INFO@LUMOSINC.COM

© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.



STOREY COUNTY  
 VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 SIX MILE CANYON WEST CULVERT DESIGN  
 VIRGINIA CITY STOREY COUNTY NEVADA

REV.	DATE	DESCRIPTION

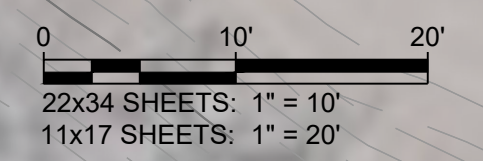
**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION**  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1

IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C6.0**

DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C6.0 OF 29



L:\MAPROJ\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - CULVERTS.dwg,06.0 SIX MILE CANYON WEST CULVERT DESIGN, 11/16/2023 12:45 pm mgodfrey



STOREY COUNTY NEVADA  
 VIRGINIA CITY STOREY COUNTY  
**VIRGINIA CITY & SIX MILE CANYON ADMP  
 ALTERNATIVES CONCEPT DESIGN  
 SIX MILE CANYON EAST CULVERT DESIGN**

REV	DATE	DESCRIPTION

**PRELIMINARY - 15%  
 NOT FOR CONSTRUCTION**  
 AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
 0 1  
 IF NOT ONE INCH ON THIS SHEET,  
 ADJUST SCALES ACCORDINGLY

**C6.1**  
 DRAWN BY: CE/IKM  
 DESIGNED BY: IKM  
 CHECKED BY: MG  
 JOB NO.: 10679.000  
 SHEETS: C6.1 OF 29



L:\AProj\10679.000 - Virginia City 6 Mi. Canyon Area Drainage\DWG\Sheets\10679.000 - CULVERTS.dwg,06.11 SIX MILE CANYON EAST CULVERT DESIGN, 11/16/2023 12:45 pm mgdofey

REV.	DATE	DESCRIPTION	BY

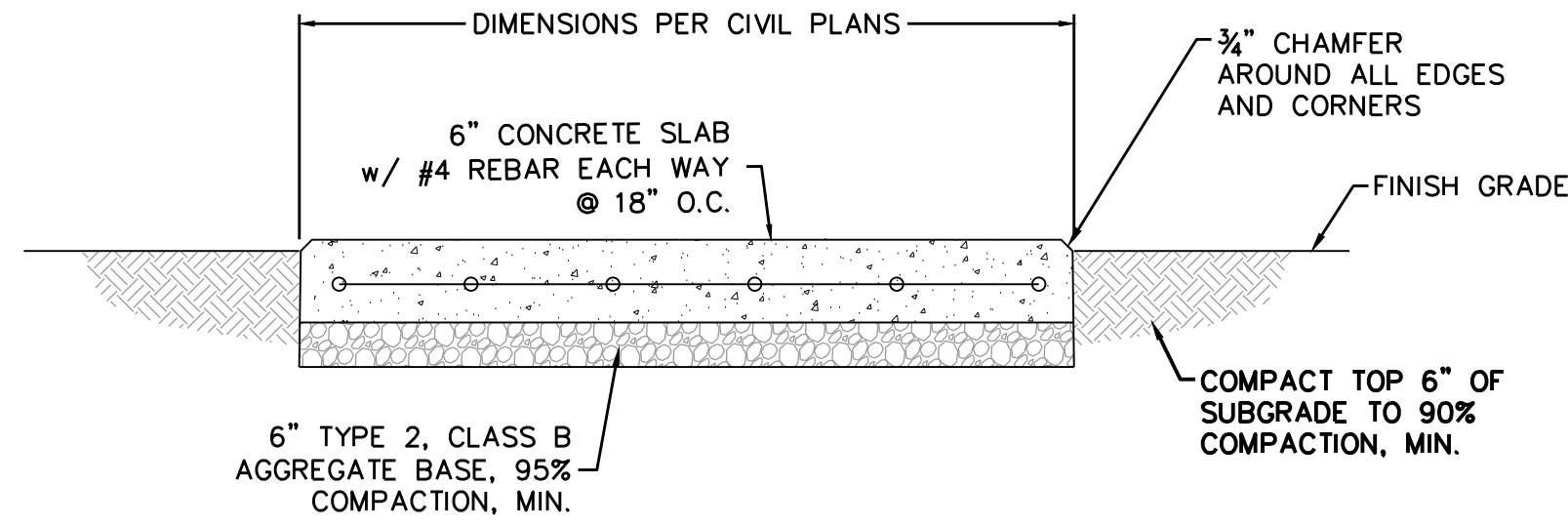
**PRELIMINARY - 15%**  
**NOT FOR CONSTRUCTION**  
AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1

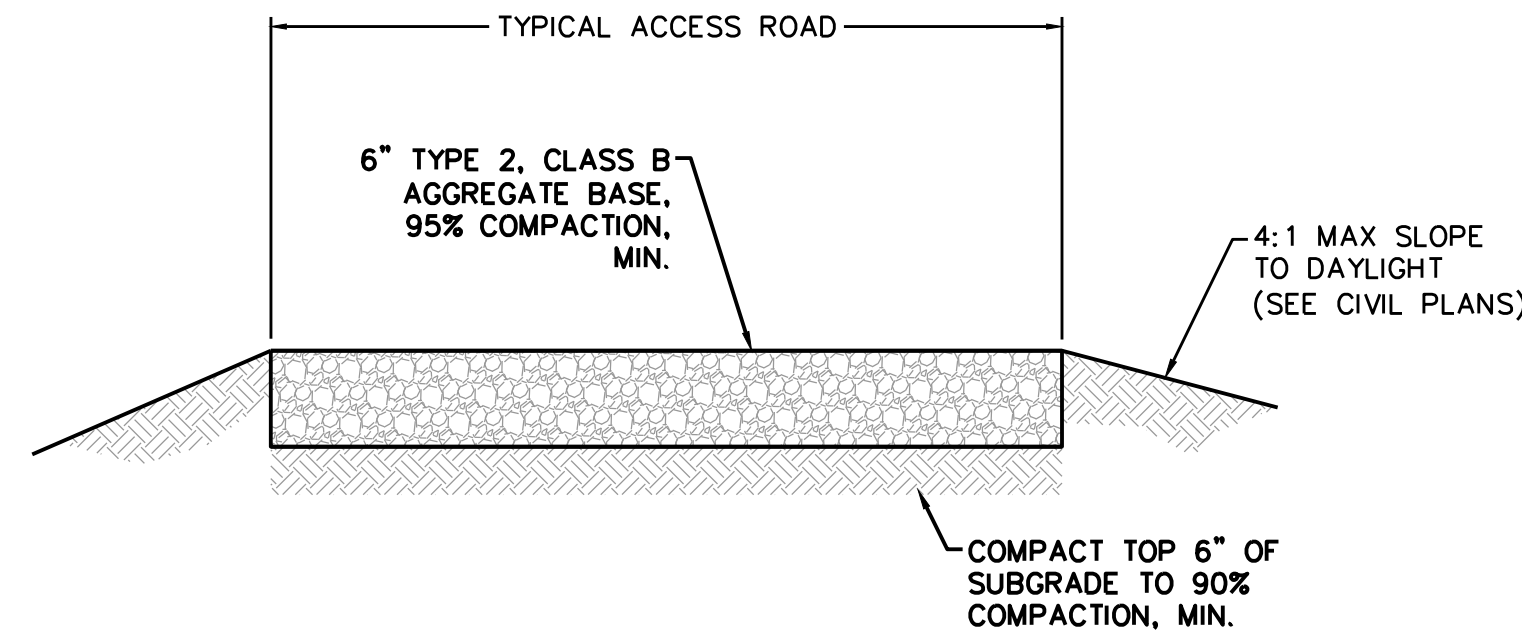
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

**D1.0**

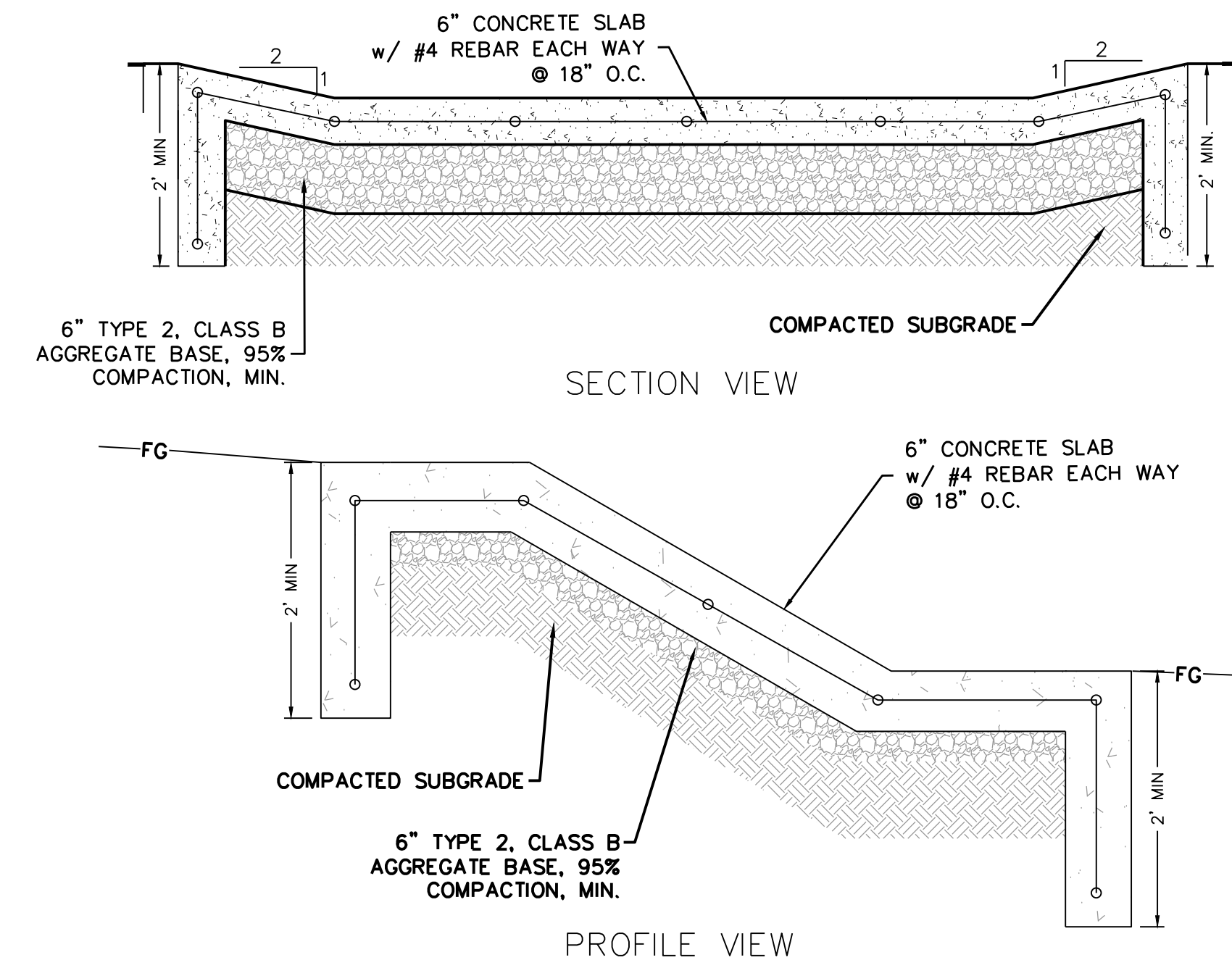
DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: D1.0 OF 29



ACCESS ROAD CONCRETE APPROACH  
N.T.S. ①

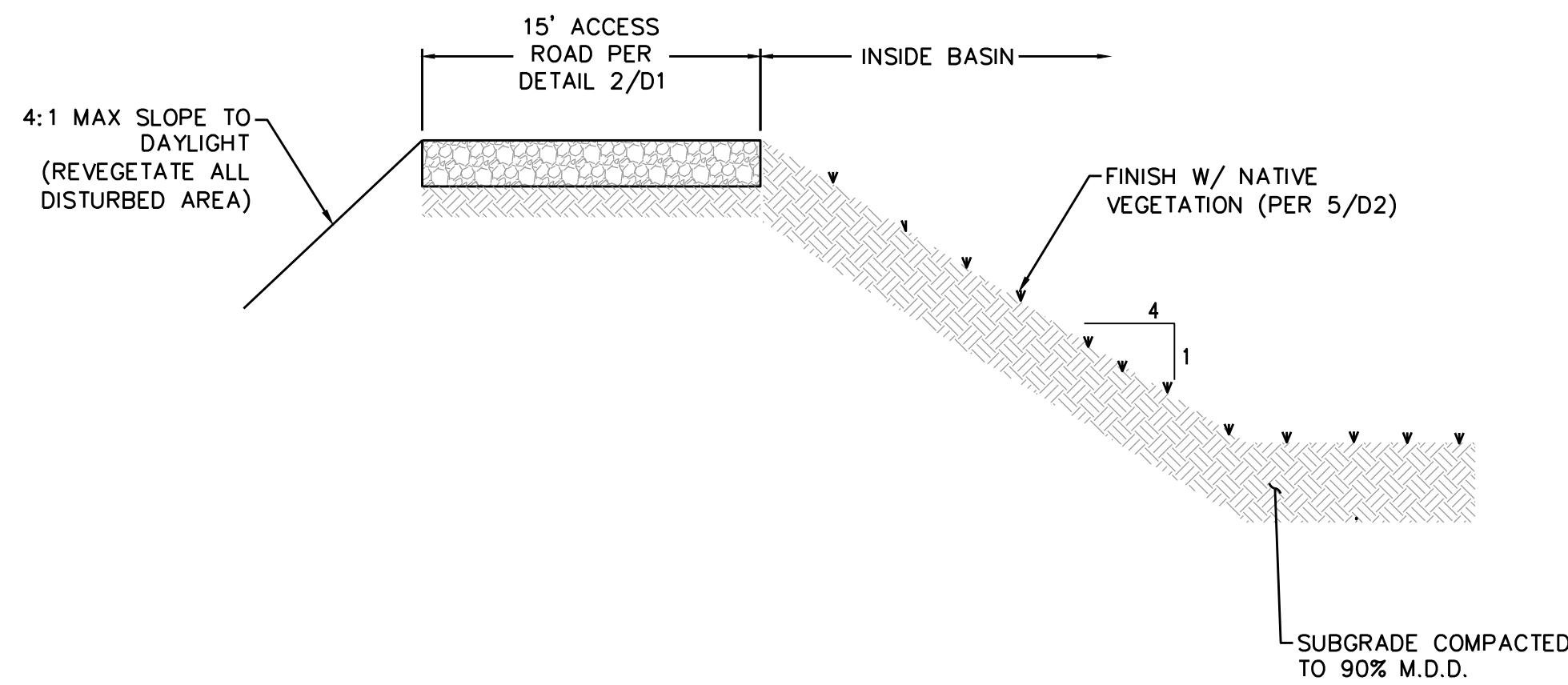


TYPICAL ACCESS ROAD SECTION  
N.T.S. ②

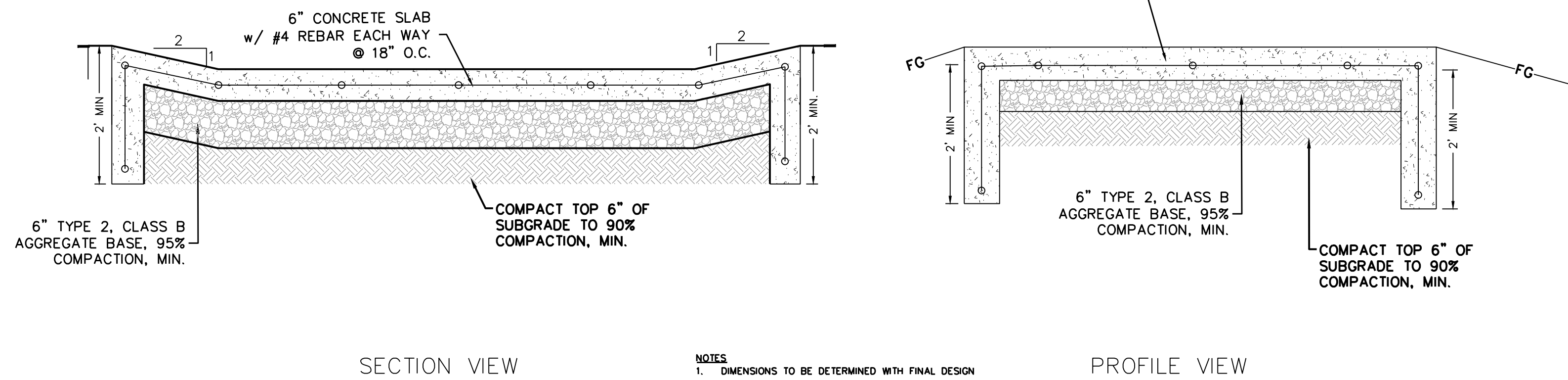


CONCRETE INLET  
N.T.S. ③

NOTES  
1. DIMENSIONS TO BE DETERMINED WITH FINAL DESIGN

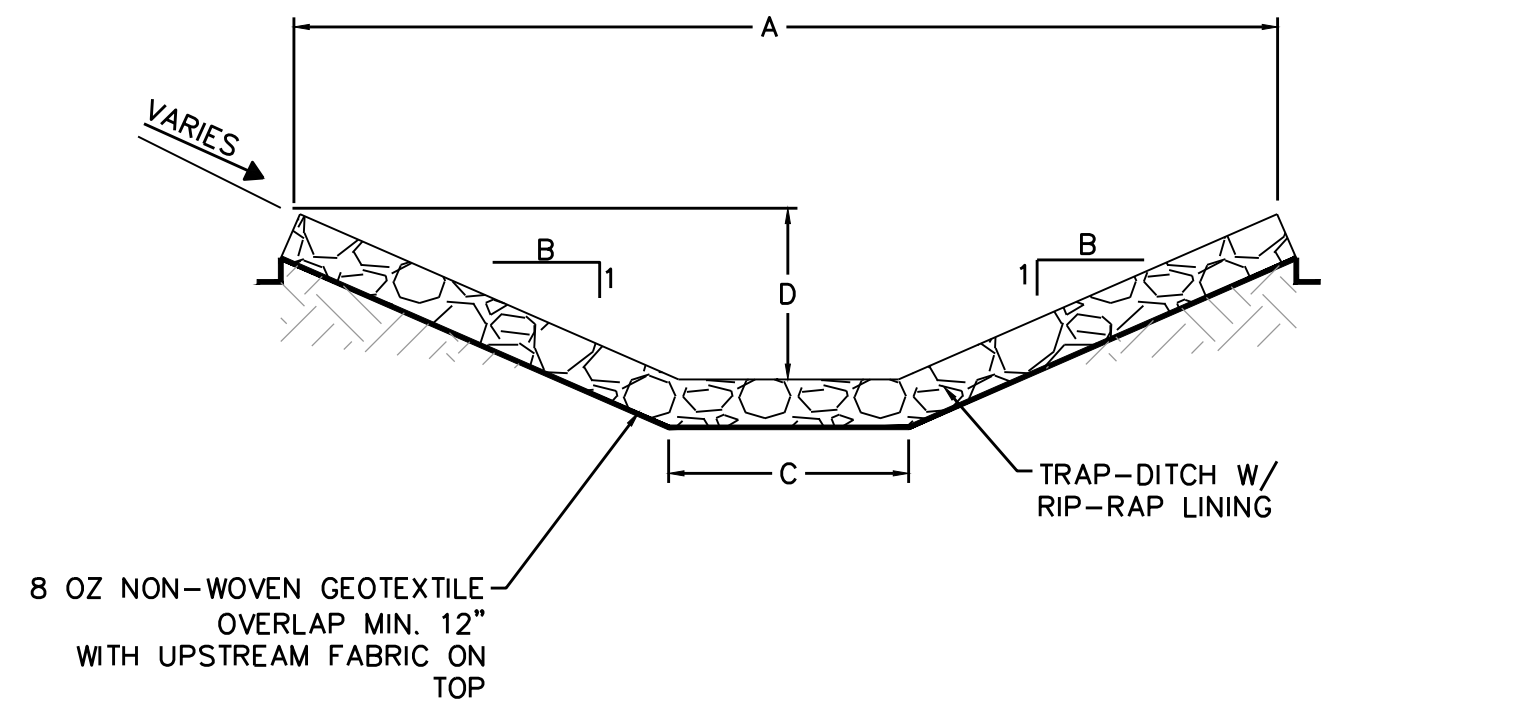


BASIN SIDE SLOPE SECTION VIEW  
N.T.S. ④



SPILLWAY W/ RIPRAP LINING  
N.T.S. ⑥

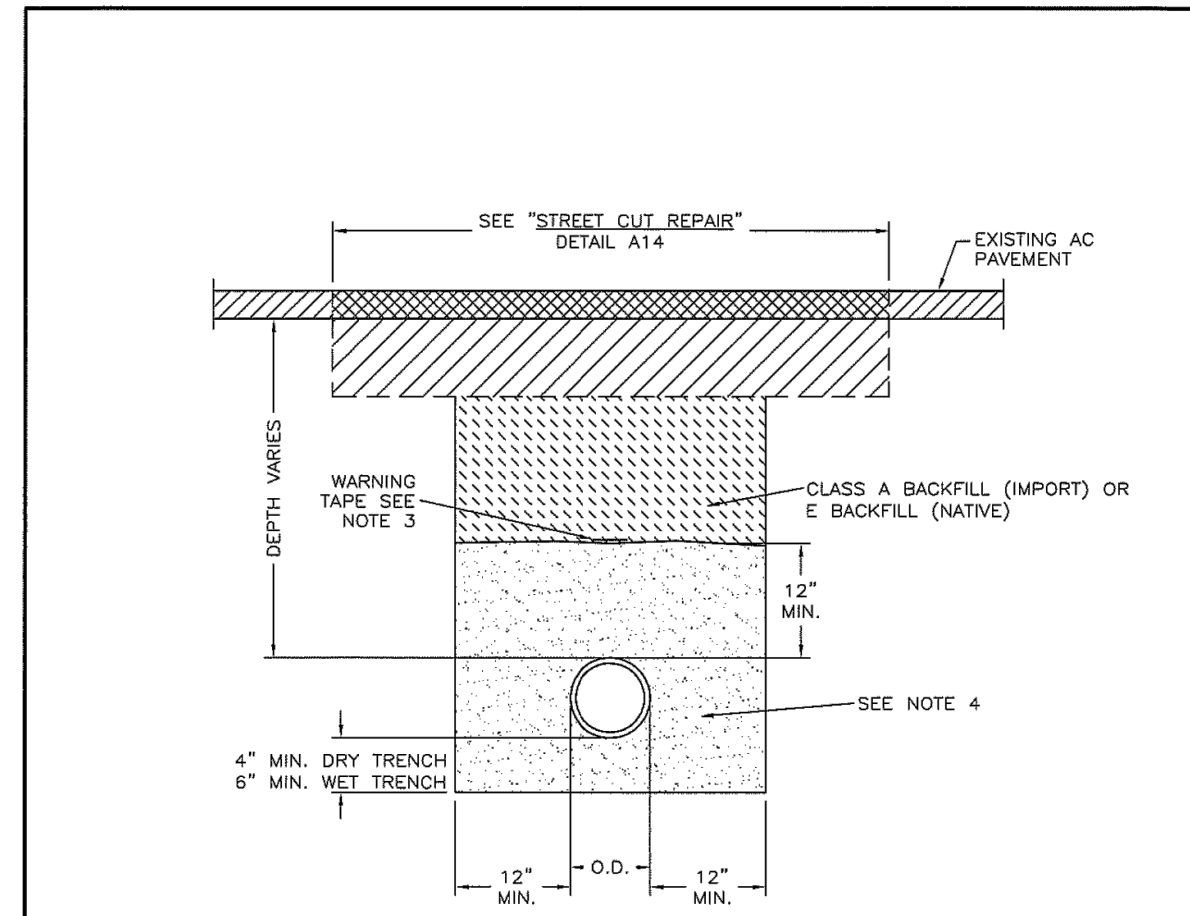
NOTES  
1. DIMENSIONS TO BE DETERMINED WITH FINAL DESIGN



NOTES  
1. DIMENSIONS TO BE DETERMINED WITH FINAL DESIGN

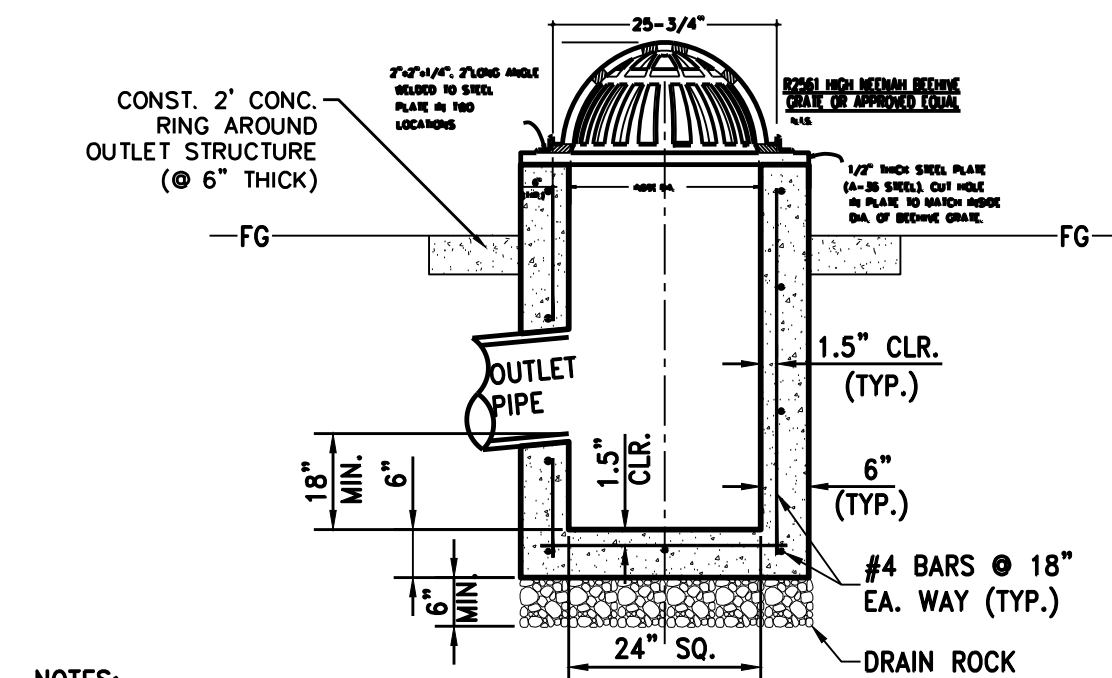
MINOR CHANNEL W/ RIPRAP LINING SECTION VIEW  
N.T.S. ①

- NOTES:
1. ALL REQUIREMENTS OF THE STORM DRAIN UTILITY ORDINANCE MUST BE MET.
  2. CLASS A AND CLASS E BACKFILL AND BEDDING MATERIAL SHALL CONFORM TO SECTION 200 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION. BEDDING AND BACKFILL SHALL BE MECHANICALLY COMPACTED IN CONFORMANCE WITH SECTION 305.10 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION.
  3. PLACE WARNING TAPE 1-FOOT ABOVE STORM DRAIN PIPE. WARNING TAPE SHALL READ "CAUTION STORM DRAIN MAIN".
  4. CLASS A BACKFILL AS BEDDING MATERIAL PER ORANGE BOOK 200.03.02. COMPACT OR CONSOLIDATE TO PROVIDE PROPER SUPPORT OF PIPE.
  5. UTILIZE WATER STOP DETAIL D02 FOR WET TRENCHES.



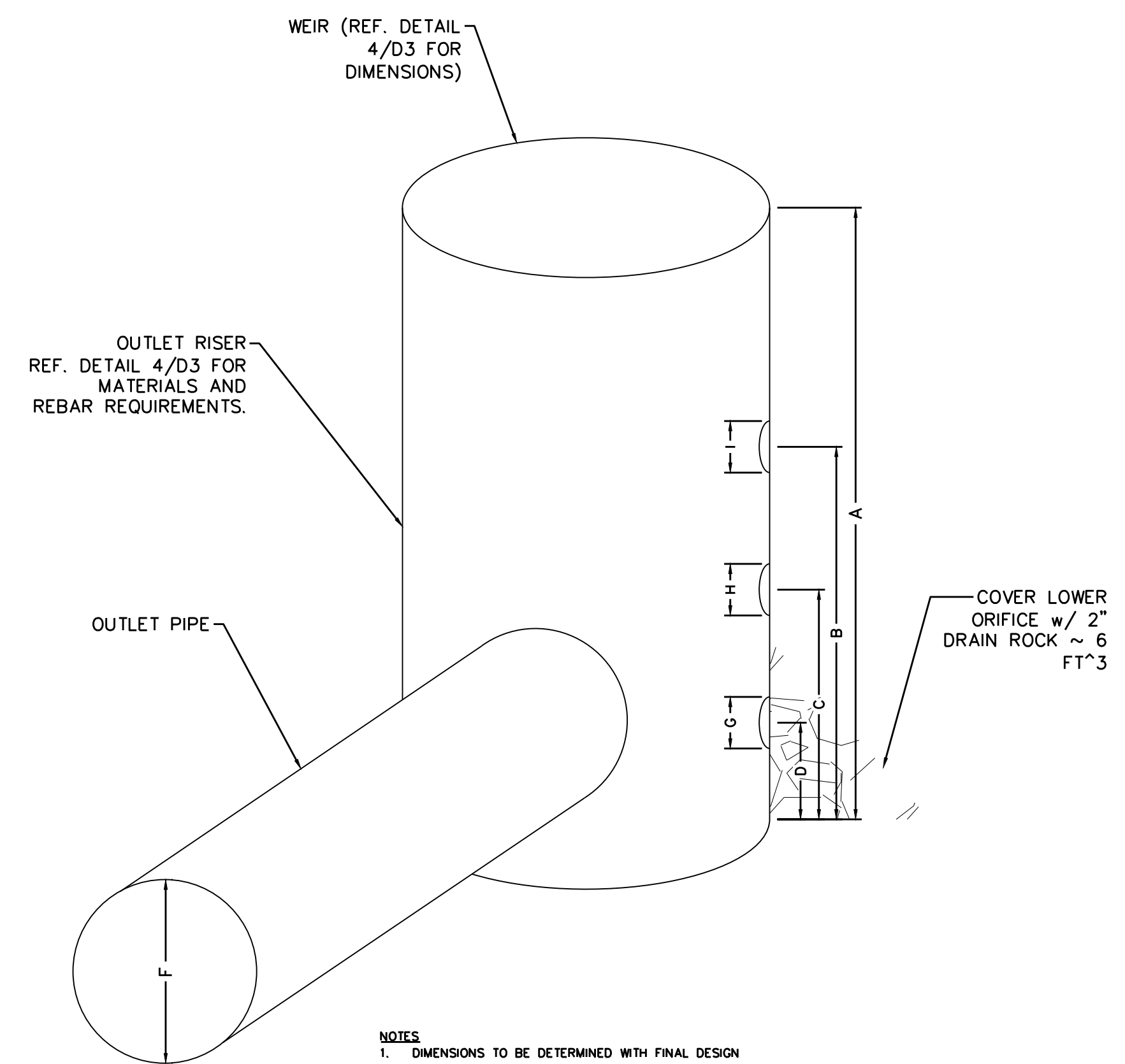
THE FOLLOWING GRADED BEDDING MATERIAL MAY BE USED IN WET TRENCHES: CLASS A BACKFILL PER ORANGE BOOK 200.03.02 USED AS BEDDING MATERIAL MUST BE USED IN

TYPICAL STORM DRAIN TRENCH  
N.T.S. ②



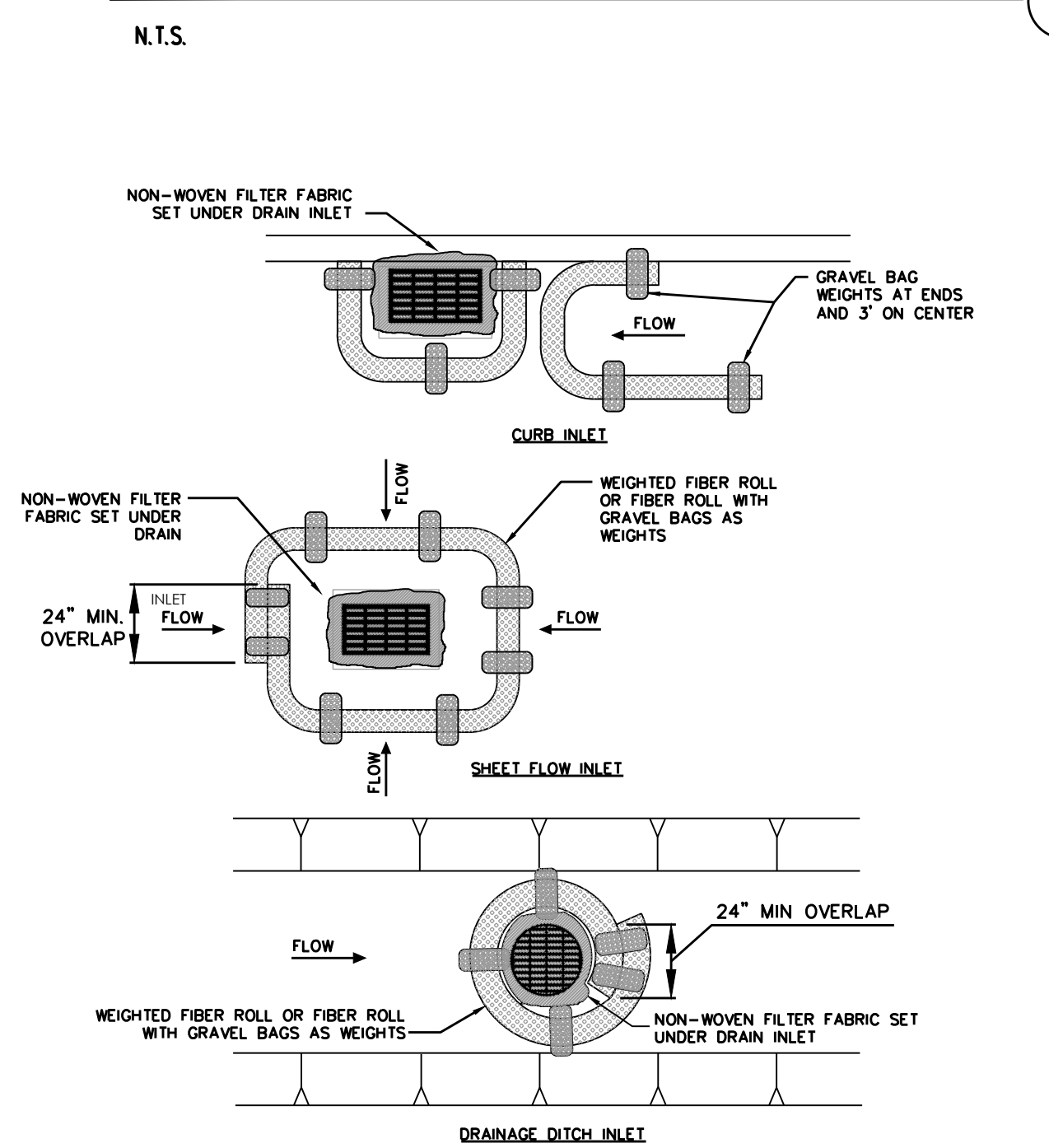
- NOTES:
1. FIBER-REINFORCED PORTLAND CEMENT CONCRETE (P.C.C.) SHALL HAVE THE FOLLOWING CHARACTERISTICS: 4000 PSI MIN. COMPRESSIVE STRENGTH AT 28 DAYS, MIN. 6 SACKS OF CEMENT PER CUBIC YARD WITH MAX. WATER-CEMENT RATIO OF 0.45, AIR ENTRAINMENT 6% ±1.5%, SLUMP AT 1 TO 4 INCHES. MIX DESIGN SHALL CONFORM TO THE REQUIREMENTS OF SECTION 337 OF STANDARD SPECIFICATIONS OF PUBLIC WORKS CONSTRUCTION (SSPWC). CEMENT SHALL BE TYPE II. ALL CEMENT CONCRETE SHALL HAVE A COARSE AGGREGATE GRADATION CONFORMING TO SIZE No. 67. POLYPROPYLENE OR CELLULOSE FIBERS SHALL BE ADDED TO THE P.C.C. AT 1.5 LBS. PER CUBIC YARD. ALL MATERIALS SHALL CONFORM TO SSPWC.
  2. REINFORCING STEEL SHALL BE GRADE 40 AND HAVE 1.5" CLEAR COVER.
  3. CONCRETE STRUCTURE MAY BE A PRE-CAST CONCRETE UNIT. BASE OF PRE-CAST CONCRETE UNIT SHALL BE PLACED ON 6" COMPACTED DRAIN ROCK.
  4. FRAME & GRATE SHALL BE D&L I-9226 OR APPROVED EQUAL.
  5. ALL CATCH BASINS, PUBLIC OR PRIVATE, SHALL BE PROVIDED WITH A "SUR-TRAP" OIL/WATER SEPARATOR OR APPROVED EQUAL.
  6. REFERENCE DETAIL 4 ON D2 FOR EACH BASIN'S OUTLET DIMENSIONS AND ADDITIONAL REQUIREMENTS

CATCH BASIN TYPE 3-R ③



NOTES  
1. DIMENSIONS TO BE DETERMINED WITH FINAL DESIGN

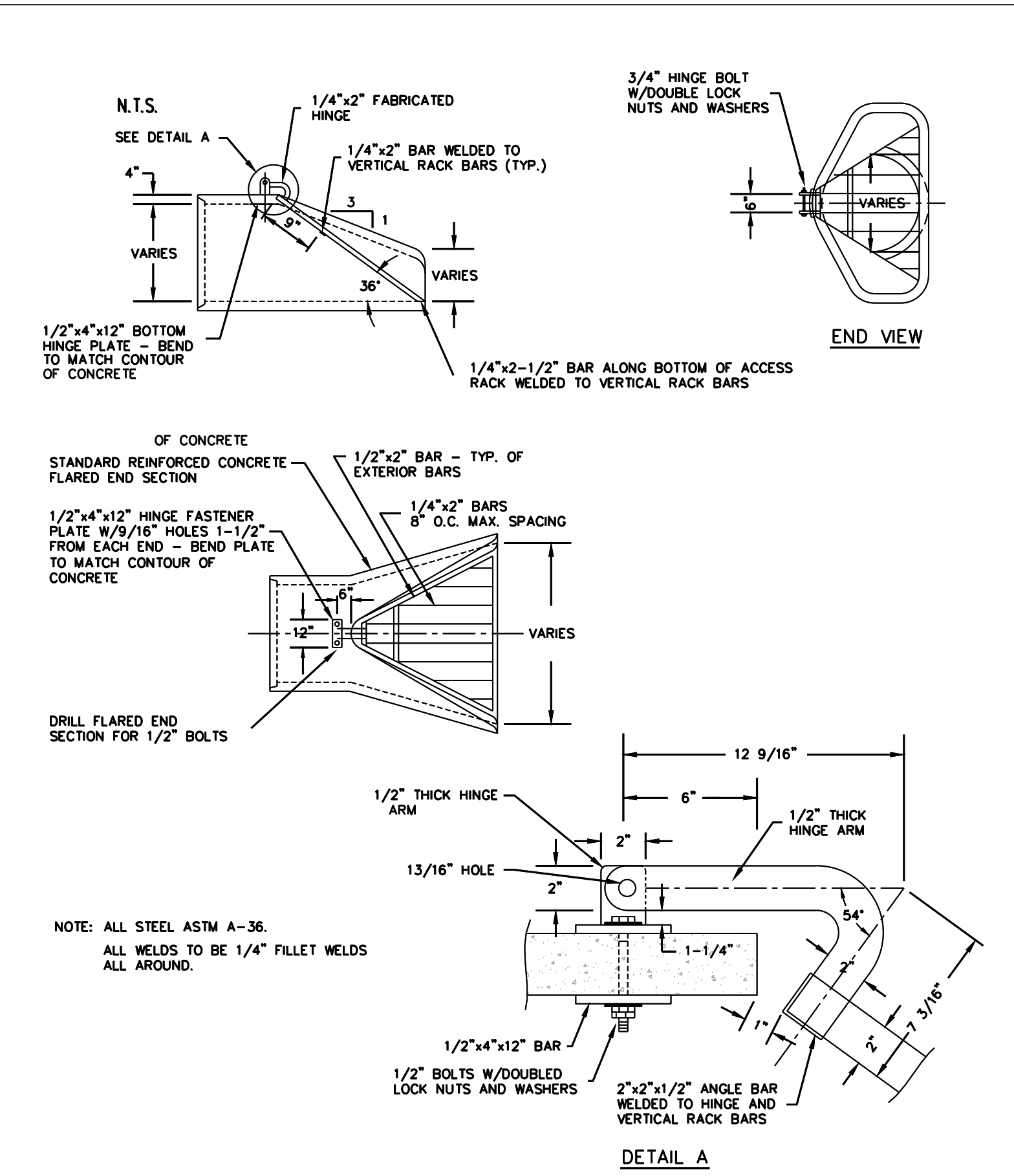
OUTLET STRUCTURE-CONCEPT  
N.T.S. ④



- NOTES:
1. FIBER ROLL DRAIN INLET PROTECTION SHALL USE A MIN 12" DIAMETER ROLL AND BE INSTALLED BEFORE CONSTRUCTION BEGINS.
  2. GRAVEL BAGS SHALL BE WOVEN FILTER FABRIC. SAND BAGS ARE NOT AN ACCEPTABLE SUBSTITUTE.
  3. ON PAVED SURFACES, SUBSTITUTE STAKES WITH GRAVEL BAGS (USE PROPER STAKING METHODS).
  4. CONSTRUCT ON GENTLY SLOPING STREETS WHERE WATER CAN POND AND ALLOW SEDIMENT TO SEPARATE OUT OF SUSPENSION.
  5. INSPECT AND REPAIR FIBER ROLLS EACH DAY AND AFTER EACH STORM EVENT. REMOVE SEDIMENT WHEN ONE THIRD OF THE FILTER DEPTH HAS BEEN FILLED. REMOVED SEDIMENT SHALL BE DISPOSED OF PROPERLY.
  6. SEDIMENT AND GRAVEL DEPOSITED ON ROADWAYS SHALL BE IMMEDIATELY REMOVED.
  7. IN HIGH TRAFFIC AREAS, MARK DRAIN INLET PROTECTION WITH VISIBLE BARRIERS SUCH AS SAFETY CONES.
  8. REMOVE DRAIN INLET PROTECTION AFTER THE SURROUNDING AREA IS STABILIZED.

DETAIL COURTESY OF TRPA EROSION CONTROL TEAM

INLET PROTECTION  
N.T.S. ⑤



NOTE: ALL STEEL ASTM A-36. ALL WELDS TO BE 1/4" FILLET WELDS ALL AROUND.

NO.	REVISION	DATE	STANDARD DETAIL FOR PUBLIC WORKS CONSTRUCTION	SECTION: DOUGLAS COUNTY
			TRASH RACK	DATE: JULY 2017
				DWG: D08

TRASH RACK  
N.T.S. ⑥



950 SANDHILL ROAD, STE 100  
RENO, NV 89521  
TEL: 775.827.6111  
WWW.LUMOSINC.COM  
INFO@LUMOSINC.COM

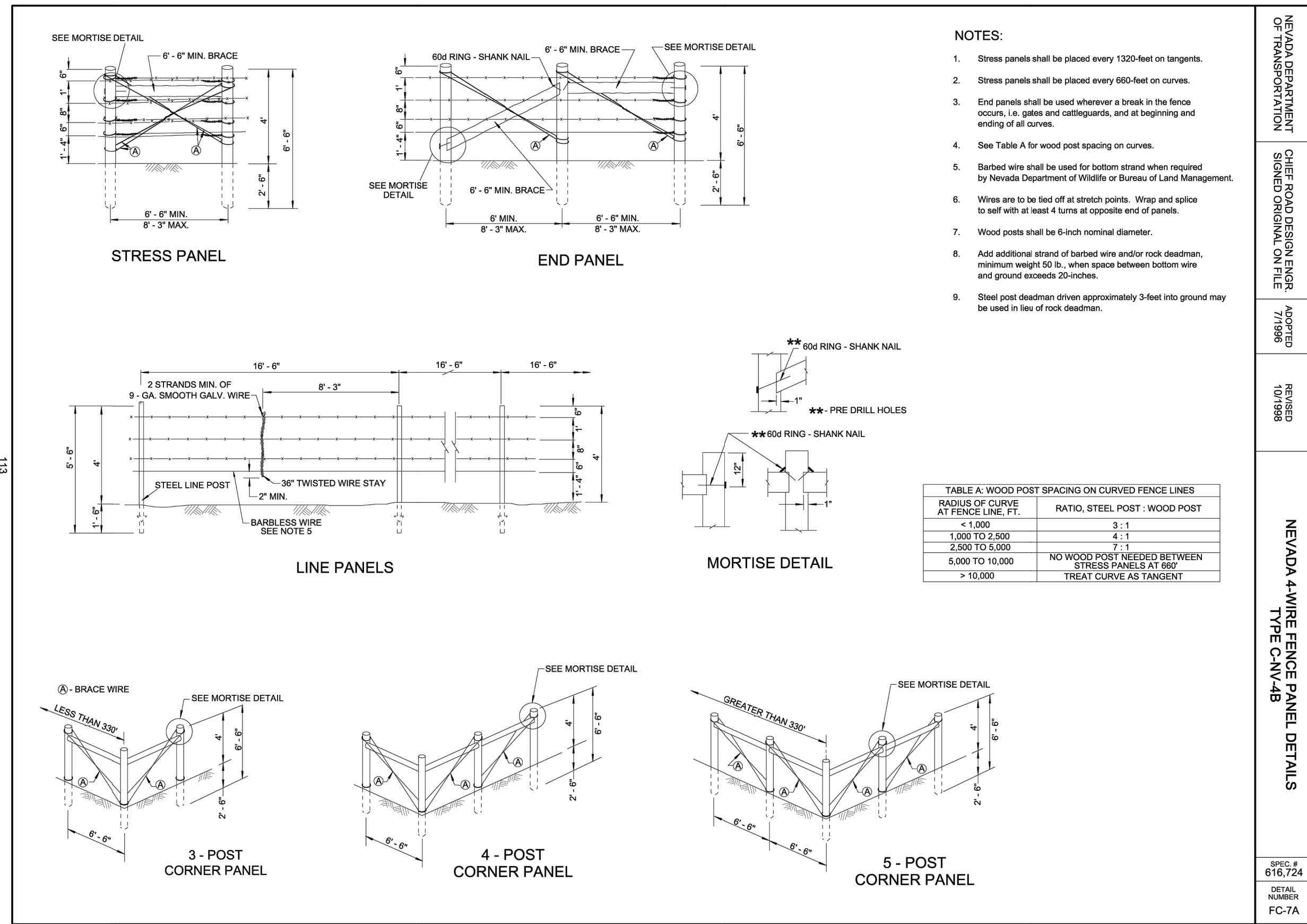
© LUMOS & ASSOCIATES, INC. THIS DRAWING IS THE PROPERTY OF LUMOS & ASSOCIATES, INC. USE OR REPRODUCTION OF THIS DRAWING IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF LUMOS & ASSOCIATES, INC. IS STRICTLY PROHIBITED. THIS DRAWING IS NOT TO BE USED FOR ANY PROJECT OTHER THAN THE PROJECT FOR WHICH IT WAS PREPARED.

STOREY COUNTY  
VIRGINIA CITY & SIX MILE CANYON ADMP  
ALTERNATIVES CONCEPT DESIGN  
DETAILS  
NEVADA  
STOREY COUNTY  
VIRGINIA CITY

REV.	DATE	DESCRIPTION
0		

PRELIMINARY - 15%  
NOT FOR CONSTRUCTION  
AUGUST 2023

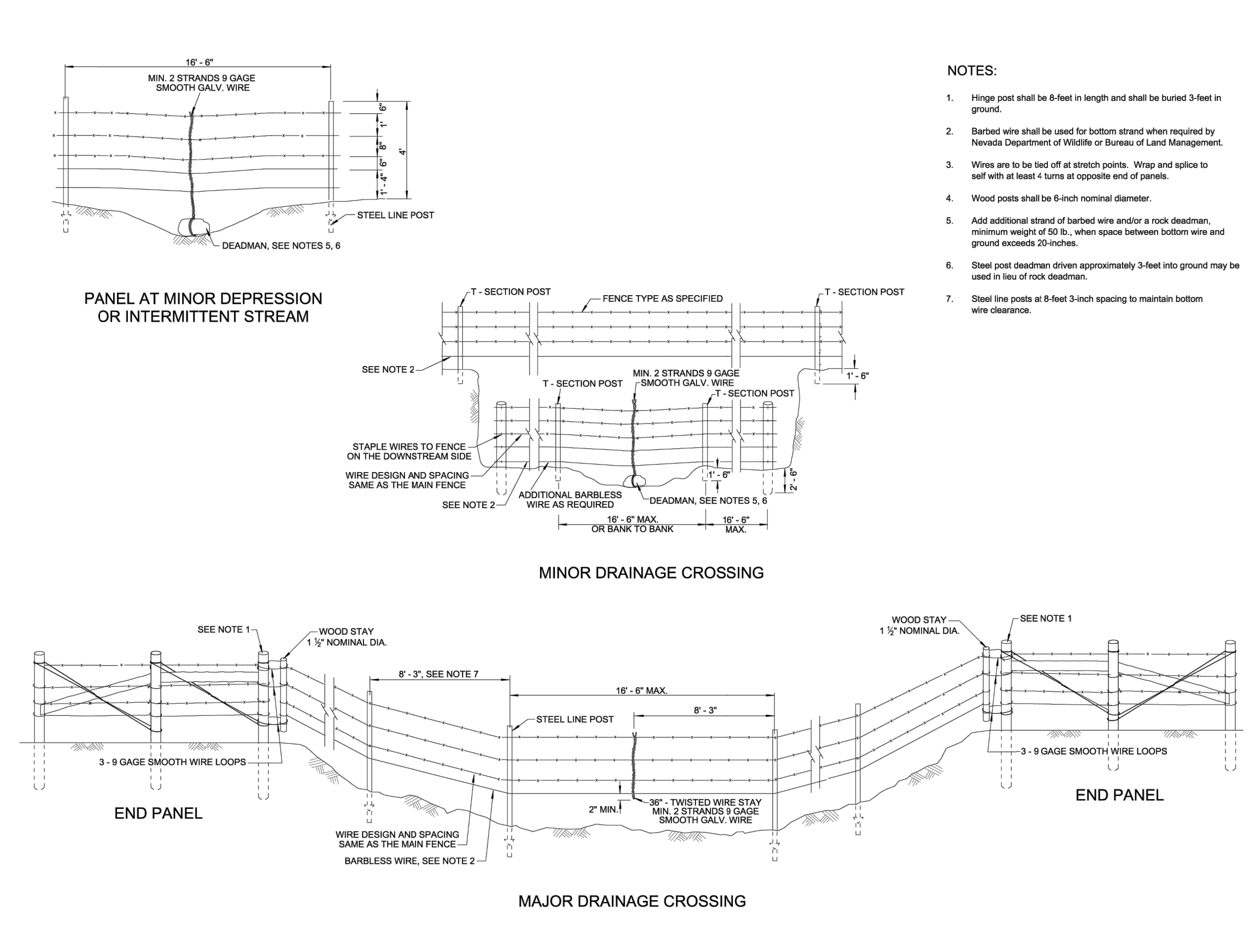
BAR IS 1/8 INCH ON ORIGINAL DRAWING  
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY  
**D1.1**  
DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: D1.1 OF 29



WIRE FENCING-PANEL DETAILS

N.T.S.

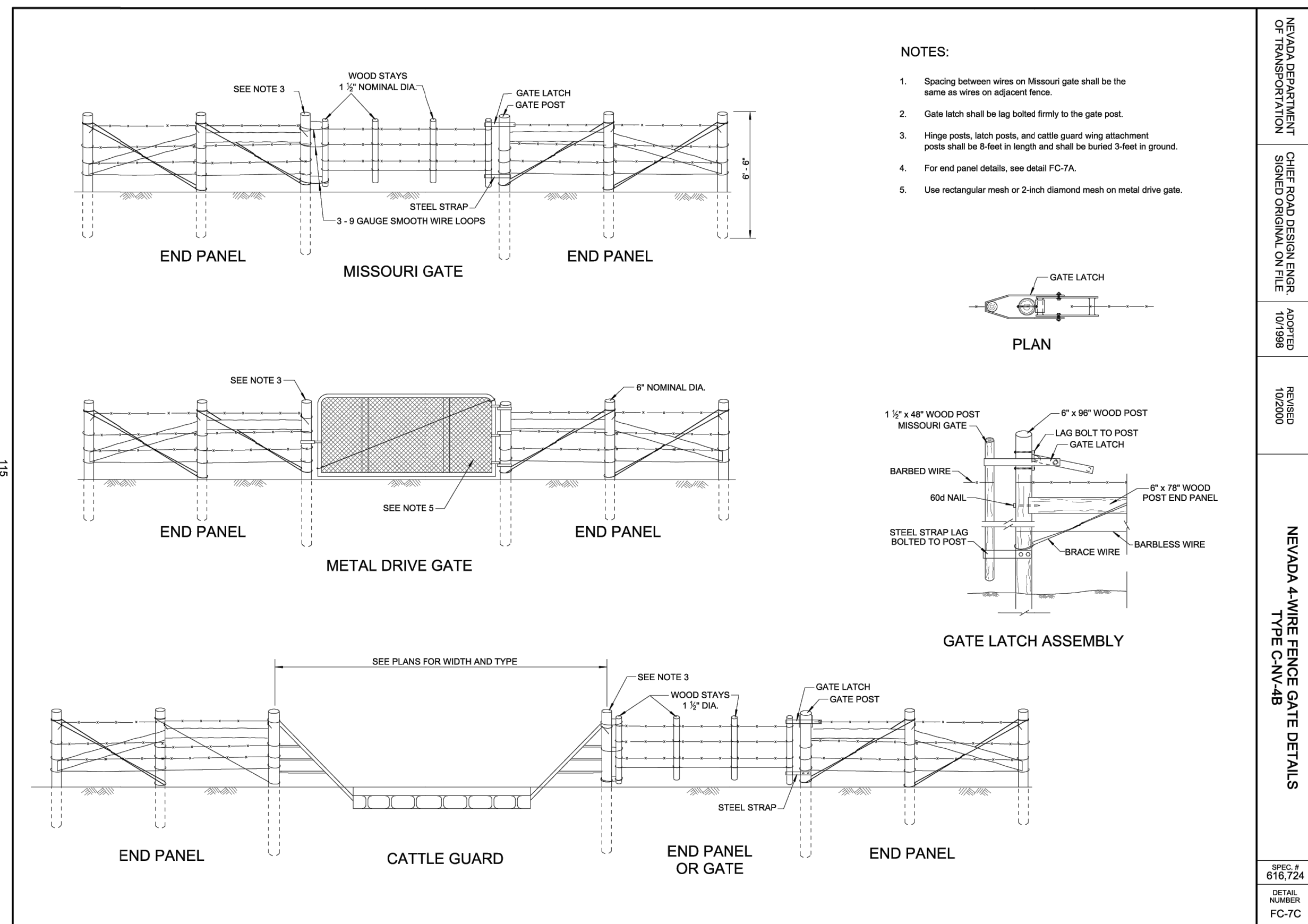
1



WIRE FENCING-GATE DETAILS

N.T.S.

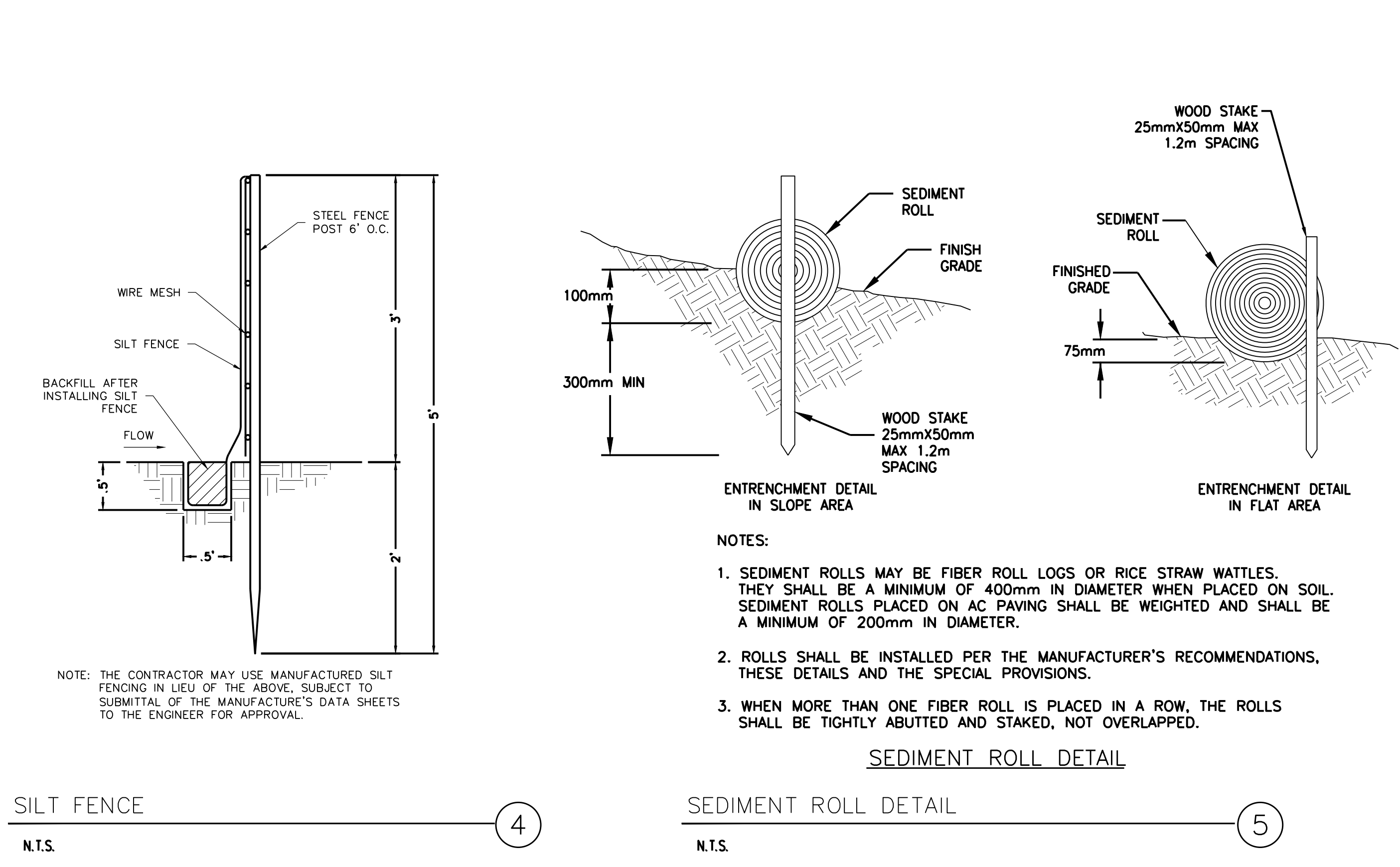
2



GATE AND FENCE DETAILS

N.T.S.

3



SILT FENCE

N.T.S.

4

SEDIMENT ROLL DETAIL

N.T.S.

5

L:\MapInfo\10679.000 - Virginia City 6 Mi Canyon Area Drainage\DWG\Sheets\10679.000 - DETAILS.dwg, D1.2 DETAILS, 11/16/2023 12:45 pm imahaffey

REV.	DATE	DESCRIPTION	BY

**PRELIMINARY - 15%  
NOT FOR CONSTRUCTION**  
AUGUST 2023

BAR IS 1 INCH ON ORIGINAL DRAWING  
0 1

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

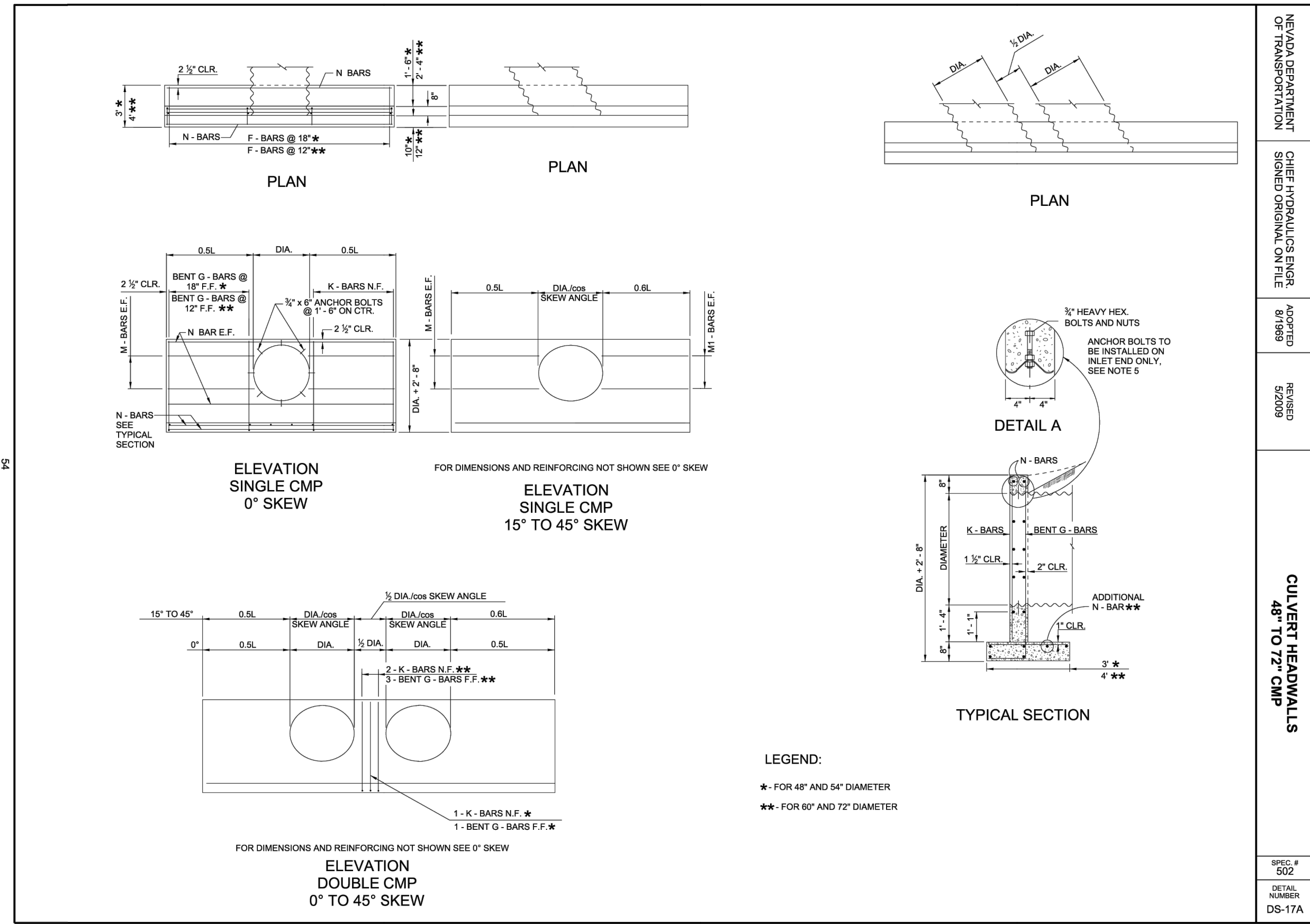
**D1.2**

DRAWN BY: CE/IKM  
DESIGNED BY: IKM  
CHECKED BY: MG  
JOB NO.: 10679.000  
SHEETS: D1.2 OF 29



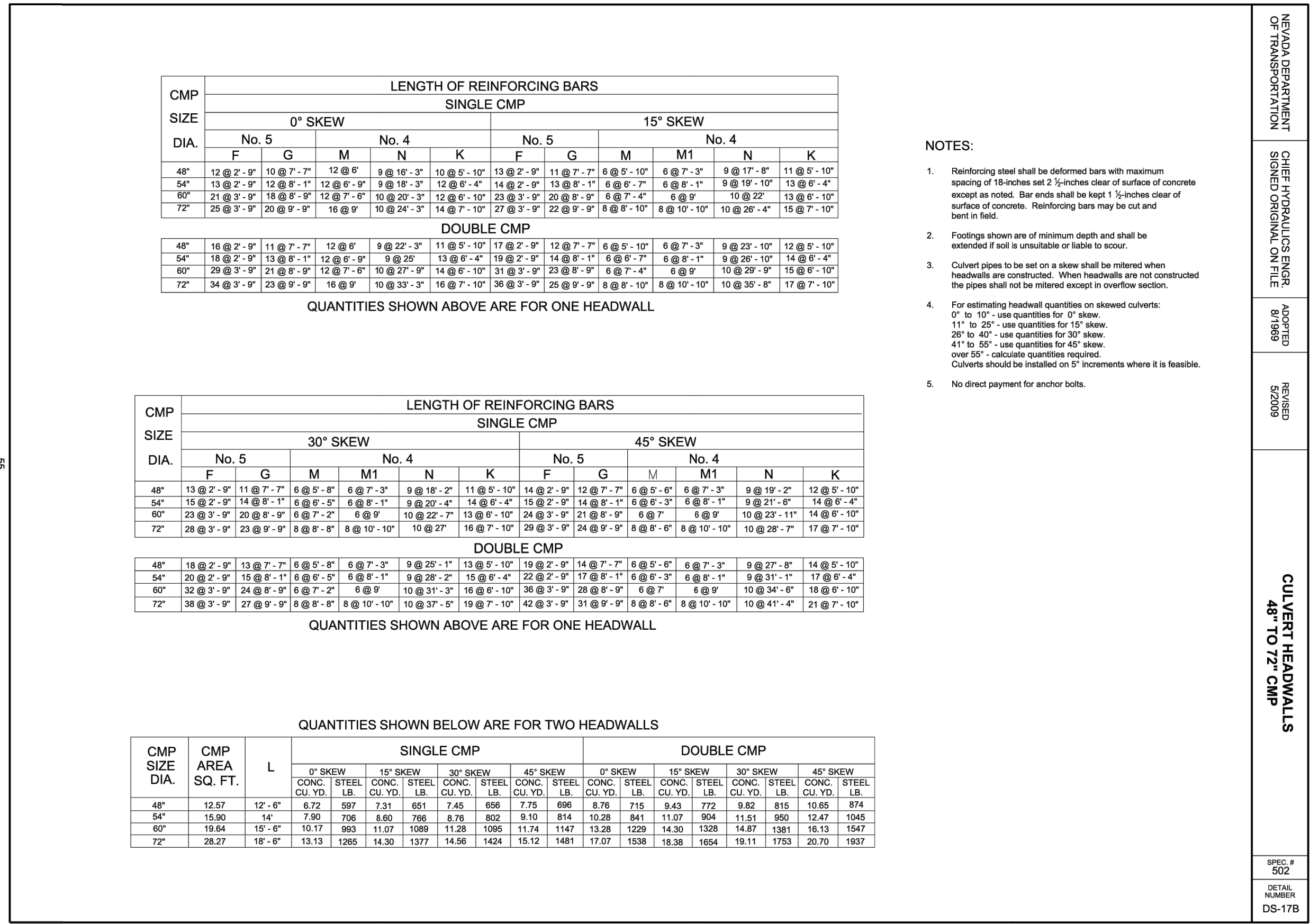
REV	DATE	DESCRIPTION

BY



CULVERT HEADWALLS 48" TO 72" CMP 1

N.T.S.



CULVERT HEADWALLS 48" TO 72" CMP 2

N.T.S.

# Appendix B

## Cost Estimates for Design Concepts

STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
SPANISH RAVINE BASIN w/ OUTLET PIPE (SRB)  
25 YEAR ESTIMATED COST  
AUGUST 2023

Item	Description	Unit	Quantity	Unit Price	Total Price
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 63,102.09	\$ 63,102
2	Clearing & Grubbing	AC	1.06	\$ 6,000.00	\$ 6,336
3	Grading Cut/Fill	CY	3500	\$ 15.00	\$ 52,500
4	Rip Rap	SF	29817	\$ 20.00	\$ 596,340
5	Type II Agg Base Road	SF	8304	\$ 3.00	\$ 24,900
6	Concrete Access Road	SF	920	\$ 21.00	\$ 19,300
7	Concrete Spillway	SF	1600	\$ 21.00	\$ 33,600
8	24" SD	LF	130	\$ 260.00	\$ 33,800
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	0	\$ 400.00	\$ -
12	48" Manhole/Outlet Structure	EA	1	\$ 8,000.00	\$ 8,000
13	60" Manhole	EA	0	\$ 10,000.00	\$ -
14	72" Manhole	EA	0	\$ 13,000.00	\$ -
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	1	\$ 5,000.00	\$ 5,000
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	0	\$ 12,000.00	\$ -
20	Fence	LF	500	\$ 18.00	\$ 9,000
21	Revegetation	AC	1.06	\$ 10,890.00	\$ 11,500
22	Erosion Control	LS	1	\$ 23,473.20	\$ 23,500
23	Contingency, 30%	LS	1	\$ 266,100	\$ 266,100
<b>Subtotal Construction Costs</b>					<b>\$ 1,153,000</b>
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 230,600
<b>Subtotal Non-Construction Costs</b>					<b>\$ 230,600</b>
<b>Total Project Costs</b>					<b>\$ 1,383,600</b>

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
SPANISH RAVINE BASIN w/ OUTLET PIPE (SRB)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 63,102.09	\$ 63,102
2	Clearing & Grubbing	AC	1.06	\$ 6,000.00	\$ 6,336
3	Grading Cut/Fill	CY	3500	\$ 15.00	\$ 52,500
4	Rip Rap	SF	29817	\$ 20.00	\$ 596,340
5	Type II Agg Base Road	SF	8304	\$ 3.00	\$ 24,900
6	Concrete Access Road	SF	920	\$ 21.00	\$ 19,300
7	Concrete Spillway	SF	1600	\$ 21.00	\$ 33,600
8	24" SD	LF	130	\$ 260.00	\$ 33,800
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	0	\$ 400.00	\$ -
12	48" Manhole/Outlet Structure	EA	1	\$ 8,000.00	\$ 8,000
13	60" Manhole	EA	0	\$ 10,000.00	\$ -
14	72" Manhole	EA	0	\$ 13,000.00	\$ -
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	1	\$ 5,000.00	\$ 5,000
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	0	\$ 12,000.00	\$ -
20	Fence	LF	500	\$ 18.00	\$ 9,000
21	Revegetation	AC	1.06	\$ 10,890.00	\$ 11,500
22	Erosion Control	LS	1	\$ 23,473.20	\$ 23,500
23	Contingency, 30%	LS	1	\$ 266,100	\$ 266,100
<b>Subtotal Construction Costs</b>					\$ 1,153,000
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 230,600
<b>Subtotal Non-Construction Costs</b>					\$ 230,600
<b>Total Project Costs</b>					\$ 1,383,600

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
OPHIR RAVINE BASIN w/ OUTLET PIPE (ORB)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 63,647.38	\$ 63,647
2	Clearing & Grubbing	AC	0.69	\$ 6,000.00	\$ 4,132
3	Grading Cut/Fill	CY	3400	\$ 15.00	\$ 51,000
4	Rip Rap	SF	23213	\$ 20.00	\$ 464,260
5	Type II Agg Base Road	SF	5280	\$ 3.00	\$ 15,800
6	Concrete Access Road	SF	826	\$ 21.00	\$ 17,300
7	Concrete Spillway	SF	1600	\$ 21.00	\$ 33,600
8	24" SD	LF	0	\$ 260.00	\$ -
9	30" SD	LF	558	\$ 300.00	\$ 167,400
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	0	\$ 400.00	\$ -
12	48" Manhole/Outlet Structure	EA	0	\$ 8,000.00	\$ -
13	60" Manhole	EA	2	\$ 10,000.00	\$ 20,000
14	72" Manhole	EA	0	\$ 13,000.00	\$ -
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	1	\$ 5,000.00	\$ 5,000
17	30" Headwall	EA	1	\$ 8,000.00	\$ 8,000
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	0	\$ 12,000.00	\$ -
20	Fence	LF	505	\$ 18.00	\$ 9,100
21	Revegetation	AC	0.69	\$ 10,890.00	\$ 7,500
22	Erosion Control	LS	1	\$ 23,743.80	\$ 23,700
23	Contingency, 30%	LS	1	\$ 267,100	\$ 267,100
<b>Subtotal Construction Costs</b>					<b>\$ 1,158,000</b>
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 231,600
<b>Subtotal Non-Construction Costs</b>					<b>\$ 231,600</b>
<b>Total Project Costs</b>					<b>\$ 1,389,600</b>

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
SPANISH TO OPHIR CONNECTOR PIPE (STOC)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 73,728.00	\$ 73,728
2	Clearing & Grubbing	AC	0	\$ 6,000.00	\$ -
3	Grading Cut/Fill	CY	0	\$ 15.00	\$ -
4	Rip Rap	SF	0	\$ 20.00	\$ -
5	Type II Agg Base Road	SF	0	\$ 3.00	\$ -
6	Concrete Access Road	SF	0	\$ 21.00	\$ -
7	Concrete Spillway	SF	0	\$ 21.00	\$ -
8	24" SD	LF	0	\$ 260.00	\$ -
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	1949	\$ 400.00	\$ 779,600
12	48" Manhole/Outlet Structure	EA	0	\$ 8,000.00	\$ -
13	60" Manhole	EA	0	\$ 10,000.00	\$ -
14	72" Manhole	EA	10	\$ 13,000.00	\$ 130,000
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	0	\$ 5,000.00	\$ -
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	1	\$ 12,000.00	\$ 12,000
20	Fence	LF	0	\$ 18.00	\$ -
21	Revegetation	AC	0.36	\$ 10,890.00	\$ 3,900
22	Erosion Control	LS	1	\$ 27,648.00	\$ 27,600
23	Contingency, 30%	LS	1	\$ 308,000	\$ 308,000
<b>Subtotal Construction Costs</b>					\$ 1,335,000
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration,				\$ 267,000
<b>Subtotal Non-Construction Costs</b>					\$ 267,000
<b>Total Project Costs</b>					\$ 1,602,000

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
OPHIR TO CEDAR CONNECTOR PIPE (OTCC)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 48,800.00	\$ 48,800
2	Clearing & Grubbing	AC	0	\$ 6,000.00	\$ -
3	Grading Cut/Fill	CY	0	\$ 15.00	\$ -
4	Rip Rap	SF	0	\$ 20.00	\$ -
5	Type II Agg Base Road	SF	0	\$ 3.00	\$ -
6	Concrete Access Road	SF	0	\$ 21.00	\$ -
7	Concrete Spillway	SF	0	\$ 21.00	\$ -
8	24" SD	LF	0	\$ 260.00	\$ -
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	1300	\$ 400.00	\$ 520,000
12	48" Manhole/Outlet Structure	EA	0	\$ 8,000.00	\$ -
13	60" Manhole	EA	0	\$ 10,000.00	\$ -
14	72" Manhole	EA	6	\$ 13,000.00	\$ 78,000
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	0	\$ 5,000.00	\$ -
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	1	\$ 12,000.00	\$ 12,000
20	Fence	LF	0	\$ 18.00	\$ -
21	Revegetation	AC	0.24	\$ 10,890.00	\$ 2,600
22	Erosion Control	LS	1	\$ 18,300.00	\$ 18,300
23	Contingency, 30%	LS	1	\$ 203,900	\$ 203,900
<b>Subtotal Construction Costs</b>					\$ 884,000
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration,				\$ 176,800
<b>Subtotal Non-Construction Costs</b>					\$ 176,800
<b>Total Project Costs</b>					\$ 1,060,800

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
OPHIR TO 6 MILE CONNECTOR PIPE (OTSC)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 80,056.00	\$ 80,056
2	Clearing & Grubbing	AC	0	\$ 6,000.00	\$ -
3	Grading Cut/Fill	CY	0	\$ 15.00	\$ -
4	Rip Rap	SF	0	\$ 20.00	\$ -
5	Type II Agg Base Road	SF	0	\$ 3.00	\$ -
6	Concrete Access Road	SF	0	\$ 21.00	\$ -
7	Concrete Spillway	SF	0	\$ 21.00	\$ -
8	24" SD	LF	0	\$ 260.00	\$ -
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	2507	\$ 350.00	\$ 877,500
11	48" SD	LF	43	\$ 400.00	\$ 17,200
12	48" Manhole/Outlet Structure	EA	0	\$ 8,000.00	\$ -
13	60" Manhole	EA	7	\$ 10,000.00	\$ 70,000
14	72" Manhole	EA	2	\$ 13,000.00	\$ 26,000
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	0	\$ 5,000.00	\$ -
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	1	\$ 10,000.00	\$ 10,000
19	48" Headwall	EA	0	\$ 12,000.00	\$ -
20	Fence	LF	0	\$ 18.00	\$ -
21	Revegetation	AC	0.46	\$ 10,890.00	\$ 5,000
22	Erosion Control	LS	1	\$ 30,021.00	\$ 30,000
23	Contingency, 30%	LS	1	\$ 334,700	\$ 334,700
<b>Subtotal Construction Costs</b>					<b>\$ 1,451,000</b>
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 290,200
<b>Subtotal Non-Construction Costs</b>					<b>\$ 290,200</b>
<b>Total Project Costs</b>					<b>\$ 1,741,200</b>

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
OPHIR EXISTING POND IMPROVEMENTS (OEP)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 1,640.00	\$ 1,640
2	Clearing & Grubbing	AC	0	\$ 6,000.00	\$ -
3	Grading Cut/Fill	CY	500	\$ 15.00	\$ 7,500
4	Rip Rap	SF	0	\$ 20.00	\$ -
5	Type II Agg Base Road	SF	0	\$ 3.00	\$ -
6	Concrete Access Road	SF	0	\$ 21.00	\$ -
7	Concrete Spillway	SF	0	\$ 21.00	\$ -
8	24" SD	LF	0	\$ 260.00	\$ -
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	0	\$ 400.00	\$ -
12	48" Manhole/Outlet Structure	EA	0	\$ 8,000.00	\$ -
13	60" Manhole	EA	0	\$ 10,000.00	\$ -
14	72" Manhole	EA	1	\$ 13,000.00	\$ 13,000
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	0	\$ 5,000.00	\$ -
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	0	\$ 12,000.00	\$ -
20	Fence	LF	0	\$ 18.00	\$ -
21	Revegetation	AC	0.5	\$ 10,890.00	\$ 5,400
22	Erosion Control	LS	1	\$ 615.00	\$ 600
23	Contingency, 30%	LS	1	\$ 8,400	\$ 8,400
<b>Subtotal Construction Costs</b>					\$ 37,000
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 7,400
<b>Subtotal Non-Construction Costs</b>					\$ 7,400
<b>Total Project Costs</b>					\$ 44,400

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
6 MILE CANYON CULVERT IMPROVEMENTS (SMC)  
25 YEAR ESTIMATED COST  
AUGUST 2023**

<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total Price</b>
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 7,256.00	\$ 7,256
2	Clearing & Grubbing	AC	0	\$ 6,000.00	\$ -
3	Grading Cut/Fill	CY	0	\$ 15.00	\$ -
4	Rip Rap	SF	3885	\$ 20.00	\$ 77,700
5	Type II Agg Base Road	SF	0	\$ 3.00	\$ -
6	Concrete Access Road	SF	0	\$ 21.00	\$ -
7	Concrete Spillway	SF	0	\$ 21.00	\$ -
8	24" SD	LF	0	\$ 260.00	\$ -
9	30" SD	LF	0	\$ 300.00	\$ -
10	36" SD	LF	0	\$ 350.00	\$ -
11	48" SD	LF	0	\$ 400.00	\$ -
12	48" Manhole/Outlet Structure	EA	0	\$ 8,000.00	\$ -
13	60" Manhole	EA	0	\$ 10,000.00	\$ -
14	72" Manhole	EA	1	\$ 13,000.00	\$ 13,000
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	0	\$ 5,000.00	\$ -
17	30" Headwall	EA	0	\$ 8,000.00	\$ -
18	36" Headwall	EA	0	\$ 10,000.00	\$ -
19	48" Headwall	EA	0	\$ 12,000.00	\$ -
20	Fence	LF	0	\$ 18.00	\$ -
21	Revegetation	AC	0.5	\$ 10,890.00	\$ 5,400
22	Erosion Control	LS	1	\$ 2,721.00	\$ 2,700
23	Contingency, 30%	LS	1	\$ 31,800	\$ 31,800
<b>Subtotal Construction Costs</b>					\$ 138,000
<b>Non-Construction Costs</b>					
13	Permitting, Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 27,600
<b>Subtotal Non-Construction Costs</b>					\$ 27,600
<b>Total Project Costs</b>					\$ 165,600

Item	Description	Unit	Quantity	Unit Price	Total Price
<b>Construction Costs</b>					
1	Mobilization and Demobilization	LS	1	\$ 338,229.47	\$ 338,229
2	Clearing & Grubbing	AC	1.74	\$ 6,000.00	\$ 10,468
3	Grading Cut/Fill	CY	7400	\$ 15.00	\$ 111,000
4	Rip Rap	SF	56915	\$ 20.00	\$ 1,138,300
5	Type II Agg Base Road	SF	13584	\$ 3.00	\$ 40,800
6	Concrete Access Road	SF	1746	\$ 21.00	\$ 36,700
7	Concrete Spillway	SF	3200	\$ 21.00	\$ 67,200
8	24" SD	LF	130	\$ 260.00	\$ 33,800
9	30" SD	LF	558	\$ 300.00	\$ 167,400
10	36" SD	LF	2507	\$ 350.00	\$ 877,500
11	48" SD	LF	3292	\$ 400.00	\$ 1,316,800
12	48" Manhole/Outlet Structure	EA	1	\$ 8,000.00	\$ 8,000
13	60" Manhole	EA	9	\$ 10,000.00	\$ 90,000
14	72" Manhole	EA	20	\$ 13,000.00	\$ 260,000
15	96" Manhole	EA	0	\$ 18,000.00	\$ -
16	24" Headwall	EA	2	\$ 5,000.00	\$ 10,000
17	30" Headwall	EA	1	\$ 8,000.00	\$ 8,000
18	36" Headwall	EA	1	\$ 10,000.00	\$ 10,000
19	48" Headwall	EA	2	\$ 12,000.00	\$ 24,000
20	Fence	LF	1005	\$ 18.00	\$ 18,100
21	Revegetation	AC	3.81	\$ 10,890.00	\$ 41,500
22	Erosion Control	LS	1	\$ 126,522.00	\$ 126,500
23	Contingency, 30%	LS	1	\$ 1,420,300	\$ 1,420,300
<b>Subtotal Construction Costs</b>					\$ 6,155,000
<b>Non-Construction Costs</b>					
24	Permitting and Environmental				\$ -
25	Engineering, Construction Management, Administration, Testing, and Inspection, 20%				\$ 1,231,000
<b>Subtotal Non-Construction Costs</b>					\$ 1,231,000
<b>Total Project Costs</b>					\$ 7,386,000

<b>Project</b>	<b>Construction Costs</b>	<b>Non-Construction Costs</b>	<b>Total</b>
SRB	\$ 1,153,000	\$ 230,600	\$ 1,383,600
ORB	\$ 1,158,000	\$ 231,600	\$ 1,389,600
STOC	\$ 1,335,000	\$ 267,000	\$ 1,602,000
OTCC	\$ 884,000	\$ 176,800	\$ 1,060,800
OTSC	\$ 1,451,000	\$ 290,200	\$ 1,741,200
OEP	\$ 37,000	\$ 7,400	\$ 44,400
SMC	\$ 138,000	\$ 27,600	\$ 165,600
<b>Total</b>	<b>\$ 6,156,000</b>	<b>\$ 1,231,200</b>	<b>\$ 7,387,200</b>

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
ANNUAL O&M COSTS FOR EACH ALTERNATIVE**

Expense Type	SRB	ORB	OEP
<i>Additional O&amp;M Costs</i>			
Maintenance/RipRap Repairs <sup>1,2</sup>	\$ 32,400	\$ 32,400	\$ 32,400
Debris Removal/Disposal <sup>1,2</sup>	\$ 56,400	\$ 56,400	\$ 56,400
Revegetate	\$ 11,600	\$ 7,600	\$ 5,500
<b>Total</b>	<b>\$ 100,400</b>	<b>\$ 96,400</b>	<b>\$ 94,300</b>

<sup>1</sup> Assume maintenance and debris removal in each pond every 12 years (schedule one pond every 1 year).

<sup>2</sup> Costs based on 2017 FEMA Schedule of Equipment Rates.

<sup>3</sup> Average cost to reseed one pond based on vegetation cots in construction cost estimate

Assume 1 shovel for 2 days-25 year and 3 days-100year w/ 20% markup  
Assume 1 loader and 2 trucks for 3 days-25 year and 5 days-100year

Excavator, Hydraulic	2.5 CY	\$137.11
Loader, Wheel	4 CY	\$78.13
Truck, Dump	18 CY	\$84.17
Graders	12 ft	\$65.12

Debris Removal Frequency            12 yrs (per pond)  
Debris Removal Scheduling         1 yrs (one pond every 12 years)

**STOREY COUNTY  
VIRGINIA CITY & 6 MILE CANYON ADMP  
LIFE CYCLE COST ANALYSIS**

Alternative	Present Value			20-Yr NPV <sup>4</sup>
	Total Cost <sup>1</sup>	Project	O&M <sup>2</sup> (for 20 Yrs)	
SRB	\$ 1,383,600	\$ 1,775,800	\$ 3,159,400	
ORB	\$ 1,389,600	\$ 1,705,100	\$ 3,094,700	
OEP	\$ 44,400	\$ 1,667,900	\$ 1,712,300	
<b>Total</b>	<b>\$ 2,817,600</b>	<b>\$ 5,148,800</b>	<b>\$ 7,966,400</b>	

<sup>1</sup> Total project cost includes construction and non-construction costs.

<sup>2</sup> Considers 20-year real discount rate of 1.2 percent per Circular A94 Appendix C from the Office of Management and Budget, revised November 2015 ([https://www.whitehouse.gov/omb/circulars\\_a094/a94\\_appx-c](https://www.whitehouse.gov/omb/circulars_a094/a94_appx-c)).

<sup>3</sup> Salvage Values are based useful material (sand) excavated collected within the

<sup>4</sup> Total 20-YR NPV = Total Project Cost + O&M (uniform series present worth) – Salvage (single payment present worth).

Discount Rate, i                      1.20%  
Period (yrs), n                         20

Uniform Series Present Worth (USPW):

$$P/A = \frac{(1 + i)^n - 1}{i(1 + i)^n}$$

Single Payment Present Worth (SPPW):

$$P/F = (1 + i)^{-n}$$

# Appendix C

## NRCS Soils Data

### Physical Soil Properties

Storey County Area, Nevada

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
561:														
Gabica	0-5	55-72	11-37	6-17	1.46-1.50	4.00-14.00	0.10-0.12	0.2-1.1	1.0-2.0	.10	.37	1	6	48
	5-9	28-50	28-47	20-35	1.42-1.51	1.40-4.00	0.05-0.09	0.9-3.3	1.0-2.0	.10	.43			
	9-15	28-50	28-47	20-35	1.33-1.51	1.40-4.00	0.05-0.09	0.9-3.3	1.0-2.0	.10	.37			
	15-80	---	---	---	---	0.00-0.42	---	---	---	---	---			
Easte	0-5	55-75	7-40	5-18	1.43-1.51	14.11-42.34	0.08-0.09	0.2-1.0	3.0-4.0	.05	.20	4	6	48
	5-13	38-72	10-44	5-18	1.35-1.52	14.11-42.34	0.08-0.09	0.2-1.4	3.0-4.0	.05	.17			
	13-42	32-50	32-50	12-18	1.37-1.48	14.11-42.34	0.05-0.07	0.2-0.6	1.0-2.0	.05	.37			
	42-83	---	---	---	---	0.01-0.42	---	---	---	---	---			
Bumborough	0-11	30-50	28-50	10-25	1.42-1.51	4.00-14.00	0.08-0.09	0.6-2.7	1.0-2.0	.17	.37	5	7	38
	11-17	25-45	20-50	18-35	1.45-1.60	4.00-14.00	0.08-0.11	0.6-2.9	0.0-1.0	.15	.32			
	17-82	25-45	20-50	18-35	1.45-1.60	4.00-14.00	0.08-0.11	0.6-2.9	0.0-1.0	.10	.32			
740:														
Reywat	0-6	35-52	35-50	10-18	1.30-1.50	4.00-14.00	0.12-0.17	0.6-1.6	1.0-3.0	.20	.49	1	6	48
	6-19	25-40	25-45	24-35	1.35-1.55	1.40-4.00	0.09-0.14	1.0-3.3	0.0-1.0	.15	.37			
	19-29	---	---	---	---	0.00-0.01	---	---	---	---	---			
Ister	0-11	50-80	10-35	10-15	1.30-1.50	14.00-42.00	0.08-0.10	0.4-1.0	1.0-2.0	.05	.20	2	6	48
	11-24	45-70	5-30	25-35	1.40-1.60	1.40-4.00	0.08-0.14	1.5-3.2	0.5-1.0	.05	.20			
	24-38	25-55	20-45	25-35	1.40-1.60	1.40-4.00	0.08-0.14	1.5-3.2	0.5-1.0	.15	.37			
	38-48	---	---	---	---	0.00-0.01	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---	---

# Map Unit Description (Brief, Generated)

Storey County Area, Nevada

[Minor map unit components are excluded from this report]

**Map unit:** 561 - Gabica-Easte-Burnborough association

**Component:** Gabica (45%)

*The Gabica component makes up 45 percent of the map unit. Slopes are 15 to 30 percent. This component is on mountains on mountains. The parent material consists of colluvium derived from volcanic rock and/or residuum weathered from volcanic rock. Depth to a root restrictive layer, bedrock, lithic, is 14 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R026XY028NV MOUNTAIN RIDGE ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface.*

**Component:** Easte (25%)

*The Easte component makes up 25 percent of the map unit. Slopes are 8 to 50 percent. This component is on mountain slopes on mountains. The parent material consists of colluvium derived from andesite and/or residuum weathered from andesite. Depth to a root restrictive layer, bedrock, paralithic, is 39 to 59 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. This component is in the F023XY092NV ABCO/CEVE ecological site. Nonirrigated land capability classification is 6s. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface.*

**Component:** Burnborough (15%)

*The Burnborough component makes up 15 percent of the map unit. Slopes are 15 to 50 percent. This component is on mountain slopes on mountains. The parent material consists of colluvium derived from volcanic rock over residuum weathered from volcanic rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R026XY005NV LOAMY 12-14 P.Z. ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface.*

# Chemical Soil Properties

Storey County Area, Nevada

[Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	Cation- exchange capacity	Effective cation- exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorption ratio
	<i>In</i>	<i>meq/100 g</i>	<i>meq/100 g</i>	<i>pH</i>	<i>Pct</i>	<i>Pct</i>	<i>mmhos/cm</i>	
561:								
Gabica	0-5	5.6-14	---	5.6 - 7.3	0-1	0	0.0-2.0	0
	5-9	17-28	---	5.6 - 7.3	0-1	0	0.0-2.0	0
	9-15	17-28	---	5.6 - 7.3	0-1	0	0.0-2.0	0
	15-60	---	---	---	---	---	---	---
Easte	0-5	9.8-20	---	5.6 - 6.5	0-1	0	0.0-2.0	0
	5-13	9.8-20	---	5.6 - 6.5	0-1	0	0.0-2.0	0
	13-42	7.6-16	---	5.1 - 6.5	0-1	0	0.0-2.0	0
	42-63	---	---	---	---	---	---	---
Burnborough	0-11	8.9-20	---	6.1 - 7.3	0-1	0	0.0-2.0	0
	11-17	12-23	---	6.1 - 7.3	0-1	0	0.0-2.0	0
	17-62	12-23	---	6.1 - 7.3	0-1	0	0.0-2.0	0
740:								
Reywat	0-6	8.9-15	---	6.6 - 7.8	0-1	0	0.0-2.0	0
	6-19	17-28	---	6.6 - 8.4	0-2	0	0.0-2.0	0
	19-29	---	---	---	---	---	---	---
Ister	0-11	8.9-12	---	6.6 - 7.8	0-1	0	0.0-0.1	0
	11-24	20-27	---	6.6 - 7.8	0-1	0	0.0-0.1	0
	24-38	20-27	---	6.6 - 7.8	0-1	0	0.0-0.1	0
	38-48	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	

# Engineering Properties

Storey County Area, Nevada

[Absence of an entry indicates that the data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
	<i>In</i>				<i>Pct</i>	<i>Pct</i>					<i>Pct</i>	
<b>561:</b>												
Gabica	0-5	Very cobbly sandy loam	SC	A-2-4	0	20-24	52-74	36-65	27-55	13-30	0-31	NP-11
	5-9	Very gravelly clay loam, very gravelly loam	GC	A-2-6	0	6-12	58-62	31-54	27-54	19-43	31-48	13-24
	9-15	Very gravelly clay loam, very gravelly loam	GC	A-2-7	0	6-12	51-61	30-54	24-51	19-41	31-48	13-24
	15-60	Bedrock	---	---	---	---	---	---	---	---	---	---
Easte	0-5	Very gravelly sandy loam	SC	A-2-4	0-6	13-14	54-67	34-59	25-50	12-28	0-36	NP-11
	5-13	Gravelly coarse sandy loam, gravelly loam, very gravelly sandy loam	GC	A-2-6	0-6	0-14	54-84	34-75	23-61	10-32	0-36	NP-12
	13-42	Very gravelly loam, extremely gravelly loam	SC	A-2-4	0-2	5-9	55-59	17-28	14-26	10-19	22-32	5-12
	42-63	Bedrock	---	---	---	---	---	---	---	---	---	---
Burnborough	0-11	Cobbly loam	SC	A-6	0	0-21	73-84	64-76	45-65	35-53	22-39	5-17
	11-17	Very gravelly clay loam, very gravelly loam	GC	A-2-6	0-6	6-12	48-70	34-55	28-55	21-44	27-45	12-25
	17-62	Very gravelly clay loam, very gravelly loam	GC	A-2-6	0-6	6-12	48-70	34-55	28-55	21-44	27-45	12-25
<b>740:</b>												
Reywat	0-6	Cobbly loam	SC	A-4	1-4	8-20	73-88	54-86	41-78	29-62	23-34	5-12
	6-19	Very gravelly clay loam, very gravelly loam	GC	A-2-6, A-6, A-7	0-5	5-20	40-60	35-55	30-45	25-40	33-46	16-25
	19-29	Bedrock	---	---	---	---	---	---	---	---	---	---

# Engineering Properties

Storey County Area, Nevada

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index		
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200				
					<i>In</i>	<i>Pct</i>	<i>Pct</i>					<i>Pct</i>		
740: Ister	0-11	Very stony sandy loam	SC-SM	A-2-4, A-4	20-30	5-10	60-80	55-75	35-55	25-40	22-29	5-9		
	11-24	Very stony clay loam, very stony sandy clay loam	GC, SC	A-2, A-6, A-7	20-30	15-25	60-85	55-80	40-60	30-50	35-46	16-25		
	24-38	Very stony clay loam, very stony sandy clay loam	GC, SC	A-2, A-6, A-7	20-30	15-25	60-85	55-80	40-60	30-50	35-46	16-25		
	38-48	Bedrock	---	---	---	---	---	---	---	---	---	---		
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---		

# Physical Soil Properties

Storey County Area, Nevada

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	<i>In</i>	<i>Pct</i>	<i>Pct</i>	<i>Pct</i>	<i>g/cc</i>	<i>micro m/sec</i>	<i>In/In</i>	<i>Pct</i>	<i>Pct</i>					
561:														
Gabica	0-5	55-72	11-37	6-17	1.46-1.59	4.00-14.00	0.10-0.12	0.2-1.1	1.0-2.0	.10	.37	1	6	48
	5-9	28-50	28-47	20-35	1.42-1.51	1.40-4.00	0.05-0.09	0.9-3.3	1.0-2.0	.10	.43			
	9-15	28-50	28-47	20-35	1.33-1.51	1.40-4.00	0.05-0.09	0.9-3.3	1.0-2.0	.10	.37			
	15-60	---	---	---	---	0.00-0.42	---	---	---	---	---			
Easte	0-5	55-75	7-40	5-18	1.43-1.51	14.11-42.34	0.06-0.09	0.2-1.0	3.0-4.0	.05	.20	4	6	48
	5-13	38-72	10-44	5-18	1.35-1.52	14.11-42.34	0.06-0.09	0.2-1.4	3.0-4.0	.05	.17			
	13-42	32-50	32-50	12-18	1.37-1.48	14.11-42.34	0.05-0.07	0.2-0.6	1.0-2.0	.05	.37			
	42-63	---	---	---	---	0.01-0.42	---	---	---	---	---			
Burnborough	0-11	30-50	28-50	10-25	1.42-1.51	4.00-14.00	0.08-0.09	0.6-2.7	1.0-2.0	.17	.37	5	7	38
	11-17	25-45	20-50	18-35	1.45-1.60	4.00-14.00	0.08-0.11	0.6-2.9	0.0-1.0	.15	.32			
	17-62	25-45	20-50	18-35	1.45-1.60	4.00-14.00	0.08-0.11	0.6-2.9	0.0-1.0	.10	.32			
740:														
Reywat	0-6	35-52	35-50	10-18	1.30-1.50	4.00-14.00	0.12-0.17	0.6-1.6	1.0-3.0	.20	.49	1	6	48
	6-19	25-40	25-45	24-35	1.35-1.55	1.40-4.00	0.09-0.14	1.0-3.3	0.0-1.0	.15	.37			
	19-29	---	---	---	---	0.00-0.01	---	---	---	---	---			
Ister	0-11	50-80	10-35	10-15	1.30-1.50	14.00-42.00	0.08-0.10	0.4-1.0	1.0-2.0	.05	.20	2	6	48
	11-24	45-70	5-30	25-35	1.40-1.60	1.40-4.00	0.08-0.14	1.5-3.2	0.5-1.0	.05	.20			
	24-38	25-55	20-45	25-35	1.40-1.60	1.40-4.00	0.08-0.14	1.5-3.2	0.5-1.0	.15	.37			
	38-48	---	---	---	---	0.00-0.01	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---	---

## RUSLE2 Related Attributes

Storey County Area, Nevada

[This report shows only the major soils in each map unit]

Map symbol and soil name	Pct. of map unit	Hydrologic group	Kf	T factor	Representative value		
					% Sand	% Silt	% Clay
561:							
Gabica	45	D	.37	1	67.0	23.0	10.0
Easte	25	A	.20	4	67.0	23.0	10.0
Burnborough	15	B	.37	5	43.0	39.0	18.0
740:							
Reywat	45	D	.49	1	45.0	41.0	14.0
Ister	30	C	.20	2	68.0	20.0	12.0
Rock outcrop	10	---	---	---	---	---	---

# Water Features

Storey County Area, Nevada

[Depths of layers are in feet. See text for definitions of terms used in this table. Estimates of the frequency of ponding and flooding apply to the whole year rather than to individual months. Absence of an entry indicates that the feature is not a concern or that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Hydrologic group	Surface runoff	Months	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
561:										
Gabica	D	High	Jan-Dec			---	---	None	---	None
Easte	A	Medium	Jan-Dec			---	---	None	---	None
Burnborough	B	High	Jan-Dec			---	---	None	---	None
740:										
Reywat	D	Very high	Jan-Dec			---	---	None	---	None
Ister	C	High	Jan-Dec			---	---	None	---	None
Rock outcrop	---	---	Jan-Dec			---	---	None	---	None

# Map Unit Description (Brief, Generated)

Storey County Area, Nevada

**Map unit:** 740 - Reywat-Ister-Rock outcrop association

**Component:** Reywat (45%)

*The Reywat component makes up 45 percent of the map unit. Slopes are 15 to 50 percent. This component is on mountains on mountains. The parent material consists of colluvium derived from volcanic rock over residuum weathered from volcanic rock. Depth to a root restrictive layer, bedrock, lithic, is 10 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R026XY015NV SHALLOW LOAM 10-12 P.Z. ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 1 percent. There are no saline horizons within 30 inches of the soil surface.*

**Component:** Ister (30%)

*The Ister component makes up 30 percent of the map unit. Slopes are 30 to 50 percent. This component is on mountain slopes on mountains. The parent material consists of colluvium derived from volcanic rock over residuum weathered from volcanic rock. Depth to a root restrictive layer, bedrock, lithic, is 20 to 39 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R026XY010NV LOAMY 10-12 P.Z. ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface.*

**Component:** Rock outcrop (10%)

*Generated brief soil descriptions are created for major soil components. The Rock outcrop is a miscellaneous area.*

# Appendix D

## LiDAR Report

---



**Virginia City/Six Mile Canyon Area Drainage Master Plan  
Final Report | November 2023**

**NV Reno Carson Urban Lidar 2017 B17**  
**SURVEY REPORT**

USGS Contract: G16PC00044  
Task Order Number: G17PD01257



**Government Point-of-Contact (POC)**

Organization: USGS/NGTOC  
Telephone: (573) 308-3756  
Address: Gail Dunn  
1400 Independence Road, MS 663  
Rolla, MO 65401



**Contractor Point-of-Contact (POC)**

Address: Digital Aerial Solutions, LLC  
Telephone: (813) 628-0788  
ATTN: Joshua Helton (VP)  
4027 Crescent Park Drive  
Riverview, FL 33578

# Table of Contents

<b>OVERVIEW</b>	<b>3</b>
<b>GLOSSARY OF TERMS</b>	<b>4</b>
<b>SUPPLEMENTAL GROUND CONTROL</b>	<b>5</b>
<b>NON-VEGETATED VERTICAL ACCURACY CHECKPOINTS</b>	<b>37</b>
Bare Earth	37
Packed Sand	71
Hard Pavement	92
<b>VEGETATED VERTICAL ACCURACY CHECKPOINTS</b>	<b>114</b>
Low Vegetation	114
Medium Vegetation	134
High Vegetation	168

# OVERVIEW

Digital Aerial Solutions, LLC (DAS) with contract number G16PC00044 was contracted by the USGS/NGTOC under task order number G17PD01257 collect a high resolution LiDAR data set covering 1534 square miles affecting Carson City, Douglas, Lyon, Sierra, Storey and Washoe counties in Nevada. Each of these categories was spread out as evenly as possible throughout the Area of Interest (AOI). The survey was completed using the Global Positioning System (GPS). Each observation was identified in the field and surveyed utilizing GPS receivers, collecting GNSS and GLONASS information and utilizing a Leica Smart-Net RTK network. In accordance with section C.1.b.(viii) of the task order, the spatial reference system used was:

## **Spatial Reference System:**

Coordinate System:	Universal Transverse Mercator 11 North
Horizontal Datum:	North American Datum 1983 of (2011)
Vertical Datum:	North American Vertical Datum of 1988
Units:	Meters
Geoid Model:	Geoid 12B

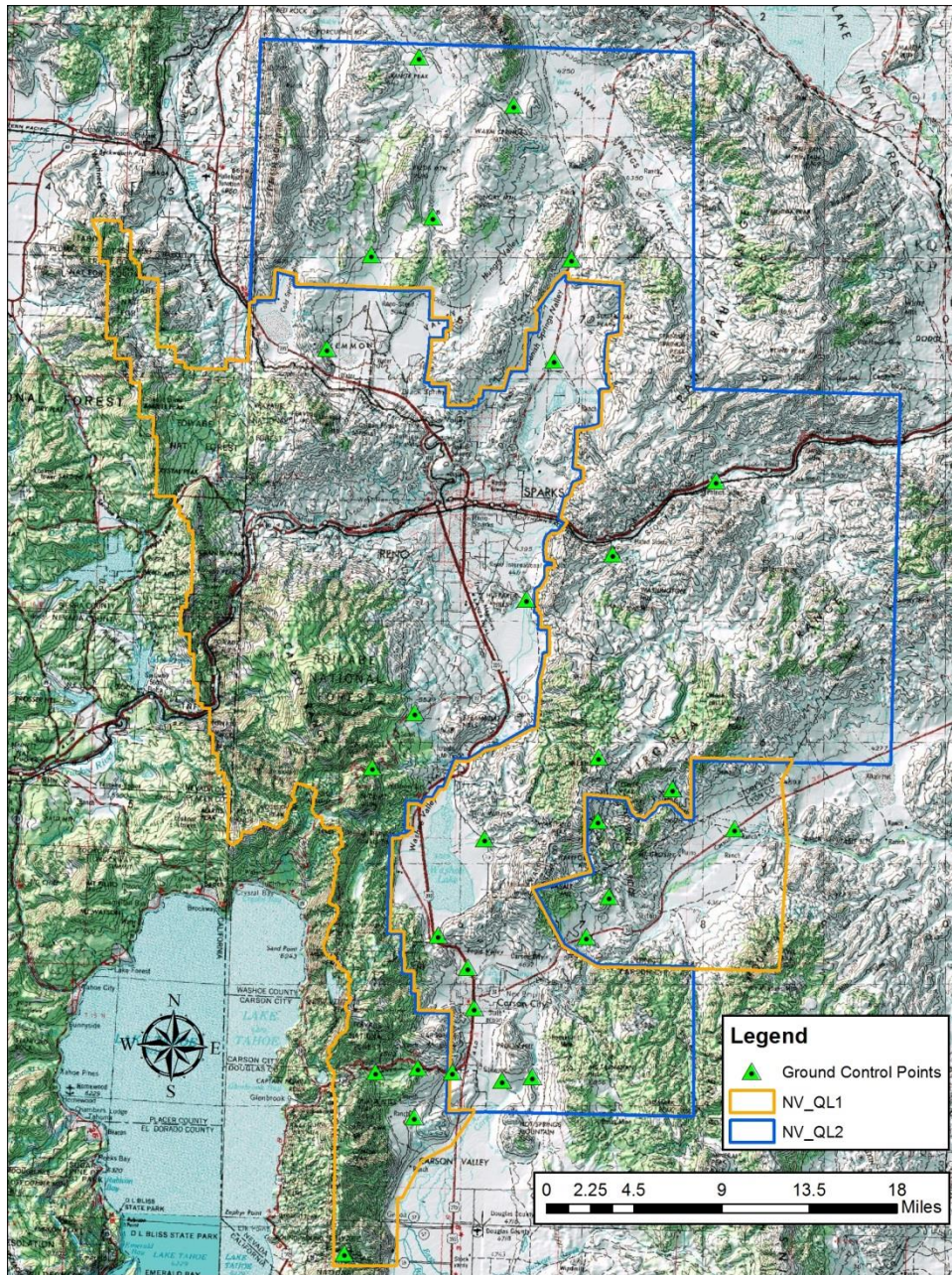
Section C.1.b.(ix) of the task order outlines the ground control minimum requirements and specifications for this LiDAR project. 30 Supplemental ground control points were collected and used to support the airborne GPS solution and positional accuracy. DAS also collected more than the required number of Non-Vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA) Quality Checkpoints as stated in the task order. These checkpoints serve as an independent delivery to the client and were not incorporated into the vertical solution.

# Glossary of Terms

<b>Term</b>	<b>Definition</b>
ATTN	- Attention
BG	- Bare-Ground Checkpoint (see NVA)
CO	- Colorado, USA
CTRL	- Control
DAS	- Digital Aerial Solutions, LLC
Ellip	- Ellipsoid Height
FIPS	- Federal Information Processing Standard
FL	- Florida
GPS	- Global Positioning Systems
HVEG	- High Vegetation(see VVA)
ID	- Identification
LVEG	- Low Vegetation (see VVA)
LiDAR	- Light Detection and Ranging
MVEG	- Medium Vegetation (see VVA)
NAD83	- North American Datum of 1983
NAVD88	- North American Vertical Datum of 1988
NGS	- National Geodetic Survey
NGTOC	- National Geospatial Technical Operations Center
NVA	- Non-Vegetated Vertical Accuracy
Ortho	- Orthometric Height
POC	- Point of Contact
PT	- Pavement(see NVA)
RTK	- Real Time Kinematics
SD	- Sand(see NVA)
USGS	- United States Geological Survey
VP	- Vice President
VVA	- Vegetated Vertical Accuracy

# Supplemental Ground Control

The Map shows the overall distribution of the Supplemental Ground Control throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. The coordinate system displayed is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
GCP.BG.01	260969.099	4338273.650	1423.118
GCP.BG.10	277392.198	4356378.341	1648.380
GCP.BG.11	277392.199	4356378.343	1648.371
GCP_NVA.BG.02	256020.902	4329290.092	1528.339
GCP_NVA.BG.03	250244.158	4318040.241	2163.541
GCP_NVA.BG.04	272152.037	4347496.544	1554.815
GCP_NVA.BG.06	271231.517	4353733.300	1907.229
GCP_NVA.BG.07	271263.717	4359012.689	2074.733
GCP_NVA.BG.11	252561.759	4358148.771	2308.951
GCP.HP.01	258003.661	4344308.104	1550.248
GCP.HP.02	272445.392	4375771.769	1338.888
GCP.HP.11	282521.926	4353104.002	1323.601
GCP.HP.12	257558.262	4403563.812	1563.345
GCP_NVA.HP.03	259189.646	4332992.955	1480.408
GCP_NVA.HP.06	263293.752	4332298.771	1438.997
GCP_NVA.HP.08	270245.594	4344174.034	1481.727
GCP_NVA.HP.09	256091.814	4362654.773	1771.648
GCP_NVA.HP.16	260442.590	4341638.183	1442.508
GCP_NVA.HP.24	280973.185	4381806.092	1308.072
GCP_NVA.LV.10	261848.550	4352267.561	1569.989
GCP.PS.01	248807.550	4392717.700	1520.357
GCP.PS.02	256445.016	4416808.361	1513.873
GCP_NVA.PS.04	256325.956	4333359.564	1631.584
GCP_NVA.PS.06	252854.437	4332996.338	1824.366
GCP_NVA.PS.08	265773.119	4332626.121	1415.375
GCP_NVA.PS.13	265301.972	4372050.220	1347.786
GCP_NVA.PS.18	252471.425	4400483.183	1575.459
GCP_NVA.PS.28	264254.101	4412809.060	1476.773
GCP_NVA.PS.30	269039.062	4400110.380	1434.329
GCP_NVA.PS.31	267592.540	4391765.602	1372.906

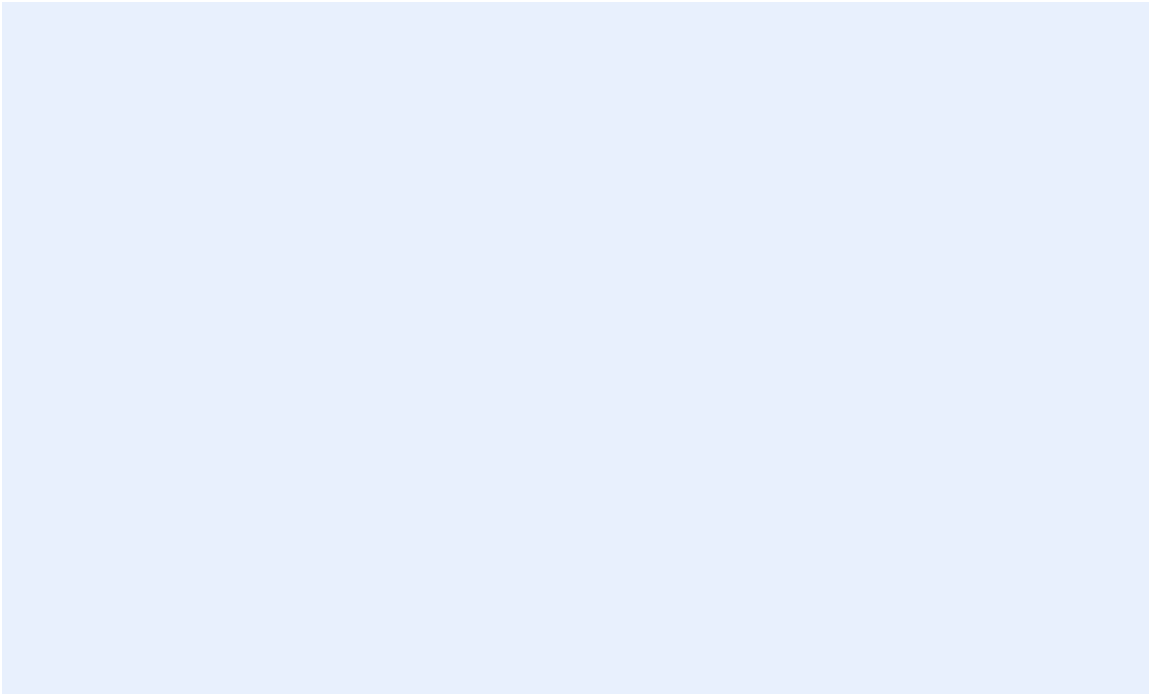
### GCP.BG.01



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.BG.01	260969.099	4338273.650	1398.696	1423.118

Point ID	LATTITUDE	LONGITUDE
GCP.BG.01	39° 9' 39.10338"	-119° 45' 59.36652"

## GCP.BG.10



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.BG.10	277392.198	4356378.341	1624.190	1648.380

Point ID	LATTITUDE	LONGITUDE
GCP.BG.10	39° 19' 41.49649"	-119° 34' 57.26532"

**GCP.BG.11**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.BG.11	277392.199	4356378.343	1624.181	1648.371

Point ID	LATTITUDE	LONGITUDE
GCP.BG.11	39° 19' 41.49656"	-119° 34' 57.26532"

GCP\_NVA.BG.02



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.BG.02	256020.902	4329290.092	1503.877	1528.339

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.BG.02	39° 4' 43.08596"	119° 49' 13.683"

GCP\_NVA.BG.03



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.BG.03	250244.158	4318040.241	2139.306	2163.541

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.BG.03	38° 58' 32.71462"	-119° 52' 58.98324"

GCP\_NVA.BG.04



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.BG.04	272152.037	4347496.544	1530.542	1554.815

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.BG.04	39° 14' 48.77308"	-119° 38' 25.08576"

GCP\_NVA.BG.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.BG.06	271231.517	4353733.300	1883.094	1907.229

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.BG.06	39° 18' 10.00015"	-119° 39' 11.07288"

GCP\_NVA.BG.07



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.BG.07	271263.717	4359012.689	2050.668	2074.733

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.BG.07	39° 21' 1.10513"	-119° 39' 16.19964"

### GCP\_NVA.BG.11



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.BG.11	252561.759	4358148.771	2285.225	2308.951

Point ID	LATITUDE	LONGITUDE
GCP_NVA.BG.11	39° 20' 14.57466"	-119° 52' 15.5046"

### GCP.HP.01



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.HP.01	258003.661	4344308.104	1525.997	1550.248

Point ID	LATTITUDE	LONGITUDE
GCP.HP.01	39° 12' 51.67526"	-119° 48' 10.5552"

**GCP.HP.02**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.HP.02	272445.392	4375771.769	1314.749	1338.888

Point ID	LATTITUDE	LONGITUDE
GCP.HP.02	39° 30' 5.28743"	-119° 38' 47.41368"

### GCP.HP.11



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.HP.11	282521.926	4353104.002	1299.269	1323.601

Point ID	LATTITUDE	LONGITUDE
GCP.HP.11	39° 18' 0.08032"	-119° 31' 19.40484"

### GCP.HP.12



Point ID	Easting <b>X</b> (m)	Northing <b>Y</b> (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.HP.12	257558.262	4403563.812	1539.593	1563.345

Point ID	LATTITUDE	LONGITUDE
GCP.HP.12	39° 44' 51.04536"	-119° 49' 46.66584"

GCP\_NVA.HP.03



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.HP.03	259189.646	4332992.955	1455.930	1480.408

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.HP. 03	39° 6' 46.23397"	-119° 47' 6.67824"

GCP\_NVA.HP.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.HP.06	263293.752	4332298.771	1414.475	1438.997

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.HP.06	39° 6' 27.78678"	-119° 44' 15.10728"

GCP\_NVA.HP.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.HP.08	270245.594	4344174.034	1457.430	1481.727

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.HP.08	39° 12' 59.29888"	-119° 39' 40.46616"

GCP\_NVA.HP.09



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.HP.09	270245.594	4344174.034	1747.778	1481.727

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.HP.09	39° 22' 44.1754"	-119° 49' 54.12108"

GCP\_NVA.HP.16



Point ID	Easting <b>X</b> (m)	Northing <b>Y</b> (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.HP.16	260442.590	4341638.183	1418.162	1442.508

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.HP.16	39° 11' 27.59921"	-119° 46' 25.56552"

GCP\_NVA.HP.24



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.HP.24	280973.185	4381806.092	1283.954	1308.072

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.HP.24	39° 33' 28.80727"	-119° 32' 57.85728"

GCP\_NVA.LV.10



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.LV.10	261848.550	4352267.561	1545.803	1569.989

Point ID	LATTITUDE	LONGITUDE
GCP_NVA.LV.10	39° 17' 13.40131"	-119° 45' 40.52664"

**GCP.PS.01**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.PS.01	248807.550	4392717.700	1496.610	1520.357

Point ID	LATTITUDE	LONGITUDE
GCP.PS.01	39° 38' 50.57023"	-119° 55' 39.03276"

GCP.PS.02



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP.PS.02	256445.016	4416808.361	1490.221	1513.873

Point ID	LATTITUDE	LONGITUDE
GCP.PS.02	39° 51' 58.97732"	-119° 50' 51.08712"

GCP\_NVA.PS.04



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.04	256325.956	4333359.564	1607.187	1631.584

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.04	39° 6' 55.24783"	-119° 49' 6.25404"

GCP\_NVA.PS.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.06	252854.437	4332996.338	1800.073	1824.366

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.06	39° 6' 39.96108"	-119° 51' 30.1608"

GCP\_NVA.PS.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.08	265773.119	4332626.121	1390.895	1415.375

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.08	39° 6' 40.80467"	-119° 42' 32.39532"

GCP\_NVA.PS.13



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.13	265301.972	4372050.220	1323.615	1347.786

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.13	39° 27' 57.79202"	-119° 43' 41.46996"

GCP\_NVA.PS.18



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.18	252471.425	4400483.183	1551.711	1575.459

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.18	39° 43' 5.98415"	-119° 53' 15.97812"

GCP\_NVA.PS.28



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.28	264254.101	4412809.060	1453.081	1476.773

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.28	39° 49' 57.34283"	-119° 45' 17.58672"

GCP\_NVA.PS.30



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.30	269039.062	4400110.380	1410.436	1434.329

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.30	39° 43' 10.6288"	-119° 41' 40.43112"

GCP\_NVA.PS.31



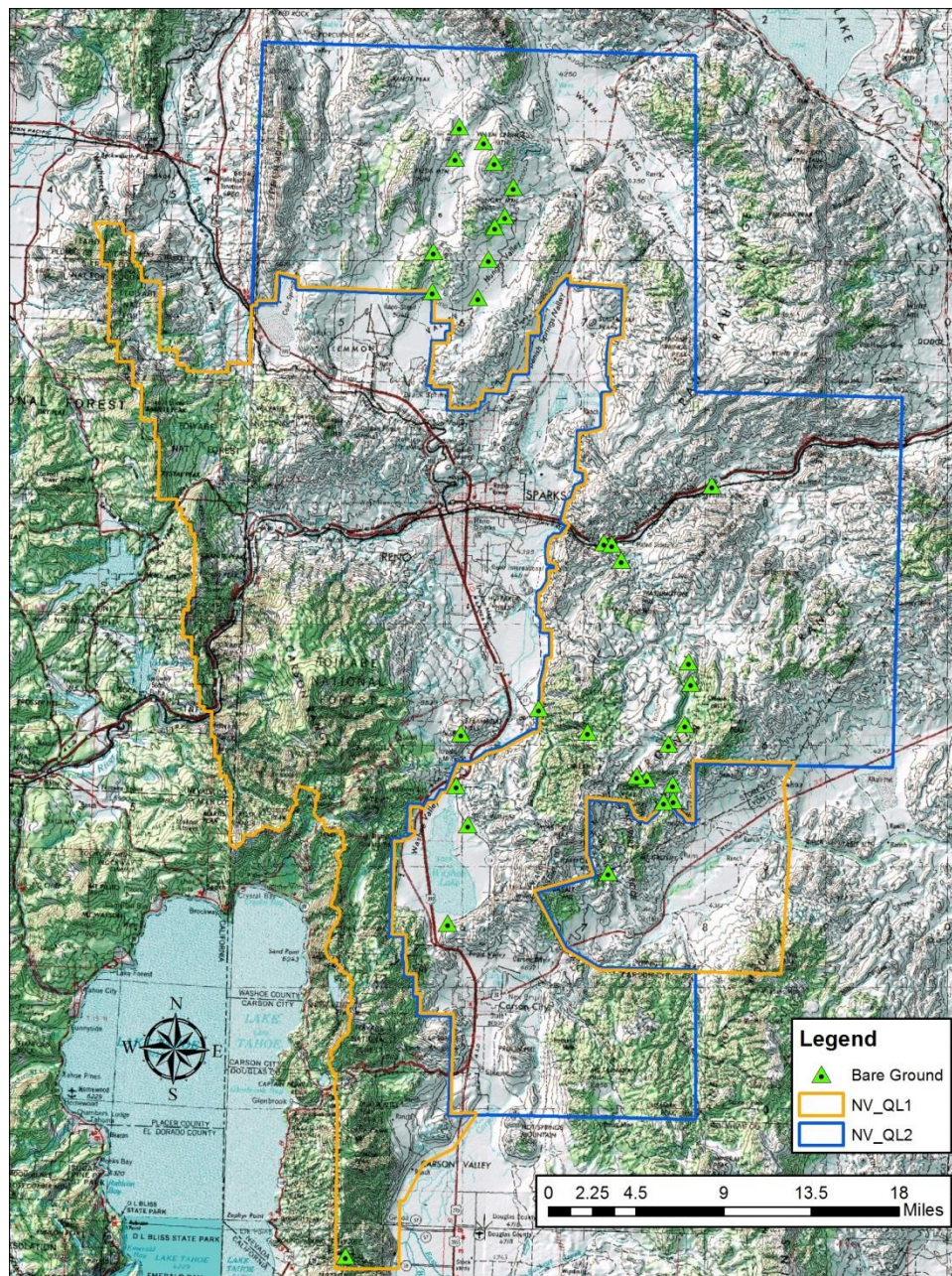
Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
GCP_NVA.PS.31	267592.540	4391765.602	1348.901	1372.906

Point ID	LATITUDE	LONGITUDE
GCP_NVA.PS.31	39° 38' 38.83801"	-119° 42' 30.546"

# Non-Vegetated Vertical Accuracy Checkpoints

## Bare Earth

The Map shows the overall distribution of the Non-Vegetated Vertical Accuracy Checkpoint, Bare Earth throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. The coordinate system displayed is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
NVA.BG.03A	250244.122	4318038.929	2163.561
NVA.BG.05	271973.423	4349694.748	1560.549
NVA.BG.08	270241.281	4361309.801	1934.795
NVA.BG.09	266248.56	4363224.658	1481.683
NVA.BG.10	259795.06	4361167.423	1838.814
NVA.BG.11	258724.86	4345532.127	1543.781
NVA.BG.12	260353.727	4353643.357	1552.69
NVA.BG.13	259421.284	4356882.446	1547.528
NVA.BG.14	271607.062	4376914.191	1354.109
NVA.BG.15	272251.052	4376819.247	1331.011
NVA.BG.16	273058.573	4375480.444	1345.184
NVA.BG.17	280558.528	4381665.727	1304.147
NVA.BG.24	277346.7	4355681.048	1537.208
NVA.BG.25	276571.055	4355540.406	1558.04
NVA.BG.26	277323.692	4356988.818	1736.75
NVA.BG.27	275141.375	4357400.1	1778.342
NVA.BG.28	274341.871	4357659.906	1931.523
NVA.BG.29	276948.999	4360293.082	1837.21
NVA.BG.30	278296.379	4361923.176	1793.652
NVA.BG.31	278800.915	4365322.289	1758.492
NVA.BG.32	278601.896	4367091.565	1714.901
NVA.BG.33	257416.204	4397686.049	1543.609
NVA.BG.34	257536.856	4400939.036	1675.732
NVA.BG.35	259328.032	4408701.385	1579.476
NVA.BG.36	259678.057	4411293.895	1616.269
NVA.BG.37	261661.994	4410052.846	1627.899
NVA.BG.38	262545.573	4408347.662	1746.511
NVA.BG.39	264149.326	4406305.152	1543.064
NVA.BG.40	263437.076	4403900.184	1562.443
NVA.BG.41	262593.578	4403012.766	1598.613
NVA.BG.42	262060.194	4400355.207	1549.99
NVA.BG.43	261180.16	4397202.348	1551.117

NVA.BG.03A



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.03 A	250244.122	4318038.929	2139.326	2163.561

Point ID	LATTITUDE	LONGITUDE
NVA.BG.03A	38° 58' 32.67206"	-119° 52' 58.98324"

NVA.BG.05



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.05	271973.423	4349694.748	1536.314	1560.549

Point ID	LATTITUDE	LONGITUDE
NVA.BG.05	39° 15' 59.83664"	-119° 38' 35.20572"

NVA.BG.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.08	270241.281	4361309.801	1910.741	1934.795

Point ID	LATTITUDE	LONGITUDE
NVA.BG.08	39° 22' 14.56385"	-119° 40' 1.70436"

NVA.BG.09



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.09	266248.56	4363224.658	1457.560	1481.683

Point ID	LATTITUDE	LONGITUDE
NVA.BG.09	39° 23' 12.75338"	-119° 42' 50.79204"

**NVA.BG.10**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.10	259795.060	4361167.423	1814.798	1838.814

Point ID	LATTITUDE	LONGITUDE
NVA.BG.10	39° 21' 59.72155"	-119° 47' 17.59884"

**NVA.BG.11**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.11	258724.860	4345532.127	1519.533	1543.781

Point ID	LATTITUDE	LONGITUDE
NVA.BG.11	39° 13' 32.05704"	-119° 47' 42.09072"

NVA.BG.12



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.12	260353.727	4353643.357	1528.535	1552.690

Point ID	LATTITUDE	LONGITUDE
NVA.BG.12	39° 17' 56.49468"	-119° 46' 44.61636"

**NVA.BG.13**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.13	259421.284	4356882.446	1523.451	1547.528

Point ID	LATTITUDE	LONGITUDE
NVA.BG.13	39° 19' 40.51236"	-119° 47' 27.67236"

NVA.BG.14



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.14	271607.062	4376914.191	1329.981	1354.109

Point ID	LATTITUDE	LONGITUDE
NVA.BG.14	39° 30' 41.5053"	-119° 39' 23.88888"

NVA.BG.15



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.15	272251.052	4376819.247	1306.879	1331.011

Point ID	LATTITUDE	LONGITUDE
NVA.BG.15	39° 30' 39.04398"	-119° 38' 56.832"

NVA.BG.16



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.16	273058.573	4375480.444	1321.043	1345.184

Point ID	LATTITUDE	LONGITUDE
NVA.BG.16	39° 29' 56.43089"	-119° 38' 21.40908"

**NVA.BG.17**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.17	280558.528	4381665.727	1280.030	1304.147

Point ID	LATTITUDE	LONGITUDE
NVA.BG.17	39° 33' 23.87729"	-119° 33' 15.0498"

NVA.BG.24



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.24	277346.700	4355681.048	1512.998	1537.208

Point ID	LATITUDE	LONGITUDE
NVA.BG.24	39° 19' 18.85786"	-119° 34' 58.332"

NVA.BG.25



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.25	276571.055	4355540.406	1533.837	1558.040

Point ID	LATTITUDE	LONGITUDE
NVA.BG.25	39° 19' 13.58047"	-119° 35' 30.525"

NVA.BG.26



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.26	277323.692	4356988.818	1712.579	1736.750

Point ID	LATTITUDE	LONGITUDE
NVA.BG.26	39° 20' 1.21614"	-119° 35' 0.85236"

NVA.BG.27



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.27	275141.375	4357400.100	1754.206	1778.342

Point ID	LATTITUDE	LONGITUDE
NVA.BG.27	39° 20' 12.51136"	-119° 36' 32.41224"

NVA.BG.28



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.28	274341.871	4357659.906	1907.402	1931.523

Point ID	LATTITUDE	LONGITUDE
NVA.BG.28	39° 20' 20.18072"	-119° 37' 6.08952"

**NVA.BG.29**



Point ID	Easting <b>X</b> (m)	Northing <b>Y</b> (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.29	276948.999	4360293.082	1813.106	1837.210

Point ID	LATTITUDE	LONGITUDE
NVA.BG.29	39° 21' 47.94577"	-119° 35' 20.44104"

NVA.BG.30



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.30	278296.379	4361923.176	1769.555	1793.652

Point ID	LATTITUDE	LONGITUDE
NVA.BG.30	39° 22' 42.01903"	-119° 34' 26.13288"

NVA.BG.31



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.31	278800.915	4365322.289	1734.402	1758.492

Point ID	LATTITUDE	LONGITUDE
NVA.BG.31	39° 24' 32.63652"	-119° 34' 9.1074"

NVA.BG.32



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.32	278601.896	4367091.565	1690.802	1714.901

Point ID	LATTITUDE	LONGITUDE
NVA.BG.32	39° 25' 29.78753"	-119° 34' 19.5294"

NVA.BG.33



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.33	257416.204	4397686.049	1519.796	1543.609

Point ID	LATTITUDE	LONGITUDE
NVA.BG.33	39° 41' 40.4768"	-119° 49' 44.83776"

NVA.BG.34



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.34	257536.856	4400939.036	1651.969	1675.732

Point ID	LATTITUDE	LONGITUDE
NVA.BG.34	39° 43' 25.9882"	-119° 49' 44.08464"

NVA.BG.35



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.35	259328.032	4408701.385	1555.756	1579.476

Point ID	LATTITUDE	LONGITUDE
NVA.BG.35	39° 47' 39.29521"	-119° 48' 39.1626"

NVA.BG.36



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.36	259678.057	4411293.895	1592.576	1616.269

Point ID	LATTITUDE	LONGITUDE
NVA.BG.36	39° 49' 3.64181"	-119° 48' 27.88092"

**NVA.BG.37**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.37	261661.994	4410052.846	1604.197	1627.899

Point ID	LATTITUDE	LONGITUDE
NVA.BG.37	39° 48' 25.44458"	-119° 47' 2.90652"

NVA.BG.38



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.38	262545.573	4408347.662	1722.791	1746.511

Point ID	LATTITUDE	LONGITUDE
NVA.BG.38	39° 47' 31.08905"	-119° 46' 23.56932"

**NVA.BG.39**



Point ID	Easting <b>X</b> (m)	Northing <b>Y</b> (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.39	264149.326	4406305.152	1519.290	1543.064

Point ID	LATTITUDE	LONGITUDE
NVA.BG.39	39° 46' 26.51927"	-119° 45' 13.57416"

NVA.BG.40



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.40	263437.076	4403900.184	1538.641	1562.443

Point ID	LATTITUDE	LONGITUDE
NVA.BG.40	39° 45' 7.88987"	-119° 45' 40.36464"

NVA.BG.41



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.41	262593.578	4403012.766	1574.810	1598.613

Point ID	LATTITUDE	LONGITUDE
NVA.BG.41	39° 44' 38.29434"	-119° 46' 14.61684"

NVA.BG.42



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.42	262060.194	4400355.207	1526.153	1549.99

Point ID	LATTITUDE	LONGITUDE
NVA.BG.42	39° 43' 11.65775"	-119° 46' 33.54528"

NVA.BG.43



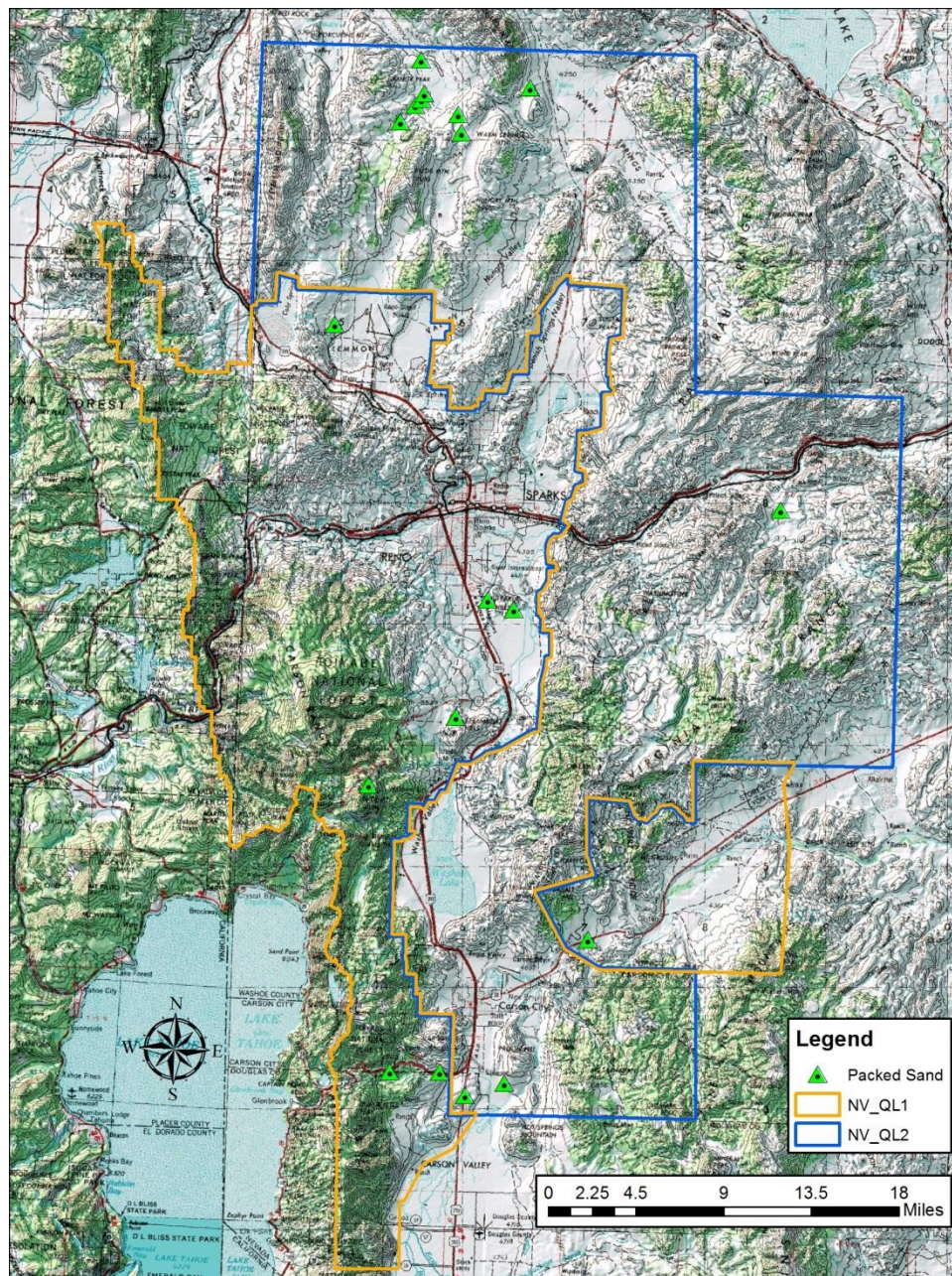
Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.BG.43	261180.16	4397202.348	1527.251	1551.117

Point ID	LATTITUDE	LONGITUDE
NVA.BG.43	39° 41' 28.62467"	-119° 47' 6.35532"

# Non-Vegetated Vertical Accuracy Checkpoints

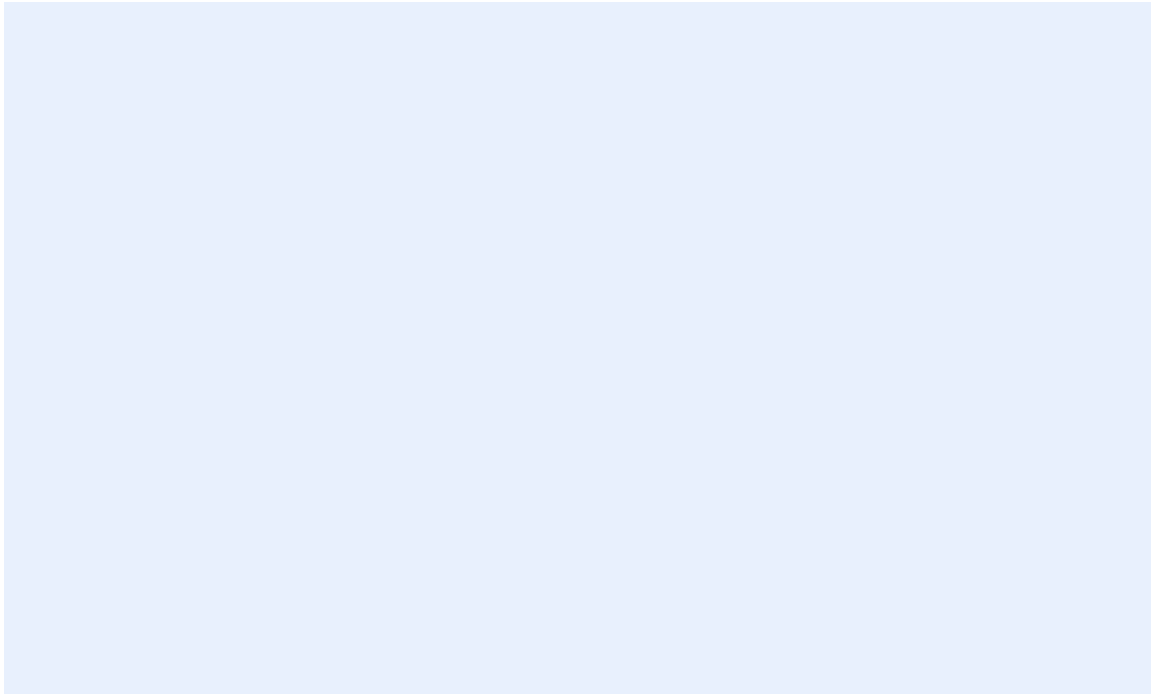
## Packed Sand

The Map shows the overall distribution of the Non-Vegetated Vertical Accuracy Checkpoints, Packed Sand throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. The coordinate system displayed is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
NVA.PS.01	260077.748	4331270.429	1499.361
NVA.PS.02	257949.35	4333225.197	1534.277
NVA.PS.05	253843.07	4333261.732	1763.536
NVA.PS.06	263283.818	4332312.137	1439.166
NVA.PS.08	270232.562	4344152.078	1481.648
NVA.PS.09	259304.563	4362515.291	1673.398
NVA.PS.11	261949.149	4372209.098	1352.894
NVA.PS.12	264091.47	4371438.505	1373.478
NVA.PS.14	286148.928	4379619.688	1376.758
NVA.PS.17	249279.308	4394940.003	1549.494
NVA.PS.19	254736.826	4411680.533	1609.864
NVA.PS.20	255956.585	4413033.566	1575.988
NVA.PS.21	256466.575	4413504.973	1561.61
NVA.PS.22	256684.262	4413982.568	1552.958
NVA.PS.23	256429.905	4416791.861	1514.027
NVA.PS.26	259511.422	4412301.519	1603.816
NVA.PS.27	259741.516	4410771.315	1624.1
NVA.PS.29	265439.212	4414492.122	1408.449
NVA.PS10	252100.416	4356929.867	2413.397

NVA.PS.01



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.01	260077.748	4331270.429	1474.834	1499.361

Point ID	LATTITUDE	LONGITUDE
NVA.PS.01	39° 5' 51.3019"	-119° 46' 27.55092"

NVA.PS.02



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.02	257949.35	4333225.197	1509.838	1534.277

Point ID	LATTITUDE	LONGITUDE
NVA.PS.02	39° 6' 52.52238"	-119° 47' 58.56108"

NVA.PS.05



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.05	253843.07	4333261.732	1739.211	1763.536

Point ID	LATTITUDE	LONGITUDE
NVA.PS.05	39° 6' 49.56678"	-119° 50' 49.39188"

NVA.PS.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.06	263283.818	4332312.137	1414.644	1439.166

Point ID	LATTITUDE	LONGITUDE
NVA.PS.06	39° 6' 28.21018"	-119° 44' 15.53712"

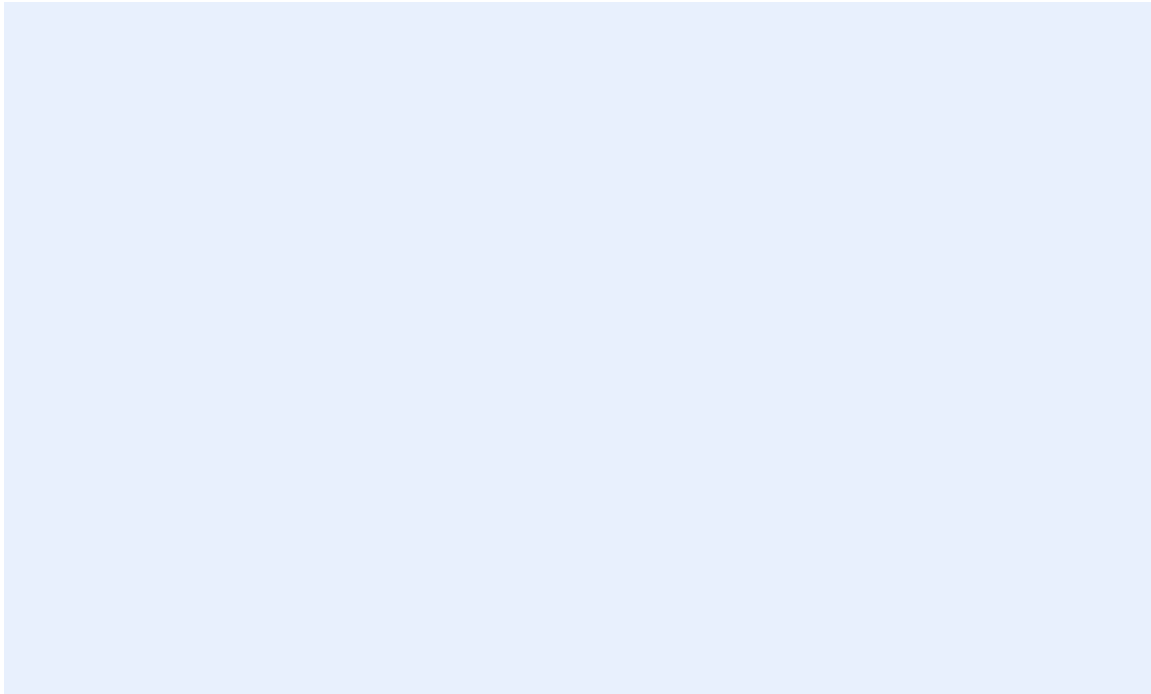
NVA.PS.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.08	270232.562	4344152.078	1457.351	1481.648

Point ID	LATTITUDE	LONGITUDE
NVA.PS.08	39° 12' 58.57499"	-119° 39' 40.98204"

NVA.PS.09



Point ID	Easting <b>X</b> (m)	Northing <b>Y</b> (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.09	259304.563	4362515.291	1649.401	1673.398

Point ID	LATTITUDE	LONGITUDE
NVA.PS.09	39° 22' 42.90121"	-119° 47' 39.8148"

NVA.PS.11



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.11	261949.149	4372209.098	1328.732	1352.894

Point ID	LATTITUDE	LONGITUDE
NVA.PS.11	39° 27' 59.62583"	-119° 46' 1.8282"

NVA.PS.12



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.12	264091.470	4371438.505	1349.303	1373.478

Point ID	LATTITUDE	LONGITUDE
NVA.PS.12	39° 27' 36.78077"	-119° 44' 31.2936"

NVA.PS.14



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.14	286148.928	4379619.688	1352.663	1376.758

Point ID	LATTITUDE	LONGITUDE
NVA.PS.14	39° 32' 22.65212"	-119° 29' 18.64032"

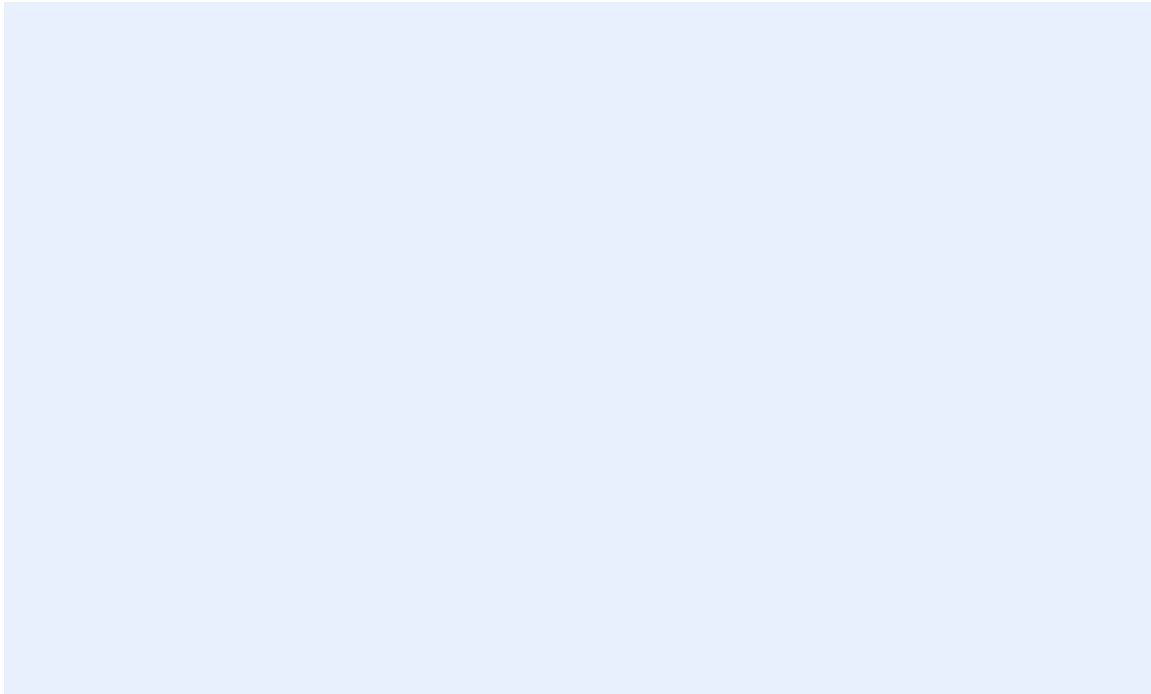
NVA.PS.17



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.17	249279.308	4394940.003	1525.729	1549.494

Point ID	LATTITUDE	LONGITUDE
NVA.PS.17	39° 40' 3.05976"	-119° 55' 22.29852"

NVA.PS.19



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.19	254736.826	4411680.533	1586.162	1609.864

Point ID	LATTITUDE	LONGITUDE
NVA.PS.19	39° 49' 11.08826"	-119° 51' 55.98612"

NVA.PS.20



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.20	255956.585	4413033.566	1552.291	1575.988

Point ID	LATTITUDE	LONGITUDE
NVA.PS.20	39° 49' 56.1846"	-119° 51' 6.5556"

NVA.PS.21



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.21	256466.575	4413504.973	1537.918	1561.61

Point ID	LATTITUDE	LONGITUDE
NVA.PS.21	39° 50' 11.98302"	-119° 50' 45.75696"

NVA.PS.22



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.22	256684.262	4413982.568	1529.272	1552.958

Point ID	LATTITUDE	LONGITUDE
NVA.PS.22	39° 50' 27.67974"	-119° 50' 37.24764"

NVA.PS.23



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.23	256429.905	4416791.861	1490.375	1514.027

Point ID	LATTITUDE	LONGITUDE
NVA.PS.23	39° 51' 58.42717"	-119° 50' 51.70056"

NVA.PS.26



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.26	259511.422	4412301.519	1580.132	1603.816

Point ID	LATTITUDE	LONGITUDE
NVA.PS.26	39° 49' 36.1164"	-119° 48' 36.2124"

NVA.PS.27



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.27	259741.516	4410771.315	1600.402	1624.1

Point ID	LATTITUDE	LONGITUDE
NVA.PS.27	39° 48' 46.77617"	-119° 48' 24.52572"

NVA.PS.29



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS.29	265439.212	4414492.122	1384.770	1408.449

Point ID	LATTITUDE	LONGITUDE
NVA.PS.29	39° 50' 53.05283"	-119° 44' 29.9544"

### NVA.PS10



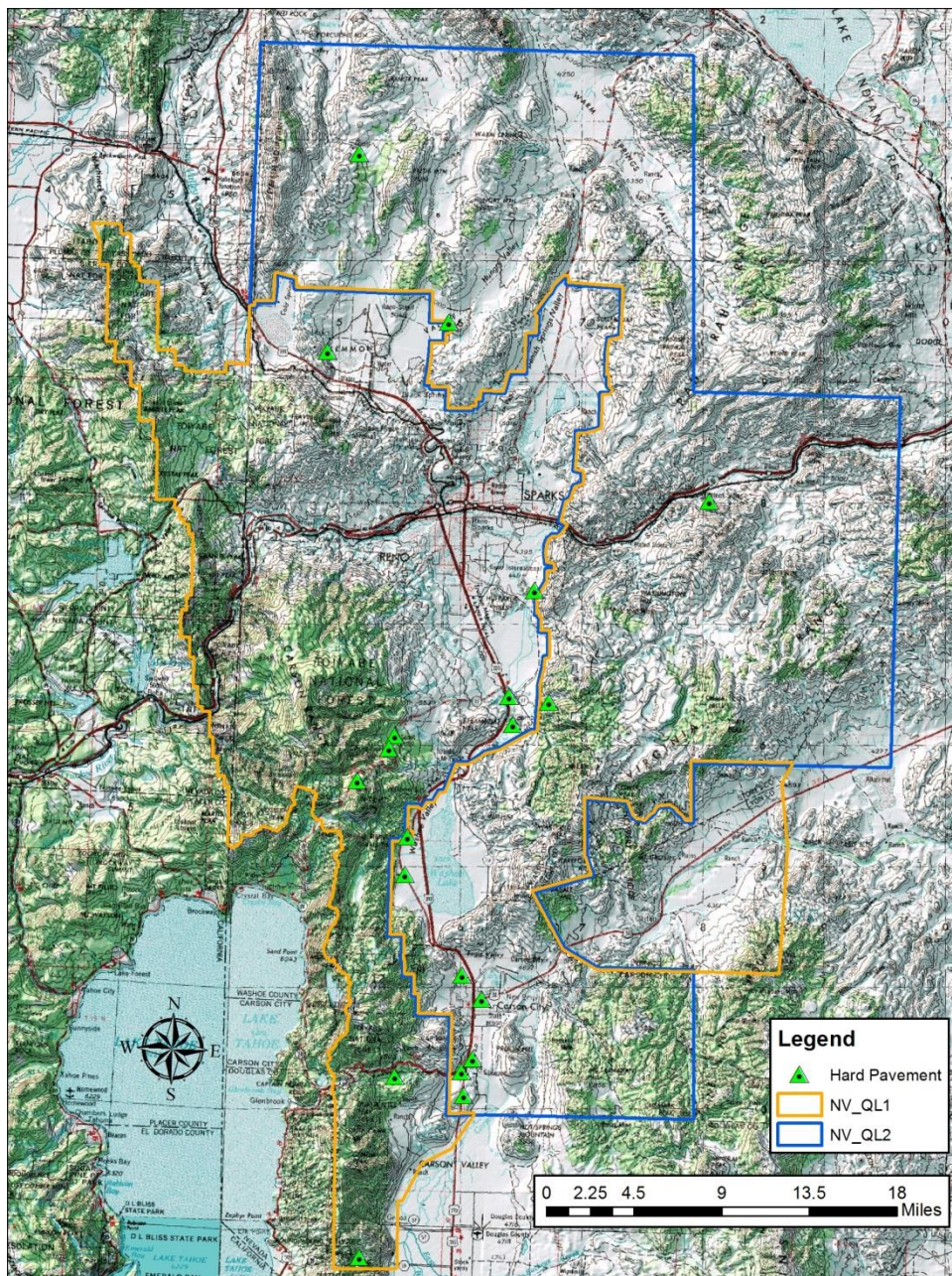
Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.PS10	252100.416	4356929.867	2389.685	2413.397

Point ID	LATTITUDE	LONGITUDE
NVA.PS10	39° 19' 34.60894"	-119° 52' 33.13308"

# Non-Vegetated Vertical Accuracy Checkpoints

## Hard Pavement

The Map shows the overall distribution of the Non-Vegetated Vertical Accuracy Checkpoints, Hard Pavement throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
NVA.HP.01	260090.266	4331304.003	1501.797
NVA.HP.02	259930.611	4333245.923	1454.073
NVA.HP.04	254432.307	4332876.681	1708.791
NVA.HP.05	260856.059	4334298.574	1445.82
NVA.HP.07	251482.829	4317967.107	2075.945
NVA.HP.08	267162.876	4363743.27	1642.658
NVA.HP.10	254431.015	4361015.03	1849.759
NVA.HP.11	253952.746	4359955.868	1906.247
NVA.HP.13	255477.844	4352644.52	1549.053
NVA.HP.14	255258.558	4349548.263	1541.022
NVA.HP.17	259991.982	4341231.157	1450.091
NVA.HP.19	264174.186	4361930.152	1413.747
NVA.HP.20	263855.503	4364228.647	1390.093
NVA.HP.22	265964.295	4372987.633	1364.119
NVA.HP.23	280396.462	4380333.896	1310.768
NVA.HP.25	248838.345	4392713.852	1519.603
NVA.HP.26	251494.758	4409036.363	1759.634
NVA.HP.34	258876.235	4395146.386	1509.969
NVA.HP12	251311.849	4357262.871	2515.081
VVA.HP.15	261606.381	4339243.81	1423.046

NVA.HP.01



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.01	260090.266	4331304.003	1477.271	1501.797

Point ID	LATTITUDE	LONGITUDE
NVA.HP.01	39° 5' 52.40216"	-119° 46' 27.07284"

NVA.HP.02



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.02	259930.611	4333245.923	1429.583	1454.073

Point ID	LATTITUDE	LONGITUDE
NVA.HP.02	39° 6' 55.16636"	-119° 46' 36.18228"

NVA.HP.04



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.04	254432.307	4332876.681	1684.438	1708.791

Point ID	LATTITUDE	LONGITUDE
NVA.HP.04	39° 6' 37.68926"	-119° 50' 24.38448"

**NVA.HP.05**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.05	260856.059	4334298.574	1421.329	1445.82

Point ID	LATTITUDE	LONGITUDE
NVA.HP.05	39° 7' 30.19048"	-119° 45' 59.02452"

NVA.HP.07



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.07	251482.829	4317967.107	2051.627	2075.945

Point ID	LATTITUDE	LONGITUDE
NVA.HP.07	38° 58' 31.6132"	-119° 52' 7.473"

NVA.HP.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.08	267162.876	4363743.27	1618.557	1642.658

Point ID	LATTITUDE	LONGITUDE
NVA.HP.08	39° 23' 30.44717"	-119° 42' 13.26276"

NVA.HP.10



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.10	254431.015	4361015.03	1825.950	1849.759

Point ID	LATTITUDE	LONGITUDE
NVA.HP.10	39° 21' 49.35571"	-119° 51' 1.29168"

NVA.HP.11



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.11	253952.746	4359955.868	1882.455	1906.247

Point ID	LATTITUDE	LONGITUDE
NVA.HP.11	39° 21' 14.55066"	-119° 51' 19.85508"

NVA.HP.13



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.13	255477.844	4352644.52	1524.980	1549.053

Point ID	LATTITUDE	LONGITUDE
NVA.HP.13	39° 17' 19.22647"	-119° 50' 6.63468"

NVA.HP.14



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.14	255258.558	4349548.263	1516.879	1541.022

Point ID	LATTITUDE	LONGITUDE
NVA.HP.14	39° 15' 38.68639"	-119° 50' 11.72832"

NVA.HP.17



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.17	259991.982	4341231.157	1425.744	1450.091

Point ID	LATTITUDE	LONGITUDE
NVA.HP.17	39° 11' 13.96349"	-119° 46' 43.8078"

NVA.HP.19



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.19	264174.186	4361930.152	1389.614	1413.747

Point ID	LATTITUDE	LONGITUDE
NVA.HP.19	39° 22' 28.77841"	-119° 44' 15.7686"

**NVA.HP.20**



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.20	263855.503	4364228.647	1365.954	1390.093

Point ID	LATTITUDE	LONGITUDE
NVA.HP.20	39° 23' 42.93967"	-119° 44' 31.98912"

NVA.HP.22



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.22	265964.295	4372987.633	1339.954	1364.119

Point ID	LATTITUDE	LONGITUDE
NVA.HP.22	39° 28' 28.81477"	-119° 43' 14.96676"

### NVA.HP.23



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.23	280396.462	4380333.896	1286.656	1310.768

Point ID	LATTITUDE	LONGITUDE
NVA.HP.23	39° 32' 40.56943"	-119° 33' 20.24964"

NVA.HP.25



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.25	248838.345	4392713.852	1495.855	1519.603

Point ID	LATTITUDE	LONGITUDE
NVA.HP.25	39° 38' 50.47811"	-119° 55' 37.73712"

NVA.HP.26



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.26	251494.758	4409036.363	1735.933	1759.634

Point ID	LATTITUDE	LONGITUDE
NVA.HP.26	39° 47' 42.04252"	-119° 54' 8.58132"

NVA.HP.34



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP.34	258876.235	4395146.386	1486.102	1509.969

Point ID	LATTITUDE	LONGITUDE
NVA.HP.34	39° 40' 19.6855"	-119° 48' 40.26852"

NVA.HP12



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
NVA.HP12	251311.849	4357262.871	2491.417	2515.081

Point ID	LATTITUDE	LONGITUDE
NVA.HP12	39° 19' 44.58292"	-119° 53' 6.47088"

### VVA.HP.15



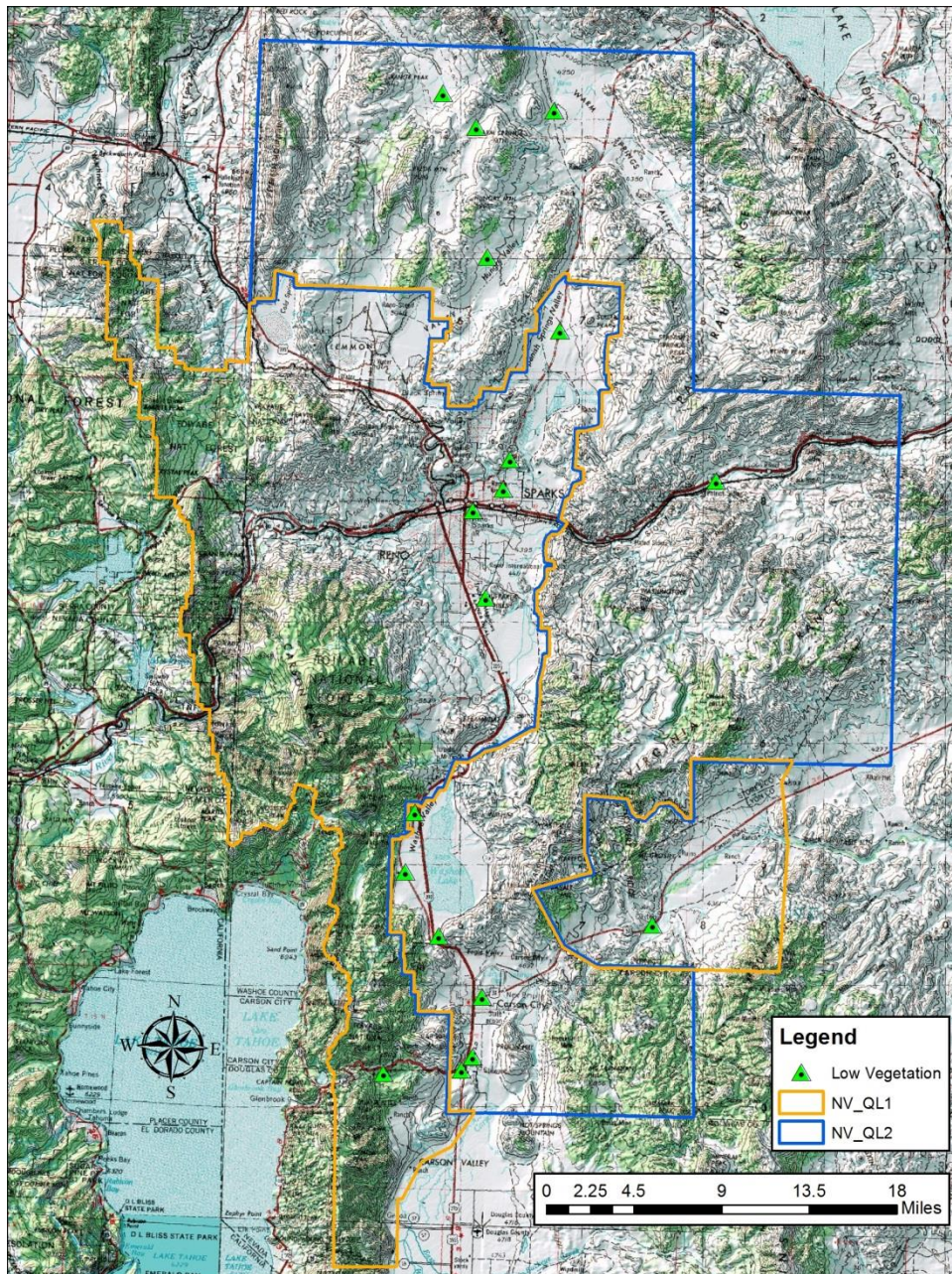
Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HP.15	261606.381	4339243.81	1398.635	1423.046

Point ID	LATTITUDE	LONGITUDE
VVA.HP.15	39° 10' 11.16804"	-119° 45' 34.07148"

# Vegetated Vertical Accuracy Checkpoints

## Low Vegetation

The Map shows the overall distribution of the Vegetated Vertical Accuracy Checkpoints, Low Vegetation throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. The coordinate system displayed is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
VVA.LV.01	259940.397	4333201.911	1454.564
VVA.LV.02	253498.44	4332973.635	1740.606
VVA.LV.03	260858.66	4334330.938	1446.07
VVA.LV.04	275740.261	4345190.586	1330.834
VVA.LV.05	256089.83	4354472.255	1556.336
VVA.LV.06	255272.953	4349568.976	1539.967
VVA.LV.07	261655.447	4339236.857	1422.16
VVA.LV.08	258033.599	4344308.81	1550.807
VVA.LV.09	261929.033	4372226.508	1353.061
VVA.LV.11	281000.312	4381820.762	1307.682
VVA.LV.14	258406.485	4413882.723	1541.97
VVA.LV.16	261156.124	4411042.802	1599.527
VVA.LV.17	267569.48	4412428.563	1316.993
VVA.LV.19	268087.132	4394276.469	1386.738
VVA.LV.20	263977.132	4383624.562	1391.741
VVA.LV.21	263370.479	4381176.125	1347.699
VVA.LV.22	260908.054	4379408.603	1353.934
VVA.LV.28	262075.273	4400359.356	1549.826

VVA.LV.01



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.01	259940.397	4333201.911	1430.073	1454.564

Point ID	LATTITUDE	LONGITUDE
VVA.LV.01	39° 6' 53.74998"	-119° 46' 35.71932"

VVA.LV.02



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.02	253498.44	4332973.635	1716.287	1740.606

Point ID	LATTITUDE	LONGITUDE
VVA.LV.02	39° 6' 39.88188"	-119° 51' 3.34836"

VVA.LV.03



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.03	260858.66	4334330.938	1421.579	1446.07

Point ID	LATTITUDE	LONGITUDE
VVA.LV.03	39° 7' 31.24171"	-119° 45' 58.95756"

VVA.LV.04



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.04	275740.261	4345190.586	1306.503	1330.834

Point ID	LATTITUDE	LONGITUDE
VVA.LV.04	39° 13' 37.41164"	-119° 35' 52.78344"

VVA.LV.05



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.05	256089.83	4354472.255	1532.298	1556.336

Point ID	LATTITUDE	LONGITUDE
VVA.LV.05	39° 18' 19.06542"	-119° 49' 43.5036"

VVA.LV.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.06	255272.953	4349568.976	1515.824	1539.967

Point ID	LATTITUDE	LONGITUDE
VVA.LV.06	39° 15' 39.37212"	-119° 50' 11.1552"

VVA.LV.07



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.07	261655.447	4339236.857	1397.748	1422.16

Point ID	LATTITUDE	LONGITUDE
VVA.LV.07	39° 10' 10.99114"	-119° 45' 32.0202"

VVA.LV.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.08	258033.599	4344308.81	1526.556	1550.807

Point ID	LATTITUDE	LONGITUDE
VVA.LV.08	39° 12' 51.72815"	-119° 48' 9.30924"

VVA.LV.09



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.09	261929.033	4372226.508	1328.900	1353.061

Point ID	LATTITUDE	LONGITUDE
VVA.LV.09	39° 28' 0.1699"	-119° 46' 2.69148"

### VVA.LV.11



Point ID	Easting <b>X</b> (m)	Northing <b>Y</b> (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.11	281000.312	4381820.762	1283.565	1307.682

Point ID	LATTITUDE	LONGITUDE
VVA.LV.11	39° 33' 29.3076"	-119° 32' 56.73912"

VVA.LV.14



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.14	258406.485	4413882.723	1518.292	1541.97

Point ID	LATTITUDE	LONGITUDE
VVA.LV.14	39° 50' 26.21436"	-119° 49' 24.73752"

VVA.LV.16



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.16	261156.124	4411042.802	1575.833	1599.527

Point ID	LATTITUDE	LONGITUDE
VVA.LV.16	39° 48' 57.00618"	-119° 47' 25.45404"

VVA.LV.17



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.17	267569.48	4412428.563	1293.248	1316.993

Point ID	LATTITUDE	LONGITUDE
VVA.LV.17	39° 49' 48.3024"	-119° 42' 57.77496"

VVA.LV.19



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.19	268087.132	4394276.469	1362.759	1386.738

Point ID	LATTITUDE	LONGITUDE
VVA.LV.19	39° 40' 0.67591"	-119° 42' 12.9888"

VVA.LV.20



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.20	263977.132	4383624.562	1367.654	1391.741

Point ID	LATTITUDE	LONGITUDE
VVA.LV.20	39° 34' 11.50457"	-119° 44' 51.62712"

VVA.LV.21



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.21	263370.479	4381176.125	1323.571	1347.699

Point ID	LATTITUDE	LONGITUDE
VVA.LV.21	39° 32' 51.57301"	-119° 45' 13.88412"

VVA.LV.22



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.22	260908.054	4379408.603	1329.805	1353.934

Point ID	LATTITUDE	LONGITUDE
VVA.LV.22	39° 31' 51.84991"	-119° 46' 54.64884"

VVA.LV.28



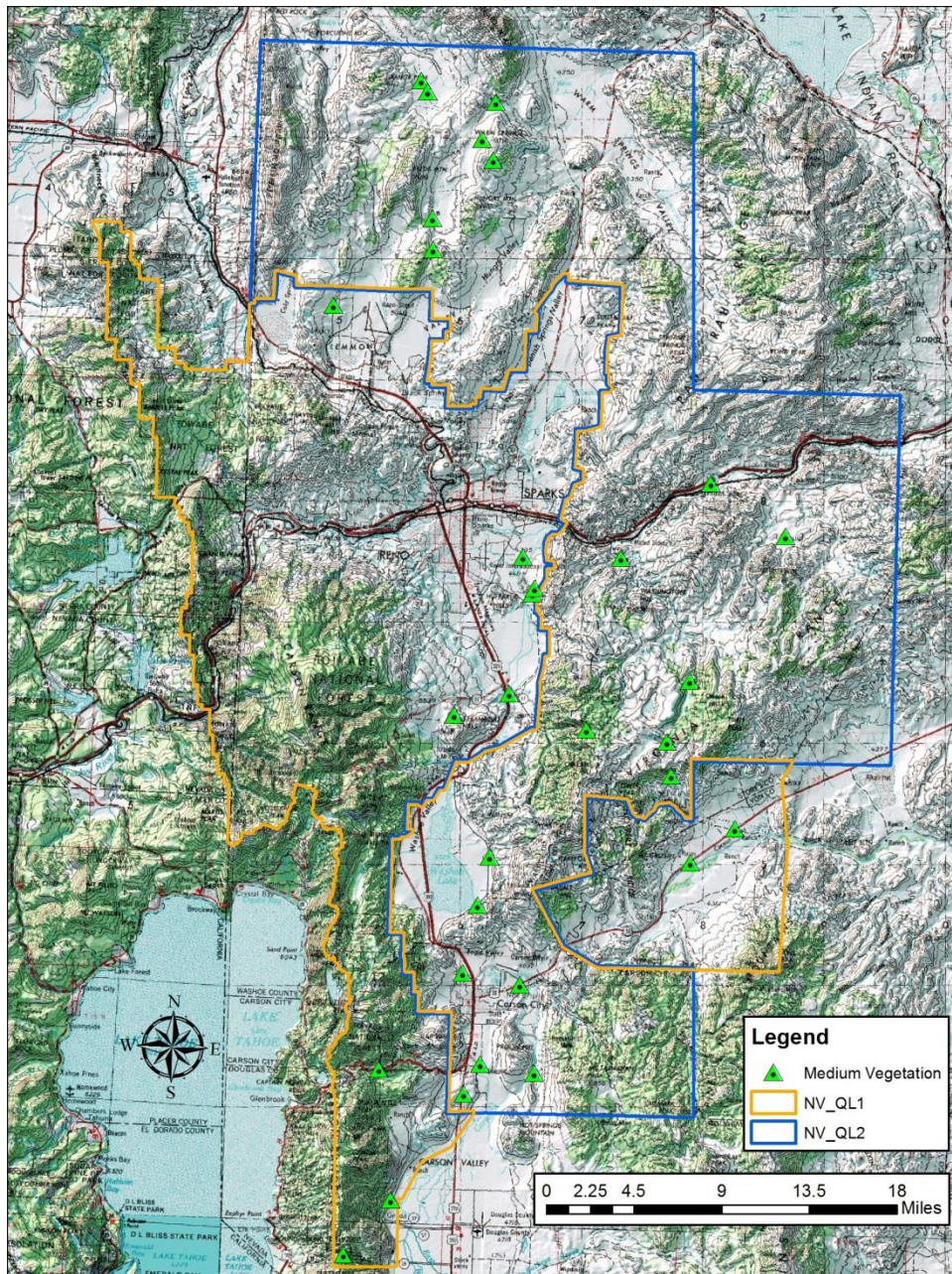
Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.LV.28	262075.273	4400359.356	1525.989	1549.826

Point ID	LATTITUDE	LONGITUDE
VVA.LV.28	39° 43' 11.80729"	-119° 46' 32.91816"

# Vegetated Vertical Accuracy Checkpoints

## Medium Vegetation

The Map shows the overall distribution of the Vegetated Vertical Accuracy Checkpoints, Medium Vegetation throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. The coordinate system displayed is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
VVA.MV.01	260123.163	4331257.599	1502.811
VVA.MV.03	253103.693	4333306.699	1794.299
VVA.MV.04	261453.963	4333719.388	1439.973
VVA.MV.05	265944.636	4332937.55	1418.247
VVA.MV.06	254068.118	4322510.346	1460.026
VVA.MV.08	250189.547	4318008.106	2166.073
VVA.MV.10	264764.773	4340278.581	1412.03
VVA.MV.11	278855.283	4350324.596	1326.654
VVA.MV.12	270277.978	4361313.335	1932.919
VVA.MV.14	259321.83	4362521.322	1672.985
VVA.MV.15	260036.705	4341230.108	1448.416
VVA.MV.16	261250.282	4346845.995	1549.494
VVA.MV.18	262230.859	4350800.154	1561.104
VVA.MV.19	263874.341	4364265.688	1389.309
VVA.MV.20	265801.209	4372569.162	1386.607
VVA.MV.21	265983.351	4372995.75	1365.034
VVA.MV.22	265023.936	4375571.919	1338.797
VVA.MV.23	273103.663	4375508.195	1345.511
VVA.MV.24	280543.625	4381675.251	1304.599
VVA.MV.25	286709.35	4377289.998	1457.819
VVA.MV.27	249355.773	4396343.949	1578.84
VVA.MV.28	256604.726	4414894.456	1546.168
VVA.MV.30	257149.992	4413997.34	1546.964
VVA.MV.31	262784.504	4413127.863	1531.308
VVA.MV.37	282521.392	4353137.669	1322.79
VVA.MV.39	277274.264	4357491.917	1773.836
VVA.MV.40	276930.14	4360314.501	1835.441
VVA.MV.41	278801.133	4365338.805	1758.597
VVA.MV.42	257564.889	4400938.394	1676.647
VVA.MV.43	257515.177	4403556.876	1563.513
VVA.MV.45	261651.638	4410039.138	1627.872
VVA.MV.47	262558.096	4408354.54	1746.299

VVA.MV.01



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.01	260123.163	4331257.599	1478.283	1502.811

Point ID	LATTITUDE	LONGITUDE
VVA.MV.01	39° 5' 50.93113"	-119° 46' 25.64616"

VVA.MV.03



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.03	253103.693	4333306.699	1770.003	1794.299

Point ID	LATTITUDE	LONGITUDE
VVA.MV.03	39° 6' 50.27098"	-119° 51' 20.20068"

VVA.MV.04



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.04	261453.963	4333719.388	1415.468	1439.973

Point ID	LATTITUDE	LONGITUDE
VVA.MV.04	39° 7' 12.01339"	-119° 45' 33.41952"

VVA.MV.05



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.05	265944.636	4332937.55	1393.773	1418.247

Point ID	LATTITUDE	LONGITUDE
VVA.MV.05	39° 6' 51.06204"	-119° 42' 25.64748"

VVA.MV.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.06	254068.118	4322510.346	1435.584	1460.026

Point ID	LATTITUDE	LONGITUDE
VVA.MV.06	39° 1' 1.44505"	-119° 50' 26.04984"

VVA.MV.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.08	250189.547	4318008.106	2141.840	2166.073

Point ID	LATTITUDE	LONGITUDE
VVA.MV.08	38° 58' 31.61741"	-119° 53' 1.20804"

VVA.MV.10



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.10	264764.773	4340278.581	1387.635	1412.03

Point ID	LATTITUDE	LONGITUDE
VVA.MV.10	39° 10' 47.79289"	-119° 43' 23.8926"

VVA.MV.11



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.11	278855.283	4350324.596	1302.319	1326.654

Point ID	LATTITUDE	LONGITUDE
VVA.MV.11	39° 16' 26.6659"	-119° 33' 49.05324"

VVA.MV.12



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.12	270277.978	4361313.335	1908.865	1932.919

Point ID	LATTITUDE	LONGITUDE
VVA.MV.12	39° 22' 14.7135"	-119° 40' 0.17688"

VVA.MV.14



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.14	259321.83	4362521.322	1648.987	1672.985

Point ID	LATTITUDE	LONGITUDE
VVA.MV.14	39° 22' 43.11397"	-119° 47' 39.10164"

VVA.MV.15



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.15	260036.705	4341230.108	1424.068	1448.416

Point ID	LATTITUDE	LONGITUDE
VVA.MV.15	39° 11' 13.97393"	-119° 46' 41.94444"

VVA.MV.16



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.16	261250.282	4346845.995	1525.254	1549.494

Point ID	LATTITUDE	LONGITUDE
VVA.MV.16	39° 14' 17.14168"	-119° 45' 58.55904"

VVA.MV.18



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.18	262230.859	4350800.154	1536.903	1561.104

Point ID	LATTITUDE	LONGITUDE
VVA.MV.18	39° 16' 26.23285"	-119° 45' 22.7214"

VVA.MV.19



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.19	263874.341	4364265.688	1365.170	1389.309

Point ID	LATTITUDE	LONGITUDE
VVA.MV.19	39° 23' 44.15838"	-119° 44' 31.24968"

VVA.MV.20



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.20	265801.209	4372569.162	1362.442	1386.607

Point ID	LATTITUDE	LONGITUDE
VVA.MV.20	39° 28' 15.09596"	-119° 43' 21.25632"

VVA.MV.21



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.21	265983.351	4372995.75	1340.870	1365.034

Point ID	LATTITUDE	LONGITUDE
VVA.MV.21	39° 28' 29.09644"	-119° 43' 14.18052"

VVA.MV.22



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.22	265023.936	4375571.919	1314.614	1338.797

Point ID	LATTITUDE	LONGITUDE
VVA.MV.22	39° 29' 51.6264"	-119° 43' 57.56052"

VVA.MV.23



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.23	273103.663	4375508.195	1321.369	1345.511

Point ID	LATTITUDE	LONGITUDE
VVA.MV.23	39° 29' 57.37294"	-119° 38' 19.55724"

VVA.MV.24



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.24	280543.625	4381675.251	1280.482	1304.599

Point ID	LATTITUDE	LONGITUDE
VVA.MV.24	39° 33' 24.1722"	-119° 33' 15.68484"

VVA.MV.25



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.25	286709.35	4377289.998	1433.732	1457.819

Point ID	LATTITUDE	LONGITUDE
VVA.MV.25	39° 31' 7.65466"	-119° 28' 52.49424"

VVA.MV.27



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.27	249355.773	4396343.949	1555.084	1578.84

Point ID	LATTITUDE	LONGITUDE
VVA.MV.27	39° 40' 48.62111"	-119° 55' 21.01116"

VVA.MV.28



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.28	256604.726	4414894.456	1522.492	1546.168

Point ID	LATTITUDE	LONGITUDE
VVA.MV.28	39° 50' 57.13933"	-119° 50' 41.81028"

VVA.MV.30



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.30	257149.992	4413997.34	1523.279	1546.964

Point ID	LATTITUDE	LONGITUDE
VVA.MV.30	39° 50' 28.63799"	-119° 50' 17.69496"

VVA.MV.31



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.31	262784.504	4413127.863	1507.636	1531.308

Point ID	LATTITUDE	LONGITUDE
VVA.MV.31	39° 50' 6.19937"	-119° 46' 19.75908"

VVA.MV.37



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.37	282521.392	4353137.669	1298.459	1322.79

Point ID	LATTITUDE	LONGITUDE
VVA.MV.37	39° 18' 1.1709"	-119° 31' 19.4664"

VVA.MV.39



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.39	277274.264	4357491.917	1749.681	1773.836

Point ID	LATTITUDE	LONGITUDE
VVA.MV.39	39° 20' 17.4737"	-119° 35' 3.51564"

VVA.MV.40



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.40	276930.14	4360314.501	1811.338	1835.441

Point ID	LATTITUDE	LONGITUDE
VVA.MV.40	39° 21' 48.62236"	-119° 35' 21.25392"

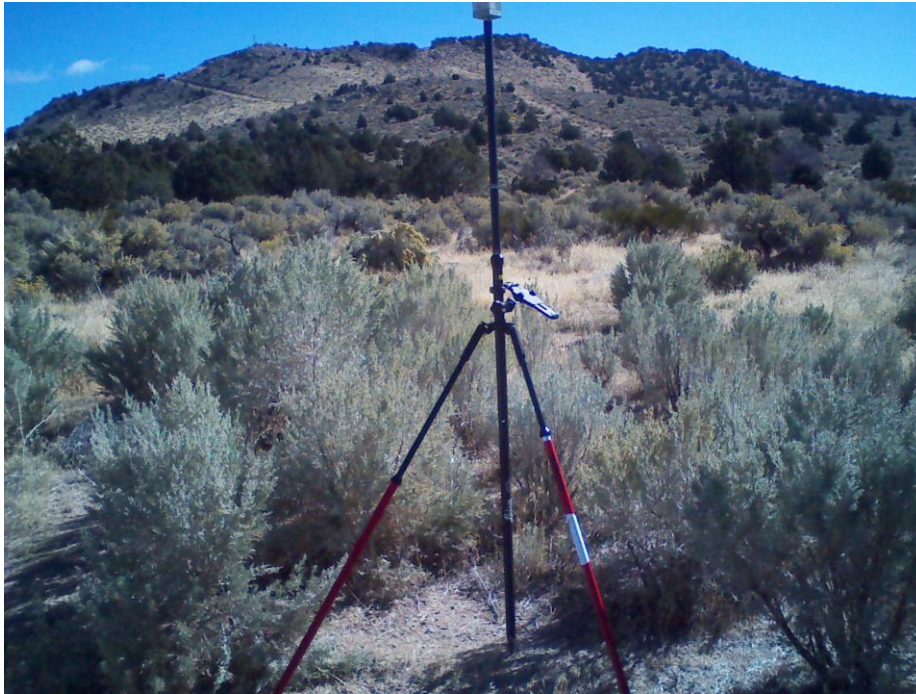
VVA.MV.41



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.41	278801.133	4365338.805	1734.507	1758.597

Point ID	LATTITUDE	LONGITUDE
VVA.MV.41	39° 24' 33.17195"	-119° 34' 9.1182"

VVA.MV.42



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.42	257564.889	4400938.394	1652.883	1676.647

Point ID	LATTITUDE	LONGITUDE
VVA.MV.42	39° 43' 25.99608"	-119° 49' 42.9078"

VVA.MV.43



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.43	257515.177	4403556.876	1539.761	1563.513

Point ID	LATTITUDE	LONGITUDE
VVA.MV.43	39° 44' 50.77655"	-119° 49' 48.46512"

VVA.MV.45



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.45	261651.638	4410039.138	1604.170	1627.872

Point ID	LATTITUDE	LONGITUDE
VVA.MV.45	39° 48' 24.99001"	-119° 47' 3.32376"

VVA.MV.47



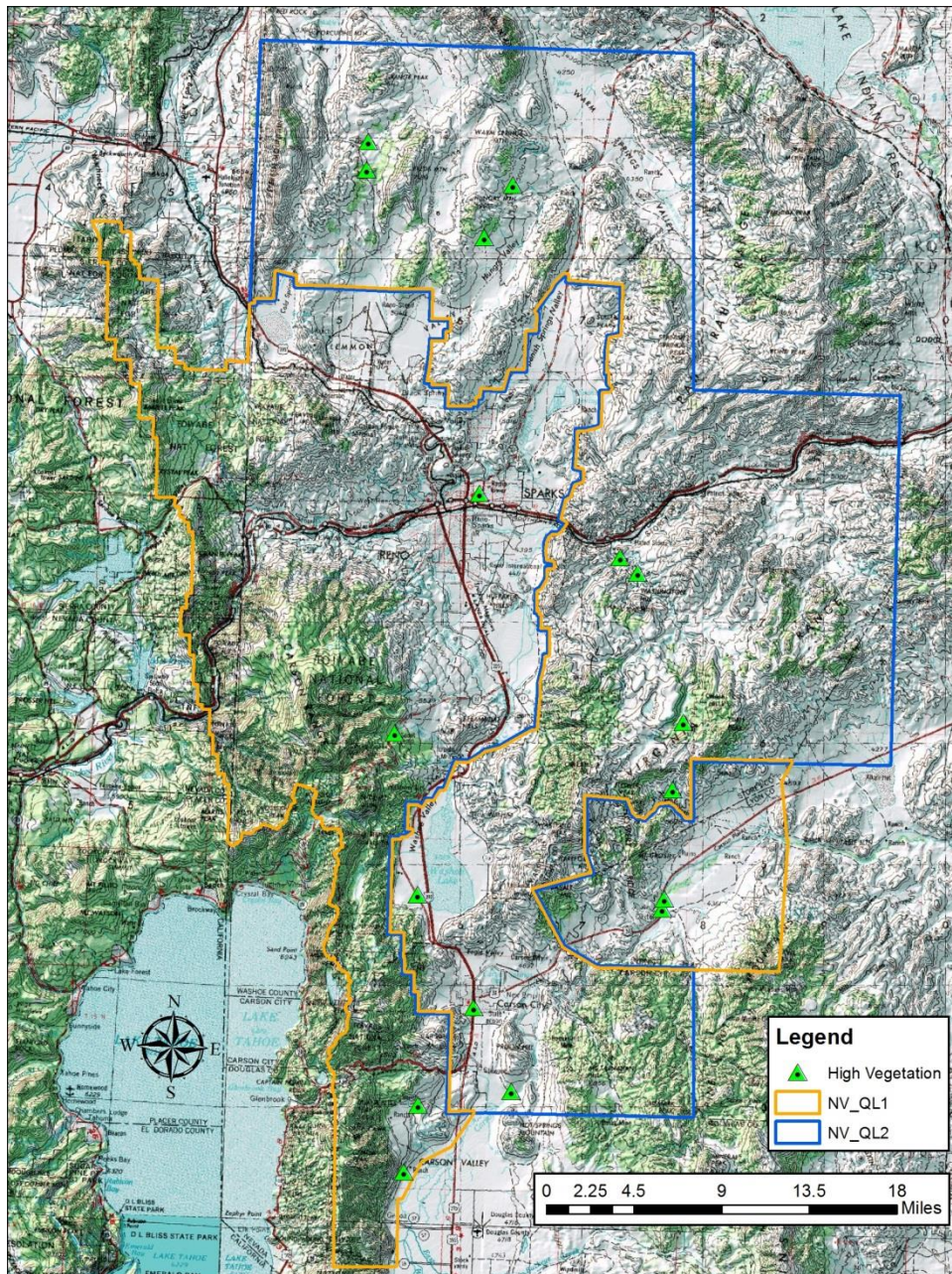
Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.MV.47	262558.096	4408354.54	1722.579	1746.299

Point ID	LATTITUDE	LONGITUDE
VVA.MV.47	39° 47' 31.32445"	-119° 46' 23.05236"

# Vegetated Vertical Accuracy Checkpoints

## High Vegetation

The Map shows the overall distribution of the Vegetated Vertical Accuracy Checkpoints, High Vegetation throughout the AOI. The following tables contain a list of the control using Easting, Northing, and Orthometric height. The coordinate system displayed is UTM 11N, NAD83 (2011), NAVD88, Geoid 12B and using Meters for measurement.



<b>Point ID</b>	<b>Easting X (Meters)</b>	<b>Northing Y (Meters)</b>	<b>Ortho (Meters)</b>
VVA.HV.03	264053.116	4331467.387	1413.68
VVA.HV.04	256327.202	4330313.766	1571.086
VVA.HV.05	255144.678	4324824.1	1448.548
VVA.HV.06	276516.238	4346526.834	1327.67
VVA.HV.07	276669.651	4347338.265	1321.574
VVA.HV.08	254408.565	4361040.25	1850.649
VVA.HV.09	256290.205	4347719.943	1543.684
VVA.HV.11	260946.977	4338375.064	1424.562
VVA.HV.12	273066.04	4375519.736	1344.23
VVA.HV.13	274508.97	4374275.62	1370.766
VVA.HV.14	252236.994	4409888.614	1677.846
VVA.HV.17	252114.228	4407548.112	1766.893
VVA.HV.18	261410.453	4380811.423	1353.853
VVA.HV.19	277397.356	4356344.905	1645.479
VVA.HV.20	278279.178	4361935.702	1794.376
VVA.HV.27	264170.594	4406300.763	1542.25
VVA.HV.28	261825.682	4401955.08	1589.923

### VVA.HV.03



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.03	264053.116	4331467.387	1389.155	1413.68

Point ID	LATTITUDE	LONGITUDE
VVA.HV.03	39° 6' 1.58803"	-119° 43' 42.48588"

VVA.HV.04



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.04	256327.202	4330313.766	1546.629	1571.086

Point ID	LATTITUDE	LONGITUDE
VVA.HV.04	39° 5' 16.56218"	-119° 49' 2.27028"

### VVA.HV.05



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.05	255144.678	4324824.1	1424.084	1448.548

Point ID	LATTITUDE	LONGITUDE
VVA.HV.05	39° 2' 17.50049"	-119° 49' 44.32692"

VVA.HV.06



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.06	276516.238	4346526.834	1303.333	1327.67

Point ID	LATTITUDE	LONGITUDE
VVA.HV.06	39° 14' 21.43496"	-119° 35' 22.04448"

VVA.HV.07



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.07	276669.651	4347338.265	1297.237	1321.574

Point ID	LATTITUDE	LONGITUDE
VVA.HV.07	39° 14' 47.87268"	-119° 35' 16.6182"

VVA.HV.08



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.08	254408.565	4361040.25	1826.842	1850.649

Point ID	LATTITUDE	LONGITUDE
VVA.HV.08	39° 21' 50.14984"	-119° 51' 2.26188"

VVA.HV.09



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.09	256290.205	4347719.943	1519.487	1543.684

Point ID	LATTITUDE	LONGITUDE
VVA.HV.09	39° 14' 40.49477"	-119° 49' 26.35392"

VVA.HV.11



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.11	260946.977	4338375.064	1400.142	1424.562

Point ID	LATTITUDE	LONGITUDE
VVA.HV.11	39° 9' 42.3675"	-119° 46' 0.41592"

VVA.HV.12



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.12	273066.04	4375519.736	1320.089	1344.23

Point ID	LATTITUDE	LONGITUDE
VVA.HV.12	39° 29' 57.71119"	-119° 38' 21.14484"

VVA.HV.13



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.13	274508.97	4374275.62	1346.633	1370.766

Point ID	LATTITUDE	LONGITUDE
VVA.HV.13	39° 29' 18.7633"	-119° 37' 19.27704"

VVA.HV.14



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.14	252236.994	4409888.614	1654.143	1677.846

Point ID	LATTITUDE	LONGITUDE
VVA.HV.14	39° 48' 10.43024"	-119° 53' 38.5692"

VVA.HV.17



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.17	252114.228	4407548.112	1743.195	1766.893

Point ID	LATTITUDE	LONGITUDE
VVA.HV.17	39° 46' 54.48101"	-119° 53' 40.54416"

VVA.HV.18



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.18	261410.453	4380811.423	1329.741	1353.853

Point ID	LATTITUDE	LONGITUDE
VVA.HV.18	39° 32' 37.80377"	-119° 46' 35.44032"

VVA.HV.19



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.19	277397.356	4356344.905	1621.288	1645.479

Point ID	LATTITUDE	LONGITUDE
VVA.HV.19	39° 19' 40.41775"	-119° 34' 57.01044"

VVA.HV.20



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.20	278279.178	4361935.702	1770.279	1794.376

Point ID	LATTITUDE	LONGITUDE
VVA.HV.20	39° 22' 42.40906"	-119° 34' 26.8662"

VVA.HV.27



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.27	264170.594	4406300.763	1518.476	1542.25

Point ID	LATTITUDE	LONGITUDE
VVA.HV.27	39° 46' 26.39827"	-119° 45' 12.6756"

VVA.HV.28



Point ID	Easting X (m)	Northing Y (m)	Ellipsoid Height (m)	Orthometric Height (m)
VVA.HV.28	261825.682	4401955.08	1566.113	1589.923

Point ID	LATTITUDE	LONGITUDE
VVA.HV.28	39° 44' 3.25583"	-119° 46' 45.46668"

# Appendix E

## Digital Data (Separate Submittal)

