



## Appendix 1

---

# LOCATION AND VICINITY MAP



### 3.2 Routing of Off-Site Flows and Location of Drainage Facilities

Proposed trapezoidal channel drainage facility improvements VCC and the existing ACC improvements constructed with Blackstone Ranch – Phase 1, have been designed to accommodate and convey the 100-year 24-hour peak flow with 1 foot of free board. Reference **Appendix 6**, “*Proposed Open Channels*” prepared by Kimley-Horn for the location of the channels traversing and located downstream of the subject property with respect to the 137 lot subdivision and proposed channel configuration based on the following design parameters:

The VCC channel will flow from east of the project site to the swale adjacent to US Route 395. The cross section for VCC is an earthen, open, 5-foot deep trapezoidal channel, with a top width of 30’, bottom width of 6’ and 3:1 side slopes.

ACC drainage facilities flows from the intersection of Robinson Road and Saliman east to the swale adjacent to US Route 395. ACC is either an earthen, open, 5-foot deep trapezoidal channel, with a top width of 34’, bottom width of 6’ and 3:1 side slopes.

### 3.3 Floodplain Modifications

The proposed channels and grading of the subject property has been designed to adhere to the 1 to 1 compensation of the displacement of the volume due to proposed construction in the floodplain. The channel design presented in the Master Drainage Study and findings summarized in **Appendix 6** denotes proposed water surface elevation (WSE) in the trapezoidal channels. The finished floor elevations (FFE) have been established at a minimum of 2 feet above the respective watershed designated BFE.

### 3.4 Mitigation Measures

The new Carson City Drainage Manual became effective July 1, 2021. The new manual updates the drainage and stormwater management requirements for new residential developments. Low Impact Development (“LID”) practices and Best Management Practices (“BMP”) shall be implemented to identify storm water mitigation measures intended to control erosion and storm water pollution as close to the source as possible. Potential sources of pollution shall be infiltrated, evapotranspired, captured and used, and/or treated through LID measures to mitigate adverse impact to downstream and adjacent properties.

Storm drains are designed to either the 10- and 100-year, 24-hour storm event and maintain a dry lane in the road. HGL storm drains are to be 1’ below final grade. Dry lane calculations are provided in the **Appendix 7**.



**Appendix 7** details the Infiltration Basins Vegetated Swales utilized in the grading plan to minimize stormwater pollution. The first 0.5” of runoff from the impervious areas are infiltrated and/or retained for an extended period (25-hours) in an area north of Ash Creek Canyon, south of Vicee Canyon and in open areas adjacent to Hwy 395. The design parameters of in the areas of the subdivision utilized for LID adhere to the following required specifications, referenced in **Appendix 7** from the updated Carson City Manual.

1. Infiltration Basin
  - 3:1 Side Slopes
  - 1' Freeboard
  
2. Vegetated Swales
  - 200' Minimum Length
  - 2-10 Bottom Width
  - 1% - 5% Channel Slope
  - Trapezoidal Geometry
  - 3:1 Side Slopes

The open areas of the site and grading patterns have been revised since implementation of the manual so that there is no direct runoff from impervious areas and infiltration areas are at a minimum designed to treat or retain the following treatment volumes or water quality flow rate:

Water Quality Treatment Volume =

$$WQv = (P \cdot Rv \cdot A) / 12$$

where  $Rv = 0.05 + 0.009 \cdot I$

P = the 90<sup>th</sup> percentile precipitation depth

I = percent of basin impervious area

A = drainage area (ft<sup>2</sup>)

#### 4 CONCLUSION

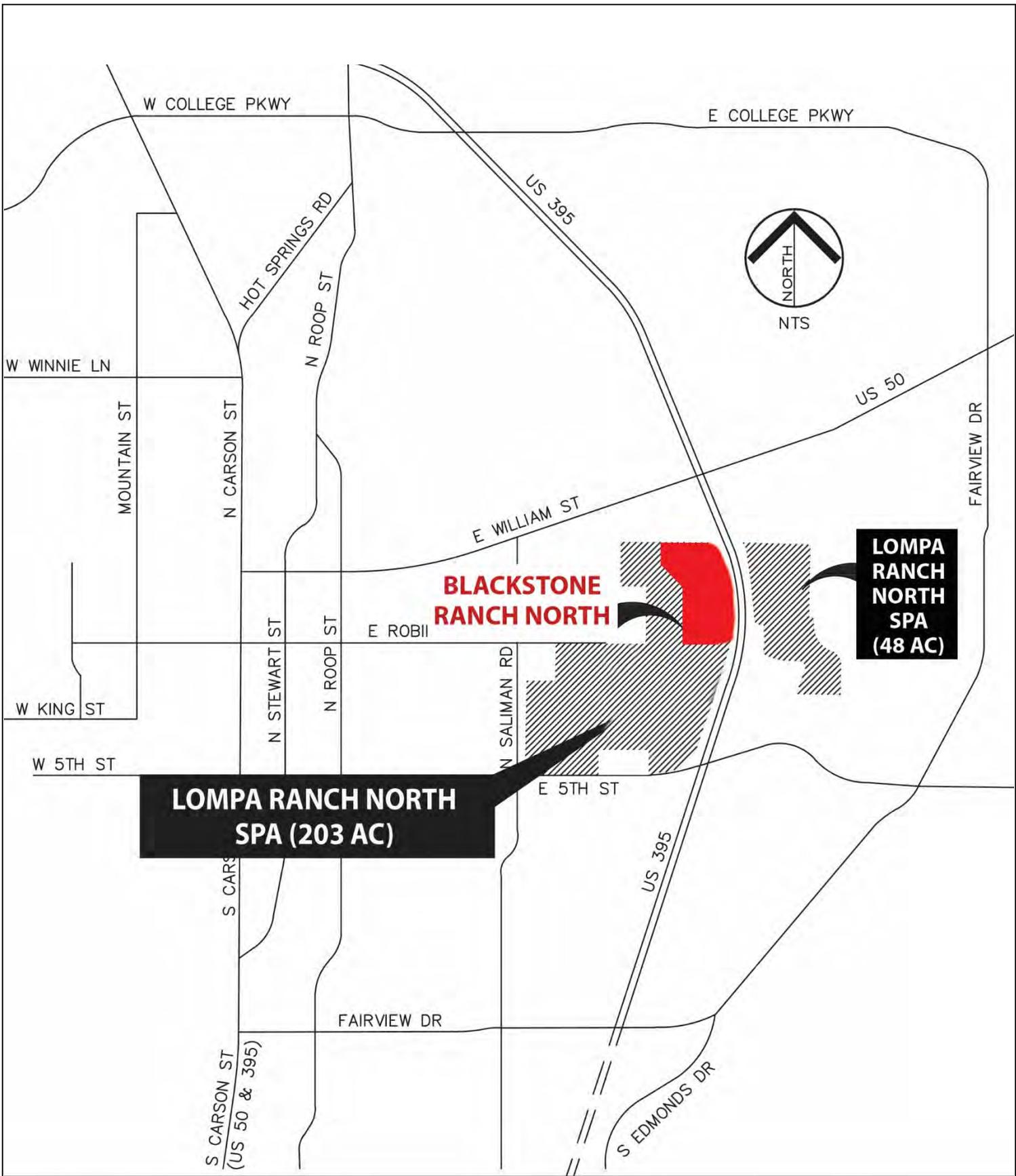
The proposed design of the 137 lot subdivision has been configured utilizing the parameters and on-/ off-site basins established in the Master Drainage Study as well designed in accordance with CCMC, FEMA and the recently implemented Carson City Drainage Manual standards. Adherence to the Master Drainage Study and recently adopted detention design and LID consideration for planning utilizing proposed drainage facilities that will convey and accommodate required design parameters, hence mitigating adverse storm water conditions and impact on downstream properties.

Appendix 6

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**DRAINAGE FACILITIES (OPEN CHANNELS)**

Prepared by: Kimley Horn



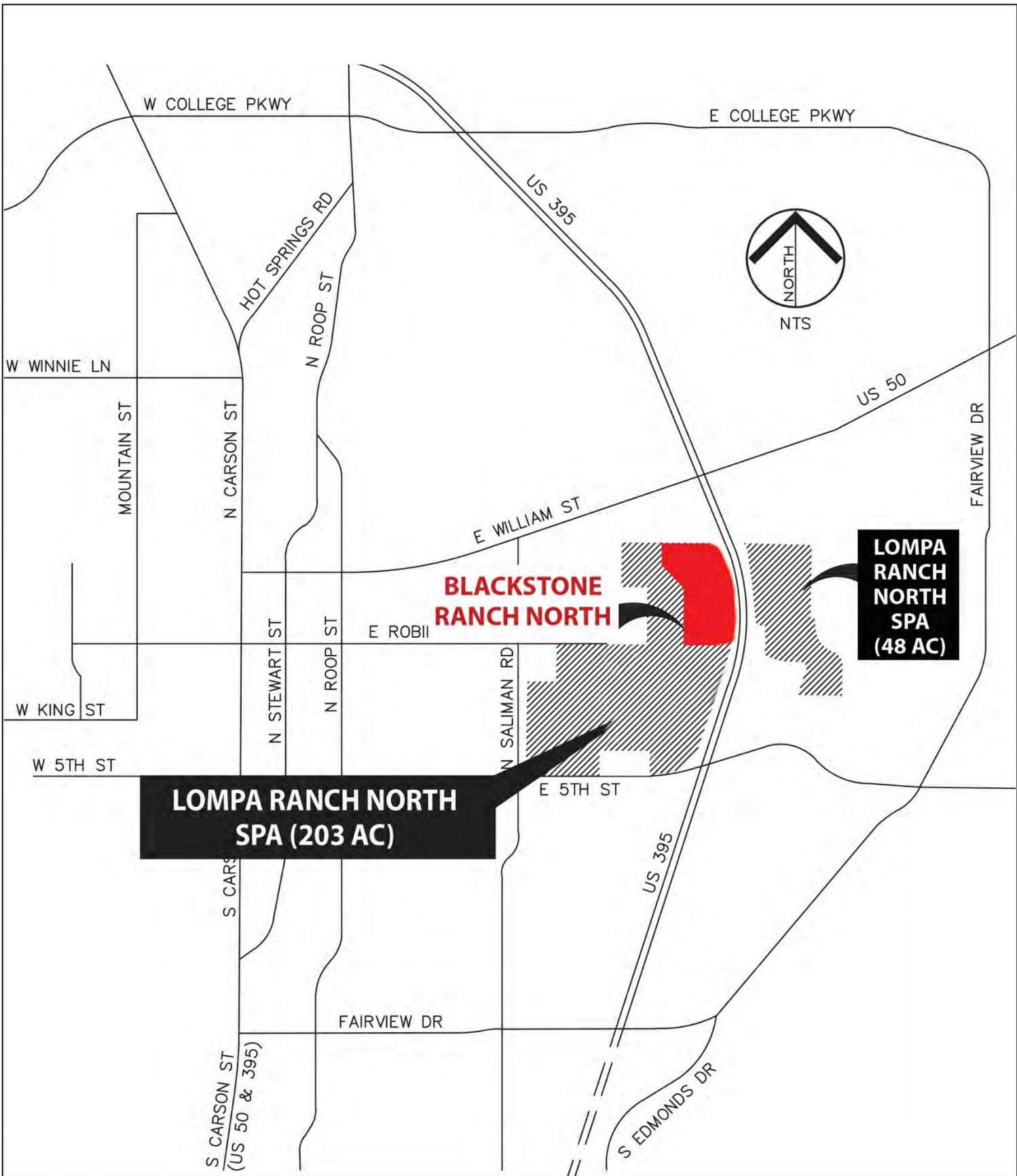
**BLACKSTONE RANCH NORTH | Vicinity Map**

## Appendix 7

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### CARSON CITY DRAINAGE MANUAL UPDATE, JULY 1, 2021 INFILTRATION BASIN, INFILTRATION TRENCH AND VEGETATED SWALE SPECIFICATIONS

### DRY LANE CALCULATIONS

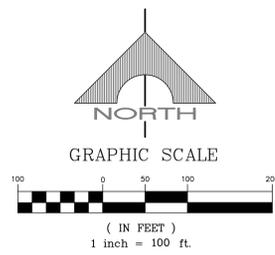


# BLACKSTONE RANCH NORTH | Vicinity Map

Appendix 2

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## BLACKSTONE RANCH NORTH – PROPOSED SITE



7272 S EL CAPITAN WAY  
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Las Vegas, NV 89148  
(702) 528-7804 office  
www.therealdtd.com

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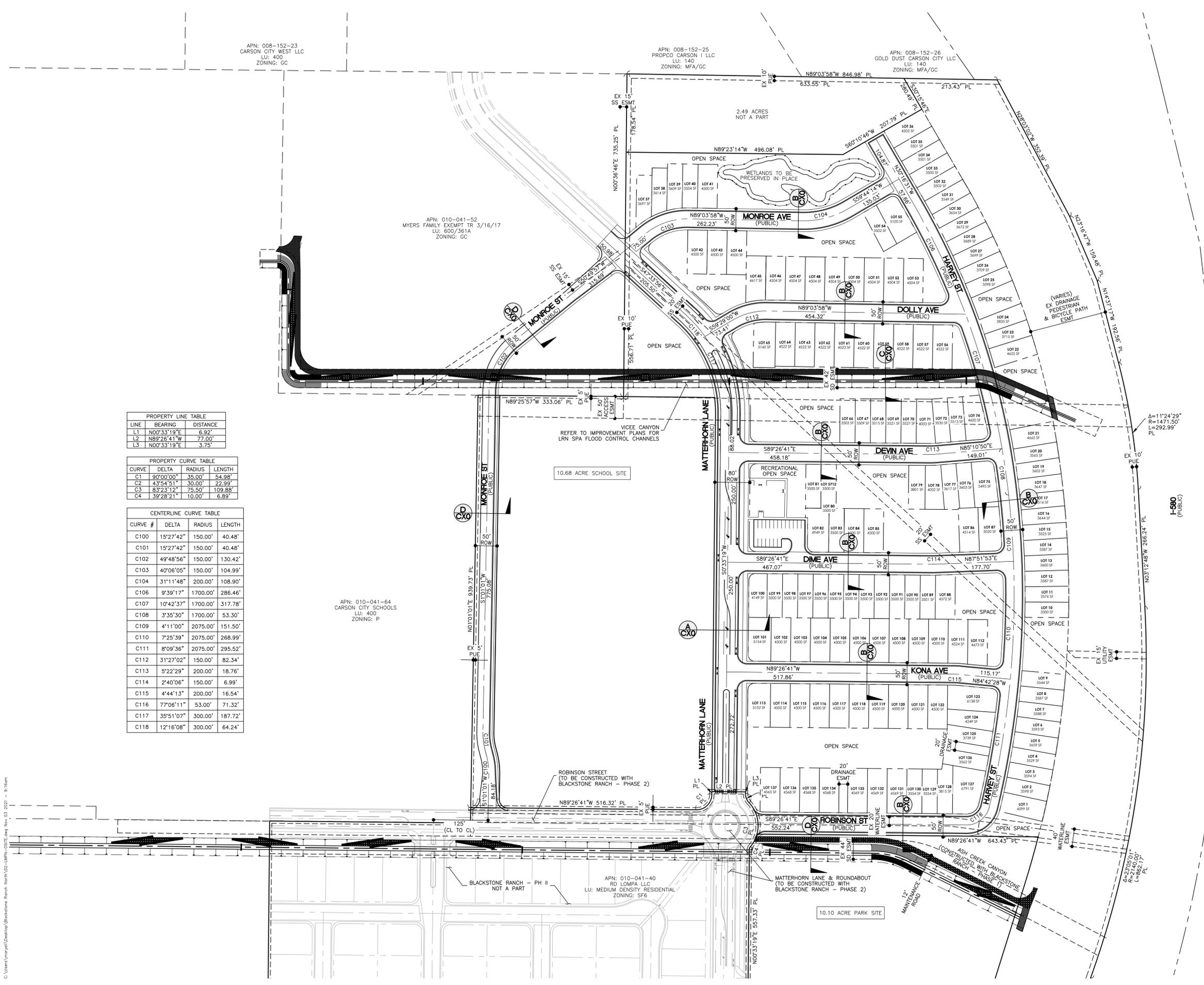
**CLIENT:**  
BLACKSTONE DEVELOPMENT GROUP  
439 PLUMB LANE  
RENO, NV 89509  
CONTACT: JOSHUA MYERS  
PHONE: (775) 352-4200

DATE	NO.	REVISIONS	APPROVED

OVERALL SITE PLAN  
BLACKSTONE RANCH NORTH  
CARSON CITY  
NEVADA

PG. JOB NO.	LMPN
DESIGNED BY	JY/MS
DRAWN BY	JY/MS
CHECKED BY	JY/MS
DATE	2021.11.03

SHT CS0 4 OF 19



PROPERTY LINE TABLE

LINE	BEARING	DISTANCE
L1	N00°33'19"E	6.92'
L2	N89°26'41"W	77.00'
L3	N00°33'19"E	3.75'

PROPERTY CURVE TABLE

CURVE	DELTA	RADIUS	LENGTH
C1	90°00'00"	35.00'	54.98'
C2	43°54'51"	30.00'	22.99'
C3	83°23'12"	75.50'	109.88'
C4	39°28'21"	10.00'	6.89'

CENTERLINE CURVE TABLE

CURVE #	DELTA	RADIUS	LENGTH
C100	15°27'42"	150.00'	40.48'
C101	15°27'42"	150.00'	40.48'
C102	49°48'56"	150.00'	130.42'
C103	40°06'05"	150.00'	104.99'
C104	31°11'48"	200.00'	108.90'
C106	9°39'17"	1700.00'	286.46'
C107	10°42'37"	1700.00'	317.78'
C108	3°35'30"	1700.00'	53.30'
C109	4°11'00"	2075.00'	151.50'
C110	7°25'39"	2075.00'	268.99'
C111	8°09'36"	2075.00'	295.52'
C112	31°27'02"	150.00'	82.34'
C113	5°22'29"	200.00'	18.76'
C114	2°40'06"	150.00'	6.99'
C115	4°44'13"	200.00'	16.54'
C116	7°06'11"	53.00'	71.32'
C117	35°51'07"	300.00'	187.72'
C118	12°16'08"	300.00'	64.24'

Exhibit 3

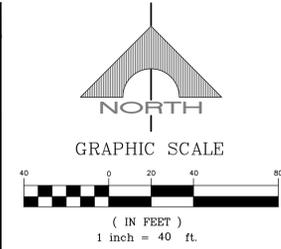
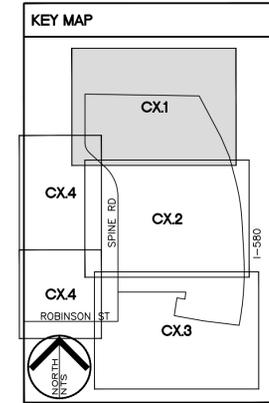
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## GRADING AND DRAINAGE PLAN

Prepared by: The Red Ltd

APN: 008-152-25  
 PROPCO CARSON I, LLC  
 LU: MIXED-USE COMMERCIAL  
 ZONING: MFA/GC

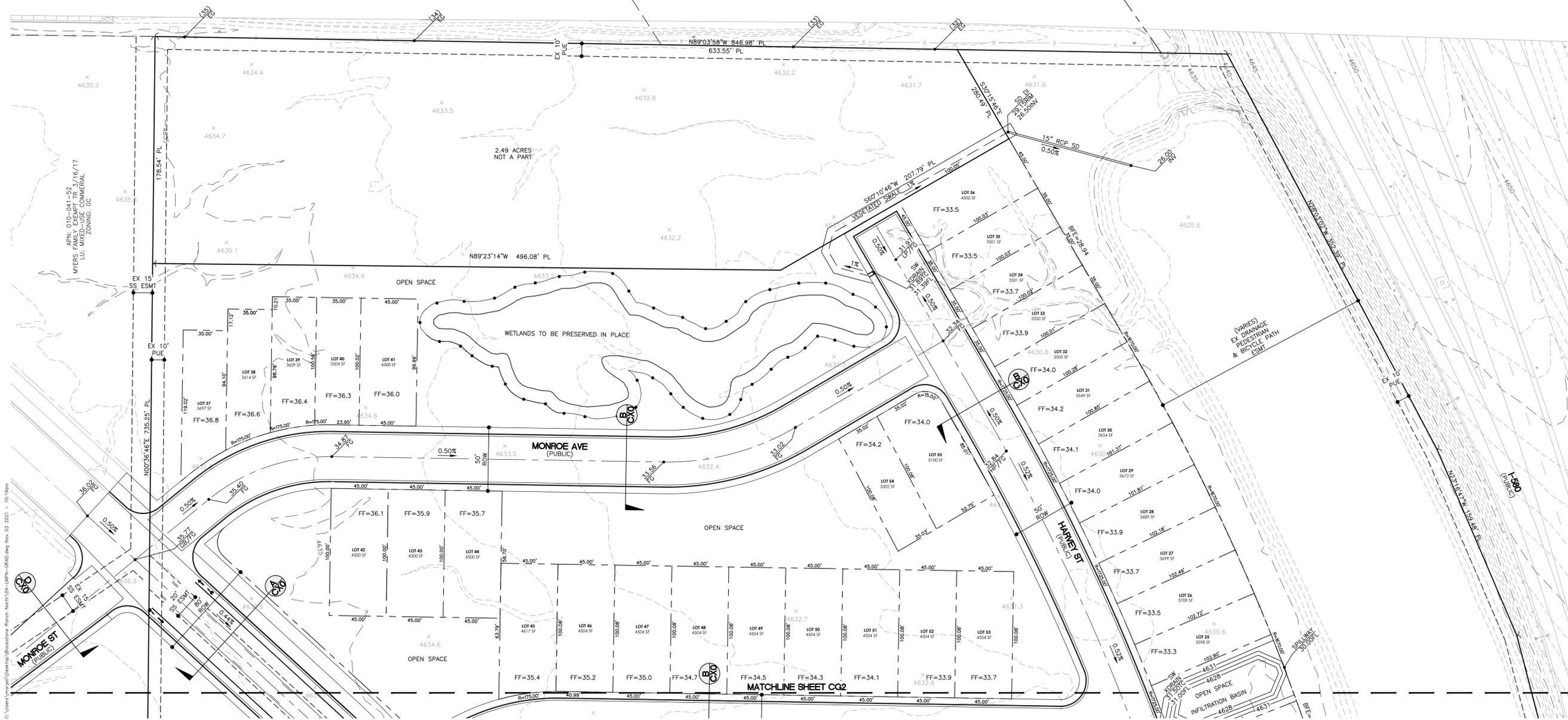
APN: 008-152-26  
 GOLD DUST CARSON CITY LLC  
 LU: MIXED-USE COMMERCIAL  
 ZONING: MFA/GC



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 GROUP  
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 PHONE: (775) 352-4200

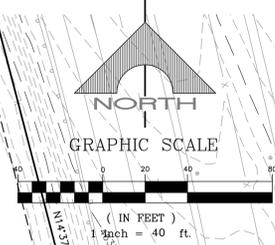
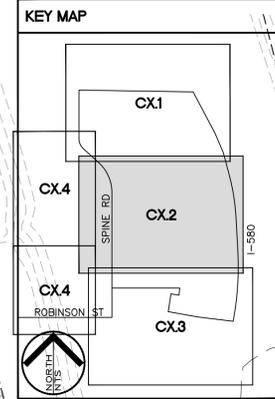
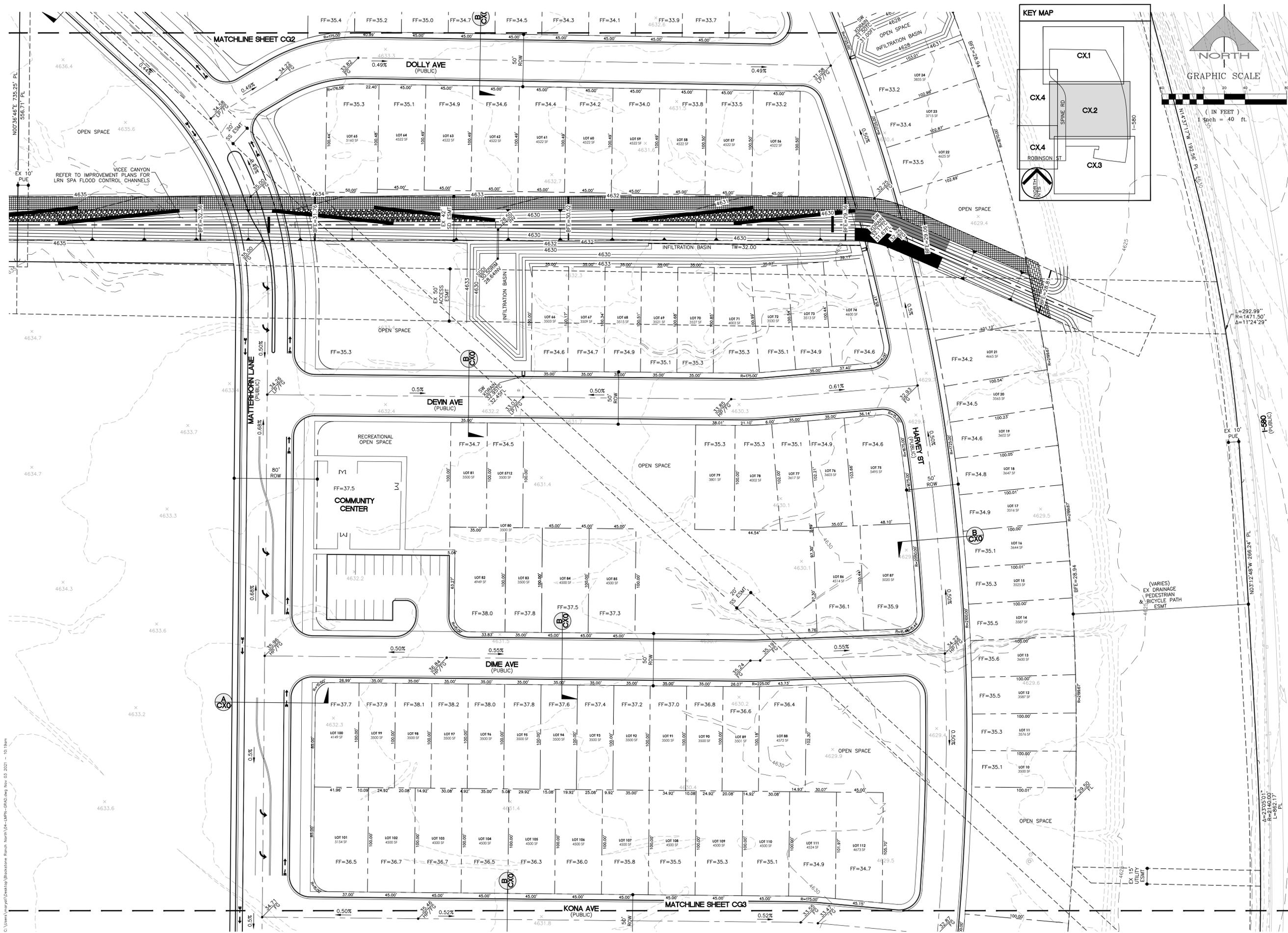


DATE	NO.	REVISIONS	APPROVED

GRADING PLAN ( 1 OF 4 )  
 BLACKSTONE RANCH NORTH  
 CARSON CITY NEVADA

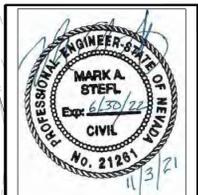
PG JOB NO.	LMPN
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CHECKED BY	JY/MS
DATE	2021 11 03

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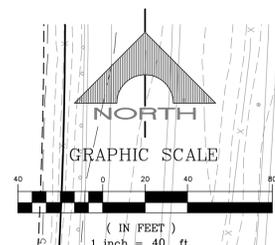
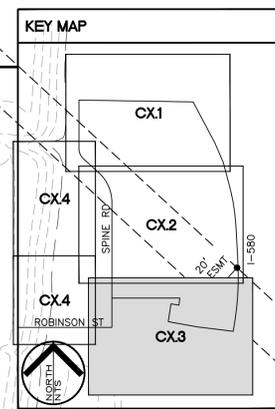
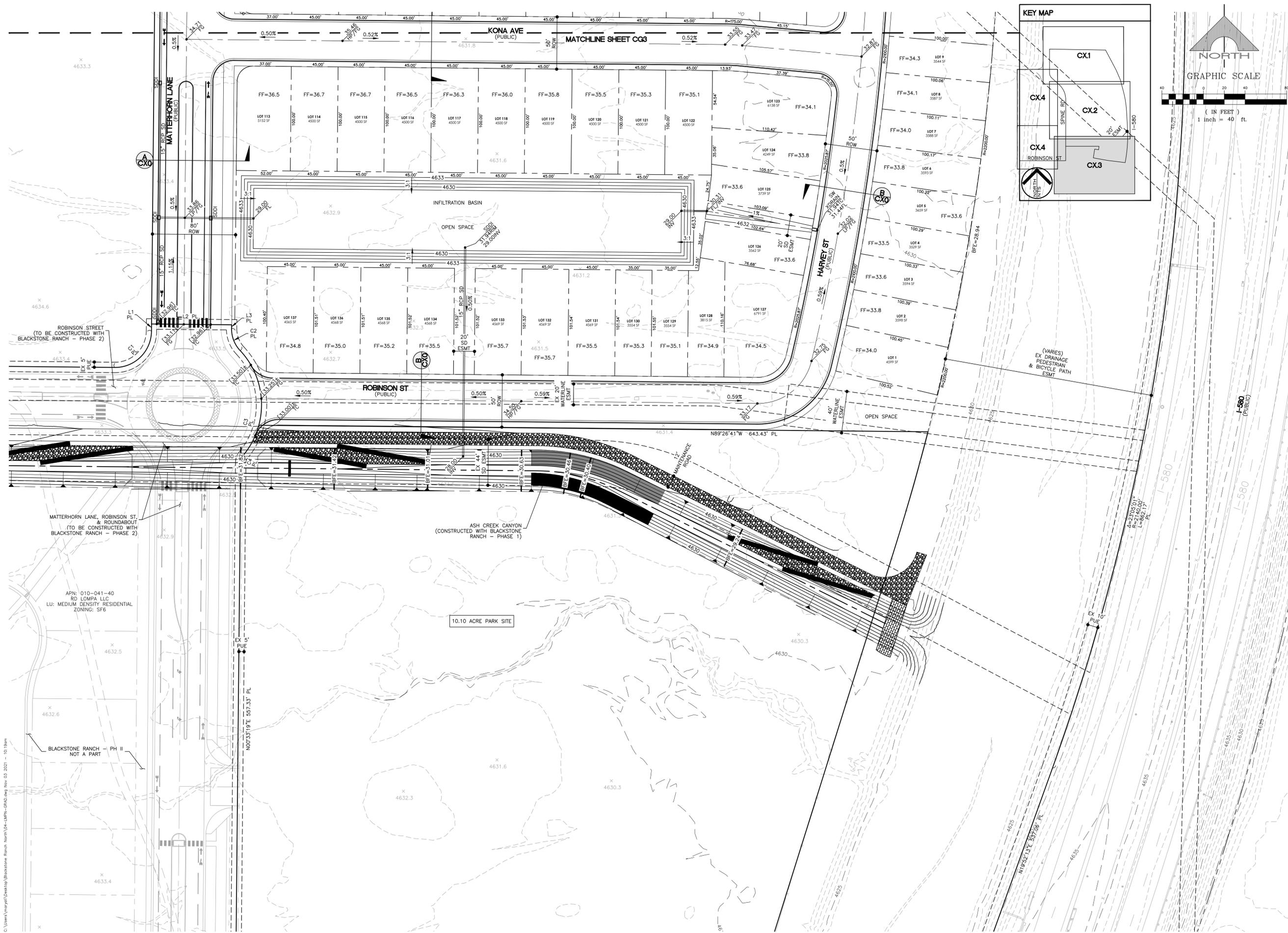
**CLIENT:**  
 BLACKSTONE DEVELOPMENT GROUP  
 439 PLUMB LANE  
 RENO, NV 89509  
 CONTACT: JOSHUA MYERS  
 PHONE: (775) 352-4200

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GRADING PLAN (2 OF 4)  
 BLACKSTONE RANCH NORTH  
 CARSON CITY, NEVADA

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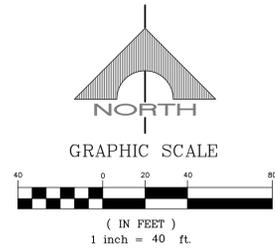
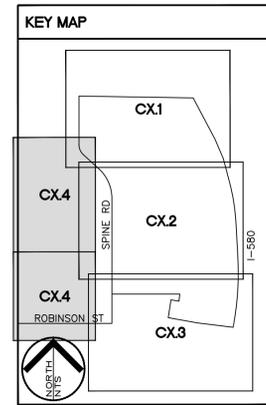
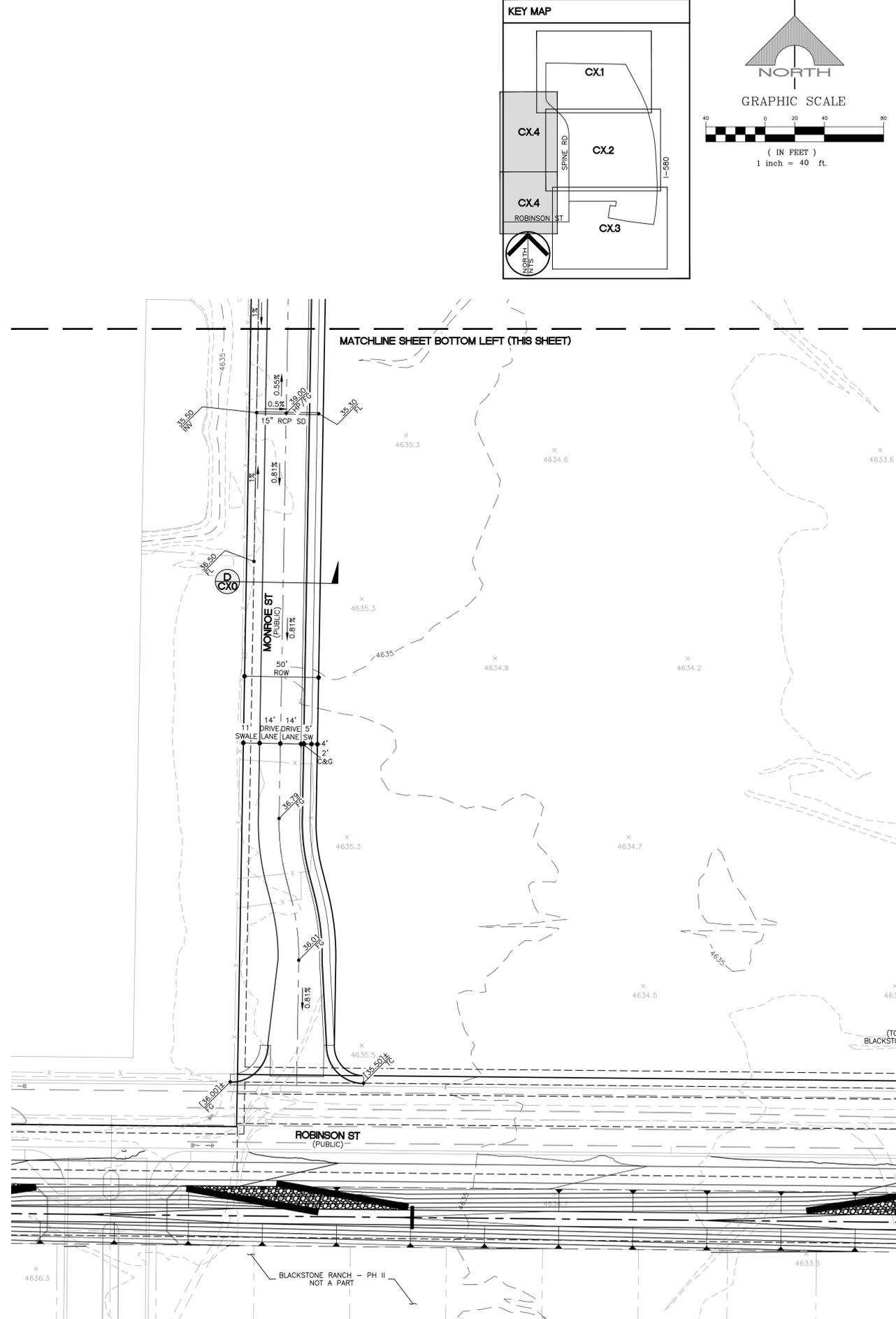
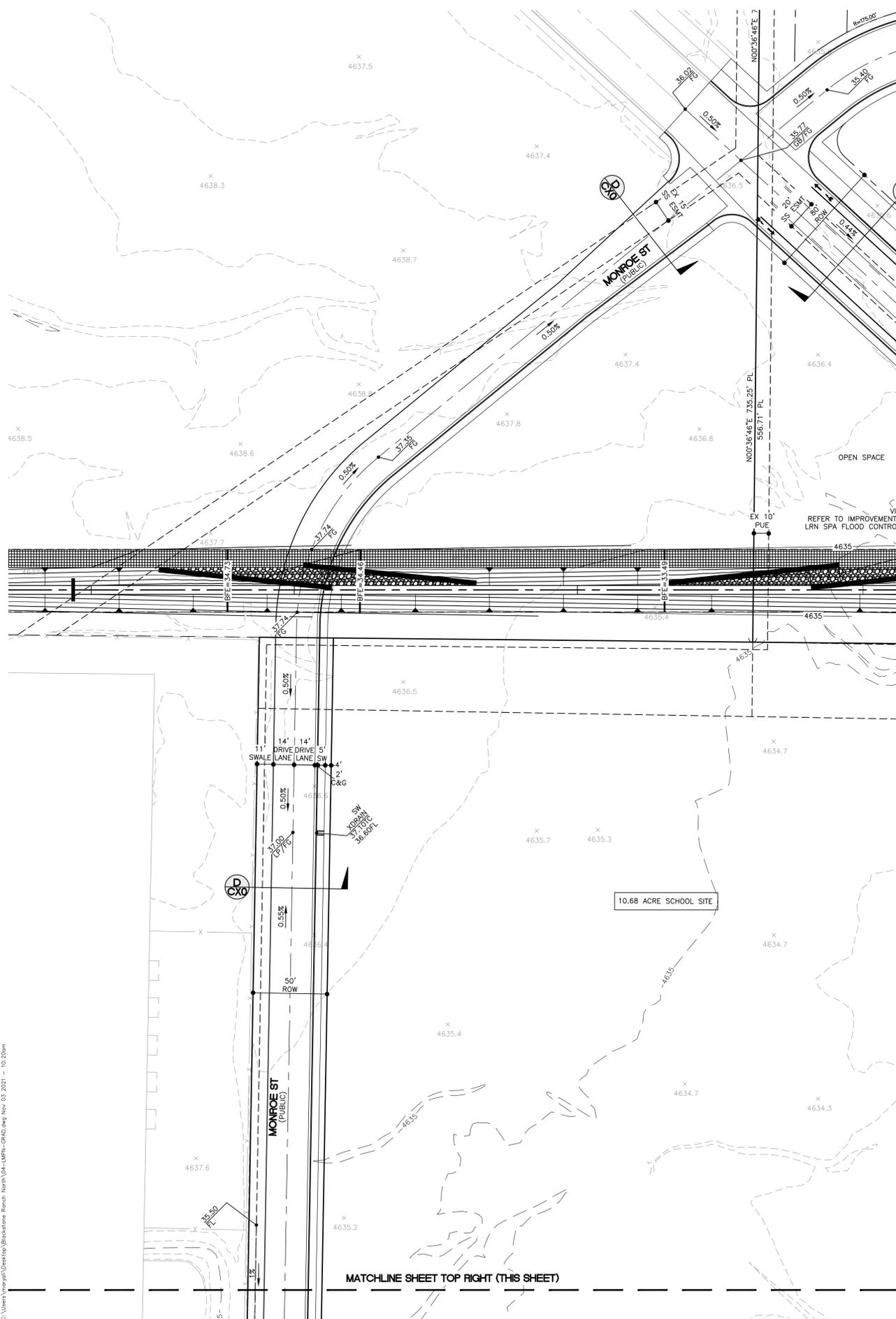
**PROFESSIONAL ENGINEER-STATE OF NEVADA**  
**MARK A. STEFL**  
 Exp. 6/30/22  
 CIVIL  
 No. 21261  
 11/3/21

**CLIENT:**  
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 RENO, NV 89509  
 CONTACT: JOSHUA MYERS  
 PHONE: (775) 352-4200

DATE	NO.	REVISIONS	APPROVED

GRADING PLAN (3 OF 4)  
**BLACKSTONE RANCH NORTH**  
 CARSON CITY, NEVADA

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DATE	2021.11.03



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PHONE: (775) 352-4200

DATE	NO.	REVISIONS	APPROVED

GRADING PLAN (4 OF 4) (OFF-SITE ROADWAY)  
**BLACKSTONE RANCH NORTH**  
CARSON CITY NEVADA

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DATE	2021.11.03

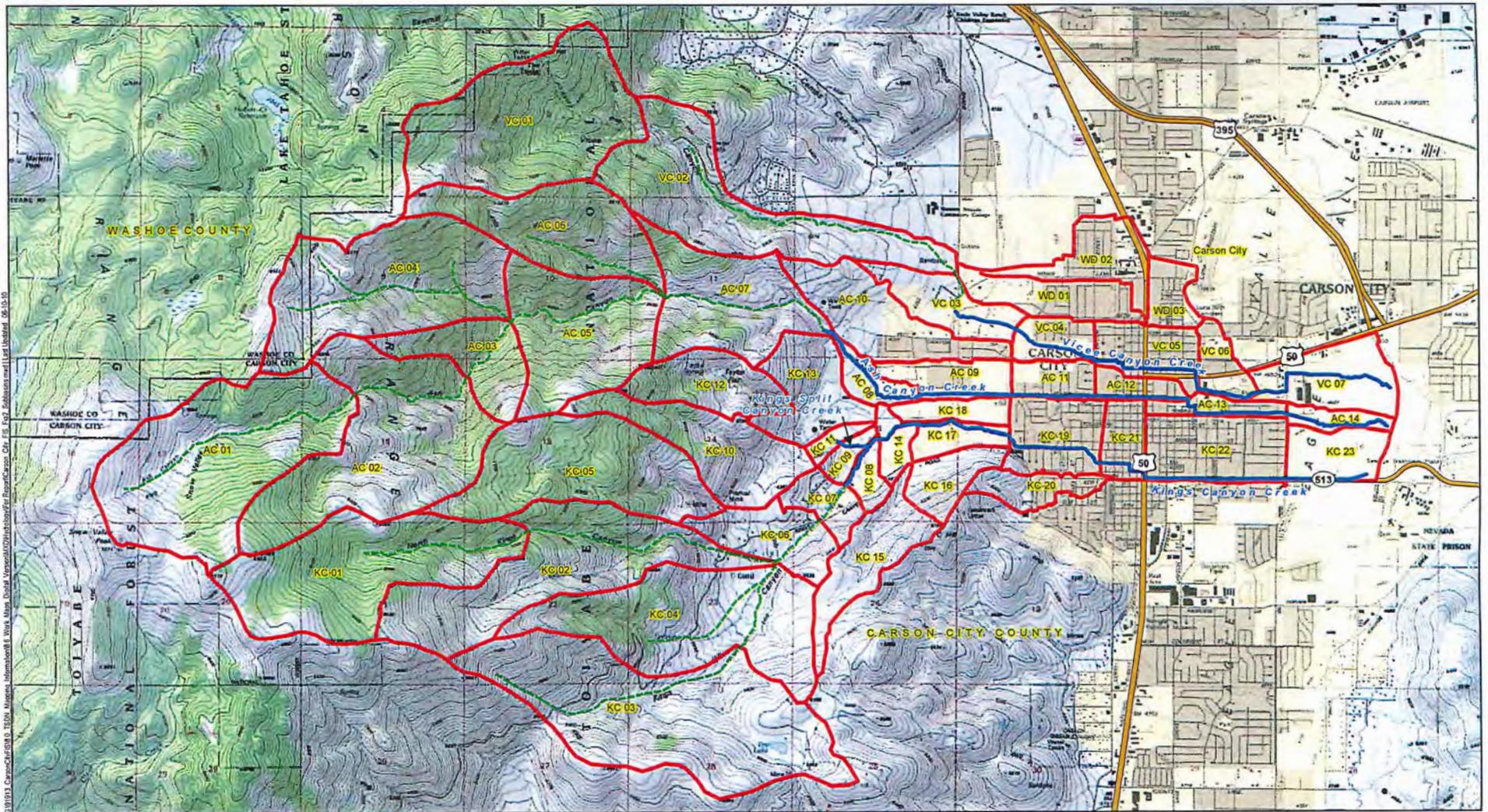
SHT CG4 12 OF 19

Exhibit 4

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## EXISTING AND PROPOSED DRAINAGE BASIN BOUNDARIES AND DESIGN FLOWS

Prepared by: Kimley-Horn (On-Site) and HDR (Off-Site)



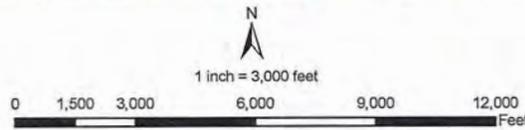
01/19/13 CarsonCity010\_100M\_Mapsheet010\_Verified/MapSheet010\_Fig\_102\_Subbasins.mxd Last Updated: 06-10-10



**HDR**  
ONE COMPANY | Many Solutions™

**Legend**

- Sub-basins
  - Stream Reaches Study Area
  - Stream Reaches (Non Study)
  - Major Roads
  - Urbanized Area
  - Counties \*
- \* Carson City County and City boundaries coincide



**Carson City Restudy - Sub-basins**

Figure 2

Image Source: NGS\_Topo\_US\_2D\_2009  
Horizontal Datum: NAD 1983  
Vertical Datum: NAVD 1988  
Date: 06-10-10

Flood Insurance Study for Carson City, NV | Project # 91913, T.O. 36





**Figure 5. Proposed Conditions**  
 Lompa Ranch North SPA  
 Carson City, NV  
 August 2018



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**Kimley Horn**

Appendix 5 - 100 Yr Peak Flow (Qp) by Subbasin



Existing Natural	
EX-1	14.2
EX-2	29.1
EX-3	27.5
EX-20	9.7
EX-21	5.7
EX-22	2.5
EX-23	1.7
EX-30	8.2
AOI 1	525.5
AOI 2	1,283.2
AOI 3	1,668.1

Existing - For Vol Calcs	
EXOS-1	5.4
EXOS-2	6.6
EXOS-3	3.9
EXOS-4	9.7
EXOS-5	3.7
EXOS-6	19.3
EXOS-7	18.7
EXOS-8	7.3
EXOS-9	3.8
EXOS-20	5.7
EXOS-21	3.0
EXOS-22	5.4
EXOS-23	1.6
EXOS-24	2.6
EXOS-30	8.2

Proposed	
PR_1	44.6
PR_11	6.1
PR_12	98.0
PR_2	61.8
PR_20	51.5
PR_21	31.1
PR_22	35.6
PR_23	4.0
PR_24	24.4
PR_3	27.3
PR_30	16.0
PR_4	70.4
PR_40	5.2
PR_41	9.2
PR_42	7.2
PR_43	4.2
PR_44	48.7
PR_45	14.3
PR_46	15.8
PR_47	1.6
PR_48	14.4
PR_49	19.9
PR_5	26.2
PR_50	3.1
PR_51	14.0
PR_52	9.4
PR_53	4.3
PR_54	1.6
PR_7	52.0
PR_8	57.7
PR_9	18.4

Exhibit 5

---

## FEMA FLOODPLAIN MAPS

Prepared by: JR Fuller

# National Flood Hazard Layer FIRMette



119°44'55"W 39°10'14"N



## Legend

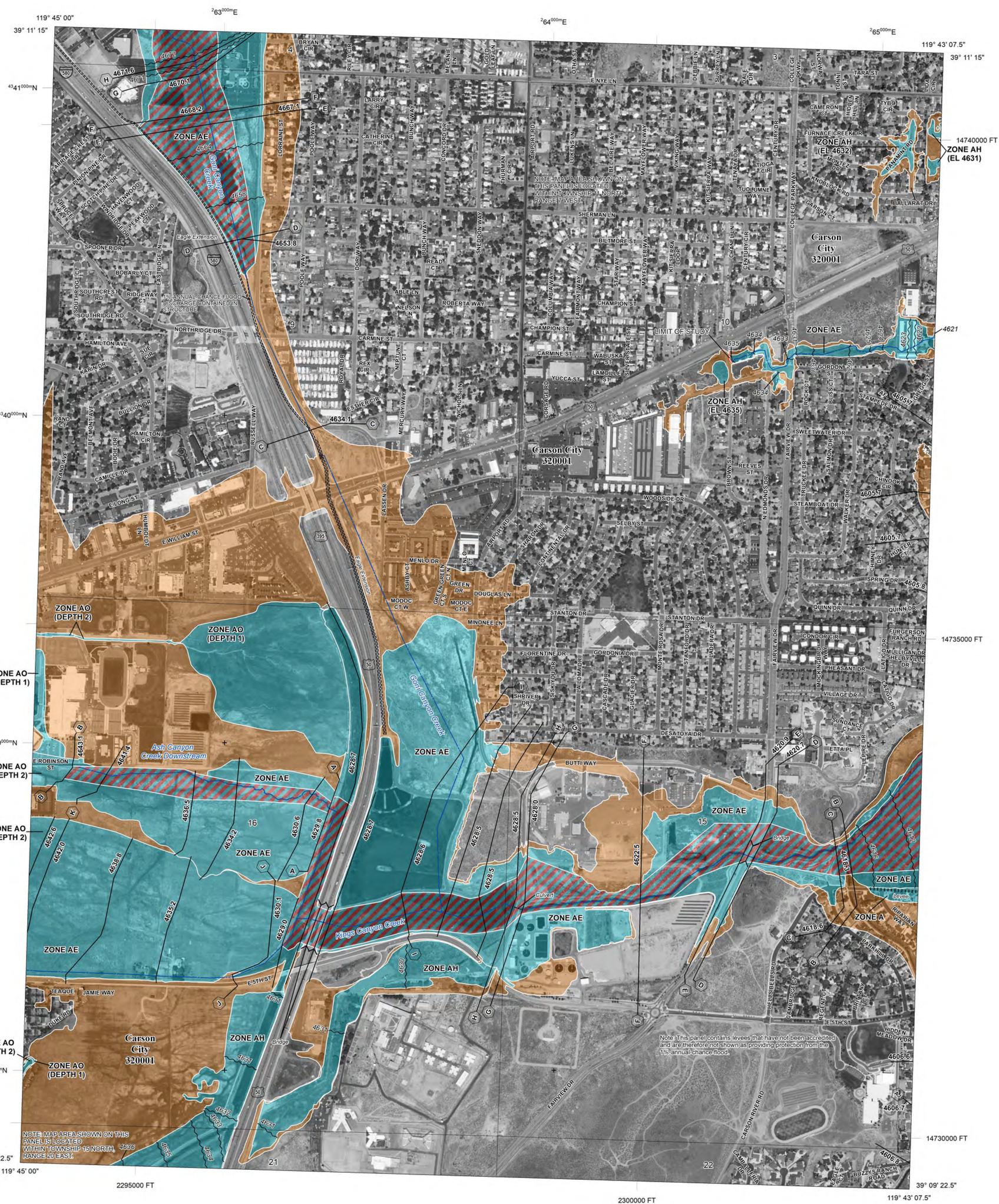
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
MAP PANELS		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/18/2021 at 3:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 NORTH, RANGE 20 EAST.

NOTE: THIS PANEL CONTAINS LEVEES THAT HAVE NOT BEEN ACCREDITED AND ARE THEREFORE NOT SHOWN AS PROVIDING PROTECTION FROM THE 1% ANNUAL CHANCE FLOOD.

**FLOOD HAZARD INFORMATION**

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP  
 THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTP://MSC.FEMA.GOV](http://msc.fema.gov)

	Without Base Flood Elevation (BFE) Zone A, V, A99 With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee See Notes. Zone X
	Areas Determined to be Outside the 0.2% Annual Chance Floodplain Zone X
	Area of Undetermined Flood Hazard Zone D
	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

**NOTES TO USERS**

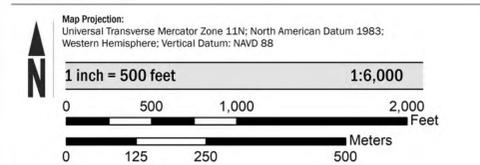
For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above. For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

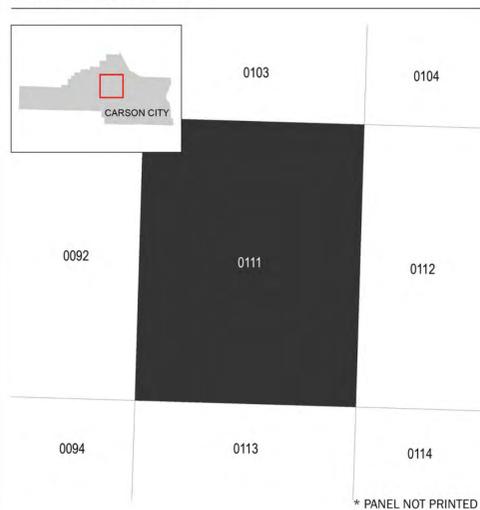
To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the National Agriculture Imagery Program (NAIP). This information was produced at a 3-foot per pixel resolution, using digital orthophotography dated 2016.

**SCALE**



**PANEL LOCATOR**



**National Flood Insurance Program**

**NATIONAL FLOOD INSURANCE PROGRAM**  
 FLOOD INSURANCE RATE MAP

**CARSON CITY, NEVADA**  
 Independent City

PANEL 111 of 275

Panel Contains:	COMMUNITY	NUMBER	PANEL SUFFIX
	CARSON CITY	320001	0111 H

VERSION NUMBER  
2.3.3.0

MAP NUMBER  
3200010111H

MAP REVISED  
JUNE 20, 2019

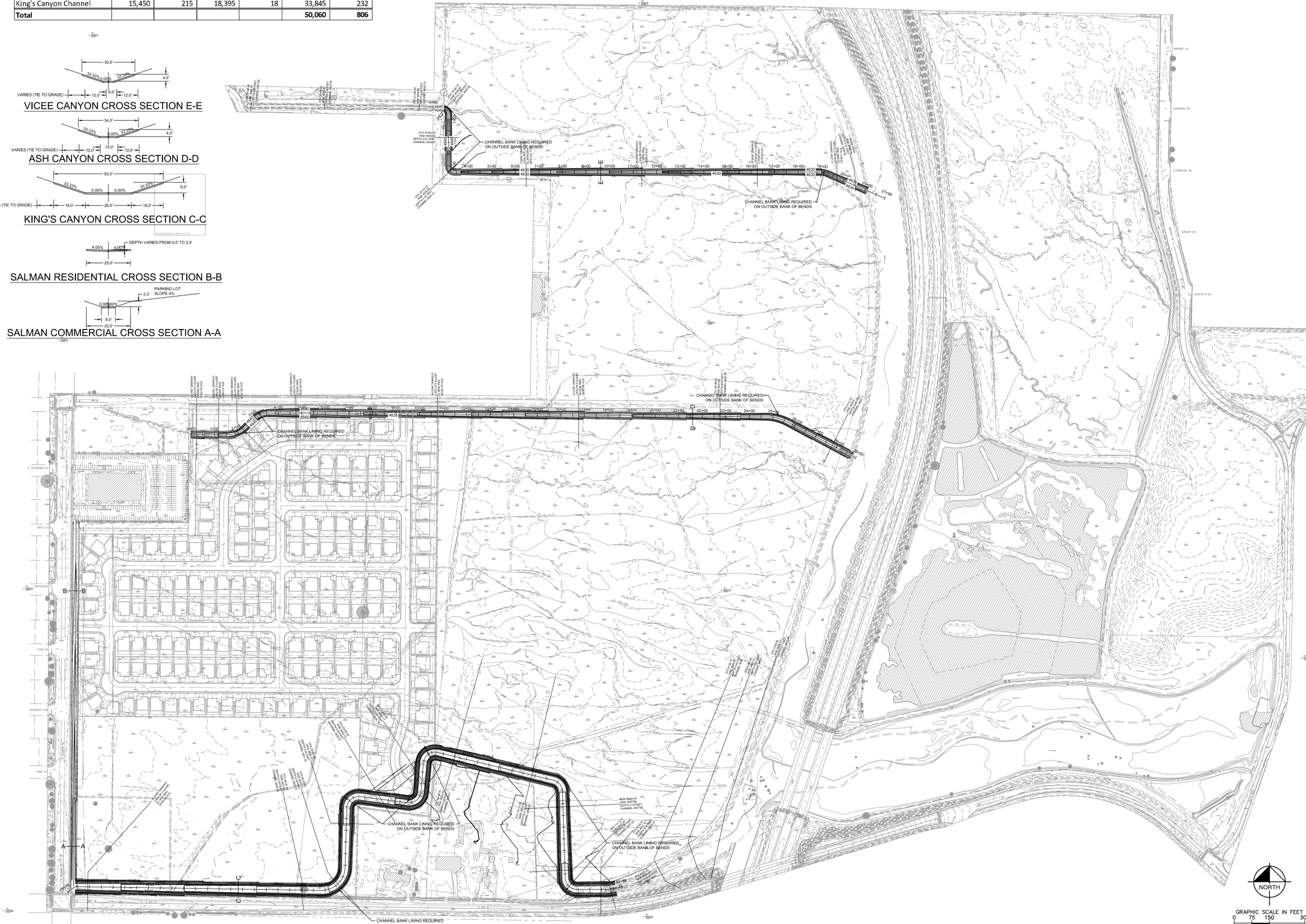
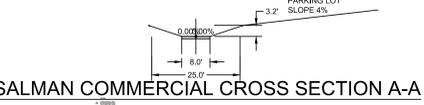
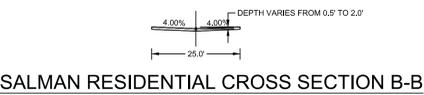
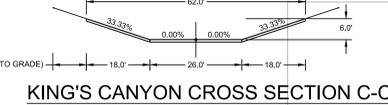
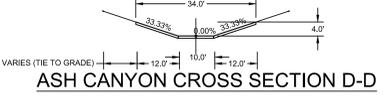
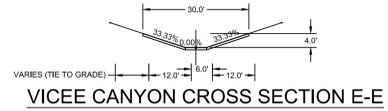
## Appendix 6

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# DRAINAGE FACILITIES (OPEN CHANNELS)

Prepared by: Kimley Horn

Channel	Phase 1 (cu.yd.)		Phase 2 (cu.yd.)		Total (cu.yd.)	
	Cut	Fill	Cut	Fill	Cut	Fill
Vice Canyon Channel			5,677	501	5,677	501
Ash Canyon Channel	4,574	68	5,963	5	10,537	72
King's Canyon Channel	15,450	215	18,395	18	33,845	232
<b>Total</b>					<b>50,060</b>	<b>806</b>



Drawing name: C:\Users\melissa.duyar\appdata\local\temp\AcPublish\_10180\Preliminary Design 018016000.dwg. Prelim Design. Dec 14, 2016 9:30am. by: melissa.duyar  
 This document, together with the contracts and designs presented herein, is intended only for the specific purpose and client for which it was prepared. Reuse of any information contained herein is prohibited without the express written permission of Kimley-Horn and Associates, Inc.

**PRELIMINARY: NOT FOR CONSTRUCTION**

<b>PROJECT:</b>	LOMPA RANCH CANYON CHANNELS FLOOD CONTROL CHANNEL EXHIBIT	<b>CLIENT:</b>	BLACKSTONE DEVELOPMENT GROUP																								
<b>DATE:</b>	12/02/2016	<b>DESIGNED BY:</b>	LW																								
<b>PROJECT NO.:</b>	018016000	<b>CHECKED BY:</b>	TC																								
<b>SHEET NUMBER:</b>	EXB-1	 © 2016 KIMLEY-HORN AND ASSOCIATES, INC. 817 W. PEACHTREE STREET, NW ATLANTA, GEORGIA 30308 PHONE (404) 419-8700 WWW.KIMLEY-HORN.COM																									
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 5%;">No.</th> <th style="width: 15%;">REVISIONS</th> <th style="width: 10%;">DATE</th> <th style="width: 10%;">BY</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>				No.	REVISIONS	DATE	BY																				
No.	REVISIONS	DATE	BY																								

## TC-2 Infiltration Basin



### Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Contain Pollutants
- ✓ Collect and Convey

### Description

An infiltration basin is a shallow earthen impoundment that is designed to collect, temporarily store and infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. However, infiltration basins can be challenging to apply on many sites because of soil requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

Figure TC-2-1 shows a typical infiltration pond configuration.

### Advantages

- It provides a 100 percent reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.
- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

### Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.

- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- The upstream drainage area must be completely stabilized before construction.
- Difficult to restore the functioning of infiltration basins once clogged.

### *Siting Criteria*

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long-term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within two (2) years. It is believed that these failures were, for the most part, due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B, or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30 percent clay, or more than 40 percent of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.
- Groundwater separation should be at least 3 m from the basin invert to the measured groundwater elevation. There is a concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.
- Location away from buildings, slopes, and highway pavement (greater than 6 m) and location away from wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15 percent should not be considered.
- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.
- Base flow should not be present in the tributary watershed.

### *Secondary Screening Based on Site Geotechnical Investigation*

- At least three (3) in-hole conductivity tests shall be performed using USBR 7300-89 or Bower-Rice procedures (the latter if groundwater is encountered within the boring), two (2) tests at different locations within the proposed basin, and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.
- The minimum acceptable hydraulic conductivity, as measured in any of the three (3) required test holes, is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.
- Exclude from consideration sites constructed on fill or partially on fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.
- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

### *Design and Sizing Guidelines*

- Water quality volume determined so that 85 percent of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

- Access should be provided for vehicles to easily maintain the forebay (presettling pond) area and not disturb vegetation or resuspend sediment any more than necessary.
- A minimum of one foot (1') of freeboard is recommended when establishing the design ponded water depth. Freeboard is measured from the rim of the infiltration facility to the maximum ponding level or from the rim down to the overflow point if overflow or a spillway is included.
- Lining Material – Ponds can be open or covered with a 6- to 12-inch layer of filter material such as coarse sand or suitable filter fabric to help prevent the buildup of impervious deposits on the soil surface. A nonwoven geotextile should be selected that will function sufficiently without plugging. The filter layer can be replaced or cleaned when/if it becomes clogged.
- Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85 percent of the annual runoff.
- Provide pretreatment if sediment loading is a maintenance concern for the basin.
- Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce the opportunity for standing water and associated vector problems.
- Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m<sup>2</sup>)

WQV = water quality volume (m<sup>3</sup>)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

- The use of vertical piping, either for distribution or infiltration enhancement, shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

#### *Construction/Inspection Considerations*

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top two inches (2") of soil after the site is stabilized.
- Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it cannot be washed back into the basin if a storm occurs during the construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

#### *Performance*

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That

report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

### Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent the establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10 percent of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

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- U.S. EPA, 1983, *Results of the Nationwide Urban Runoff Program: Volume 1 – Final Report*, WH-554, Water Planning Division, Washington, DC.
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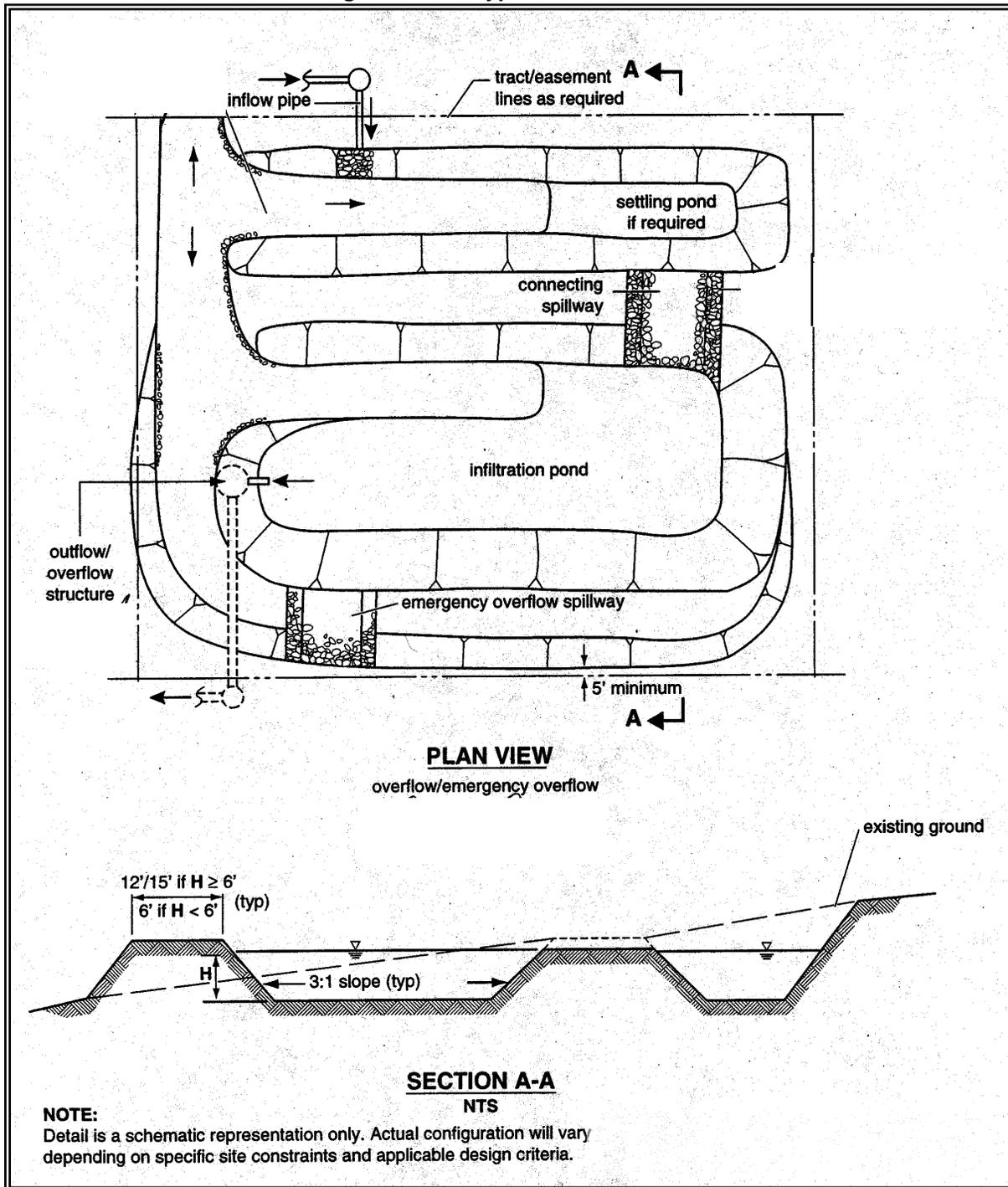
#### Information Resources

- Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for U.S. Environmental Protection Agency Office of Wetlands, Oceans and Watersheds. Washington, DC.
- Ferguson, B.K., 1994. *Stormwater Infiltration*. CRC Press, Ann Arbor, MI.
- USEPA. 1993. *Guidance to Specify Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

From: California Stormwater BMP Handbook, New Development and Redevelopment, 2003, California Stormwater Quality Association

Stormwater Management Manual for Eastern Washington, 2003, Washington Department of Ecology

Figure TC-2-1 Typical Infiltration Pond



Source: Washington Department of Ecology, 2004, Stormwater Management Manual for Eastern Washington

## TC-6 Vegetated Swales



### Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Water Quality Treatment
- ✓ Collect and Convey

### Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. Vegetated treatment systems, also known as biofiltration systems, remove pollutants by means of sedimentation, filtration, soil sorption, and/or plant uptake. They are typically configured as swales or filter strips. These facilities are designed to remove low concentrations and quantities of total suspended solids (TSS), heavy metals, petroleum hydrocarbons, and/or nutrients from stormwater. The vegetated swale biofiltration BMP is described in this section. The vegetated filter strip is described in BMP TC-7.

### Application

Biofiltration treatment facilities can be used as a basic treatment BMP for contaminated runoff from roadways, driveway, parking lots, and highly impervious ultra-urban areas or as the first stage of a treatment train. In cases where hydrocarbons, high TSS, or debris would be present in the runoff, such as high-use sites, a pretreatment system for those components would be necessary. Off-line location is preferred to avoid flattening vegetation and the erosive effects of high flows.

Biofiltration is the simultaneous process of filtration, particle settling, adsorption, and biological uptake of pollutants in stormwater that occurs when runoff flows over and through vegetated areas. A biofiltration swale is a sloped, vegetated channel or ditch that provides both conveyance and water quality treatment to stormwater runoff. It does not provide stormwater quantity control but can convey runoff to BMPs designed for that purpose.

### General Criteria

- Though the actual dimensions for a specific site may vary, the swale should generally have a length of 200 feet. The maximum bottom width is typically 10 feet. The depth of flow should not exceed four inches (4") during the design storm. The flow velocity should not exceed one (1) ft/sec.
- The channel slope should be at least one percent (1%) and no greater than five percent (5%).
- The swale can be sized as both a treatment facility for the 6-month storm and as a conveyance system to pass the peak hydraulic flows of the 25-year storm if it is located "on-line."

- The ideal cross-section of the swale should be a trapezoid. The side slopes should be no steeper than 3:1.
- Roadside ditches should be regarded as significant potential biofiltration sites and should be utilized for this purpose whenever possible.
- If a flow is to be introduced through curb cuts, place pavement slightly above the biofilter elevation. Curb cuts should be at least 12 inches wide to prevent clogging.
- Biofilters must be vegetated in order to provide adequate treatment of runoff.
- It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing grasses (or other vegetation) that can withstand prolonged periods of wetting, as well as prolonged dry periods (to minimize the need for irrigation). Consult the local NRCS office for specific vegetation selection recommendations.
- Biofilters should generally not receive construction-stage runoff. If they do, pre-settling of sediments should be provided. See BMPs (Sediment Trap) and (Temporary Sediment Pond) in Development Standard Division 13 – Erosion and Sediment Control Manual. Such biofilters should be evaluated for the need to remove sediments and restore vegetation following construction. The maintenance of pre-settling basins or sumps is critical to their effectiveness as pretreatment devices.
- If possible, divert runoff (other than necessary irrigation) during the period of vegetation establishment. Where runoff diversion is not possible, protect graded and seeded areas with suitable erosion control measures.

#### Design Procedure

- Step 1 - Determine the peak flow rate to the biofilter from the Water Quality Design Storm.
- Step 2 - Determine the slope of the biofilter. This will be somewhat dependent on where the biofilter is placed. The slope should be at least one percent (1%) and shall be no steeper than five percent (5%). When slopes less than two percent (2%) are used, the need for underdrainage must be evaluated.
- Step 3 - Select a swale shape. Trapezoidal is the most desirable shape; however, rectangular and triangular shapes can be used. The remainder of the design process assumes that a trapezoidal shape has been selected.
- Step 4 - Use Manning's Equation to estimate the bottom width of the biofilter. Manning's Equation for English units is as follows:

$$Q = (1.486 A R^{0.667} S^{0.5}) / n$$

Where: Q = flow (cfs)  
 A = cross sectional area of flow (ft<sup>2</sup>)  
 R = hydraulic radius of flow cross section (ft)  
 S = longitudinal slope of biofilter (ft/ft)  
 n = Manning's roughness coefficient. Values for grasses range from 0.15 to 0.40. Use n = 0.30 for a typical biofilter with turf/lawn vegetation; n = 0.20 for a biofilter with less dense vegetation such as meadow or pasture; or other n values for specific site vegetation as determined by the site professional. These values may be subject to approval by the project review authority.

For a trapezoid, this equation cannot be directly solved for bottom width. However, for trapezoidal channels that are flowing very shallow, the hydraulic radius can be set equal to the depth of flow. Using this assumption, the equation can be altered to:

$$B = ((0.135 Q) / (y^{1.667} S^{0.5})) - zy$$

For  $n = 0.20$  and where:

B = bottom width of the swale

y = depth of flow

Z = the side slope of the biofilter in the form of z:1

For other values of n, use the following equation:

$$B = (((n / 1.486) Q) / (y^{1.667} S^{0.5})) - zy$$

Typically, the depth of flow for turfgrass is selected to be four inches (4"). For dryland grasses, the depth of flow should be set to three inches (3"). It can be set lower, but doing so will increase the bottom width. Sometimes when the flow rate is very low, the equation listed above will generate a negative value for B. Since it is not possible to have a negative bottom width, the bottom width should be set to one foot (1') when this occurs.

Biofilters are limited to a maximum bottom width of 10 feet. If the required bottom width is greater than 10 feet, parallel biofilters should be used in conjunction with a device that splits the flow and directs the proper amount to each biofilter.

- Step 5 - Calculate the cross-sectional area of flow for the given channel using the calculated bottom width and the selected side slopes and depth.
- Step 6 - Calculate the velocity of flow in the channel using:  $V = Q / A$ . If V is less than or equal to 1 ft/sec, the biofilter will function correctly with the selected bottom width. Proceed to design Step 7.

If V is greater than 1 ft/sec, the biofilter will not function correctly. Increase the bottom width, recalculate the depth using Manning's Equation and return to Step 5.

- Step 7 - Select a location where a biofilter with the calculated width and a length of 200 feet will fit. If a length of 200 feet is not possible, the width of the biofilter must be increased so that the area of the biofilter is the same as if a 200-foot length had been used.
- Step 8 - Select a vegetation cover suitable for the site. Consult the local NRCS office for guidance.
- Step 9 - Determine the peak flow rate to the biofilter during the 25-year, 24-hour storm (a 10-year storm is acceptable, provided that reparative maintenance will be performed following every 10-year event). Using Manning's Equation, find the depth of flow (typically,  $n = 0.04$  during the 25-year flow; n may need to be adjusted if a 10-year event is used). The depth of the channel shall be one foot (1') deeper than the depth of flow. Check to determine that shear stresses do not cause erosion; the velocity needs to stay below two (2) ft/sec. This step can be skipped if all storms larger than the short duration water quality storm bypass the biofiltration swale.

#### *Construction and Maintenance Criteria*

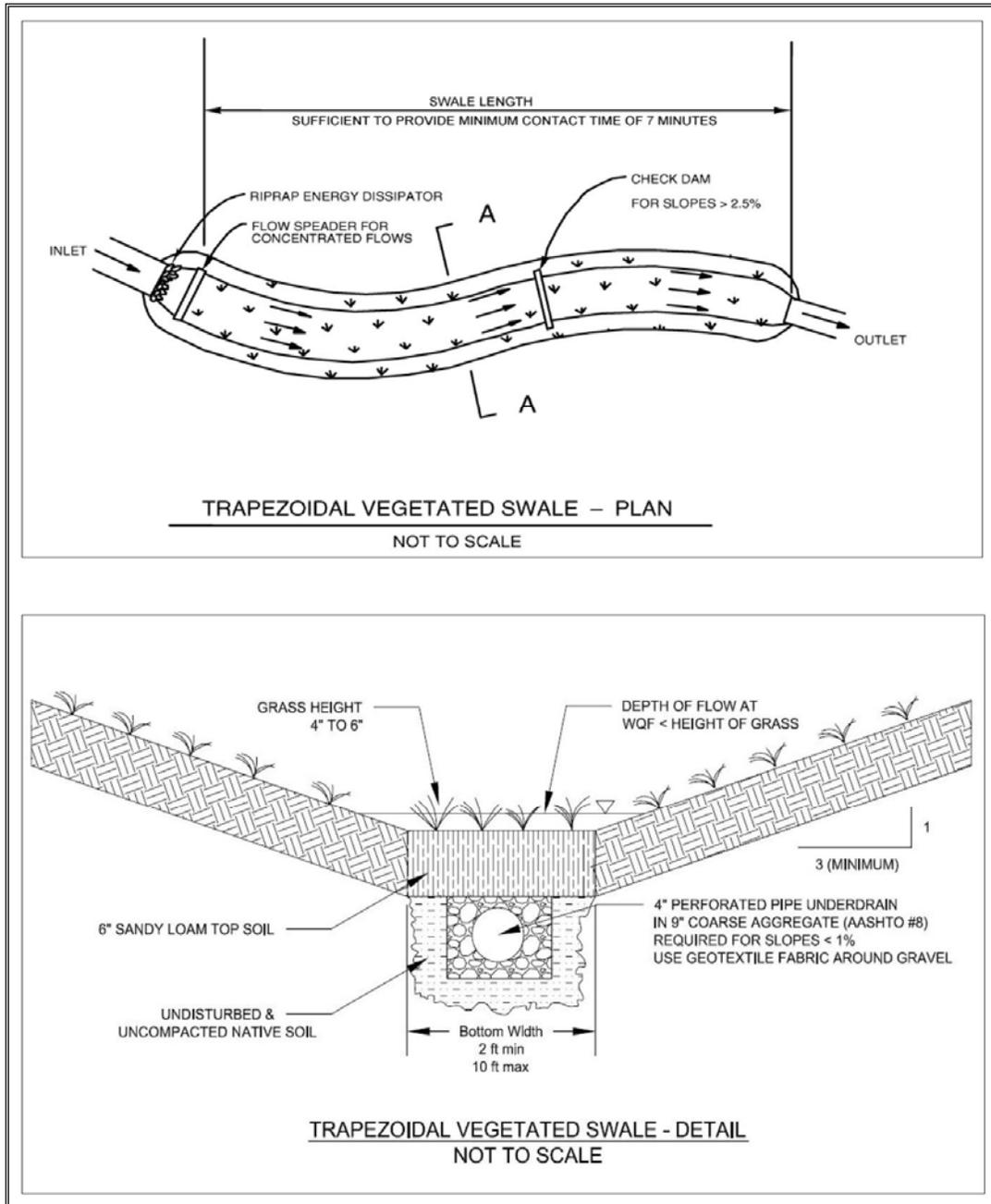
- Groomed biofilters planted in grasses shall be mowed during the summer to promote growth and pollutant uptake.
- Remove sediments during summer months when they build up to four inches (4") at any spot, cover biofilter vegetation, or otherwise interfere with biofilter operation. Reseed bare spots created by removal equipment.
- Inspect biofilters periodically, especially after periods of heavy runoff. Remove sediments, fertilize, and reseed as necessary. Be careful to avoid introducing fertilizer to receiving waters or groundwater.
- Clean curb cuts when soil and vegetation buildup interfere with flow introduction.

- Remove litter to keep biofilters free of external pollution.

From: California Stormwater BMP Handbook, New Development and Redevelopment, 2003, California Stormwater Quality Association.

Stormwater Management Manual for Eastern Washington, 2004, Washington Department of Ecology.

Figure TC 5-1 Vegetated Swale Plan View/Section



From: Stormwater Quality Design Manual for the Sacramento Region, July 2018

Figure TC 5-2 Vegetated Swale Section View

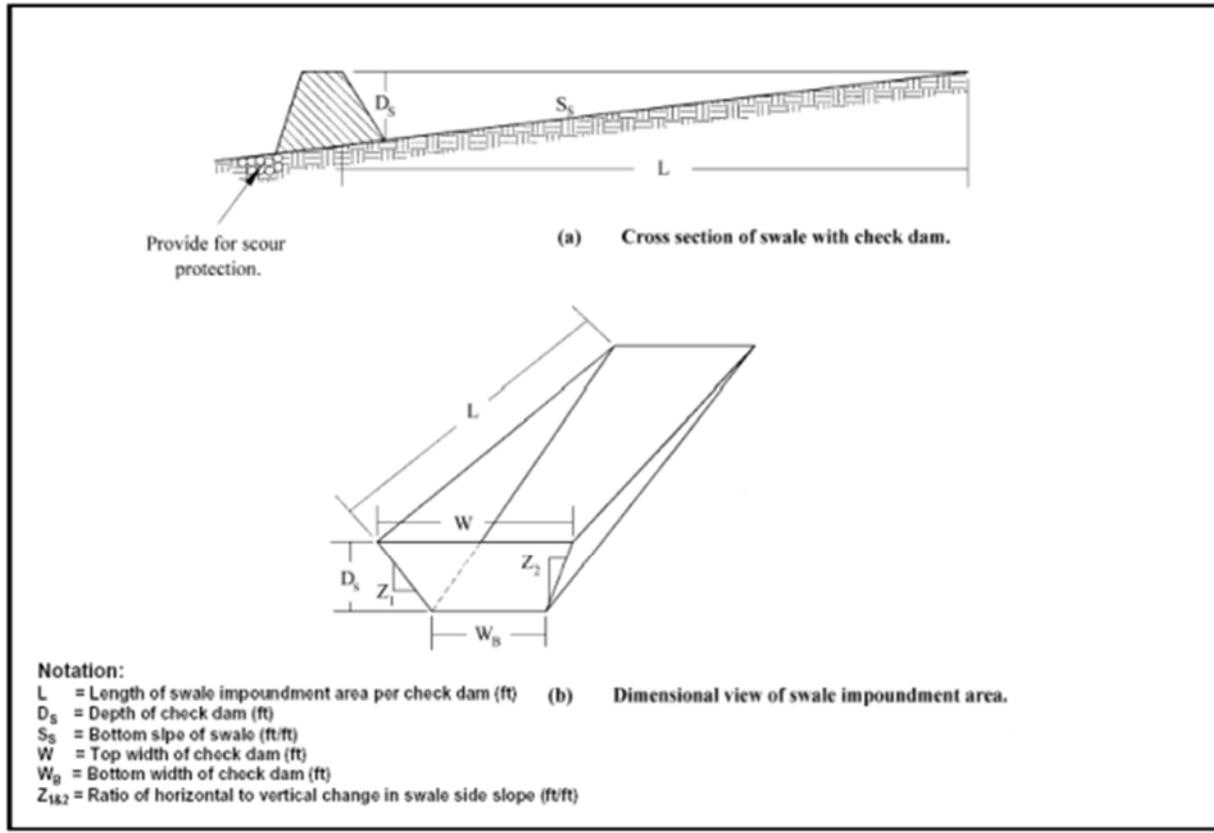


Figure adapted from California Stormwater BMP Handbook, New Development and Redevelopment, 2003, California Stormwater Quality Association

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## Dry Lane - Local Q10max

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### Project Description

Solve For Spread

### Input Data

Channel Slope	0.00500	ft/ft
Discharge	5.04	ft <sup>3</sup> /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	

### Results

Spread	13.50	ft
Flow Area	1.89	ft <sup>2</sup>
Depth	0.36	ft
Gutter Depression	0.09	ft
Velocity	2.66	ft/s

---

## Dry Lane - Local Q100max

---

### Project Description

Solve For                      Spread

### Input Data

Channel Slope	0.00500	ft/ft
Discharge	12.84	ft <sup>3</sup> /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	

### Results

Spread	19.49	ft
Flow Area	3.87	ft <sup>2</sup>
Depth	0.48	ft
Gutter Depression	0.09	ft
Velocity	3.32	ft/s

---

## Dry Lane - Collector Q10max

---

### Project Description

Solve For                      Spread

### Input Data

Channel Slope	0.00500	ft/ft
Discharge	8.36	ft <sup>3</sup> /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	

### Results

Spread	16.49	ft
Flow Area	2.79	ft <sup>2</sup>
Depth	0.42	ft
Gutter Depression	0.09	ft
Velocity	3.00	ft/s

---

## Dry Lane - Collector Q100max

---

### Project Description

Solve For Spread

### Input Data

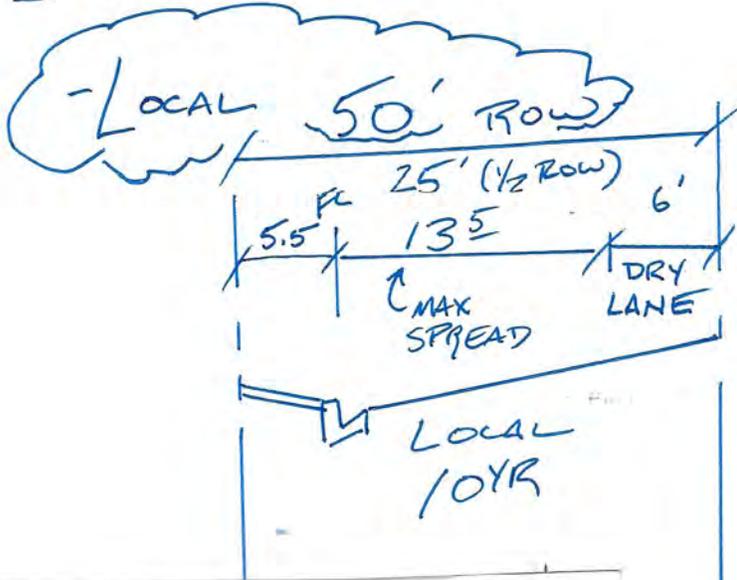
Channel Slope	0.00500	ft/ft
Discharge	12.84	ft <sup>3</sup> /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	

### Results

Spread	19.49	ft
Flow Area	3.87	ft <sup>2</sup>
Depth	0.48	ft
Gutter Depression	0.09	ft
Velocity	3.32	ft/s

# BLACKSTONE N.

2021 10 26 DRY LANE CALCCS.



$Q_{10} = 12'$  DRY LANE

$S = 0.5\%$

$C = 0.9$

$i_5 = 1.83$

$i_{10} = 2.14$

$i_{100} = 3.26$

\*ALL 24 HR STORMS.

$Q_{MAX}^{10}$  (FLOWMASTER) FOR DRY LANE = 5.04 CFS

DOUBLE FOR FULL ST

= 10.08 CFS

$Q = C i A$   
 $10.08 = 0.9 \cdot 2.14 \cdot A$   
 $A = 5.23$  MAX ACRES.

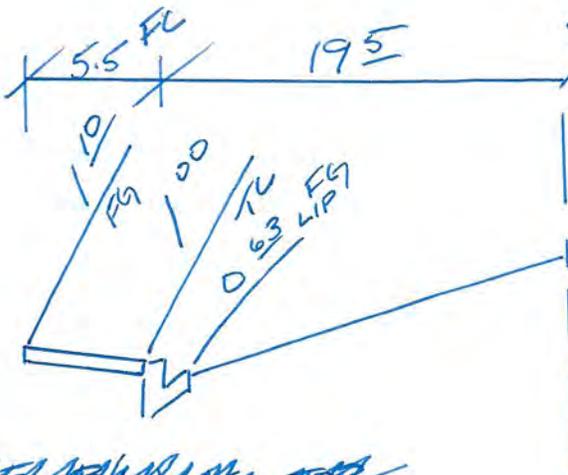
= 227,319 SF

LOCAL 100 YR.

USE THIS!

ST FLOODED.

MAX DEPTH @ GUT FE = 1'



$12.84 \text{ CFS} \times 2 = 25.68 \text{ CFS}$

↑ LINES 19.49 SPREAD

$Q = C i A$

$25.68 = 0.9 \cdot 3.26 \cdot A$

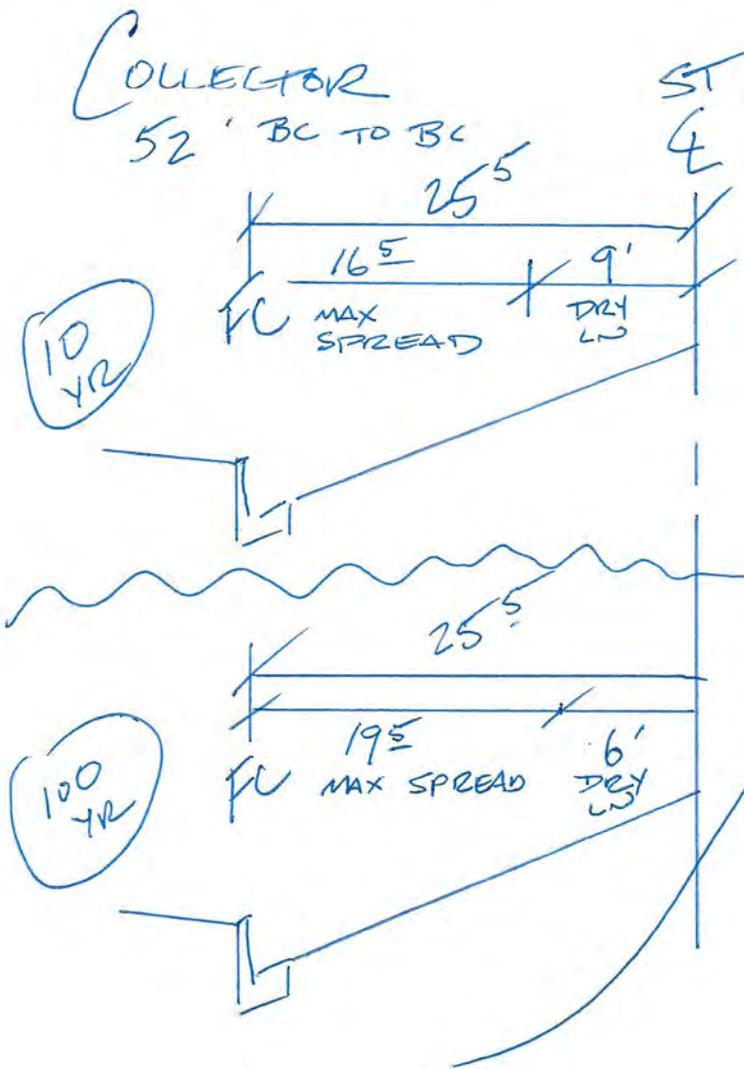
$A_{MAX} = 8.75$  ACRES

~~Handwritten scribbles~~

~~Handwritten scribbles~~

# BLACKSTONE N

2021 10 29 DRY LAKE  
(CALCS)



$Q_{10}$  18' WIDE DRY LAKE

$$Q_{MAX} = 8.36 \text{ CFS}$$

(0.5%)

FLOWMASTER DBL FULL ST

$$8.36 \times 2 = 16.72 \text{ CFS MAX}$$

$$Q = C i A$$

$i_{10 \text{ YR}} = 2.14$

$$A_{10 \text{ MAX}} = 8.68 \text{ ACRES}$$

$Q_{100}$  12' WIDE DRY LAKE

$$Q_{MAX} = 12.84 \text{ CFS}$$

(0.5%)

FLOWMASTER

$$\times 2 = 25.68 \text{ CFS MAX}$$

$$Q = C i A$$

$i_{100 \text{ YR}} = 3.26$

$$A_{MAX} = 8.79 \text{ ACRES}$$

USE THIS



NOAA Atlas 14, Volume 1, Version 5  
 Location name: Carson City, Nevada, USA\*  
 Latitude: 39.1644°, Longitude: -119.7462°  
 Elevation: 4637.08 ft\*\*  
 \* source: ESRI Maps  
 \*\* source: USGS



**POINT PRECIPITATION FREQUENCY ESTIMATES**

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

**PF tabular**

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.095 (0.082-0.113)	0.119 (0.103-0.141)	0.159 (0.136-0.188)	0.197 (0.168-0.233)	0.260 (0.214-0.308)	0.317 (0.253-0.379)	0.386 (0.298-0.466)	0.468 (0.347-0.574)	0.598 (0.418-0.749)	0.716 (0.476-0.913)
10-min	0.145 (0.125-0.171)	0.181 (0.156-0.214)	0.242 (0.207-0.287)	0.300 (0.255-0.355)	0.395 (0.326-0.469)	0.483 (0.386-0.577)	0.588 (0.454-0.709)	0.712 (0.528-0.874)	0.910 (0.636-1.14)	1.09 (0.725-1.39)
15-min	0.180 (0.155-0.212)	0.224 (0.194-0.266)	0.299 (0.257-0.355)	0.371 (0.316-0.441)	0.490 (0.404-0.582)	0.598 (0.478-0.715)	0.728 (0.562-0.878)	0.883 (0.654-1.08)	1.13 (0.789-1.41)	1.35 (0.899-1.72)
30-min	0.242 (0.208-0.286)	0.301 (0.261-0.358)	0.403 (0.346-0.478)	0.500 (0.426-0.593)	0.660 (0.544-0.784)	0.806 (0.644-0.963)	0.981 (0.757-1.18)	1.19 (0.881-1.46)	1.52 (1.06-1.90)	1.82 (1.21-2.32)
60-min	0.300 (0.258-0.354)	0.373 (0.323-0.443)	0.499 (0.428-0.592)	0.619 (0.527-0.734)	0.817 (0.673-0.970)	0.997 (0.797-1.19)	1.21 (0.937-1.46)	1.47 (1.09-1.81)	1.88 (1.32-2.36)	2.25 (1.50-2.87)
2-hr	0.406 (0.361-0.466)	0.504 (0.448-0.577)	0.643 (0.568-0.735)	0.766 (0.669-0.876)	0.952 (0.809-1.09)	1.12 (0.929-1.30)	1.31 (1.06-1.53)	1.53 (1.20-1.83)	1.92 (1.44-2.38)	2.29 (1.65-2.90)
3-hr	0.485 (0.434-0.546)	0.605 (0.545-0.684)	0.760 (0.678-0.858)	0.887 (0.784-0.998)	1.07 (0.928-1.21)	1.22 (1.04-1.40)	1.39 (1.17-1.61)	1.62 (1.32-1.89)	1.97 (1.57-2.40)	2.32 (1.79-2.93)
6-hr	0.671 (0.603-0.751)	0.839 (0.753-0.941)	1.04 (0.932-1.17)	1.21 (1.07-1.35)	1.42 (1.25-1.60)	1.60 (1.38-1.81)	1.77 (1.50-2.02)	1.97 (1.64-2.28)	2.27 (1.84-2.67)	2.53 (2.00-3.03)
12-hr	0.885 (0.789-0.994)	1.11 (0.992-1.25)	1.40 (1.24-1.58)	1.63 (1.44-1.83)	1.93 (1.69-2.19)	2.16 (1.87-2.47)	2.40 (2.04-2.77)	2.65 (2.21-3.09)	2.98 (2.42-3.54)	3.24 (2.57-3.91)
24-hr	1.16 (1.05-1.28)	1.45 (1.32-1.60)	1.83 (1.67-2.02)	2.14 (1.94-2.36)	2.57 (2.32-2.83)	2.91 (2.60-3.20)	3.26 (2.90-3.61)	3.62 (3.19-4.03)	4.12 (3.58-4.61)	4.51 (3.87-5.10)
2-day	1.39 (1.25-1.55)	1.74 (1.56-1.95)	2.21 (1.99-2.48)	2.60 (2.32-2.91)	3.13 (2.78-3.52)	3.56 (3.14-4.01)	4.00 (3.50-4.53)	4.47 (3.87-5.10)	5.11 (4.38-5.89)	5.63 (4.73-6.55)
3-day	1.52 (1.36-1.71)	1.92 (1.71-2.15)	2.45 (2.19-2.76)	2.89 (2.57-3.25)	3.50 (3.09-3.95)	3.99 (3.50-4.52)	4.51 (3.92-5.13)	5.05 (4.35-5.78)	5.82 (4.92-6.71)	6.43 (5.35-7.49)
4-day	1.66 (1.48-1.87)	2.09 (1.87-2.36)	2.69 (2.39-3.04)	3.18 (2.82-3.59)	3.87 (3.41-4.39)	4.42 (3.86-5.03)	5.01 (4.34-5.72)	5.64 (4.82-6.46)	6.52 (5.47-7.54)	7.23 (5.98-8.44)
7-day	1.93 (1.72-2.17)	2.44 (2.17-2.75)	3.15 (2.80-3.55)	3.71 (3.30-4.19)	4.51 (3.99-5.11)	5.15 (4.51-5.84)	5.81 (5.05-6.62)	6.51 (5.61-7.45)	7.49 (6.35-8.65)	8.26 (6.90-9.63)
10-day	2.11 (1.88-2.38)	2.69 (2.39-3.03)	3.48 (3.09-3.92)	4.10 (3.64-4.62)	4.95 (4.36-5.58)	5.62 (4.91-6.35)	6.30 (5.47-7.14)	7.01 (6.03-7.97)	7.98 (6.78-9.17)	8.73 (7.33-10.1)
20-day	2.58 (2.31-2.89)	3.28 (2.94-3.67)	4.23 (3.79-4.72)	4.95 (4.42-5.52)	5.91 (5.25-6.60)	6.64 (5.86-7.42)	7.38 (6.48-8.29)	8.12 (7.08-9.16)	9.10 (7.84-10.4)	9.84 (8.39-11.3)
30-day	2.91 (2.62-3.24)	3.70 (3.33-4.12)	4.76 (4.28-5.29)	5.55 (4.98-6.17)	6.61 (5.90-7.35)	7.42 (6.57-8.26)	8.23 (7.24-9.20)	9.03 (7.88-10.2)	10.1 (8.72-11.5)	10.9 (9.33-12.5)
45-day	3.42 (3.09-3.79)	4.35 (3.92-4.81)	5.59 (5.04-6.17)	6.50 (5.85-7.17)	7.67 (6.87-8.48)	8.53 (7.61-9.45)	9.36 (8.33-10.4)	10.2 (9.00-11.3)	11.2 (9.80-12.5)	11.9 (10.4-13.4)
60-day	3.93 (3.54-4.36)	5.00 (4.50-5.55)	6.42 (5.76-7.09)	7.42 (6.67-8.20)	8.67 (7.77-9.59)	9.57 (8.55-10.6)	10.4 (9.28-11.6)	11.2 (9.95-12.5)	12.1 (10.7-13.6)	12.8 (11.3-14.4)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

November 3, 2021

Darren Anderson, PE  
Senior Project Manager  
Public Works Department | Carson City  
3505 Butti Way, Carson City, NV 89701

**RE: SEWER ANALYSIS FOR BLACKSTONE NORTH, 137 LOT SFR TENTATIVE MAP  
("TM")**

Dear Mr. Anderson,

Blackstone Development Group, Inc. is submitting a Tentative Map for a portion of Parcel No. 10-041-39 and 10 041-51. The 137 lot residential subdivision is generally located west of North Saliman Road, north of 5th Street and south of Robinson Street. The proposed project is located in the Lompa Ranch Specific Plan Area (SPA).

A sewer analysis submitted for the Lompa Ranch North SPA was based on the underlying zoning and planned density, Multi Family Duplex (MFD) allowing for 15.0 dwelling units/acre and Multi Family Apartments (MFA) allows for 26.0 dwelling units/acre – 39.0 dwelling units/acre. The 137 lot SFR subdivision has a density of 4.68 units/acre, based on the gross acreage and a density of 8.48 units/acre based on the net acreage, a substantially lower density. Pursuant to a recent inquiry, there was not a concern regarding capacity of the 33" sewer main with the reduced density. The previous sewer analysis submitted and details of the density reduction here in are being made available for your review.

Please contact me at (702) 325-2114 if you have any questions.

Sincerely,

**ENCORE ENGINEERING LLC**



Jaimee Yoshizawa



---

R | REAL ESTATE • E | ENGINEERING • D | DEVELOPMENT

## LOMPA RANCH NORTH SPECIFIC PLAN AREA (SPA) SANITARY SEWER FEASIBILITY STUDY

CARSON CITY, NEVADA

Prepared for:  
BLACKSTONE DEVELOPMENT GROUP

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May 23, 2017



May 23, 2017

Mr. Stephen Pottéy, PE  
Carson City Development Services  
108 E. Proctor Street  
Carson City, NV 89701

**RE: LOMPA RANCH NORTH SPECIFIC PLAN AREA (SPA) – SANITARY SEWER  
FEASIBILITY STUDY**

Dear Mr. Pottey:

The Red Ltd is pleased to provide a Sanitary Sewer Feasibility Study for the Lompa Ranch North Specific Plan Area (SPA). The development proposes to connect to existing sanitary sewer facilities on the peripheral of the project as well sanitary sewer lines within the project boundaries.

The data presented herein was compiled from as-builts, existing capacity and utility atlas' provided by Carson City Public Works and survey data provided by Blackstone Development Group. Pursuant to the analysis of the existing sanitary sewer mains in the vicinity of the subject property, the existing facilities with the proposed build-out as outlined in this study shall adequately service the proposed development.

If you have any questions or require additional information, please do not hesitate to call me at (702) 325-2114.

Sincerely,

THE RED LTD

R – Real Estate Advisors | E – Engineering | D – Development

Edgar León, P.E.

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**APPENDICES**

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**1 APPENDIX 1***Figure 1: Vicinity Map**Figure 2: Location Map**Figure 3: Existing Site Topography**Figure 4: Lompa Ranch North SPA - Phasing Plan**Figure 5: Lompa Ranch North SPA - Concept Plan***2 APPENDIX 2****Sewer Calculations***Lompa Ranch North - Sanitary Sewer Demand Analysis**Carson City's Municipal Code Title 12.06.270**Carson City's Municipal Code Title 12.06.280**Hydraulic Analysis Calculations***3 APPENDIX 3****Sewer Alignments***Carson City Public Works Utility Run Book**As-Built Drawings***4 APPENDIX 4****Master Concept Sanitary Sewer and Water System Layout***Carson City Public Works Utility Run Book*

*This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by The Red Ltd shall be without liability to The Red Ltd.*

## **1 GENERAL INFORMATION OF SITE**

### **1.1 Introduction**

The Red Ltd was retained by Blackstone Development Group to perform a Sanitary Sewer Feasibility Study for the Lompa Ranch North Specific Plan Area (SPA). The site is currently undeveloped with existing public utility infrastructure both within and on the peripheral of the subject property. The purpose of this Sanitary Sewer Feasibility Study is to assess the wastewater demand of the ultimate build-out of the project and determine the feasibility of utilizing existing sanitary sewer facilities to service the proposed development.

### **1.2 Project Site**

Lompa Ranch North is approximately 251.31+/- acres located in Carson City, Nevada. The western portion of Lompa Ranch North encompasses as 203.27 +/- acres is located on the west side of Interstate 580. The western portion of the property is located east of North Saliman Road, north of East 5th Street and south of US Highway 50 (East William Street). The remaining 48.04+/- acres is located on the east side of Interstate 580, west of Airport Road and south of West/East of Merdoc Court. The subject site is within Section 16 and a portion of the NW ¼ of Section 21 of Township 15 North, Range 20 East, M.D.M. & M. The Assessor's Parcel Numbers are 010-041-16, 010-041-38, 010-041-52, 010-041-70, 010-04-71, 010-041-73 and 010-36-04.

Reference **Figure 1** for the project vicinity map, **Figure 2** for the location map, **Figure 5** for the Lompa Ranch North SPA – Concept Plan. These figures are provided within **Appendix 1**.

## **2 SEWER GENERATION**

### **2.1 Lot Coverage**

For a conservative analysis, the sewer generation for the project site is based on the anticipated acreage for each phase of the project. This acreage does not regard the area for improvements such as proposed roadways like Lompa Ranch Boulevard and Robinson Street.

TABLE 1: PROPOSED LAND USE DESIGNATION

LOMPA RANCH NORTH		
PHASE	ACREAGE	LAND USE DESIGNATION
A1	44.5	Medium Density Residential
A2	17.5	High Density Residential
A3	4.0	Commercial
B1	29.0	Medium Density Residential
B2	27.1	Medium Density Residential
Park	10.0	Public Facility
C1	9.6	Commercial
C2	17.2	High Density Residential
C3	6.6	Commercial
C4	17.1	Medium Density Residential
School	5.1	Commercial
D1	16.0	High Density Residential
D2	22.0	Medium Density Residential
D3	7.3	Commercial
Park	3.0	Public Facility
<b>TOTAL:</b>	<b>229.3</b>	

## 2.2 Calculations

Pursuant to Clark County Municipal Code (“CCMC”), Title 12.06.280.A., new sewer systems shall be designed on the basis of the most recent zoning and master plan, using the following minimum daily per capita contributions.

TABLE 2: PER CAPITA DESIGN FACTORS

TITLE 12, SECTION 12.06.280.A. – SANITARY SEWER	
DESCRIPTION	PER CAPITA DESIGN FACTORS
Average daily flow rate	150 gpcd*
Minimum flow rate	90 gpcd*
Peak design flow rate for lateral sewers and interceptors serving a tributary population of less than 5,000	300 gpcd*
Peak design flow rate for interceptors serving a tributary population of 5,000 or more	250 gpcd*
Infiltration from areas of high water table	200 gal/acre/day

\* *Gallons per capita per day*

Pursuant to CCMC, Title 12.06.280.B., new sewer systems shall also be designed on the basis of minimum equivalent population densities.

TABLE 3: POPULATION DENSITIES

LOMPA RANCH NORTH		
DESCRIPTION	TYPICAL ZONING LAND USE CLASSIFICATION	EQUIVALENT POPULATION PER ACRE
Low Density Residential	SF 12,000 / SF 25,000	14
Medium Density Residential	SF 6,000 / MFD	29
High Density Residential	MFA	60
Commercial	LC / GC	12
Public (School-Park-Government)	P	12
Industrial District	GI / LI	12

Based on the above-mentioned, the estimated sewage flow for each proposed phase of the project is summarized and included within **Appendix 2**. Referenced Title 12.06.270 and Title 12.06.280 are also included in **Appendix 2**.

### **3 PROJECT SEWER ANALYSIS**

#### **3.1 Jurisdiction**

The proposed project site falls under the service jurisdiction of Carson City Public Works. The Mandatory Sewer Connection Program was created and defined by Resolution No. 1995-R-31. The resolution requires that all properties in the designated areas must sewer using the Carson City sewer system, as it becomes available.

#### **3.2 Exiting Public Sewer Facilities**

18" Main in Robinson Street: As denoted in Carson City Public Works Utility Run Books, the existing public sewer in the vicinity of the project site includes an 18" main on Robinson Street, just east of Saliman Road. Pursuant to recent correspondence with Carson City Public Works the main is currently at 45% capacity. Although the High School Sewer Project as-builts depict a 21" main, an 18" main was assumed in this feasibility study to be conservative.

33" Main Traversing Phase C4 and 48" Main Traversing Phase D2: An existing 33" main conveys wastewater southeast, traversing proposed Phase C4 and is increased in size to a 48" main before crossing Interstate 580. The 48" main continues traversing the southern portion of Phase D2 and conveys wastewater flows to the east toward the intersection of Butti Way and Airport Road. Pursuant to recent correspondence with Carson City Public Works, the existing 48" sanitary sewer main is currently at 25% capacity.

8" Main in Saliman Road: An 8" sanitary sewer main exists in Saliman Road, between Robinson Street and 5th Street. Carson City Public Works does not currently have as-built drawings for this facility. The current capacity is unknown.

24" Main in 5<sup>th</sup> Street: A 27" main exists in 5<sup>th</sup> Street just east of Saliman Road and decreases in size to a 24" main prior to the proposed Lompa Ranch Boulevard point-of-connection. Carson City Public Works does not currently have as-built drawings for this facility and the current capacity is unknown.

18" Main in Existing Easement, West of Airport Road: An 18" main exists in an utility easement that runs north-south, just west of Airport Road. This main connects to the 48" main just south of Phase D2. The current capacity is unknown.

Reference **Appendix 3** for existing sewer information provided by Carson City Public Works.

### 3.3 Project Outfall

Based on existing topography, the lowest point on the project site appears to be located south of proposed Phase D3, near the Airport Road and Butti Way intersection. However, the existing public sewer facilities noted in Section 3.2 allows for preliminary points-of-connection and adequate slopes for future onsite gravity sewer lines servicing the individual parcels within the project.

Reference **Appendix 1** for the exiting site topography.

## 4 PROPOSED SANITARY SEWER ALIGNMENT

### 4.1 Proposed Sanitary Sewer Point-of-Connections and Alignments

The current streets and easements surrounding the Lompa Ranch North SPA project allows for connectivity to the existing public sewer facilities.

Phase A1: It is proposed that the Point-of-Connection (POC) for Phase A1 will be the 18" sanitary sewer main on Robinson Street. Pursuant to the analysis in Section 2 of this report, it is anticipated that the Peak Design Flow Rate for Phase A1 will be approximately 322,625 gpd ( $\pm 0.50$  cfs). The existing 18" main is currently at 45% capacity pursuant to Carson City Public Works. The results of the hydraulic analysis for the existing 18" sanitary sewer main with an additional proposed 0.50 cfs for Phase A1 are as follows:

- Depth of Flow: 0.75'
- Velocity: 3.75 ft/sec
- Percent Full: 50.0%

*Therefore, the 18" main on Robinson Street should adequately service Phase A1.*

Phase A2 & Phase A3: It is proposed that the POC for both Phase A2 and Phase A3 will be at the 8" main on Saliman Road. Per the analysis in Section 2 of this report, it is anticipated that the Peak Design Flow Rate for both Phase A2 and A3 will be a combined

total of approximately 274,500 gpd ( $\pm 0.42$  cfs). The existing capacity is unknown. Hydraulic analysis for the existing 8" main with the proposed 0.42 cfs for Phase A2 and Phase A3 are as follows.

- Depth of Flow: 0.35'
- Velocity: 2.24 ft/sec
- Percent Full: 52.5%

*Therefore, the 8" sanitary sewer main on Saliman Road should adequately service Phase A2 and Phase A3.*

Phase B1 (North-Half): Due to likely future depth of cover constraints for the sanitary sewer main, the north-half of proposed Phase B1 will be obligated to continue the existing 18" main on Robinson Street further east along its frontage with a 12" main. It is assumed and proposed that the POC for the north-half of Phase B1 will be at this 12" sanitary sewer main extension on Robinson Street. Pursuant to the data provided in Section 2 of this report, it is anticipated that the Peak Design Flow Rate for the north-half of Phase B1 will be approximately 105,125 gpd ( $\pm 0.16$  cfs). This is half of the total Peak Design Flow Rate for Phase B1. Hydraulic analysis for the proposed 12" main extension is as follows:

- Depth of Flow: 0.22'
- Velocity: 1.28 ft/sec
- Percent Full: 21.7%

*Therefore, the 12" sanitary sewer main on Robinson Street can adequately service the north-half of Phase B1.*

Phase B1 (South-Half) & Phase B2: Due to likely future constraints regarding depth of cover for the sanitary sewer main, the northernmost portion of proposed Phase B2 may be forced to extend a 12" main from the north. This concept is depicted on the Master Sewer & Water Plans. Due to the uncertainties of future grading, this report assumes that the south-half of Phase B1 and Phase B2 will be able to connect to a proposed 12" main along future Lompa Ranch Boulevard. This proposed 12" main is proposed to slope downward toward the south where a Point-of-Connection will be established with the existing 24" sanitary sewer main on East 5<sup>th</sup> Street. Pursuant to the data presented in Section 2 of this report, it is anticipated that the Peak Design Flow Rate for the south-half of Phase B1 and Phase B2 will be approximately 301,600 gpd ( $\pm 0.47$  cfs). Hydraulic analysis for the proposed 12" main extension along Lompa Ranch Boulevard is as follows:

- Depth of Flow: 0.38'
- Velocity: 1.73 ft/sec
- Percent Full: 37.7%

*Therefore, the 12" main on Lompa Ranch Boulevard can adequately service the south-half of Phase B1 as well as Phase B2.*

Phase C: It is proposed that the POC for Phase C (which includes Phases C1, C2, C3, C4, and C5) will be at the existing 33" main that runs across both proposed Phase C2 and C4. A proposed 12" main is proposed to run along future Lompa Ranch Boulevard and connect to this existing 33" sanitary sewer. Pursuant to the analysis in Section 2 of this report, it is anticipated that the Peak Design Flow Rate for Phase C will be approximately 430,575 gpd ( $\pm 0.67$  cfs). The results of the hydraulic analysis for the proposed 12" main are as follows: *Therefore, the proposed 12" sanitary sewer main on Lompa Ranch Blvd should adequately service Phase C.*

- Depth of Flow: 0.46'
- Velocity: 1.91 ft/sec
- Percent Full: 45.9%

*Likewise, the hydraulic analysis below also indicates that the existing 33" main should adequately service Phase C.*

- Depth of Flow: 0.27'
- Velocity: 2.23 ft/sec
- Percent Full: 9.8%

Phase D: It is proposed that the POC for Phases D1 and D2 will be at the existing 18" SS main that runs along an existing on-site (north-south) easement. It is also proposed that the POC for Phase D3 will be at the existing 48" SS main (north-south), along the west boundary line of Phase D3.

Pursuant to the data provided in Section 2 of this report, it is anticipated that the Peak Design Flow Rate for Phases D1 and D2 will be approximately 399,500 gpd ( $\pm 0.62$  cfs) within the existing 18" main. It is also anticipated that the Peak Design Flow Rate for Phase D3 will be approximately 21,000 gpd ( $\pm 0.03$  cfs) within the 48" SS main. However, to be conservative, the total Peak Design Flow Rate for Phases D1, D2 and D3 is 420,500 gpd (0.65 cfs) and was utilized for the existing 48" SS main. Please recall that pursuant to recent correspondence with Carson City Public Works, the existing 48" SS main is currently at 25% capacity, which equates to about 11.75 cfs. Therefore, 12.40 cfs (11.75 cfs + 0.65 cfs) was the discharge used for the analysis of the existing 48" SS main. The results of the hydraulic analysis for the existing 18" SS main and existing 48" SS main are as follows.

#### Existing 18" SS Main

- Depth of Flow: 0.32'
- Velocity: 2.25 ft/sec
- Percent Full: 21.3%

#### Existing 48" SS Main

- Depth of Flow: 1.03'
- Velocity: 4.83 ft/sec
- Percent Full: 25.8%

*Therefore, pursuant to validating that the existing capacity is not currently at a significant level, the hydraulic analysis indicates that the existing 18" main should adequately service Phase D.*

Reference **Appendix 1** for the Lompa Ranch North SPA – Phasing Plan (Figure 5) and **Appendix 4** for the **Master Concept Sanitary Sewer and Water System Layout**. The hydraulic analysis calculations for all the above-mentioned sanitary sewer facilities are provided in **Appendix 2**.

## 5 ON SITE SEWER

### 5.1 On-Site Proposed Sewer Main Alignments

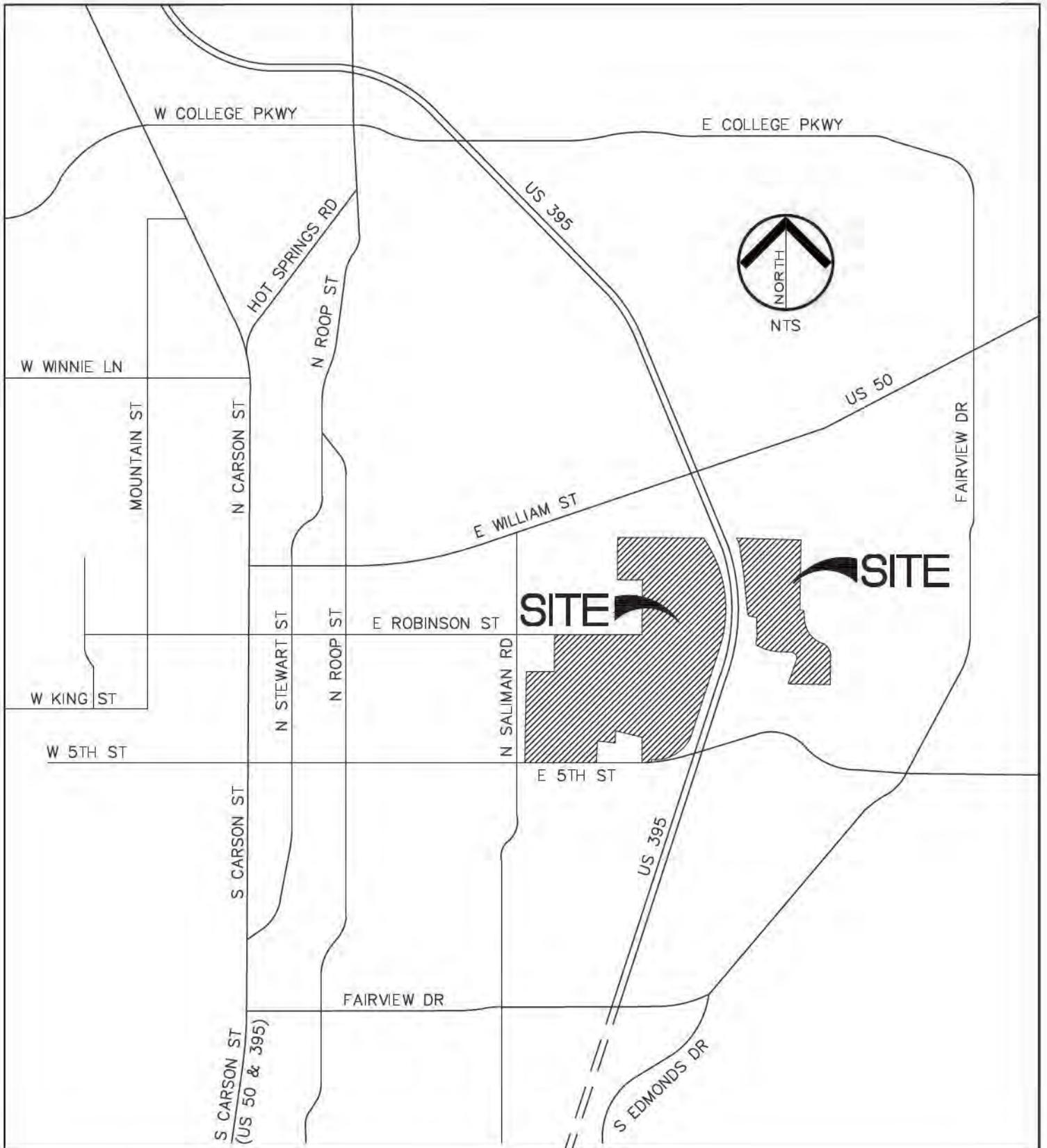
The proposed Points-of-Connection shown on the **Master Conceptual Sanitary Sewer and Water System Layout** plans (presented with this report) is for preliminary planning and discussion purposes only. The on-site sewer is sized at 8" in this feasibility analysis. Due to the preliminary stage and the dynamic nature of the project, the on-site sewer main alignment and size may vary with further analyses that will be required with future phases of the master planned community to ultimate build-out. The final on-site sewer main alignments may further vary contingent on detailed coordination required in consideration of other on-site dry and wet utilities alignments, utility crossings and the layout of proposed roadways. Pursuant to review of the existing topography and facilities, the preliminary sewer alignments presented herein should be at adequate depths to provide gravity sewer service for the project.

## 6 CONCLUSION

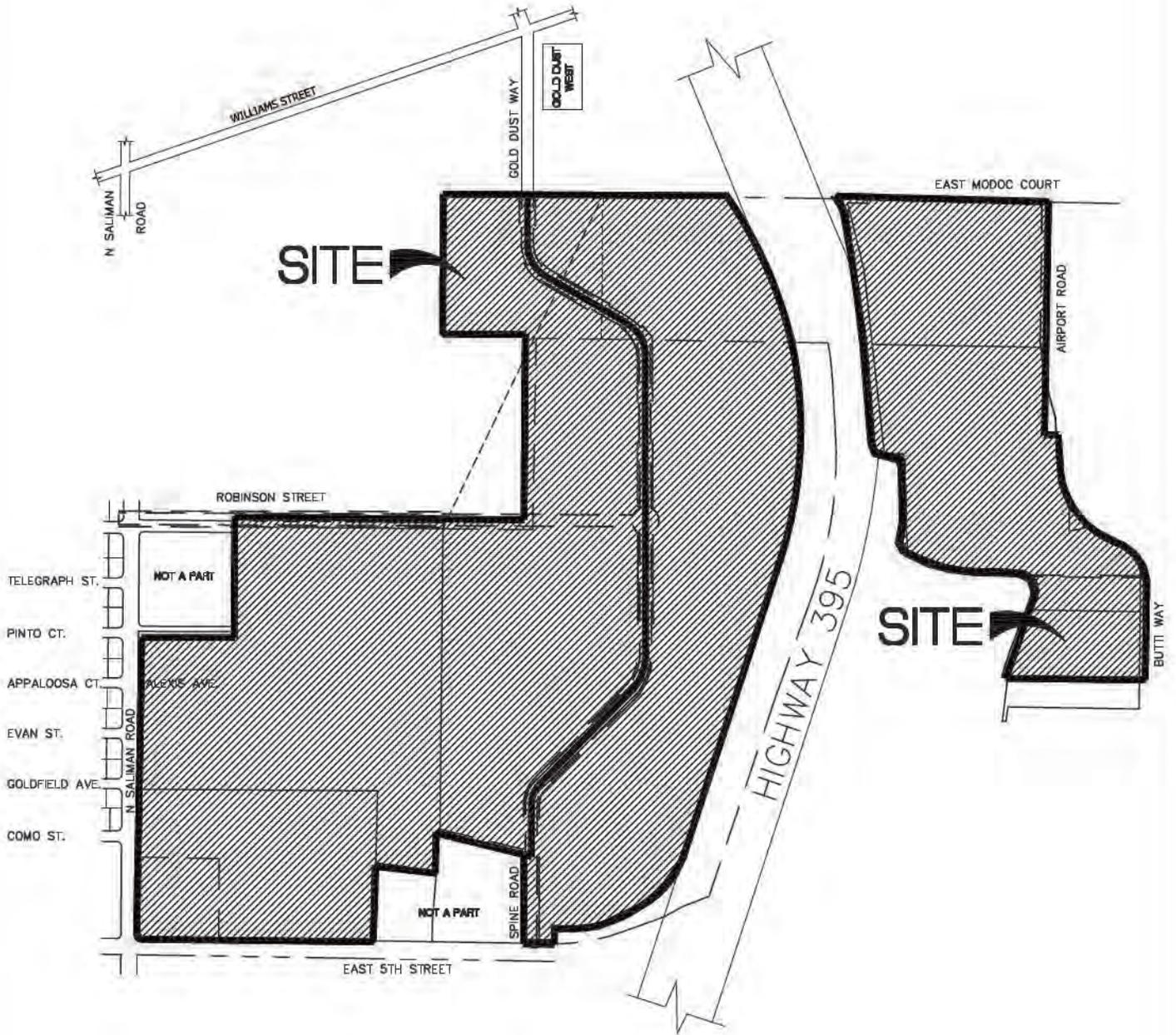
Based on the information provided to The Red Ltd and presented in the appendices herein, the proposed sanitary sewer improvements represents the preferred manner to proceed in consideration of the geographical constraints and the future roadway connectivity. Furthermore, the existing sanitary sewer system facilities on the peripheral and within the boundaries of the master planned community has the capacity to adequately service the proposed development based on the available information that was analyzed.

## LOMPA RANCH NORTH

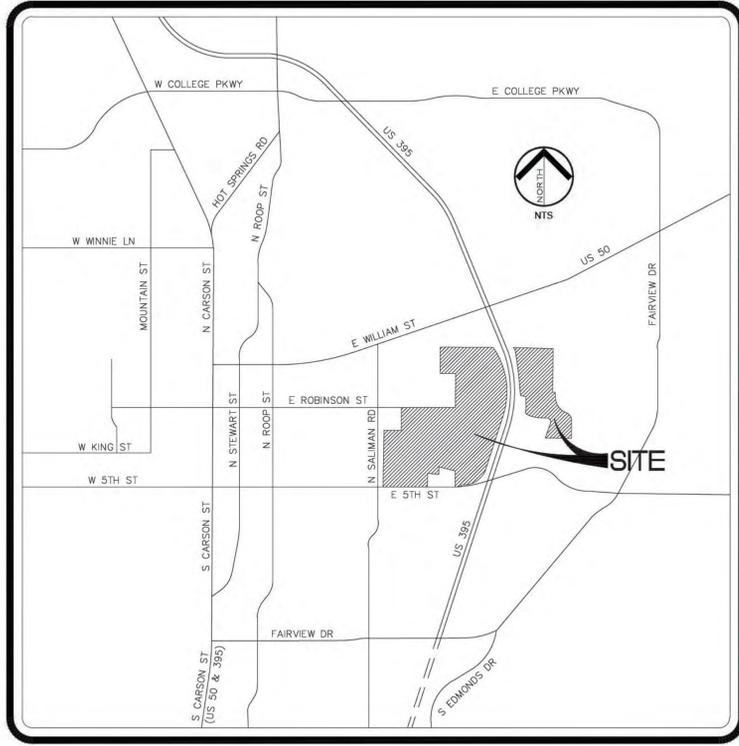
- FIGURE 1: VICINITY MAP
- FIGURE 2: LOCATION MAP
- FIGURE 3: EXISTING SITE TOPOGRAPHY
- FIGURE 4: LOMPA RANCH NORTH SPA - PHASING PLAN
- FIGURE 5: LOMPA RANCH NORTH SPA – CONCEPT PLAN



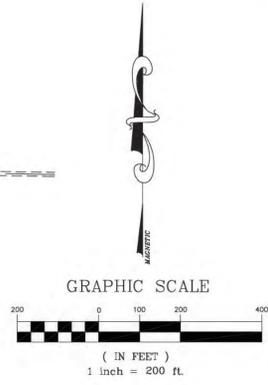
## LOMPA RANCH NORTH | Vicinity Map



## LOMPA RANCH NORTH | Location Map



LOCATION MAP  
SCALE: NTS



**THE RED LTD**

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(702) 528-7804 office  
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E | ENGINEERING  
D | DEVELOPMENT

CLIENT:  
BLACKSTONE DEVELOPMENT GROUP  
439 PLUMB LANE  
RENO, NV 89509  
CONTACT: JOSHUA MYERS  
PHONE: (775) 352-4200

DATE	NO.	REVISIONS	APPROVED

SITE TOPOGRAPHY

LOMPA RANCH NORTH

CARSON CITY NEVADA

PROJECT NO.	EN138-000
DESIGNED BY	MAS/EL
DRAWN BY	EL
CHECKED BY	JY
DATE	2017 05 23

SHT 1 of 1

CC PROJECT #

# LOMPA RANCH WEST

## COMMERCIAL & RESIDENTIAL WEST OF HIGHWAY 395

CARSON CITY, NEVADA

### COMMERCIAL SITE (2) | 9.6 ACRES

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	010-041-20
ACRES:	9.6 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	MIXED-USE COMMERCIAL
EXISTING ZONING:	GENERAL COMMERCIAL
PROPOSED ZONING:	GENERAL COMMERCIAL
PARKING ANALYSIS	
PARKING REQUIRED	80,000 SF
50 FT. PROPOSED OFFICE	247 SPACES
PARKING OFFICE	7 SPACES
REQ'D: 1 STALL / 320 SF	
NO. OF ADA STALLS REQUIRED	
PARKING PROVIDED (EST.)	330 SPACES
PARKING STALLS (STANDARD)	12 SPACES
ADA STANDARDS	507 SPACES
TOTAL PARKING PROVIDED (EST.)	

### COMMERCIAL SITE (1) | 6.6 ACRES

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-37
ACRES:	6.6 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	MIXED-USE COMMERCIAL
EXISTING ZONING:	GENERAL COMMERCIAL
PROPOSED ZONING:	GENERAL COMMERCIAL
PARKING ANALYSIS	
PARKING REQUIRED	100,000 SF
50 FT. PROPOSED MINI-STORAGE WAREHOUSE	13 SPACES
PARKING WAREHOUSE	1 SPACE
REQ'D: 1 STALL / 1,000 SF + 1 STALL / EMPLOYEE	
NO. OF ADA STALLS REQUIRED	
PARKING PROVIDED (EST.)	12 SPACES
PARKING STALLS (STANDARD)	1 SPACE
ADA STANDARDS	13 SPACES
TOTAL PARKING PROVIDED (EST.)	

### COMMERCIAL SITE (3) | 5.1 ACRES

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-37
ACRES:	5.1 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	MIXED-USE COMMERCIAL
EXISTING ZONING:	GENERAL COMMERCIAL
PROPOSED ZONING:	GENERAL COMMERCIAL
PARKING ANALYSIS	
PARKING REQUIRED	30,000 SF
50 FT. PROPOSED SCHOOL	103 SPACES
PARKING SCHOOL	0 SPACES
REQ'D: 1 STALL / 1.3 EMPLOYEE OR FACILITY	
1 STALL / 20 SF OF ASSEMBLY AREA	
NO. OF ADA STALLS REQUIRED	
PARKING PROVIDED (EST.)	101 SPACES
PARKING STALLS (STANDARD)	0 SPACES
ADA STANDARDS	100 SPACES
TOTAL PARKING PROVIDED (EST.)	

### RESIDENTIAL SITE (1)

SINGLE FAMILY RESIDENTIAL SITE (1) | 44.5 ACRES  
TOTAL LOTS: 189 LOTS  
MINIMUM LOT SIZE: 6,000 SF

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 10-014-036 (44.5 ACRES)
JURISDICTION:	CARSON CITY, NEVADA
LAND USE PLAN:	MEDIUM DENSITY RESIDENTIAL
EXISTING ZONING:	SF6
ALLOWABLE DENSITY:	3 - 8 DU / ACRE
PROPOSED DENSITY:	4.2 DU / ACRE
LEGEND	
	189 LOTS 6,000 SF MINIMUM

### MULTI-FAMILY SITE (3) | 17.5 ACRES

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 10-014-036
ACRES:	17.5 ACRES
JURISDICTION:	CARSON CITY, NEVADA
LAND USE PLAN:	HIGH DENSITY RESIDENTIAL
EXISTING ZONING:	MFA
ALLOWABLE DENSITY:	UP TO 32 DU / ACRE
PROPOSED DENSITY:	20 - 25 DU / ACRE

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	010-041-38 & A PORTION OF 010-041-32
ACRES:	17.2 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	HIGH DENSITY RESIDENTIAL
EXISTING ZONING:	MULTI-FAMILY APARTMENTS
ALLOWABLE DENSITY:	32 DU / ACRE
PROPOSED DENSITY:	19.6 DU / ACRE (330 UNITS)

### MULTI-FAMILY SITE (2) | 17.1 ACRES

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	010-041-38 & A PORTION OF 010-041-32
ACRES:	17.1 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	MEDIUM DENSITY RESIDENTIAL
EXISTING ZONING:	MULTI-FAMILY DUPLEX
ALLOWABLE DENSITY:	3 - 8 DU / ACRE
PROPOSED DENSITY:	6.7 DU / ACRE
LEGEND	
	LOT OPTION C - 115 LOTS 85' X 60', APPROX 3,300 SF MINIMUM (W/ PUD)

### SINGLE FAMILY RESIDENTIAL SITE (2) | 29.0 ACRES

TOTAL LOTS: 131 SINGLE FAMILY RESIDENTIAL LOTS  
MINIMUM LOT SIZE: 6,000 SF

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-71 (29.0 ACRES)
JURISDICTION:	CARSON CITY, NEVADA
LAND USE PLAN:	MEDIUM DENSITY RESIDENTIAL
EXISTING ZONING:	SF6
ALLOWABLE DENSITY:	3 - 8 DU / ACRE
PROPOSED DENSITY:	4.5 DU / ACRE
LEGEND	
	131 LOTS 6,000 SF MINIMUM

### SINGLE FAMILY RESIDENTIAL SITE (3) | 27.1 ACRES

TOTAL LOTS: 80 SINGLE FAMILY RESIDENTIAL LOTS  
MINIMUM LOT SIZE: 6,000 SF

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-71 (27.1 ACRES)
JURISDICTION:	CARSON CITY, NEVADA
LAND USE PLAN:	MEDIUM DENSITY RESIDENTIAL
EXISTING ZONING:	SF6
ALLOWABLE DENSITY:	3 - 8 DU / ACRE
PROPOSED DENSITY:	3.0 DU / ACRE
LEGEND	
	80 LOTS 6,000 SF MINIMUM



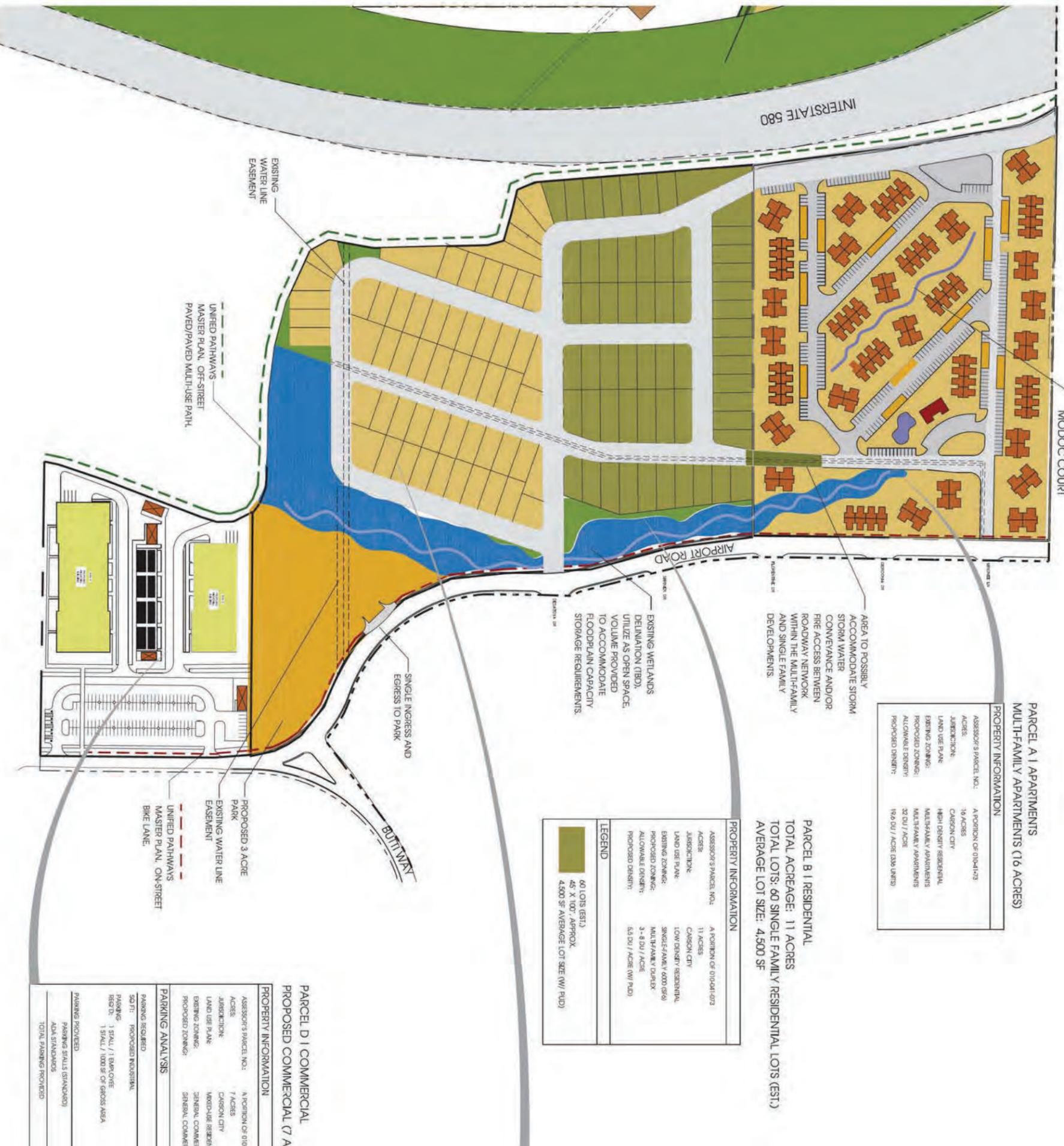
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Las Vegas, Nevada 89148  
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E | ENGINEERING  
D | DEVELOPMENT

**B** BLACKSTONE  
DEVELOPMENT GROUP

# LOMPA RANCH EAST

48 ACRES | APN 010-041-73 & 010-036-04

CARSON CITY, NEVADA



### PARCEL A | APARTMENTS MULTI-FAMILY APARTMENTS (16 ACRES)

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-73
ACRES:	16 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	HIGH DENSITY RESIDENTIAL
EXISTING ZONING:	MULTIFAMILY APARTMENTS
PROPOSED ZONING:	MULTIFAMILY APARTMENTS
ALLOWABLE DENSITY:	32 DU / ACRE
PROPOSED DENSITY:	15.6 DU / ACRE (134 UNITS)

AREA TO POSSIBLY ACCOMMODATE STORM WATER CONVEYANCE AND/OR FIRE ACCESS BETWEEN ROADWAY NETWORK WITHIN THE MULTI-FAMILY AND SINGLE FAMILY DEVELOPMENTS.

### PARCEL B | RESIDENTIAL TOTAL ACREAGE: 11 ACRES TOTAL LOTS: 60 SINGLE FAMILY RESIDENTIAL LOTS (EST.) AVERAGE LOT SIZE: 4,500 SF

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-073
ACRES:	11 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	LOW DENSITY RESIDENTIAL
EXISTING ZONING:	SINGLE-FAMILY 6000 (SF6)
PROPOSED ZONING:	MULTIFAMILY DUPLEX
ALLOWABLE DENSITY:	3-4 DU / ACRE
PROPOSED DENSITY:	5.5 DU / ACRE (W/ PUD)

EXISTING WETLANDS DELINEATION (FBI). UTILIZE AS OPEN SPACE. VOLUME PROVIDED TO ACCOMMODATE FLOODPLAIN CAPACITY STORAGE REQUIREMENTS.

### PARCEL C | RESIDENTIAL TOTAL ACREAGE: 11 ACRES TOTAL LOTS: 60 SINGLE FAMILY RESIDENTIAL LOTS (EST.) AVERAGE LOT SIZE: 4,500 SF

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-041-073
ACRES:	11 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	LOW DENSITY RESIDENTIAL
EXISTING ZONING:	SINGLE-FAMILY 6000 (SF6)
PROPOSED ZONING:	MULTIFAMILY DUPLEX
ALLOWABLE DENSITY:	3-4 DU / ACRE
PROPOSED DENSITY:	5.5 DU / ACRE (W/ PUD)

### PARCEL D | COMMERCIAL PROPOSED COMMERCIAL (7 ACRES)

PROPERTY INFORMATION	
ASSESSOR'S PARCEL NO.:	A PORTION OF 010-036-04
ACRES:	7 ACRES
JURISDICTION:	CARSON CITY
LAND USE PLAN:	WAREHOUSE RESIDENTIAL
EXISTING ZONING:	GENERAL COMMERCIAL
PROPOSED ZONING:	GENERAL COMMERCIAL

PARKING ANALYSIS	
PARKING REQUIRED	70,000 SF
SOFT: PROPOSED INDUSTRIAL	90 SPACES
PARKING RECD: 1 STALL / EMPLOYEE	
	1 STALL / 1000 SF OF GROSS AREA
PARKING PROVIDED	153 SPACES
PARKING STALLS (STANDARD)	8 SPACES
ADA STALLS	161 SPACES
TOTAL PARKING PROVIDED	161 SPACES





## SEWER CALCULATIONS

- LOMPA RANCH NORTH – SANITARY SEWER DEMAND ANALYSIS
  - CARSON CITY’S MUNICIPAL CODE TITLE 12.06.270
  - CARSON CITY’S MUNICIPAL CODE TITLE 12.06.280
    - HYDRAULIC ANALYSIS CALCULATIONS

# SANITARY SEWER DEMAND ANALYSIS

## Lompa Ranch North (West of Interstate 580)

Phase	Acreage	Land Use Designation	Existing Zoning	Proposed Zoning	Allowed Dwelling Units (Per Acre)	Proposed Dwelling Units (Per Acre)	Equivalent Population per Acre (12.06,270.B)	Population Estimate	Average Daily Flow Rate (150 gpcd)	Minimum Daily Flow Rate (90 gpcd)	Peak Design Flow Rate (250 gpcd)	Infiltration (200 gal/acre/day)
A1	44.5	Medium Density Residential	SF6	SF6	3 - 8	4.2	29	1,291	193,575	116,145	322,625	8,900
A2	17.5	High Density Residential	MFA	MFA	Up to 32	20.0	60	1,050	157,500	94,500	262,500	3,500
A3	4	Commercial	NB	NB			12	48	7,200	4,320	12,000	800
B1	29	Medium Density Residential	SF6	SF6	3 - 8	4.5	29	841	126,150	75,690	210,250	5,800
B2	27.1	Medium Density Residential	MFD	MFD	Up to 2	3.0	29	786	117,885	70,731	196,475	5,420
Park	10	Public Facility	P	P				-	-	-	-	-
C1	9.6	Commercial	GC	GC			12	115	17,280	10,368	28,800	1,920
C2	17.2	High Density Residential	MFA	MFA	32	19.6	60	1,032	154,800	92,880	258,000	3,440
C3	6.6	Commercial	GC	GC			12	79	11,880	7,128	19,800	1,320
C4	17.1	Medium Density Residential	MFD	MFD	3 - 8	6.7	29	496	74,385	44,631	123,975	3,420
School	5.1	Commercial	GC	GC			12	61	9,180	5,508	15,300	1,020
<b>Totals WEST</b>	<b>187.7</b>							<b>5,799</b>	<b>869,835</b>	<b>521,901</b>	<b>1,449,725</b>	<b>35,540</b>

## Lompa Ranch North (East of Interstate 580)

Phase	Acreage	Land Use Designation	Existing Zoning	Proposed Zoning	Allowed Dwelling Units (Per Acre)	Proposed Dwelling Units (Per Acre)	Equivalent Population per Acre (12.06,270.B)	Population Estimate	Average Daily Flow Rate (150 gpcd)	Minimum Daily Flow Rate (90 gpcd)	Peak Design Flow Rate (250 gpcd)	Infiltration (200 gal/acre/day)
D1	16	High Density Residential	MFA	MFA	32	21.0	60	960	144,000	86,400	240,000	3,200
D2	22	Medium Density Residential	SF6	MFD	3 - 8	5.5	29	638	95,700	57,420	159,500	4,400
D3	7	Commercial	GC	GC			12	84	12,600	7,560	21,000	1,400
Park	3	Public Facility	P	P				-	-	-	-	-
<b>Total EAST</b>	<b>48</b>							<b>1,682</b>	<b>252,300</b>	<b>151,380</b>	<b>420,500</b>	<b>825,862</b>

**NOTES:**

The total acreage shown above varies from the Lompa Ranch Specific Plan (dated January 14, 2016) due to regard for proposed right-of-way areas such as roadways. Note: Gallons per Capita, per Day (gpcd) 105,125  
196,475

A 15" Sanitary Sewer main at full flow has the capacity to accommodate approximately 2,952,000 gallons per day (gpd). A 15" Sanitary Sewer main also has the capacity to accommodate approximately 2,691,360 gallons per day (gpd) at 75% capacity.

A 12" Sanitary Sewer main at full flow has the capacity to accommodate approximately 1,628,035 gallons per day (gpd). A 12" Sanitary Sewer main also has the capacity to accommodate approximately 1,484,640 gallons per day (gpd) at 75% capacity.

Due to the availability of existing Sanitary Sewer mains within the vicinity of the Lompa Ranch North project, it is anticipated that 12" Sanitary Sewer mains will adequately service the site at full build-out. Each project phase shall analyze, validate capacity, and upgrade any Sanitary Sewer improvement as needed.



**12.06.270 - Sanitary sewer design standards and specifications—Factors.**

In determining the required capacities of sanitary sewers, the following factors shall be considered:

- A. Maximum hourly sewage flow;
- B. Additional maximum sewage or waste flow from industrial plants, institutions, residential subdivisions, etc.;
- C. Groundwater infiltration;
- D. Topography of area to be sewered;
- E. Location of waste treatment plant;
- F. Depth of excavation;
- G. Pumping requirements.

(Ord. 1977-12 (part), 1977).

**12.06.280 - Sanitary sewer design standards and specifications—Basis.**

- A. Per Capita Flow. New sewer systems shall be designed on the basis of the most recent zoning and master plan, using the following minimum daily per capita contributions:

	<b>Per Capita Design Factors</b>
Average daily flow rate	150 gpcd*
Minimum flow rate	90 gpcd*
Peak design flow rate for lateral sewers and interceptors serving a tributary population of less than 5,000	300 gpcd*
Peak design flow rate for interceptors serving a tributary population of 5,000 or more	250 gpcd*
Infiltration from areas of high water table	200 gal/acre/day.

\* Gallons per capita per day

B. Population Densities. The following are minimum equivalent population densities for use in computing typical sewage contributions:

	<b>Typical Zoning Land Use Classification</b>	Equivalent Population Per Acre
Low density residential	SF12,000/ SF25,000	14
Medium density residential	SF6,000/ MFD	29
High density residential	MFA	60
Commercial	LC/GC	12
Public (School-Park-Government)	P	12
Industrial district	GI/LI	12

A report on estimated sewage flow shall be submitted for each proposed project. When deviations from the foregoing per capita flows and occupancy rates are demonstrated, a description of the design shall be included in the report, and the department may allow such deviations. Flow generation and peaking factors may be per recommended standards for wastewater facilities (ten states standards).

(Ord. 1995-36 § 4, 1995: Ord. 1977-12 (part), 1977).

## Robinson St - Ex 18" SS @ 45% Capacity (Phase A1)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00400	ft/ft
Normal Depth	0.68	ft
Diameter	1.50	ft

### Results

Discharge	2.80	ft <sup>3</sup> /s
Flow Area	0.78	ft <sup>2</sup>
Wetted Perimeter	2.22	ft
Hydraulic Radius	0.35	ft
Top Width	1.49	ft
Critical Depth	0.64	ft
Percent Full	45.3	%
Critical Slope	0.00509	ft/ft
Velocity	3.60	ft/s
Velocity Head	0.20	ft
Specific Energy	0.88	ft
Froude Number	0.88	
Maximum Discharge	7.15	ft <sup>3</sup> /s
Discharge Full	6.64	ft <sup>3</sup> /s
Slope Full	0.00071	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	45.33	%
Downstream Velocity	Infinity	ft/s

---

## Robinson St - Ex 18" SS @ 45% Capacity (Phase A1)

---

### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.68	ft
Critical Depth	0.64	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00509	ft/ft

## Robinson St - Ex 18" SS @ 45% Capacity (Phase A1)

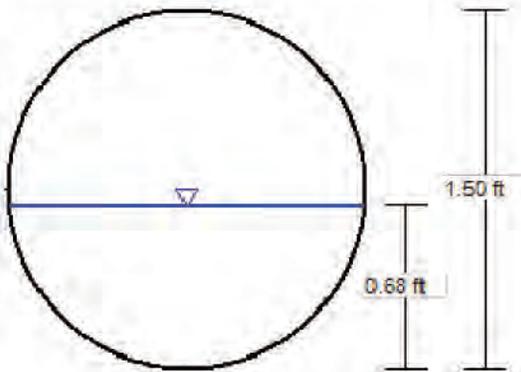
### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00400 ft/ft
Normal Depth	0.68 ft
Diameter	1.50 ft
Discharge	2.80 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Robinson St - Ex 18" SS + 0.50 CFS (Phase A1)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00400    ft/ft  
Diameter                                        1.50    ft  
Discharge                                        3.30    ft<sup>3</sup>/s

### Results

Normal Depth                                0.75    ft  
Flow Area                                        0.88    ft<sup>2</sup>  
Wetted Perimeter                            2.35    ft  
Hydraulic Radius                            0.37    ft  
Top Width                                        1.50    ft  
Critical Depth                                0.69    ft  
Percent Full                                    49.8    %  
Critical Slope                                0.00520    ft/ft  
Velocity                                        3.75    ft/s  
Velocity Head                                0.22    ft  
Specific Energy                                0.97    ft  
Froude Number                                0.86  
Maximum Discharge                        7.15    ft<sup>3</sup>/s  
Discharge Full                                6.64    ft<sup>3</sup>/s  
Slope Full                                        0.00099    ft/ft  
Flow Type                                        SubCritical

### GVF Input Data

Downstream Depth                        0.00    ft  
Length                                        0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise            0.00    %  
Normal Depth Over Rise                    49.79    %  
Downstream Velocity                        Infinity    ft/s

---

## Robinson St - Ex 18" SS + 0.50 CFS (Phase A1)

---

### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.69	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00520	ft/ft

## Robinson St - Ex 18" SS + 0.50 CFS (Phase A1)

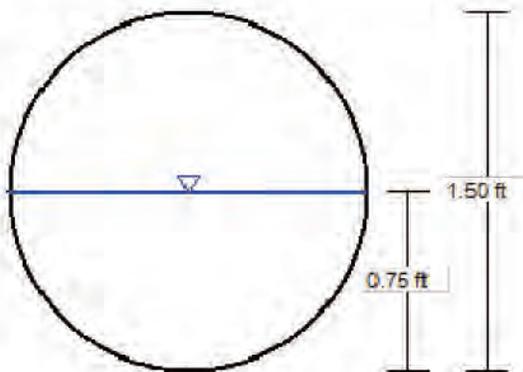
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00400 ft/ft
Normal Depth	0.75 ft
Diameter	1.50 ft
Discharge	3.30 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Saliman Rd - Ex 8" SS + 0.42 CFS (Phase A2 & A3)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00400	ft/ft
Diameter	0.67	ft
Discharge	0.42	ft <sup>3</sup> /s

### Results

Normal Depth	0.35	ft
Flow Area	0.19	ft <sup>2</sup>
Wetted Perimeter	1.09	ft
Hydraulic Radius	0.17	ft
Top Width	0.67	ft
Critical Depth	0.30	ft
Percent Full	52.5	%
Critical Slope	0.00674	ft/ft
Velocity	2.24	ft/s
Velocity Head	0.08	ft
Specific Energy	0.43	ft
Froude Number	0.75	
Maximum Discharge	0.83	ft <sup>3</sup> /s
Discharge Full	0.77	ft <sup>3</sup> /s
Slope Full	0.00118	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	52.47	%
Downstream Velocity	Infinity	ft/s

---

## Saliman Rd - Ex 8" SS + 0.42 CFS (Phase A2 & A3)

---

### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.30	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00674	ft/ft

## Saliman Rd - Ex 8" SS + 0.42 CFS (Phase A2 & A3)

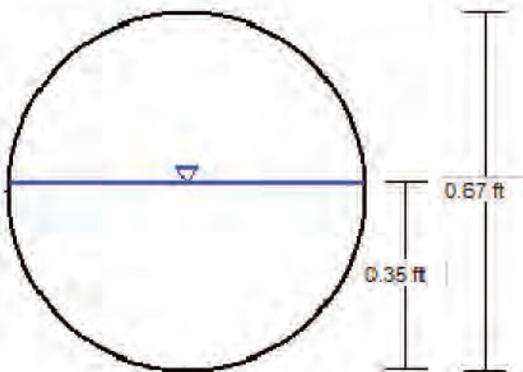
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00400 ft/ft
Normal Depth	0.35 ft
Diameter	0.67 ft
Discharge	0.42 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Lompa Ranch Blvd Prop 12" SS + 0.47 CFS (B2 & South-Half Phase B1)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00190	ft/ft
Diameter	1.00	ft
Discharge	0.47	ft <sup>3</sup> /s

### Results

Normal Depth	0.38	ft
Flow Area	0.27	ft <sup>2</sup>
Wetted Perimeter	1.32	ft
Hydraulic Radius	0.21	ft
Top Width	0.97	ft
Critical Depth	0.28	ft
Percent Full	37.7	%
Critical Slope	0.00563	ft/ft
Velocity	1.73	ft/s
Velocity Head	0.05	ft
Specific Energy	0.42	ft
Froude Number	0.58	
Maximum Discharge	1.67	ft <sup>3</sup> /s
Discharge Full	1.55	ft <sup>3</sup> /s
Slope Full	0.00017	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	37.73	%
Downstream Velocity	Infinity	ft/s

## Lompa Ranch Blvd Prop 12" SS + 0.47 CFS (B2 & South-Half Phase B1)

### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.28	ft
Channel Slope	0.00190	ft/ft
Critical Slope	0.00563	ft/ft

# Lompa Ranch Blvd Prop 12" SS + 0.47 CFS (B2 & South-Half Phase B1)

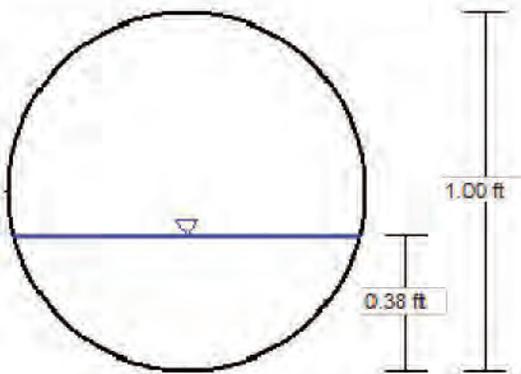
## Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

## Input Data

Roughness Coefficient	0.013
Channel Slope	0.00190 ft/ft
Normal Depth	0.38 ft
Diameter	1.00 ft
Discharge	0.47 ft <sup>3</sup> /s

## Cross Section Image



V: 1  
H: 1

## Robinson St - Prop 12" SS + 0.16 CFS (North-Half of Phase B1)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00190	ft/ft
Diameter	1.00	ft
Discharge	0.16	ft <sup>3</sup> /s

### Results

Normal Depth	0.22	ft
Flow Area	0.13	ft <sup>2</sup>
Wetted Perimeter	0.97	ft
Hydraulic Radius	0.13	ft
Top Width	0.82	ft
Critical Depth	0.16	ft
Percent Full	21.7	%
Critical Slope	0.00597	ft/ft
Velocity	1.28	ft/s
Velocity Head	0.03	ft
Specific Energy	0.24	ft
Froude Number	0.58	
Maximum Discharge	1.67	ft <sup>3</sup> /s
Discharge Full	1.55	ft <sup>3</sup> /s
Slope Full	0.00002	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	21.67	%
Downstream Velocity	Infinity	ft/s

---

## Robinson St - Prop 12" SS + 0.16 CFS (North-Half of Phase B1)

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### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.16	ft
Channel Slope	0.00190	ft/ft
Critical Slope	0.00597	ft/ft

## Robinson St - Prop 12" SS + 0.16 CFS (North-Half of Phase B1)

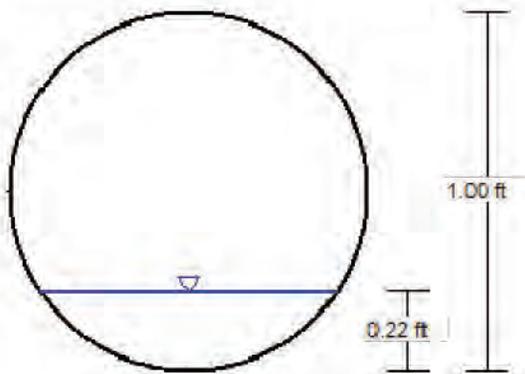
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00190 ft/ft
Normal Depth	0.22 ft
Diameter	1.00 ft
Discharge	0.16 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Lompa Ranch Blvd - Prop 12" SS + 0.67 CFS (Phase C)

### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00190	ft/ft
Diameter	1.00	ft
Discharge	0.67	ft <sup>3</sup> /s

### Results

Normal Depth	0.46	ft
Flow Area	0.35	ft <sup>2</sup>
Wetted Perimeter	1.49	ft
Hydraulic Radius	0.24	ft
Top Width	1.00	ft
Critical Depth	0.34	ft
Percent Full	45.9	%
Critical Slope	0.00564	ft/ft
Velocity	1.91	ft/s
Velocity Head	0.06	ft
Specific Energy	0.52	ft
Froude Number	0.57	
Maximum Discharge	1.67	ft <sup>3</sup> /s
Discharge Full	1.55	ft <sup>3</sup> /s
Slope Full	0.00035	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	45.89	%
Downstream Velocity	Infinity	ft/s

---

## Lompa Ranch Blvd - Prop 12" SS + 0.67 CFS (Phase C)

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### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.34	ft
Channel Slope	0.00190	ft/ft
Critical Slope	0.00564	ft/ft

## Lompa Ranch Blvd - Prop 12" SS + 0.67 CFS (Phase C)

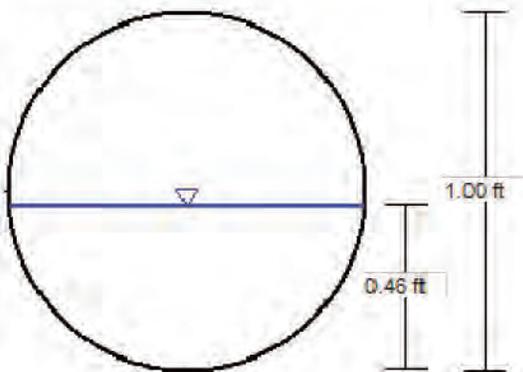
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00190 ft/ft
Normal Depth	0.46 ft
Diameter	1.00 ft
Discharge	0.67 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Lompa Ranch Blvd - Ex 33" SS + 0.67 CFS (Phase C)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00400    ft/ft  
Diameter                                        2.75    ft  
Discharge                                      0.67    ft<sup>3</sup>/s

### Results

Normal Depth                                0.27    ft  
Flow Area                                      0.30    ft<sup>2</sup>  
Wetted Perimeter                            1.75    ft  
Hydraulic Radius                            0.17    ft  
Top Width                                      1.64    ft  
Critical Depth                                0.26    ft  
Percent Full                                  9.8    %  
Critical Slope                                0.00481    ft/ft  
Velocity                                        2.23    ft/s  
Velocity Head                                0.08    ft  
Specific Energy                              0.35    ft  
Froude Number                                0.92  
Maximum Discharge                        35.98    ft<sup>3</sup>/s  
Discharge Full                                33.45    ft<sup>3</sup>/s  
Slope Full                                      0.00000    ft/ft  
Flow Type                                      SubCritical

### GVF Input Data

Downstream Depth                        0.00    ft  
Length                                        0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise            0.00    %  
Normal Depth Over Rise                9.81    %  
Downstream Velocity                      Infinity    ft/s

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## Lompa Ranch Blvd - Ex 33" SS + 0.67 CFS (Phase C)

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### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.26	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00481	ft/ft

# Lompa Ranch Blvd Prop 12" SS + 0.47 CFS (B2 & South-Half Phase B1)

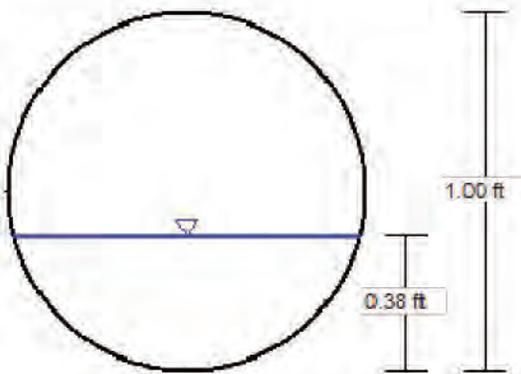
## Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

## Input Data

Roughness Coefficient	0.013
Channel Slope	0.00190 ft/ft
Normal Depth	0.38 ft
Diameter	1.00 ft
Discharge	0.47 ft <sup>3</sup> /s

## Cross Section Image



V: 1  
H: 1

## Ex Easement - Ex 18" SS + 0.62 CFS (Phase D1 & D2)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00350	ft/ft
Diameter	1.50	ft
Discharge	0.62	ft <sup>3</sup> /s

### Results

Normal Depth	0.32	ft
Flow Area	0.28	ft <sup>2</sup>
Wetted Perimeter	1.44	ft
Hydraulic Radius	0.19	ft
Top Width	1.23	ft
Critical Depth	0.29	ft
Percent Full	21.3	%
Critical Slope	0.00508	ft/ft
Velocity	2.25	ft/s
Velocity Head	0.08	ft
Specific Energy	0.40	ft
Froude Number	0.84	
Maximum Discharge	6.68	ft <sup>3</sup> /s
Discharge Full	6.21	ft <sup>3</sup> /s
Slope Full	0.00003	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	21.33	%
Downstream Velocity	Infinity	ft/s

---

## Ex Easement - Ex 18" SS + 0.62 CFS (Phase D1 & D2)

---

### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.29	ft
Channel Slope	0.00350	ft/ft
Critical Slope	0.00508	ft/ft

## Ex Easement - Ex 18" SS + 0.62 CFS (Phase D1 & D2)

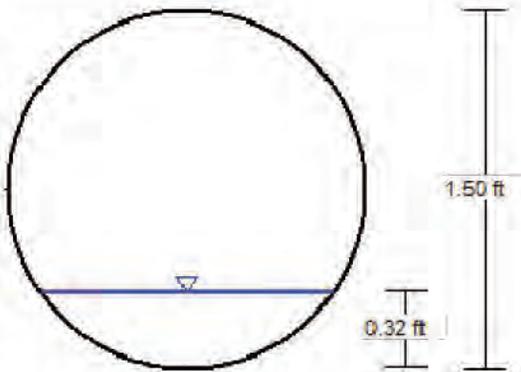
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00350 ft/ft
Normal Depth	0.32 ft
Diameter	1.50 ft
Discharge	0.62 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Ex Easement - Ex 48" SS @ 25% Capacity (Phase D3)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00350	ft/ft
Diameter	4.00	ft
Discharge	11.75	ft <sup>3</sup> /s

### Results

Normal Depth	1.00	ft
Flow Area	2.47	ft <sup>2</sup>
Wetted Perimeter	4.20	ft
Hydraulic Radius	0.59	ft
Top Width	3.47	ft
Critical Depth	1.00	ft
Percent Full	25.1	%
Critical Slope	0.00355	ft/ft
Velocity	4.75	ft/s
Velocity Head	0.35	ft
Specific Energy	1.36	ft
Froude Number	0.99	
Maximum Discharge	91.41	ft <sup>3</sup> /s
Discharge Full	84.98	ft <sup>3</sup> /s
Slope Full	0.00007	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	25.12	%
Downstream Velocity	Infinity	ft/s

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## Ex Easement - Ex 48" SS @ 25% Capacity (Phase D3)

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### GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.00	ft
Channel Slope	0.00350	ft/ft
Critical Slope	0.00355	ft/ft

## Ex Easement - Ex 48" SS @ 25% Capacity (Phase D3)

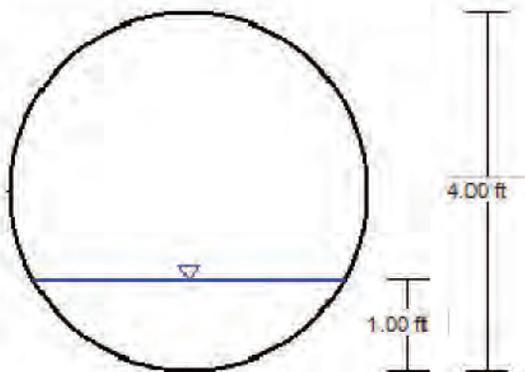
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00350 ft/ft
Normal Depth	1.00 ft
Diameter	4.00 ft
Discharge	11.75 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1

## Ex Easement - Ex 48" SS 75% Capacity + 0.65 (Phase D1+D2+D3)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00350	ft/ft
Diameter	4.00	ft
Discharge	12.40	ft <sup>3</sup> /s

### Results

Normal Depth	1.03	ft
Flow Area	2.57	ft <sup>2</sup>
Wetted Perimeter	4.26	ft
Hydraulic Radius	0.60	ft
Top Width	3.50	ft
Critical Depth	1.03	ft
Percent Full	25.8	%
Critical Slope	0.00355	ft/ft
Velocity	4.83	ft/s
Velocity Head	0.36	ft
Specific Energy	1.39	ft
Froude Number	0.99	
Maximum Discharge	91.41	ft <sup>3</sup> /s
Discharge Full	84.98	ft <sup>3</sup> /s
Slope Full	0.00007	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	25.81	%
Downstream Velocity	Infinity	ft/s

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**Ex Easement - Ex 48" SS 75% Capacity + 0.65 (Phase D1+D2+D3)**

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**GVF Output Data**

Upstream Velocity	Infinity	ft/s
Normal Depth	1.03	ft
Critical Depth	1.03	ft
Channel Slope	0.00350	ft/ft
Critical Slope	0.00355	ft/ft

## Ex Easement - Ex 48" SS 75% Capacity + 0.65 (Phase D1+D2+D3)

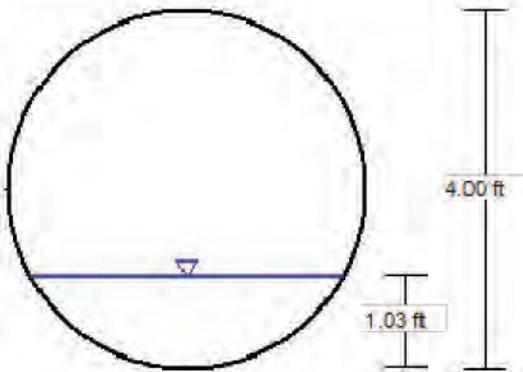
### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.013
Channel Slope	0.00350 ft/ft
Normal Depth	1.03 ft
Diameter	4.00 ft
Discharge	12.40 ft <sup>3</sup> /s

### Cross Section Image



V: 1  
H: 1