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# 1.0 Introduction

Along the Highway 49 trunk, Auburn Pacific Properties, LLC have proposed a development located east of Highway 49 and south of Rock Creek Road known as the Auburn Creekside project.

## 1.1 PURPOSE

Placer County (County) owns and operates the wastewater collection system within Sewer Maintenance District 1 (SMD 1), which is located north of the City of Auburn in western Placer County. The collection system consists of two main sewer trunks, the Hghway 49 trunk and the DeWitt trunk. These trunks convey flows from the southern portion of the SMD 1 service area to the County's wastewater treatment plant (WWTP) located on Joeger Road, west of Highway 49 and north of Dry Creek Road in the unincorporated area north of the City of Auburn (herein referred to as North Auburn).

The purpose of this study is to assess the capacity of the Highway 49 trunk to convey existing flows, the impact of the proposed Auburn Creekside project upon the capacity of the system, and to determine any upgrades that may be required to the gravity sewer system as a result.

## 1.2 BACKGROUND

The proposed Auburn Creekside project is a commercial retail center on a 13.2-acre parcel that is expected to generate wastewater equivalent to 32 equivalent dwelling units (EDUs, which is similar to 32 single family residences). The project parcel is located east of Highway 49, immediately north of the Target store in North Auburn. The proposed development areas are situated on the east and west sides of a tributary to Rock Creek, which traverses the site from south to north. The development will be phased, ultimately consisting of approximately 93,100 square feet of new retail space.

The project is currently completing the entitlement process through the Placer County Community Development Resource Agency (CDRA). This includes preparation of a CEQA document which is to identify all potential impacts resulting from the development of the project and any mitigation measures proposed to reduce those impacts to a less than significant level.

This report was required by the Placer County Facility Services Department (Facility Services), which has responsibility for managing the SMD 1 collection, treatment and disposal facilities, to assess the impact of the project on the SMD 1 wastewater collection system. In addition to this report, specific to the potential project impacts on the sewer collection system, Auburn Pacific Properties has prepared an overall capacity evaluation of the Highway 49 trunk sewer, also required by Facility Services. The model developed for the overall Highway 49 trunk sewer capacity evaluation was also used to assess the impact of the Auburn Creekside project on the SMD 1 collection system.

# 2.0 Project Characteristics

Information as to the characteristics of existing serviced parcels, the proposed Auburn Creekside project and future development within the Highway 49 trunk sewer shed is necessary to estimate wastewater flows and assess system capacity.

## 2.1 PURPOSE

The purpose of this chapter is to describe the County's existing wastewater collection system and future flow projections.

This chapter is divided into the following sections:

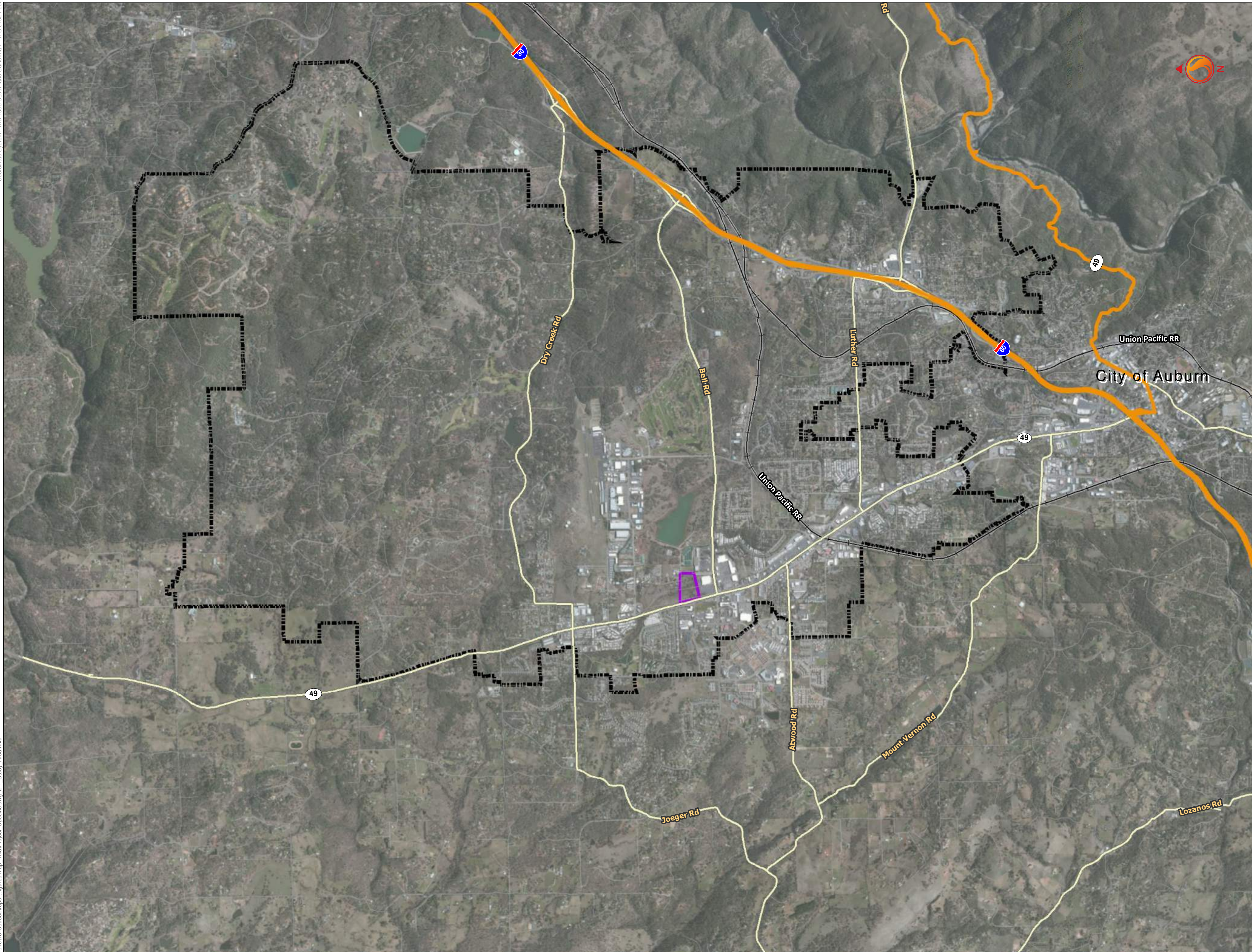
- Project Location
- Land Use Data
- Future Wastewater Flows

## 2.2 PROJECT LOCATION

**Figure 2-1** shows the location of the proposed Auburn Creekside development in relation to the SMD 1 wastewater collection system for the North Auburn Highway 49 Trunk Sewer Evaluation. The Study area (portion of SMD 1) is defined as the wastewater subcatchments that contribute flows to the Joeger Road WWTP serviced by the Highway 49 trunk. The Auburn Creekside development is located east of Highway 49 and immediately south of Rock Creek Road, and will add approximately 13.6 acres of serviced land to the existing Highway 49 sewershed.

The portion of the SMD 1 service area which discharges into the Highway 49 trunk covers an area of approximately 2,740 acres and currently serves approximately 6,413 EDUs. The wastewater generated by these users is collected and conveyed to the County's SMD 1 WWTP, located west of Highway 49 just north of Joeger Road, via a network of gravity trunk mains, force mains, and lift stations. Tributary to the Highway 49 trunk, the County owns, operates, and maintains this network of over 92 of pipelines (ranging in size from 2 to 30 inches in diameter) and a number of lift stations.

The Highway 49 trunk generally follows California State Route 49 from the City of Auburn, north to the treatment plant on Joeger Road. This trunk collects flows from commercial, industrial and residential developments along the Highway 49 corridor and developments to the east. To account for the foothill terrain in the service area, lift stations convey flows from lower areas to system gravity collectors or the Highway 49 trunk itself.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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Legend

Auburn Creekside Development Lands
Hwy49 Buildout Boundary

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
North Auburn, Placer County

Title

**Sewer Maintenance District 1**

Project No.
184030352

Scale
0 0.2 0.4 0.6 Miles

Figure No.
**2-1**

Issue/Revision
A/

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## 2.3 LAND USE DATA

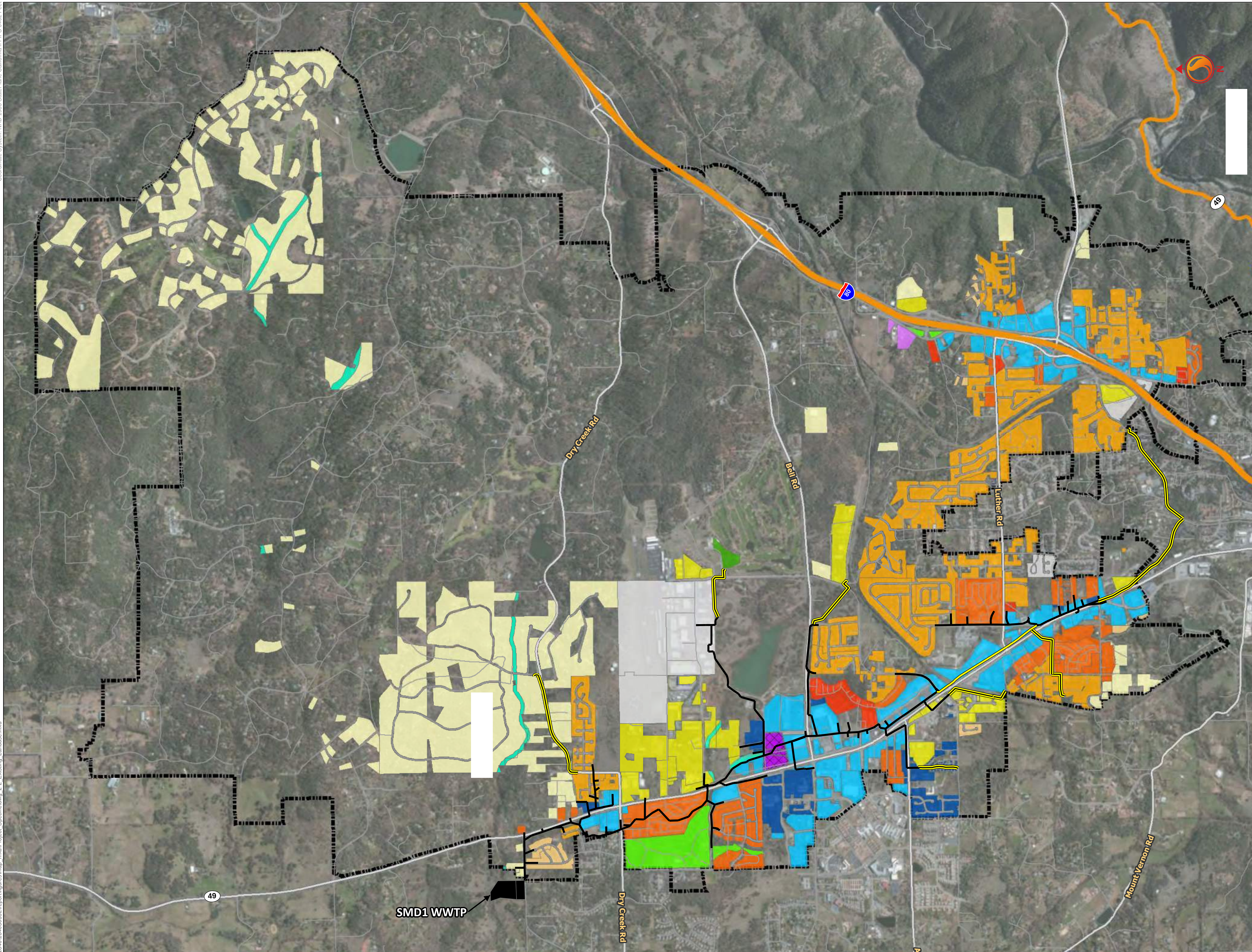
The proposed Auburn Creekside development is located east of Highway 49 and immediately south of Rock Creek Road. Sewage generated on the project site will drain to the Highway 49 trunk system and will contain 32 EDUs.

The existing land use and parcel data for the Highway 49 trunk sewer shed was provided by the County in GIS format. Total EDUs were provided by the County. Land uses for existing developments are shown in **Figure 2-2** and **Figure 2-3** and summarized along with the estimated number of EDUs associated with each land use, in **Table 2-1**. A detailed list of the APNs entitled, but not yet connected within the Highway 49 sewershed is included in Appendix A (a CD containing all APNs which contribute to existing flow is included as well).

### Table 2-1 Existing Land Use Summary[(a)]

| | SMD 1 | | Highway 49 Sewershed | |
|---|---|---|---|---|
| **Land Use Designation** | Total Acreage (Acres) | Total Population (EDUs) | Total Acreage (Acres) | Total Population (EDUs) |
| **City of Auburn** | 150 | 135 | 150 | 135 |
| **Commercial** | 251 | 976 | 245 | 966 |
| **Industrial** | 145 | 332 | 25 | 143 |
| **Mixed Use** | 17 | 98 | 145 | 332 |
| **Open Space** | 58 | 28 | 27 | 73 |
| **Open Space / Business Park** | 6 | 21 | 617 | 1928 |
| **Professional Office** | 55 | 226 | 250 | 1312 |
| **Riparian Drainage** | 206 | 164 | 17 | 98 |
| **Rural Estate 2.3 - 10 Ac. Min.** | 244 | 194 | 57 | 26 |
| **Rural Estate 4.6 - 10 Ac. Min.** | 24 | 17 | 6 | 21 |
| **Rural Low Density Residential** | 285 | 575 | 55 | 226 |
| **Rural Residential 1 - 2.3 Ac. Min.** | 10 | 5 | 162 | 120 |
| **Rural Residential 2.3 - 4.6 Ac. Min.** | 654 | 631 | 244 | 194 |
| **Low Density Residential** | 139 | 231 | 15 | 10 |
| **Low Medium Density Residential** | 999 | 2727 | 89 | 233 |
| **Medium Density Residential** | 310 | 1441 | 10 | 5 |
| **High Density Residential** | 25 | 143 | 626 | 591 |
| **Total** | **3578** | **7944** | **2740** | **6413** |

(a) Provided by Placer County.





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Legend

**Land Use**
- City of Auburn
- Commercial
- Professional Office
- Industrial
- High Density Residential 10 - 15 DU/Ac.
- Medium Density Residential 5 - 10 DU./Ac.
- Low Medium Density Residential 2 - 5 DU/Ac.
- Low Density Residential 0.4 - 0.9 Ac. Min.
- Mixed Use
- Open Space
- Open Space / Business Park
- Riparian Drainage
- Rural Real Estate/Rural Residential
- Auburn Creekside Development Lands

**Sanitary Sewer**
- Sanitary Sewer
- Siphon
- Forcemain
- SMD1 WWTP

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

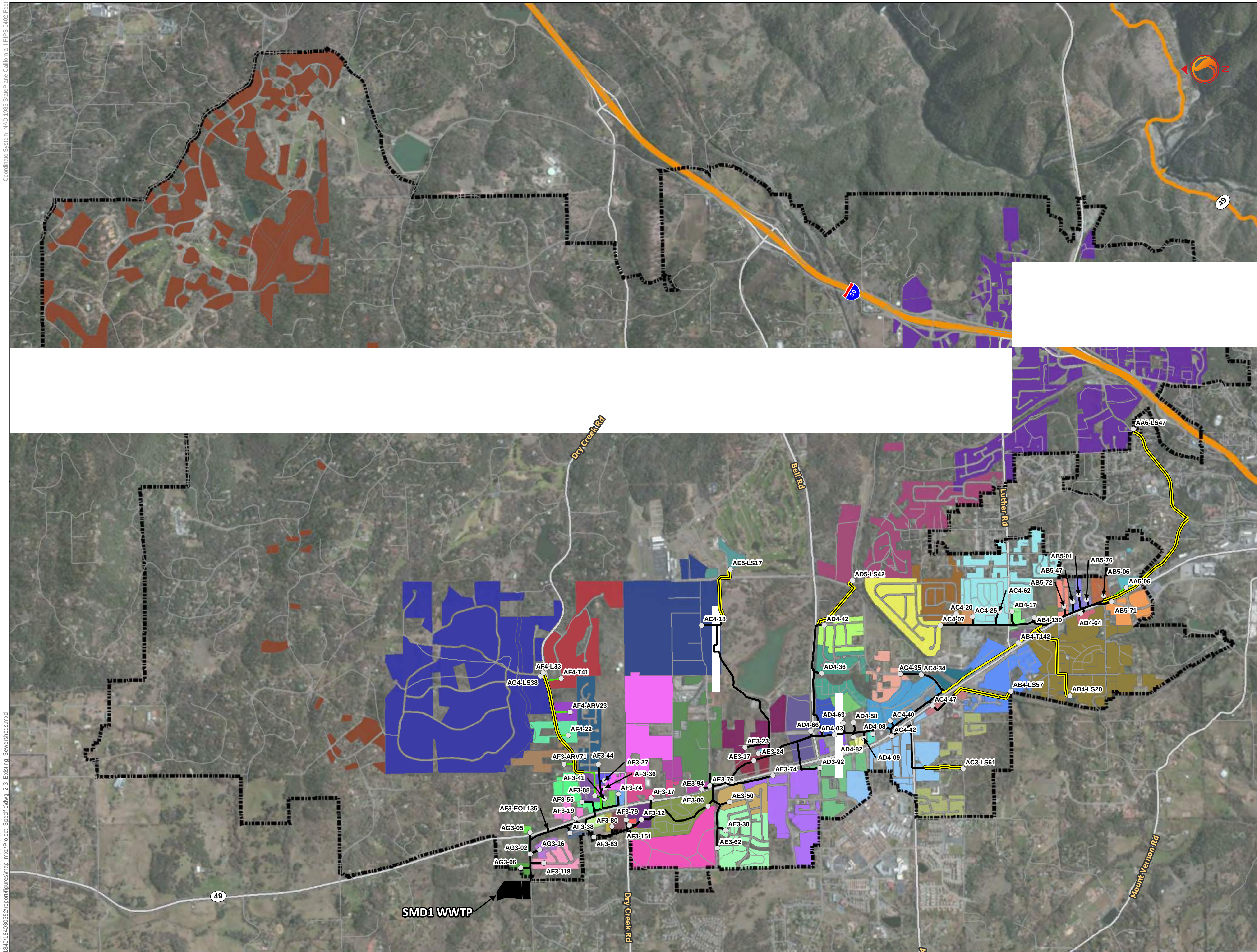
**Existing Land Use**

Project No. 184030352

Scale 0 0.125 0.25 0.375 0.5 Miles

Figure No. **2-2**

Issue/Revision A/

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**Legend**

**Sewer Connection**

| | | |
|---|---|---|
| AA5-06 | AD3-92 | AF3-151 |
| AA6-LS47 | AD4-03 | AF3-17 |
| AB4-130 | AD4-08 | AF3-19 |
| AB4-17 | AD4-09 | AF3-27 |
| AB4-64 | AD4-36 | AF3-36 |
| AB4-LS20 | AD4-42 | AF3-38 |
| AB4-LS57 | AD4-58 | AF3-41 |
| AB4-T142 | AD4-63 | AF3-44 |
| AB5-01 | AD4-66 | AF3-55 |
| AB5-06 | AD4-82 | AF3-74 |
| AB5-47 | AD5-LS42 | AF3-79 |
| AB5-71 | AE3-06 | AF3-80 |
| AB5-72 | AE3-17 | AF3-83 |
| AB5-76 | AE3-23 | AF3-88 |
| AC3-LS61 | AE3-24 | AF3-ARV71 |
| AC4-07 | AE3-30 | AF4-22 |
| AC4-20 | AE3-50 | AF4-ARV23 |
| AC4-25 | AE3-62 | AF4-L33 |
| AC4-34 | AE3-74 | AF4-T41 |
| AC4-35 | AE3-76 | AG3-02 |
| AC4-40 | AE3-94 | AG3-05 |
| AC4-42 | AE4-18 | AG3-06 |
| AC4-47 | AE5-LS17 | AG3-16 |
| AC4-62 | AF3-118 | AG4-LS38 |
| | AF3-12 | |

**Sanitary Sewer**

- Sanitary Sewer
- Low Pressure Sewer
- Siphon
- Forcemain
- Modeled Nodes
- Hwy49 Buildout Boundary
- SMD1 WWTP

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Connection of Existing Sewersheds to Modeled Network**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.125 0.25 0.375 0.5 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 2-3 | A/ |

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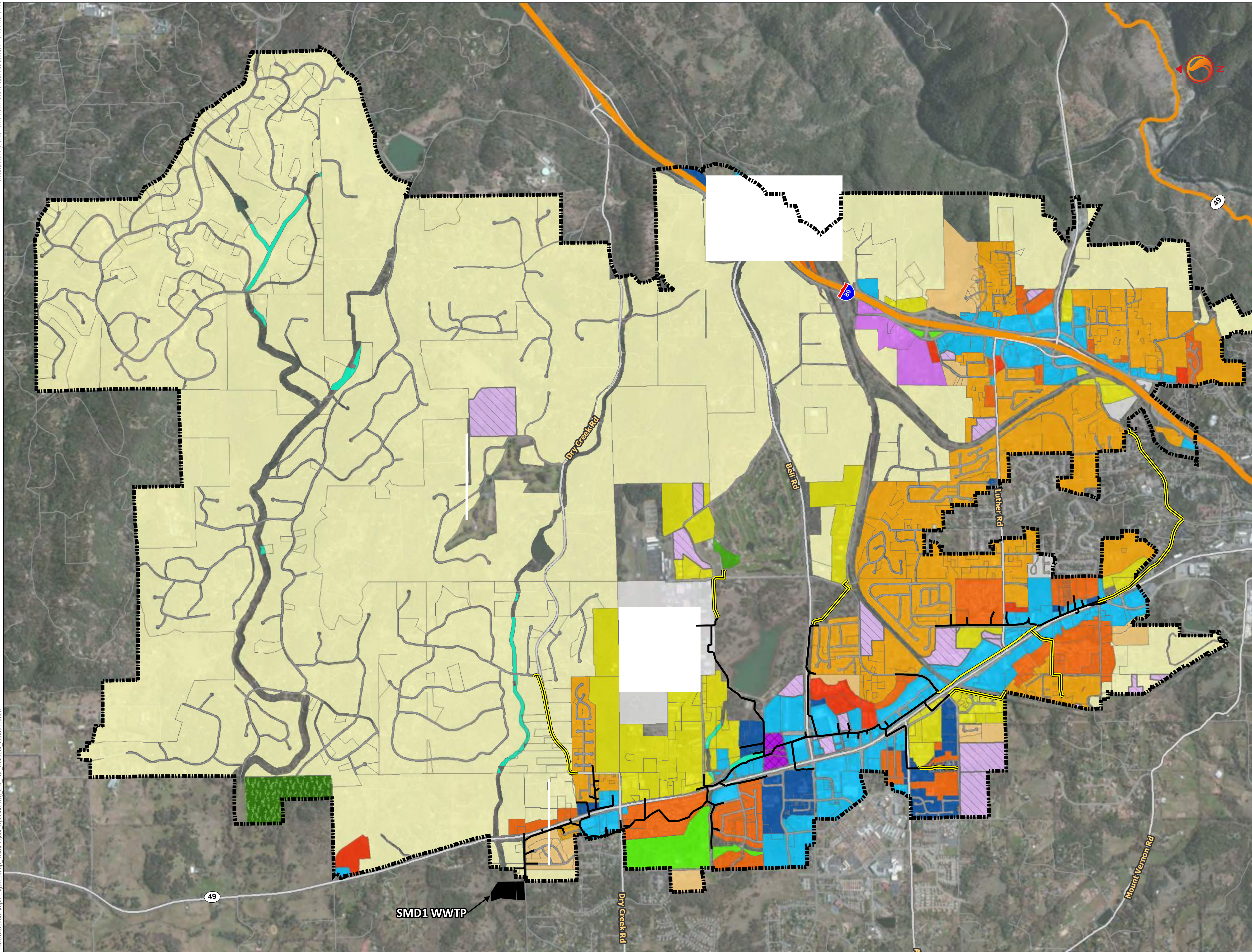
In addition to the existing APN connections, there are currently 18 entitled development projects that are planned to be served by the Highway 49 trunk sewer but which are not currently connected. In total, these developments represent approximately 412 EDUs. A detailed list of these developments is included in **Appendix A**.

Furthermore, Placer County Facility Services provided information for the land use designations and EDU counts of the expected growth in population and associated land uses within the SMD 1 service area by means of two shapefiles (complete with description):

- **"SMD1Basins_20130603.shp"** – Future service area build-out extents with projected population and land area, organized by manhole.
- **"SMD1ParcelsWithBasinAndLanduse_20130603.shp"** – Future build-out extents with project population (EDUs) and land area, broken down by parcels and landuse designations. This file is imilar to the preceding shapefile, though with slightly less effective land area and population.

The information contained within these shapefiles was intended to represent the ultimate build-out of SMD 1 and is independent of the existing land use data discussed prior. Through discussion with the County, it was decided that a combination of the two shapefiles was to be used. The population estimate within the "SMD1Basins" shapefile was deemed a more accurate prediction of future populations by the County. However, the "SMD1ParcelsWithBasinAndLanduse" shapefile provided the information regarding serviced and non-serviced area. As explained in further detail in Section 2.4, Future Flow Estimation, the non-serviced area will not contribute to I&I within the sewer system and is not included within the hydraulic model. The future build-out land use is shown in **Figure 2-4** and **Figure 2-5** and summarized in **Table 2-2**. A detailed list of the APN's which contribute to the future system is include on a CD.

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**Legend**

- Hwy49 Buildout Boundary

**Land Use**

- City of Auburn
- Commercial
- Professional Office
- Industrial
- High Density Residential 10 - 15 DU/Ac.
- Medium Density Residential 5 - 10 DU./Ac.
- Low Medium Density Residential 2 - 5 DU/Ac.
- Low Density Residential 0.4 - 0.9 Ac. Min.
- Mixed Use
- Open Space
- Open Space / Business Park
- Agricultural 10 - 80 Ac. Min.
- Riparian Drainage
- Rural Real Estate/Rural Residential
- Entitled Catchments
- Auburn Creekside Development Lands

**Sanitary Sewer**

- Sanitary Sewer
- Siphon
- Forcemain
- SMD1 WWTP

Client/Project

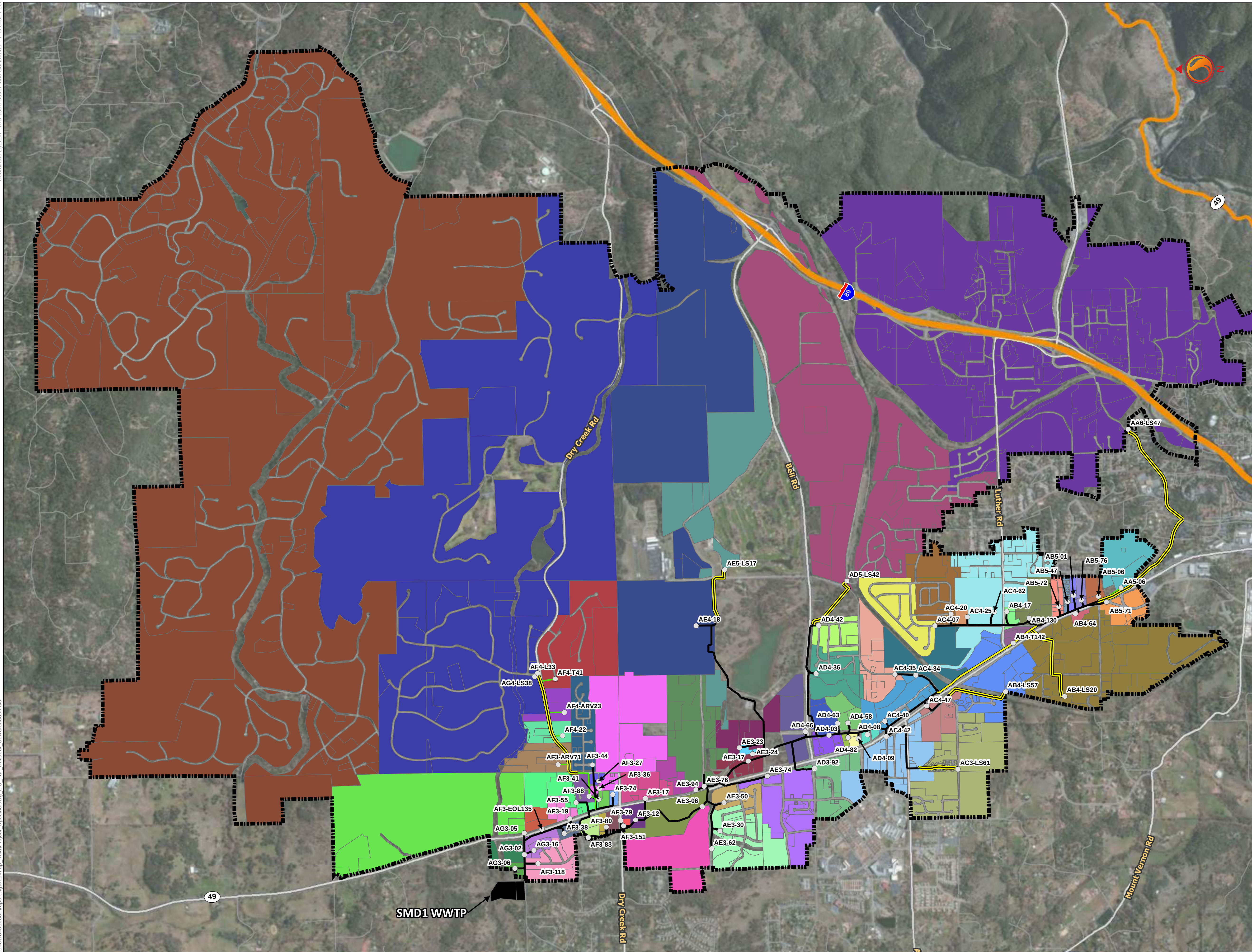
**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Full Build-Out Land Use**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.125 0.25 0.375 0.5 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 2-4 | A/ |




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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Legend

AssetName

AA5-06, AA6-LS47, AB4-130, AB4-17, AB4-64, AB4-LS20, AB4-LS57, AB4-T142, AB5-01, AB5-06, AB5-47, AB5-71, AB5-72, AB5-76, AC3-LS61, AC4-07, AC4-20, AC4-25, AC4-34, AC4-35, AC4-40, AC4-42, AC4-47, AC4-62, AD3-92, AD4-03, AD4-08, AD4-09, AD4-36, AD4-42, AD4-58, AD4-63, AD4-66, AD4-82, AD5-LS42, AE3-06, AE3-17, AE3-23, AE3-24, AE3-30, AE3-50, AE3-62, AE3-74, AE3-76, AE3-94, AE4-18, AE5-LS17, AF3-118, AF3-12, AF3-151, AF3-17, AF3-19, AF3-27, AF3-36, AF3-38, AF3-41, AF3-44, AF3-55, AF3-74, AF3-79, AF3-80, AF3-83, AF3-88, AF3-ARV71, AF3-EOL135, AF4-22, AF4-ARV23, AF4-L33, AF4-T41, AG3-02, AG3-05, AG3-06, AG3-16, AG4-LS38

Sanitary Sewer
Low Pressure Sewer
Siphon
Forcemain
auburn_buildout_nodes
SMD1 WWTP
Hwy49 Buildout Boundary

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
North Auburn, Placer County

Title

**Connection of Future Sewersheds to Modeled Network**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.125 0.25 0.375 0.5 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 2-5 | A/ |

## Table 2-2 Future Land Use Projection

| | SMD 1 | | Highway 49 Sewershed | |
|---|---|---|---|---|
| **Landuse Designation** | Total Acreage (Acres) | Total Population (EDUs) | Total Acreage (Acres) | Total Population (EDUs) |
| **Agricultural** | 52 | 26 | 52 | 26 |
| **City of Auburn** | 315 | 0 | 315 | 0 |
| **Commercial** | 679 | 2957 | 479 | 1778 |
| **Industrial** | 454 | 694 | 454 | 694 |
| **Mixed Use** | 66 | 268 | 53 | 182 |
| **Open Space** | 467 | 0 | 418 | 0 |
| **Open Space / Business Park** | 166 | 0 | 166 | 0 |
| **Professional Office** | 92 | 297 | 92 | 297 |
| **Riparian Drainage** | 220 | 0 | 197 | 0 |
| **Rural Estate 2.3 - 10 Ac. Min.** | 1012 | 591 | 1012 | 591 |
| **Rural Estate 4.6 - 10 Ac. Min.** | 827 | 519 | 734 | 469 |
| **Rural Low Density Residential** | 1409 | 1997 | 477 | 930 |
| **Rural Residential 1 - 2.3 Ac. Min.** | 0 | 0 | 0 | 0 |
| **Rural Residential 2.3 - 4.6 Ac. Min.** | 4769 | 3144 | 4500 | 2952 |
| **Low Density Residential** | 253 | 708 | 160 | 431 |
| **Low Medium Density Residential** | 1027 | 3820 | 872 | 3206 |
| **Medium Density Residential** | 372 | 2537 | 327 | 2233 |
| **High Density Residential** | 75 | 424 | 53 | 270 |
| **Total** | **12255** | **17982** | **10361** | **14059** |

## 2.4 FUTURE WASTEWATER FLOWS

The estimates for future (build-out) system flow were derived from a combination of existing system information, per the Placer County Design Guidelines, and through discussions with County Staff. The following provides a brief summary of the wastewater loading characteristics:

- **GWI** (groundwater infiltration) = 100 gpd / ac
  - Extrapolated from existing system performance

- **Average DWF** (dry weather flow) = 200 gpd / edu
  - Extrapolated from existing system performance
  - Diurnal loading assumed to be identical to existing system

- **RDII** (rainfall dependent infiltration and inflow) **Allowance** – 1338 gpd / ac
  - This value was derived from a technical memorandum issued by RMC entitled *South Placer Regional Wastewater & Recycled Water Systems Evaluation Project*, May, 2005 (RMC TM3a). In the report, a peak WWF (wet weather flow) of 1368 gpd/edu and a peak DWF of 380 gpd/edu are recommended. This approximates to 1000 gpd/edu infiltration. Note that the RDII allowance parameter is presented as an acreage basis rather than an EDU basis as recommended within the RMC report. As discussed later in Section 3.4.2, the hydraulic model derives the I&I based upon land area. **Table 2-3** and **Table 2-4** provide a summary of the RDII Allowance considerations.

### Table 2-3 Population Density Summary

| Rainfall Event | Contributing Area (ac) | Contributing EDUs | Density (edu/ac) |
|---|---|---|---|
| Existing System Model (Design Event) | 3583 | 7944 | 2.22 |
| Future Catchments Only(a) | 7503 | 10039 | 1.338 |

a) Landuse designations that contain no population is considered to not be serviced, and therefore not included as contributing area or EDU count. These designations are: City of Auburn, Open Space, Open Space / Business Park, and Riparian Drainage.

### Table 2-4 Future Flow and Infiltration Allowance Summary

| Rainfall Event | Peak DWF [mgd] | Peak WWF [mgd] | Peak I&I [mgd] | RDII [gpd/ac] | RDII [gpd/edu] | PWWF [gpd/edu] |
|---|---|---|---|---|---|---|
| Existing System Model (Design Event) | 2.67 | 11.5 | 8.8 | 2464 | 1112 | 1448 |
| Future Catchments Only | 4.97 | 15.0 | 10.0 | 1338 | 1000 | 1495 |

# 3.0 Overview of Hydraulic Model

A computer model was developed by Stantec to assess the impact of the Auburn Creekside development on the Highway 49 sewer trunk system.

## 3.1 PURPOSE

The purpose of this chapter is to present an overview of the development and calibration of the hydraulic model of the Highway 49 sewer trunk system located in SMD 1 of Placer County.

This chapter is divided into the follow sections:

- Modeling Software
- Model Inputs and Construction
- Model Calibration

## 3.2 MODELING SOFTWARE

The wastewater collection system capacity was evaluated using a hydrodynamic routing model, Mike Urban 2011, Service Pack 7, by DHI.

## 3.3 MODEL INPUTS AND CONSTRUCTION

The GIS database files containing the physical collection system information (pipe lengths, diameters, inverts, manhole depths, etc.) were imported into the modeling software. The data import resulted in an initial model build containing the necessary information for pipes and junctions. A Manning "n" roughness coefficient was assigned to gravity sewer based upon the identified pipe material, as per **Table 3-1**.

**Table 3-1 Sewer Roughness Values**

| Material | Manning's "n" value |
|---|---|
| **Asbestos Cement** | 0.013 |
| **Ductile Iron** | 0.0145 |
| **PVC** | 0.012 |
| **Tranzite** | 0.013 |
| **Unidentified** | 0.013 |
| **Vitrified Clay Pipe** | 0.0145 |

Mike Urban also uses manhole loss coefficients to further determine the total resistance to flow within the network. An universal "Km" value of 0.10 was applied using the "MOUSE Mean Energy Approach" equations to calculate the resistance to the flow. Mike Urban calculates the total loss through a manhole by applying additional modifiers to the “Km” value automatically. These additional modifiers represent factors such as, but not exclusively:

- Manhole entry and exit loss coefficients
- Flow angle
- Plunging manholes
- Drop elevation

These factors are calculated within the MOUSE module, and are not user determined. The “Km” value was determined to be most appropriate through discussions with DHI staff.

Once imported into the model, a number of technical issues were found in the GIS source data, needed resolution in order to allow creation of a useable hydraulic model:

- Connectivity errors. These errors were most common, and were addressed either by revisiting the as-built data or through discussions with County staff.

- Incomplete data. Assumptions were made to complete the model database connectivity, pipe sizes, and elevations, where data was incomplete.

- Invert and pipe slope and size inconsistency. In many cases, GIS data indicates pipes with negative slopes. These pipes were adjusted to have positive slopes in the model. Negative slopes are generally mistakes in the GIS database, and likely do not represent actual negative slopes in the wastewater system pipes.

The model is comprised of a network of data elements called *nodes* and *links*. The *nodes* and *links* represent the components of a typical wastewater collection system.

- A *node* is a point in the network having an X and Y coordinate. *Nodes* can represent manholes, wet wells, chamber, or outfalls.

- *Links* convey flow between nodes. They are connected at one end to a *start node* and the other end to an *end node*. *Links* can represent gravity sewers, force mains or pumps.

### 3.3.1 Sewer Pipes and Manholes

The sewers to be modeled were identified by the County prior to the initiation of this project. They are generally defined as any sewer trunks tributary to and including the Highway 49 trunk downstream of all active lift stations. In general, the collection system upstream of lift stations was not included in the model.

### 3.3.2 Lift Stations

Lift stations were included within the model to facilitate the start/stop effects of the forcemains upon the downstream collection system. Note that the performance and the capacity of the lift stations were not assessed within this study.

The lift stations to be included in the model were identified by the County prior to the initiation of this project. The modeled lift stations include:

- Airport Lift Station
- Alpine Lift Station
- Auburn Ravine Lift Station
- Edgewood Lift Station
- Golf Course Lift Station
- Kemper Lift Station
- Saddleback Lift Station

ISCO Pumplink data was used as the basis for determining the actual discharge capacity of the forcemains. This data was provided by the County. However, it was identified that the Auburn Ravine Lift Station operates with a VFD with a peak capacity of 1200 gpm. This lift station was modeled as pressurized sewer. **Table 3-2** summarizes the parameters used within the model.

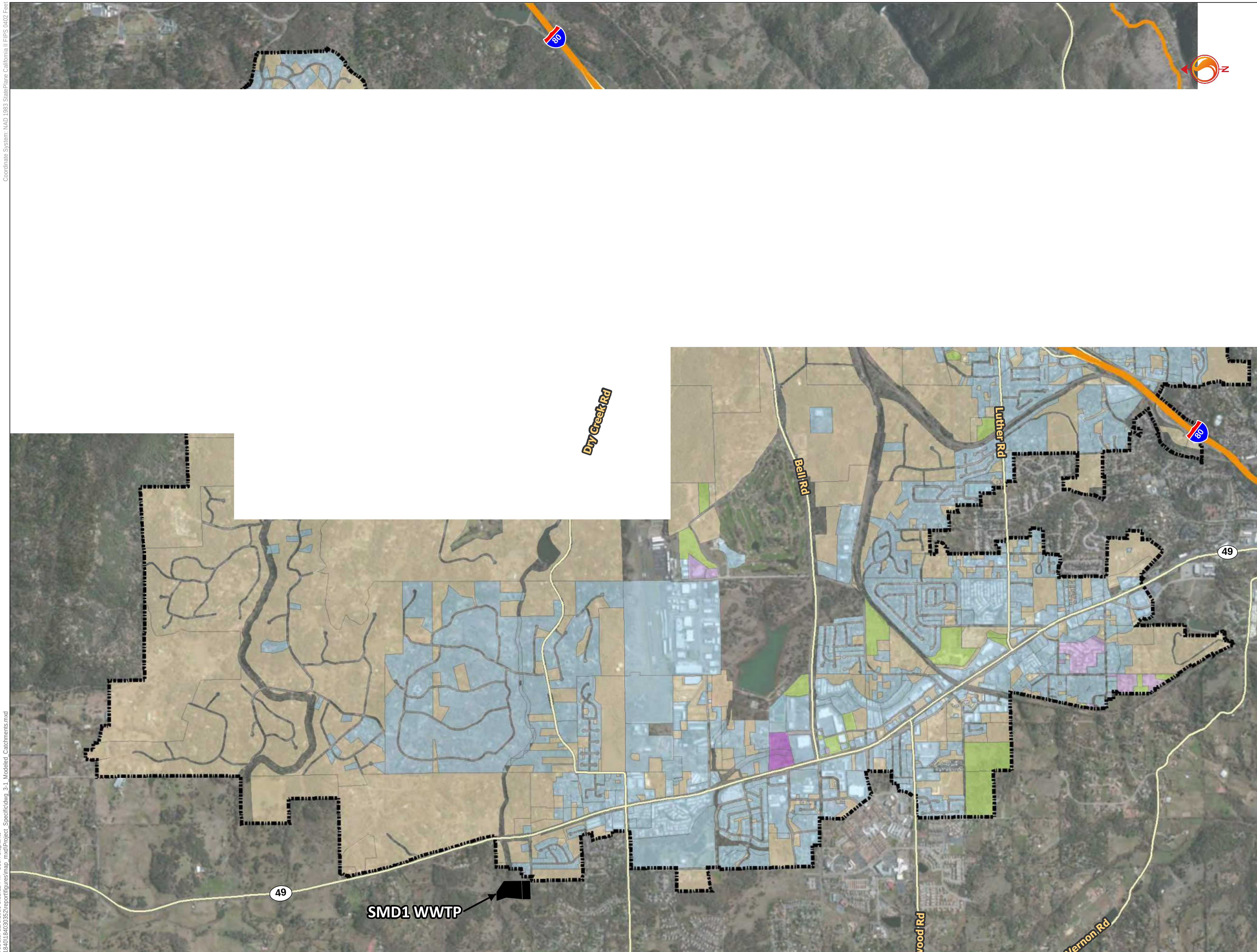
**Table 3-2 Sewer Maintenance District 1 (SMD 1) – Highway 49 Trunk Lift Station Information**

| Lift Station | Model ID No. | Lead Pump Start Level (ft) | Lag Pump Start Level (ft) | Lead Pump Modeled Flow Rate (gpm)[(a)] | Lag Pump Modeled Flow Rate (gpm)[(a)] |
|---|---|---|---|---|---|
| Airport Lift Station | AD5-LS42 | 1446.4 | 1446.9 | 181 | 21 |
| Alpine Lift Station | AB4-LS57 | 1341.0 | 1341.5 | 97 | 14 |
| Edgewood Lift Station | AB4-LS20 | 1349.0 | 1350.0 | 299 | 125 |
| Golf Course Lift Station | AE5-LS17 | 1467.0 | 1468.0 | 153 | 21 |
| Kemper Lift Station | AC3-LS61 | 1382.5 | 1446.9 | 188 | 21 |
| Saddleback Lift Station | AG4-LS38 | 1309.0 | 1309.5 | 179 | 21 |
| Auburn Ravine Lift Station | Modeled as Pressurized Sewer | | | | |

(a) The flow rates listed are the modeled flow discharged from the modeled wet well after water level reaches the lead/lag START levels. The lag pump flow rate is additive to the lead pump flow rate.

### 3.3.3 Subcatchments

Subcatchments are used within hydrodynamic models to represent the combined land area and population that contribute to wastewater flows in a particular part of the system. Often these subcatchments are the areas upstream of a particular manhole, or lift station. The overall service area of the Highway 49 Trunk shown on **Figure 3-1** is made up of a number of subcatchments. The County provided the population and extents of the subcatchments for the Highway 49 Trunk within the landuse information provided in the file "SMD1ParcelsWithBasinAndLanduse_20130603.shp" discussed in section 2.3.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet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**Legend**

- Hwy49 Buildout Boundary
- Existing Catchments
- Existing Catchments w/ Entitled
- Entitled Catchments
- Auburn Creekside Development Lands
- Full Buildout Catchments
- SMD1 WWTP

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Highway 49**
**Modeled Catchments**

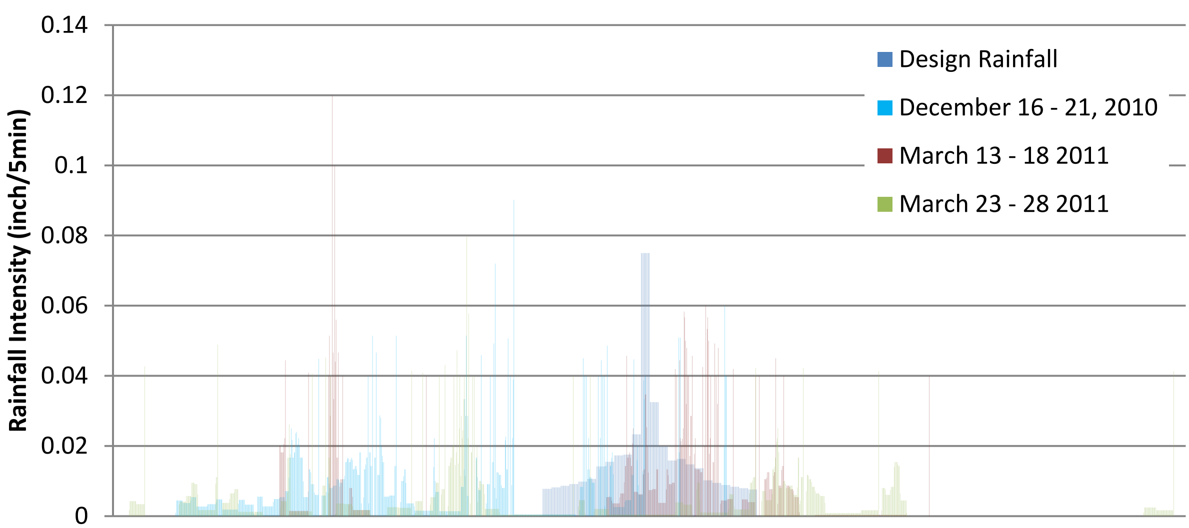
| Project No. | Scale |
|---|---|
| 184030352 | 0 0.2 0.4 0.6 Miles |
| Figure No. | Issue/Revision |
| 3-1 | A/ |

### 3.3.4 Design Storms

Design storms are usually simulated in the hydraulic model to assess the capacity of the sewer system being studied under wet weather conditions. This is typically done with the goal of assessing potential risk of surcharging the system and experiencing SSOs. For the SMD 1 collection system, Placer County Facility Services directed the use of a 10-year, 24-hour design storm to assess the capacity of the wastewater collection system.

The procedure outlined in the "Placer County Flood Control and Water Conservation District Stormwater Management Manual" was used as the basis for creating the design storm. The design storm total rainfall over a 24 hour period at 1400 feet elevation was 4.59 inches, distributed such that the peak intensity (0.90 inches/hour) occurred at the mid-way point of the storm event (as prescribed in the Placer County Flood Control and Water Conservation District Stormwater Management Manual). The hyetographs from the 10-year, 24-hour theoretical design storm, as well as three other, representative storms that occurred in the area during 2010 – 2012 are shown in **Figure 3-2**. Further explanation of how these design storms are used in the modeling and capacity assessment is provided in the model calibration section of this chapter.

**Figure 3-2 10-year, 24-hour Design Storm Hyetograph**




## 3.4 MODEL CALIBRATION

The calibration process is required to ensure the accuracy of the model at predicting the system performance under varying flow conditions. Using the flow monitoring data provided, the model was calibrated using actual dry weather and wet weather conditions (both flow monitoring and precipitation data). The calibrated model was then used to assess system performance under design storm conditions.

### 3.4.1 Dry Weather Flow Calibration

To establish a baseline for the results, the model was calibrated to DWF conditions. It should be noted that the DWF will remain unaffected regardless of the amount of rainfall that occurs, and therefore is the most consistent metric available. The model was calibrated against sixteen (16) weeks of data collected from the Joeger Road WWTP Influent Flow Meter (June 12, 2011 through October 2, 2011) and against over three (3) weeks of data collected from the Dewitt Flow Meter (November 25, 2008 through December 20, 2008). A rainfall event occurred on June 28th that produced a WWF response within the network. As per County standards, the flow data gathered on June 28th and the following subsequent five (5) days were not considered for the DWF calibration.

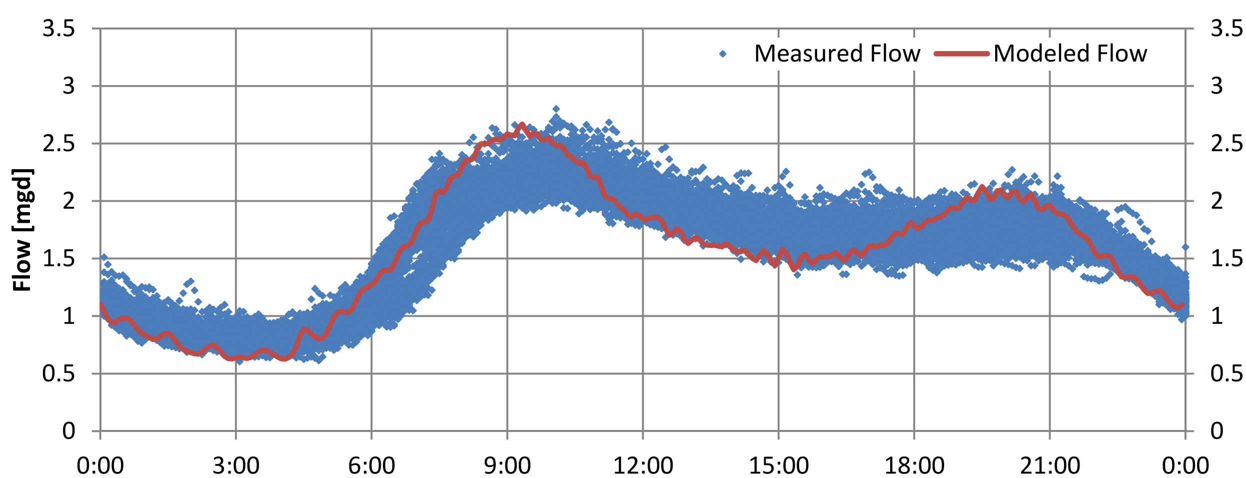
The process for calibration included the establishment of a DWF diurnal pattern. The values of the GWI, the ADWF and the DWF peaking factors (within the diurnal pattern) were adjusted based upon the calibration criteria. The accuracy of each calibration iteration was determined qualitatively by a visual inspection of the plots of measured and modeled flows and quantitatively through an analysis of the minimum, maximum, and average flows for the period. The comparison of these statistics is shown in **Table 3-3**.

**Table 3-3 DWF Calibration Results**

| Calibration Results for WWTP Flows | Average DWF [mgd] | Peak DWF [mgd] | Minimum DWF [mgd] |
|---|---|---|---|
| **Modeled Flow** | **1.573** | **2.668** | **0.627** |
| **Measured Flow** | 1.576 | 2.799 | 0.605 |
| **% Error** | **-0.18%** | **-4.69%** | **3.61%** |

**Figure 3-3** shows the comparison of the "Measured" and "Modeled" DWF at the WWTP.

**Figure 3-3 DWF Calibration Plot**



### 3.4.2 Wet Weather Flow Calibration

The calibrated DWF model was used as the basis for expanding the model to include WWF. The four rainfall events established in Section 3.3.4 of this report were used for the calibration.

The Mike Urban software utilizes two sets of calculation engines to model the RDII response in the network during WWF. The RDII response is simulated through the use of the "RDI" and the "Model A" equations.

The "RDI" equations characterize how the network responds to the long duration infiltration of water into the network through seepage or cracks in the sewers (the slow response). The "Model A" equations characterize how the network responds to the direct inflow of water into the network through manholes, cross-connections, roof leaders or other openings (the fast response).

A summary of the WWF finalized calibration parameters used by Mike Urban is shown in **Table 3-4.**

**Table 3-4 RDII Equation Parameters**

| Model A Parameters | |
|---|---|
| Impervious Area [%] | 1.1 |
| Reduction Factor [1/1] | 0.7 |
| Initial Loss [inch] | 0.03 |
| Time of Concentration [min] | 120 |
| **RDI Parameters** | |
| RDI Area [%] | 14 |
| Umax [inch] | 2 |
| Lmax [inch) | 40 |
| Cqof [1/1] | 0.3 |
| Carea [1/1] | 1 |
| Ck [h] | 8 |
| Ckif [h] | 300 |
| Ckbf [h] | 500 |
| Tof [1/1] | 0 |
| Tif [1/1] | 0 |
| Tg [1/1] | 0 |
| InitU [inch] | 0 |
| InitL [inch] | 20 |
| InitGwl [ft] | 32.808 |
| InitOf [in/h] | 0 |
| InitIf [in/h] | 0 |
| GwSy [1/1] | 0.3 |
| GwLmin [ft] | 0 |
| GWLbf0 [ft] | 32.808 |
| GWLfl1 [ft] | 0 |

The WWF model results for the rain events were plotted against the flow monitoring data. **Figure 3-4** through **3-6** show the comparison of the "Measured" and "Modeled" WWF. Results are also summarized in **Table 3-5**.

**Table 3-5 WWF Calibration Results**

| Calibration Results for WWTP Flows | Dec 16 – 21, 2010 | | Mar 13 – 18, 2011 | | March 23 – 28, 2011 | | Nov 28 – Dec 5, 2012 | |
|---|---|---|---|---|---|---|---|---|
| | WWF Peak [mgd] | Total Volume [mil gal] | WWF Peak [mgd] | Total Volume [mil gal] | WWF Peak [mgd] | Total Volume [mil gal] | WWF Peak [mgd] | Total Volume [mil gal] |
| Modeled Flow | 9.55 | 24.66 | 10.69 | 21.73 | 10.33 | 27.73 | 11.32 | 28.99 |
| Measured Flow | 9.98 | 23.72 | 10.42 | 20.80 | 9.85 | 24.97 | 10.43 | 29.06 |
| % Error | (4.33%) | 3.96 | 2.56% | 4.48% | 4.85% | 11.02% | 8.55% | (0.23%) |

**Figure 3-4 December 16th – 21st, 2010 Calibration Results**

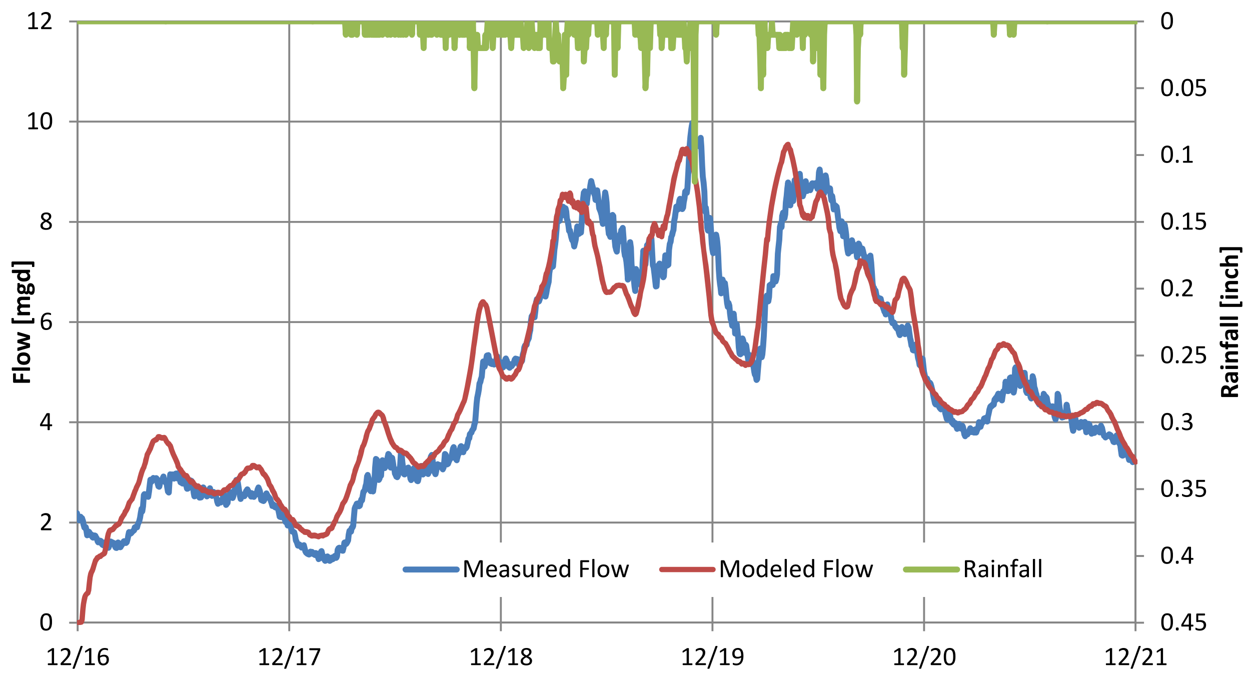


**Figure 3-5 March 13th – 18th, 2011 Calibration Results**

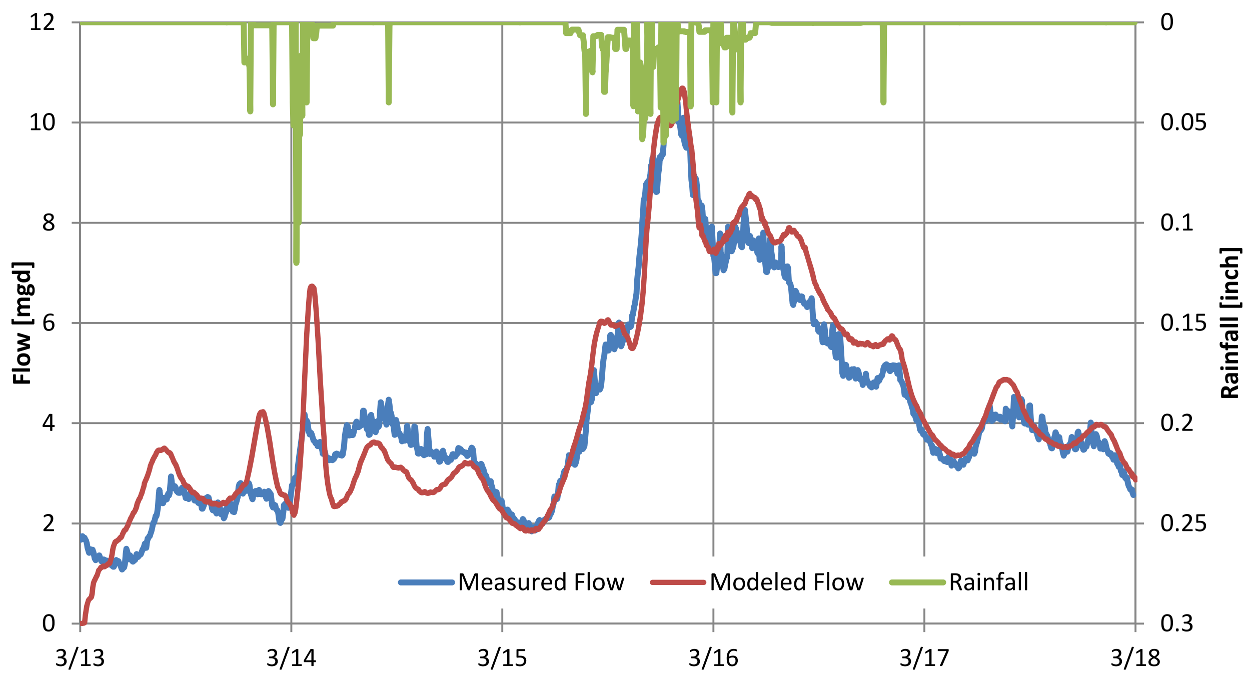
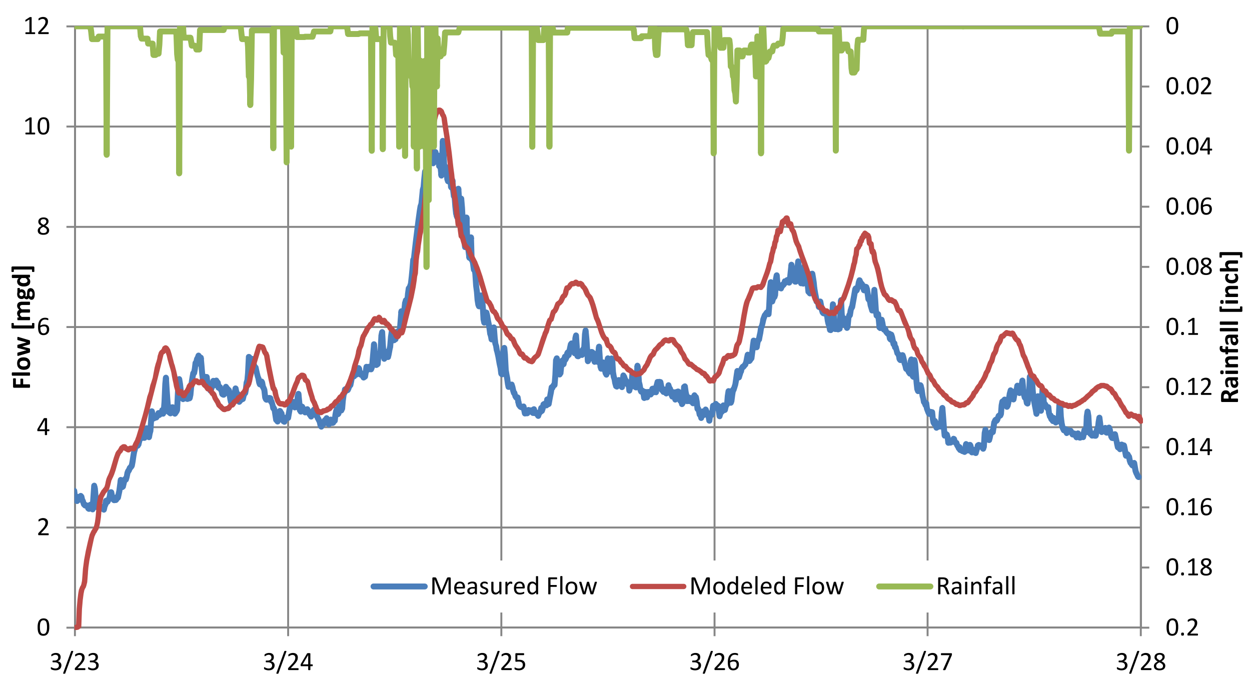
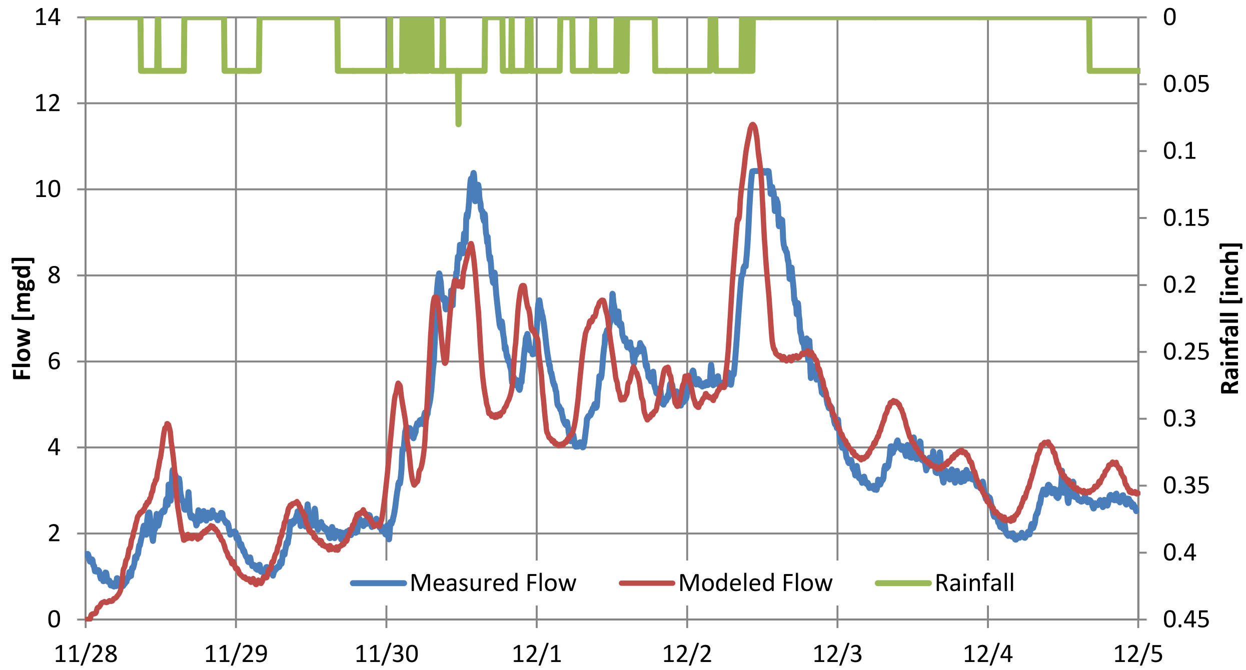



**Figure 3-6 March 23rd – 28th, 2011 Calibration Results**



### Figure 3-7 November 28th – December 5th, 2012 Calibration Results



# 4.0 Wastewater Collection System Capacity Evaluation

The DHI model described in Chapter 3.0 was exercised to evaluate performance of the Highway 49 trunk sewer under various scenarios.

## 4.1 PURPOSE

The purpose of this chapter is to provide a summary of the results of the level of service (LOS) performance of the Highway 49 Trunk Sewer applying the 1:10-year, 24-hour design storm design event upon the various growth scenarios.

This chapter is divided into the following sections:

- Recommended Capacity Evaluation Criteria
- Modeled Scenarios
- Model Results:
    - Existing System
    - Existing System + Entitled
    - Existing System + Entitled + Auburn Creekside Development
    - Build-out of System

## 4.2 RECOMMENDED CAPACITY EVALUATION CRITERIA

The design rainfall event was applied to the Mike Urban model to evaluate the LOS performance in meeting the following primary criteria, which were defined by Placer County Facility Services:

- Freeboard
- Velocity
- Pipe capacity

### 4.2.1 Level of Service Criteria

Freeboard in a manhole is defined as the distance between the rim elevation and the hydraulic grade line (HGL). The manhole is considered to be surcharged when the HGL exceeds the pipe crown.

For freeboard in existing manholes, there are two deficiency criteria for this analysis:

1. When the rim elevation is less than or equal to 8-feet above the pipe crown:

   a. No surcharging is allowed.
2. When the rim elevation is more than 8-feet above the pipe crown:
   a. A pipeline is hydraulically deficient if there is less than 8-feet of freeboard or the surcharging is equal to or greater than 1-foot above the pipe crown.

For new improvements to the Hwy 49 trunk system, no hydraulic surcharging is allowed in manholes.

### 4.2.2 Velocity

Gravity sewer shall allow a minimum flow velocity of 2.5 ft/s and a maximum of 7 ft/s. All sewers that have a velocity outside of these criteria shall be identified.

Force mains shall allow a minimum flow velocity of 2 ft/s and a maximum of 7 ft/s. All force mains that have a velocity outside of these criteria shall be identified.

### 4.2.3 Pipe Capacity

Sewer pipes shall conform to the following capacity criteria under design storm conditions, where d = depth of flow and D = pipe diameter.

- d/D shall be a maximum of 70% for pipe less than or equal to 24 inch
- d/D shall be a maximum of 100% for pipe greater than 24 inch

## 4.3 MODEL RESULTS

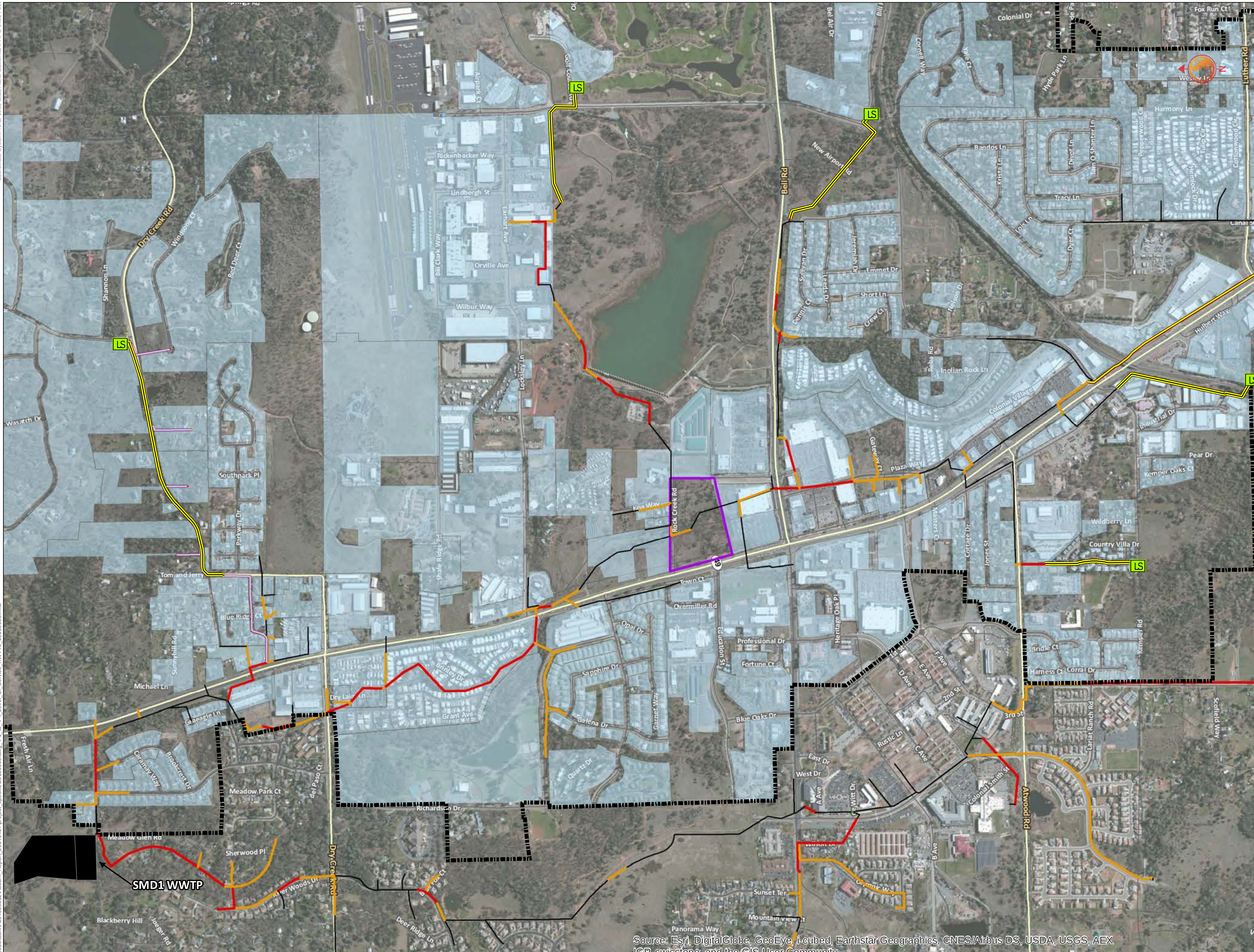
The average DWF and peak WWF model results for the Highway 49 trunk system are summarized in **Table 4-1** and described in more detail in the following sections.

**Table 4-1 Design Event Flow Summary at Joeger Road WWTP**

| | Average DWF [mgd] | Peak DWF [mgd] | Peak WWF [mgd] |
|---|---|---|---|
| **Existing Conditions** | 1.573 | 2.643 | 11.489 |
| **Existing + Entitled** | 1.690 | 2.784 | 11.534 |
| **Existing + Entitled + Auburn Creekside** | 1.699 | 2.798 | 11.609 |
| **Ultimate Build-out** | 3.986 | 6.358 | 13.684 |

### 4.3.1 Existing System – Design Storm Event

Under existing conditions, a 10-year, 24-hour design storm event is predicted to generate a peak flow of 11.3 mgd at the WWTP. This storm event is predicted to cause surcharging in several reaches along the Highway 49 Trunk sewer as well as in lateral sewers downstream of several of the lift stations. Model simulation results for the existing system during peak WWF conditions are presented in **Figure 4-1**, which indicate the following:





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Legend

- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Siphon
- Forcemain
- Low Pressure Sewer
- Existing Catchments
- Auburn Creekside Development Lands
- SMD1 WWTP
- Hwy49 Buildout Boundary
- LS Lift Stations

**Note:** Sewers identified as "Throttled with allowable freeboard" have surcharged as a result of a localized capacity restraint, though the degree of surcharging meet the County's design standard. Sewers identified as "Throttled without allowable freeboard" have surcharged as a result of a localized capacity restraint and do not meet the County's design standard.

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Existing**
**Level of Service**
**1:10 Year 24hr WWF**

Project No. 184030352

Scale 0 0.05 0.1 0.15 0.2 Miles

Figure No. **4-1**

Issue/Revision A/

- Sewers shown as black lines are not predicted to have capacity issues.

- Sewers shown in green are identified as sewers that are surcharged due to downstream conditions though have sufficient freeboard to meet the County's Level of Service (LOS) criteria.

- Sewers shown in blue are identified as sewers that are surcharged due to insufficient capacity though have sufficient freeboard to meet the County's LOS criteria.

- Sewers shown in orange and red are sewers that are surcharged to an extent such that they do not meet the County's LOS criteria, and are resultant from downstream conditions and insufficient capacity, respectively.

To help identify the extent of surcharging within the existing network, hydraulic grade line (HGL) profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Highway 49 Trunk. Note that these profiles also include the results for the other growth scenarios (Existing + Entitled, etc.), to be discussed in the following sections.

The following provides a summary of the Existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: severe surcharging in approximately 1600 ft of 15 inch and 18 inch sewer along Plaza Way, with expected surcharging to surface near Gateway Ct. The surcharging is a result of insufficient capacity.

- **Figure B-3**: minor surcharging (<1ft) in the first manhole upstream of the proposed Auburn Creekside development. The predicted HGL freeboard is greater than 8 ft and therefore meets the County's LOS criteria. There is also major surcharging shown near the downstream portion of Profile 2. This surcharging is a result of insufficient capacity, primarily in Profile 3.

- **Figure B-4**: severe surcharging along the Highway 49 sanitary sewer trunk starting approximately 400ft upstream of where it crosses under Hwy49 near Locksley Lane and ends near Rock Creek Circle, approximately 900ft upstream of Dry Creek Rd. In total, approximately 1050 linear feet of 24-inch sewer and 1500 linear feet of 21-inch sewer is affected. The surcharging is expected to result in a sanitary sewer overflow (surface flooding) near Hwy49.

- **Figure B-5**: minor surcharging (<1ft) along Highway 49 and Joeger road affecting 600 linear feet of 18-inch sewer and 400 linear feet of 21-inch sewer. The surcharging is expected to have just less than 8 feet of HGL freeboard, and therefore does not meet the County's Level of Service criteria.

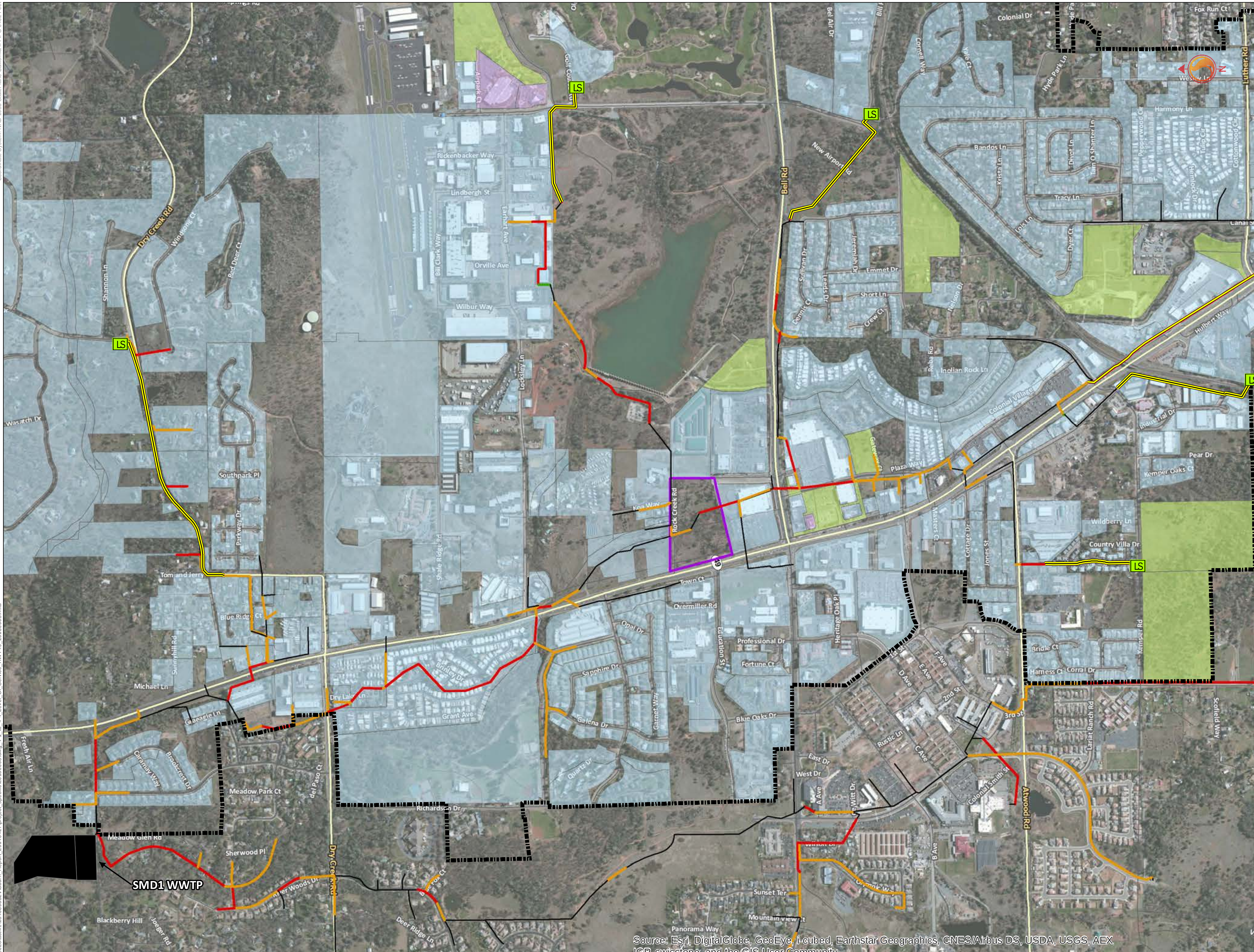
### 4.3.2 Existing System + Entitled Developments – Design Storm Event

It is predicted that should every property that is currently entitled to wastewater service proceed through full development, a peak flow of 11.4 mgd will be experienced at the WWTP. This scenario is predicted to cause very minor amounts of surcharging over and above what was experienced for the Existing system analysis. Model simulation results for the existing system and entitled projects during peak WWF conditions are shown in **Figure 4-2**.

To help identify the extent of surcharging within the existing network when the known entitled developments are added, HGL profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Highway 49 Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles for the Existing + Entitled scenario:

- **Figure B-2**: the severe surcharging identified in the Existing System results are expected to worsen slightly, affecting an additional 200 linear feet of 18-inch sewer at the upstream portion of Plaza way. This additional sewer surcharging is a result of the existing capacity restriction.
- **Figure B-3**: there are expected to be no additional sewers surcharged in this profile. The HGL of the surcharged sewers is expected to increase by a maximum of 0.2 feet with the inclusion of the entitled developments.
- **Figure B-4**: one additional manhole (AE3-05, two manholes upstream of Rock Creek Circle) is expected to overflow as a result of the increase in flows from the Entitled developments.
- **Figure B-5:** there are expected to be no additional sewers surcharged in this profile. The HGL of the surcharged sewers is expected to increase by a maximum of 0.1 feet with the inclusion of the entitled developments.

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Legend

- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Siphon
- Forcemain

**Scenario**

- Existing Catchments
- Existing Catchments w/ Entitled
- Entitled Catchments
- Auburn Creekside Development Lands
- SMD1 WWTP
- Hwy49 Buildout Boundary
- LS Lift Stations

**Note:** Sewers identified as "Throttled with allowable freeboard" have surcharged as a result of a localized capacity restraint, though the degree of surcharging meet the County's design standard. Sewers identified as "Throttled without allowable freeboard" have surcharged as a result of a localized capacity restraint and do not meet the County's design standard.

Client/Project

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**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Existing + Entitled**
**Level of Service**
**1:10 Year 24hr WWF**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.05 0.1 0.15 0.2 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 4-2 | A/ |

### 4.3.3 Existing System + Entitled Developments + Auburn Creekside – Design Storm Event

As part of the development, Auburn Creekside has agreed to install improvements to the Highway 49 Trunk sewer within their parcel. At the time of the analysis and publication of earlier drafts of this report, Auburn Creekside proposed a pipe alignment through the center of their parcel similar to the existing alignment, upsized to 24-inch diameter as required by the Placer County Code Section 13.12.230. According to the County, Projects are required to construct a sewer collection system along the entire frontage of their parcel. To meet the County Code, improvement of the existing 18-inch in the form of upsizing to a 24-inch diameter pipe was considered sufficient at the time of this analysis. It was also consistent with the agreed upon scope of the sewer study the County required of the Auburn Creekside development. The evaluation of the Auburn Creekside project indicated no significant impacts to the Highway 49 trunk sewer would result from the projects construction and operation.

Since that time, Auburn Creekside and the County have come to an agreement upon an alternative alignment that would consist of a 24-inch sewer that would divert flow around the Target building through the Auburn Creekside parcel closer to Highway 49. This alignment is discussed in more detail in Section 5.4.1. Please note that the results presented within this section are based upon the information that was available at the time of the analysis, which included improvements along the proposed alignment at that time (upsizing of the existing 18-inch sewer).

For this scenario, it is predicted that the WWTP will experience a peak flow of 11.425. The inclusion of the Auburn Creekside development is not predicted to cause any additional sewer segments to become surcharged; rather, the additional loading will cause the existing surcharging to worsen trivially. Model simulation results for this scenario during peak WWF conditions are shown in **Figure 4-3**. The relative contribution to this additional surcharging is small given the number of EDUs included in the Auburn Creekside development.

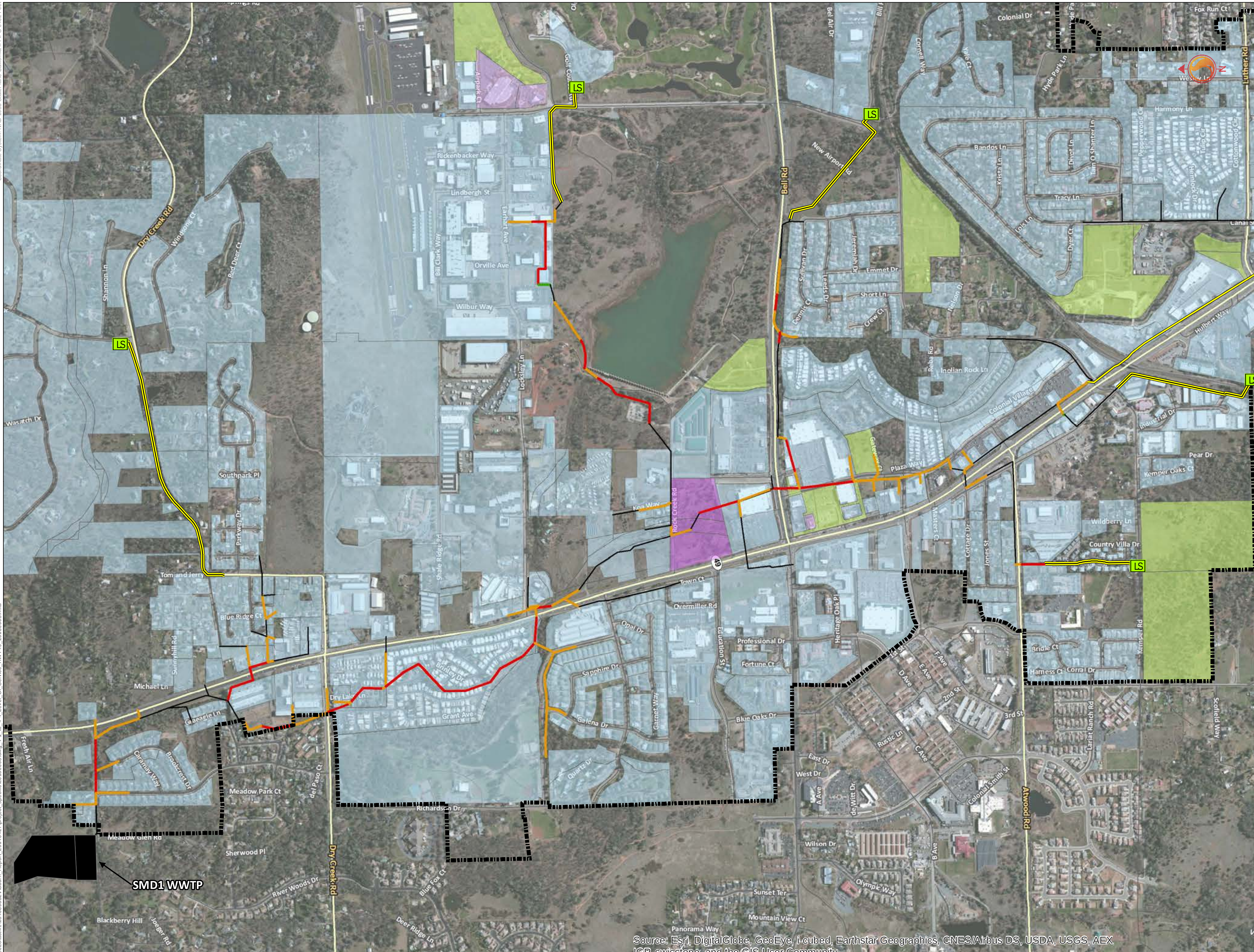
To help identify the extent of surcharging within the existing network, HGL profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Highway 49 Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: there are expected to be no additional sewers surcharged in this profile. The HGL of the surcharged sewers is expected to increase by a maximum of 0.1 feet with the inclusion of the Auburn Creekside development respective to the “Existing + Entitled scenario”.

- **Figure B-3**: there are expected to be no additional sewers surcharged in this profile. The HGL of the surcharged sewers is expected to increase by a maximum of 0.1 feet with the inclusion of the Auburn Creekside development respective to the “Existing + Entitled scenario”.

- **Figure B-4**: there are expected to be no additional sewers surcharged in this profile. The HGL of the surcharged sewers is expected to increase by a maximum of 0.1 feet with the inclusion of the Auburn Creekside development respective to the “Existing + Entitled scenario”.

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- Siphon
- Forcemain

**Scenario**

- Existing Catchments
- Existing Catchments w/ Entitled
- Entitled Catchments
- Auburn Creekside Development Lands
- SMD1 WWTP
- Hwy49 Buildout Boundary
- LS Lift Stations

**Note:** Sewers identified as "Throttled with allowable freeboard" have surcharged as a result of a localized capacity restraint, though the degree of surcharging meet the County's design standard. Sewers identified as "Throttled without allowable freeboard" have surcharged as a result of a localized capacity restraint and do not meet the County's design standard.

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**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Existing + Entitled + Auburn Level of Service 1:10 Year 24hr WWF**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.05 0.1 0.15 0.2 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 4-3 | A/ |

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- **Figure B-5**: there are expected to be no additional sewers surcharged in this profile. The HGL of the surcharged sewers is expected to increase by a maximum of 0.1 feet with the inclusion of the Auburn Creekside development respective to the "Existing + Entitled scenario".

### 4.3.4 Full Build-out

Similarly to the "Existing + Entitled + Auburn Creekside" scenario, this scenario was developed using the alignment through the Auburn Creekside property proposed at the time of the analysis. It is predicted that the WWTP will experience a peak flow of 13.3 mgd for this growth scenario under design storm conditions with no improvement made to the collection system. If improvements are made to the collection system to address deficiencies described herein and no reduction in infiltration and inflow is achieved, the model predicts the WWTP will experience peak flows of approximately 18 to 19 mgd under design storm conditions. The inclusion of all potential catchments using the County's land use projects is predicted to cause system wide capacity constraints and deficiencies. Model simulation results for this scenario during peak WWF conditions are shown in **Figure 4-4**.

It should be noted that during the modeling process, it was discovered that the existing lift stations are expected to be extremely under capacity for this scenario. As the purpose of this study is to assess the impact of the Auburn Creekside development upon the Highway 49 Trunk Sewer, it was assumed that the capacities of all of the lift stations were increased and all pumps outfitted with VFDs. This approach avoids any potential underestimate of peak flow and capacity needs downstream of the lift stations while avoiding speculation regarding how the County intends to address these lift station capacity issues. This is an area of the collection system which the County may wish to study further.

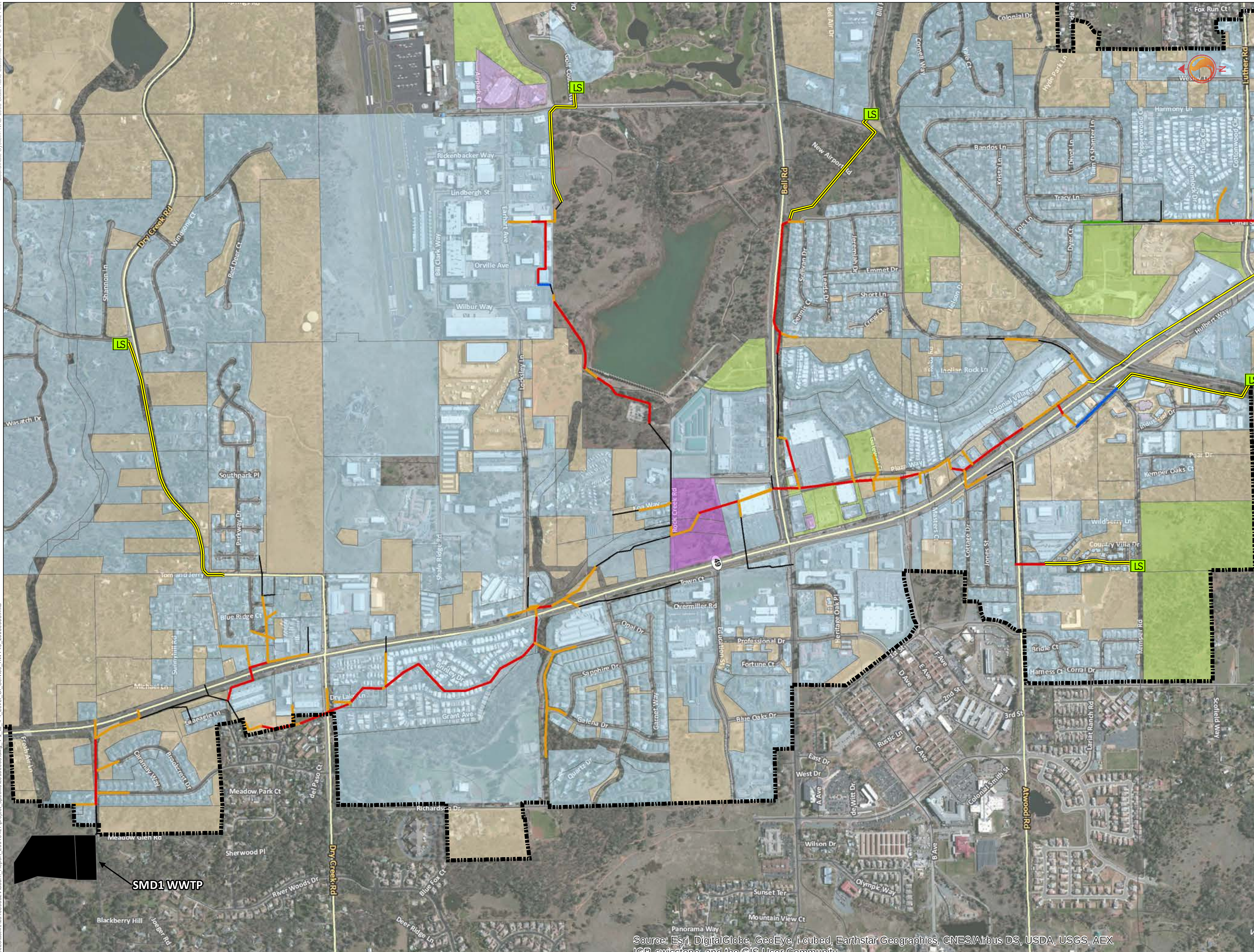
How the County chooses to address system deficiencies could affect the ultimate peak flow predicted at the WWTP. For example, if more system storage is provided, peak flow seen at the WWTP could potentially be lower than predicted here. It is Stantec's understanding that system storage in the form of surcharging is not considered by the County a viable option at this time.

To help identify the extent of surcharging within the existing network, HGL profiles have been included in **Appendix B**, which show the peak surcharge elevation along the Highway 49 Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: surcharging, reaching to surface at several manholes primarily along Plaza Way, is expected to occur along the entire length of this profile. The surcharging is primarily due to a severe capacity restraint along Plaza Way.

- **Figure B-3:** moderate surcharging (<3 feet) in the first manhole upstream of the proposed Auburn Creekside development. The predicted surcharging is greater than 1 feet and therefore does not meet the County's LOS criteria. Furthermore, all surcharging near Hwy 49 is expected to worsen, with surcharging to surface expected to occur. This is a result of a capacity constraint within the 24-inch sewer that is also present downstream beyond Dry Creek Road (shown in Figure B-4).

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- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Siphon
- Forcemain

**Scenario**

- Existing Catchments
- Existing Catchments w/ Entitled
- Entitled Catchments
- Auburn Creekside Development Lands
- Full Buildout Catchments
- SMD1 WWTP
- Hwy49 Buildout Boundary
- LS Lift Stations

**Note:** Sewers identified as "Throttled with allowable freeboard" have surcharged as a result of a localized capacity restraint, though the degree of surcharging meet the County's design standard. Sewers identified as "Throttled without allowable freeboard" have surcharged as a result of a localized capacity restraint and do not meet the County's design standard.

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
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**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Full Build-out**
**Level of Service**
**1:10 Year 24hr WWF**

Project No. 184030352

Scale 0 0.05 0.1 0.15 0.2 Miles

Figure No. **4-4**

Issue/Revision A/

- **Figure B-4**: severe surcharging is expected to occur along the entire 3100 linear feet profile. The surcharging is a result of highly insufficient capacity to handle the additional build-out flows.

- **Figure B-5**: moderate surcharging is expected to occur in approximately 650 linear feet of 24-inch sewer downstream of Dry Creek Road. This surcharging has a freeboard of less than 8 feet and therefore does not meet the County's LOS criteria. Furthermore, the surcharging that was identified under the Existing System conditions near Joeger Road is predicted to worsen. Approximately 1000 linear feet of sewer is expected to be surcharged along Hwy 49 and Joeger Road, just upstream (and east) of the SMD 1 WWTP.

# 5.0 Recommended Capital Improvement Projects

## 5.1 PURPOSE

The purpose of this chapter is to provide recommendations for capital improvements along the Highway 49 wastewater trunk sewer to provide sufficient capacity to eliminate all occurrences of surcharging that were predicted to occur during a 10-year, 24-hour design storm event. It is anticipated that the County will review and incorporate the recommended capital improvements into a Capital Improvement Plan (CIP) unless the County chooses to evaluate alternate servicing options not limited to upsizing of existing sections of trunk sewer. The scope of this study is limited to upsizing options. No alternative trunk alignments (parallel or otherwise) or pumping options have been considered. The model results for the ultimate build-out system during a 10-year, 24-hour storm event, detailed in Chapter 4, have been used as the basis for these capital improvement recommendations.

The *Highway 49 Trunk Sewer Capacity Evaluation Report* includes suggestions for the County to consider prior to implementing the recommended Highway 49 Trunk improvements predicted to be necessary to accommodate full build-out. The improvements described in the following sections represent only one of the possible alternatives to conveying flows from existing and future developments.

## 5.2 RECOMMENDED IMPROVEMENT TO EXISTING TRUNK SYSTEM TO ACCOMMODATE EXISTING AND NEAR-TERM (EXISTING + ENTITLED, EXISTING + ENTITLED + AUBURN CREEKSIDE) DEFICIENCIES

The results of the existing system, existing system + entitled development, and the existing system + entitled + Auburn Creekside development are the basis for the recommendation of upgrades to the existing Highway 49 trunk sewer presented in this section. Note that the results indicate throttling of the peak flow, and that upgrades to only the surcharged sewer may result in surcharging in sewers previously unaffected. Therefore, an upgrade scenario was modeled to identify all sewers along the Highway 49 trunk that require upgrades to produce a result that does not exceed the County's LOS criteria. A summary of the findings is presented in **Table 5-1**.

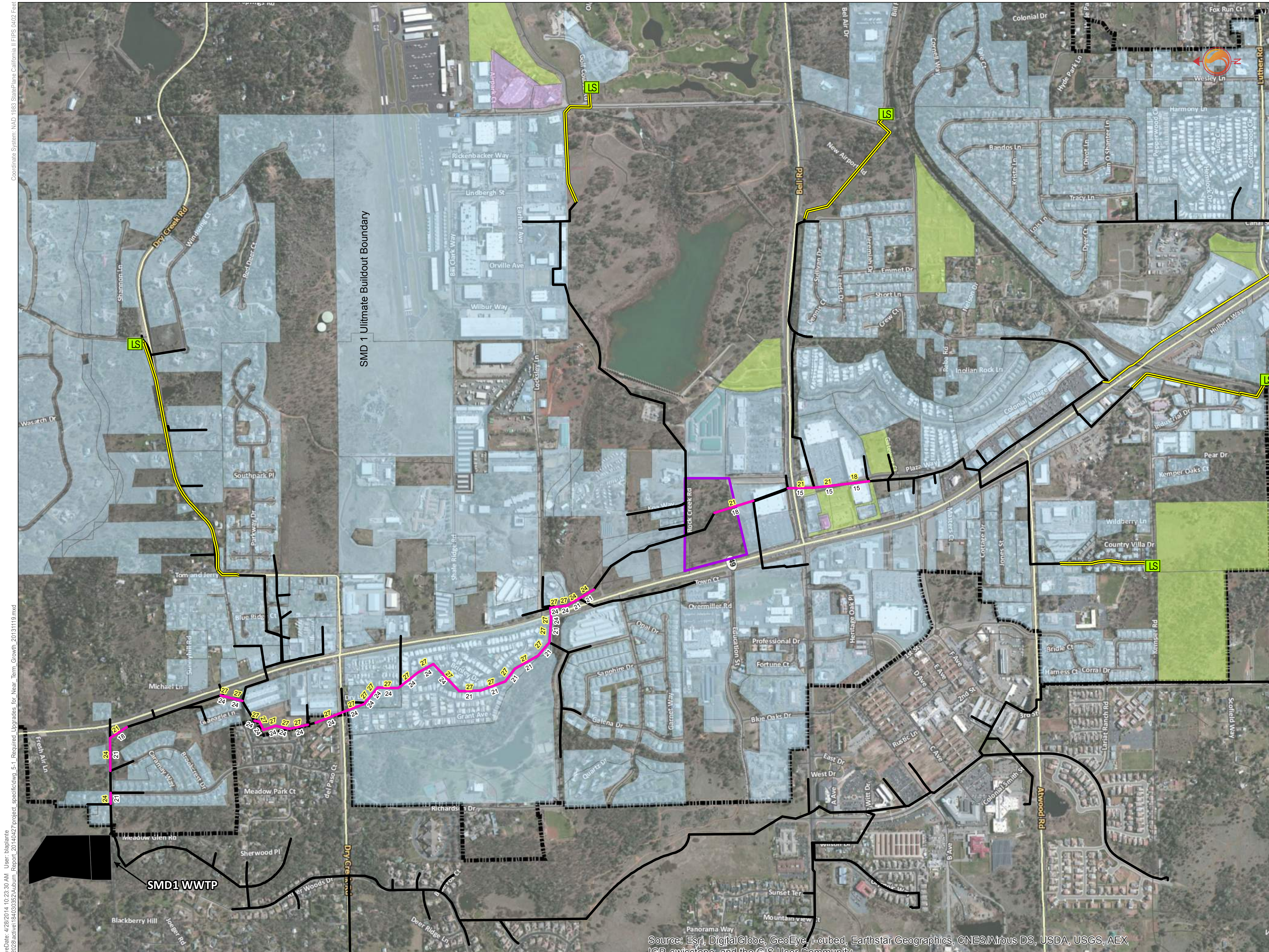
**Table 5-1 Recommended Sewer Upgrades For Near-Term Developments**

| Pipe Segment | | Existing Diameter, inches | Length of Sewer Upgrades, linear feet | Sizing for Existing System, inches (a) | Sizing for Existing + Entitled, inches | Sizing for Existing + Entitled + Auburn Creekside, inches |
|---|---|---|---|---|---|---|
| Upstream MH ID | Downstream MH ID | | | | | |
| AD4-04 | AD4-03 | 15 | 298 | 18 | 18 | 18 |
| AD4-03 | AD4-01 | 15 | 634 | 21 | 21 | 21 |
| AD3-03 | AD3-02 | 18 | 466 | 21 | 21 | 21 |
| AD3-13 | AE3-11 | 21 | 311 | 24 | 24 | 24 |
| AE3-10 | AE3-02 | 21 | 1819 | 27 | 27 | 27 |
| AE3-02 | AF3-09 | 24 | 1985 | 27 | 27 | 27 |
| AF3-81 | AF3-07 | 24 | 689 | 27 | 27 | 27 |
| AF3-06 | AF3-04 | 24 | 257 | 27 | 27 | 27 |
| AG3-04 | AG3-03 | 18 | 230 | 27 | 27 | 27 |
| AG3-03 | AG3-02 | 21 | 375 | 27 | 27 | 27 |
| AG3-14 | AG3-01 | 21 | 126 | 27 | 27 | 27 |
| AG2-26 | AG2-25 | 30 | 52 | 36 | 36 | 36 |

(a) Sizing for Existing System represents the sewer sizing (diameter) required to accommodate existing wastewater flows with no deficiency predicted by the model simulation(s), while maintaining the County requirement that no sewer installed downstream shall be of smaller diameter than sewer installed upstream.

**Figure 5-1** shows, in plan view, the sewers that are recommended to be upgraded for the near-term growth scenarios.

**Figures B-6** through **B-9** in Appendix B show the impact of the improvements upon the existing system as HGL profiles. **Figures B-10** through **B-13** show the impact of the improvements upon the existing system with entitled projects. **Figure B-1** in Appendix B provides a keyplan for the specified profiles.

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Legend

**Scenario**

- Existing Catchments
- Existing Catchments w/ Entitled
- Entitled Catchments
- Auburn Creekside Development Lands
- Siphon
- Forcemain
- Existing Required Upgrades
- Existing System
- Near Term Required Upgrades
- Hwy49 Buildout Boundary
- SMD1 WWTP
- LS Lift Stations
- 27 Recommended Upgrade Diameter
- 24 Existing Pipe Diameter

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
North Auburn, Placer County

Title

**Highway 49 Required Upgrades For Existing, Entitled and Auburn Creekside Developments**

| Project No. | Scale |
| --- | --- |
| 184030352 | 0 0.05 0.1 0.15 0.2 Miles |

| Figure No. | Issue/Revision |
| --- | --- |
| 5-1 | A/ |

## 5.3 RECOMMENDED IMPROVEMENTS TO EXISTING TRUNK SYSTEM TO ACCOMMODATE ULTIMATE BUILD-OUT OF SYSTEM

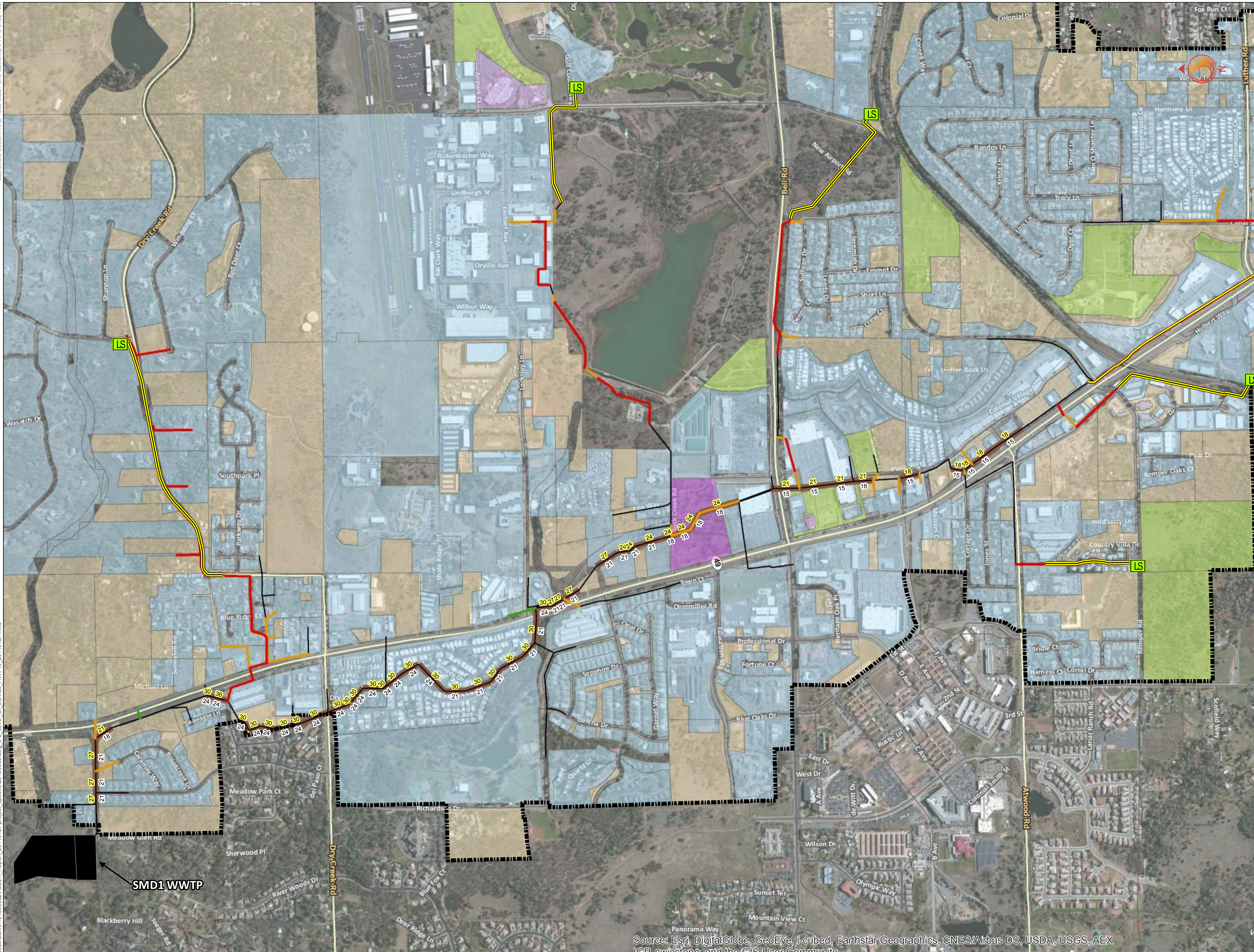
The results of the ultimate build-out analysis were the basis for the recommendation of upgrades to the existing Highway 49 trunk sewer. Note that the results indicate significant throttling of the peak flow, and that upgrades to only the surcharged sewer may result in surcharging in sewers previously unaffected. Therefore, an upgrade scenario was modeled to identify all sewers along the Highway 49 trunk that require upgrades. A summary of the findings is presented in **Table 5-2**. Note that there are pipe size differences between **Table 5-2** and **Table 5-1** which represent different spans requiring different pipe sizes to accommodate differing hydraulic conditions. Appendix D provides a combined version of Tables 5-1 and 5-2.

### Table 5-2 Recommended Sewer Upgrades For Full-Buildout

| Pipe Segment | | Existing Diameter, inches | Length of Sewer Upgrades, linear feet | Sizing for Full Build-out, inches |
|---|---|---|---|---|
| Upstream MH ID | Downstream MH ID | | | |
| AD4-30 | AD4-53 | 15 | 966 | 18 |
| AD4-07 | AD4-06 | 15 | 240 | 18 |
| AD4-05 | AD4-04 | 18 | 216 | 21 |
| AD4-04 | AD4-01 | 15 | 932 | 21 |
| AD3-03 | AE3-18 | 18 | 1003 | 24 |
| AE3-15 | AE3-10 | 21 | 979 | 27 |
| AE3-10 | AE3-08 | 24 | 307 | 30 |
| AE3-08 | AE3-02 | 21 | 1513 | 30 |
| AE3-02 | AF3-04 | 24 | 3286 | 30 |
| AG3-04 | AG3-03 | 18 | 230 | 30 |
| AG3-03 | AG3-01 | 21 | 750 | 30 |
| AG2-26 | AG2-25 | 30 | 52 | 36 |

**Figure 5-2** shows the results of the capacity assessment post-completion of the capital improvements and identify in plan view the sewers that are recommended to be upgraded.

**Figures B-14** through **B-17** in Appendix B show the impact of the improvements as HGL profiles. **Figure B-1** in Appendix B provides a keyplan for the specified profiles.





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Legend

- Siphon
- Forcemain
- Recommended Sewers to Upgrade

Scenario

- Existing Catchments
- Existing Catchments w/ Entitled
- Entitled Catchments
- Auburn Creekside Development Lands
- Full Buildout Catchments
- SMD1 WWTP
- Hwy49 Buildout Boundary
- 27 Recommended Upgrade Diameter
- 24 Existing Pipe Diameter

**Note:** The existing pipe alignment across the Auburn Creekside project will remain in place for the foreseeable future until a connection is made to the new 24-inch pipe to be constructed across the project frontage. That new frontage alignment and proposed future connection across the Target project is shown in Figure C-1, Appendix C of this report. The purpose for showing the existing pipe alignment upsized is to allow an evaluation of the necessary downstream upsizing (and possible reduced upstream backwatering) when a new connection is ultimately made across the Target parking lot.

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
North Auburn, Placer County

Title

**Full Build-out With Upgrades**
**Level of Service**
**1:10 Year 24hr WWF**

Project No. 184030352

Scale 0 0.05 0.1 0.15 0.2 Miles

Figure No. 5-2

Issue/Revision A/

It should be noted that, recommendations for lift stations, etc. were not included in the scope of this evaluation. As discussed in Section 4.3.4, many of the lift stations were identified as potentially having insufficient capacity. It is recommended that the capacity of the lift stations be assessed to supplement this trunk evaluation.

As discussed in the preceding sections, reducing the throttling of flow in the Highway 49 trunk sewer will increase the peak flow in the system. Accordingly, it is recommended that the capacity of the WWTP and the proposed Regional Sewer Project pump station to be located there be reviewed, and upgrades to proceed as required. To assist with the planning, **Table 5-3** provides a summary of the ADWF, PDWF and PWWF that the WWTP is predicted to experience before and after the system upgrades.

**Table 5-3 WWTP Flow Summary - Build-out Conditions Pre/Post Capital Improvements**

| | Average DWF [mgd] | Peak DWF [mgd] | Peak WWF [mgd] |
|---|---|---|---|
| **Ultimate Build-out** | 3.986 | 6.358 | 13.684 |
| **Ultimate Build-out With Capital Improvements** | 3.986 | 6.358 | 18.719 |

## 5.4 AUBURN CREEKSIDE PROJECT SPECIFIC IMPACTS TO HIGHWAY 49 TRUNK

Based on the information presented in Chapter 4 of this report and in the *Highway 49 Trunk Sewer Capacity Evaluation Report* (December 2013, Stantec), the impact of the proposed Auburn Creekside project on the Highway 49 Trunk is minimal. Analysis of the results of model simulations suggests that the upsizing necessary to address existing deficiencies would also be sufficient to provide capacity for wastewater generated by the Auburn Creekside project.

Analysis of the results of the Existing + Entitled Developments + Auburn Creekside simulations reveal that upsizing necessary to accommodate proposed development on the Highway 49 Trunk would also be sufficient to provide capacity for the Auburn Creekside project. Chapter 4 of this report identifies limited impacts (0.1 to 0.2 feet increase in select HGLs) resulting from addition of the Auburn Creekside project.

It is Stantec's understanding that Placer County Facility Services wishes to address relative impacts of projects connecting to the Highway 49 Trunk in the context of the trunk sizing suggested by the *Highway 49 Trunk Sewer Capacity Evaluation Report* necessary to accommodate full build-out of the SMD 1 service area. As such, it would appear that impact of the Auburn Creekside on the Highway 49 Trunk could be expressed as the proportional share of the project of the cost of trunk upsizing necessary downstream of the project to provide capacity for full service area buildout.

This leads to the conclusion that the Auburn Creekside "share" of these improvements can be described as the pipe upsizing necessary to bring the downstream trunk diameters with Sizing for Existing System presented in Table 5-1 up to the diameter identified in Table 5-2. For example, the pipe segment AD3-03 through AE3-18 shows that the existing system requires an 18-in sewer (Table 5-1) and the ultimate build-out requires a 24-in sewer (Table 5-2). The incremental cost to buy and install a 21-in pipe segment versus a 24-in pipe segment would be added towards the total costs of building the other segments and then divided up by Auburn Creekside and other future projects. If the proposed Auburn Creekside project representing 32 EDUs of needed capacity is compared to the total number of future build-out EDUs utilizing capacity in the various trunk segments downstream, a percentage of the expected cost for those improvements can be estimated. That estimate would be based on the share of 32 out of 7,646 future EDUs (7,646 = 14,059 (Table 2-2) – 6,413 (Table 2-1)), or 0.4% of the cost of build-out improvements downstream of the project site.

**Table 5-4** summarizes the relative share of the capacity increase recommended in Table 5-2 attributable to the Auburn Creekside project.

**Table 5-4 Relative Growth Increase**

| | Total Acreage (Acres) | Total Population (EDUs) | Relative Increase in Growth (EDUs) | % of Total Growth |
|---|---|---|---|---|
| **Highway 49 Existing Developments** | 2,740 | 6,413 | - | - |
| **Entitled Projects Only** | 150 | 412 | 412 | 5.4 |
| **Auburn Creekside Only** | 14 | 32 | 32 | 0.4 |
| **Full Build-out (Highway 49 Developments Only)** | 10,361 | 14,059 | 7,646 | 100 |

### 5.4.1 Auburn Creekside Frontage Improvements

As discussed within Section 4.3.3, Auburn Creekside and the County have (subsequent to the time of this analysis) agreed upon an alignment for trunk sewer frontage improvements that would accommodate sewer flows through the Auburn Creekside property. A plan-view alignment has been drafted by Morton & Pitallo and included within Appendix C.

The agreed-upon alignment would consist of a 24-inch sewer that would connect to manhole AD4-01 (south of Target) and divert flow to the north along the west side of the Target and Auburn Creekside properties, and to reconnect to the existing Highway 49 Trunk sewer at Rock Creek Road. As per the requirements of the County, the Auburn Creekside development will include the construction of the 24-inch sewer within the Auburn Creekside property, and will remain capped at the upstream side until such time that the 24-inch diversion in the Target property is constructed. Until such time, the existing 18-inch sewer within the Auburn Creekside property will continue to convey flow from upstream sewersheds.

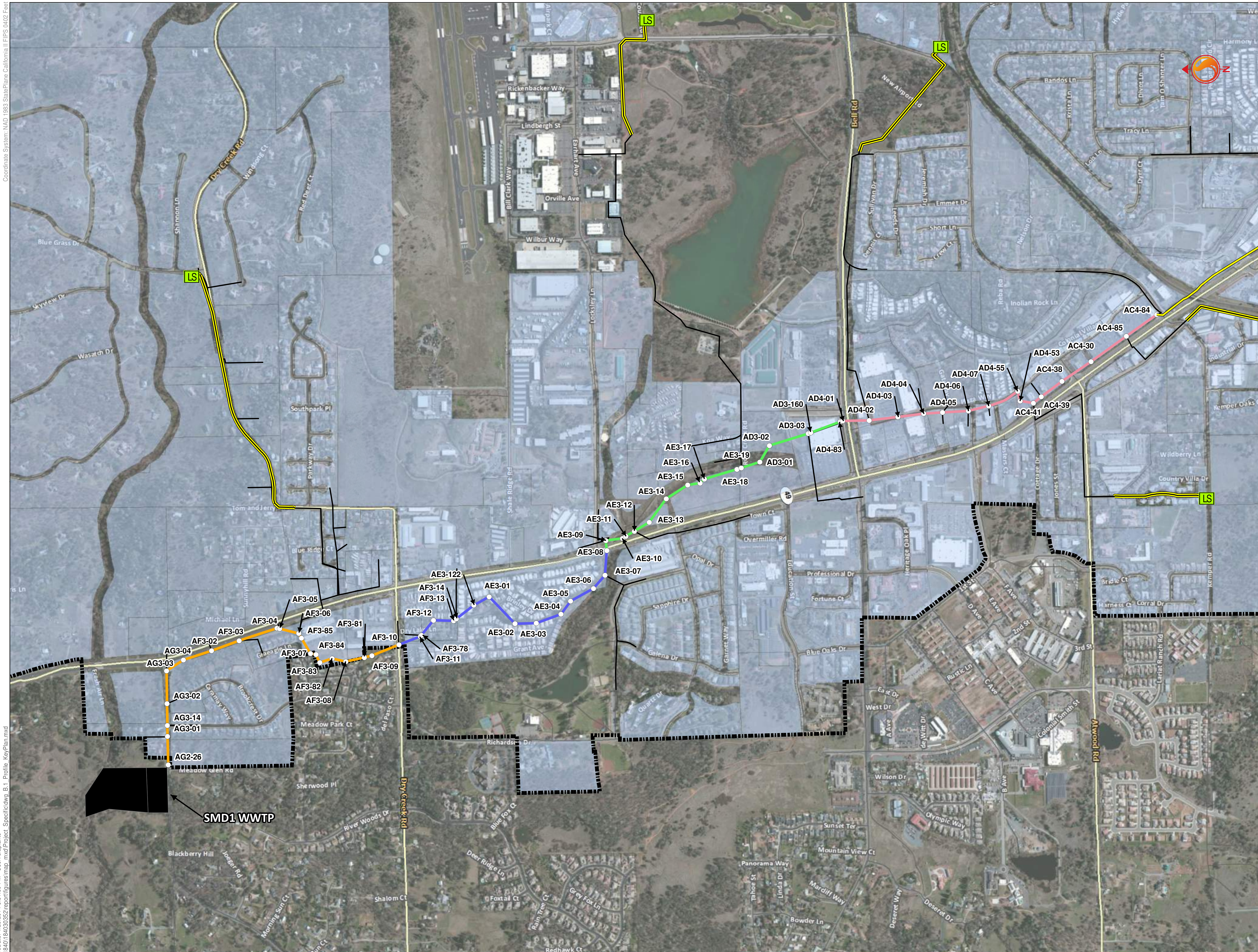
# Appendix A Highway 49 Entitled Projects

Note that all APNs which contribute to existing flow in the Highway 49 sewershed are provided on a CD that is attached to the back cover of the original hard copies of this report provided to Placer County staff.

| Pt No. | Northing | Easting | Rim Elevation | Invert Elevation | Description |
|---|---|---|---|---|---|
| | | | | | |
| **50101** | 2106345.049 | 6819125.433 | 1373.7 | 1353.85 | AD4-01 |
| **50102** | 2106374.199 | 6819113.323 | 1368.81 | - | AD4-83 |
| **50103** | 2106376.291 | 6819106.782 | 1369.31 | - | AD4-84 |
| **50104** | 2106789.983 | 6818978.393 | 1368.41 | 1349.96 | AD3-160 |
| **50105** | 2106797.262 | 6818983.304 | 1368.33 | 1351.75 | AD3-03 |
| **50106** | 2107193.799 | 6818859.038 | 1357.08 | 1349.65 | AD3-02 |
| **50107** | 2107299.918 | 6818675.596 | 1352.43 | 1344.16 | AD3-01 |
| **50110** | 2107934.86 | 6818482.381 | 1346.29 | 1337.27 | AE3-17 |
| **50111** | 2107986.277 | 6818447.027 | 1342.82 | 1335.54 | AE3-16 |
| **50112** | 2108131.866 | 6818408.308 | 1340.78 | 1333.57 | AE3-15 |
| **50113** | 2108383.666 | 6818247.396 | 1338.94 | 1332.94 | AE3-14 |
| **50114** | 2108573.804 | 6817974.236 | 1336.9 | 1329.20 | AE3-13 x w rim |
| **50115** | 2108745.234 | 6817870.398 | 1335.68 | 1326.88 | AE3-12 |
| **50116** | 2108836.14 | 6817814.286 | 1332.54 | 1324.015 | AE3-11 |
| **50117** | 2108879.334 | 6817790.425 | 1331.47 | 1323.495 | AE3-10 |
| **50118** | 2109067.086 | 6817746.555 | 1333.6 | 1323.36 | AE3-09 |
| **50119** | 2109067.717 | 6817603.754 | 1328.71 | 1322.97 | AE3-08 |
| **50122** | 2109098.698 | 6817375.547 | 1329.22 | 1322.74 | AE3-07 |
| **50123** | 2109241.08 | 6817239.892 | 1328.9 | 1322.45 | AE3-06 |
| **50128** | 2111148.423 | 6816736.791 | 1324.79 | 1318.81 | AF3-78 |
| **50130** | 2111458.26 | 6816541.814 | 1322.58 | 1318.26 | AF3-10 |
| **50133** | 2111765.647 | 6816435.501 | 1322.42 | 1317.63 | AF3-09 |
| **50134** | 2111839.497 | 6816420.441 | 1322.44 | 1317.37 | AF3-81 |
| **50135** | 2112055.364 | 6816371.5 | 1322.52 | 1317.13 | AF3-08 |
| **50136** | 2112211.924 | 6816409.311 | 1324.18 | 1317.04 | AF3-82 |
| **50137** | 2112347.85 | 6816361.54 | 1322.93 | 1316.58 | AF3-83 |
| **50138** | 2112390.284 | 6816452.724 | 1327.77 | 1316.58 | AF3-84 |
| **50142** | 2114068.656 | 6815171.123 | 1218.42 | 1211.12 | AG2-26 |
| **50143** | 2114076.339 | 6815497.472 | 1240.85 | 1231.59 | AG3-01 |
| **50144** | 2114080.981 | 6815647.14 | 1244.91 | 1232.41 | AG3-14 |
| **50145** | 2114090.366 | 6815929.064 | 1245.66 | 1233.94 | AG3-02 |
| **50146** | 2114100.277 | 6816241.966 | 1247.71 | 1236.14 | AG3-03 |
| **50147** | 2113896.49 | 6816418.107 | 1262.36 | 1242.26 | AG3-04 |
| **50148** | 2113577.405 | 6816528.206 | 1283.24 | 1265.98 | AF3-02 |
| **50149** | 2113245.316 | 6816641.331 | 1307.72 | 1290.83 | AF3-03 |
| **50150** | 2112924.581 | 6816750.415 | 1324.66 | 1316.16 | AF3-04 |
| **50151** | 2112873.338 | 6816743.268 | 1321.89 | 1316.66 | AF3-05 |
| | | | | | |

No manhole dip information was provided for manholes AD4-83 and AD4-84.

# Appendix B Hydraulic Gradeline Profiles




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

SaveDate: 4/29/2014 3:31:30 PM User: blaplante
V:\1840\184030352\report\figures\map_mxd\Project_Specific\dwg_B.1_Profile_KeyPlan.mxd

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Legend

- No Profile
- HGL Profile 1
- HGL Profile 2
- HGL Profile 3
- HGL Profile 4
- Siphon
- Forcemain
- SMD1 WWTP
- Hwy49 Buildout Boundary
- LS Lift Stations

Client/Project

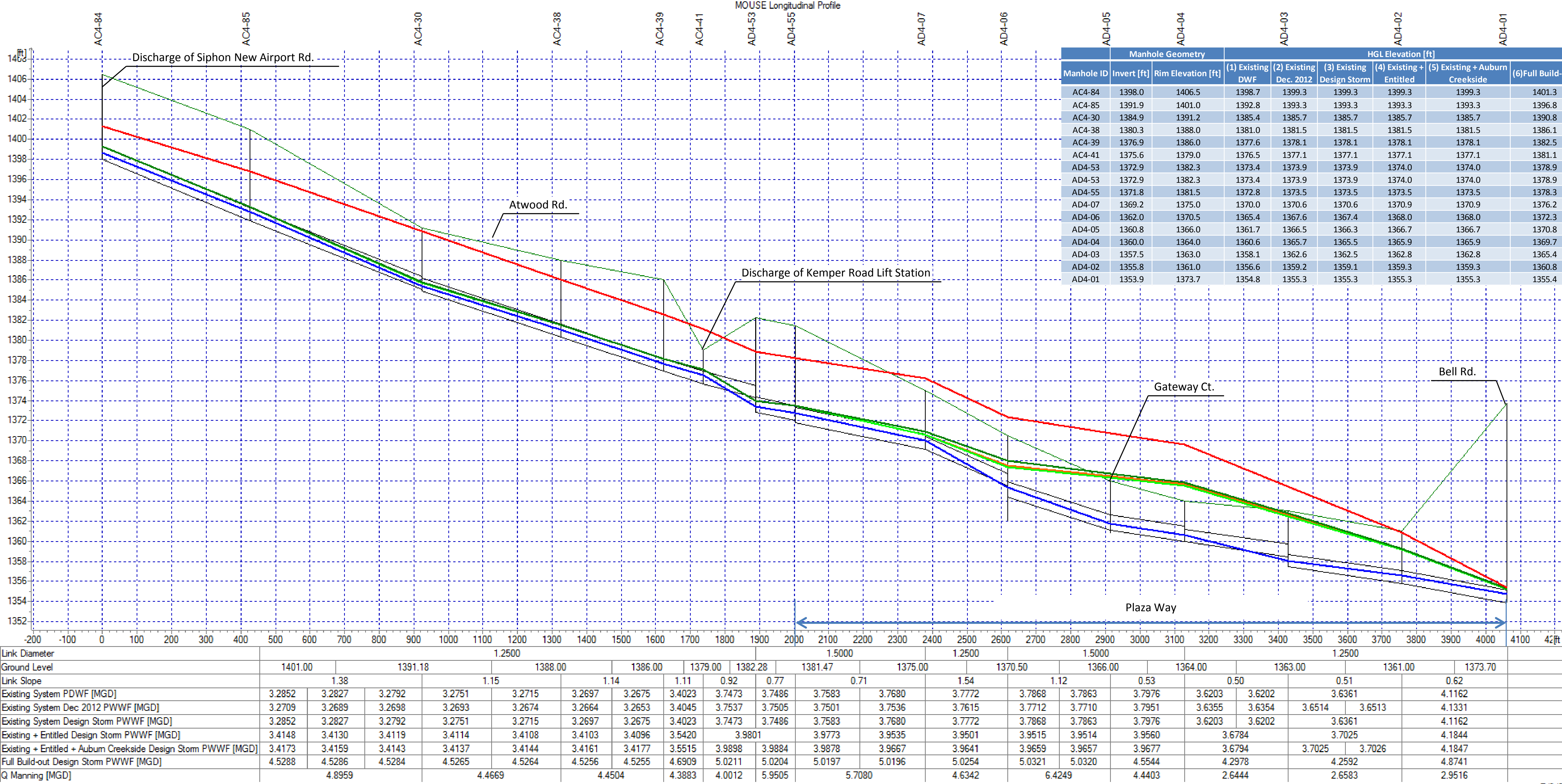
**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
North Auburn, Placer County

Title

**HGL Profile Key Plan**

| Project No. | Scale |
| --- | --- |
| 184030352 | 0 0.1 0.2 Miles |

| Figure No. | Issue/Revision |
| --- | --- |
| B-1 | A/ |




| | Manhole Geometry | | HGL Elevation [ft] | | | | | |
|---|---|---|---|---|---|---|---|---|
| Manhole ID | Invert [ft] | Rim Elevation [ft] | (1) Existing DWF | (2) Existing Dec. 2012 | (3) Existing Design Storm | (4) Existing + Entitled | (5) Existing + Auburn Creekside | (6)Full Build-out |
| AC4-84 | 1398.0 | 1406.5 | 1398.7 | 1399.3 | 1399.3 | 1399.3 | 1399.3 | 1401.3 |
| AC4-85 | 1391.9 | 1401.0 | 1392.8 | 1393.3 | 1393.3 | 1393.3 | 1393.3 | 1396.8 |
| AC4-30 | 1384.9 | 1391.2 | 1385.4 | 1385.7 | 1385.7 | 1385.7 | 1385.7 | 1390.8 |
| AC4-38 | 1380.3 | 1388.0 | 1381.0 | 1381.5 | 1381.5 | 1381.5 | 1381.5 | 1386.1 |
| AC4-39 | 1376.9 | 1386.0 | 1377.6 | 1378.1 | 1378.1 | 1378.1 | 1378.1 | 1382.5 |
| AC4-41 | 1375.6 | 1379.0 | 1376.5 | 1377.1 | 1377.1 | 1377.1 | 1377.1 | 1381.1 |
| AD4-53 | 1372.9 | 1382.3 | 1373.4 | 1373.9 | 1373.9 | 1374.0 | 1374.0 | 1378.9 |
| AD4-53 | 1372.9 | 1382.3 | 1373.4 | 1373.9 | 1373.9 | 1374.0 | 1374.0 | 1378.9 |
| AD4-55 | 1371.8 | 1381.5 | 1372.8 | 1373.5 | 1373.5 | 1373.5 | 1373.5 | 1378.3 |
| AD4-07 | 1369.2 | 1375.0 | 1370.0 | 1370.6 | 1370.6 | 1370.9 | 1370.9 | 1376.2 |
| AD4-06 | 1362.0 | 1370.5 | 1365.4 | 1367.6 | 1367.4 | 1368.0 | 1368.0 | 1372.3 |
| AD4-05 | 1360.8 | 1366.0 | 1361.7 | 1366.5 | 1366.3 | 1366.7 | 1366.7 | 1370.8 |
| AD4-04 | 1360.0 | 1364.0 | 1360.6 | 1365.7 | 1365.5 | 1365.9 | 1365.9 | 1369.7 |
| AD4-03 | 1357.5 | 1363.0 | 1358.1 | 1362.6 | 1362.5 | 1362.8 | 1362.8 | 1365.4 |
| AD4-02 | 1355.8 | 1361.0 | 1356.6 | 1359.2 | 1359.1 | 1359.3 | 1359.3 | 1360.8 |
| AD4-01 | 1353.9 | 1373.7 | 1354.8 | 1355.3 | 1355.3 | 1355.3 | 1355.3 | 1355.4 |

Existing System DWF HGL
Existing System Dec 2012 HGL
Existing System Design Storm HGL
Existing + Entitled Design Storm HGL
Existing + Entitled + Auburn Creekside Design Storm HGL
Full Build-out Design Storm HGL

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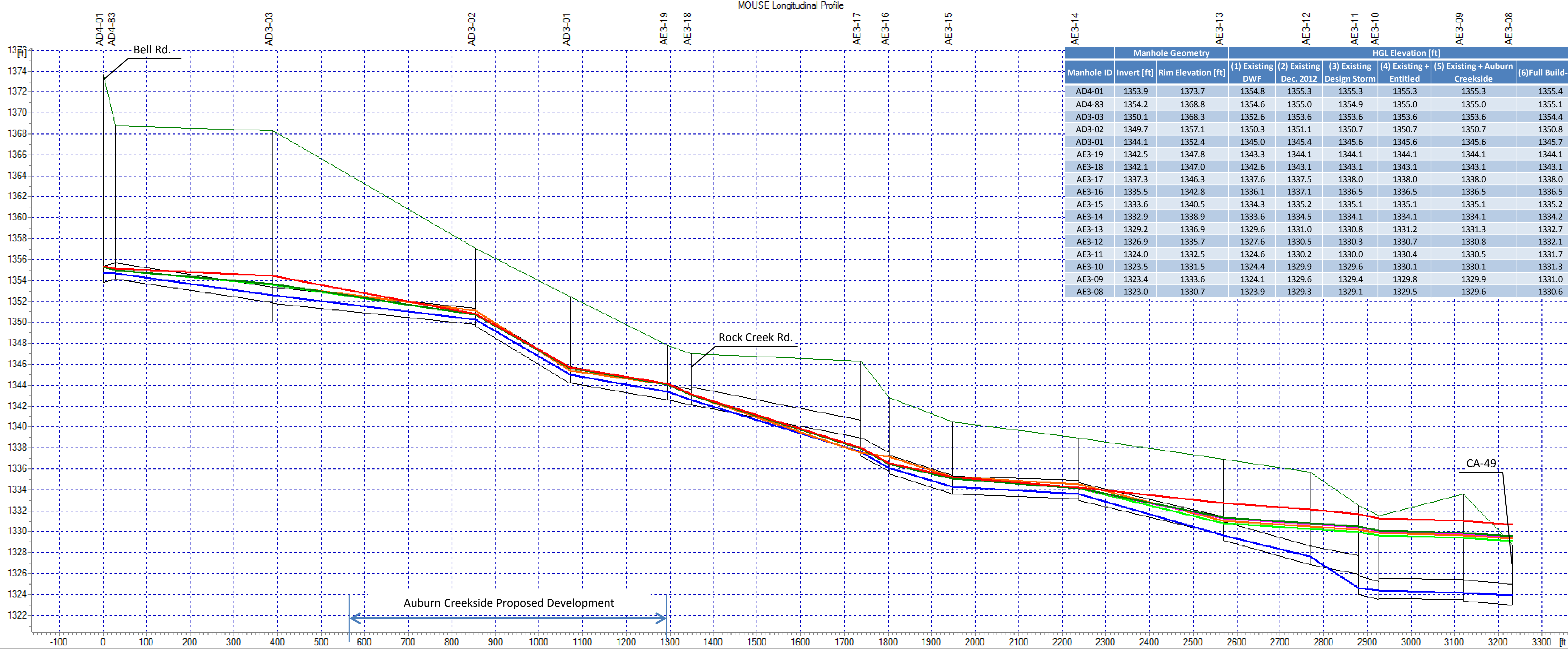
Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-2

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 1




| | Manhole Geometry | | HGL Elevation [ft] | | | | | |
|---|---|---|---|---|---|---|---|---|
| Manhole ID | Invert [ft] | Rim Elevation [ft] | (1) Existing DWF | (2) Existing Dec. 2012 | (3) Existing Design Storm | (4) Existing + Entitled | (5) Existing + Auburn Creekside | (6)Full Build-out |
| AD4-01 | 1353.9 | 1373.7 | 1354.8 | 1355.3 | 1355.3 | 1355.3 | 1355.3 | 1355.4 |
| AD4-83 | 1354.2 | 1368.8 | 1354.6 | 1355.0 | 1354.9 | 1355.0 | 1355.0 | 1355.1 |
| AD3-03 | 1350.1 | 1368.3 | 1352.6 | 1353.6 | 1353.6 | 1353.6 | 1353.6 | 1354.4 |
| AD3-02 | 1349.7 | 1357.1 | 1350.3 | 1351.1 | 1350.7 | 1350.7 | 1350.7 | 1350.8 |
| AD3-01 | 1344.1 | 1352.4 | 1345.0 | 1345.4 | 1345.6 | 1345.6 | 1345.6 | 1345.7 |
| AE3-19 | 1342.5 | 1347.8 | 1343.3 | 1344.1 | 1344.1 | 1344.1 | 1344.1 | 1344.1 |
| AE3-18 | 1342.1 | 1347.0 | 1342.6 | 1343.1 | 1343.1 | 1343.1 | 1343.1 | 1343.1 |
| AE3-17 | 1337.3 | 1346.3 | 1337.6 | 1337.5 | 1338.0 | 1338.0 | 1338.0 | 1338.0 |
| AE3-16 | 1335.5 | 1342.8 | 1336.1 | 1337.1 | 1336.5 | 1336.5 | 1336.5 | 1336.5 |
| AE3-15 | 1333.6 | 1340.5 | 1334.3 | 1335.2 | 1335.1 | 1335.1 | 1335.1 | 1335.2 |
| AE3-14 | 1332.9 | 1338.9 | 1333.6 | 1334.5 | 1334.1 | 1334.1 | 1334.1 | 1334.2 |
| AE3-13 | 1329.2 | 1336.9 | 1329.6 | 1331.0 | 1330.8 | 1331.2 | 1331.3 | 1332.7 |
| AE3-12 | 1326.9 | 1335.7 | 1327.6 | 1330.5 | 1330.3 | 1330.7 | 1330.8 | 1332.1 |
| AE3-11 | 1324.0 | 1332.5 | 1324.6 | 1330.2 | 1330.0 | 1330.4 | 1330.5 | 1331.7 |
| AE3-10 | 1323.5 | 1331.5 | 1324.4 | 1329.9 | 1329.6 | 1330.1 | 1330.1 | 1331.3 |
| AE3-09 | 1323.4 | 1333.6 | 1324.1 | 1329.6 | 1329.4 | 1329.8 | 1329.9 | 1331.0 |
| AE3-08 | 1323.0 | 1330.7 | 1323.9 | 1329.3 | 1329.1 | 1329.5 | 1329.6 | 1330.6 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter | 1.5000 | 1.7500 | 2.0000 | | | | | | | | | | | | | | | | |
| Ground Level | 1368.33 | 1357.08 | 1352.43 | 1347.75 | 1347.00 | 1346.29 | 1342.82 | 1340.48 | 1338.94 | 1336.90 | 1335.68 | 1332.54 | 1331.47 | 1333.60 | ......... | | | | |
| Link Slope | .... | 0.98 | 0.85 | 0.82 | 2.22 | 1.34 | 0.15 | 0.98 | 1.17 | 0.84 | 1.14 | 0.04 | 0.31 | | | | | | |
| Existing System PDWF [MGD] | .... | 4.3026 | 4.3025 | ......... | 5.0091 | 5.0092 | 5.0431 | 5.0432 | 5.0429 | 5.0410 | 5.0518 | 5.2740 | ....... | 5.2761 | 5.4690 | | | | |
| Existing System Dec 2012 PWWF [MGD] | .... | 4.3272 | 4.3271 | 4.3273 | 4.3275 | ......... | 5.0094 | 5.0096 | 5.0445 | 5.0444 | 5.0418 | 5.0415 | 5.0413 | 5.0460 | 5.0474 | 5.2954 | ....... | 5.2958 | 5.4929 |
| Existing System Design Storm PWWF [MGD] | .... | 4.3026 | 4.3025 | ......... | 5.0091 | 5.0092 | 5.0431 | 5.0432 | 5.0429 | 5.0410 | 5.0518 | 5.2740 | ....... | 5.2761 | 5.4690 | | | | |
| Existing + Entitled Design Storm PWWF [MGD] | .... | 4.3857 | 4.3856 | 4.3855 | 5.1001 | 5.1342 | 5.1343 | 5.1340 | 5.1318 | 5.1425 | 5.3685 | ....... | 5.3703 | 5.5674 | | | | | |
| Existing + Entitled + Auburn Creekside Design Storm PWWF [MGD] | .... | 4.3861 | 4.3860 | 4.3859 | ......... | 5.1241 | 5.1583 | 5.1584 | 5.1585 | 5.1580 | 5.1549 | 5.1655 | 5.3895 | ....... | 5.3912 | 5.5878 | | | |
| Full Build-out Design Storm PWWF [MGD] | .... | 4.9870 | 4.9878 | 4.9887 | 4.9889 | 5.6165 | 5.6451 | 5.6450 | 5.6449 | 5.6430 | 5.6428 | 5.8386 | ....... | 5.8343 | 6.1606 | | | | |
| Q Manning [MGD] | .... | 3.9951 | 10.7889 | 5.2694 | ......... | 9.2549 | ......... | 11.8364 | 3.9324 | 10.1185 | 11.0510 | 9.3801 | ....... | 2.9765 | 8.0859 | | | | |

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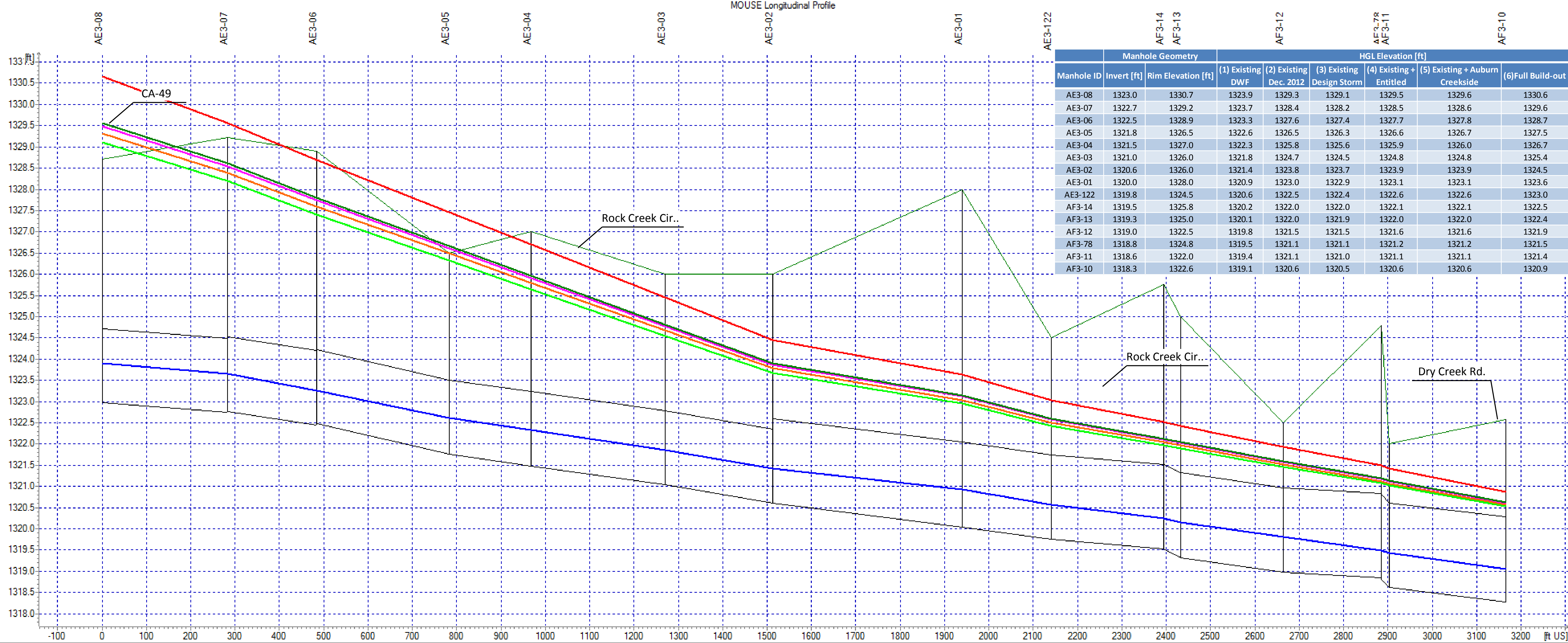
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Entitled Design Storm HGL
- Existing + Entitled + Auburn Creekside Design Storm HGL
- Full Build-out Design Storm HGL

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-3

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 2

MOUSE Longitudinal Profile




| | Manhole Geometry | | HGL Elevation [ft] | | | | | |
|---|---|---|---|---|---|---|---|---|
| Manhole ID | Invert [ft] | Rim Elevation [ft] | (1) Existing DWF | (2) Existing Dec. 2012 | (3) Existing Design Storm | (4) Existing + Entitled | (5) Existing + Auburn Creekside | (6)Full Build-out |
| AE3-08 | 1323.0 | 1330.7 | 1323.9 | 1329.3 | 1329.1 | 1329.5 | 1329.6 | 1330.6 |
| AE3-07 | 1322.7 | 1329.2 | 1323.7 | 1328.4 | 1328.2 | 1328.5 | 1328.6 | 1329.6 |
| AE3-06 | 1322.5 | 1328.9 | 1323.3 | 1327.6 | 1327.4 | 1327.7 | 1327.8 | 1328.7 |
| AE3-05 | 1321.8 | 1326.5 | 1322.6 | 1326.5 | 1326.3 | 1326.6 | 1326.7 | 1327.5 |
| AE3-04 | 1321.5 | 1327.0 | 1322.3 | 1325.8 | 1325.6 | 1325.9 | 1326.0 | 1326.7 |
| AE3-03 | 1321.0 | 1326.0 | 1321.8 | 1324.7 | 1324.5 | 1324.8 | 1324.8 | 1325.4 |
| AE3-02 | 1320.6 | 1326.0 | 1321.4 | 1323.8 | 1323.7 | 1323.9 | 1323.9 | 1324.5 |
| AE3-01 | 1320.0 | 1328.0 | 1320.9 | 1323.0 | 1322.9 | 1323.1 | 1323.1 | 1323.6 |
| AE3-122 | 1319.8 | 1324.5 | 1320.6 | 1322.5 | 1322.4 | 1322.6 | 1322.6 | 1323.0 |
| AF3-14 | 1319.5 | 1325.8 | 1320.2 | 1322.0 | 1322.0 | 1322.1 | 1322.1 | 1322.5 |
| AF3-13 | 1319.3 | 1325.0 | 1320.1 | 1322.0 | 1321.9 | 1322.0 | 1322.0 | 1322.4 |
| AF3-12 | 1319.0 | 1322.5 | 1319.8 | 1321.5 | 1321.5 | 1321.6 | 1321.6 | 1321.9 |
| AF3-78 | 1318.8 | 1324.8 | 1319.5 | 1321.1 | 1321.1 | 1321.2 | 1321.2 | 1321.5 |
| AF3-11 | 1318.6 | 1322.0 | 1319.4 | 1321.1 | 1321.0 | 1321.1 | 1321.1 | 1321.4 |
| AF3-10 | 1318.3 | 1322.6 | 1319.1 | 1320.6 | 1320.5 | 1320.6 | 1320.6 | 1320.9 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter | 1.7500 | 2.0000 | | | | | | | | | | | |
| Ground Level | ..... | 1328.90 | 1326.50 | 1327.00 | 1326.00 | 1328.00 | 1324.50 | 1325.75 | 1325.00 | 1322.50 | 1324.79 | 1322.00 | 1322.58 |
| Link Slope | 0.16 | 0.24 | 0.15 | 0.18 | 0.13 | 0.14 | 0.09 | ...... | 0.15 | 0.06 | ... | 0.13 | |
| Existing System PDWF [MGD] | 5.8946 | 6.0341 | 6.0340 | 6.0329 | 6.0326 | 6.0323 | 6.0320 | 6.0317 | ...... | 6.0748 | 6.1068 | ... | 6.1113 |
| Existing System Dec 2012 PWWF [MGD] | 5.9554 | 6.1021 | 6.1019 | 6.0984 | 6.0986 | 6.0987 | 6.0989 | 6.0991 | 6.0993 | 6.0995 | ...... | 6.1441 | 6.1773 |
| | ... | 6.1827 | | | | | | | | | | | |
| Existing System Design Storm PWWF [MGD] | 5.8946 | 6.0341 | 6.0340 | 6.0329 | 6.0326 | 6.0323 | 6.0320 | 6.0317 | ...... | 6.0748 | 6.1068 | ... | 6.1113 |
| Existing + Entitled Design Storm PWWF [MGD] | 5.9984 | 6.1423 | 6.1422 | 6.1390 | 6.1391 | 6.1392 | 6.1828 | 6.2150 | 6.2197 | | | | |
| Existing + Entitled + Auburn Creekside Design Storm PWWF [MGD] | 6.0184 | 6.1609 | 6.1608 | 6.1581 | 6.1580 | 6.1579 | 6.1578 | 6.2013 | 6.2334 | 6.2380 | | | |
| Full Build-out Design Storm PWWF [MGD] | 6.2726 | 6.4312 | 6.4297 | 6.4301 | 6.4304 | 6.4306 | 6.4308 | 6.4311 | 6.4946 | 6.5289 | 6.5341 | | |
| Q Manning [MGD] | 4.0811 | 5.0233 | 3.9770 | 3.9082 | 4.3556 | 5.2889 | 4.9752 | 4.3923 | ...... | 5.6860 | 3.8350 | ... | 5.1802 |

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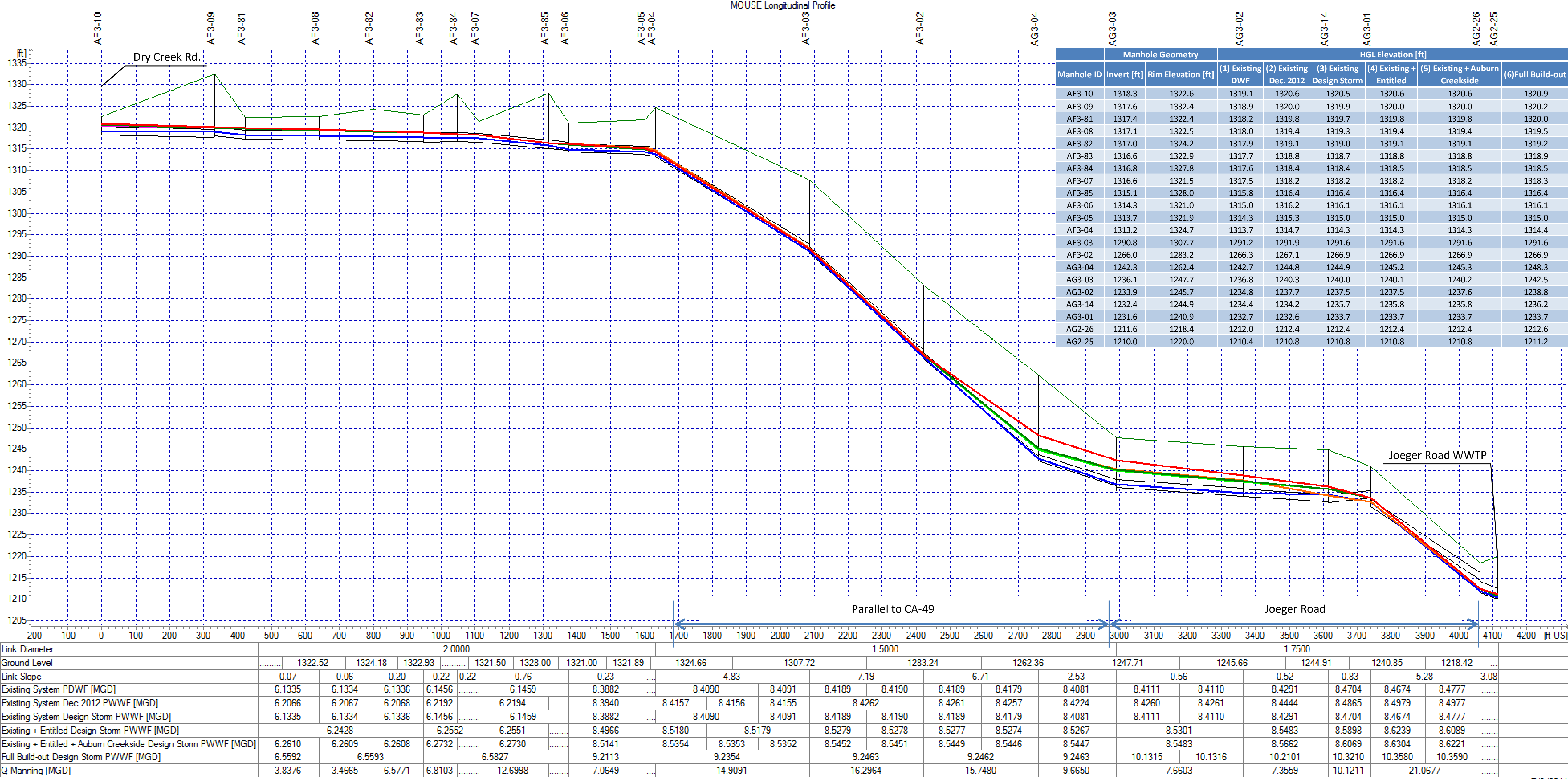
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Entitled Design Storm HGL
- Existing + Entitled + Auburn Creekside Design Storm HGL
- Full Build-out Design Storm HGL

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-4

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 3




| | Manhole Geometry | | HGL Elevation [ft] | | | | | |
|---|---|---|---|---|---|---|---|---|
| Manhole ID | Invert [ft] | Rim Elevation [ft] | (1) Existing DWF | (2) Existing Dec. 2012 | (3) Existing Design Storm | (4) Existing + Entitled | (5) Existing + Auburn Creekside | (6)Full Build-out |
| AF3-10 | 1318.3 | 1322.6 | 1319.1 | 1320.6 | 1320.5 | 1320.6 | 1320.6 | 1320.9 |
| AF3-09 | 1317.6 | 1332.4 | 1318.9 | 1320.0 | 1319.9 | 1320.0 | 1320.0 | 1320.2 |
| AF3-81 | 1317.4 | 1322.4 | 1318.2 | 1319.8 | 1319.7 | 1319.8 | 1319.8 | 1320.0 |
| AF3-08 | 1317.1 | 1322.5 | 1318.0 | 1319.4 | 1319.3 | 1319.4 | 1319.4 | 1319.5 |
| AF3-82 | 1317.0 | 1324.2 | 1317.9 | 1319.1 | 1319.0 | 1319.1 | 1319.1 | 1319.2 |
| AF3-83 | 1316.6 | 1322.9 | 1317.7 | 1318.8 | 1318.7 | 1318.8 | 1318.8 | 1318.9 |
| AF3-84 | 1316.8 | 1327.8 | 1317.6 | 1318.4 | 1318.4 | 1318.5 | 1318.5 | 1318.5 |
| AF3-07 | 1316.6 | 1321.5 | 1317.5 | 1318.2 | 1318.2 | 1318.2 | 1318.2 | 1318.3 |
| AF3-85 | 1315.1 | 1328.0 | 1315.8 | 1316.4 | 1316.4 | 1316.4 | 1316.4 | 1316.4 |
| AF3-06 | 1314.3 | 1321.0 | 1315.0 | 1316.2 | 1316.1 | 1316.1 | 1316.1 | 1316.1 |
| AF3-05 | 1313.7 | 1321.9 | 1314.3 | 1315.3 | 1315.0 | 1315.0 | 1315.0 | 1315.0 |
| AF3-04 | 1313.2 | 1324.7 | 1313.7 | 1314.7 | 1314.3 | 1314.3 | 1314.3 | 1314.4 |
| AF3-03 | 1290.8 | 1307.7 | 1291.2 | 1291.9 | 1291.6 | 1291.6 | 1291.6 | 1291.6 |
| AF3-02 | 1266.0 | 1283.2 | 1266.3 | 1267.1 | 1266.9 | 1266.9 | 1266.9 | 1266.9 |
| AG3-04 | 1242.3 | 1262.4 | 1242.7 | 1244.8 | 1244.9 | 1245.2 | 1245.3 | 1248.3 |
| AG3-03 | 1236.1 | 1247.7 | 1236.8 | 1240.3 | 1240.0 | 1240.1 | 1240.2 | 1242.5 |
| AG3-02 | 1233.9 | 1245.7 | 1234.8 | 1237.7 | 1237.5 | 1237.5 | 1237.6 | 1238.8 |
| AG3-14 | 1232.4 | 1244.9 | 1234.4 | 1234.2 | 1235.7 | 1235.8 | 1235.8 | 1236.2 |
| AG3-01 | 1231.6 | 1240.9 | 1232.7 | 1232.6 | 1233.7 | 1233.7 | 1233.7 | 1233.7 |
| AG2-26 | 1211.6 | 1218.4 | 1212.0 | 1212.4 | 1212.4 | 1212.4 | 1212.4 | 1212.6 |
| AG2-25 | 1210.0 | 1220.0 | 1210.4 | 1210.8 | 1210.8 | 1210.8 | 1210.8 | 1211.2 |

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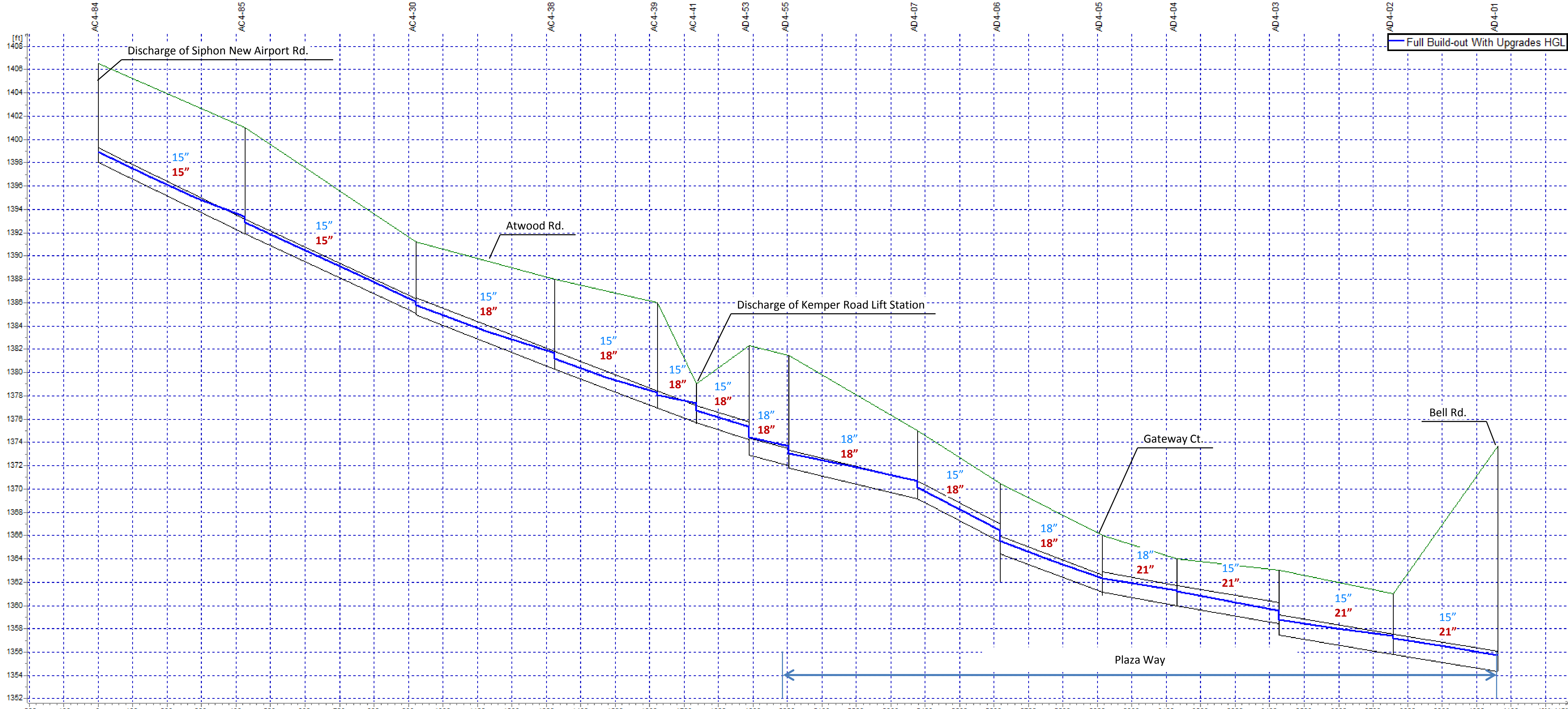
Existing System DWF HGL
Existing System Dec 2012 HGL
Existing System Design Storm HGL
Existing + Entitled Design Storm HGL
Existing + Entitled + Auburn Creekside Design Storm HGL
Full Build-out Design Storm HGL

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-5

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 4




| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.2500 | 1.5000 | 1.7500 | | | | | | | | | | | | | | | | | | |
| Ground Level [ft] | .. | 1401.00 | 1391.18 | 1388.00 | 1386.00 | 1379.00 | 1382.28 | 1381.47 | 1375.00 | 1370.50 | 1366.00 | 1364.00 | 1363.00 | 1361.00 | 1373.70 | | | | | | |
| Link Slope [%] | 1.43 | 1.38 | 1.15 | 1.14 | 1.11 | 0.92 | 0.77 | 0.71 | 1.54 | 1.12 | 0.53 | 0.50 | 0.51 | 0.48 | | | | | | | |
| Full Build-out With Upgrades Peak WWF [MGD] | 4.3036 | 4.3035 | 4.6528 | 4.6526 | 4.6527 | 4.6526 | 4.6524 | 4.6527 | 4.8202 | 5.4489 | 5.4482 | 5.4479 | 5.4618 | 5.4737 | 5.4735 | 5.5523 | 5.6100 | 5.6095 | 5.6493 | 5.6491 | 6.2690 | 6.2693 |
| Q Manning [MGD] | 4.9929 | 4.8959 | 7.2642 | 7.2373 | 7.1364 | 6.5068 | 5.9505 | 5.7080 | 7.5362 | 6.4249 | 6.6982 | 6.4872 | 6.5212 | 6.3421 | | | | | | | |

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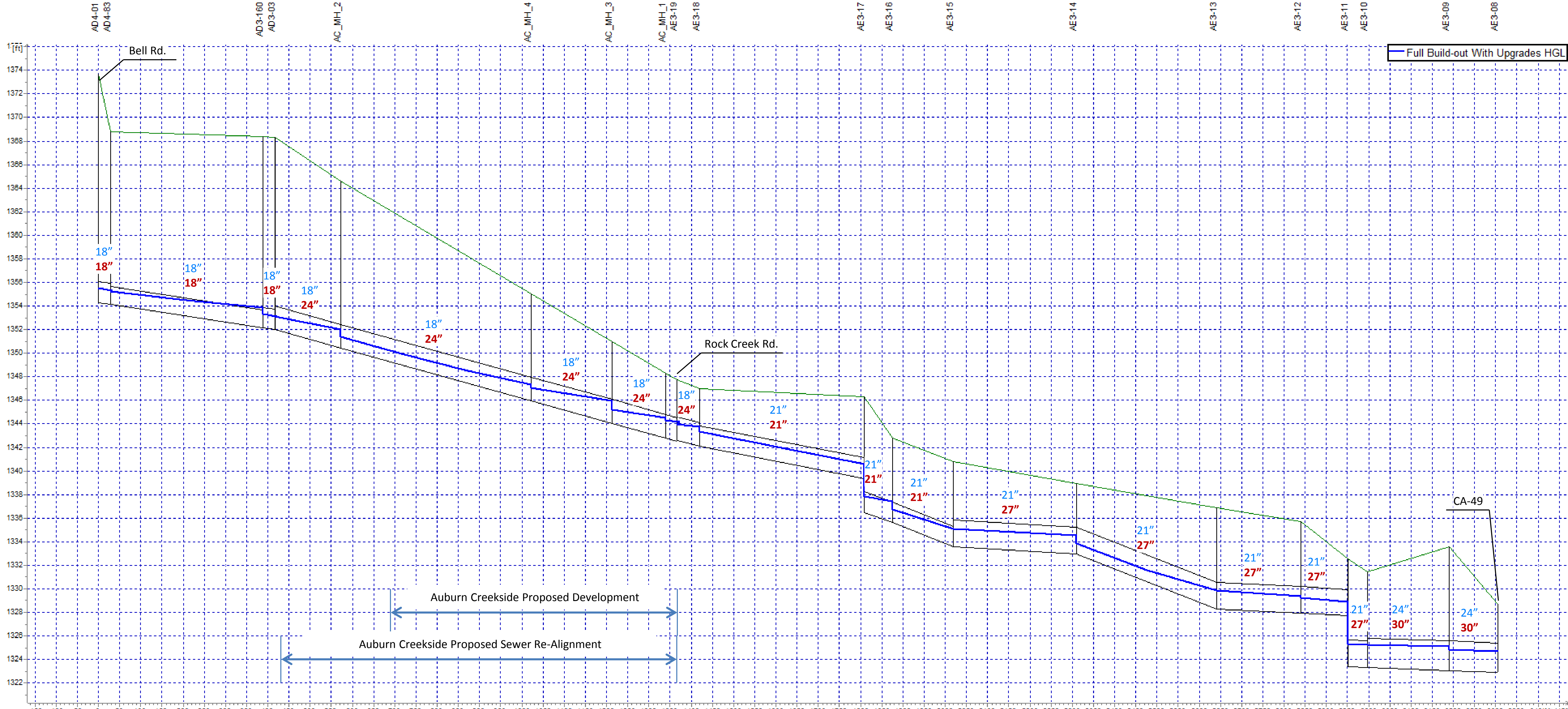
**Legend:**
#″ Existing sewer size
#″ Recommended sewer size

**Note:**
- Recommended sewer size is based upon the minimum industry standard size available to eliminate surcharging.
- Build-out with upgrades scenario assumes that all lift stations and forcemains have been upgraded and outfitted with VFDs. It is assumed that no onsite storage or attenuation is present. This results in the peak potential flow through the sewer trunk network.

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside
Figure No.
B-6
Title
Build-out With Upgrades – 1:10 Year Design Rainfall HGL Profile 1




| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.5000 | .... | 2.0000 | 1.7500 | 2.2500 | 2.5000 | | | | | | | | | | | | | | | |
| Ground Level [ft] | ........ | 1368.41 | 1368.33 | 1364.58 | 1355.02 | 1350.99 | 1348.29 | ....... | 1347.00 | 1346.29 | 1342.82 | 1340.78 | 1338.94 | 1336.90 | 1335.68 | 1332.54 | 1331.47 | 1333.60 | ........ | | |
| Link Slope [%] | 0.57 | .... | .... | 0.85 | 0.70 | 1.28 | 1.44 | 0.21 | 1.41 | 0.19 | 0.20 | 0.15 | 0.12 | 0.14 | | | | | | | |
| Full Build-out With Upgrades Peak WWF [MGD] | ........ | 3.5968 | .... | 6.5308 | 6.5307 | 6.5306 | 6.5305 | 6.5532 | 6.5531 | .... | 7.3235 | 7.3233 | 7.3690 | 7.3689 | 7.3688 | 7.3686 | 7.3685 | 7.3691 | 7.6830 | ....... | 7.6836 | 8.0085 |
| Q Manning [MGD] | 4.5755 | .... | 13.0902 | 14.2010 | 14.2366 | 14.2231 | .... | ........ | 8.3454 | 11.2655 | 11.9806 | 9.0801 | 23.7206 | 8.7426 | 8.8723 | ....... | 9.3492 | 9.9132 | | | |

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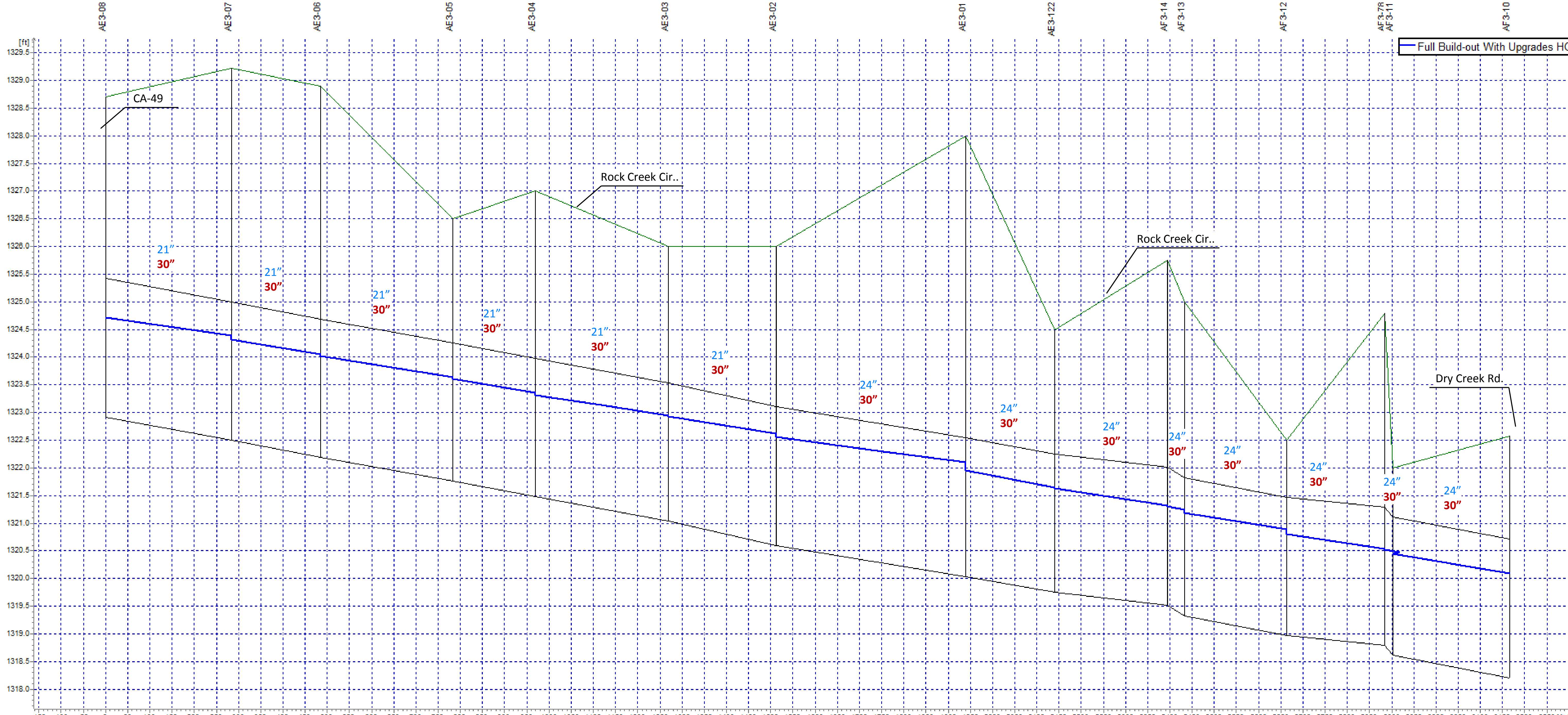
**Legend:**
#" Existing sewer size
#" Recommended sewer size

**Note:**
- Recommended sewer size is based upon the minimum industry standard size available to eliminate surcharging.
- Build-out with upgrades scenario assumes that all lift stations and forcemains have been upgraded and outfitted with VFDs. It is assumed that no onsite storage or attenuation is present. This results in the peak potential flow through the sewer trunk network.

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-7

Title
Build-out With Upgrades – 1:10 Year Design Rainfall
HGL Profile 2




| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 2.5000 | | | | | | | | | | |
| Ground Level [ft] | 1329.22 | 1328.90 | 1326.50 | 1327.00 | 1326.00 | 1328.00 | 1324.50 | 1325.75 | 1325.00 | 1322.50 | 1324.79 | 1322.00 | 1322.58 |
| Link Slope [%] | 0.15 | 0.14 | 0.15 | 0.18 | 0.13 | 0.14 | 0.09 | 0.53 | 0.15 | 0.08 | ... | 0.15 |
| Full Build-out With Upgrades Peak WWF [MGD] | 8.0081 | 8.3674 | 8.5568 | 8.5556 | 8.5543 | 8.5530 | 8.5518 | 8.5503 | 8.5488 | 8.5477 | 8.5467 | 8.5458 | ...... | 8.6235 | 8.6601 | ... | 8.6637 |
| Q Manning [MGD] | 10.1921 | 10.3993 | 10.0504 | 10.2963 | 10.1181 | 11.2765 | 9.5902 | 9.0213 | 7.9643 | ...... | 10.3102 | 8.1826 | ... | 10.3414 |

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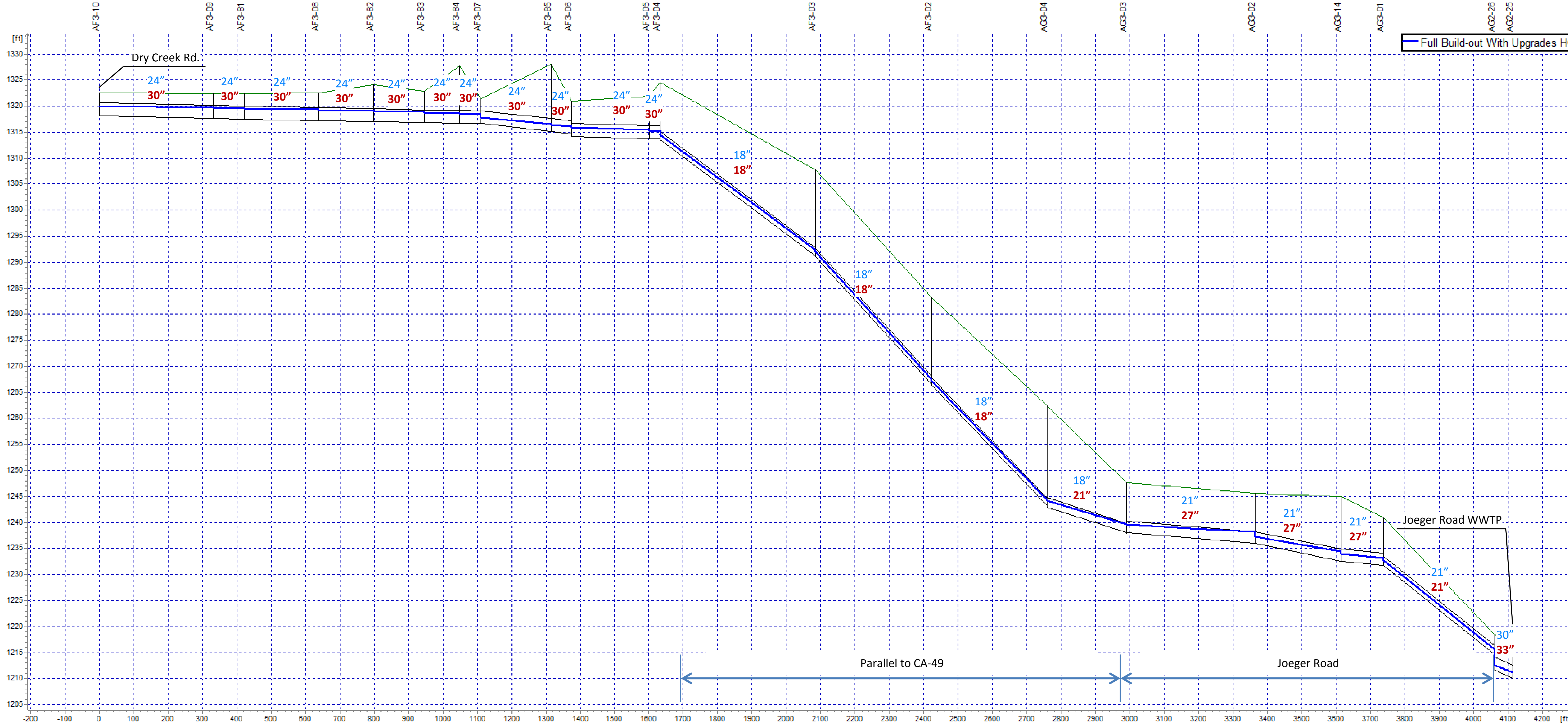
**Legend:**
#" Existing sewer size
#" Recommended sewer size

**Note:**
- Recommended sewer size is based upon the minimum industry standard size available to eliminate surcharging.
- Build-out with upgrades scenario assumes that all lift stations and forcemains have been upgraded and outfitted with VFDs. It is assumed that no onsite storage or attenuation is present. This results in the peak potential flow through the sewer trunk network.

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-8

Title
Build-out With Upgrades – 1:10 Year Design Rainfall HGL Profile 3




| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 2.5000 | 1.5000 | 1.7500 | 2.2500 | 1.7500 | ....... | | | | | | | | | | | | | | |
| Ground Level [ft] | 1322.42 | 1322.44 | 1322.52 | 1324.18 | 1322.93 | 1327.77 | 1321.50 | 1328.00 | 1321.00 | 1321.89 | 1324.66 | 1307.72 | 1283.24 | 1262.36 | 1247.71 | 1245.66 | 1244.91 | 1240.85 | 1218.42 | ... |
| Link Slope [%] | 0.15 | 0.26 | 0.11 | 0.14 | 0.16 | 0.07 | 0.14 | 0.76 | 0.20 | ... | 4.91 | 7.27 | 6.85 | 2.18 | 0.54 | 1.36 | 0.63 | 5.34 | 3.08 | |
| Full Build-out With Upgrades Peak WWF [MGD] | 8.6774 | 8.6764 | 8.6862 | 8.6857 | 8.6853 | 8.7097 | 8.7096 | ....... | 11.2288 | 11.2663 | 11.2834 | 11.3039 | 11.3041 | 12.2249 | 12.2248 | 12.3035 | 12.4149 | 12.4313 | 12.4314 | ....... |
| Q Manning [MGD] | 10.2785 | 13.4010 | 8.6166 | 9.8275 | 10.4423 | 6.9657 | ....... | 23.0279 | ....... | 11.9345 | ... | 15.0309 | 16.3971 | 15.9142 | 13.5504 | 14.6495 | 23.3092 | 17.1606 | 21.1971 | ....... |

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**Legend:**
#″ Existing sewer size
#″ Recommended sewer size

**Note:**
- Recommended sewer size is based upon the minimum industry standard size available to eliminate surcharging.
- Build-out with upgrades scenario assumes that all lift stations and forcemains have been upgraded and outfitted with VFDs. It is assumed that no onsite storage or attenuation is present. This results in the peak potential flow through the sewer trunk network.

Client/Project
Auburn Pacific Properties, LLC
Sewer Capacity – Auburn Creekside

Figure No.
B-9

Title
Build-out With Upgrades – 1:10 Year Design Rainfall
HGL Profile 4

# Appendix C Auburn Creekside Proposed Sewer Re-Alignment

This figure is extracted from the Highway 49 Trunk model and is based on site plan information provided by Morton & Pitalo which Stantec understands to be current as of the date of this report.


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Legend
- Proposed New Manholes
- Existing Manholes

Proposed Re-Alignment
- <all other values>
- By Auburn Creekside
- By Others
- Existing Sewer To Be Abandoned
- Existing Sewer Line
- Auburn Creekside Development Lands

Client/Project

**AUBURN PACIFIC PROPERTIES, LLC**
**AUBURN CREEKSIDE EVALUATION**
**NORTH AUBURN HWY 49 TRUNK**
**North Auburn, Placer County**

Title

**Auburn Creekside**
**Proposed Sewer Re-Alignment**
**With Inverts**

Project No.
184030352

Scale
0 50 100 150 200 Feet

Figure No.
C-1

Issue/Revision
A/

# Appendix D Necessary Highway 49 Trunk Upgrades by Scenario

The table shown below provides a combined summary of the upgrades required to accommodate the various scenarios from Existing conditions through Build-out. The sewer sizes highlighted in bold font identify the sewers requiring upsizing.

| Pipe Segment | | Existing Diameter, inches | Length of Sewer Upgrades, linear feet | Sizing for Existing System, inches (a) | Sizing for Existing + Entitled, inches | Sizing for Existing + Entitled + Auburn Creekside, inches | Sizing for Full Build-out, inches |
|---|---|---|---|---|---|---|---|
| Upstream MH ID | Downstream MH ID | | | | | | |
| AC4-30 | AD4-53 | 15 | 966 | 15 | 15 | 15 | **18** |
| AD4-07 | AD4-06 | 15 | 240 | 15 | 15 | 15 | **18** |
| AD4-05 | AD4-04 | 18 | 216 | 18 | 18 | 18 | **21** |
| AD4-04 | AD4-03 | 15 | 298 | **18** | **18** | **18** | **21** |
| AD4-03 | AD4-01 | 15 | 634 | **21** | **21** | **21** | **21** |
| AD3-03 | AD3-02 | 18 | 466 | **21** | **21** | **21** | **24** |
| AD3-02 | AE3-18 | 18 | 537 | 18 | 18 | 18 | **24** |
| AE3-15 | AE3-13 | 21 | 499 | 21 | 21 | 21 | **27** |
| AE3-13 | AE3-11 | 21 | 311 | **24** | **24** | **24** | **27** |
| AE3-11 | AE3-10 | 21 | 193 | 21 | 21 | 21 | **27** |
| AE3-10 | AE3-08 | 24 | 307 | **27** | **27** | **27** | **30** |
| AE3-08 | AE3-02 | 21 | 1513 | **27** | **27** | **27** | **30** |
| AE3-02 | AF3-09 | 24 | 1985 | **27** | **27** | **27** | **30** |
| AF3-09 | AF3-81 | 24 | 89 | 24 | 24 | 24 | **30** |
| AF3-81 | AF3-07 | 24 | 689 | **27** | **27** | **27** | **30** |
| AF3-07 | AF3-06 | 24 | 205 | 24 | 24 | 24 | **30** |
| AF3-06 | AF3-04 | 24 | 257 | **27** | **27** | **27** | **30** |
| AG3-04 | AG3-03 | 18 | 230 | **21** | **21** | **21** | **30** |
| AG3-03 | AG3-02 | 21 | 375 | **24** | **24** | **24** | **30** |
| AG3-02 | AG3-14 | 21 | 250 | 21 | 21 | 21 | **30** |
| AG3-14 | AG3-01 | 21 | 126 | **24** | **24** | **24** | **30** |
| AG2-26 | AG2-25 | 30 | 52 | **36** | **36** | **36** | **36** |

**North Auburn Dewitt Trunk Sewer Capacity Evaluation Report**

Revised Final Report

Prepared for:
Western Care Construction, Inc.

Prepared by:
Stantec Consulting Services Inc.

March 6, 2016

| Revision Record | | | | | | | |
|---|---|---|---|---|---|---|---|
| Revision | Description | Prepared By | | Checked By | | Approved By | |
| A | Draft Report | BL | 01/23/2014 | MVD | 03/02/2014 | DP | 03/03/2014 |
| B | Final Report | BL | 04/29/2014 | | | DP | 04/30/2014 |
| C | Revised Final Report | BL | 07/29/2014 | DP | 08/10/2014 | DP | 08/10/2014 |
| D | Revised Final Report | BL | 03/06/2015 | DP | 03/06/2015 | DP | 03/06/2015 |

## Sign-off Sheet

This document entitled North Auburn Dewitt Trunk Sewer Capacity Evaluation Report was prepared by Stantec Consulting Services Inc. for the account of Western Care Construction, Inc. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

Prepared by ______________________________

(signature)

**Brett Laplante, E.I.T.**

REGISTERED PROFESSIONAL ENGINEER
DAVID WILLIAM PRICE
No.60449
Exp.6/30/16
CIVIL
STATE OF CALIFORNIA

Reviewed by 03/06/2015

**Dave Price, P.E.**

Stantec

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# 1.0 Introduction

## 1.1 PURPOSE

Placer County (County) owns and operates the wastewater collection system within Sewer Maintenance District 1 (SMD 1), which is located north of the City of Auburn in western Placer County. The collection system consists of two main sewer trunks, the Highway 49 trunk and the DeWitt trunk. These trunks convey flows from the southern portion of the SMD 1 service area to the County's wastewater treatment plant (WWTP) located on Joeger Road, west of Highway 49 and north of Dry Creek Road in the unincorporated area north of the City of Auburn (herein referred to as North Auburn).

Along the Dewitt trunk, Western Care Construction, Inc. has proposed a development located north of Bell Road and east of Richardson Drive. The purpose of this study is to assess the capacity of the Dewitt trunk to convey existing flows, and to assess the impact of this development upon the capacity of the system, to determine any upgrades that may be required to the gravity sewer system.

## 1.2 BACKGROUND

The proposed Timberline development is a Continuing Care community on 91.4-acres that is expected to generate wastewater equivalent to 839 EDUs (similar to 839 single family residences). The project parcel is located north of Bell Road and east of Richardson Drive in North Auburn.

This report was required by the Placer County Facility Services Department (Facility Services), which operates and maintains the SMD 1 collection, treatment and disposal facilities, to assess the impact of the project on the SMD 1 wastewater collection system. The results of the capacity evaluation were also used to assess the impact of the Timberline project on the SMD 1 collection system.

# 2.0 Project Characteristics

## 2.1 PURPOSE

The purpose of this chapter is to describe the County's existing wastewater collection system.

This chapter is divided into the following sections:

- Project Location
- Land Use Data
- Future Wastewater Flows

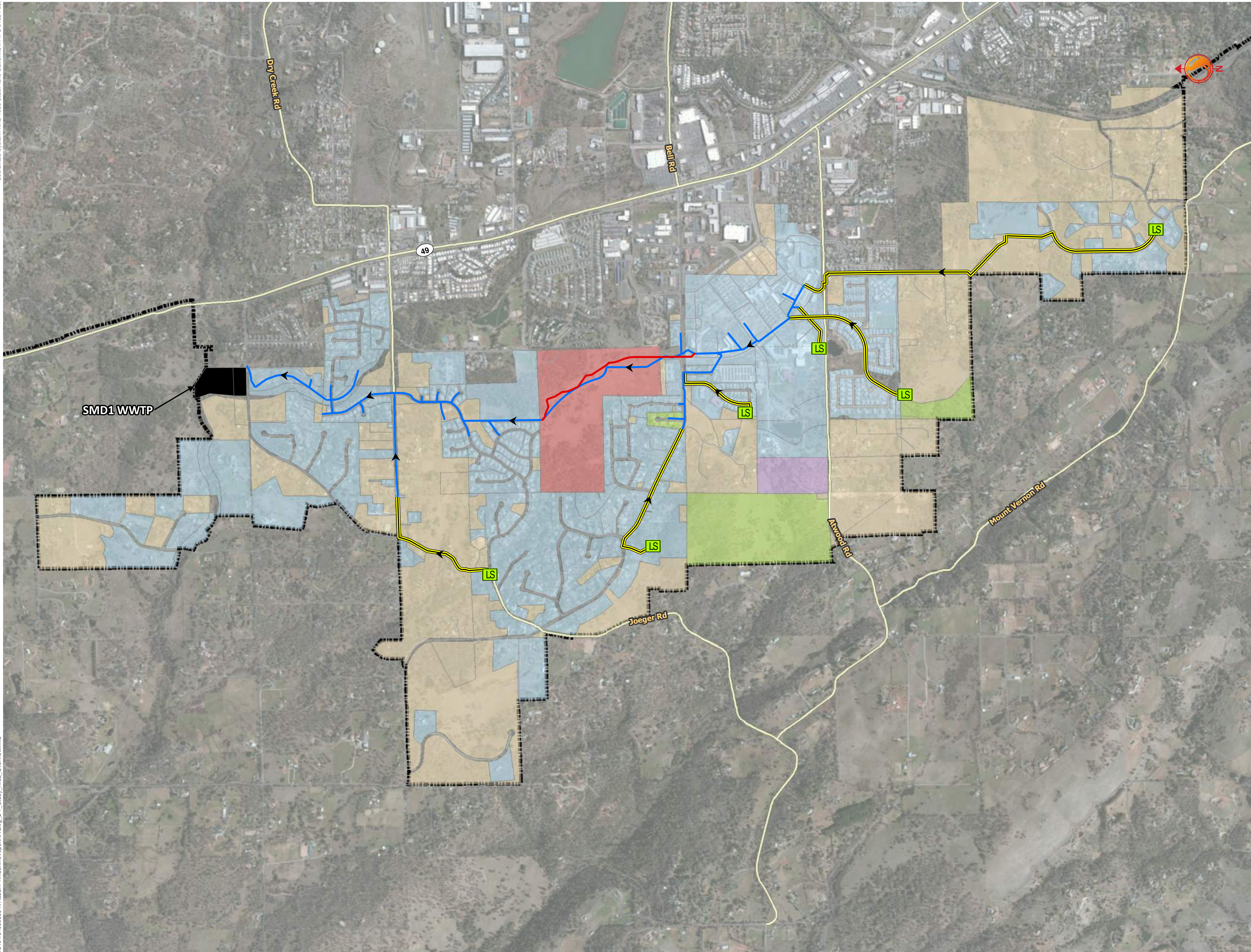
## 2.2 PROJECT LOCATION

**Figure 2-1** shows the location of the proposed Timberline development in relation to the SMD 1 wastewater collection system for the North Auburn Dewitt Trunk Sewer Evaluation. The Study area (portion of SMD 1) is defined as the wastewater subcatchments that contributes flows to the Joeger Road WWTP serviced by the Dewitt trunk. The Timberline development is located north of Bell Road at Richardson Drive, and will add approximately 91.4 acres of serviced land to the existing Dewitt sewershed.

The portion of the SMD 1 service area which discharges into the Dewitt trunk covers an area of approximately 841 acres and currently serves approximately 1,532 equivalent dwelling units (EDUs). The wastewater generated by these users is collected and conveyed to the County's WWTP, located west of Highway 49 on Joeger Road, via a network of sewer pipelines, force mains, and lift stations.

The Dewitt trunk generally follows North Auburn roads from Vineyard Drive to Bean Road, Richardson Drive, Deer Ridge Lane, River Woods Drive, and onto Joeger Road. This trunk collects flows from commercial, industrial and residential developments along the Dewitt corridor and developments to the west. To account for the foothill terrain in the service area, lift stations convey flows from lower areas to system gravity collectors or the Dewitt trunk itself.

This Timberline development has also been tasked with re-aligning the Dewitt trunk within the Timberline development, and re-apportioning the distribution of a few neighbouring parcels. The proposed alignment has been included within this study for assessment.

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Legend

- Sanitary Sewer
- Proposed New Sewer Alignment
- Forcemain

Scenario

- Existing Catchments
- Existing Catchments with Internal Growth
- Entitled Catchments
- Full Buildout Catchments
- Timberline Development Lands
- SMD1 WWTP
- SMD1 Buildout Boundary
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
North Auburn, Placer County

Title

**Study Area Overview**

Project No.
184030365

Scale
0 0.1 0.2 0.3 Miles

Figure No.
**2-1**

Issue/Revision
A/

## 2.3 LAND USE DATA

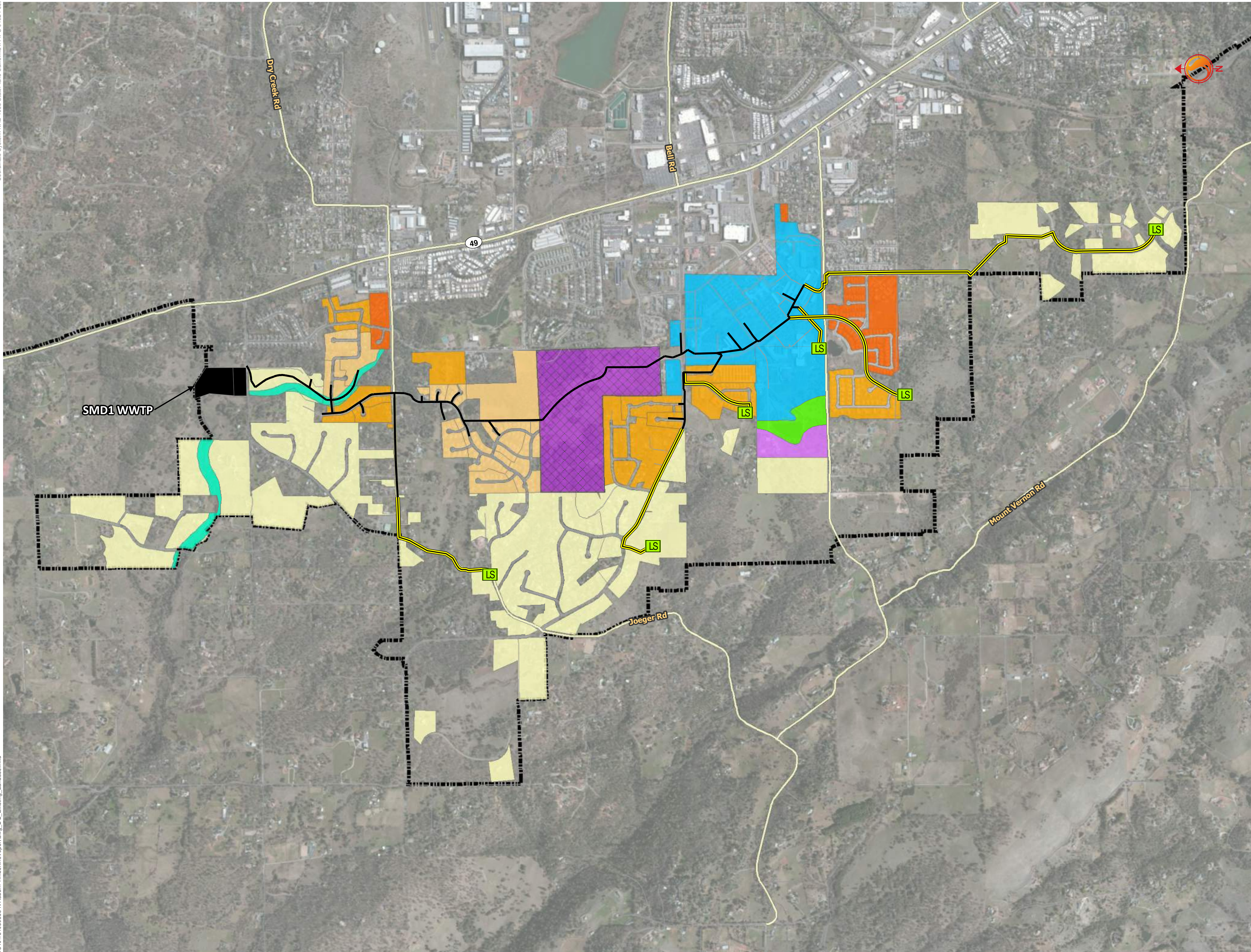
The proposed Timberline development is located north of Bell Road and east of Richardson Drive. In the first phase of the development, it is planned to add 14.4 acres of serviced land to the existing sewershed, and will contain 186 equivalent dwelling units (EDUs). The remaining phases of the development will account for an additional 77.0 acres (combined total of 91.4 acres) and 653 EDUs (combined total of 839 EDUs).

The existing land use and parcel data for the Dewitt trunk sewer shed was provided by the County in GIS format. The number of EDUs was provided by the County. Land uses for existing developments are shown in **Figure 2-2** and **Figure 2-3** and summarized along with the estimated number of EDUs associated with each land use, in **Table 2-1**.

**Table 2-1 Existing Land Use Summary[(a)]**

| | SMD 1 | | Dewitt Sewershed | |
|---|---|---|---|---|
| **Land Use Designation** | Total Acreage (Acres) | Total Population (EDUs) | Total Acreage (Acres) | Total Population (EDUs) |
| **City of Auburn** | 150 | 135 | 0 | 0 |
| **Commercial** | 251 | 976 | 7 | 10 |
| **Industrial** | 145 | 332 | 0 | 0 |
| **Mixed Use** | 17 | 98 | 0 | 0 |
| **Open Space** | 58 | 28 | 1 | 2 |
| **Open Space / Business Park** | 6 | 21 | 0 | 0 |
| **Professional Office** | 55 | 226 | 0 | 0 |
| **Riparian Drainage** | 206 | 164 | 44 | 44 |
| **Rural Estate 2.3 - 10 Ac. Min.** | 244 | 194 | 0 | 0 |
| **Rural Estate 4.6 - 10 Ac. Min.** | 24 | 17 | 9 | 7 |
| **Rural Low Density Residential** | 285 | 575 | 197 | 342 |
| **Rural Residential 1 - 2.3 Ac. Min.** | 10 | 5 | 0 | 0 |
| **Rural Residential 2.3 - 4.6 Ac. Min.** | 654 | 631 | 28 | 40 |
| **Low Density Residential** | 139 | 231 | 112 | 158 |
| **Low Medium Density Residential** | 999 | 2727 | 383 | 800 |
| **Medium Density Residential** | 310 | 1441 | 60 | 129 |
| **High Density Residential** | 25 | 143 | 0 | 0 |
| **Total** | **3578** | **7944** | **841** | **1532** |

(a) Provided by Placer County.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet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Legend

**Land Use**

- Commercial
- Industrial
- Medium Density Residential 5 - 10 DU./Ac.
- Low Medium Density Residential 2 - 5 DU/Ac.
- Low Density Residential 0.4 - 0.9 Ac. Min.
- Mixed Use
- Open Space
- Riparian Drainage
- Rural Real Estate/Rural Residential
- Timberline Development Lands
- SMD1 WWTP
- SMD1 Buildout Boundary
- Sanitary Sewer
- Forcemain
- LS Lift Stations

Client/Project

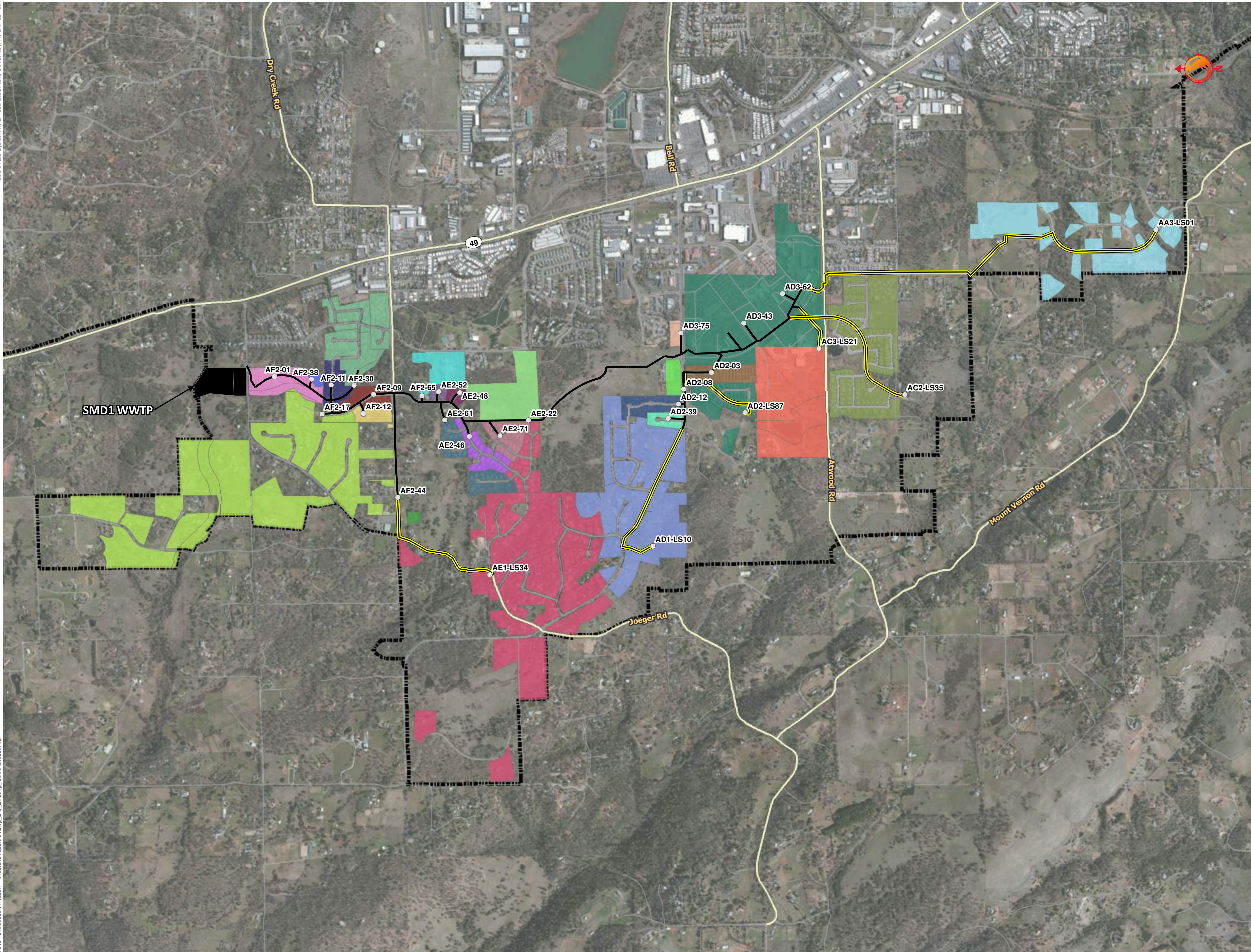
**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Existing Land Use**

| Project No. | Scale |
|---|---|
| 184030365 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 2-2 | A/ |

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Legend

**Sewer Connection**

- AA3-LS01
- AC2-LS35
- AC3-LS21
- AD1-LS10
- AD2-03
- AD2-08
- AD2-12
- AD2-39
- AD2-LS87
- AD3-75
- AE1-LS34
- AE2-22
- AE2-46
- AE2-48
- AE2-52
- AE2-61
- AE2-71
- AF2-01
- AF2-09
- AF2-11
- AF2-12
- AF2-17
- AF2-30
- AF2-38
- AF2-44
- AF2-65

- Modeled Nodes
- SMD1 WWTP
- SMD1 Buildout Boundary
- Sanitary Sewer
- Forcemain

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Connection of Existing Sewersheds to Modeled Network**

Project No. 184030365

Scale 0 0.1 0.2 0.3 Miles

Figure No. **2-3**

Issue/Revision A/

Placer County Facility Services provided information for the land use designations and EDU counts of the expected population and servicing growth within the SMD 1 service area by means of two shapefiles (complete with description):

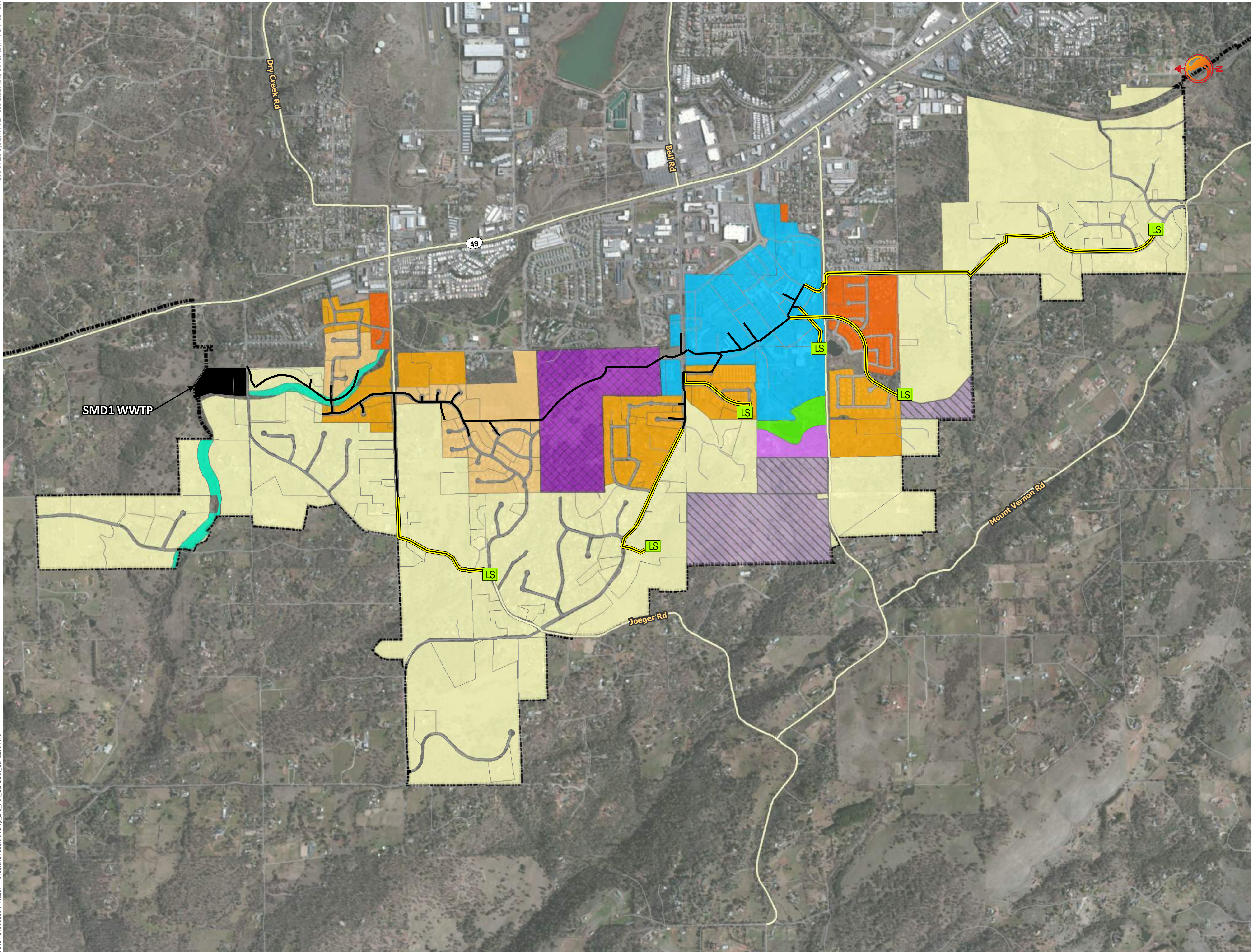
- **"SMD1Basins_20130603.shp"** – Future service area build-out extents with projected population and land area, organized by which manhole they drain to.
- **"SMD1ParcelsWithBasinAndLanduse_20130603.shp"** – Future build-out extents with project population (EDUs) and land area, discretized by parcels and landuse designations. Similar to the preceding shapefile, though with slightly less effective land area and population.

The information contained within these shapefiles were intended to represent the ultimate build-out of SMD 1 and is completely independent of the existing land use data discussed prior. Through discussion with the County, it was decided that a combination of the two shapefiles was to be used. The population estimate within the "SMD1Basins" shapefile was deemed a more accurate prediction of future populations by the County. However, the "SMD1ParcelsWithBasinAndLanduse" shapefile provided the information regarding serviced and non-serviced area. As explained in further detail in Section 4, Future Flow Estimation, the non-serviced area will not contribute to I&I within the system and is not included within the hydraulic model. The future build-out land use is shown in **Figure 2-4** and **Figure 2-5** summarized in **Table 2-2**.

**Table 2-2 Future Land Use Projection**

| | SMD 1 | | Dewitt Sewershed | |
|---|---|---|---|---|
| **Landuse Designation** | Total Acreage (Acres) | Total Population (EDUs) | Total Acreage (Acres) | Total Population (EDUs) |
| **Agricultural** | 52 | 26 | 0 | 0 |
| **City of Auburn** | 315 | 0 | 0 | 0 |
| **Commercial** | 679 | 2,957 | 200 | 1,179 |
| **Industrial** | 454 | 694 | 0 | 0 |
| **Mixed Use** | 66 | 268 | 13 | 85 |
| **Open Space** | 467 | 0 | 49 | 0 |
| **Open Space / Business Park** | 166 | 0 | 0 | 0 |
| **Professional Office** | 92 | 297 | 0 | 0 |
| **Riparian Drainage** | 220 | 0 | 23 | 0 |
| **Rural Estate 2.3 - 10 Ac. Min.** | 1,012 | 591 | 0 | 0 |
| **Rural Estate 4.6 - 10 Ac. Min.** | 827 | 519 | 92 | 51 |
| **Rural Low Density Residential** | 1,409 | 1,997 | 931 | 1,067 |
| **Rural Residential 1 - 2.3 Ac. Min.** | 0 | 0 | 0 | 0 |
| **Rural Residential 2.3 - 4.6 Ac. Min.** | 4769 | 3,144 | 269 | 192 |
| **Low Density Residential** | 253 | 708 | 93 | 276 |
| **Low Medium Density Residential** | 1,027 | 3,820 | 155 | 614 |
| **Medium Density Residential** | 372 | 2,537 | 46 | 304 |
| **High Density Residential** | 75 | 424 | 22 | 155 |
| **Total** | **12,255** | **17,982** | **1,893** | **3,923** |

Not including the Timberline development, there are currently 3 additional entitled development projects that are planned to be served by the Dewitt trunk sewer. In total, these three developments represent approximately 94 EDUs. A detailed list of these developments is included in **Appendix A**.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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Legend

**Land Use**

- Commercial
- Industrial
- Medium Density Residential 5 - 10 DU./Ac.
- Low Medium Density Residential 2 - 5 DU/Ac.
- Low Density Residential 0.4 - 0.9 Ac. Min.
- Mixed Use
- Open Space
- Riparian Drainage
- Rural Real Estate/Rural Residential
- Entitled Catchments
- Timberline Development Lands
- SMD1 WWTP
- SMD1 Buildout Boundary
- Sanitary Sewer
- Forcemain
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Full Build-Out Land Use**

| Project No. | Scale |
| --- | --- |
| 184030365 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
| --- | --- |
| 2-4 | A/ |

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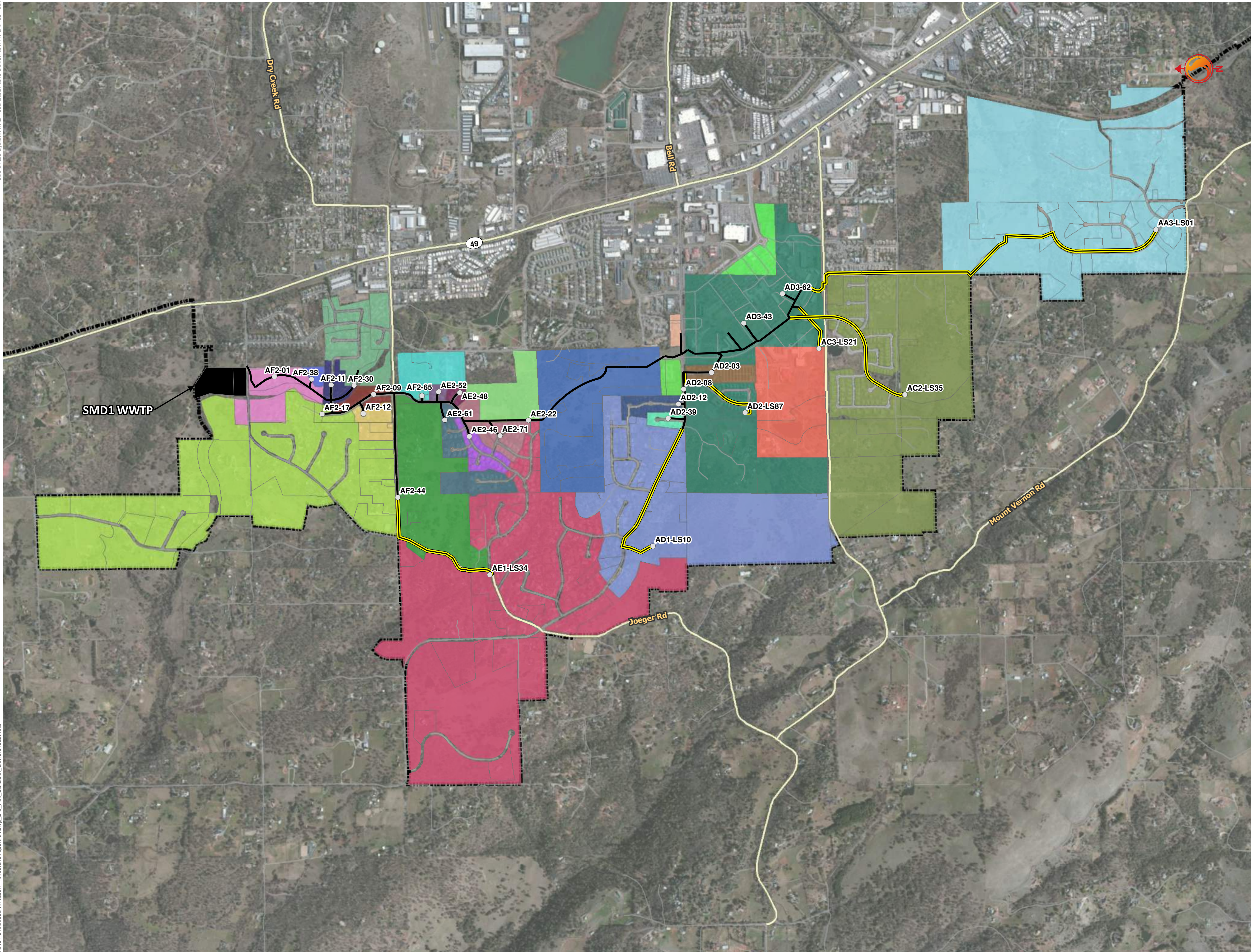


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Sewer Connection

| | |
|---|---|
| AA3-LS01 | AE2-22 |
| AC2-LS35 | AE2-46 |
| AC3-LS21 | AE2-48 |
| AD1-LS10 | AE2-52 |
| AD2-03 | AE2-61 |
| AD2-08 | AE2-71 |
| AD2-12 | AF2-01 |
| AD2-39 | AF2-09 |
| AD2-50 | AF2-11 |
| AD2-LS87 | AF2-12 |
| AD3-43 | AF2-17 |
| AD3-62 | AF2-30 |
| AD3-75 | AF2-38 |
| AE1-LS34 | AF2-44 |
| | AF2-65 |

Modeled Nodes
SMD1 WWTP
SMD1 Buildout Boundary
Sanitary Sewer
Forcemain

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
North Auburn, Placer County

Title

**Connection of Future Sewersheds to Modeled Network**

| Project No. | Scale |
|---|---|
| 184030365 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 2-5 | A/ |

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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## 2.4 FUTURE WASTEWATER FLOWS

The estimates for future (build-out) system flow were derived from a combination of existing system information, per the Placer County Design Guidelines, and through discussions with County Staff. The following provides a brief summary of the wastewater loading characteristics:

- **GWI** (groundwater infiltration) = 100 gpd / ac
    - Extrapolated from existing system performance

- **Average DWF** (dry weather flow) = 200 gpd / edu
    - Extrapolated from existing system performance
    - Diurnal loading assumed to be identical to existing system

- **RDII** (rainfall dependent infiltration and inflow) **Allowance** – 1338 gpd / ac
    - This value was derived from a technical memorandum issued by RMC entitled *South Placer Regional Wastewater & Recycled Water Systems Evaluation Project*, May, 2005 (RMC TM3a). In the report, a peak WWF (wet weather flow) of 1368 gpd/edu and a peak DWF of 380 gpd/edu are recommended. This approximates to 1000 gpd/edu infiltration. Note that the RDII allowance parameter is presented as an acreage basis rather than an EDU basis as recommended within the RMC report. As discussed later in Section 3.4.2, the hydraulic model derives the I&I based upon land area. **Table 2-3** and **Table 2-4** provide a summary of the RDII Allowance considerations.

### Table 2-3 Population Density Summary

| Rainfall Event | Contributing Area (ac) | Contributing EDUs | Density (edu/ac) |
|---|---|---|---|
| Existing System Model (Design Event) | 3583 | 7944 | 2.22 |
| Future Catchments Only(a) | 7503 | 10039 | 1.338 |

a) Landuse designations that contain no population is considered to not be serviced, and therefore not included as contributing area or EDU count. These designations are: City of Auburn, Open Space, Open Space / Business Park, and Riparian Drainage.

### Table 2-4 Future Flow and Infiltration Allowance Summary

| Rainfall Event | Peak DWF [mgd] | Peak WWF [mgd] | Peak I&I [mgd] | RDII [gpd/ac] | RDII [gpd/edu] | PWWF [gpd/edu] |
|---|---|---|---|---|---|---|
| Existing System Model (Design Event) | 2.67 | 11.5 | 8.8 | 2464 | 1112 | 1448 |
| Future Catchments Only | 4.97 | 15.0 | 10.0 | 1338 | 1000 | 1495 |

# 3.0 Overview of Hydraulic Model

## 3.1 PURPOSE

The purpose of this chapter is to present an overview of the development and calibration of the hydraulic model of the Dewitt wastewater trunk collector located in SMD 1 of Placer County.

This chapter is divided into the follow sections:

- Modeling Software
- Model Inputs and Construction
- Model Calibration

## 3.2 MODELING SOFTWARE

The wastewater collection system capacity was evaluated using a hydrodynamic routing model, Mike Urban 2011, Service Pack 7, by DHI.

## 3.3 MODEL INPUTS AND CONSTRUCTION

The GIS database files containing the physical collection system information (pipe lengths, diameters, inverts, manhole depths, etc.) were imported into the modeling software. The data import resulted in an initial model build containing the necessary information for pipes and junctions. A Manning "n" roughness coefficient was assigned to gravity sewer based upon the identified pipe material, as per **Table 3-1**.

**Table 3-1 Sewer Roughness Values**

| Material | Manning's "n" value |
|---|---|
| **Asbestos Cement** | 0.013 |
| **Ductile Iron** | 0.0145 |
| **PVC** | 0.012 |
| **Tranzite** | 0.013 |
| **Unidentified** | 0.013 |
| **Vitrified Clay Pipe** | 0.0145 |

Mike Urban also uses manhole loss coefficients to further determine the total resistance to flow within the network. An universal "Km" value of 0.10 was applied using the "MOUSE Mean Energy Approach" equations to calculate the resistance to the flow. Mike Urban calculates the total loss through a manhole by applying additional modifiers to the "Km" value automatically. These additional modifiers represent factors such as, but not exclusively:

- Manhole entry and exit loss coefficients

- Flow angle
- Plunging manholes
- Drop elevation

These factors are calculated within the MOUSE module, and are not user determined. The "Km" value was determined to be most appropriate through discussions with DHI staff.

Once imported into the model, a number of issues were found in the GIS source data:

- Connectivity errors. These errors were most common, and were addressed either by revisiting the as-built data or through discussions with County staff.

- Incomplete data. Assumptions were made to complete the model database connectivity, pipe sizes, and elevations.

- Invert and pipe slope and size inconsistency. In many cases, GIS data indicates pipes with negative slopes. These pipes were adjusted to have positive slopes in the model. Negative slopes are generally mistakes in the GIS database, and likely do not represent actual negative slopes in the wastewater system pipes.

The model is comprised of a network of data elements called *nodes* and *links*. The *nodes* and *links* represent the components of a typical wastewater collection system.

- A *node* is a point in the network having an X and Y coordinate. *Nodes* can represent manholes, wet wells, chamber, or outfalls.

- *Links* convey flow between nodes. They are connected at one end to a *start node* and the other end to an *end node*. *Links* can represent gravity sewers, force mains or pumps.

### 3.3.1 Sewer Pipes and Manholes

The sewers to be modeled were identified by the County prior to the initiation of this project. They are generally defined as any sewer trunks tributary to and including the Dewitt trunk downstream of all active lift stations. In general, the collection system upstream of lift stations was not included in the model.

### 3.3.2 Lift Stations

Lift stations were included within the model to facilitate the start/stop effects of the forcemains upon the downstream collection system. Note that the performance and the capacity of the lift stations were not assessed within this study.

The lift stations to be included in the model were identified by the County prior to the initiation of this project. The modeled lift stations include:

- Vineyards Lift Station
- Bell Road Lift Station

- Joeger Road Lift Station
- County Jail Lift Station
- Olympic Village Lift Station
- Atwood 3 Lift Station

ISCO Pumplink data was used as the basis for determining the actual discharge capacity of the forcemains. This data was provided by the County. **Table 3-2** summarizes the parameters used within the model.

**Table 3-2 Sewer Maintenance District 1 (SMD 1) – Highway 49 Trunk Lift Station Information**

| Lift Station | Model ID No. | Lead Pump Start Level (ft) | Lag Pump Start Level (ft) | Lead Pump Modeled Flow Rate (gpm) | Lag Pump Modeled Flow Rate (gpm) |
|---|---|---|---|---|---|
| Vineyards Lift Station | AA3-LS01 | 1195.5 | 1196.0 | 90 | 21 |
| Joeger Road Lift Station | AE1-LS34 | 1266.0 | 1266.5 | 146 | 132 |
| County Jail Lift Station | AC3-LS21 | 1395.6 | 1395.9 | 167 | 90 |
| Olympic Village Lift Station | AD2-LS87 | 1379.7 | 1379.9 | 243 | 14 |
| Atwood 3 Lift Station | AC2-LS35 | 1312.7 | 1313.2 | 90 | 83 |

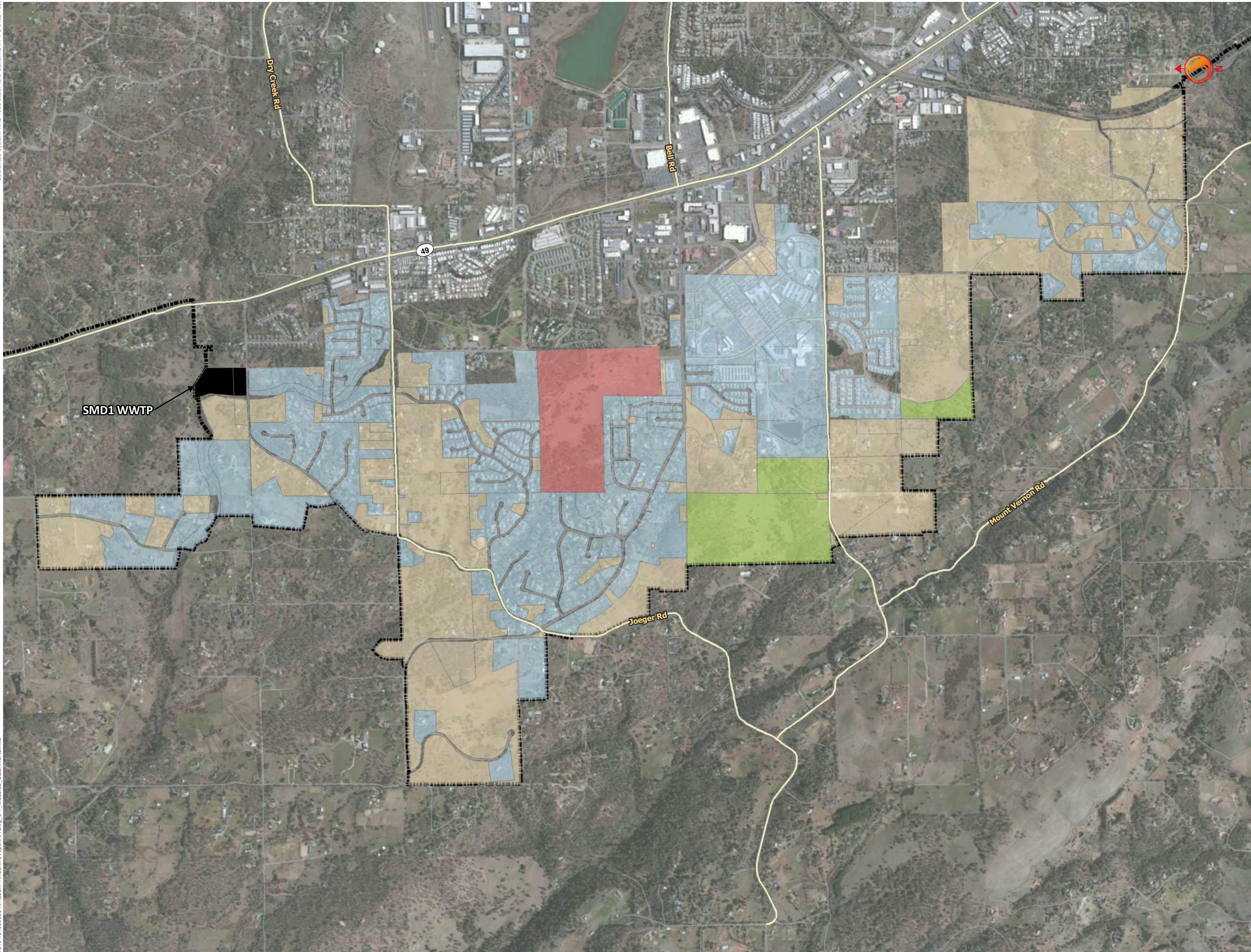
### 3.3.3 Subcatchments

Subcatchments are used within hydrodynamic models to represent the combined land area and population that contribute to wastewater flows in a particular part of the system. Often these subcatchments are the areas upstream of a particular manhole, or lift station. The overall service area of the Dewitt Trunk shown on **Figure 3-1** is made up of a number of subcatchments. The County provided the population and extents of the subcatchments for the Dewitt Trunk within the landuse information provided in the file "SMD1ParcelsWithBasinAndLanduse_20130603.shp" discussed in section 2.3.

### 3.3.4 Design Storms

Design storms are usually simulated in the hydraulic model to assess the capacity of the sewer system being studied under wet weather conditions. This is typically done with the goal of assessing potential risk of surcharging the system and experiencing SSOs. For the SMD 1 collection system, Placer County Facility Services directed the use of a 10-year, 24-hour design storm to assess the capacity of the wastewater collection system.

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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**Legend**

**Scenario**
- Existing Catchments
- Entitled Catchments
- Full Buildout Catchments
- Timberline Development Lands
- SMD1 WWTP
- SMD1 Buildout Boundary

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Dewitt**
**Modeled Catchments**

Project No. 184030365

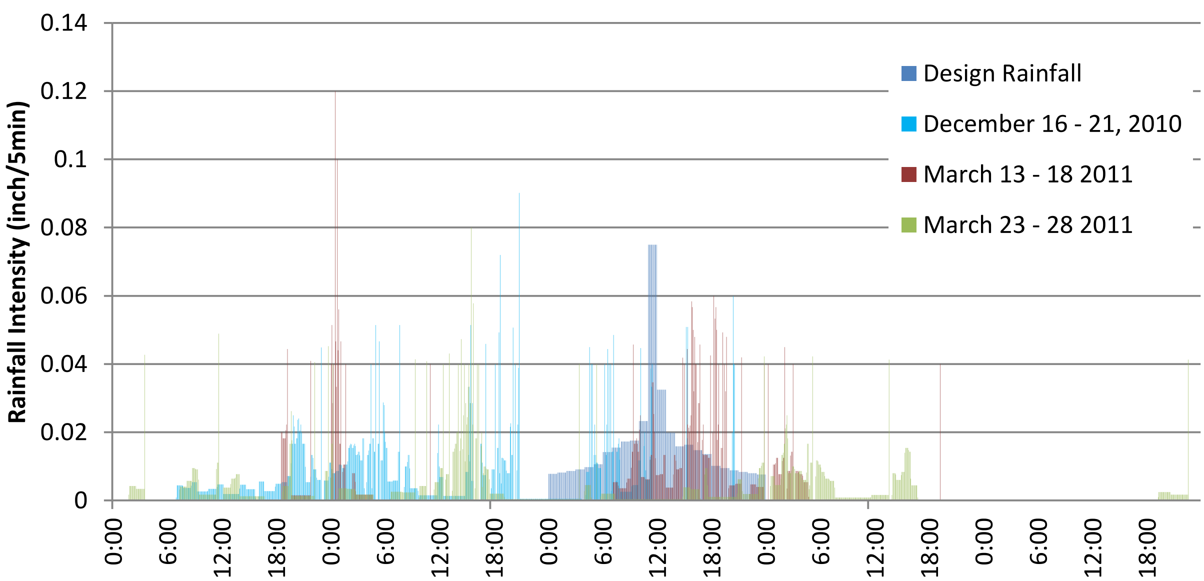
Scale 0 0.1 0.2 0.3 Miles

Figure No. **3-1**

Issue/Revision A/

The procedure outlined in the "Placer County Flood Control and Water Conservation District Stormwater Management Manual" was used as the basis for creating the design storm. The design storm total rainfall over a 24 hour period at 1400 feet elevation was 4.59 inches, distributed such that the peak intensity (0.90 inches/hour) occurred at the mid-way point of the storm event (as prescribed in the Placer County Flood Control and Water Conservation District Stormwater Management Manual). The hyetographs from the 10-year, 24-hour theoretical design storm, as well as three other, representative storms that occurred in the area during 2010 – 2012 are shown in **Figure 3-2**. Further explanation of how these design storms are used in the modeling and capacity assessment is provided in the model calibration section of this chapter.

**Figure 3-2 10-year, 24-hour Design Storm Hyetograph**




## 3.4 MODEL CALIBRATION

The calibration process is required to ensure the accuracy of the model at predicting the system performance under varying flow conditions. Using the flow monitoring data provided, the model was calibrated using actual dry weather and wet weather conditions (both flow monitoring and precipitation data). The calibrated model was then used to assess system performance under design storm conditions.

### 3.4.1 Dry Weather Flow Calibration

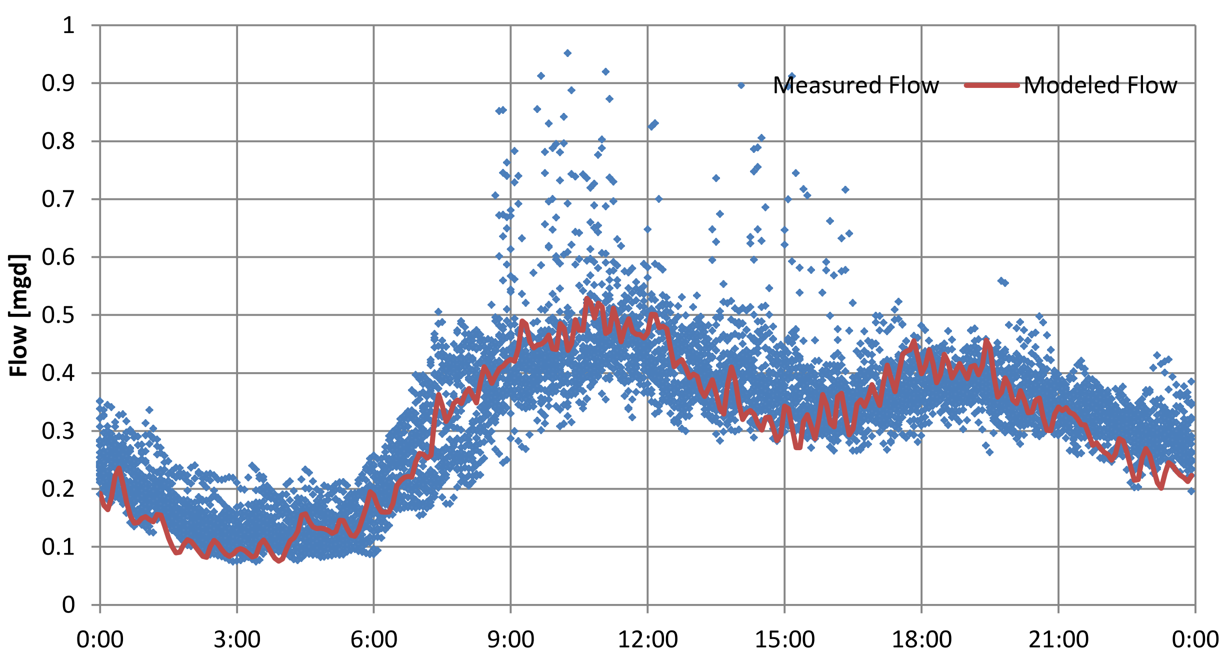
To establish a baseline for the results, the model was calibrated to DWF conditions. It should be noted that the DWF will remain unaffected regardless of the amount of rainfall that occurs, and therefore is the most consistent metric available. The model was compared against four (4) weeks of data (Nov 25, 2008 to Dec. 20, 2008) collected from a flow monitor located downstream along the Dewitt Trunk, in manhole AG2-03. The process for calibration included the establishment of a DWF diurnal pattern. The values of the GWI, the ADWF and the DWF peaking factors (within the diurnal pattern) were adjusted based upon the calibration criteria. The accuracy of each calibration iteration was determined qualitatively by a visual inspection and quantitatively through an analysis of the minimum, maximum, and average flows for the period. The comparison of these statistics is shown in **Table 3-3**.

### Table 3-3 DWF Calibration Results

| Calibration Results for WWTP Flows | Average DWF [mgd] | Peak DWF [mgd] | Minimum DWF [mgd] |
|---|---|---|---|
| **Modeled Flow** | **0.301** | **0.529** | **0.075** |
| **Measured Flow** | 0.317 | 0.952 | 0.075 |
| **% Error** | **-5.29%** | **-44.46%** | **1.14%** |

**Figure 3-3** shows the comparison of the "Measured" and "Modeled" DWF at the WWTP, with all of the data superimposed to eliminate the extraneous variability in day-to-day flow.

### Figure 3-3 DWF Calibration Plot




Generally, the model would be considered calibrated if the difference between the modeled flow and the measured flow was less than 5%. As the reported difference in peak flow is in excess of 44% difference, an explanation is warranted. During the course of the calibration, it was determined that a short, intense increase in flow was occurring at unpredictable times during the 2008 flow monitoring season. This increase in flow was assessed to be "real" data (i.e., not a result of flow monitoring error) as the increase was also measured at the Joeger Road WWTP. However, more recent data collected at the Joeger Road WWTP suggests that this unpredictable source of flow has been eliminated. Unfortunately, no data from the flow monitor in manhole AG2-03 is available for the more recent years, and is not unable to corroborate this suggestion. Regardless, these spikes in flow were considered to be abnormal and not representative of typical flow.

### 3.4.2 Wet Weather Flow Calibration

The calibrated DWF model was used as the basis for expanding the model to include WWF. The four rainfall events established in Section 3.3.4 of this report were used for the calibration. Note that the rainfall events occurred after the collection of flow data along the Dewitt Trunk terminated. Therefore, the flow data gathered at the Joeger Road WWTP was used as the basis for the WWF model.

The Mike Urban software utilizes two sets of calculation engines to model the RDII response in the network during WWF. The RDII response is simulated through the use of the "RDI" and the "Model A" equations.

The "RDI" equations characterize how the network responds to the long duration infiltration of water into the network through seepage or cracks in the sewers (the slow response). The "Model A" equations characterize how the network responds to the direct inflow of water into the network through manholes, cross-connections, roof leaders or other openings (the fast response).

A summary of the WWF finalized calibration parameters is shown in **Table 3-4**.

### Table 3-4 Mike Urban RDII Equation Parameters

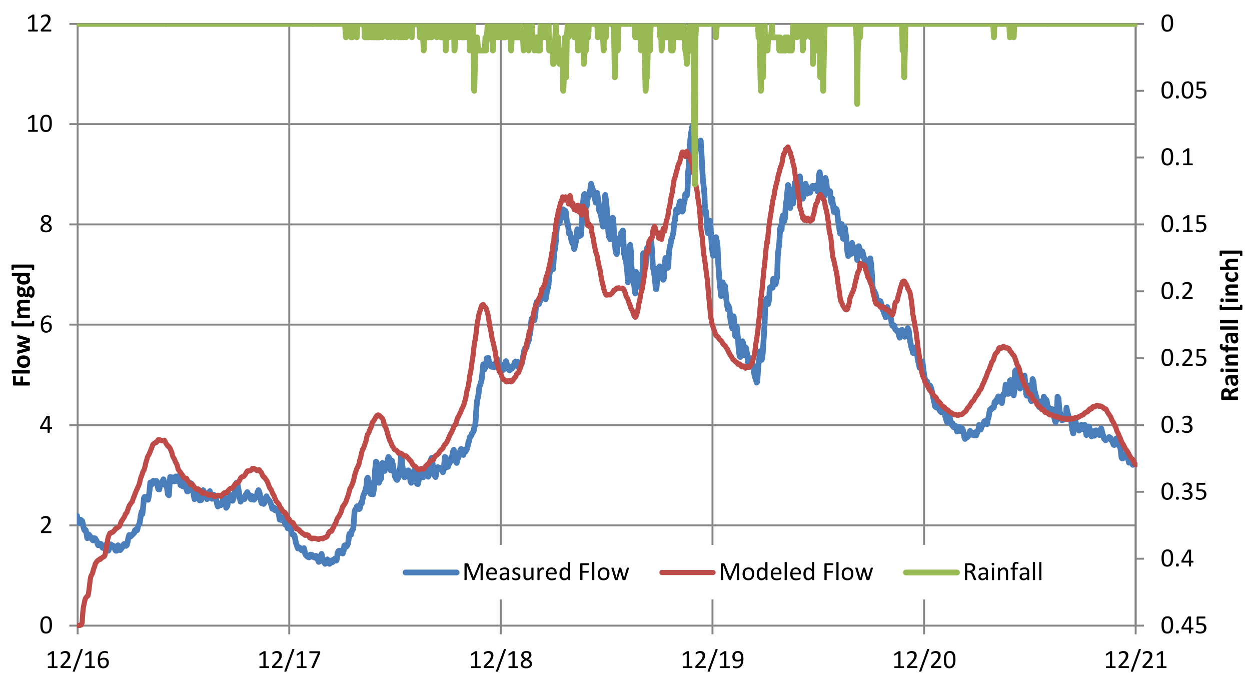
| Model A Parameters | |
|---|---|
| Impervious Area [%] | 1.1 |
| Reduction Factor [1/1] | 0.7 |
| Initial Loss [inch] | 0.03 |
| Time of Concentration [min] | 120 |
| | |
| RDI Parameters | |
| RDI Area [%] | 14 |
| Umax [inch] | 2 |
| Lmax [inch) | 40 |
| Cqof [1/1] | 0.3 |
| Carea [1/1] | 1 |
| Ck [h] | 8 |
| Ckif [h] | 300 |
| Ckbf [h] | 500 |
| Tof [1/1] | 0 |
| Tif [1/1] | 0 |
| Tg [1/1] | 0 |
| InitU [inch] | 0 |
| InitL [inch] | 20 |
| InitGwl [ft] | 32.808 |
| InitOf [in/h] | 0 |
| InitIf [in/h] | 0 |
| GwSy [1/1] | 0.3 |
| GwLmin [ft] | 0 |
| GWLbf0 [ft] | 32.808 |
| GWLfl1 [ft] | 0 |

The WWF model results for the rain events were plotted against the flow monitoring data. **Figure 3-4** through **3-6** show the comparison of the "Measured" and "Modeled" WWF. Results are also summarized in **Table 3-5**.

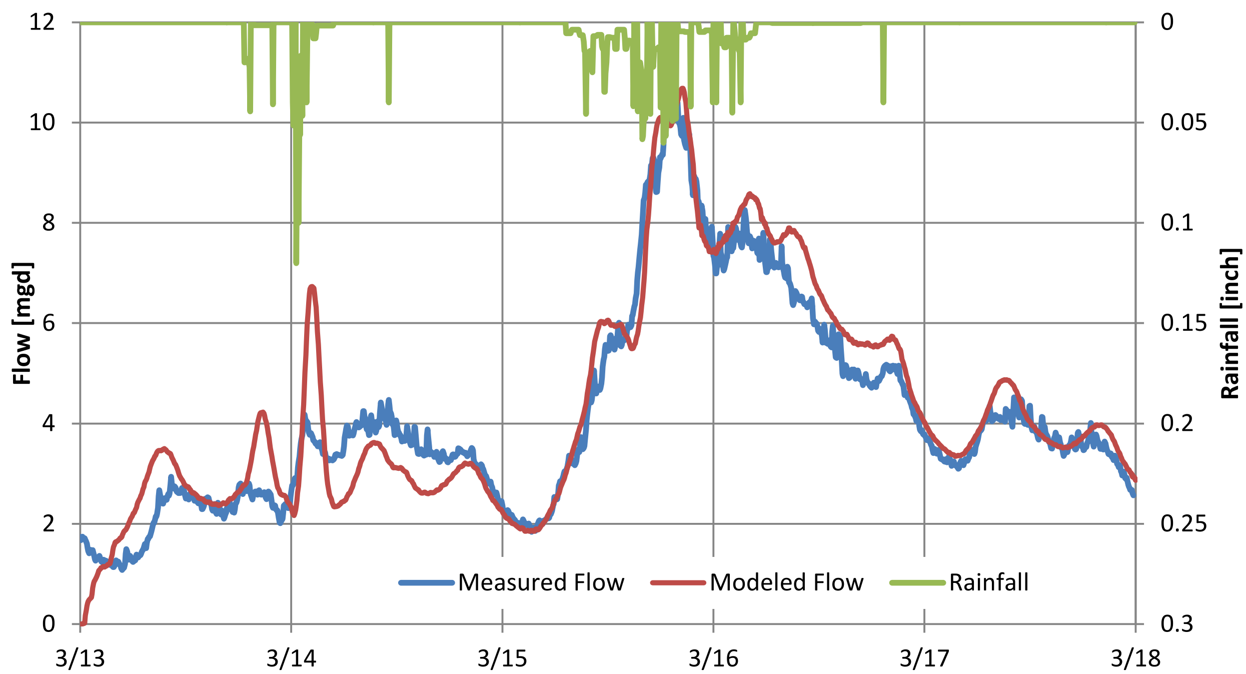
**Table 3-5 WWF Calibration Results**

| Calibration Results for WWTP Flows | Dec 16 – 21, 2010 | | Mar 13 – 18, 2011 | | March 23 – 28, 2011 | | Nov 28 – Dec 5, 2012 | |
|---|---|---|---|---|---|---|---|---|
| | WWF Peak [mgd] | Total Volume [mil gal] | WWF Peak [mgd] | Total Volume [mil gal] | WWF Peak [mgd] | Total Volume [mil gal] | WWF Peak [mgd] | Total Volume [mil gal] |
| **Modeled Flow** | 9.55 | 24.66 | 10.69 | 21.73 | 10.33 | 27.73 | 11.32 | 28.99 |
| **Measured Flow** | 9.98 | 23.72 | 10.42 | 20.80 | 9.85 | 24.97 | 10.43 | 29.06 |
| **% Error** | **(4.33%)** | **3.96** | **2.56%** | **4.48%** | **4.85%** | **11.02%** | **8.55%** | **(0.23%)** |

**Figure 3-4 December 16th – 21st, 2010 Calibration Results**



### Figure 3-5 March 13th – 18th, 2011 Calibration Results




### Figure 3-6 March 23rd – 28th, 2011 Calibration Results

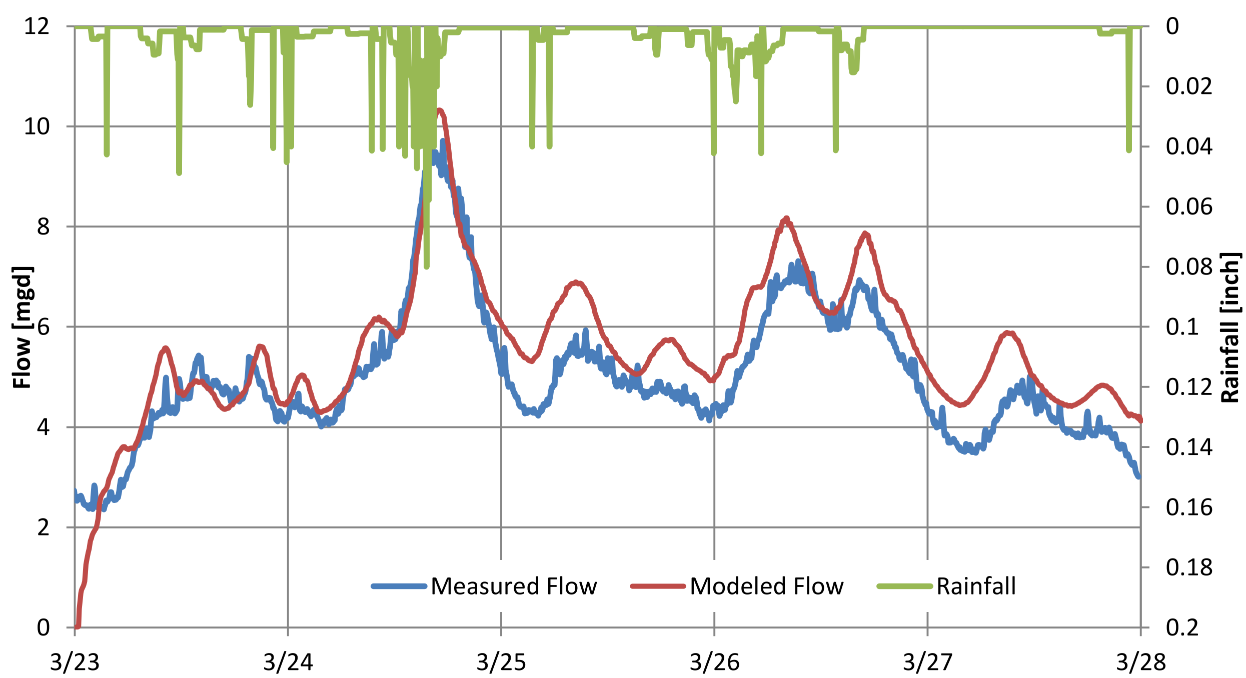
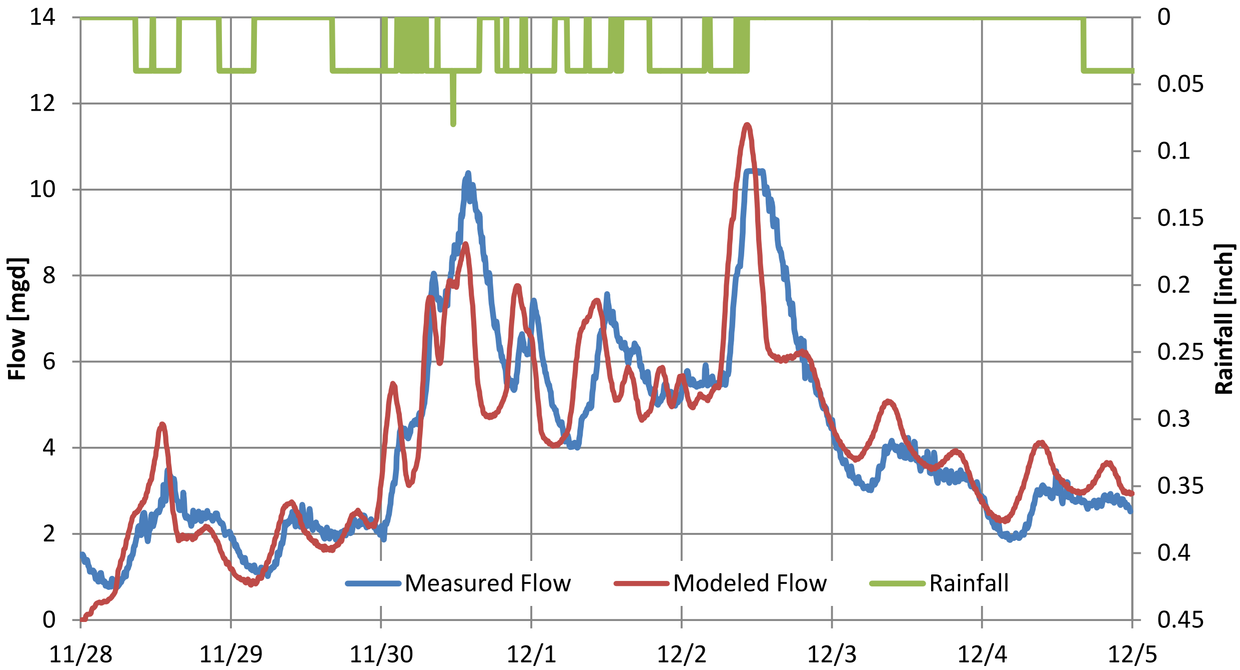


**Figure 3-7 November 28th – December 5th, 2012 Calibration Results**



# 4.0 Wastewater Collection System Capacity Evaluation

## 4.1 PURPOSE

The purpose of this chapter is to provide a summary of the results of the level of service (LOS) performance of the Dewitt Trunk Sewer applying the 1:10-year, 24-hour design storm design event upon the various growth scenarios.

This chapter is divided into the following sections:

- Recommended Capacity Evaluation Criteria
- Modeled Scenarios
- Model Results:
    - Existing System
    - Existing System + Timberline Phase 1 Development
    - Existing System + Entitled
    - Existing System + Entitled + Timberline Phase 1 Development
    - Existing System + Entitled + Timberline Full Build-out Development
    - Build-out of System

## 4.2 RECOMMENDED CAPACITY EVALUATION CRITERIA

The design rainfall event was applied to the Mike Urban model to evaluate the LOS performance in meeting the following primary criteria, which were defined by Placer County Facility Services:

- Freeboard
- Velocity
- Pipe capacity

### 4.2.1 Level of Service Criteria

Freeboard in a manhole is defined as the distance between the rim elevation and the hydraulic grade line (HGL). The manhole is considered to be surcharged when the HGL exceeds the pipe crown.

For freeboard for existing manholes, there are two deficiency criteria for this analysis:

1. When the rim elevation is less than or equal to 8-feet above the pipe crown:

   a. No surcharging is allowed.

2. When the rim elevation is more than 8-feet above the pipe crown:
   a. A pipeline is hydraulically deficient if there is less than 8-feet of freeboard or the surcharging is equal to or greater than 1-foot above the pipe crown.

For new improvements to the Dewitt trunk system, no hydraulic surcharging is allowed in manholes.

### 4.2.2 Velocity

Gravity sewer shall allow a minimum flow velocity of 2.5 ft/s and a maximum of 7 ft/s. All sewers that have a velocity outside of these criteria shall be identified.

Force mains shall allow a minimum flow velocity of 2 ft/s and a maximum of 7 ft/s. All force mains that have a velocity outside of these criteria shall be identified.

### 4.2.3 Pipe Capacity

Sewer pipes shall conform to the following capacity criteria under design storm conditions.

- d/D shall be a maximum of 70% for pipe less than or equal to 24 inch
- d/D shall be a maximum of 100% for pipe greater than 24 inch

## 4.3 MODEL RESULTS

The average DWF and peak WWF model results are summarized in **Table 4-1** and described in more detail in the following sections.

**Table 4-1 Design Event Flow Summary (Dewitt Trunk @ MH AG2-03)**

| | Average DWF [mgd] | Peak DWF [mgd] | Peak WWF [mgd] |
|---|---|---|---|
| **Existing Conditions** | 0.282 | 0.518 | 2.909 |
| **Existing + Timberline Phase 1** | 0.322 | 0.607 | 2.934 |
| **Existing + Entitled** | 0.309 | 0.557 | 2.917 |
| **Existing + Entitled + Timberline Phase 1** | 0.356 | 0.627 | 2.938 |
| **Existing + Entitled + Timberline Full Build-out** | 0.494 | 0.854 | 2.983 |
| **Dewitt Trunk Ultimate Build-out** | 0.838 | 1.319 | 3.233 |

### 4.3.1 Existing System – Design Storm Event

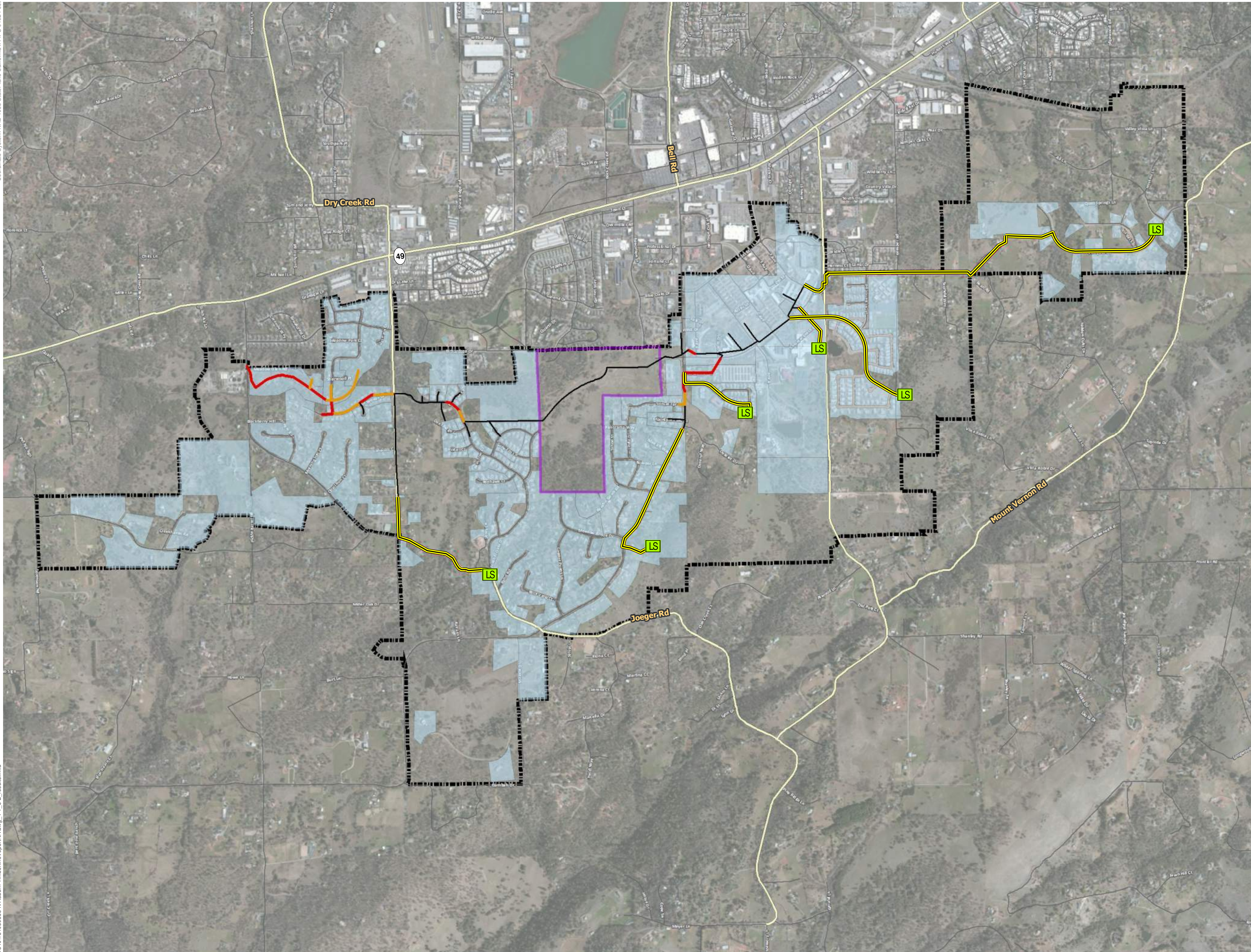
Under existing conditions, a 10-year, 24-hour design storm event is predicted to generate a peak flow of 2.909 mgd in the Dewitt Trunk sewer. This storm event is predicted to cause surcharging in several reaches along the Dewitt Trunk Sewer as well as in lateral sewers downstream of several of the lift stations. Model simulation results for the existing system during peak WWF conditions are presented in **Figure 4-1**, which indicate the following:

- Sewers shown as black lines are not predicted to have capacity issues.
- Sewers shown in green are identified as sewers that are surcharged due to downstream conditions though have sufficient freeboard to meet the County's Level of Service (LOS) criteria.
- Sewers shown in blue are identified as sewers that are surcharged due to insufficient capacity though have sufficient freeboard to meet the County's LOS criteria.
- Sewers shown in orange and red are sewers that are surcharged to an extent such that they do not meet the County's LOS criteria, and are resultant from downstream conditions and insufficient capacity, respectively.

To help identify the extent of surcharging within the existing network, hydraulic grade line (HGL) profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Dewitt Trunk. Note that these profiles also include the results for the other growth scenarios, to be discussed in the following sections.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: there is no expected surcharging.
- **Figure B-3A**: there is no expected surcharging.
- **Figure B-4**: minor surcharging (<2ft) along Deer Ridge Lane and terminating approximately 50ft downstream of White Doe Court, affecting approximately 700ft of 10 inch sewer. The surcharging is a result of insufficient sewer capacity and is expected to have less than 8ft of HGL freeboard, and therefore does not meet the County's LOS criteria.
- **Figure B-5**: severe surcharging resulting along Riverwoods Drive and Sherwood Way, an expected sanitary sewer overflows (SSOs) downstream of Sherwood Lane, affecting a total of over 3500ft of sewer ranging in size from 8 inches to 15 inches.

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Legend

**LOS Results - 1:10yr Design Rainfall**
- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Forcemain

**Scenario**
- Existing Catchments
- Timberline Development Lands
- Dewitt Buildout Boundary
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
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**North Auburn, Placer County**

Title

## Existing Level of Service

| Project No. | Scale |
|---|---|
| 184030365 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 4-1 | A/ |

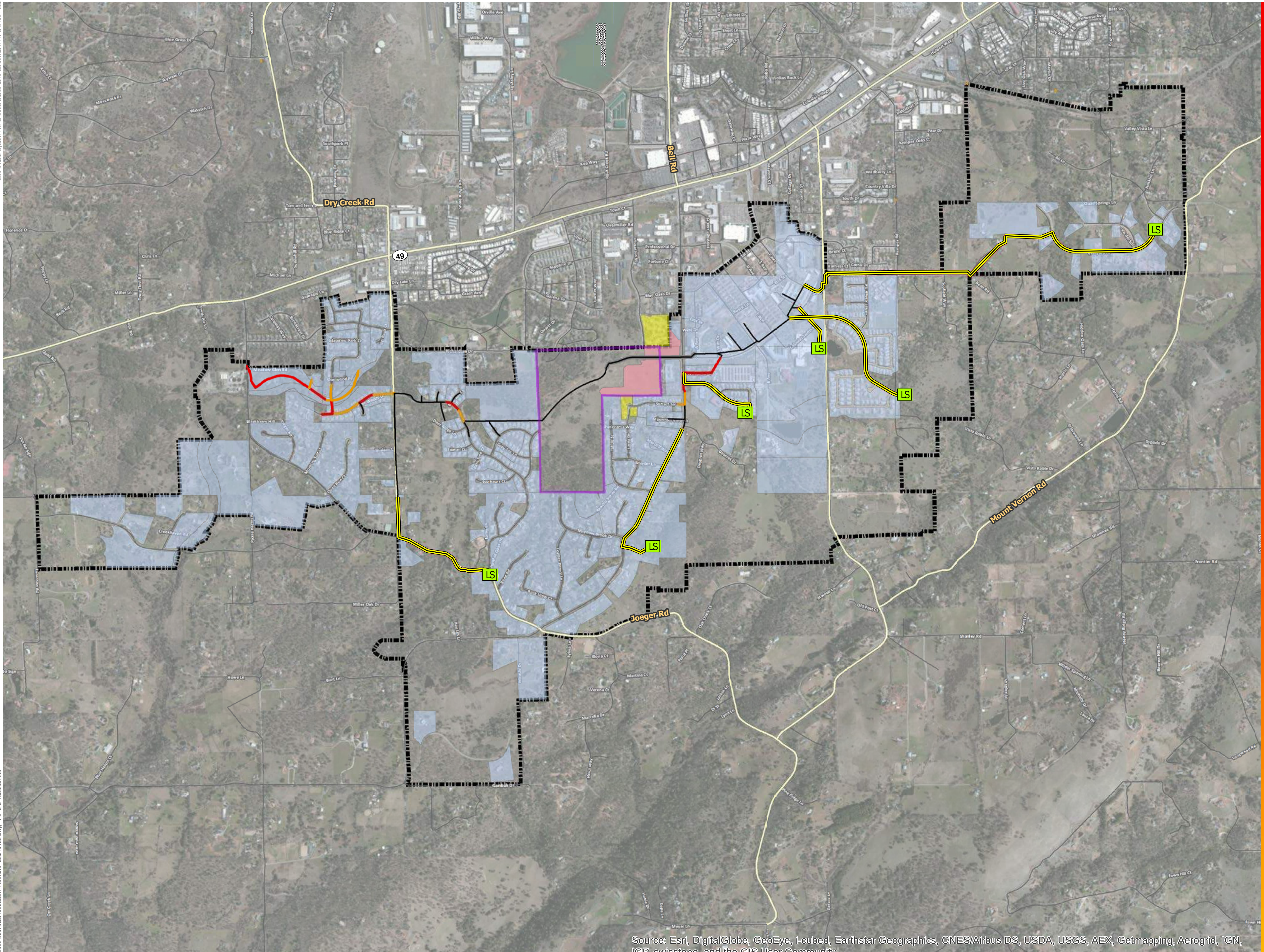
### 4.3.2 Existing System + Timberline Phase 1 Development – Design Storm Event

As part of the phase 1 Timberline development, a portion of the Dewitt trunk has been proposed to be re-aligned. It is predicted that the inclusion of phase 1 of the Timberline development, along with the re-alignment, will increase the flow within the Dewitt Trunk to 2.921 mgd. The surcharging in this scenario is expected to increase, but is not expected to affect any sewers not already surcharged under existing conditions. Model simulation results for the existing system and entitled projects during peak WWF conditions are shown in **Figure 4-2**.

To help identify the extent of surcharging within the existing network, HGL profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Dewitt Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: there is no expected surcharging.
- **Figure B-3B**: there is no expected surcharging along either the portion of realigned sewer, or the downstream existing sewer.
- **Figure B-4**: the surcharging along Deer Ridge Lane is not expected to affect any additional sewer. However, the HGL freeboard is expected to decrease by up to 0.9 ft (manhole AE2-51).
- **Figure B-5:** the surcharging in this reach is expected to universally worsen. No additional SSOs are expected to occur, though it is predictable that the intensity of overflow will increase.

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Legend

**LOS Results - 1:10yr Design Rainfall**

- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Forcemain
- Timberline Development Lands

**Scenario**

- Existing Catchments
- Timberline Phase 1 New Alignment
- Timberline Phase 1
- Offsite Catchments
- Dewitt Buildout Boundary
- LS Lift Stations

Client/Project

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**North Auburn, Placer County**

Title

**Existing + Timberline PH1 Level of Service**

| Project No. | Scale |
| --- | --- |
| 184030352 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
| --- | --- |
| 4-2 | A/ |

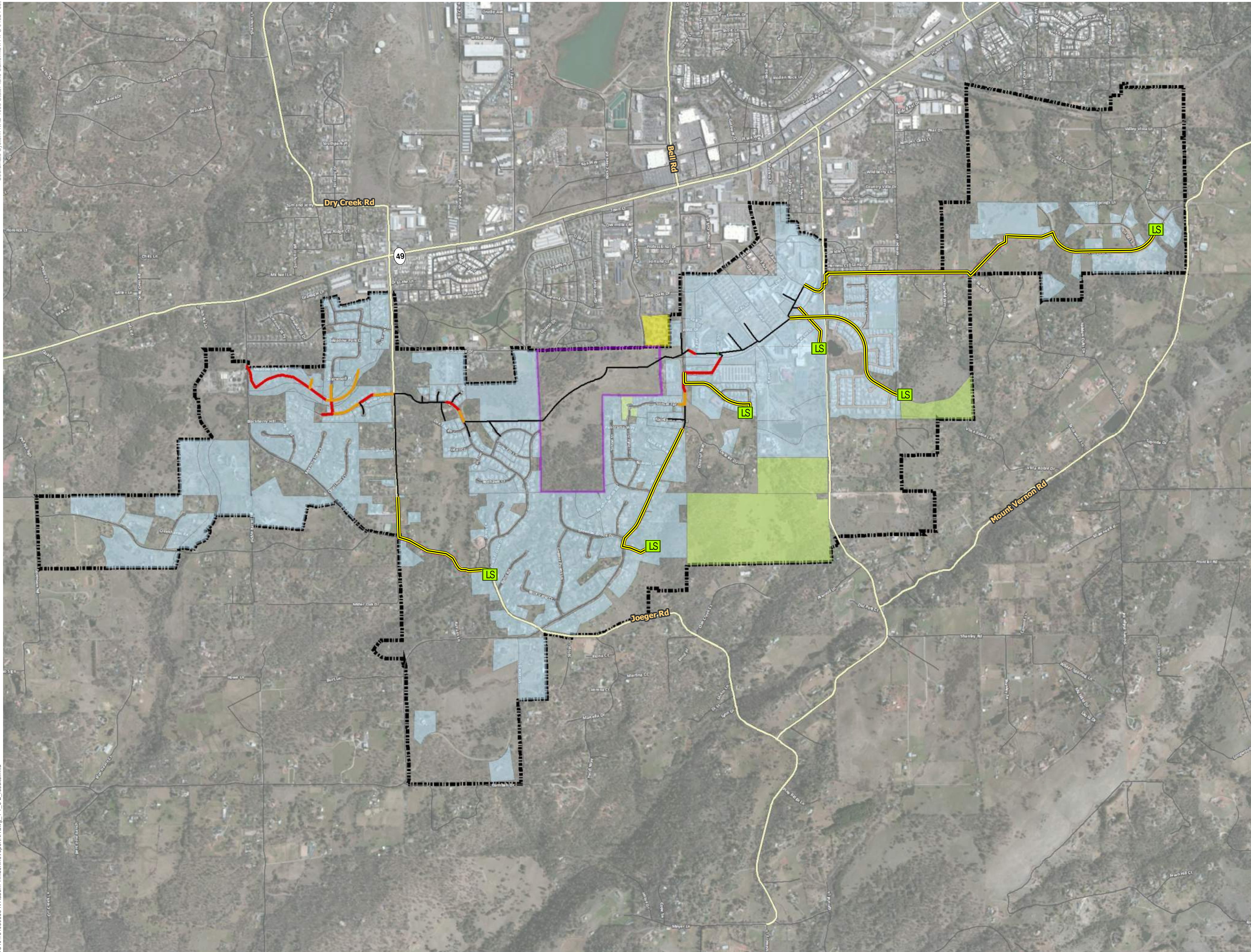
### 4.3.3 Existing System + Entitled Developments – Design Storm Event

It is predicted that should every property that is currently entitled to wastewater service proceed through full development, 2.924 mgd will flow through the Dewitt Trunk. Similar to the inclusion of Timberline phase 1, the surcharging in this scenario is expected to increase, but is not expected to affect any sewers not already surcharged under existing conditions. Model simulation results for the existing system and entitled projects during peak WWF conditions are shown in **Figure 4-3**.

To help identify the extent of surcharging within the existing network, HGL profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Dewitt Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: there is no expected surcharging.
- **Figure B-3A**: there is no expected surcharging
- **Figure B-4**: the surcharging along Deer Ridge Lane is not expected to affect any additional sewer. However, the HGL freeboard is expected to decrease by up to 0.9 ft (manhole AE2-51).
- **Figure B-5:** the surcharging in this reach is expected to universally worsen. No additional SSOs are expected to occur, though it is predictable that the intensity of overflow will increase.





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Legend

**LOS Results - 1:10yr Design Rainfall**
- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Forcemain

**Scenario**
- Existing Catchments
- Entitled Catchments
- Timberline Development Lands
- Offsite Catchments
- Dewitt Buildout Boundary
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
North Auburn, Placer County

Title

**Existing + Entitled Level of Service**

Project No. 184030365

Scale 0 0.1 0.2 0.3 Miles

Figure No. 4-3

Issue/Revision A/

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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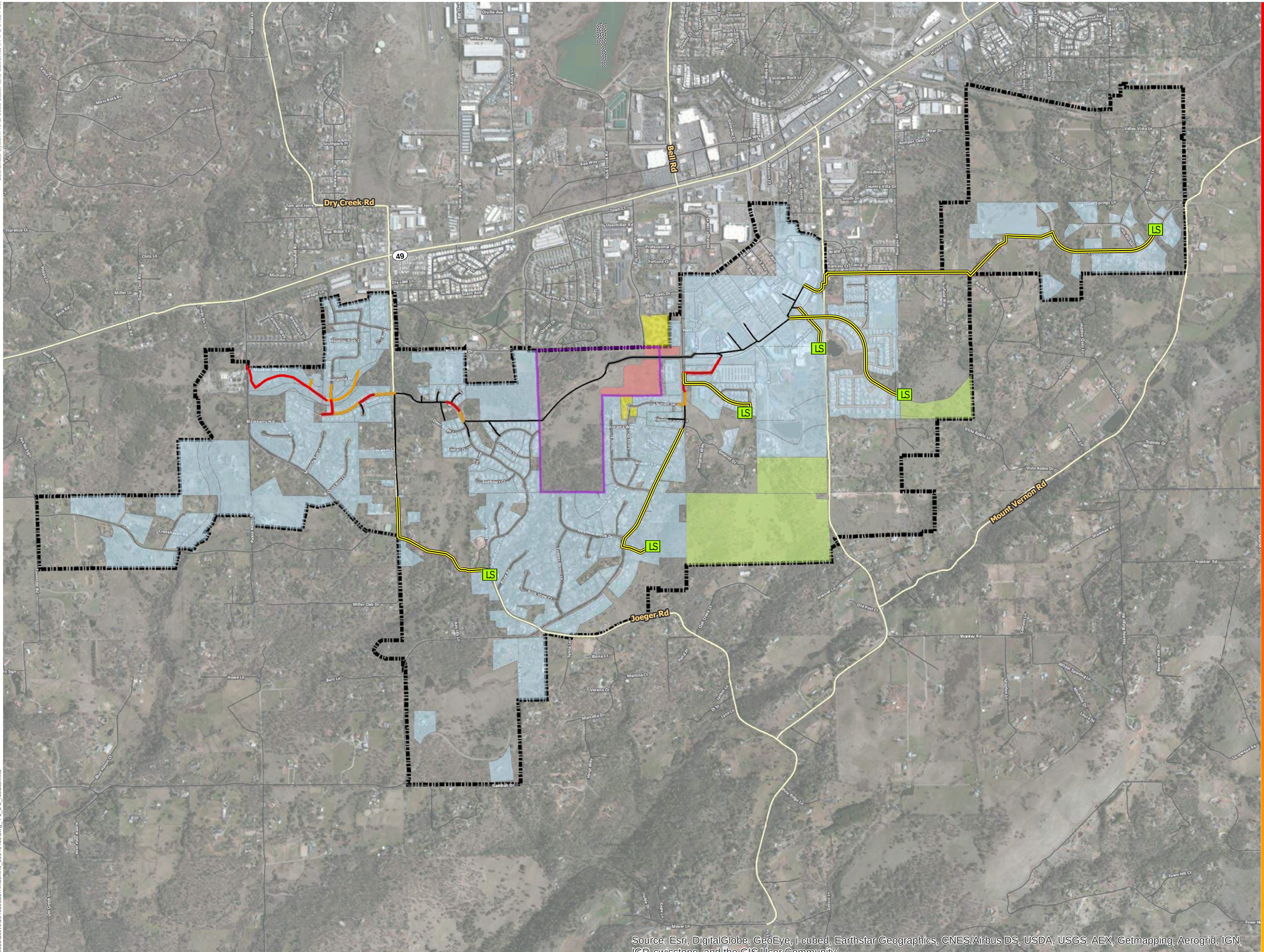
### 4.3.4 Existing System + Entitled Developments + Timberline Phase 1 – Design Storm Event

As part of the phase 1 Timberline development, a portion of the Dewitt trunk has been proposed to be re-aligned. It is predicted that the inclusion of the first phase of the Timberline development and entitled developments, along with the re-alignment, will increase the flow through the Dewitt trunk to 2.938 mgd. Again, the surcharging in this scenario is expected to increase, but is not expected to affect any sewers not already surcharged under existing conditions. Model simulation results for this scenario during peak WWF conditions are shown in **Figure 4-4**.

To help identify the extent of surcharging within the existing network, HGL profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Dewitt Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: there is no expected surcharging.
- **Figure B-3B**: there is no expected surcharging along either the portion of realigned sewer, or the downstream existing sewer.
- **Figure B-4**: the surcharging along Deer Ridge Lane is not expected to affect any additional sewer. However, the HGL freeboard is expected to decrease by up to 1.2 ft (manhole AE2-50).
- **Figure B-5**: the surcharging in this reach is expected to universally worsen. No additional SSOs are expected to occur, though it is predictable that the intensity of overflow will increase.

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Legend

**LOS Results - 1:10yr Design Rainfall**
- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Forcemain
- Timberline Development Lands
- Timberline Phase 1 New Alignment

**Scenario**
- Existing Catchments
- Entitled Catchments
- Timberline PH1
- Offsite Catchments
- Dewitt Buildout Boundary
- LS Lift Stations

Client/Project

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North Auburn, Placer County

Title

**Existing + Entitled + Timberline PH1 Level of Service**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 4-4 | A/ |

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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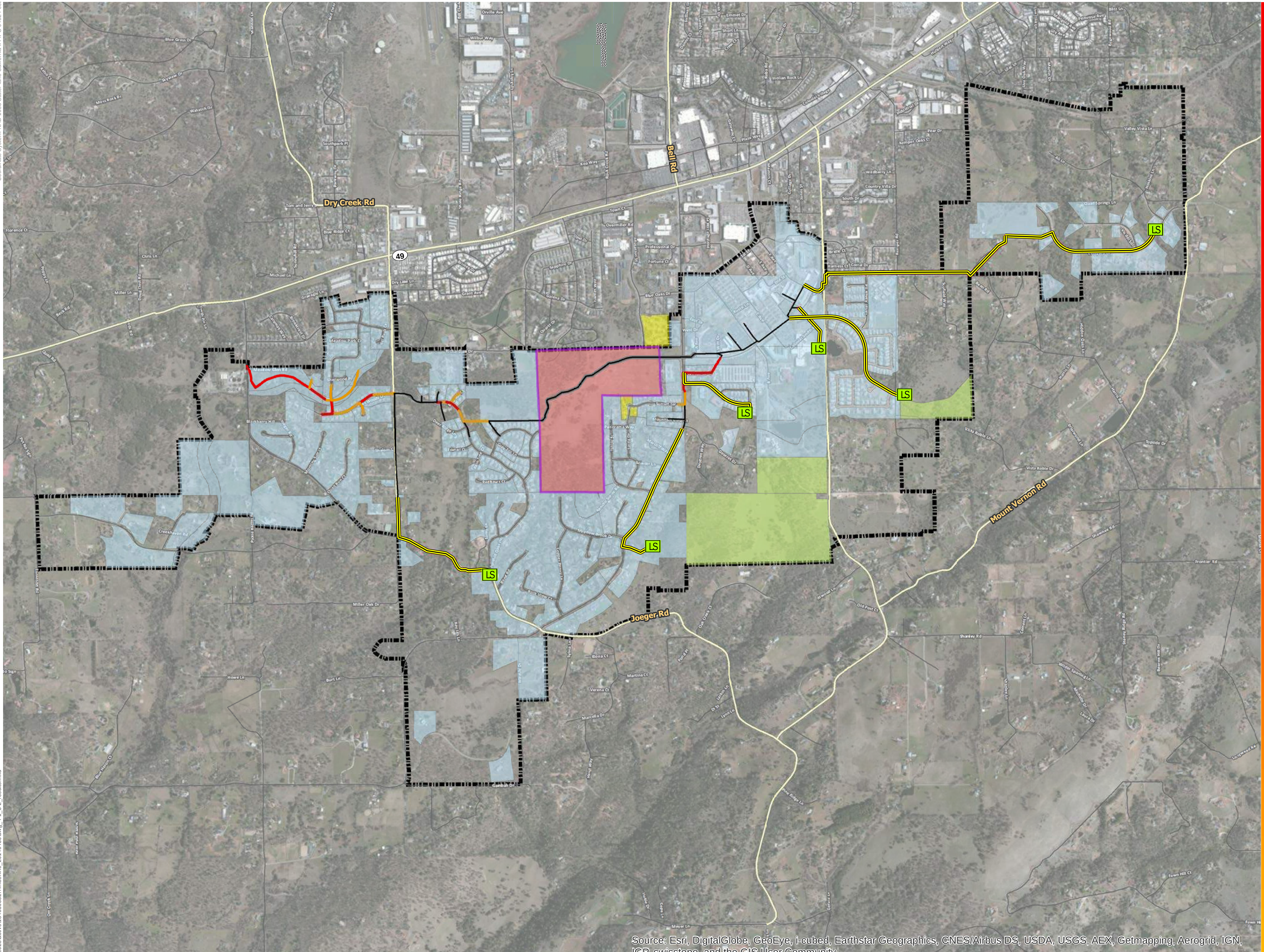
### 4.3.5 Existing System + Entitled Developments + Timberline Buildout – Design Storm Event

This scenario models the Timberline development with the complete re-alignment of the Dewitt trunk within the development area. It is predicted that the inclusion of the full Timberline development and entitled developments, as well as with the re-alignment, the flow through the Dewitt trunk will increase to 2.983 mgd. The additional flow is expected to worsen the surcharging, and affect a few additional sewer sections near to where the surcharging is already occurring. Model simulation results for this scenario during peak WWF conditions are shown in **Figure 4-5**.

To help identify the extent of surcharging within the existing network, HGL profiles have been included and identified by a plan-view keyplan within **Appendix B**, which show the peak surcharge elevation along the Dewitt Sanitary Sewer Trunk for this scenario.

The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: there is no expected surcharging.
- **Figure B-3C**: there is no expected surcharging along the proposed re-aligned sewer.
- **Figure B-4**: the surcharging along Deer Ridge Lane is expected to increase, resulting in an SSO in manhole AE2-26, and will also result in additional surcharging for approximately 440ft upstream.
- **Figure B-5**: the surcharging in this reach is expected to universally worsen. No additional SSOs are expected to occur, though it is predictable that the intensity of overflow will increase further.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet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Legend

**LOS Results - 1:10yr Design Rainfall**

- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Forcemain
- Timberline Development Lands
- Timberline Full Build-out New Alignment

**Scenario**

- Existing Catchments
- Entitled Catchments
- Timberline Full Buildout
- Offsite Catchments
- Dewitt Buildout Boundary
- LS Lift Stations

Client/Project

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**North Auburn, Placer County**

Title

**Existing + Entitled + Timberline BO Level of Service**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 4-5 | A/ |

### 4.3.6 Full Build-out

It is predicted that the Dewitt Trunk will convey a peak flow of 3.23 mgd for this growth scenario under design storm conditions with no improvement made to the collection system. If improvements are made to the collection system to address deficiencies described herein and no reduction in infiltration and inflow is achieved, the model predicts the WWTP will experience peak flows of approximately 6 to 7 Mgal/d from the Dewitt trunk under design storm conditions. The inclusion of all potential catchments using the County's landuse projects is predicted to cause system wide capacity constraints and deficiencies. Model simulation results for this scenario during peak WWF conditions are shown in **Figure 4-6**.

It should be noted that during the modeling process, it was discovered that the existing lift stations are expected to be extremely under capacity for this scenario. As the purpose of this study is to assess the impact of the Timberline development upon the Dewitt Trunk Sewer, it was assumed that the capacities of all of the lift stations were increased and all pumps outfitted with VFDs. This approach avoids any potential underestimate of peak flow and capacity needs downstream of the lift stations while avoiding speculation regarding how the County intends to address these lift station capacity issues. This is an area of the collection system which the County may wish to study further.

How the County chooses to address system deficiencies could affect the ultimate peak flow predicted at the WWTP. For example, if more system storage is provided, peak flow seen at the WWTP could potentially be lower than predicted here. It is Stantec's understanding that system storage in the form of surcharging is not considered by the County a viable option at this time.

To help identify the extent of surcharging within the existing network, HGL profiles have been included in **Appendix B**, which show the peak surcharge elevation along the Dewitt Sanitary Sewer Trunk for this scenario.

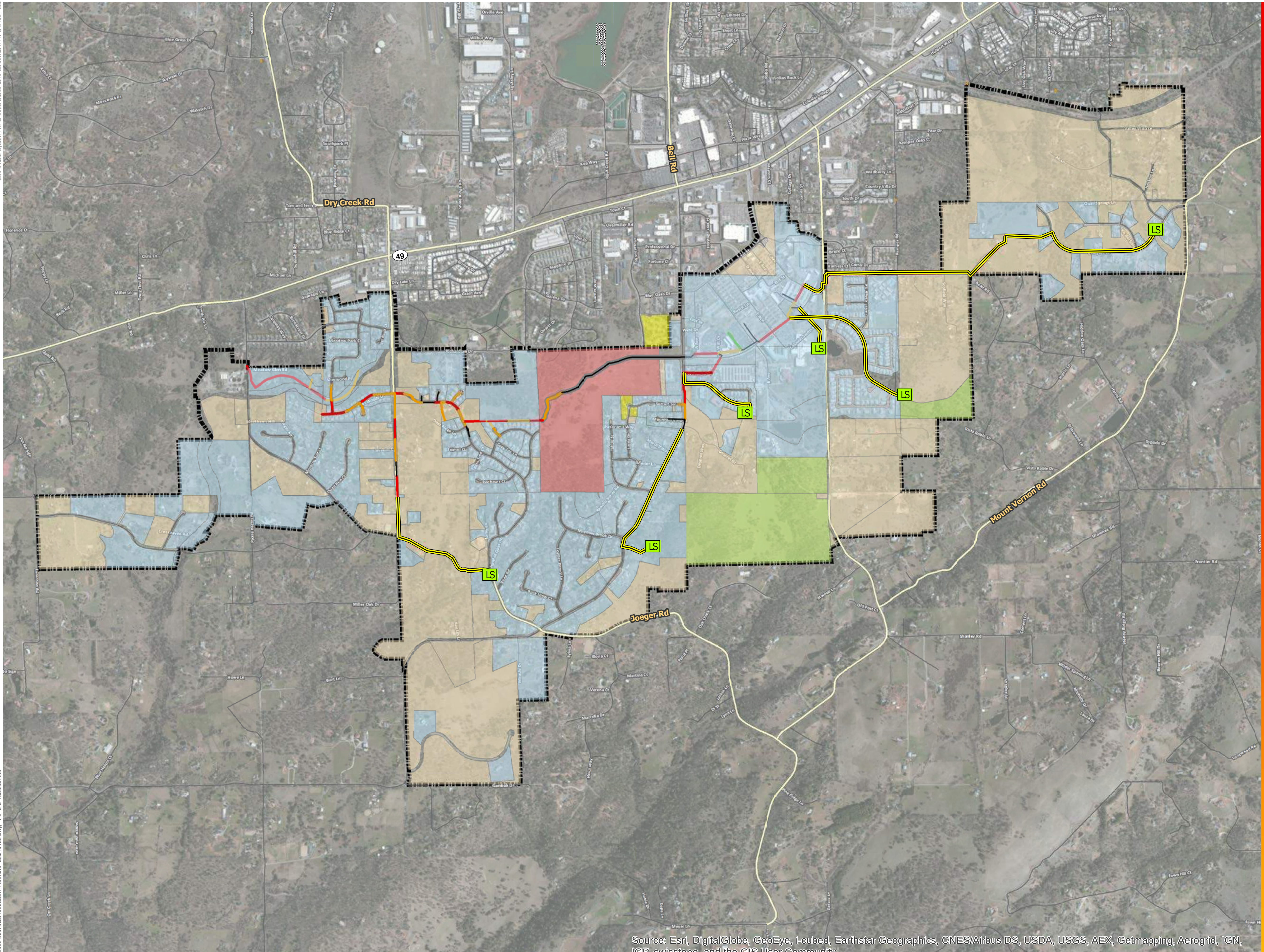
The following provides a summary of the existing system surcharging and corresponding HGL profiles:

- **Figure B-2**: the majority of this profile is expected to surcharge, and an SSO may occur at F Avenue. The surcharging is a result of insufficient capacity in these sewers.

- **Figure B-3C**: severe surcharging is expected to occur in approximately 800 ft of 18 inch sewer. The surcharging is expected to result in an SSO at the downstream manhole within the Timberline development. The surcharging is a direct result of downstream throttling, and is not a result of insufficient pipe sizing in the development.

- **Figure B-4**: severe surcharging is expected to occur along the majority of the 3000ft profile. Many of the manholes are expected to contain SSOs, which is a result of highly insufficient capacity to handle the additional build-out flows.

- **Figure B-5**: severe surcharging is expected to occur along the majority of the 3500ft profile. Many of the manholes are expected to contain SSOs, which is a result of highly insufficient capacity to handle the additional build-out flows.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet


**Stantec**

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3875 Atherton Road
Rocklin, CA 95765
www.stantec.com




Legend

**LOS Results - 1:10yr Design Rainfall**

- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard
- Forcemain

**Scenario**

- Existing Catchments
- Entitled Catchments
- Timberline Full Buildout
- Timberline Full Build-out New Alignment
- Offsite Catchments
- Full Buildout Catchments
- Dewitt Buildout Boundary
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Full Build-out**
**Level of Service**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 4-6 | A/ |

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# 5.0 Recommended Capital Improvement Projects

## 5.1 PURPOSE

The purpose of this chapter is to provide recommendations for capital improvements along the Dewitt wastewater trunk sewer to provide sufficient capacity to eliminate all occurrences of surcharging that were predicted to occur during a 10-year, 24-hour design storm event. It is anticipated that the County will review and incorporate the recommended capital improvements into a short term Capital Improvement Plan (CIP) unless the County chooses to evaluate alternate servicing options not limited to upsizing of existing sections of trunk sewer. The scope of this study is limited to upsizing options. No alternative trunk alignments (parallel or otherwise) or pumping options have been considered. The model results for the ultimate build-out system during a 10-year, 24-hour storm event, detailed in Chapter 4, have been used as the basis for these capital improvement recommendations.

## 5.2 RECOMMENDED IMPROVEMENT TO EXISTING TRUNK SYSTEM TO ACCOMMODATE EXISTING BUILD-OUT AND NEAR-TERM BUILD-OUT DEFICIENCIES

The results of the existing system scenario and all scenarios through to the existing system + entitled projects + full Timberline development scenario are the basis for recommendation of upgrades to the existing Dewitt trunk sewer presented in this section. Note that the results indicate throttling of the peak flow, and that upgrades to only the surcharged sewer may result in surcharging in sewers previously unaffected. Therefore, an upgrade scenario was modeled to identify all sewers along the Dewitt trunk that require upgrades to produce a result that does not exceed the County's LOS criteria. A summary of the findings is presented in **Table 5-1**.

### Table 5-1 Recommended Sewer Upgrades For Near-Term Developments

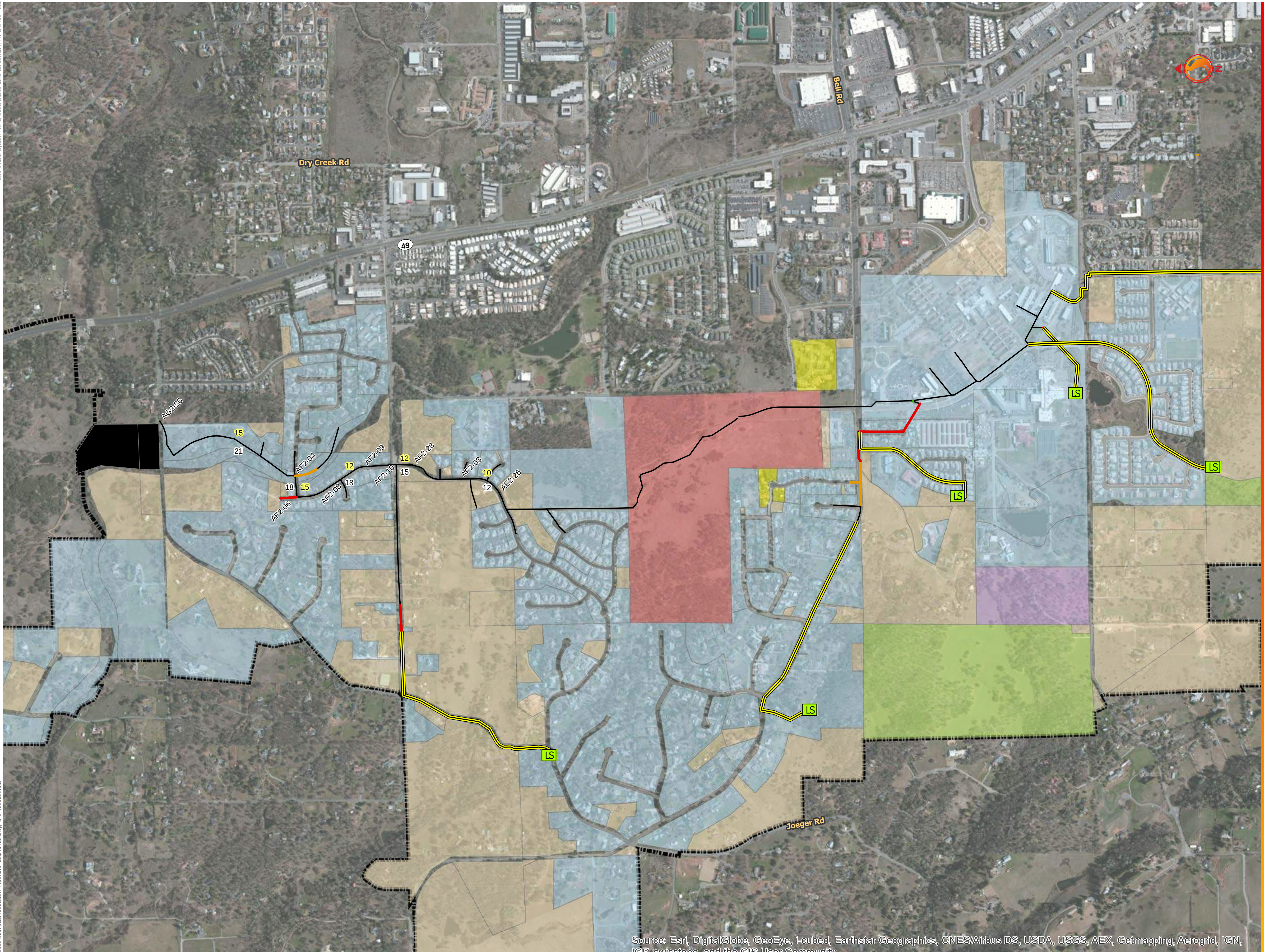
| Pipe Segment | | Existing Diameter, inches | Length of Sewer Upgrades, feet | Sizing for Existing System, inches (a) | Sizing for Existing + Timberline Phase 1, inches | Sizing for Existing + Entitled, inches | Sizing for Existing + Entitled + Timberline Phase 1, inches | Sizing for Existing + Entitled + Timberline Buildout, inches |
|---|---|---|---|---|---|---|---|---|
| Upstream MH ID | Downstream MH ID | | | | | | | |
| AE2-26 | AF2-63 | 10 | 503 | 12 | 12 | 12 | 12 | 12 |
| AF2-28 | AF2-10 | 12 | 193 | 12 | 12 | 12 | 12 | 15 |
| AF2-09 | AF2-08 | 12 | 303 | 15 | 15 | 15 | 15 | 18 |
| AF2-06 | AF2-04 | 15 | 331 | 18 | 18 | 18 | 18 | 18 |
| AF2-04 | AG2-26 | 15 | 1931 | 21 | 21 | 21 | 21 | 21 |

(a) Sizing for Existing System represents the sewer sizing (diameter) required to accommodate existing wastewater flows with no deficiency predicted by the model simulation(s).

**Figure 5-1** shows, in plan view, the sewers that are recommended to be upgraded for the near-term growth scenarios.

**Figures B-6** through **B-9** in Appendix B show the impact of the improvements upon the existing system and all near-term development as HGL profiles. **Figure B-1** in Appendix B provides a keyplan for the specified profiles.

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet





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Legend

- \# Existing Sewer Diameter [inch]
- \# Upgrade Diameter [inch]
- Forcemain
- No Surcharging
- Backwatered with allowable freeboard
- Backwatered without allowable freeboard
- Throttled with allowable freeboard
- Throttled without allowable freeboard

**Scenario**

- Existing Catchments
- Existing Catchments with Internal Growth
- Entitled Catchments
- buildout_nodes
- Timberline Full Buildout
- Offsite Catchments
- Full Buildout Catchments
- SMD1 WWTP
- SMD1 Buildout Boundary
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Full Build-out With Near Term Upgrades**
**Level of Service**
**1:10 Year 24hr WWF**

| Project No. | Scale |
|---|---|
| 184030365 | 0 300 600 900 Feet |

| Figure No. | Issue/Revision |
|---|---|
| 5-1 | A/ |

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## 5.3 RECOMMENDED IMPROVEMENTS TO EXISTING TRUNK SYSTEM TO ACCOMMODATE ULTIMATE BUILD-OUT OF SYSTEM

The results of the ultimate build-out analysis were the basis for the recommendation of upgrades to the existing Dewitt trunk sewer. Note that the results indicate significant throttling of the peak flow, and that upgrades to only the surcharged sewer may result in surcharging in sewers previously unaffected. Therefore, an upgrade scenario was modeled to identify all sewers along the Dewitt trunk that require upgrades. A summary of the findings is presented in **Table 5-2**.

**Table 5-2 Recommended Sewer Upgrades For Full-Buildout**

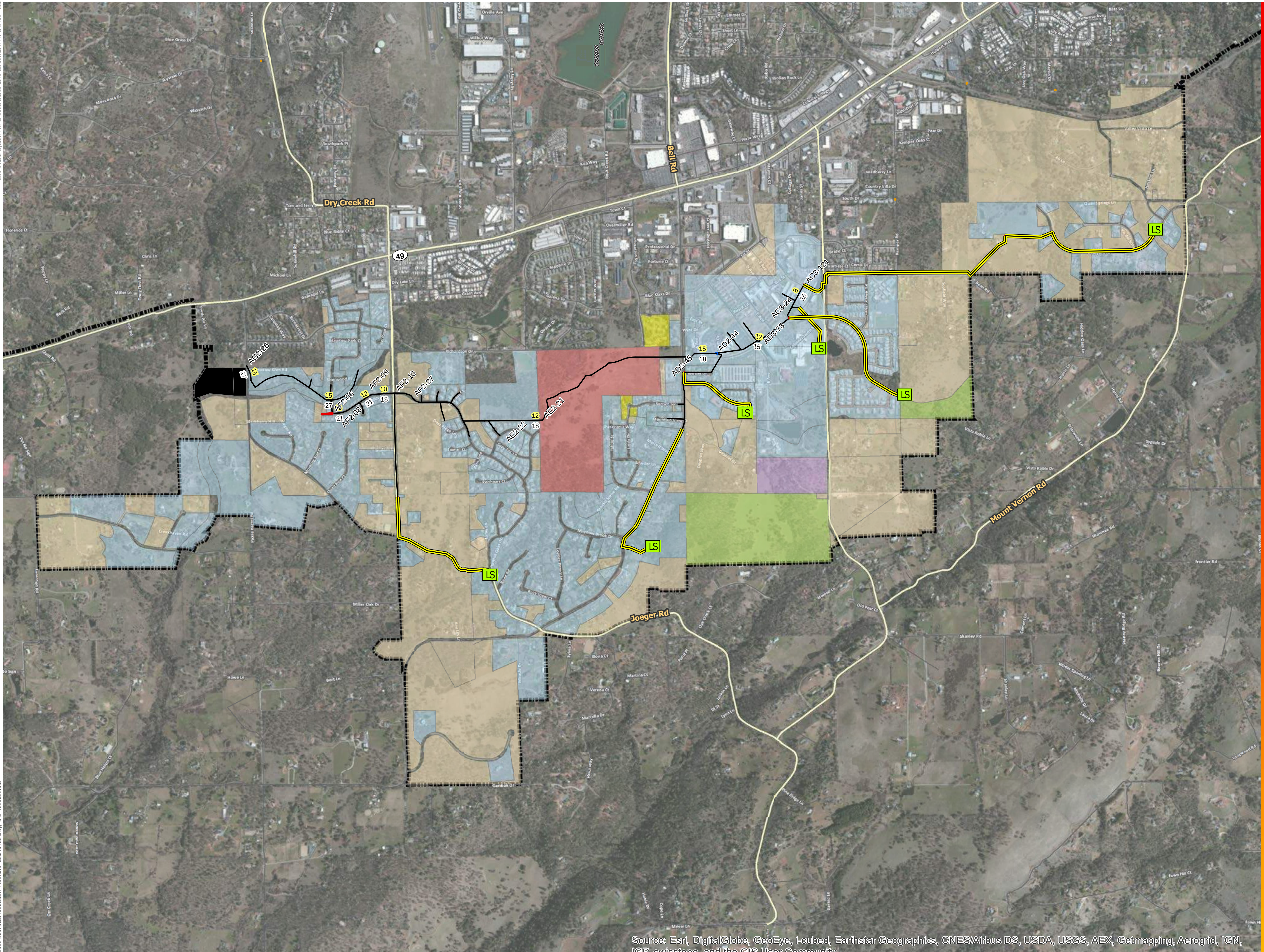
| Pipe Segment | | Existing Diameter, inches | Length of Sewer Upgrades, feet | Hydraulically Required Diameter, inches | Sewer Diameter Based on Placer County Policy[1], inches |
|---|---|---|---|---|---|
| Upstream MH ID | Downstream MH ID | | | | |
| AC3-121 | AC3-24 | 8 | 332 | 15 | 15 |
| AC3-24 | AD3-78 | 12 | 1097 | 15 | 15 |
| AD2-44 | AD2-45 | 15 | 395 | 18 | 18 |
| AE2-21 | AE2-22 | 12 | 261 | 18 | 18 |
| AE2-22 | AF2-27 | 10 | 2330 | 15 | 18 |
| AF2-27 | AF2-10 | 12 | 374 | 18 | 18 |
| AF2-10 | AF2-09 | 10 | 365 | 18 | 18 |
| AF2-09 | AF2-08 | 12 | 303 | 21 | 21 |
| AF2-08 | AF2-06 | 10 | 551 | 18 | 21 |
| AF2-06 | AG2-26 | 15 | 2262 | 27 | 27 |

1 Placer County has adopted a policy requiring downstream sewer pipes to be of equal or greater diameter to the upstream pipe, despite the fact that steeper downstream sewers may have greater hydraulic capacity than larger diameter but flatter upstream sewers.

**Figure 5-2** shows the results of the capacity assessment post-completion of the capital improvements and identify in plan view the sewers that are recommended to be upgraded.

**Figures B-10** through **B-13** in Appendix B show the impact of the improvements as HGL profiles. **Figure B-1** in Appendix B provides a keyplan for the specified profiles.

Note, recommendations for lift stations, etc. were not included in the scope of this evaluation. As discussed within Section 4.3.6, many of the lift stations were identified as potentially having insufficient capacity. It is recommended that the capacity of the lift stations be assessed, and upgrades to proceed as required.




Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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Legend

- # Existing Diameter [inch]
- # Upgrade Diameter [inch]
- Forcemain
- SMD1 WWTP
- Timberline Full Buildout

**Scenario**

- Existing Catchments
- Existing Catchments with Internal Growth
- Entitled Catchments
- Full Buildout Catchments

**MajorShed**

- Offsite Catchments
- SMD1 Buildout Boundary
- LS Lift Stations

Client/Project

**WESTERN CARE CONSTRUCTION, INC.**
**SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE**
**North Auburn, Placer County**

Title

**Full Build-out With Upgrades**
**Level of Service**
**1:10 Year 24hr WWF**

| Project No. | Scale |
|---|---|
| 184030352 | 0 0.1 0.2 0.3 Miles |

| Figure No. | Issue/Revision |
|---|---|
| 5-2 | A/ |

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## 5.4 TIMBERLINE DEVELOPMENT SPECIFIC IMPACTS TO DEWITT TRUNK

Based on the information presented in Chapter 4 of this report, the impact of the proposed Timberline development on the Dewitt Trunk is limited. Analysis of the results of simulations suggests that the upsizing necessary to address existing deficiencies would also be sufficient to provide capacity for wastewater generated by the majority of the Timberline development. Only one additional upgrade of 100 feet would be required over and above the upgrades to the existing system.

It is Stantec's understanding that Placer County Facility Services wishes to address relative impacts of projects connecting to the Dewitt Trunk in the context of the trunk sizing necessary to accommodate full build-out of the SMD 1 service area. As such, it would appear that impact of the Timberline development on the Dewitt Trunk could be expressed as the proportional share of the project of the cost of trunk upsizing necessary downstream of the project to provide capacity for full service area build-out.

This leads to the conclusion that the Timberline development "share" of these improvements can be described as the pipe upsizing necessary to bring the downstream trunk diameters with sizing for Existing System presented in Table 5-1 up to the diameter identified in Table 5-2. If the proposed Timberline Development project representing 839 EDU of needed capacity is compared to the total number of future build-out EDUs utilizing capacity in the various trunk segments downstream, a percentage of the expected cost for those improvements can be estimated.

**Table 5-4** summarizes the relative share of the capacity increase recommended in Table 5-2 attributable to the Timberline project.

**Table 5-3 Relative Growth Increase**

| | Total Acreage (Acres) | Total Population (EDUs) | Relative Increase in Growth (EDUs) | % of Total Growth |
|---|---|---|---|---|
| **Dewitt Existing Developments** | 841 | 1532 | - | - |
| **Entitled Projects Only (Excluding Timberline)** | 109 | 91 | 91 | 1.3% |
| **Timberline Development (All Phases)** | 91.4 | 839 | 839 | 12.4% |
| **Full Build-out (Dewitt Developments Only)** | 4378 | 8322 | 6790 | 100% |

## 5.5 OTHER CONSIDERATIONS

A report of a separate project, *Highway 49 Trunk Sewer Capacity Evaluation Report* (December 2013, Stantec), includes suggestions for the County to consider prior to implementing the recommended upgrades presented here as necessary to accommodate full build-out. Although the report focuses upon the Highway 49 Trunk sewer, the suggestions are also valid for the Dewitt trunk. As mentioned previously, these improvements are required only if upsizing of trunk sewer segments is prescribed as the only approach to mitigating the potential impact of new development in the SMD 1 service area. Unfortunately the LOS criteria adopted by the County would require significant improvement of large portions of the Dewitt Trunk to address existing capacity deficiencies within the system, regardless of how impacts to the system due to growth from development are addressed.

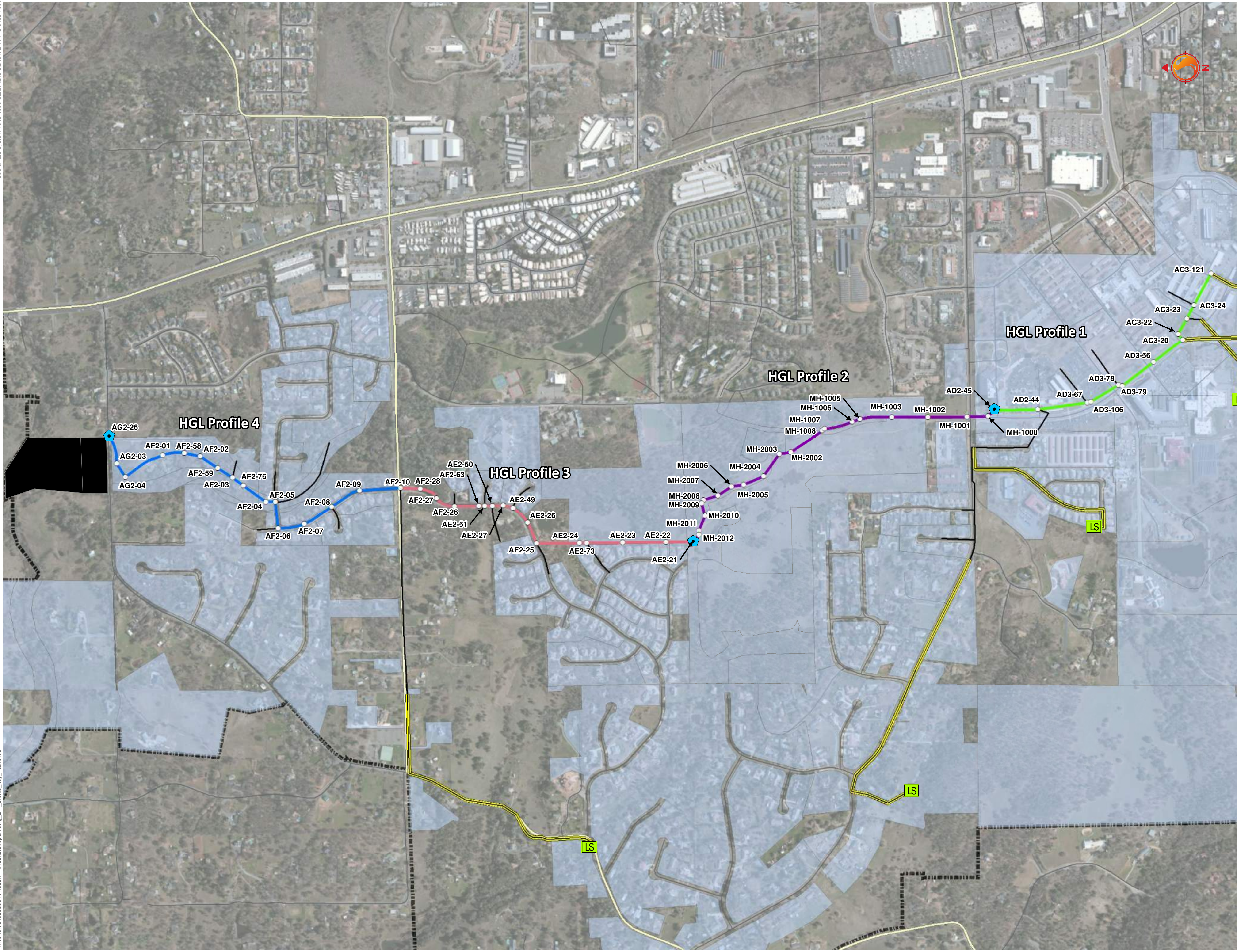
# Appendix A DeWitt Trunk Entitled Projects

Note that all APNs which contribute to existing flow in the DeWitt Trunk sewershed are provided on a CD that is attached to the back cover of the original hard copies of this report provided to Placer County staff.

**SMD 1 - Entitled Development Projects not currently connected**
**DeWitt Trunk Sewer**

| Project Name | EDUs | APN |
|---|---|---|
| Atwood 80 Subdivision | 65 | 051-070-009 |
| Hidden Creek Subdivision (Atwood 20) | 18 | 051-120-007 |
| Hidden Ravine Estates Subdivision | 11 | 051-100-069 |
| Timberline at Auburn | 839 | 051-140-056 |
| **SUBTOTAL** | 933 | |

# Appendix B Hydraulic Gradeline Profiles

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Rocklin, CA 95765
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Legend

- Hydrograph Location
- LS Lift Stations

HGL Profile

- No Profile
- HGL Profile 1
- HGL Profile 2
- HGL Profile 3
- HGL Profile 4
- Forcemain
- SMD1 WWTP
- SMD1 Buildout Boundary

Client/Project

WESTERN CARE CONSTRUCTION, INC.
SEWER CAPACITY EVALUATION - NORTH AUBURN DEWITT TRUNK - TIMBERLINE
North Auburn, Placer County

Title

HGL Profile Key Plan

Project No. 184030365

Scale 0 0.05 0.1 0.15 Miles

Figure No. B-1

Issue/Revision A/

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet

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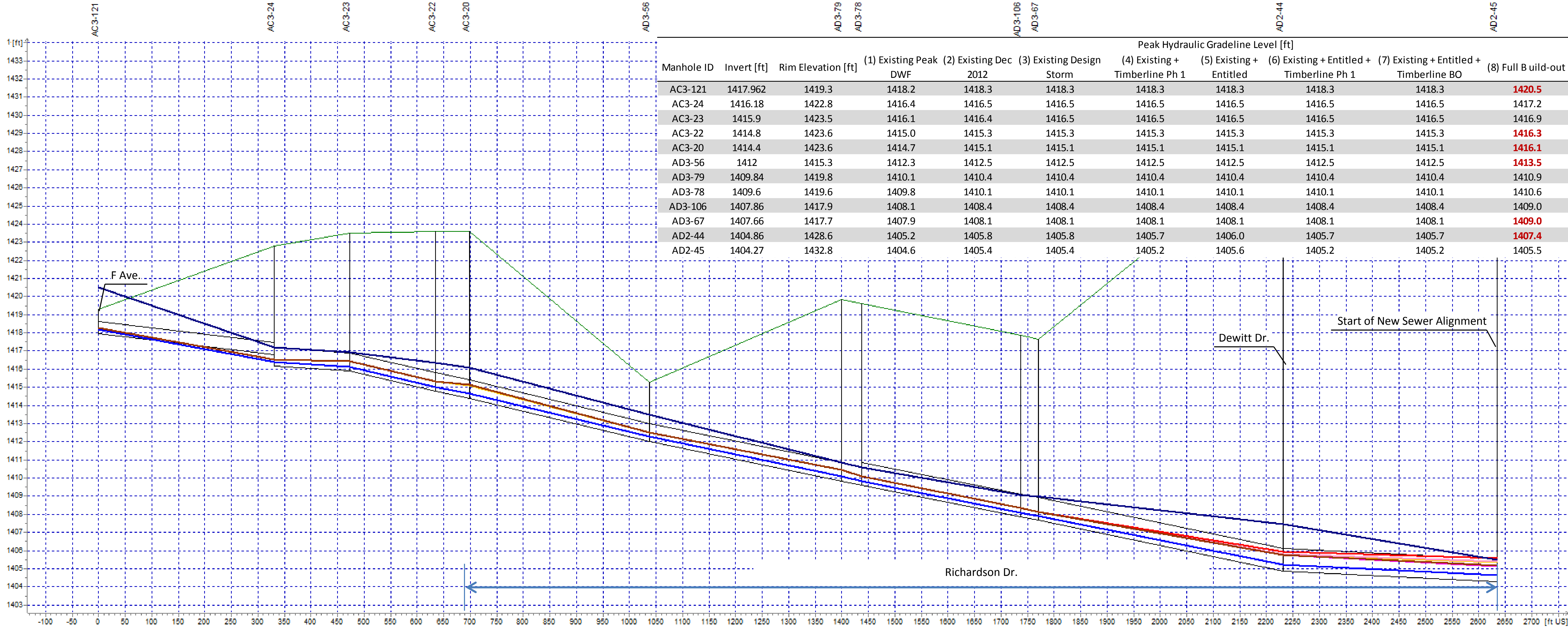



| Manhole ID | Invert [ft] | Rim Elevation [ft] | Peak Hydraulic Gradeline Level [ft]<br>(1) Existing Peak DWF | (2) Existing Dec 2012 | (3) Existing Design Storm | (4) Existing + Timberline Ph 1 | (5) Existing + Entitled | (6) Existing + Entitled + Timberline Ph 1 | (7) Existing + Entitled + Timberline BO | (8) Full B uild-out |
|---|---|---|---|---|---|---|---|---|---|---|
| AC3-121 | 1417.962 | 1419.3 | 1418.2 | 1418.3 | 1418.3 | 1418.3 | 1418.3 | 1418.3 | 1418.3 | **1420.5** |
| AC3-24 | 1416.18 | 1422.8 | 1416.4 | 1416.5 | 1416.5 | 1416.5 | 1416.5 | 1416.5 | 1416.5 | 1417.2 |
| AC3-23 | 1415.9 | 1423.5 | 1416.1 | 1416.4 | 1416.5 | 1416.5 | 1416.5 | 1416.5 | 1416.5 | 1416.9 |
| AC3-22 | 1414.8 | 1423.6 | 1415.0 | 1415.3 | 1415.3 | 1415.3 | 1415.3 | 1415.3 | 1415.3 | **1416.3** |
| AC3-20 | 1414.4 | 1423.6 | 1414.7 | 1415.1 | 1415.1 | 1415.1 | 1415.1 | 1415.1 | 1415.1 | **1416.1** |
| AD3-56 | 1412 | 1415.3 | 1412.3 | 1412.5 | 1412.5 | 1412.5 | 1412.5 | 1412.5 | 1412.5 | **1413.5** |
| AD3-79 | 1409.84 | 1419.8 | 1410.1 | 1410.4 | 1410.4 | 1410.4 | 1410.4 | 1410.4 | 1410.4 | 1410.9 |
| AD3-78 | 1409.6 | 1419.6 | 1409.8 | 1410.1 | 1410.1 | 1410.1 | 1410.1 | 1410.1 | 1410.1 | 1410.6 |
| AD3-106 | 1407.86 | 1417.9 | 1408.1 | 1408.4 | 1408.4 | 1408.4 | 1408.4 | 1408.4 | 1408.4 | 1409.0 |
| AD3-67 | 1407.66 | 1417.7 | 1407.9 | 1408.1 | 1408.1 | 1408.1 | 1408.1 | 1408.1 | 1408.1 | **1409.0** |
| AD2-44 | 1404.86 | 1428.6 | 1405.2 | 1405.8 | 1405.8 | 1405.7 | 1406.0 | 1405.7 | 1405.7 | **1407.4** |
| AD2-45 | 1404.27 | 1432.8 | 1404.6 | 1405.4 | 1405.4 | 1405.2 | 1405.6 | 1405.2 | 1405.2 | 1405.5 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 0.6667 | 1.0000 | | | | | | | | 1.2500 | | | | | | | |
| Ground Level [ft] | 1422.80 | 1423.50 | | 1423.60 | | | 1415.30 | 1419.84 | | 1419.60 | 1417.86 | | 1417.66 | | 1428.60 | | 1432.80 |
| Link Slope [%] | 0.35 | 0.20 | 0.68 | | 0.71 | | 0.60 | | 0.62 | 0.58 | | 0.59 | 0.61 | | | 0.15 | |
| Existing System PDWF [MGD] | 0.1284 | 0.1249 | 0.2367 | 0.2052 | 0.3074 | 0.2962 | 0.3137 | 0.3042 | ....... | 0.2730 | 0.2602 | ....... | 0.2610 | 0.2630 | 0.2585 | 0.3470 | 0.3299 |
| Existing System Dec 2012 PWWF [MGD] | 0.1613 | 0.1735 | 0.4900 | 0.4663 | 0.6993 | 0.6945 | 0.7074 | 0.7150 | ....... | 0.7067 | 0.7082 | ....... | 0.6958 | 0.6886 | 0.6768 | 1.2448 | 1.2408 |
| Existing System Design Storm PWWF [MGD] | 0.1613 | 0.1722 | 0.5108 | 0.4918 | 0.7278 | 0.7393 | 0.7398 | 0.7319 | ....... | 0.7101 | 0.7008 | ....... | 0.6863 | 0.6809 | 0.6889 | 1.2898 | 1.2794 |
| Existing + Timberline Phase 1 PWWF [MGD] | 0.1613 | 0.1728 | 0.5160 | 0.5010 | 0.7400 | 0.7262 | 0.7303 | 0.7334 | ....... | 0.7162 | 0.7085 | ....... | 0.6981 | 0.6966 | 0.6937 | 1.2937 | 1.2826 |
| Existing + Entitled PWWF [MGD] | 0.1613 | 0.1714 | 0.5149 | 0.5024 | 0.7424 | 0.7296 | 0.7248 | 0.7321 | ....... | 0.7175 | 0.7107 | ....... | 0.6963 | 0.6957 | 0.6922 | 1.3078 | 1.3111 |
| Existing + Entitled + Timberline Phase 1 PWWF [MGD] | 0.1613 | 0.1729 | 0.5148 | 0.4984 | 0.7367 | 0.7330 | 0.7217 | 0.7320 | ....... | 0.7189 | 0.7131 | ....... | 0.6986 | 0.6959 | 0.6944 | 1.3007 | 1.2926 |
| Existing + Entitled + Timberline Buildout PWWF [MGD] | 0.1613 | 0.1722 | 0.5139 | 0.5020 | 0.7428 | 0.7312 | 0.7264 | 0.7207 | ....... | 0.7172 | 0.7154 | ....... | 0.7016 | 0.6958 | 0.6917 | 1.3120 | 1.3016 |
| Full Buildout PWWF [MGD] | 0.6935 | 0.9103 | 1.1690 | 1.1715 | 1.7573 | | 1.7570 | | | 2.0161 | 2.0115 | ....... | 2.1241 | | | 2.8199 | |
| Q Manning [MGD] | 0.4144 | 0.9159 | 1.7005 | 1.6321 | 1.7328 | | 1.5943 | | ....... | 3.4508 | | ....... | 2.9139 | | | 1.5931 | |

7/3/2011

Stantec Consulting Ltd.
3875 Atherton Road
Rocklin CA 95765
Tel. 916.773.8100
Fax. 916.773.8448

- Existing System DWF HGL
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Timberline Phase 1 HGL
- Existing + Entitled HGL
- Existing + Entitled + Timberline Phase 1 HGL
- Existing + Entitled + Timberline Buildout HGL
- Full Build-out Design Storm HGL

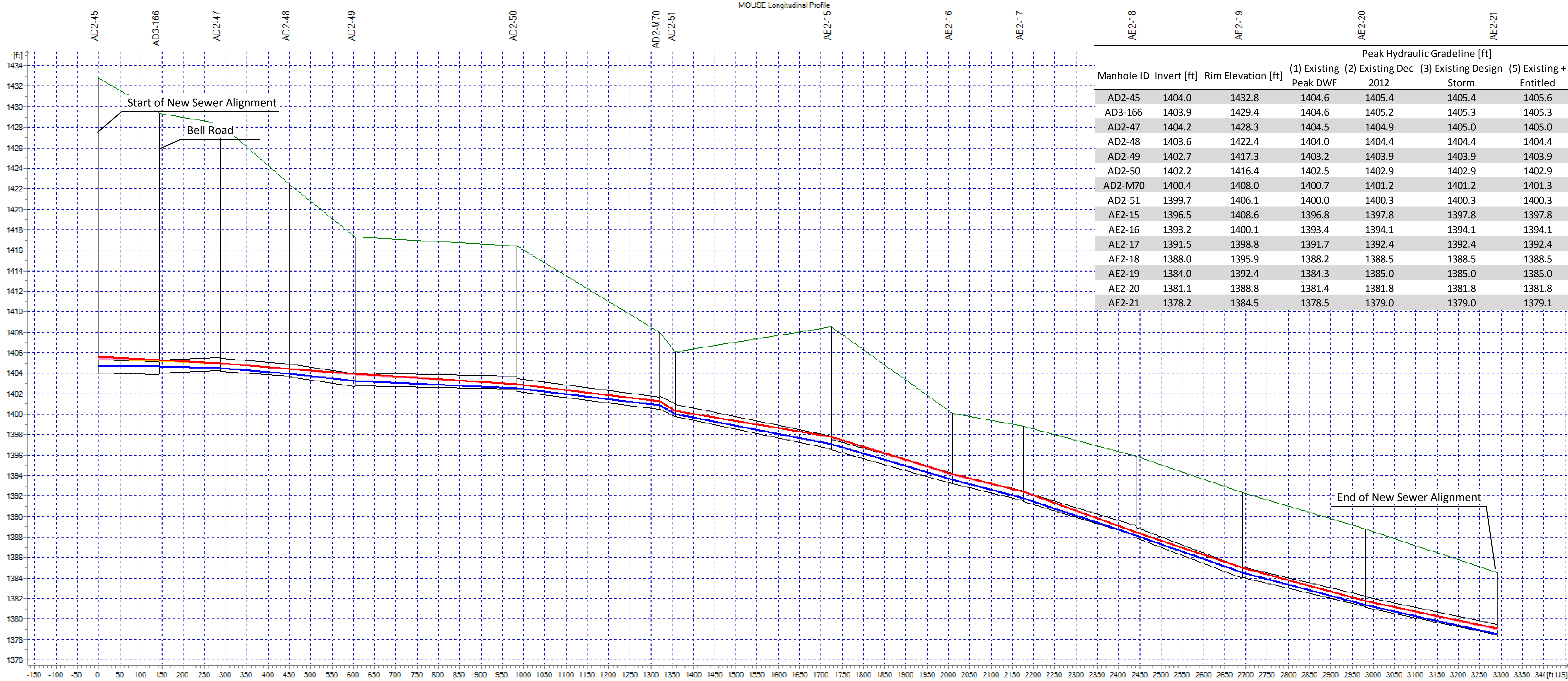
**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project
Western Care Construction, Inc.
Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.
B-2

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 1




| Manhole ID | Invert [ft] | Rim Elevation [ft] | Peak Hydraulic Gradeline [ft] (1) Existing Peak DWF | (2) Existing Dec 2012 | (3) Existing Design Storm | (5) Existing + Entitled |
|---|---|---|---|---|---|---|
| AD2-45 | 1404.0 | 1432.8 | 1404.6 | 1405.4 | 1405.4 | 1405.6 |
| AD3-166 | 1403.9 | 1429.4 | 1404.6 | 1405.2 | 1405.3 | 1405.3 |
| AD2-47 | 1404.2 | 1428.3 | 1404.5 | 1404.9 | 1405.0 | 1405.0 |
| AD2-48 | 1403.6 | 1422.4 | 1404.0 | 1404.4 | 1404.4 | 1404.4 |
| AD2-49 | 1402.7 | 1417.3 | 1403.2 | 1403.9 | 1403.9 | 1403.9 |
| AD2-50 | 1402.2 | 1416.4 | 1402.5 | 1402.9 | 1402.9 | 1402.9 |
| AD2-M70 | 1400.4 | 1408.0 | 1400.7 | 1401.2 | 1401.2 | 1401.3 |
| AD2-51 | 1399.7 | 1406.1 | 1400.0 | 1400.3 | 1400.3 | 1400.3 |
| AE2-15 | 1396.5 | 1408.6 | 1396.8 | 1397.8 | 1397.8 | 1397.8 |
| AE2-16 | 1393.2 | 1400.1 | 1393.4 | 1394.1 | 1394.1 | 1394.1 |
| AE2-17 | 1391.5 | 1398.8 | 1391.7 | 1392.4 | 1392.4 | 1392.4 |
| AE2-18 | 1388.0 | 1395.9 | 1388.2 | 1388.5 | 1388.5 | 1388.5 |
| AE2-19 | 1384.0 | 1392.4 | 1384.3 | 1385.0 | 1385.0 | 1385.0 |
| AE2-20 | 1381.1 | 1388.8 | 1381.4 | 1381.8 | 1381.8 | 1381.8 |
| AE2-21 | 1378.2 | 1384.5 | 1378.5 | 1379.0 | 1379.0 | 1379.1 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter | 1.2500 | 1.0000 | | | | | | | | | | | | | | | | | | | |
| Invert Level | 1403.88 | 1404.17 | 1403.63 | 1402.71 | 1402.23 | 1400.44 | 1399.73 | 1396.53 | 1393.18 | 1391.46 | 1387.96 | 1384.00 | 1381.13 | 1378.23 | | | | | | | |
| Link Slope | | | | | | | | | | | | | | | | | | | | | |
| Existing System PDWF [MGD] | 0.3874 | 0.3816 | 0.3738 | 0.3753 | 0.3761 | 0.3744 | 0.3709 | ..... | 0.3666 | 0.3671 | 0.3662 | 0.3664 | 0.3644 | 0.3632 | 0.3620 | 0.3615 | 0.3622 | 0.3624 | 0.3625 | 0.3623 | 0.3619 |
| Existing System Dec 2012 PWWF [MGD] | 1.6664 | 1.6742 | 1.6698 | 1.6615 | 1.6557 | 1.6578 | 1.6597 | ..... | 1.6609 | 1.6614 | 1.6606 | 1.6602 | 1.6592 | 1.6577 | 1.6566 | 1.6552 | 1.6538 | 1.6532 | 1.6544 | 1.6557 | 1.6567 |
| Existing System Design Storm PWWF [MGD] | 1.7073 | 1.7155 | 1.7142 | 1.7129 | 1.7123 | 1.7120 | 1.7117 | ..... | 1.7111 | 1.7107 | 1.7116 | 1.7121 | 1.7123 | 1.7124 | 1.7123 | 1.7121 | 1.7119 | 1.7115 | 1.7110 | | |
| Existing + Entitled Design Storm PWWF [MGD] | 1.7520 | 1.7607 | 1.7597 | 1.7583 | 1.7572 | 1.7575 | 1.7578 | ..... | 1.7580 | 1.7582 | 1.7581 | 1.7580 | 1.7578 | 1.7577 | 1.7575 | 1.7573 | 1.7571 | 1.7568 | 1.7571 | | |
| Q Manning [MGD] | 1.7144 | 2.2734 | 3.2302 | 1.2296 | 3.2912 | ..... | 3.8213 | 2.6928 | 2.4791 | 2.7972 | 3.1300 | 2.4771 | 2.3037 | | | | | | | | |

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- Existing System DWF HGL
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Timberline Phase 1 HGL
- Existing + Entitled HGL
- Existing + Entitled + Timberline Phase 1 HGL
- Existing + Entitled + Timberline Buildout HGL
- Full Build-out Design Storm HGL

**Note:**

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Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.

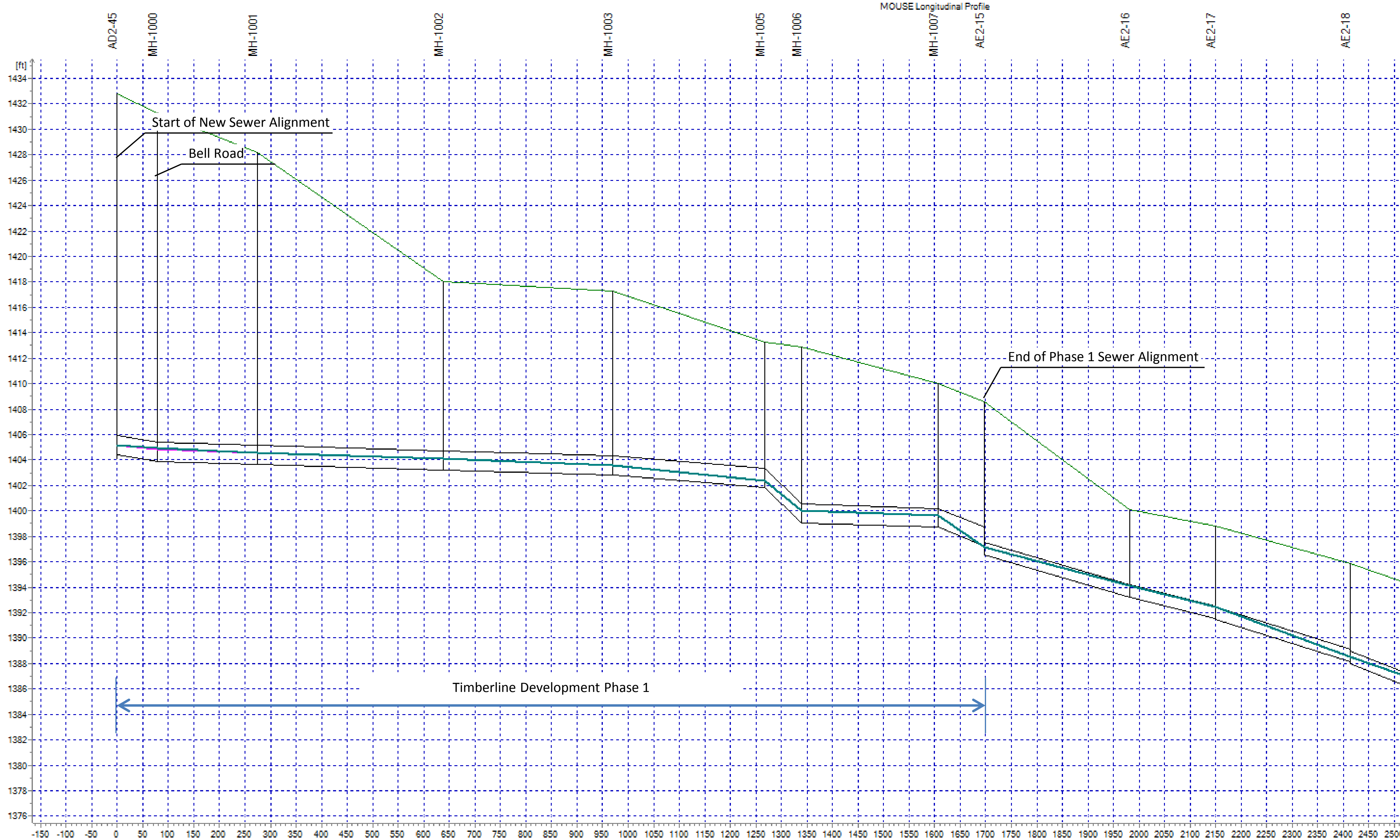
B-3A

Title

Existing System Results – 1:10 Year Design Rainfall

HGL Profile 2

MOUSE Longitudinal Profile




| Manhole ID | Invert [ft] | Rim Elevation [ft] | Peak Hydraulic Gradeline [ft] (4) Existing + Timberline Ph 1 | Peak Hydraulic Gradeline [ft] (6) Existing + Entitled + Timberline Ph 1 |
|---|---|---|---|---|
| AD2-45 | 1404.0 | 1432.8 | 1405.2 | 1405.2 |
| MH-1000 | 1403.9 | 1431.3 | 1404.9 | 1404.9 |
| MH-1001 | 1403.7 | 1428.2 | 1404.6 | 1404.6 |
| MH-1002 | 1403.2 | 1418.0 | 1404.1 | 1404.1 |
| MH-1003 | 1402.8 | 1417.3 | 1403.6 | 1403.6 |
| MH-1005 | 1401.8 | 1413.3 | 1402.4 | 1402.4 |
| MH-1006 | 1399.0 | 1412.9 | 1400.0 | 1400.0 |
| MH-1007 | 1398.7 | 1410.0 | 1399.6 | 1399.6 |
| AE2-15 | 1396.5 | 1408.6 | 1397.1 | 1397.1 |
| AE2-16 | 1393.2 | 1400.1 | 1394.1 | 1394.1 |
| AE2-17 | 1391.5 | 1398.8 | 1392.5 | 1392.5 |
| AE2-18 | 1388.0 | 1395.9 | 1388.5 | 1388.5 |
| AE2-19 | 1384.0 | 1392.4 | 1385.0 | 1385.0 |
| AE2-20 | 1381.1 | 1388.8 | 1381.8 | 1381.8 |
| AE2-21 | 1378.2 | 1384.5 | 1379.1 | 1379.1 |

| | |
|---|---|
| Link Diameter | 1.5000; 1.0000 |
| Invert Level | 1403.67; 1403.23; 1402.83; 1401.83; 1399.02; 1398.70; 1396.53; 1393.18; 1391.46; 1387.96; 1384.00; 1381.13; 1378.23 |
| Link Slope | |
| Existing + Timberline Phase 1 PWWF [MGD] | 1.7326; 1.7404; 1.7388; 1.7371; 1.7356; 1.7665; 1.7662; 1.7668; 1.8511; 1.8517; 1.8520; 1.8523; 1.8525; 1.8524; 1.8523; 1.8521; 1.8519; 1.8516; 1.8513; 1.8508; 1.8500; 1.8493 |
| Existing + Entitled + Timberline Phase 1 PWWF [MGD] | 1.7506; 1.7582; 1.7578; 1.7572; 1.7565; 1.7881; 1.7874; 1.7869; 1.8542; 1.8539; 1.8544; 1.8548; 1.8551; 1.8553; 1.8554; 1.8555; 1.8554; 1.8553; 1.8551; 1.8548; 1.8543 |
| Q Manning [MGD] | 2.5646; 2.5577; 2.5471; 4.2625; 14.4781; 2.5408; 9.5097; 2.6928; 2.4791; 2.7972; 3.1300; 2.4771; 2.3037 |

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- Existing System DWF HGL
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Timberline Phase 1 HGL
- Existing + Entitled HGL
- Existing + Entitled + Timberline Phase 1 HGL
- Existing + Entitled + Timberline Buildout HGL
- Full Build-out Design Storm HGL

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
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Client/Project
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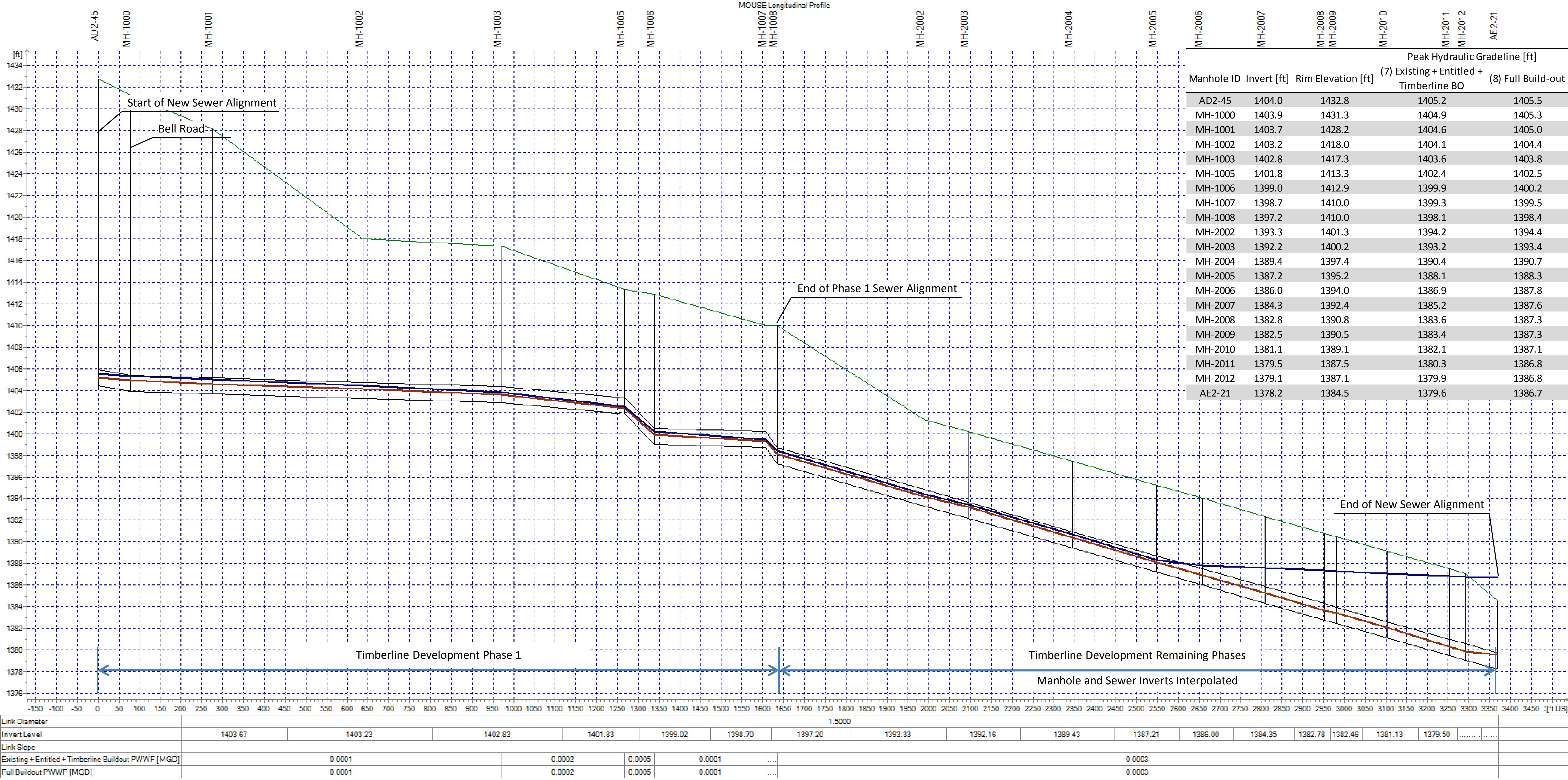
Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.
B-3B

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 2




| Manhole ID | Invert [ft] | Rim Elevation [ft] | Peak Hydraulic Gradeline [ft] (7) Existing + Entitled + Timberline BO | Peak Hydraulic Gradeline [ft] (8) Full Build-out |
|---|---|---|---|---|
| AD2-45 | 1404.0 | 1432.8 | 1405.2 | 1405.5 |
| MH-1000 | 1403.9 | 1431.3 | 1404.9 | 1405.3 |
| MH-1001 | 1403.7 | 1428.2 | 1404.6 | 1405.0 |
| MH-1002 | 1403.2 | 1418.0 | 1404.1 | 1404.4 |
| MH-1003 | 1402.8 | 1417.3 | 1403.6 | 1403.8 |
| MH-1005 | 1401.8 | 1413.3 | 1402.4 | 1402.5 |
| MH-1006 | 1399.0 | 1412.9 | 1399.9 | 1400.2 |
| MH-1007 | 1398.7 | 1410.0 | 1399.3 | 1399.5 |
| MH-1008 | 1397.2 | 1410.0 | 1398.1 | 1398.4 |
| MH-2002 | 1393.3 | 1401.3 | 1394.2 | 1394.4 |
| MH-2003 | 1392.2 | 1400.2 | 1393.2 | 1393.4 |
| MH-2004 | 1389.4 | 1397.4 | 1390.4 | 1390.7 |
| MH-2005 | 1387.2 | 1395.2 | 1388.1 | 1388.3 |
| MH-2006 | 1386.0 | 1394.0 | 1386.9 | 1387.8 |
| MH-2007 | 1384.3 | 1392.4 | 1385.2 | 1387.6 |
| MH-2008 | 1382.8 | 1390.8 | 1383.6 | 1387.3 |
| MH-2009 | 1382.5 | 1390.5 | 1383.4 | 1387.3 |
| MH-2010 | 1381.1 | 1389.1 | 1382.1 | 1387.1 |
| MH-2011 | 1379.5 | 1387.5 | 1380.3 | 1386.8 |
| MH-2012 | 1379.1 | 1387.1 | 1379.9 | 1386.8 |
| AE2-21 | 1378.2 | 1384.5 | 1379.6 | 1386.7 |

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- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Timberline Phase 1 HGL
- Existing + Entitled HGL
- Existing + Entitled + Timberline Phase 1 HGL
- Existing + Entitled + Timberline Buildout HGL
- Full Build-out Design Storm HGL

**Note:**

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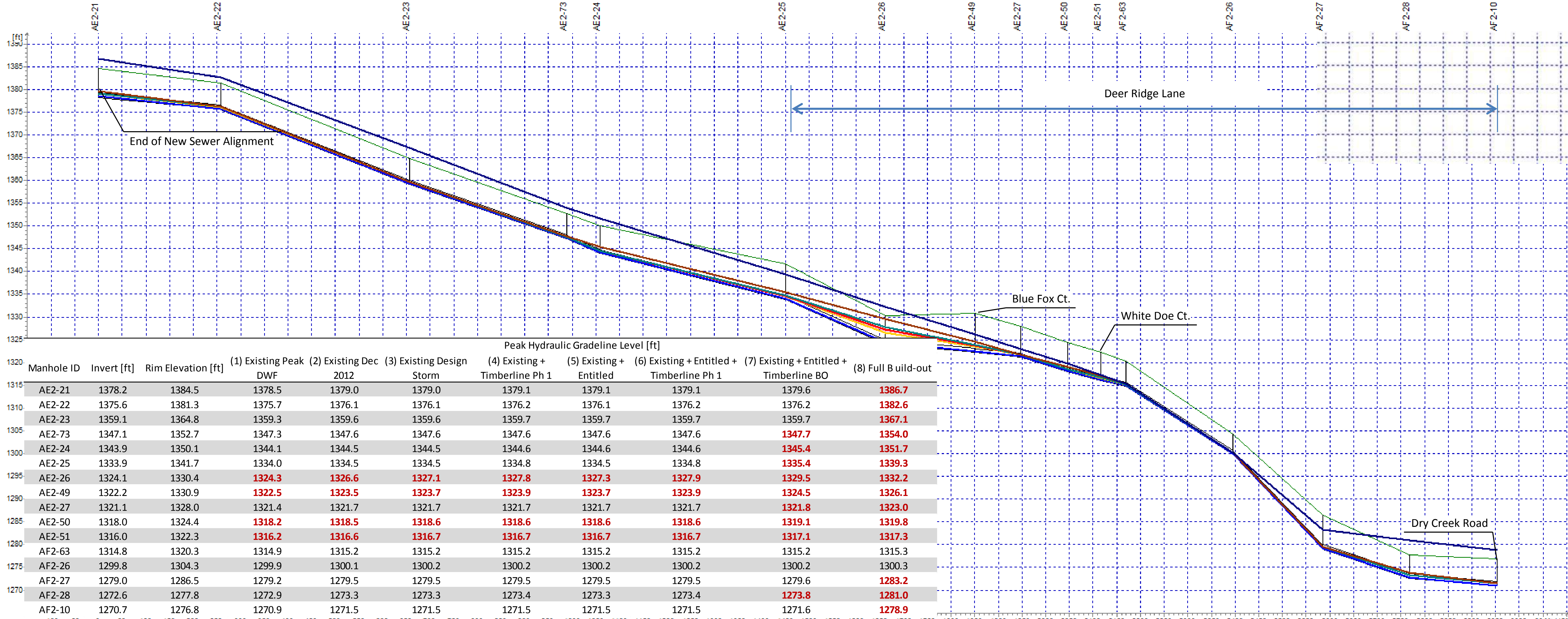
Client/Project
Western Care Construction, Inc.
Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.
B-3C

Title
Existing System Results – 1:10 Year Design Rainfall
HGL Profile 2




Peak Hydraulic Gradeline Level [ft]

| Manhole ID | Invert [ft] | Rim Elevation [ft] | (1) Existing Peak DWF | (2) Existing Dec 2012 | (3) Existing Design Storm | (4) Existing + Timberline Ph 1 | (5) Existing + Entitled | (6) Existing + Entitled + Timberline Ph 1 | (7) Existing + Entitled + Timberline BO | (8) Full B uild-out |
|---|---|---|---|---|---|---|---|---|---|---|
| AE2-21 | 1378.2 | 1384.5 | 1378.5 | 1379.0 | 1379.0 | 1379.1 | 1379.1 | 1379.1 | 1379.6 | **1386.7** |
| AE2-22 | 1375.6 | 1381.3 | 1375.7 | 1376.1 | 1376.1 | 1376.2 | 1376.1 | 1376.2 | 1376.2 | **1382.6** |
| AE2-23 | 1359.1 | 1364.8 | 1359.3 | 1359.6 | 1359.6 | 1359.7 | 1359.7 | 1359.7 | 1359.7 | **1367.1** |
| AE2-73 | 1347.1 | 1352.7 | 1347.3 | 1347.6 | 1347.6 | 1347.6 | 1347.6 | 1347.6 | **1347.7** | **1354.0** |
| AE2-24 | 1343.9 | 1350.1 | 1344.1 | 1344.5 | 1344.5 | 1344.6 | 1344.6 | 1344.6 | **1345.4** | **1351.7** |
| AE2-25 | 1333.9 | 1341.7 | 1334.0 | 1334.5 | 1334.5 | 1334.8 | 1334.5 | 1334.8 | **1335.4** | **1339.3** |
| AE2-26 | 1324.1 | 1330.4 | **1324.3** | **1326.6** | **1327.1** | **1327.8** | **1327.3** | **1327.9** | **1329.5** | **1332.2** |
| AE2-49 | 1322.2 | 1330.9 | **1322.5** | **1323.5** | **1323.7** | **1323.9** | **1323.7** | **1323.9** | **1324.5** | **1326.1** |
| AE2-27 | 1321.1 | 1328.0 | 1321.4 | 1321.7 | 1321.7 | 1321.7 | 1321.7 | 1321.7 | **1321.8** | **1323.0** |
| AE2-50 | 1318.0 | 1324.4 | **1318.2** | **1318.5** | **1318.6** | **1318.6** | **1318.6** | **1318.6** | **1319.1** | **1319.8** |
| AE2-51 | 1316.0 | 1322.3 | **1316.2** | **1316.6** | **1316.7** | **1316.7** | **1316.7** | **1316.7** | **1317.1** | **1317.3** |
| AF2-63 | 1314.8 | 1320.3 | 1314.9 | 1315.2 | 1315.2 | 1315.2 | 1315.2 | 1315.2 | 1315.2 | 1315.3 |
| AF2-26 | 1299.8 | 1304.3 | 1299.9 | 1300.1 | 1300.2 | 1300.2 | 1300.2 | 1300.2 | 1300.2 | 1300.3 |
| AF2-27 | 1279.0 | 1286.5 | 1279.2 | 1279.5 | 1279.5 | 1279.5 | 1279.5 | 1279.5 | 1279.6 | **1283.2** |
| AF2-28 | 1272.6 | 1277.8 | 1272.9 | 1273.3 | 1273.3 | 1273.4 | 1273.3 | 1273.4 | **1273.8** | **1281.0** |
| AF2-10 | 1270.7 | 1276.8 | 1270.9 | 1271.5 | 1271.5 | 1271.5 | 1271.5 | 1271.5 | 1271.6 | **1278.9** |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.0000 | 0.8333 | 1.0000 | | | | | | | | | | | | | | | | | | |
| Ground Level [ft] | 1381.29 | 1364.79 | 1352.74 | 1350.12 | 1341.66 | 1330.36 | 1330.87 | 1328.04 | 1324.35 | 1322.26 | 1320.29 | 1304.33 | 1286.50 | 1277.82 | 1276.80 | | | | | | |
| Link Slope [%] | 1.02 | 4.10 | 3.58 | 4.42 | 2.55 | 4.63 | 0.96 | 1.07 | 3.17 | 2.70 | 2.20 | 6.62 | 10.91 | 3.48 | 0.89 | | | | | | |
| Existing System PDWF [MGD] | 0.3719 | 0.3770 | 0.3755 | 0.3741 | 0.3750 | 0.3754 | 0.3841 | 0.3839 | 0.3833 | 0.3821 | 0.3904 | 0.3921 | 0.3949 | 0.3947 | 0.4041 | 0.4058 | 0.4052 | 0.4044 | 0.4065 | 0.4071 | 0.4073 |
| Existing System Dec 2012 PWWF [MGD] | 1.6578 | 1.7333 | 1.7330 | 1.7325 | 1.7628 | 1.7621 | 1.7613 | 1.7603 | 1.7885 | 1.7874 | 1.7975 | 1.7978 | 1.8424 | 1.8503 | 1.8508 | 1.8855 | 1.8859 | | | | |
| Existing System Design Storm PWWF [MGD] | 1.7154 | 1.8093 | 1.8097 | 1.8099 | 1.8102 | 1.8104 | 1.8467 | 1.8466 | 1.8807 | 1.8798 | 1.8903 | 1.8902 | 1.9425 | 1.9505 | 1.9502 | 1.9929 | 1.9925 | 1.9915 | | | |
| Existing + Timberline Phase 1 PWWF [MGD] | 1.8503 | 1.9384 | 1.9388 | 1.9391 | 1.9395 | 1.9398 | 1.9741 | 1.9743 | 1.9745 | 1.9746 | 2.0067 | 2.0064 | 2.0167 | 2.0166 | 2.0661 | 2.0741 | 2.0740 | 2.1144 | 2.1142 | | |
| Existing + Entitled PWWF [MGD] | 1.7575 | 1.8451 | 1.8799 | 1.8800 | 1.8801 | 1.9131 | 1.9132 | 1.9238 | 1.9746 | 1.9829 | 1.9830 | 2.0246 | 2.0247 | | | | | | | | |
| Existing + Entitled + Timberline Phase 1 PWWF [MGD] | 1.8534 | 1.9439 | 1.9437 | 1.9436 | 1.9437 | 1.9798 | 1.9796 | 1.9793 | 1.9790 | 2.0128 | 2.0115 | 2.0223 | 2.0738 | 2.0824 | 2.0826 | 2.1248 | 2.1251 | 2.1256 | | | |
| Existing + Entitled + Timberline Buildout PWWF [MGD] | 2.1232 | 2.2171 | 2.2170 | 2.2168 | 2.2166 | 2.2488 | 2.2454 | 2.2452 | 2.2450 | 2.2769 | 2.2771 | 2.2875 | 2.3371 | 2.3453 | 2.3859 | 2.3860 | 2.3859 | | | | |
| Full Buildout PWWF [MGD] | 2.7121 | 2.7511 | 2.7510 | 2.5238 | 2.5237 | 2.5392 | 2.5059 | 2.5058 | 2.5243 | 2.4995 | 2.5060 | 2.5064 | 2.5512 | 2.5561 | 2.6426 | 2.6415 | 2.4415 | | | | |
| Q Manning [MGD] | 2.3248 | 2.8644 | 2.3983 | 2.9723 | 2.2579 | 3.0429 | 1.3851 | 1.4659 | 2.5194 | 2.3216 | 2.0991 | 3.6383 | 4.6697 | 4.2871 | 2.1735 | | | | | | |

7/3/2011

- Existing System DWF HGL
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Timberline Phase 1 HGL
- Existing + Entitled HGL
- Existing + Entitled + Timberline Phase 1 HGL
- Existing + Entitled + Timberline Buildout HGL
- Full Build-out Design Storm HGL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Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

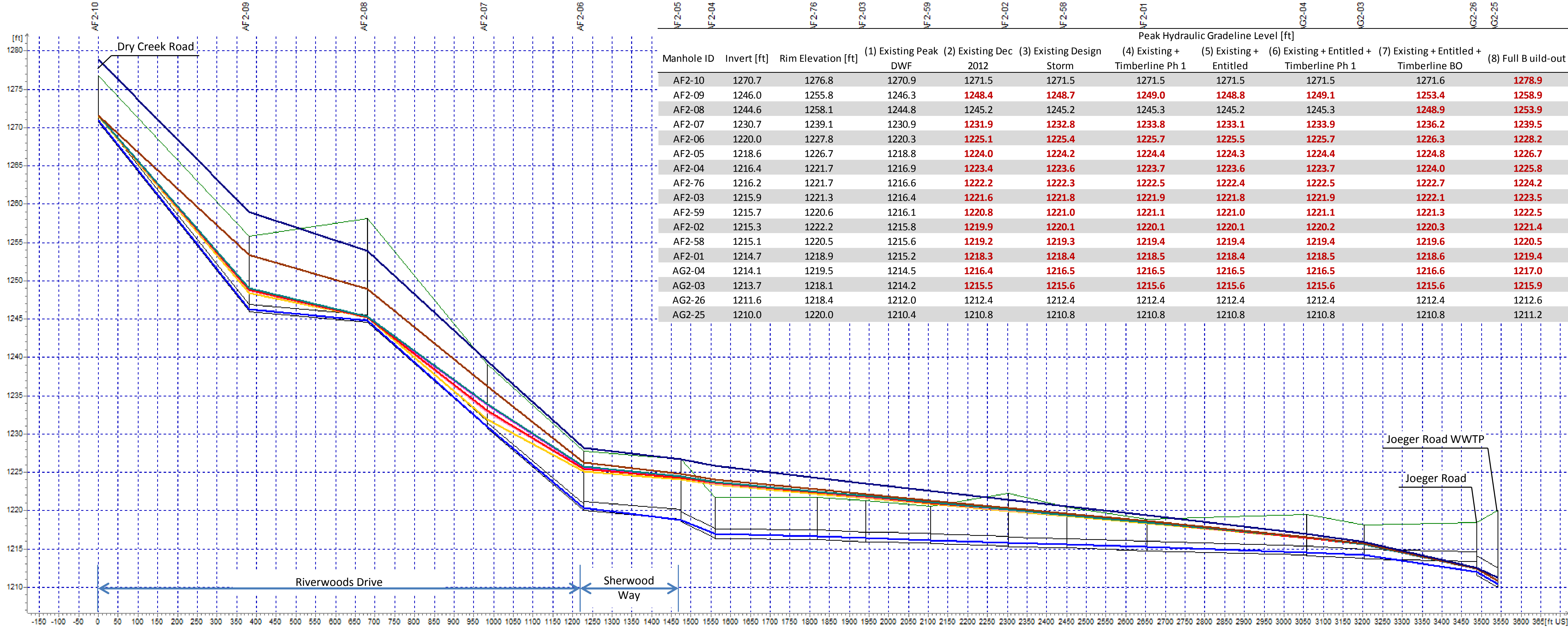
Figure No.

B-4

Title

Existing System Results – 1:10 Year Design Rainfall

HGL Profile 3




| Manhole ID | Invert [ft] | Rim Elevation [ft] | Peak Hydraulic Gradeline Level [ft] (1) Existing Peak DWF | (2) Existing Dec 2012 | (3) Existing Design Storm | (4) Existing + Timberline Ph 1 | (5) Existing + Entitled | (6) Existing + Entitled + Timberline Ph 1 | (7) Existing + Entitled + Timberline BO | (8) Full B uild-out |
|---|---|---|---|---|---|---|---|---|---|---|
| AF2-10 | 1270.7 | 1276.8 | 1270.9 | 1271.5 | 1271.5 | 1271.5 | 1271.5 | 1271.5 | 1271.6 | **1278.9** |
| AF2-09 | 1246.0 | 1255.8 | 1246.3 | **1248.4** | **1248.7** | **1249.0** | **1248.8** | **1249.1** | **1253.4** | **1258.9** |
| AF2-08 | 1244.6 | 1258.1 | 1244.8 | 1245.2 | 1245.2 | 1245.3 | 1245.2 | 1245.3 | **1248.9** | **1253.9** |
| AF2-07 | 1230.7 | 1239.1 | 1230.9 | **1231.9** | **1232.8** | **1233.8** | **1233.1** | **1233.9** | **1236.2** | **1239.5** |
| AF2-06 | 1220.0 | 1227.8 | 1220.3 | **1225.1** | **1225.4** | **1225.7** | **1225.5** | **1225.7** | **1226.3** | **1228.2** |
| AF2-05 | 1218.6 | 1226.7 | 1218.8 | **1224.0** | **1224.2** | **1224.4** | **1224.3** | **1224.4** | **1224.8** | **1226.7** |
| AF2-04 | 1216.4 | 1221.7 | 1216.9 | **1223.4** | **1223.6** | **1223.7** | **1223.6** | **1223.7** | **1224.0** | **1225.8** |
| AF2-76 | 1216.2 | 1221.7 | 1216.6 | **1222.2** | **1222.3** | **1222.5** | **1222.4** | **1222.5** | **1222.7** | **1224.2** |
| AF2-03 | 1215.9 | 1221.3 | 1216.4 | **1221.6** | **1221.8** | **1221.9** | **1221.8** | **1221.9** | **1222.1** | **1223.5** |
| AF2-59 | 1215.7 | 1220.6 | 1216.1 | **1220.8** | **1221.0** | **1221.1** | **1221.0** | **1221.1** | **1221.3** | **1222.5** |
| AF2-02 | 1215.3 | 1222.2 | 1215.8 | **1219.9** | **1220.1** | **1220.1** | **1220.1** | **1220.2** | **1220.3** | **1221.4** |
| AF2-58 | 1215.1 | 1220.5 | 1215.6 | **1219.2** | **1219.3** | **1219.4** | **1219.4** | **1219.4** | **1219.6** | **1220.5** |
| AF2-01 | 1214.7 | 1218.9 | 1215.2 | **1218.3** | **1218.4** | **1218.5** | **1218.4** | **1218.5** | **1218.6** | **1219.4** |
| AG2-04 | 1214.1 | 1219.5 | 1214.5 | **1216.4** | **1216.5** | **1216.5** | **1216.5** | **1216.5** | **1216.6** | **1217.0** |
| AG2-03 | 1213.7 | 1218.1 | 1214.2 | **1215.5** | **1215.6** | **1215.6** | **1215.6** | **1215.6** | **1215.6** | **1215.9** |
| AG2-26 | 1211.6 | 1218.4 | 1212.0 | 1212.4 | 1212.4 | 1212.4 | 1212.4 | 1212.4 | 1212.4 | 1212.6 |
| AG2-25 | 1210.0 | 1220.0 | 1210.4 | 1210.8 | 1210.8 | 1210.8 | 1210.8 | 1210.8 | 1210.8 | 1211.2 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 0.8333 | 1.0000 | 0.8333 | 1.2500 | ........ | | | | | | | | | | | | | | | | | | |
| Ground Level [ft] | 1255.84 | 1258.11 | 1239.08 | 1227.77 | 1226.68 | 1221.67 | 1221.68 | 1221.25 | 1220.57 | 1222.23 | 1220.46 | 1218.86 | 1219.47 | 1218.14 | 1218.42 | .... | | | | | | | |
| Link Slope [%] | 6.49 | 0.47 | 4.55 | 4.32 | 0.46 | 2.47 | 0.05 | 0.22 | 0.06 | 0.18 | 0.11 | 0.20 | 0.15 | 0.26 | 0.11 | 3.08 | | | | | | | |
| Existing System PDWF [MGD] | 0.4968 | 0.5075 | 0.5089 | 0.5160 | 0.5170 | 0.5168 | 0.5155 | 0.5339 | 0.5215 | 0.5469 | 0.5532 | 0.5556 | 0.5565 | 0.5532 | 0.5453 | 0.5344 | 0.5376 | 0.5405 | 0.5358 | 0.5289 | 0.5308 | 0.5321 | ........ |
| Existing System Dec 2012 PWWF [MGD] | .... 2.2974 | 2.3218 | 2.3217 | 2.3406 | 2.3396 | 2.3309 | 2.3310 | 2.8205 | 2.8203 | 2.9637 | 2.8026 | 2.8025 | 2.7960 | 2.7962 | 2.7944 | 2.7942 | 2.7943 | 2.8336 | 2.8337 | ........ | | | |
| Existing System Design Storm PWWF [MGD] | .... 2.4077 | 2.4357 | 2.4358 | 2.4561 | 2.4559 | 2.4545 | 2.4544 | 2.9529 | 2.9527 | 3.0950 | 2.8351 | 2.8350 | 2.8258 | 2.8259 | 2.8261 | 2.8262 | 2.8609 | ........ | | | | | |
| Existing + Timberline Phase 1 PWWF [MGD] | 2.5172 | 2.5440 | 2.5626 | 2.5608 | 2.5595 | 3.0464 | 3.0463 | 3.1807 | 2.8638 | 2.8637 | 2.8477 | 2.8467 | 2.8469 | 2.8470 | 2.8471 | 2.8807 | ........ | | | | | | |
| Existing + Entitled PWWF [MGD] | 2.4280 | 2.4553 | 2.4753 | 2.4750 | 2.4734 | 2.4733 | 2.9698 | 2.9696 | 3.1113 | 2.8435 | 2.8434 | 2.8329 | 2.8335 | 2.8340 | 2.8341 | 2.8342 | 2.8676 | 2.8677 | ........ | | | | |
| Existing + Entitled + Timberline Phase 1 PWWF [MGD] | 2.5291 | 2.5568 | 2.5749 | 2.5743 | 2.5711 | 3.0576 | 3.0575 | 3.1943 | 2.8684 | 2.8539 | 2.8534 | 2.8535 | 2.8536 | 2.8863 | ........ | | | | | | | | |
| Existing + Entitled + Timberline Buildout PWWF [MGD] | .... 2.7871 | 2.8091 | 2.8086 | 2.8263 | 2.8259 | 2.8240 | 2.8239 | 3.2839 | 3.2838 | 3.4038 | 2.9293 | 2.9073 | 2.8989 | 2.8952 | 2.8953 | 2.9261 | ........ | | | | | | |
| Full Buildout PWWF [MGD] | 3.1622 | 2.9905 | 3.0086 | 3.0079 | 3.4740 | 3.4739 | 3.5939 | 3.2627 | 3.1907 | 3.1533 | 3.1333 | 3.1593 | ........ | | | | | | | | | | |
| Q Manning [MGD] | 3.6009 | 1.5691 | 3.0148 | 2.9372 | 2.8142 | 6.5510 | 0.9713 | 1.9487 | 1.0284 | 1.7617 | 1.4111 | 1.8569 | 1.6063 | 2.1083 | 1.3938 | ........ | | | | | | | |

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- Existing System DWF HGL
- Existing System Dec 2012 HGL
- Existing System Design Storm HGL
- Existing + Timberline Phase 1 HGL
- Existing + Entitled HGL
- Existing + Entitled + Timberline Phase 1 HGL
- Existing + Entitled + Timberline Buildout HGL
- Full Build-out Design Storm HGL

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project

Western Care Construction, Inc.

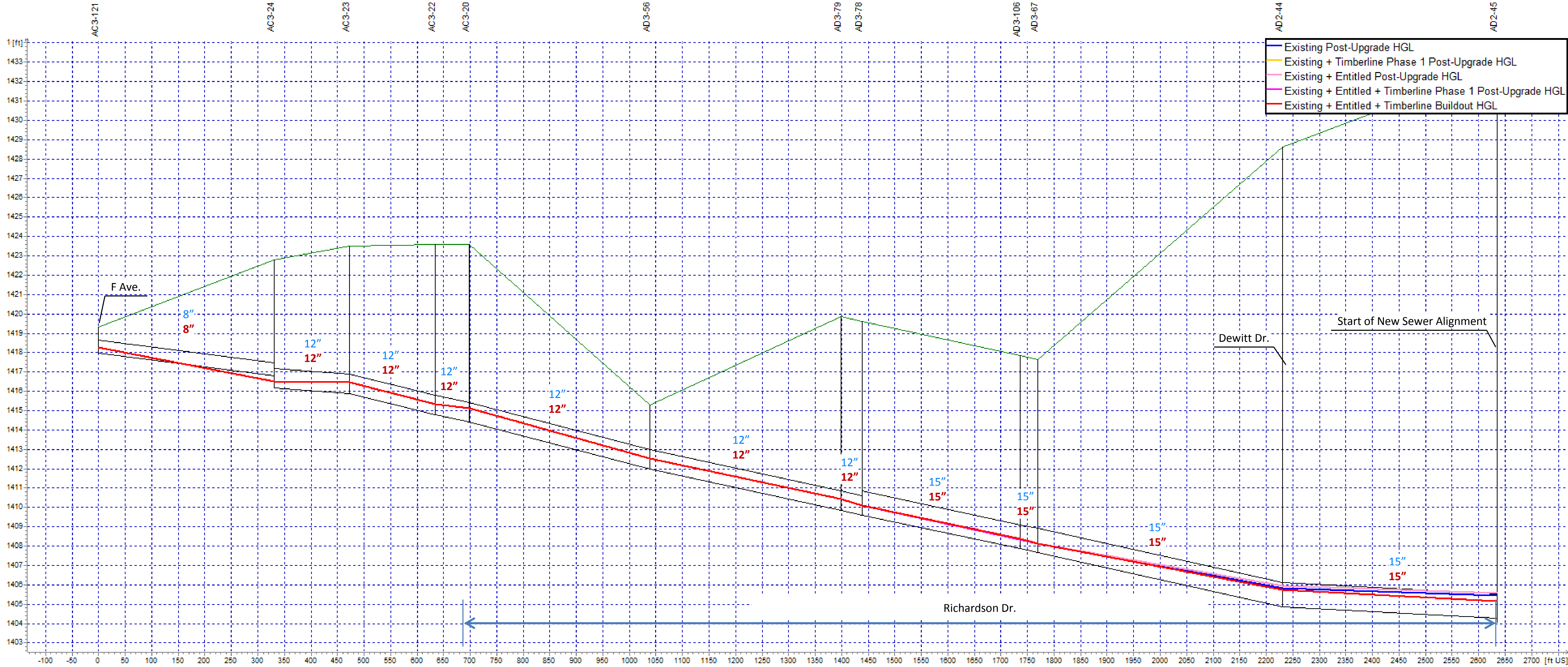
Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.

B-5

Title

Existing System Results – 1:10 Year Design Rainfall HGL Profile 4




| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 0.6667 | 1.0000 | | | | | | | | 1.2500 | | | | | | | |
| Ground Level [ft] | 1422.80 | 1423.50 | 1423.60 | | | | 1415.30 | 1419.84 | | 1419.60 | 1417.86 | | 1417.66 | | 1428.60 | | 1432.80 |
| Link Slope [%] | 0.35 | 0.20 | 0.68 | | 0.71 | | 0.60 | | 0.62 | 0.58 | | 0.59 | 0.61 | | | 0.15 | |
| Existing Post-Upgrade PWWF [MGD] | 0.1613 | 0.1731 | 0.5127 | 0.4949 | 0.7439 | 0.7398 | 0.7275 | 0.7162 | ....... | 0.7157 | 0.7153 | ....... | 0.7023 | 0.6966 | 0.6942 | 1.2888 | 1.2824 |
| Existing + Timberline Phase 1 Post-Upgrade PWWF [MGD] | 0.1613 | 0.1728 | 0.5160 | 0.5010 | 0.7400 | 0.7262 | 0.7303 | 0.7334 | ....... | 0.7162 | 0.7085 | ....... | 0.6981 | 0.6966 | 0.6937 | 1.2937 | 1.2826 |
| Existing + Entitled Post-Upgrade PWWF [MGD] | 0.1613 | 0.1729 | 0.5117 | 0.4933 | 0.7313 | 0.7453 | 0.7416 | 0.7310 | ....... | 0.7086 | 0.7065 | ....... | 0.6967 | 0.6979 | 0.6905 | 1.3084 | 1.3030 |
| Existing + Entitled + Timberline Phase 1 Post-Upgrade PWWF [MGD] | 0.1613 | 0.1729 | 0.5148 | 0.4984 | 0.7367 | 0.7330 | 0.7217 | 0.7320 | ....... | 0.7189 | 0.7131 | ....... | 0.6986 | 0.6959 | 0.6944 | 1.3007 | 1.2926 |
| Existing + Entitled + Timberline Buildout Post-Upgrade PWWF [MGD] | 0.1613 | 0.1719 | 0.5162 | 0.5005 | 0.7393 | 0.7347 | 0.7309 | 0.7183 | ....... | 0.7064 | 0.7052 | ....... | 0.7035 | 0.7053 | 0.7000 | 1.3080 | 1.3055 |
| Q Manning Post-Upgrade [MGD] | 0.4144 | 0.9159 | 1.7005 | 1.6321 | 1.7328 | | 1.5943 | | ....... | 3.4508 | | ....... | 2.9139 | | | 1.5931 | |

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**Legend**

12” Existing Sewer Diameter

12” Recommended Sewer Diameter to Eliminate Surcharging

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

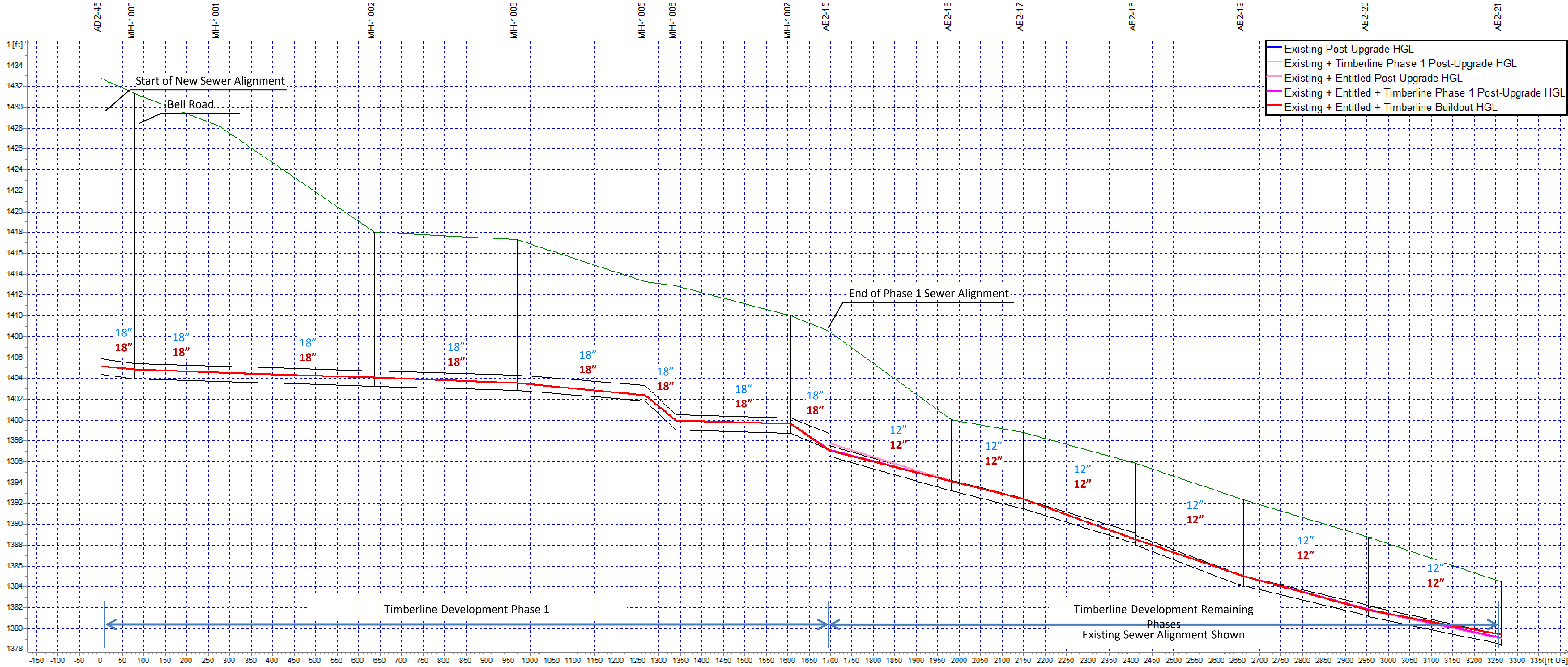
Figure No.

B-6

Title

Impact of Upgrades Upon Near-Term Developments

HGL Profile 1




| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.5000 | | | | | | | | | | 1.0000 | | | | | | | | | | |
| Ground Level [ft] | 1428.20 | 1418.00 | | 1417.30 | | 1413.30 | | 1412.90 | 1410.00 | | 1408.55 | 1400.08 | | 1398.79 | 1395.87 | | 1392.36 | | 1388.78 | | 1384.52 |
| Link Slope [%] | | | | | | | | | | | | | | | | | | | | | |
| Existing Post-Upgrade PWWF [MGD] | | | | | | | | | | | 1.7353 | 1.7357 | 1.7362 | 1.7366 | 1.7370 | 1.7372 | 1.7373 | 1.7374 | 1.7373 | 1.7371 | 1.7369 |
| Existing + Timberline Phase 1 Post-Upgrade PWWF [MGD] | 1.7404 | 1.7388 | 1.7371 | 1.7356 | 1.7665 | 1.7662 | 1.7668 | 1.8511 | 1.8517 | 1.8520 | 1.8523 | 1.8525 | 1.8524 | 1.8523 | 1.8521 | 1.8519 | 1.8516 | 1.8513 | 1.8508 | 1.8500 | 1.8493 |
| Existing + Entitled Post-Upgrade PWWF [MGD] | | | | | | | | | | | 1.7589 | | | 1.7587 | 1.7585 | 1.7582 | 1.7580 | 1.7576 | 1.7572 | 1.7566 | 1.7570 |
| Existing + Entitled + Timberline Phase 1 Post-Upgrade PWWF [MGD] | 1.7582 | 1.7578 | 1.7572 | 1.7565 | 1.7881 | 1.7874 | 1.7869 | 1.8542 | 1.8539 | 1.8544 | 1.8548 | 1.8551 | 1.8553 | 1.8554 | 1.8555 | | 1.8554 | 1.8553 | 1.8551 | 1.8548 | 1.8543 |
| Existing + Entitled + Timberline Buildout Post-Upgrade PWWF [MGD] | 1.7602 | 1.7565 | 1.7553 | 1.7544 | 1.7858 | 1.7862 | 1.7872 | 1.7972 | 1.7977 | 1.7979 | 1.7981 | 1.7980 | 1.7977 | 1.7974 | 1.7970 | 1.7966 | 1.7962 | 1.7958 | 1.7953 | 1.7948 | 1.7946 |
| Q Manning Post-Upgrade [MGD] | 2.5577 | | 2.5471 | | 4.2625 | | 14.4781 | 2.5408 | | 9.5097 | 2.6928 | | 2.4791 | 2.7972 | | 3.1300 | | 2.4771 | | 2.3037 | |

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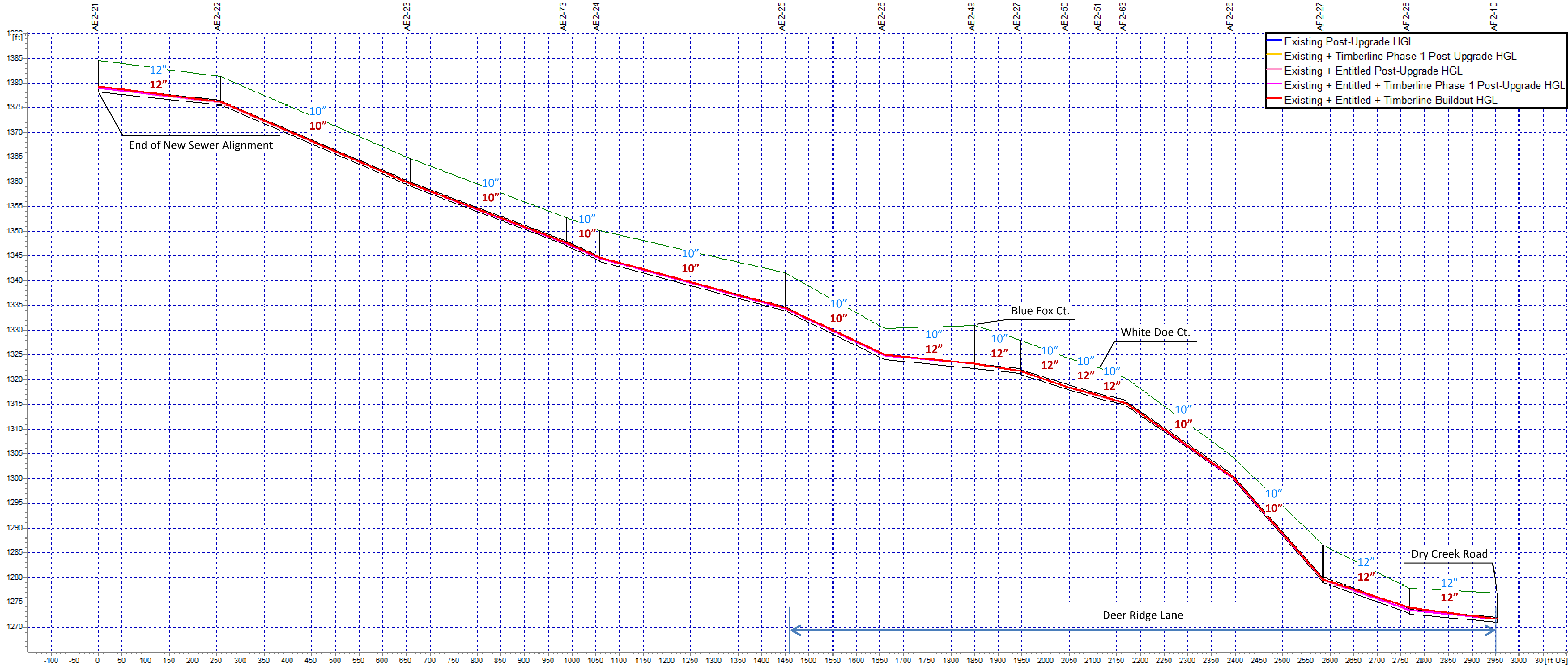
**Legend**
12” Existing Sewer Diameter
12” Recommended Sewer Diameter to Eliminate Surcharging

**Note:**
- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project
Western Care Construction, Inc.
Sewer Capacity – North Auburn Dewitt Trunk - Timberline
Figure No.
B-7
Title
Impact of Upgrades Upon Near-Term Developments
HGL Profile 2




| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 0.8333 | 1.0000 | 0.8333 | 1.0000 | | | | | | | | | | | | | | | |
| Ground Level [ft] | 1381.29 | 1364.79 | 1352.74 | 1350.12 | 1341.66 | 1330.36 | 1330.87 | 1328.04 | 1324.35 | 1322.26 | 1320.29 | 1304.33 | 1286.50 | 1277.82 | 1276.80 | | | | |
| Link Slope [%] | 4.10 | 3.58 | 4.42 | 2.55 | 4.63 | 0.96 | 1.07 | 3.17 | 2.70 | 2.20 | 6.62 | 10.91 | 3.48 | 0.89 | | | | | |
| Existing Post-Upgrade PWWF [MGD] | 1.8268 | 1.8267 | 1.8266 | 1.8265 | 1.8264 | 1.8614 | 1.8613 | 1.8612 | 1.8946 | 1.9053 | 1.9570 | 1.9653 | 1.9654 | 2.0074 | 2.0075 | 2.0077 | | | |
| Existing + Timberline Phase 1 Post-Upgrade PWWF [MGD] | 1.9384 | 1.9388 | 1.9391 | 1.9395 | 1.9398 | 1.9741 | 1.9743 | 1.9745 | 1.9746 | 2.0068 | 2.0067 | 2.0171 | 2.0170 | 2.0664 | 2.0744 | 2.1148 | 2.1147 | 2.1145 | |
| Existing + Entitled Post-Upgrade PWWF [MGD] | 1.8457 | 1.8459 | 1.8461 | 1.8464 | 1.8467 | 1.8810 | 1.8811 | 1.8813 | 1.8814 | 1.9136 | 1.9137 | 1.9241 | 1.9751 | 1.9835 | 1.9836 | 2.0258 | 2.0260 | 2.0262 | |
| Existing + Entitled + Timberline Phase 1 Post-Upgrade PWWF [MGD] | 1.9439 | 1.9437 | 1.9436 | 1.9437 | 1.9798 | 1.9796 | 1.9794 | 1.9790 | 2.0128 | 2.0118 | 2.0223 | 2.0222 | 2.0736 | 2.0821 | 2.0824 | 2.1247 | 2.1252 | 2.1260 | |
| Existing + Entitled + Timberline Buildout Post-Upgrade PWWF [MGD] | 2.2226 | 2.2225 | 2.2224 | 2.2222 | 2.2218 | 2.2575 | 2.2571 | 2.2566 | 2.2561 | 2.2897 | 2.2898 | 2.3007 | 2.3011 | 2.3525 | 2.3611 | 2.3614 | 2.4036 | 2.4039 | 2.4041 |
| Q Manning Post-Upgrade [MGD] | 2.8644 | 2.3983 | 2.9723 | 2.2579 | 3.0429 | 2.2526 | 2.3841 | 4.0975 | 3.7758 | 3.4139 | 3.6383 | 4.6697 | 4.2871 | 2.1735 | | | | | |

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**Legend**

12” Existing Sewer Diameter

12” Recommended Sewer Diameter to Eliminate Surcharging

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.

B-8

Title

Impact of Upgrades Upon Near-Term Developments

HGL Profile 3


| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | .... | 1.2500 | 0.8333 | 1.5000 | 1.7500 | ........ | | | | | | | | | | | | | | | |
| Ground Level [ft] | 1255.84 | 1258.11 | 1239.08 | 1227.77 | 1226.68 | 1221.67 | 1221.68 | 1221.25 | 1220.57 | 1222.23 | 1220.46 | 1218.86 | 1219.47 | 1218.14 | 1218.42 | ... | | | | | |
| Link Slope [%] | .... | 0.47 | 4.55 | 4.32 | 0.46 | 2.47 | 0.05 | 0.22 | 0.06 | 0.18 | 0.11 | 0.20 | 0.15 | 0.26 | 0.11 | 3.08 | | | | | |
| Existing Post-Upgrade PWWF [MGD] | .... | 2.4502 | 2.4498 | 2.4694 | 2.4692 | 2.4690 | 2.4688 | 3.0292 | 3.1863 | 3.1855 | 3.1838 | 3.1862 | 3.1835 | 3.1819 | 3.1822 | 3.2322 | 3.2316 | 3.2307 | 3.2299 | 3.2292 | ........ |
| Existing + Timberline Phase 1 Post-Upgrade PWWF [MGD] | .... | 2.5452 | 2.5449 | 2.5647 | 2.5645 | 2.5643 | 2.5641 | 3.1273 | 3.2860 | 3.2840 | 3.2839 | 3.2878 | 3.2870 | 3.2856 | 3.2841 | 3.3342 | 3.3339 | 3.3343 | 3.3345 | ........ | |
| Existing + Entitled Post-Upgrade PWWF [MGD] | .... | 2.4570 | 2.4567 | 2.4765 | 2.4763 | 2.4761 | 2.4759 | 3.0379 | 3.1962 | 3.1963 | 3.1956 | 3.1989 | 3.1975 | 3.1956 | 3.1940 | 3.2451 | 3.2454 | 3.2453 | 3.2451 | ........ | |
| Existing + Entitled + Timberline Phase 1 Post-Upgrade PWWF [MGD] | .... | 2.5576 | 2.5777 | 2.5776 | 2.5775 | 3.1424 | 3.3009 | 3.2982 | 3.2983 | 3.3022 | 3.3015 | 3.3001 | 3.2986 | 3.3486 | 3.3477 | 3.3482 | 3.3485 | 3.3487 | ........ | | |
| Existing + Entitled + Timberline Buildout Post-Upgrade PWWF [MGD] | .... | 2.8333 | 2.8317 | 2.8512 | 2.8508 | 2.8507 | 2.8509 | 3.4082 | 3.5658 | 3.5661 | 3.5654 | 3.5687 | 3.5673 | 3.5654 | 3.5634 | 3.6137 | 3.6141 | 3.6143 | 3.6142 | ........ | |
| Q Manning Post-Upgrade [MGD] | .... | 2.8451 | 3.0148 | 2.9372 | 4.5765 | 10.6533 | 2.3826 | 4.7805 | 2.5228 | 4.3218 | 3.4616 | 4.5551 | 3.9404 | 5.1719 | 3.4191 | ........ | | | | | |

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**Legend**

12” Existing Sewer Diameter
12” Recommended Sewer Diameter to Eliminate Surcharging
15” Recommended Sewer Diameter to Eliminate Surcharging for Timberline Full Build-out Only

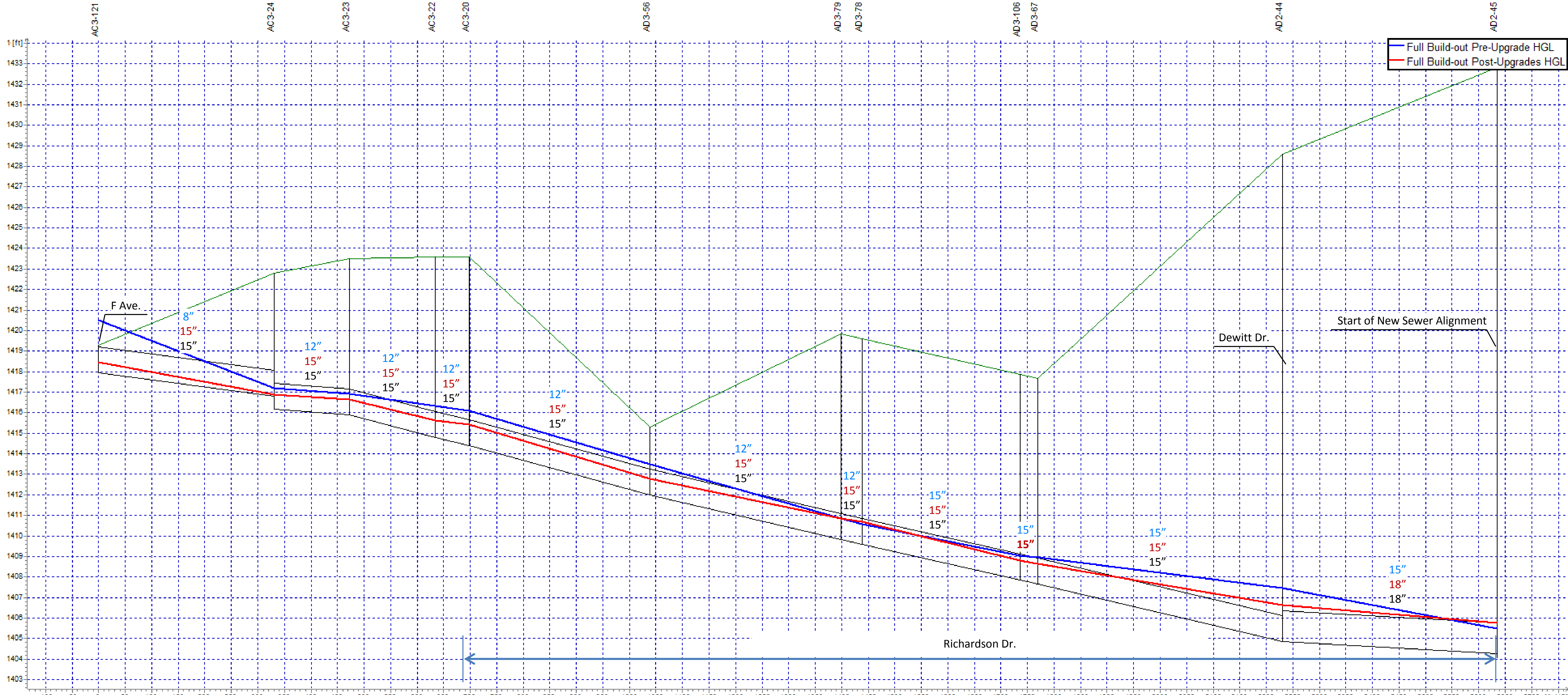
**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project
Western Care Construction, Inc.
Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.
B-9

Title
Impact of Upgrades Upon Near-Term Developments
HGL Profile 4




| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.2500 | 1.5000 | | | | | | | | | | | | | | | | |
| Ground Level [ft] | 1419.30 | 1422.80 | 1423.50 | 1423.60 | 1415.30 | 1419.84 | 1419.60 | 1417.86 | 1417.66 | 1428.60 | 1432.80 | | | | | | | |
| Link Slope [%] | 0.35 | 0.20 | 0.68 | | 0.71 | 0.60 | 0.62 | 0.58 | 0.59 | 0.61 | 0.15 | | | | | | | |
| Full Build-out Pre-Upgrades PWWF [MGD] | 0.6935 | 0.9103 | 1.1690 | 1.1715 | 1.7573 | 1.7570 | 2.0161 | 2.0115 | ...... | 2.1241 | 2.8199 | | | | | | | |
| Full Build-out Post-Upgrades PWWF [MGD] | 0.7479 | 0.7472 | 0.9668 | 1.2230 | 1.2220 | 1.8339 | 1.8340 | 1.8333 | 1.8323 | ...... | 2.0894 | 2.0887 | ...... | 2.2099 | 2.2075 | 2.2076 | 3.0831 | 3.0830 |
| Q Manning Post-Upgrade [MGD] | 2.2156 | 1.6608 | 3.0835 | 2.9595 | 3.1420 | 2.8908 | ...... | 3.4508 | ...... | 2.9139 | 2.5907 | | | | | | | |

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**Legend**

#″ Existing Sewer Diameter

#″ Hydraulically Required Diameter to Eliminate Surcharging

#″ Required Diameter to meet Placer County Policy of sewer diameter consistency

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

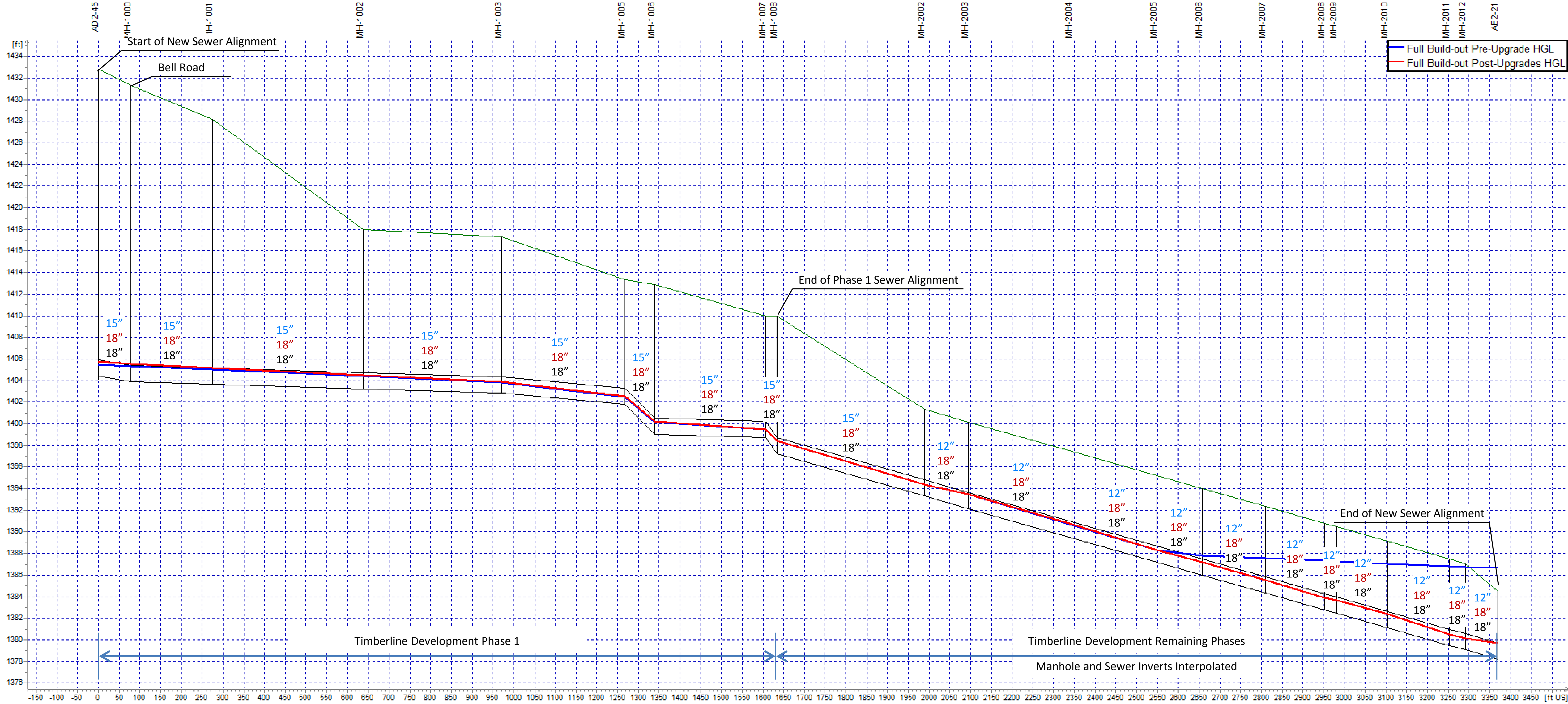
Figure No.

B-10

Title

Impact of Upgrades Upon Full Build-out System

HGL Profile 1




| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.5000 | | | | | | | | | | | | | | | | | | | | | |
| Ground Level [ft] | ........ | 1428.20 | 1418.00 | 1417.30 | 1413.30 | 1412.90 | 1410.00 | 1401.33 | 1400.16 | 1397.43 | 1395.21 | 1394.00 | 1392.35 | 1390.78 | 1390.46 | 1389.13 | 1387.50 | ......... | ...... | | | | |
| Link Slope [%] | | | | | | | | | | | | | | | | | | | | | | | |
| Full Build-out Pre-Upgrades PWWF [MGD] | 2.8179 | 2.8292 | 2.8291 | 2.8290 | 2.8291 | 2.9025 | 2.9024 | 2.9089 | 2.9088 | .... | 2.9086 | 2.9084 | 2.9081 | 2.9080 | 2.9083 | 2.9042 | 2.9007 | 2.8992 | .... | 2.8964 | 2.8950 | ...... | 2.8910 |
| Full Build-out Post-Upgrades PWWF [MGD] | 3.0823 | 3.0936 | 3.0925 | 3.0915 | 3.0909 | 3.1666 | 3.1661 | 3.1658 | 3.1724 | 3.1729 | .... | 3.1734 | 3.1737 | 3.1738 | 3.1739 | 3.1737 | 3.1735 | 3.1733 | 3.1730 | .... | 3.1725 | 3.1721 | ...... | 3.1716 |
| Q Manning Post-Upgrade [MGD] | 2.5646 | 2.5577 | 2.5471 | 4.2625 | 14.4781 | 2.5408 | .... | 7.6830 | .... | 7.6830 | | | | | | | | | | | | | |

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**Legend**

#" Existing Sewer Diameter

#" Hydraulically Required Diameter to Eliminate Surcharging

#" Required Diameter to meet Placer County Policy of sewer diameter consistency

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.

B-11

Title

Impact of Upgrades Upon Full Build-out System

HGL Profile 2


| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.5000 | 1.2500 | | | | | | | | | | | | | | 1.5000 | |
| Ground Level [ft] | ... | 1381.29 | 1364.79 | 1352.74 | 1350.12 | 1341.66 | 1330.36 | 1330.87 | 1328.04 | 1324.35 | 1322.26 | 1320.29 | 1304.33 | 1286.50 | 1277.82 | 1276.80 | |
| Link Slope [%] | 1.02 | 4.10 | 3.58 | 4.42 | 2.55 | 4.63 | 0.96 | 1.07 | 3.17 | 2.70 | 2.20 | 6.62 | 10.91 | 3.48 | 0.89 | | |
| Full Build-out Pre-Upgrades PWWF [MGD] | ... | 2.7121 | 2.7511 | 2.7510 | 2.5238 | 2.5237 | 2.5392 | 2.5059 | 2.5058 | 2.5243 | 2.4995 | 2.5060 | 2.5064 | 2.5512 | 2.5561 | 2.6426 | 2.6415 | 2.4415 |
| Full Build-out Post-Upgrades PWWF [MGD] | ... | 3.4151 | 3.5177 | 3.5759 | 3.5760 | 3.6093 | 3.6199 | 3.6200 | 3.6968 | 3.7048 | 3.7975 | 3.7976 | 3.7977 | | | | | |
| Q Manning Post-Upgrade [MGD] | 6.8551 | 8.4472 | 7.0726 | 8.7655 | 6.6585 | 8.9735 | 4.0846 | 4.3230 | 7.4298 | 6.8465 | 6.1902 | 10.7296 | 13.7711 | 12.6414 | 6.4091 | | |

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**Legend**

#" Existing Sewer Diameter

#" Hydraulically Required Diameter to Eliminate Surcharging

#" Required Diameter to meet Placer County Policy of sewer diameter consistency

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project

Western Care Construction, Inc.

Sewer Capacity – North Auburn Dewitt Trunk - Timberline

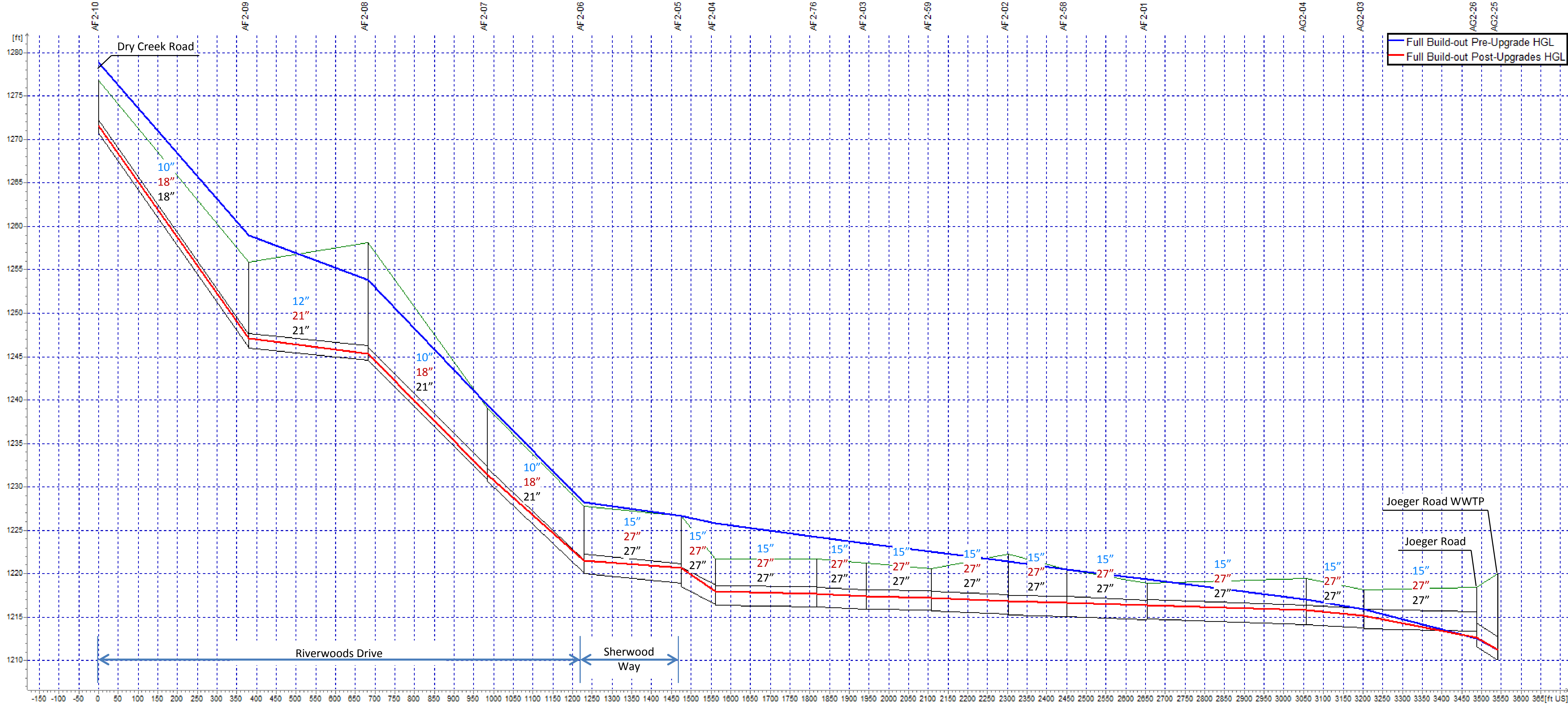
Figure No.

B-12

Title

Impact of Upgrades Upon Full Build-out System

HGL Profile 3




| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Diameter [ft] | 1.5000 | 1.7500 | 1.5000 | 2.2500 | ........ | | | | | | | | | | | | | | | | |
| Ground Level [ft] | ........ | 1255.84 | 1258.11 | 1239.08 | 1227.77 | 1226.68 | 1221.67 | 1221.68 | 1221.25 | 1220.57 | 1222.23 | 1220.46 | 1218.86 | 1219.47 | 1218.14 | 1218.42 | .... | | | | |
| Link Slope [%] | 6.49 | 0.47 | 4.55 | 4.32 | 0.46 | 2.47 | 0.05 | 0.22 | 0.06 | 0.18 | 0.11 | 0.20 | 0.15 | 0.26 | 0.11 | 3.08 | | | | | |
| Full Build-out Pre-Upgrades PWWF [MGD] | 3.1622 | 2.9905 | 3.0086 | 3.0079 | 3.4740 | 3.4739 | 3.5939 | 3.2627 | 3.1907 | 3.1533 | 3.1333 | 3.1593 | ........ | | | | | | | | |
| Full Build-out Post-Upgrades PWWF [MGD] | ........ | 5.2464 | 5.2745 | 5.2754 | 5.3174 | 5.3176 | 5.3177 | 6.0575 | 6.2273 | 6.2245 | 6.2208 | 6.2262 | 6.2224 | 6.2234 | 6.2239 | 6.2958 | 6.2952 | 6.2944 | 6.2937 | 6.2929 | ........ |
| Q Manning Post-Upgrade [MGD] | 17.2689 | 6.9795 | 14.4580 | 14.0863 | 9.8569 | 22.9454 | 4.6574 | 9.3445 | 4.9315 | 8.4480 | 6.7664 | 8.9041 | 7.7024 | 10.1097 | 6.6834 | ........ | | | | | |

7/3/2011


Stantec Consulting Ltd.
3875 Atherton Road
Rocklin CA 95765
Tel. 916.773.8100
Fax. 916.773.8448


**Legend**

#″ Existing Sewer Diameter

#″ Hydraulically Required Diameter to Eliminate Surcharging

#″ Required Diameter to meet Placer County Policy of sewer diameter consistency

**Note:**

- Scenarios 1, 2, 3, and 5 Results are based on the existing sewer alignment through proposed timberline development.
- Scenarios 4 and 6 results are based on future proposed alignment through Phase 1 development only.
- Scenarios 7 and 8 is based on ultimate future alignment.

Client/Project
Western Care Construction, Inc.
Sewer Capacity – North Auburn Dewitt Trunk - Timberline

Figure No.
B-13

Title
Impact of Upgrades Upon Full Build-out System
HGL Profile 4

# PLACER COUNTY GOVERNMENT CENTER

SEWER MODEL OUTPUT

**PLACER COUNTY GOVERNMENT CENTER**

SEWER MODEL OUTPUT (CONDUITS)

| ID | Label | Start Node | Invert (Start) (ft) | Stop Node | Invert (Stop) (ft) | Length (Scaled) (ft) | Slope (Calculated) (ft/ft) | Diameter (in) | Manning's n | Flow (cfs) | Velocity (ft/s) | Depth (Middle) (ft) | Capacity (Full Flow) (cfs) | Flow / Capacity (Design) (%) | Depth/Rise (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71 | P-67 | AD2-85 | 1394 | O-2 | 1393 | 361.8 | 0.003 | 6 | 0.01 | 0.17 | 1.91 | 0.24 | 0.38 | 45.4 | 47.3 |
| 74 | P-70 | AD2-104 | 1402.24 | AD2-100 | 1395.16 | 400.1 | 0.018 | 6 | 0.011 | 0.04 | 2.33 | 0.08 | 0.88 | 4.9 | 15.1 |
| 75 | P-85 | UNK-17 | 1386 | O-3 | 1384.05 | 53.3 | 0.037 | 8 | 0.01 | 0.03 | 2.85 | 0.05 | 3.01 | 1.1 | 7.5 |
| 77 | P-56 | UNK-16 | 1390 | UNK-18 | 1385 | 82.1 | 0.061 | 8 | 0.01 | 0.3 | 6.61 | 0.16 | 3.88 | 7.8 | 23.7 |
| 78 | P-57 | AC3-32 | 1391 | UNK-16 | 1390 | 344.8 | 0.003 | 8 | 0.01 | 0.23 | 2.07 | 0.24 | 0.85 | 27.8 | 36.1 |
| 79 | P-58 | AC3-123 | 1392.65 | AC3-32 | 1391 | 109.2 | 0.015 | 8 | 0.01 | 0.2 | 3.58 | 0.2 | 1.93 | 10.4 | 29.4 |
| 80 | P-59 | AC2-099 | 1393.65 | AC3-123 | 1392.65 | 154.5 | 0.006 | 8 | 0.01 | 0.17 | 2.52 | 0.16 | 1.27 | 13.3 | 24.7 |
| 81 | P-60 | AD2-098 | 1394.52 | AC2-099 | 1393.65 | 179.7 | 0.005 | 8 | 0.01 | 0.13 | 2.13 | 0.17 | 1.09 | 12.3 | 24.9 |
| 82 | P-61 | AD02-057 | 1395.04 | AD2-098 | 1394.52 | 64.9 | 0.008 | 8 | 0.01 | 0.1 | 2.33 | 0.14 | 1.41 | 7.2 | 21.4 |
| 83 | P-62 | AC2-002 | 1397.96 | AD02-057 | 1395.04 | 237.3 | 0.012 | 8 | 0.01 | 0.07 | 2.41 | 0.11 | 1.74 | 3.8 | 16.4 |
| 84 | P-63 | AC2-001 | 1400 | AC2-002 | 1397.96 | 127.2 | 0.016 | 8 | 0.01 | 0.03 | 2.15 | 0.08 | 1.99 | 1.7 | 11.9 |
| 85 | P-82 | UNK-18 | 1385 | O-3 | 1384.05 | 29.6 | 0.032 | 8 | 0.01 | 0.3 | 5.24 | 0.15 | 2.8 | 10.8 | 22.2 |
| 86 | P-89 | AD3-45 | 1420.86 | AD3-44 | 1419.84 | 118.6 | 0.009 | 12 | 0.01 | 0.82 | 4.2 | 0.32 | 4.29 | 19 | 31.7 |
| 90 | P-6 | UNK-06 | 1410.8 | AD3-78 | 1409.6 | 326.6 | 0.004 | 18 | 0.011 | 1.56 | 3.36 | 0.54 | 7.52 | 20.8 | 35.8 |
| 91 | P-7 | UNK-05 | 1411.4 | UNK-06 | 1410.8 | 61.4 | 0.01 | 18 | 0.011 | 1.56 | 4.78 | 0.42 | 12.31 | 12.7 | 28.1 |
| 92 | P-8 | AD3-57 | 1413.3 | UNK-05 | 1411.4 | 134.5 | 0.014 | 6 | 0.01 | 0.18 | 3.49 | 0.28 | 0.87 | 20.9 | 55.2 |
| 93 | P-9 | AD3-156 | 1416 | AD3-57 | 1413.3 | 138 | 0.02 | 6 | 0.01 | 0.14 | 3.61 | 0.15 | 1.02 | 13.3 | 29.8 |
| 94 | P-10 | AD3-58 | 1419.9 | AD3-156 | 1416 | 140.5 | 0.028 | 6 | 0.01 | 0.09 | 3.64 | 0.12 | 1.21 | 7.5 | 23.6 |
| 97 | P-15 | AD3-61 | 1429.5 | AD3-58 | 1419.9 | 236.3 | 0.041 | 6 | 0.01 | 0.05 | 3.39 | 0.09 | 1.47 | 3.1 | 17.3 |
| 98 | P-16 | AD3-56 | 1411.9 | UNK-05 | 1411.4 | 18.5 | 0.028 | 18 | 0.011 | 1.38 | 6.65 | 0.33 | 20.69 | 6.7 | 22 |
| 99 | P-17 | AC3-20 | 1414.4 | AD3-56 | 1411.9 | 311 | 0.008 | 18 | 0.011 | 1.38 | 4.29 | 0.36 | 11.13 | 12.4 | 23.8 |
| 100 | P-18 | AC3-22 | 1414.8 | AC3-20 | 1414.4 | 73 | 0.005 | 18 | 0.011 | 0.98 | 3.39 | 0.36 | 9.19 | 10.7 | 23.9 |
| 101 | P-19 | AC3-23 | 1415.9 | AC3-22 | 1414.8 | 149.1 | 0.007 | 18 | 0.01 | 0.98 | 4.03 | 0.32 | 11.73 | 8.3 | 21.4 |
| 102 | P-20 | AC3-24 | 1416.18 | AC3-23 | 1415.9 | 143.3 | 0.002 | 12 | 0.01 | 0.64 | 2.31 | 0.39 | 2.05 | 31.4 | 38.5 |
| 103 | P-21 | AC3-25 | 1417.96 | AC3-24 | 1416.18 | 343.9 | 0.005 | 8 | 0.01 | 0.32 | 2.79 | 0.32 | 1.13 | 28.5 | 47.8 |
| 104 | P-22 | AC3-62 | 1423.29 | AC3-24 | 1416.18 | 271.5 | 0.026 | 8 | 0.01 | 0.21 | 4.43 | 0.26 | 2.54 | 8.4 | 39.3 |
| 105 | P-23 | AD3-63 | 1424.9 | AC3-62 | 1423.29 | 75.9 | 0.021 | 8 | 0.011 | 0.11 | 3.13 | 0.13 | 2.08 | 5.2 | 19.8 |
| 109 | P-29 | AD3-42 | 1409.64 | AD3-78 | 1409.6 | 127.5 | 0 | 12 | 0.01 | 1.22 | 1.55 | 0.76 | 0.82 | 148.8 | 75.7 |
| 110 | P-30 | AD3-43 | 1415.86 | AD3-42 | 1409.64 | 278.8 | 0.022 | 12 | 0.01 | 1.17 | 6.57 | 0.53 | 6.92 | 17 | 53.3 |
| 111 | P-31 | AD3-44 | 1419.84 | AD3-43 | 1415.86 | 173.3 | 0.023 | 12 | 0.01 | 1.13 | 6.56 | 0.31 | 7.02 | 16.1 | 30.8 |
| 112 | P-51 | AC3-141 | 1414.7 | AC3-20 | 1414.4 | 143 | 0.002 | 10 | 0.01 | 0.4 | 2.1 | 0.35 | 1.3 | 30.7 | 42.1 |
| 113 | P-52 | AC3-31 | 1416.2 | AC3-23 | 1415.9 | 124.8 | 0.002 | 12 | 0.01 | 0.34 | 2.07 | 0.29 | 2.27 | 14.8 | 28.9 |
| 114 | P-72 | AD3-78 | 1409.6 | AD3-106 | 1407.86 | 284.1 | 0.006 | 15 | 0.01 | 2.78 | 5.13 | 0.6 | 6.57 | 42.3 | 47.7 |
| 115 | P-73 | AD3-106 | 1407.86 | AD3-67 | 1407.66 | 36.7 | 0.005 | 15 | 0.01 | 2.78 | 4.9 | 0.61 | 6.17 | 45.1 | 49.2 |
| 116 | P-1 | AD3-166 | 1403.87 | AD2-047 | 1403.48 | 114.9 | 0.003 | 18 | 0.01 | 4.3 | 4.59 | 0.79 | 7.95 | 54.1 | 52.4 |
| 117 | P-2 | AD2-45 | 1404.27 | AD3-166 | 1403.87 | 136.6 | 0.003 | 18 | 0.01 | 4.3 | 4.34 | 0.82 | 7.38 | 58.3 | 54.9 |
| 118 | P-3 | AD2-44 | 1404.86 | AD2-45 | 1404.27 | 381.6 | 0.002 | 15 | 0.01 | 3.23 | 3.07 | 1 | 3.3 | 98 | 80.2 |
| 119 | P-4 | AD3-67 | 1407.66 | AD2-44 | 1404.86 | 454.2 | 0.006 | 15 | 0.01 | 3.06 | 5.27 | 0.81 | 6.59 | 46.4 | 64.6 |
| 120 | P-42 | NEW AD3-68 | 1418 | AD3-67 | 1407.66 | 374.7 | 0.028 | 10 | 0.01 | 0.07 | 3.1 | 0.36 | 4.73 | 1.4 | 42.6 |
| 121 | P-48 | AD2-01 | 1417.09 | AD2-44 | 1404.86 | 41.9 | 0.291 | 8 | 0.01 | 0.17 | 9.69 | 0.37 | 8.48 | 2.1 | 55 |
| 122 | P-49 | AD2-002 | 1420 | AD2-01 | 1417.09 | 75.3 | 0.039 | 8 | 0.01 | 0.17 | 4.78 | 0.16 | 3.09 | 5.6 | 24 |
| 123 | P-86 | NEW MH01 | 1420.26 | AD3-44 | 1419.84 | 353 | 0.001 | 10 | 0.01 | 0.27 | 1.53 | 0.32 | 0.98 | 27.2 | 38.1 |
| 124 | P-87 | AD3-101 | 1420.47 | NEW MH01 | 1420.26 | 176.6 | 0.001 | 10 | 0.01 | 0.27 | 1.53 | 0.3 | 0.98 | 27.2 | 35.7 |
| 125 | P-45 | AD3-069 | 1422 | AD3-101 | 1420.47 | 141 | 0.011 | 8 | 0.01 | 0.2 | 3.18 | 0.23 | 1.64 | 12.2 | 34.4 |
| 126 | P-46 | AD3-71 | 1427.79 | AD3-069 | 1422 | 368 | 0.016 | 8 | 0.01 | 0.13 | 3.22 | 0.15 | 1.97 | 6.8 | 21.8 |
| 127 | P-47 | AD3-72 | 1430.7 | AD3-71 | 1427.79 | 81.5 | 0.035 | 8 | 0.011 | 0.07 | 3.25 | 0.1 | 2.69 | 2.5 | 15.4 |
| 128 | P-90 | NEW MH-71 | 1421.26 | AD3-45 | 1420.86 | 134.8 | 0.003 | 12 | 0.01 | 0.82 | 2.86 | 0.39 | 2.52 | 32.3 | 39.1 |
| 129 | P-91 | NEW MH-72 | 1424.67 | NEW MH-71 | 1421.26 | 846.8 | 0.004 | 10 | 0.01 | 0.2 | 2.18 | 0.29 | 1.81 | 11.1 | 34.7 |
| 130 | P-92 | NEW MH-73 | 1427.02 | NEW MH-72 | 1424.67 | 541.6 | 0.004 | 8 | 0.01 | 0.1 | 1.88 | 0.16 | 1.03 | 9.7 | 24.5 |
| 131 | P-88 | NEW MH-68 | 1422.12 | NEW MH-71 | 1421.26 | 278.7 | 0.003 | 12 | 0.01 | 0.62 | 2.69 | 0.36 | 2.57 | 23.9 | 36.2 |
| 132 | P-93 | NEW AD3-46 | 1422.53 | NEW MH-68 | 1422.12 | 129.9 | 0.003 | 12 | 0.01 | 0.62 | 2.71 | 0.33 | 2.6 | 23.7 | 33.2 |
| 134 | P-81 | NEW MH-100 | 1429.61 | AD3-48 | 1426 | 210.8 | 0.017 | 8 | 0.01 | 0.05 | 2.4 | 0.09 | 2.05 | 2.2 | 14.1 |

**PLACER COUNTY GOVERNMENT CENTER**

SEWER MODEL OUTPUT (CONDUITS)

| ID | Label | Start Node | Invert (Start) (ft) | Stop Node | Invert (Stop) (ft) | Length (Scaled) (ft) | Slope (Calculated) (ft/ft) | Diameter (in) | Manning's n | Flow (cfs) | Velocity (ft/s) | Depth (Middle) (ft) | Capacity (Full Flow) (cfs) | Flow / Capacity (Design) (%) | Depth/Rise (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 135 | P-79 | AD3-47 | 1424.09 | NEW AD3-46 | 1422.53 | 302.2 | 0.005 | 12 | 0.01 | 0.14 | 2.08 | 0.24 | 3.33 | 4.1 | 24 |
| 136 | P-36 | AD3-48 | 1426 | AD3-47 | 1424.09 | 382.7 | 0.005 | 12 | 0.01 | 0.09 | 1.82 | 0.13 | 3.27 | 2.8 | 13 |
| 137 | P-94 | AD3-103 | 1426.53 | NEW AD3-46 | 1422.53 | 302.9 | 0.013 | 6 | 0.01 | 0.43 | 4.31 | 0.3 | 0.84 | 51.8 | 59.8 |
| 224 | CO-1 | AD2-100 | 1395.16 | NEW MH-101 | 0 | 103.8 | 13.415 | 6 | 0.01 | 0.09 | 31.47 | 0.02 | 26.72 | 0.3 | 4.1 |
| 225 | P-69 | NEW MH-101 | 0 | NEW MH-102 | 1395 | 204.5 | -6.805 | 6 | 0.01 | 0.09 | 0.44 | 0.41 | 19.03 | 0.5 | 82.3 |
| 226 | CO-3 | NEW MH-102 | 1395 | NEW MH-103 | 1394.78 | 78.9 | 0.003 | 12 | 0.013 | 0.13 | 1.38 | 0.18 | 1.88 | 7 | 18.1 |
| 227 | P-68 | NEW MH-103 | 1394.78 | AD2-85 | 1394 | 200.6 | 0.004 | 6 | 0.01 | 0.13 | 2 | 0.21 | 0.45 | 28.8 | 42.6 |
| 229 | P-102 | AC3-30 | 1437.5 | MH-3 | 1429 | 212.1 | 0.04 | 6 | 0.01 | 0.11 | 4.33 | 0.1 | 1.46 | 7.3 | 20.1 |
| 230 | P-101 | MH-3 | 1429 | AC3-25 | 1417.96 | 550.4 | 0.02 | 6 | 0.01 | 0.11 | 3.4 | 0.18 | 1.03 | 10.4 | 36.4 |
| 232 | P-103 | AC3-26 | 1419 | AC3-25 | 1417.96 | 127.2 | 0.008 | 6 | 0.01 | 0 | 0 | 0.13 | 0.66 | 0 | 25.5 |
| 234 | CO-8 | NEW MH-5 | 1427.4 | AD3-103 | 1426.53 | 181.8 | 0.005 | 6 | 0.01 | 0.1 | 2 | 0.2 | 0.5 | 19.8 | 40.6 |
| 235 | CO-9 | AC3-510 | 1397 | UNK-16 | 1390 | 100 | 0.07 | 6 | 0.01 | 0.03 | 3.72 | 0.12 | 1.93 | 1.7 | 24 |
| 242 | CO-10 | MH-6 | 1426 | MH-8 | 1408.51 | 701.4 | 0.025 | 6 | 0.01 | 0.07 | 3.24 | 0.29 | 1.15 | 6.1 | 58.4 |
| 243 | CO-11 | MH-8 | 1408.51 | MH-9 | 1408.38 | 256.6 | 0.001 | 6 | 0.01 | 0.14 | 0.71 | 0.5 | 0.16 | 85.3 | 100 |
| 244 | CO-12 | MH-9 | 1408.38 | MH-10 | 1408.18 | 402.4 | 0 | 6 | 0.01 | 0.21 | 1.07 | 0.46 | 0.16 | 129.1 | 91.7 |
| 249 | CO-15 | MH-10 | 1408.18 | MH-13 | 1407.84 | 686.8 | 0 | 12 | 0.013 | 0.21 | 0.85 | 0.59 | 0.79 | 26.5 | 58.7 |
| 250 | CO-16 | MH-13 | 1407.84 | MH-12 | 1407.68 | 323.9 | 0 | 6 | 0.01 | 0.21 | 1.07 | 0.5 | 0.16 | 129.6 | 100 |
| 251 | CO-17 | MH-12 | 1407.68 | AD3-67 | 1407.66 | 33.4 | 0.001 | 6 | 0.01 | 0.21 | 1.07 | 0.5 | 0.18 | 116.9 | 100 |
| 258 | CO-18 | NEW MH-14 | 1424.5 | NEW MH-15 | 1424.36 | 267.8 | 0.001 | 6 | 0.01 | 0.1 | 0.89 | 0.28 | 0.17 | 60 | 55.8 |
| 259 | CO-19 | NEW MH-15 | 1424.36 | NEW MH-17 | 1422.5 | 79.2 | 0.024 | 6 | 0.01 | 0.2 | 4.32 | 0.14 | 1.12 | 17.9 | 28.6 |
| 260 | CO-20 | NEW MH-17 | 1422.5 | NEW MH-18 | 1414.5 | 210.1 | 0.038 | 6 | 0.01 | 0.2 | 5.11 | 0.13 | 1.42 | 14 | 25.3 |
| 261 | CO-21 | NEW MH-18 | 1414.5 | NEW MH-19 | 0 | 232.6 | 6.071 | 6 | 0.01 | 0.2 | 30.19 | 0.27 | 17.97 | 1.1 | 53.7 |
| 262 | CO-22 | NEW MH-16 | 1424.5 | NEW MH-15 | 1424.36 | 244 | 0.001 | 6 | 0.01 | 0.1 | 0.92 | 0.27 | 0.17 | 57.2 | 54.2 |
| 264 | CO-23 | NEW MH-19 | 0 | O-1 | 1393.58 | 119.9 | -11.613 | 6 | 0.01 | 0.2 | 1.02 | 0.43 | 24.86 | 0.8 | 86.2 |

**PLACER COUNTY GOVERNMENT CENTER**

SEWER MODEL OUTPUT (MANHOLES)

| ID | Label | Elevation (Ground) (ft) | Elevation (Rim) (ft) | Elevation (Invert) (ft) | Flow (Total In) (cfs) | Flow (Total Out) (cfs) | Depth (Out) (ft) | Hydraulic Grade Line (Out) (ft) | Hydraulic Grade Line (In) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | AD2-85 | 1400.2 | 1400.2 | 1394 | 0.13 | 0.17 | 0.24 | 1394.24 | 1394.24 |
| 3 | NEW MH-102 | 1400 | 1400 | 1395 | 0.09 | 0.13 | 0.18 | 1395.18 | 1395.18 |
| 4 | AD2-100 | 1400.47 | 1400.47 | 1395.16 | 0.04 | 0.09 | 0.02 | 1395.18 | 1395.18 |
| 5 | AD2-104 | 1409.64 | 1409.64 | 1402.24 | 0 | 0.04 | 0.08 | 1402.32 | 1402.32 |
| 6 | UNK-17 | 1394 | 1394 | 1386 | 0 | 0.03 | 0.05 | 1386.05 | 1386.06 |
| 7 | UNK-18 | 1394.3 | 1394.3 | 1385 | 0.3 | 0.3 | 0.15 | 1385.15 | 1385.19 |
| 8 | AC3-510 | 1402 | 1402 | 1397 | 0 | 0.03 | 0.05 | 1397.05 | 1397.05 |
| 9 | UNK-16 | 1401.8 | 1401.8 | 1390 | 0.27 | 0.3 | 0.13 | 1390.13 | 1390.19 |
| 10 | AC3-32 | 1405 | 1405 | 1391 | 0.2 | 0.23 | 0.24 | 1391.24 | 1391.25 |
| 11 | AC3-123 | 1407.24 | 1407.24 | 1392.65 | 0.17 | 0.2 | 0.15 | 1392.8 | 1392.82 |
| 12 | AC2-099 | 1407.67 | 1407.67 | 1393.65 | 0.13 | 0.17 | 0.16 | 1393.81 | 1393.82 |
| 13 | AD2-098 | 1410.79 | 1410.79 | 1394.52 | 0.1 | 0.13 | 0.16 | 1394.68 | 1394.68 |
| 14 | AD02-057 | 1404.75 | 1404.75 | 1395.04 | 0.07 | 0.1 | 0.12 | 1395.16 | 1395.17 |
| 15 | AC2-002 | 1403.57 | 1403.57 | 1397.96 | 0.03 | 0.07 | 0.09 | 1398.05 | 1398.06 |
| 16 | AC2-001 | 1405 | 1405 | 1400 | 0 | 0.03 | 0.06 | 1400.06 | 1400.07 |
| 18 | AD3-45 | 1427.6 | 1427.6 | 1420.86 | 0.82 | 0.82 | 0.3 | 1421.16 | 1421.16 |
| 20 | AC3-30 | 1443.5 | 1443.5 | 1437.5 | 0 | 0.11 | 0.09 | 1437.59 | 1437.62 |
| 22 | AD3-78 | 1411.4 | 1411.4 | 1409.6 | 2.78 | 2.78 | 0.57 | 1410.17 | 1410.21 |
| 23 | UNK-06 | 1413.8 | 1413.8 | 1410.8 | 1.56 | 1.56 | 0.46 | 1411.26 | 1411.28 |
| 24 | UNK-05 | 1414 | 1414 | 1411.4 | 1.56 | 1.56 | 0.36 | 1411.76 | 1411.8 |
| 25 | AD3-57 | 1417.8 | 1417.8 | 1413.3 | 0.14 | 0.18 | 0.16 | 1413.46 | 1413.47 |
| 26 | AD3-156 | 1421 | 1421 | 1416 | 0.09 | 0.14 | 0.12 | 1416.12 | 1416.14 |
| 27 | AD3-58 | 1425.2 | 1425.2 | 1419.9 | 0.05 | 0.09 | 0.09 | 1419.99 | 1420.01 |
| 30 | AD3-61 | 1434.5 | 1434.5 | 1429.5 | 0 | 0.05 | 0.06 | 1429.56 | 1429.58 |
| 31 | AD3-56 | 1414 | 1414 | 1411.9 | 1.38 | 1.38 | 0.26 | 1412.16 | 1412.23 |
| 32 | AC3-20 | 1420.38 | 1420.38 | 1414.4 | 1.38 | 1.38 | 0.36 | 1414.76 | 1414.79 |
| 33 | AC3-22 | 1421 | 1421 | 1414.8 | 0.98 | 0.98 | 0.33 | 1415.13 | 1415.15 |
| 34 | AC3-23 | 1420 | 1420 | 1415.9 | 0.98 | 0.98 | 0.29 | 1416.19 | 1416.22 |
| 35 | AC3-24 | 1420 | 1420 | 1416.18 | 0.54 | 0.64 | 0.39 | 1416.57 | 1416.57 |
| 36 | AC3-25 | 1419.64 | 1419.64 | 1417.96 | 0.11 | 0.32 | 0.24 | 1418.2 | 1418.22 |
| 37 | AC3-62 | 1427.58 | 1427.58 | 1423.29 | 0.11 | 0.21 | 0.13 | 1423.42 | 1423.45 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 38 | AD3-63 | 1429.2 | 1429.2 | 1424.9 | 0 | 0.11 | 0.1 | 1425 | 1425.02 |
| 42 | AD3-42 | 1414.94 | 1414.94 | 1409.64 | 1.17 | 1.22 | 0.78 | 1410.42 | 1410.43 |
| 43 | AD3-43 | 1420.86 | 1420.86 | 1415.86 | 1.13 | 1.17 | 0.28 | 1416.14 | 1416.21 |
| 44 | AD3-44 | 1425.26 | 1425.26 | 1419.84 | 1.08 | 1.13 | 0.27 | 1420.11 | 1420.18 |
| 45 | AC3-141 | 1418.7 | 1418.7 | 1414.7 | 0 | 0.4 | 0.32 | 1415.02 | 1415.02 |
| 46 | AC3-31 | 1422 | 1422 | 1416.2 | 0 | 0.34 | 0.26 | 1416.46 | 1416.47 |
| 47 | AD3-106 | 1418.36 | 1418.36 | 1407.86 | 2.78 | 2.78 | 0.59 | 1408.45 | 1408.49 |
| 49 | AD3-166 | 1429.32 | 1429.32 | 1403.87 | 4.3 | 4.3 | 0.79 | 1404.66 | 1404.69 |
| 50 | AD2-45 | 1432.42 | 1432.42 | 1404.27 | 3.23 | 4.3 | 0.82 | 1405.09 | 1405.12 |
| 51 | AD2-44 | 1428.87 | 1428.87 | 1404.86 | 3.23 | 3.23 | 1 | 1405.86 | 1405.88 |
| 52 | AD3-67 | 1419.47 | 1419.47 | 1407.66 | 3.06 | 3.06 | 0.6 | 1408.26 | 1408.3 |
| 53 | NEW AD3-68 | 1423.81 | 1423.81 | 1418 | 0 | 0.07 | 0.07 | 1418.07 | 1418.08 |
| 54 | AD2-01 | 1426.25 | 1426.25 | 1417.09 | 0.17 | 0.17 | 0.07 | 1417.16 | 1417.3 |
| 55 | AD2-002 | 1427 | 1427 | 1420 | 0 | 0.17 | 0.11 | 1420.11 | 1420.14 |
| 56 | NEW MH01 | 1426 | 1426 | 1420.26 | 0.27 | 0.27 | 0.3 | 1420.56 | 1420.56 |
| 57 | AD3-101 | 1427.57 | 1427.57 | 1420.47 | 0.2 | 0.27 | 0.3 | 1420.77 | 1420.77 |
| 58 | AD3-069 | 1429.13 | 1429.13 | 1422 | 0.13 | 0.2 | 0.16 | 1422.16 | 1422.17 |
| 59 | AD3-71 | 1431.72 | 1431.72 | 1427.79 | 0.07 | 0.13 | 0.12 | 1427.91 | 1427.92 |
| 60 | AD3-72 | 1433.82 | 1433.82 | 1430.7 | 0 | 0.07 | 0.07 | 1430.77 | 1430.79 |
| 61 | NEW MH-71 | 1431.2 | 1431.2 | 1421.26 | 0.82 | 0.82 | 0.39 | 1421.65 | 1421.65 |
| 62 | NEW MH-72 | 1434 | 1434 | 1424.67 | 0.1 | 0.2 | 0.19 | 1424.86 | 1424.86 |
| 63 | NEW MH-73 | 1431.91 | 1431.91 | 1427.02 | 0 | 0.1 | 0.14 | 1427.16 | 1427.16 |
| 64 | NEW MH-68 | 1433 | 1433 | 1422.12 | 0.62 | 0.62 | 0.33 | 1422.45 | 1422.45 |
| 65 | NEW MH-100 | 1433.87 | 1433.87 | 1429.61 | 0 | 0.05 | 0.07 | 1429.68 | 1429.69 |
| 67 | NEW AD3-46 | 1430 | 1430 | 1422.53 | 0.57 | 0.62 | 0.33 | 1422.86 | 1422.87 |
| 68 | AD3-47 | 1429.14 | 1429.14 | 1424.09 | 0.09 | 0.14 | 0.14 | 1424.23 | 1424.23 |
| 69 | AD3-48 | 1432.5 | 1432.5 | 1426 | 0.05 | 0.09 | 0.11 | 1426.11 | 1426.12 |
| 70 | AD3-103 | 1434 | 1434 | 1426.53 | 0.1 | 0.43 | 0.26 | 1426.79 | 1426.79 |
| 222 | NEW MH-101 | 0 | 0 | 0 | 0.09 | 0.09 | 0 | 0 | 0 |
| 223 | NEW MH-103 | 1400 | 1400 | 1394.78 | 0.13 | 0.13 | 0.18 | 1394.96 | 1394.96 |
| 228 | MH-3 | 1433 | 1433 | 1429 | 0.11 | 0.11 | 0.11 | 1429.11 | 1429.11 |
| 231 | AC3-26 | 1423 | 1423 | 1419 | 0 | 0 | 0 | 1419 | 1419 |
| 233 | NEW MH-5 | 1434 | 1434 | 1427.4 | 0 | 0.1 | 0.15 | 1427.55 | 1427.55 |
| 236 | MH-6 | 1430 | 1430 | 1426 | 0 | 0.07 | 0.08 | 1426.08 | 1426.08 |
| 238 | MH-8 | 1410 | 1410 | 1408.51 | 0.07 | 0.14 | 0.52 | 1409.03 | 1409.03 |
| 239 | MH-9 | 1410 | 1410 | 1408.38 | 0.14 | 0.21 | 0.55 | 1408.93 | 1408.93 |
| 240 | MH-10 | 1420.38 | 1420.38 | 1408.18 | 0.21 | 0.21 | 0.42 | 1408.6 | 1408.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 247 | MH-12 | 1419.47 | 1419.47 | 1407.68 | 0.21 | 0.21 | 0.65 | 1408.33 | 1408.33 |
| 248 | MH-13 | 1411.4 | 1411.4 | 1407.84 | 0.21 | 0.21 | 0.76 | 1408.6 | 1408.6 |
| 252 | NEW MH-14 | 1428 | 1428 | 1424.5 | 0 | 0.1 | 0.28 | 1424.78 | 1424.78 |
| 253 | NEW MH-15 | 1428 | 1428 | 1424.36 | 0.2 | 0.2 | 0.14 | 1424.5 | 1424.5 |
| 254 | NEW MH-16 | 1428 | 1428 | 1424.5 | 0 | 0.1 | 0.27 | 1424.77 | 1424.77 |
| 255 | NEW MH-17 | 1426 | 1426 | 1422.5 | 0.2 | 0.2 | 0.13 | 1422.63 | 1422.63 |
| 256 | NEW MH-18 | 1418 | 1418 | 1414.5 | 0.2 | 0.2 | 0.04 | 1414.54 | 1414.54 |
| 257 | NEW MH-19 | 1399.23 | 1399.23 | 0 | 0.2 | 0.2 | 1394.03 | 1394.03 | 1394.03 |

# Appendix D – Storm Drainage

Williams + Paddon Architects + Planners Inc.
DRAFT Master Plan Update – Wet Utility Infrastructure

# PLACER COUNTY GOVERNMENT CENTER MASTER DRAINAGE REPORT

October 25, 2018

DRAFT

A report prepared by Peter Kulchawik, P.E. and Teresa Garrison, P.E. on behalf of:

CARTWRIGHT

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# Executive Summary

A master drainage report was prepared to support the wet utility infrastructure component of the Placer County Government Center (PCGC) Master Plan Update by providing a comprehensive analysis of the existing and anticipated future storm drain systems. No previous master drainage report has been prepared for PCGC, and thus far stormwater planning has occurred in a piecemeal fashion without overarching guidance on integrating individual projects into a cohesive stormwater system. A coupled hydrologic-hydraulic model was developed with the XP-STORM platform for the entire 200-acre PCGC to (1) gain an understanding of shortcomings in the existing stormwater infrastructure, and (2) guide stormwater planning according to state and local requirements as the campus evolves toward the ultimate buildout condition.

A baseline (existing conditions) model was developed based on site-specific survey data, engineering plans, and drainage reports, and later supplemented by a focused field investigation to resolve data gaps. The model was validated against stormwater studies from previous projects; in most instances the studies agreed with the baseline model results, and discrepancies that occurred could be explained by land use changes or the higher-resolution data used for the master drainage report. Five outfall locations (where stormwater leaves PCGC) were identified to establish limits for stormwater flow rates under the buildout condition. The baseline model highlighted several shortcomings in the existing stormwater system, including many undersized pipes in the southeast portion of the campus, roadway overtopping at Atwood Drive, shallow flooding near the Finance Administration Building, and insufficient freeboard in detention basins.

The findings from the baseline model were used to inform the alternatives analysis, and eventually identify a land plan for the Final Option. The stormwater management approach for the Final Option is to meet flood control and hydromodification management requirements with several detention basins strategically placed throughout the campus to provide flow controls for the entire PCGC, and leave meeting water-quality treatment requirements to individual projects as they come online.

A total of seven new stormwater basins and reconfiguration of three existing basins are needed to meet County requirements for flood control and hydromodification management. Several new pipes and upsizing of existing pipes in select locations are needed to convey the anticipated future flow rates. The model showed that the stormwater basins are effective in limiting peak flow rates at each of the five outfalls from PCGC to be no greater than the existing peak flow rates. Individual projects will incorporate water-quality features according to the West Placer Storm Water Quality Design Manual, and will include site design, source control, and storm water treatment features. Stormwater treatment features such as bioretention basins typically provide some level of flow control, and will likely reduce flow rates beyond the post-construction flow rates estimated by the XPSTORM model.

# 1 INTRODUCTION

This report supports the wet utility infrastructure component of the Placer County Government Center (PCGC) Master Plan Update by providing a comprehensive analysis of the existing and anticipated future storm drain systems. The Master Plan Update will build on the Comprehensive Facilities Master Plan for Placer County (1993) by providing a long-term vision and ongoing facilities planning with a 20-year horizon. As part of this effort, all utilities are being evaluated to ensure they are sufficient to support the proposed improvements. In the case of the storm drain system, the primary analysis tool for the 200-acre PCGC site is a coupled hydrologic-hydraulic model. This sub-regional scale model was developed to provide an integral understanding of the current storm drain system, and to facilitate comprehensive stormwater planning for the entire project site.

## 1.1 OBJECTIVES AND PURPOSE

The purpose of this report is to supplement the overall wet utility infrastructure study by Cartwright Engineers (in progress). The objectives of the Cartwright study are to support the Master Plan Update by providing a comprehensive overview of the wet utilities, encompassing the water, sewer and stormwater systems, through (1) collection of existing wet utilities information, and (2) assessment of the existing utility systems and the future utility system improvements needed for the planned PCGC buildout condition. The former objective has been addressed by Cartwright and is not discussed in detail herein. Nonetheless, to assist in preparing this report, a thorough understanding of the existing storm drain system was gained through a review of background information along with field investigations. The main purpose of this report is to address the second study objective through the following work flow:

1. Develop a coupled hydrologic-hydraulic model of baseline (i.e. existing) conditions for PCGC and its storm drain system;
2. Review and validate the model to be consistent with previously completed stormwater studies;
3. Present the baseline model results with particular emphasis on undersized portions of the storm drain system that have the potential to cause flooding;
4. Model multiple alternatives to inform the planning team of storm drain system considerations for each alternative, and to guide the selection of a preferred alternative;
5. Present the necessary storm drain system improvements for the preferred alternative that addresses site-specific constraints and meet state and local regulatory requirements; and
6. Develop an overall strategy and recommendations for a Storm Water and Drainage Management Plan for the Placer County Government Center Campus Master Plan that addresses the drainage planning elements necessary to mitigate storm water impacts including conveyance, storage, general recommendations for project specific water-quality treatment, and hydromodification controls.

## 1.2 DESIGN STANDARDS AND CRITERIA

Design Standards applied to the formulation of this study include:

- Placer County Flood Control and Water Conservation District Stormwater Management Manual

(September 1994);

- Placer County Land Development Manual (October 1996);
- Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (MS4s; State Water Resources Control Board Water Quality Order No. 2013-001-DWQ); and
- West Placer Storm Water Quality Design Manual (April 2016).

# 2 BASELINE MODEL

The baseline model was generated using the XPSTORM software package (XP Solutions, 2016) to evaluate the existing conditions of the PCGC. A preliminary model was built based on background information on the existing infrastructure, and then was refined with additional information collected during a site visit. The final baseline model was validated against flowrates estimated in previously completed drainage reports and other hydraulic analyses throughout PCGC.

## 2.1 BACKGROUND INFORMATION

Cartwright Engineers compiled a large amount of background information on the existing stormwater infrastructure within and around the PCGC. The background information consisted of engineering plans, drainage reports, survey information, and additional reports that provided insight into how the stormwater infrastructure for the site functions. The following documents were reviewed to prepare the baseline model:

- City of Auburn Stormwater Management Plan by City of Auburn Department of Public Works (2008);
- Placer County Government Center Storm Drain Plan by West Yost Associates (2010);
- Auburn/Bowman Community Plan Hydrology Study by Placer County Department of Public Works (1992);
- Engineering Plans for Placer County Finance Administration Building: Drainage and Sewer Plan by Morton and Pitalo, Inc (1995);
- Engineering Plans for Placer County Dewitt Center Auburn Justice Center: Utilities by Placer County (2004);
- Draft - Placer County Government Center Master Plan Update - Wet Utilities Infrastructure by Cartwright Engineers (2016, in progress);
- NRCS Hydrologic Soil Report downloaded from the USDA Web Soil Survey (data accessed October 2016);
- Drainage Report, Home Depot Shopping Center, Auburn, Placer County, CA by Blair, Church and Flynn Consulting Engineers (2007);
- Photos and notes from site visit by Cartwright Engineers (August 2016);
- Preliminary Drainage Study for Placer County Auburn Animal Shelter by Wood Rodgers (2013);
- DeWitt Center Stormwater Detention Storage Study for Watersheds A1-A3 by A.R. Associates (2003a);
- DeWitt Center Land Development Building Stormwater Detention Storage Study for Bell Road/Rock Creek Watershed (Shed B1) by A.R. Associates (2003b);
- Placer County Main Jail Housing Unit 4 Stormwater Detention Pond Final Report by A.R. Associates (2000);
- Grading Study, Placer Animal Shelter by Wood Rodgers (2013);

- Draft - Stormwater and Surface Water Quality Best Management Practices (BMP) Plan for Placer County Auburn Animal Shelter by Wood Rodgers (2013);
- Improvement Plans for Olympus Village, Placer County, CA, Engineering Plans by GW Consulting Engineers (2002);
- Improvement Plans Atwood Ranch Unit III, Placer County, CA, Engineering As-Built Plans by A.R. Associates (2008);
- DeWitt Center Site Directory for Utilities, Engineering Plans by County of Placer (1994).
- Administrative Draft Storm Drainage and Water Quality Existing Conditions Report by URS (2002);
- 2012 Monitoring Report for the DeWitt Government Center by Dudek (2012);
- Drainage Study for Timberline at Auburn Phase 1 by Wood Rodgers (2014);
- Willow Creek Shopping Center On-Site Improvement Plans by TSD Engineering, Inc (2015);
- Drainage Report for Sunset Terrace Estates by Western Planning and Engineering (1990);
- Willow Creek Retail Placer County, CA, Preliminary Hydrology and Hydraulics, by TSD Engineering (2014);
- Placer County, CA Flood Insurance Rate Map Number 0601C0275 F by FEMA (Effective Date June 8, 1998);
- Placer County, CA Flood Insurance Rate Map Number 0601C0288F by FEMA (Effective Date June 8, 1998);
- Improvement Plans Land Development Building Placer County, CA by A.R. Associates (2004);
- Home Depot Utility Engineering As-built Plans by Lars Andersen and Associates (2005);
- Atwood Ranch 1 drainage calculations by A.R. Associates (1988);
- County of Placer DeWitt Center Auburn Justice Center technical drawings by Beverly Prior Architects (2004); and
- Aerial mapping of DeWitt County Center by Andregg Geomatics (May 1, 2015).

## 2.2 HYDROLOGIC SETTING

The PCGC spans a topographic high point, with the western portion of the site (roughly 80% of the total area) draining south into the North Auburn Ravine watershed (Catchments 1, 2, 3, and 6) and the eastern portion draining north into the Rock Creek Watershed (Catchments 4 and 5). The project site was separated into six main catchments based on the site topography and the locations of outfalls where stormwater leaves the site. Each catchment was then divided into sub-catchments based on the locations of storm drain inlets and storage basins. The six catchments were divided into a total of 37 sub-catchments for a total tributary area of 231 acres (Plate 2).

Mean annual precipitation at the PCGC is on the order of 36 inches. Precipitation is almost entirely rainfall, with the winter months typically being the wettest time of year, although intense rainfall during summer thunderstorms is also common.

The following paragraphs provide a description of the individual catchments and the general layout of the storm drain network within each catchment. See Plate 1 for a general map of PCGC and the names of nodes and links used in the XPSTORM baseline model. Catchments and subcatchments are shown in Plate 2.

- Catchment 1. Catchment 1 (C1) is located on the western edge of the PCGC and is bounded by Bell Road and the Combie Canal to the north and Atwood Drive to the south. C1 has an area of 88.5 acres and drains to the North Auburn Ravine watershed. Subcatchment 1J is the highest portion of C1 and includes the northern portion of the Community Development Resources Center. Flows from 1J are detained in a 0.3-acre-foot detention basin (1J/Storage1) at the southeast corner of the intersection of Bell Road and Richardson Drive. Flows leaving the detention basin flow west along Bell Road in a combination of pipes and open channels to the intersection of Bell Road and Olympic Way. Flow crosses Olympic Way through a 24-inch culvert and drains southwest in a natural channel. The natural channel continues until it enters a 0.05-acre-foot on-line detention basin (Node 1I/Storage1) located to the west of the Olympic Residential Development. The outflow from the detention basin is controlled by an 18-inch pipe and overflow spillway. The flow continues down the natural channel toward B Avenue. On the upstream side of B Avenue a small amount of flow ponds (Node 1E/Storage2) before entering three parallel box culverts (each 5.2-feet wide by 3.7-feet high) under B Avenue. Runoff from Sub-catchments 1F and 1G also flows into Node E1/Storage upstream of B Avenue. Flow passing under B Avenue then enters the large southwest pond (Node 1B/Storage1, capacity 13.4 acre-feet). Runoff from sub-catchment 1D is collected by a series of inlets along B Avenue and piped through an 18-inch pipe into the northeastern end of this pond. Flows from the Animal Services Center (Subcatchment 1C) also flow into Node 1B/Storage1 on the southern end, after being collected and detained by a 0.33-acre-foot detention basin (Node 1C/Storage1). Flows out of Node 1B/Storage are controlled by a weir box at the southern end and flow through a 48-inch diameter pipe to a natural channel. Flow is constricted at an old 6-foot wide concrete structure represented by Link 122. The southernmost storage (Node 1A/Storage1) is a natural depression, created from the natural topography and the Atwood Drive road embankment. The outfall from C1 is a 48-inch culvert under Atwood Drive with open channel downstream.
- Catchment 2. Catchment 2 (C2) has an area of 41.4 acres. C2 spans the central portion of the PCGC and drains to the south towards the North Auburn Ravine watershed. The upstream extent of C2 is the southern portion of the Community Development Resources Center, Finance Administration Building, Auburn Justice Center, and associated parking lots. A series of inlets collects runoff from Subcatchments 2B through 2F and conveys flow under Catchment 3 (the Jail complex) and to a 3-acre-foot detention basin (Node 2A/Storage1) located to the west of Jail House #4. Outflow from the detention basin is metered by an outlet control structure (Node 2A Control Structure: a combination orifice, v-notch weir and overflow weir); this feature was modeled in XPSTORM by a stage-discharge table. Flow leaves through a 42-inch pipe to a natural channel and storage pond (Node 2A/Storage2) located just north of Atwood Road. Flow from Catchment 3, and overflow from Catchment 6 combine at the Node 2A/Storage2 pond. Two culverts (one 30- and one 15-inch pipe) convey flows under Atwood Drive to an existing pond south of Atwood Road (not modeled), with the inflow to the pond designated as Outfall C2/C3.
- Catchment 3. Catchment 3 (C3) has an area of 12.8 acres located in the south-central portion of the PCGC and drains to the North Auburn Ravine watershed. Catchment 3 drains the Jail and

Juvenile Detention Center. Runoff is collected by the parking lots and drains through a 42-inch diameter pipe to the southern end of the Jail Complex and into the natural pond (Node 2A/Storage2).

- Catchment 4. Catchment 4 (C4) has an area of 12.7 acres located in the northeast corner of the PCGC and drains to the Rock Creek watershed. The Ophir Canal traverses C4, but is not part of the storm drain system and only receives direct precipitation. C4 collects runoff from the Health and Human Services buildings and parts of 1st Street, with flow directed beneath the Ophir Canal in a pipe. Flow travels north to an inlet at the eastern boundary of the PCGC, then is conveyed offsite via a 24-inch pipe directed east toward Professional Drive.
- Catchment 5. Catchment 5 (C5) has an area of 29.9 acres located on the eastern boundary of the PCGC and drains to the Rock Creek Watershed. C5 includes the Home Depot development and the 1st Street and Professional Drive stormwater basins. Runoff from the southern end of C5 (Subcatchment 5C) drains to the 1.03-acre-foot 1st Street detention basin (Node 5C/Storage1) where the outflow is controlled by an orifice outlet. Outflow from the 1st Street detention basin combines with runoff from Subcatchment 5E and is piped along Willow Creek Drive and under the Home Depot parking lot. Runoff from the west end of C5 (Subcatchment 5D) drains to the 2.00-acre-feet Professional Drive detention basin (Node 5D/Storage1) where the outflow is controlled by an orifice outlet. Flow is then piped along the northern edge of Home Depot and routed to the 30-inch outlet pipe (Outlet C5) located at the northeast corner of the C5. On-site runoff from Home Depot is collected and detained in an underground storage facility (Node 5A/Storage1) beneath the parking lot. Flows are controlled by multiple orifices before entering the 30-inch outfall pipe.
- Catchment 6. Catchment 6 (C6) drains the southeastern 45.8-acre portion of the PCGC and drains to the North Auburn Ravine watershed. C6 includes the County Government offices, the Corporation Yard, and the Atwood Ranch 1 development (Subcatchement 6I). The C6 storm drain system appeared to contain some of the oldest storm drain infrastructure of the PCGC. All runoff in C6 drains toward an open channel along the north side of Atwood Drive. Many of the collector storm pipes were not incorporated into the XPSTORM baseline model as they are less than 10 inches in diameter. The model simplified the feeder drain layout by selecting a main point of concentration for each of the subcatchments. Runoff from the northern Subcatchments 6E, 6F, 6G and 6H are piped to a common junction at Richardson Drive. Runoff from Subcatchments 6B, 6C and 6D are piped towards Atwood Drive where they daylight into the open channel along Atwood Drive. Flows then converge at Richardson Drive and flow west under the road through a 36-inch culvert. After the culvert a natural channel routes flow to the west to a junction and culvert along Atwood Drive. A 22-inch culvert goes under Atwood Drive as Outfall C6. At that junction (Node 6A/6) an overflow weir allows flows in excess of the capacity of the 22-inch culvert to overflow to the east along an open channel to the Node 3A/Storage1 pond, and leave the site through Outfall C2/C3

Two irrigation canals traverse the PCGC: the Combie Canal runs along the western boundary and the Ophir Canal runs parallel to 1st Street though the eastern portion of the site. Neither canal is known to be managed as part of the storm drain system, although it is possible they receive small amounts of runoff during extreme storm events.

## 2.3 BASELINE MODEL DEVELOPMENT

The hydrology and storm drain hydraulics of PCGC were modeled using the XPSTORM software package (XP Solutions, 2016). XPSTORM integrates hydrologic and hydraulic computations into a single model thereby streamlining the modeling process. The model includes multiple hydrologic parameterization methods which allow the rainfall-to-runoff calculations to conform to the prevailing engineering standards. Lastly, XPSTORM is well-suited for modeling complex urban watersheds because it is capable of simulating a variety of features including pipes, manholes, ponds, weirs, and overland flow. The model development described herein is consistent with the methods described in Section V.3 of the Placer County Flood Control and Water Conservation District Stormwater Management Manual (SWMM) for HEC-1 models, which are required for master planning models. XPSTORM has the ability to parameterize a hydrologic model in an identical manner as HEC-1.

*Table 1 – Baseline model catchment parameters*

| Catchment / Subcatchment | Area (acres) | Percent Impervious (%) |
|---|---|---|
| Catchment 1 | | |
| 1A | 12.4 | 3.0 |
| 1B | 13.4 | 8.6 |
| 1C | 5.0 | 59.5 |
| 1D | 3.7 | 37.8 |
| 1E | 14.8 | 16.4 |
| 1F | 10.6 | 51.2 |
| 1G | 11.8 | 67.9 |
| 1H | 2.9 | 41.9 |
| 1I | 7.7 | 43.2 |
| 1J | 6.3 | 46.0 |
| C1 Total | 88.5 | 33.0 |
| Catchment 2 | | |
| 2A | 1.7 | 8.0 |
| 2B | 15.9 | 43.2 |
| 2C | 3.2 | 68.1 |
| 2D | 3.9 | 55.6 |
| 2E | 5.7 | 42.6 |
| 2F | 7.4 | 74.2 |
| 2G | 3.6 | 52.6 |
| C2 Total | 41.4 | 51.1 |
| Catchment 3 | | |
| 3A | 3.3 | 36.7 |
| 3B | 4.7 | 75.5 |
| 3C | 4.7 | 69.2 |
| C3 Total | 12.8 | 63.0 |

| Catchment / Subcatchment | Area (acres) | Percent Impervious (%) |
|---|---|---|
| Catchment 4 | | |
| 4A | 2.4 | 12.0 |
| 4B | 9.0 | 39.9 |
| 4C | 1.3 | 75.3 |
| C4 Total | 12.7 | 38.3 |
| Catchment 5 | | |
| 5A | 11.2 | 81.2 |
| 5B | 0.8 | 99.2 |
| 5C | 3.6 | 57.9 |
| 5D | 11.6 | 41.9 |
| 5E | 2.6 | 0.1 |
| C5 Total | 29.9 | 56.6 |
| Catchment 6 | | |
| 6A | 11.5 | 55.7 |
| 6B | 7.7 | 76.3 |
| 6C | 1.4 | 99.4 |
| 6D | 5.3 | 64.7 |
| 6E | 4.9 | 67.7 |
| 6F | 2.4 | 42.4 |
| 6G | 2.3 | 69.9 |
| 6H | 3.8 | 90.4 |
| 6I | 6.5 | 59.4 |
| C6 Total | 45.8 | 66.2 |
| Total | 231.0 | 47.8 |

Rainfall depths for the 2-, 10-, and 100-year, 24-hour storms were estimated from the Design Storm Procedures presented in Appendix V-B of the SWMM as 2.78, 4.53, and 6.73 inches, respectively. The depths were adjusted for the average elevation of PCGC, approximately 1,400 feet (NAVD88). Design storm hyetographs were generated for each storm using the depth-duration-frequency coefficients in Appendix V-A of the SWMM.

The runoff routing of the catchments was modeled using the Kinematic wave method for overland flow. The required data for this method includes area (acres), percent impervious, subcatchment width (feet), and slope (feet/feet). Soil mapping for the PCGC showed the site is predominately Auburn silt loam with small patches of the Auburn-Rock outcrop complex (roughly 5 percent of the total area). Both soil types are classified as Hydrologic Soil Group (HSG) C Soils, indicating moderate runoff potential and somewhat restricted water transmission through the soil. Rainfall abstractions were represented as an initial loss of zero and a constant infiltration rate of 0.16 inches/hour. This value is based on Section V of the Placer County SWMM for landscaped areas, and was selected because the majority of pervious, open space is landscaping and has been previously disturbed.

The geometry of the storm drain system was assimilated into the model based on the background information for pipe sizes, lengths, alignments, materials, and elevations. Manning's roughness values were applied based on the pipe material or assumed to be 0.014 if no material was known. The storm system was simplified for the modeling, and smaller (less than 10-inch) lateral pipes were generally excluded from the model. The sections of the storm drain system with open channel flow were modeled as either an irregular or a trapezoidal channel shape, as appropriate. The roughness for the channels was approximated during the site visits and averaged over the channel length.

In instances where the amount of flow was greater than the capacity of the storm drain system, the baseline model was configured to show temporary surface flooding at the model nodes. When flooding occurred at a node, water was stored above ground at the respective node until there is sufficient hydraulic capacity within the system for it to reenter the network. This method allows areas to be identified where the storm drain system is inadequately sized to convey flood flows and where shallow surface flooding would be expected.

The baseline PCGC model included 13 storage basins which represented the existing stormwater detention basins or natural depressions that attenuate stormwater runoff. Storage in the basins was modeled using stage-storage tables generated from the background information or from survey data provided by Cartwright Engineers.

As discussed previously, PCGC has five outfall locations, with three along Atwood Drive (C1, C2/C3, and C6), one on Professional Drive (C4), and one between Highway 49 and Heritage Oaks Circle (C5). All outfalls were set with a free outfall boundary condition, with the depth set equal to the minimum of the normal or critical depth for the flow in the outfall conduit. The three outfalls along Atwood Road are all free outfalls because the 100-year flood level in the pond in the Atwood Ranch development (A.R. Associates, 2008) is lower than the invert of the outfall pipe. For the other two outfalls the 10- and 100-year events are completely contained within the pipes. No previous studies were found that suggested there is a tailwater condition that would violate the assumption of a free outfall boundary condition, and this study assumed that the downstream pipe system was designed to convey the 10-

and 100-year events.

The detention ponds along Atwood Drive were modeled by A.R. Associates (2000) for the addition of Unit 4 to the Placer County Main Jail House. A wetland area located south of the jail was slated to be used as a detention pond (approximate location of Node 3A/Storage1), however, the wetland designation prompted relocating the detention pond to the east (location of Node 2A/Storage2). Based on an October 2016 site visit it is clear the wetland area receives stormwater runoff from Atwood Drive. The culvert along Atwood Drive (Link 136) was partially blocked with sediment at the time of the site visit (the Mannings roughness was set to 0.1 to account for the loss of capacity), which causes water to overflow into the wetland. For this reason, the wetland was modeled as a shallow storage facility in the baseline model.

The precise alignment of a storm drain pipe along Atwood Drive between 1st Street and F Avenue (Link 16 in Subcatchment 6B) could not be confirmed through the background information or field verification. This pipe connects the northern Corporation Yard to an open channel along Atwood Drive. The pipe size for this link was assumed to be the same as the upstream pipe sized leaving the Corporation Yard, and its length was estimated from an assumed alignment.

Sunset Terrace Estates was assumed to drain to the north and away from the PCGC stormwater catchments. The Sunset Terrace Estates are located to the northwest of the Bell Road and Richardson Drive intersection. The drainage report for Sunset Terrace Estates (Western Planning and Engineering, 1990) showed all on-site stormwater draining to an 18-inch pipe located near a low point on the north side of Bell Road. The 18-inch pipe is not believed to turn south and drain through Catchment 1 because (1) it would require crossing the Combie Canal, and (2) no storm drain outlet was found in this location during field investigation. For these reasons, runoff from Sunset Terrace Estates was assumed to drain north.

## 2.4 BASELINE MODEL VALIDATION

The baseline model was validated by comparing the modeled output flow rates to other modeled/calculated rates obtained from previous studies in the background research. No recorded streamflow or flood data is available for calibration with actual storm events, so the validation effort focused on comparing flow rates at major outfalls from the project site to previously completed work.

Slight variations in the output between any two models are expected. However, any significant differences were investigated to determine if there is a reasonable explanation for the difference. Table 2 is a list of the locations near outfalls where there was available information that could be used in the model validation process. Explanations for significant differences in flow rates are discussed in the following paragraphs.

*Table 2 – Baseline model validation: comparison of modeled flow rates to previously-completed modeled flow rates by others*

| Point Description | Peak Flow Rate - Q (cfs) | | | | Source # |
|---|---|---|---|---|---|
| | Modeled 10-yr | Sourced 10-yr | Modeled 100-yr | Sourced 100-yr | |
| Outfall C5 | 20.1 | 9.7 | 34.2 | - | 1 |
| 5D/Storage - Professional Drive Basin | 2.9 | 3.1 | 4.1 | 3.9 | 2 |
| 5C/Storage - First Street Basin | 2.9 | 2.7 | 3.4 | 3.7 | 2 |
| 5A/Storage - Home Depot Onsite | 8.4 | 7.3 | 16.9 | 12.9 | 2 |
| 1J/Storage - Bell and Richardson Drive | 3.4 | 4.0 | 4.6 | 6.0 | 3 |
| 2A/Storage 1- West of Jail House #4 | 29.6 | 46.0 | 54.4 | 92.0 | 4 |

Source key:
1 Willow Creek Retail Placer County, CA, Preliminary Hydrology and Hydraulics by TSD Engineering (2014).
2 Drainage Report Home Depot Shopping Center, by Blair, Church and Flynn Consulting Engineers (2007).
3 DeWitt Center Land Development Building Stormwater Detention Storage Study for Bell Road/Rock Creek Watershed (Shed B1) by A.R. Associates (2003).
4 Placer County Main Jail Housing Unit 4 Stormwater Detention Pond Final Report by A.R. Associates (2000).

The Willow Creek Retail Preliminary Hydrology and Hydraulic report (TSD Engineering, 2014) described a peak flow of 7.3 cfs during the 10-year event flowing from the Home Depot storm drain system to the receiving 30-inch pipe. Review of the drainage report for Home Depot (Blair, Church and Flynn Consulting Engineers, 2007) showed that 7.3 cfs is just the effluent from the on-site underground detention system (XPSTORM Node 5A/Storage1) and that additional flow enters the 30-inch pipe from off-site facilities, namely the 1st Street and Professional Drive detention basins (XPSTORM Nodes 5C/Storage1 and 5D/Storage1, respectively). The simulated flows in the XPSTORM model closely agreed with the modeling from the Home Depot Report for the outflows of the respective detention basins (Blair, Church and Flynn Consulting Engineers, 2007). Moreover, the XPSTORM baseline model considered flow rates from the entire watershed (Catchment 5). For these reasons, the XPSTORM results are a more complete representation of flow rates in the 30-inch pipe (i.e. Outfall C5), and are adopted as the baseline flow rates.

The model estimated outflow from Node 2A/Storage1 (the detention basin west of Jail House) to be much lower than described by A.R. Associates (2000). It appears three factors are related to the difference in flows between the modeling described by A.R. Associates (2000) and the XPSTORM results:

1. A.R. Associates (2000) estimated the contributing watershed area using 20-foot interval contours. The XPSTORM model was developed with a one-foot contour photogrammetric survey (i.e. Andregg Geomatics, 2015), which resulted in a contributing watershed area that is roughly 20% smaller than the A.R. Associates (2000) area. The difference is attributed to the ability to detect small-scale topographic features, and changes to the land use and site grading since 2000.

2. Development in the vicinity of the Jail has occurred in the years since the study by A.R. Associates (2000), which has changed local drainage patterns. Specifically, A.R. Associates (2000) routed runoff from an 8-acre area north of the Jail through the permanent detention pond. Field

investigation and the storm drain mapping by West Yost Associates (2010)—showed that this area (Subcatchments 3B and 3C) bypasses the detention basin via a 48-inch main directed beneath the Jail building complex.

3. The watershed maps in the A.R. Associates (2000) study and review of historical aerial images on Google Earth show three complexes of original DeWitt Center buildings in 2000 that no longer exist. The absence of these buildings in the XPSTORM baseline model manifested as a decrease in the impervious coverage for a nearly 10-acre area spread over Subcatchments 2B, 2D, and 2E. The expected effect from this change in land use would be more infiltration of rainfall and lower peak flow rates.

For the reasons described above, the XPSTORM results can be considered more representative of present day conditions, and are adopted as baseline flow rates at Node 2A/Storage1. The A.R. Associates (2000) study described the permanent detention pond as being sized to accommodate a complete buildout condition of the contributing watershed and is discussed further in the alternatives analysis portion of this report.

## 2.5 BASELINE MODEL RESULTS

The baseline model was run for the 2-year, 10-year, and the 100-year, 24-hour storms. The unabridged baseline model output tables are included in Appendix A of this report. The outfall flowrates are provided in Table 3. Locations where the existing storm drain does not have the capacity to convey the full 10- and 100-year flow rates are shown in Plate 2 and Plate 3.

*Table 3 – Baseline model results for peak flow rates at outfalls from PCGC*

| Outfall Location by Catchment | Peak Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| C1 | 17.8 | 44.2 | 85.3 |
| C2/3 | 23.5 | 41.2 | 66.5 |
| C4 | 9.3 | 18.2 | 29.5 |
| C5 | 9.2 | 20.1 | 34.2 |
| C6 | 22.8 | 32.1 | 37.7 |

The model showed the area subject to the most significant flooding (for both the 10- and 100-year event) as being along Atwood Road just west of the Richardson Drive intersection. The model suggested that during a 100-year event 1.5 acre-feet of runoff is not contained within the storm drain system and overtops Atwood Road. Sediment accumulation was observed in the Atwood Road culvert during the October 2016 field investigations; the existing 18-inch pipe was at least 80% blocked and likely exacerbates the overtopping.

The model also showed spot areas of flooding at various locations throughout Catchment 6, with the collection point for Subcatchment 6H having an overflow volume of 0.55 acre-feet during the 100-year storm event; this excess volume of water is presumed to sheet flow southwesterly via E Avenue and parking areas. Many of the Catchment 6 buildings appear to be original to the World War II era DeWitt Center, and the storm drains are likely of the same vintage. Many of the Catchment 6 pipes are 8 and 10 inches in diameter and do not meet the current storm drain sizing requirements (i.e. 12-inch minimum diameter). The flooding throughout Catchment 6 is likely the reason why flowrates in Table 3 for the 10- and 100-year events are more similar compared to other catchments; ponded water would have the effect of lowering peak flow rates in Catchment 6.

The model suggested that flooding occurs during a 100-year event in the upper portions of Catchment 2, near the Finance Administrative Building. The total volume of overtopping in this location is relatively small, no more than 0.22 acre-feet at any location. Given that the flooding will be minor and only occurs during an extreme event, this finding is treated as acceptable and will not be treated as a major consideration in the alternatives analysis.

*Table 4 – Freeboard availability in stormwater detention basins*

| Model Node | Description | Basin Rim Ground Elev. (ft) | Max Water Surface Elev. (ft) | | Remaining Freeboard (ft) | |
|---|---|---|---|---|---|---|
| | | | 10-yr | 100-yr | 10-yr | 100-yr[1] |
| 1A/Storage1 | Natural Storage Basin on Atwood Drive | 1,367.5 | 1,358.1 | 1,358.5 | 9.4 | 9.0 |
| 1B/Storage1 | Southwest Pond | 1,384.3 | 1,381.2 | 1,381.6 | 3.1 | 2.7 |
| 1C/Storage1 | Animal Control Center SW Pond/Basin | 1,392.3 | 1,390.9 | 1,391.6 | 1.3 | *0.7* |
| 1E/Storage2 | Natural Upstream Storage from Southwest SW Pond | 1,387.7 | 1,382.8 | 1,383.1 | 4.9 | 4.6 |
| 1I/Storage1 | Olympic Way SW Basin | 1,393.0 | 1,390.6 | 1,391.8 | 2.4 | 1.2 |
| 1J/Storage1 | Bell/Richardson SW Basin | 1,429.4 | 1,427.7 | 1,428.6 | 1.7 | *0.8* |
| 2A/Storage1 | Jail House #4 SW Basin | 1,399.0 | 1,397.2 | 1,398.2 | 1.8 | *0.8* |
| 2A/Storage2 | Natural Pond Along Atwood Drive | 1,391.1 | 1,388.4 | 1,389.4 | 2.7 | 1.7 |
| 3A/Storage1 | Old SW Basin, now Wetland | 1,390.0 | 1,388.8 | 1,389.4 | 1.2 | *0.6* |
| 5A/Storage1 | Home Depot On-site Underground SW Detention | 1,406.0 | 1,390.5 | 1,390.7 | NA[2] | NA[2] |
| 5C/Storage1 | 1st Street SW Basin | 1,435.0 | 1,430.3 | 1,431.2 | 4.7 | 3.8 |
| 5D/Storage1 | Professional Drive SW Basin | 1,412.7 | 1,410.0 | 1,412.0 | 2.7 | *0.7* |

1. Italicized cells do not meet the 1-foot minimum freeboard requirement set by Placer County SWMM.
2. Storage is provided by underground pipes and not subject to freeboard requirements.

The stormwater storage basins were evaluated based on the available freeboard between the maximum water surface elevation for a storm event and the existing ground elevation of the basin rim. The Placer County SWMM requires a minimum of 1 feet of freeboard above the 100-year water level. For the 100-year storm event, five of the 13 basins do not meet this requirement (Table 4). The basins that do not meet the freeboard requirement would not have excess capacity (as currently designed) for additional stormwater storage.

## 2.6 CONSIDERATIONS FOR ALTERNATIVES ANALYSIS

The following list is a summary of findings from the baseline model and the review of background information. This information is highlighted as being pertinent to the alternatives analysis.

- The 1st Street detention basin (Node 5C/Storage1) appears to have additional volume available for stormwater attenuation that could be utilized while still meeting the County requirement for one feet of freeboard during the 100-year event. The amount of extra storage is relatively small, and supplemental detention facilities in the vicinity of Subcatchment 5C should be anticipated. Nonetheless, using the extra volume in the 1st Street detention basin in conjunction with other facilities has the potential to decrease the required size of the supplemental detention facilities.

- The “permanent detention pond” (Node 2A/Storage1) located west of the jail complex was originally described as being sized to accommodate a complete buildout condition of the contributing watershed. However, the current modeling suggested that the basin has insufficient freeboard under existing conditions. The basin could still be utilized, but its volume will need to be increased.

- The baseline model showed the storm drain system as having inadequate capacity to contain storm flows throughout Catchment 6. Development within this portion of PCGC will likely require an overhaul of much of the storm drain system.

# 3 ALTERNATIVES ANALYSIS

Three land use alternatives developed by Williams + Paddon Architects + Planners, Inc. (Appendix B) were reviewed in order to provide input and recommendations on how each land plan would affect the PCGC storm drain system. The illustrative nature of the land plans did not lend to reliably simulating each alternative with the XPSTORM model, however, the results for the baseline conditions model were applied to highlight where proposed development coincides with existing deficiencies of the storm drain system. This section documents the input and recommendations provided to the design team in order to guide the alternatives analysis process.

## 3.1 SITE-SPECIFIC ISSUES AND RECOMMENDATIONS

Alternative land use appears to impact on existing storm drain infrastructure in the following locations:

- The 1st Street Stormwater Detention Basin is located southwest of the roundabout between 1st Street and F Avenue. All three alternatives propose development that would impact this detention basin. The detention basin is part of the off-site improvements for Home Depot. Any alteration of the 1st Street Stormwater Detention Basin will require that the stormwater management system for Home Depot and the surrounding area be evaluated in detail.

- The Professional Drive Stormwater Detention Basin is located at the corner of Professional Drive and 1st Street. Alternatives 1 and 3 propose development that has the potential to impact this detention basin. Although Alternative 2 shows this area as green space, it will still need to account for this basin being part of the future landscape. The detention basin is part of off-site improvements for Home Depot. Any alteration of the Professional Drive Detention Basin will require that the stormwater management system for Home Depot and the surrounding area be evaluated in detail.

Alternatives appear to coincide with areas that are prone to flooding and/or the storm drain system is undersized in the following locations:

- The baseline model suggested that Subcatchments 6E, 6G, and 6H flood in the 10-year storm event. Any development that increases the impervious area within this area would exacerbate existing flooding problems. The storm drain system in this area appears to have been constructed as part of the original DeWitt Center, and would require upgrades extending down to Atwood Drive at the jail maintenance access driveway (approximately 1,600 linear feet) to comply with current Placer County design standards.

- Field observations and topographic mapping suggest that Atwood Drive may overtop during extreme events. In part, the overtopping is likely related to inadequacies in the storm drain system described in the item above.

- Field efforts thus far have not been conclusive in mapping stormwater infrastructure in the vicinity of Subcatchment 6B; it is likely that key manholes and/or drain inlets have been buried or overgrown with vegetation. Any development in this area will either require (1) subsurface investigations to conclusively locate existing stormwater infrastructure or (2) treating the area as new development requiring an entirely new stormwater system.

- The baseline model suggests that the area of the proposed Buildings D & L (Clerk Recorder Facility and CDRC Growth and Consolidation) floods in the 100-year storm event. Development of this area may require stormwater detention facilities to meet current Placer County design standards and should focus on minimizing additional impervious area.

Additional considerations are summarized as follows:

- Based on the available data, Building H (Fire Station Expansion) does not appear to be hydrologically connected to one of the five outfalls analyzed herein. Since its drainage does not impact campus-scale storm water planning issues, it was not included in the model. Improvements to this portion of PCGC should be accompanied by an on-site drainage report.

- The Ophir Canal is located along the eastern boundary between Willow Creek Drive and 1st Street. Any development in this area would need to accommodate the canal through the project footprint.

## 3.2 CAMPUS-WIDE ISSUES AND RECOMMENDATIONS

Beyond addressing the specific issues described in the previous section, additional considerations apply for stormwater planning of the entire PCGC campus. Given there are multiple stormwater basins already in place, controlling flow rates through regional basins may be an effective stormwater management strategy. Several regional basins could be designed to control the 10- and 100-year events, as well as the 2-year, 24-hour event to meet hydromodification requirements. It would be difficult, however, to design the regional basins to meet water-quality treatment criteria. Moreover, centralized water-quality treatment is not consistent with guidance of the West Placer Storm Water Quality Design Manual (2016). As such, water-quality treatment should be the responsibility of individual projects, and would achieve the favored dispersed treatment approach. Each project should plan to set aside roughly 10 percent of the total acreage for water-quality treatment features, although advanced planning and calculations may demonstrate less space is required.

The success of this approach hinges on the assumption that the land use of individual developments will closely resemble the land use assumed for sizing of regional basins. If an individual project violates this assumption, the project may need to provide additional on-site flow control and storage volume. The approach will also require coordination with County staff for approval, and establishing a fee structure to share the cost of the regional basins among individual developments.

# 4 STRATEGY FOR OVERALL STORMWATER MANAGEMENT PLAN

This section describes the model results for the final PCGC Master Plan option ('Final Option'), and the full suite of stormwater infrastructure needed to meet regulatory requirements for flow and water-quality controls. The Final Option represents the evolution of the alternatives presented in the previous section into a vision for the PCGC that incorporates feedback from a variety of stakeholders and community members. This section begins by presenting the development of the XPSTORM model for the Final Option, goes on to present the model results and required improvements to the storm drain system, and concludes by providing general recommendations for how individual projects should approach water-quality treatment.

## 4.1 FINAL OPTION MODEL DEVELOPMENT

The baseline model was adapted to simulate the ultimate buildout condition for the Final Option. Land use in the model was revised based on a land plan provided by Williams + Paddon (dated October 10, 2018; see Appendix C). Land use was able to be revised in greater detail for two projects where preliminary grading plans were available: the Health and Human Services building in Subcatchements 2H and 2I and the Affordable Housing project in Subcatchment 4A. Subcatchment boundaries were revised based on the land plan and by assuming minimal adjustments to the existing topography (Plate 5). Subcatchment parameters were updated to reflect land use under the buildout condition (Table 5). The total watershed area for the Final Option is 9.2 acres larger than the baseline condition; the increase is from development in Subcatchments 1K, 4A, 5E, and 5F which were conservatively assumed to all drain to one of the five outfalls. Stormwater basins were added to the model, and in some cases, their shape and size adjusted. Similarly, outlet control structures for stormwater basins were redesigned to provide the appropriate flow controls. In all cases, preliminary grading plans for stormwater basins were developed to ensure they fit within the spatial confines of the land plan. Where new development coincided with pipes that the baseline model suggested to be undersized, the pipes were upsized to convey the 100-year event. The Final Option model maintained the same five outfalls from the PCGC campus as the baseline model, and utilized the baseline flow rates from the outfalls to establish thresholds for future outflow rates.

Preliminary designs for stormwater basins were developed according to Section VII of the SWMM to meter outflow rates from the 2-year, 24-hour event (to meet hydromodification requirements) up to the 100-year, 24-hour event. The PCGC stormwater basins will be classified as local detention basins; as such, one foot of freeboard for the 100-year event is required. Outlet structures for all basins were designed to have a low-flow orifice at the basin floor, and a high-flow weir near the basin rim elevation (with the exception of Basin 2A where the outlet structure will remain unchanged). All side slopes are no steeper than 3:1 (horizontal to vertical). None of the basins are so big as to fall under the jurisdiction of the California Division of Safety of Dams.

All pipes that the model indicated to be undersized are assumed to be upsized according to Section VI of the SWMM, which requires new development to convey the 10-year event and to prevent property damage and loss of life during the 100-year event. Without a detailed grading and site plan it is difficult to predict how the 100-year event might pose a threat to property or loss of life. For this reason, and to provide a conservative estimate for pipe sizes, all upsized pipes were designed to convey the entire 100-year event. However, parts of the PCGC not slated for redevelopment (for instance, the parking area for the Community Development Resource Center where the baseline model showed to pipes to surcharge) were not upsized.

*Table 5 – Final Option model catchment parameters*

| Catchment / Subcatchment | Area (acres) | Percent Impervious (%) |
|---|---|---|
| Catchment 1 | | |
| 1A | 10.0 | 4.2 |
| 1B | 13.3 | 8.7 |
| 1C | 5.0 | 58.6 |
| 1D | 3.7 | 38.8 |
| 1E | 12.5 | 16.6 |
| 1F | 10.6 | 51.2 |
| 1G | 11.8 | 72.2 |
| 1H | 2.9 | 31.8 |
| 1I | 7.7 | 43.2 |
| 1J | 6.1 | 46.2 |
| 1K | 3.4 | 43.8 |
| 1L | 2.3 | 62.4 |
| C1 Total | 89.4 | 35.8 |
| Catchment 2 | | |
| 2A | 1.7 | 8.6 |
| 2B | 4.4 | 70.5 |
| 2C | 3.2 | 68.8 |
| 2D | 4.2 | 62.3 |
| 2E | 6.9 | 46.0 |
| 2F | 7.0 | 69.0 |
| 2G | 3.6 | 52.6 |
| 2H | 5.5 | 71.9 |
| 2I | 6.2 | 71.2 |
| C2 Total | 42.5 | 61.7 |

| Catchment / Subcatchment | Area (acres) | Percent Impervious (%) |
|---|---|---|
| Catchment 3 | | |
| 3A | 3.3 | 36.7 |
| 3B | 4.7 | 75.5 |
| 3C | 4.7 | 69.6 |
| C3 Total | 12.8 | 63.2 |
| Catchment 4 | | |
| 4A | 2.9 | 54.8 |
| 4B | 9.9 | 67.6 |
| C4 Total | 12.8 | 64.7 |
| Catchment 5 | | |
| 5A | 11.2 | 80.9 |
| 5C | 5.8 | 73.6 |
| 5D | 6.6 | 62.0 |
| 5E | 9.0 | 69.7 |
| 5F | 2.0 | 65.6 |
| C5 Total | 34.6 | 72.3 |
| Catchment 6 | | |
| 6A | 11.6 | 57.5 |
| 6B | 7.2 | 72.4 |
| 6C | 1.4 | 99.4 |
| 6D | 2.0 | 91.0 |
| 6E | 1.6 | 30.6 |
| 6F | 8.6 | 57.6 |
| 6G | 8.9 | 66.4 |
| 6I | 6.4 | 59.4 |
| C6 Total | 47.7 | 63.4 |
| Total | 239.7 | 54.2 |

## 4.2 FINAL OPTION MODEL RESULTS

A total of seven new stormwater basins and reconfiguration of three existing basins are needed to meet County requirements for flood control and hydromodification management. The locations of the stormwater basins are shown in Plate 6, and their preliminary dimensions are summarized in Table 6. Other pertinent details for each basin are summarized as follows:

- Basin 1K: A new small basin to control runoff from the proposed residential development in the southwest corner of the planning area.

- Basin 1L: A new small basin to control runoff from Subcatchments 1G and 1L.

- Basin 2A: A large existing basin to control runoff from Catchment 2. A study by A.R. Associates (2000) indicated this basin is sized to accommodate a complete buildout condition, however, their study assumed different ultimate watershed conditions than the current land plan. The model indicated that the volume of Basin 2A will need to be increased to accommodate the additional runoff. We assumed the basin could be expanded into the open space south of the solar farm. The footprint of the basin would need to be increased by roughly 8,700 square feet (34 percent).

- Basin 4A: A new small basin located in the northeast corner of the project site to control runoff from the north portion of the Affordable Housing project (Subcatchment 4A). The basin is proposed for dual use for flood control and water-quality treatment for the north portion of the Affordable Housing project.

- Basin 4B: A new small basin to control runoff from Subcatchment 4B.

- Basin 5C (1st Street Basin): An existing basin, the volume of which is not fully utilized under existing conditions. The land plan impinges on the footprint of the existing basin, and it will need to be regraded to be compatible with the Final Option. The outlet structure will need to be reconfigured to control flow rates in a way that enhances utilization of the storage volume.

- Basin 5D (Professional Drive Basin): An existing basin that controls runoff from Subcatchments 5D and 5F (the south portion of the Affordable Housing project). The only change to Basin 5D is minor regrading of the emergency overflow outlet to raise its elevation by 1.0 feet so the basin will comply with the County freeboard criteria.

- Basin 5E: A new medium-sized basin to control runoff from Subcatchment 5E. While the footprint of this basin fits within the current land plan, it may be possible to reduce its size by grading a portion of Subcatchment 5E to drain to Basin 5C, thereby using the extra volume in Basin 5C to control flows from a portion of Subcatchment 5E.

- Basin 6A: A new large basin to control runoff from Catchment 6. If the size of Basin 6A cannot fit within the final land plan, there appear to be other areas in Catchment 6 (for instance, the landscaped area along Atwood Drive) that could be utilized to meet the total storage volume requirement.

- Basin 6F: A new medium-sized basin to control runoff from Subcatchments 6G and 6F. The footprint of Basin 6A was maximized within the open space south of the jail building, and Basin 6F is needed to provide supplemental storage to alleviate flooding that the baseline model showed to occur along Atwood Drive.

*Table 6 - Summary new and retrofitted stormwater basins*

| Basin | Basin Geometry | | | | Outlet Structure Geometry | | |
|---|---|---|---|---|---|---|---|
| | Bottom Area ($ft^2$) | Top Area ($ft^2$) | Depth (ft) | Total Volume (ac-ft) | Orifice Diameter (in) | Weir Width (ft) | Weir Stage (ft) |
| 1K | 1,665 | 5,588 | 6 | 0.48 | 6 | 4 | 4.25 |
| 1L | 2,600 | 8,244 | 6 | 0.72 | 15 | 5 | 3.75 |
| 2A | 14,939 | 35,720 | 6.5 | 3.81 | same as existing | | |
| 4A | 3,320 | 5,760 | 3 | 0.31 | 1.0' x 0.5' | 3 | 1.5 |
| 4B | 572 | 2,783 | 4 | 0.15 | 12 | 4 | 2.5 |
| 5C | 6,975 | 16,207 | 7 | 1.83 | 8 | 5 | 7 |
| 5D | 923 | 20,015 | 7 | 2.00 | same as existing | | |
| 5E | 9,705 | 21,156 | 8 | 2.78 | 4 | 5 | 6 |
| 6A | 32,015 | 49,549 | 6 | 5.59 | 2.5' x 2.5' | 4 | 4.75 |
| 6F | 8,303 | 16,678 | 6 | 1.70 | 10 | 4 | 4.85 |

1. Basin geometry is inclusive of the required 1 foot of freeboard for storage basins.
2. All orifices were designed at stage = 0.0 ft (at basin floor).
3. For basins proposed to be regraded (e.g. 2A and 5C) the figures are for the total new size.

Pipe segments that the model indicated do not meet County standard for conveyance are shown in Plate 6. Many new minor collector pipes will need to be installed as each project comes online, but are not shown since the model focused on major arterial pipes only. Drainage studies for individual projects should consider how the capacity of collector pipes is affected by the hydraulic grade lines in the receiving arterial pipes.

The land plan shows development occurring on top of the existing Ophir Canal alignment. The canal is not known to be part of the current storm drain system, as such, enclosing the canal should simply consider the anticipated flow rates and other Nevada Irrigation District design requirements (beyond the scope of this report).

The model suggests that the stormwater basins are effective in limiting peak flow rates at each of the five outfalls from PCGC to be no greater than the existing peak flow rates. Table 7 compares peak flow rates under existing conditions to the buildout condition. The buildout condition will be implemented in four phases. Each phase will be completed within five years for a total time of 20 years to achieve the buildout condition. Interim site conditions—where the campus would be somewhere between the existing and buildout condition—will be evaluated in detail in a forthcoming update to this document wherein the stormwater system will be modeled at the completion of each phase. The interim conditions analysis will also include recommendations for an appropriate phasing strategy for the various improvements to the PCGC stormwater system.

*Table 7 – Comparison of peak flow rates at outfalls under existing and buildout conditions*

| Outfall | 2-yr Event | | | 10-yr Event | | | 100-yr Event | | |
|---|---|---|---|---|---|---|---|---|---|
| | Existing | Buildout | Change | Existing | Buildout | Change | Existing | Buildout | Change |
| C1 | 17.8 | 17.1 | -0.7 | 44.2 | 41.7 | -2.5 | 85.3 | 82.4 | -2.9 |
| C2/3 | 23.5 | 20.2 | -3.3 | 41.2 | 33.8 | -7.4 | 66.5 | 62.9 | -3.6 |
| C4 | 9.3 | 8.9 | -0.4 | 18.2 | 17.9 | -0.3 | 29.5 | 29.4 | -0.1 |
| C5 | 9.2 | 9.0 | -0.2 | 20.1 | 19.0 | -1.1 | 34.2 | 32.3 | -1.9 |
| C6 | 22.8 | 12.3 | -10.5 | 32.1 | 22.6 | -9.5 | 37.7 | 31.5 | -6.2 |

## 4.3 WATER-QUALITY TREATMENT

The design team along with the County has agreed on a strategy of meeting flood control and hydromodification requirements with several campus-scale stormwater basins while leaving water-quality treatment requirements to individual projects as they come online. The West Placer Storm Water Quality Design Manual (WPSWQDM; 2016) provides detailed guidance for integrating low-impact development (LID) strategies into the site design for projects so that they will comply with Clear Water Act regulations, specifically, the National Pollutant Discharge Eliminations System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit.

The requirements for a project will vary depending on the amount of impervious area to be created or replaced, but in general, the work flow to meet water-quality requirements will be as follows:

1. Complete a site assessment to evaluate local conditions and identify constraints and opportunities for LID features;

2. Develop a site layout that includes site design measures, source control, and stormwater treatment features;

3. Implement site design measures to reduce surface runoff to the maximum extent practicable by infiltration, evapotranspiration, and/or harvesting;

4. Include source control measures to reduce the potential for stormwater and pollutants from coming in contact with one another (e.g. trash enclosures, covered storage areas, and developing "good housekeeping" operational practices);

5. Treat the remaining portion of the post-construction 85th percentile, 24-hour storm with stormwater treatment features (infiltration-based features such as bioretention basins are preferred, but flow-through systems may be permitted in special cases);

6. Develop a Post-Construction Storm Water Quality Plan (SWQP) using the templates provided in the WPSWQDM and submit to the County for review and approval; and

7. Maintain the LID features for the life of the project through a well-developed operations and maintenance plan.

The WPSWQDM presents hydromodification management as a component of water-quality treatment design process, however, the campus-scale stormwater basins for PCGC will be designed to control the 2-year, 24-hour event to meet the County's hydromodification criteria. Bioretention basins and other LID features typically provide some level of flow control, and will likely reduce flow rates beyond the post-construction flow rates estimated by the XPSTORM model.

# 5 CONCLUSIONS

The XPSTORM model showed that regulatory requirements for flood control and hydromodification can be met by installing a series of campus-scale stormwater basins. Water-quality treatment will be addressed as each individual project comes online, the design for which will follow the guidance of the WPSWQDM.

Several arterial storm drain pipes will need to be upsized to accommodate the flow rates anticipated for the Final Option, particularly in Catchment 6 where much of the storm drain infrastructure has not been improved since the original DeWitt Center was constructed.

All of the improvements to the storm drain system are expected to alleviate the surface flooding problems that predicted under existing conditions during the 10-year and larger events. The only exception is the shallow flooding the model predicted for the parking lot of the Community Development Resources Center, which is outside of the development envelope for the Final Option.

Minor collector storm drain pipes were not modeled as part of this study; this subject will be addressed in subsequent drainage reports for individual projects, and should consider how the hydraulics of the arterial storm drain pipes affects the performance of smaller, feeder pipes.

# 6 LIMITATIONS

This report was prepared in general accordance with the accepted standard of practice in surface-water hydrology existing in Northern California for projects of similar scale at the time the investigations were performed. No other warranties, expressed or implied, are made.

As is customary, we note that readers should recognize that interpretation and evaluation of subsurface conditions and physical factors affecting the hydrologic context of any site is a difficult and inexact art. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present. More extensive or extended studies, including additional hydrologic baseline monitoring, can reduce the inherent uncertainties associated with such studies. We note, in particular, that many factors affect local and regional ground-water levels. If the client wishes to further reduce the uncertainty beyond the level associated with this study, the authors should be notified for additional consultation.

We have used standard environmental information such as precipitation, topographic mapping, and soil mapping, in our analyses and approaches without verification or modification, in conformance with local custom. New information or changes in regulatory guidance could influence the plans or recommendations, perhaps fundamentally. As updated information becomes available, the interpretations and recommendations contained in this report may warrant change. To aid in revisions, we ask that readers or reviewers advise us of new plans, conditions, or data of which they are aware.

Concepts, findings and interpretations contained in this report are intended for the exclusive use of the Cartwright Engineering under the conditions presently prevailing except where noted otherwise. Their use beyond the boundaries of the site could lead to environmental or structural damage, and/or to noncompliance with water-quality policies, regulations or permits. Data developed or used in this report were collected and interpreted solely for developing an understanding of the hydrologic context at the site as an aid to stormwater master planning. They should not be used for other purposes without great care, updating, review of sampling and analytical methods used, and consultation with the authors.

Finally, we ask once again that readers who have additional pertinent information, who observed changed conditions, or who may note material errors should contact us with their findings at the earliest possible date, so that timely changes may be made.

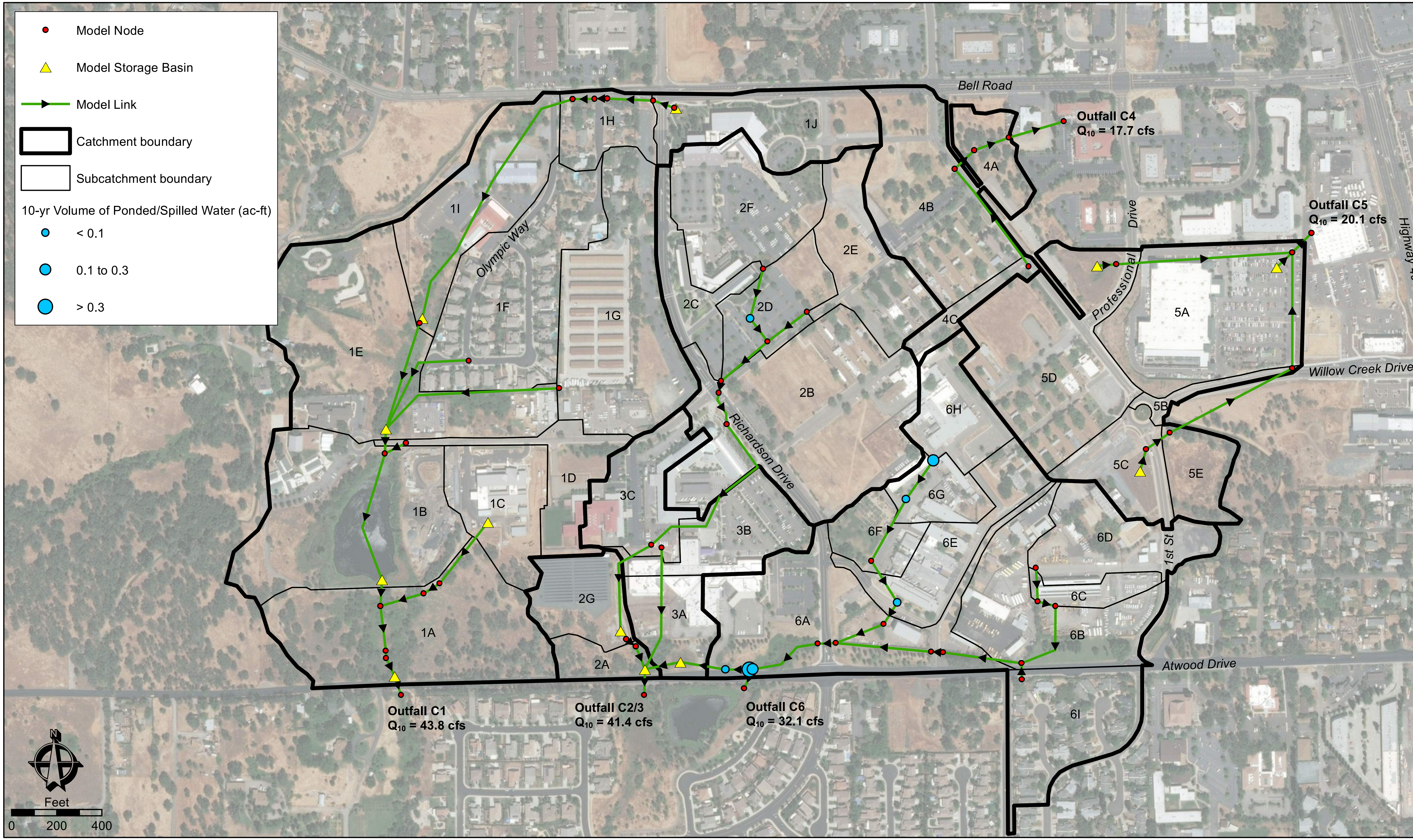
# Plates


DRAFT Master Plan Update - Wet Utility Infrastructure
Master Drainage Report

**Plate 1. Baseline model configuration schematic, Placer County Government Center, Placer County, California**

Basemap source: ESRI ArcGIS Online and data partners

Y:\GIS\Projects\216145 Placer Government Center Stormwater\figures\216145 Plate 1.mxd

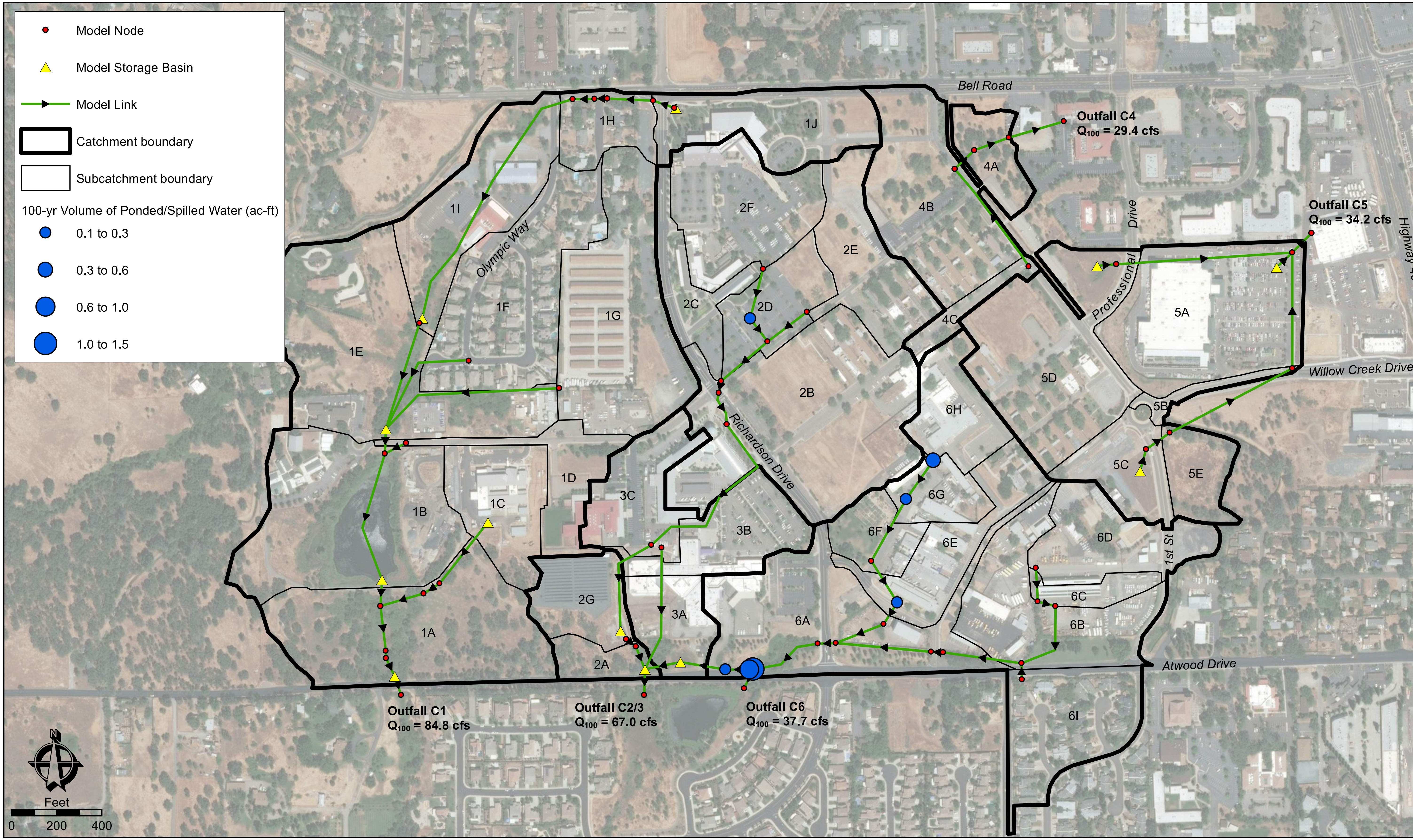



*DRAFT Master Plan Update - Wet Utility Infrastructure*
*Master Drainage Report*

**Plate 2. Baseline model results for the 10-year event**
**Placer County Government Center, Placer County, California**

Basemap source: ESRI ArcGIS Online and data partners

…ojects\216145 Placer Government Center Stormwater\figures\216145 Plate 2.mxd

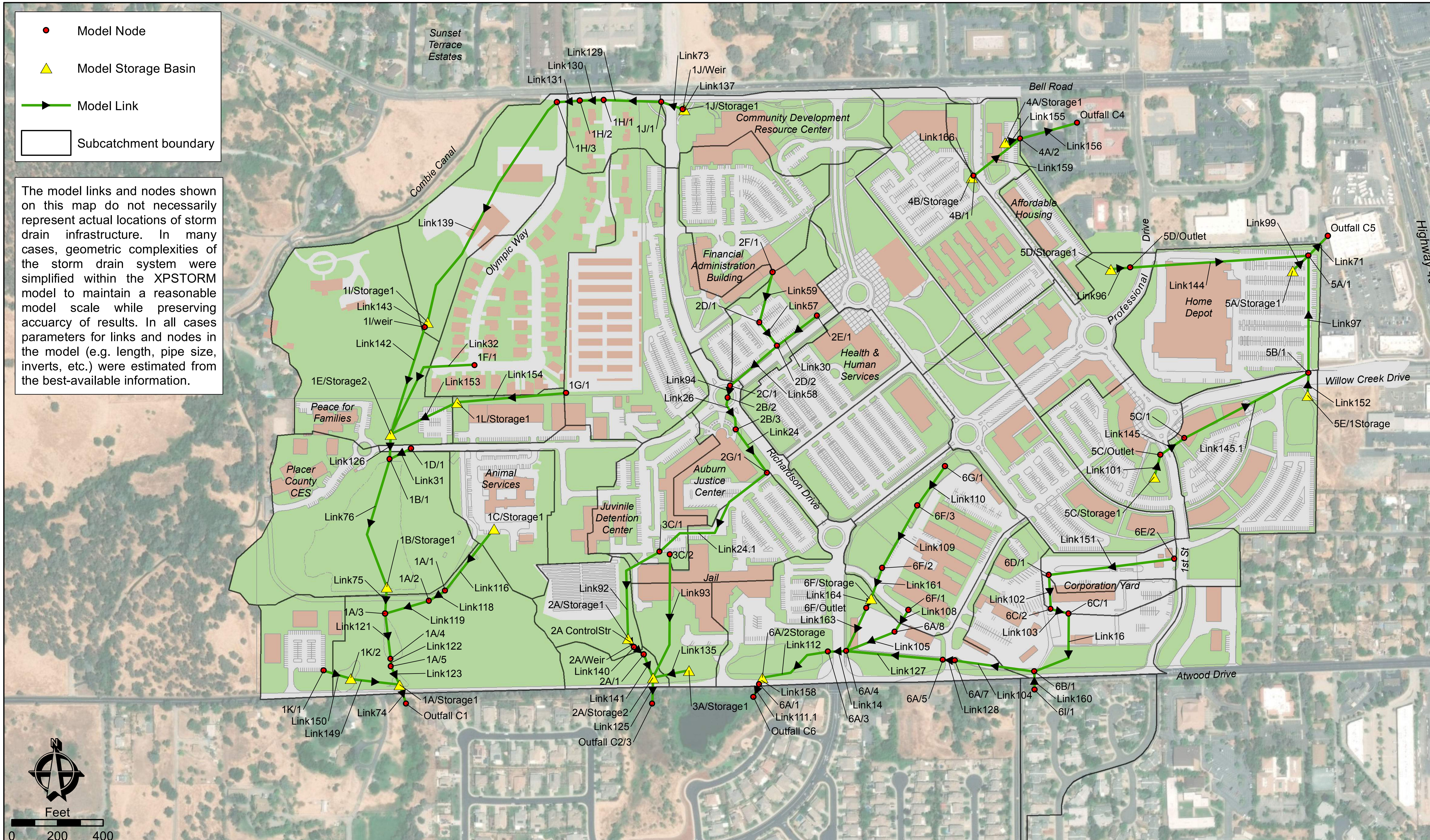



*DRAFT Master Plan Update - Wet Utility Infrastructure*
*Master Drainage Report*

**Plate 3. Baseline model results for the 100-year event**
**Placer County Government Center, Placer County, California**

Basemap source: ESRI ArcGIS Online and data partners

...ojects\216145 Placer Government Center Stormwater\figures\216145 Plate 3.mxd

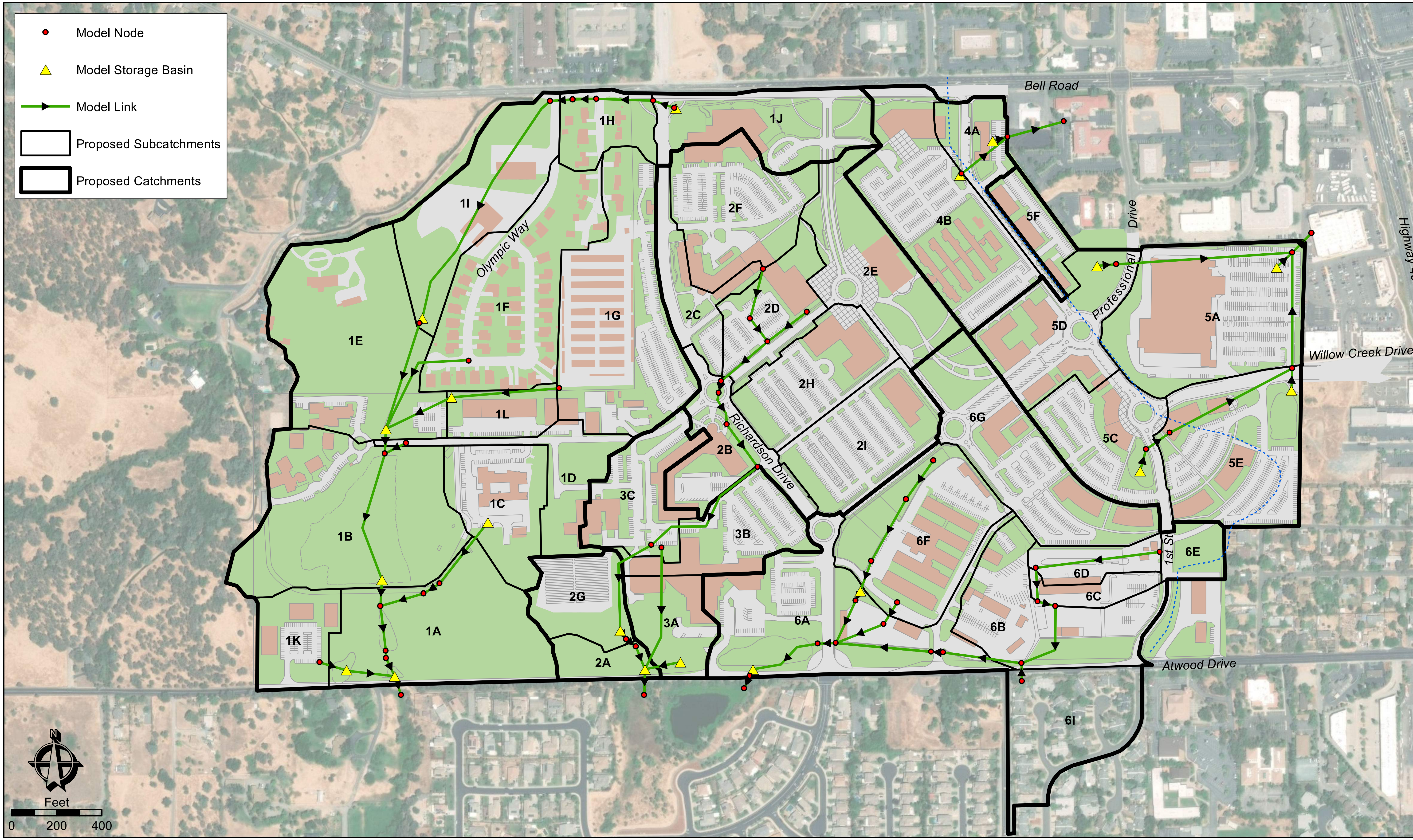



**DRAFT Master Plan Update - Wet Utility Infrastructure**
**Master Drainage Report**

**Plate 4. Final Option model configuration schematic,**
**Placer County Government Center, Placer County, California**

Basemap source: Williams + Paddon Architects + Planners, Inc.

Y:\GIS\Projects\216145 Placer Government Center Stormwater\figures\216145 Plate 4.mxd

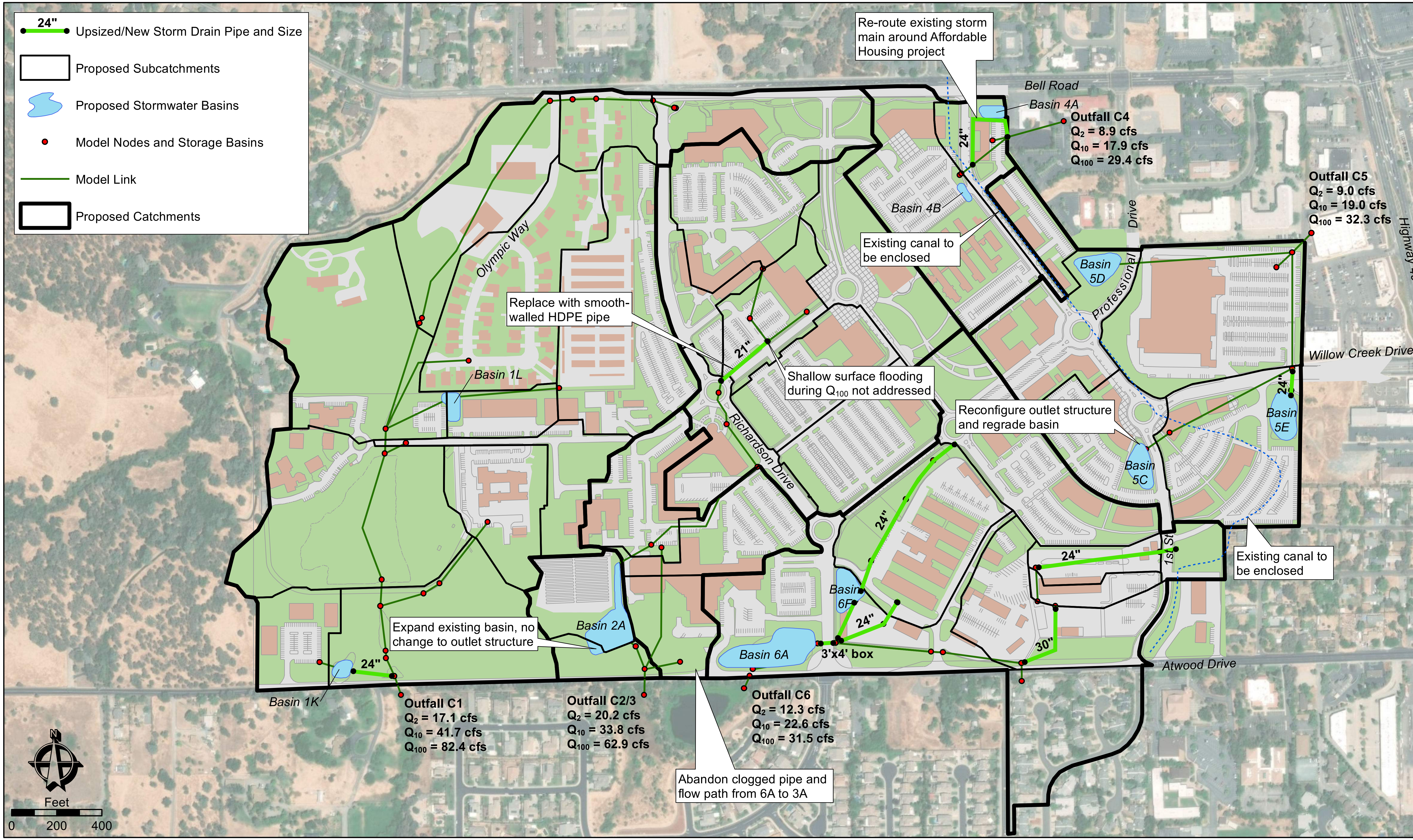



*DRAFT Master Plan Update - Wet Utility Infrastructure*
*Master Drainage Report*

**Plate 5. Final Option catchments and subcatchments,**
**Placer County Government Center, Placer County, California**

Basemap source: ESRI ArcGIS Online and data partners

Y:\GIS\Projects\216145 Placer Government Center Stormwater\figures\216145 Plate 5.mxd




*DRAFT Master Plan Update - Wet Utility Infrastructure*
*Master Drainage Report*

**Plate 6. Final Option model results,**
**Placer County Government Center, Placer County, California**

Basemap source: ESRI ArcGIS Online and data partners

Y:\GIS\Projects\216145 Placer Government Center Stormwater\figures\216145 Plate 6.mxd

# Appendix A: XP STORM Model Results

| Name | Maximum Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| Link14 | 25.0 | 44.2 | 69.2 |
| Link16 | 4.3 | 7.6 | 12.6 |
| Link24 | 25.7 | 46.6 | 62.6 |
| Link24.1 | 31.1 | 56.1 | 78.2 |
| Link26 | 22.4 | 40.4 | 52.0 |
| Link30 | 5.7 | 10.2 | 15.0 |
| Link31 | 3.0 | 5.5 | 9.2 |
| Link32 | 7.9 | 15.3 | 26.2 |
| Link57 | 6.0 | 10.6 | 18.4 |
| Link58 | 15.0 | 27.1 | 31.4 |
| Link59 | 6.0 | 10.6 | 13.8 |
| Link71 (C5) | 9.0 | 19.0 | 32.3 |
| Link73 | 2.5 | 3.4 | 4.6 |
| Link74 (C1) | 17.1 | 41.7 | 82.4 |
| Link75 | 13.5 | 32.5 | 63.0 |
| Link76 | 31.5 | 60.6 | 111.7 |
| Link92 | 31.0 | 56.1 | 78.1 |
| Link93 | 8.1 | 14.4 | 23.8 |
| Link97 | 3.3 | 5.6 | 8.6 |
| Link102 | 3.1 | 5.5 | 9.1 |
| Link103 | 3.0 | 5.5 | 9.1 |
| Link104 | 15.9 | 28.3 | 43.7 |
| Link105 | 7.2 | 12.9 | 21.4 |
| Link108 | 7.2 | 12.9 | 21.4 |
| Link109 | 7.7 | 13.6 | 22.5 |
| Link110 | 7.7 | 13.6 | 22.5 |
| Link111.1 (C6) | 12.3 | 22.6 | 31.5 |
| Link112 | 25.0 | 44.1 | 69.1 |
| Link116 | 3.7 | 6.7 | 8.7 |
| Link118 | 3.7 | 6.8 | 8.7 |
| Link119 | 3.7 | 6.8 | 8.7 |
| Link121 | 14.4 | 34.9 | 70.4 |
| Link122 | 14.4 | 34.9 | 70.4 |
| Link123 | 14.4 | 34.9 | 70.4 |
| Link125 (C2/3) | 20.2 | 33.8 | 62.9 |
| Link129 | 2.5 | 3.4 | 4.6 |
| Link130 | 2.5 | 3.4 | 4.6 |
| Link131 | 2.5 | 3.4 | 4.6 |
| Link135 | 0.0 | 0.0 | 0.0 |
| Link139 | 3.6 | 6.5 | 9.7 |
| Link140 | 14.5 | 26.3 | 55.0 |
| Link141 | 14.5 | 26.3 | 55.0 |
| Link142 | 7.9 | 16.1 | 26.8 |
| Link144 | 1.7 | 2.6 | 3.5 |
| Link145 | 1.5 | 2.2 | 3.0 |

| Name | Maximum Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| Link145.1 | 2.7 | 4.7 | 7.6 |
| Link149 | 1.0 | 1.6 | 2.7 |
| Link151 | 1.2 | 2.3 | 3.9 |
| Link154 | 8.8 | 16.8 | 29.0 |
| Link156 (C4) | 8.9 | 17.9 | 29.4 |
| Link159 | 7.7 | 14.6 | 24.6 |
| Link160 | 5.4 | 9.7 | 13.6 |
| Link161 | 7.7 | 13.6 | 22.5 |
| Link163 | 2.5 | 3.7 | 4.9 |

| Node Name | Ground Elevation (ft) | Maximum HGL (ft) | | |
|---|---|---|---|---|
| | | 2-yr | 10-yr | 100-yr |
| 1A/1 | 1387.50 | 1386.08 | 1386.34 | 1386.53 |
| 1A/2 | 1388.00 | 1385.24 | 1385.32 | 1385.36 |
| 1A/3 | 1370.00 | 1365.15 | 1365.25 | 1365.38 |
| 1A/4 | 1366.00 | 1360.21 | 1360.38 | 1360.59 |
| 1A/5 | 1365.00 | 1358.36 | 1358.63 | 1358.97 |
| 1A/Storage1 | 1367.50 | 1357.69 | 1358.08 | 1358.53 |
| 1B/1 | 1387.70 | 1381.07 | 1381.25 | 1381.66 |
| 1B/Storage1 | 1384.30 | 1380.74 | 1381.17 | 1381.64 |
| 1C/Storage1 | 1396.50 | 1390.61 | 1390.90 | 1391.57 |
| 1D/1 | 1387.26 | 1383.31 | 1383.48 | 1383.71 |
| 1E/Storage2 | 1387.70 | 1382.46 | 1382.76 | 1383.11 |
| 1F/1 | 1395.00 | 1386.84 | 1387.24 | 1388.08 |
| 1G/1 | 1398.78 | 1395.41 | 1395.62 | 1395.89 |
| 1H/1 | 1426.00 | 1424.00 | 1424.08 | 1424.19 |
| 1H/2 | 1425.00 | 1423.47 | 1423.54 | 1423.64 |
| 1H/3 | 1425.10 | 1421.76 | 1421.83 | 1421.89 |
| 1I/Storage1 | 1393.00 | 1389.88 | 1390.57 | 1391.75 |
| 1I/weir | 1393.00 | 1388.91 | 1389.05 | 1389.20 |
| 1J/1 | 1428.00 | 1425.53 | 1425.62 | 1425.75 |
| 1J/Storage1 | 1430.00 | 1426.97 | 1427.72 | 1428.60 |
| 1J/Weir | 1430.00 | 1426.17 | 1426.28 | 1426.44 |
| 2A/1 | 1399.00 | 1392.89 | 1393.03 | 1393.20 |
| 2A/Storage1 | 1402.00 | 1395.67 | 1397.24 | 1398.20 |
| 2A/Storage2 | 1390.50 | 1387.93 | 1388.40 | 1389.36 |
| 2A/Weir | 1398.00 | 1393.89 | 1394.21 | 1394.61 |
| 2B/2 | 1411.17 | 1408.48 | 1408.99 | 1409.30 |
| 2B/3 | 1411.46 | 1407.80 | 1408.31 | 1408.73 |
| 2C/1 | 1411.61 | 1409.32 | 1409.72 | 1409.98 |
| 2D/1 | 1417.18 | 1413.61 | 1417.31 | 1418.20 |
| 2D/2 | 1417.19 | 1412.68 | 1416.81 | 1417.60 |
| 2E/1 | 1422.00 | 1418.09 | 1418.65 | 1421.83 |
| 2F/1 | 1421.76 | 1417.39 | 1420.28 | 1422.19 |
| 3A/Storage1 | 1390.50 | 1388.70 | 1388.76 | 1389.35 |
| 3C/1 | 1405.92 | 1401.18 | 1401.67 | 1402.07 |
| 3C/2 | 1404.34 | 1395.73 | 1395.92 | 1396.14 |
| 4A | 1415.50 | 1412.83 | 1413.10 | 1413.40 |
| 4A/1 | 1425.84 | 1420.39 | 1420.55 | 1420.69 |
| 4B/1 | 1429.00 | 1424.74 | 1425.10 | 1427.04 |
| 4C/1 | 1429.30 | 1427.47 | 1428.79 | 1429.47 |
| 5A/1 | 1405.36 | 1386.38 | 1386.90 | 1387.43 |
| 5A/Storage1 | 1406.00 | 1390.16 | 1390.45 | 1390.70 |
| 5B/1 | 1404.76 | 1396.09 | 1396.25 | 1396.44 |
| 5C/1 | 1433.00 | 1423.39 | 1423.53 | 1423.68 |
| 5C/Outlet | 1435.00 | 1428.38 | 1428.47 | 1428.52 |

| Node Name | Ground Elevation (ft) | Maximum HGL (ft) | | |
|---|---|---|---|---|
| | | 2-yr | 10-yr | 100-yr |
| 5C/Storage1 | 1435.00 | 1429.58 | 1430.28 | 1431.24 |
| 5D/Outlet | 1413.00 | 1406.39 | 1406.50 | 1406.60 |
| 5D/Storage1 | 1413.00 | 1408.25 | 1409.95 | 1412.01 |
| 6A/1 | 1408.00 | 1406.03 | 1406.24 | 1406.46 |
| 6A/2 | 1407.70 | 1404.44 | 1404.62 | 1404.77 |
| 6A/3 | 1405.00 | 1403.11 | 1403.19 | 1403.26 |
| 6A/4 | 1397.86 | 1396.43 | 1396.93 | 1397.57 |
| 6A/5 | 1395.89 | 1393.55 | 1393.72 | 1395.02 |
| 6A/6 | 1393.00 | 1391.66 | 1393.40 | 1394.74 |
| 6A/7 | 1391.00 | 1390.74 | 1391.51 | 1392.14 |
| 6A/Weir | 1390.00 | 1390.74 | 1391.51 | 1392.14 |
| 6B/1 | 1416.50 | 1414.94 | 1415.28 | 1415.64 |
| 6C/1 | 1427.57 | 1421.06 | 1421.36 | 1426.27 |
| 6C/2 | 1426.04 | 1420.70 | 1421.29 | 1426.19 |
| 6D/1 | 1426.99 | 1422.42 | 1422.65 | 1426.85 |
| 6E/1 | 1406.89 | 1405.97 | 1407.19 | 1407.89 |
| 6F/1 | 1414.95 | 1412.76 | 1412.91 | 1413.13 |
| 6G/1 | 1424.34 | 1424.42 | 1424.71 | 1425.10 |
| 6H/1 | 1429.78 | 1430.29 | 1430.83 | 1431.40 |
| 6I/1 | 1417.00 | 1415.18 | 1416.11 | 1417.27 |
| Outfall C1 | 1358.00 | 1354.69 | 1355.08 | 1355.53 |
| Outfall C2/3 | 1390.00 | 1385.93 | 1386.40 | 1387.30 |
| Outfall C4 | 1407.00 | 1401.92 | 1402.20 | 1402.50 |
| Outfall C5 | 1391.57 | 1386.10 | 1386.58 | 1387.04 |
| Outfall C6 | 1391.00 | 1389.83 | 1389.83 | 1389.83 |

| Name | Shape | Diameter/ Height (ft) | Bottom Width (ft) | Length (ft) | Downstream Invert Elevation (ft) | Upstream Invert Elevation (ft) | Slope (ft/ft) |
|---|---|---|---|---|---|---|---|
| Link14 | Circular | 3 | -- | 80 | 1392.89 | 1394.86 | 0.025 |
| Link16 | Circular | 2 | -- | 486 | 1414.00 | 1419.60 | 0.012 |
| Link24 | Circular | 4 | -- | 864 | 1400.00 | 1406.50 | 0.008 |
| Link26 | Circular | 3 | -- | 154 | 1406.50 | 1407.20 | 0.005 |
| Link30 | Circular | 1.5 | -- | 218 | 1411.24 | 1417.59 | 0.029 |
| Link31 | Circular | 1.5 | -- | 80 | 1381.00 | 1382.85 | 0.023 |
| Link32 | Circular | 2 | -- | 70 | 1385.25 | 1386.00 | 0.011 |
| Link33 | Circular | 0.833 | -- | 542 | 1424.00 | 1427.00 | 0.006 |
| Link34 | Circular | 1.67 | -- | 120 | 1420.00 | 1424.00 | 0.033 |
| Link35 | Circular | 2 | -- | 250 | 1401.30 | 1412.20 | 0.044 |
| Link57 | Circular | 1.75 | -- | 129 | 1410.78 | 1412.81 | 0.016 |
| Link58 | Circular | 1.75 | -- | 270 | 1408.58 | 1410.38 | 0.007 |
| Link59 | Circular | 1.5 | -- | 227 | 1412.81 | 1416.64 | 0.017 |
| Link71 | Circular | 3 | -- | 70 | 1385.14 | 1385.30 | 0.002 |
| Link73 | Circular | 1.5 | -- | 115 | 1425.00 | 1425.50 | 0.004 |
| Link74 | Circular | 4 | 3 | 70 | 1354.00 | 1357.00 | 0.043 |
| Link75 | Circular | 4 | 3 | 125 | 1365.00 | 1380.00 | 0.120 |
| Link76 | Trapezoidal | 4.3 | 100 | 110 | 1380.00 | 1380.80 | 0.007 |
| Link87 | Trapezoidal | 3 | 6 | 600 | 1383.00 | 1395.00 | 0.020 |
| Link92 | Circular | 3.5 | -- | 167 | 1398.00 | 1400.00 | 0.012 |
| Link93 | Circular | 3.5 | -- | 407 | 1387.00 | 1395.14 | 0.020 |
| Link95 | Trapezoidal | 0.5 | 1.2 | 154 | 1412.20 | 1420.00 | 0.051 |
| Link97 | Circular | 2 | -- | 516 | 1385.30 | 1395.62 | 0.020 |
| Link102 | Circular | 2 | -- | 150 | 1420.44 | 1421.76 | 0.009 |
| Link103 | Circular | 2.5 | -- | 84 | 1419.60 | 1420.44 | 0.010 |
| Link104 | Circular | 2.5 | -- | 350 | 1405.50 | 1414.00 | 0.024 |
| Link105 | Circular | 1.5 | -- | 227 | 1394.86 | 1402.49 | 0.034 |
| Link107 | Circular | 1.25 | -- | 217 | 1403.61 | 1412.25 | 0.040 |
| Link108 | Circular | 1.25 | -- | 112 | 1402.49 | 1403.61 | 0.010 |
| Link109 | Circular | 0.667 | -- | 313 | 1412.25 | 1422.29 | 0.032 |
| Link110 | Circular | 0.5 | -- | 211 | 1422.29 | 1427.00 | 0.022 |
| Link111 | Special | 2.83 | -- | 93 | 1388.00 | 1388.20 | 0.002 |
| Link112 | Natural | 0 | -- | 325 | 1388.20 | 1392.89 | 0.014 |
| Link116 | Circular | 1.25 | -- | 256 | 1385.50 | 1390.00 | 0.018 |
| Link118 | Circular | 1.25 | -- | 54 | 1383.00 | 1385.50 | 0.046 |
| Link119 | Trapezoidal | 3 | 3 | 165 | 1365.00 | 1385.00 | 0.121 |
| Link121 | Trapezoidal | 3 | 25 | 33 | 1360.00 | 1365.00 | 0.152 |
| Link122 | Trapezoidal | 6 | 6 | 33 | 1358.00 | 1360.00 | 0.061 |
| Link123 | Trapezoidal | 2 | 15 | 50 | 1357.00 | 1358.00 | 0.020 |
| Link129 | Circular | 1.5 | -- | 250 | 1423.50 | 1425.00 | 0.006 |
| Link130 | Trapezoidal | 2 | 2 | 105 | 1423.00 | 1423.50 | 0.005 |
| Link131 | Circular | 2 | 1.5 | 100 | 1421.50 | 1423.00 | 0.015 |
| Link134 | Circular | 1.5 | -- | 200 | 1386.00 | 1388.00 | 0.010 |

| Name | Shape | Diameter/ Height (ft) | Bottom Width (ft) | Length (ft) | Downstream Invert Elevation (ft) | Upstream Invert Elevation (ft) | Slope (ft/ft) |
|---|---|---|---|---|---|---|---|
| Link135 | Trapezoidal | 2 | 7 | 60 | 1387.00 | 1388.50 | 0.025 |
| Link136 | Trapezoidal | 1 | 1 | 120 | 1388.00 | 1388.20 | 0.002 |
| Link139 | Natural | 0 | -- | 1200 | 1390.00 | 1421.50 | 0.026 |
| Link140 | Circular | 3.5 | -- | 40 | 1392.50 | 1393.00 | 0.013 |
| Link141 | Natural | 0 | -- | 100 | 1387.00 | 1392.50 | 0.055 |
| Link142 | Natural | 0 | -- | 500 | 1381.90 | 1388.50 | 0.013 |
| Link144 | Circular | 1.25 | -- | 822 | 1388.32 | 1406.00 | 0.022 |
| Link145 | Circular | 1.5 | -- | 268 | 1423.00 | 1428.00 | 0.019 |
| Link145.1 | Circular | 1.5 | -- | 630 | 1395.62 | 1423.00 | 0.043 |
| Link147 | Circular | 1.5 | -- | 83 | 1413.62 | 1413.89 | 0.003 |

| Name | Maximum Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| Link14 | 25.8 | 41.5 | 58.5 |
| Link16 | 5.7 | 10.1 | 14.7 |
| Link24 | 25.1 | 46.9 | 67.1 |
| Link26 | 15.7 | 27.5 | 32.9 |
| Link30 | 4.0 | 7.9 | 13.9 |
| Link31 | 3.0 | 5.5 | 9.2 |
| Link32 | 7.9 | 15.2 | 26.2 |
| Link33 | 1.1 | 2.0 | 2.2 |
| Link34 | 7.6 | 14.8 | 23.7 |
| Link35 | 9.3 | 18.2 | 29.5 |
| Link57 | 6.3 | 11.7 | 14.9 |
| Link58 | 13.1 | 22.8 | 25.2 |
| Link59 | 6.4 | 11.3 | 13.9 |
| Link71 | 9.2 | 20.1 | 34.2 |
| Link73 | 2.5 | 3.4 | 4.6 |
| Link74 | 17.8 | 44.2 | 85.3 |
| Link75 | 13.5 | 33.7 | 64.5 |
| Link76 | 34.7 | 69.7 | 120.3 |
| Link87 | 8.7 | 16.8 | 29.1 |
| Link92 | 25.0 | 46.9 | 67.3 |
| Link93 | 8.0 | 14.3 | 23.7 |
| Link95 | 7.6 | 14.8 | 23.7 |
| Link97 | 3.5 | 6.4 | 10.5 |
| Link102 | 4.5 | 8.0 | 13.3 |
| Link103 | 4.5 | 8.0 | 13.3 |
| Link104 | 17.8 | 31.7 | 47.7 |
| Link105 | 8.1 | 10.1 | 11.2 |
| Link107 | 4.2 | 5.8 | 8.2 |
| Link108 | 8.1 | 10.1 | 11.2 |
| Link109 | 2.2 | 2.2 | 2.3 |
| Link110 | 1.0 | 1.1 | 1.1 |
| Link111 | 22.8 | 32.1 | 37.7 |
| Link112 | 25.6 | 41.5 | 101.9 |
| Link116 | 3.7 | 6.8 | 8.7 |
| Link118 | 3.7 | 6.8 | 8.7 |
| Link119 | 3.7 | 6.8 | 8.7 |
| Link121 | 14.6 | 36.3 | 72.4 |
| Link122 | 14.6 | 36.3 | 72.4 |
| Link123 | 14.6 | 36.3 | 72.4 |
| Link129 | 2.5 | 3.4 | 4.6 |
| Link130 | 2.5 | 3.4 | 4.6 |
| Link131 | 2.5 | 3.4 | 4.6 |
| Link134 | 1.4 | 1.6 | 1.8 |
| Link135 | 3.8 | 6.2 | 9.7 |
| Link136 | 3.4 | 6.3 | 6.1 |

| Name | Maximum Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| Link139 | 3.6 | 6.5 | 9.7 |
| Link140 | 14.9 | 29.6 | 54.9 |
| Link141 | 14.9 | 29.6 | 54.9 |
| Link142 | 8.0 | 16.2 | 26.9 |
| Link144 | 1.9 | 2.9 | 4.1 |
| Link145 | 1.8 | 2.9 | 3.4 |
| Link145.1 | 3.1 | 5.5 | 8.5 |
| Link147 | 5.5 | 9.8 | 14.1 |

| Node Name | Ground Elevation (ft) | Invert Elevation (ft) | Type |
|---|---|---|---|
| 1A/1 | 1387.50 | 1385.50 | Node |
| 1A/2 | 1388.00 | 1383.00 | Node |
| 1A/3 | 1370.00 | 1365.00 | Node |
| 1A/4 | 1366.00 | 1360.00 | Node |
| 1A/5 | 1365.00 | 1358.00 | Node |
| 1A/Storage1 | 1367.50 | 1357.00 | Storage Node |
| 1B/1 | 1387.70 | 1380.80 | Node |
| 1B/Storage1 | 1384.30 | 1380.00 | Storage Node |
| 1C/Storage1 | 1396.50 | 1390.00 | Storage Node |
| 1D/1 | 1387.26 | 1382.85 | Node |
| 1E/Storage2 | 1387.70 | 1381.90 | Storage Node |
| 1F/1 | 1395.00 | 1386.00 | Node |
| 1G/1 | 1400.00 | 1397.00 | Node |
| 1H/1 | 1426.00 | 1423.50 | Node |
| 1H/2 | 1425.00 | 1423.00 | Node |
| 1H/3 | 1425.10 | 1421.50 | Node |
| 1I/Storage1 | 1393.00 | 1388.50 | Storage Node |
| 1I/weir | 1393.00 | 1388.50 | Node |
| 1J/1 | 1428.00 | 1425.00 | Node |
| 1J/Storage1 | 1430.00 | 1426.00 | Storage Node |
| 1J/Weir | 1430.00 | 1425.50 | Node |
| 1K/1 | 1386.00 | 1380.00 | Node |
| 1K/2 | 1385.00 | 1360.00 | Storage Node |
| 1L/Storage1 | 1395.00 | 1389.00 | Storage Node |
| 2A/1 | 1399.00 | 1392.50 | Node |
| 2A/Storage1 | 1401.50 | 1393.00 | Storage Node |
| 2A/Storage2 | 1390.50 | 1387.00 | Storage Node |
| 2A/Weir | 1398.00 | 1393.00 | Node |
| 2B/2 | 1411.17 | 1407.20 | Node |
| 2B/3 | 1411.46 | 1406.50 | Node |
| 2C/1 | 1411.61 | 1408.58 | Node |
| 2D/1 | 1417.18 | 1412.81 | Node |
| 2D/2 | 1417.19 | 1410.38 | Node |
| 2E/1 | 1422.00 | 1417.59 | Node |
| 2F/1 | 1421.76 | 1416.64 | Node |
| 2G/1 | 1411.95 | 1404.74 | Node |
| 3A/Storage1 | 1390.50 | 1386.00 | Storage Node |
| 3C/1 | 1405.92 | 1400.00 | Node |
| 3C/2 | 1404.34 | 1395.14 | Node |
| 4A/2 | 1420.00 | 1412.00 | Node |
| 4A/Storage1 | 1415.00 | 1412.00 | Storage Node |
| 4B/1 | 1430.00 | 1423.32 | Node |
| 4B/Storage | 1430.00 | 1426.00 | Storage Node |
| 5A/1 | 1405.36 | 1385.30 | Node |
| 5A/Storage1 | 1406.00 | 1388.76 | Storage Node |

| Node Name | Ground Elevation (ft) | Invert Elevation (ft) | Type |
|---|---|---|---|
| 5B/1 | 1404.76 | 1395.62 | Node |
| 5C/1 | 1433.00 | 1423.00 | Node |
| 5C/Outlet | 1435.00 | 1428.00 | Node |
| 5C/Storage1 | 1435.00 | 1428.00 | Storage Node |
| 5D/Outlet | 1413.00 | 1388.32 | Node |
| 5D/Storage1 | 1413.00 | 1406.00 | Storage Node |
| 5E/1Storage | 1412.00 | 1405.00 | Storage Node |
| 6A/1 | 1393.00 | 1388.00 | Node |
| 6A/2Storage | 1394.00 | 1388.00 | Storage Node |
| 6A/3 | 1395.89 | 1392.89 | Node |
| 6A/4 | 1397.86 | 1394.86 | Node |
| 6A/5 | 1407.70 | 1403.50 | Node |
| 6A/7 | 1408.00 | 1405.50 | Node |
| 6A/8 | 1405.00 | 1401.00 | Node |
| 6B/1 | 1416.50 | 1413.62 | Node |
| 6C/1 | 1426.04 | 1419.60 | Node |
| 6C/2 | 1427.57 | 1420.44 | Node |
| 6D/1 | 1426.99 | 1421.76 | Node |
| 6E/2 | 1436.00 | 1427.45 | Node |
| 6F/1 | 1406.89 | 1403.61 | Node |
| 6F/2 | 1414.95 | 1412.25 | Node |
| 6F/3 | 1424.34 | 1422.29 | Node |
| 6F/Outlet | 1412.00 | 1405.00 | Node |
| 6F/Storage | 1412.00 | 1406.00 | Storage Node |
| 6G/1 | 1429.78 | 1427.00 | Node |
| 6I/1 | 1417.00 | 1413.89 | Node |
| Outfall C1 | 1358.00 | 1354.00 | Node |
| Outfall C2/3 | 1390.00 | 1385.00 | Node |
| Outfall C4 | 1407.00 | 1401.30 | Node |
| Outfall C5 | 1391.57 | 1385.14 | Node |
| Outfall C6 | 1391.00 | 1388.00 | Node |

| Node Name | Ground Elevation (ft) | Maximum HGL (ft) | | |
|---|---|---|---|---|
| | | 2-yr | 10-yr | 100-yr |
| 1A/1 | 1387.50 | 1386.08 | 1386.34 | 1386.53 |
| 1A/2 | 1388.00 | 1385.24 | 1385.32 | 1385.36 |
| 1A/3 | 1370.00 | 1365.14 | 1365.24 | 1365.37 |
| 1A/4 | 1366.00 | 1360.21 | 1360.37 | 1360.58 |
| 1A/5 | 1365.00 | 1358.35 | 1358.61 | 1358.96 |
| 1A/Storage1 | 1367.50 | 1357.68 | 1358.05 | 1358.50 |
| 1B/1 | 1387.70 | 1381.05 | 1381.23 | 1381.64 |
| 1B/Storage1 | 1384.30 | 1380.74 | 1381.15 | 1381.62 |
| 1C/Storage1 | 1396.50 | 1390.61 | 1390.90 | 1391.57 |
| 1D/1 | 1387.26 | 1383.31 | 1383.48 | 1383.71 |
| 1E/Storage2 | 1387.70 | 1382.42 | 1382.68 | 1383.05 |
| 1F/1 | 1395.00 | 1386.84 | 1387.24 | 1388.08 |
| 1G/1 | 1400.00 | 1397.57 | 1397.86 | 1398.24 |
| 1H/1 | 1426.00 | 1424.00 | 1424.08 | 1424.19 |
| 1H/2 | 1425.00 | 1423.47 | 1423.54 | 1423.64 |
| 1H/3 | 1425.10 | 1421.76 | 1421.83 | 1421.89 |
| 1I/Storage1 | 1393.00 | 1389.88 | 1390.56 | 1391.75 |
| 1I/weir | 1393.00 | 1388.91 | 1389.05 | 1389.20 |
| 1J/1 | 1428.00 | 1425.54 | 1425.62 | 1425.75 |
| 1J/Storage1 | 1430.00 | 1426.96 | 1427.68 | 1428.55 |
| 1J/Weir | 1430.00 | 1426.17 | 1426.28 | 1426.44 |
| 1K/1 | 1386.00 | 1381.57 | 1382.91 | 1384.40 |
| 1K/2 | 1385.00 | 1360.30 | 1360.37 | 1360.48 |
| 1L/Storage1 | 1395.00 | 1392.15 | 1393.24 | 1393.89 |
| 2A/1 | 1399.00 | 1392.89 | 1393.00 | 1393.20 |
| 2A/Storage1 | 1401.50 | 1395.55 | 1397.02 | 1398.21 |
| 2A/Storage2 | 1390.50 | 1387.85 | 1388.19 | 1389.07 |
| 2A/Weir | 1398.00 | 1393.87 | 1394.15 | 1394.61 |
| 2B/2 | 1411.17 | 1408.74 | 1409.36 | 1409.83 |
| 2B/3 | 1411.46 | 1407.80 | 1408.31 | 1408.68 |
| 2C/1 | 1411.61 | 1409.42 | 1410.00 | 1410.67 |
| 2D/1 | 1417.18 | 1413.50 | 1416.18 | 1418.00 |
| 2D/2 | 1417.19 | 1411.88 | 1415.52 | 1417.42 |
| 2E/1 | 1422.00 | 1418.19 | 1418.66 | 1422.20 |
| 2F/1 | 1421.76 | 1417.38 | 1418.85 | 1422.08 |
| 2G/1 | 1411.95 | 1406.19 | 1406.74 | 1407.18 |
| 3A/Storage1 | 1390.50 | 1386.00 | 1386.00 | 1389.07 |
| 3C/1 | 1405.92 | 1401.32 | 1401.85 | 1402.29 |
| 3C/2 | 1404.34 | 1395.73 | 1395.92 | 1396.15 |
| 4A/2 | 1420.00 | 1412.61 | 1412.89 | 1413.23 |
| 4A/Storage1 | 1415.00 | 1413.59 | 1413.84 | 1414.14 |
| 4B/1 | 1430.00 | 1423.91 | 1424.15 | 1424.44 |
| 4B/Storage | 1430.00 | 1427.96 | 1428.38 | 1428.87 |
| 5A/1 | 1405.36 | 1386.36 | 1386.85 | 1387.36 |

| Node Name | Ground Elevation (ft) | Maximum HGL (ft) | | |
|---|---|---|---|---|
| | | 2-yr | 10-yr | 100-yr |
| 5A/Storage1 | 1406.00 | 1390.16 | 1390.45 | 1390.70 |
| 5B/1 | 1404.76 | 1396.07 | 1396.21 | 1396.36 |
| 5C/1 | 1433.00 | 1423.37 | 1423.49 | 1423.64 |
| 5C/Outlet | 1435.00 | 1428.35 | 1428.43 | 1428.50 |
| 5C/Storage1 | 1435.00 | 1429.83 | 1430.74 | 1431.96 |
| 5D/Outlet | 1413.00 | 1406.37 | 1406.46 | 1406.55 |
| 5D/Storage1 | 1413.00 | 1407.96 | 1409.30 | 1410.96 |
| 5E/1Storage | 1412.00 | 1407.84 | 1409.97 | 1411.36 |
| 6A/1 | 1393.00 | 1390.18 | 1390.99 | 1392.06 |
| 6A/2Storage | 1394.00 | 1390.33 | 1391.51 | 1392.99 |
| 6A/3 | 1395.89 | 1393.54 | 1393.74 | 1393.94 |
| 6A/4 | 1397.86 | 1395.45 | 1395.73 | 1396.06 |
| 6A/5 | 1407.70 | 1404.42 | 1404.58 | 1404.74 |
| 6A/7 | 1408.00 | 1405.99 | 1406.19 | 1406.41 |
| 6A/8 | 1405.00 | 1401.55 | 1401.74 | 1401.99 |
| 6B/1 | 1416.50 | 1414.89 | 1415.21 | 1415.55 |
| 6C/1 | 1426.04 | 1420.40 | 1420.70 | 1421.09 |
| 6C/2 | 1427.57 | 1420.94 | 1421.13 | 1421.37 |
| 6D/1 | 1426.99 | 1422.30 | 1422.49 | 1422.72 |
| 6E/2 | 1436.00 | 1427.78 | 1427.90 | 1428.03 |
| 6F/1 | 1406.89 | 1404.29 | 1404.54 | 1404.86 |
| 6F/2 | 1414.95 | 1412.77 | 1412.95 | 1413.17 |
| 6F/3 | 1424.34 | 1422.95 | 1423.18 | 1423.49 |
| 6F/Outlet | 1412.00 | 1405.34 | 1405.41 | 1405.47 |
| 6F/Storage | 1412.00 | 1407.57 | 1408.69 | 1410.15 |
| 6G/1 | 1429.78 | 1427.68 | 1427.93 | 1428.27 |
| 6I/1 | 1417 | 1415.14 | 1416.01 | 1417.00 |
| Outfall C1 | 1358 | 1354.67 | 1355.05 | 1355.50 |
| Outfall C2/3 | 1390 | 1385.85 | 1386.19 | 1387.07 |
| Outfall C4 | 1407 | 1401.91 | 1402.19 | 1402.53 |
| Outfall C5 | 1391.574 | 1386.09 | 1386.54 | 1386.98 |
| Outfall C6 | 1391 | 1389.83 | 1389.83 | 1389.83 |

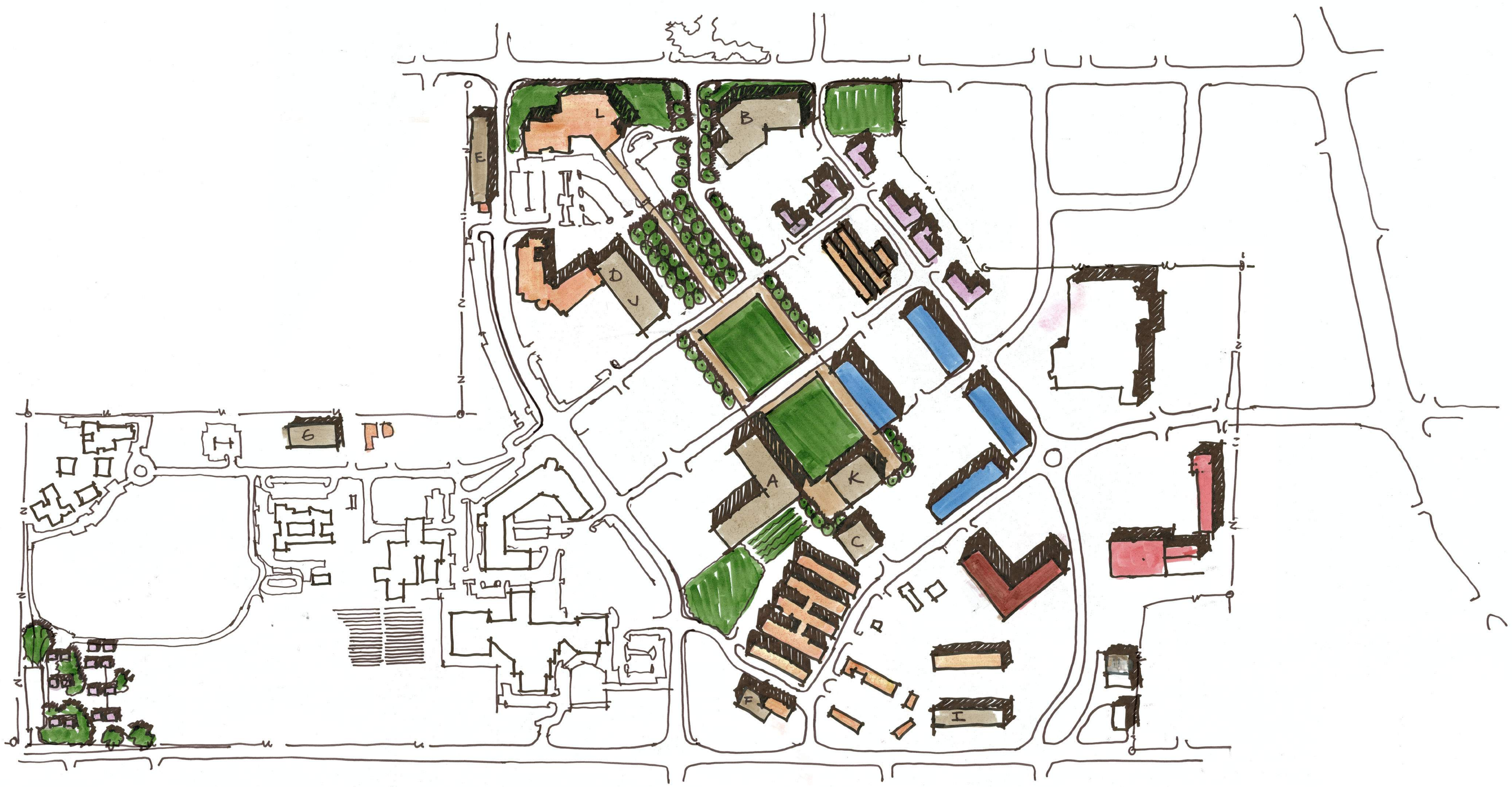
| Name | Shape | Diameter/ Height (ft) | Bottom Width (ft) | Length (ft) | Downstream Invert Elevation (ft) | Upstream Invert Elevation (ft) | Slope (ft/ft) |
|---|---|---|---|---|---|---|---|
| Link14 | Rectangular | 3 | 4 | 80 | 1392.89 | 1394.86 | 0.025 |
| Link16 | Circular | 2.5 | -- | 486 | 1414.00 | 1419.60 | 0.012 |
| Link24 | Circular | 4 | -- | 234 | 1404.74 | 1406.50 | 0.008 |
| Link24.1 | Circular | 4 | -- | 630 | 1400.00 | 1404.74 | 0.008 |
| Link26 | Circular | 3 | -- | 154 | 1406.50 | 1407.20 | 0.005 |
| Link30 | Circular | 1.5 | -- | 218 | 1411.24 | 1417.59 | 0.029 |
| Link31 | Circular | 1.5 | -- | 80 | 1381.00 | 1382.85 | 0.023 |
| Link32 | Circular | 2 | -- | 70 | 1385.25 | 1386.00 | 0.011 |
| Link57 | Circular | 1.75 | -- | 129 | 1410.78 | 1412.81 | 0.016 |
| Link58 | Circular | 1.75 | -- | 270 | 1408.58 | 1410.38 | 0.007 |
| Link59 | Circular | 1.5 | -- | 227 | 1412.81 | 1416.64 | 0.017 |
| Link71 | Circular | 3 | -- | 70 | 1385.14 | 1385.30 | 0.002 |
| Link73 | Circular | 1.5 | -- | 115 | 1425.00 | 1425.50 | 0.004 |
| Link74 | Circular | 4 | 3 | 70 | 1354.00 | 1357.00 | 0.043 |
| Link75 | Circular | 4 | 3 | 125 | 1365.00 | 1380.00 | 0.120 |
| Link76 | Trapezoidal | 4.3 | 100 | 110 | 1380.00 | 1380.80 | 0.007 |
| Link92 | Circular | 3.5 | -- | 167 | 1398.00 | 1400.00 | 0.012 |
| Link93 | Circular | 3.5 | -- | 407 | 1387.00 | 1395.14 | 0.020 |
| Link97 | Circular | 2 | -- | 516 | 1385.30 | 1395.62 | 0.020 |
| Link102 | Circular | 2 | -- | 150 | 1420.44 | 1421.76 | 0.009 |
| Link103 | Circular | 2.5 | -- | 84 | 1419.60 | 1420.44 | 0.010 |
| Link104 | Circular | 2.5 | -- | 350 | 1405.50 | 1414.00 | 0.024 |
| Link105 | Circular | 2 | -- | 227 | 1394.86 | 1401.00 | 0.027 |
| Link108 | Circular | 2 | -- | 112 | 1401.00 | 1403.61 | 0.023 |
| Link109 | Circular | 2 | -- | 313 | 1412.25 | 1422.29 | 0.032 |
| Link110 | Circular | 2 | -- | 211 | 1422.29 | 1427.00 | 0.022 |
| Link111.1 | Special | 2.83 | -- | 60 | 1388.00 | 1388.10 | 0.002 |
| Link112 | Natural | 0 | -- | 325 | 1388.20 | 1392.89 | 0.014 |
| Link116 | Circular | 1.25 | -- | 256 | 1385.50 | 1390.00 | 0.018 |
| Link118 | Circular | 1.25 | -- | 54 | 1383.00 | 1385.50 | 0.046 |
| Link119 | Trapezoidal | 3 | 3 | 165 | 1365.00 | 1385.00 | 0.121 |
| Link121 | Trapezoidal | 3 | 25 | 33 | 1360.00 | 1365.00 | 0.152 |
| Link122 | Trapezoidal | 6 | 6 | 33 | 1358.00 | 1360.00 | 0.061 |
| Link123 | Trapezoidal | 2 | 15 | 50 | 1357.00 | 1358.00 | 0.020 |
| Link129 | Circular | 1.5 | -- | 250 | 1423.50 | 1425.00 | 0.006 |
| Link130 | Trapezoidal | 2 | 2 | 105 | 1423.00 | 1423.50 | 0.005 |
| Link131 | Circular | 2 | 1.5 | 100 | 1421.50 | 1423.00 | 0.015 |
| Link135 | Trapezoidal | 2 | 7 | 60 | 1387.00 | 1388.50 | 0.025 |
| Link139 | Natural | 0 | -- | 1200 | 1390.00 | 1421.50 | 0.026 |
| Link140 | Circular | 3.5 | -- | 40 | 1392.50 | 1393.00 | 0.013 |
| Link141 | Natural | 0 | -- | 100 | 1387.00 | 1392.50 | 0.055 |
| Link142 | Natural | 0 | -- | 500 | 1381.90 | 1388.50 | 0.013 |
| Link144 | Circular | 1.25 | -- | 822 | 1388.32 | 1406.00 | 0.022 |

| Name | Shape | Diameter/ Height (ft) | Bottom Width (ft) | Length (ft) | Downstream Invert Elevation (ft) | Upstream Invert Elevation (ft) | Slope (ft/ft) |
|---|---|---|---|---|---|---|---|
| Link145 | Circular | 1.5 | -- | 268 | 1423.00 | 1428.00 | 0.019 |
| Link145.1 | Circular | 1.5 | -- | 630 | 1395.62 | 1423.00 | 0.043 |
| Link149 | Circular | 2 | -- | 200 | 1358.00 | 1360.00 | 0.010 |
| Link151 | Circular | 2 | -- | 569 | 1421.76 | 1427.45 | 0.010 |
| Link154 | Trapezoidal | 3 | 6 | 960 | 1390.00 | 1397.00 | 0.007 |
| Link156 | Circular | 2 | -- | 250 | 1401.30 | 1412.00 | 0.043 |
| Link159 | Circular | 2 | -- | 350 | 1412.00 | 1423.32 | 0.032 |
| Link160 | Circular | 1.5 | -- | 83 | 1413.62 | 1413.89 | 0.003 |
| Link161 | Circular | 2 | -- | 70 | 1408.00 | 1412.25 | 0.061 |
| Link163 | Circular | 2 | -- | 235 | 1394.86 | 1405.00 | 0.043 |

| Name | Maximum Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| Link14 | 25.2 | 44.4 | 69.3 |
| Link16 | 4.4 | 7.8 | 12.7 |
| Link24 | 25.7 | 46.6 | 62.6 |
| Link24.1 | 31.1 | 56.1 | 78.3 |
| Link26 | 22.4 | 40.4 | 52.0 |
| Link30 | 5.6 | 10.2 | 15.0 |
| Link31 | 3.0 | 5.5 | 9.2 |
| Link32 | 7.9 | 15.2 | 26.2 |
| Link57 | 6.0 | 10.7 | 18.4 |
| Link58 | 15.0 | 27.1 | 31.4 |
| Link59 | 6.0 | 10.6 | 13.9 |
| Link71 | 9.0 | 19.1 | 32.4 |
| Link73 | 2.5 | 3.4 | 4.6 |
| Link74 | 17.1 | 41.9 | 82.2 |
| Link75 | 13.5 | 32.5 | 63.0 |
| Link76 | 31.5 | 60.6 | 111.6 |
| Link92 | 31.0 | 56.2 | 78.2 |
| Link93 | 8.1 | 14.4 | 23.8 |
| Link97 | 3.3 | 5.6 | 8.7 |
| Link102 | 3.2 | 5.6 | 9.2 |
| Link103 | 3.2 | 5.6 | 9.2 |
| Link104 | 16.2 | 28.6 | 43.8 |
| Link105 | 7.2 | 12.9 | 21.5 |
| Link108 | 7.2 | 12.9 | 21.5 |
| Link109 | 7.6 | 13.5 | 22.4 |
| Link110 | 7.6 | 13.5 | 22.4 |
| Link111.1 | 12.5 | 22.7 | 31.6 |
| Link112 | 25.2 | 44.4 | 69.3 |
| Link116 | 3.7 | 6.7 | 8.7 |
| Link118 | 3.7 | 6.8 | 8.7 |
| Link119 | 3.7 | 6.8 | 8.7 |
| Link121 | 14.4 | 34.9 | 70.4 |
| Link122 | 14.4 | 34.9 | 70.4 |
| Link123 | 14.4 | 34.9 | 70.4 |
| Link129 | 2.5 | 3.4 | 4.6 |
| Link130 | 2.5 | 3.4 | 4.6 |
| Link131 | 2.5 | 3.4 | 4.6 |
| Link135 | 0.0 | 0.0 | 0.0 |
| Link139 | 3.6 | 6.5 | 9.7 |
| Link140 | 14.5 | 26.4 | 55.1 |
| Link141 | 14.5 | 26.4 | 55.1 |
| Link142 | 7.9 | 16.1 | 26.8 |
| Link144 | 1.7 | 2.5 | 3.5 |
| Link145 | 1.6 | 2.3 | 3.0 |
| Link145.1 | 2.7 | 4.8 | 7.7 |

| Name | Maximum Flow Rate (cfs) | | |
|---|---|---|---|
| | 2-yr | 10-yr | 100-yr |
| Link149 | 1.0 | 1.5 | 1.9 |
| Link151 | 1.4 | 2.4 | 4.0 |
| Link154 | 8.8 | 16.8 | 29.0 |
| Link156 | 8.7 | 17.7 | 30.0 |
| Link159 | 7.5 | 14.4 | 24.5 |
| Link160 | 5.5 | 9.8 | 13.5 |
| Link161 | 7.6 | 13.5 | 22.4 |
| Link163 | 2.4 | 3.7 | 4.8 |

# Appendix B: Alternative Land Plans




LEGEND

- A HEALTH AND HUMAN SERVICES
- B COUNTY ADMINISTRATIVE CENTER
- C AGRICULTURAL COMMISSIONER AND FARM ADVISOR FACILITY
- D CLERK RECORDER ELECTIONS TRAINING/ WAREHOUSE FACILITY
- E MUSEUM WAREHOUSE FACILITY
- F CORPORATION YARD ADMINISTRATION AND TRAINING CENTER
- G SHERIFF AND PROBATION SUPPORT FACILITY
- H FIRE STATION 180 EXPANSION
- I ADMINISTRATION SERVICES IT/TELECOM/ WAREHOUSE
- J FINANCE ADMINISTRATION BUILDING ANNEX
- K COMMUNITY BUILDING
- L CDRC GROWTH AND CONSOLIDATION

- NEW COUNTY BUILDINGS
- RESIDENTIAL
- HOTEL
- FLEX SPACE/ MIXED-USE
- RETAIL

**OPTION 1**

**PLACER COUNTY GOVERNMENT CENTER**
AUBURN, CALIFORNIA

0 200 800
100 400

**LEGEND**

| | |
|---|---|
| A | HEALTH AND HUMAN SERVICES |
| B | COUNTY ADMINISTRATIVE CENTER |
| C | AGRICULTURAL COMMISSIONER AND FARM ADVISOR FACILITY |
| D | CLERK RECORDER ELECTIONS TRAINING/ WAREHOUSE FACILITY |
| E | MUSEUM WAREHOUSE FACILITY |
| F | CORPORATION YARD ADMINISTRATION AND TRAINING CENTER |
| G | SHERIFF AND PROBATION SUPPORT FACILITY |
| H | FIRE STATION 180 EXPANSION |
| I | ADMINISTRATION SERVICES IT/TELECOM/ WAREHOUSE |
| J | FINANCE ADMINISTRATION BUILDING ANNEX |
| K | COMMUNITY BUILDING |
| L | CDRC GROWTH AND CONSOLIDATION |

- NEW COUNTY BUILDINGS
- RESIDENTIAL
- HOTEL
- FLEX SPACE/ MIXED-USE
- RETAIL

## OPTION 2

**PLACER COUNTY GOVERNMENT CENTER**
AUBURN, CALIFORNIA

0 100 200 400 800


| LEGEND | |
|---|---|
| A | HEALTH AND HUMAN SERVICES |
| B | COUNTY ADMINISTRATIVE CENTER |
| C | AGRICULTURAL COMMISSIONER AND FARM ADVISOR FACILITY |
| D | CLERK RECORDER ELECTIONS TRAINING/ WAREHOUSE FACILITY |
| E | MUSEUM WAREHOUSE FACILITY |
| F | CORPORATION YARD ADMINISTRATION AND TRAINING CENTER |
| G | SHERIFF AND PROBATION SUPPORT FACILITY |
| H | FIRE STATION 180 EXPANSION |
| I | ADMINISTRATION SERVICES IT/TELECOM/ WAREHOUSE |
| J | FINANCE ADMINISTRATION BUILDING ANNEX |
| K | COMMUNITY BUILDING |
| L | CDRC GROWTH AND CONSOLIDATION |
| | NEW COUNTY BUILDINGS |
| | RESIDENTIAL |
| | HOTEL |
| | FLEX SPACE/ MIXED-USE |
| | RETAIL |

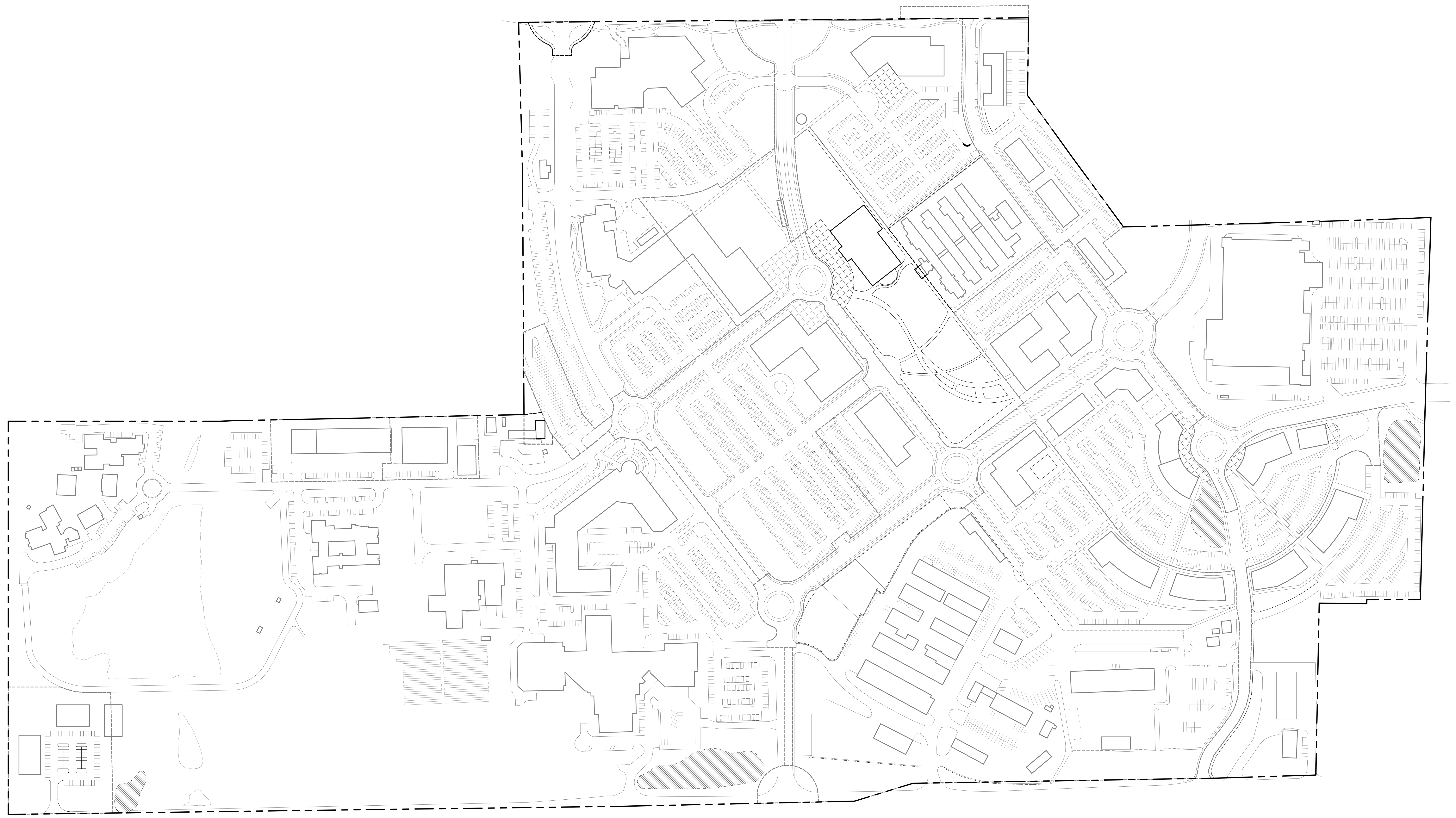
**OPTION 3**

**PLACER COUNTY GOVERNMENT CENTER**
AUBURN, CALIFORNIA

0 100 200 400 800

# Appendix C: Final Option Land Plan

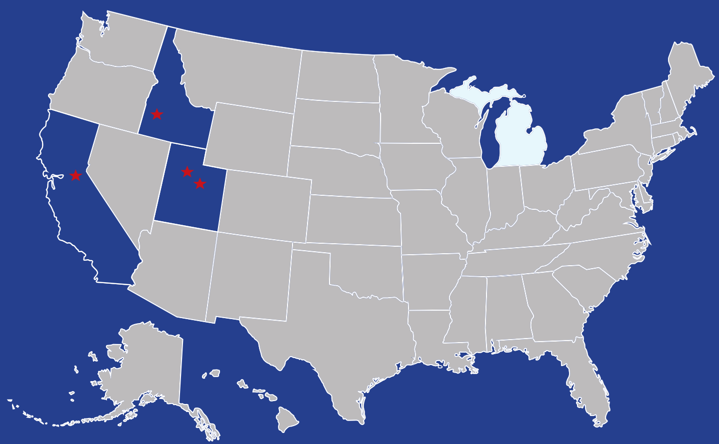
TIER 4 - NEW CONSTRUCTION



williams+paddon

ARCHITECTS + PLANNERS

10 OCTOBER 2018



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