Santa Cruz County
Flood Control and Water Conservation District – Zone 5
Draft Storm Drain Master Plan Update
2023

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List of Abbreviations

Ac	Acres
BMP	Best Management Practices
CIP	Capital Improvement Program
CIPP	Cured-in-Place Pipe Lining
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
LiDAR	Light Detection and Ranging
NAVD 88	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
SCCDC	Santa Cruz County Design Criteria
SDMP	Storm Drain Master Plan
SFHA	Special Flood Hazard Area
SLR	Sea Level Rise
UHM	Unit Hydrograph Method
USDA	United States Department of Agriculture

1 Executive Summary

1.1 Background and Context

A significant planning effort has been undertaken to help guide the Santa Cruz County Flood Control and Water Conservation District (FCWCD), County of Santa Cruz, and City of Capitola in establishing a prioritized Master Plan Improvement Program for regional systems in the Zone 5 service area, including the City of Capitola.

Three prior drainage studies have been completed for the Zone 5 area. Most recently, the Zone 5 and Zone 6 Storm Drain Master Plan (SDMP) was completed in 2013. That study sought to develop a capital improvement plan with the goal of meeting a 10-year level of service standard throughout the storm drain network. This study did not include the City of Capitola. Models developed for the prior study remain a valid tool for evaluating impacts on local systems and should also be maintained.

The study area and existing stormwater conveyance system are shown in Figure 1-1.

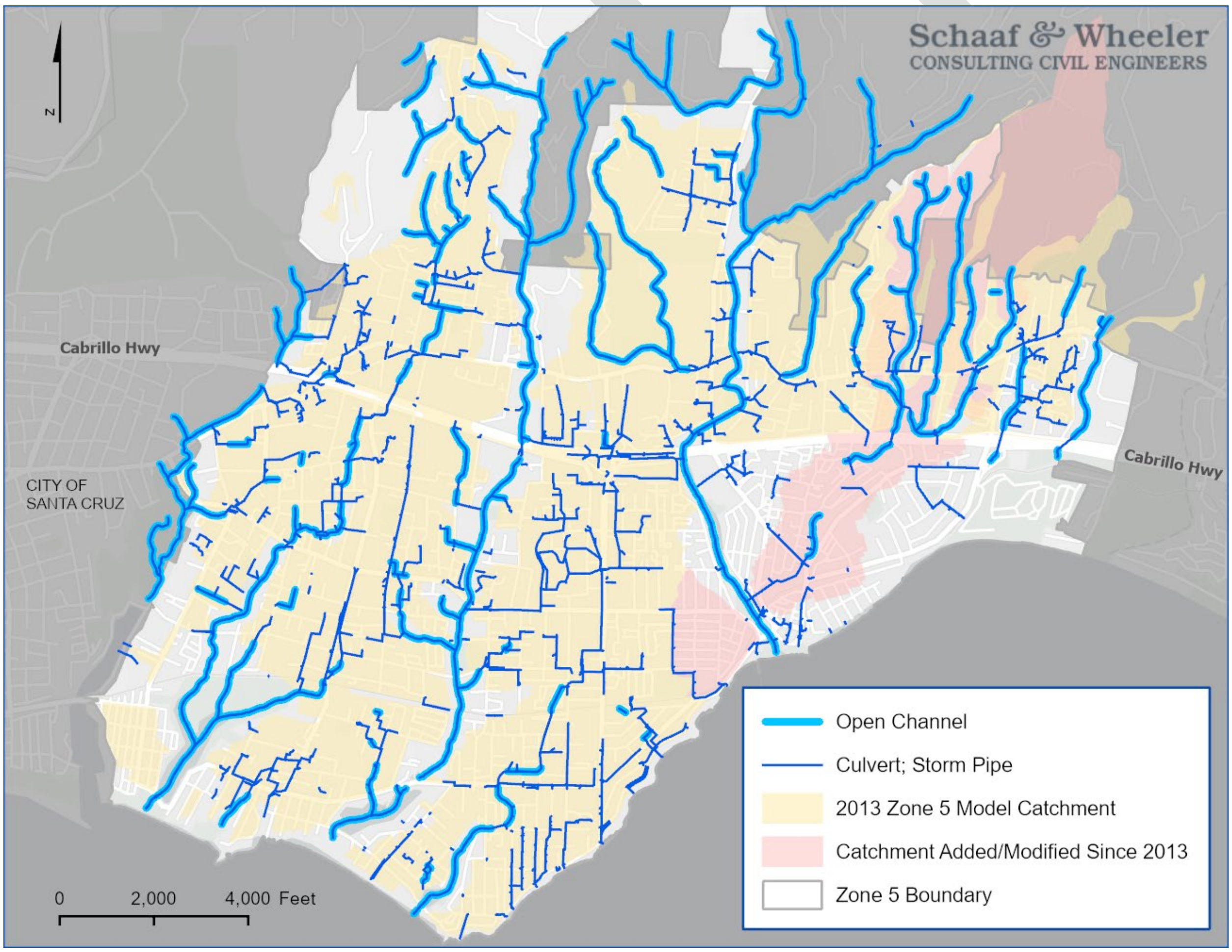

Figure 1-1: Study Area and Existing Storm Drainage System

This master plan is intended to be a planning guide for Zone 5 and is based on best readily available data and information. The recommended projects and activities should be addressed and prioritized based on life safety, potential for property impacts, funding, and public concerns. The engineering analyses performed for this study are intended to segue into design of projects which are funded. The construction design process should use more detailed improved data including surveys, utility mapping, and property/easement acquisition.

Known ownership of the drainage infrastructure has uncertainty in serval reaches. Engineering and operations analyses were completed on a watershed basis to create a comprehensive document. The proposed improvement projects and maintenance activities are not intended to imply Zone 5 ownership nor responsibility. Communication and coordination will be key elements of completing projects where system conveyance overlaps with private property.

1.1.1 Local Agency Responsibilities

Santa Cruz County, the City of Capitola and the Zone 5 Flood Control and Water Conservation District (Zone 5) work to protect local water resources by managing creeks and streams, cleaning up trash and pollution, and managing storm drains to minimize flooding. Despite these efforts, our community faces significant challenges from climate change and natural disasters, and an aging storm drainage infrastructure.

Protecting Local Beaches and Water Resources from Pollution

During a storm, rainwater is "runoff," meaning that it runs off roofs, roads, driveways, parking lots, and many surfaces, washing with it trash and pollutants, including fertilizers, vehicle fluids, pesticides, pet waste and other bacteria sources as it makes its way through storm drains and ditches – untreated – into our streams, rivers, and ocean, impacting the Monterey Bay National Marine Sanctuary. Keeping our beaches open and clean and maintaining shoreline water quality in the Sanctuary is critical for the health of Santa Cruz County residents, visitors, aquatic life, and the local economy.

Minimizing the Damaging Effects of Floods

Natural geography puts lower elevation areas of Santa Cruz County at high flood risk. The severe atmospheric rivers that occurred during the 2023 winter storm season resulted in devastating flooding and underscored the need to prepare for emergencies and to protect local, natural water resources.

Maintaining aging storm drainage systems is essential to helping prevent significant property damage in neighborhoods and loss of life during major floods.

Protecting Public Health and Long-Term Water Supplies

Public agencies in Santa Cruz County recognize the importance of effective storm drainage and watershed management to minimize flooding and protect local waterways, which are vital to the overall health of our ecosystem.

Our region’s system of storm drains, pumps, channels, pipes, culverts, outlets, and lagoons are essential to collect and manage storm runoff to protect our beaches and local waterways from pollution. Keeping these water resources safe and clean is critical to protecting both public health and local wildlife.

Upgrading and Maintaining Aging, Deteriorating Stormwater System

Much of the storm drain infrastructure in Santa Cruz County is more than 50 years old, and many channels, pipes and pumps located on both public and private properties are deteriorating. Without repairs or improvements, local communities face an elevated risk of flooding in our low-lying communities and pollution of our beaches, rivers, and other local water resources.

1.1.2 Climate Change

Climate change impacts on sea-levels and precipitation are addressed to gage future system needs. Capital projects cost presented in this report are based on existing deficiencies and construction costs. Climate adaptation and resiliency should be incorporated into each project as they are funded and designed.

This document does not consider coastal protection needs (e.g., erosion protection, armoring, flood walls, or levees). With a focus on interior drainage systems, the implications of sea level rise (SLR) are contemplated. However, a regional scale solution may be required for coastal protection as well to develop greater resilience against a broader array of climate hazards. This is beyond the scope of this analysis.

1.2 Study Objective

This storm drainage study builds on prior analysis in the Zone 5 service area with a narrower focus on meeting a 25-year level of service standard for regional systems consisting of closed conduits and open drainage ditches. The study looks at the 100-year conveyance of the major creek systems, including Rodeo Creek Gulch, Arana Gulch, Soquel Creek, and Noble Creek. This study includes the City of Capitola, which was not studied in the 2013 report. Regional facilities include “backbone” closed-conduit systems and open channels where stormwater concentrates from local systems.

The basic objective of this study is to identify capacity issues and project alternatives to mitigate flooding on the regional system.

The tasks completed as part of this study include:

- A condition assessment of various system elements, including pipe systems, open conveyances, and culverts;
- Collection of field data to supplement GIS data for building an existing conditions model of the storm drainage network;
- Examination and refinement of existing drainage area delineations;
- Assessment of the performance of existing regional storm drainage systems;
- Identification of capital improvement alternatives to reduce flood risk;
- Estimation of project costs for the Capital Improvement Program (CIP);
- Development of an Operations and Maintenance (O&M) Program; and
- An evaluation of funding strategies to implement the CIP.

This study applies the same methodologies as the 2013 study to develop hydrologic and hydraulic models of the regional pipe and open conveyance systems. The 2013 study models remain valid tools for evaluating system capacity as needed, in conjunction with other Zone 5 infrastructure projects for development and redevelopment. The two models should be used hand-in-hand when possible, with the wider system model used to evaluate localized capacity and impacts, and the updated regional system model developed for this SDMP to be used for those projects and changes expected to impart wider system impacts.

1.2.1 Regional Stormwater Coordination

Prior master planning efforts including Zone 5 did not include areas within the City of Capitola's boundaries. Runoff from portions of Zone 5 outside of Capitola drain into the Noble and Soquel Creeks, which impacts regional drainage systems within Capitola. The City of Capitola has provided funding to support this effort and includes these previously excluded areas in this analysis. Historical drainage issues are well known and recorded in Noble Gulch in particular. These capacity issues, as well as an evaluation of the condition of these systems, are addressed in this report.

This SDMP primarily forms a guide for addressing regional system capacity issues. However, municipal stormwater management is a multi-faceted endeavor requiring both inter- and intra-jurisdictional coordination. Consideration must be given to the impact of new capital assets (CIP), finances, O&M, and regulatory compliance (the Central Coast Regional Water Quality Control Board [RWQCB] National Pollutant Discharge Elimination System [NPDES] Permit).

1.3 Evaluation

This study utilized and further developed InfoSWMM models for Zone 5 built for prior studies. These models include subcatchment hydrology (rainfall-runoff) and conveyance system hydraulics (dynamic wave routing).

Detailed review, field investigations, analysis, and modeling of the area's storm drainage system led to several conclusions. We used these conclusions to recommend improvements to the system intended to reduce flood risk for Zone 5's regional systems.

The recommended improvements are considered planning level and based on currently available information. Detailed project designs will ultimately require more data, including utility locations and any necessary geotechnical information.

We evaluated the current physical condition of the drainage system using pole-mounted camera topside observations. Based on the observed condition during topside investigation, specific reaches were identified for a more detailed CCTV inspection. Most of the observed system is in good condition. However, there are reaches with heavy debris and sediment accumulation.

1.4 Capital Improvement Recommendations

This study includes a CIP based on model results and suggested improvements. Capital projects recommended in this document to address capacity and condition deficiencies are estimated to cost between approximately $37 million and $63 million in 2023 dollars. A range of costs is provided, as for certain projects, multiple alternatives are identified. The actual value of the improvements will ultimately depend upon the final design of each project, which could vary based on several factors, including whether systems are replaced or augmented with new, parallel systems.

It is important to remember that in addition to design and construction, California Environmental Quality Act (CEQA) must be satisfied for any capital improvement project described in this report that may be implemented in the future through the preparation of an appropriate Environmental Impact Report (EIR), Mitigated Negative Declaration (MND), or determined to be categorically excluded.

While projects within public right of way are often preferred, capital improvements identified in this document do pass through privately owned properties in some locations, which may limit feasibility. A summary of estimated costs by priority are summarized in Table 1-1.

Table 1-1: Approximate Cost Ranges of Capital Improvements by Priority

Priority	Description	Approximate Cost
High	High magnitude, high impact flooding where heavy erosion and property damage pose major risk; Urgent repairs or replacement of existing system in very poor condition	$22,760,000 - $47,760,000
Medium	Moderate magnitude flooding with relatively extensive impact on regional and local systems, posing some risk of property damage or erosion; Repair or replacement of existing system in poor condition	$7,320,000 - $7,730,000
Low	Low magnitude flooding with relatively low impact on regional and local systems and little risk of property damage or erosion; Low priority repairs	$7,560,000

1.5 Operation and Maintenance Program

Schaaf & Wheeler's subconsultant, NCE, reviewed the County and City of Capitola existing O&M programs and evaluated the storm drain system maintenance needs. A maintenance plan was developed for the County and City to provide recommendations for asset inventory, analysis and forecasting, work program actions, and tracking and reporting. Associated costs for implementing these recommendations were also developed as part of the funding and financial plan.

1.6 Funding and Financial Plan

Schaaf & Wheeler's subconsultants, NCE and NBS, worked together with information contained in this SDMP to develop a funding and finance plan that includes funding the recommended O&M and CIP projects within this report, as well as remaining compliant with NPDES Permit Requirements handed down by the State. Costs of implementation are subdivided into four categories: Capital Improvements, Operations and Maintenance, NPDES Permit Compliance, and Program Management. The breakdown of these costs across Zone 5, County of Santa Cruz, and the City of Capitola is shown in Figure 1-2.

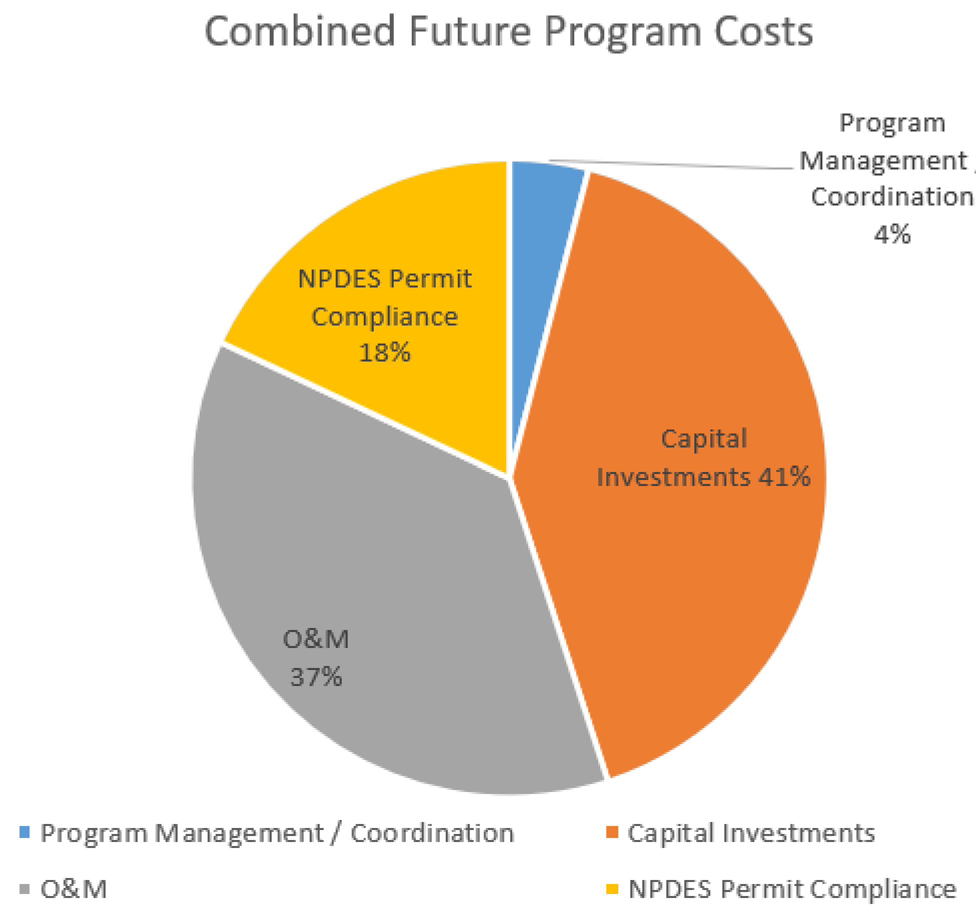

Figure 1-2: Funding Requirements for Stormwater System O&M, Capital Improvements, and Management Across Zone 5 and the City of Capitola

1.7 Conclusion

This storm drain system analysis provides a tool for agency staff to use in their efforts to reduce both nuisance flooding and the likelihood of more serious stormwater-related hazards to private and/or public property in Zone 5 and City of Capitola communities. This study and capital improvement alternatives are merely the conceptual starting point since funding sources for design and construction have yet to be determined.

Once funding sources have been secured, we anticipate that the County, the City, the Zone 5 Flood Control District, and/or their consultants will perform more detailed studies and alternatives analyses to identify the most affordable and effective capacity and condition improvement projects. It is expected that this will require information gathered as part of the design process, including more detailed topography, utility conflicts, available easements and rights-of-way, construction impacts, permitting needs, and long-term O&M. This report ventures to consider these factors in developing an alternatives analysis for various improvement strategies. However, more detailed information will always provide the best tool in making informed decisions.

2 Introduction

2.1 Overview

This document provides a capacity analysis and condition assessment of existing storm drain collection systems, a discussion of drainage design standards, and recommended improvement projects to reduce the risk of flooding for regional facilities with estimated costs within Zone 5.

This analysis should be used to guide local agency staff in planning, financing, engineering, and maintaining the regional storm drain infrastructure. Each chapter of this report is intended to identify problems, manage resources, and provide cost-effective and comprehensive solutions.

This chapter provides a general discussion of drainage and flood management systems and issues currently affecting the community. It also describes the objectives of this analysis, explains the criteria used to evaluate storm drain system performance, and presents a summary of the data collected to support this effort.

2.2 Setting

The study area encompasses portions of multiple jurisdictions within Santa Cruz County, including incorporated Capitola, and unincorporated areas to the west and north. The drainage area is situated adjacent to Monterey Bay to the south and the City of Santa Cruz immediately to the west. A vicinity map showing the boundary of Zone 5 overlain with jurisdictional boundaries and regional drainage systems is provided in Figure 2-1.

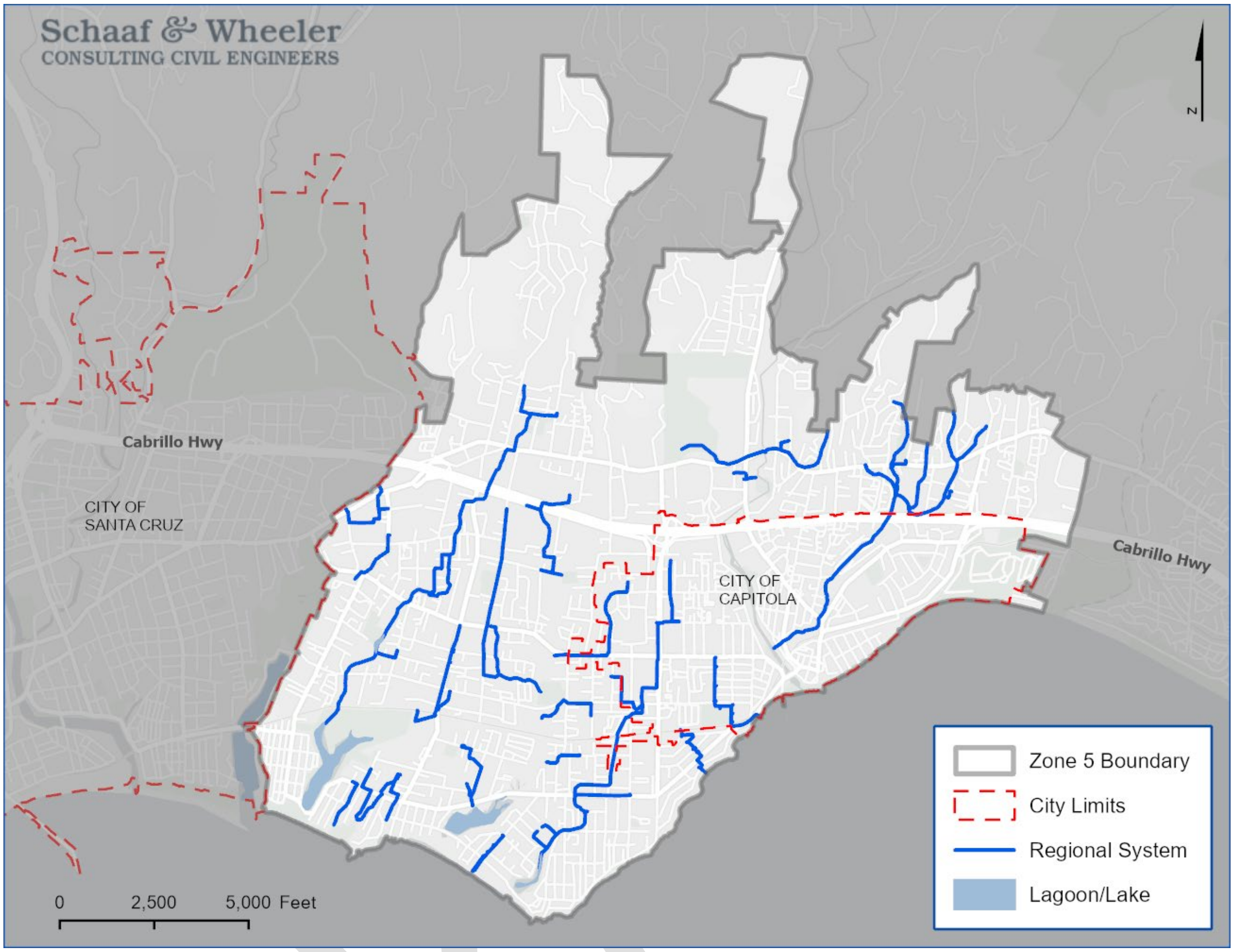

Figure 2-1: Santa Cruz County Zone 5 Vicinity Map

The study area rests at the base of the Santa Cruz Mountains. Urban systems consisting of a mix of closed-conduit and drainage ditches generally drain higher ground into creeks and lagoons that attenuate and convey runoff to Monterey Bay.

Land use within Zone 5 is predominantly urban, with a mix of commercial and residential land cover and ranges in elevation from 0 to approximately 700-feet on the North American Vertical Datum of 1988 (NAVD 88). The study area, defined by the drainage area to the existing regional stormwater conveyance systems, covers an area of approximately 4.5 square miles (Figure 2-4 shows the area served by the regional conveyance systems).

Three creeks receive drainage from these systems. Their drainage areas cover a larger area, including drainage from upstream of the study area and from local pipe systems that were previously studied but not included in this modeling effort. Arana Gulch, Rodeo Creek, and Soquel Creek convey drainage through Zone 5 from a total area of 3.5 square miles, 3.0 square miles, and 42.5 square miles, respectively. These larger drainage areas are shown in Figure 2-2.

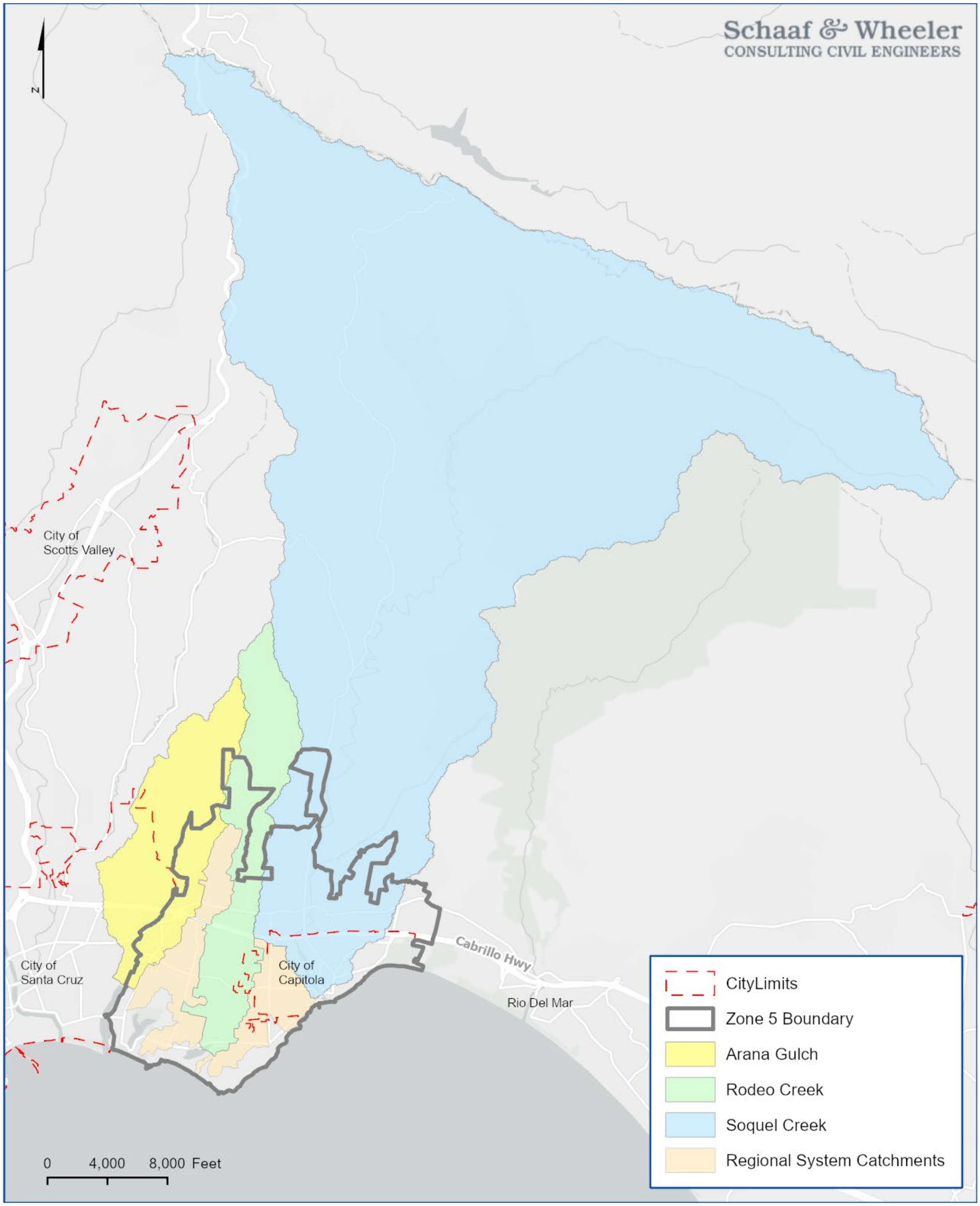

Figure 2-2: Major Creek Drainage Areas

The low-lying portions of the area to the south rest in, or adjacent to, the FEMA-defined coastal Zone VE Special Flood Hazard Area (SFHA). Other SFHAs defined within Zone 5 include Zone A, Zone AE (with and without Floodways) and Zone X, primarily centered around creeks and lagoons. Flood hazard areas in the vicinity of the Zone 5 area are shown in Figure 2-3.

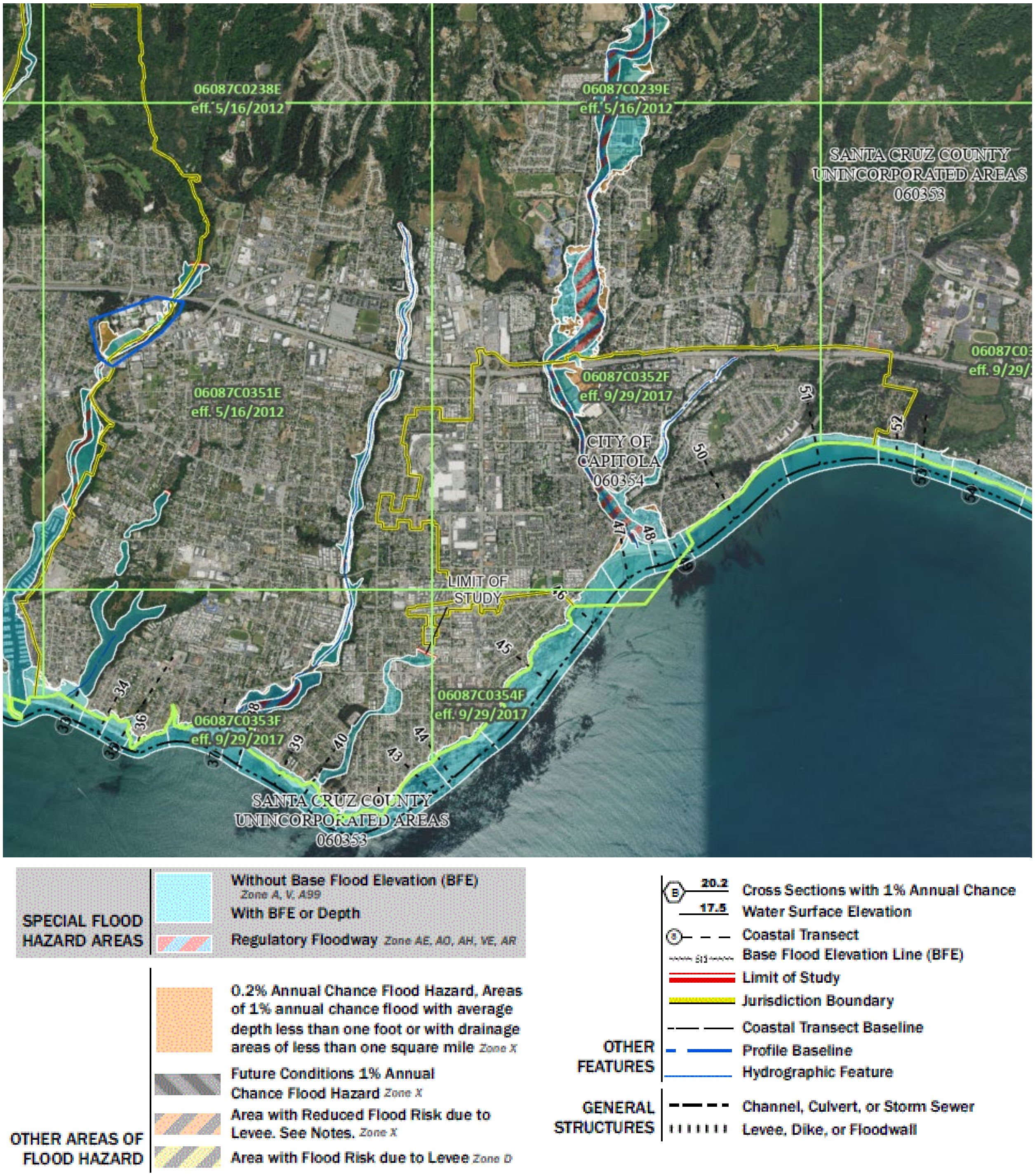

Figure 2-3: FEMA Special Flood Hazard Areas in the Vicinity of Zone 5

2.3 Climate

The Zone 5 study area generally experiences a mild year-round climate, with warm, dry summers and wet winters. Proximity to the Pacific Ocean results in small daily and seasonal temperature ranges with high relative humidity. The coastal region at the base of the Santa Cruz Mountains also experiences frequent fog and low overcast conditions.

The average annual high temperature is approximately 70°F, and the average annual low temperature is approximately 48°F. Most of the rainfall occurs during fall and winter months of October through April (NOAA[1]). Mean annual precipitation (MAP) depth varies across the County, with higher elevations in the mountains experiencing generally greater depths due to orographic uplift effects.

Within Zone 5, MAP varies from approximately 30 to 36 inches per year. Countywide, MAP varies from 20 inches per year at low elevations near the southern boundary with Monterey County up to 56 inches per year at higher elevations in the mountains (California-Nevada River Forecast Center[2]). The average for the nearby Santa Cruz climate station is about 31.4 inches per year (representative of the low-lying urban areas).

The topography of the Santa Cruz Mountains to the north and exposure to Pacific weather systems to the south and west has a defining influence on precipitation patterns in Santa Cruz County. Precipitation events are dominantly orographic, since moist air is lifted over the mountains and then cools and condenses, or cyclonic, where rain is caused by air mass movement from higher barometric pressure regions to lower pressure. Cyclonic events can also be caused by frontal activity. Warm fronts are generally associated with broad bands of low-intensity rainfall, while higher rainfall intensities are typical of cold fronts (Western Regional Climate Center[3]).

This study also considers the potential impacts of climate change on the stormwater systems. Anticipated regional and local changes in seasonal precipitation and storm characteristics are available in published research and climate prediction tools provided by the EPA and Cal-Adapt. This study evaluates the impacts of climate change by increasing the overall depth of the 25-year design storm event to reflect those published predictions.

2.4 Existing System

Runoff generated by precipitation within the Zone 5 area is conveyed through a system of pipes, open ditches, and creeks. All runoff captured by the drainage system ultimately discharges to Monterey Bay, though some is stored in lagoons near the coastline. The study area and existing stormwater conveyance system are shown in Figure 1-1.

Drainage systems within Zone 5 encompass a network of open channel conveyance (e.g., ditches and creeks), inlet structures, and storm drain pipes. The area drains to 20 distinctive, contiguous regional subsystems. These areas can be grouped into eight larger regions by receiving body. These regions drain to three creeks (Arana Gulch, Rodeo Gulch, and Soquel Creek), four Lagoons (Schwan, Corcoran, Moran, and Bonita) and directly to the Monterey Bay, as shown in Figure 2-4.

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[1] https://www.weather.gov/wrh/climate?wfo=mtr
[2] https://www.cnrfc.noaa.gov/?product=QPEWYNormal&zoom=11&lat=37.107&lng=-122.081&PNGtypeID=QPEWYNormal
[3] https://wrcc.dri.edu/Climate/narrative_ca.php

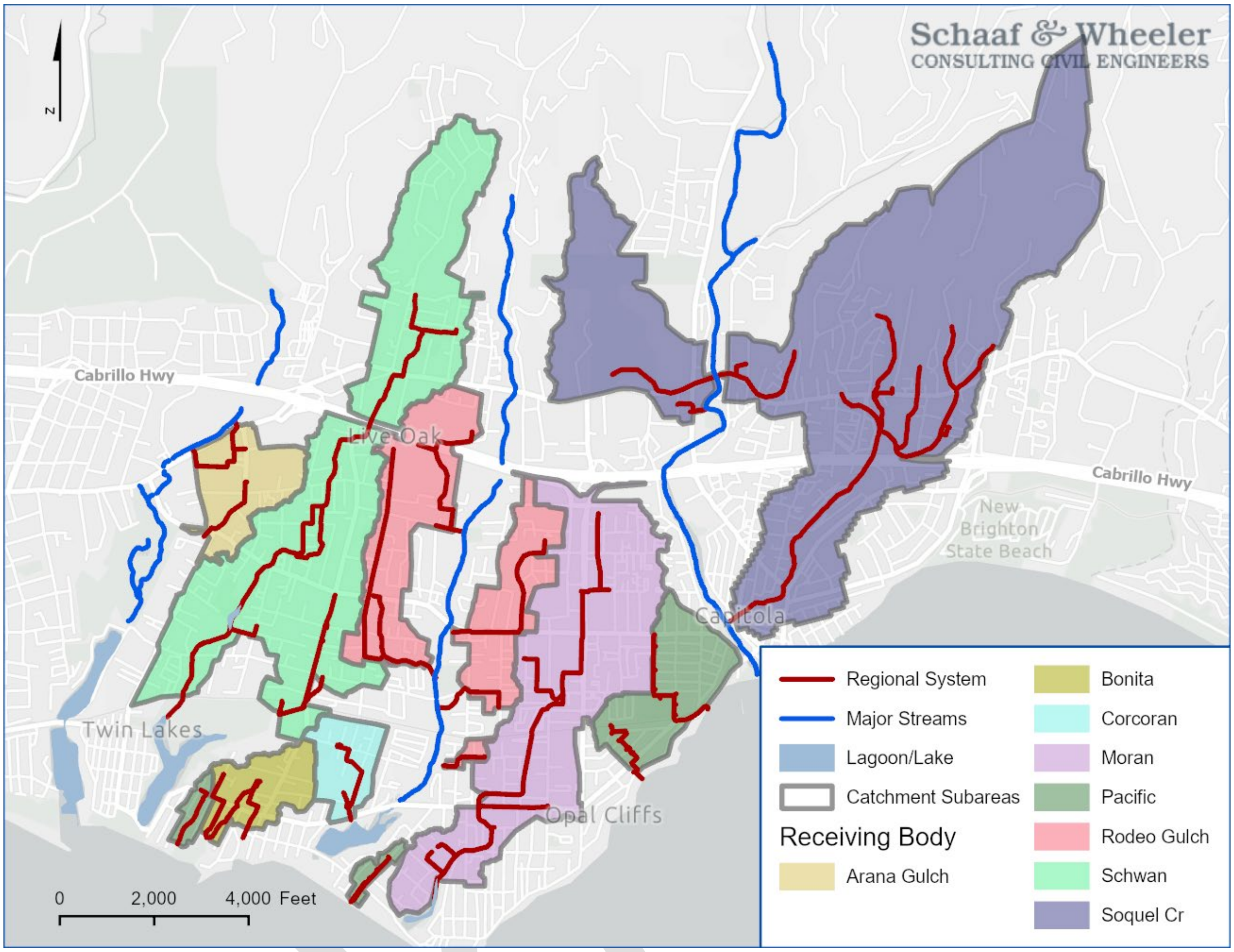

Figure 2-4: Catchments Grouped into Drainage Regions by Receiving Body

As further development and redevelopment occurs in Zone 5, Santa Cruz County, and the City of Capitola, runoff patterns will be impacted. Some developments will be subject to the requirements of the NPDES permit, while smaller-scale projects may not be. It is difficult to anticipate the exact impact of land use change on storm drainage systems and floodplains. Emphasis and incentivization of higher density development and increased housing availability and affordability further complicates this effort, but available data can be used to estimate the impacts on some level.

Existing storm drainage facilities must evolve with population and land use change, and this SDMP provides some tools to prepare for and respond to those changes as they occur. This may include case-by-case impact analysis on pipe systems, drainage channels, and floodplains, or feasibility analysis for regional detention or recharge facilities.

2.5 History of Drainage Issues and Flooding

A history of natural disasters, including flooding, is well documented within Santa Cruz County and its incorporated cities. Flooding is documented as far back as 1871 – 1872, when the Santa Cruz Mission, in the San Lorenzo River's floodplain, was destroyed in its first year of existence.

The December 1955 Christmas Floods are documented as the highest historic flooding in the area, though 90% of the damage caused by the event occurred within the City of Santa Cruz and its downtown area. Although, on Soquel Creek, a peak flow rate of over 15,000 cfs destroyed the Soquel Bridge.

In 1982, flooding due to a roughly 30-year event in Santa Cruz County killed 22 people, injured 50 others, and destroyed several homes and businesses, with damages reaching over $100 million in total[4]. During the 1982 event, a log jam formed at the reconstructed Soquel Drive bridge and the creek overflowed its banks. According to eyewitness accounts, the event flooded the Old Mill Mobile Home Park, followed within hours by Downtown Soquel, with floodwaters reaching up to 5 feet in depth.

Most recently, the storms of 2022 – 2023 caused a wide range of damage throughout the County and incorporated areas within. In the northern areas of the County, in the Santa Cruz Mountains, landslides and downed trees caused blockage and damage on highways (including Highways 1, 9, and 17) and other roads, requiring closure during cleanup and repairs.

Widespread high flows in streams tributary to the major creeks and rivers washed out culverts, and bridges including: the Bates Creek culvert crossing at North Main Street (within Zone 5), as well as large crossings on Redwood Loge Road and China Grade Road. In many locations, these failures washed out all lanes of the crossing roadway and stranded a number of residents for an extended period of time.

Soquel Creek also overflowed its banks near the Soquel Drive bridge, causing flooding of the Old Mill Mobile Home Park, Porter Street, and surrounding businesses. During that storm, Soquel Creek registered a flow rate of 9,310 cfs, exceeding an estimated 25-year return period based on stream gage statistics. That event also produced a peak flow of very nearly the same magnitude as the 1982 flood (9,700 cfs).

In Capitola, Pacific Ocean waves destroyed a large section of the Capitola Wharf, while high stage and wave propagation along Soquel Creek caused extensive damage to restaurants and other infrastructure along the Creek's banks.

Historically, both Soquel and the City of Capitola have primarily been affected by flooding from Soquel Creek, which impacts low-lying areas within its floodplain. However, Noble Creek and Tannery Creek floods occurring in March 2011 caused extensive flooding and damage in the City of Capitola. During the 2011 flood event, a large storm drain pipe failed in Noble Gulch, destroying portions of Pacific Cove Mobile Home Park and releasing impounded flood waters downstream. Subsequently, the Mobile Home Park was closed, its tenants were nearly entirely relocated, and the property was converted to a parking lot (Santa Cruz Sentinel).

Photos of various flood events and damages are shown in Figure 2-5.

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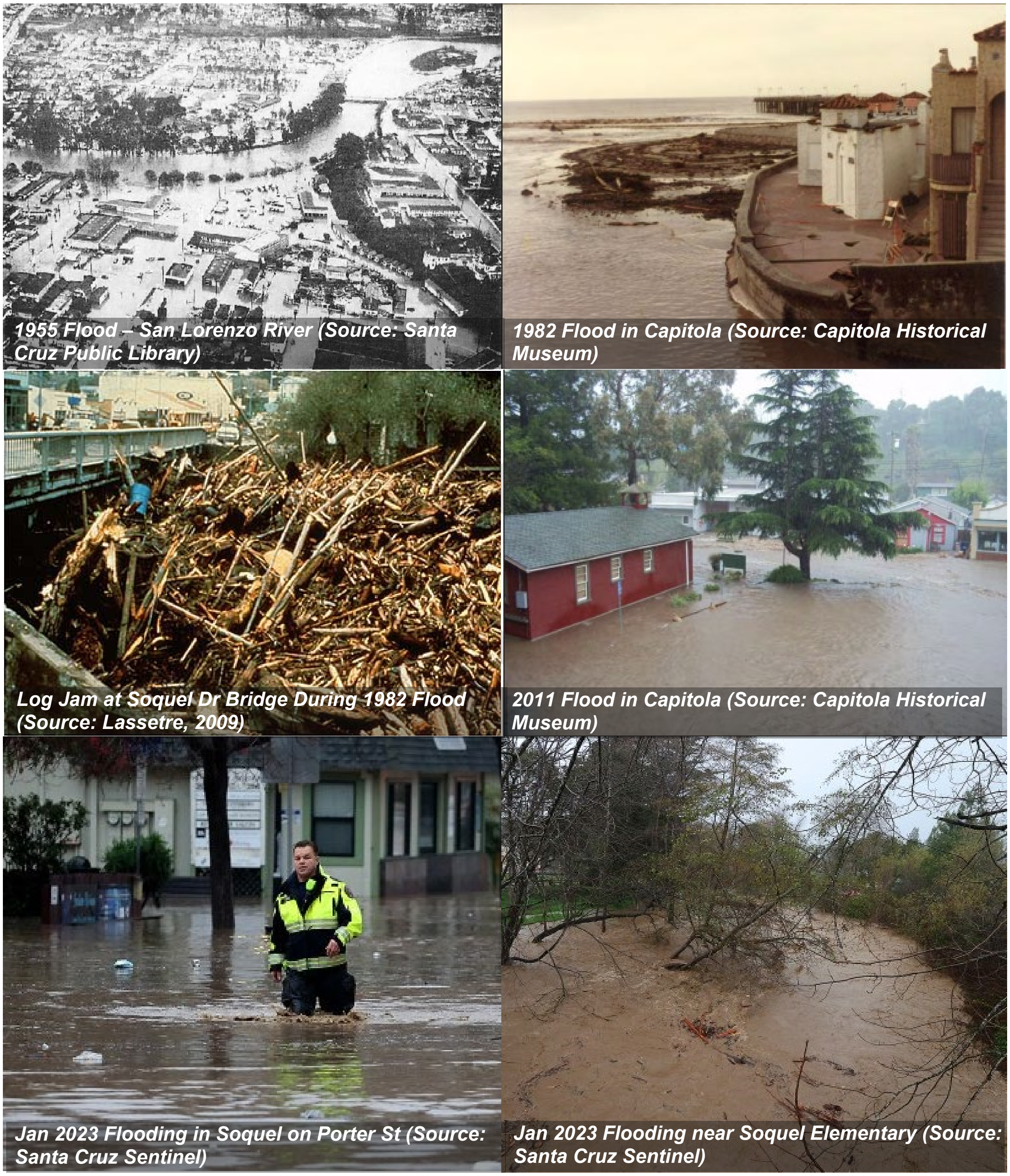
[4] Santa Cruz Public Libraries. *The Nature and History of Flooding in Soquel Village*. Accessed October 2023. https://history.santacruzpl.org/omeka/files/original/f127e52f2fc2073f773c61a6336186fd.pdf



1955 Flood – San Lorenzo River (Source: Santa Cruz Public Library)

1982 Flood in Capitola (Source: Capitola Historical Museum)

Log Jam at Soquel Dr Bridge During 1982 Flood (Source: Lassetre, 2009)

2011 Flood in Capitola (Source: Capitola Historical Museum)

Jan 2023 Flooding in Soquel on Porter St (Source: Santa Cruz Sentinel)

Jan 2023 Flooding near Soquel Elementary (Source: Santa Cruz Sentinel)

Figure 2-5: Photos of Historical Flooding in Santa Cruz County and City of Capitola

3 Data

3.1 Data Sources

Schaaf & Wheeler reviewed and used readily available land use, topographic, geological, geographical, and storm drain system data within the study area. Available data, while mostly complete, had some missing or incorrect information.

The existing set of models was updated to reflect improved information and ensure that elevations in the model are on a fully unified datum (the North American Vertical Datum of 1988). Fieldwork was conducted to update missing information and collect additional information on the regional storm drain system to supplement existing GIS databases.

Engineering judgment and assumptions were used to complete remaining data gaps. This chapter summarizes the findings and data acquired as part of this storm drainage study. It also summarizes data limitations, assumptions, and impacts.

3.1.1 Topography and Aerial Imagery

All project data and results are in US units on the NAVD 88 and the State Plane California Zone III coordinate system.

Schaaf & Wheeler created a digital elevation model (DEM) covering the Zone 5 drainage area with available FEMA 2017 Region 9 LiDAR data to aid in developing the hydrologic and hydraulic models for the system analysis. The DEM provides elevations on a continuous grid with a 3-foot resolution on the NAVD 88.

This updated topographic dataset was used to improve the 2012 model data. An updated ground surface elevation was applied to all nodes in the regional system using GIS tools to extract values from the DEM. Invert elevations from the previous model were then updated as well to maintain node depths based on measurements and proper pipe cover throughout the model.

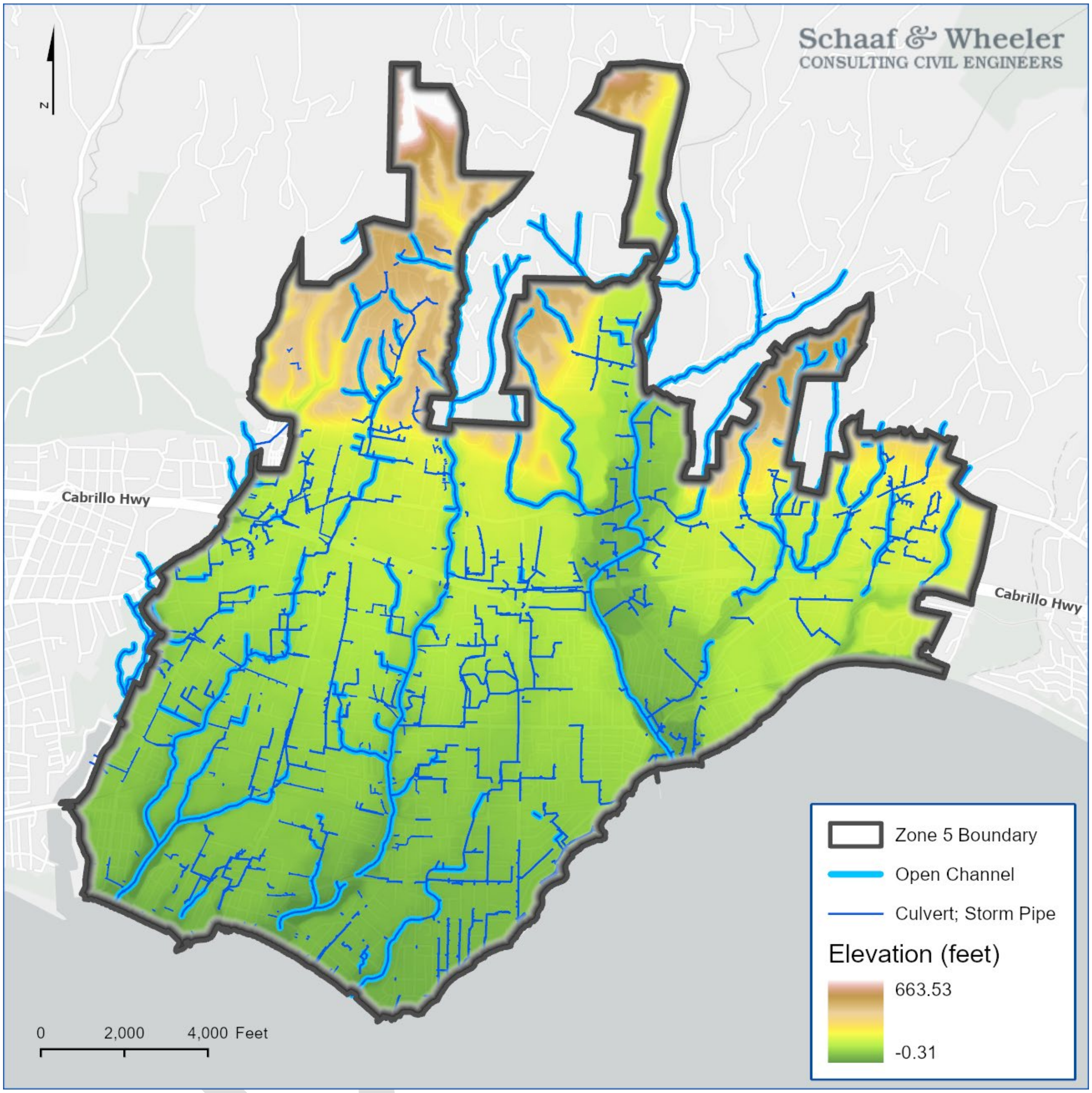


Figure 3-1: FEMA 2017 Region 9 LiDAR DEM in the Vicinity of Zone 5

3.1.2 GIS Data

Santa Cruz County and the City of Capitola provided available GIS data representing storm drain nodes (e.g., inlets, manholes, and outfalls) and storm drain links (e.g., pipes, culverts, and open channels) to Schaaf & Wheeler in GIS formats (e.g., .gdb, .shp, etc). Initial data included:

- Pipe locations and lengths;
- Node types and locations (Drain Inlet – DI, Catch Basin – CB, Outfall – O);
- Location of outfalls;
- Depth at approximately 64% of model nodes (344 out of 539); and
- Sizes for all pipes.

The storm network elements were placed in GIS software, then the regional systems (pipes 36-inches and larger in diameter) were isolated. Schaaf & Wheeler identified missing data as well as items in need of verification. Information needed to refine regional system models included:

- Verification of pipe diameters;
- Measurement and documentation of open channel and culvert physical properties; and
- Node depth and rim elevations.

The County GIS included ground surface elevations from prior efforts and GIS datasets. However, the more recent LiDAR was used to verify surface elevations, aid in assigning properties to open channel systems, and develop projects where new storm drainage structures are required. We also used aerial imagery available in ArcGIS to evaluate related data, such as road networks, land use, and the extent of water bodies.

Schaaf and Wheeler conducted field visits in January 2021 to document system condition and collect information, including:

- Structure type (manhole, catch basin, etc.)
- Incoming/outgoing pipe diameters and materials
- Structure and pipe invert depth(s)
- Debris accumulation status (by percentage of depth)
- Depth of standing water
- Priority of maintenance or replacement need
- Whether the pipe required CCTV for further evaluation
- Any other relevant notes

System depths were verified at 128 locations, including four that previously had no data available. These were updated or added to the GIS. Some system nodes occurring along open channel segments or in the vicinity of culverts were missing inverts. These were estimated from the same LiDAR data set used to assign ground surface elevations where possible. Inverts were approximated at the ends of the modeled system based on surrounding node inverts, pipe slopes, and minimum pipe cover of three feet. This enabled the use of interpolation tools within the model to fill in missing invert elevation data throughout the system. These interpolated inverts were checked in profiles to ensure a sensible result, with positive pipe slope and pipe cover. Where interpolation tools produced apparently incorrect inverts, they were corrected manually and nearby nodes were re-interpolated as necessary.

The entire storm drain system was used in prior studies to delineate drainage areas to the regional system. Since this study focuses on regional systems, subcatchment areas from prior studies were aggregated into larger catchment areas tributary to those regional conveyance elements. The regional system and associated drainage catchments modeled in InfoSWMM are shown in Figure 3-2. The figure overlays regional catchments on those modeled in the 2013 SDMP for reference.

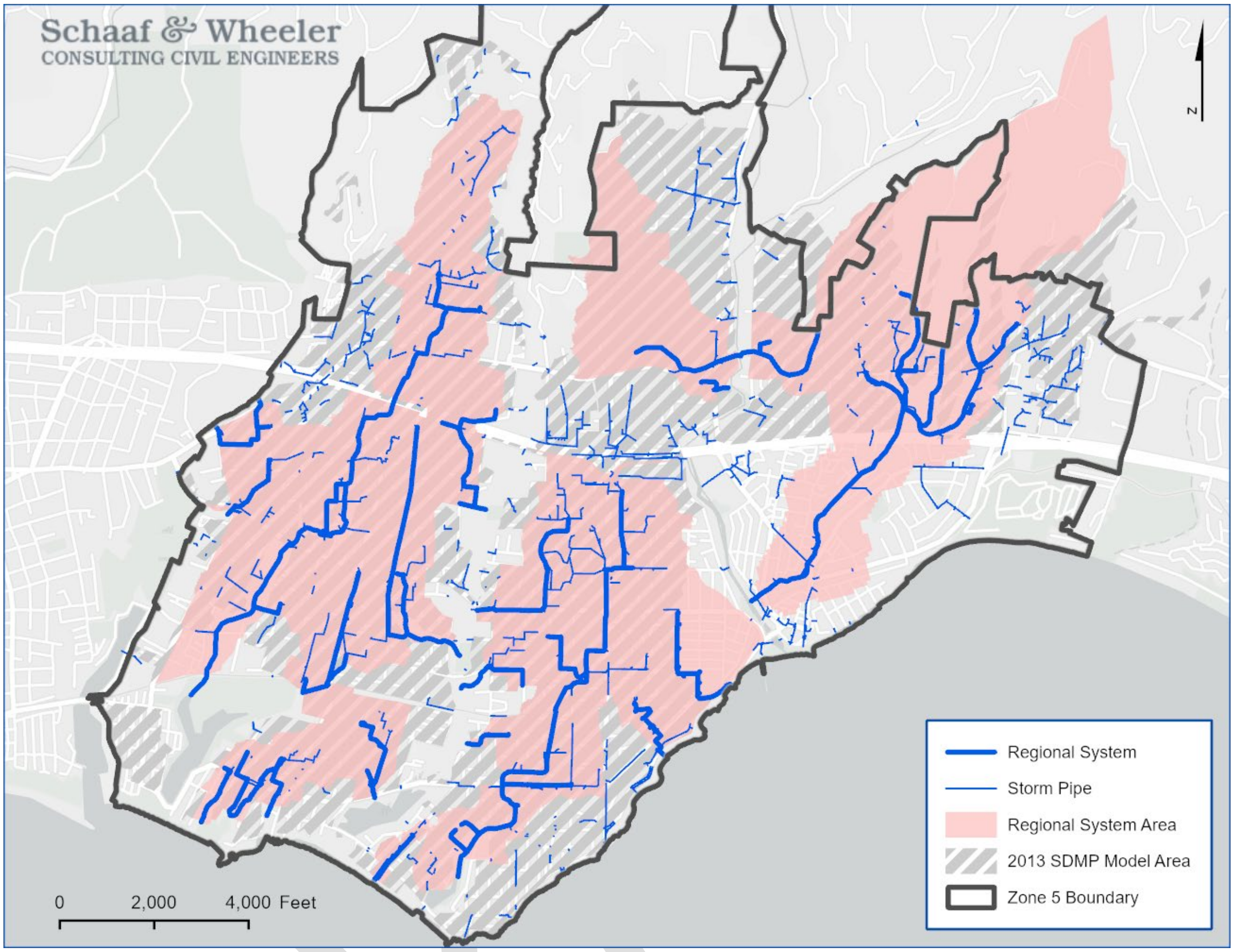


Figure 3-2: Zone 5 Storm Drainage Network

Some areas from prior studies do not drain to larger regional systems modeled in InfoSWMM. Instead, they drain either directly to a major creek, lagoon, or ocean. These areas have been removed from the InfoSWMM models. Drainage from each catchment is routed by the model directly into its respective regional system.

Catchments were also delineated for areas not included in prior plans. These areas include those within the City of Capitola (approximately 0.3 square miles) and those areas draining into Noble Creek from the north (approximately 0.7 square miles).

Other GIS data collected for this planning effort includes land cover and soil characteristics, two essential factors in the development of a hydrologic model. Land use data was defined based on a combination of Santa Cruz County and City of Capitola parcel information obtained in GIS shapefile format. Soils information was acquired from the United States Department of Agriculture (USDA) Web Soil Survey system.

3.1.3 Field Data Collection and Inspection

The process of collecting field data and inspecting system condition began with a review of existing GIS, previous studies, as-built drawings, and aerial imagery to identify missing information vital to the SDMP development process. Field data collection included relevant model attributes, including open channel dimensions, pipe depth from the ground surface, pipe sizes, materials, maintenance issues, and condition assessment.

For the pipe system, the condition assessment started with the use of a pole-mounted camera to get a clear image of the pipe from access points (manholes, inlets, outfalls, etc.). Any pipes that were difficult to access or appeared to require more detailed inspection were further assessed with CCTV.

Conditions assessed for pipe systems were:

1. Signs of high or standing water
2. Infrastructure damage (concrete spalling or cracking, failing metal, etc.)
3. Debris or sediment accumulation
4. Depth and pipe material

For open conveyances and culverts, staff utilized cameras to document the condition of approximately 13 miles of open conveyance channels. Photos were geocoded and compared to those collected for the 2013 study.

Conditions documented and assessed for open channels included:

1. Channel erosion, debris, or sediment deposition, and vegetation
2. Channel shape (bottom width, depth, top width)
3. Channel material (natural, concrete lined, etc.)
4. Signs of damage or high water
5. Hydraulic obstructions (dams, weirs, structures, other blockages, in channel)

Culverts were assessed using a hydraulic field sheet to document parameters such as culvert size, headwall conditions, and bridge deck properties. Conditions affecting culvert capacity were documented with photos as required. After an initial topside inspection of the system, 59 system elements were identified for additional CCTV inspection. These elements are shown in Figure 3-3.

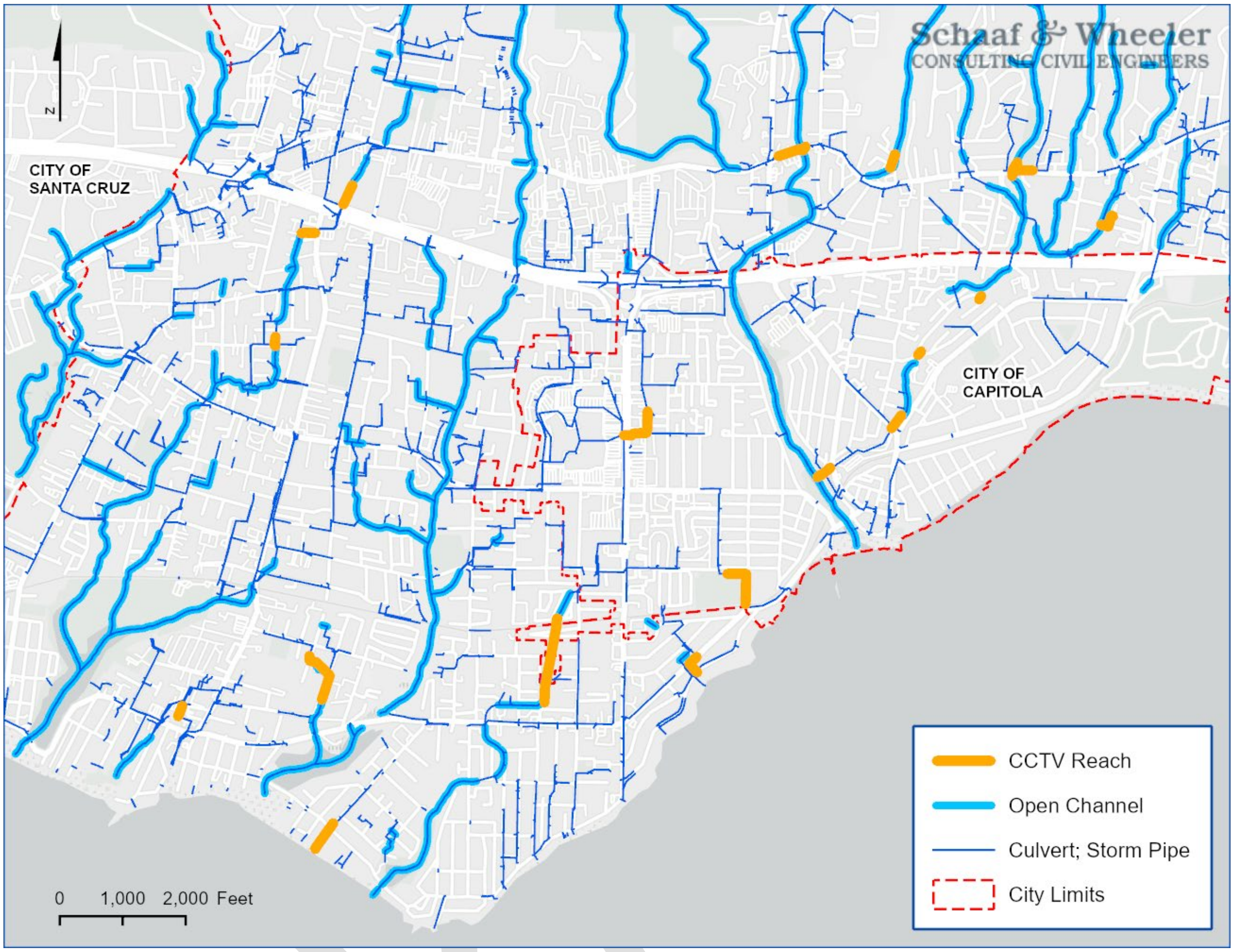


Figure 3-3: Map of Conduit, Culverts, and Open Channel Where CCTV Inspection was Performed

From field data, photos, and CCTV video, a conditions assessment geodatabase was developed. Regional facilities that were examined during the field data collection period were assessed using two scales. The National Association of Sewer Service Companies (NASSCO) ratings system was applied to pipes, while two ratings were applied to open conveyances – one for environmental condition (scour, erosion, trash accumulation, illegal dumping, vegetation, etc.) and one for hydraulic capacity (obstructions, sedimentation, debris).

3.2 Land Use Data and Runoff Characteristics

3.2.1 Land Cover

Raw zoning data consisted of approximately 150 different land use types. These were reclassified into 14 categories for the purposes of this analysis. These categories sufficiently represent variability in imperviousness and land use impact on rainfall runoff characteristics.

Current land use derived from County Assessor parcel information is shown in Figure 3-4.

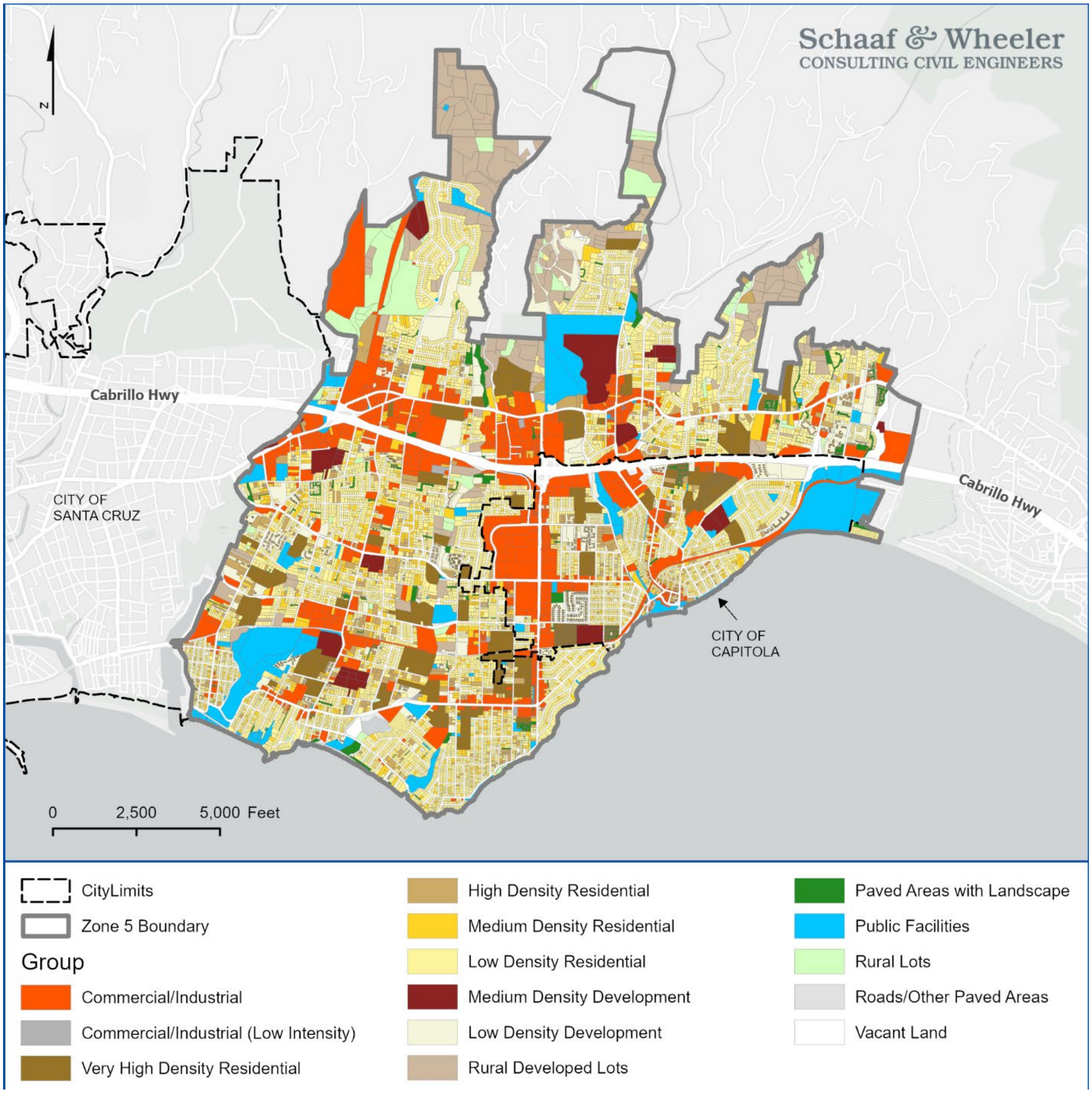


Figure 3-4: Existing Land Use Information Used in the Development of the Hydrologic Model

The data was used to verify and update hydrologic parameters from prior studies to reflect conditions affecting existing hydrology as accurately as possible.

Future condition land cover was modified based on County and City zoning data, which is assumed to better represent future development potential across the model areas. Zoning data classified to match curve number tables presented in this report is shown in Figure 3-5

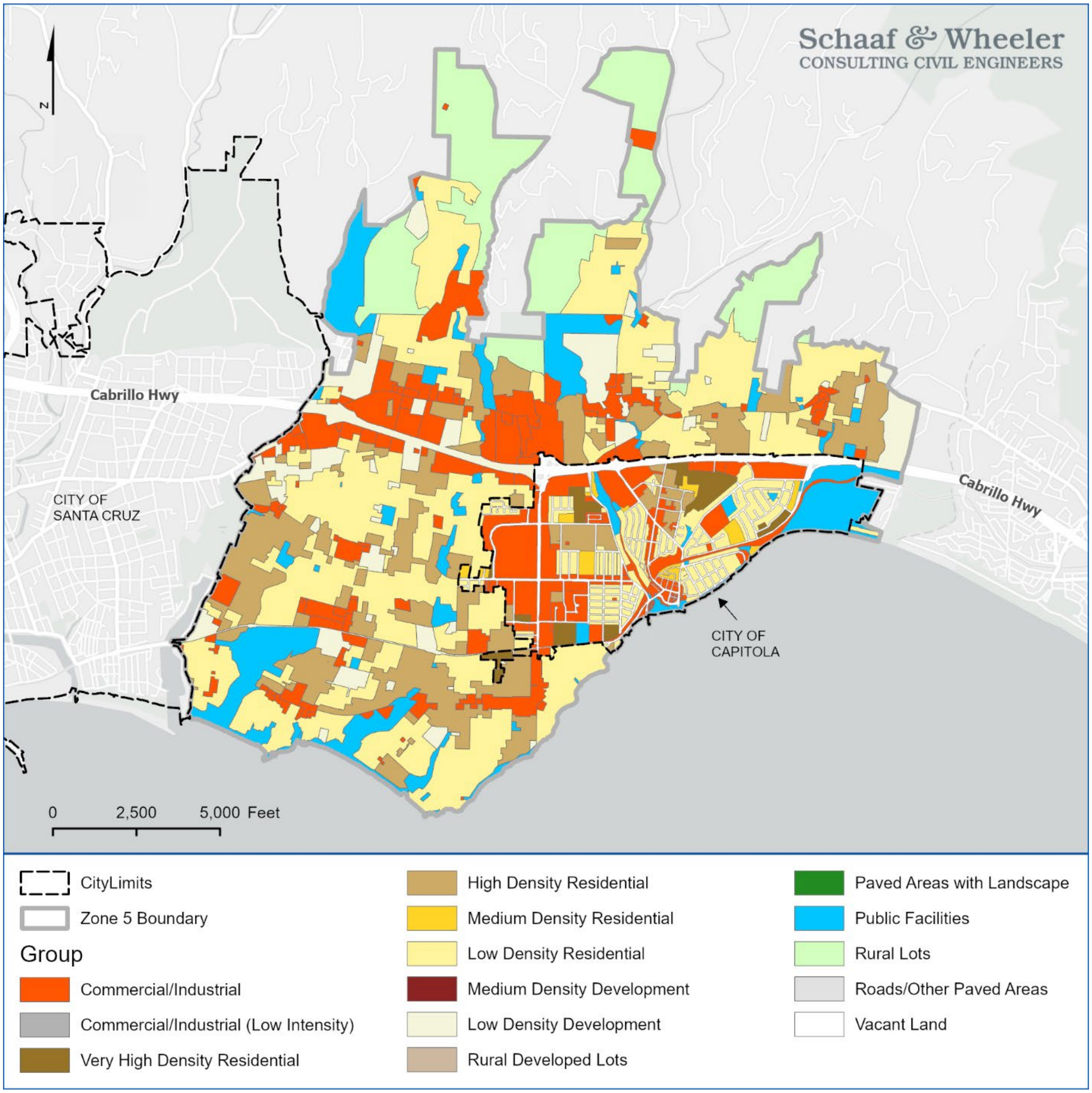


Figure 3-5: Zoning Information Used in the Development of the Hydrologic Model

3.2.2 Soil Classifications

The Natural Resources Conservation Service (NRCS) has classified soils into four hydrologic soil groups (A, B, C, and D), according to their infiltration rates. Group "A" soils have low runoff potential when wetted and typically consist of sand and gravel. Group "B" soils are moderately well-draining when thoroughly wetted and consist of loamy sand or sandy loam textures. Group "C" soils have moderately high runoff potential when thoroughly wetted and consist of loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group "D" soils have high runoff potential when thoroughly wet and consist of clayey textures.

Soils within the delineated regional system catchments primarily consist of Watsonville Loam (47.8%) and Elkhorn Sandy Loam (24.3%). The remaining 27.9% of the catchment areas consist of a mixture of other soil types, as summarized in Table 3-1.

A map of hydrologic soil groups in the area is shown in Figure 3-6.

Table 3-1: Catchment Soil Type Summary

NRCS Soil Map Unit	Hydrologic Soil Group	Area (Acre)	Percent of Area
Aptos Loam	C	28.1	1.0%
Beaches	C	3.2	0.1%
Ben Lomond-Catelli-Sur complex	B	28.3	1.0%
Bonnydoon-Rock outcrop complex	D	25.6	0.9%
Danville loam	C	103	3.5%
Elder sandy loam	B	28.1	1.0%
Elkhorn sandy loam	B	704	24.3%
Elkhorn-Pfeiffer complex	B	81.0	2.8%
Fagan loam	C	10.8	0.4%
Lompico-Felton complex	C	1.3	0.0%
Los Osos loam	C	58.0	2.0%
Nisene-Aptos complex	C	22.8	0.8%
Pinto loam	C	48.4	1.7%
Soquel loam	B	137	4.7%
Tierra-Watsonville complex	D	220	7.6%
Water	N/A	14.3	0.5%
Watsonville loam	D	1,385	47.8%
	Total	**2,899**	**100%**

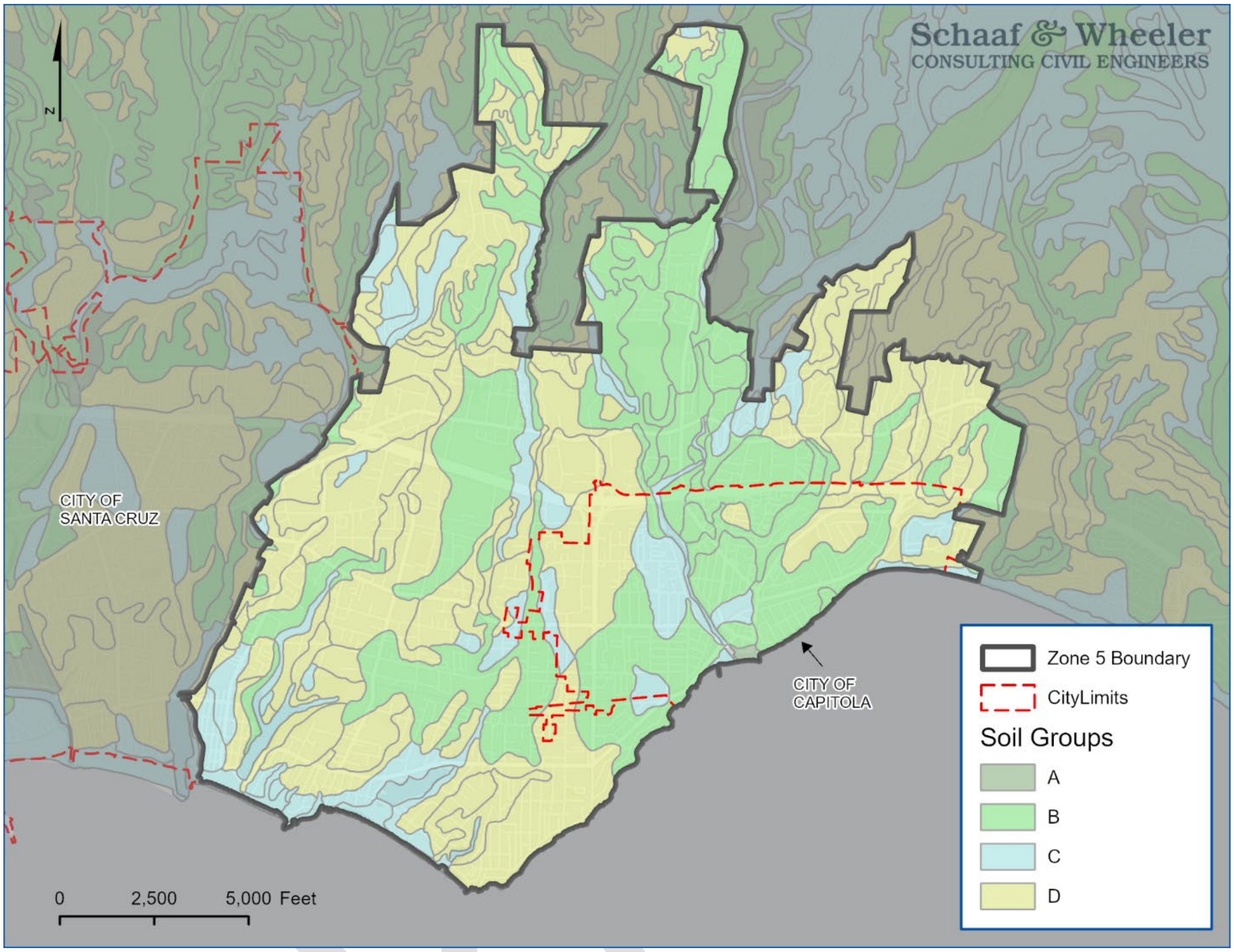


Figure 3-6: Hydrologic Soil Group Data Used in the Development of the Hydrologic Model

3.2.3 Runoff Curve Numbers

The NRCS curve number methodology is applied to aid in estimating runoff from catchments based on soil and land cover characteristics. Curve numbers vary from 0 to 100, with 0 representing no runoff and 100 meaning that all precipitation will run off. Curve numbers have been assigned based on land use categories, imperviousness, and soil types as summarized in Table 3-2. These values account for varying levels of imperviousness across land use types.

Curve numbers can vary for a given drainage area based on the Antecedent Moisture Condition (AMC), representing soil moisture content at the start of a storm. AMC can vary between dry (AMC I) and wet (AMC III). Values were initially assigned to the catchments assuming an "average" moisture condition (AMC II), then adjusted based on the methodology presented in Section 4.

Table 3-2: AMC II Curve Number Summary by Land Use and Soil Type

	Hydrologic Soil Group			
Description	**A**	**B**	**C**	**D**
Vacant Land	43	65	76	82
Public Facilities/Rural Lots	49	69	79	84
Rural Developed Lots	57	72	81	86
Low Density Residential	61	75	83	87
Low Density Developed	68	79	86	89
Medium Density Residential	69	80	87	90
Medium Density Development	77	85	90	92
High Density Residential	77	85	90	92
Very High Density Residential	89	92	94	95
Commercial/Industrial (Low Intensity)	81	88	91	93
Commercial/Industrial (High Intensity)	89	92	94	95
Paved Areas with Landscape	90	90	90	90
Roads/Other Paved Areas, Water	100	100	100	100

4 Methodology

4.1 Overview

The criteria used to evaluate storm drain system performance must be technically sound and simple to understand and apply. Ideally, the same methodology used to analyze system performance for this report will continue to be used for future infrastructure design.

Schaaf & Wheeler applied the same methodology presented in the 2013 SDMP for Zone 5 and Zone 6 to estimate stormwater runoff based on land cover and soil types present in the study area. This approach to modeling applies the NRCS curve number hydrology method to generate runoff hydrographs and dynamic wave hydraulics with Manning's and Darcy-Weisbach methods to generate hydraulic grades and conveyance system flows.

The hydrologic methodology applied in this analysis is based on the Santa Cruz County Design Criteria (SCCDC) – Part 3. The hydraulic methodology is also based on the SCCDC, with some modification to account for ponding and "storage" of water above ground level. The SCCDC hydraulic requirements primarily deal with flows contained below ground level with freeboard. The way that the model accounts for this is discussed further in this section.

4.2 Evaluation Criteria

The SCCDC specifies that system designs maintain 8 inches of freeboard between the rim elevation of stormwater structures and the 10-year water surface. For regional systems, however, the County has indicated a desire to explore alternative levels of service.

Schaaf & Wheeler created hydrologic analysis and one-dimensional hydraulic models for the 25-year and 100-year events. For regional systems modeled in InfoSWMM, the 25-year level of service standard was agreed upon as the governing criteria for general storm drain system conveyance. For creeks modeled in HEC-RAS, where FEMA 100-year flood hazard areas are defined, the 100-year event model represents governing criteria. Creeks and pipe/ditch systems were not evaluated in the same model. Instead, water surface boundary conditions were applied where the regional system outfalls to the creeks..

We recommend improvements to reduce the 25-year hydraulic grade to no higher than 0.5 feet above the rim elevation at any location in regional closed-conduit and ditch systems. This represents containment to the top of curb level at the peak of the storm, generally preventing property damage to the greatest extent possible.

4.3 Modeling Software

Zone 5 has opted to continue using InfoSWMM stormwater modeling software by Innovyze (formerly by MWH Soft) as a primary means of assessing system performance, identifying deficiencies, and evaluating and recommending necessary improvements. Physical parameters used in the analysis are based on information detailed in Chapter 3 – Data.

The program works within the ArcMap interface and is capable of applying the hydrologic and hydraulic methods discussed here. However, its full numerical modeling capabilities include modeling overland flow, weirs, pumps, and complex storage areas. These capabilities are not fully utilized by the current regional system InfoSWMM model, but they could be developed further for future modeling efforts or for more local studies as projects are designed and constructed.

Other capabilities of the software include import and export of model data, network editing and gap-filling, catchment delineation, and network interpolation and connectivity tools. InfoSWMM can also be used to present results including plan, longitudinal, and cross-section views; animation of results; and presentation of flooding, including water depth and pressure. With the software built to function within ArcMap, results can easily be viewed on background graphics such as maps, aerial photos, and other GIS data.

Unlike prior modeling efforts, all regional systems with outfalls to creeks, lagoons, and Monterey Bay have been placed in a single model for this effort.

HEC-RAS models have been developed for four creeks (Arana Gulch, Noble Gulch, Rodeo Creek, and Soquel Creek). 100-year flows are used as inputs to the HEC-RAS models to evaluate the HGL through the creeks. The major creek crossings are primarily bridges, with the exception of culverts under Highway 1. Since the Zone 5 does not have jurisdiction on the Caltrans culverts, those crossings were not evaluated in detail. The models may underestimate peak water surface elevations at certain outfalls as a result.

However, using a peak water surface elevation from these models is somewhat conservative, given a fairly sizable difference in timing between the peak of local discharge to the creeks and the peak water surface at the outfalls. This is because the creek drainage areas tend to be much larger and less developed.

The biggest impact of including a highway bridge is likely to be on Soquel Creek at Highway 1, where the 25-year water flow rate in the creek can easily cause flooding in the vicinity of Downtown Soquel on its own. At this location, storm system improvements may be deemed beneficial. However, addressing the much more impactful issue of creek overflows is challenging and can be guided somewhat by the RAS model and prior planning efforts.

Culverts on regional ditch conveyances were included in the InfoSWMM model as details of the ditches and culverts were collected in the field that allowed for a detailed evaluation in the modeling system. Figure 4-1 shows these culvert crossings.

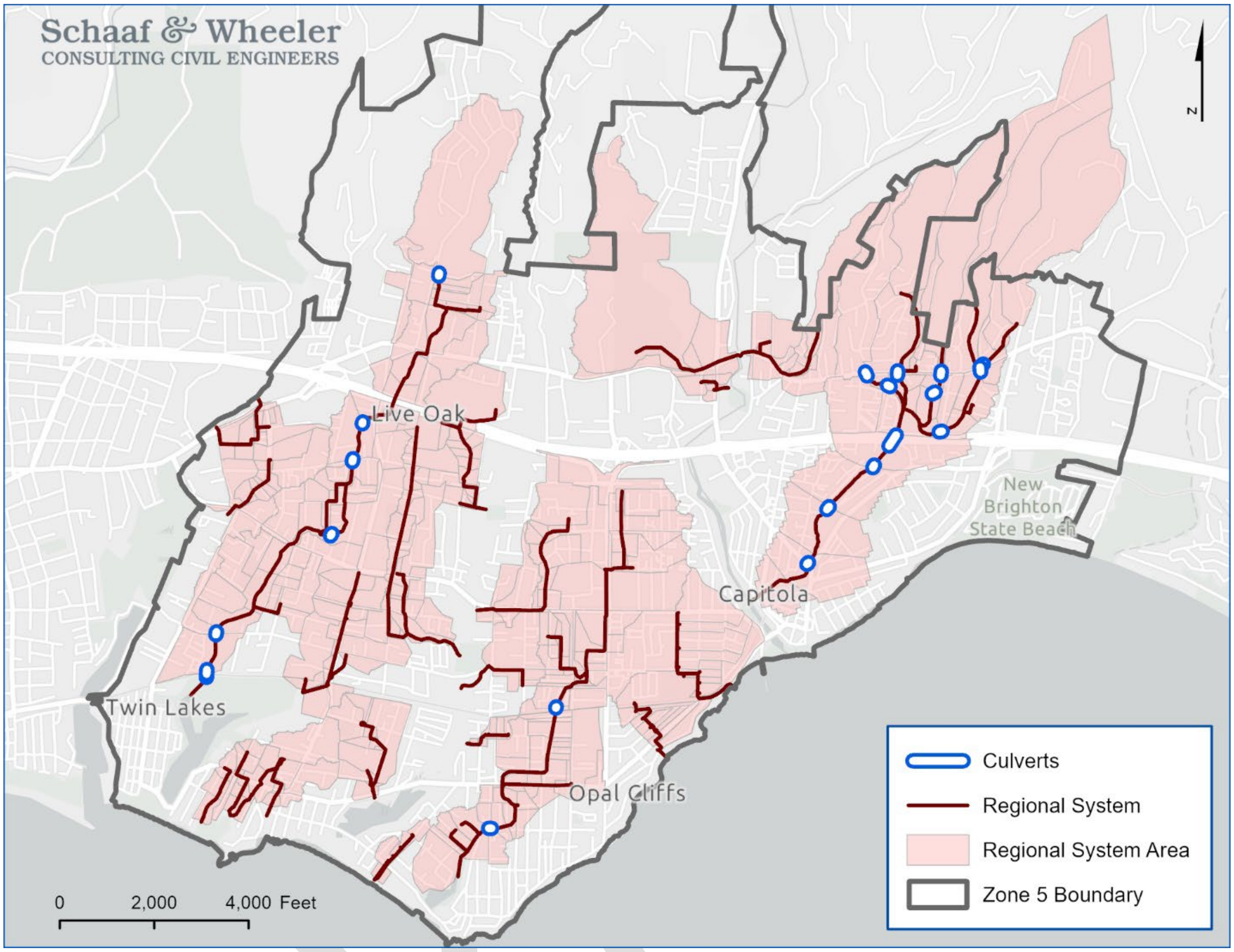


Figure 4-1: Major Culvert Crossings on Open Channel Alignments in the Regional System

4.4 Model Operation

InfoSWMM performs two separate calculations for the Zone 5 regional system model. First, a runoff calculation (hydrologic analysis) estimates the amount of water entering the storm drain system from each catchment during a design rainfall event. Second, a network flow calculation (hydraulic modeling) replicates how the storm drain system will convey flows to outlet locations. Flows resulting from the runoff calculation are used as inflows for the subsequent network flow calculation.

The InfoSWMM runoff model offers a choice of three distinctive infiltration methods: Horton, Green-Ampt, and NRCS curve number. The Zone 5 Regional system models use the NRCS curve number with a dimensionless unit hydrograph method (UHM) to calculate surface runoff.

This analysis uses a 24-hour storm, so the simulation window is set to 24 hours as well. However, a simulation can be started at any point during the chosen design storm to assess surface runoff for any period of the design storm, with computations made based on a user-specified time step. The 24-hour storm was ultimately chosen because it represents a "balanced" design event that causes some level of saturation of soils prior to the short duration peak flow rates that tend to be the most important factor in determining the required size of local pipe systems. Longer duration storms are more appropriate for large detention facilities susceptible to high inflow volumes rather than solely high peak flow rates. The Zone 5 system lacks detention systems of this magnitude.

The pipe flow model offers a choice of three flow and hydraulic grade calculation methods: steady state, kinematic wave, and dynamic wave. Each is distinguished based on the set of forces that they take into account. The Zone 5 storm drain model uses the most comprehensive method, dynamic wave, which incorporates the effects of gravitation, friction, pressure gradient, and inertial forces. Because it accounts for all forces affecting flow characteristics, this method allows the model to accurately simulate fast transients and backwater profiles. In the absence of 2D surface flow routing, flooding above-structure rims is characterized by storage in an artificial basin above the model nodes' defined ground surface elevations.

Volume stored above these nodes is characterized by a "ponded area" input in square feet. Without considering ponding spread above the system, the model assumes that essentially the entire peak flow into the node must be forced through the pipe system. This would overestimate flooding depths.

In reality, surcharged flows spread out over street gutters, sidewalks, parking lots, and other areas. This storage volume provides some attenuation of peak flows, impacting the head on the downstream pipe inlet. In general, surcharge in the regional system would pond on the surface directly above, as well as above private and local systems not included in the model. A representative ponded area value of 30,000 square feet is used in the model for closed-conduit systems. For larger ditches, that value is modified up to 450,000 square feet depending on the characteristics of surrounding topography.

Pipe flow simulations can be executed using either a constant or variable time step. Simulations can also be run for any portion of the full time interval defined by the rainfall time series and corresponding calculated runoff hydrograph. A time step of two seconds is used for the Zone 5 models, which is sufficient to model gradients across even the shortest lengths of pipe in the model with relatively high flow velocities.

The HEC-RAS model performs a steady state backwater hydraulic analysis of the open channel profiles based on a series of cross sections defined along a stream centerline. Cross sections were developed using the LIDAR data. FEMA flows were used in 1D, steady state models.

4.4.1 Input and Output

Surface runoff calculations require two types of input data: boundary data and catchment data. Boundary data for the run-off computation consists of an input rainfall time series representing the design storm event for the model.

Catchment data includes the boundaries of each drainage catchment, along with relevant physical and hydrologic parameters including surface area, runoff curve number, and lag time (or parameters used by the model to calculate lag).

A summary of model input and output is listed in Table 4-1.

Table 4-1: Summary of Model Input and Output for the Regional System Models

Model	Inputs	Outputs
InfoSWMM Runoff (Hydrologic)	Boundary Data • Rainfall time series Urban Catchment Data • Drainage catchments • Lag time • Curve number	Runoff hydrographs for each individual catchment
InfoSWMM Pipe and Channel Flow (Hydraulic)	Storm Drain Network • Nodes (catch basins, manholes, outlets, etc.) • Links (pipes, culverts, open channels) • Cross section data (for open channel sections) • Basin geometry (elevation-volume) • Operational data • Catchment connections • Junction losses • Boundary data (e.g., water surfaces at outfalls) • Catchment runoff hydrographs • Water surface elevation time series	Water level at each node Water level in network links Velocity in network links Water volume in the system Discharges Flood depth and volume above ground
HEC-RAS (Open Channel Hydraulics)	Open Channels • River/stream centerline • Cross section geometry • Roughness • Culverts/bridges • Boundary data (water surfaces and/or inflow)	Water level at cross sections Hydraulic grade profile Flow velocity at cross sections Volume in reaches

4.5 Rainfall Depth and Pattern

In keeping with the methodology applied in the previous master planning effort, the NRCS Type I synthetic, 24-hour rainfall pattern was used (TR-55, Appendix B). Depths for the pattern were adjusted based on local rainfall statistics. To that end, patterns with a 15-minute time interval were modified to create rainfall time series that are considered "balanced" for each return period. Each resulting time series provides total rainfall depths equal to those represented by its respective IDF curve (10-year, 25-year, and 100-year) for durations of 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, and 24 hours.

The 10-year storm used for the previous master planning effort is shown in Figure 4-2 for reference, along with 25- and 100-year storm rainfall timeseries. The 10-year, 25-year, and 100-year 24-hour storm rainfall depths at this location are 7.44 inches, 8.93 inches, and 11.16 inches, respectively.

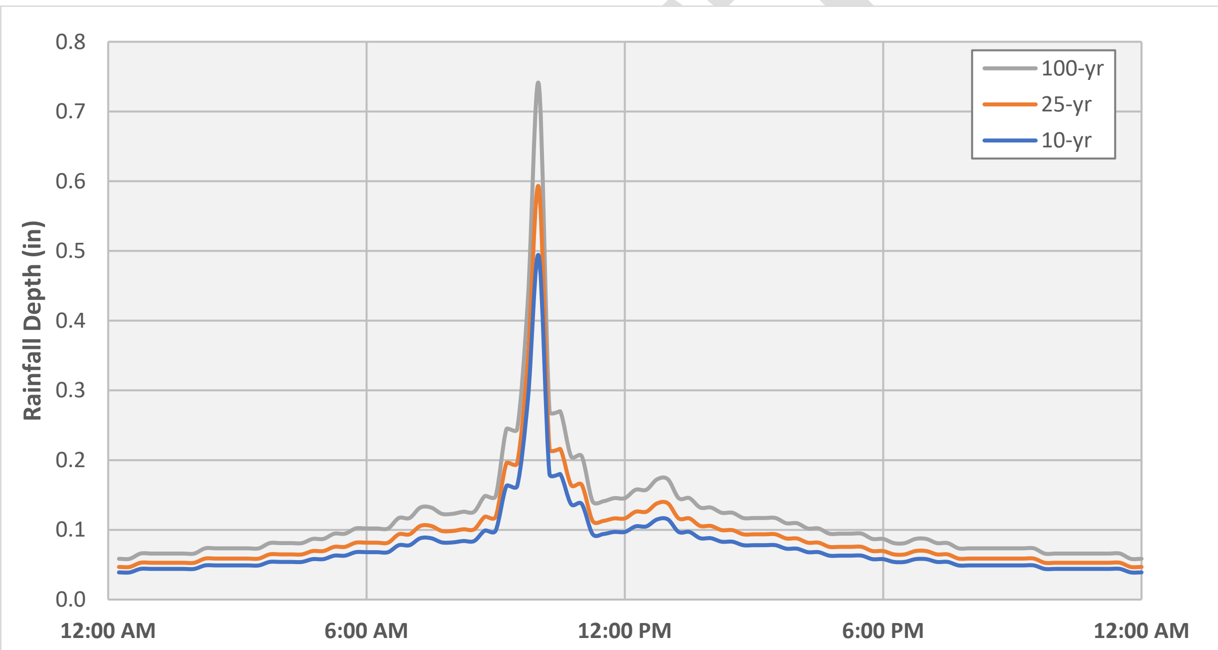


Figure 4-2: 24-hour Design Storm Events for Zone 5

4.5.1 Climate Change

The models also consider the potential impacts of climate change. This is accomplished by using EPA SWMM Climate Adjustment Tool (SWMM-CAT). The tool provides location-specific adjustment factors for Near-Term (2035) and Far-Term (2060) projects derived from global climate change model developed by the World Climate Research Program. The tool generates adjustment factors for several climate parameters. However, this analysis is primarily concerned with future changes in precipitation. Predictions generated by the tool are shown in Figure 4-3 and Figure 4-4 for near- and far-term cases, respectively.

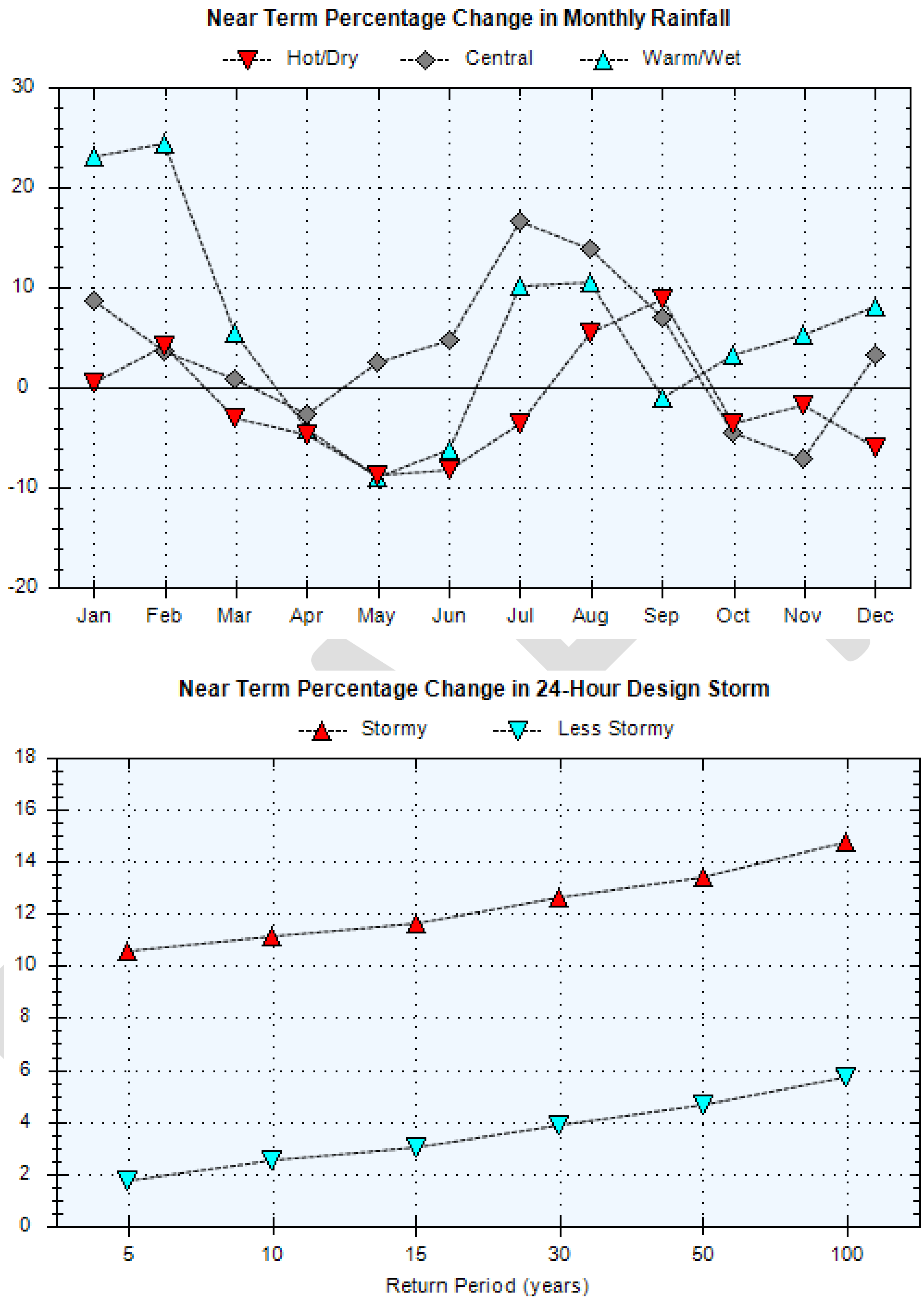


Figure 4-3: Near-Term Monthly Rainfall and 24-Hour Design Storm SWMM-CAT Predictions (95010 Zip Code)

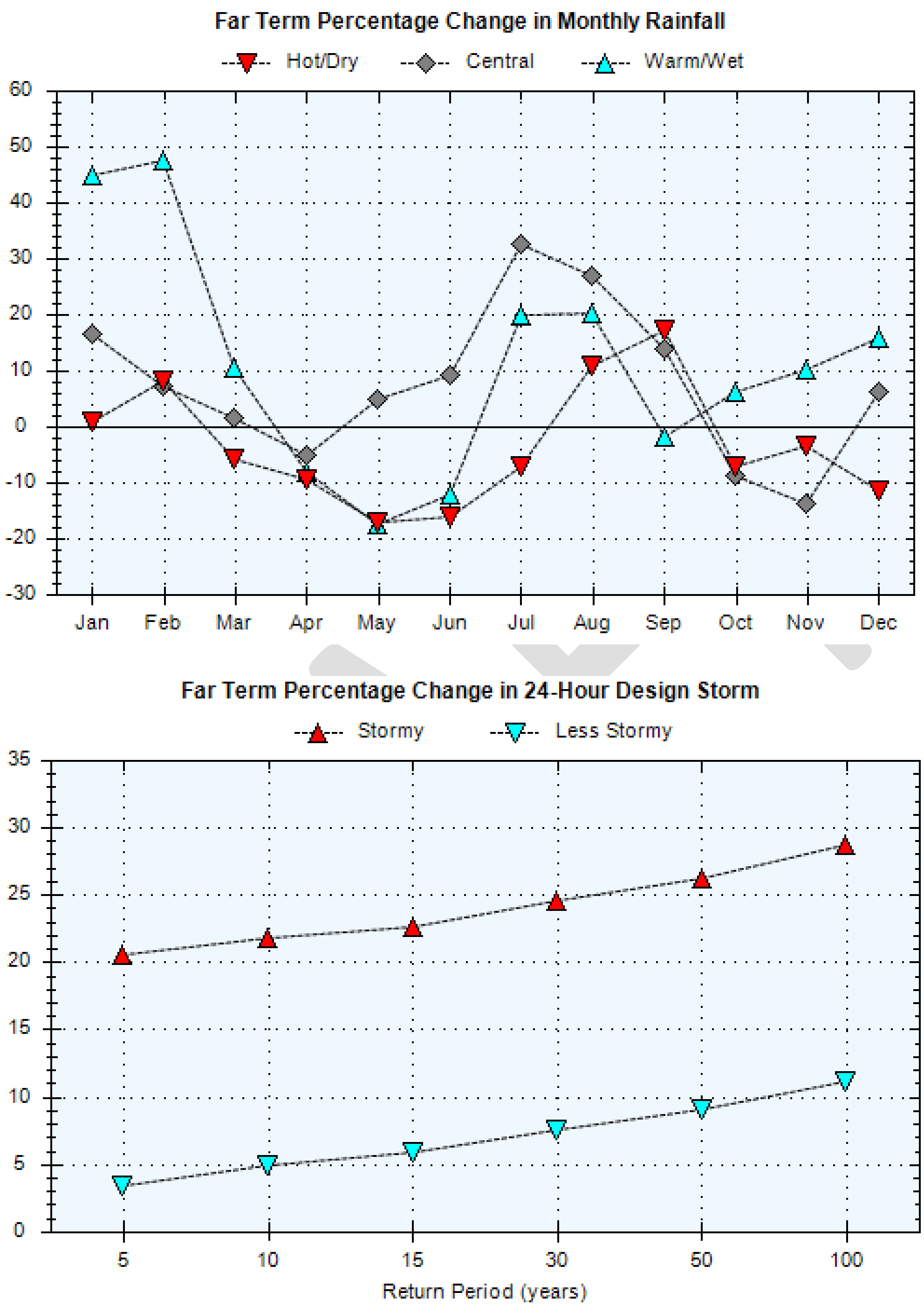


Figure 4-4: Far-Term Monthly Rainfall and 24-Hour Design Storm SWMM-CAT Predictions (95010 Zip Code)

Cal Adapt provides another source of climate change predictions. For the Regional System Model area, Cal Adapt predicts 30-year average precipitation to increase by approximately 25% under the high emissions model scenarios in their long-term modeling (End-Century, 2070-2099). For individual extreme storm events, it predicts that End-Century intensities could increase by 20% on average for the high emissions scenario, and up to 40% for cool, wet climate conditions.

The regional systems models use single storms to evaluate system capacity and identify projects. While the predictions from EPA and Cal Adapt indicate monthly and seasonal increases in precipitation depths on the order of 25 to 40%, single 24-hour design storm change are estimated on the order of 15 to 30%. For a 25-year event, the EPA tool predicts far-term increases in precipitation for a single storm of approximately 24 to 25%. The climate change SWMM model used the design 25-year storm with depths increased uniformly by a factor of 0.25.

The climate change model was not used to increase the size of CIPs. It's instead used to highlight where those CIPs may require additional climate change consideration during design and to identify where additional projects may require consideration in the future. There are only a handful of locations where additional, significant flooding appears in the climate change model. The results presented in Section 5 show that the CIP identified in this document is largely resilient to the expected increases in extreme precipitation events.

4.6 Catchment Data

Catchment inputs include boundaries of each catchment, along with relevant physical and representative hydrologic parameters including surface area, land use characteristics and parameters used to calculate lag times for the unit hydrograph method.

4.6.1 Lag Time

The UHM also requires the definition of lag time for the catchments. The previous master planning method applied a standard lag equation for basins. Lag is a function of the longest flow path, measured from the catchment outlet to the most remote point in the catchment, the centroidal flow path, and the average slope along the principal flow path.

The lag time equation carried through from prior planning efforts in Zone 5 is:

$$t_l = K * N * \left(\frac{L * L_c}{\sqrt{S_0}}\right)^{0.38}$$

Where: t_l = Lag time (hours)

K = 24 (unitless constant)

N = Unitless basin roughness factor (NOT the same as Manning's *n* values)

L = Longest flow path (mi)

L_c = The Centroidal flow path length (distance from the outlet to a point orthogonal to the catchment centroid) (mi)

S_0 = The average slope of the longest flow path (ft/mi)

Flow paths were estimated in GIS based on LiDAR topographic data. Elevations were extracted at the top and bottom of the flow paths to estimate slopes. Basin roughness factors are summarized in Table 4-2.

Table 4-2: Summary of Roughness Parameters by Basin Type

Basin Type	Basin Roughness (N)
Urban watersheds	0.021*
Rural watersheds with generally clear stream beds and minimal vegetation growth in drainage reaches	0.05
Rural watersheds with moderate to high levels of vegetation growth, or rock and boulder deposits within the main drainage reaches	0.07
Rural watersheds with dense vegetation or high levels of boulder deposits within the main drainage reaches	0.08

**Calculated from a Manning's n value of 0.013 by the following equation:* $N = 0.52n^{0.79}$

4.6.2 Hydrologic Model

The unit hydrograph is a numerical representation of the time response of catchment runoff caused by rainfall applied uniformly over a unit of time. Various unit hydrograph options exist, including NRCS dimensionless, NRCS triangular, Clark, and Snyder.

The InfoSWMM model for Zone 5 uses the NRCS curve number with the NRCS dimensionless unit hydrograph (NRCS, 2007) to estimate catchment runoff hydrographs in response to modeled rainfall events.

Catchment area, time of concentration, and curve number were used as inputs to the InfoSWMM model. Current assessor parcel information and aerial imagery were used to develop curve numbers representative of existing conditions. The parcel GIS shapefile contains an attribute called USECDDESC that was used for existing land use. For the future conditions model, the zoning GIS shapefile was used to update curve numbers to reflect additional development and redevelopment that might occur within Zone 5 and City of Capitola drainage areas based on County and City zoning designations.

4.6.2.1 Curve Number Calibration

In the 2013 study, the AMC was calibrated based on hydrology models for Soquel and Carbonera Creeks. These hydrologic models were revisited to update gage statistics based on more recent flow data and to calibrate AMC to the 25-year storm event specifically. Similar results were produced, and the AMC was selected at I-1/4, representing a generally drier than average condition at the start of a 25-year storm.

Soquel Creek calibration is discussed in the 2013 SDMP. AMC adjustments have been evaluated for the gaged Carbonera Creek basin by a similar methodology. First, gage data has been evaluated to develop a peak runoff frequency curve with USGS PeakFQ (shown in Figure 4-5).

Curve numbers have been assigned to the basin based on land use and soil characteristics and lag calculated based on flow paths and basin slope as described in Section 4.6.1. HEC-1 was then used to estimate peak runoff from the 3.74 square-mile basin for various storm events for AMC I and AMC I-1/4 curve number values. The results of this analysis are summarized in Table 4-3 and confirm that AMC I-1/4 remains a valid conservative assumption for a 25-year return period.

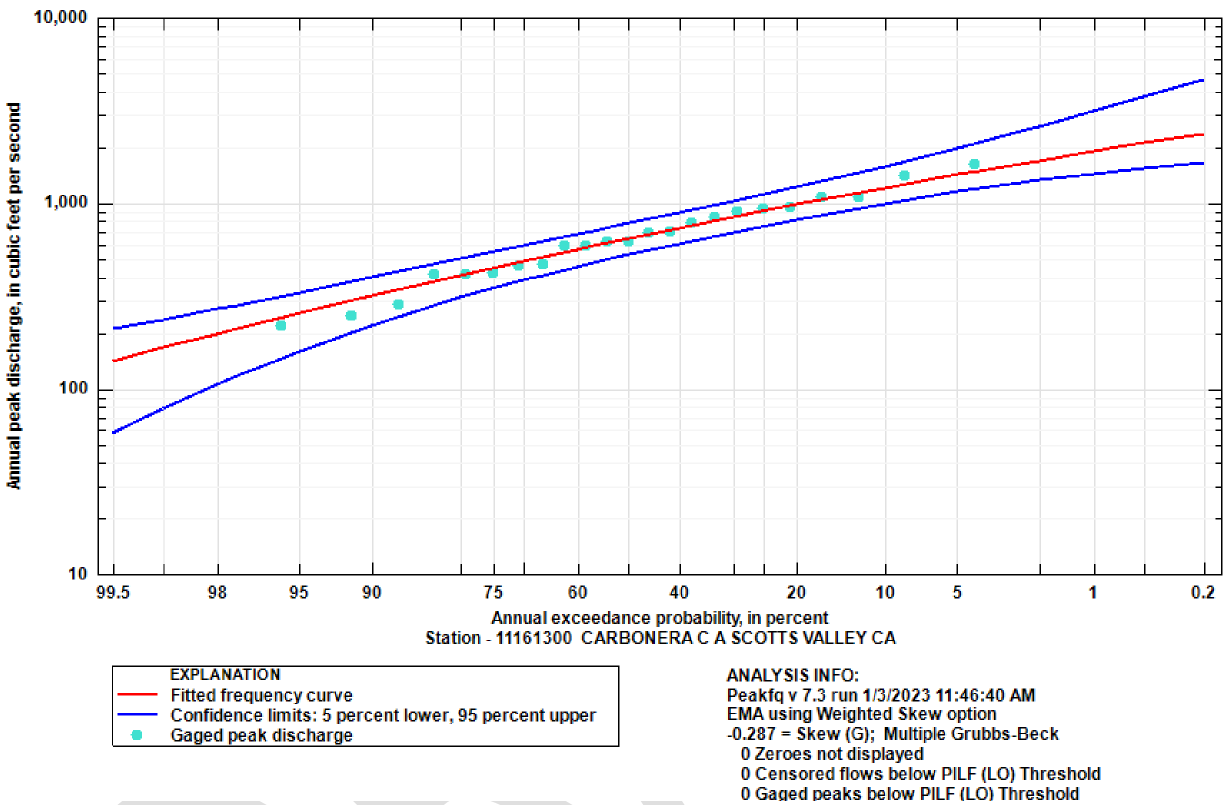


Figure 4-5: USGS PeakFQ Duration-Frequency Curves for Carbonera Creek

Table 4-3: Carbonera Creek Peak Flow (cfs) & AMC Evaluation

Return Period (Exceedance Prob.)	PeakFQ Predicted	Peak FQ Confidence Limits	HEC-1 (AMC I)	HEC-1 (AMC I-1/4)
100-year (1%)	1,906	1,449 - 2,898	2,064	2,178
50-year (2%)	1,701	1,333 – 2,604	1,787	1,898
25-year (4%)	1,493	1,200 – 2,130	1,411	*1,493*
10-year (10%)	1,210	994 – 1,581	1,149	1,251
5-year (20%)	986	814 – 1,221	935	980
2-year (50%)	645	528 - 779	536	616

While Carbonera Creek is more representative of a more heavily urbanized condition, the Soquel Creek at Soquel USGS gag has a much longer record, covering the period since 1951, plus an additional historical event in 1937. This gage was also examined in PeakFQ (Figure 4-6), and a 25-year event hydrology model was applied to verify that AMC I-¼ is an appropriate choice (Table 4-4).

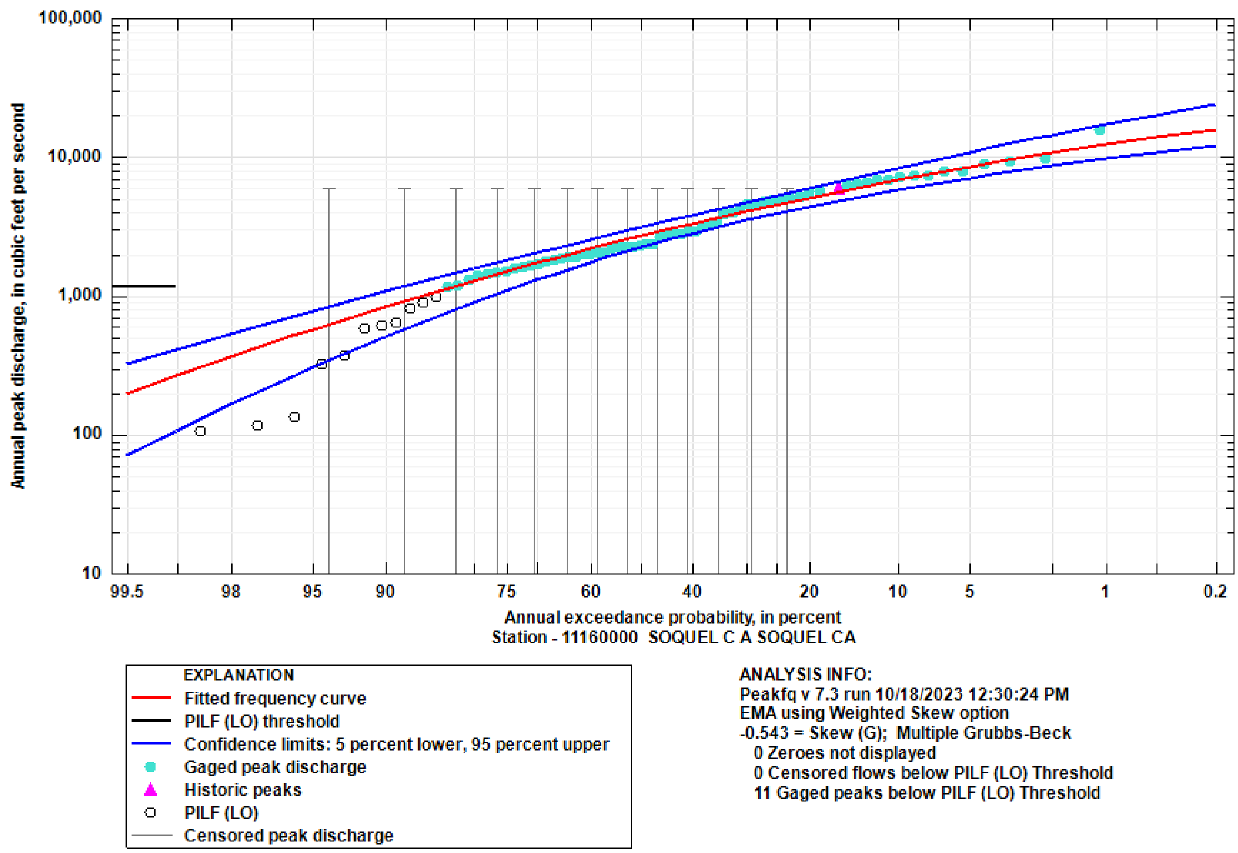


Figure 4-6: USGS PeakFQ Duration-Frequency Curves for Soquel Creek

Table 4-4: Soquel Creek at Soquel 25-year AMC Evaluation

	Peak Discharge (cfs)
PeakFQ Predicted	9,020
AMC I	6,715
AMC I-1/4	*8,180*
AMC I-1/2	*9,390*
AMC I-3/4	10,600
AMC II	11,790

For Soquel Creek, the PeakFQ predicted discharge lies in between AMC I-¼ and AMC I-½ hydrologic model results for the basin. Each drainage area possesses its own unique properties, which leads to variability even in adjacent basins. Coupled with the Carbonera Creek calibration results, this provides a regional confirmation based on a relatively extensive gage record that I-¼ is likely an appropriate choice for a smaller, urban basin.

4.6.2.2 Curve Number Assignment

Catchments were first overlain with land use and soils information in GIS to estimate curve numbers using the values presented in Table 3-2. This was done for both existing land cover conditions and future conditions based on zoning designations. Curve numbers were then adjusted to corresponding AMC I-1/4 values. The result of this process is shown in Figure 4-7.

For many areas of the County and City, using zoning designations actually causes curve numbers to decrease, since commercial/industrial areas would become residential land use types with a lesser percentage of impervious area. Even those developments that are higher density must meet current NPDES permit and local stormwater management design requirements. For most development that substantially increases imperviousness on a site, stormwater detention is required. While these requirements apply to a 10-year design storm, they do impact the characteristics of discharge in other storms and inevitably do decrease peak discharge.

The model is still a useful exercise, as other areas of the model where curve numbers increase may see greater magnitudes of runoff to the regional stormwater systems. The future condition model assumes a worst-case scenario, where lower curve numbers are ignored and development occurring only where curve numbers would increase.

This approach also adequately considers the impact of development subject to detention requirements. Traditionally, residential zoning might decrease curve numbers without considering trends towards allowance of higher density housing. By keeping the curve numbers the same for these catchments, we are effectively considering the possibility that redevelopment is more impervious but subject to detention requirements that would keep peak flows similar to pre-development conditions.

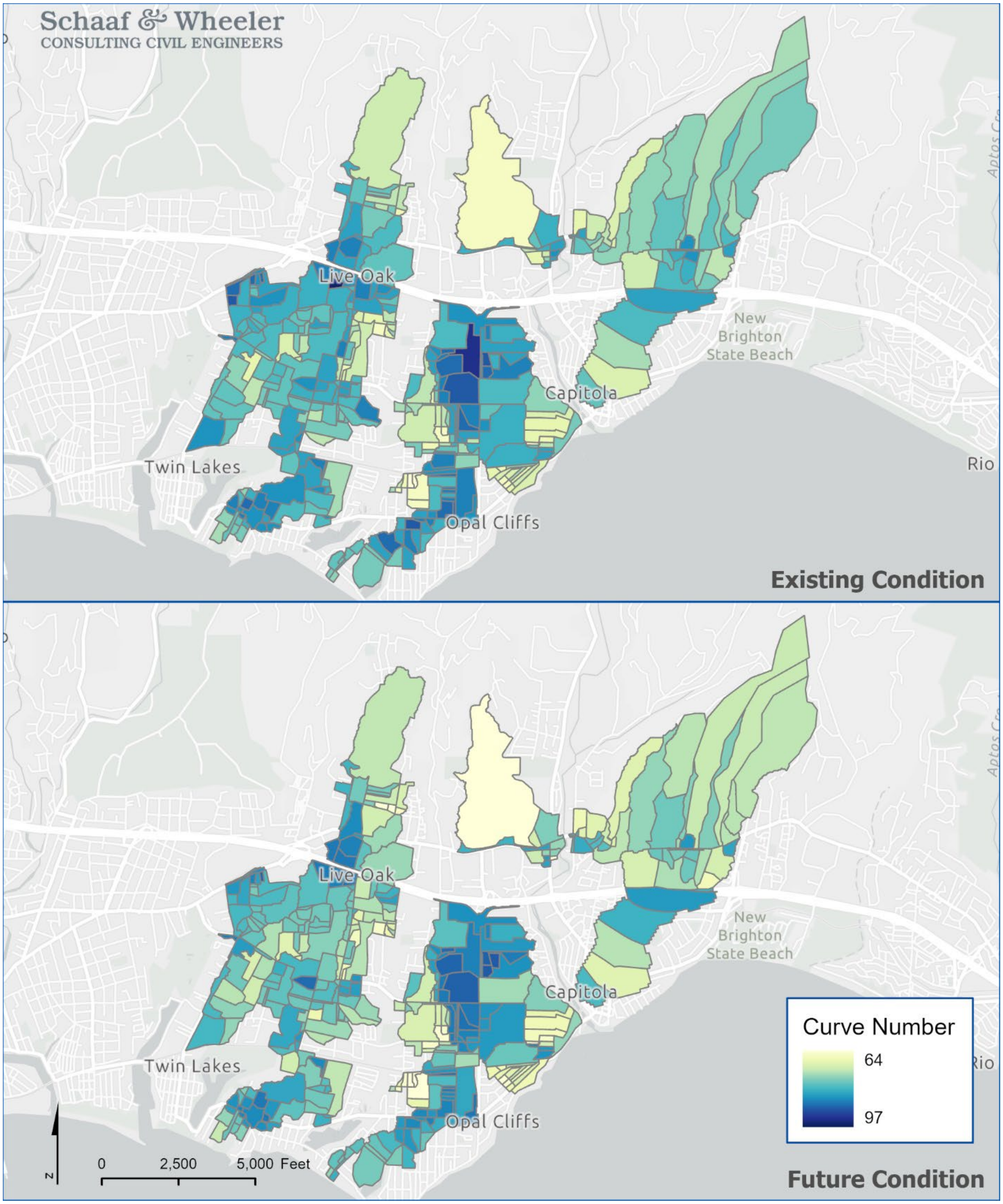


Figure 4-7: Existing and Future Condition Curve Numbers

5 Evaluation of Storm Drain Systems

5.1 Overview

Zone 5 regional systems have been evaluated based on both their condition and capacity. Condition assessment was initially performed by Schaaf & Wheeler over multiple days in January 2021. Certain elements of the system were revisited at a later time by a CCTV contractor to better evaluate the condition of the pipes where it could not be ascertained from the surface alone. Capacity analysis has been performed for a number of representative physical basin conditions:

- Existing Land Use and Soil Conditions
- Future Land Use Condition
- Future Land Use Condition with far-term (or end-century) climate change (25% adjustment to 25-year design storm)

Existing land use and soil conditions were first run in InfoSWMM with the existing pipe system to evaluate capacity deficiencies. Pipes were then upsized or added in the model until the deficiency diminished to meet level-of-service standards. These CIPs have been further evaluated with the future land use conditions to ensure that systems will continue to meet level-of-service standards with additional development in the Zone 5 area. Finally, the system with identified projects complete was also evaluated with climate change considered, increasing the magnitude of rainfall time series uniformly by 25% based on far-term predictions from SWMM-CAT (shown in Figure 4-4) for a single, 24-hour design storm event.

Modeled projects are primarily developed by upsizing existing pipe or channels. However, in some locations, constraints on the system profile or property ownership may have been identified that make installation of new, parallel pipe systems, with the existing pipe remaining in place, a more feasible means of addressing capacity deficiency.

The results of the existing analysis have also been used to inform prioritization of the projects. Factors considered for prioritization include the magnitude and extent of flooding reduced by a project, potential for property damage if the project is not constructed, mitigation of flooding occurring in major roadways, known flooding issues or historical damages, and system condition that may exacerbate flooding.

Alternatives exist for all projects. While some are explored to address known challenges, the design process should include alternatives analysis for any CIP project. Parallel pipes, alternative alignments, and LID/open channel replacements for pipe should be considered where cost savings and other opportunities are found.

5.2 Existing System Evaluation

5.2.1 System Condition

After examining available system data and aerial imagery, field inspection was performed for specific system elements (pipes, ditches, and culverts). With topside and CCTV inspections completed, the condition ratings were assigned based on the factors discussed in Section 3.1.3. NASSCO ratings and open ditches condition ratings are shown in Figure 5-1. Initial input from Zone 5 staff and observations from the surface with a pole-mounted GoPro were used to identify which elements of the system would require further inspection by CCTV.

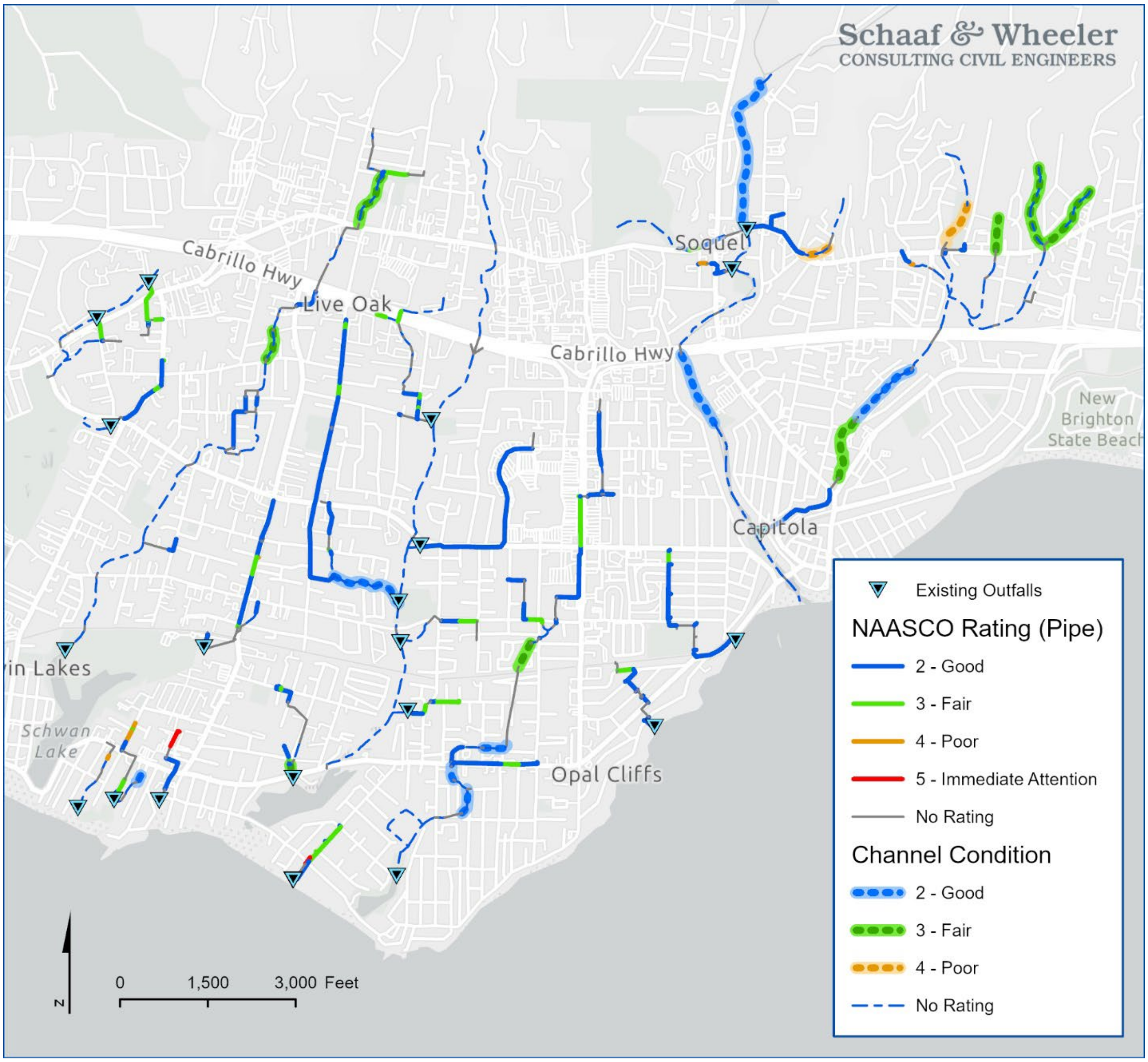


Figure 5-1: Surface Inspection System Condition Ratings Map

Most inspected system elements achieved a rating of "Good." None achieved an "Excellent" rating. In the northeast portion of Zone 5, two reaches of open channel were identified in "Poor" condition. This condition rating was determined based on the extent of unmaintained vegetation posing a capacity restriction. In the southwest portion of Zone 5, multiple reaches of pipe were rated as “Poor” or “Immediate Attention.” These elements require removal of debris and sediment at a minimum.

CCTV ratings are shown in Figure 5-2. On 26th Street, further examination by CCTV revealed that the pipe may require full replacement based on the prevalence of corrosion and cracking.

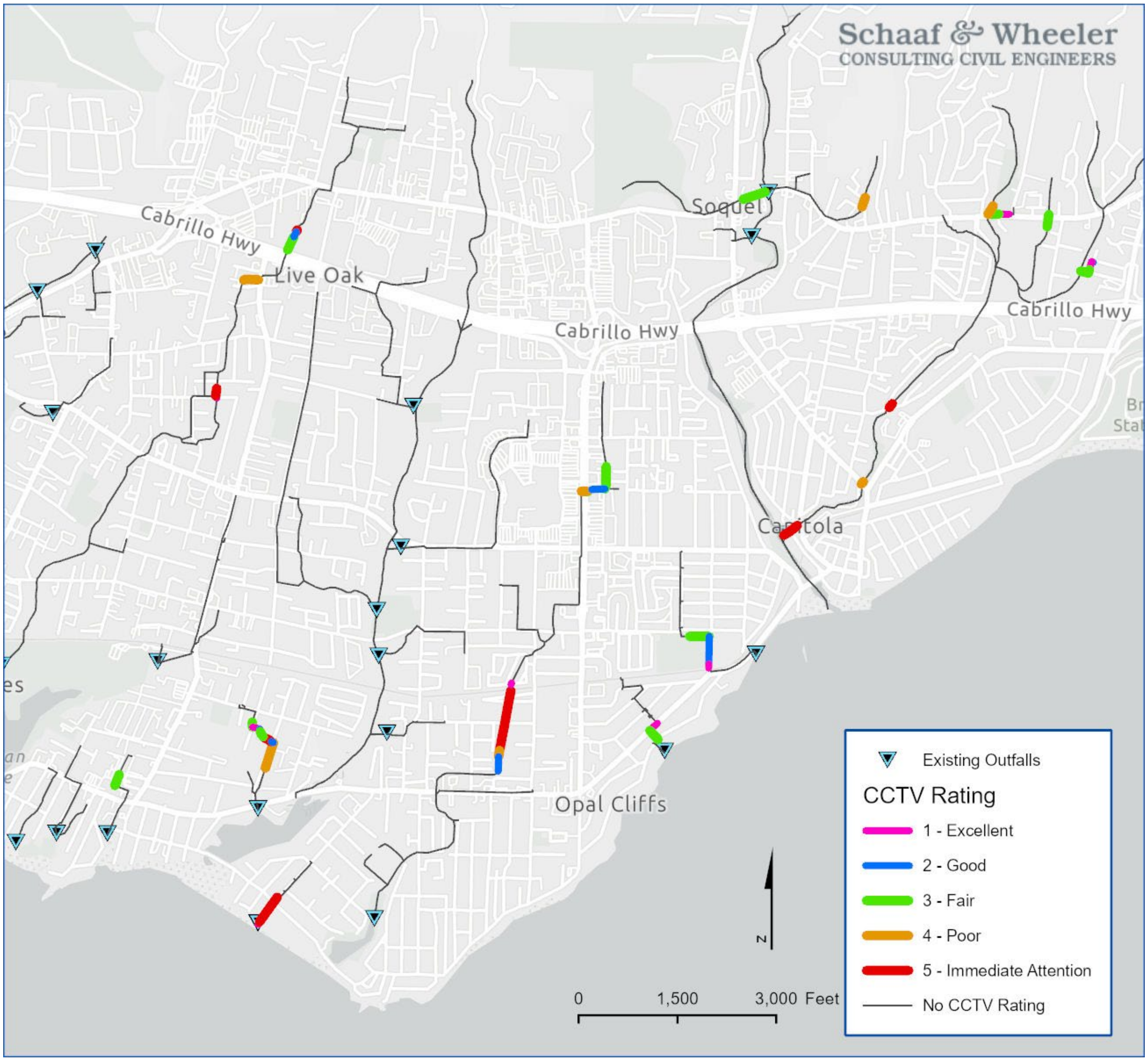


Figure 5-2: CCTV Condition Ratings Map

The need for maintenance was distinguished in the ratings from condition deficiencies that require replacement of pipes. In some cases, for example, a rating of “Immediate Attention” was applied purely based on a loss of capacity due to an extreme accumulation of sediment and debris. In other locations, pipes were given the same rating for structural deficiencies like corrosion or localized failures.

5.2.2 Regional System Capacity

The regional system model has been used to identify areas where overflow occurs due to a lack of available conveyance capacity. HEC-RAS models of larger open channels (Soquel Creek and Rodeo Gulch) were used to apply reasonable, conservative water surface boundary conditions at modeled system outfalls. The capacity of both closed-conduit and open channel segments are considered.

Results have been processed to visualize the locations of flooding (the depth of stormwater surcharge above ground surface at each node) throughout the Zone 5 regional systems. These areas are shown in Figure 5-3.

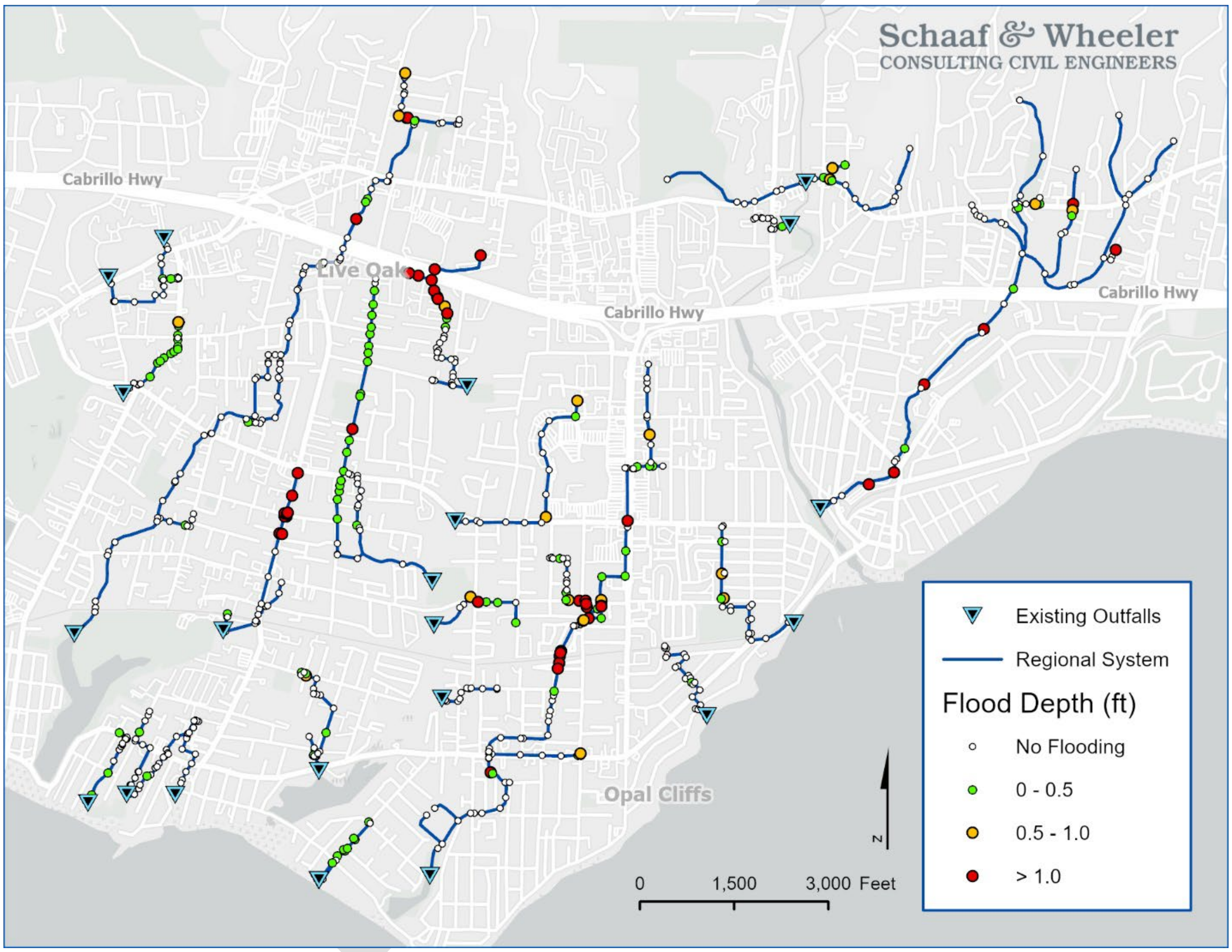


Figure 5-3: Existing Regional System 25-year Node Flooding Results from InfoSWMM

The model result shows many locations where "flooding" as estimated by the model is 1 foot or greater in depth.

It is important to understand the limitations of a one-dimensional model in order to contemplate the real-world implications of this result. The model utilizes the calculated hydraulic grade line, representing the water surface that would be required for a given flow rate to pass through the system. This does not consider the topography above the pipe system in extensive detail, consisting of roadways, gutters, sidewalks, and landscaping. In reality, some of this flow might run down the street in the gutter and enter the system at another inlet. Consideration of these conditions is necessary in interpreting these results and developing projects that mitigate potential flood damage and hazard conditions.

5.2.2.1 Comparison to Prior Modeling Results

There are locations where the model shows more or less flooding than the 2012 – 2013 master planning analysis. Inspection of the model inputs at these locations indicates that various conditions are the primary driver for these differences:

- Changes to the ground surface and invert elevations to reflect updated topographic information and field measurements;
- Updated curve number inputs based on up-to-date land cover and soil unit data;
- Removal of capacity restrictions in smaller local systems that was attenuating peak flows into the regional system in prior models; and
- A combination of these factors.

5.2.3 Creek Capacity Deficiencies

There are some locations where creek overflow is a known cause of flooding. HEC-RAS models provide some insight as to the reasons these areas tend to flood.

5.2.3.1 Soquel Creek

Soquel Creek is generally a deeply incised creek with depths of approximately 25 feet from the top of the channel banks to the channel thalweg (the lowest point in the channel cross section). The one-dimensional HEC-RAS model cross sections show that the areas in the overbanks most prone to flooding, surrounding Soquel Drive bridge, occur where the depth of the main channel is roughly 15 feet. Given the extent of existing development within Soquel Creek's floodplain, developing solutions for flood impacts is beyond the scope of this study.

A prior planning effort for Soquel Village identified the need to purchase property in the area to mitigate flood damage. The Soquel Village plan was adopted in May 1990 and alluded to developing a resident relocation plan for the Old Mill Mobile Home Park using FEMA funding. Following the acquisition of property and relocation of residents, the plan considered construction of a park along the west bank of Soquel Creek. Rather than providing flood protection infrastructure, the long-term plan after that initial phase contemplated redevelopment of commercial and industrial properties, bringing new structures into conformance with floodplain and floodway construction guidelines.

Only portions of that plan were implemented, including replacement of the Soquel Drive bridge to prevent debris racking (the accumulation of logs, vegetations, and other debris on a bridge pier, abutment, or culvert face) that historically worsened flooding and some limited acquisition of the Heart of Soquel Mobile Home Park with the Redevelopment Agency. Purchase of the Old Mill Mobile Home Park by local agencies was never completed as the Redevelopment Agency dissolved.

Given current conditions robust flood protection solutions for Soquel Village require additional study and contemplation that is beyond the scope of this study. Potential solutions may include completion of the Soquel Village Plan, flood walls, levees, floodplain retreat, channel capacity improvements, etc.

Climate change has been evaluated with the HEC-RAS model by increasing runoff up to 25% for a 100-year flow rate. This is in line with modifications to precipitation in the storm drain system SWMM models. SLR has been modeled with both 3 and 6 feet of rise added to the existing condition's downstream water surface boundary. The results of this modeling exercise are shown in Figure 5-4.

At the downstream end of the creek, SLR may have an expansive impact on the City of Capitola and coastal bluffs. Exploring solutions for this is beyond the scope of this report. However, planning for the impacts of SLR in a coastal community should be a priority, and the design and construction of any CIP project should consider the project's resilience against SLR. This will be essential for the proposed Noble Gulch system improvements near Capitola Avenue. Climate change impacts must also be considered for flood protection solutions (flood walls, levees, floodplain retreat, channel capacity improvements, etc.) implemented upstream.

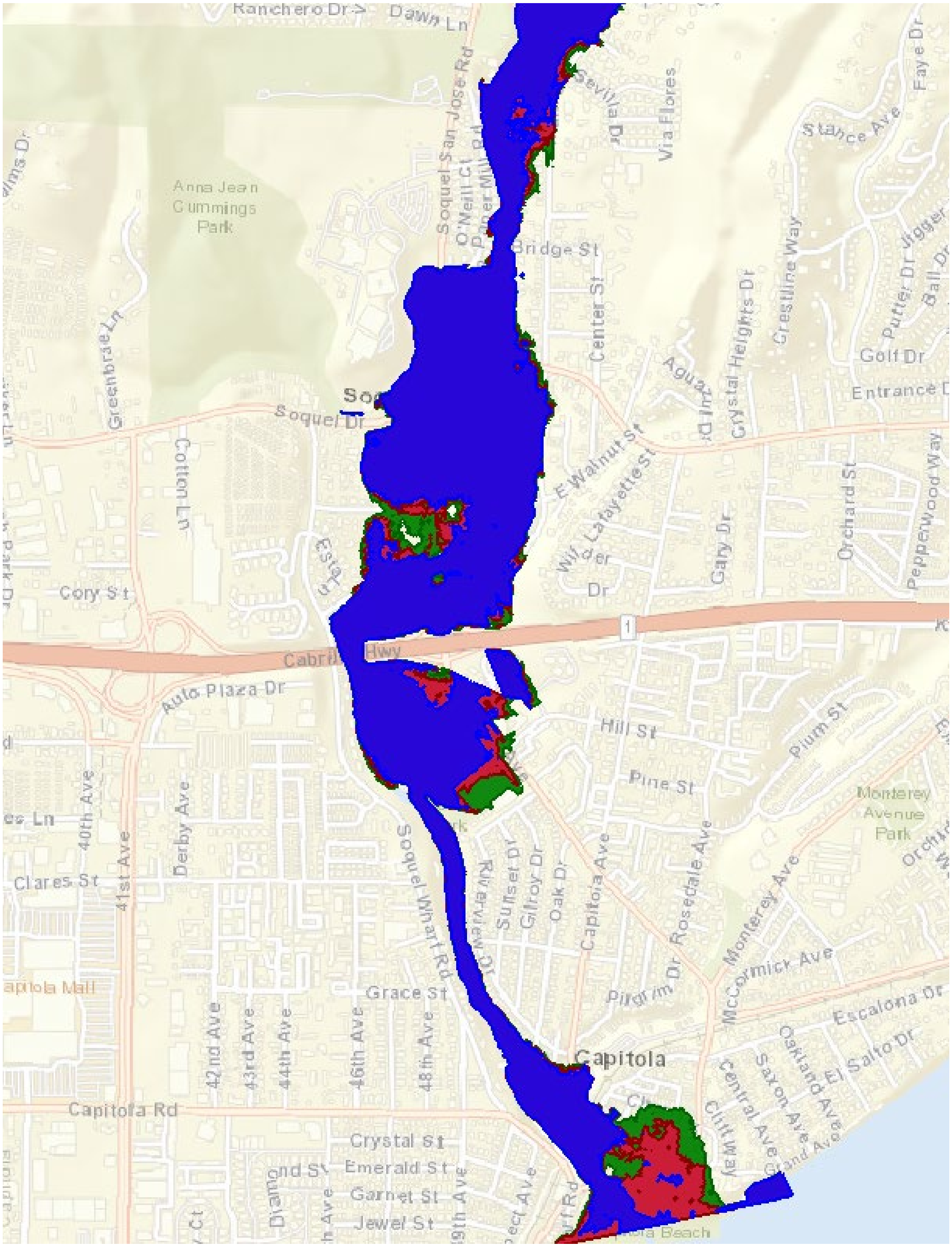


Figure 5-4: Soquel Creek HEC-RAS Climate Change Model Inundation, Including Existing Conditions (Blue), 3 Feet of SLR with 12% Increase in Runoff (Red), and 6 Feet of SLR with 25% Increase in Runoff (Green)

5.2.3.2 Arana Gulch

Arana Gulch lies near the boundary between Zone 5 and the City of Santa Cruz. Ownership of culvert facilities along the channel varies. A reach of Arana Gulch from Highway 1 (Soquel Avenue) to just downstream of the culvert crossing Capitola Road has been evaluated with a 1-dimensional, steady state HEC-RAS model.

Climate change impacts were modeled for Arana Gulch by increasing peak flow rates by 25%. A 100-year inundation extent for existing conditions with the FEMA effective flow rate is compared to the 100-year inundation extent with climate change in Figure 5-5. Sea level rise does not impact the reach of Arana Gulch analyzed for this effort. Creek elevations are well above even 100-year tidal water surface elevations.

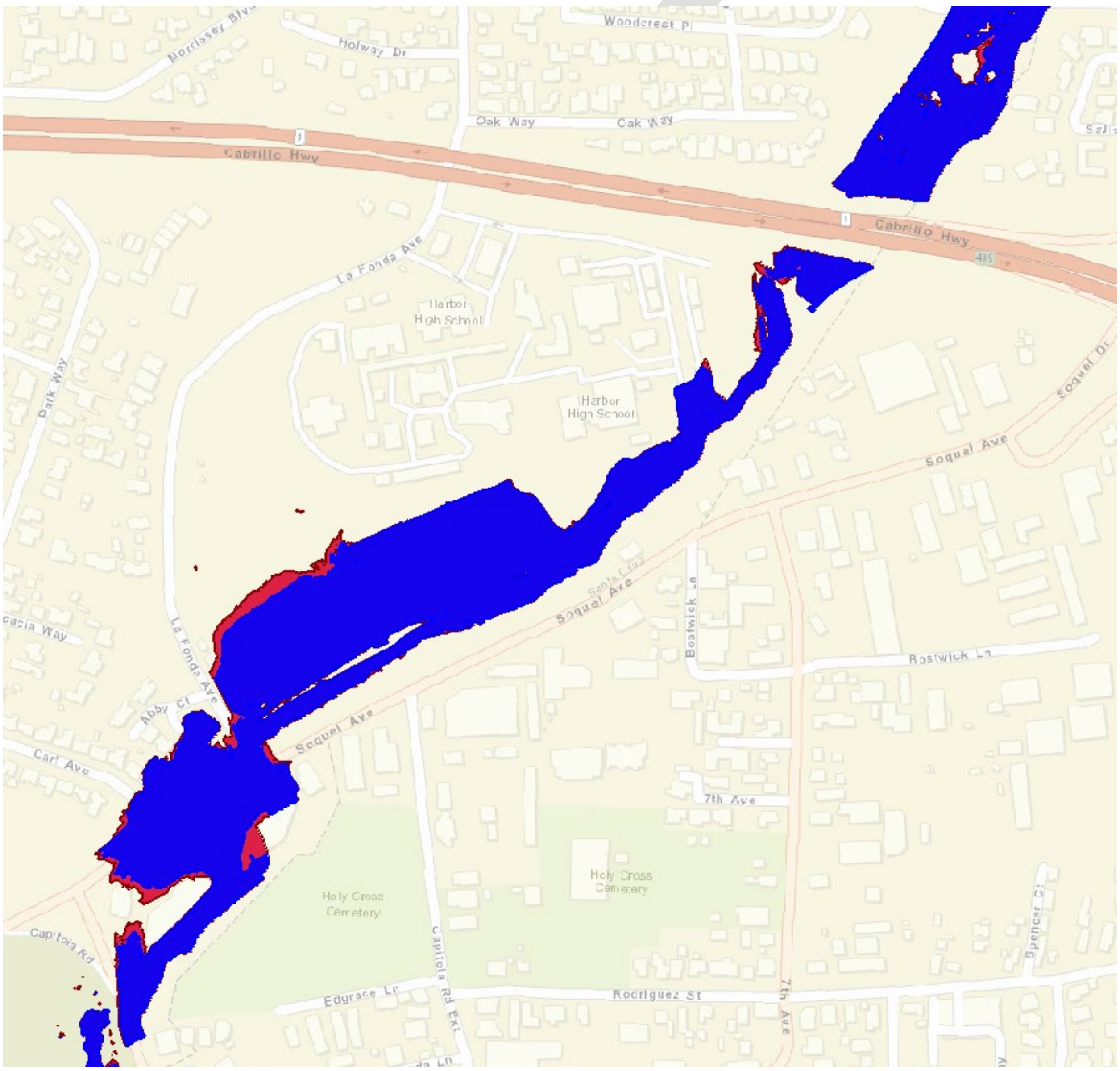


Figure 5-5: 100-year Inundation Extents for Existing Conditions (Blue) and for the Existing Channel and Culverts with 25% Increase in Flow Rates (Red)

5.2.3.3 Rodeo Gulch

Rodeo Gulch is more deeply incised than Soquel Creek, with depths from the upper banks to the thalweg of 40 feet or more. The gulch appears to easily contain an estimated 100-year discharge within the boundary of Zone 5. Flooding has not been observed around Rodeo Gulch that would have been caused by a lack of open channel conveyance at this location.

The HEC-RAS model built for Rodeo Gulch indicates that the 100-year flow rate is well contained in the absence of highly constricted culvert crossings and with a downstream tidal water surface boundary of 10.5 ft NAVD.

Climate change impacts were evaluated with similar conditions to those used for Soquel Creek (3 feet of SLR with a 12% increase in 100-year peak flows and 6 feet of SLR with a 25% increase in peak flows). Results of this modeling exercise are shown in Figure 5-6.

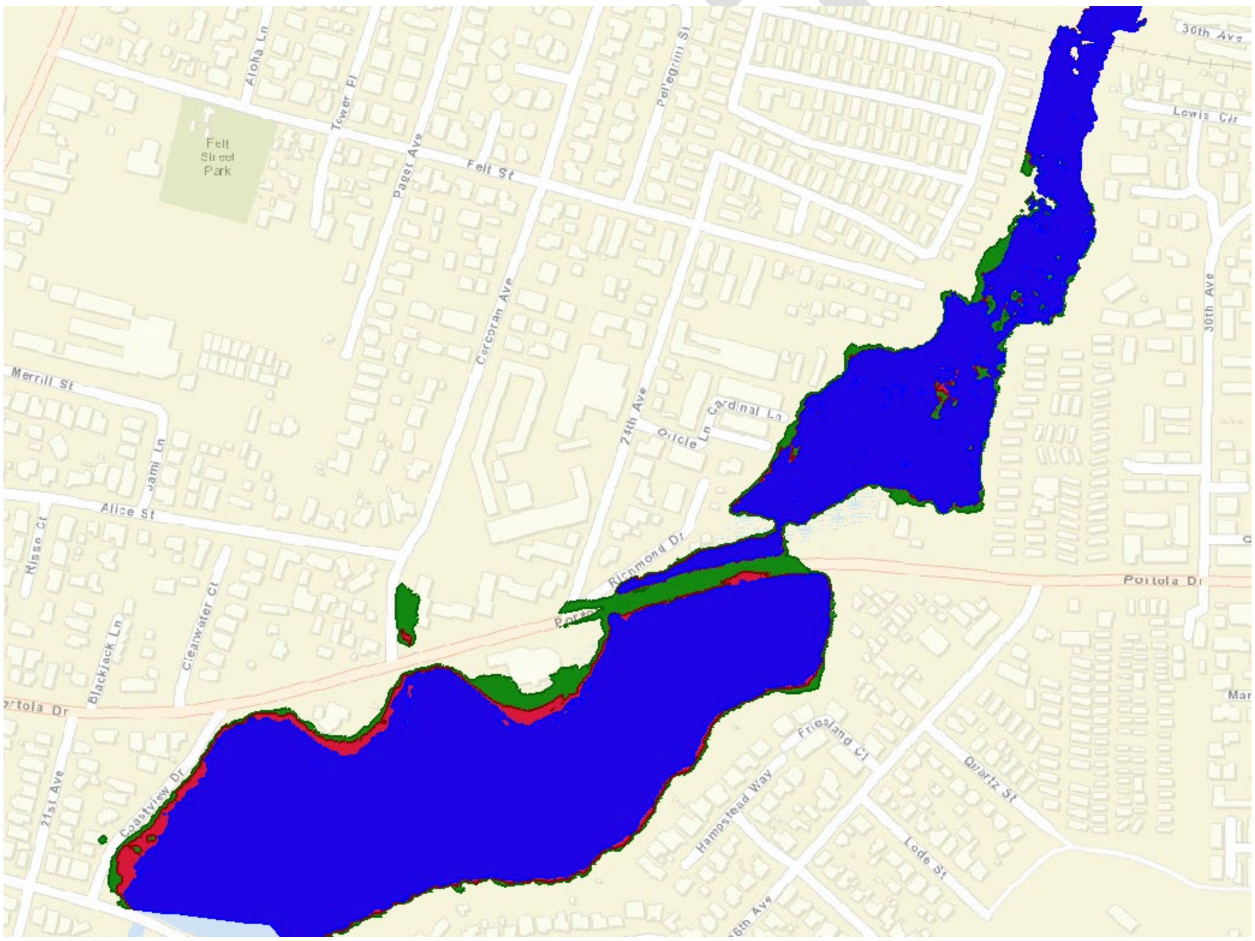


Figure 5-6: Rodeo Gulch HEC-RAS Climate Change Model Inundation, Including Existing Condition (Blue), 3 Feet of SLR with 12% Increase in Runoff (Red), and 6 Feet of SLR with 25% Increase in Runoff (Green)

Climate change impacts are generally isolated to the less incised reach of Rodeo Gulch, downstream of the railroad crossing. Lower reaches of this creek may become more susceptible to tidal boundaries with SLR. The climate change model indicates that the Portola Drive crossing is inundated with high tides and a 100-year peak inflow. However, there does not appear to be extreme risk to structures based on SLR and increased riverine flows alone. This does not consider any increased threat from coastal erosion or waves.

5.2.3.4 Noble Gulch

A simple HEC-RAS model of the Noble Creek Gulch channel has also been developed. However, this channel is included in the SWMM model with the closed-conduit systems and culverts that are the primary limit on capacity. Nonetheless, the HEC-RAS model helps to confirm that the channel upstream of Bay Avenue has sufficient capacity to handle a 25-year event. The capacity restrictions in the system are therefore isolated to culverts that are not large enough to convey 25-year peak flows.

The HEC-RAS model has also been used to evaluate the 100-year event peak flow rate and climate change impacts on the channel for two scenarios. In the first scenario, the existing culverts remain in place and in the second, the proposed capacity improvements to the culverts are constructed.

Figure 5-7: Noble 100-yr HEC-RAS (with Existing Culverts) Climate Change Model Inundation, Including Existing Condition (Blue), with 12% Increase in Runoff (Red), and with 25% Increase in Runoff (Green)

Figure 5-8: Noble 100-yr HEC-RAS (with CIPs Constructed) Climate Change Model Inundation, Including Existing Condition (Blue), with 12% Increase in Runoff (Red), and with 25% Increase in Runoff (Green)

The model results indicate that with the proposed CIP projects completed (Noble Upstream and Noble Downstream), there is some improvement in the 100-year floodplain. However, even with the CIPs in place, the channel itself lacks conveyance capacity to contain the 100-year peak flow rate. For both scenarios, increased precipitation depth and flow rate associated with climate change predictions does increase flooding outside of the channel and could impact some properties around Plum Street.

5.3 Capital Improvements

Recommendations for capital improvements to the regional systems are broken into two primary categories. One is intended to target reaches of the system in poor condition that are not capacity deficient. The second deals with actual system capacity (pipe and inlets) in the absence of high tailwater in receiving bodies (lakes, lagoons, creeks, etc.).

A summary of all capital improvement projects by priority (including larger repair or pipe lining projects and in-kind replacements of existing pipe in poor condition) is provided in Table 5-1. This does not include smaller repairs or cleaning.

Table 5-1: Capital Improvement Summary by Priority (Capacity Improvements and Repair and Replacement Projects)

Priority	Number of Projects	Length of Pipe*	Cost*
High	6	8,110 – 10,210	$22,590,000 - $47,560,000
Moderate	6	1,880 – 3,600	$7,320,000 - $7,730,000
Low	6	2,800	$7,560,000

**For certain projects, multiple alternatives result in a wide variance in cost and pipe length*

Maintenance items are also identified in this chapter where CCTV or pipe inspection indicated that a significant amount of debris and sediment accumulation or vegetation overgrowth has occurred, but pipes are in otherwise serviceable condition. The cost of these O&M items are not included as capital improvements.

5.3.1 Condition/Maintenance Projects

The system condition evaluation revealed some locations where the system is in need of replacement due to structural defects. These projects are identified separately from capacity-related projects and have been prioritized based on the severity of identified deficiency. Their purpose is to maintain existing capacity and ensure that failure of a system does not cause flooding.

Some recommended projects are driven completely by the observed condition of one or more system elements (structures, pipes, etc.). O&M issues identified by CCTV and inspection for the development of this SDMP are highlighted in Table 5-2. These are generally locations where sediment and debris has accumulated and may have a mild impact on system capacity or small spot repairs may be needed, but the pipes are in otherwise serviceable condition. They do not carry capital cost, but they allow for prioritization of O&M in portions of the system as part of regular maintenance practices.

Projects where there are structural deficiencies (partial or complete failure of pipe, including severe corrosion or cracking) that necessitate more extensive repair or full replacement are identified in Table 5-3. These projects do not overlap with a capacity deficiency identified by the models. Some are located near capacity projects, making it potentially worth combining these O&M and repair projects with adjacent construction projects.

Table 5-2: Priority Maintenance Project Summary

Project	Name	Description	Approx. Length (ft)
OM1	Tremont Drive Sediment Management	Remove high levels of sediment accumulation from pipes at the end of Tremont Dr	310
OM2	14th Avenue Sediment Management	Remove sediment, debris, and standing water from pipes on 14th Ave	360
OM3	Soquel Drive Open Channel Vegetation Management	Vegetation management in Crystal Heights Ditch and Monterey Ave Ditch 4 on the north side of Soquel Dr	1,220
OM4	Jade St Park near 47th Ave	Remove settled materials from pipe system at Jade Park near 47th Ave	300
OM5	Corcoran Cleaning	Remove settled materials and small debris from pipe system at Corcoran Ave	590
OM6	17th Ave Cleaning	Remove settled materials from pipe system near 17th Ave (downstream of 17th Ave Repair/CIPP and upstream of Soquel at 17th capacity project)	305
OM7	41st Ave Cleaning	Remove settled materials from pipe system upstream of 41st Ave near Capitola Mall	555
OM8	Soquel Dr near Porter Cleaning/Repair	Remove sediment deposits from concrete box; spot repair for old plywood repair	350
OM9	Soquel Dr at Farm Park Cleaning/Repair	Remove sediment deposits; spot repairs for displaced or strained joints	500
OM10	Alturas Cleaning	Remove sediment deposits and tree debris obstructing pipe	170

Table 5-3: Priority Structural Deficiency Project Summary (Replacement or Repair)

Project	Name	Length (ft)	Diameter (inches)
RR1	38th Ave (Railroad to Star Lane)**	1,020	54-72
RR2	26th Ave (East Cliff to Outfall)	465	12
RR3	Leona Creek Culvert at Capitola Road	185	66
RR4	Webster Street near Pinewood	120	60
RR5	17th Ave Repair/CIPP*	340	54
RR6	41st Ave Repair/CIPP (at Capitola Mall)*	86	42
RR7	Aguazul to Douglas Dr CIPP (near Soquel Dr)*	155	36

**Repair project (assumed CIPP for all). Other projects are assumed to be replacements.*
***Overlaps with some capacity project alternatives. May not be required as an in independent project*

Condition-driven projects are prioritized based on the severity of identified defects. The project locations and priorities are shown in Figure 5-9 (OM numbered projects) and in**Error! Reference source not found.** Figure 5-10 (RR numbered projects).

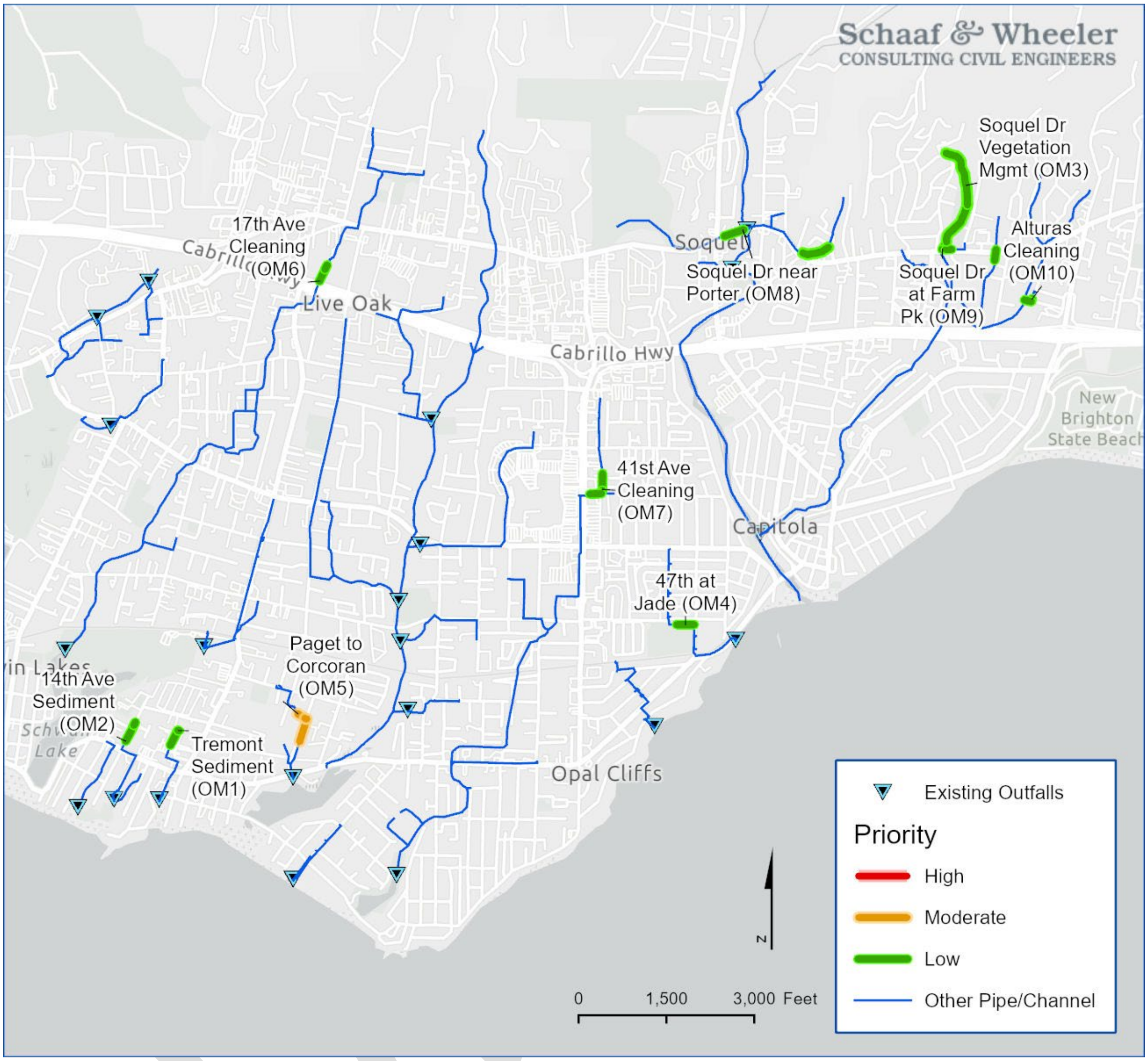


Figure 5-9: Overview Map of Prioritized System Maintenance (OM) Needs

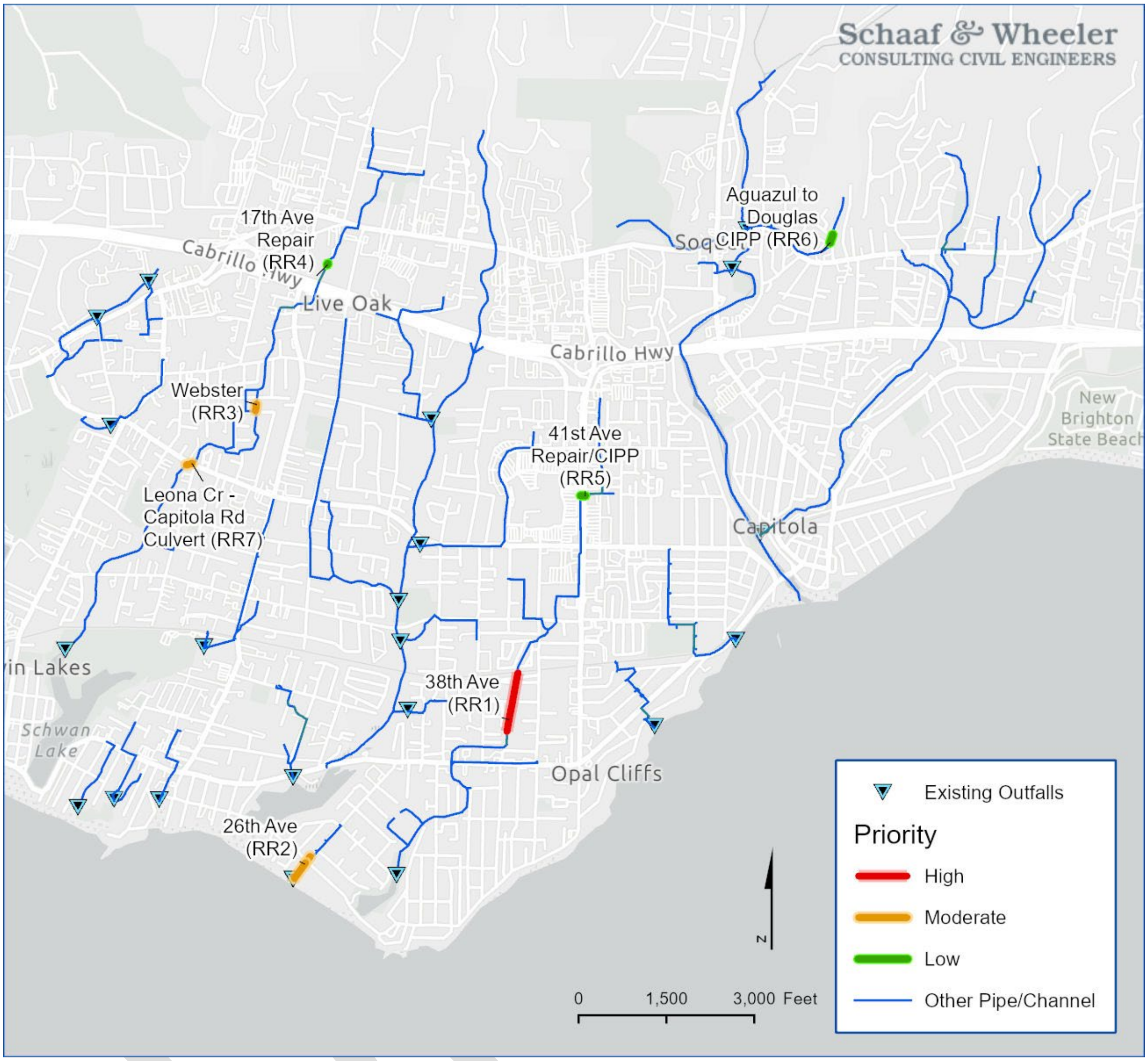


Figure 5-10: Overview Map of Prioritized System Repair & Replacement (RR) Projects

5.3.2 Capacity-Related Projects

Capacity-related projects are identified to mitigate capacity deficiencies. None of the identified capacity deficiencies occur where system condition ratings of "Poor" or worse were identified. Projects are shown in Figure 5-11 and summarized in Table 5-4. Model results with all baseline capital improvement projects (no project alternatives) complete are shown in Figure 5-12.

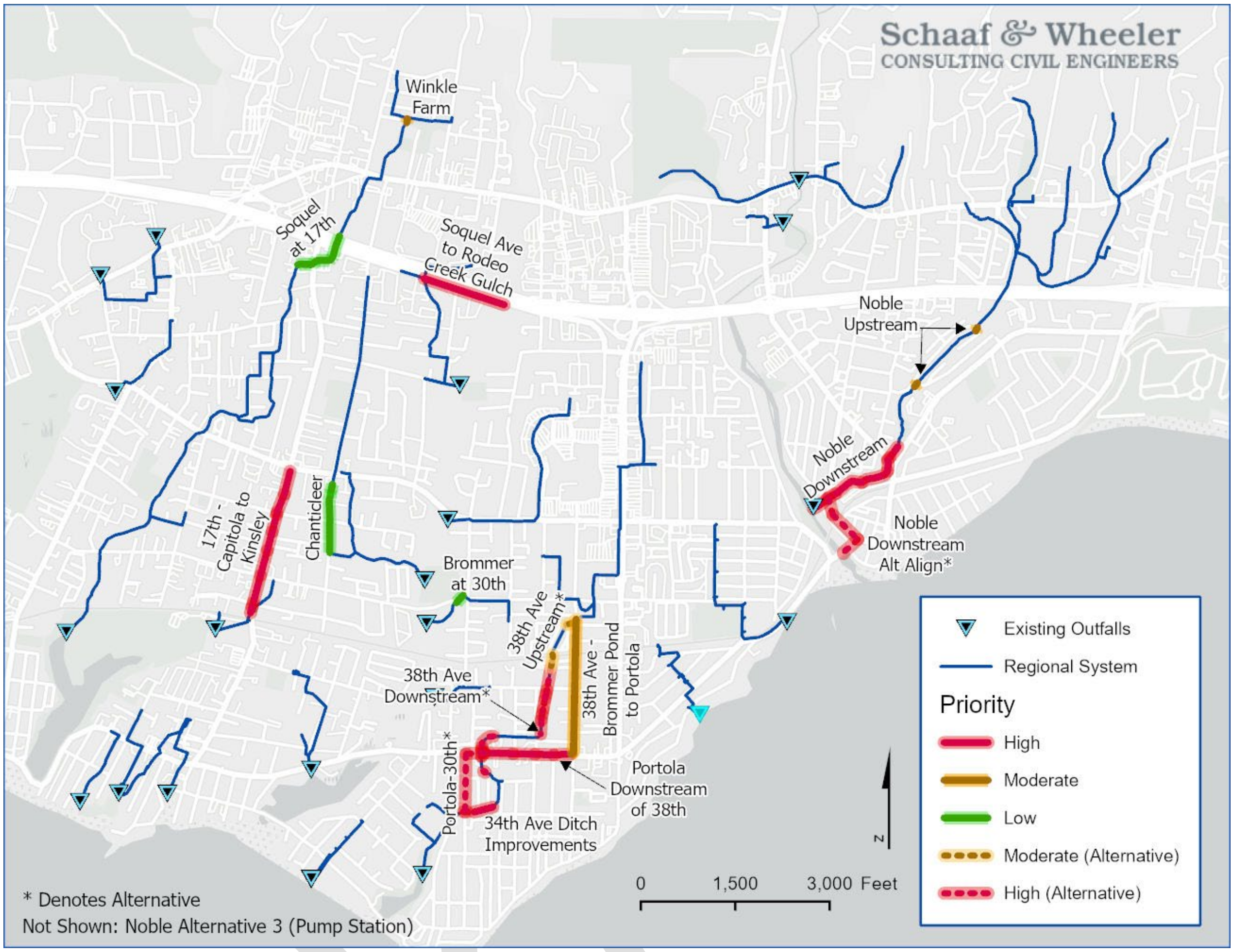


Figure 5-11: Map of Prioritized System Capacity Projects

Table 5-4: Capital Improvement Projects Summary (Capacity-Driven)

ID	Project	Length (ft)	Pipe Diameters (in)
1	17th - Capitola to Kinsley	2,340	30-42
2	34th Ave Ditch Improvements	400	84-144**
*2A**	*Portola-30th (34th Avenue Ditch Alternative)*	*1,250*	*36*
3	Portola Downstream of 38th	1,495	48
*3A**	*38th Ave Downstream*	*1,515*	*48**-84***
4	Noble Downstream	1,515	120**-144**
*4A**	*Noble Downstream (Alt. Gravity Alignment)*	*2,750*	*84-144***
*4B**	*Noble Downstream (600 cfs Pump Station)*	*1,550*	*72-144***
5	Soquel Avenue to Rodeo Creek Gulch	1,340	42
6	38th Avenue - Brommer Pond to Portola	2,115	36
*6A**	*38th Ave Upstream*	*395*	*48**-72***
7	Noble Upstream	660	120**-144**
8	Winkle Farm	65	42
9	Brommer at 30th	160	30
10	Chanticleer	1,100	42
11	Soquel at 17th	960	84-144**
	Total:	***10,430-14,255***	

**Project alternatives identified*

***Represents a nearest equivalent circular pipe diameter for a proposed box culvert*

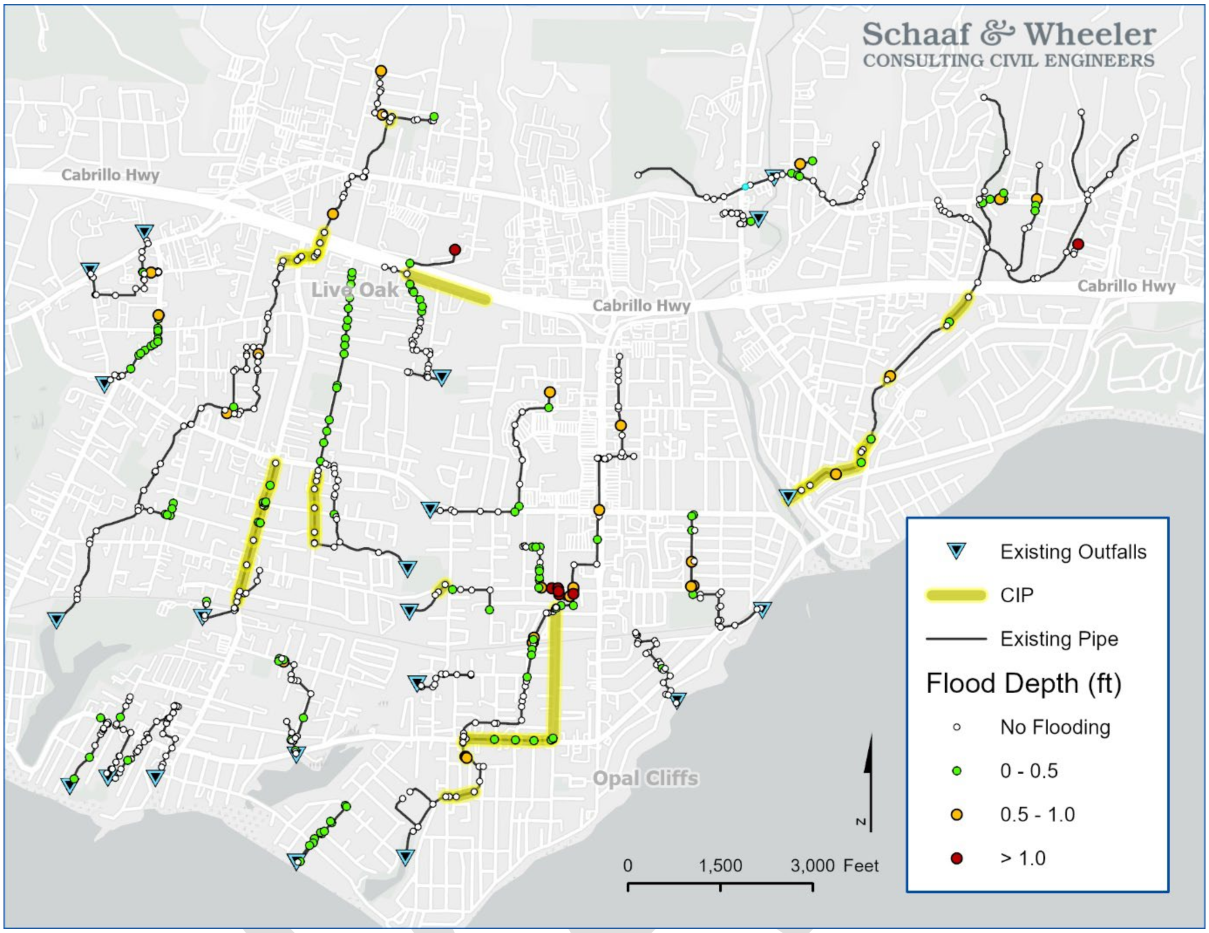


Figure 5-12: Modeled Flood Depth for Baseline Capital Improvement Projects

In some cases, it may not be feasible to meet the desired 25-year standard at every node within Zone 5. Reasons may include constraints on how large system elements can be, utilities or such extensive private property impacts that the construction of new drainage infrastructure along existing alignments is infeasible. Residual flooding beyond 6 inches in depth may also remain at single, isolated nodes in the system. At many of these locations, flooding is not likely to reach the modeled depths since the surrounding topography may provide relief and surface conveyance to portions of the system where capacity is available immediately downslope.

5.3.2.1 Capacity Project Alternatives

For most identified projects, the existing system has been upsized to mitigate capacity deficiencies without changing its alignment. Alternatives for any project that should be explored at a design level include:

1. Installation of parallel pipe in lieu of removal and replacement with larger pipe;

2. Daylighting systems into open channel conveyances where opportunities arise (e.g., development/redevelopment proposals); and

3. Alternative alignments that may address unexpected conflicts with private properties or utilities.

Parallel pipe alternatives take advantage of existing system capacity and may reduce the cost of increasing capacity, allowing for the installation of smaller pipes and circumventing the need for removal and disposal of existing systems that may be in serviceable condition. This may not be the best solution for systems where existing pipe is both capacity deficient and has limited remaining service life.

Daylighting systems into open channel conveyances generally requires a similar level of capital investment as pipe replacement projects, but the approach has numerous benefits. Stormwater conveyance can be integrated into landscaping as a beautification measure, open channels are more accessible for maintenance purposes, and there may be significantly lower replacement cost. This may not be possible for pipe systems along highly trafficked roadways. However, if transportation projects or redevelopment of private properties occurs where stormwater conveyance is in need of capital investment, that may be leveraged to explore these alternatives.

In some cases, alternatives have been identified to address obvious challenges to projects on existing pipe alignments.

Alternatives for two projects are shown in Figure 5-11 that warrant some additional discussion: 34th Avenue Ditch and Noble Downstream. Because much of the existing alignment would be challenging to upsize due to property ownership, these projects have been examined more closely for less costly or disruptive alternatives.

The CIP cost estimates for these projects do include assumptions of property acquisition cost based on approximate property values in the vicinity of the projects. It is likely that for both of these projects, an easement on its own will not be sufficient to construct them. For the purposes of this analysis, it is assumed that property acquisition will be required. This is because some existing systems pass underneath structures or proposed conveyances would need to be installed within the footprint of existing structures.

34th Avenue Ditch Project

The 34th Avenue Ditch project includes an existing 72-inch pipe that runs beneath a mobile home park between 34th Avenue and 30th Avenue. Even if this project is constructible, it is likely that the cost would be much higher than a standard open trenching approach, and it would remain disruptive to residents. Instead, an alternative alignment of new pipe is proposed along Portola Drive and 30th Avenue, intersecting the new system again at the existing outfall location into the channel upstream of Moran Lake. While this would increase the length of pipe required for the project, it would place conveyance within the right-of-way.

Noble

In a similar fashion, Noble Downstream includes a large box culvert that runs through easements across properties on the west side of Capitola Ave. It may not be feasible to protect existing structures if these box sections are to be upsized all the way to Soquel Creek. Instead, a reach of approximately 1,200 feet of new 84-inch pipe would stretch from near Riverview Drive, along Capitola Avenue and Stockton Avenue to a new outfall at Stockton Avenue Bridge.

A second alternative exists at this location. Rather than constructing a long reach of new pipe and a new outfall, a pump station could be constructed in or adjacent to the parking lot near the City Hall building, with a forcemain running through or adjacent to the existing box and outfall to

Soquel Creek. However, it is likely that this option would be far more costly and would eliminate parking spaces in the existing lot (a portion of the lot would be replaced with a wetwell, access points, and a control building). This analysis assumes that the existing undersized gravity outfall continues to function in some capacity.

The flood depth result with the Portola-30th and Noble Downstream Alternative 1 projects is shown in Figure 5-13. Flood depth results are shown with the Noble Pump Station Alternative in Figure 5-14.

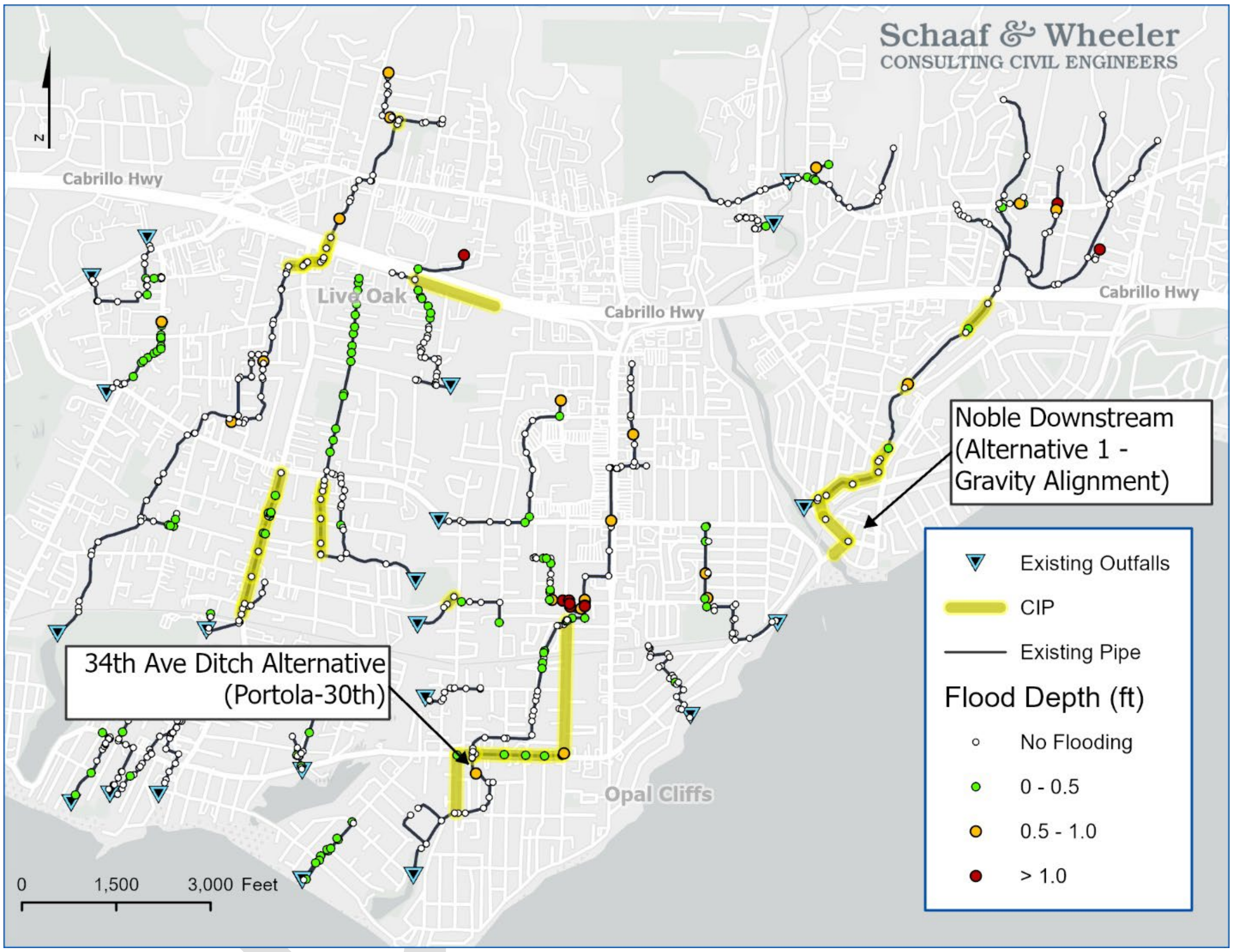


Figure 5-13: Modeled Flood Depth for Alternative Projects Avoiding Private Property Impact

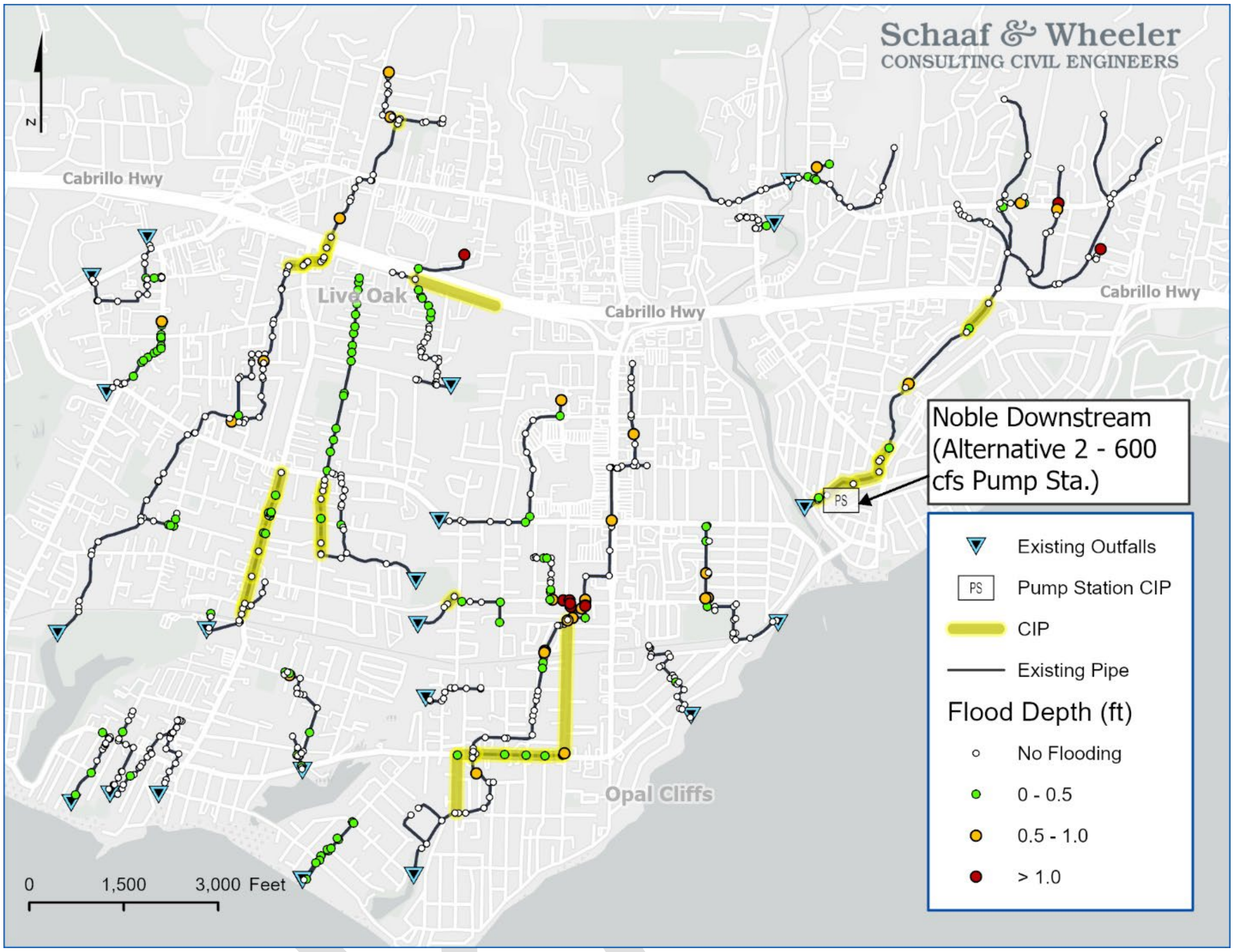


Figure 5-14: Modeled Flood Depth with a 600 cfs Pump Station Noble Alternative

38th Avenue

Systems in the vicinity of 38th Avenue pose a particular challenge. Flooding is prevalent upstream of the railroad, surrounding the existing detention basin at Brommer and 38th. The existing alignment from 38th Avenue to Portola Drive consists of a mix of very shallow closed conduit and open channel systems running through mobile home parks. This also includes a shallow, undersized railroad crossing in close proximity to the nearby mobile homes. Furthermore, a long reach of the closed conduit system was examined by CCTV and deemed in need of immediate attention for structural deficiencies.

Two projects are identified within public right of way that address the upstream flooding: ‘38th from Brommer to Portola’ (Moderate priority) and ‘Portola Downstream of 38th’ (High priority). These projects rely on restoring the existing systems by completing repair and replacement project RR1. In theory, equivalent capacity could be provided along the existing alignment. Alternatives to the two preferred projects have been explored.

However, since the system is extremely shallow, it’s assumed that this would require installation of boxes with a depth equivalent to existing systems. This means that proposed systems for the two identified projects must be wider than existing systems. Existing systems are already situated beneath approximately 40 mobile homes. The cost of the two alternatives reflects the temporary relocation of residents of the 40 mobile homes (36 for the downstream, high priority project and 4 for the upstream, moderate priority project).

5.3.2.2 Downstream Boundary Conditions

Projects have been initially developed with free outfall conditions. However, the models have been adapted to include constant water surface conditions in the downstream receiving bodies as well. Generally speaking, the regional system continues to perform well in spite of tailwater conditions at outfalls. The exception is systems along Soquel Creek. Upstream of Highway 1, this is not an issue that can be addressed by upsizing gravity systems, as floodplains extend well beyond the banks of the creek and inundate stormwater systems (as shown in Figure 2-3). This would require larger flood protection projects, as described in Section 5.2.3.

In particular, the Noble Downstream project should be carefully considered in light of potential tailwater conditions. At this location, the model includes boundary conditions representing a 25-year water surface elevation in Soquel Creek to evaluate the three alternatives for Noble Creek. Water surfaces have been set to an approximate elevation of 15 feet NAVD at the existing outfall near Riverview Avenue and elevation 14 feet at the new Stockton outfall proposed by Noble Creek Alternative 1.

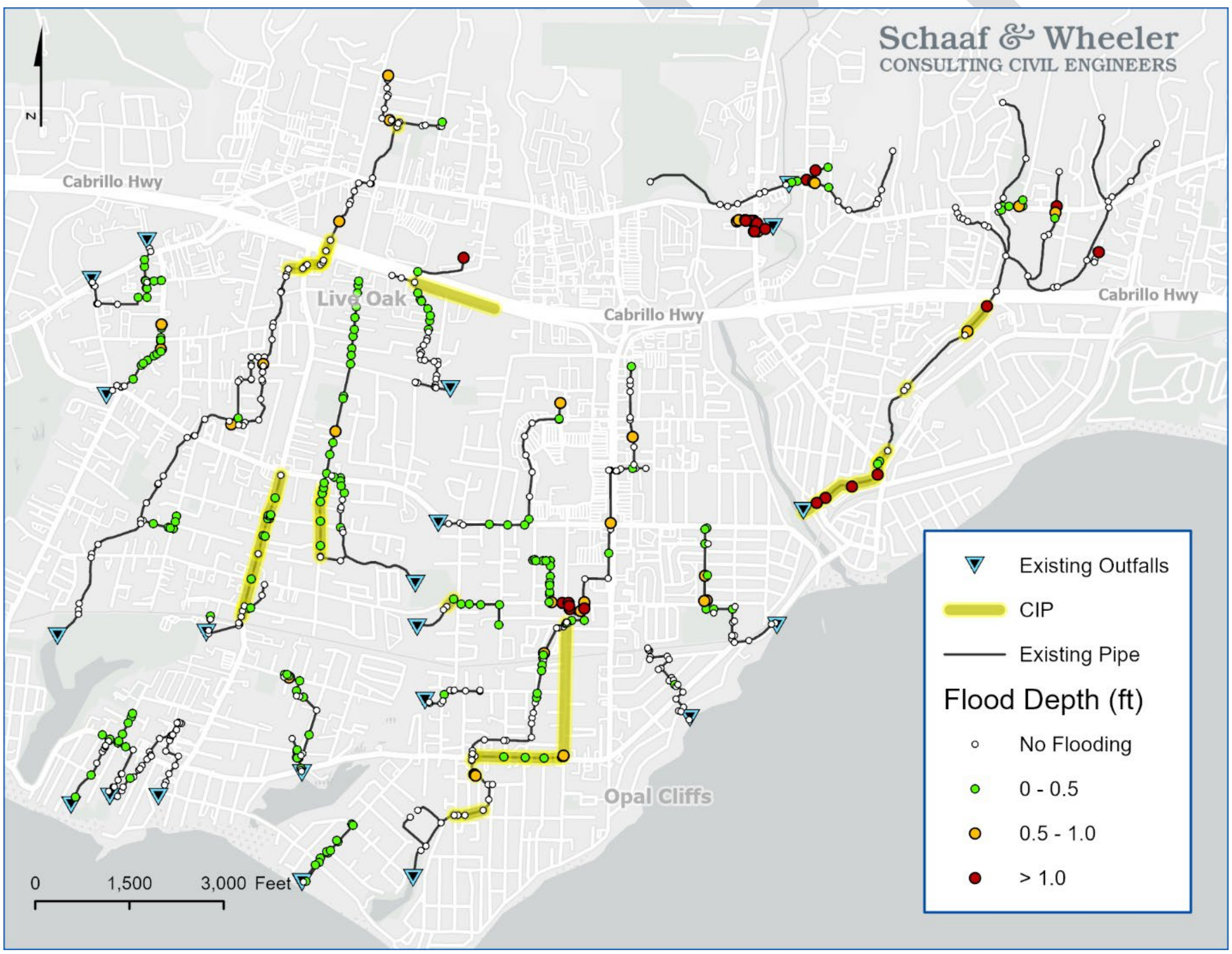


Figure 5-15: Modeled Flood Depth for Baseline Capital Improvement Projects with Boundary Conditions

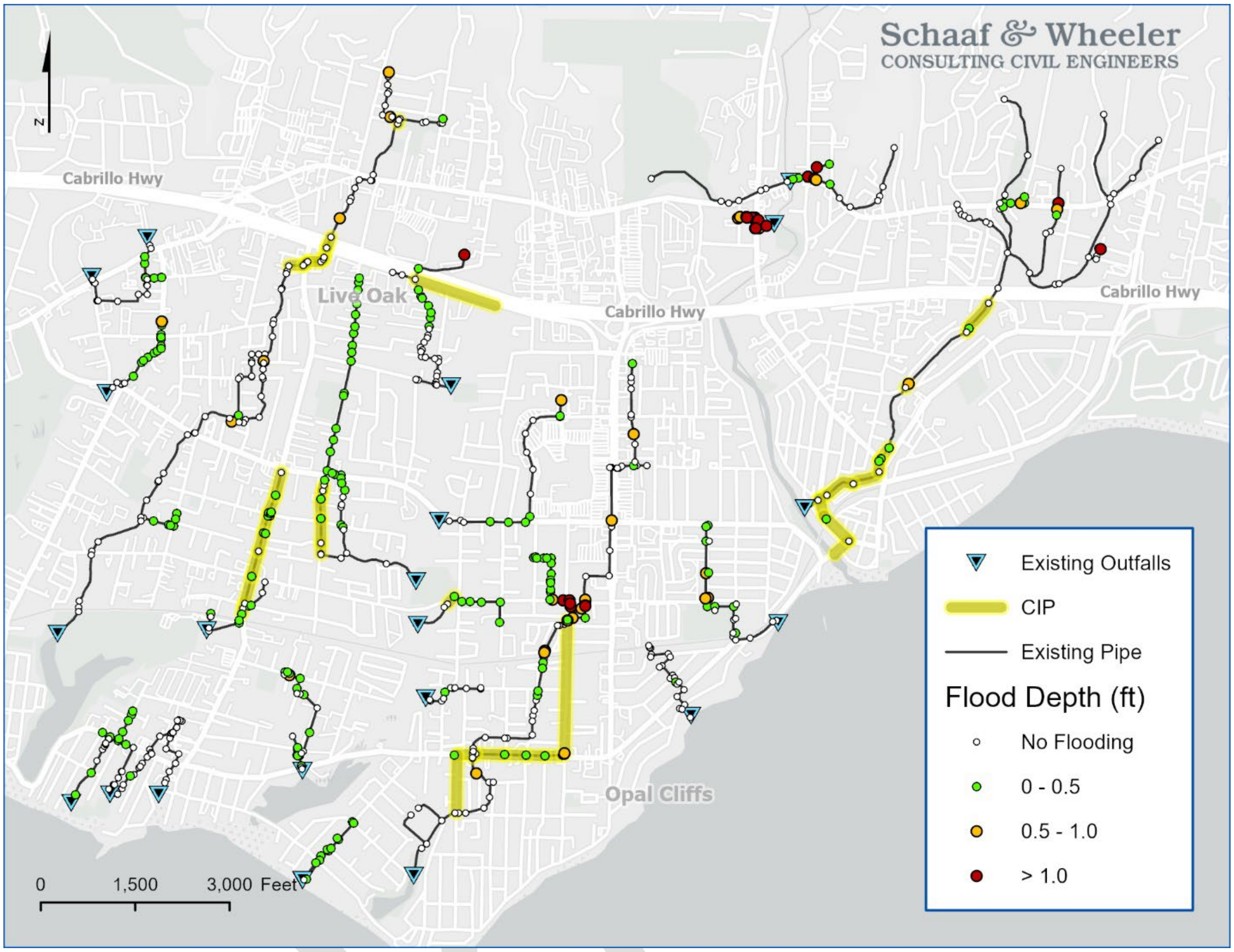


Figure 5-16: Modeled Flood Depth for Alternative 1 Capital Improvement Projects with Boundary Conditions

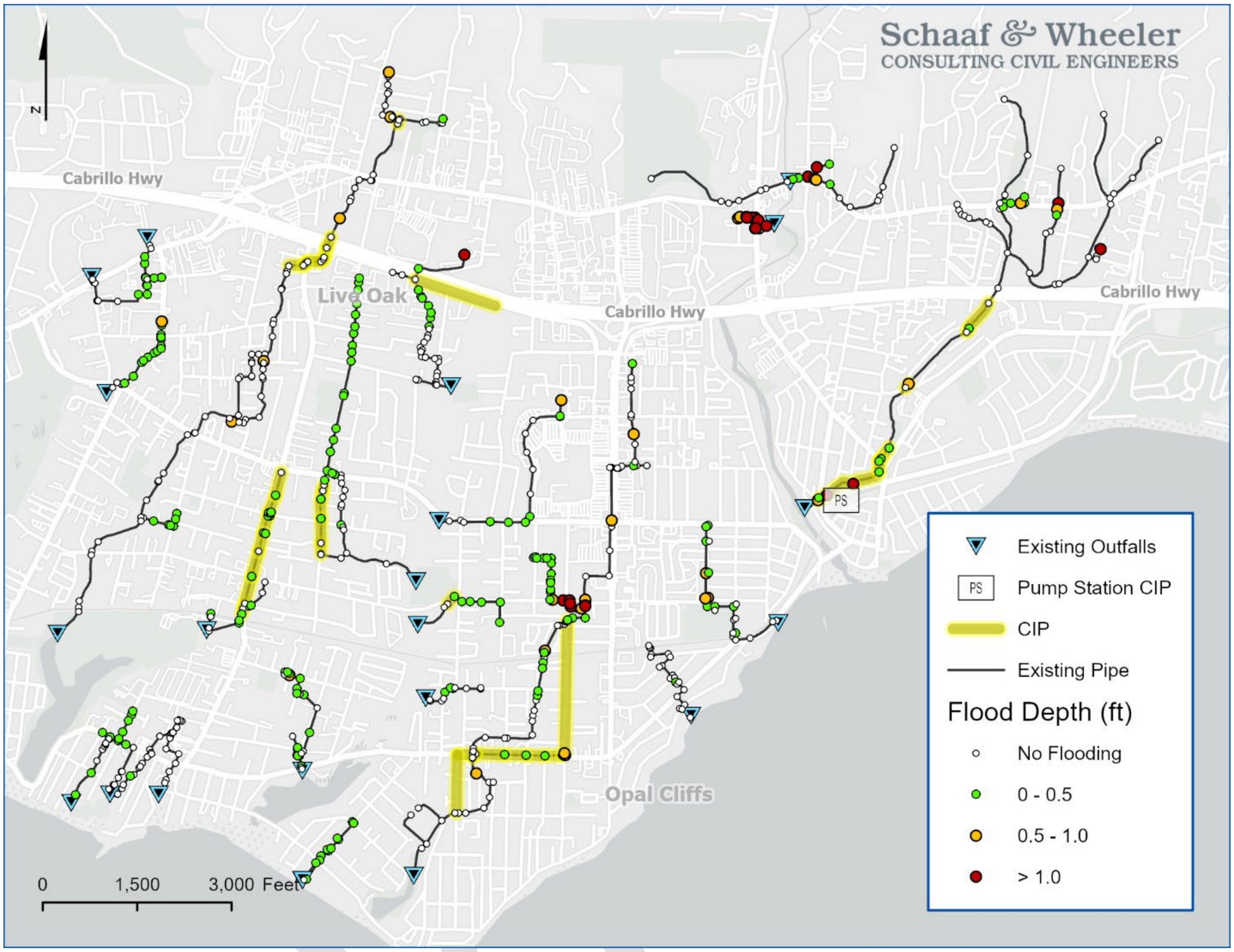


Figure 5-17: Modeled Flood Depth for Alternative 2 Capital Improvement Projects with Boundary Conditions

The model for Alternative 1 with a high-water boundary condition in Soquel Creek shows that performance is still greatly improved with the new 84-inch outfall at Stockton. This is primarily because the tailwater condition is generally more favorable further downstream in the creek.

The model also indicates that for Alternative 2, a 600 cfs pump station does not provide sufficient capacity when the level in Soquel Creek inhibits the existing gravity line from functioning. The pump station still improves the performance of the system but does not meet the 25-year standard. It is likely that if the pump station is brought forward, additional study will be required considering a wide range of conditions.

In addition to construction feasibility, timelines, and cost, resiliency should be factored into the project development process. Climate change is a complex issue, touched on in this plan by adjusting rainfall depths. However, with backwater impacts of SLR potentially impacting outfalls, pumping may become the only reliable option to prevent or reduce flooding in the area. A detailed economic and engineering analysis should be performed at a project level, including consideration of climate resilience programs that may be undertaken by local agencies.

5.3.2.3 Future Condition CIP Performance

Projects explored by this analysis have also been evaluated with the future buildout condition drainage area parameters. The results of this analysis are presented in Figure 5-18 for the baseline capital improvement projects.

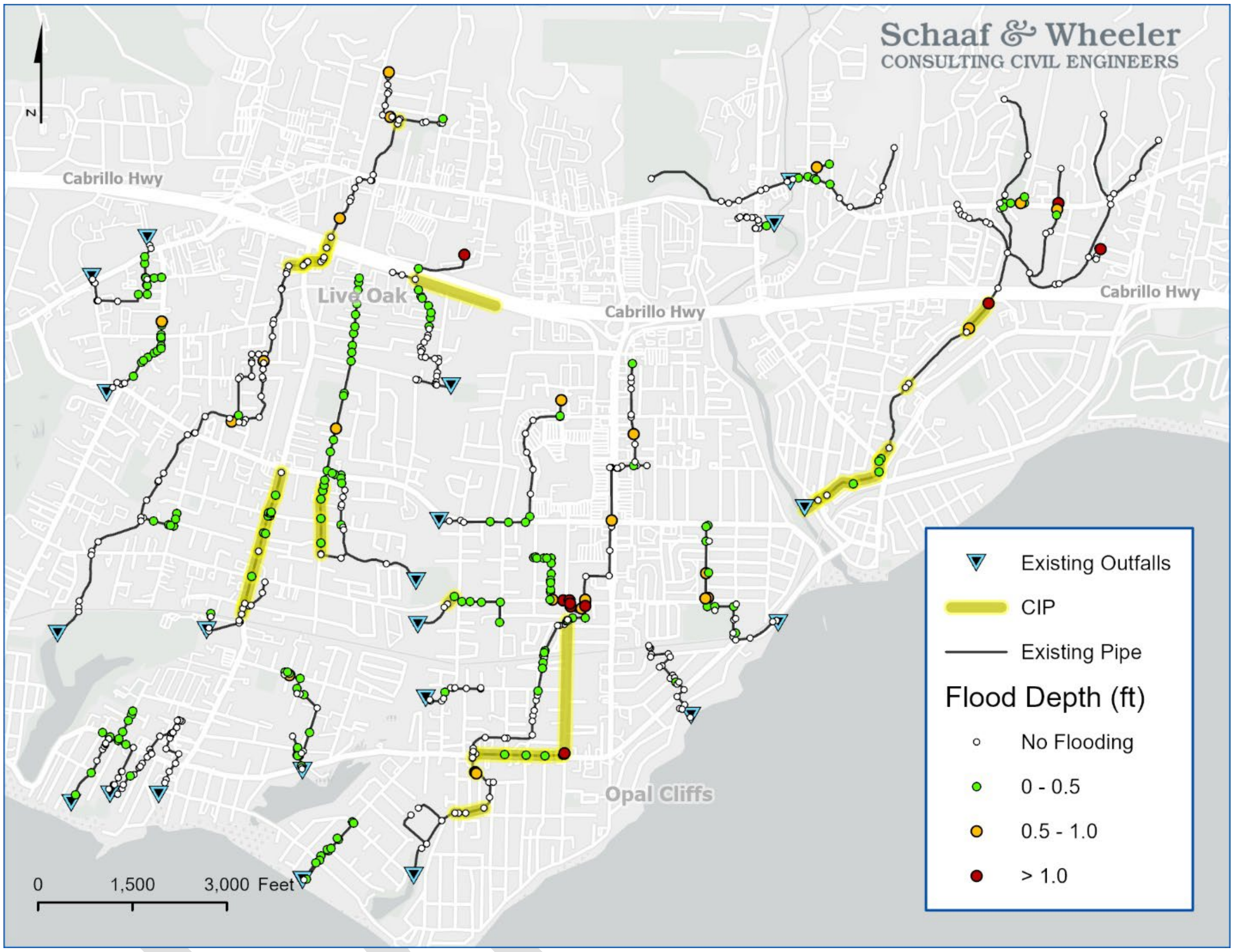


Figure 5-18: Modeled Flood Depth for Baseline Capital Improvement Projects with Future Buildout Catchment Parameters

In order to highlight locations where deficiencies would likely require additional projects or increased pipe sizing, change in flooding depth is highlighted in Figure 5-19.

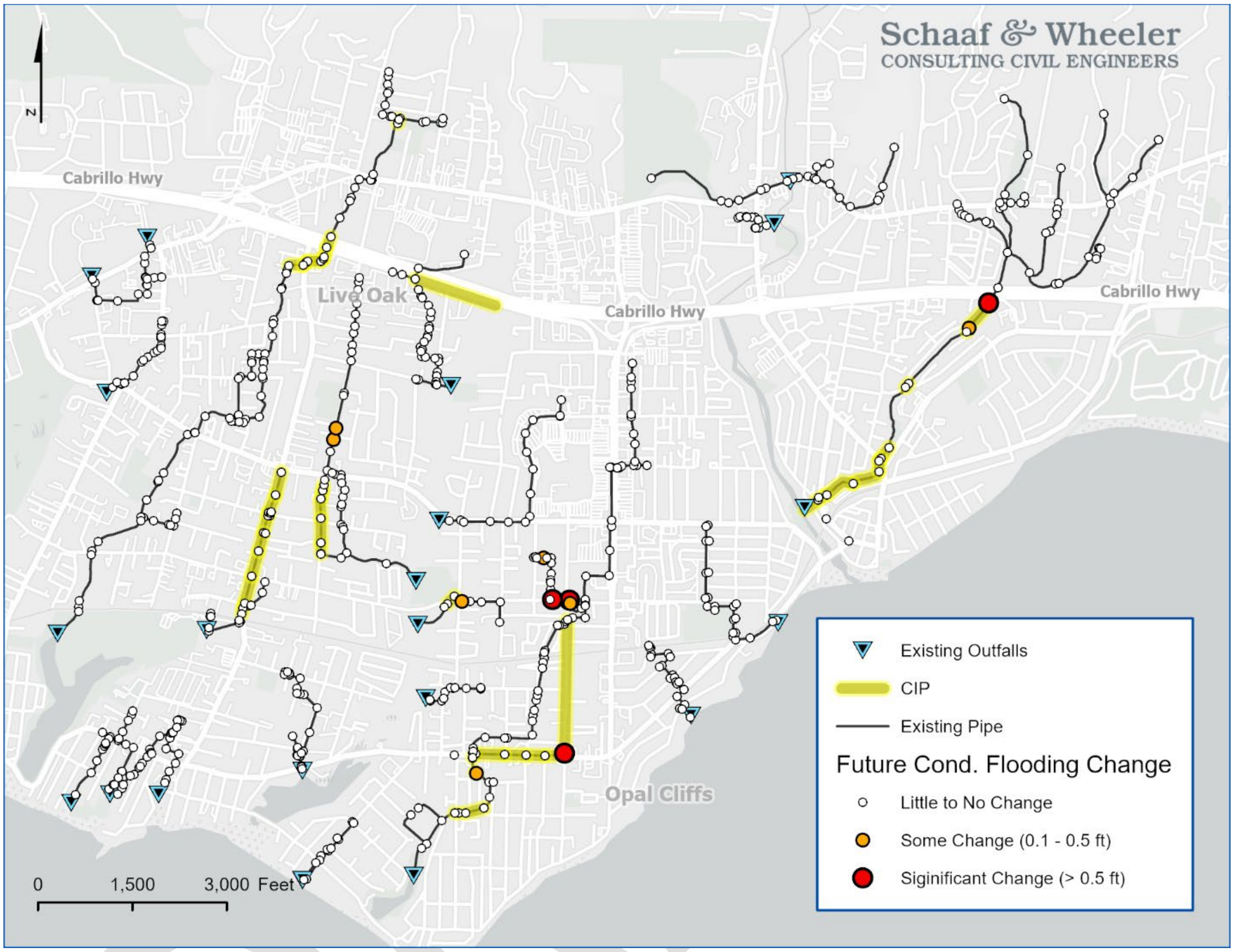


Figure 5-19: Location of Significant System Flooding Impact with Future Condition

The model has been additionally modified with a 25% increase in 24-hour storm depth to account for potential impacts of climate change. This increase has been placed on future buildout catchments. Results of this analysis are presented in Figure 5-20.

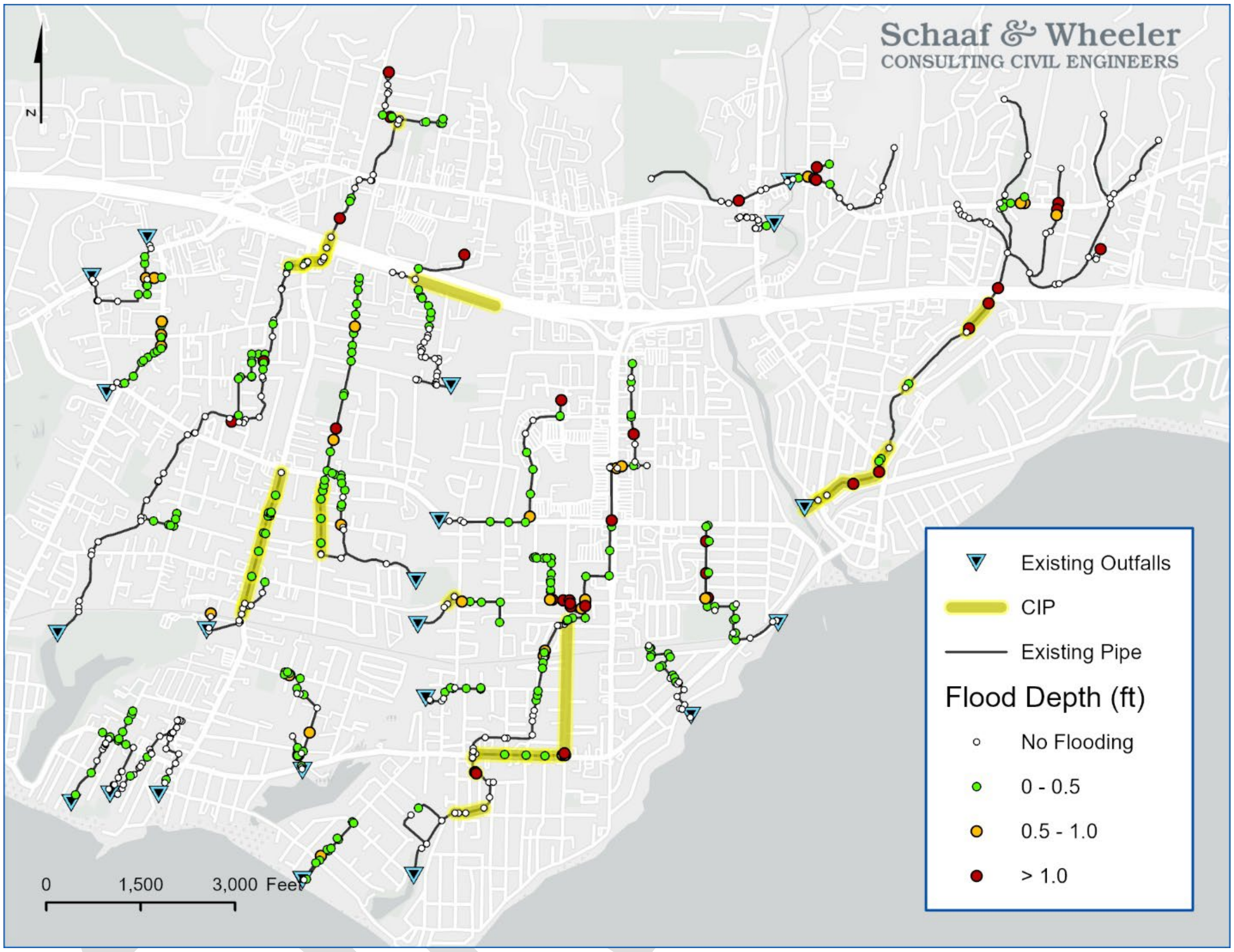


Figure 5-20: Modeled Flood Depth for Baseline Capital Improvement Projects with Future Buildout Catchment Parameters and a 25% Increase in Rainfall Depth

While the model produces the depth of flooding most directly, it is also useful to examine the change in magnitude of flooding. Change in flood depth has been calculated for each node where flooding occurs with and without climate change. The result of this analysis is shown in Figure 5-21. This figure highlights the locations where further planning and design efforts for capital improvements should consider potential climate change impacts to produce the most resilient projects possible. This may be as simple as installing larger pipe for an identified project. However, this analysis also shows significant potential increases in flooding depths where projects are not identified based on current conditions.

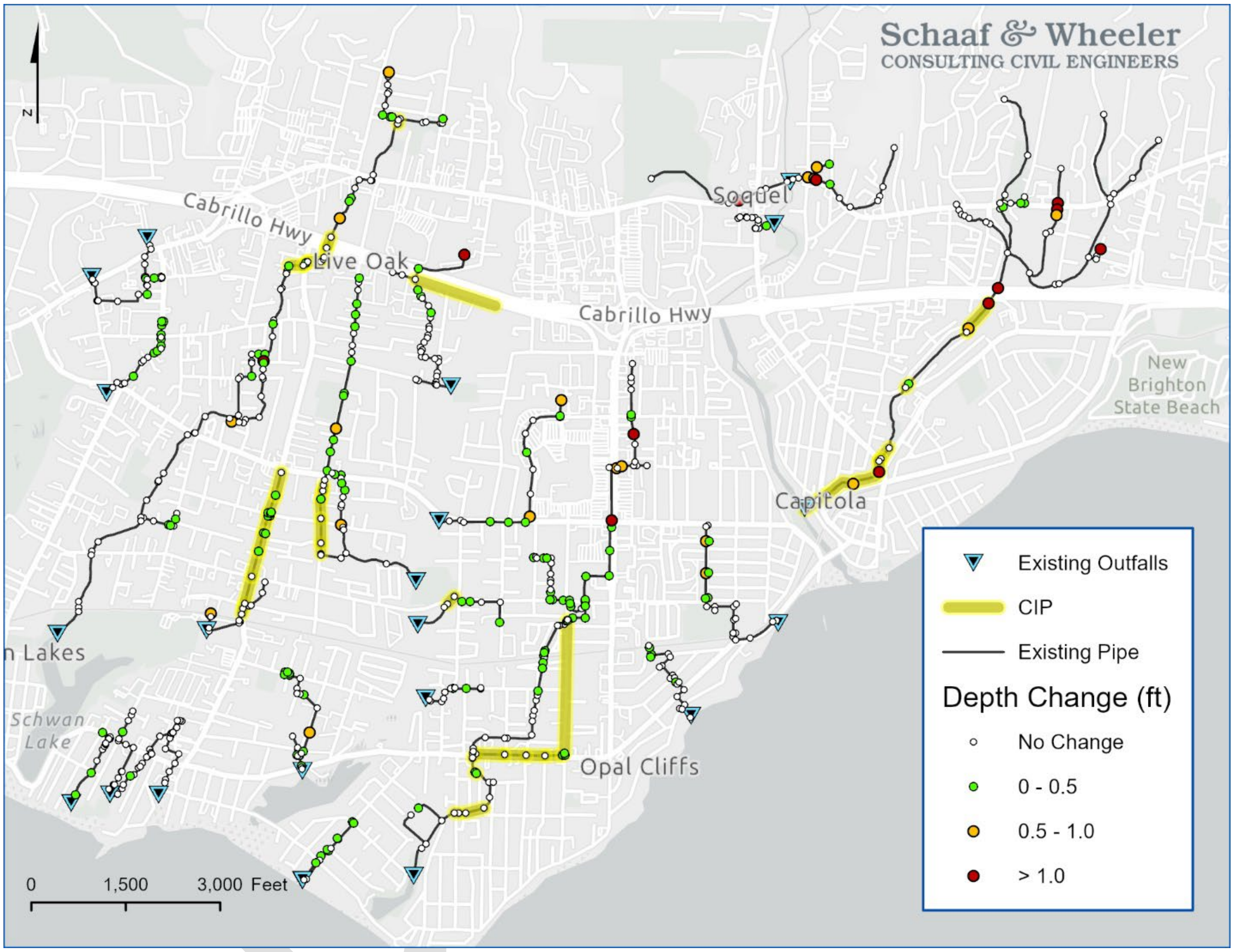


Figure 5-21: Change in Flooding Depth Due to Potential Climate Change (Future Condition)

6 Capital Improvement Costs

6.1 Overview

Chapter 5 discusses storm drainage system condition, capacity, and known and modeled deficiencies. It further lays out an alternatives analysis for addressing various issues and improving overall system performance and level of service to the community.

This chapter provides an analysis of cost for the proposed alternatives.

6.2 Cost Basis

Costs have been estimated based on a variety of available information, including:

- Cost estimation guides (e.g., RSMeans)
- Inflation indices, published by the Engineering News Record (ENR)
- Actual cost and bid data from recent projects
- Engineering judgement

The ENR Construction Cost Index (CCI) for San Francisco as of September 2023 is 15,490, compared with a 20-city average of approximately 13,000. Schaaf & Wheeler performed a detailed unit cost analysis for storm drain pipe and structures. This information has also been used with adjustment based on the ENR CCI to establish unit costs in September 2023 dollars (Table 6-1).

Table 6-1: Storm Drain Conveyance Conduit Unit Costs in September 2023 Dollars (Per Linear Foot)

Item	New Conduit	Removal/Disposal Unit Cost
12” Pipe	--	$30
15” Pipe	--	$35
18” Pipe	--	$40
21” Pipe	--	$45
24” Pipe	--	$50
27” Pipe	--	$55
30” Pipe	$410	$60
36” Pipe	$490	$70
42” Pipe	$570	$75
48” Pipe	$670	$80
54” Pipe	$780	$85
60” Pipe	$880	$95
66” Pipe	$1,010	$100
72” Pipe	$1,190	$120
84” Pipe	$1,670	$150
96” Pipe	$2,010	$200
120” Pipe or 72” x 96” box	$2,510	$225
132” Pipe or 96” x 96” Box	$2,760	$250
144” Pipe or 96” x 120”	$3,010	$300

Unit costs have also been estimated for storm drain structures, including connection of new and existing pipe. These are summarized in Table 6-2.

Table 6-2: Storm Drain Structure Unit Costs in 2022 Dollars

Connecting Conduit	Unit Cost
30" Pipe	$17,500
36" Pipe	$17,700
42" Pipe	$18,300
48" Pipe	$18,600
54" Pipe	$20,200
60" Pipe	$20,600
66" Pipe	$22,400
72" Pipe	$22,900
84" Pipe	$26,100
96" Pipe	$28,700
120" Pipe or 72" x 96" box	$33,900
132" Pipe or 96" x 96" Box	$36,500
144" Pipe or 96" x 120" Box	$39,000

Relocation of mobile home residents for certain project alternatives is assumed to include the following costs:

- Four months of temporary housing during construction at $5,000 per month per mobile home
- Relocation expenses at the start and end of the project at $20,000 total
- Relocation and storage of the mobile homes at $20,000 per home.
- $15,000 in additional costs for structural implications of replacing mobile homes over widened, shallow storm drain box sections.

These costs, totaling $75,000 per mobile home are included as "special costs" on projects where mobile home relocation is expected to be necessary.

6.3 Recommended Project Costs

The cost of the recommended projects are summarized by priority in Table 6-4 through Table 6-5 for each jurisdiction and each type of capital project (capacity and repair & replacement).

Table 6-3: Baseline Capacity Project Cost Estimate Summary (Zone 5)

Priority	Project	Pipe Length (ft)	Estimated Cost
High	17th - Capitola to Kinsley	2,340	$2,740,000
	34th Avenue Ditch Improvements*	400	$2,380,000
	Portola Downstream of 38th*	1,520	$2,280,000
	Soquel Avenue to Rodeo Creek Gulch	1,340	$1,720,000
Moderate	Winkle Farm	65	$110,000
Low	Brommer at 30th	160	$170,000
	Chanticleer	1,100	$1,480,000
	Soquel at 17th	960	$5,560,000
	TOTAL:	7,885	$16,440,000

**Project has alternatives summarized in Table 6-6*
Note: Lengths to nearest 5 ft increment, costs rounded to nearest $10,000

Table 6-4: Baseline Repair and Replacement Project Cost Estimate Summary (Zone 5)

Priority	Project	Pipe Length (ft)	Estimated Cost
Moderate	26th Avenue (East Cliff to Outfall)	465	$260,000
	Leona Cr at Capitola Rd Culvert	185	$650,000
	Webster Street near Pinewood	120	$240,000
Low	17th Ave Repair/CIPP**	340	$240,000
	Aguazul to Douglas Drive CIPP (near Soquel Dr)**	155	$70,000
	TOTAL:	1,265	$1,460,000

***Project is a probable repair or CIPP project to correct a condition deficiency*

Table 6-5: Baseline Capacity Project Cost Estimate Summary (Within City of Capitola)

Priority	Project	Pipe Length (ft)	Estimated Cost
High	Noble Downstream*	1,820	$10,050,000
Moderate	38th Avenue - Brommer Basin to Portola*†	2,115	$2,600,000
	Noble Upstream	660	$3,460,000
	TOTAL:	4.595	$16,110,000

**Project has alternatives summarized in Table 6-6*
†Project is mostly within City of Capitola, with a small portion in the County
***Project is a probable repair or CIPP project to correct a condition deficiency*

Table 6-6: Baseline Repair and Replacement Project Cost Estimate Summary (Within City of Capitola)

Priority	Project	Pipe Length (ft)	Estimated Cost
High	38th Avenue (Railroad to Star Lane) Replacement	1,020	$3,100,000
Low	41st Avenue Repair/CIPP (at Capitola Mall)**	85	$40,000
	TOTAL:	1,105	$3,140,000

**Project has alternatives summarized in Table 6-6*
***Project is a probable repair or CIPP project to correct a condition deficiency*

Alternatives to Noble Creek, 34th Avenue Ditch, and 38th Avenue area projects are summarized in Table 6-6.

Table 6-7: Alternative Project Cost Estimate Summary

Priority	Project	Pipe Length (ft)	Estimated Cost
High (City of Capitola)	Noble Downstream (Alternative 1 – Gravity Alignment Alternative)	2,750	$13,010,000
	Noble Downstream (Alternative 2 – 600 cfs Pump Station)	1,560	$32,000,000
High (Zone 5)	Portola-30th (34th Avenue Ditch Alternative)	1,250	$1,250,000
	38th Ave Downstream (Portola Downstream of 38th Alternative)	1,515	$8,920,000
Moderate (City of Capitola)	38th Ave Upstream (Brommer Basin to Portola Alternative)	400	$3,005,000

More detailed estimates for each project are provided in Appendix A. Further detail, by pipe, is provided in Appendix B. Finally, project-specific data sheets with finer scale mapping are provided in Appendix C for high priority capital projects.

7 Operation and Maintenance

7.1 Introduction

Santa Cruz County (County) is responsible for a storm drain network consisting of facilities along more than 600 miles of County roads. Municipalities within the County include the Cities of Santa Cruz, Scotts Valley, Watsonville, and Capitola. Each city has additional storm drain facilities they are responsible for operating and maintaining. To manage such a large system, the County has established four drainage or flood control zones (Zones 5 – 8) based on defined watersheds associated with urban areas.

The Zones also define the boundaries for O&M activities. Maintenance resources across the County include five crews made up of more than three dozen maintenance staff, three maintenance yards, and various equipment and tools. In addition, each municipality has its respective maintenance resources.

Flood Control Zone 5 includes the urban area encompassing Capitola to the east, Soquel to the north, and Live Oak to the west. The O&M Plan developed for Zone 5 (Appendix D) consists of five critical components.

1. Program Management – Overviews the O&M program, identifies roles and responsibilities, and documents equipment, software, and applications.

2. Asset Inventory – Defines the spatial location and attribute information for the storm drain assets (junctions and conveyances) in the system. Key information includes the horizontal and vertical spatial location, asset type, material, dimensions, maintenance condition, and invert elevations.

3. Analysis and Forecasting – Describes the process of identifying the annual O&M priorities. These priorities help identify storm drain assets that require a work program action during the year. This section presents the queries necessary to identify which assets are inspected, inspection timing and frequency, as well as the O&M cost estimates.

4. Work Program Actions – Describes the procedures, equipment, and methodologies used to implement the O&M program (e.g., visual, emergency, or closed-circuit television [CCTV] inspections; maintenance; repairs or replacements; and capital improvements).

5. Tracking and Reporting – Describes the various elements of the Lucity asset management software and the use of GIS software to navigate to asset locations, tracks inspection and maintenance activities, and reports various analytics to forecast short-term and long-term needs.

The O&M Plan is one element of the Zone 5 SDMP and establishes a formal program for O&M activities.

7.2 Recommendations

Santa Cruz County, Zone 5, and the City desire a storm drain O&M program that is proactive, supports a functional storm drain system at the desired level of service, and allows the flexibility to reallocate O&M resources as conditions change. To achieve these goals, the O&M Plan recommends the following enhancements to the existing O&M program:

- **Asset Inventory** – Improve the accuracy and completeness of the storm drain asset inventory by conducting field verifications of spatial and attribute data. The current asset inventory has various inconsistencies and redundancies that should be addressed to improve the accuracy and completeness of the data.

- **Analysis and Forecasting** – Implement a proactive O&M program based on the inspection, maintenance, and repair procedures recommended in the O&M Plan. See the *O&M Standard Operating Procedures – Proposed* table in the O&M Plan in Appendix D.

  Implement regular CCTV inspections of the storm drain system. While it is unnecessary to conduct a CCTV inspection on every linear foot of storm drain pipe, up to 5,000 linear feet of pipe each year should be inspected, focusing on priority storm drain pipes. These CCTV inspections will provide critical pipe condition information and allow the County, Zone 5, or the City, to proactively address identified issues before they become major problems.

- **Work Program Actions** – The *O&M Standard Operating Procedures – Existing and Proposed* tables present guidelines for inspections, maintenance, and repairs, including documenting the type, frequency, season, and overall process for completing work program actions. This table should not take the place of developing a comprehensive Standard Operating Procedures Manual, which would benefit existing and new O&M staff.

- **Tracking and Reporting** – Consider implementing robust tracking analytics to determine how O&M work program actions change over time to further optimize the O&M program.

- **O&M Plan Linkage to Lucity** – The final enhancement to the County's O&M program will be to link the above recommendations to the Lucity asset management system. Because Lucity is the overarching framework within which the County manages the Zone 5 storm drain system, any changes to the O&M program must be tied back to Lucity. Asset inventory updates, changes to inspection or repair frequencies, CCTV inspections, tracking or reporting changes must all be linked back to the Lucity system.

8 Funding

8.1 Overview

This chapter presents the funding strategies and their implications that are available to the County, Zone 5, and City of Capitola to fund capital improvement projects and maintenance program recommendations within this SDMP. This chapter presents a high-level overview of financial options. The project team is also working on a more detailed funding and financial plan that will use information within this SDMP.

This chapter has been prepared following a “revenue requirements” analytical methodology common to financial analyses underlying most utility rates and charges imposed by traditional utilities, similar to the sanitary sewer systems.

While California law does not enable municipalities to impose “utility rates” for stormwater management services, the storm drain system shares similarities to traditional utilities and will likely require a primary, dedicated revenue source akin to rates.

The SDMP includes long-term capital financing requirements to fund equipment, infrastructure, problem-spot maintenance projects, and ongoing operations, maintenance, administration, and regulatory obligations to fund.

Properly managing the program may also require establishing reserves and using debt financing. Therefore, the following analyses have been prepared:

- Evaluation of financing strategies for the CIP;
- Projected debt proceeds and debt service payments;
- Analysis of cash and reserve requirements; and
- Determination of net annual revenue requirements for the program.

8.2 Program Costs

Implementation costs for this SDMP fall under four program elements:

- Program Management/Coordination
- Capital Investments
- Operations and Maintenance
- NPDES Permit Compliance

Several tasks have been evaluated under each of these four major elements to determine funding requirements for a successful stormwater program. Capital investment costs are informed by technical analysis presented in earlier chapters of this document.

A detailed, annualized future cost analysis was performed for Zone 5, the County, and the City of Capitola individually, as well as a combined program cost. Costs associated with the four major program elements are summarized in Table 8-1. Each element as a proportion of total costs is shown in Figure 8-1 for the entire regional system SDMP, and in Figure 8-2 for Zone 5 and Capitola individually.

Table 8-1: Annual Stormwater Program Cost (2023 Dollars, Rounded to Nearest $1,000)

Program Element	City	County	Zone 5 Total
Program Management/Coordination	$145,000	$114,000	$259,000
Capital Investments	$986,000	$1,392,000	$2,378,000
Operations & Maintenance	$143,000	$1,994,000	$2,137,000
NPDES Permit Compliance	$66,000	$963,000	$1,029,000
Total:	**$1,340,000**	**$4,463,000**	**$5,803,000**

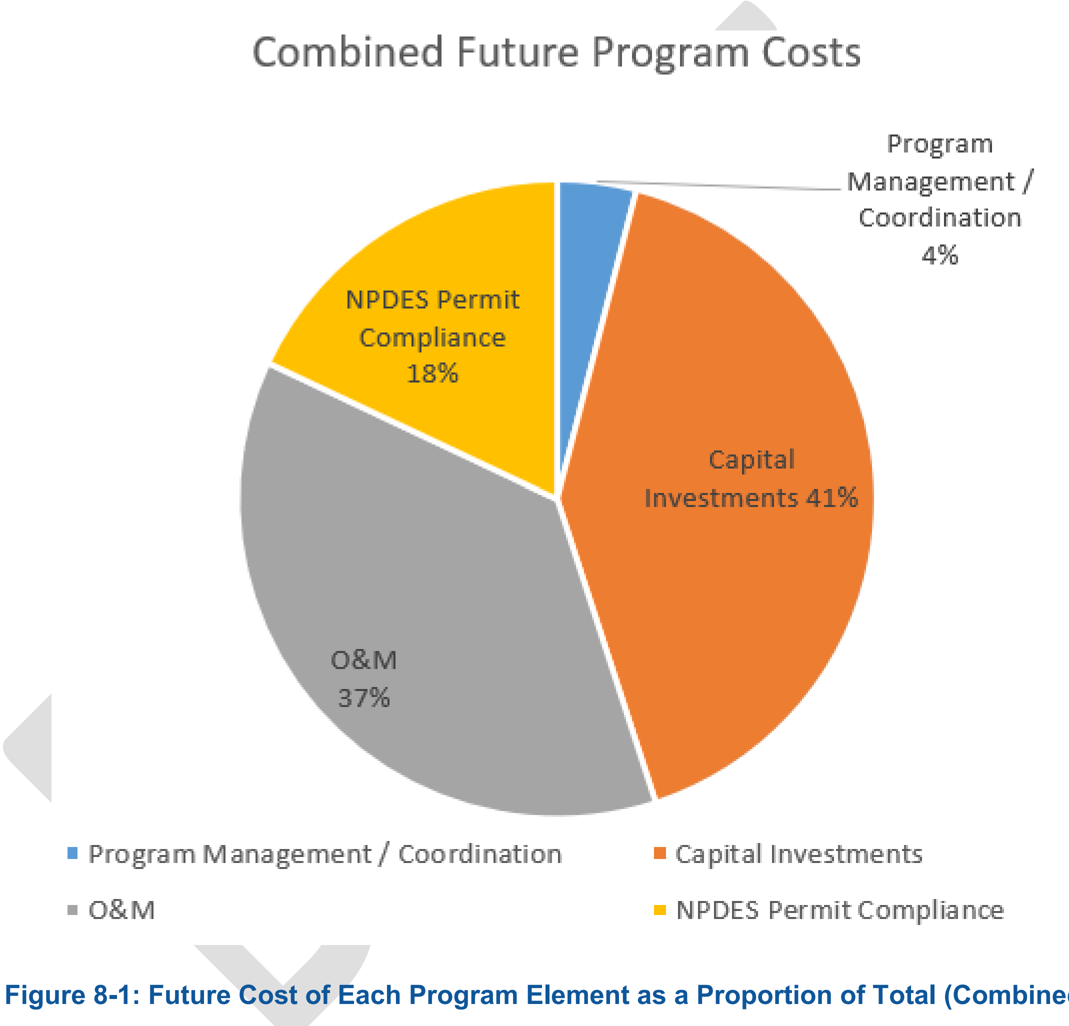
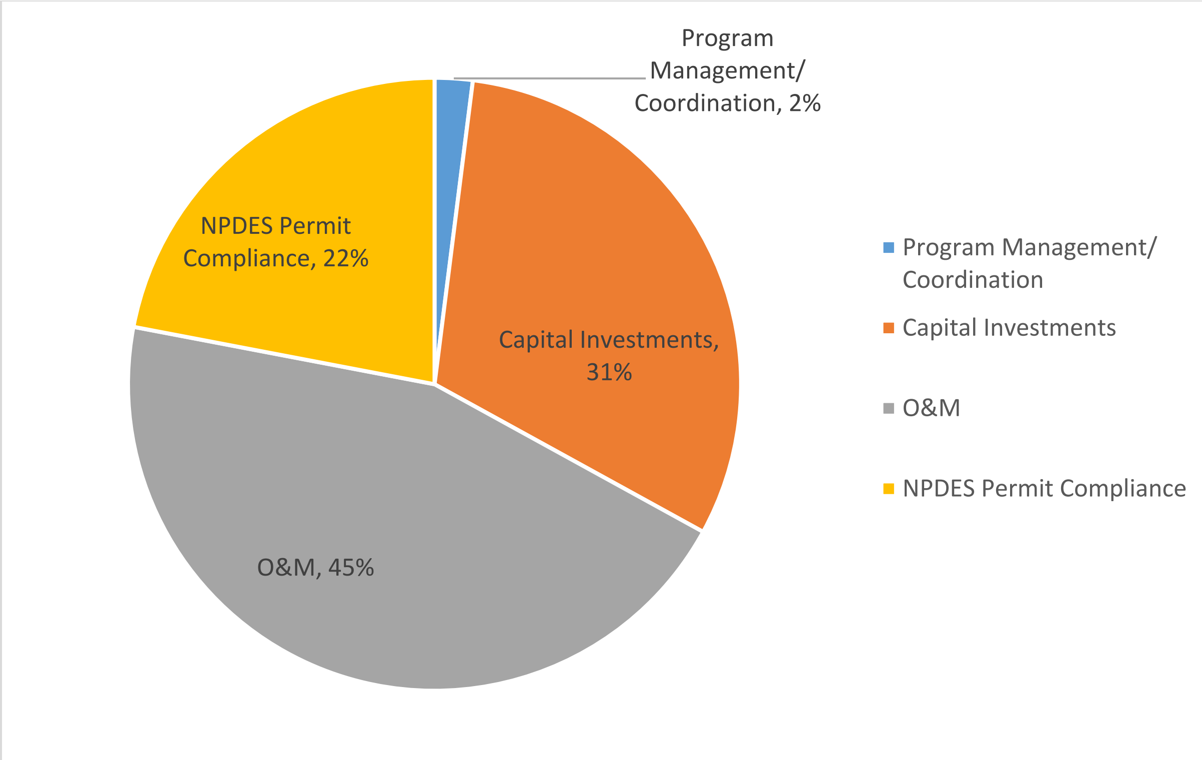


Figure 8-1: Future Cost of Each Program Element as a Proportion of Total (Combined)



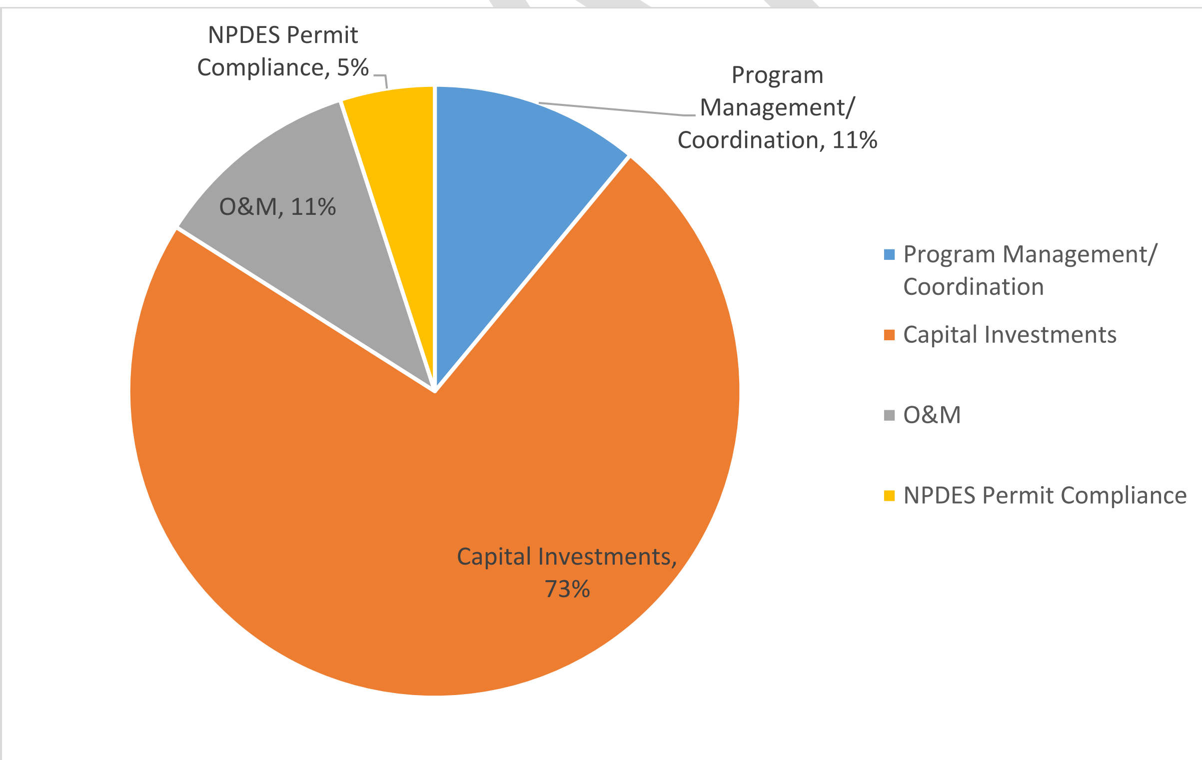


Figure 8-2: Future Cost of Each Program Element as a Proportion of Total for Zone 5 (Top) and City of Capitola (Bottom)

8.3 Potential Revenue Sources

In establishing a dedicated revenue stream for the SDMP, the County, Zone 5, or City may want to pursue a property-related fee or a special tax. The political feasibility of these mechanisms will likely be critical factors in determining which one the County, Zone 5, or City implements.

8.3.1 Property-Related Fee

A property-related fee is a fee for service attributable to the parcel being charged. A fee for stormwater services may be levied upon the County tax roll and is imposed as an incident of property ownership. As such, it would be subject to the substantive and procedural requirements of California Constitution Article XIII D (known commonly by its enacting ballot measure: Proposition 218).

Following a noticed Public Hearing (assuming lack of written protests being filed by a majority of property owners), the fee must be submitted and approved by a majority vote of the property owners or by a two-thirds vote of the electorate. The amount charged to each parcel must be proportional to the cost of service attributable to that parcel. Due to this proportionality requirement, the costs attributable to public parcels should be paid by City and County revenues (e.g., General Fund appropriation) or by individual County and City departments.

For a property owner election, each parcel generally receives one ballot, and each ballot has one vote regardless of the potential levy amount. In one-parcel-per-vote elections, a large commercial parcel with a calculated levy that is an order of magnitude greater than that of a smaller parcel would have the same, single vote as the smaller parcel, unless some form of weighted voting system is implemented.

The revenue stream from a property-related fee may be used for capital, annual operating, and maintenance costs. This revenue stream could also be pledged as credit support for a revenue bond issued to fund major capital improvements.

8.3.2 Special Tax

A Community Facilities District (CFD) can be formed pursuant to the Mello-Roos Community Facilities Act of 1982. A CFD can fund capital projects as well as ongoing maintenance. Bonds would be issued to pay for capital costs secured by a special tax levy. The same CFD can also fund ongoing maintenance costs through a special tax levy.

There is great flexibility in both the geographic area to be levied and the formula by which to levy when using a CFD. A CFD may include non-contiguous geographic areas. There is no requirement that the special tax is apportioned based on the benefit to any property. Property owned by a public entity is generally exempt from the CFD special tax, ensuring no lingering obligation of other City revenues.

Successful creation of a CFD requires the approval of two-thirds of the registered voters voting in an election. With a voter election, each voter has one vote, regardless of their weighted share of the proposed special tax levy. In a landowner election, the vote is one vote per acre or portion thereof, however landowner elections are only allowed in instances when there are 12 or fewer registered voters in the boundary of the CFD.

Another type of special tax, typically referred to as a Parcel Tax, may be approved pursuant to Government Code Section 50075 and following. The Parcel Tax may fund ongoing maintenance costs and all or a portion of the Parcel Tax revenue may be pledged as credit support for a revenue bond to fund major capital improvements. Like the CFD, the Parcel Tax must be approved by two-thirds of the registered voters voting in an election. With a voter election, each voter has one vote, regardless of their weighted share of the proposed special tax levy.

The Parcel Tax does not require the recordation of either a Boundary Map or Notice of Special Tax Lien, which are requirements of the CFD. Depending on which entity forms the Parcel Tax, “uniformity” requirements may apply, which limit the flexibility in the structure of the tax.

8.4 Other Sources of Revenue

Although the revenue strategy introduced in this chapter has estimated the full cost to property owners of funding the entire SDMP, there are at least two other additional revenue sources that, if justifiable and collectible on a substantive scale, would reduce that final levy amount needed from the community, or in other words, the total revenue requirement.

The chief benefit of examining the viability of these revenue sources is that both may be approved by consensus of the County, Zone 5, and City alone after proper public noticing and public hearing processes.

8.4.1 Development Impact Fees

A development impact fee is a one-time fee imposed as a condition of approval on new development, infill, or redevelopment that creates new, unmitigated impermeable surface area. Development impact fees are authorized by Government Code 66000 et seq., created by the Mitigation Fee Act, and commonly referred to as “AB 1600” fees.

A development impact fee may be justifiable for the SDMP under one of two conditions:

- The County, Zone 5, or City has previously invested in drainage infrastructure which has remaining value and is available and/or sized to meet impacts caused by future development/redevelopment.
- The capital and maintenance projects documented in this SDMP are sized to meet stormwater-related impacts caused by future development/redevelopment and not just the demands of existing development.

An impact fee may be based on 1) a “buy-in” to existing infrastructure or 2) the “incremental” costs of new facilities necessary to serve new development that will create additional impermeable surface areas. A combination of these two impact fees may also be used to repay existing customers for historical capital investments. However, they cannot be used to fund operating or maintenance costs, which must be met through the SDMP’s annual fees.

8.4.2 Regulatory Fees

Regulatory fees are imposed to recover costs associated with the City and County’s respective constitutional and statutory power to govern activities, such as development and construction. For example, within the stormwater program, the County, Zone 5, or City provides services/activities which may be eligible for recovery in a regulatory fee. These services/activities may include:

- Plan review and site inspection of development/construction that must meet stormwater program regulations. (A common area for stormwater program activity is grading and drainage permitting/oversight.)
- Review of maintenance plans for, and periodic site inspection of, onsite stormwater management/mitigation facilities.
- Inspection of properties documented under the municipal permit as high-pollution risk operations requiring onsite management and/or facilities to mitigate risk to the environment and public rights-of-way.

The statutory limit in imposing these fees is that they may not exceed the estimated reasonable cost of service. Most regulatory fees like these have historically been implemented by consensus of the County, Zone 5, or City alone. Data used to justify fee amounts must be prepared and made available to the public in advance of the public hearing.

8.4.3 Benefit-Assessment District

A benefit-assessment district assigns project costs in direct proportion to the benefits received. Benefit assessment districts are often formed for specific projects within a specific watershed. The only properties assessed are those that directly benefit from the projects and in direct proportion to that benefit.

8.4.4 Grants

There are grant opportunities for stormwater, flood control and climate adaptation projects in California. These grants are competitive and require a good deal of effort to secure. If the County, Zone 5, or City wishes to pursue grant opportunities, it is recommended they secure a grant writer or dedicate significant staff time to the application process.

8.5 Summary

This SDMP presents capital improvement projects and a maintenance program that exceed the County, Zone 5, and City current funding sources. Consultants NCE and NBS are working on refining and providing more details on what the options presented above would look like specific to the County, Zone 5, and the City. The issues faced in Zone 5 are not unique since most municipalities within California are facing budget shortfalls when it comes to funding storm drain infrastructure. Most California municipalities lack sufficient financial resources to adequately maintain, repair, and upgrade aging storm drainage infrastructure.

Appendix A

CIP Construction Project Cost Summary Tables

Table A-1: Detailed Capacity Project Cost Summary

	PROJECT	PRIORITY	QUANTITIES			PROJECT SUBTOTALS					OTHER COSTS					PROJECT TOTAL
			Pipe Length (LF)	Pipe Count	# of Outfalls	Ave Unit Cost (LF)	Pipe/Demo Subtotal	Structure Subtotal	Outfall Cost	Project Subtotal	Traffic Control	Mobilization	Contingency	Design/ Engineering	Special Costs	
1	17th - Capitola to Kinsley	High	2,341	9	0	$508	$1,300,000	$160,000	$-	$1,470,000	$70,000	$150,000	$590,000	$460,000	$-	***$2,740,000***
2	34th Ave Ditch Improvements	High	399	3	0	$2,117	$760,000	$90,000	$-	$850,000	$40,000	$90,000	$340,000	$260,000	$800,000	***$2,380,000***
2A	*Portola-30th*	*High*	*1,250*	*2*	*0*	*$490*	*$610,000*	*$50,000*	*$-*	*$670,000*	*$30,000*	*$70,000*	*$270,000*	*$210,000*	*$-*	***$1,250,000***
3	Portola Downstream of 38th	High	1,494	6	0	$670	$1,110,000	$110,000	$-	$1,230,000	$60,000	$120,000	$490,000	$380,000	$-	***$2,280,000***
3A	*38th Ave Downstream*	High	*1,515*	*11*	*0*	*$2,010*	*$3,190,000*	*$140,000*	*$-*	*$3,340,000*	*$170,000*	*$330,000*	*$1,340,000*	*$1,040,000*	*$2,700,000*	***$8,920,000***
4	Noble Downstream (Alt 1)	High	1,515	7	1	$2,617	$4,300,000	$280,000	$100,000	$4,680,000	230,000	$470,000	$1,870,000	$1,450,000	$3,000,000	***$11,700,000***
4A	*Noble Downstream (Alt 2)*	*High*	*2,748*	*8*	*1*	*$2,351*	*$6,600,000*	*$290,000*	*$100,000*	*$6,990,000*	*350,000*	*$700,000*	*$2,800,000*	*$2,170,000*	*$-*	***$13,010,000***
4B	*Noble Downstream (Alt 3)*	*High*	*1,550*	*6*	*1*	*$2,415*	*$3,960,000*	*$240,000*	*$100,000*	*$4,300,000*	*220,000*	*$430,000*	*$1,720,000*	*$1,330,000*	*$24,00,000*	***$32,000,000***
5	Soquel Ave to Rodeo Creek Gulch	High	1,340	1	0	$570	$760,000	$50,000	$100,000	$920,000	$40,000	$80,000	$330,000	$250,000	$-	***$1,720,000***
6	38th Ave - Brommer Pond to Portola	Moderate	2,115	1	0	$490	$1,040,000	$90,000	$-	$1,130,000	$60,000	$110,000	$450,000	$350,000	$500,000	***$2,600,000***
6A	*38th Ave Upstream*	Moderate	*395*	*7*	*0*	*$1,670*	*$700,000*	*$180,000*	*$-*	*$880,000*	*$40,000*	*$90,000*	*$350,000*	*$270,000*	*$1,375,000*	***$3,005,000***
7	Noble Upstream	Moderate	658	3	0	$2,760	$1,720,000	$140,000	$-	$1,860,000	$90,000	$190,000	$740,000	$580,000	$-	***$3,460,000***
8	Winkle Farm	Moderate	64	1	0	$570	$40,000	$20,000	$-	$60,000	$-	$10,000	$20,000	$20,000	$-	***$110,000***
9	Brommer at 30th	Low	161	1	0	$410	$70,000	$20,000	$-	$90,000	$-	$10,000	$40,000	$30,000	$-	***$170,000***
10	Chanticleer	Low	1,097	5	0	$570	$700,000	$90,000	$-	$790,000	$40,000	$80,000	$320,000	$250,000	$-	***$1,480,000***
11	Soquel at 17th	Low	961	8	1	$2,675	$2,530,000	$290,000	$100,000	$2,920,000	$150,000	$290,000	$1,170,000	$910,000	$120,000	***$5,560,000***

Table A-2: Detailed Repair and Replacement (RR) Project Cost Summary

	PROJECT	PRIORITY	QUANTITIES			PROJECT SUBTOTALS					OTHER COSTS					PROJECT TOTAL
			Pipe Length (LF)	Pipe Count	# of Outfalls	Ave Unit Cost (LF)	Pipe/Demo Subtotal	Structure Subtotal	Outfall Cost	Project Subtotal	Traffic Control	Mobilization	Contingency	Design/ Engineering	Special Costs	
RR1	38th Avenue	High	1,019	8	0	$1,050	$1,220,000	$170,000	$-	$1,390,000	$70,000	$140,000	$560,000	$430,000	$510,000	$3,100,000
RR2	26th Avenue	Moderate	464	2	0	$200	$110,000	$30,000	$-	$140,000	$10,000	$10,000	$60,000	$40,000	$-	$260,000
RR3	Leona Culvert	Moderate	185	1	0	$1,520	$300,000	$-	$-	$300,000	$20,000	$30,000	$120,000	$90,000	$90,000	$650,000
RR4	Webster	Moderate	116	1	0	$850	$110,000	$20,000	$-	$130,000	$10,000	$10,000	$50,000	$40,000	$-	$240,000
RR5	17th Ave Repair	Low	337	1	0	$375	$130,000	$-	$-	$130,000	$10,000	$10,000	$50,000	$40,000	$-	$240,000
RR6	41st Ave Repair/CIPP	Low	86	1	0	$275	$20,000	$-	$-	$20,000	$-	$-	$10,000	$10,000	$-	$40,000
RR7	Soquel CIPP	Low	155	1	0	$235	$40,000	$-	$-	$40,000	$-	$-	$20,000	$10,000	$-	$70,000

Appendix B

CIP Project Detail Tables

Table B-1: Detailed Capacity Capital Project Summary (by Pipe)

PIPE ID	PROJECT	PRIORITY	QUANTITIES			PIPE/DEMO SUBTOTALS				
			Pipe Length (LF)	Ex. Size	Imp. Size	Unit Cost - Demo (Per LF)	Unit Cost – Pipe (Per LF)	Demo/ New Pipe Subtotal	Manhole/ Structure Subtotal	Project Subtotal
Z5_PIPE_1885	17th - Capitola to Kinsley	High	80	30	42	$60	$570	$50,600	$18,300	$68,900
Z5_PIPE_1270	17th - Capitola to Kinsley	High	442	30	42	$60	$570	$278,500	$18,300	$296,800
Z5_PIPE_1326	17th - Capitola to Kinsley	High	43	18	30	$40	$410	$19,500	$17,500	$37,000
Z5_PIPE_4578	17th - Capitola to Kinsley	High	94	30	42	$60	$570	$59,000	$18,300	$77,300
Z5_PIPE_1893	17th - Capitola to Kinsley	High	415	30	42	$60	$570	$261,200	$18,300	$279,500
Z5_PIPE_1896	17th - Capitola to Kinsley	High	281	18	36	$40	$490	$149,100	$17,900	$167,000
Z5_PIPE_1897	17th - Capitola to Kinsley	High	304	18	42	$40	$570	$185,200	$18,300	$203,600
Z5_PIPE_1900	17th - Capitola to Kinsley	High	305	12	30	$30	$410	$134,100	$17,500	$151,600
Z5_PIPE_1903	17th - Capitola to Kinsley	High	377	12	30	$30	$410	$166,000	$17,500	$183,500
Z5_PIPE_1882	34th Ave Ditch Improvements	High	33	57 x 84	60 x 120	$150	$3,010	$103,000	$39,000	$141,900
Z5_PIPE_2055	34th Ave Ditch Improvements	High	306	72	84	$120	$1,670	$546,900	$26,100	$573,000
Z5_PIPE_2696	34th Ave Ditch Improvements	High	61	72	84	$120	$1,670	$109,000	$26,100	$135,100
PORTOLA-30th_1*	Portola-30th	High	350		36	$-	$490	$171,500	$17,900	$189,400
PORTOLA-30th_2*	Portola-30th	High	900		36	$-	$490	$441,000	$35,800	$476,800
Z5_PIPE_2293	Portola Downstream of 38th	High	74	42	48	$75	$670	$55,200	$18,600	$73,800
Z5_PIPE_2305	Portola Downstream of 38th	High	45	36	48	$70	$670	$33,000	$18,600	$51,600
Z5_PIPE_2306	Portola Downstream of 38th	High	274	36 x 24	48	$80	$670	$205,500	$18,600	$224,200
Z5_PIPE_2307	Portola Downstream of 38th	High	300	42	48	$75	$670	$223,300	$18,600	$241,800
Z5_PIPE_2308	Portola Downstream of 38th	High	347	42	48	$75	$670	$258,500	$18,600	$277,100
Z5_PIPE_2312	Portola Downstream of 38th	High	455	42	48	$75	$670	$338,900	$18,600	$357,500

PIPE ID	PROJECT	PRIORITY	QUANTITIES			PIPE/DEMO SUBTOTALS				
			Pipe Length (LF)	Ex. Size	Imp. Size	Unit Cost - Demo (Per LF)	Unit Cost – Pipe (Per LF)	Demo/ New Pipe Subtotal	Manhole/ Structure Subtotal	Project Subtotal
Z5_PIPE_498	38th Ave Downstream	High	157	44x72	48x144	$80	$2,010	$328,700	$28,700	$357,400
Z5_PIPE_3107	38th Ave Downstream	High	367	44x72	48x144	$80	$2,010	$767,300	$28,700	$796,000
Z5_PIPE_5549	38th Ave Downstream	High	49	66	48x144	$100	$2,010	$103,400	$-	$103,400
Z5_PIPE_5550	38th Ave Downstream	High	34	66	48x144	$100	$2,010	$70,900	$-	$70,900
Z5_PIPE_5554	38th Ave Downstream	High	69	44x72	48x144	$80	$2,010	$145,100	$-	$145,100
Z5_PIPE_5555	38th Ave Downstream	High	87	44x72	48x144	$80	$2,010	$182,300	$-	$182,300
Z5_PIPE_5556	38th Ave Downstream	High	86	44x72	48x144	$80	$2,010	$179,100	$28,700	$207,800
Z5_PIPE_417	38th Ave Downstream	High	69	72	48x144	$120	$2,010	$146,200	$-	$146,200
Z5_PIPE_497	38th Ave Downstream	High	91	44x72	48x144	$80	$2,010	$189,400	$-	$189,400
Z5_PIPE_2319	38th Ave Downstream	High	222	48x96	48x144	$150	$2,010	$478,700	$28,700	$507,400
Z5_PIPE_2558	38th Ave Downstream	High	285	66	48x144	$100	$2,010	$601,000	$28,700	$629,700
Z5_PIPE_5438	Noble Downstream (Alt 1)	High	213	70	72 x 96	$100	$2,510	$557,200	$33,900	$591,100
Z5_PIPE_5439	Noble Downstream (Alt 1)	High	51	45 x 72	72 x 96	$120	$2,510	$134,900	$33,900	$168,700
Z5_PIPE_5429_1	Noble Downstream (Alt 1)	High	564	72	96 x 120	$120	$3,010	$1,766,600	$78,000	$1,844,600
PIPE0003	Noble Downstream (Alt 1)	High	259	48 x 72	72 x 96	$120	$2,510	$680,200	$33,900	$714,100
Z5_PIPE_5429_2	Noble Downstream (Alt 1)	High	163	72	96 x 96	$120	$2,760	$468,200	$36,500	$504,700
Z5_PIPE_5438	Noble Downstream (Alt 1)	High	213	70	72 x 96	$100	$2,510	$557,200	$33,900	$591,100
Z5_PIPE_5439	Noble Downstream (Alt 1)	High	51	45 x 72	72 x 96	$120	$2,510	$134,900	$33,900	$168,700
Z5_PIPE_5429_1	Noble Downstream (Alt 2)	High	464	72	96 x 120	$120	$3,010	$1,453,600	$39,000	$1,492,600
PIPE0003	Noble Downstream (Alt 2)	High	259	48 x 72	72 x 96	$120	$2,510	$680,200	$33,900	$714,100
Z5_PIPE_5429_2	Noble Downstream (Alt 2)	High	163	72	96 x 96	$120	$2,760	$468,200	$36,500	$504,700

PIPE ID	PROJECT	PRIORITY	QUANTITIES			PIPE/DEMO SUBTOTALS				
			Pipe Length (LF)	Ex. Size	Imp. Size	Unit Cost - Demo (Per LF)	Unit Cost – Pipe (Per LF)	Demo/ New Pipe Subtotal	Manhole/ Structure Subtotal	Project Subtotal
Z5_PIPE_5429_3	Noble Downstream (Alt 2)	High	493	72	96 x 120	$120	$3,010	$1,544,100	$39,000	$1,583,100
Z5_PIPE_5429	Noble Downstream (Alt 2)	High	179	72	72 x 96	$120	$2,510	$470,900	$33,900	$504,800
NOBLE-DS_1*	Noble Downstream (Alt 2)	High	350		84	$-	$1,670	$584,500	$26,100	$610,600
NOBLE-DS_2*	Noble Downstream (Alt 2)	High	530		84	$-	$1,670	$885,100	$52,200	$937,300
NOBLE-DS_3*	Noble Downstream (Alt 2)	High	310		84	$-	$1,670	$517,700	$26,100	$543,800
Z5_PIPE_2870	Noble Downstream (Alt 3)	High	213	70	72 x 96	$100	$2,510	$557,200	$33,900	$591,100
Z5_PIPE_2891	Noble Downstream (Alt 3)	High	51	45 x 72	72 x 96	$120	$2,510	$134,900	$33,900	$168,700
Z5_PIPE_2892	Noble Downstream (Alt 3)	High	564	72	96 x 120	$120	$3,010	$1,766,60	$78,000	$1,844,600
PIPE0002	Noble Downstream (Alt 3)	High	259	48 x 72	72 x 96	$120	$2,510	$680,200	$33,900	$714,100
Z5_PIPE_1477_1859	Noble Downstream (Alt 3)	High	163	72	96 x 96	$120	$2,760	$468,200	$36,500	$504,700
Z5_PIPE_2870	Noble Downstream (Alt 3)	High	300		72	$-	$1,190	$357,000	$22,900	$379,900
CIPCOND_2*	Soquel Ave to Rodeo Creek Gulch	High	1,340		42	$-	$570	$763,900	$54,900	$818,800
PROPCOND_2*	38th Ave - Brommer Pond to Portola	Moderate	2,115		36	$-	$490	$1,036,300	$89,500	$1,125,800
Z5_PIPE_5557	38th Ave Upstream	Moderate	74	54	48x96	$85	$1,670	$130,300	$26,100	$156,400
Z5_PIPE_5558	38th Ave Upstream	Moderate	87	44x72	48x96	$80	$1,670	$153,100	$26,100	$179,200
Z5_PIPE_5563	38th Ave Upstream	Moderate	38	24x72	36x120	$80	$1,670	$65,900	$26,100	$92,000
Z5_PIPE_3106	38th Ave Upstream	Moderate	46	60	48x96	$95	$1,670	$81,700	$26,100	$107,800
Z5_PIPE_3059	38th Ave Upstream	Moderate	35	24x72	36x120	$80	$1,670	$61,600	$26,100	$87,700
CUL0006	38th Ave Upstream	Moderate	27	65x60	60x72	$120	$1,670	$47,500	$26,100	$73,600
BLUE_AND_GOLD_MHP_DITCH_1	38th Ave Upstream	Moderate	88	65x60	60x72	$120	$1,670	$156,800	$26,100	$182,900
CUL0007	Noble Upstream	Moderate	65	48	48 x 120	$80	$2,760	$183,300	$36,500	$219,700

PIPE ID	PROJECT	PRIORITY	QUANTITIES			PIPE/DEMO SUBTOTALS				
			Pipe Length (LF)	Ex. Size	Imp. Size	Unit Cost - Demo (Per LF)	Unit Cost – Pipe (Per LF)	Demo/ New Pipe Subtotal	Manhole/ Structure Subtotal	Project Subtotal
CUL0002	Noble Upstream	Moderate	79	72	72 x 120	$120	$3,010	$247,100	$39,000	$286,100
NOBLE_GULCH_2*	Noble Upstream	Moderate	514		72 x 96	$-	$2,510	$1,290,700	$67,800	$1,358,500
Z5_PIPE_3355	Winkle Farm	Moderate	64	30	42	$60	$570	$40,100	$18,300	$58,400
Z5_PIPE_2424	Brommer at 30th	Low	161	18	30	$40	$410	$72,600	$17,500	$90,100
Z5_PIPE_5610	Chanticleer	Low	138	36	42	$70	$570	$88,400	$18,300	$106,700
Z5_PIPE_1594	Chanticleer	Low	312	36	42	$70	$570	$199,900	$18,300	$218,100
Z5_PIPE_1595	Chanticleer	Low	88	36	42	$70	$570	$56,600	$18,300	$74,900
Z5_PIPE_1864	Chanticleer	Low	168	36	42	$70	$570	$107,400	$18,300	$125,700
Z5_PIPE_1873	Chanticleer	Low	391	36	42	$70	$570	$250,200	$18,300	$268,400
Z5_PIPE_3314	Soquel at 17th	Low	228	54	60 x 120	$85	$3,010	$705,400	$39,000	$744,400
Z5_PIPE_5636	Soquel at 17th	Low	35	54	60 x 120	$85	$3,010	$108,400	$39,000	$147,400
Z5_PIPE_1859	Soquel at 17th	Low	158	72	84	$120	$1,670	$283,500	$26,100	$309,600
Z5_PIPE_2870	Soquel at 17th	Low	38	54	60 x 120	$85	$3,010	$119,200	$39,000	$158,100
Z5_PIPE_2891	Soquel at 17th	Low	50	54	60 x 120	$85	$3,010	$155,400	$39,000	$194,400
Z5_PIPE_2892	Soquel at 17th	Low	209	54	60 x 120	$85	$3,010	$646,500	$39,000	$685,500
PIPE0002	Soquel at 17th	Low	63	54	60 x 120	$85	$3,010	$194,400	$39,000	$233,400
Z5_PIPE_1477_1859	Soquel at 17th	Low	179	72	84	$120	$1,670	$320,800	$26,100	$346,900

**Denotes new pipe added to system, rather than upsizing of existing pipe with an existing ID*

Table B-2: Detailed Repair and Replacement Capital Project Summary (by Pipe)

PIPE ID	PROJECT	PRIORITY	QUANTITIES			PIPE/DEMO SUBTOTALS				
			Pipe Length (LF)	Ex. Size	Imp. Size	Unit Cost - Demo (Per LF)	Unit Cost – Pipe (Per LF)	Demo/ New Pipe Subtotal	Manhole/ Structure Subtotal	Project Subtotal
Z5_PIPE_498	38th Ave (Railroad to Star Lane)	High	157	72	72	$120	$1,150	$199,700	$18,300	$22,200
Z5_PIPE_3107	38th Ave (Railroad to Star Lane)	High	367	72	72	$120	$1,150	$466,300	$18,300	$22,200
Z5_PIPE_5554	38th Ave (Railroad to Star Lane)	High	69	72	72	$120	$1,150	$88,200	$17,500	$22,200
Z5_PIPE_5555	38th Ave (Railroad to Star Lane)	High	87	72	72	$120	$1,150	$110,700	$18,300	$22,200
Z5_PIPE_5556	38th Ave (Railroad to Star Lane)	High	86	72	72	$120	$1,150	$108,800	$18,300	$22,200
Z5_PIPE_5557	38th Ave (Railroad to Star Lane)	High	74	54	54	$85	$750	$62,000	$17,900	$19,500
Z5_PIPE_5558	38th Ave (Railroad to Star Lane)	High	87	72	72	$120	$1,150	$111,100	$18,300	$22,200
Z5_PIPE_497	38th Ave (Railroad to Star Lane)	High	91	54	54	$85	$750	$75,700	$17,500	$19,500
Z5_PIPE_15001	Webster St near Pinewood	Moderate	116	60	60	$95	$850	$110,000	$26,100	$19,900
Z5_PIPE_898	26th Avenue (East Cliff to Outfall)	Moderate	137	12	12	$30	$200	$31,600	$17,900	$15,900
Z5_PIPE_898_904	26th Avenue (East Cliff to Outfall)	Moderate	327	12	12	$30	$200	$75,300	$35,800	$15,900
Leona Creek Culvert	Leona Cr. Culvert at Capitola Rd	Moderate	185	66	66	$100	$1,520	$299,700	$18,600	$29,200
Z5_PIPE_5534	Aguazul to Douglas Dr CIPP	Low	155	36	36	$-	$235	$36,500	$17,500	$-
Z5_PIPE_1477B	17th Ave Repair/CIPP	Low	337	54	54	$-	$375	$126,400	$39,000	$-
Z5_PIPE_2392	41st Ave Repair/CIPP	Low	86	42	42	$-	$275	$23,600	$26,100	$-

Appendix C

High Priority CIP Project Detail Sheets

A. Project ID: 1 | **B. Project Name:** **17th - Capitola to Kinsley**

C. Project Location: Capacity Improvement along 17th Ave between Capitola Road and Kinsley Street

D. Priority: **High**

E. Type: **Capacity**

G. Description: Upsize pipe on 17th Avenue to mitigate flooding due to undersized pipe between Capitola Road and Kinsley Street/Union Pacific RR

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
30	42	36	1,031
18	30	24	43
18	36	33	281
18	42	39	304
12	30	27	682

H. Project-Specific Considerations: N/A

I. Alternatives: Leave existing pipe in place and install new parallel pipe to achieve equivalent capacity

J. Project Location Map:

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A. Project ID: 1	**B. Project Name:**	**17th - Capitola to Kinsley**
C. Project Location: Capacity Improvement along 17th Ave between Capitola Road and Kinsley Street		
D. Priority:	**High**	

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_1885, Z5_PIPE_1270, Z5_PIPE_4578, Z5_PIPE_1893	30	7	1,031	LF	$60	$62,000
Z5_PIPE_1326, Z5_PIPE_1896, Z5_PIPE_1897	18	6	628	LF	$40	$25,000
Z5_PIPE_1900, Z5_PIPE_1903	12	6	682	LF	$30	$20,000
Pipe Construction						
Z5_PIPE_1326, Z5_PIPE_1900, Z5_PIPE_1903	30	6	725	LF	$410	$299,000
Z5_PIPE_1885, Z5_PIPE_1270, Z5_PIPE_4578, Z5_PIPE_1893, :	42	7	1,334	LF	$570	$760,000
Z5_PIPE_1896	36	6	281	LF	$490	$140,000
Structures						
Manhole/Catch Basin Connection						$163,000
Outfalls						$0
SUBTOTAL						**$1,470,000**
Mobilization/Demobilization					10%	$150,000
Traffic Control					5%	$70,000
Contingency					40%	$590,000
CONSTRUCTION COST TOTAL						**$2,280,000**
Engineering/Inspection					20%	$460,000
Site-Specific Costs						
ROW Acquisition/Easements						$0
Environmental/Jurisdictional Permitting						$0
CIP TOTAL						**$2,740,000**

**Totals rounded to nearest $10,000*

A. Project ID: 2 | **B. Project Name:** 34th Ave Ditch Improvements

C. Project Location: Capacity improvements for culverts between Portola and 30th

D. Priority: High

E. Type: Capacity

G. Description: Upsize existing closed conduit systems (ditches are sufficiently sized) beneath mobile home parks south of Portola and east of 30th Ave

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
57 x 84	60 x 120	120	33
72	84	42	366

H. Project-Specific Considerations: Mobile homes situated atop existing storm drainage infrastructure

I. Alternatives: Install parallel pipe (see Project ID 2A for alternative project alignment within ROW)

J. Project Location Map:

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A. Project ID: 2 | **B. Project Name:** **34th Ave Ditch Improvements**

C. Project Location: Capacity improvements for culverts between Portola and 30th

D. Priority: **High**

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_1882, Z5_PIPE_2055	57 x 84	8	33	LF	$150	$5,000
Z5_PIPE_2055, Z5_PIPE_2696	72	9	366	LF	$120	$44,000
Pipe Construction						
Z5_PIPE_1882, Z5_PIPE_2055	60 x 120	6	33	LF	$3,010	$100,000
Z5_PIPE_2055, Z5_PIPE_2696	84	7	366	LF	$1,670	$610,000
Structures						
Manhole/Catch Basin Connection						$92,000
Outfalls						$0
SUBTOTAL						**$850,000**
Mobilization/Demobilization					10%	$90,000
Traffic Control					5%	$40,000
Contingency					40%	$340,000
CONSTRUCTION COST TOTAL						**$1,320,000**
Engineering/Inspection					20%	$260,000
Site-Specific Costs						
ROW Acquisition/Easements						$800,000
Environmental/Jurisdictional Permitting						$0
CIP TOTAL						**$2,380,000**

**Totals rounded to nearest $10,000*

A. Project ID: 2A | **B. Project Name:** Portola-30th

C. Project Location: Alternative parallel pipe alignment on Portola and 30th

D. Priority: High

E. Type: Capacity

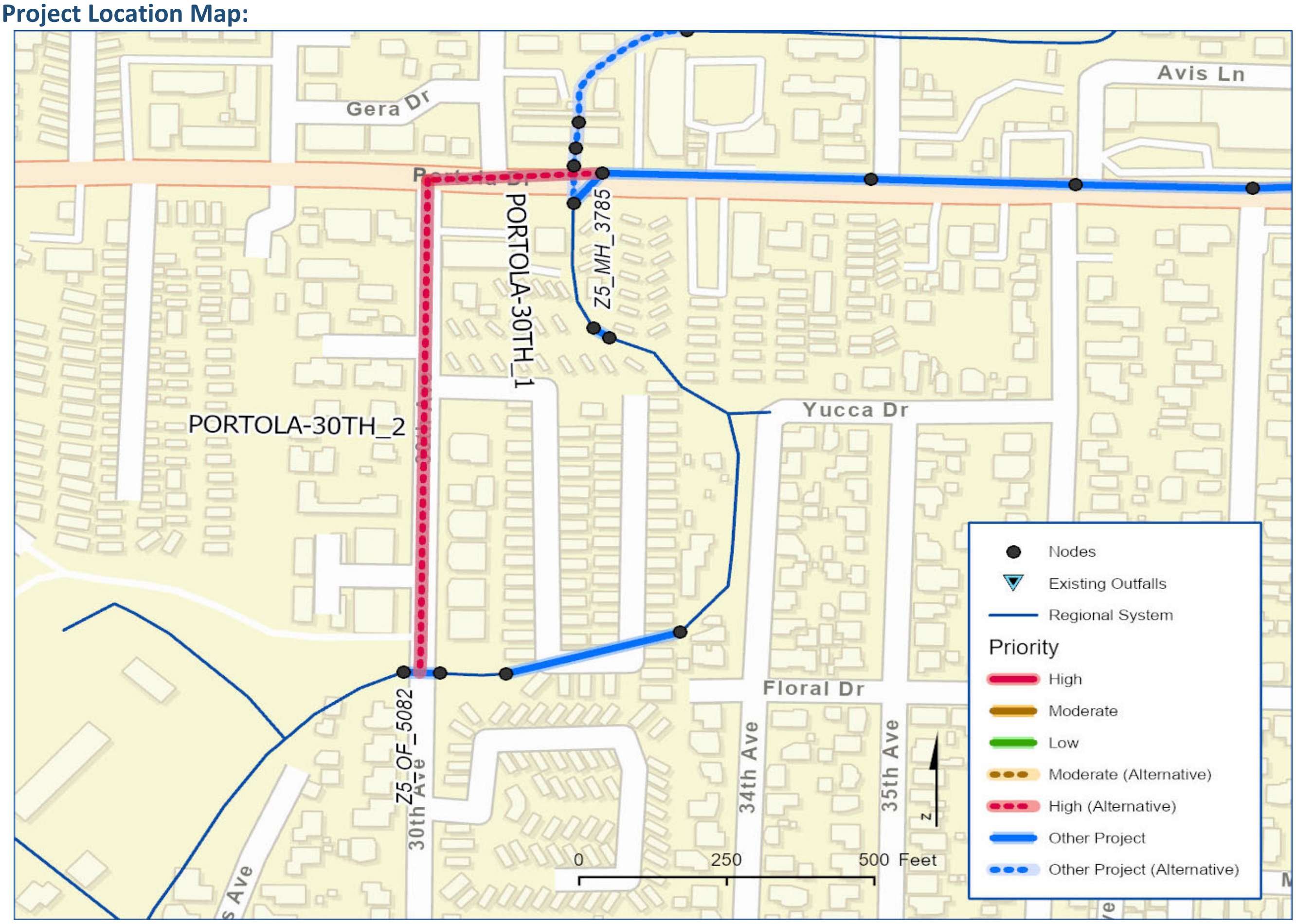
G. Description: [DESCRIPTION]

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
N/A	36	N/A	1,250

H. Project-Specific Considerations: N/A

I. Alternatives: Leave existing pipe in place and install new parallel pipe to achieve equivalent capacity

J. Project Location Map:



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A. Project ID: 2A	**B. Project Name:**	**Portola-30th**				
C. Project Location:	Alternative parallel pipe alignment on Portola and 30th					
D. Priority:	**High**					
E. Project Cost						

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
N/A						
Pipe Construction						
PORTOLA-30th_1, PORTOLA-30th_2	36	6	1,250	LF	$490	$613,000
Structures						
Manhole/Catch Basin Connection						$54,000
Outfalls						$0
SUBTOTAL						**$670,000**
Mobilization/Demobilization					10%	$70,000
Traffic Control					5%	$30,000
Contingency					40%	$270,000
CONSTRUCTION COST TOTAL						**$1,040,000**
Engineering/Inspection					20%	$210,000
Site-Specific Costs						
ROW Acquisition/Easements						$0
Environmental/Jurisdictional Permitting						$0
CIP TOTAL						**$1,250,000**

**Totals rounded to nearest $10,000*

A. Project ID: 3 | **B. Project Name:** **Portola Downstream of 38th**

C. Project Location: Capacity improvements on Portola (sized to allevitae flooding north of railroad)

D. Priority: **High**

E. Type: **Capacity**

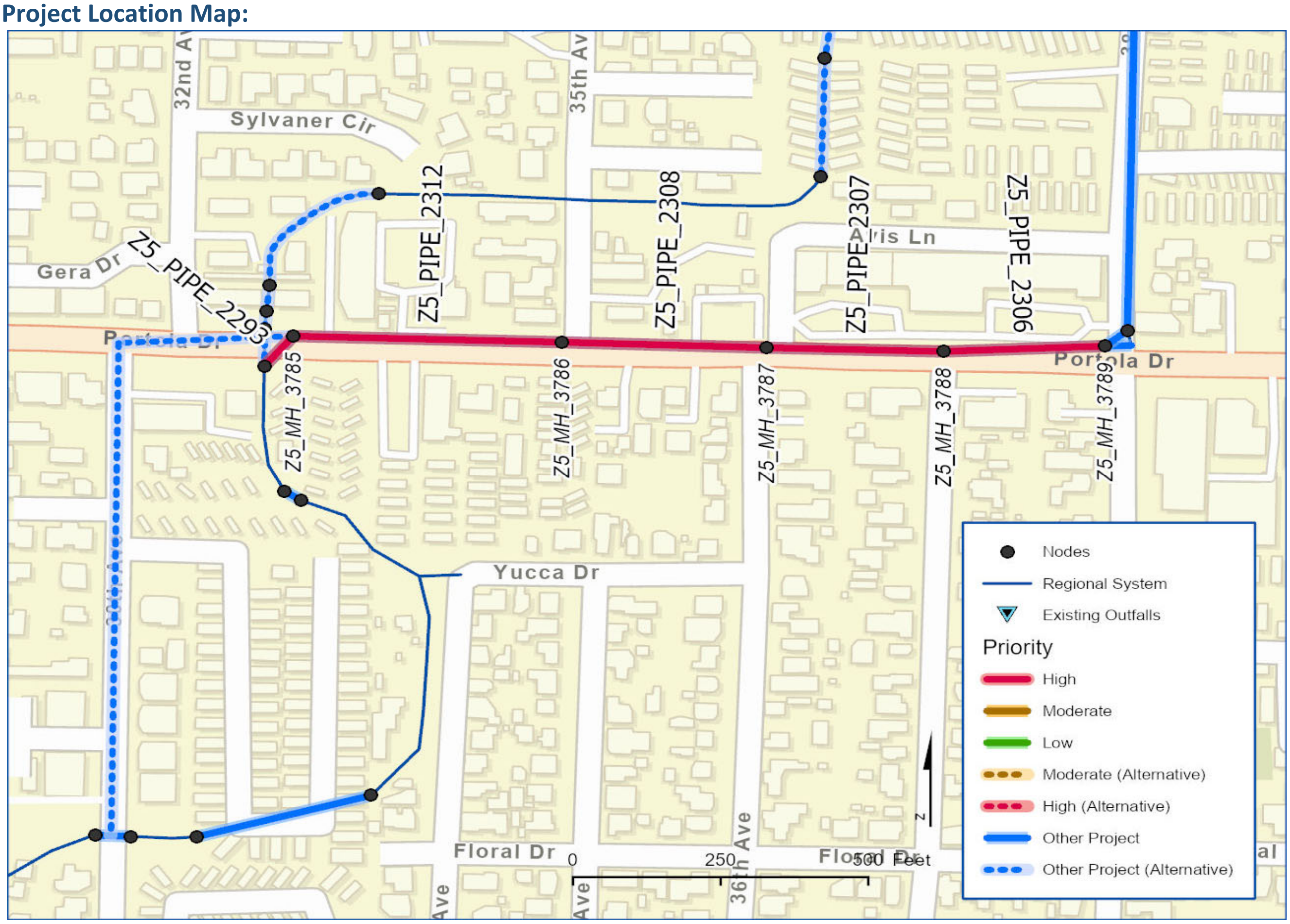
G. Description: Upsize existing pipe in Portola Drive. Works in tandem with upstream project to alleviate flooding north of the railroad near 38th Ave

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
42	48	30	1,176
36	48	36	45
36 x 24	48	36	274

H. Project-Specific Considerations: N/A

I. Alternatives: Remain on existing parallel alignment (See Project ID 3A)

J. Project Location Map:



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A. Project ID: 3 | **B. Project Name:** **Portola Downstream of 38th**

C. Project Location: Capacity improvements on Portola (sized to allevitae flooding north of railroad)

D. Priority: **High**

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_2293, Z5_PIPE_2307, Z5_PIPE_2308, Z5_PIPE_2312	42	6.5	1,176	LF	$75	$88,000
Z5_PIPE_2305	36	6	45	LF	$70	$3,000
Z5_PIPE_2306	36 x 24	6	274	LF	$80	$22,000
Pipe Construction						
Z5_PIPE_2293, Z5_PIPE_2305, Z5_PIPE_2306, Z5_PIPE_2307, :	48	7	1,494	LF	$670	$1,003,000
Structures						
Manhole/Catch Basin Connection						$113,000
Outfalls						$0
SUBTOTAL						**$1,230,000**
Mobilization/Demobilization					10%	$120,000
Traffic Control					5%	$60,000
Contingency					40%	$490,000
CONSTRUCTION COST TOTAL						**$1,900,000**
Engineering/Inspection					20%	$380,000
Site-Specific Costs						
ROW Acquisition/Easements						$0
Environmental/Jurisdictional Permitting						$0
CIP TOTAL						**$2,280,000**

**Totals rounded to nearest $10,000*

A. Project ID: 3A **B. Project Name:** **38th Ave (Portola D/S 38th Alt)**

C. Project Location: Capacity improvements on system parallel to 38th Ave and Portola

D. Priority: **High**

E. Type: **Capacity**

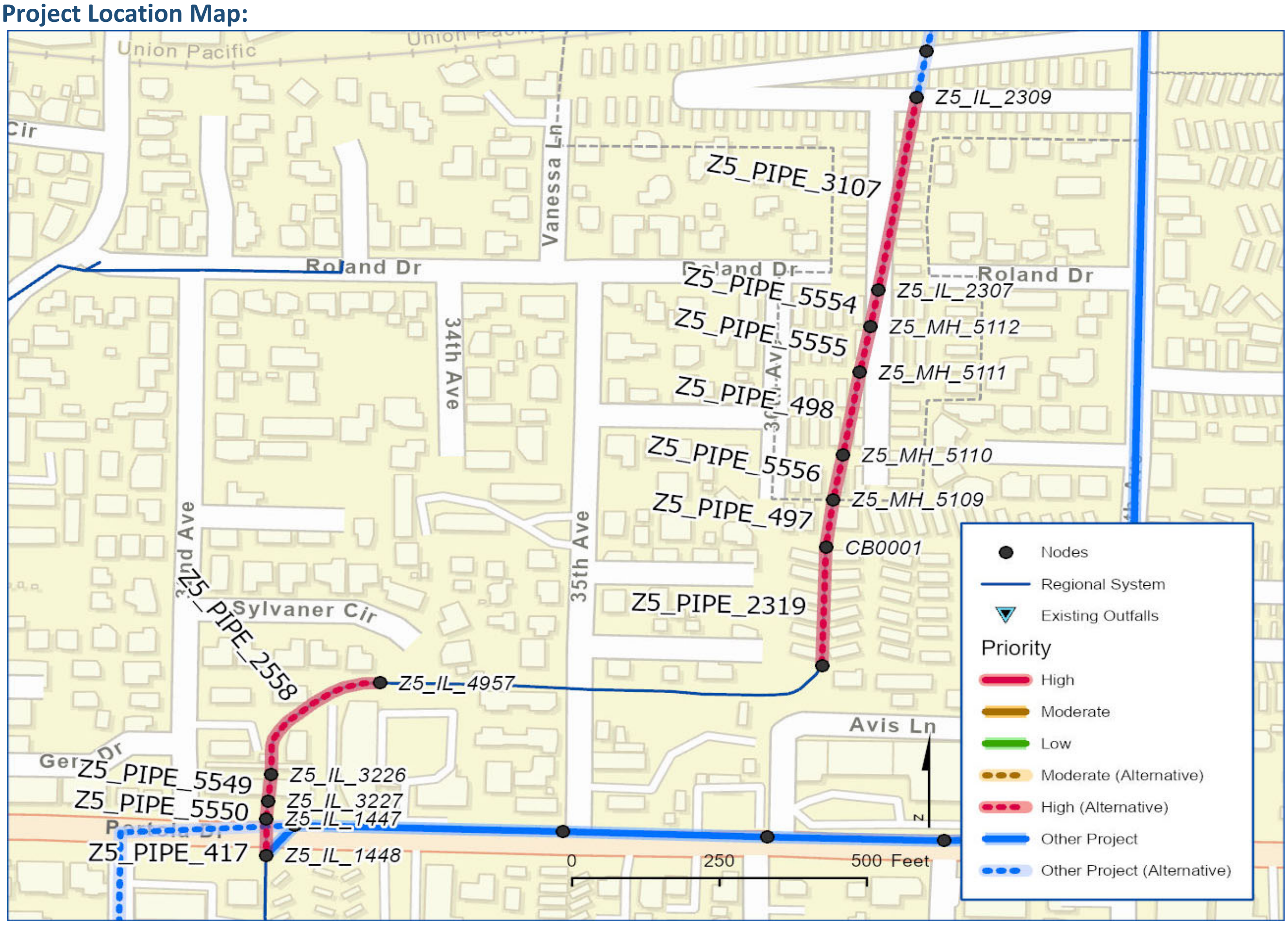
G. Description: Replace existing closed conduit storm drainage infrastructure between railroad and Portola Ave, keeping on existing alignment. System is shallow and runs beneath mobile homes

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
44x72 Arch	48x144	84	857
66	48x144	54	367
72	48x144	48	69
48x96	48x144	42	222

H. Project-Specific Considerations: Project runs underneath approximately 36 existing mobile homes

I. Alternatives: See Project ID 3 for identified alternative

J. Project Location Map:



Schaaf & Wheeler

A. Project ID: **3A**	**B. Project Name:** **38th Ave (Portola D/S 38th Alt)**
C. Project Location: Capacity improvements on system parallel to 38th Ave and Portola	
D. Priority: **High**	

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_498, Z5_PIPE_3107, Z5_PIPE_5554, Z5_PIPE_5555,	44x72 Arch	7	857	LF	$80	$69,000
Z5_PIPE_5549, Z5_PIPE_5550, Z5_PIPE_2558	66	7	367	LF	$100	$37,000
Z5_PIPE_417	72	7	69	LF	$120	$8,000
Z5_PIPE_2319	48x96	7	222	LF	$150	$33,000
Pipe Construction						
All	48x144	7	1,515	LF	$2,010	$3,050,000
Structures						
Manhole/Catch Basin Connection						$144,000
Outfalls						$0
SUBTOTAL						**$3,340,000**
Mobilization/Demobilization					10%	$330,000
Traffic Control					5%	$170,000
Contingency					40%	$1,340,000
CONSTRUCTION COST TOTAL						**$5,180,000**
Engineering/Inspection					20%	$1,040,000
Site-Specific Costs						
Temporary Relocation of Mobile Home Residents						$2,700,000
ROW Acquisition/Easements						$0
Environmental/Jurisdictional Permitting						$0
CIP TOTAL						**$8,920,000**

**Totals rounded to nearest $10,000*

A. Project ID: 4 | **B. Project Name:** **Noble Downstream (Alt 1)**

C. Project Location: Capacity Improvement at downstream end of Noble Creek Culvert

D. Priority: **High**

E. Type: **Capacity**

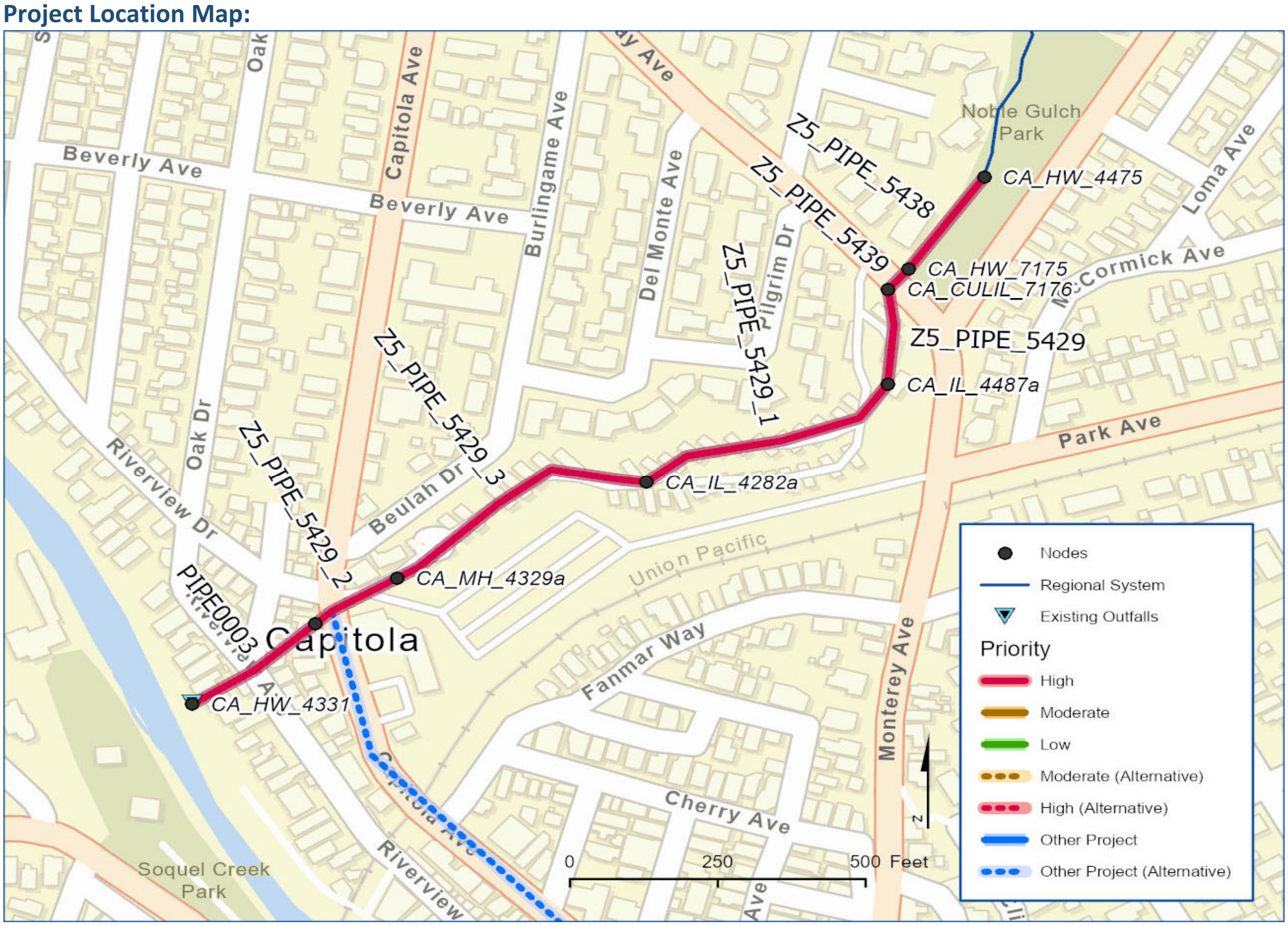
G. Description: Upsize Noble Creek culvert downstream end to provide adequate capacity for a 10-year storm event. Remain on existing alignment

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
70	72 x 96	N/A	427
45 x 72	72 x 96	N/A	103
72	96 x 120	N/A	564
48 x 72	72 x 96	N/A	259
72	96 x 96	N/A	163

H. Project-Specific Considerations: Existing alignment beneath homes and through narrow easement

I. Alternatives: See Project IDs 4A and 4B for identified alternatives

J. Project Location Map:



Schaaf & Wheeler

A. Project ID: 4	**B. Project Name:**	**Noble Downstream (Alt 1)**
C. Project Location:	Capacity Improvement at downstream end of Noble Creek Culvert	
D. Priority:	**High**	

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_5438, Z5_PIPE_5438	70	9	427	LF	$100	$43,000
Z5_PIPE_5439, Z5_PIPE_5439	45 x 72	9	103	LF	$120	$12,000
Z5_PIPE_5429_1, Z5_PIPE_5429_2	72	11	727	LF	$120	$87,000
PIPE0003	48 x 72	9	259	LF	$120	$31,000
Pipe Construction						
Z5_PIPE_5438, Z5_PIPE_5439, PIPE0003, Z5_PIPE_5438, Z5_PIPE_5439	72 x 96	9	788	LF	$2,510	$1,980,000
Z5_PIPE_5429_1	96 x 120	11	564	LF	$3,010	$1,700,000
Z5_PIPE_5429_2	96 x 96	11	163	LF	$2,760	$450,000
Structures						
Manhole/Catch Basin Connection						$285,000
Outfalls						$100,000
SUBTOTAL						**$4,680,000**
Mobilization/Demobilization					10%	$470,000
Traffic Control					5%	$230,000
Contingency					40%	$1,870,000
CONSTRUCTION COST TOTAL						**$7,250,000**
Engineering/Inspection					20%	$1,450,000
Site-Specific Costs						
ROW Acquisition/Easements						$2,900,000
Environmental/Jurisdictional Permitting						$100,000
CIP TOTAL						**$11,700,000**

**Totals rounded to nearest $10,000*

A. Project ID: 4A | **B. Project Name:** Noble Downstream (Alt 2)

C. Project Location: Capacity Improvement at downstream end of Noble Creek Culvert

D. Priority: High

E. Type: Capacity

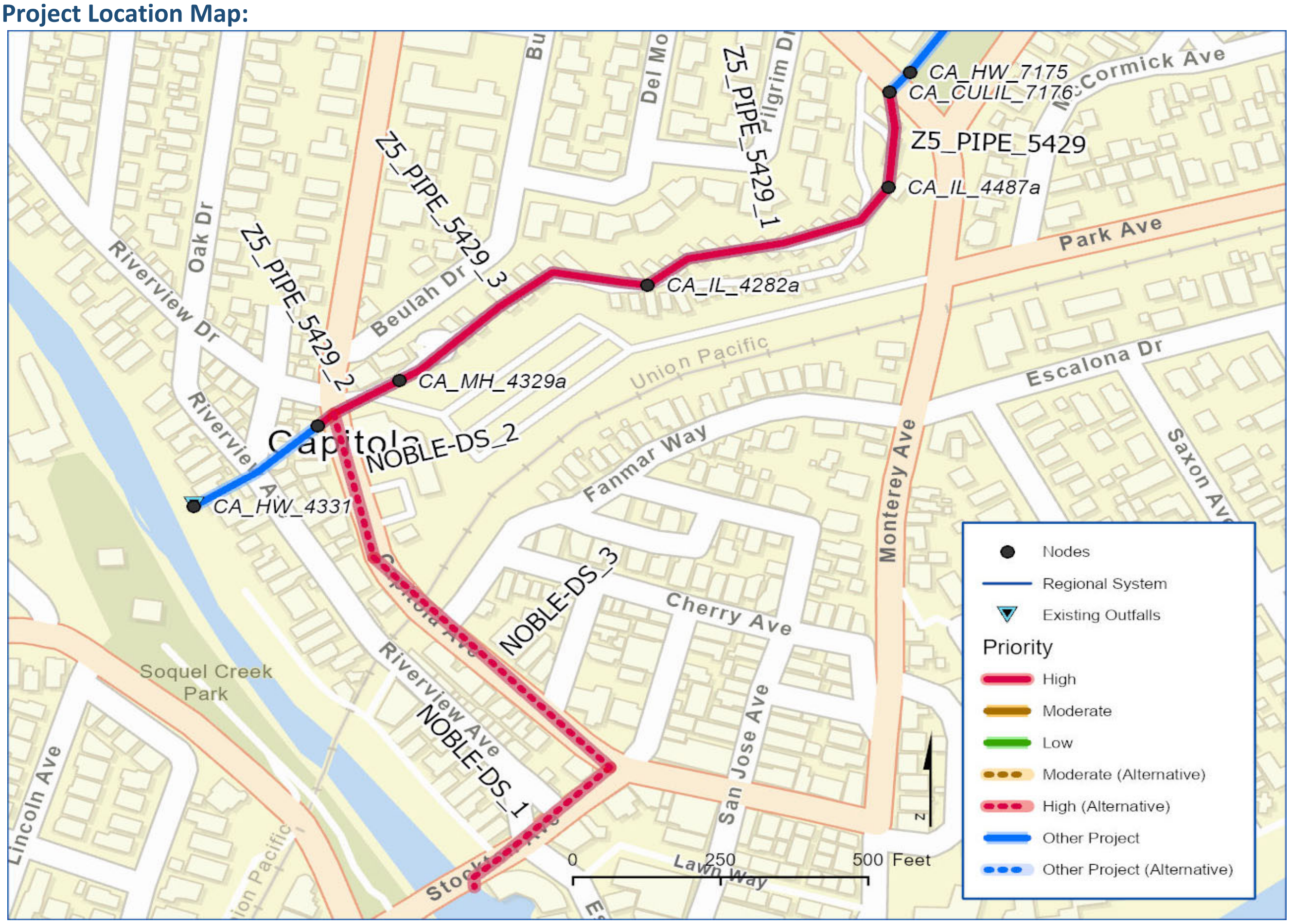
G. Description: Replace existing culvert downstream of Monterey Ave, but install a new parallel pipe on Capitola Ave and Stockton to re-route drainage to a point along Soquel Creek with lower HGL

Ex. Size (in)	Replacement Pipe Size (in)	Parallel Pipe Diam (in)	Length (ft)
72	96 x 120	#N/A	958
48 x 72	72 x 96	#N/A	259
72	96 x 96	#N/A	163
72	72 x 96	#N/A	179
N/A	84	N/A	1,190

H. Project-Specific Considerations: N/A

I. Alternatives: See Project IDs 4 and 4B for identified alternatives

J. Project Location Map:



Schaaf & Wheeler

A. Project ID: 4A | **B. Project Name:** Noble Downstream (Alt 2)

C. Project Location: Capacity Improvement at downstream end of Noble Creek Culvert

D. Priority: High

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_5429_1, Z5_PIPE_5429_2, Z5_PIPE_5429_3, Z5_PIPE_	72	11	1,299	LF	$120	$156,000
PIPE0003	48 x 72	9	259	LF	$120	$31,000
Pipe Construction						
Z5_PIPE_5429_1, Z5_PIPE_5429_3	96 x 120	11	958	LF	$3,010	$2,880,000
PIPE0003, Z5_PIPE_5429	72 x 96	9	438	LF	$2,510	$1,100,000
Z5_PIPE_5429_2	96 x 96	11	163	LF	$2,760	$450,000
NOBLE-DS_1, NOBLE-DS_2, NOBLE-DS_3	84	10	1,190	LF	$1,670	$1,987,000
Structures						
Manhole/Catch Basin Connection						$286,700
Outfalls						$100,000
Site-Specific Costs						
Utility Relocation						$0
ROW Acquisition						$0
Environmental/Jurisdictional Permitting						$0
SUBTOTAL						**$6,990,000**
Mobilization/Demobilization					10%	$700,000
Traffic Control					5%	$350,000
Contingency					40%	$2,800,000
CONSTRUCTION COST TOTAL						**$10,840,000**
Engineering/Inspection					20%	$2,170,000
CIP TOTAL						**$13,010,000**

**Totals rounded to nearest $10,000*

A. Project ID: 4B | **B. Project Name:** **Noble Downstream (Alt 3)**

C. Project Location: Capacity Improvement at downstream end of Noble Creek Culvert

D. Priority: **High**

E. Type: **Capacity**

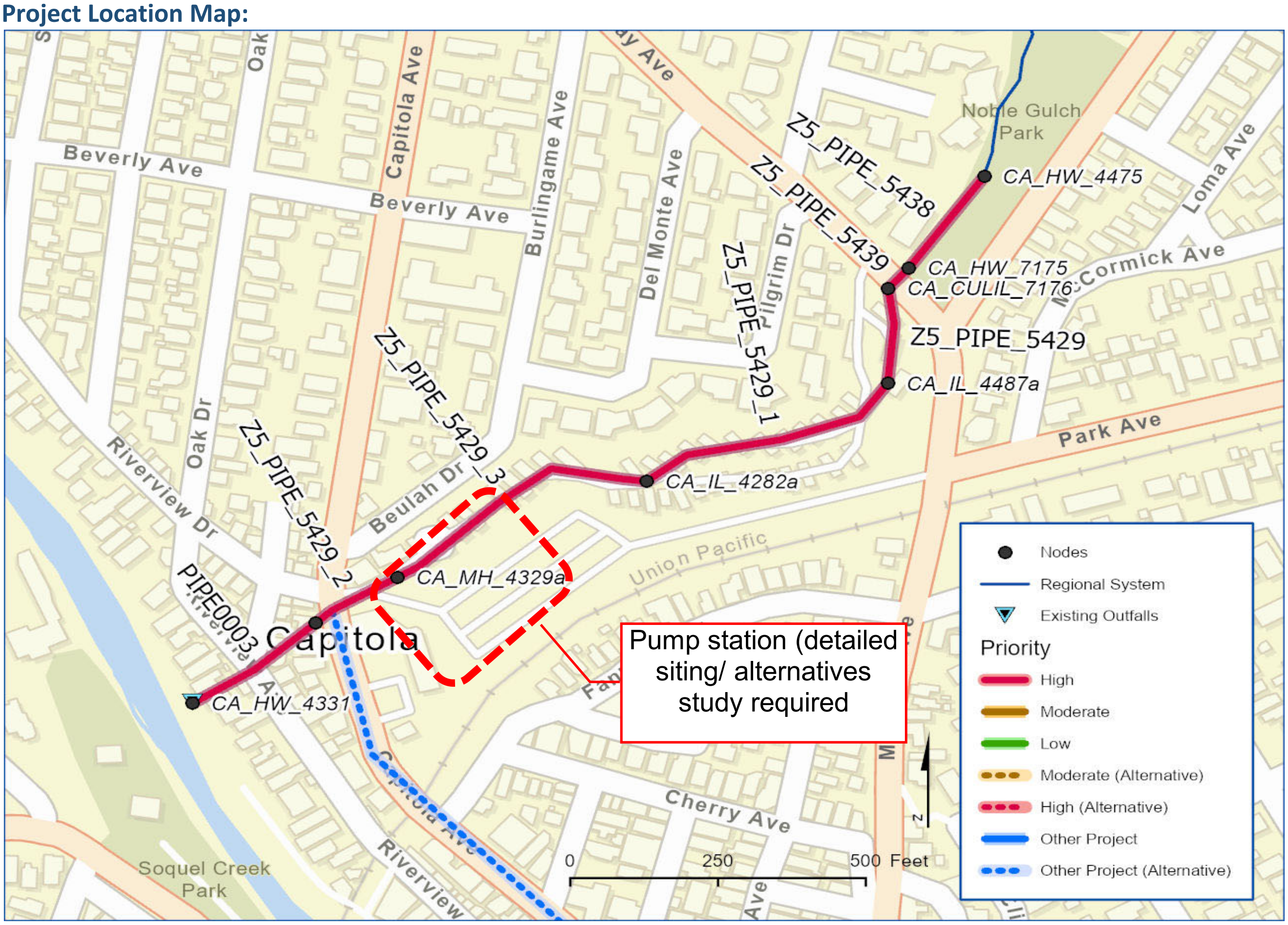
G. Description: Gravity improvements to downstream Noble Creek culverts; Construct new pump station and forcemain (~72") for greater resilience to sea level rise. Requires detailed siting, capacity, and alternatives analysis study

Ex. Diameter (in)	Replacement Pipe Diameter (in)	Parallel Pipe Diam (in)	Length (ft)
N/A	72	N/A	300
70	72 x 96	N/A	213
45 x 72	72 x 96	N/A	51
72	96 x 120	N/A	564
48 x 72	72 x 96	N/A	259
72	96 x 96	N/A	163

H. Project-Specific Considerations: New pump station requires detailed design study

I. Alternatives: See Project IDs 4 and 4A for identified alternatives

J. Project Location Map:



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A. Project ID: 4B	B. Project Name: Noble Downstream (Alt 3)
C. Project Location:	Capacity Improvement at downstream end of Noble Creek Culvert
D. Priority:	High

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
Z5_PIPE_5429_1, Z5_PIPE_5429_2	72	11	727	LF	$120	$87,000
Z5_PIPE_5438	70	9	213	LF	$100	$21,000
Z5_PIPE_5439	45 x 72	9	51	LF	$120	$6,000
PIPE0003	48 x 72	9	259	LF	$120	$31,000
Pipe Construction						
NOBLEPS_Forcemain	72	9	300	LF	$1,300	$390,000
Z5_PIPE_5438, Z5_PIPE_5439, PIPE0003	72 x 96	9	523	LF	$2,510	$1,310,000
Z5_PIPE_5429_1	96 x 120	11	564	LF	$3,010	$1,700,000
Z5_PIPE_5429_2	96 x 96	11	163	LF	$2,510	$409,000
Structures						
Manhole/Catch Basin Connection						#VALUE!
Outfalls						#VALUE!
SUBTOTAL						**#VALUE!**
Mobilization/Demobilization					10%	#VALUE!
Traffic Control					5%	#VALUE!
Contingency					40%	#VALUE!
CONSTRUCTION COST TOTAL						**#VALUE!**
Engineering/Inspection					20%	#VALUE!
Site-Specific Costs						
Pump Station						#VALUE!
ROW Acquisition						#VALUE!
Environmental/Jurisdictional Permitting						#VALUE!
CIP TOTAL						**#VALUE!**

**Totals rounded to nearest $10,000*

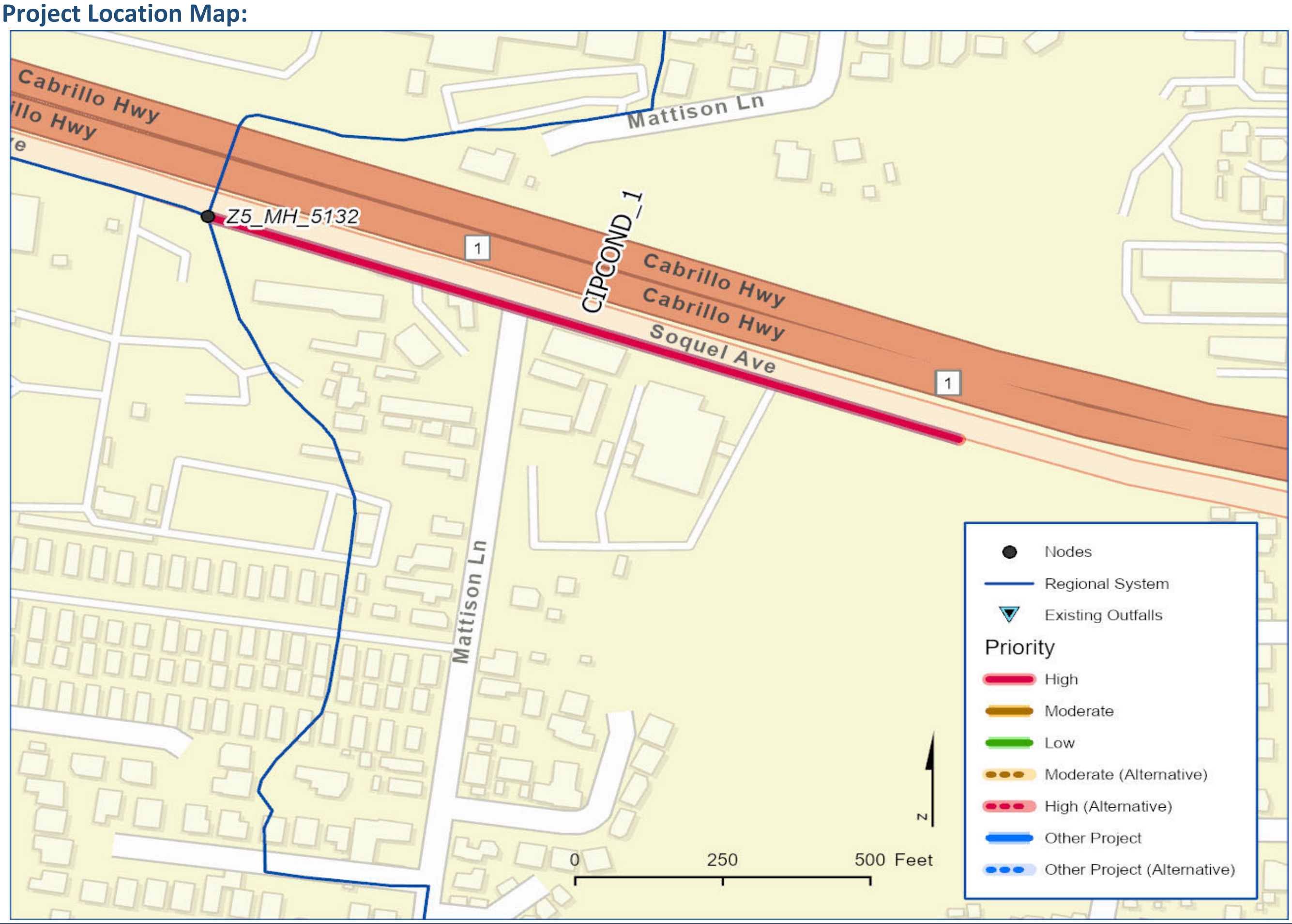
A. Project ID: 5	B. Project Name: **Soquel Ave to Rodeo Creek Gulch**
C. Project Location:	Capacity Improvement along Soquel Ave, from upstream of Mattison to Rodeo Cr Gulch
D. Priority:	**High**
E. Type:	**Capacity**
G. Description:	Install new outfall pipe connecting existing pipe system to Rodeo Creek Gulch along Soquel Ave to alleviate flooding on private properties adjacent to Mattison Lane

Ex. Diameter (in)	Replacement Pipe Diameter (in)	Parallel Pipe Diam (in)	Length (ft)
N/A	42	N/A	1,340

H. Project-Specific Considerations: N/A

I. Alternatives: Replace pipe through existing private properies with larger or parallel system

J. Project Location Map:



Schaaf & Wheeler

A. Project ID: 5	B. Project Name: Soquel Ave to Rodeo Creek Gulch
C. Project Location:	Capacity Improvement along Soquel Ave, from upstream of Mattison to Rodeo Cr Gulc
D. Priority:	High

E. Project Cost

MAJOR ITEMS	DIAM (in)	AVE DEPTH (ft)	QTY.	UNIT	UNIT COST	COST
BASELINE CONSTRUCTION COST						
Pipe Demo/Disposal						
N/A						
Pipe Construction						
CIPCOND_1	42	7	1,340	LF	$570	$764,000
Structures						
Manhole/Catch Basin Connection						$54,900
Outfalls						$100,000
SUBTOTAL						**$920,000**
Mobilization/Demobilization					10%	$90,000
Traffic Control					5%	$50,000
Contingency					40%	$370,000
CONSTRUCTION COST TOTAL						**$1,430,000**
Engineering/Inspection					20%	$290,000
Site-Specific Costs						
ROW Acquisition						$0
Environmental/Jurisdictional Permitting						$0
CIP TOTAL						**$1,720,000**

**Totals rounded to nearest $10,000*

Appendix D

Operations and Maintenance (O&M) Plan

Collaboration. Commitment. Confidence.SM

Zone 5 Storm Drain Master Plan

Operations and Maintenance Plan

Santa Cruz County, CA

November 10, 2023

Prepared for:

Santa Cruz County
701 Ocean Street
Santa Cruz, CA 95060

Prepared by:

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Associate

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NCE Project Number: 1045.03.55

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List of Abbreviations

App	Application
CCTV	closed-circuit television
County	Santa Cruz County
ESRI	Environmental Systems Research Institute
GIS	Geographic Information Systems
Lucity	Lucity Asset Management System
MS4	Municipal Separate Storm Water Sewer System
NPDES	National Pollutant Discharge Elimination System
O&M	Operations & Maintenance
Water Board	Regional Water Quality Control Board

1 Introduction

Santa Cruz County (County) is responsible for a storm drain network consisting of facilities along more than 600 miles of County roads. Municipalities within the County include the cities of Santa Cruz, Scotts Valley, Watsonville, and Capitola. Each city has additional storm drain facilities they are responsible for operating and maintaining.

To manage such a large system, the County has established four drainage or flood control zones (Zones 5-8) based on defined watersheds associated with urban areas. The Zones also define the boundaries for operations and maintenance (O&M) activities. Maintenance resources across the County include five crews made up of more than three dozen maintenance staff, three maintenance yards, and various equipment and tools. In addition, each municipality has its respective maintenance resources.

This Operations & Maintenance (O&M) Plan is one element of the Zone 5 Storm Drain Master Plan and establishes a formal program for O&M activities. The O&M Plan consists of five critical components 1) Program Management 2) Asset Inventory 3) Analysis and Forecasting 4) Work Program Actions and 5) Tracking and Reporting.

1.1 ASSET MANAGEMENT CYCLE

Storm water asset management is an iterative and evolving process that provides a comprehensive means of cost effectively operating, maintaining, and investing in storm drain systems. **Figure 1** illustrates this process. The baseline asset inventory provides the information necessary to analyze and forecast inspection, maintenance, and repair needs. As needs are identified, work program actions – including inspections, maintenance, and repairs – create new data. This new information is captured as part of tracking and reporting and is managed within the County's existing Lucity asset management and Geographic Information Systems (GIS) software. As repairs are made and targeted capital improvement projects are implemented to improve the storm drain network, the

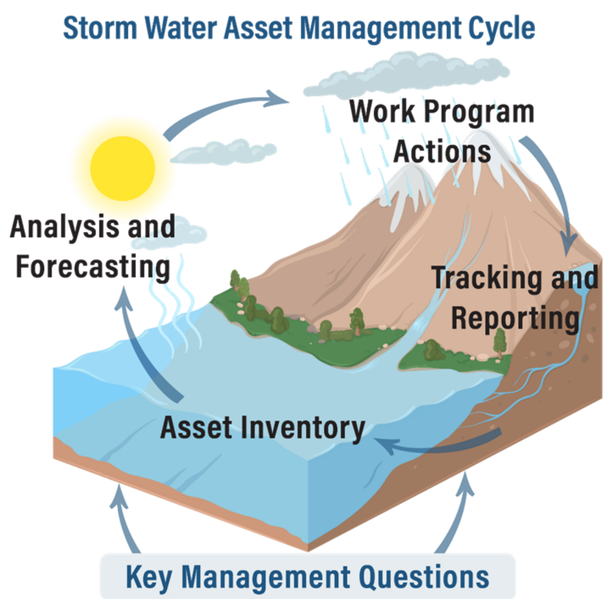

Figure 1. Storm Water Asset Management Cycle

asset inventory is updated, thus completing the cycle. Together, the elements of this cycle comprise the County's O&M Program. The O&M Program is fluid and changes over time to meet the County's needs. Therefore, this O&M Plan should be revisited and updated every 3-to-4 years to maximize its effectiveness.

1.2 O&M PROGRAM ELEMENTS AND DEFINITIONS

Asset Inventory – Defines the spatial location and attribute information for the storm drain assets (junctions and conveyances) in the system. Key information includes the horizontal and vertical spatial location, asset type, material, dimensions, maintenance condition, and invert elevations. Primary asset types include:

- **Structures** – Structures are assets where storm water enters/exits the system. Some structures include trash and sediment trap features. Other structures provide access points for maintenance (e.g., inlet, catch basin, manhole, outfall).
- **Conduits** – Conduits are linear assets that carry storm water between structures either above or below ground to a receiving water outfall or other portion of the storm drain system (e.g., pipe, culvert, open channel).

Analysis and Forecasting – Describes the process of identifying the annual O&M priorities; these priorities help identify storm drain assets that require a work program action during the year. This section presents the queries necessary to identify which assets are inspected, inspection timing and frequency, as well as the O&M cost estimates.

Work Program Actions – Describes the procedures, equipment, and methodologies used to implement the O&M Program (e.g., visual, emergency, or closed-circuit television [CCTV] inspections; maintenance; repairs or replacements; and capital improvements). Details regarding capital investments including repair, replacement, and capital projects are described in the Zone 5 Storm Drain Master Plan.

Tracking and Reporting – Describes the various elements of the Lucity asset management software and the use of GIS software to navigate to asset locations, track inspection and maintenance activities, and report various analytics to forecast short-term and long-term needs. This section also summarizes annual internal and National Pollutant Discharge Elimination System (NPDES) reporting.

1.3 KEY MANAGEMENT QUESTIONS

As previously mentioned, an O&M Program should evolve and change, as necessary, to meet the needs of the managing jurisdiction and describe the current O&M Program. This section provides questions asked in the development of this O&M Plan and that the County should consider as it implements its O&M Program.

This list is not intended to be exhaustive; rather, the questions illustrate the site-specific storm drain concerns and challenges that directly inform the County's O&M Program.

- What are the County's O&M Program goals?
- What specific outcomes does the County desire from its O&M Program?
- What resources (financial and personnel) are currently available to support the O&M Program?
- What existing work program actions does the County implement on a routine or periodic basis as part of the O&M Program?
- What frequency should work program actions be executed?
- How do existing or future routine maintenance agreements with the California Department of Fish and Wildlife factor into the O&M program?
- What equipment is used by in-house staff to perform work program actions?
- Should the O&M program be completed in house and/or with vendors?
- What reports or analysis should be done to analyze and forecast O&M needs?
- How can the County best leverage their existing GIS and Lucity asset management software?
- What processes should be in place for documenting inspections, maintenance, and repairs?
- Is using digital handheld devices a good approach to capturing inspection and maintenance records?
- What level of documentation for standard operating procedures is recommended?

1.4 ROLES AND RESPONSIBILITIES

The County has a Management Team and an Operations Team responsible for implementing its O&M Program.

1.4.1 Management Team

The Management Team oversees the overall storm water program and manages the maintenance crews, with varying responsibilities distributed across three maintenance yards within the County. The team consists of Program Managers (one from the County and one from the City of Capitola), a Superintendent and Crew Supervisors, and a GIS Manager.

Program Managers

Program Managers are responsible for the coordination and overall implementation of the County Storm Water Program. They are responsible for securing adequate financial and personnel resources to successfully implement the O&M Program. The Program Managers also provide critical support to the Operations Team with the identification and resolution of issues as they arise.

At the time this O&M Plan was written, the following County and City staff were assigned the role of Program Managers:

- Steve Wiesner – Assistant Director of Public Works who also oversees the County's O&M Program
- Rachel Fatoohi – Santa Cruz County Storm Water Program Coordinator
- Jessica Kahn – City of Capitola Public Works Director

Superintendent & Crew Supervisors

The Superintendent and Crew Supervisors coordinate day-to-day activities identified throughout the County. Crew Supervisors (one for each of the five County maintenance crews) receive direction from the Superintendent and delegate work assignments to their crew. Issues identified in the field are conveyed to Crew Supervisors, and if necessary, to the Superintendent or Program Managers for resolution.

At the time this O&M Plan was written, the following County staff were assigned the roles of Superintendent or Crew Supervisor:

- Alex Sandoval – Superintendent
- Augie Waltrip – Assistant Superintendent Roads
- Elliot Vega – Assistant Superintendent Drainage, Special Crew
- Vacant – Drainage Crew Supervisor (manages 6 staff)
- Gavino Mosqueda – Special Crew Supervisor (manages 14 staff)
- Jose Ramirez – North County Supervisor (manages 11 staff)
- Mark Hernandez – Mid-County Supervisor (manages 11 staff)
- Henry Munoz – South County Crew Supervisor (manages 11 staff)

GIS Manager

The GIS Manager is responsible for maintaining the storm drain system's geospatial data and the integration of these data with the County's Lucity Asset Management System (Lucity). The County uses GIS to record the spatial location of storm drain assets and considers the GIS dataset to be a foundational component of O&M. The attribution and condition assessment history, including previous inspections and maintenance actions, is handled within Lucity, and will be integrated into the GIS in the near future. Both of these systems are overseen by the GIS Manager.

Over time, the GIS manager has continued to develop and improve the spatial accuracy of mapped assets and the schema (i.e., list of attributes) to make querying and reporting capabilities more powerful. As Lucity integration improves over time, more functions of Lucity are forecasted to become available to staff. This includes Lucity Mobile, which will enable better visualization of and navigation to assets.

A variety of applications and software are currently being utilized by operations staff to perform their duties. The GIS Manager develops and controls some of these applications, including Environmental Systems Research Institute (ESRI) ArcGIS web applications and mobile applications (Field Maps and Survey123). Other software, including aspects of Lucity and Google Earth for traffic control, are managed by others.

At the time this O&M Plan was written, one person was assigned the role of GIS Manager:

- Bryan Kriete – GIS Analyst for Santa Cruz County Public Works

1.4.2 Operations Team

The Operations Team[1] includes five maintenance crews with varying numbers of staff. The Operations Team also includes the Superintendents and Crew Supervisors as described above, who are responsible for managing and delegating daily operations. In addition, contractors (currently Sergey Mariniuk of Fastlane Tek) periodically support Lucity troubleshooting or custom reporting.

Below, each crew is described and their various responsibilities are outlined.

Drainage Crew

The Drainage Crew, based out of the Wilson Yard, consists of six staff supervised by a supervisor whose position is currently vacant. This crew is responsible for drainage asset inspection related to five separate flood zone districts (Zone 5, 6, 7, 8 and the Pajaro Storm Drain Maintenance District) and maintenance of county culverts (there is some crossover with the Road Crews), catch basins, pipes, open channels relative to the flood zone districts. Drainage also maintains unique facilities like the 38th Avenue detention basin and Shell Rd pump station.

Special Crew

The Special Crew, based out of the Brommer Yard, consists of 14 staff supervised by Gavino Mosqueda. This crew maintains materials in the yard, calibrates meters, inspects/maintains unique assets like traffic control devices, road markings, guardrails, street sweeping, litter and maintains silt and grease traps in all County zones. The Special Crew is also responsible for inspecting and maintaining assets associated with the NPDES.

[1] Details about the Operations Team, including photos from Brommer Yard, and descriptions of work program actions were from a field meeting with the Operations Team, Santa Cruz County, March 2021.

Road Crews

There are three Road Crews, including the North County, Mid-County, and South County crews. The Road Crews are responsible for roadway-related assets on over 600 miles of County roads. Crews focus mostly on pavement repairs, roadside mowing and ditch clearing. Road crews assist in cross culvert inspections/replacements as well as minor visual inspections of Zone 5 inlets.

North County Crew

The North County Crew, based out of the Felton Yard, consists of 11 staff supervised by Jose Ramirez. This crew is responsible for County road culverts, catch basins, and other roadway assets west of Highway 17.

Mid-County Crew

The Mid-County Crew, based out of the Brommer Yard, consists of 11 staff supervised by Mark Hernandez. This crew is responsible for County road culverts, catch basins, and other roadway assets from Highway 17 to the Spreckles Drive area.

South County Crew

The South County Crew, based out of the Wilson Yard, consists of 11 staff supervised by Henry Munoz. This crew is responsible for County road culverts and catch basins along their maintained road network.

1.5 Equipment

The following list summarizes existing equipment stored at the Brommer Yard. Based on current staffing levels, the equipment and supplies appear adequate for O&M staff to perform their current work activities.

- Vactor Truck (**Figure 2**)
  - Used every day in the fall between August and October for NPDES work
  - Used ad-hoc other times of the year
  - One vactor truck is available for use

Figure 2. Vactor Truck at Brommer Yard

- Sweepers (**Figure 3**)
    - Two sweepers including a Vac Sweeper and Elgin Conveyor sweeper
    - Run multiple times per week following a pre-set route
    - Sweepers are run simultaneously at times
    - Takes about one month to sweep Zone 5
    - Sweeping quantities are calculated in Lucity
    - Average 2,500 miles of sweeping each year

Figure 3. Sweepers at Brommer Yard

- CCTV camera truck (**Figure 4**)
    - New addition in 2021
    - 400 feet of cable
    - Superintendent and supervisors direct use of camera truck
    - No routine program in place, used to video specific neighborhood as part of a long-term study
    - Storm drain CCTV camera (**Figure 5**)

Figure 4. CCTV Camera Truck Located at Brommer Yard

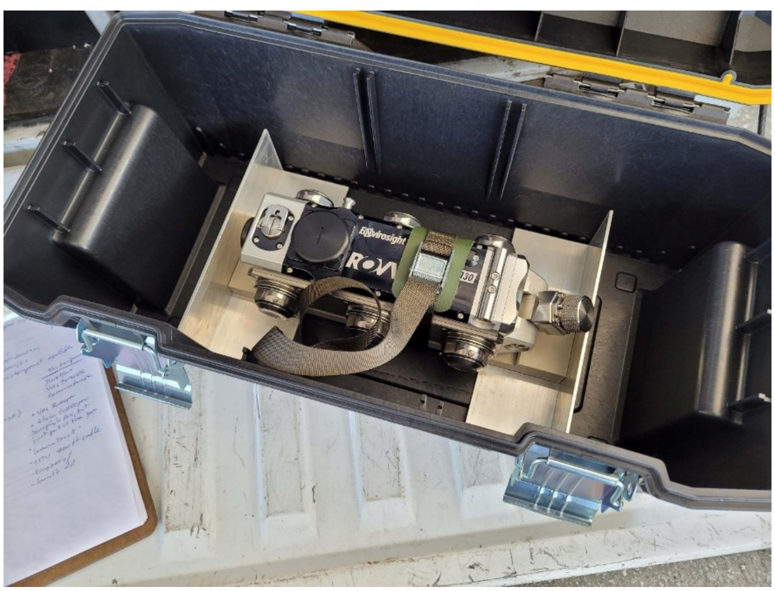

Figure 5. Storm Drain CCTV Camera

- Misc. equipment (**Figure 6**)
    - Backhoe, dump truck, excavators, loaders, and other equipment available to all County staff including O&M
    - Tablets (total tablet count not determined, each person assigned a tablet)
    - Android tablets run Lucity, Collector, and Survey123 – currently meeting the needs of field staff (**Figure 7**)
    - Various handheld equipment including a Ventis MX-4 handheld multi-gas detector (**Figure 8**)

Figure 6. Miscellaneous Brommer Yard Equipment

Figure 7. Field Tablet Running Lucity

Figure 8. Ventis MX-4 Handheld Multi-Gas Detector

1.6 SOFTWARE AND APPLICATIONS

County O&M staff rely on a suite of software packages and other applications to document, track, report, and forecast the management history of storm drain assets. The County uses two key software: ESRI ArcGIS and ArcGIS Online to manage the geospatial component of their assets and the Lucity asset management software to manage the work order system through inspection, maintenance, and repair cycles. Lucity and ESRI are integrated to the extent that Operations staff are able to track ongoing work program actions, and Program Managers are able to run end-of-year summaries to present program progress.

Additional details regarding O&M reporting and tracking, as it relates to the suite of software package used by the County, are provided in **Section 5**.

2 Asset Inventory

2.1 GIS Asset Dataset Overview

Effective storm water asset management relies on a complete and accurate asset inventory. The County's GIS asset dataset contains detailed information about the storm drain system, including the critical spatial and attribute information. This dataset is described below.

The County's GIS data are stored in an Enterprise geodatabase housed on a County server and managed by the GIS Manager. The geodatabase contains all County assets. Two feature datasets within the geodatabase contain the storm drain data used by the O&M team. The Storm Water feature dataset contains two "classes" – Storm Water Structures and Storm Water Conduits. The Transportation feature dataset contains a single class called Maintained Channels (referred to as "Open Channels" within the O&M Program).

The Storm Water Structures class includes several asset types: catch basin/inlets with trash capture devices, catch basin/inlets, manholes/junctions, outfalls, and detention basin. The Storm Water Conduits class includes pipes and culverts. The Open Channels class has a single asset type, Open Channel. Each of these feature classes contains key attributes used to further describe each asset (e.g., material, dimensions, elevation). Details related to the feature classes and their associated assets are available within the geodatabase.

Unique aspects of the storm drain asset inventory include a regional storm water basin located in the City of Capitola, but maintained by Zone 5. Additionally, the network of open channels maintained by Zone 5 includes approximately 5 to 10 priority channels, which require multiple visits across the year to inspect and maintain.

2.2 Condition Assessment Data Collection

This section describes the condition assessment completed to support development of the Storm Drain Master Plan for Zone 5. Schaaf and Wheeler conducted the condition assessment during the summer of 2020. The objectives of this field effort were to:

1. Assess the condition of the regional storm drain open conveyance system and culvert crossings included within the open conveyance system.
2. Collect storm drain system attributes to inform subsequent hydrologic and hydraulic modeling.

3. Develop a conditions assessment geodatabase using a simplified National Association of Sewer Service Companies (NASSCO) ranking approach to further assess the regional facilities.
4. Provide the County with an updated regional storm drain asset geodatabase.

Additional information or attributes collected during the data collection effort are presented in **Appendix A**.

2.3 ZONE 5 STORM DRAIN SYSTEM SUMMARY AND SYSTEM MAP

The existing Zone 5 storm drain system described in this O&M Plan includes the large diameter conduits, adjoining structures, and open channels. This regional storm drain system defines the study area for the Zone 5 Storm Drain Master Plan[2]. The system map is presented in **Appendix B** and the asset summary is presented below (**Table 1**):

Table 1. Existing Storm Drain System Asset Summary

	GIS Layer	Asset Type	Count
Existing O&M System	Structures	Trash Capture Devices	3
		Catch basins/Inlets	245
		Manhole/Junctions	238
		Outfalls	63
		Detention Basins	1
	Conduits	Pipes	417
		Culverts	58
		Open Channels	124

2.4 ASSET INVENTORY UPDATES

Periodic updates to the asset inventory are made in order to ensure the spatial and attribute information is up to date. ESRI Field Maps, or previously ESRI Collector, are used to update attribute information during inspections. New data are sent to the County's GIS Specialist who reviews the data, assigns a new Lucity ID, and then integrates the data into the Lucity system upon receipt of new asset information.

[2] Schaaf and Wheeler Consulting Civil Engineers. 2022. Zone 5 Storm Drain Master Plan.

3 Analysis and Forecasting

This section describes the analysis and forecasting activities including establishing program definitions, defining O&M priorities, and presenting the O&M budget. This information helps shape the County's O&M Program and determines which storm drain assets require a work program action during the year. It is important to note that within an annual O&M Program cycle, not all storm drain assets will require a work program action such as an inspection, maintenance, or repair.

3.1 Definitions

Santa Cruz County uses Lucity to manage the O&M workflow of inspections, maintenance, repairs, and reporting. This system is described in more detail in **Section 5**. The following definitions are provided as context for analysis and forecasting within the O&M Program. However, this O&M Plan is not intended to replace formal training with the Lucity system.

Assets – As described previously, these are the individual storm drain components (e.g., inlets/catch basins, pipes, or open channels) that are included in the storm drain system.

Service Requests – Requests are developed when a member of the public fills out a request on the Santa Cruz County – My Santa Cruz County website or requests are called into Dispatch. Service requests are manually or automatically entered into Lucity for the crew supervisors to review. Service requests are then attached to a Work Order and will be linked to the data. Requests typically result in inspection or maintenance.

Tasks – Tasks include the specific work program actions identified within a work order. For example, the main task included within the **Appendix C** (pages 9-12) work order is "NPDES-Catch Basin Cleaning." Tasks log what equipment and personnel were part of the Work Order.

Work Orders – Work orders are used to track work program actions (inspections, maintenance, or repairs) performed by the maintenance crews. For example, the Superintendent developed a work order for routine or annual trash capture device cleaning for Zone 5 as well as Countywide. **Appendix C** presents the work order for annual trash capture device cleaning for Zone 5.

Work orders are created any time a crew member visits an asset to perform a work program action (e.g., inspection, maintenance, or repair). Each work order contains the assigned crew, start and end date, list of locations and assets, and assigned resources (e.g., vac truck, employee, and equipment).

3.2 O&M Priorities

The following O&M priorities guide current inspection, maintenance, and repair work program actions for the County, per the Existing O&M Standard Operating Procedures table (**Appendix F**).

- Annual visual, emergency, and new construction inspections will be performed on all asset types[3].
- Priority asset types will be inspected at least once per year[4]. The remainder of the system will be inspected on an as-needed or requested basis.
- Catch basin/inlets with trash capture devices, silt and grease structures, and open channels are the priority assets for the County and are visually inspected multiple times per year.
- Storm drain pipe CCTV inspections will be performed on an as-needed basis. No current routine CCTV inspections are in place.
- Asset maintenance frequency depends on the asset type.
    - Open channels are inspected at least twice per year.
    - Silt & grease traps are hydrovaced annually.
    - Priority drainage inlets are maintained multiple times per year.
- Minor repairs are completed on storm drain assets as issues are noted during inspections or requests are filed.
- Major repairs are handled by the County's civil engineering group.

As discussed in **Section 1.4**, each Crew Supervisor has a specific set of assets or portion of the storm drain system they are responsible for inspecting, maintaining, and repairing. In addition to the routine activities performed by each crew, emergency inspections or maintenance may be performed by any crew at any time and are typically addressed on an as-needed basis.

The Drainage Crew maintains a running list of their open channels that require routine maintenance; repair needs are noted during inspections. The Special Crew has a single, pre-developed work order for routine or annual trash capture device cleaning (**Appendix C**) and work orders for sweeping within Zone 5. No other Special Crew assets have a pre-developed work order and work program actions are identified during ongoing inspections. The Road Crew have an established maintenance schedule for approximately 60 percent of the year (30 out of 52 weeks). The remaining 40 percent of the year is dedicated to emergency response and winter preparedness.

Future O&M priorities are addressed in **Section 6**.

---

[3] No visual inspections are proposed for pipes; no new construction inspections are anticipated for open channels.
[4] Storm drain pipes will be inspected during ongoing CCTV inspections, on an emergency basis, and following the construction of new assets.

3.3 COST ESTIMATES

Understanding the financial resources invested to implement the current O&M Program (**Section 3.2**) and required to support the proposed future O&M Program (**Section 6**) is critical. A fiscal analysis was prepared as part of the Zone 5 Storm Drain Master Plan and included evaluating existing and proposed O&M Program costs. This section overviews those costs and detailed information can be found in the appendices of the Storm Drain Master Plan.

Current Program – Based on the fiscal analysis, the County's current O&M expenditures approximate $834,000 annually. Of this total, approximately $709,000 is related to work program actions including inspections, maintenance, and repairs. An additional $40,000 is spent on tracking and reporting and $85,000 on equipment-related costs. These O&M-related expenses correspond to the Existing O&M Standard Operating Procedures table (**Appendix F**).

Proposed Program – The Proposed O&M Standard Operating Procedures table (**Appendix H**) formed the basis for the future costs which approximate $2.1 million, in 2023 dollars. The work program actions for inspections, maintenance, and repairs will approximate $1.9 million. Tracking, reporting, and equipment costs are approximately $200,000.

4 Work Program Actions

4.1 INTRODUCTION

The work program actions performed on the storm drain system include inspections, maintenance, and repairs. The overall process for inspecting and maintaining the storm drain system is described below. Detailed information about the Existing O&M Standard Operating Procedures is provided in a table within **Appendix F**. The table presents the type, frequency, season, description, and documentation requirements for each asset type.

4.2 INSPECTIONS

The following sections describe the storm drain inspections conducted within Zone 5, including visual, emergency, and CCTV. Through an agreement with the City of Capitola, County staff also maintain the 38th Avenue detention basin. The purpose of inspections is to 1) document the condition of the storm drain assets, and 2) identify any follow-up work program actions that are necessary.

4.2.1 Visual Inspections

Visual inspections are routine visits to storm drain assets in order to observe the condition and function of the assets. Within Zone 5, priority storm drain assets include full trash capture devices, open channels, and a single detention basin. Additionally, there are a few non-full-trash-capture manholes/inlets/catch basins that are inspected when time allows.

Trash/Sediment Capture Devices

Trash/Sediment capture devices include storm drain inlet/catch basins with sumps (silt/grease trap), screens for capturing floatables, or hydrodynamic separators such as the Contech CDS storm water treatment facility, which includes separation chambers and physical screens. These devices are important assets for the County and are inspected up to two times each year. At a minimum, these devices are inspected annually from August to October.

Open Channels

There are 58 open channels within Zone 5 that are inspected twice each year, including 10 higher priority channels that are monitored more frequently. Open channel inspections involve either walking the entire length of the asset or inspecting a specific location. Examples of open channels within Zone 5 are presented below.

Simpkins Ditch (**Figure 9**) is one of the higher priority ditches that requires regular maintenance. The open ditch and adjoining structures and conduits are located behind the Simpkins Family Swim Center. This facility experiences debris and garbage build-up behind an existing trash rack. Maintenance is required in the spring, summer, and fall. Storm events also trigger the need for maintenance.

Figure 9. Simpkins Ditch and Outfall with Trash Rack

Rodeo Gulch (**Figure 10**) outfalls to Corcoran Lagoon, along Portola Drive and near Richmond Drive. This facility and adjoining structures and conduits require periodic maintenance. However, conducting maintenance is complicated because of existing regulatory permits from the California Department of Fish and Wildlife that limit the type of maintenance and time of year maintenance can be performed.

Figure 10. Rodeo Gulch at Corcoran Lagoon Outfall

4.2.2 Emergency Inspections

Emergency inspections are conducted when there is a documented issue with one or more storm drain assets. Emergency inspections occur on an as-needed basis. The Operations Team responds to approximately 12- 24 emergency inspections annually, but the frequency varies depending on annual storm activity.

4.2.3 CCTV Inspections

In January 2021, the O&M Program purchased the hardware and software necessary to conduct CCTV inspections. Prior to this purchase, the County's Sewer (Sanitation) Division would be hired to conduct targeted CCTV inspections and routine CCTV inspections were not conducted. The County is in the process of determining a reasonable level-of-effort for annually televising storm drain pipes (e.g., 5,000 feet of pipe each year).

4.3 Maintenance

Inspections often lead to follow-up maintenance on storm drain assets. However, there are assets within the storm drain system that require routine or scheduled maintenance. The following storm drain asset maintenance is scheduled each year, based on historical observations and recurring maintenance needs:

- Open channels – Maintained up to two times per year.
- Trash captures devices – Maintained at least once per year.
- Conduits/inlets/outlets – Visited as time permits, often following open channel maintenance (e.g., drainage patrols).

- Drainage inlets – Priority assets maintained annually, through visual inspections conducted by road crews during "storm patrol".
- Soquel Creek at Bargetto Bridge – Annual vegetation management and invasive plant species removal.
- 38th avenue detention basin - The 38th Avenue detention basin (**Figure 11**) is a unique storm drain asset that is within the Capitola City limits but is maintained by Zone 5. This basin includes a series of overflow channels, head gates, pumps, and sumps that help control water levels during large rain events. There are four (two large and two small) pumps that are monitored by the Sanitation Division. During 2020 and 2021, significant maintenance was performed at the 38th Avenue detention basin, including removal of 400 cubic yards of material, constructing a perimeter fence, installing plantings, replacing, and maintaining the pump system, and confirming the system was operational.

Figure 11. 38th Avenue Detention Basin

4.4 REPAIRS

Spot repairs are completed by the Operations staff as they are identified. There have been no major repairs within Zone 5; however, major repairs in other County zones are typically handled by the senior civil engineering team (e.g., Leona Creek at Capitola Road).

In 2020, approximately 12 culvert replacement projects were completed. The County's Superintendent maintains a list of culvert projects for all of the roads and drainage crews and these projects are completed as time permits.

4.5 DOCUMENTATION

4.5.1 Work Plans

The day-to-day activities for the O&M team are site- and case-specific. As a result, there are no standard operations procedures in place to guide work program actions. Site-specific work plans are developed, and in some cases reused, for recurring work program actions. Work plans include a description of the work program action including a checklist and a work zone map created using Google Earth that shows road closures, signage, and flagger requirements. These work plans are distributed at tailgate meetings and outline tasks for all involved staff. A sample work plan is provided in **Appendix G**.

5 Tracking and Reporting

5.1 INTRODUCTION

The Tracking and Reporting[5] element completes the Storm Water Asset Management Cycle and links back into the asset inventory, the foundation of the O&M Program. Changes to the storm drain system might include updated attribute or spatial information, new or removed storm drain assets, or changes to the storm drain reporting. These modifications will be reflected within the GIS and Lucity system to ensure the storm drain system is up-to-date, complete, and accurate.

There are several key software packages used Countywide and by the County's O&M Program within Zone 5. These software packages as well as their primary uses are described below. This section also includes a description of the County's ongoing tracking and reporting. Finally, the County's annual reporting is described.

5.2 TRACKING AND REPORTING SOFTWARE

5.2.1 ESRI GIS

ESRI is the industry standard for creating, analyzing, managing, and presenting geospatial information. The County uses the full suite of ESRI software described below.

ArcGIS Desktop – ArcGIS Desktop is the legacy software platform that is still available for use, but currently outdated and no longer supported. ArcGIS Desktop or ArcMap will be retired on March 1, 2026. This software appears to still be in use at the County for day-to-day GIS operations.

ArcGIS Pro – ArcGIS Pro supports data visualization, basic and advanced analysis, data management, and data sharing across the suite of ArcGIS platforms. ArcGIS Pro is the industry standard in geospatial software. Usage of ArcGIS Pro at the County is assumed to be widespread; however, the O&M Program has not fully integrated this new software package.

ArcGIS Online – ArcGIS Online is a cloud-based software used to create and share geospatial information through interactive web maps and web applications. ArcGIS Online is the primary clearinghouse for the County's O&M geospatial data and along with Lucity (discussed in detail below), this software is used to visualize and share the County's storm drain GIS.

ArcGIS Field Maps – ArcGIS Field Maps, formerly ArcGIS Collector, is an all-in-one application (app) that leverages ArcGIS Online-developed web maps to support mobile field data collection, editing, asset locating, and real-time location reporting.

[5] Tracking and Reporting details were obtained during a series of virtual meetings with County staff including the Stormwater Program Manager, Superintendent, and GIS Manager from February through December 2021.

While this app is not available to everyone, it is used by field inspectors and technicians to locate and update storm drain asset attribute information, perform sign inventories, support road closures, track rodents, and support the culvert discovery and assessment project.

ArcGIS Survey123 – ArcGIS Survey123 is a form-centric mobile app used to create, share, and analyze survey information. Currently, the County uses ArcGIS Survey123 to support road closures and the culvert discovery and assessment project.

5.2.2 Lucity

Lucity is a comprehensive GIS and web-enabled software solution geared toward local governments, public works, and utility departments. While Lucity offers a mapping and spatial viewer, the power of the software is its form-based graphical interface and robust database backbone. Lucity allows users to manage an asset inventory, assess the condition of assets, and determine maintenance needs, all within the software.

Lucity is the cornerstone of the County's asset management system and is used across various departments. Lucity is the framework for tracking inspections, maintenance, and other operational activities discussed herein.

5.3 ASSET TRACKING AND REPORTING

Asset tracking and reporting within Zone 5 are closely linked and typically managed by the Maintenance Superintendent and the County's Storm Water Coordinator. Asset tracking and reporting also include web applications developed for specific data updating or inventorying needs.

Below is a description of the web applications, asset tracking, as well as the annual reports produced each year that summarize inspection, maintenance, and NPDES-related activities.

5.3.1 Web Applications

The County's GIS Manager has developed a series of web maps and web applications that support ongoing data tracking and maintenance. They also use third-party CCTV software. These are summarized below.

Drainage Channels Application

There are numerous mapped open channels across the County. Some of these channels are maintained by the County, while other channels are on private property. There are also a variety of unmapped channels that need to be verified as County maintained assets or as privately maintained channels. Additionally, the ingress and egress locations for these assets need to be documented.

The purpose of the drainage channel application is to identify unmapped open channels and identify acceptable access points to the County-maintained assets.

Culvert Discovery and Assessment Application

Storm drain culverts are located within urban, rural, and mountainous areas of the County. While the Zone 5 culvert inventory is mostly complete, the County-wide inventory continues to be updated. Many of the existing culverts are mapped and include relevant attribute information (e.g., diameter, material, conditions). Yet, additional work is needed to adequately map and describe all existing culverts within the County.

The purpose of the culvert discovery and assessment application is to enable County staff to identify unmapped culverts, populate relevant attribute information for unmapped culverts, and update inaccurate information for existing mapped culverts.

GraniteNet (Third-party CCTV software)

GraniteNet is a third-party CCTV system that includes both software and hardware. The GraniteNet system is used for closed pipe inspection and rehabilitation planning. This tool is used primarily within the Sanitation Division, but also has the ability to be used on the storm drain system. Currently, the storm water program uses this tool as needed. There is an interest to better leverage the GraniteNet system for conducting storm drain pipe CCTV inspections and rehabilitation planning.

5.3.2 Asset Tracking

Ongoing asset tracking within Zone 5 is the responsibility of the Maintenance Supervisor. Management metric reports are generated through the Lucity system and provide a glimpse or snapshot into how the O&M Program is functioning.

Of the approximately 16 standard management metric reports, 7 reports are storm drain asset-related and include the following:

- Ditch cleaning mileage and collected volume
- Culvert maintenance/cleaning
- Culvert repair and replacement
- Sweeping mileage
- Culvert replacement footage
- Storm debris removal
- CCTV inspections

The Maintenance Superintendent runs management metric reports periodically and defines the time period of interest. For example, to understand whether culvert repair and replacement work program actions may differ among the crews, a report will be generated to calculate how many feet of culvert repair or culvert replacements have occurred for each crew over a given time period. This information informs not just resourcing decisions (e.g., does a crew need more staff), but also budget allocations (e.g., does one crew need more financial resources in order to meet culvert repair or culvert replacement demands).

5.4 ANNUAL REPORTING

The County prepares reports on an annual basis in support of their NPDES program and to inform the budgeting and resourcing for the O&M program. Each of these reports are described in more detail below.

5.4.1 Annual NPDES Report

Santa Cruz County is a traditional small municipal separate storm water sewer system (MS4) permittee covered under the Phase II MS4 general permit (State Water Resources Control Board (Water Board) Water Quality Order No. 2013-001-DWQ). This program is managed by the County's stormwater coordinator. The Phase II general permit covers municipalities that serve less than 100,000 persons. The Phase II general permit conditions require municipalities to report annually how their program ensures pollutant discharges are reduced, protects water quality, and broadly satisfies the appropriate water quality requirements of the Clean Water Act of 1972.

Each year, Santa Cruz County is required to prepare and submit an Annual Report to the Water Board, per the requirements of the NPDES Phase II MS4 permit. The purpose of the Annual NPDES Report is to present an evaluation of the storm water program, summarize the effectiveness of best management practices and goals, and identify improvement opportunities.

One area of focus for the County's NPDES program is particulate reduction. The County's Annual NPDES Report must present the volume of solids removed each year which is directly informed by O&M management metric reports. Specifically, particulate reduction is estimated over time using MS4 program-effectiveness software and ongoing County-derived tracking information from Lucity. These data are captured as maintenance crews complete work program actions and record the information into Lucity. The following reports summarize the ongoing O&M activities that directly inform the particulate reduction estimates.

- Ditch cleaning mileage and collected volume
- Culvert maintenance/cleaning
- Sweeping mileage

- Storm debris removal (also includes vegetation removal)

Samples of the metric reports and particulate reduction chart are presented in **Appendix D**.

5.4.2 Internal O&M Reporting

The O&M Superintendent produces periodic reports that help inform workloads, resourcing, and budgeting. These reports are produced using the Lucity software and are summarized below. Sample reports are included in **Appendix E**.

- Management metric reports
  - Ditch cleaning
  - Culvert maintenance/cleaning
  - Culvert repair and replace
  - Sweeping mileage
- Roads Reports
  - Completed work orders by crew
  - Employee hours by activity type
  - Drainage crew work orders
  - Flap gate work orders

6 Recommendations

Santa Cruz County desires a storm drain O&M program that is proactive, supports a functional storm drain system at the desired level of service, and allows the County flexibility to reallocate O&M resources as conditions change. In order to achieve these goals, NCE makes the following recommendations for the O&M Program:

- **Asset Inventory** – Improve the accuracy and completeness of the storm drain asset inventory by conducting field verifications of spatial and attribute data. The current asset inventory has various inconsistencies and redundancies that should be addressed to improve the accuracy and completeness of the data.

- **Analysis and Forecasting** – Develop and implement a proactive O&M program that has the necessary resources to inspect, maintain, and repair storm drain assets at recommended frequencies. See the *O&M Standard Operating Procedures – Proposed* table in **Appendix H**.

  Implement regular CCTV inspections of the storm drain system. While it is unnecessary to conduct a CCTV inspection on every linear foot of storm drain pipe within the County, up to 5,000 linear feet of pipe each year should be inspected, focusing on priority storm drain pipes. These CCTV inspections will provide the County with critical pipe condition information and allow the County to proactively address identified issues before they become major problems.

- **Work Program Actions** – The *O&M Standard Operating Procedures – Existing and Proposed* tables present guidelines for inspections, maintenance, and repairs, including documenting the type, frequency, season, and overall process for completing work program actions. This table should not take the place of developing a comprehensive Standard Operating Procedures Manual, which would benefit existing and new O&M staff.

- **Tracking and Reporting** – The County should continue the ongoing tracking and reporting activities as described above in **Section 5**. Additionally, implementation of robust tracking analytics is recommended to determine how O&M work program actions change over time to further optimize the O&M Program.

- **O&M Plan Linkage to Lucity** – The final enhancement to the County's O&M program will be to link the above recommendations to the Lucity asset management system. Because Lucity is the overarching framework within which the County manages the Zone 5 storm drain system, any changes to the O&M program must be tied back to Lucity. Asset inventory updates, changes to inspection or repair frequencies, CCTV inspections, tracking or reporting changes must all be linked back to the Lucity system.

Distribution and Quality Control

Zone 5 Storm Drain Master Plan

Operations and Maintenance Plan

Santa Cruz County, CA

November 10, 2023

Copy 1: Schaaf and Wheeler (digital)

Copy 2: Project File (digital)

Quality Control Reviewer:

Jason Drew, CPESC, CPSWQ
Principal

NCE Project No. 1045.03.55

Appendix A

Schaaf and Wheeler Condition Assessment Attribute Tables

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Open Channels

Material	Dimensions (LxWxH, Inches)	Invert In (Inches)	Invert Out (Inches)	Maintenance Condition	Debris (%)	Debris (location)	Water (%)	Channel Condition Priority	NOTES
Concrete				Good				5 - immediate attention	
Asphalt				Fair				4 - poor	
Soil/Earth				Poor				3 - fair	
Rock								2 - good	
Vegetation								1 - excellent	
Other									

Pipes

Material	Diameter (Inches)	Invert In (Inches)	Invert Out (Inches)	Maintenance Condition	Debris (location)	Debris (%)	Water (location)	Water (%)	CCTV	CCTV Rating	CCTV Priority	NOTES
RCP				Good					Yes	5 - immediate attention	High	
CMP				Fair					No	4 - poor	Moderate	
HDPE				Poor						3 - fair	Low	
VCP										2 - good		
PVC										1 - excellent		
See notes												

Type	Material	Diameter / Dimensions (Inches)	Crossing Type	Inlet Configuration	Invert In (Inches)	Outlet Configuration	Invert Out (Inches)	Maintenance Condition	Debris (%)	Debris Location	Water (%)	Water Location	CCTV	CCTV Rating	CCTV Priority	NOTES
Circular	RCP		Ditch Relief	Open Pipe		Open Pipe		Good					Yes	5 - immediate attention	High	
Rectangular / Box	CMP		Ephemeral	Headwall		Headwall		Fair					No	4 - poor	Moderate	
Arch	HDPE		Creek	Box		Rock Dissipator		Poor						3 - fair	Low	
See Notes	VCP		See Notes	See Notes		See Notes								2 - good		
	PVC													1 - excellent		
	See Notes															

Structures

Type	Material	Diameter / Dimensions (Inches)	Invert In (Inches)	Invert Out (Inches)	No Dumping, Drains to Bay Marking?	Debris (%)	Water (%)	Structure Condition	Structure Priority	NOTES
Inlet	RCP				Yes - good, fair			5 - immediate attention	High	
Outlet	CMP				Yes - bad			4 - poor	Moderate	
Manhole	HDPE				None			3 - fair	Low	
Treatment	VCP							2 - good		
Detention	PVC							1 - excellent		
Pump	See Notes									

Appendix B

EXISTING ZONE 5 O&M PROGRAM SYSTEM MAP

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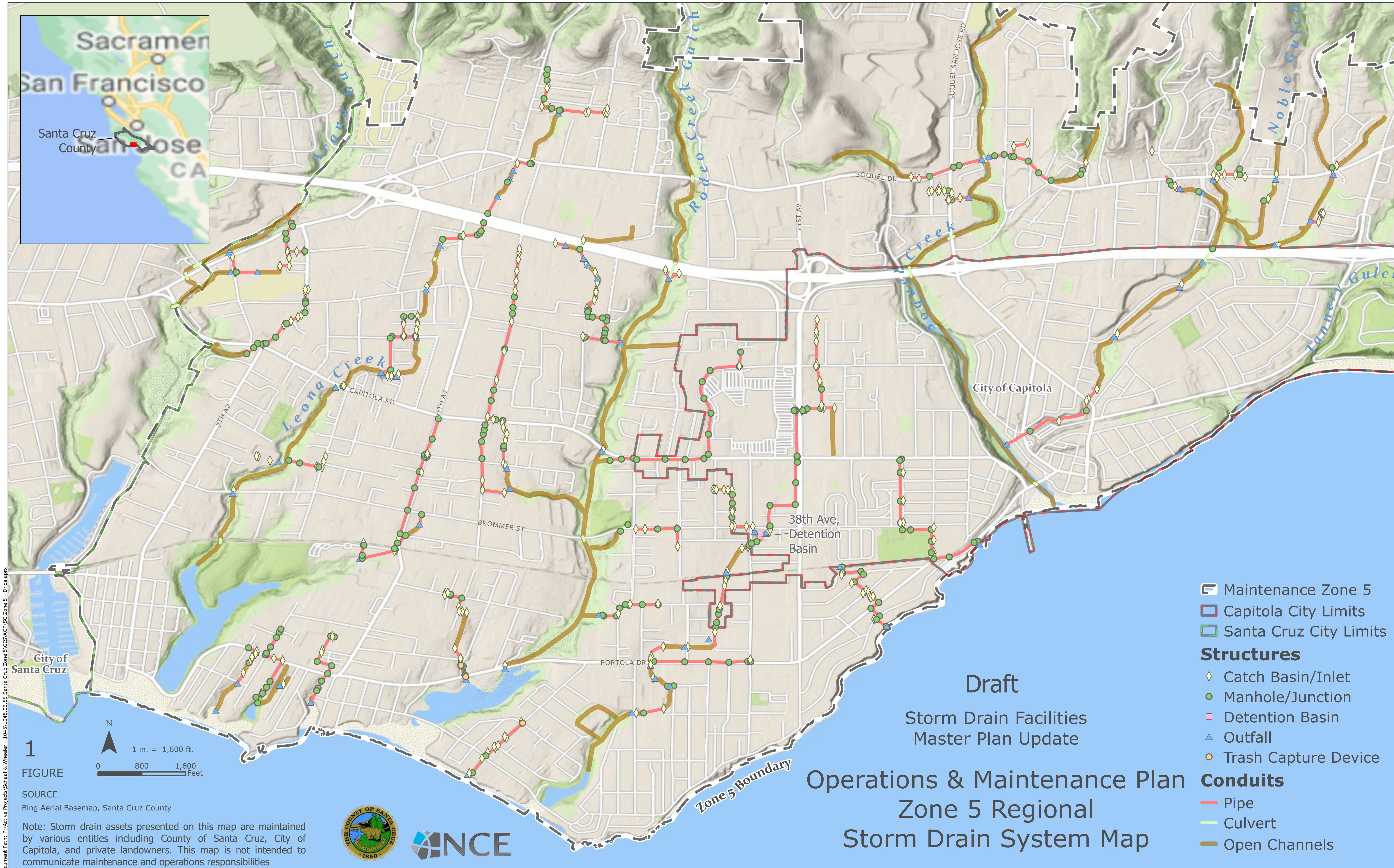

Draft

Storm Drain Facilities
Master Plan Update

Operations & Maintenance Plan
Zone 5 Regional
Storm Drain System Map

1

FIGURE

SOURCE

Bing Aerial Basemap, Santa Cruz County

Note: Storm drain assets presented on this map are maintained by various entities including County of Santa Cruz, City of Capitola, and private landowners. This map is not intended to communicate maintenance and operations responsibilities

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Appendix C

Sample Work Orders

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Work Order Detail Report

11/4/2021
7:21 AM

WO Number: 2021/06/01-021		**Category:**	Storm Structure
Status:	Closed In Field	**Problem:**	Zone 5 - Drainage
Status Date:	7/16/2021 10:26 am	**Main Task:**	NPDES-CATCH BASIN CLEANING

Asset: Z5_SGMH_4875 BROMMER YARD

Location: 647 MELLO LN

Cause:
Assigned Crew: Roads Special Crew
Supervisor: Vega, Elliot
Lead Worker:
Priority:
Account #:
Proj No - Acct:
Project: NPDES Zone 5 Stormwater Structures
Reason: Regular
Received By:
Inspected By:
Contractor:
Inspector Comments:

Assigned By: 10139 Sandoval, Alex
Assigned Date: 6/1/2021 7:00 AM
Start Date: 6/1/2021 7:00 AM
End Date: 7/1/2021 4:30 PM
Sched Start Date:
Project ID:
Project Name:

Override Notifications
- Problem ☐
- Overdue ☐
- Lead Worker ☐
- Task ☐
- Supervisor ☐
- Hard Lock WO ☐
- Publically Available ☐

Request Comments for Work Order

ROUTINE CLEANING OF ZONE 5 SILT AND GREESE TRAPS

Location

Department: Roads
Division: Roads-Drainage
Sub-Division:
Area:
Sub-Area:
Owner:
Location:
Classification:

Comments for Crew

Maintenance Zone:
Alternate Zone:
External Source:
External WO ID:

Work Order Locations

Address / X Coord	Y Coord	General Location	Address 2
647 MELLO LN			7TH AVE
6,124,289.13537681	1,815,156.45989989	645 MELLO LN	
430 LAKE AVE			EATON ST
6,123,083.33070180	1,814,028.95362473	430 LAKE AVE ACROSS FROM	
4515 LAKE AVE			CARMEL ST
6,123,164.49392530	1,813,547.00905056	333 LAKE AVE	
135 5TH AVE			LAKE AVE
6,123,331.97784230	1,813,130.68934515	430 LAKE AVE ACROSS FROM	
14TH AVE			
6,125,369.60139172	1,811,854.70305198	191 14TH AV	
CLIFF DR			
6,125,814.15365222	1,812,645.32548648	21400 E CLIFF DR	
TWIN LAKES SB			
6,125,803.36889689	1,812,085.42339106	15TH AV	
16TH AVE			
6,126,313.86984439	1,812,519.93728581	229 16TH AV	
6,126,542.50226113	1,812,011.53836823	JOHAN'S BEACH DR	
PORTOLA DR			
6,128,336.17124598	1,812,222.23939039	CORCORAN AND E. CLIFF	
680 30TH AVE			
6,131,219.18122797	1,811,596.64287256	680 30TH AVE	

22811 CLIFF DR			PALISADES AVE
6,130,052.98342913	1,809,807.50340623	22811 E CLIFF DR	
6,128,808.33992106	1,810,579.08093131	101 26TH AV	
6,135,630.93946481	1,814,434.98496489	4825 PORTOLA DR	
6,126,294.41450273	1,820,146.50700639	630 BOSTWICK LN	
6,131,303.86445755	1,814,668.50811990		
1185 OMAR CT			EL DORADO AVE
6,126,305.66415213	1,815,484.65510964	1185 OMAR CT	
1175 OMAR CT			EL DORADO AVE
6,126,291.60807788	1,815,542.52015139	1175 BROMMER CIR	
41ST AVE			
6,133,657.94505122	1,812,646.12896256	821 41ST AVE	
7TH AVE			
6,125,155.17301480	1,816,959.73549281	1255 7TH AVE	
6,127,298.63559139	1,814,522.15506615	979 17TH AVE	
6,128,314.37273313	1,812,220.78401272	2300 PORTOLA DR	
0.00000000	0.00000000	23211 E CLIFF DR	
2700 BROMMER ST			DARLENE DR
6,130,526.08090813	1,814,177.78173915	BROMMER YARD	
6,130,273.56336856	1,814,813.71911556	BROMMER YARD	
6,130,287.45244838	1,814,813.71911556	BROMMER YARD	
6,130,402.90005213	1,812,601.94204307	2533 PORTOLA DR EAST OF	
CLEARWATER CT			
6,128,138.64080113	1,812,257.50375555	116 CLEARWATER CT	
515 CORCORAN AVE			ALICE ST
6,128,713.44378538	1,812,548.40606089	15TH AV	
MATTHEWS LN			
6,127,125.62511064	1,812,690.60689197	1715 MATTHEWS LN	
CLIFF DR			
6,126,318.90559547	1,812,586.27245498	21501 E CLIFF DR	
21501 CLIFF DR			
6,126,254.32239130	1,812,623.42493972	21501 E CLIFF DR	
21401 CLIFF DR			
6,125,874.19454263	1,812,816.66307031	21401 E CLIFF DR	
TWIN LAKES SB			
6,124,166.65989996	1,812,444.32391998	TWIN LAKES SB	
7TH AVE			
6,123,880.16440997	1,812,929.20287147	200 7TH AV	
6,124,351.98925371	1,814,533.03594990	216 HARBOR BEACH CT	
715 TANNER CT			
6,125,740.14198922	1,817,995.67403772	715 TANNER CT	
ADELAIDA CT			JOSE AVE
6,126,297.75635955	1,817,360.58934990	938 ADELAIDA CT	
1125 HARPER CT			EL DORADO AVE
6,126,659.94231497	1,816,826.57991923	1125 HARPER CT	
EL DORADO AVE			
6,126,691.54067697	1,816,202.95616648	1413 EL DORADO AVE	
6,126,302.92990564	1,815,476.97271031	OMAR LN	

BROMMER ST			CAPTAINS CT
6,125,414.94841389	1,815,828.33191572	CAPTAINS CT DRIVEWAY WEST	
PORTOLA DR			
6,128,781.57619506	1,812,336.50819072	CORCORAN AND E. CLIFF	
6,128,815.78806889	1,810,579.08093131	101 26TH AV	
23211 CLIFF DR			33RD AVE
6,131,617.54132363	1,809,805.63398740	33RD AT E CLIFF DR	
6,128,808.38552463	1,810,578.34864931		
119 32ND AVE			E CLIFF DR
6,131,490.89131448	1,809,923.46019532	BROMMER AVE	
CLIFF DR			34TH AVE
6,131,777.97341748	1,809,954.67010665	111 34TH AVE	
6,132,021.15895472	1,810,260.34108323	35TH AND E. CLIFF	
CLIFF DR			36TH AVE
6,132,269.47768380	1,810,425.53596281	23615 E CLIFF DR	
6,132,788.89626439	1,810,815.74778081	E CLIFF AT MANZANITA	
6,133,167.26427406	1,811,022.00655465	3840 E CLIFF DR	
500 41ST AVE			
6,133,664.45159988	1,811,332.63946356	500 41ST AVE	
OPAL CLIFF DR			
6,134,817.90565780	1,813,287.27564615	4520 OPAL CLIFF DR	
30TH AVE			
6,131,290.21979980	1,815,080.10080065	1380 30TH AVE	
GROSS RD			
6,131,959.96452330	1,818,189.11393955	3141 GROSS RD	
VIA GARGANO			
6,131,453.75753047	1,818,040.08864707	3330 VIA GARGANO	
GREYSTONE CT			
6,130,889.41253056	1,818,857.26122531	110 GREYSTONE CT	
CHANTICLEER LN			
6,129,479.54658389	1,818,327.79312414	2199 CHANTICLEER LN	
WILLA WAY			
6,130,281.26446864	1,816,953.48189640	1730 WILLA WAY	
MACIEL AVE			CAPITOLA RD
6,130,414.42430730	1,816,902.78744398	2542 MACIEL AV	
CAPITOLA RD			
6,130,709.59005556	1,816,560.33406064	2546 CAPITOLA RD	
AMBER AVE			WOODROSE AVE
6,129,575.24750797	1,816,622.60296498	2170 AMBER LN	
2236 IVY LN			
6,129,400.16977413	1,815,686.12649147	2284 IVY LN	
HARPER ST			PESCE WAY
6,127,196.75948280	1,816,708.66545689	1245 HARPER ST	
6,127,047.39495213	1,817,698.48040639	1115 CAPITOLA RD	
GREY SEAL RD			
6,126,151.81308189	1,818,285.17509915	1723 GREY SEAL RD	
JOSE AVE			
6,126,941.38105655	1,818,558.59187515	1910 JOSE AV	
16TH AVE			CAPITOLA RD
6,128,283.91446072	1,817,976.85452156	1851 16TH AVE	
RODRIGUEZ ST			DUSTIN WAY
6,128,278.43087588	1,819,448.70787705	1465 RODRIGUEZ ST	
7TH AVE			
6,125,956.73145105	1,818,464.99363714	7TH AV	

CAPITOLA RD		
6,125,157.67399405	1,818,570.26803289	15TH AV
17TH AVE		
6,128,949.54403497	1,820,926.07204831	2617 17TH AVE
CAMDEN CT		
6,130,770.20312330	1,822,134.27107547	2445 CAMDEN CT
6,132,409.00496380	1,821,302.20088923	S RODEO GULCH @ SOQUEL
PORTER ST		
6,136,029.52528180	1,820,364.88353814	2700 PORTER ST
2800 PORTER ST		
6,136,156.82555214	1,820,962.71337923	2800 PORTER ST
ALDO CT		
6,135,912.87722114	1,825,115.00199065	ALDO CT
2750 ORCHARD ST		
6,139,094.28982155	1,821,074.43330014	2750 ORCHARD ST
CHEN WAY		
6,139,922.79111731	1,821,265.94210348	3003 CHEN WAY
CUNNISON LN		
6,140,257.78782263	1,821,424.42669465	3060 CUNNISON LN
6,140,773.80811605	1,820,054.50226915	MONTEREY AVE
BASELINE DR		
6,143,348.36267821	1,820,973.07589132	BASELINE DR
SOQUEL DR		
6,143,504.56610598	1,822,236.22756448	3139 CORTE CABRILLO
CORTE CABRILLO		
6,143,637.11833431	1,822,927.63366197	3170 CORTE CABRILLO
CORTE CABRILLO		
6,143,587.24868339	1,823,108.23238215	3210 CORTE CABRILLO
CORTE CABRILLO		
6,143,529.82655413	1,822,863.05045781	3165 CORTE CABRILLO
CORTE CABRILLO		
6,143,512.85677180	1,822,588.89385389	3139 CORTE CABRILLO

Work Order Assets

Object Type / System ID 1	System ID 2	Description 1 / Odometer	Hourmeter	Othermeter	Description 2 / PM Description	Asset ID	Completed	
Storm Structure Z5_SGMH_4875		BROMMER YARD				34131	6/1/2021	8:45 am
Storm Structure Z5_SGIL_19424		BROMMER YARD				45587	6/1/2021	11:20 am
Storm Structure Z5_SGIL_19425		BROMMER YARD				45588	6/1/2021	10:50 am
Storm Structure Z5_SGIL_19437		2533 PORTOLA DR EAST OF				45589	6/1/2021	11:35 am
Storm Structure Z5_IL_2232					Sediment weir (S&W)	19485	6/2/2021	8:40 am
Storm Structure Z5_SGIL_4718		116 CLEARWATER CT				18963	6/1/2021	1:05 pm
Storm Structure Z5_SGMH_4317		15TH AV				19862	6/14/2021	8:15 am
Storm Structure Z5_SGIL_4724		1715 MATTHEWS LN			NCS	18965	6/1/2021	1:30 pm
Storm Structure Z5_SGIL_4722		21501 E CLIFF DR			2.2' 3.2'	20741	6/2/2021	9:10 am
Storm Structure Z5_SGIL_4721		21501 E CLIFF DR			CS/ Baffle Added	18964	6/4/2021	8:00 am
Storm Structure Z5_SGMH_3743		21401 E CLIFF DR			also seen on F-27	19017	6/15/2021	12:30 pm
Storm Structure Z5_SGMH_4855		TWIN LAKES SB				18942	6/4/2021	11:00 am
Storm Structure Z5_SGMH_4856		200 7TH AV				18931	6/1/2021	2:05 pm
Storm Structure Z5_SGIL_19410		216 HARBOR BEACH CT				45586	6/2/2021	9:35 am
Storm Structure Z5_IL_3335		1255 7TH AVE			V-64	22307	7/1/2021	7:34 am
Comment: CAN NOT LOCATE								
Storm Structure Z5_SGIL_2756		715 TANNER CT			GOOD COND	22144	6/2/2021	10:00 am
Storm Structure Z5_SGIL_4603		938 ADELAIDA CT			Catch Basin	18943	6/4/2021	12:45 pm
Storm Structure Z5_SGIL_990		1125 HARPER CT				19283	6/2/2021	11:10 am
Storm Structure Z5_SGMH_4864		1413 EL DORADO AVE				18937	6/2/2021	11:30 am
Storm Structure Z5_SGMH_19413		OMAR LN				45596	6/2/2021	12:50 pm
Storm Structure Z5_SGIL_4757		1185 OMAR CT			FAIR COND, ODOR	18974	6/2/2021	2:45 pm
Storm Structure Z5_SGMH_4918		CAPTAINS CT DRIVEWAY WEST				17327	6/3/2021	8:20 am
Storm Structure Z5_SGIL_4810		1175 BROMMER CIR			GOOD COND, STANDING WATER	18986	6/2/2021	2:15 pm
Storm Structure Z5_SGMH_3888		645 MELLO LN			Filtration station	19082	6/3/2021	11:40 am
Storm Structure Z5_SGMH_3911		430 LAKE AVE ACROSS FROM			GOOD COND, RIGHT NEXT TO R072716D	17326	6/4/2021	9:00 am
Storm Structure Z5_SGMH_4877		333 LAKE AVE				34135	6/4/2021	9:30 am
Storm Structure Z5_SGMH_3951		430 LAKE AVE ACROSS FROM				19115	6/4/2021	10:00 am

Storm Structure Z5_SGIL_4868	191 14TH AV	FAIR COND, ODOR, MOSQUITOS, GARBAGE	18939	6/3/2021	1:00 pm
Storm Structure Z5_SGIL_4694	21400 E CLIFF DR		20726	6/3/2021	1:40 pm
Storm Structure Z5_SGMH_4847	15TH AV	MED. SIZE DOG, DEAD 11 FT DOWN HAS BEEN	18926	6/3/2021	2:05 pm
Storm Structure Z5_SGIL_4623	229 16TH AV		20045	6/7/2021	8:30 am
Storm Structure Z5_SGMH_19415	JOHAN'S BEACH DR		45598	6/3/2021	3:00 pm
Storm Structure Z5_SGMH_4853	CORCORAN AND E. CLIFF		18929	6/14/2021	9:00 am
Storm Structure Z5_SGMH_4328	680 30TH AVE	NEXT TO PHONE POLE	18703	6/14/2021	10:30 am
Storm Structure Z5_SGIL_3551	22811 E CLIFF DR		18685	7/1/2021	7:25 am
Storm Structure Z5_SGMH_19420	23211 E CLIFF DR		45603	6/7/2021	10:20 am
Storm Structure Z5_SGMH_19417	101 26TH AV		45600	6/10/2021	8:45 am
Storm Structure Z5_SGMH_3932	33RD AT E CLIFF DR	Double Bolted Drop Str GOOD COND	20835	6/7/2021	12:45 pm
Storm Structure Z5_SGIL_4870			56360	6/10/2021	8:00 am
Storm Structure Z5_SGMH_3713	BROMMER AVE		18345	6/10/2021	9:20 am
Storm Structure Z5_SGMH_4851	111 34TH AVE		18337	6/15/2021	8:15 am
Storm Structure Z5_SGMH_19421	35TH AND E. CLIFF		45604	6/15/2021	8:45 am
Storm Structure Z5_SGMH_4850	23615 E CLIFF DR		18336	6/15/2021	10:10 am
Storm Structure Z5_SGMH_19422	E CLIFF AT MANZANITA		45605	6/7/2021	10:55 am
Storm Structure Z5_SGMH_19423	3840 E CLIFF DR		45606	6/15/2021	10:50 am
Storm Structure Z5_SGMH_3747	500 41ST AVE		18346	6/7/2021	1:30 pm
Storm Structure Z5_IL_1454	821 41ST AVE		18534	6/28/2021	7:45 am
Storm Structure Z5_SGMH_4865	4520 OPAL CLIFF DR	Manhole # 2, Silt and Grease trap, NEEDS A NEW	18338	6/14/2021	11:15 am
Storm Structure Z5_SGIL_4749	1380 30TH AVE	FAIR COND, ODOR, STANDING WATER	18969	6/7/2021	3:10 pm
Storm Structure CA_SGIL_2889	4825 PORTOLA DR		55810	6/14/2021	12:45 pm
Storm Structure Z5_SGIL_4672	3141 GROSS RD	GO	18953	6/8/2021	10:30 am
Storm Structure Z5_SGIL_4660	3330 VIA GARGANO	GO	18952	6/8/2021	10:00 am
Storm Structure Z5_SGMH_4860	110 GREYSTONE CT	Drop Manhole	18934	6/10/2021	10:30 am
Storm Structure Z5_SGIL_4604	2199 CHANTICLEER LN		18944	6/10/2021	11:00 am
Storm Structure Z5_SGIL_4709	1730 WILLA WAY	GO	18960	6/4/2021	1:15 pm
Storm Structure Z5_SGIL_4710	2542 MACIEL AV	GO	20046	6/7/2021	2:10 pm

Storm Structure Z5_SGIL_4783	2546 CAPITOLA RD		18978	6/8/2021	11:25 am
Storm Structure Z5_SGIL_4729	2170 AMBER LN		18966	6/4/2021	1:30 pm
Storm Structure Z5_SGMH_4858	979 17TH AVE		18933	7/1/2021	10:40 am
Storm Structure Z5_SGIL_19436	2284 IVY LN	FAIR COND, ODOR	18940	6/8/2021	12:40 pm
Storm Structure Z5_SGIL_4747	1245 HARPER ST	FAIR COND, ODOR, PPP IS BROKEN	18968	6/8/2021	1:10 pm
Storm Structure Z5_MH_4872	1115 CAPITOLA RD		56356	6/10/2021	11:30 am
Storm Structure Z5_SGMH_4862	1723 GREY SEAL RD	GO	18935	6/8/2021	1:30 pm
Storm Structure Z5_SGIL_4605	1910 JOSE AV		20638	6/8/2021	3:20 pm
Storm Structure Z5_MH_4800	1851 16TH AVE		18982	6/10/2021	2:00 pm
Storm Structure Z5_SGIL_4645	1465 RODRIGUEZ ST		18949	6/8/2021	2:30 pm
Storm Structure Z5_SGMH_4854	7TH AV	aprox. 5' from invert to ex. ground	18930	6/24/2021	8:30 am
Storm Structure Z5_SGMH_4867	15TH AV	GOOD COND	18938	6/10/2021	1:15 pm
Storm Structure Z5_SGIL_4717	630 BOSTWICK LN		18962	6/10/2021	2:50 pm
Storm Structure Z5_SGMH_4846	2617 17TH AVE		18925	6/14/2021	1:45 pm
Comment: WE CANNOT ACCESS TRAP DUE TO TEMP METAL FENCE AT ADDRESS 2617					
Storm Structure Z5_SGIL_4745	2445 CAMDEN CT	BAD COND, STANDING WATER	20753	6/14/2021	1:50 pm
Storm Structure Z5_SGIL_19438	S RODEO GULCH @ SOQUEL		45590	6/15/2021	2:10 pm
Storm Structure Z5_MH_4807	2700 PORTER ST		17758	6/14/2021	2:50 pm
Storm Structure Z5_SGIL_4712	2800 PORTER ST	Inlet with a silt and grease trap	17746	7/1/2021	6:15 am
Storm Structure Z5_SGIL_4708	ALDO CT	GO	17745	6/28/2021	8:25 am
Storm Structure Z5_SGMH_4873	4941 E WALNUT ST		17741	6/24/2021	11:00 am
Storm Structure Z5_SGIL_2557	2750 ORCHARD ST		17970	6/24/2021	1:00 pm
Storm Structure Z5_SGIL_4730	3003 CHEN WAY		17747	6/28/2021	9:00 am
Storm Structure Z5_SGMH_4866	3060 CUNNISON LN		17740	6/24/2021	1:40 pm
Storm Structure Z5_SGMH_0001	MONTEREY AVE		56350	6/28/2021	9:40 am
Storm Structure Z5_SGIL_4814	BASELINE DR		17760	6/28/2021	10:30 am
Storm Structure Z5_SGIL_4780	3139 CORTE CABRILLO		17756	6/16/2021	1:00 pm
Storm Structure Z5_SGIL_4732	3170 CORTE CABRILLO	FAIR COND, DEBRIS, SILT	17749	6/16/2021	1:30 pm
Storm Structure Z5_SGIL_4731	3210 CORTE CABRILLO	FAIR COND, SILT, STANDING WATER, MA	17748	6/16/2021	1:55 pm

Storm Structure	3165 CORTE CABRILLO	GOOD COND, STANDING WATER			
Z5_SGIL_4733			17750	6/16/2021	2:20 pm
Storm Structure	3139 CORTE CABRILLO	BAD COND, DEBRIS, SILT, PPP NEEDS R			
Z5_SGIL_4734			17751	7/1/2021	8:00 am
Storm Structure	2300 PORTOLA DR				
Z5_SGMH_4852			18928	6/28/2021	11:20 am

Tasks/Resources

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/1/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 1.00 ***Unit Cost:** $0.00 **End Dt:** 6/1/2021

Employee

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
13903 Craig, Ariel		9.00	$0.00		6/1/2021	6/1/2021
14495 Miller, Joshua		9.00	$0.00		6/1/2021	6/1/2021

Equipment

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL C.	6/1/2021	6/1/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/2/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 9.00 ***Unit Cost:** $0.00 **End Dt:** 6/2/2021

Employee

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
13903 Craig, Ariel		9.00	$0.00		6/2/2021	6/2/2021
14495 Miller, Joshua		9.00	$0.00		6/2/2021	6/2/2021

Equipment

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL C.	6/2/2021	6/2/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/3/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 1.00 ***Unit Cost:** $0.00 **End Dt:** 6/3/2021

Employee

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
13903 Craig, Ariel		9.00	$0.00		6/3/2021	6/3/2021
14495 Miller, Joshua		9.00	$0.00		6/3/2021	6/3/2021

Equipment

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL C	6/3/2021	6/3/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/4/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 1.00 ***Unit Cost:** $0.00 **End Dt:** 6/4/2021

Employee

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
14495 Miller, Joshua		9.50	$0.00		6/4/2021	6/4/2021
13903 Craig, Ariel		9.50	$0.00		6/4/2021	6/4/2021

Equipment

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.50	$0.00	ARIEL CRAIG	6/4/2021	6/4/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/7/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 6.00 ***Unit Cost:** $0.00 **End Dt:** 6/7/2021

Employee

Resource	*UOM*	*Units*	**Total Cost*	*Alt Description*	*Start Dt*	*End Dt*
13903 Craig, Ariel		9.00	$0.00		6/7/2021	6/7/2021

14495 Miller, Joshua		9.00	$0.00		6/7/2021	6/7/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL C.	6/7/2021	6/7/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/10/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 3.00 ***Unit Cost:** $0.00 **End Dt:** 6/10/2021

Employee

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
13903 Craig, Ariel		9.00	$0.00		6/10/2021	6/10/2021
14495 Miller, Joshua		9.00	$0.00		6/10/2021	6/10/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL C.	6/10/2021	6/10/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/14/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 1.00 ***Unit Cost:** $0.00 **End Dt:** 6/14/2021

Employee

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
14495 Miller, Joshua		9.00	$0.00		6/14/2021	6/14/2021
14298 Garcia, Gabriel		9.00	$0.00		6/14/2021	6/14/2021
7277 Phariss, Kevin		9.00	$0.00		6/14/2021	6/14/2021
13903 Craig, Ariel		9.00	$0.00		6/14/2021	6/14/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
02-123 2001 DODGE 2500 PICKUP		9.00	$0.00	GABRIEL GARCIA	6/14/2021	6/14/2021
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL CRAIG	6/14/2021	6/14/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/15/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 6.00 ***Unit Cost:** $0.00 **End Dt:** 6/15/2021

Employee

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
13903 Craig, Ariel		9.00	$0.00		6/15/2021	6/15/2021
14495 Miller, Joshua		9.00	$0.00		6/15/2021	6/15/2021
14414 Williams, John		9.00	$0.00		6/15/2021	6/15/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL CRAIG	6/15/2021	6/15/2021
02-152 2003 GMC SIERRA 3/4 TON PICKUP		9.00	$0.00	JOHN WILLIAMS	6/15/2021	6/15/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/16/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 4.00 ***Unit Cost:** $0.00 **End Dt:** 6/16/2021

Employee

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
13903 Craig, Ariel		3.50	$0.00		6/16/2021	6/16/2021

14495 Miller, Joshua		3.50	$0.00		6/16/2021	6/16/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
04-100 2004 VacCon Sewer Cleaning Truck	Hours	3.50	$0.00	JOSH MILLER	6/16/2021	6/16/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** Complete ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 6/28/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 6.00 ***Unit Cost:** $0.00 **End Dt:** 6/28/2021

Employee

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
13903 Craig, Ariel		6.50	$0.00		6/28/2021	6/28/2021
14495 Miller, Joshua		6.50	$0.00		6/28/2021	6/28/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
04-100 2004 VacCon Sewer Cleaning Truck	Hours	6.50	$0.00	JOSH MILLER	6/28/2021	6/28/2021

5420 NPDES-CATCH BASIN CLEANING

Crew: Roads Special Crew **Status:** ***Cal'c UC:** $0.00 ***Task Cost:** $0.00 **Start Dt:** 7/1/2021
Supervisor: Vega, Elliot **UOM:** **# of Units:** 1.00 ***Unit Cost:** $0.00 **End Dt:** 7/1/2021

Employee

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
13903 Craig, Ariel		9.00	$0.00		7/1/2021	7/1/2021
14495 Miller, Joshua		9.00	$0.00		7/1/2021	7/1/2021

Equipment

Resource	UOM	Units	*Total Cost	Alt Description	Start Dt	End Dt
04-100 2004 VacCon Sewer Cleaning Truck	Hours	9.00	$0.00	ARIEL CRAIG	7/1/2021	7/1/2021

Task Material Kit

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

5420 NPDES-CATCH BASIN CLEANING

Material Kit	Description	Units	Est Units	UOM	Make	Model
		0	0			

Projected Complete: Lock: ☐
Repair Type:
Subcontractor:
Profit Center:

Quantity: 87.00 Lock: ☐
Unit of Measure: Each
***Unit Cost:** $0.00
WO Hours: 0.00

	*Actual	*Estimated	*Difference
WO Duration	249.50	0.00	0.00
Labor Hours	210.00	0.00	0.00
Labor Costs	$0.00	$0.00	$0.00
Material Costs	0.00	0.00	0.00
Fluids Costs	0.00	0.00	0.00
Equipment Costs	0.00	0.00	0.00
Contractor Costs	0.00	0.00	0.00
Misc. Costs	0.00	0.00	0.00
Total Costs	**$0.00**	**$0.00**	**$0.00**
Use Task Info:	True	True	

Work Order Detail Report

Billing

Billed Party

Customer ID:
Customer Name:
Address:
City:
State:
Zip:
Customer Number:
Last Name:
Phone:
Cell #:
Fax #:
E-mail:

Billing Data

Contact Name:
Invoice Number:
Incoming Account #:
***Billing Amount:**
Date Bill Sent:
Payment Received:
Payment Method:
Billing Required: ☐
Billing Processed: ☐
Imported to Financials: ☐

Simple Work Orders

Employee:
End Date:
Hours:
Asset Type: Storm Structure

CS

General Ledger:
General Key:
General Object:
Job Ledger:
Job Key:
Job Object:

Associated PMs

PM Code and Description	Closed
NPDES_Z5 NPDES Zone 5 Stormwater Structures	☑

Tracking

Item	Description	By	Date	Time
Work Order Creation	From Routine Work NPDES_Z5 - NPDES Zone 5 Stormwater Structures	dpw447	6/1/2021	7:34 AM
Status Change	From New Work Order to Closed In Field	dpw447	7/16/2021	10:26 AM

Real or False Alarm:
PM Type:
WO User 3:
WO User 16:
WO User 17:
WO User 18:
PrevReqStatus:
Road:
WO User 21:
WO User 50:
WO User 51:
Reported By:
Data History:
WO User 4:
Spill Vol. Gallons:
User 13:
WO User 23:
NA:
NA:
Investigated Date:
User 11 Date:
WO User 25 Date:
Job Number:
Add'l Work Descriptior
Overflow: ☐
Property Damage: ☐
Cleanup: ☐
Addl Work Required: ☐
Bike Lane Related: ☐
WO User 28: ☐
WO User 29: ☐
RQ_Stat_Change: ☐

Work Metrics:
WO User 32:
WO User 33:
WO User 34:
WO User 35:
WO User 36:
WO User 37:
WO User 38:
WO User 39:
MileMarker_or_PM:
WO User 41:
WorkMetricsNum:
Volume:
District:
Item Count:
WO User 46:
WO User 47:
WO User 48:

* A 'Hidden' field indicates permission to view the secured field is turned off .

WO User 52:		**WO User 62:**			
WO User 53:		**WO User 63:**			
WO User 54:		**WO User 64:**			
WO User 55:		**WO User 65:**			
WO User 56:		**WO User 66:**			
WO User 57:		**WO User 67:**			
WO User 58:		**WO User 68:**			
WO User 59:		**WO User 69:**			
WO User 60:		**WO User 70:**			
WO User 61:		**WO User 71:**			
WO User 72:		**WO User 82:**		**WO User 102:**	☐
WO User 73:		**WO User 83:**		**WO User 103:**	☐
WO User 74:		**WO User 84:**		**WO User 104:**	☐
WO User 75:		**WO User 85:**		**WO User 105:**	☐
WO User 76:		**WO User 86:**		**WO User 106:**	☐

WO User 92 Date:		**WO User 97 Date:**	
WO User 93 Date:		**WO User 98 Date:**	
WO User 94 Date:		**WO User 99 Date:**	
WO User 95 Date:		**WO User 100 Date:**	
WO User 96 Date:		**WO User 101 Date:**	

WO User 77:		**WO User 87:**		**WO User 107:**	☐
WO User 78:		**WO User 88:**		**WO User 108:**	☐
WO User 79:		**WO User 89:**		**WO User 109:**	☐
WO User 80:		**WO User 90:**		**WO User 110:**	☐
WO User 81:		**WO User 91:**		**WO User 111:**	☐

WO Creator:	dpw447	**WO Creation Date:**	6/1/2021	**PM Trigger:**		**Rec #:**	104921

Appendix D

SAMPLE PARTICULATE REDUCTION CHART AND ASSOCIATED LUCITY REPORTS

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Photos - Particulate reduction, 20-21.PNG

See all photos | Add to | Edit & Create | Share

Annual Reporting > Particulate Reduction

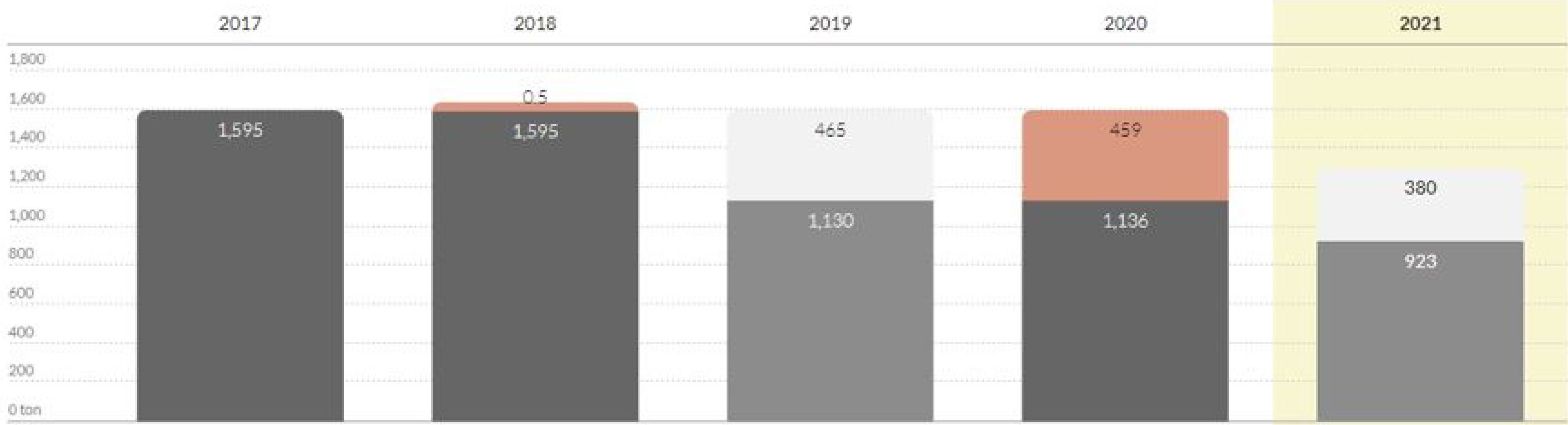
Progress Map | Chart | Summary | Inputs | Opportunity

Year: 2021

Sort: Receiving Water

County of Santa Cruz	(380.1)	↓ 29.2%
Aptos Creek	(7.6)	↓ 30.7%
Arana Gulch	(17.1)	↓ 34.6%
Bates Creek	(2.5)	↓ 18.9%
Bean Creek	(2.4)	↓ 24.1%
Bear Creek	(0.4)	↓ 22.1%
Borregas Creek	(5.0)	↓ 30.9%
Boulder Creek	(4.3)	↓ 19.0%
Branciforte Creek	(0.5)	↓ 31.6%
Browns Creek	(0.2)	↓ 14.1%
Camp Evers Creek	(0.8)	↓ 19.8%
Carbonera Creek	(17.1)	↓ 35.3%
Corralitos Creek	(11.4)	↓ 12.8%
Fall Creek	(1.3)	↓ 28.8%
Gold Gulch Creek	(2.8)	↓ 14.8%
Harkin Slough	(6.5)	↓ 25.1%
Leona Creek	(29.7)	↓ 44.3%
Lompico Creek	(9.0)	↓ 30.3%
Love Creek	(0.8)	↓ 24.3%
Manson Creek	0	0%
Monterey Bay	(88.2)	↓ 42.4%
Moore Creek	(0.6)	↓ 11.9%
Newell Creek	(3.3)	↓ 19.6%
Noble Creek	(6.6)	↓ 21.9%
Pajaro River	(0.06)	↓ 7.8%

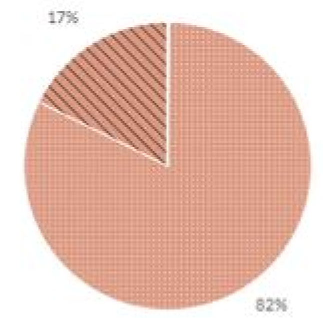
County of Santa Cruz



	2017	2018	2019	2020	2021
Baseline (ton)	1,595	1,595	1,595	1,595	1,303
Current (ton)	1,595	1,595	1,130	1,136	923
% Reduction	0%	0%	29%	29%	29%

Current | Reduction

2021 Particulates Reduction



Treatment	Contribution
Runoff disconnection	1 ton/yr
Street sweeping	312 ton/yr
Decentralized structural BMPs	67 ton/yr
Centralized structural BMPs	0.01 ton/yr
Particulate load reduction	380 ton/yr

Department of Public Works - County of Santa Cruz

Sweeping Mileage by Supervisory District Report

Report Period from 9/1/2020 to 9/9/2021

		Sweeping Mileage WO Entry (older)	Sweeping Mileage WO Asset Entry	Volume Collected
District			111.11	194.25
District	1		78.26	184.60
District	2		29.79	24.75
District	3		41.28	60.60
District	5		98.94	215.75
Total Mileage for this period (WO Entry)				
Total Mileage for this period (WO Asset Entry)			359.38	
Total Mileage for this period (All Entries)				
Total Volume Collected (All Entries)				679.95

*****NOTE: To see details of corresponding Work Orders for each district, please Double-Click District Number or Mileage for specific District. Detail page wiill open in new report tab**

Department of Public Works - County of Santa Cruz

NPDES Program: Storm Structures Solid Materials Collected

Reporting Period: from 9/1/2020 **to** 9/9/2021

Zone Number		Structures Inspected /	Struct. Cleaned /	Total Zone Structures	Solid Materials Collected (Cu. Yds.)
Zone: 5					
	Block:	0	2	2	1.78
	Block: B2	0	1	1	0.56
	Block: B3	0	1	1	0.26
	Block: CC1	0	33	33	159.96
	Block: Z5SG	0	34	34	47.06
Total for Zone: 5		**0**	**71**	**71**	**209.61**
Zone: 6					
	Block: Z6SG	0	9	9	10.20
Total for Zone: 6		**0**	**9**	**9**	**10.20**
Zone: 7					
	Block:	0	1	1	
	Block: Z7SG	0	9	9	16.63
Total for Zone: 7		**0**	**10**	**10**	**16.63**
Zone: 8					
	Block:	0	1	1	
	Block: B1	0	7	7	0.93
	Block: Z8SG	0	4	4	3.13
Total for Zone: 8		**0**	**12**	**12**	**4.06**
Total for this period:		**0**	**102**	**102**	**240.49**

Appendix E

Sample Internal O&M Reports

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Management Metrics Reports

_SCC Roads - Management Metrics Mowing Mileage - Select Time Period
_SCC Roads - Management Metrics Ditch Cleaning Mileage and Collected Volume over selected time period
_SCC Roads - Management Metrics Pothole Patching Work - Select Time Period
_SCC Roads - Management Metrics Culvert Maintenance/Cleaning - Select Time Period
_SCC Roads - Management Metrics Culvert Repair and Replace - Select Time Period
_SCC Roads - Management Metrics Roadbed Maintenance and Digouts - Select Time Period
_SCC Roads - Management Metrics Sweeping Mileage - Select Time Period
_SCC Roads - Management Metrics Pavement Striping Mileage - Select Time Period
_SCC Roads - Management Metrics Bike Lane Related Work - Select Time Period
_SCC Roads - Management Metrics Prismatic Markers - Select Time Period
_SCC Roads - Management Metrics Guardrail footage - Select Time Period
_SCC Roads - Management Metrics Culvert Replacement footage - Select Time Period
_SCC Roads - Management Metrics Curb Painting footage - Select Time Period
_SCC Roads - Management Metrics Grind/Pave and Skin Patch - Select Time Period.
_SCC Roads - Management Metrics Storm Debris Removal - Select Time Period.
_SCC Roads - Management Metrics CCTV Inspections - Select Time Period.

Reports - Claims Format: WO Detail

SCC Roads - Work Order Detail Report - Claims Format (Assets, Tasks, Location, Employees, Equipment)
_SCC Roads - Completed Work Orders by Road - Claims Format - Select Road and Time Period
_SCC Signs - Completed Work Orders by Road - Claims Format - select Road and Time period

Roads Reports - Work Orders and Hours by Employee

Signs Reports - Work Orders and Hours by Employee

Appendix F

EXISTING O&M STANDARD OPERATING PROCEDURES

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O&M Standard Operating Procedures - EXISTING

Asset Type		Inspection				Work Plans	Maintenance	Repairs	Documentation
GIS Layer	**Asset Type**	**Type**	**Frequency**	**Season**	**Description**				
Structures	Catch Basin/Inlets with Trash Capture Devices	Visual	Inspect all facilities 1 time each year	Conduct inspections in summer/fall	Conduct catch basin inspection survey to document structural, maintenance, or other conditions including: 1. Inspect grate for damage or maintenance issues 2. Inspect the structure walls or structure opening for any physical damage 3. Inspect the facility for any built up debris, trash, or sediment	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the curb flows lines, top of grate, or within the facility using hand tools or vactor truck	Perform the following repairs, as necessary: 1. Repair grate damage 2. Repair damage to structure walls or opening 3. Repair or replace catch basin steps 4. Remove and replace damaged storm drain emblems	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
	Catch Basin / Inlets	Emergency	Inspect facilities on an emergency basis	As-needed	1. Inspect grate for damage or maintenance issues 2. Inspect the structure walls or structure opening for any physical damage 3. Inspect the facility for any built up debris, trash, or sediment	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the curb flows lines, top of grate, or within the facility using hand tools or vactor truck	Perform the following repairs, as necessary: 1. Repair grate damage 2. Repair damage to structure walls or opening 3. Repair or replace catch basin steps 4. Remove and replace damaged storm drain emblems	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
	Manhole / Junction	Emergency	Inspect facilities on an emergency basis	As-needed	1. Inspect for blockages 2. Inspect lid or grate for damage or maintenance issues 3. Inspect the structure walls or structure opening for any physical damage 4. Inspect the facility for any built up debris, trash, or sediment	If traffic control is necessary, work plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Perform necessary maintenance to reestablish the function of the facility	Perform the following repairs, as necessary: 1. Repair grate or lid damage 2. Repair damage to structure walls or opening 3. Repair or replace manhole steps	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
	Outfall	Visual	Inspect facilities, as time permits	Following completion of open channel inspections	Following the work plan, conduct field inspection to document structural, maintenance, or other conditions including: 1. Inspect for blockages 2. Inspect headwall for physical damage or maintenance issues 3. Inspect the outfall structure for physical damage or debris accumulation 4. Inspect riprap or other dissipation structures for debris accumulation, or erosion including scour, rilling, gullying, and seepage	Work Plans will be developed in advance of performing maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the outfall pipe or immediately downstream using hand tools, heavy equipment, or vactor truck	Perform the following repairs, as necessary: 1. Repair culvert inverts 2. Repair any damage to the headwall structure 3. Repair damage to the pipe 4. Repair damage to dissipation structures including erosion or misplaced riprap 5. Replace pipe	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
		Emergency	Inspect facilities on an emergency basis	As-needed	1. Inspect for blockages 2. Inspect headwall for physical damage or maintenance issues 3. Inspect the outfall structure for physical damage or debris accumulation 4. Inspect riprap or other dissipation structures for debris accumulation, or erosion including scour, rilling, gullying, and seepage		Perform necessary maintenance to reestablish the function of the facility		

<table>
<tr><th colspan="10">O&M Standard Operating Procedures - EXISTING</th></tr>
<tr><th colspan="2">Asset Type</th><th colspan="4">Inspection</th><th rowspan="2">Work Plans</th><th rowspan="2">Maintenance</th><th rowspan="2">Repairs</th><th rowspan="2">Documentation</th></tr>
<tr><th>GIS Layer</th><th>Asset Type</th><th>Type</th><th>Frequency</th><th>Season</th><th>Description</th></tr>
<tr><td rowspan="2">Structures</td><td rowspan="2">Detention Basins</td><td>Visual</td><td>Inspect facilities annually</td><td>Conduct annual inspection in late fall before wet season</td><td>Following the work plan, the inspector should visit the following detention basin locations: inlet, inlet slope, forebay, basin slopes, riparian vegetation, water quality, outlet, outlet low flow pipes, vector controls, perimeter fence, etc.

At a minimum, the following observations should be made:

1. Vegetation growth (too much/too little)
2. Erosion or stability issues of side slopes or basin bottom
3. Debris at the inlet or outlet
4. Trash accumulation
5. Invasive weeds
6. Excessive floating material in wet basins</td><td rowspan="2">Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs</td><td>Depending on the results of the inspection, the following maintenance may be necessary:

1. Remove built up debris, trash, or sediment from the inlet, outlet, or other basin areas using vactor truck or other equipment</td><td rowspan="2">Perform the following repairs, as necessary:

1. Repair erosion or stability issues along basin side slopes or basin bottom
2. Repair any damage to the inlet or outlet pipe
3. Repair damage to pumps, fences, gates, etc.</td><td rowspan="2">Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.</td></tr>
<tr><td>Emergency</td><td>Inspect facilities on an emergency basis</td><td>As-needed</td><td>Emergency detention basin inspections should focus on addressing the reported issue. Additional observations, consistent with a visual inspections, should be conducted.</td><td>Perform necessary maintenance to reestablish the function of the facility</td></tr>
</table>

O&M Standard Operating Procedures - EXISTING

Asset Type		Inspection				Work Plans	Maintenance	Repairs	Documentation
GIS Layer	Asset Type	Type	Frequency	Season	Description				
Conduits	Pipes	Emergency	Inspect facilities on an emergency basis	As-needed	Following the work plan, inspect the storm drain pipe to document structural, maintenance, or other conditions including the following: 1. Inspect the pipe for any debris accumulation 2. Inspect pipe for physical damage 3. Inspect the pipe for cracks and/or spalling	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Perform necessary maintenance to reestablish the function of the facility	Perform the following repairs, as necessary: 1. Repair or replace damaged pipes 2. Repair pipe cracks or spalling 3. Address any erosion issues	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
		CCTV	Conduct CCTV inspections on an as-needed basis	As-needed	Conduct CCTV inspection per Standard Operating Procedure.	n/a	n/a	n/a	n/a
	Culverts	Visual	Inspect facilities, as time permits	Conduct annual inspections in late fall before wet season	Following the work plan, inspect the storm drain pipe to document structural, maintenance, or other conditions including the following: 1. Inspect the pipe for any debris accumulation 2. Inspect pipe for physical damage 3. Inspect the pipe for cracks and/or spalling	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance using hand tools or a vactor truck may be necessary: 1. Remove built up debris, trash, or sediment from the culvert inlet or outlet 2. Remove damaged concrete or other material from within the culvert	Perform the following repairs, as necessary: 1. Repair or replace damaged pipes 2. Repair pipe cracks or spalling 3. Address any erosion issues 4. repair any headwall damage 5. Invert repairs	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
		Emergency	Inspect facilities on an emergency basis	As-needed	Inspect the storm drain pipe to document structural, maintenance, or other conditions including the following: 1. Inspect the pipe for any debris accumulation 2. Inspect pipe for physical damage 3. Inspect the pipe for cracks and/or spalling		Perform necessary maintenance to reestablish the function of the facility		
	Open Channel	Visual	Inspect priority facilities 2 times each year	Conduct inspections in spring and late fall before wet season	Following the work plan, inspect open channels to document structural, maintenance, or other conditions including the following: 1. Inspect trash rack or grate structure 2. Inspect the headwall or dissipation structures 3. Inspect the open channel for any debris accumulation 4. Inspect open channel any erosion including scour, rilling, gullying, and seepage	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove vegetation and log jams 2. Remove built up debris, trash, or sediment from the channel 3. Remove any blockage from any trash racks or gate structures	Perform the following repairs, as necessary: 1. Repair or replace damaged pipes adjacent to the channel 2. Repair trash racks or other grates associated with the channel	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details.
		Emergency	As needed on an emergency basis	As-needed	Emergency open channel inspections should focus on addressing the reported issue. Additional observations, consistent with a visual inspections, should be conducted.		Perform necessary maintenance to reestablish the function of the facility		

Appendix G

SAMPLE WORK PLAN

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DI & Silt/Grease Trap maintenance

Work Plan

DI & Silt/Grease trap maintenance is an operation that consist of cleaning various types of sub surface structures. When using our Vac-Con vehicle to clean out vaults, proper PPE is to be used at all times when in operation. Hardhats, Vests, Gloves, Eye protection and Ear protection must be worn. The boom of the Vac truck shall keep a 10' minimum distance from any overhead wires present. To secure your job site, 28" cones shall be placed approximately 10' apart, in a fashion that safely transitions traffic around your work zone.

When doing work with no road encroachment or minor road encroachment on a 40 mph/less and doesn't include heavy commercial vehicles a minimum lane width of 9' must be kept. Where the opposite shoulder is suitable for carrying vehicular traffic and of adequate width, lanes may be shifted by use of traffic channelizing devices. Road Work Ahead signs shall be placed at no less than 250' before entering the work zone. If the work zone follows all above stipulations but is on a road of 40mph/over or includes heavy commercial vehicles additional signs, Flagger Ahead and Prepare To Stop, shall be added in the appropriate distance specified by the MUTCD chapter 6 documents. A additional flagger shall be used to help the flow of traffic safely.

Gas monitors are to be used at all time before opening a manhole cover lid style structure. A open air lid is not required to be gas checked prior to opening but, if any unusual odor is present monitor the structure safely.

STREET SWEEPING WORK PLAN

Street sweeping is a mobile operation that moves continuously, therefore no stationary TTC signage is needed. While operating the sweeper on county roads all high intensity rotating, flashing, oscillating, or strobe lights must be on. Place an 18" cone at the rear of the vehicle when parked. A hard hat and reflective vest must be worn at all times when out of the vehicle on county roadways. A hard hat must be worn during the clean-up of sweepers as well as when performing pre and post ops. The sweepers are all equipped with truck mounted attenuators (arrow boards) The County's policy is not to use the arrow to send traffic around the sweeper so the lights on the board should just be a flashing bar. When approaching an obstacle that you must go around such as a parked car or low hanging tree branch, make sure the travel lane you are pulling into is clear. Obey all traffic laws when operating. You must stop at red lights and stop intersections. When operating one of the Schwarze Sweepers, remember the blast orifice is very close to the ground. If you see an irregularity in the road surface which may cause damage to the blast orifice pick up the sweeping head until you're clear of the hazard and report its location to your supervisor at the end of your shift. If you need to pull off the road onto a pull out, be aware of uneven surfaces that may cause damage to the blast orifice. Use a combination of your mirrors and the back-up camera for backing. Remember if you are not sure how close you are to something get out and look.

Date:____

Supervisor:__________________________________

Print: Sign:

Appendix H

PROPOSED O&M STANDARD OPERATING PROCEDURES

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O&M Standard Operating Procedures - PROPOSED

Asset Type		Inspection				Work Plans	Maintenance	Repairs	Documentation
GIS Layer	Asset Type	Type	Frequency	Season	Description				
Structures	Catch Basin/Inlets with Trash Capture Devices	Visual	Inspect priority facilities before, during, and after storm events Inspect all facilities 2-3 times each year	Conduct annual inspections in late fall before wet season	Following the work plan, conduct "windshield" survey to document structural, maintenance, or other conditions including: 1. Inspect grate for damage or maintenance issues 2. Inspect the structure walls or structure opening for any physical damage 3. Inspect the facility for any built up debris, trash, or sediment	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the curb flows lines, top of grate, or within the facility using hand tools or vactor truck	Perform the following repairs, as necessary: 1. Repair grate damage 2. Repair damage to structure walls or opening 3. Repair or replace catch basin steps 4. Remove and replace damaged storm drain emblems	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		Emergency	Inspect facilities on an emergency basis	As-needed	1. Inspect grate for damage or maintenance issues 2. Inspect the structure walls or structure opening for any physical damage 3. Inspect the facility for any built up debris, trash, or sediment		Perform necessary maintenance to reestablish the function of the facility		
		New Construction	Inspect facilities prior to releasing contractor and within 1 year following construction	As-needed	New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.		New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list. If maintenance is necessary and the contractor has been released, perform any necessary maintenance including: 1. Remove built up debris, trash, or sediment from the curb flow lines, top of grate, or within the facility using hand tools or vactor truck		
	Catch Basin / Inlets	Visual	Inspect priority facilities before, during, and after storm events Inspect all facilities annually	Conduct annual inspections in late fall before wet season	Following the work plan, conduct "windshield" survey to document structural, maintenance, or other conditions including: 1. Inspect grate for damage or maintenance issues 2. Inspect the structure walls or structure opening for any physical damage 3. inspect the facility for any built up debris, trash, or sediment	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the curb flows lines, top of grate, or within the facility using hand tools or vactor truck	Perform the following repairs, as necessary: 1. Repair grate damage 2. Repair damage to structure walls or opening 3. Repair or replace catch basin steps 4. Remove and replace damaged storm drain emblems	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		Emergency	Inspect facilities on an emergency basis	As-needed	1. Inspect grate for damage or maintenance issues 2. Inspect the structure walls or structure opening for any physical damage 3. Inspect the facility for any built up debris, trash, or sediment		Perform necessary maintenance to reestablish the function of the facility		
		New Construction	Inspect facilities prior to releasing contractor and within 1 year following construction	As-needed	New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.		New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list. If maintenance is necessary and the contractor has been released, perform any necessary maintenance including: 1. Remove built up debris, trash, or sediment from the curb flow lines, top of grate, or within the facility using hand tools or vactor truck		

<table>
<tr><th colspan="10">O&M Standard Operating Procedures - PROPOSED</th></tr>
<tr><th colspan="2">Asset Type</th><th colspan="4">Inspection</th><th rowspan="2">Work Plans</th><th rowspan="2">Maintenance</th><th rowspan="2">Repairs</th><th rowspan="2">Documentation</th></tr>
<tr><th>GIS Layer</th><th>Asset Type</th><th>Type</th><th>Frequency</th><th>Season</th><th>Description</th></tr>
<tr><td rowspan="3">Structures</td><td rowspan="3">Manhole / Junction</td><td>Visual</td><td>Inspect priority facilities before, during, and after storm events

Inspect all facilities annually</td><td>Conduct annual inspections in late fall before wet season</td><td>Following the work plan, conduct field inspection to document structural, maintenance, or other conditions including:

1. Inspect for blockages
2. Inspect lid or grate for damage or maintenance issues
3. Inspect the structure walls or structure opening for any physical damage
4. Inspect the facility for any built up debris, trash, or sediment</td><td rowspan="3">Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs</td><td>Depending on the results of the inspection, the following maintenance may be necessary:

1. Remove built up debris, trash, or sediment from the top of grate or within the facility using hand tools or vactor truck</td><td rowspan="3">Perform the following repairs, as necessary:

1. Repair grate or lid damage
2. Repair damage to structure walls or opening
3. Repair or replace manhole steps</td><td rowspan="3">Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details</td></tr>
<tr><td>Emergency</td><td>Inspect facilities on an emergency basis</td><td>As-needed</td><td>1. Inspect for blockages
2. Inspect lid or grate for damage or maintenance issues
3. Inspect the structure walls or structure opening for any physical damage
4. Inspect the facility for any built up debris, trash, or sediment</td><td>Perform necessary maintenance to reestablish the function of the facility</td></tr>
<tr><td>New Construction</td><td>Inspect facilities prior to releasing contractor and within 1 year following construction</td><td>As-needed</td><td>New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.</td><td>New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list.

If maintenance is necessary and the contractor has been released, perform any necessary maintenance using hand tools or vactor truck including:

1. Remove built up debris, trash, or sediment from the top of grate or within the facility using hand tools or vactor truck</td></tr>
</table>

O&M Standard Operating Procedures - PROPOSED										
Asset Type		**Inspection**				**Work Plans**	**Maintenance**	**Repairs**	**Documentation**
GIS Layer	**Asset Type**	**Type**	**Frequency**	**Season**	**Description**				
Structures	Outfall	Visual	Inspect all facilities annually Inspect priority facilities before, during, and after storm events	Conduct annual inspections in late fall before wet season	Following the work plan, conduct field inspection to document structural, maintenance, or other conditions including: 1. Inspect for blockages 2. Inspect headwall for physical damage or maintenance issues 3. Inspect the outfall structure for physical damage or debris accumulation 4. Inspect riprap or other dissipation structures for debris accumulation, or erosion including scour, rilling, gullying, and seepage	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the outfall pipe or immediately downstream using hand tools, heavy equipment, or vactor truck	Perform the following repairs, as necessary: 1. Repair culvert inverts 2. Repair any damage to the headwall structure 3. Repair damage to the pipe 4. Repair damage to dissipation structures including erosion or misplaced riprap	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		Emergency	Inspect facilities on an emergency basis	As-needed	1. Inspect for blockages 2. Inspect headwall for physical damage or maintenance issues 3. Inspect the outfall structure for physical damage or debris accumulation 4. Inspect riprap or other dissipation structures for debris accumulation, or erosion including scour, rilling, gullying, and seepage		Perform necessary maintenance to reestablish the function of the facility		
		New Construction	Inspect facilities prior to releasing contractor and within 1 year following construction	As-needed	New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.		New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list. If maintenance is necessary and the contractor has been released, perform any necessary maintenance using hand tools or vactor truck including: 1. Remove built up debris, trash, or sediment from the outfall pipe or immediately downstream		

O&M Standard Operating Procedures - PROPOSED

Asset Type		Inspection				Work Plans	Maintenance	Repairs	Documentation
GIS Layer	Asset Type	Type	Frequency	Season	Description				
Structures	Detention Basins	Visual	Inspect all facilities annually Inspect priority facilities before, during, and after storm events	Conduct annual inspections in late fall before wet season	Following the work plan, the inspector should visit the following detention basin locations: inlet, inlet slope, forebay, basin slopes, riparian vegetation, water quality, outlet, outlet low flow pipes, vector controls, perimeter fence, etc. At a minimum, the following observations should be made: 1. Vegetation growth (too much/too little) 2. Erosion or stability issues of side slopes or basin bottom 3. Debris at the inlet or outlet 4. Trash accumulation 5. Invasive weeds 6. Excessive floating material in wet basins	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove built up debris, trash, or sediment from the inlet, outlet, or other basin areas using vactor truck or other equipment	Perform the following repairs, as necessary: 1. Repair erosion or stability issues along basin side slopes or basin bottom 2. Repair any damage to the inlet or outlet pipe 3. Repair damage to pumps, fences, gates, etc.	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		Emergency	Inspect facilities on an emergency basis	As-needed	Emergency detention basin inspections should focus on addressing the reported issue. Additional observations, consistent with a visual inspections, should be conducted.		Perform necessary maintenance to reestablish the function of the facility		
		New Construction	Inspect facilities prior to releasing contractor and within 1 year following construction	As-needed	New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.		New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list. If maintenance is necessary and the contractor has been released, perform any necessary maintenance including: 1. Remove built up debris, trash, or sediment from the inlet, outlet, or other basin areas		

O&M Standard Operating Procedures - PROPOSED

Asset Type		Inspection				Work Plans	Maintenance	Repairs	Documentation
GIS Layer	**Asset Type**	**Type**	**Frequency**	**Season**	**Description**				
Conduits	Pipes	Emergency	Inspect facilities on an emergency basis	As-needed	Following the work plan, inspect the storm drain pipe to document structural, maintenance, or other conditions including the following: 1. Inspect the pipe for any debris accumulation 2. Inspect pipe for physical damage 3. Inspect the pipe for cracks and/or spalling	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Perform necessary maintenance to reestablish the function of the facility	Perform the following repairs, as necessary: 1. Repair or replace damaged pipes 2. Repair pipe cracks or spalling 3. Address any erosion issues	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		New construction	Inspect facilities prior to releasing contractor and within 1 year following construction	As-needed	New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.		New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list. If maintenance is necessary and the contractor has been released, perform any necessary maintenance using hand tools or vactor truck including: 1. Remove built up debris, trash, or sediment from the pipe 2. Remove damaged concrete or other material from within the pipe		
		CCTV	Conduct CCTV inspections once every 10 years routinely and on an emergency basis	Spring - Summer	Conduct CCTV inspection per Standard Operating Procedure	n/a	n/a	n/a	n/a
	Culverts	Visual	Inspect priority facilities before, during, and after storm events Inspect all facilities annually	Conduct annual inspections in late fall before wet season	Following the work plan, inspect the storm drain pipe to document structural, maintenance, or other conditions including the following: 1. Inspect the pipe for any debris accumulation 2. Inspect pipe for physical damage 3. Inspect the pipe for cracks and/or spalling	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance using hand tools or a vactor truck may be necessary: 1. Remove built up debris, trash, or sediment from the culvert inlet or outlet. 2. Remove damaged concrete or other material from within the culvert	Perform the following repairs, as necessary: 1. Repair or replace damaged pipes 2. Repair pipe cracks or spalling 3. Address any erosion issues 4. Repair any headwall damage	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		Emergency	Inspect facilities on an emergency basis	As-needed	Inspect the storm drain pipe to document structural, maintenance, or other conditions including the following: 1. Inspect the pipe for any debris accumulation 2. Inspect pipe for physical damage 3. Inspect the pipe for cracks and/or spalling		Perform necessary maintenance to reestablish the function of the facility		
		New Construction	Inspect facilities prior to releasing contractor and within 1 year following construction	As-needed	New construction should be inspected for consistency with the construction drawings. Inconsistencies should be reported to the County Engineer, punch list developed, and issues corrected or resolved.		New construction should be fully functional. If there is a maintenance issue the contractor should address as part of the completing the end of the project punch list. If maintenance is necessary and the contractor has been released, perform any necessary maintenance including: 1. Conduct hydro flush cleaning 2. Remove built up debris, trash, or sediment from the culvert inlet or outlet. 3. Remove damaged concrete or other material from within the culvert		

O&M Standard Operating Procedures - PROPOSED									
Asset Type		Inspection				Work Plans	Maintenance	Repairs	Documentation
GIS Layer	Asset Type	Type	Frequency	Season	Description				
Conduits	Open Channel	Visual	Inspect all facilities annually Inspect priority facilities before, during, and after storm events	Conduct annual inspections in late fall before wet season	Following the work plan, inspect open channels to document structural, maintenance, or other conditions including the following: 1. Inspect trash rack or grate structure 2. Inspect the headwall or dissipation structures 3. Inspect the open channel for any debris accumulation 4. Inspect open channel any erosion including scour, rilling, gullying, and seepage	Work Plans will be developed in advance of performing scheduled maintenance and repairs. A sample work plan and template is available. All work plans should include a list of staff, equipment, traffic control requirements, a map, the specific work to be completed, and other considerations while performing the maintenance or repairs	Depending on the results of the inspection, the following maintenance may be necessary: 1. Remove vegetation and log jams 2. Remove built up debris, trash, or sediment from the channel 3. Remove any blockage from any trash racks or gate structures	Perform the following repairs, as necessary: 1. Repair or replace damaged pipes adjacent to the channel 2. Repair trash racks or other grates associated with the channel	Following each inspection, maintenance, and repair action, the general Work Order Form will be filled out in Lucity. This forms includes the following information: asset type, ID, start/end date/time, tasks performed, and Work details
		Emergency	As needed on an emergency basis	As-needed	Emergency open channel inspections should focus on addressing the reported issue. Additional observations, consistent with a visual inspections, should be conducted.		Perform necessary maintenance to reestablish the function of the facility		