Town of Moraga	Agenda Item
Ordinances, Resolutions, Requests for Action	11. A

Meeting Date: November 13, 2019

TOWN OF MORAGA **STAFF REPORT**

To: **Honorable Mayor and Councilmembers**

From: **Cynthia Battenberg, Town Manager**
Edric Kwan, Public Works Director / Town Engineer

Subject: **Review and Accept the 2019 Addendum to the Storm Drain Master Plan**

Request

The Fiscal Year 2019/20 Budget includes a Capital Improvement Project to update the Town's 2015 Storm Drain Master Plan. Schaaf & Wheeler prepared a 2019 Addendum to the Storm Drain Master Plan (2019 Addendum) which incorporates information from NCE's FY 2018/19 project to develop and implement an enhanced Storm Drain Operations and Maintenance (O&M) Program and NCE's work this summer on a storm drain field mapping project. Staff recommends the Town Council review and accept the 2019 Addendum.

Background

On February 26, 2014, Town Council awarded a consultant services contract to Schaaf & Wheeler (S&W) to prepare a Storm Drain Master Plan (SDMP). The SDMP was created as a proactive approach to determine the needs, costs, and priorities associated with storm drain improvements. This information was critical for the Town to understand how much funding was needed to properly program future repair, replacement, and potentially increase the capacity of the Town's storm drains.

The SDMP, adopted by the Town Council on July 8, 2015, included a detailed review of the storm drain collection system, analysis and modeling of the system (including creek culverts) to identify capacity and condition concerns and recommend capital improvements to the storm drain system.

In May 2018, a Proposition 218 Property-Related Stormwater Fee measure with a portion of the revenue dedicated to addressing high priority projects identified in the

SDMP was defeated by a narrow margin. The Town still has significant storm drain infrastructure needs that should be addressed in order to prevent costly system failures.

In FY 2018/19 the Town budgeted $170,000 for design and implementation of an enhanced storm drain O&M program. The receipt of one-time reimbursement funds for the temporary Canyon Road Bridge enabled the Town to assign an additional $195,000 in funding towards storm drains at the close of fiscal year 2018/19, the majority of which was used to complete a storm drain field mapping project.

On June 26, 2019, Town Council adopted the FY 2019/20 Budget which included $45,000 in funding for a 2019 Addendum to the Storm Drain Master Plan, which was added to the SDMP capital improvement project (CIP 14-201). The 2019 Addendum updates the SDMP based on a re-evaluation of the Town's storm drain capital and annual operations and maintenance (O&M) needs in light of improved system information, maintenance records, and lower prioritization of capacity-related capital projects. The FY 2019/20 Budget also includes $140,000 for the enhanced storm drain program.

Discussion

S&W was tasked with updating the SDMP since they developed the original 2015 SDMP, have intimate knowledge of the Town's storm drain system and provide ongoing technical assistance on storm drain infrastructure related matters to the Town. The S&W team worked closely with Town staff and NCE (the Town's storm drain O&M and field mapping consultant) to develop a stand-alone technical memorandum that updates the SDMP focusing on updating cost estimates and re-prioritizing projects based on the Town's experience with failing storm drain systems and wetter winters over the past four years since the SDMP was finalized. The scope did not include re-analysis or modeling for capacity-related issues as the Town has not experienced any flooding related to storm drain capacity since the SDMP was adopted. The goal of the 2019 Addendum is to provide more information about the storm drain system and its current condition and quantify the monetary needs of the Town to address high and moderate capital needs over the next ten years. The 2019 Addendum also incorporates the O&M Program needs into one comprehensive document.

Prior to the SDMP update, the Town contracted with NCE to develop and implement an enhanced storm drain O&M program. The Final Storm Drain Operations & Maintenance Plan (O&M Plan) is described in Chapter 6 of the 2019 Addendum and included as an attachment to the 2019 Addendum. The O&M Plan details the cleaning, CCTV, maintenance and repair schedules and activities to inspect, maintain, and repair the existing storm drain system over the next ten years. This initiative was funded in FY 2018/19 and completed in October 2019.

Town staff and NCE also conducted fieldwork to collect and update the Town's storm drain Geographic Information System (GIS) mapping during the summer of 2019. This updated system mapping information was incorporated into the 2019 Addendum and NCE's O&M Plan. The field mapping project focused on obtaining pipe material, size,

location, ownership, etc. and enabled the Town to determine that Moraga is responsible for the maintenance of the 21 miles of publicly owned storm drain infrastructure. Privately owned storm drain infrastructure was excluded from the O&M Plan and the capital improvement needs assessment. The decrease in the recommended capital needs funding from $9 million for high priority projects in 2015 to $1 million for high and moderate priority projects in 2019 is due to the exclusion of private storm drain infrastructure and the reprioritization of capacity projects to low priority. The increase in the enhanced O&M program funding from $240,000 to $420,000 is based on a better understanding of the Town's storm drain system through the field mapping project and includes $115,000 in funding for proactive repairs anticipated through the new video inspection program to prolong the life of the storm drain infrastructure and $27,500 for GIS technical support to manage and update the storm drain infrastructure database.

The 2019 Addendum to the SDMP (Attachment A) is meant to serve as a planning tool for the Town to identify funding needs over the next ten years to implement the O&M Plan and high and moderate priority capital improvement projects. The Addendum identified $540,000 in ongoing additional annual financial support over the next ten years for a $420,000 enhanced O&M Program and a $120,000 annual storm drain capital improvement program to prevent future failures and flooding using a Reserve Funding Strategy.

Next Steps

Town staff is working to make more information available to residents regarding suggested maintenance of their private storm drain infrastructure. Additionally, staff is developing specific criteria to be used should private property owners request the Town accept a storm drain easement. This information will be brought to the Council for consideration in the coming months.

The 2019 Addendum is the final of three unfunded needs assessments requested by the Council. The Capital Asset Replacement Analysis and Report was presented to the Council on September 25, 2019 and the CalPERS Actuarial Analysis June 30, 2019 Valuation Report was presented to the Council on October 23, 2019.

Staff will share the report findings in the About Town Newsletter, Facebook and NextDoor and post the report on the Town's website. Staff plans to create an unfunded needs assessment brochure (similar to the Budget at a Glance) to share the totality of this information with the community. Staff recommends distribution of the Unfunded Needs Assessment at a Glance brochure in January, through the Lamorinda Weekly. The cost of development and distribution, based on the cost of the Budget at a Glance brochure, is $2,100. This cost would be covered by the $25,000 included in the FY 2019/20 Budget for Community Promotions.

As directed by the Council on September 25, 2019, staff also plans to hold community meetings to discuss the findings of the unfunded needs assessments and solicit community priorities. These meetings are tentatively scheduled for Tuesday,

December 3 at 2:00 pm and Wednesday, December 4 at 6:30 pm in the Fireside Room at the Hacienda de las Flores.

A discussion on next steps, following the meetings and prior to brochure distribution, is tentatively scheduled for the January 8, 2020 Town Council agenda.

Fiscal Impact

There is no fiscal impact to accepting the 2019 Addendum to the Storm Drain Master Plan. There is a $2,100 cost for the development and distribution of the Unfunded Needs Assessment at a Glance brochure, which will be paid from Account No. 101-510-050-10 (Town Manager – Community Promotions).

Alternatives

1) Review and accept the 2019 Addendum to the Storm Drain Master Plan; or
2) Do not accept the 2019 Addendum to the Storm Drain Master Plan and provide direction to staff.

Recommendation

Staff recommends the Town Council review and accept the 2019 Addendum to the Storm Drain Master Plan and direct staff to develop an Unfunded Needs Assessment at a Glance brochure for distribution in January 2020.

Attachments

A. 2019 Addendum to the Storm Drain Master Plan

ATTACHMENT A

2019 Addendum to the Storm Drain Master Plan

2019 Addendum to the Storm Drain Master Plan

Town Moraga

November 2019

Prepared for:

Town of Moraga
Public Works Department

Designers Attest:

The following report has been prepared under the supervision of the undersigned, who hereby certifies that he is a Registered Civil Engineer in the State of California.

Prepared by:

11/13/19

ROBIN J. LEE, RCE No. 70040 (Date)

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

REGISTERED PROFESSIONAL ENGINEER
ROBIN JOANNE LEE
C70040
CIVIL
STATE OF CALIFORNIA

THIS PAGE INTENTIALLY LEFT BLANK

Table of Contents

Chapter 1. Introduction

This 2019 Addendum is meant to serve as a standalone document to inform the Town and residents of a ten-year capital improvement program to maintain, repair, and improve the public storm drain infrastructure to prevent future failures of the storm drain infrastructure throughout the Town. This Addendum focuses on reprioritizing and updating cost estimates for the projects presented in the 2015 Storm Drain Master Plan (2015 SDMP). More details on the high and moderate priority projects can be found in Attachment 1. The remainder of the low priority and projects that have been completed or removed can be found in the 2015 SDMP.

1.1. Purpose of the Addendum

The purpose of the 2019 Addendum to the Storm Drain Master Plan (2019 Addendum) is to provide the Town with an updated 10-year Capital Improvement Plan (CIP) that accounts for work completed since the 2015 Storm Drain Master Plan and updates project costs based on escalation and recent bid estimates. The 2019 Addendum also re-prioritizes the projects based on what has happened in the Town over the past five years. The 2019 Addendum updates the costs from the 2015 SDMP report, updates GIS data based on the completed field mapping project, and updates the completed projects since the 2015 SDMP was provided to the Town of Moraga. The unfunded ten year CIP presented in Chapter 8 does not include unfunded Clean Water Program requirements, which are discussed in Chapter 7.

This Addendum identifies and prioritizes a list of projects to maintain and improve the public storm drain infrastructure and creek culvert systems within the Town of Moraga. It focuses on Town owned drainage facilities and should be used to guide the Town in planning, financing, engineering, and maintaining drainage infrastructure. The enhanced Operations and Maintenance (O&M) Program recommendations developed by NCE have been included in Chapter 6 so this document to identifies both the O&M and CIP funding needs for the public storm drain infrastructure for the next ten years.

The 2019 Addendum is meant to serve as a standalone document that provides the Town a planning tool to identify problems, manage resources, and provide cost-effective and comprehensive solutions. For more information, the 2015 SDMP should be referred to and can be downloaded at the following link:

http://www.moraga.ca.us/dept/publicworks/Moraga_SDMP_July2015.pdf

1.2. Changes Since the 2015 SDMP

California experienced a drought from 2011 through the development of the 2015 SDMP. Flooding related to extreme precipitation did not occur during this time period due to lack of rainfall. In 2016, heavy rains caused failure of a 96-inch diameter corrugated metal pipe (CMP) which then caused a sinkhole to form in at the intersection of Rheem Boulevard and Center Street. A light pole fell into the

sinkhole and broke a gas distribution line, temporarily leaving thousands without service. Approximately 100 feet of the failed pipe located in public right-of-way was replaced with reinforced concrete pipe (RCP) in 2017. In 2019, the CMP pipe failed again, causing a sinkhole on private property approximately 75 feet away from the 2016 sinkhole location.

With heavy rainfall in 2017, the Town of Moraga did not experience any flooding due to undersized storm drain infrastructure. Instead, what appears to be more impactful to the Town is the condition of the storm drain infrastructure which has repeatedly failed and caused sinkholes. As the majority of the storm drain infrastructure in the Town was installed in the 1950s through 1980s, some of the pipes are nearing or past their useful life cycle.

Since 2015, the Town has been researching pipe easements and updating information regarding their public versus private pipe responsibilities. This effort is further described in Chapter 2.

1.3. 2018 Stormwater Fee Measure

In 2018, the Town of Moraga undertook a Proposition 218 Property-Related Stormwater Fee Ballot Measure for Town property owners to vote on. The measure which required a simple majority approval, was defeated 52% to 48% and the fee was not put into place. Some Town property owners raised particular concerns in their objection to the fee measure about capacity projects that had not experienced flooding, high contingencies in cost estimates, high cost to schools/churches/small businesses, and no sunset clause.

1.4. Summer 2019 Public Storm Drain System Mapping

Prior to the development of the 2015 SDMP, the Town did not have a digital map of the storm drain infrastructure throughout the Town. Instead, Town staff relied on hard paper maps that were developed in the 1980s. Part of the work to develop the 2015 SDMP included digitizing the hard paper maps into Geospatial Information System (GIS) format that was then used to develop hydraulic models of the system. It was estimated that approximately 85% of the infrastructure was mapped, however, many of the features mapped were missing key attributes such as diameter and material.

In 2018, the Town hired NCE to develop a stormwater operations and maintenance program (Stormwater O&M Program). Part of this work included a field mapping project to obtain more accurate GIS data to develop the O&M Program. During the summer of 2019, NCE along with Town staff collected data on over 29 miles of storm drain infrastructure, of which 21 miles are public and maintained by the Town. This information will be made available to the public using an online mapping service so that Town residents can see the storm drain infrastructure. The Town's Stormwater O&M Program is described in more detail in Chapter 6.

Chapter 2. Storm Drain Infrastructure

This chapter provides some basic information on the storm drain infrastructure that exists throughout the Town and the maintenance responsibilities of the infrastructure.

2.1. Overview of Storm Drain Features

The majority of the storm drain infrastructure throughout the Town of Moraga was installed in the 1960s under the jurisdiction of Contra Costa County and 1970s after the Town incorporated. Figure 2-2 depicts the Town's public storm drain infrastructure that was mapped during the 2019 summer field mapping project. Over 29 miles of storm drain infrastructure data was collected during the fieldwork of which 21 miles are Town owned. The various types of infrastructure are further described in the following sections.

2.1.1. Pipes

Pipes are installed under public roads to convey the runoff generated from the roads and surrounding properties to the creek systems. The town has roughly 1,092 pipes mapped that cover a length of 20.8 miles. The majority of the pipes, roughly 88%, are made of reinforced concrete pipe (RCP), then about 7% of corrugated metal pipe (CMP), with a handful of plastic pipes made of polyvinyl chloride (PVC) or high-density polyethylene (HDPE) material. The pipe diameters start as low as 10 inches and get bigger as the drainage area increases and the pipes get closer to the creek systems where they eventually discharge. Figure 2-1 below shows typical RCP and CMP pipes in the Town of Moraga.

The Town's design standard for pipes is to convey the 10-year storm event, which is consistent with many Bay Area jurisdictions and Contra Costa County Flood Control and Drainage Standards. A 10-year storm event is the amount of rainfall that has a 10% chance of occurring each year. In the Town of Moraga, this is approximately 5 inches of rainfall occurring over a period of 24 hours. According to stream gage data in Contra Costa County, 10-year storm events occurred during 1982, 1997 and 2006.

Figure 2-1. Typical Public Storm Drain Pipes – RCP (left) and CMP (right)

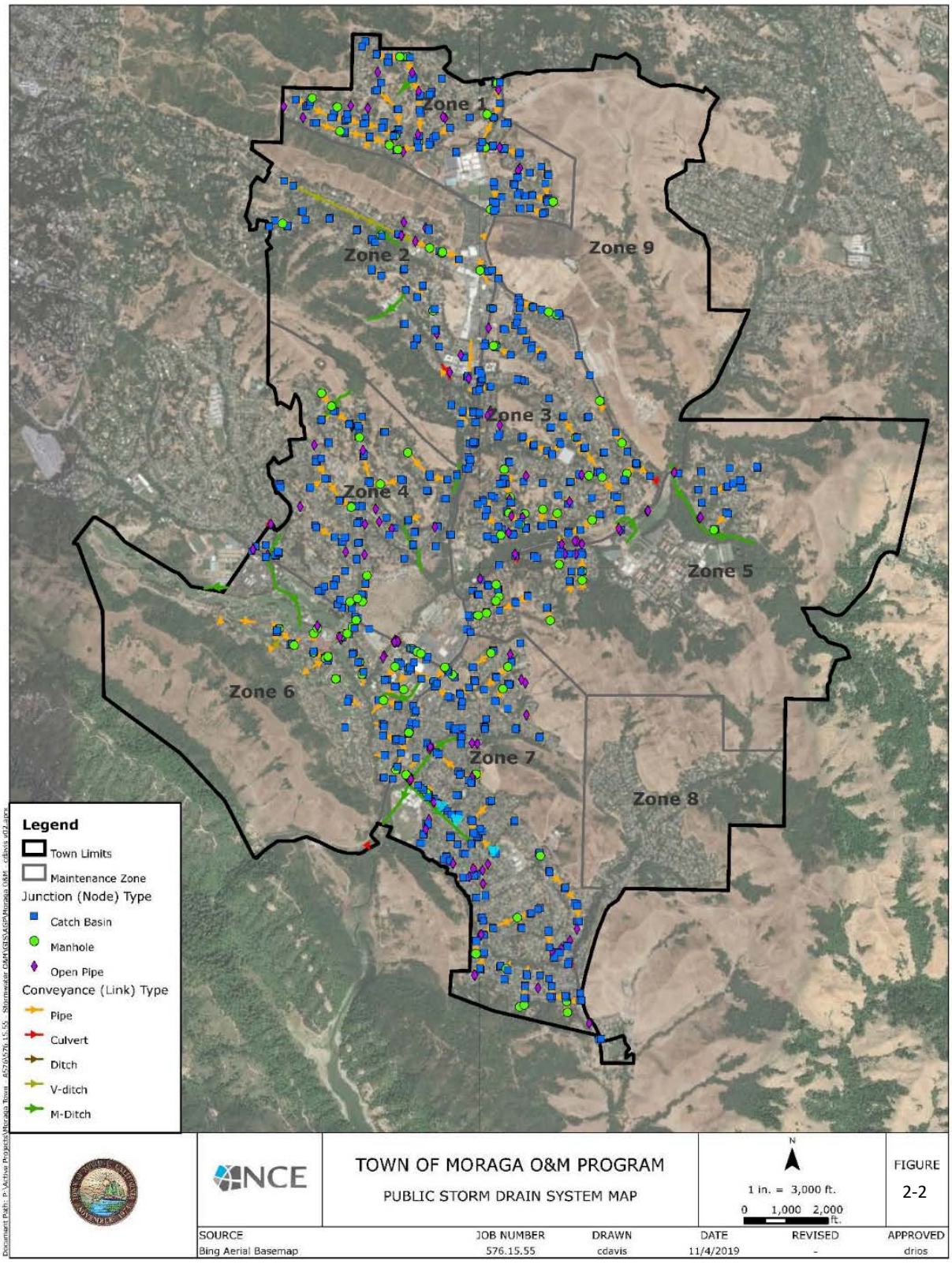


Figure 2-2. Public Storm Drain Infrastructure

2.1.2. Creeks

There are a number of tributaries and creeks that flow through the Town. Most notably, Laguna Creek, Moraga Creek, and Las Trampas Creek all run through the Town limits. The majority of the creeks and streams in the Town of Moraga are privately owned and maintained. The Creeks provide the backbone of the drainage system throughout the Town. Typically, creek and streams have the capacity to convey a 100-year storm event. When they do not have this capacity, the Federal Emergency Management Agency (FEMA) maps these areas susceptible to flooding in a special flood hazards area (SFHA) to notify property owners of their flood risks. Hydraulic analysis by FEMA indicates flooding potential at several locations in Moraga. Flooding is limited to shallow flows at road culverts, where the waters cross the road and then reenter the channel. This shallow flooding occurs on Laguna Creek at Campolindo Drive and Moraga Road, on St. Mary's Creek at Moraga Road, on Corliss Creek at Corliss Drive, and on Larch Creek at Larch Avenue. Laguna Creek, at the upper end of the culvert under Rheem Boulevard, causes flooding in several old homes on the creek banks. Laguna Creek has mapped SFHA near Campolindo High School and Hacienda de las Flores.

According to stream gage data on San Ramon Creek and Walnut Creek in Contra Costa County, since 1970, the County has not experienced a 100-year flood event. Larger storm events have occurred in 1955, 1958, 1963, 1982, 1997 and 2006 but all were recorded somewhere between a 10-year and 15-year event. FEMA maps can be downloaded from the following link:

https://msc.fema.gov/portal/home

2.1.3. Culverts

When a roadway crosses a stream or creek, a culvert is constructed to convey the creek or stream under the roadway. These culverts should be designed to convey the 100-year storm event. The newly collected GIS data shows 46 culverts in the Town, of which 23 cross under private roadways and are maintained by the private property owners or through a Homeowner Association (HOA). Figure 2-3 shows a typical creek culvert.

2.1.4. Ditches

There are two types of ditches in the Town of Moraga - concrete or asphalt-lined v-ditches and earthen or vegetated ditches. The majority of the ditches throughout the Town are located on private property or hillside slopes and were constructed by developers to develop the land. There are also ditches along the roadside that convey water under private driveways. The Town maintains ditches that are shown in Figure 2-2 which are classified as M-Ditches. There is approximately 2,100 linear feet of M-Ditches that are maintained by the Town. Many of the ditches throughout the Town are not mapped in the Town's GIS due to access issues. A typical concrete lined ditch is shown in Figure 2-3.

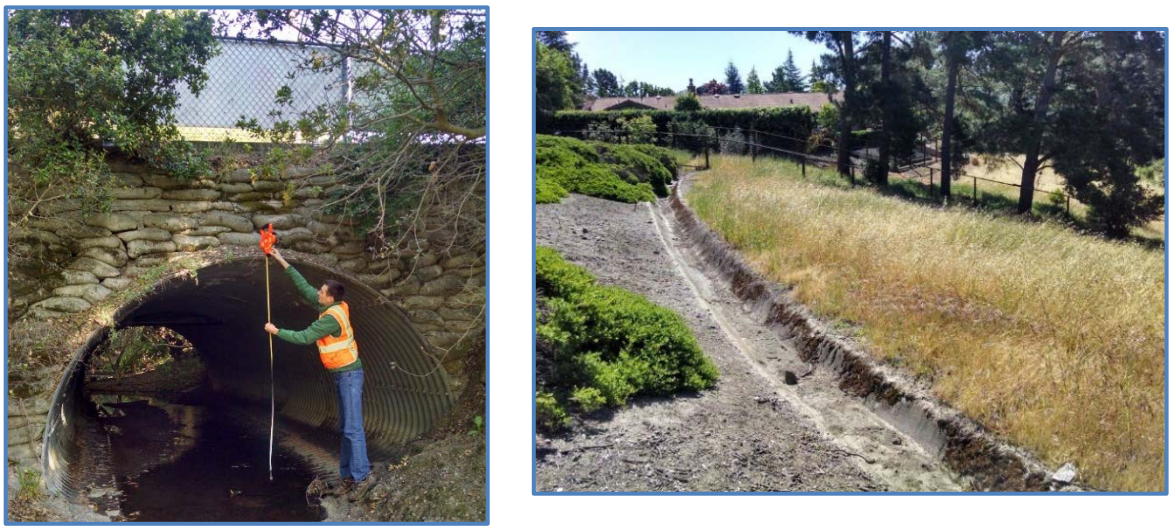


Figure 2-3. Creek Culvert (left) and Concrete Lined Ditch (right)

2.1.5. Other Structures

Storm drain infrastructure consists of a variety of structures that are used for different purposes. These consist primarily of drain inlets, outfalls, and manholes that provide inflows, outflows, and junctions of the storm drain system. These structures are described below.

Manholes

A manhole is constructed to connect two pipes at a bend in a pipe or at a location to provide access to the pipe system for cleaning and maintenance. A manhole has a solid lid that can be removed to inspect or clean the pipes. Figure 2-5 (right) shows a typical manhole in the Town.

Storm Drain Inlets and Trash Capture Devices

Storm drain inlets allow surface runoff to enter into the underground storm drain pipes. Storm drain inlets are typically located on a curb at the low point in a street to collect the runoff that flows by gravity to the inlet. The Town has approximately 754 publicly-owned storm drain inlets. Figure 2-4 (left) shows a typical inlet on the left.

Some of the storm drain inlets have trash capture devices located in them to collect trash and debris and prevent contamination of the receiving Creeks and Streams. The Town has 33 Town-owned trash capture devices installed in the public right-of-way and approximately 92 privately-owned trash capture devices on private property.

Figure 2-4. Storm Drain Inlet (left) Storm Drain Manhole (right)

Bioretention and Sedimentation Basins

A bioretention basin is designed to detain and infiltrate runoff through a soil media to remove the pollutants. It is known as a low impact development (LID) that is required under the Municipal Regional Permit (MRP). Bioretention basins are typically required of private new and redevelopment projects. The Town has two bioretention basins - one at the Corp Yard and the other near Commons Park. Figure 2-5 shows one of the Town's bioretention basins.

A sedimentation basin is designed to hold back water to allow sediment to settle out rather than being conveyed downstream. The Town has a sedimentation basin at the end of El Camino Ricardo Street that is controlled by a structure called a "Missouri Riser" that detains runoff from the hillside and allows sediment to settle out. Figure 3-1 shows the Missouri Riser structure and the sediment basin.

Outfalls

An outfall is where a pipe, culvert, or ditch that discharges storm water into a receiving water body. In the Town of Moraga, there are approximately 245 mapped outfalls where Stormwater enters into a creek or stream. Of the 245 mapped outfalls, approximately 114 outfalls that are located in public right-of-way or public property. The rest of the outfalls are located on private property. Figure 2-5 shows an outfall pipe in the Town.

Figure 2-5. Bioretention Basin (left) Storm Drain Outfall (right)

2.2. Responsibility for Maintenance of Storm Drain Infrastructure

A drainage easement is a right granted from a property owner to a public agency for specific use of a portion of the private owner's land for the purpose of maintaining drainage and other storm drain infrastructure. An easement prevents any use of the property within the easement area from encroachments such as a home addition, grading for a pool, planting of trees or other activities that would diminish the functionality of the drainage feature or ability to maintain it.

While many subdivision maps within the Town may show offers of dedication for drainage easements, very few offers of dedication were actually accepted by either Contra Costa County or the Town of Moraga. As a result, the Town of Moraga has a limited number of drainage easements on private property. Prior to the Town's incorporation, Contra Costa County neither accepted nor rejected dedicated drainage easements from private property owners when record maps were created which is a common practice followed by surrounding cities. The County had no obligation to assume any responsibility for construction of improvements, repair, or maintenance of storm drain infrastructure (e.g., pipes, creeks, culverts, ditches, other structures, etc.) within private property. When the Town incorporated in 1974, it inherited the same responsibility that had been accepted by the County with regard to maintenance of private property drainage easements. The Town maintains storm drain infrastructure within the public right-of-way, but not within private property, unless there is proof of an accepted drainage easement. The Town is aware of a handful of easements that have been accepted by the Town through resolution and for those limited number of properties the Town assumes responsibility for construction of improvements, repair, or maintenance of storm drain infrastructure within private property. For all other properties, the property owner remains responsible for the construction of improvements, repair, or maintenance of storm drain infrastructure.

2.3. Town's Policy on Private Pipes

Storm drain infrastructure under private property is to be maintained and improved by the private property owners, unless the Town or its predecessor, the County, has previously obtained a recorded drainage easement that has been accepted by legal documentation. The recent failure of storm drain pipes under private property has brought to light that some private property owners could benefit from understanding their responsibilities relating to maintenance of storm drain infrastructure that is on their private property. Town staff are working to make more information available to the Town's residents regarding maintenance of their private storm drain infrastructure and are in the process of developing information and guidance that will be hosted on the Town's website to provide that information. As drainage issues arise from privately owned drainage features, the Town staff will continue to work with private property owners to ensure they understand their maintenance responsibilities. In the event that the Town identifies that certain private drainage infrastructure meets specific criteria, the Town may elect to accept a drainage easement if there is an existing mapped easement or the private property owner is willing to dedicate an easement to the Town. In order for the Town to accept a drainage easement, the Town will have to identify a funding source to ensure proper maintenance of proposed drainage infrastructure.

2.4. Criteria Considerations for Town to Accept Easements

Town staff are working to identify specific criteria for storm drain infrastructure that would be considered for acceptance. Below are suggested criteria that were compiled from surrounding jurisdictions:

- Storm drain infrastructure within easement
- Storm drain infrastructure must be constructed to Town standards and be well maintained
- Storm drain infrastructure is accessible for Town maintenance staff to easily inspect and maintain
- Storm drain infrastructure where there is predominantly Town water flowing through an altered drainage
- Storm drainage infrastructure that the Town has identified a funding source to maintain and there is a substantial public benefit associated with Town acceptance

Chapter 3. Re-Prioritization of Capital Improvement Projects

This chapter takes a look at the projects presented in the 2015 SDMP and re-prioritizes those projects by removing projects with private infrastructure and completed projects, and adding new projects identified by Town staff.

3.1. Removal of Projects with Private Storm Drain Infrastructure

The 2015 SDMP contains projects that involve storm drain infrastructure under private property. At the time of the 2015 SDMP development, it was decided to leave the private storm drain projects in the SDMP, but tag them as private. Since the storm drain fee measure did not pass, projects that include storm drain infrastructure located on private property were removed, reducing the total public cost of the Capital Improvement Program (CIP) from $26 million to $7.4 million.

3.2. Completed Projects Since 2015

Since the completion of the SDMP in July of 2015, the Town has been working on improvements to problems identified in the plan where possible. In addition, the Town has been televising pipes under roads prior to being repaved and improving pipes as necessary based on televised data. Since the Town has limited funding mechanisms for storm drain improvements, many of the projects listed below were either done in conjunction with other projects or done by Town staff in reaction to a system failure. The projects completed include:

Table 3-1. Town of Moraga Completed Projects since 2015

2015 SDMP Project ID	Name	Actual Cost
N01	Joseph Rd	$20,000
C13	271 Scofield	$26,770
S10	Donald & Fernwood	$184,000
S20	1528 St Marys Rd	$4,000
S21	Canyon Road Outfall past Bridge	$28,608
n/a	Pipe Repairs on Corliss, Scofield, Natalie and Bollinger Canyon	$160,000
S18	Rheem/Center Sinkhole and Storm Drain Replacement	$2,857,326
n/a	CMP at Canyon Bridge	$30,397
n/a	Baitx Drive at El Camino Flores	$13,828
n/a	Calle La Mesa at Campolindo	$11,970
n/a	Rheem Blvd. at St. Mary's	$40,104
n/a	End of Camino Ricardo, De-silt around Missouri Riser	$13,860
	TOTAL	**$3,390,863**

Additionally, the Town has obtained grant funding to daylight the culverted section of Laguna Creek at the Hacienda de las Flores. This was a high priority project identified in the 2015 SDMP to upsize the 96-inch diameter deteriorated CMP. The daylighting project will increase the capacity to prevent reoccurring flooding at the Pavilion Building and remove the storm drain infrastructure from needing future maintenance, repair, and replacement. This $1.35M CIP project is currently under design.

3.3. Revised Projects Since 2015

Since 2015, two projects have been updated by Town staff with more detailed information. Those projects are the sedimentation basin at the top of El Camino Ricardo – N05 and needed inlets near the intersection of Laguna Creek and Corliss Drive – N06. One new project (H01) has been added to update the 2015 hydraulic models with the updated data from field data collection efforts.

It is anticipated that the Town will identify more projects as they begin implementation of the enhanced Operation and Maintenance Program (O&M Program) that is described in Chapter 6. These projects are identified as "proactive repairs" in response to the annual televising of pipes that will identify necessary repairs.

3.3.1. Sedimentation Basin Design and Sediment Removal Optimization Study – N05

There is a sedimentation basin controlled by a Missouri Riser structure (Figure 3-1) located at the end of El Camino Ricardo Street. Each year, the basin fills up with sediment that is deposited when the runoff is held back by the Missouri Riser, which is the purpose of the basin and riser. The removal of the sediment can cost the Town up to $15,000 per year. The source of the sediment has been identified as active landslides on the steep hillslopes above the sedimentation basin. In order to reduce the amount of sediment that needs to be removed each year, Schaaf & Wheeler researched materials and developed a conceptual project to stabilize the hillside by installing geotextile products and replanting vegetation to hold the soil in place. When costing out this project, it was determined that to properly stabilize the steep hillside, the project would cost upwards of $800,000. Since the maintenance of this basin over the course of ten years is significantly less than the project cost, the annual cleaning fee has been included into the annual operations and maintenance budget for the Town in Table 6-1.

Town staff has requested that the sedimentation basin design and the excavation of the sediments be optimized to potentially reduce the annual maintenance budget required. So instead of a construction project, N05 is a study to value engineer the sedimentation basin and optimize the excavation of the sediments. This study is estimated to cost around $20,000 and is included in the list of projects in Table 5-1 as a high priority project. If the study determines that a construction project could improve the function of the sedimentation basin and reduce the annual maintenance cost, the Town staff may elect to use the money set aside for maintenance to construct improvements to the basin.

Figure 3-1. Missouri Riser Structure (left) Active Landslide Areas in Yellow (right)

3.3.2. Installation of Drain Inlets on Corliss Drive – N06

A project to mitigate nuisance flooding caused by storm drain inlets and pipes clogging on Corliss Drive near the crossing of Laguna Creek was identified in the 2015 SDMP. This project was categorized as a pipe maintenance project in the 2015 SDMP, but further investigation by Town staff has identified the need to install additional catch basins to allow roadway runoff to enter into the drain inlets and drain to Laguna Creek. Schaaf & Wheeler worked with Town staff to develop a conceptual design and cost estimate for this project.

3.3.3. Updating 2015 Hydraulic Model – H01

In order to get the most accurate analysis of the Town's storm drain system, the hydraulic models created in 2015 should be updated sometime within the next ten years after the ongoing O&M Program discussed in Chapter 6 has collected more information on the connectivity of the storm drain system. In addition, the hydrologic standards have been revised by Contra Costa County since the development of the 2015 SDMP hydraulic models. It is estimated that it will cost approximately $50,000 for the Town to hire a consultant to update the hydraulic models with new storm drain data, analyze and update the existing capacity related projects, and identify new projects.

3.4. Re-Prioritization of Projects

Since 2015, the Town has not experienced significant storm events caused from undersized pipes. However, the Town has also not experienced a 10-year storm event since 2006. The Town has experienced several sinkholes from aging infrastructure and additional maintenance required on pipes that are clogging from debris and sediment. To address the ongoing maintenance, the Town hired a consultant to develop an Operations and Maintenance Program (O&M Program) which is detailed in Chapter 6.

Schaaf & Wheeler evaluated the projects identified in the 2015 SDMP and raised the priority of the condition related projects (i.e., pipes that need repair) over the capacity related projects (i.e., pipes that

need increasing in size). Higher priority was also given to the nuisance projects (i.e., re-occurring issues) that have been identified by Town staff, especially the nuisance projects discussed in 3.3.1 and 3.3.2. Capacity projects remain low priority in the 2019 Addendum. If the Town experiences higher storm events during the next ten years, those areas will be documented and needed improvements should be identified in the updated hydraulic model that is part of project H01, detailed in Section 3.3.3.

Chapter 4. Updating Cost Estimates

Construction costs have steadily escalated since 2015. Turner & Townsend, a worldwide program and cost management consultant, have deemed the Bay Area the most expensive place to build in the world. The Engineering News-Record (ENR) cost estimates of both materials and labor have increased by at least 12% between 2015 and mid-2019. Contractors are extremely busy, making it difficult to get competitive bids on construction projects. This chapter reviews and revises the costs estimated in the 2015 SDMP to bring the costs to 2020 dollars.

4.1. Updating 2015 Costs to 2020 Dollars

The 2015 costs were updated based on common resources for escalating project costs over time. Schaaf & Wheeler used data provided by the following resources to update the costs to 2020 dollars:

- Engineering News-Record (ENR) Construction Cost Index (CCI).
- Gordian Heavy Construction Costs with RS Means Data (2019 edition).
- Other Schaaf & Wheeler produced storm drain construction cost estimates.

Estimated construction costs for storm drain master plans are based on available GIS data and known field conditions. They are not based on site specific surveys or as-built plans. These cost estimates are conceptual and should be refined during detailed design process. The cost estimates shown in the table in Chapter 5 include construction costs and soft costs which are inclusive of staff administration, engineering and permitting services, construction management, inspection, and testing.

The tables in Chapter 5 present a summary of projects and total costs, which is a sum of the construction costs and soft costs.

Chapter 5. Town's 10-year Storm Drain CIP

This chapter presents the proposed CIP for the next ten years (2020-2030) for the Town of Moraga to repair and maintain the public storm drain infrastructure. The projects are prioritized into high, moderate, and low priority but they are not given specific years for completion as the Town may need to shift priorities if issues arise that are not presented in Tables 5-1 through 5-3.

5.1. Updated Capital Improvement Projects and Costs

Table 5-1 through 5-3 present the Town's ten-year storm drain CIP in the high, moderate, and low priorities. The high and moderate priority projects in Tables 5-1 and 5-2 are listed in recommended order of completion. The overall CIP is estimated to cost the Town $7,400,000 and consists of $560,000 in high priority projects, $430,000 in moderate priority projects, and $6,410,000 in low priority projects. Figure 5-1 shows a breakdown of the CIP costs into priorities and Figure 5-2 shows the priorities on a map.

Table 5-1. Town of Moraga Ten Year Storm Drain HIGH Priority CIP List

Project ID	Name	Category	Estimated Cost
N05	Sedimentation Basin Study	Nuisance	$20,000
N06	Corliss Dr Drain Inlets	Nuisance	$40,000
N02	Moraga Drive Drainage	Nuisance	$220,000
N03	Ascot and Moraga Drain Inlet	Nuisance	$210,000
S11	Bollinger Clean/Replace	Condition	$70,000
		Total	**$560,000**

Table 5-2. Town of Moraga Ten Year Storm Drain MODERATE Priority CIP List

Project ID	Name	Category	Estimated Cost
CC04- LC5	Laguna Creek at Hacienda	Culvert Capacity	Grant Funded
N07	St. Mary's Road Culvert Replacement	Nuisance	$370,000
S12	Del Rio Way Cleaning	Condition	$5,000
S15	Rimer Dr. Cleaning	Condition	$5,000
H01	Update Hydraulic Modeling	Hydraulic Modeling	$50,000
		Total	**$430,000**

Table 5-3. Town of Moraga Ten Year Storm Drain LOW Priority CIP List

Project ID	Name	Category	Estimated Cost
CC01- MC3	Moraga Creek	Capacity - Creeks	$ 840,000
CC02-SMC2	South Moraga Creek at Camino Pablo	Capacity - Creeks	$ 320,000
C03	Campolindo	Capacity - Pipes	$ 980,000
C07	Hazelwood	Capacity - Pipes	$ 50,000
C09	Larch	Capacity - Pipes	$ 280,000
C14	Fernwood	Capacity - Pipes	$ 210,000
C15	Camino Ricardo 2	Capacity - Pipes	$ 200,000
C19	Deerfield	Capacity - Pipes	$ 410,000
CC05- MC1	Moraga Creek	Capacity - Creeks	$ 420,000
CC06- STM2	St Marys Rd Trib	Capacity - Creeks	$ 260,000
CC07- ID2	Ivy Drive Creek	Capacity - Creeks	$ 290,000
CC08- CD1	Corliss Drive Trib	Capacity - Creeks	$ 250,000
CC10- ID1	Ivy Drive Creek	Capacity - Creeks	$ 100,000
CC12- RT1	Rheem Trib	Capacity - Creeks	$ 50,000
CC13- STM1	St Marys Rd Trib	Capacity - Creeks	$ 190,000
CC14- LC1	Laguna Creek	Capacity - Creeks	$ 590,000
CC17- STM4	St Marys Rd Trib	Capacity - Creeks	$ 190,000
CC18- STM5	Rheem Trib	Capacity - Creeks	$ 30,000
N08	End of Camino Ricardo	Nuisance	$ 750,000
		Total	**$ 6,410,000**

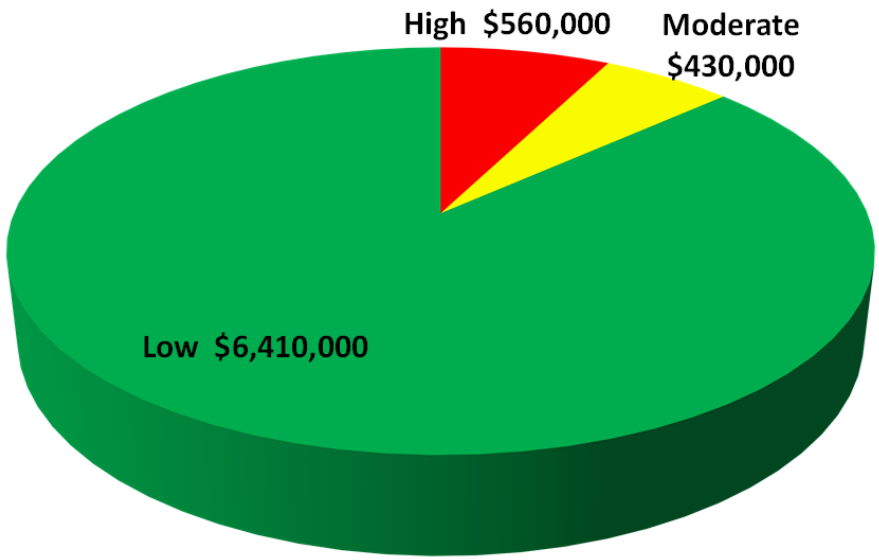


Figure 5-1. 10-yr Storm Drain $7.4M CIP Breakdown into Priorities

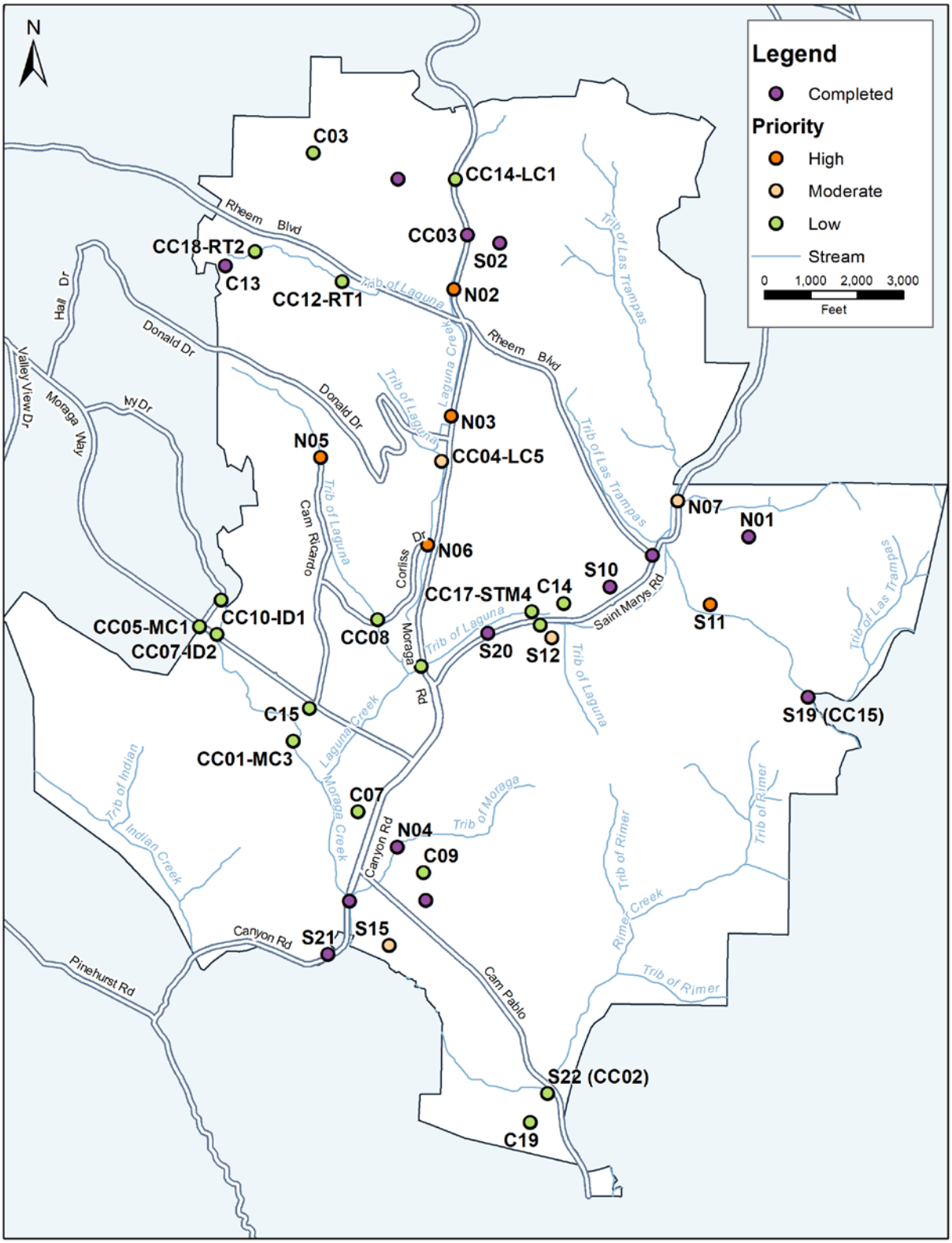


Figure 5-2. Ten Year Storm Drain Prioritized CIP

5.2. High and Moderate Capital Improvement Projects Funding

The Town has developed a Reserve Funding Strategy for implementation of the high and moderate CIP projects presented in the 2019 Addendum. Using a Reserve Funding Strategy an annual funding need of $120,680 was determined. This is the amount that would need to be budgeted each year for the next ten years to complete the nine projects. The strategy includes a 2.92% escalation rate based on Engineering News Record – 20 City Average Building Construction Cost index (ENR-BCI) and an interest income rate of 2.62%. The schedule and Storm Drain Capital Improvement Project Replacement Fund calculation is included as Attachment 5.

The projects would be completed according to the following schedule shown in Table 5-4. During the next ten years the Town may need to reorganize the schedule due to changing conditions or response to system failures that may occur without warning. Towards the end of the ten year program, the Town will complete a new hydraulic model that will identify new and revised capacity related projects that will serve the basis of the next ten year CIP from 2030 -2040.

Table 5-4. Project Implementation Schedule

	2020 Cost	FY 21/22	FY 23/24	FY 25/26	FY 26/27	FY 29/30	FY 30/31
Sedimentation Basin Study	$20,000	$21,000					
Corliss Dr Drain Inlets	$40,000	$42,000					
Moraga Drive Drainage	$220,000		$269,000				
Ascot and Moraga Drain Inlet	$210,000			$250,000			
Bollinger Clean/Replace	$70,000				$86,000		
St. Mary's Road Culvert Replacement	$370,000					$493,000	
Del Rio Way Cleaning	$5,000						$7,000
Rimer Dr. Cleaning	$5,000						$7,000
Update Hydraulic Modeling	$50,000						$69,000
TOTAL		**$63,000**	**$269,000**	**$250,000**	**$86,000**	**$493,000**	**$83,000**

Chapter 6. Town's Operation and Maintenance Program

NCE has been working with Town staff to develop the Town's Stormwater Operations & Maintenance (O&M) Program since early 2019. This project has included several key tasks which are summarized below:

- Review Preliminary O&M Documentation
- Asset Management Evaluation
- Storm Drain Asset Inventory
- O&M Program Development
    - Complete O&M gap analysis for inspections and system maintenance (cleaning)
    - Develop annual schedule for inspections and cleaning
    - Prepare inspection and cleaning procedures and support development of vendor RFPs
    - Develop web-based GIS database to track and manage the storm drain system
    - Conduct training

6.1. Summary of Storm Drain Asset Inventory

Prior to initiating the current project, the Town estimated that the existing storm drain inventory was 85% complete. A preliminary gap analysis by NCE demonstrated that completeness was 40% for junction assets (e.g. manholes, catch basins, drain inlets, etc.) and 58% for conveyance assets (e.g. pipes, ditches, culverts, etc.). Completeness is defined as having the necessary spatial and attribute data for an asset. The preliminary gap analysis did not evaluate the accuracy of the existing data, it only considered if the data existed.

As a result of the identified data gap, NCE recommended the Town complete a comprehensive storm drain asset inventory. The objective of the inventory was to collect spatial and attribute data for the Town's storm drain assets in order to create a storm drain network (a network identifies connectivity between assets).

6.2. 2019 Field Mapping Project

The field data collection was conducted over the course of five weeks beginning on June 17 and finishing on July 25, 2019. Field data collection was conducted by three teams, each consisting of two technicians. NCE partnered with three of the Town's Engineering Interns to execute the data collection project.

Field teams collected spatial and attribute data for publicly accessible storm drain assets within publicly owned parcels, the right of way or easements within the Town. Assets located on private property or in inaccessible locations were not collected. The original intent was to focus data collection on large diameter pipes, establish system connectivity, and identify portions of the system with missing or duplicate spatial data and areas with known maintenance issues.

Due to an overall efficient process and focused effort, field crews were able to collect more data than originally anticipated. This included most assets, regardless of pipe size, within the Town's right-of-way and in some cases assets within private communities located within the Town boundaries. The ability to collect additional data provides a more complete inventory and network, allowing for improved modeling and enhanced stormwater O&M.

6.3. O&M Program Development

Following the completion of the storm drain inventory, a more complete and accurate storm drain GIS will exist. As a result, NCE has developed an O&M Program for the Town's storm drain infrastructure. One primary deliverable of the O&M Program is the Stormwater O&M Plan that describes the primary elements of the Town's Stormwater O&M Program. The Town's O&M Plan includes the following chapters:

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, dimensions, maintenance condition, invert elevations, etc.

Analysis and Forecasting –Defines the inspection, CCTV, and maintenance (cleaning) O&M Selection Criteria for the junctions and conveyances. Defines the Work Program Action prioritization, inspection and tracking schedule, and costs for each program component.

Work Program Actions – Describes the primary components of the Work Program Actions including inspections (e.g., visual or CCTV inspections), maintenance (e.g., Town cleaning and vendor vactoring), spot repairs (e.g., Town repairs and contracted repairs), and capital improvements (primarily larger improvement projects). This section will describe the procedures, equipment, and methodologies for conducting the various Work Program Actions.

Tracking and Reporting – Describes the processes by which the Work Program Actions are integrated into the GIS, annually updated, and reported.

6.4. Preliminary O&M Cost Estimates

NCE has evaluated the Town's storm drain GIS and come up with preliminary estimates for 2020 visual inspections, CCTV inspections, vactor cleaning, spot repairs, and staff administration. These estimates are based on the updated storm drain inventory, updated unit cost information, storm drain assets that should be prioritized for CCTV or vactor cleaning, and recommendations from the 2015 Storm Drain Master Plan.

These estimates will be further refined as the O&M Program is implemented and new information is gathered. For example, once the visual inspections and CCTV inspections have been completed, additional cleaning (or repairs) will be identified.

At this time, it is anticipated that 7.5% of the CCTV pipes will require some sort of spot repair to prevent future failures. It is estimated from spot repairs performed by the Town since 2015 that the average cost

per linear foot of repair is approximately $310 which calculates to $115,000 for proactive repairs. The recommended reactive repair project budget, based on actuals from the past few years, is $116,000. Staffing budget for engineering, construction management, and inspection is recommended for proactive repairs but not for reactive repairs.

Table 6-1 below summarizes the anticipated 2020 cost to implement the proposed O&M program that NCE developed for the Town. This cost is assumed to be an annual cost for the Town, which differs from the capital improvement projects that are presented in Chapter 5 as they are a one-time capital cost to the Town.

Table 6-1. 2020 Enhanced O&M Program Cost Estimates

O&M Component	Quantity	Unit Cost	Estimated Cost
Maintenance Staff	853	$64.1	$54,667
CCTV Inspections	5,000 linear feet (lf)	$2.50/lf	$12,500
Vactor Cleaning	5 days	$2,850/day	$14,250
Reactive Spot Repairs			$116,000
Proactive Spot Repairs			$115,000
O&M Program Administration	832	$72.32	$60,170
Internal O&M GIS Technician	500	$55.00	$27,456
External O&M Technical Support			$20,000
TOTALS	-	-	**$420,043**

Chapter 7. Clean Water Program Mandates

The Town of Moraga is a member of the Contra Costa Clean Water Program (CCCWP or Program) which assists in managing a shared common Municipal Regional Stormwater NPDES Permit (MRP) to discharge stormwater to the San Francisco Bay which can be found here:

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/mrp.shtml.

7.1. Current Permit Requirements

The Town is required to meet all stormwater management requirements set forth by the MRP. The current MRP was adopted October 14, 2009 (Order no. R2-2009-0074), and became effective as of December 1, 2009. On November 19, 2015, the Regional Board released a draft MRP 2.0 (ORDER No. R2-2015-0049), NPDES Permit No. CAS612008.

MRP 2.0 outlines the State's requirements for municipal agencies in the San Francisco Bay Area to address the water quality and flow-related impacts of stormwater runoff. MRP 2.0 is a comprehensive permit that requires activities related to construction sites, industrial sites, illegal discharges and illicit connections, new development, and municipal operations. The permit also requires a public education program, implementing targeted pollutant reduction strategies, and a monitoring program to help characterize local water quality conditions and to begin evaluating the overall effectiveness of the permit's implementation.

7.2. Town's Current Expenditures and Funding Source

The Town hires a consultant to assist with compliance with MRP 2.0. Tasks include completing the annual report, developing a Green Infrastructure Plan, compliance with trash reduction mandates, etc. The current annual budget for MRP compliance is $86,000. This funding comes from the National Pollutant Discharge Elimination System funds and is not included in this Addendum as part of the CIP as the funding source has been established.

7.3. MRP 3.0

The current permit term expires at the end of 2019 and the Regional Water Quality Control Board (RWQCB) is developing an updated permit that will be called MRP 3.0. It is unclear at this time what additional requirements might be placed on jurisdictions. Moraga is represented on the joint state RWQCB staff/Permittee Work Group. It will have additional requirements related to trash capture and green infrastructure. It will continue to require all new regulated projects to have bioretention low impact design features. This will mean that Town staff will need to comply with incorporating new green infrastructure into Town construction projects.

Chapter 8. Summary of Unfunded O&M and CIP Needs

This 2019 Addendum is meant to serve as a planning tool for the Town to identify funding and additional resources to implement the O&M and CIP presented in Chapters 5 and 6 over the course of the next ten years.

8.1. Identify Funding Sources

The Town should identify $540,000 in ongoing annual revenue to fund a $420,000 annual O&M Program and $120,000 a year ten year CIP program to maintain the storm drain infrastructure and prevent future failures that may result in flooding.

8.2. CIP Summary

The CIP funding is meant to complete the re-prioritized the public projects from the 2015 SDMP that have not yet been completed. The high and moderate priority projects consist primarily of condition related projects that require some sort of repair and outstanding maintenance issues that need addressing. Completion of these projects should prolong the life span of the existing infrastructure and should prevent future failures. In addition, the cleaning of heavy debris out of pipes identified in this report should prevent future flooding issues arising from blocked pipes.

Using a Reserve Funding Strategy which assumes both inflation and interest on the fund balance, $120,000 is needed annually to fund these nine projects over a ten-year period. A list of the high and moderate priority projects and the cost estimate in 2020 dollars follows.

Table 8-1. CIP Summary

High & Moderate Capital Improvement Projects	Cost Estimate in 2020 $
Sedimentation Basin Study	$20,000
Corliss Dr Drain Inlets	$40,000
Moraga Drive Drainage	$220,000
Ascot and Moraga Drain Inlet	$210,000
Bollinger Clean/Replace	$70,000
St. Mary's Road Culvert Replacement	$370,000
Del Rio Way Cleaning	$5,000
Rimer Dr. Cleaning	$5,000
Update Hydraulic Modeling[1]	$50,000
TOTAL	$990,000

1. The hydraulic modeling effort to be completed near the end of the ten-year period will incorporate the GIS data collected and Contra Costa's revised hydraulic modeling criteria to update and reprioritize the capacity related projects for future consideration.

8.3. O&M Summary

Historically, the Town has been operating and maintaining the public storm drain infrastructure in a reactive manner. This is not uncommon throughout the Bay Area where very few jurisdictions have a dedicated storm drain funding source. Through the implementation of the $420,000 proposed O&M Program, the Town could expect to see a decrease in reactive repairs and an increase in proactive repairs. This should reduce the overall failures throughout the system. The proposal annual expenditures are summarized below.

Table 8-2. O&M Summary

O&M Component	Quantity	Unit Cost	Estimated Cost
Maintenance Staff	853	$64.1	$54,667
CCTV Inspections	5,000 linear feet (lf)	$2.50/lf	$12,500
Vactor Cleaning	5 days	$2,850/day	$14,250
Reactive Spot Repairs			$116,000
Proactive Spot Repairs			$115,000
O&M Program Administration	832	$72.32	$60,170
Internal O&M GIS Technician	500	$55.00	$27,456
External O&M Technical Support			$20,000
TOTALS	-	-	**$420,043**

ATTACHMENT 1

High and Moderate Priority

Project Summary Sheets

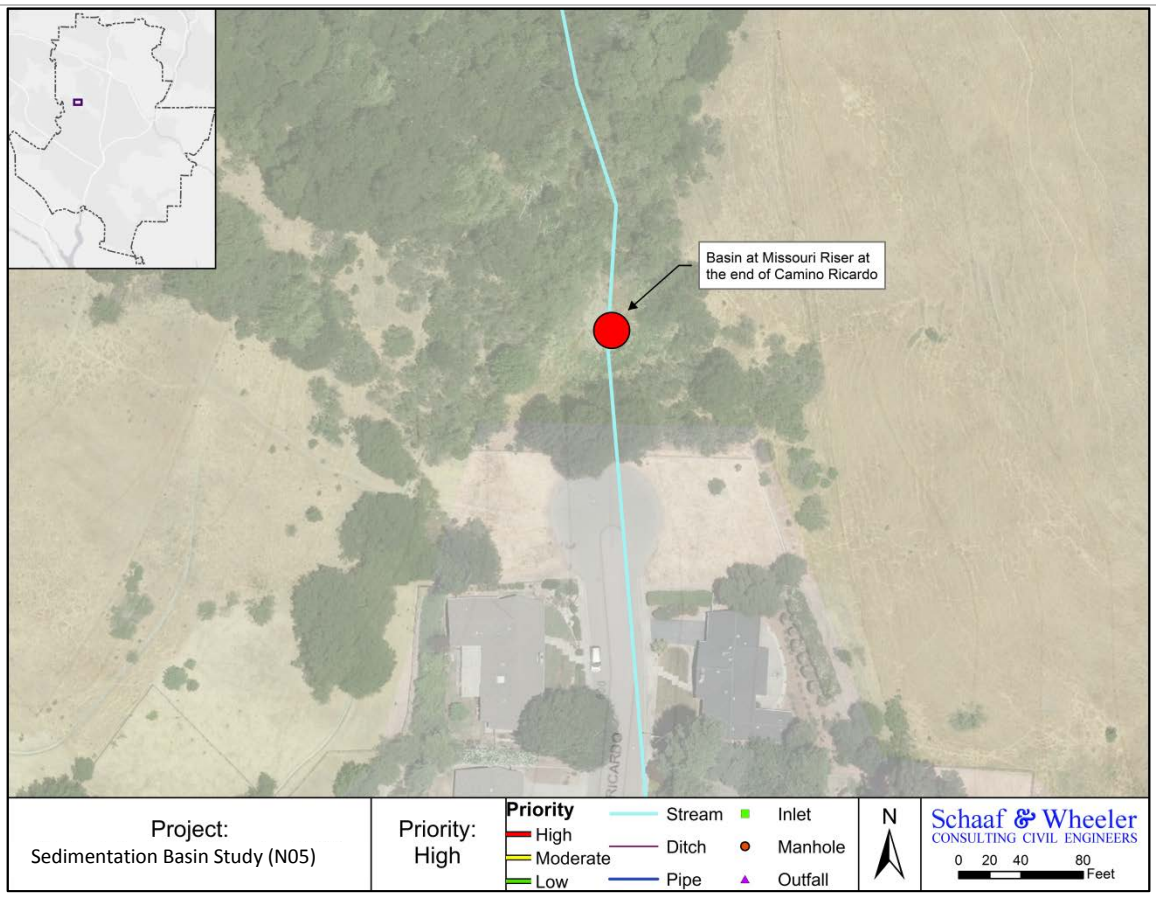
A. Project ID: N05	B. Project Name: Sedimentation Basin Study

C. Project Location: End of Camino Ricardo at the Missouri Riser structure

D. Priority: High (Nuisance)

Project Description: Perform a value engineering study of the existing Missouri riser basin to evaluate whether the existing basin can be improved for better sediment retention and sediment transport. The result of this study will include conceptual level design improvements, recommendation and conceptual level cost estimates. If it's determined that the cost of improving the basin will decrease the overall cost of cleaning the basin, funds from the Operations and Maintenance program will be re-allocated for the construction of recommended improvements.

E. Total Preliminary CIP Cost..... $20,000



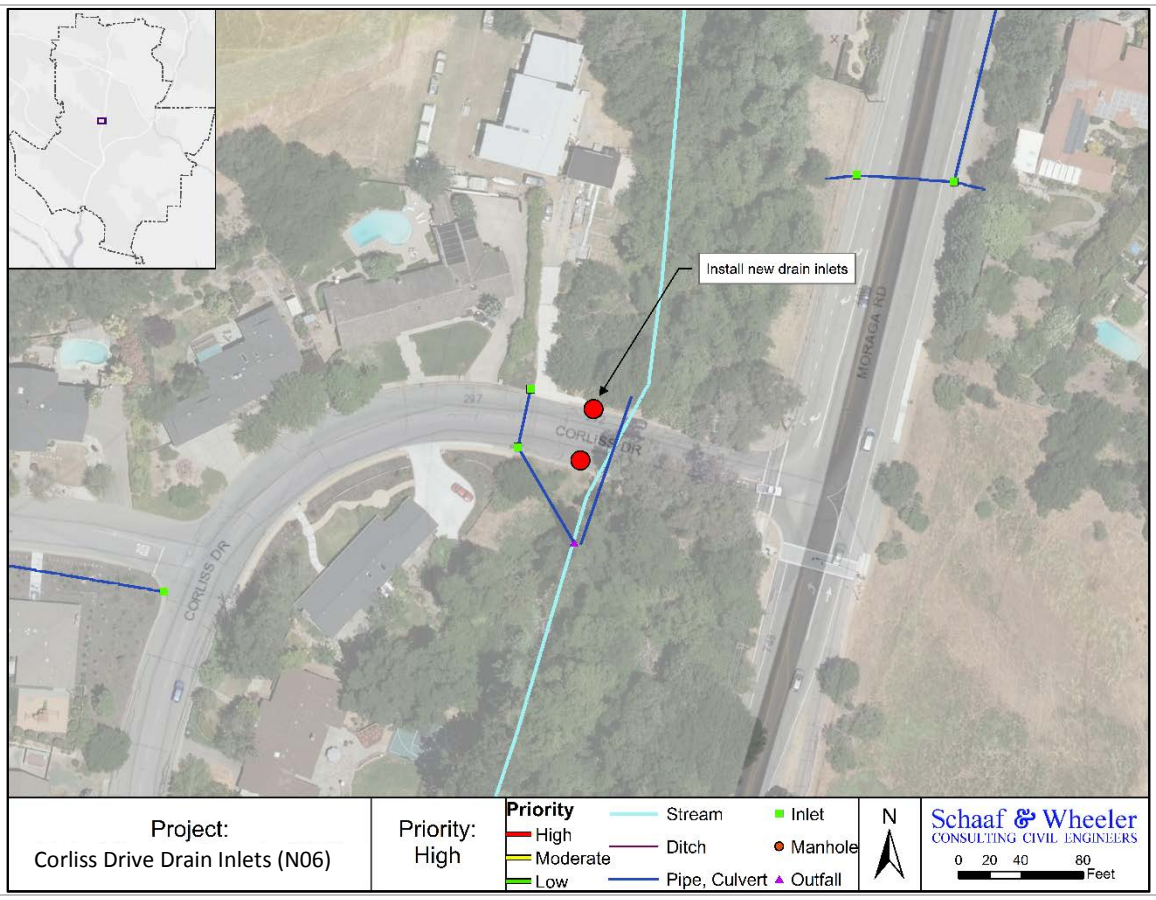
A. Project ID: N06	B. Project Name: Corliss Dr Drain Inlets

C. Project Location: Adjacent to 299 Corliss Drive near the corner of Corliss Drive and Moraga Road

D. Priority: High (Nuisance)

Project Description: Install two additional storm drain inlets on Corliss drive and two new outlets to the creek to prevent surface ponding on Corliss Drive. The existing two storm drain inlets are not sufficient to drain the street.

E. Total Preliminary CIP Cost..... $40,000



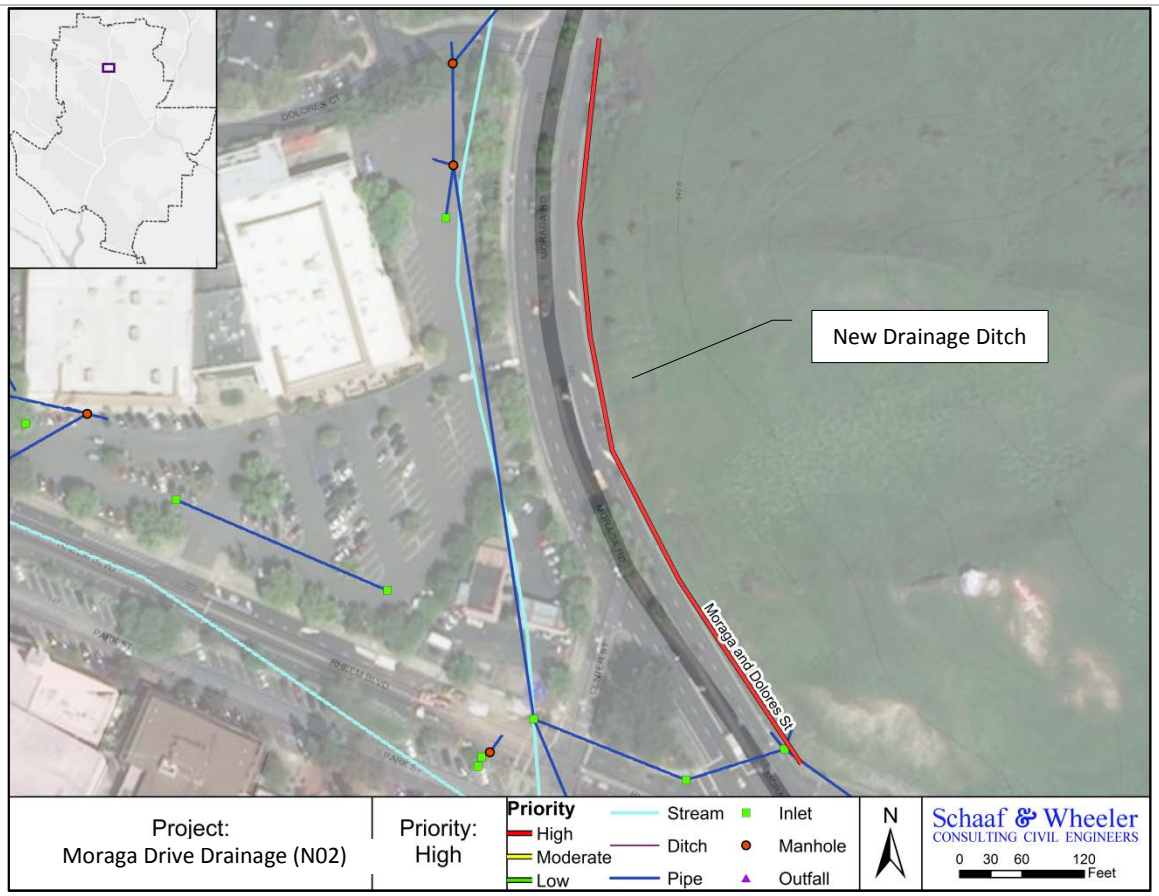
A. **Project ID**: **N02**	B. **Project Name**: **Moraga Drive Drainage**

C. Project Location: **Intersection of Paseo Grande and Paseo Del Rio East side of Moraga Road between Dolores St. and Rheem Blvd.**

D. Priority: **High (Nuisance)**

Project Description: Install roadside ditch along east side of Moraga Road between Dolores Court and Rheem Blvd. to allow for the east side of the roadway to drain. Add additional storm drain inlets at the corner of Rheem Blvd. and Moraga Road to allow for runoff to enter the existing storm drain system.

E. Total Preliminary CIP Cost..... $220,000



A. Project ID: N03 | **B. Project Name: Ascot and Moraga Drain Inlet**

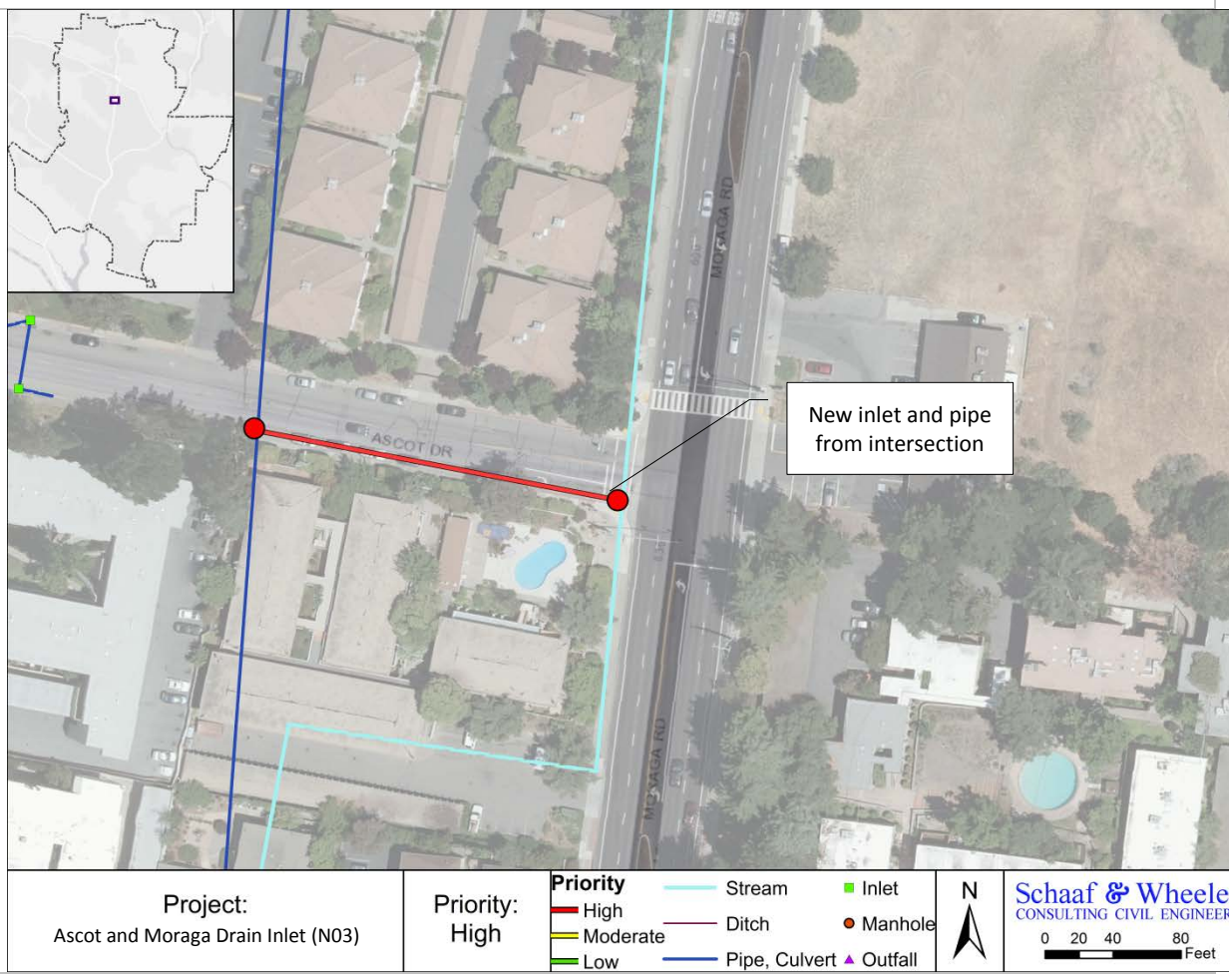
C. Project Location: Intersection of Ascot Rd. and Moraga Rd.

D. Priority: High (Nuisance)

Project Description: Install a storm drain inlet near the south corner of Ascot Rd. and Moraga Road and install 250 feet of 24-inch diameter reinforced concrete pipe (RCP). This pipe will tie into the large culvert approximately 250 feet west of the intersection of Ascot Road and Moraga Road. Add an additional drop inlet where the 250-foot-long pipe ties into the existing storm drain system.

Length	Diameter	Material	Number of New Storm Drain Inlets
250	24”	Concrete	2

E. Total Preliminary CIP Cost..... $210,000



A. Project ID: S11 | **B. Project Name: Bollinger Clean/Replace**

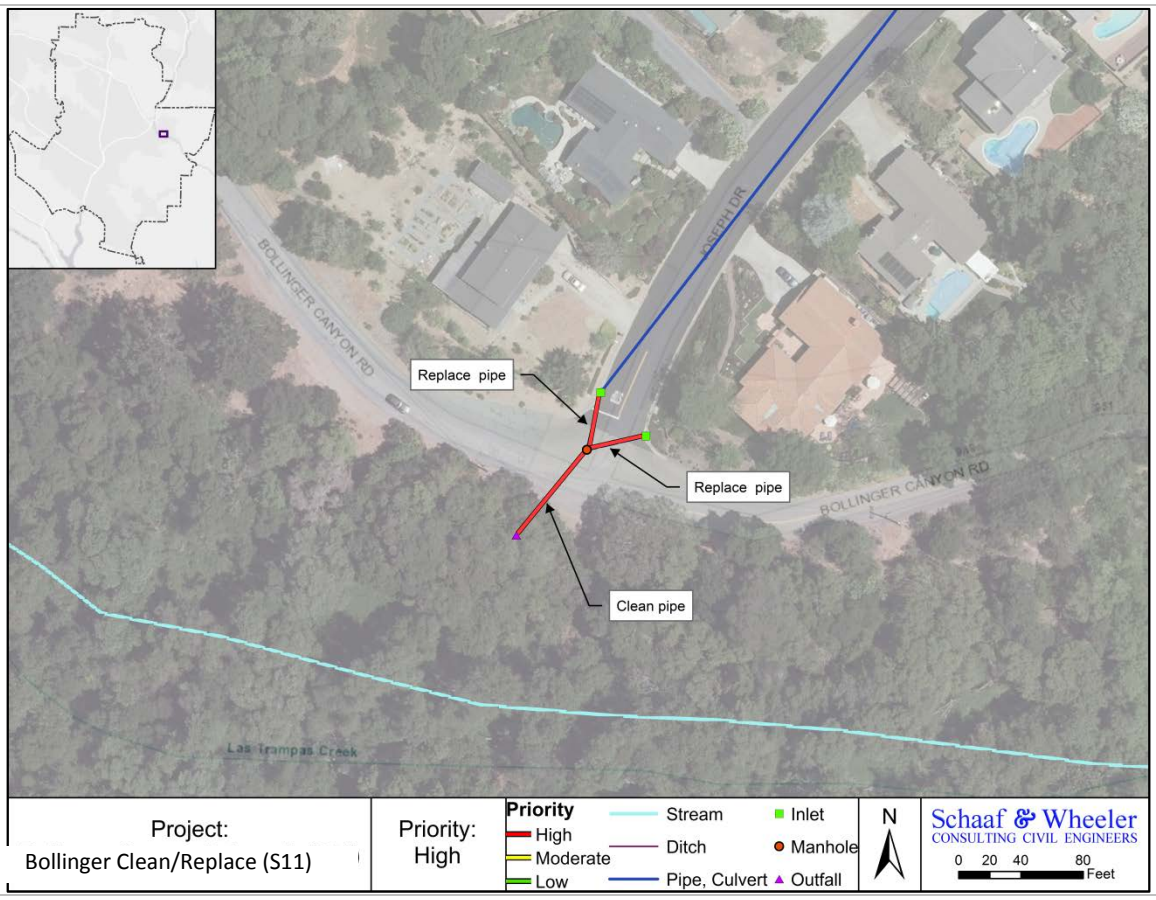
C. Project Location: Near intersection of Bollinger Canyon Road and Joseph Drive

D. Priority: High (Condition)

Project Description: Condition assessment conducted in 2014 showed two damaged pipes and one sediment-filled pipe at the intersection of Bollinger Canyon Road and Joseph Drive. This project includes televising all 3 pipes prior to pipe replacement and cleaning. If CCTV requires replacement, replace the two 18" damaged pipes with reinforced concrete pipe and clean one sediment-filled 18" pipe.

Pipe ID	Length	Diameter	VANDA Rating	Improved Material	Project Type
Z5_LINK_0098	40	18"	4	Concrete	Replace
Z5_LINK_0099	44	18"	2	Concrete	Replace
Z5_LINK_0155	55	15"	3	n/a	Clean

E. Total Preliminary CIP Cost..... $70,000



A. Project ID: N07

B. Project Name: St. Mary's Road Culvert Replacement

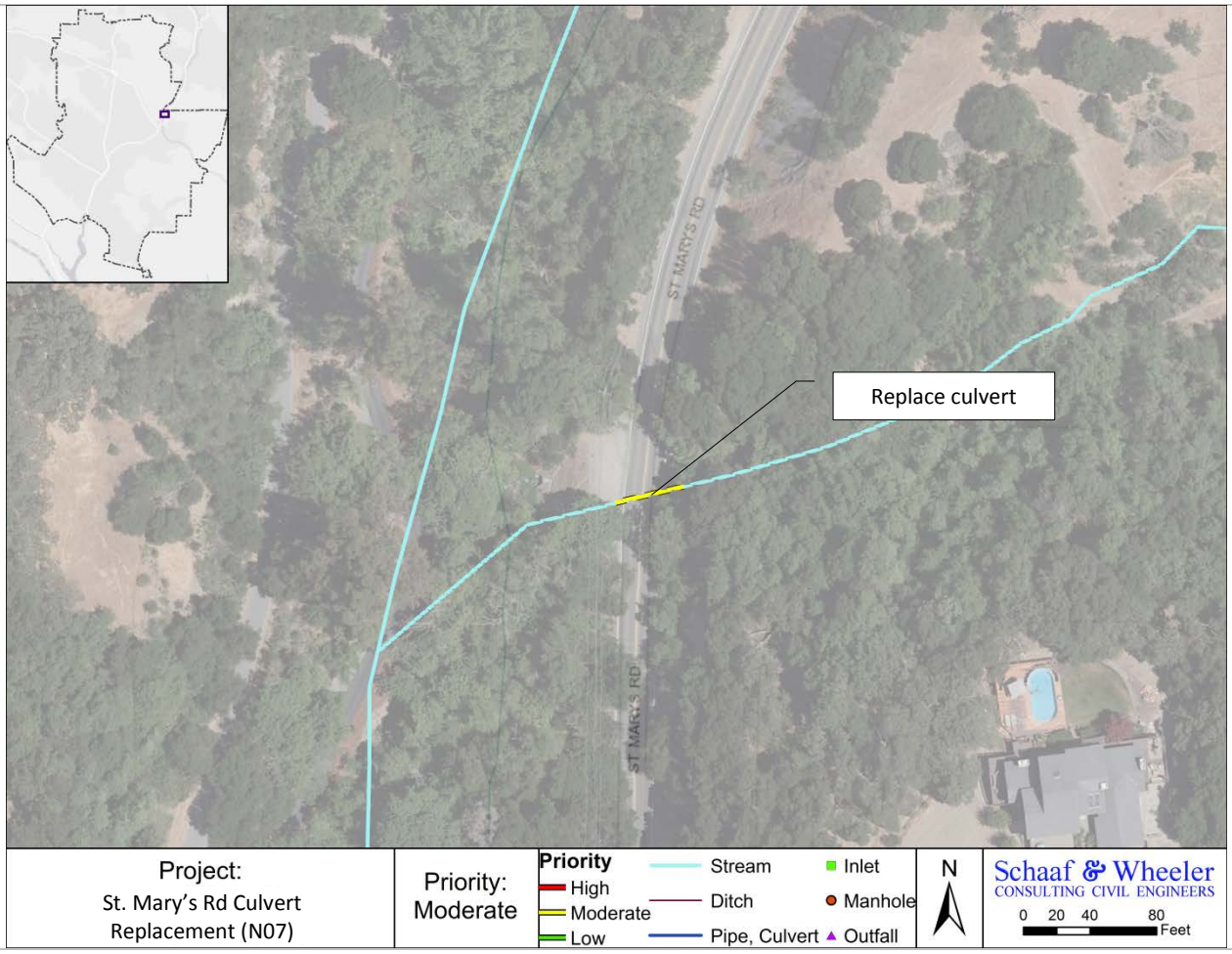
C. Project Location: At Laguna Tributary under St. Mary's Road

D. Priority: Moderate (Nuisance)

Project Description: The Laguna Tributary culvert under St. Mary's Road is undersized, causing nuisance flooding n St. Mary's Road. This project would upsize the existing culvert to allow for higher flows to remain contained within the culvert under the road. In addition, the current pipe is CMP, this project proposes to replace with RCP culvert.

Culvert ID	Length	Existing Size	Improved Size	Improved Material
LTC2	40	54" x 32"	60" x 36"	Concrete

E. Total Preliminary CIP Cost..... $370,000



A. Project ID: S12 | **B. Project Name: Del Rio Way Cleaning**

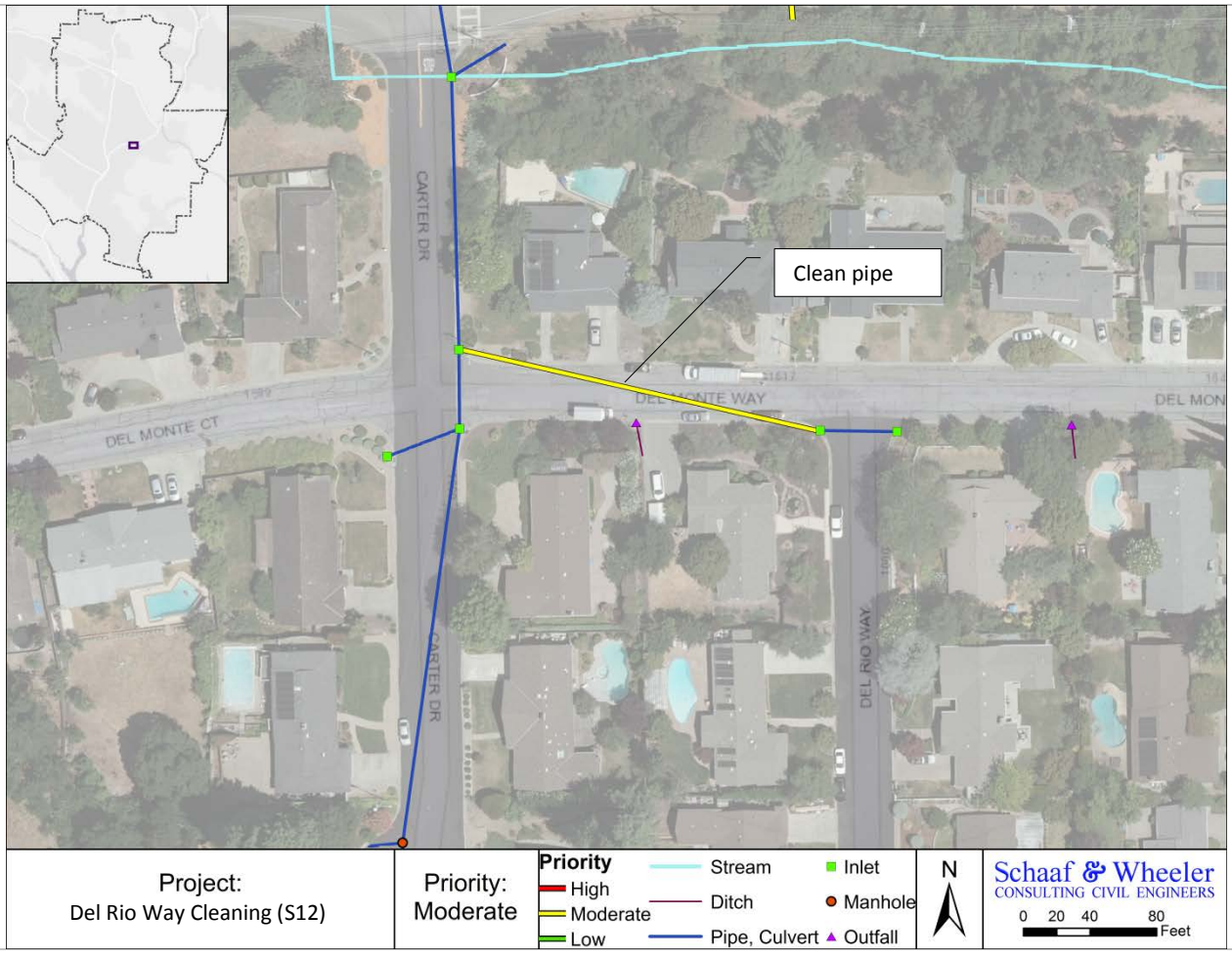
C. Project Location: On Del Monte Way from Del Rio Way to Carter Drive

D. Priority: Moderate (Capacity)

Project Description: Condition assessment conducted in 2014 showed one pipe partially blocked with sediment on Del Monte Way between Del Rio Way and Carter Drive. This project includes cleaning the sediment out of the existing pipe, assumes one day of cleaning is required.

Pipe ID	Length	Diameter	VANDA Rating	Improved Material	Project Type
Z5_LINK_0066	58	36”	n/a	n/a	Clean

E. Total Preliminary CIP Cost..... $5,000



A. Project ID: S15 | **B. Project Name: Rimer Dr Cleaning**

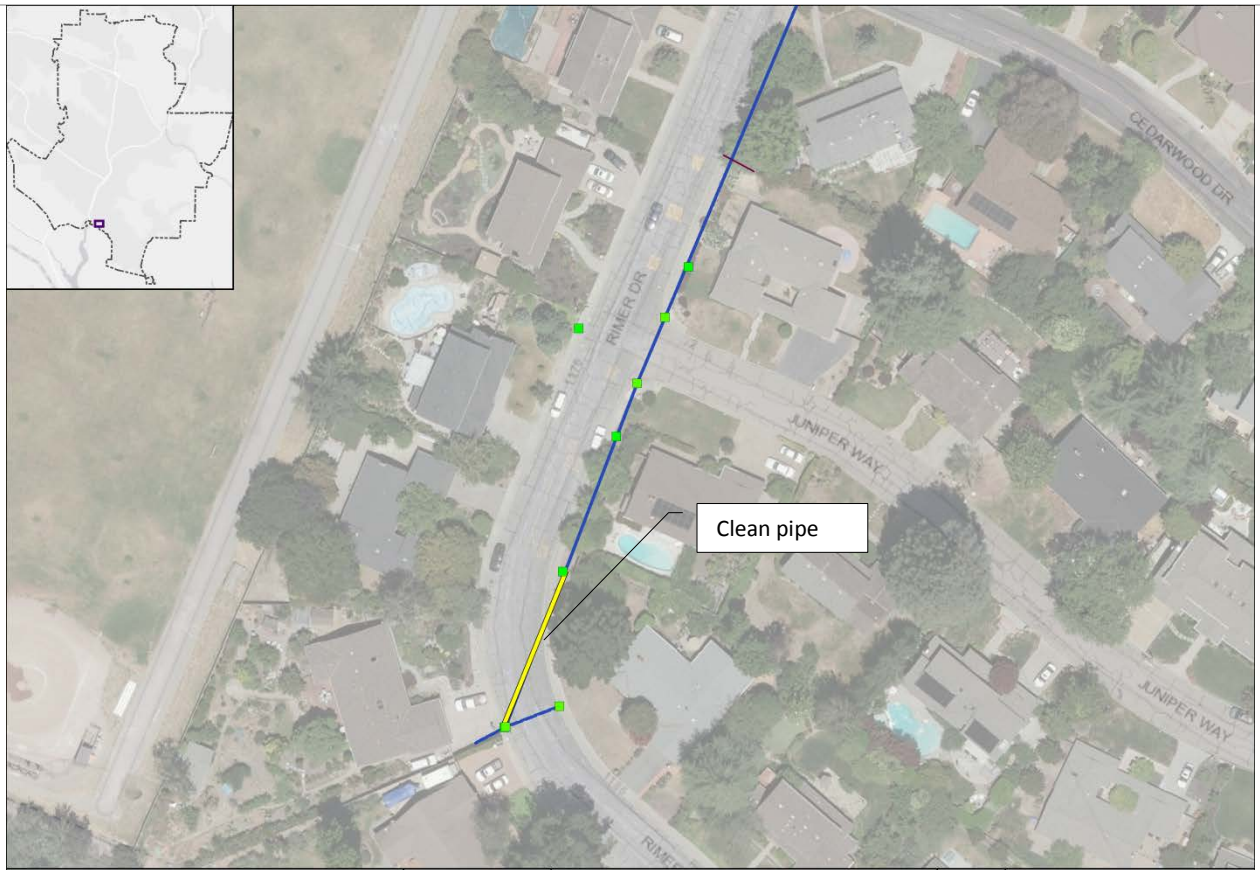
C. Project Location: On Rimer Drive south of Juniper Way

D. Priority: Moderate (Condition)

Project Description: Condition assessment conducted in 2014 showed the culvert under Rimer Drive partially blocked with sediment. This project includes cleaning the sediment out of the existing pipe, assumes one day of cleaning is required.

Pipe ID	Length	Diameter	VANDA Rating	Improved Material	Project Type
ZL-201907170730	106	18”	3	n/a	Clean

E. Total Preliminary CIP Cost..... $5,000



ATTACHMENT 2

Operations & Maintenance Program

FINAL Storm Drain Operations & Maintenance Plan

November 4, 2019

NCE

Richmond, CA
501 Canal Blvd., Suite I
Richmond, CA 94804

Town of Moraga

329 Rheem Boulevard
Moraga, CA 94556

Collaboration. Commitment. Confidence.SM

FINAL Storm Drain Operations & Maintenance Plan

Prepared for:

Town of Moraga
329 Rheem Boulevard
Moraga, CA 94556

Prepared by:

Dave Rios
Associate Scientist

Jason Drew
Principal

NCE
501 Canal Boulevard, Suite I
Richmond, CA 94804

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

AGOL	ArcGIS Online
BMP	Best Management Practice
CCTV	Closed Circuit Television
CIP	Capital Improvement Program
CMP	Corrugated Metal Pipe
FTE	Full Time Equivalent
GDB	Geodatabase
GIS	Geographic Information System
GPS	Global Positioning System
Hydrovac	Hydrovac Cleaning
LF	Linear Foot
O&M	Operations and Maintenance
RFQ	Request for Qualifications
Town	Town of Moraga

1.0 INTRODUCTION

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. The diagram below presents the cycle and relationship between the various elements of Storm Water Asset Management. For the Town of Moraga (Town) the storm drain Operations & Maintenance (O&M) Program is effectively the Town's Storm Water Asset Management Program. As the Town continues to implement enhancements to the Program, new information will be gathered through ongoing visual and Closed-Circuit Television (CCTV) inspections, annual and recurring maintenance and repairs, and the implementation of capital improvement program (CIP) projects. The components of the O&M Program will change overtime and this O&M Plan should be revisited and updated every few years to reflect the most current information.

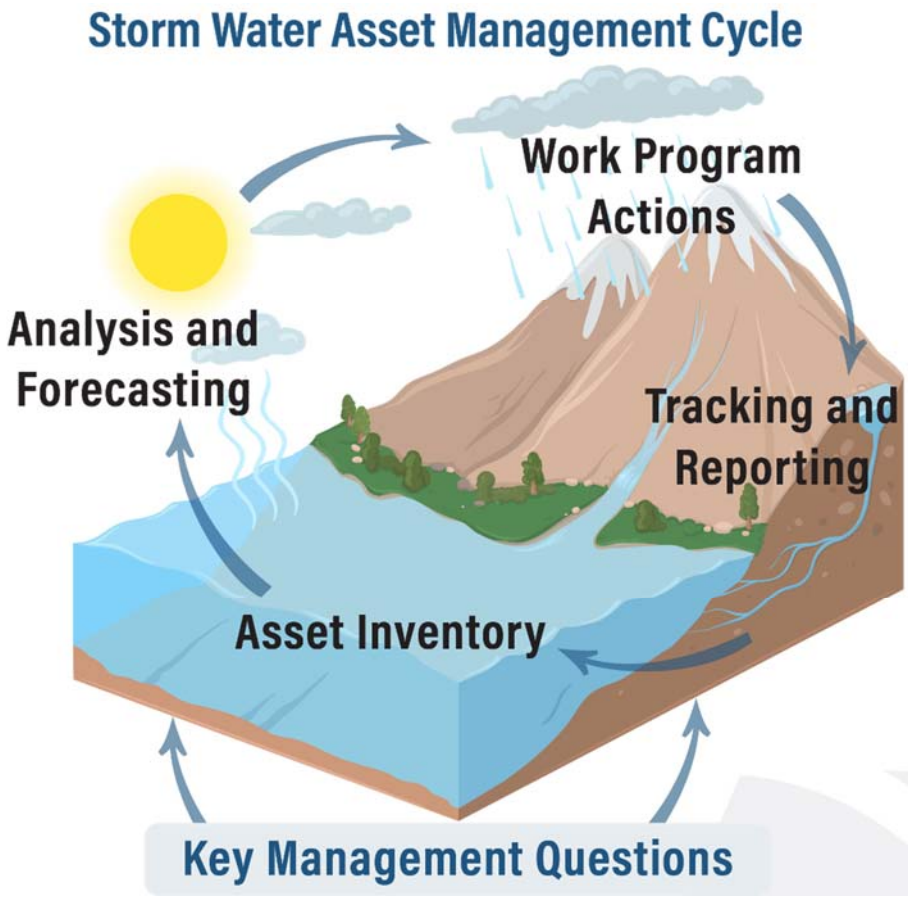


Figure 1. Storm Water Asset Management Cycle

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, dimensions, maintenance condition, invert elevations, etc.

Analysis and Forecasting – Defines the O&M Selection Criteria for inspections and maintenance and the Work Program Action approach for 2020 and beyond. In addition, cost estimates for the various elements of the O&M Program are presented.

Work Program Actions – Describes the primary components of the Work Program Actions including inspections (e.g., visual or CCTV inspections), maintenance (e.g., basic and routine maintenance), repairs or replacements, and capital improvements (primarily larger improvement projects). This section will describe the procedures, equipment, and methodologies for conducting the various Work Program Actions. Details regarding capital investments including repair, replacement, and capital projects are described within the 2019 Addendum to the Storm Drain Master Plan prepared by Schaaf & Wheeler (Schaaf & Wheeler 2019).

Tracking and Reporting – Describes the various elements of the web Geographic Information System (GIS) including the storm drain feature service, web maps, field application, and web applications.

Junction – Junctions or nodes are assets where stormwater enters the system or are access points for maintenance (e.g., inlet, catch basin, manhole, etc.).

Conveyance – Conveyances or links are linear assets that carry stormwater between junctions either above or below ground to a receiving water outfall or other portion of the storm drain system (e.g. curb and gutter, ditches, swales, pipe, etc.).

O&M Selection Criteria – The criteria used to identify storm drain assets that require inspection or maintenance.

Nuisance Assets (Recurring issues) – Nuisance assets are a node or link that 1) requires repeated maintenance by Town staff each year, 2) has a tendency to cause flooding or clog during storm events, or 3) located in an area in need of additional storm drain infrastructure or modifications to existing infrastructure in order to adequately collect and convey stormwater.

1.3 Key Management Questions

Each jurisdiction or municipality has a specific set of key management questions that establish priority areas, priority assets, how decisions are made, which assets are important, etc. The purpose of this document is to consider higher level key management questions in the context of jurisdiction-specific questions with the goal of documenting the resulting approach to the O&M Program. The list below presents a set of questions specific to the Town of Moraga. While this list is not intended to be exhaustive, the questions illustrate the site-specific storm drain concerns and challenges that have directly informed the Town's O&M Program.

1. What are the critical or priority (i.e., essential or important) storm drain assets within in the Town's system?
2. How often should assets be visually inspected?
3. How often and which assets should receive CCTV inspection?
4. How often should maintenance (e.g., basic or routine) be conducted on assets?
5. Which assets should be prioritized for spot repairs, replacement, or capital improvement?
6. What are the annual costs associated with visual and CCTV inspections, cleaning, and repairs, and replacement?
7. How are visual and CCTV inspections conducted?

8. What is the current process for tracking and reporting inspections, repairs, and replacement?

1.4 Roles and Responsibility

The Town's O&M Program is a collective effort and involves staff at the Town management, project, and technician level. Everyone identified below plays an important role in supporting the ongoing implementation of the O&M Program.

1.4.1 Management

The Town Manager and Town Engineer play an important role with the implementation of the O&M Program. The following lists the responsibilities of these two individuals:

- Guides the overall implementation of the program
- Seeks adequate staffing and funding to complete the various tasks for a successful O&M Program
- Supports Town staff with identifying and resolving issues if they arise
- Ensures the GIS Technician and maintenance staff have received sufficient training regarding web GIS workflows
- Work with the GIS Technician on reporting alternatives and constraints

1.4.2 Project Staff

During the planning, design, and construction of improvement projects, Engineering staff, with support from consultants as necessary, at the Project level will support the O&M Program by identifying issues or challenges as they come up on projects. It is critical that any changes to existing assets or new assets are reflected in the asset inventory. These issues or challenges may include any of the following:

- Identify maintenance or asset inventory issues or concerns
- Provide direction and support to Maintenance staff for inspection, maintenance and repair of storm drain assets
- Share observations with the GIS Technician or Management as they relate to field verification, asset inventory inaccuracies, or other relevant information

1.4.3 GIS Technician

The GIS Technician's role is focused on the maintenance, accuracy, completeness, and function of the web GIS and storm drain asset inventory. This individual must actively manage and coordinate incoming and outgoing information and become familiar with and improve the various components of the web GIS.

- Maintain the web GIS including updating web maps and apps as necessary
- Back up the storm drain feature service periodically (export to file GDB and download to local server)

- Train field staff to use the Collector mobile application including updating existing storm drain GIS assets, adding new storm drain GIS assets, and adding inspection records
- Conduct quality control of spatial and attribute asset inventory data
- Maintain the O&M Program workflow including backfilling Work Program Action information into the related inspection tables (i.e., "closing" inspection records once identified issues have been resolved)
- Update the O&M Program GIS with new hydrovac and CCTV inspection results
- Produce reports as requested by Management

1.4.4 Maintenance Staff

The Town maintenance staff play a critical role in the implementing the O&M Program. This team has the most intimate knowledge of the storm drain assets, the condition of the assets, and what is needed to ensure the storm drain infrastructure continues to function as designed and constructed. Town maintenance staff will be responsible for the following:

- Update storm drain spatial and attribute information via Collector mobile application (e.g., field verification of legacy data not collected during NCE's data collection project)
- Conduct visual and CCTV inspection, basic cleaning, and oversee hydrovac and repair of storm drain assets
- "Open" storm drain inspection records via Collector mobile application
- Follow up with the GIS Technician, Project staff, and/or Management to discuss issues identified in the field
- Alerting the GIS Technician with any issues pertaining to the Collector mobile application process including recording inspections, documenting maintenance, etc.

2.0 ASSET INVENTORY

The foundation of Storm Water Asset Management is the Asset Inventory. The Town's asset inventory includes detailed information about the storm drain system including the critical spatial and attribute information. The components of Storm Water Asset Management rely on a complete and accurate asset inventory and below is a summary of the recently completed asset inventory or field data collection project and summary statistics as of Fall 2019.

2.1 Asset Inventory Project

In July and August of 2019, NCE completed an asset inventory or field data collection project in order to assist the Town with developing a more comprehensive, complete, and accurate GIS storm drain network. The GIS storm drain network is necessary to fully assess the Town's storm drain system for maintenance and capital investment. Details of the asset inventory project are documented in the Town of Moraga Storm Drain Mapping – Project Development Plan (NCE 2019).

Prior to the field effort, NCE worked with the Town to document data needs and to review the Town's existing data model and existing storm drain GIS. From this effort, a set of priority storm drain assets to be collected were established within a newly designed geodatabase (GDB). These assets included: catch basins, manholes, open pipes, culverts, ditches, pipes, and v-ditches. Storm drain assets were separated into two GIS feature classes, Junctions and Conveyances. Junctions include catch basins, manholes, and open pipes and are noted as the "node" feature class in the GDB. Conveyances include culverts, ditches, pipes, and v-ditches and are noted as the "link" feature class in the GDB.

The field data collection was completed over the course of five weeks beginning on June 17, 2019 and finishing on July 25, 2019. Field data collection was conducted by three teams, each consisting of two technicians. NCE partnered with three of the Town's Engineering Interns to execute the data collection work. One of the teams was tasked with collecting spatial information for the node assets (catch basins, manholes, open pipes) using a mapping grade Global Positioning System (GPS) unit while the other two teams collected attribute data (basin depth, pipe diameter, etc.). Once the spatial team had completed spatial data collection for the project area, they shifted to assist with the collection of attribute data.

Field teams were able to collect spatial and attribute data for publicly accessible storm drain assets within the publicly owned parcels, the right-of-way or easements within Town's boundary. Storm drain assets located on private property such as back-yards of private homes or in inaccessible locations were not collected. Given the constrained project schedule, NCE had originally proposed a targeted approach focused on collecting data for assets associated only with large diameter pipes (greater than 15-inch diameter). This would have resulted in gaps in the GDB but ensured that the most critical elements would be collected. Due to an efficient process and focused effort, field crews were able to collect more data than originally anticipated. These data included almost all assets, regardless of pipe size, within the Town's right-of-way and in some cases assets within private communities located within the Town's boundary. These data will provide extra context for the system and will be useful for modeling and assessing the relative contributions of private runoff to the system.

During the field data collection, node spatial information was collected and saved as point assets. Links were collected as point assets associated with a node and then later converted into conveyance assets during data processing. In cases where a pipe crossed between maintenance zones, the "Maintenance Zone" field for the link asset was populated from the upstream point of the link. Link assets that did not have both an upstream and a downstream

point (i.e., pipes that flow onto private property behind houses) were displayed in the final GDB as "stubs" with a flow direction identified, but without connection to either an upstream or downstream node.

The final GDB completed during this project represents a greatly improved storm drain network for the Town's right-of-way and includes data for some assets on private property. Data gaps are associated with assets that were inaccessible or within private property where data collection teams could not gain access. Recommendations for future data collection to fill these data gaps are provided below.

The Town will be provided a large format storm drain system map (**Appendix A**) that can be printed out and used as a reference by Town staff when discussing the details of the storm drain system. The storm drain system links and nodes are presented on separate maps to more clearly present asset labels. Assets are labeled using an index instead of the longer unique ID. Two tables are provided in **Appendix A** that present the node or link index along with the corresponding unique id.

2.2 Storm Drain GIS Data Gaps

The storm drain asset inventory is the foundation of the O&M Program and will form the basis for future storm drain mapping, modeling, and the ongoing implementation of the O&M Program. However, future data collection and field verification is necessary in order to maintain the storm drain asset inventory. The Town is urged to focus on parts of the system that were inaccessible during NCE's asset inventory such as outfalls behind houses on private property or inlets that had trash capture devices blocking the visibility of connected pipes. The following list summarizes the existing data gaps and will provide the Town a starting point for ongoing storm drain GIS maintenance:

Private Property – During the July field data collection project, private property access was the main challenge that impeded complete data collection. Uncollected data was generally associated with inaccessible assets such as outfalls and pipelines behind homes that flowed through private property.

V-Ditches – The expansive network of v-ditches that crisscross the hillsides within and surrounding the Town boundaries were not collected. V-Ditches were collected as stubs where they intersected with the storm drain system along the accessible rights-of-way, but due to data collection process limitations and access issues, the v-ditches surrounding the Town were not mapped in their entirety.

Trash Capture Devices/ Construction Best Management Practices– In catch basins with trash capture devices or construction settlement and erosion control measures (Best Management Practices), pipeline connectivity was generally not visible limiting field crews' ability to determine system connectivity and making collection of pipe attribute data impossible.

Moraga Way Manholes – An active paving project was ongoing along Moraga Way during the field data collection project. As part of the paving project, manholes were removed and or covered with asphalt eliminating the potential for data collection. Less than five manholes were affected by this construction and data should be collected once the project is complete.

Nodes Without Pipes – One hundred eighty-two (182) nodes do not have pipe data associated with them. Details on these assets are available within the Project Development Plan (NCE 2019). These assets lack pipe connectivity for the following reasons:

1. Access Issue: Some assets were inaccessible due to impediments such as vegetation or vehicles blocking access or visibility to the pipeline associated with the facility. These assets should be revisited by the Town once vegetation is cleared, vehicles are no longer obstructing the assets, or when maintenance crews have addressed sealed lids or grates. Access issues accounted for approximately 18% of the nodes without pipes in the dataset.

2. Non-System: These assets are on private property and are not part of the Town's publicly maintained storm drain system. These assets can be collected if the Town decides these assets are important. Non-system assets accounted for approximately 62% of the nodes without pipes in the dataset.

3. Open Pipe Outlet to Curb Gutter: These assets represent the outlet points of hill slope v-ditches. They convey flows collected from behind residential areas into the Town's system of curb and gutter. Data collection can be targeted if the extensive hillside v-ditch network is deemed important by the town. Open pipe outlets to curb gutter accounted for approximately 20% of the nodes without pipes in the dataset.

2.3 Summary Statistics

Two summary tables are presented below that provide the count and length of the various storm drain feature types within the asset inventory. **Table 1** presents the summary statistics for the entire asset inventory. There is a total of 1,630 junctions (nodes) and 1,731 conveyances (links) with approximately 29 miles of storm drain pipes and culverts. **Figure 2** below presents the public and private storm drain system map.

Table 1. Public and Private Asset Inventory Summary Statistics

Storm Drain Feature Type	Count	Length (linear feet)	Length (miles)
Catch Basin (Node)	1,215	-	-
Manhole (Node)	170	-	-
Open Pipe (Node)	245	-	-
Culvert (Link)	46 (5 stubs*)	4,175	0.79
Ditch (Link)	23 (3 stubs)	22,143	4.19
Pipe (Link)	1,581 (512 stubs)	151,192	28.58
V-Ditch (Link)	81 (69 stubs)	6,461	1.22

* Stubs represent conveyance segments in the network where upstream or downstream junctions could not be collected due to inaccessibility or location on private property.

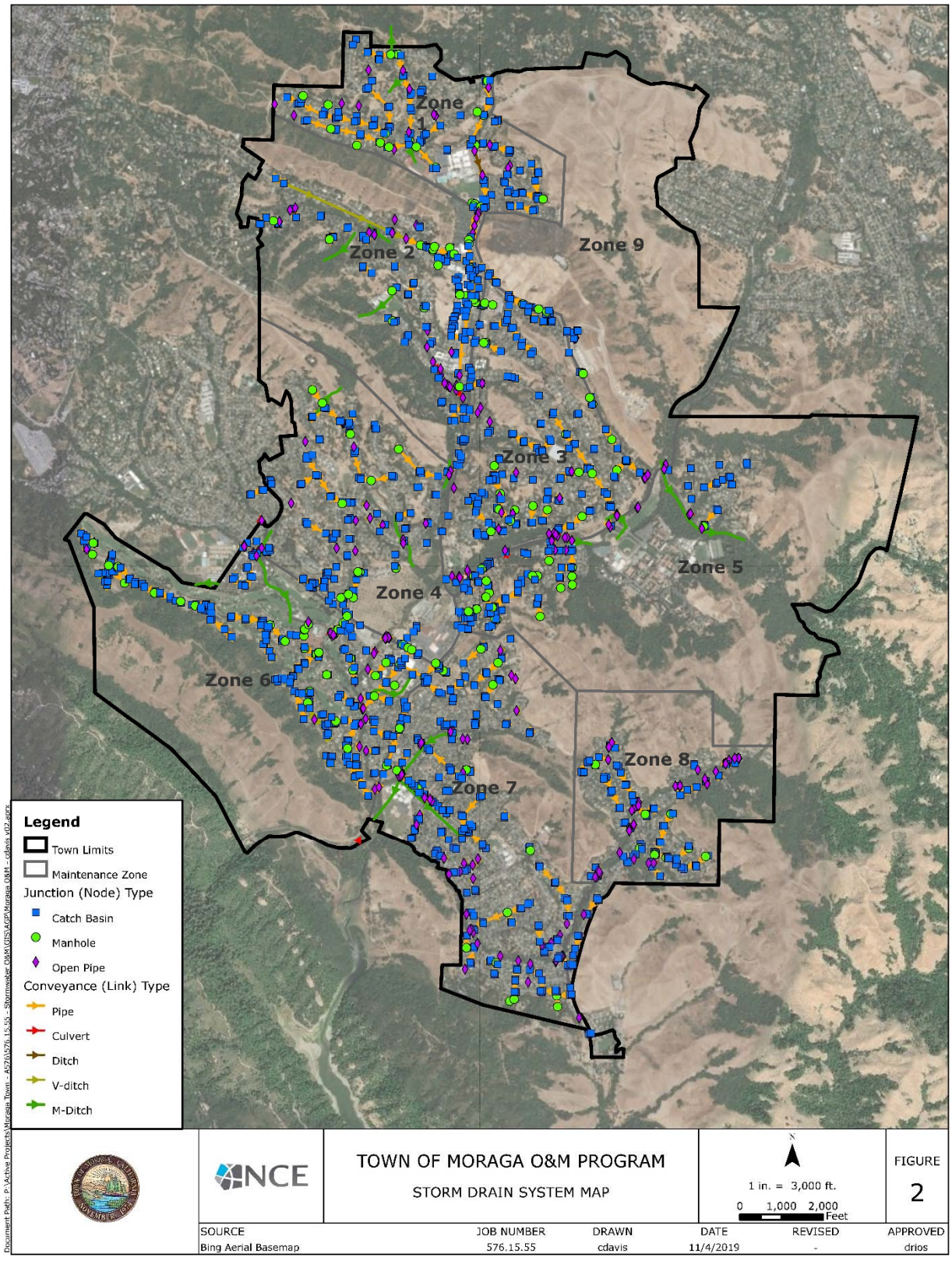


Figure 2: Storm Drain System Map

The public only asset inventory summary statistics are presented in **Table 2** below. These assets represent the storm drain assets that the Town is responsible for maintaining. There is a total of 974 junctions (nodes) and 1,161 conveyances (links) with approximately 21 miles of storm drain pipes and culverts. **Figure 3** below presents the public storm drain system map.

Table 2. Public-Only Asset Inventory Summary Statistics

Storm Drain Feature Type	Count	Length (linear feet)	Length (miles)
Catch Basin (Node)	754	-	-
Manhole (Node)	106	-	-
Open Pipe (Node)	114	-	-
Culvert (Link)	23 (3 stubs*)	220	0.42
Ditch (Link)	17 (2 stubs)	18,844	3.56
Pipe (Link)	1,092 (339 stubs)	110,230	20.83
V-Ditch (Link)	29 (27 stubs	3,677	0.70

* Stubs represent conveyance segments in the network where upstream or downstream junctions could not be collected due to inaccessibility or location on private property.

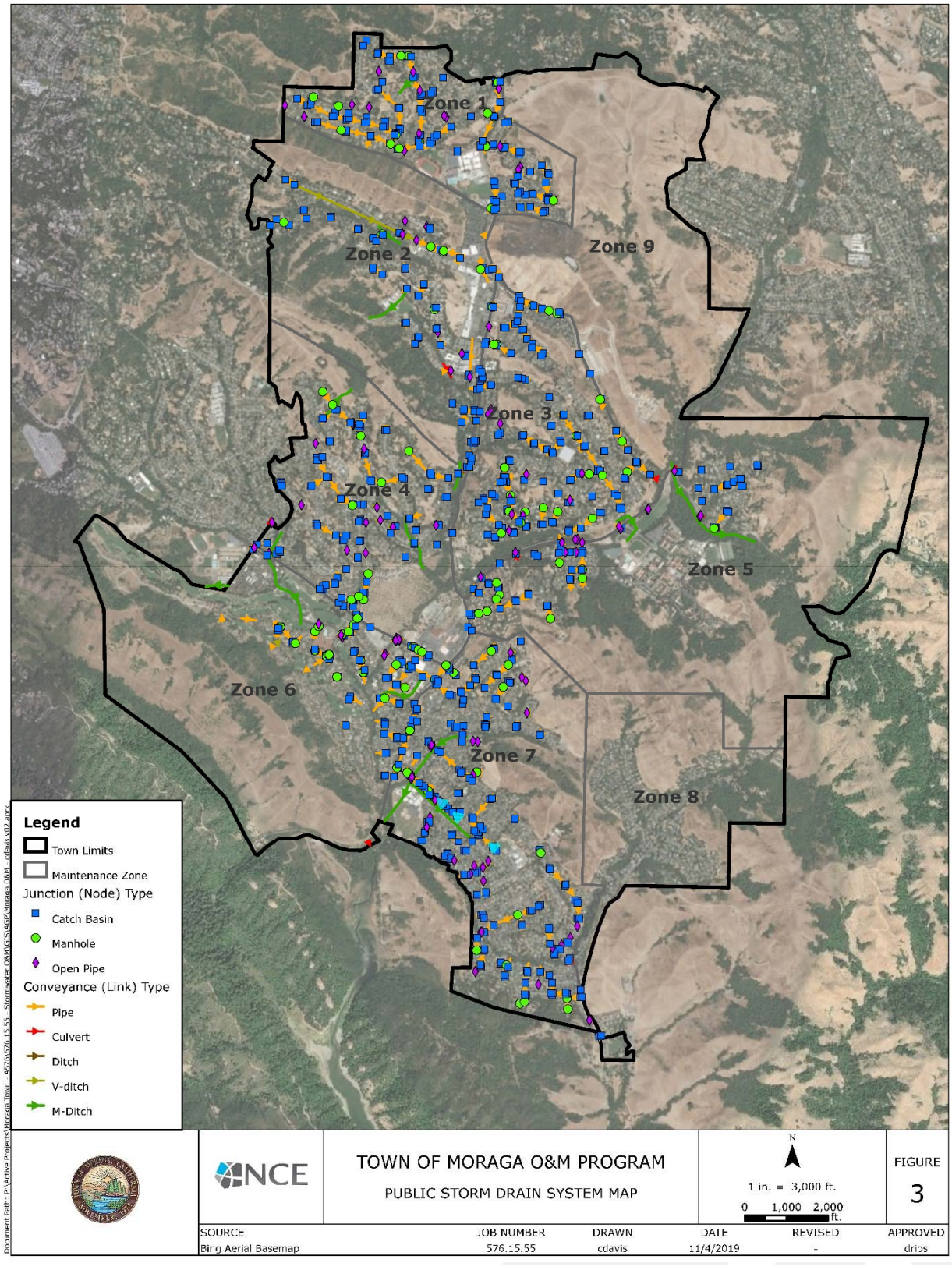


Figure 3: Public Storm Drain System Map

3.0 ANALYSIS AND FORECASTING

3.1 Introduction

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. As a result, the Analysis and Forecasting Section of the O&M Plan assists the Town with determining which storm drain assets require a Work Program Action in any given year. The O&M Selection Criteria is a list of factors that will allow the Town to develop annual lists of assets requiring a Work Program Action. For inspections, due to the relatively small size of the Town's system and the need to inspect a majority of the system each year, lists are only generated for CCTV inspections and hydrovac maintenance (routine maintenance).

Below we describe in more detail the O&M Selection Criteria for inspections (visual and CCTV inspections) and maintenance (hydrovac) for 2020 and beyond, present the 2020 storm drain assets that will require CCTV inspections and maintenance (hydrovac), and present costs estimates for implementing the inspections and maintenance for the O&M Program. Estimates for repairs (spot repairs, replacement, or capital improvement projects) will be discussed further within the 2019 Addendum to the Storm Drain Master Plan (Schaaf & Wheeler 2019).

3.2 O&M Selection Criteria

O&M Selection Criteria is presented in the **Table 3** below. This information guides which assets require inspections or maintenance.

Table 3. O&M Program Selection Criteria

Selection Criteria	Inspection		Maintenance	
	Visual Inspection	CCTV Inspection	Town Cleaning (Basic Maintenance)	Vactor (Routine Maintenance)
Public assets	X	X	X	X
Material		X		
2015 VANDA		X		
PACP Score		X		
Maintenance Condition	X	X	X	X
Flat slopes (<3%)				X
Time since last inspection	X	X		
Nuisance assets	X	X	X	X
Confirmed field condition		X	X	X
Catch basins	X			
M-ditches*	X			

* Moraga maintained ditches

3.3 Inspections Selection Criteria

3.3.1 Visual Inspections

Visual inspections of the Town's storm drain assets are currently conducted by Town maintenance staff and focused on catch basins, M-ditches (Town of Moraga maintained ditches), and nuisance assets. The visual inspections are limited to publicly maintained storm drain assets. Visual inspections for assets located on the surface or below ground at private properties are not included as part of the annual inspection program.

The Town conducts a minimum of one (1) visual inspection annually during the fall months prior to the onset of the rainy season. The visual inspections are generally accomplished over the course of a two-week period and require two (2) Town maintenance staff. During major storm events, all five (5) Town maintenance staff complete visual inspections throughout the Town and clean catch basins, M-ditches and other assets as needed. There are approximately 15 to 20 days annually of major storm event inspections. It is recommended that new storm drain assets be inspected within the first year following construction and during major storm events to confirm that the assets are functioning as designed.

In addition to the annual and storm event visual inspections, emergency inspections are completed by Town maintenance staff when drainage-related issues are discovered by either the public or Town maintenance staff. These emergency inspections require activities beyond

the typical visual inspection including removal of catch basin grates, clearing of debris, making observations of pipe conditions, or possibly conducting minor repairs to storm drain infrastructure at the time of inspection. Maintenance staff currently spend approximately 80 hours annually with support from engineering staff and consultants.

Annual inspections of all catch basins, M-ditches, and nuisance assets should be the goal each year moving forward. The exception would be when storm drain assets are at or nearing their design life, more frequent inspections may be necessary.

The enhanced O&M Program will require additional maintenance staff time, above and beyond the existing effort and these estimates are presented in **Section 3.7** below.

The selection criteria for visual inspections is presented below:

- Located within the public right-of-way or within accepted easements
- Node type is catch basin
- Asset is an M-ditch
- Nuisance assets

3.3.2 CCTV Inspections

The Town currently has a limited CCTV inspection program which includes up to 500 LF of CCTV inspections associated with emergency projects, Town-identified problem assets, or other reactive CCTV needs. An essential element of the enhanced O&M program is the addition of CCTV inspections to provide the Town with an understanding of the condition of the storm drain system. These inspections need not be conducted on every storm drain asset within the Town. Instead, the CCTV inspections should focus on the assets that could prove to be most problematic. The criteria for selecting assets for CCTV inspection will be discussed in more detail below.

The Enhanced O&M Program will involve the Town contracting with vendor(s) to perform complete condition assessments for up to 5,000 linear feet (LF) of storm drain pipe each year which is approximately $2.50/LF totaling $12,500 annually and an additional 80 hours of maintenance staff time. Depending on system conditions and observations, the Town will continue to televise storm drain assets at a rate of up to 5,000 LF/year for up to 10 years, or as long as resources are available. If CCTV inspections are reduced or ceased, Town staff will reevaluate the need for future CCTV inspections. The list of storm drain assets to receive a CCTV inspection for 2020 is included in **Appendix B**.

Many link records are stubs with a length of “20.00”; however, these are not actual lengths but instead represent a placeholder for future field verification based on the results of the asset inventory project. As a result, Town staff will need to field verify storm drain pipe assets with a length of “20.00”, confirm connectivity, update the GIS, and implement the CCTV inspections accordingly.

To estimate the total length of the 2020 list, we need to estimate lengths for the records with a length of “20.00” LF. Based on the available data, the list presented in **Appendix B** includes 48 records with an unknown length. The average of the known length is 95 LF. Summing the known lengths with the estimated lengths (known average length * count of unknown length)

results in an estimated total length of storm drain pipe to receive a CCTV inspection to be 8,836 LF.

The Town's pavement resurfacing program funds additional CCTV inspections on candidate streets planned for an overlay or reconstruction to ensure newly paved roads are not cut into if the underlying storm drain pipes need repair. Minor storm drain repairs are included as part of the paving projects.

If a storm drain pipe has been CCTV'd and no structural defects exist, the Town may opt to perform a follow-up inspection at least once every 10 years. It is recommended that if a storm drain pipe contains identified defects, the Town should increase the CCTV inspection frequency up one time per year or repair if defects are significant.

The selection criteria for assets requiring a CCTV inspection in 2020 is presented below:

- Located within the public right-of-way or within accepted easements
- 2015 VANDA score of 4 or 5
- Pipe material is corrugated metal pipe (CMP)

If an asset has been included in a CCTV inspection within the past three years, it is ineligible for inclusion in the 2020 inspection unless field conditions suggest a CCTV inspection is necessary or if there is a known identified defect. The criteria for selection of assets for CCTV inspection beyond 2020 will include the following:

- Located within the public right-of-way or within accepted easements
- Remaining assets not televised from the 2020 list
- Known or suspected structural or poor conditions as identified from visual inspections or other observations
- Last CCTV inspection is 10 years or older
- Assets requiring frequent cleaning
- Assets that have surpassed or are within 85% of their expected service life

Estimating the service life of storm drain pipes is not straight forward and is influenced by a variety of factors. With regard to pipe material, plastic pipes such as PVC or HDPE may outlast steel or concrete storm drain pipe; however, storm drain pipe service life depends on in-situ soil conditions, resistivity, abrasion, flow velocities, bedload, etc. Therefore, it is difficult to estimate expected service life for storm drain pipes within an entire storm drain system. The Town should rely on visual observations and CCTV inspection history to determine whether a storm drain pipe should be televised, repaired, or replaced.

3.4 Maintenance Selection Criteria

Maintenance for the Town includes basic maintenance (Town maintenance) or routine maintenance (hydrovac cleaning) and below we describe in more detail the selection criteria for maintenance.

3.4.1 Basic Maintenance

It is anticipated that during visual inspections, the Town may be able to efficiently maintain storm drain assets. As a result, Town staff may choose to clear debris or sediment from curb and gutter flow lines, tops of grates, or within other accessible portions of the storm drain system. These activities are categorized as basic maintenance. Given the Town currently has limited staff and equipment, basic maintenance will be completed at the discretion of the maintenance staff.

Storm drain assets that will require basic maintenance will meet the following criteria:

- Located within the public right-of-way or within accepted easements
- In-situ maintenance condition is fair or poor
- Asset can be efficiently maintained by Town staff using shovel, buckets, or other basic equipment

3.4.2 Routine Maintenance (Hydrovac Cleaning)

Routine maintenance or hydrovac cleaning allows the storm drain system to perform as designed and constructed. Storm drain assets that cannot be efficiently maintained by Town staff through basic maintenance may be identified for routine maintenance. The Town will plan to hire a vendor to conduct hydrovac cleaning for up to approximately five (5) days each year. This approach to routine maintenance is based on past practices, the current list of storm drain assets to be cleaned, and a reasonable rate of hydrovac cleaning given the Town's limited resources.

The Town will develop a list of storm drain assets that require cleaning based on a set of criteria. The assets to be included in the 2020 Hydrovac services should meet the following criteria:

- Located within the public right-of-way or within accepted easements
- Demonstrated poor maintenance condition in July 2019
- Visible inspection by the Town staff confirm the need for Hydrovac services
- Clogged or partially clogged pipes requiring CCTV inspection

The criteria for selection of assets for Hydrovac services beyond 2020 will include the following:

- Located within the public right-of-way or within accepted easements
- Low slope pipes (<3%) (prioritizing the flattest slopes)
- Demonstrated poor maintenance condition
- Clogged or partially clogged pipes requiring CCTV inspection

The enhanced O&M program assumes five (5) days of hydrovac services at a cost of $2,850/day totaling $14,250 and an additional 80 hours of maintenance staff time. Additional hydrovac services may be required in support of CCTV inspections. This effort would be above and beyond

the proposed five (5) days each year. The list of storm drain assets to receive hydrovac cleaning for 2020 is included in **Appendix C**.

3.5 Repairs Selection Criteria

The Town has limited staff and equipment to dedicate toward completing repairs to the storm drain infrastructure. Based on conversations with Town staff, there are two types of repair projects that the Town must address including spot repairs/replacements and CIP projects. While there is no clear definition that can be applied to differentiate spot repairs from capital improvement projects, typically, the cost and magnitude of repair as well as risk will determine whether a project is categorized as a spot repair/replacement or a CIP.

For the purposes of this document, spot repair/replacement projects include any improvements to the existing storm drain infrastructure that are not identified as CIP projects in the 2019 Addendum to the Storm Drain Master Plan (Schaaf & Wheeler 2019). Moving forward, the Town will need to determine how spot repair/replacement projects vs. CIP projects are identified, tracked, and funded.

3.5.1 Spot Repairs/Replacement Projects Selection Criteria

Spot repairs or replacement include minor improvement projects to the storm drain infrastructure. On past projects, the Town has completed storm drain pipe lining, patching, grouting, manhole rehabilitation, or similar activities. Given that the Town has limited staff and equipment to address spot repair/replacement projects, the Town will typically hire a drainage contractor to complete these projects.

The Town desires an annual estimate of how much to spend on repair projects moving forward to properly maintain the storm drain system. While these cost estimates are likely to change as the Town implements the O&M Program, the following estimates provide a starting point for estimating spot repair costs.

In order to arrive at reasonable estimates, the Town relied on past repair project costs including pavement rehabilitation projects that involved televising underlying storm drain pipes and the percentage of those televised pipes that needed repair. Cost estimates were calculated based on these assumptions and the estimated 5,000 LF of pipe to be televised each year. The Town provided the underlying assumptions that were used to generate repair cost estimates for both proactive and reactive projects. Proactive spot repairs are discovered by CCTV inspections while reactive spot repairs are unplanned and discovered through sinkholes, drainage issues, and flooding, etc.

- Proactive spot repairs
    - Past pavement rehabilitation projects resulted in approximately 7.5% of televised storm drain pipe needing a proactive repair.
    - The unit cost for each repair was calculated to be $310/LF, based on actual costs of past proactive repair projects.
    - Considering 5,000 LF of storm drain pipe will be televised each year beginning in 2020, an estimated 7.5% will need to be repaired at $310/LF totaling $115,000 for 2020. Engineering, construction management, and inspection will be handled by engineering and maintenance staff (included in Vendor Administration and Overall O&M Program Administration Enhanced Staff estimates).

- Reactive spot repairs
    - The recommended reactive repair project budget, based on actuals from the past few years, is $116,000. Engineering, construction management, and inspection has been handled by existing engineering and maintenance staff and no additional staffing budget is recommended.

3.6 Capital Improvement Projects Selection Criteria

Capital Improvement Project details are discussed within the 2019 Addendum to the Storm Drain Master Plan (Schaaf & Wheeler 2019).

3.7 O&M Program Inspection, Maintenance, and Labor Cost Estimates

The following O&M Program cost estimates were developed based on conversations and input from Town staff, decisions made during the O&M Program discussion held on October 16, 2019 between NCE, Town of Moraga, and Schaaf & Wheeler, as well as NCE's professional judgement.

Table 4 and **Table 5** below presents the existing O&M Program labor estimates and enhanced 2020 O&M Program labor estimates, respectively. The enhanced O&M Program labor estimates are in addition to the existing O&M Program labor estimates.

For the purposes of estimating labor, NCE has divided the O&M Program into three components including inspections, maintenance, and administrative/technical support. Footnotes are included below the table to clarify calculations and the source of information.

Table 4: Existing O&M Program Labor Estimates

O&M Component		Existing Staff[1]					
		# Staff	# Weeks	# Weeks per Year	Total Hours	FTE[2]	Total FTE / Year
Inspections	Visual Inspections	2	2	4	160	0.08	0.5
	Storm Event Inspections	5	3	15	600	0.3	
	Emergency Inspections	1	2	2	80	0.04	
Maintenance	M-Ditch Maintenance	2	1	2	80	0.04	
Administration and Tech Support	Vendor Administration	1	2	2	80	0.04	
	Overall O&M Program Administration	-	-	-	-	0.44	0.84
	Clean Water Admin	-	-	-	-	0.4	

[1]Existing estimates based on input from maintenance staff
[2]1 FTE = 2080 hours

Table 5: 2020 Enhanced O&M Program Labor Estimates

O&M Component		Enhanced Staff					
		# Staff	# Weeks	# Weeks per Year	Total Hours	FTE	Total FTE/Year
Inspections	Visual Inspections	2	2	4	160	0.08	0.41
	Emergency Inspections	-	-	-	-	-	
	CCTV Inspections	2	1	2	80	0.04	
Maintenance	Vactor cleaning[1]	2	1	2	80	0.04	
Administration and Tech Support	Vendor Administration	2	2	4	160	0.08	
	Overall O&M Program Administration	-	-	-	-	0.4[2]	0.64
	GIS Technician	-	-	-	-	0.24[3]	

[1]Assumes the Town has a facility for storing vactor debris
[2]Includes 0.2 Associate Engineer position included in FY 2019/20 budget
[3]Shared Lamorinda GIS Tech position

Table 6 below presents the proposed 2020 Enhanced O&M Program cost estimates. Unit costs are based on up to date estimates from vendors providing these services to the Town of Moraga or other jurisdictions in the Bay Area. The proposed quantities are based on decisions made during the October 16, 2019 O&M Program meeting.

The external O&M technical support line item reflects the potential need for the Town to hire a consultant to support advanced GIS data processing, data collection, or ongoing GIS maintenance. This line item may also be used in support of other O&M Program tasks if the Town requires external support.

Table 6: 2020 Enhanced O&M Program Cost Estimates

O&M Component	2020 Cost Estimate				
	Quantity	Unit Cost	Quantity (days)	Unit Cost ($/day)	Estimated Costs
Maintenance Staff	852.8	$64.10	-	-	$ 54,667
CCTV Inspections[1]	5,000	$2.50	-	-	$ 12,500
Vactor Cleaning[2]	-	-	5	$2,850	$ 14,250
Reactive Repairs					$ 116,000
Proactive Repairs		-	-	-	$ 115,000
Overall O&M Program Administration	832	$72.32	-	-	$ 60,170
Internal O&M GIS Technician	499.2	$55.00	-	-	$ 27,456
External O&M Technical Support	-	-	-	-	$ 20,000
Totals					$ 420,043

[1]Does not include the $13,000 budgeted for CCTV inspections associated with the 2020 Moraga Road Rehabilitation Program
[2]Assumes the Town has a facility for reviewing vactor debris
[3]Technical support may include advanced GIS data processing, data collection, or GIS maintenance

4.0 WORK PROGRAM ACTIONS

4.1 Introduction

Work Program Actions include inspections, maintenance, and repair/replacement. This section includes a description of the different types of Work Program Actions and references standard operating procedures or inspection and maintenance tables, where appropriate. For more detail on the proposed CIP, please refer to the 2019 Addendum to the Storm Drain Master Plan (Schaaf & Wheeler 2019).

4.2 Standard Operating Procedures

The following section addresses the standard operating procedures for the various Work Program Actions. Reference will be made to the O&M Inspection and Maintenance Tables which presents a summary of the Work Program Actions including the type, frequency, description, and documentation necessary for the various storm drain assets that require inspection or maintenance (**Appendix D**).

4.2.1 Inspections

The following information provides general guidance regarding site inspection and maintenance activities for all publicly maintained storm drain assets. The purpose of the inspections is to 1) document the condition of the storm drain assets and 2) identify any follow up Work Program Actions such as a CCTV inspection or maintenance.

4.2.2 Visual Inspections

Visual inspections will be performed at the frequency and locations described in **Section 2**. Visual inspections will be performed via a “windshield survey” during which maintenance staff will drive by all publicly maintained catch basins, M-ditches or nuisance assets. The time spent at each asset will be based on observations made during the “windshield survey”. In some cases, maintenance staff will drive near an asset, visually inspect the condition, and move on. In other instances, if basic maintenance can be performed including sediment or debris removal, maintenance staff will safely park the vehicle and address the maintenance concern. Finally, if visual observations indicate a public safety concern (flooding, damaged infrastructure, etc.), extensive debris or sediment, or any other notable observation, the maintenance crew may opt to safely park the vehicle and exit the vehicle to examine and document the issue and any required routine maintenance.

Standard equipment will be used to facilitate visual inspections. Any removed sediments and debris should be disposed of responsibly and in a manner so that it cannot re-enter the storm drain system. Removal of sediments and debris does not require documentation.

Documentation during a visual inspection may include 1) the need for follow up routine maintenance (hydrovac cleaning), 2) the need for a follow up CCTV inspection, or 3) the need for a repair or replacement. These observations will be documented using ArcGIS Collector field application on a tablet or phone.

Town maintenance staff are encouraged to document any significant drainage or maintenance issues, public safety or environmental concern, or any structural defects to the catch basin frame, grate, or inlet. Standing water may be an indicator of a clogged pipe requiring maintenance. The condition of the storm drain pipes and laterals will also be noted. Any of these structural concerns should be noted in ArcGIS Collector.

A visual inspection of an M-ditch will note accumulation of sediment or debris in the flow line or locations of damage to the structure itself. Upon approaching an M-ditch, if localized conditions exhibit excess sediment or debris and limited effort is required to remove the sediments and debris then removal shall be performed. Otherwise, if follow up hydrovac cleaning is recommended, this finding will be documented using the ArcGIS Collector field application on the tablet or phone.

The preferred time to remove excess sediments and/or accumulated debris is when the M-ditch is dry. The M-ditch embankments should be visibly inspected for erosion (gullies, sloughing of the banks), disturbances to the banks, differential settlement, and scour and documented using the ArcGIS Collector application on the tablet or phone, as needed.

4.2.3 CCTV Inspections

CCTV inspections provide information on the condition of the Town's storm drain pipes and culverts through application of a self-propelled camera to capture precise photos and video of storm drain pipes. Depending on the Town's needs, the cameras are capable of zooming, panning, and tilting while traversing longitudinally through the pipes in order to focus on specific pipe defects such including cracking, disfiguring, or corrosion. Defect ratings are assigned to pipe segments following the Pipeline Assessment Certification Program developed by the National Association of Sewer Service Companies. CCTV inspection reports or condition assessment reports may include recommendations for an appropriate level of maintenance or rehabilitation required for each pipe segment.

The approach for completing the CCTV inspection is for maintenance staff to document the need for a CCTV inspection in the field using the ArcGIS Collector field application.

The Town will develop a list of prequalified vendors through a Request for Qualifications (RFQ) or similar process. Annually, when the list of storm drain assets to receive a CCTV Inspection is developed, the Town will engage with prequalified vendors where a competitive bid process will result in the Town selecting a vendor and scheduling the CCTV inspections.

The Town will negotiate the specific scope of services, which may include a combined hydrovac and CCTV inspection, depending on the Town's needs. In addition, seasonal unit costs ($/linear foot or $/day) will be negotiated with the selected vendor(s) to establish the best rate for CCTV inspections or hydrovac cleaning.

4.2.4 Hydrovac Cleaning (Routine Maintenance)

Hydrovac cleaning or routine maintenance of the Town's storm drain assets with a focus on catch basins, manholes, pipes and culverts will be performed to remove accumulated sediments and debris. The sediments and debris will be removed by Town hired vendor using a Hydrovac truck and specially trained crew. Hydrovac cleaning involves a hydrovac truck that vacuums the debris through a large tube into the truck.

The Town will develop a list of prequalified vendors through a Request for Qualifications (RFQ) or similar process. Annually, when the list of storm drain assets to be cleaned using a vendor is developed, the Town will engage with prequalified vendors where a competitive bid process will result in the Town selecting a vendor and scheduling the hydrovac cleaning.

The Town will negotiate the specific scope of services, which may include a combined hydrovac and CCTV inspection, depending on the Town's needs. In addition, seasonal unit costs ($/linear

foot or $/day) will be negotiated with the selected vendor(s) to establish the best rate for CCTV inspections or hydrovac cleaning.

Prior to the Town hiring a vendor to perform hydrovac or CCTV inspection services, Town staff will conduct a visual inspection of the identified assets to verify the need for CCTV inspection and hydrovac cleaning. The purpose of this visual inspection is to avoid performing vendor services on a storm drain assets not requiring a CCTV inspection or hydrovac cleaning.

4.2.5 Spot Repairs/Replacement Projects

The approach to addressing spot repairs and replacement will be for the Town to establish an on-call drainage contractor list by releasing an RFQ that describes the possible repair or replacement activities.

The Town will develop a list of prequalified drainage repair contractors through a Request for Qualifications (RFQ) or similar process. Annually, when the Town has developed a list of storm drain assets to be repaired, the Town will engage with prequalified contractors where a competitive bid process will result in the Town selecting a contractor and scheduling the repairs.

Spot repairs can be very site, asset, and condition specific and as a result it is recommended that once the list of repair projects is developed, standard specifications, local design standards, or other guidance be developed and included in the package released to the prequalified contractors.

5.0 TRACKING AND REPORTING

The tracking and reporting portion of the O&M program defines the workflow to manage Work Program Actions. The framework for the workflow is captured within a web GIS (see below) and starts in the field with an action such as a visual or CCTV inspection to "open" an inspection record. Inspection information is gathered and sent to the cloud using an application loaded onto a mobile device. Next, using the same GIS stored in the cloud, the Town's GIS Technician generates tables or reports for in-house maintenance and/or vendors to resolve issues identified. Once issues are resolved, the inspection record is "closed".

Tracking is accomplished over time through the total number of inspection records generated for a given storm drain asset. Planning and decisions can then be derived from cumulative inspection records. For example, if a particular catch basin tends to clog with sediment and debris ever year, tracking established through inspections documented over time in tables linked (or related) to the GIS, will facilitate a decision to flag the asset for annual vactor cleaning. The process allows for systematic evaluation over time through a continuous feedback loop to improve decisions.

The following sections provide an overview of the Town's web GIS components and a description of how these components are managed and used within the tracking and reporting workflow.

5.1 Web GIS Components

A web GIS consists of several interrelated components, some of which can be used as stand-alone tools, while others build off and rely on the existence and configuration of others. The web GIS for this project is developed using ESRI software (i.e., ESRI Solutions), and stored on ArcGIS Online (AGOL).

AGOL is ESRI's online-based, web GIS content and user/license management interface. Named users are provided access to all or a selection of privileges based on the user type and role assigned. For details regarding user types, roles, and privileges, see ESRI's documentation on the subject (https://doc.arcgis.com/en/arcgis-online/reference/roles.htm).

While a comprehensive list of all web GIS components is beyond the scope of this document, the relevant components for the Town include the storm drain feature service, a series of web maps, a field application, and a series of web applications. Each are described in more detail below.

5.1.1 Feature Service

Also known as a Hosted Feature Layer, a feature service is essentially the web version of a GDB. It contains one or a collection of feature classes (geometry and attributes) or tables that serve as the source data used in other web GIS components, such as web maps. In the Town's case, the storm drain feature service also contains a stand-alone inspection table related to each storm drain feature class that allows the ongoing tracking of the Town's O&M inspections and maintenance.

5.1.2 Web Maps

A web map contains one or more feature services and a basemap (e.g., ortho imagery, street map, topographic, etc.). Layer symbology and transparency, labeling, visibility range, and pop-up configuration are controlled within a web map. The web map is the visual representation of the Town's storm drain system and typically includes a map, table, legend, and the ability to view or edit data.

A web map is a key building block of a web GIS because it serves to visualize geospatial data stored in a feature service, and is used to access the GIS in the field. It also is a required component for more advanced web applications that provide additional functionality. Web maps can also be used as stand-alone tools and are effective for visualization of data not requiring advanced functionality.

In order to address a number of specific needs, it is assumed that up to four (4) web maps will require development as foundational components to other applications including one for Collector, one for a viewer web app, one that can serve both a manager web app and operations dashboard, and one for an editor web app.

5.1.3 Field Application

The Collector mobile application, loaded onto a mobile device such as a phone or tablet, is used in the field to access a configured web map. Collector provides the ability for field staff to add, remove, or modify assets, as well as, add or modify inspection records related to the storm drain feature classes.

5.1.4 Web Applications

Desktop web applications (web apps) are built off configured web maps to provide additional functionality such as advanced querying, filtering, reporting, and summary analysis. It is assumed the Town will have a need for up to four (4) web applications including:

- View web app
    - Public facing storm drain GIS viewer with limited functionality (may present public vs. private storm drain infrastructure)
    - Editing disabled
    - Accessible with or without sign in credentials
    - The view web app will be useful for sharing the Town's storm drain system with the public or other stakeholders
- Manager web app
    - Detailed and highly functional app for in-house management
    - Functions to include advanced searching, querying, filtering, printing, and possibly reporting (see reporting section below)
    - Editing disabled - application will be safe to distribute

  - The manager web app will be a useful tool for Town Management to independently view storm drain system data

- Editor web app
  - Configured with editing functionality
  - Should only be distributed to a select number of qualified staff
  - Because editing tools are limited within the web app environment, an alternative approach is to edit data through ArcGIS Pro; however, a Standard license is required to edit data configured with relationship classes. If this is the preferred approach, the Town may opt to hire a consultant to support significant edits to the web GIS using ArcGIS Pro. This can be accomplished by including in your ESRI AGOL Organization, a named user with access to a Standard License.
  - The Editor web app is primarily a tool for the GIS Technician or Maintenance Staff
- Operations Dashboard
  - Likely built off the same web map as either the viewer app or manager app, an operations dashboard is a useful tool for viewing summary statistics updated in real time
  - Dashboards can be configured with or without a map
  - Example statistics the Town might in interested in viewing in real-time is the remaining number of assets requiring annual visual inspection or the remaining number of open inspection records classified as high priority
  - All users will benefit from the Operations Dashboard. It will provide all with access to a snapshot of the status of the O&M Program

5.1.5 Reporting

Reporting can take several forms and ranges of complexity. Until reporting requirements are better understood, it is unknown at this stage which form(s) it may take to meet the needs of the Town.

The simplest solution involves querying the data based on a question (e.g., how many linear feet of CMP pipe exist in public right-of-way), then exporting the result to a database table or spreadsheet for additional manipulation. Custom reports can then be designed in Microsoft Word or Access to meet the needs of the Town. The downside to this approach is the lack of mapping automation within the process. Maps can be added to custom reports as part of a separate step.

Another option is to add a reporting function to the Manager web app. Configuration is fairly limited with the available reporting functions, so this option would need to be evaluated against the needs of the Town before choosing. Maps are included as components of reports generated from a web app, but again, configuration options are limited.

A third option, likely to require the most development and testing, is reporting through ArcGIS Pro. Using a combination of map series (previously known as data driven pages) and the reporting function, a custom report template with configured maps can be created.

6.0 REFERENCES

NCE, 2019. Town of Moraga Storm Drain Mapping Project Development Plan, June.

Schaaf & Wheeler Consulting Civil Engineers, 2019. Draft Final Addendum to the Storm Drain Master Plan, November.

Schaaf & Wheeler Consulting Civil Engineers, 2015. Moraga Storm Drain Master Plan, July.

Appendix A

Storm Drain System Map

Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
Zone 9

Legend

Town Limits
Maintenance Zone

Junction (Node) Type
- Catch Basin
- Manhole
- Open Pipe
- Legacy Node

Conveyance (Link) Type
- Pipe
- Culvert
- Ditch
- V-ditch
- M-Ditch
- Legacy Link
- Streams

TOWN OF MORAGA O&M PROGRAM

STORM DRAIN SYSTEM MAP (NODE)

N

1 in. = 800 ft.

0 1,000 2,000 ft.

ATTACHMENT

A.1

SOURCE	JOB NUMBER	DRAWN	DATE	REVISED	APPROVED
Bing Hybrid Basemap	576.15.55	cdavis, mcasterman	9/17/2019	11/4/19	drios

Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
Zone 9

Legend

Town Limits
Maintenance Zone

Junction (Node) Type
- Catch Basin
- Manhole
- Open Pipe
- Legacy Node

Conveyance (Link) Type
- Pipe
- Culvert
- Ditch
- V-ditch
- M-Ditch
- Legacy Link
- Streams

TOWN OF MORAGA O&M PROGRAM

STORM DRAIN SYSTEM MAP (LINKS)

N

1 in. = 800 ft.

0 1,000 2,000 ft.

ATTACHMENT

A.2

SOURCE	JOB NUMBER	DRAWN	DATE	REVISED	APPROVED
Bing Hybrid Basemap	576.15.55	jhall, cdavis	9/17/2019	11/4/19	drios

Table A.3

Unique ID	Index	Node Type
N-0001	1	Manhole
N-0002	2	Open Pipe
N-0003	3	Catch Basin
N-0004	4	Open Pipe
N-0005	5	Open Pipe
N-0006	6	Catch Basin
N-0007	7	Catch Basin
N-0008	8	Open Pipe
N-0009	9	Manhole
N-0010	10	Manhole
N-0011	11	Manhole
N-0012	12	Open Pipe
N-0013	13	Manhole
N-0014	14	Catch Basin
N-0015	15	Manhole
N-0016	16	Catch Basin
N-0017	17	Open Pipe
N-0018	18	Open Pipe
N-0019	19	Manhole
N-0020	20	Manhole
N-0021	21	Catch Basin
N-0022	22	Manhole
N-0023	23	Catch Basin
N-0024	24	Catch Basin
N-0025	25	Catch Basin
N-0026	26	Manhole
N-0027	27	Catch Basin
N-0028	28	Manhole
N-0029	29	Catch Basin
N-0030	30	Open Pipe
N-0031	31	Open Pipe
N-0032	32	Open Pipe
N-0033	33	Open Pipe
N-0034	34	Open Pipe
N-0035	35	Open Pipe
N-0036	36	Manhole
N-0037	37	Manhole
N-0038	38	Catch Basin
N-0039	39	Catch Basin
N-0040	40	Manhole
N-0041	41	Catch Basin
N-0042	42	Catch Basin
N-0043	43	Catch Basin
N-0044	44	Catch Basin
N-0045	45	Catch Basin

Unique ID	Index	Node Type
N-0046	46	Catch Basin
N-0047	47	Open Pipe
N-0048	48	Open Pipe
N-0049	49	Catch Basin
N-0050	50	Manhole
N-0051	51	Open Pipe
N-0052	52	Catch Basin
N-0053	53	Catch Basin
N-0054	54	Catch Basin
N-0055	55	Open Pipe
N-0056	56	Catch Basin
N-0057	57	Catch Basin
N-0058	58	Open Pipe
N-0059	59	Open Pipe
N-0060	60	Open Pipe
N-0061	61	Catch Basin
N-0062	62	Open Pipe
N-0063	63	Open Pipe
N-0064	64	Open Pipe
N-0065	65	Catch Basin
N-0066	66	Catch Basin
N-0067	67	Catch Basin
N-0068	68	Catch Basin
N-0069	69	Catch Basin
N-0070	70	Open Pipe
N-0071	71	Manhole
N-0072	72	Open Pipe
N-0073	73	Open Pipe
N-0074	74	Catch Basin
N-0075	75	Catch Basin
N-0076	76	Catch Basin
N-0077	77	Catch Basin
N-0078	78	Catch Basin
N-0079	79	Catch Basin
N-0080	80	Catch Basin
N-0081	81	Catch Basin
N-0082	82	Catch Basin
N-0083	83	Catch Basin
N-0084	84	Open Pipe
N-0085	85	Catch Basin
N-0086	86	Catch Basin
N-0087	87	Catch Basin
N-0088	88	Catch Basin
N-0089	89	Catch Basin
N-0090	90	Catch Basin

Table A.3

Unique ID	Index	Node Type
N-0091	91	Catch Basin
N-0092	92	Catch Basin
N-0093	93	Catch Basin
N-0094	94	Catch Basin
N-0095	95	Catch Basin
N-0096	96	Catch Basin
N-0097	97	Catch Basin
N-0098	98	Catch Basin
N-0099	99	Catch Basin
N-0100	100	Catch Basin
N-0101	101	Catch Basin
N-0102	102	Catch Basin
N-0103	103	Catch Basin
N-0104	104	Catch Basin
N-0105	105	Catch Basin
N-0106	106	Open Pipe
N-0107	107	Manhole
N-0108	108	Catch Basin
N-0109	109	Catch Basin
N-0110	110	Open Pipe
N-0111	111	Catch Basin
N-0112	112	Open Pipe
N-0113	113	Catch Basin
N-0114	114	Open Pipe
N-0115	115	Catch Basin
N-0116	116	Open Pipe
N-0117	117	Catch Basin
N-0118	118	Open Pipe
N-0119	119	Open Pipe
N-0120	120	Open Pipe
N-0121	121	Open Pipe
N-0122	122	Open Pipe
N-0123	123	Open Pipe
N-0124	124	Open Pipe
N-0125	125	Catch Basin
N-0126	126	Catch Basin
N-0127	127	Catch Basin
N-0128	128	Catch Basin
N-0129	129	Open Pipe
N-0130	130	Open Pipe
N-0131	131	Open Pipe
N-0132	132	Open Pipe
N-0133	133	Open Pipe
N-0134	134	Catch Basin
N-0135	135	Catch Basin

Unique ID	Index	Node Type
N-0136	136	Open Pipe
N-0137	137	Open Pipe
N-0138	138	Open Pipe
N-0139	139	Manhole
N-0140	140	Catch Basin
N-0141	141	Catch Basin
N-0142	142	Catch Basin
N-0143	143	Catch Basin
N-0144	144	Catch Basin
N-0145	145	Catch Basin
N-0146	146	Catch Basin
N-0147	147	Catch Basin
N-0148	148	Catch Basin
N-0149	149	Catch Basin
N-0150	150	Catch Basin
N-0151	151	Catch Basin
N-0152	152	Catch Basin
N-0153	153	Catch Basin
N-0154	154	Open Pipe
N-0155	155	Catch Basin
N-0156	156	Catch Basin
N-0157	157	Catch Basin
N-0158	158	Catch Basin
N-0159	159	Catch Basin
N-0160	160	Catch Basin
N-0161	161	Manhole
N-0162	162	Catch Basin
N-0163	163	Manhole
N-0164	164	Catch Basin
N-0165	165	Catch Basin
N-0166	166	Manhole
N-0167	167	Catch Basin
N-0168	168	Catch Basin
N-0169	169	Manhole
N-0170	170	Catch Basin
N-0171	171	Catch Basin
N-0172	172	Catch Basin
N-0173	173	Catch Basin
N-0174	174	Catch Basin
N-0175	175	Catch Basin
N-0176	176	Catch Basin
N-0177	177	Catch Basin
N-0178	178	Catch Basin
N-0179	179	Catch Basin
N-0180	180	Catch Basin

Table A.3

Unique ID	Index	Node Type
N-0181	181	Catch Basin
N-0182	182	Catch Basin
N-0183	183	Catch Basin
N-0184	184	Catch Basin
N-0185	185	Catch Basin
N-0186	186	Catch Basin
N-0187	187	Catch Basin
N-0188	188	Catch Basin
N-0189	189	Catch Basin
N-0190	190	Catch Basin
N-0191	191	Catch Basin
N-0192	192	Catch Basin
N-0193	193	Catch Basin
N-0194	194	Catch Basin
N-0195	195	Catch Basin
N-0196	196	Catch Basin
N-0197	197	Catch Basin
N-0198	198	Catch Basin
N-0199	199	Catch Basin
N-0200	200	Catch Basin
N-0201	201	Catch Basin
N-0202	202	Catch Basin
N-0203	203	Catch Basin
N-0204	204	Catch Basin
N-0205	205	Catch Basin
N-0206	206	Catch Basin
N-0207	207	Catch Basin
N-0208	208	Open Pipe
N-0209	209	Manhole
N-0210	210	Open Pipe
N-0211	211	Catch Basin
N-0212	212	Manhole
N-0213	213	Catch Basin
N-0214	214	Catch Basin
N-0215	215	Catch Basin
N-0216	216	Catch Basin
N-0217	217	Catch Basin
N-0218	218	Catch Basin
N-0219	219	Manhole
N-0220	220	Open Pipe
N-0221	221	Manhole
N-0222	222	Open Pipe
N-0223	223	Open Pipe
N-0224	224	Open Pipe
N-0225	225	Open Pipe

Unique ID	Index	Node Type
N-0226	226	Open Pipe
N-0227	227	Open Pipe
N-0228	228	Open Pipe
N-0229	229	Open Pipe
N-0230	230	Open Pipe
N-0231	231	Open Pipe
N-0232	232	Open Pipe
N-0233	233	Catch Basin
N-0234	234	Catch Basin
N-0235	235	Catch Basin
N-0236	236	Catch Basin
N-0237	237	Open Pipe
N-0238	238	Catch Basin
N-0239	239	Catch Basin
N-0240	240	Open Pipe
N-0241	241	Open Pipe
N-0242	242	Catch Basin
N-0243	243	Catch Basin
N-0244	244	Catch Basin
N-0245	245	Catch Basin
N-0246	246	Catch Basin
N-0247	247	Catch Basin
N-0248	248	Catch Basin
N-0249	249	Catch Basin
N-0250	250	Catch Basin
N-0251	251	Catch Basin
N-0252	252	Catch Basin
N-0253	253	Catch Basin
N-0254	254	Catch Basin
N-0255	255	Catch Basin
N-0256	256	Catch Basin
N-0257	257	Catch Basin
N-0258	258	Catch Basin
N-0259	259	Catch Basin
N-0260	260	Manhole
N-0261	261	Catch Basin
N-0262	262	Catch Basin
N-0263	263	Catch Basin
N-0264	264	Manhole
N-0265	265	Catch Basin
N-0266	266	Catch Basin
N-0267	267	Catch Basin
N-0268	268	Catch Basin
N-0269	269	Catch Basin
N-0270	270	Catch Basin

Table A.3

Unique ID	Index	Node Type
N-0271	271	Catch Basin
N-0272	272	Catch Basin
N-0273	273	Catch Basin
N-0274	274	Manhole
N-0275	275	Catch Basin
N-0276	276	Catch Basin
N-0277	277	Catch Basin
N-0278	278	Catch Basin
N-0279	279	Catch Basin
N-0280	280	Catch Basin
N-0281	281	Catch Basin
N-0282	282	Catch Basin
N-0283	283	Catch Basin
N-0284	284	Catch Basin
N-0285	285	Catch Basin
N-0286	286	Catch Basin
N-0287	287	Catch Basin
N-0288	288	Catch Basin
N-0289	289	Catch Basin
N-0290	290	Catch Basin
N-0291	291	Catch Basin
N-0292	292	Catch Basin
N-0293	293	Catch Basin
N-0294	294	Catch Basin
N-0295	295	Catch Basin
N-0296	296	Catch Basin
N-0297	297	Catch Basin
N-0298	298	Catch Basin
N-0299	299	Catch Basin
N-0300	300	Catch Basin
N-0301	301	Catch Basin
N-0302	302	Catch Basin
N-0303	303	Catch Basin
N-0304	304	Catch Basin
N-0305	305	Catch Basin
N-0306	306	Catch Basin
N-0307	307	Catch Basin
N-0308	308	Catch Basin
N-0309	309	Catch Basin
N-0310	310	Catch Basin
N-0311	311	Catch Basin
N-0312	312	Open Pipe
N-0313	313	Open Pipe
N-0314	314	Open Pipe
N-0315	315	Open Pipe

Unique ID	Index	Node Type
N-0316	316	Open Pipe
N-0317	317	Catch Basin
N-0318	318	Catch Basin
N-0319	319	Catch Basin
N-0320	320	Catch Basin
N-0321	321	Catch Basin
N-0322	322	Catch Basin
N-0323	323	Manhole
N-0324	324	Catch Basin
N-0325	325	Catch Basin
N-0326	326	Manhole
N-0327	327	Open Pipe
N-0328	328	Open Pipe
N-0329	329	Open Pipe
N-0330	330	Catch Basin
N-0331	331	Catch Basin
N-0332	332	Catch Basin
N-0333	333	Catch Basin
N-0334	334	Catch Basin
N-0335	335	Catch Basin
N-0336	336	Manhole
N-0337	337	Catch Basin
N-0338	338	Catch Basin
N-0339	339	Catch Basin
N-0340	340	Catch Basin
N-0341	341	Catch Basin
N-0342	342	Catch Basin
N-0343	343	Open Pipe
N-0344	344	Open Pipe
N-0345	345	Open Pipe
N-0346	346	Open Pipe
N-0347	347	Open Pipe
N-0348	348	Open Pipe
N-0349	349	Open Pipe
N-0350	350	Open Pipe
N-0351	351	Open Pipe
N-0352	352	Open Pipe
N-0353	353	Catch Basin
N-0354	354	Manhole
N-0355	355	Catch Basin
N-0356	356	Manhole
N-0357	357	Catch Basin
N-0358	358	Catch Basin
N-0359	359	Catch Basin
N-0360	360	Catch Basin

Table A.3

Unique ID	Index	Node Type
N-0361	361	Open Pipe
N-0362	362	Open Pipe
N-0363	363	Open Pipe
N-0364	364	Open Pipe
N-0365	365	Open Pipe
N-0366	366	Open Pipe
N-0367	367	Open Pipe
N-0368	368	Open Pipe
N-0369	369	Open Pipe
N-0370	370	Open Pipe
N-0371	371	Open Pipe
N-0372	372	Open Pipe
N-0373	373	Catch Basin
N-0374	374	Catch Basin
N-0375	375	Catch Basin
N-0376	376	Open Pipe
N-0377	377	Open Pipe
N-0378	378	Manhole
N-0379	379	Open Pipe
N-0380	380	Open Pipe
N-0381	381	Open Pipe
N-0382	382	Open Pipe
N-0383	383	Open Pipe
N-0384	384	Open Pipe
N-0385	385	Open Pipe
N-0386	386	Open Pipe
N-0387	387	Open Pipe
N-0388	388	Catch Basin
N-0389	389	Catch Basin
N-0390	390	Catch Basin
N-0391	391	Catch Basin
N-0392	392	Catch Basin
N-0393	393	Catch Basin
N-0394	394	Catch Basin
N-0395	395	Catch Basin
N-0396	396	Catch Basin
N-0397	397	Catch Basin
N-0398	398	Manhole
N-0399	399	Open Pipe
N-0400	400	Open Pipe
N-0401	401	Open Pipe
N-0402	402	Open Pipe
N-0403	403	Open Pipe
N-0404	404	Catch Basin
N-0405	405	Open Pipe

Unique ID	Index	Node Type
N-0406	406	Open Pipe
N-0407	407	Open Pipe
N-0408	408	Catch Basin
N-0409	409	Catch Basin
N-0410	410	Manhole
N-0411	411	Open Pipe
N-0412	412	Catch Basin
N-0413	413	Catch Basin
N-0414	414	Catch Basin
N-0415	415	Catch Basin
N-0416	416	Open Pipe
N-0417	417	Open Pipe
N-0418	418	Catch Basin
N-0419	419	Catch Basin
N-0420	420	Catch Basin
N-0421	421	Open Pipe
N-0422	422	Open Pipe
N-0423	423	Open Pipe
N-0424	424	Catch Basin
N-0425	425	Open Pipe
N-0426	426	Catch Basin
N-0427	427	Catch Basin
N-0428	428	Catch Basin
N-0429	429	Open Pipe
N-0430	430	Open Pipe
N-0431	431	Catch Basin
N-0432	432	Catch Basin
N-0433	433	Catch Basin
N-0434	434	Catch Basin
N-0435	435	Open Pipe
N-0436	436	Open Pipe
N-0437	437	Open Pipe
N-0438	438	Catch Basin
N-0439	439	Catch Basin
N-0440	440	Open Pipe
N-0441	441	Open Pipe
N-0442	442	Open Pipe
N-0443	443	Open Pipe
N-0444	444	Open Pipe
N-0445	445	Catch Basin
N-0446	446	Catch Basin
N-0447	447	Open Pipe
N-0448	448	Open Pipe
N-0449	449	Open Pipe
N-0450	450	Catch Basin

Table A.3

Unique ID	Index	Node Type
N-0451	451	Manhole
N-0452	452	Open Pipe
N-0453	453	Open Pipe
N-0454	454	Open Pipe
N-0455	455	Catch Basin
N-0456	456	Open Pipe
N-0457	457	Open Pipe
N-0458	458	Open Pipe
N-0459	459	Open Pipe
N-0460	460	Open Pipe
N-0461	461	Open Pipe
N-0462	462	Open Pipe
N-0463	463	Open Pipe
N-0464	464	Open Pipe
N-0465	465	Open Pipe
N-0466	466	Open Pipe
N-0467	467	Open Pipe
N-0468	468	Open Pipe
N-0469	469	Open Pipe
N-0470	470	Open Pipe
N-0471	471	Catch Basin
N-0472	472	Open Pipe
N-0473	473	Catch Basin
N-0474	474	Open Pipe
N-0475	475	Open Pipe
N-0476	476	Manhole
N-0477	477	Manhole
N-0478	478	Catch Basin
N-0479	479	Catch Basin
N-0480	480	Manhole
N-0481	481	Manhole
N-0482	482	Catch Basin
N-0483	483	Catch Basin
N-0484	484	Catch Basin
N-0485	485	Catch Basin
N-0486	486	Catch Basin
N-0487	487	Catch Basin
N-0488	488	Catch Basin
N-0489	489	Catch Basin
N-0490	490	Catch Basin
N-0491	491	Catch Basin
N-0492	492	Catch Basin
N-0493	493	Catch Basin
N-0494	494	Catch Basin
N-0495	495	Catch Basin

Unique ID	Index	Node Type
N-0496	496	Catch Basin
N-0497	497	Catch Basin
N-0498	498	Manhole
N-0499	499	Catch Basin
N-0500	500	Manhole
N-0501	501	Catch Basin
N-0502	502	Catch Basin
N-0503	503	Catch Basin
N-0504	504	Catch Basin
N-0505	505	Catch Basin
N-0506	506	Catch Basin
N-0507	507	Catch Basin
N-0508	508	Catch Basin
N-0509	509	Manhole
N-0510	510	Catch Basin
N-0511	511	Catch Basin
N-0512	512	Catch Basin
N-0513	513	Catch Basin
N-0514	514	Catch Basin
N-0515	515	Open Pipe
N-0516	516	Open Pipe
N-0517	517	Open Pipe
N-0518	518	Open Pipe
N-0519	519	Catch Basin
N-0520	520	Open Pipe
N-0521	521	Manhole
N-0522	522	Catch Basin
N-0523	523	Catch Basin
N-0524	524	Catch Basin
N-0525	525	Open Pipe
N-0526	526	Catch Basin
N-0527	527	Manhole
N-0528	528	Open Pipe
N-0529	529	Open Pipe
N-0530	530	Open Pipe
N-0531	531	Catch Basin
N-0532	532	Manhole
N-0533	533	Catch Basin
N-0534	534	Manhole
N-0535	535	Open Pipe
N-0536	536	Open Pipe
N-0537	537	Open Pipe
N-0538	538	Catch Basin
N-0539	539	Open Pipe
N-0540	540	Open Pipe

Table A.3

Unique ID	Index	Node Type
N-0541	541	Catch Basin
N-0542	542	Open Pipe
N-0543	543	Catch Basin
N-0544	544	Manhole
N-0545	545	Catch Basin
N-0546	546	Catch Basin
N-0547	547	Open Pipe
N-0548	548	Catch Basin
N-0549	549	Open Pipe
N-0550	550	Open Pipe
OR_0002	559	Catch Basin
OR_0014	560	Catch Basin
OR_0015	561	Catch Basin
OR_0016	562	Catch Basin
Z1_NODE_0001	563	Catch Basin
Z1_NODE_0003	564	Catch Basin
Z1_NODE_0004	565	Catch Basin
Z1_NODE_0006	566	Catch Basin
Z1_NODE_0007	567	Catch Basin
Z1_NODE_0008	568	Catch Basin
Z1_NODE_0009	569	Catch Basin
Z1_NODE_0011	570	Catch Basin
Z1_NODE_0012	571	Manhole
Z1_NODE_0015	572	Catch Basin
Z1_NODE_0016	573	Catch Basin
Z1_NODE_0018	574	Open Pipe
Z1_NODE_0019	575	Catch Basin
Z1_NODE_0020	576	Catch Basin
Z1_NODE_0023	577	Catch Basin
Z1_NODE_0024	578	Catch Basin
Z1_NODE_0025	579	Catch Basin
Z1_NODE_0027	580	Catch Basin
Z1_NODE_0028	581	Catch Basin
Z1_NODE_0029	582	Catch Basin
Z1_NODE_0030	583	Catch Basin
Z1_NODE_0031	584	Catch Basin
Z1_NODE_0032	585	Catch Basin
Z1_NODE_0036	586	Catch Basin
Z1_NODE_0040	587	Catch Basin
Z1_NODE_0041	588	Catch Basin
Z1_NODE_0042	589	Catch Basin
Z1_NODE_0043	590	Catch Basin
Z1_NODE_0044	591	Catch Basin
Z1_NODE_0045	592	Catch Basin
Z1_NODE_0046	593	Catch Basin

Unique ID	Index	Node Type
Z1_NODE_0047	594	Catch Basin
Z1_NODE_0048	595	Catch Basin
Z1_NODE_0049	596	Catch Basin
Z1_NODE_0050	597	Catch Basin
Z1_NODE_0052	598	Catch Basin
Z1_NODE_0053	599	Catch Basin
Z1_NODE_0055	600	Manhole
Z1_NODE_0058	601	Catch Basin
Z1_NODE_0059	602	Catch Basin
Z1_NODE_0060	603	Catch Basin
Z1_NODE_0073	604	Catch Basin
Z1_NODE_0078	605	Manhole
Z1_NODE_0079	606	Catch Basin
Z1_NODE_0084	607	Catch Basin
Z1_NODE_0085	608	Catch Basin
Z1_NODE_0086	609	Manhole
Z1_NODE_0087	610	Catch Basin
Z1_NODE_0088	611	Manhole
Z1_NODE_0095	612	Manhole
Z1_NODE_0096	613	Catch Basin
Z1_NODE_0097	614	Catch Basin
Z1_NODE_0098	615	Catch Basin
Z1_NODE_0099	616	Catch Basin
Z1_NODE_0100	617	Catch Basin
Z1_NODE_0102	618	Catch Basin
Z1_NODE_0103	619	Manhole
Z1_NODE_0104	620	Catch Basin
Z1_NODE_0105	621	Catch Basin
Z1_NODE_0106	622	Catch Basin
Z1_NODE_0108	623	Manhole
Z1_NODE_0109	624	Catch Basin
Z1_NODE_0110	625	Catch Basin
Z1_NODE_0111	626	Catch Basin
Z1_NODE_0114	627	Manhole
Z1_NODE_0115	628	Catch Basin
Z1_NODE_0119	629	Manhole
Z1_NODE_0120	630	Catch Basin
Z1_NODE_0121	631	Catch Basin
Z1_NODE_0122	632	Catch Basin
Z1_NODE_0123	633	Catch Basin
Z1_NODE_0126	634	Catch Basin
Z1_NODE_0127	635	Catch Basin
Z1_NODE_0130	636	Catch Basin
Z1_NODE_0131	637	Catch Basin
Z1_NODE_0132	638	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z1_NODE_0136	639	Catch Basin
Z1_NODE_0137	640	Catch Basin
Z1_NODE_0138	641	Catch Basin
Z1_NODE_0140	642	Catch Basin
Z1_NODE_0141	643	Catch Basin
Z1_NODE_0142	644	Catch Basin
Z1_NODE_0145	645	Manhole
Z1_NODE_0148	646	Catch Basin
Z1_NODE_0150	647	Catch Basin
Z1_NODE_0151	648	Catch Basin
Z1_NODE_0152	649	Catch Basin
Z1_NODE_0153	650	Catch Basin
Z1_NODE_0154	651	Catch Basin
Z1_NODE_0159	652	Catch Basin
Z1_NODE_0160	653	Catch Basin
Z1_NODE_0162	654	Catch Basin
Z1_NODE_0166	655	Catch Basin
Z1_NODE_0167	656	Catch Basin
Z1_NODE_0169	657	Catch Basin
Z1_NODE_0170	658	Catch Basin
Z1_NODE_0171	659	Catch Basin
Z1_NODE_0172	660	Catch Basin
Z1_NODE_0174	661	Catch Basin
Z1_NODE_0175	662	Catch Basin
Z1_NODE_0177	663	Catch Basin
Z1_NODE_0178	664	Catch Basin
Z1_NODE_0180	665	Open Pipe
Z1_NODE_0184	666	Catch Basin
Z1_NODE_0185	667	Catch Basin
Z1_NODE_0186	668	Catch Basin
Z1_NODE_0190	669	Catch Basin
Z1_NODE_0191	670	Catch Basin
Z1_NODE_0192	671	Catch Basin
Z1_NODE_0193	672	Catch Basin
Z1_NODE_0194	673	Open Pipe
Z1_NODE_0196	674	Open Pipe
Z1_NODE_0198	675	Open Pipe
Z1_NODE_0202	676	Open Pipe
Z1_NODE_0204	677	Catch Basin
Z1_NODE_0205	678	Catch Basin
Z1_NODE_0206	679	Open Pipe
Z1_NODE_0208	680	Open Pipe
Z1_NODE_0212	681	Catch Basin
Z1_NODE_0214	682	Open Pipe
Z1_NODE_0218	683	Catch Basin

Unique ID	Index	Node Type
Z1_NODE_0219	684	Manhole
Z1_NODE_0220	685	Catch Basin
Z1_NODE_0222	686	Catch Basin
Z1_NODE_0226	687	Catch Basin
Z1_NODE_0227	688	Catch Basin
Z1_NODE_0228	689	Catch Basin
Z1_NODE_0229	690	Catch Basin
Z1_NODE_0230	691	Catch Basin
Z1_NODE_0233	692	Catch Basin
Z1_NODE_0234	693	Catch Basin
Z1_NODE_0237	694	Open Pipe
Z1_NODE_0240	695	Catch Basin
Z1_NODE_0241	696	Open Pipe
Z1_NODE_0245	697	Open Pipe
Z1_NODE_0246	698	Catch Basin
Z1_NODE_0294	699	Catch Basin
Z2_NODE_0003	700	Catch Basin
Z2_NODE_0004	701	Catch Basin
Z2_NODE_0008	702	Catch Basin
Z2_NODE_0011	703	Catch Basin
Z2_NODE_0012	704	Catch Basin
Z2_NODE_0013	705	Catch Basin
Z2_NODE_0014	706	Catch Basin
Z2_NODE_0019	707	Catch Basin
Z2_NODE_0022	708	Catch Basin
Z2_NODE_0023	709	Catch Basin
Z2_NODE_0027	710	Catch Basin
Z2_NODE_0030	711	Catch Basin
Z2_NODE_0032	712	Catch Basin
Z2_NODE_0036	713	Open Pipe
Z2_NODE_0038	714	Catch Basin
Z2_NODE_0039	715	Catch Basin
Z2_NODE_0041	716	Open Pipe
Z2_NODE_0042	717	Catch Basin
Z2_NODE_0043	718	Catch Basin
Z2_NODE_0049	719	Catch Basin
Z2_NODE_0050	720	Catch Basin
Z2_NODE_0054	721	Manhole
Z2_NODE_0056	722	Catch Basin
Z2_NODE_0057	723	Catch Basin
Z2_NODE_0064	724	Open Pipe
Z2_NODE_0065	725	Catch Basin
Z2_NODE_0068	726	Catch Basin
Z2_NODE_0073	727	Manhole
Z2_NODE_0079	728	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z2_NODE_0080	729	Catch Basin
Z2_NODE_0081	730	Catch Basin
Z2_NODE_0083	731	Catch Basin
Z2_NODE_0084	732	Catch Basin
Z2_NODE_0085	733	Catch Basin
Z2_NODE_0086	734	Catch Basin
Z2_NODE_0088	735	Catch Basin
Z2_NODE_0089	736	Catch Basin
Z2_NODE_0090	737	Catch Basin
Z2_NODE_0093	738	Catch Basin
Z2_NODE_0094	739	Catch Basin
Z2_NODE_0095	740	Catch Basin
Z2_NODE_0097	741	Catch Basin
Z2_NODE_0098	742	Catch Basin
Z2_NODE_0099	743	Catch Basin
Z2_NODE_0103	744	Catch Basin
Z2_NODE_0113	745	Catch Basin
Z2_NODE_0114	746	Catch Basin
Z2_NODE_0125	747	Catch Basin
Z2_NODE_0126	748	Catch Basin
Z2_NODE_0132	749	Open Pipe
Z2_NODE_0133	750	Catch Basin
Z2_NODE_0134	751	Catch Basin
Z2_NODE_0141	752	Catch Basin
Z2_NODE_0148	753	Catch Basin
Z2_NODE_0153	754	Open Pipe
Z2_NODE_0157	755	Catch Basin
Z2_NODE_0158	756	Catch Basin
Z2_NODE_0159	757	Manhole
Z2_NODE_0160	758	Catch Basin
Z2_NODE_0165	759	Manhole
Z2_NODE_0166	760	Catch Basin
Z2_NODE_0167	761	Catch Basin
Z2_NODE_0171	762	Catch Basin
Z2_NODE_0178	763	Open Pipe
Z2_NODE_0180	764	Catch Basin
Z2_NODE_0182	765	Catch Basin
Z2_NODE_0183	766	Catch Basin
Z2_NODE_0184	767	Catch Basin
Z2_NODE_0185	768	Catch Basin
Z2_NODE_0186	769	Manhole
Z2_NODE_0187	770	Catch Basin
Z2_NODE_0188	771	Catch Basin
Z2_NODE_0189	772	Catch Basin
Z2_NODE_0198	773	Catch Basin

Unique ID	Index	Node Type
Z2_NODE_0199	774	Catch Basin
Z2_NODE_0200	775	Catch Basin
Z2_NODE_0201	776	Catch Basin
Z2_NODE_0202	777	Catch Basin
Z2_NODE_0203	778	Catch Basin
Z2_NODE_0204	779	Catch Basin
Z2_NODE_0205	780	Catch Basin
Z2_NODE_0206	781	Manhole
Z2_NODE_0207	782	Catch Basin
Z2_NODE_0208	783	Catch Basin
Z2_NODE_0209	784	Catch Basin
Z2_NODE_0211	785	Catch Basin
Z2_NODE_0212	786	Catch Basin
Z2_NODE_0213	787	Catch Basin
Z2_NODE_0214	788	Catch Basin
Z2_NODE_0216	789	Catch Basin
Z2_NODE_0217	790	Catch Basin
Z2_NODE_0218	791	Catch Basin
Z2_NODE_0219	792	Catch Basin
Z2_NODE_0223	793	Manhole
Z2_NODE_0225	794	Catch Basin
Z2_NODE_0226	795	Catch Basin
Z2_NODE_0227	796	Catch Basin
Z2_NODE_0228	797	Manhole
Z2_NODE_0229	798	Catch Basin
Z2_NODE_0231	799	Catch Basin
Z2_NODE_0232	800	Catch Basin
Z2_NODE_0233	801	Catch Basin
Z2_NODE_0239	802	Catch Basin
Z2_NODE_0240	803	Catch Basin
Z2_NODE_0241	804	Catch Basin
Z2_NODE_0245	805	Catch Basin
Z2_NODE_0248	807	Catch Basin
Z2_NODE_0249	808	Catch Basin
Z2_NODE_0251	809	Manhole
Z2_NODE_0252	810	Catch Basin
Z2_NODE_0257	811	Catch Basin
Z2_NODE_0266	812	Catch Basin
Z2_NODE_0267	813	Catch Basin
Z2_NODE_0268	814	Catch Basin
Z2_NODE_0269	815	Catch Basin
Z2_NODE_0270	816	Catch Basin
Z2_NODE_0271	817	Catch Basin
Z2_NODE_0272	818	Catch Basin
Z2_NODE_0273	819	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z2_NODE_0274	820	Manhole
Z2_NODE_0276	821	Catch Basin
Z2_NODE_0277	822	Catch Basin
Z2_NODE_0278	823	Catch Basin
Z2_NODE_0279	824	Catch Basin
Z2_NODE_0280	825	Catch Basin
Z2_NODE_0281	826	Catch Basin
Z2_NODE_0282	827	Catch Basin
Z2_NODE_0283	828	Catch Basin
Z2_NODE_0286	829	Manhole
Z2_NODE_0287	830	Manhole
Z2_NODE_0289	831	Manhole
Z2_NODE_0291	832	Open Pipe
Z2_NODE_0293	833	Catch Basin
Z2_NODE_0294	834	Catch Basin
Z2_NODE_0304	835	Catch Basin
Z2_NODE_0305	836	Catch Basin
Z3_NODE_0001	837	Open Pipe
Z3_NODE_0004	838	Catch Basin
Z3_NODE_0006	839	Catch Basin
Z3_NODE_0007	840	Catch Basin
Z3_NODE_0008	841	Catch Basin
Z3_NODE_0011	842	Catch Basin
Z3_NODE_0012	843	Catch Basin
Z3_NODE_0013	844	Manhole
Z3_NODE_0016	845	Catch Basin
Z3_NODE_0017	846	Catch Basin
Z3_NODE_0018	847	Catch Basin
Z3_NODE_0023	848	Catch Basin
Z3_NODE_0025	849	Catch Basin
Z3_NODE_0026	850	Catch Basin
Z3_NODE_0027	851	Manhole
Z3_NODE_0028	852	Catch Basin
Z3_NODE_0029	853	Catch Basin
Z3_NODE_0030	854	Manhole
Z3_NODE_0037	855	Catch Basin
Z3_NODE_0038	856	Open Pipe
Z3_NODE_0040	857	Manhole
Z3_NODE_0041	858	Catch Basin
Z3_NODE_0042	859	Catch Basin
Z3_NODE_0043	860	Catch Basin
Z3_NODE_0044	861	Catch Basin
Z3_NODE_0046	862	Open Pipe
Z3_NODE_0047	863	Manhole
Z3_NODE_0049	864	Catch Basin

Unique ID	Index	Node Type
Z3_NODE_0050	865	Catch Basin
Z3_NODE_0051	866	Catch Basin
Z3_NODE_0052	867	Manhole
Z3_NODE_0053	868	Catch Basin
Z3_NODE_0054	869	Catch Basin
Z3_NODE_0058	870	Catch Basin
Z3_NODE_0059	871	Catch Basin
Z3_NODE_0060	872	Manhole
Z3_NODE_0070	873	Catch Basin
Z3_NODE_0071	874	Catch Basin
Z3_NODE_0073	875	Catch Basin
Z3_NODE_0077	876	Catch Basin
Z3_NODE_0079	877	Manhole
Z3_NODE_0080	878	Catch Basin
Z3_NODE_0081	879	Catch Basin
Z3_NODE_0082	880	Catch Basin
Z3_NODE_0086	881	Catch Basin
Z3_NODE_0087	882	Catch Basin
Z3_NODE_0088	883	Catch Basin
Z3_NODE_0089	884	Catch Basin
Z3_NODE_0090	885	Catch Basin
Z3_NODE_0094	886	Open Pipe
Z3_NODE_0097	887	Catch Basin
Z3_NODE_0098	888	Catch Basin
Z3_NODE_0099	889	Catch Basin
Z3_NODE_0100	890	Open Pipe
Z3_NODE_0101	891	Open Pipe
Z3_NODE_0102	892	Catch Basin
Z3_NODE_0103	893	Catch Basin
Z3_NODE_0104	894	Catch Basin
Z3_NODE_0107	895	Manhole
Z3_NODE_0111	896	Catch Basin
Z3_NODE_0112	897	Catch Basin
Z3_NODE_0113	898	Catch Basin
Z3_NODE_0114	899	Catch Basin
Z3_NODE_0115	900	Catch Basin
Z3_NODE_0116	901	Catch Basin
Z3_NODE_0117	902	Open Pipe
Z3_NODE_0119	903	Catch Basin
Z3_NODE_0123	904	Open Pipe
Z3_NODE_0124	905	Catch Basin
Z3_NODE_0126	906	Catch Basin
Z3_NODE_0127	907	Catch Basin
Z3_NODE_0129	908	Manhole
Z3_NODE_0130	909	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z3_NODE_0131	910	Catch Basin
Z3_NODE_0132	911	Catch Basin
Z3_NODE_0133	912	Catch Basin
Z3_NODE_0136	913	Catch Basin
Z3_NODE_0137	914	Catch Basin
Z3_NODE_0138	915	Open Pipe
Z3_NODE_0140	916	Catch Basin
Z3_NODE_0142	917	Catch Basin
Z3_NODE_0143	918	Catch Basin
Z3_NODE_0144	919	Catch Basin
Z3_NODE_0145	920	Catch Basin
Z3_NODE_0148	921	Manhole
Z3_NODE_0149	922	Catch Basin
Z3_NODE_0150	923	Catch Basin
Z3_NODE_0151	924	Manhole
Z3_NODE_0152	925	Catch Basin
Z3_NODE_0153	926	Catch Basin
Z3_NODE_0154	927	Catch Basin
Z3_NODE_0155	928	Catch Basin
Z3_NODE_0156	929	Catch Basin
Z3_NODE_0158	930	Catch Basin
Z3_NODE_0159	931	Catch Basin
Z3_NODE_0160	932	Manhole
Z3_NODE_0161	933	Catch Basin
Z3_NODE_0166	934	Catch Basin
Z3_NODE_0167	935	Catch Basin
Z3_NODE_0173	936	Catch Basin
Z3_NODE_0174	937	Catch Basin
Z3_NODE_0179	938	Catch Basin
Z3_NODE_0180	939	Catch Basin
Z3_NODE_0182	940	Catch Basin
Z3_NODE_0187	941	Catch Basin
Z3_NODE_0188	942	Catch Basin
Z3_NODE_0189	943	Catch Basin
Z3_NODE_0190	944	Catch Basin
Z3_NODE_0191	945	Manhole
Z3_NODE_0195	946	Catch Basin
Z3_NODE_0196	947	Catch Basin
Z3_NODE_0197	948	Catch Basin
Z3_NODE_0202	949	Manhole
Z3_NODE_0204	950	Catch Basin
Z3_NODE_0205	951	Catch Basin
Z3_NODE_0207	952	Catch Basin
Z3_NODE_0208	953	Catch Basin
Z3_NODE_0210	954	Catch Basin
Z3_NODE_0217	955	Manhole
Z3_NODE_0218	956	Catch Basin
Z3_NODE_0220	957	Catch Basin
Z3_NODE_0221	958	Catch Basin
Z3_NODE_0222	959	Catch Basin
Z3_NODE_0223	960	Catch Basin
Z3_NODE_0226	961	Catch Basin
Z3_NODE_0230	962	Catch Basin
Z3_NODE_0232	963	Catch Basin
Z3_NODE_0233	964	Catch Basin
Z3_NODE_0234	965	Catch Basin
Z3_NODE_0235	966	Catch Basin
Z3_NODE_0236	967	Catch Basin
Z3_NODE_0238	968	Catch Basin
Z3_NODE_0239	969	Catch Basin
Z3_NODE_0240	970	Catch Basin
Z3_NODE_0241	971	Catch Basin
Z3_NODE_0242	972	Catch Basin
Z3_NODE_0243	973	Catch Basin
Z3_NODE_0244	974	Catch Basin
Z3_NODE_0245	975	Catch Basin
Z3_NODE_0246	976	Catch Basin
Z3_NODE_0247	977	Catch Basin
Z3_NODE_0259	978	Catch Basin
Z3_NODE_0260	979	Catch Basin
Z3_NODE_0263	980	Catch Basin
Z3_NODE_0264	981	Open Pipe
Z3_NODE_0269	982	Catch Basin
Z3_NODE_0277	983	Manhole
Z3_NODE_0281	984	Manhole
Z3_NODE_0283	985	Catch Basin
Z3_NODE_0286	986	Catch Basin
Z3_NODE_0287	987	Catch Basin
Z3_NODE_0288	988	Catch Basin
Z3_NODE_0289	989	Catch Basin
Z3_NODE_0290	990	Catch Basin
Z3_NODE_0291	991	Catch Basin
Z3_NODE_0308	992	Catch Basin
Z3_NODE_0311	993	Catch Basin
Z3_NODE_0313	994	Catch Basin
Z3_NODE_0314	995	Manhole
Z4_NODE_0003	996	Manhole
Z4_NODE_0004	997	Catch Basin
Z4_NODE_0009	998	Catch Basin
Z4_NODE_0010	999	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z4_NODE_0011	1000	Catch Basin
Z4_NODE_0013	1001	Catch Basin
Z4_NODE_0015	1002	Catch Basin
Z4_NODE_0017	1003	Catch Basin
Z4_NODE_0018	1004	Catch Basin
Z4_NODE_0019	1005	Catch Basin
Z4_NODE_0021	1006	Catch Basin
Z4_NODE_0022	1007	Open Pipe
Z4_NODE_0024	1008	Open Pipe
Z4_NODE_0025	1009	Catch Basin
Z4_NODE_0026	1010	Catch Basin
Z4_NODE_0027	1011	Catch Basin
Z4_NODE_0028	1012	Catch Basin
Z4_NODE_0029	1013	Catch Basin
Z4_NODE_0034	1014	Catch Basin
Z4_NODE_0035	1015	Catch Basin
Z4_NODE_0039	1016	Catch Basin
Z4_NODE_0040	1017	Catch Basin
Z4_NODE_0042	1018	Catch Basin
Z4_NODE_0043	1019	Open Pipe
Z4_NODE_0045	1020	Catch Basin
Z4_NODE_0046	1021	Catch Basin
Z4_NODE_0047	1022	Open Pipe
Z4_NODE_0048	1023	Open Pipe
Z4_NODE_0058	1024	Open Pipe
Z4_NODE_0060	1025	Catch Basin
Z4_NODE_0061	1026	Catch Basin
Z4_NODE_0062	1027	Open Pipe
Z4_NODE_0071	1028	Manhole
Z4_NODE_0072	1029	Catch Basin
Z4_NODE_0073	1030	Catch Basin
Z4_NODE_0075	1031	Catch Basin
Z4_NODE_0076	1032	Catch Basin
Z4_NODE_0079	1033	Catch Basin
Z4_NODE_0080	1034	Catch Basin
Z4_NODE_0081	1035	Catch Basin
Z4_NODE_0083	1036	Catch Basin
Z4_NODE_0084	1037	Catch Basin
Z4_NODE_0085	1038	Catch Basin
Z4_NODE_0088	1039	Catch Basin
Z4_NODE_0089	1040	Catch Basin
Z4_NODE_0090	1041	Catch Basin
Z4_NODE_0091	1042	Catch Basin
Z4_NODE_0092	1043	Catch Basin
Z4_NODE_0093	1044	Catch Basin

Unique ID	Index	Node Type
Z4_NODE_0096	1045	Open Pipe
Z4_NODE_0098	1046	Catch Basin
Z4_NODE_0100	1047	Catch Basin
Z4_NODE_0102	1048	Catch Basin
Z4_NODE_0103	1049	Catch Basin
Z4_NODE_0104	1050	Manhole
Z4_NODE_0108	1051	Catch Basin
Z4_NODE_0111	1052	Catch Basin
Z4_NODE_0112	1053	Catch Basin
Z4_NODE_0116	1054	Catch Basin
Z4_NODE_0117	1055	Catch Basin
Z4_NODE_0119	1056	Catch Basin
Z4_NODE_0123	1057	Catch Basin
Z4_NODE_0124	1058	Catch Basin
Z4_NODE_0125	1059	Open Pipe
Z4_NODE_0128	1060	Catch Basin
Z4_NODE_0129	1061	Open Pipe
Z4_NODE_0131	1062	Catch Basin
Z4_NODE_0132	1063	Catch Basin
Z4_NODE_0133	1064	Catch Basin
Z4_NODE_0136	1065	Catch Basin
Z4_NODE_0137	1066	Catch Basin
Z4_NODE_0138	1067	Catch Basin
Z4_NODE_0139	1068	Open Pipe
Z4_NODE_0140	1069	Manhole
Z4_NODE_0141	1070	Catch Basin
Z4_NODE_0142	1071	Catch Basin
Z4_NODE_0143	1072	Catch Basin
Z4_NODE_0144	1073	Catch Basin
Z4_NODE_0145	1074	Manhole
Z4_NODE_0146	1075	Manhole
Z4_NODE_0149	1076	Catch Basin
Z4_NODE_0153	1077	Manhole
Z4_NODE_0155	1078	Catch Basin
Z4_NODE_0156	1079	Catch Basin
Z4_NODE_0158	1080	Catch Basin
Z4_NODE_0159	1081	Catch Basin
Z4_NODE_0160	1082	Catch Basin
Z4_NODE_0161	1083	Catch Basin
Z4_NODE_0163	1084	Catch Basin
Z4_NODE_0164	1085	Catch Basin
Z4_NODE_0166	1086	Catch Basin
Z4_NODE_0171	1087	Catch Basin
Z4_NODE_0174	1088	Catch Basin
Z4_NODE_0175	1089	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z4_NODE_0178	1090	Catch Basin
Z4_NODE_0182	1091	Catch Basin
Z4_NODE_0189	1092	Catch Basin
Z4_NODE_0190	1093	Catch Basin
Z4_NODE_0192	1094	Catch Basin
Z4_NODE_0193	1095	Catch Basin
Z4_NODE_0195	1096	Catch Basin
Z4_NODE_0200	1097	Catch Basin
Z4_NODE_0201	1098	Catch Basin
Z4_NODE_0202	1099	Catch Basin
Z4_NODE_0206	1100	Catch Basin
Z4_NODE_0210	1101	Catch Basin
Z4_NODE_0211	1102	Catch Basin
Z4_NODE_0221	1103	Catch Basin
Z4_NODE_0222	1104	Manhole
Z4_NODE_0222	1104	Manhole
Z4_NODE_0222	1105	Manhole
Z4_NODE_0222	1105	Manhole
Z4_NODE_0223	1106	Catch Basin
Z4_NODE_0224	1107	Manhole
Z4_NODE_0226	1108	Catch Basin
Z4_NODE_0230	1109	Catch Basin
Z4_NODE_0233	1110	Catch Basin
Z5_NODE_0001	1111	Catch Basin
Z5_NODE_0002	1112	Catch Basin
Z5_NODE_0003	1113	Catch Basin
Z5_NODE_0005	1114	Manhole
Z5_NODE_0006	1115	Manhole
Z5_NODE_0007	1116	Catch Basin
Z5_NODE_0008	1117	Catch Basin
Z5_NODE_0009	1118	Catch Basin
Z5_NODE_0009	1118	Manhole
Z5_NODE_0009	1119	Catch Basin
Z5_NODE_0009	1119	Manhole
Z5_NODE_0010	1120	Manhole
Z5_NODE_0011	1121	Catch Basin
Z5_NODE_0012	1122	Catch Basin
Z5_NODE_0013	1123	Catch Basin
Z5_NODE_0014	1124	Manhole
Z5_NODE_0015	1125	Catch Basin
Z5_NODE_0016	1126	Manhole
Z5_NODE_0017	1127	Catch Basin
Z5_NODE_0018	1128	Catch Basin
Z5_NODE_0019	1129	Manhole
Z5_NODE_0027	1130	Catch Basin

Unique ID	Index	Node Type
Z5_NODE_0028	1131	Catch Basin
Z5_NODE_0029	1132	Catch Basin
Z5_NODE_0031	1133	Catch Basin
Z5_NODE_0032	1134	Catch Basin
Z5_NODE_0033	1135	Catch Basin
Z5_NODE_0034	1136	Catch Basin
Z5_NODE_0035	1137	Catch Basin
Z5_NODE_0036	1138	Catch Basin
Z5_NODE_0037	1139	Catch Basin
Z5_NODE_0038	1140	Catch Basin
Z5_NODE_0039	1141	Catch Basin
Z5_NODE_0041	1142	Catch Basin
Z5_NODE_0043	1143	Catch Basin
Z5_NODE_0046	1144	Catch Basin
Z5_NODE_0047	1145	Catch Basin
Z5_NODE_0049	1146	Catch Basin
Z5_NODE_0050	1147	Catch Basin
Z5_NODE_0051	1148	Catch Basin
Z5_NODE_0053	1149	Catch Basin
Z5_NODE_0055	1150	Manhole
Z5_NODE_0056	1151	Catch Basin
Z5_NODE_0057	1152	Catch Basin
Z5_NODE_0058	1153	Manhole
Z5_NODE_0061	1154	Catch Basin
Z5_NODE_0062	1155	Catch Basin
Z5_NODE_0064	1156	Catch Basin
Z5_NODE_0066	1157	Catch Basin
Z5_NODE_0067	1158	Catch Basin
Z5_NODE_0068	1159	Catch Basin
Z5_NODE_0069	1160	Catch Basin
Z5_NODE_0070	1161	Manhole
Z5_NODE_0074	1162	Catch Basin
Z5_NODE_0075	1163	Catch Basin
Z5_NODE_0076	1164	Catch Basin
Z5_NODE_0077	1165	Catch Basin
Z5_NODE_0078	1166	Catch Basin
Z5_NODE_0080	1167	Catch Basin
Z5_NODE_0081	1168	Catch Basin
Z5_NODE_0082	1169	Catch Basin
Z5_NODE_0086	1170	Catch Basin
Z5_NODE_0087	1171	Catch Basin
Z5_NODE_0088	1172	Catch Basin
Z5_NODE_0089	1173	Catch Basin
Z5_NODE_0090	1174	Catch Basin
Z5_NODE_0091	1175	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z5_NODE_0092	1176	Catch Basin
Z5_NODE_0094	1177	Manhole
Z5_NODE_0099	1178	Catch Basin
Z5_NODE_0100	1179	Catch Basin
Z5_NODE_0101	1180	Catch Basin
Z5_NODE_0105	1181	Manhole
Z5_NODE_0107	1182	Manhole
Z5_NODE_0109	1183	Manhole
Z5_NODE_0118	1184	Manhole
Z5_NODE_0119	1185	Catch Basin
Z5_NODE_0120	1186	Manhole
Z5_NODE_0122	1187	Catch Basin
Z5_NODE_0123	1188	Catch Basin
Z5_NODE_0126	1189	Manhole
Z5_NODE_0127	1190	Catch Basin
Z5_NODE_0128	1191	Catch Basin
Z5_NODE_0129	1192	Catch Basin
Z5_NODE_0130	1193	Catch Basin
Z5_NODE_0133	1194	Catch Basin
Z5_NODE_0137	1195	Catch Basin
Z5_NODE_0140	1196	Catch Basin
Z5_NODE_0143	1197	Catch Basin
Z5_NODE_0144	1198	Catch Basin
Z5_NODE_0145	1199	Catch Basin
Z5_NODE_0146	1200	Catch Basin
Z5_NODE_0147	1201	Catch Basin
Z5_NODE_0148	1202	Catch Basin
Z5_NODE_0149	1203	Catch Basin
Z5_NODE_0150	1204	Catch Basin
Z5_NODE_0156	1205	Catch Basin
Z5_NODE_0161	1206	Catch Basin
Z5_NODE_0161	1206	Catch Basin
Z5_NODE_0161	1207	Catch Basin
Z5_NODE_0161	1207	Catch Basin
Z5_NODE_0162	1208	Open Pipe
Z5_NODE_0163	1209	Open Pipe
Z5_NODE_0166	1210	Manhole
Z5_NODE_0167	1211	Catch Basin
Z5_NODE_0171	1212	Open Pipe
Z6_NODE_0003	1213	Catch Basin
Z6_NODE_0007	1214	Catch Basin
Z6_NODE_0008	1215	Catch Basin
Z6_NODE_0009	1216	Catch Basin
Z6_NODE_0010	1217	Catch Basin
Z6_NODE_0011	1218	Catch Basin

Unique ID	Index	Node Type
Z6_NODE_0012	1219	Catch Basin
Z6_NODE_0013	1220	Catch Basin
Z6_NODE_0014	1221	Catch Basin
Z6_NODE_0018	1222	Catch Basin
Z6_NODE_0019	1223	Manhole
Z6_NODE_0020	1224	Catch Basin
Z6_NODE_0021	1225	Catch Basin
Z6_NODE_0026	1226	Catch Basin
Z6_NODE_0027	1227	Catch Basin
Z6_NODE_0028	1228	Catch Basin
Z6_NODE_0033	1229	Catch Basin
Z6_NODE_0039	1230	Catch Basin
Z6_NODE_0040	1231	Catch Basin
Z6_NODE_0041	1232	Catch Basin
Z6_NODE_0043	1233	Catch Basin
Z6_NODE_0047	1234	Catch Basin
Z6_NODE_0049	1235	Manhole
Z6_NODE_0055	1236	Catch Basin
Z6_NODE_0056	1237	Manhole
Z6_NODE_0057	1238	Catch Basin
Z6_NODE_0069	1239	Catch Basin
Z6_NODE_0070	1240	Manhole
Z6_NODE_0071	1241	Manhole
Z6_NODE_0073	1242	Catch Basin
Z6_NODE_0074	1243	Manhole
Z6_NODE_0076	1244	Catch Basin
Z6_NODE_0077	1245	Catch Basin
Z6_NODE_0078	1246	Catch Basin
Z6_NODE_0079	1247	Catch Basin
Z6_NODE_0080	1248	Manhole
Z6_NODE_0081	1249	Manhole
Z6_NODE_0082	1250	Catch Basin
Z6_NODE_0083	1251	Catch Basin
Z6_NODE_0084	1252	Catch Basin
Z6_NODE_0086	1253	Catch Basin
Z6_NODE_0087	1254	Catch Basin
Z6_NODE_0088	1255	Manhole
Z6_NODE_0089	1256	Manhole
Z6_NODE_0090	1257	Manhole
Z6_NODE_0091	1258	Manhole
Z6_NODE_0092	1259	Catch Basin
Z6_NODE_0093	1260	Catch Basin
Z6_NODE_0094	1261	Catch Basin
Z6_NODE_0095	1262	Catch Basin
Z6_NODE_0097	1263	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z6_NODE_0098	1264	Catch Basin
Z6_NODE_0099	1265	Catch Basin
Z6_NODE_0104	1266	Manhole
Z6_NODE_0105	1267	Manhole
Z6_NODE_0107	1268	Catch Basin
Z6_NODE_0108	1269	Catch Basin
Z6_NODE_0109	1270	Catch Basin
Z6_NODE_0110	1271	Catch Basin
Z6_NODE_0111	1272	Catch Basin
Z6_NODE_0114	1273	Catch Basin
Z6_NODE_0115	1274	Catch Basin
Z6_NODE_0116	1275	Catch Basin
Z6_NODE_0117	1276	Catch Basin
Z6_NODE_0118	1277	Catch Basin
Z6_NODE_0119	1278	Catch Basin
Z6_NODE_0120	1279	Open Pipe
Z6_NODE_0121	1280	Open Pipe
Z6_NODE_0122	1281	Open Pipe
Z6_NODE_0123	1282	Open Pipe
Z6_NODE_0127	1283	Catch Basin
Z6_NODE_0128	1284	Manhole
Z6_NODE_0129	1285	Catch Basin
Z6_NODE_0130	1286	Catch Basin
Z6_NODE_0136	1287	Catch Basin
Z6_NODE_0142	1288	Catch Basin
Z6_NODE_0150	1289	Catch Basin
Z6_NODE_0151	1290	Catch Basin
Z6_NODE_0152	1291	Manhole
Z6_NODE_0153	1292	Manhole
Z6_NODE_0154	1293	Catch Basin
Z6_NODE_0155	1294	Catch Basin
Z6_NODE_0159	1295	Catch Basin
Z6_NODE_0162	1296	Catch Basin
Z6_NODE_0163	1297	Catch Basin
Z6_NODE_0164	1298	Manhole
Z6_NODE_0166	1299	Catch Basin
Z6_NODE_0167	1300	Manhole
Z6_NODE_0170	1301	Catch Basin
Z6_NODE_0171	1302	Manhole
Z6_NODE_0173	1303	Catch Basin
Z6_NODE_0176	1304	Catch Basin
Z6_NODE_0178	1305	Manhole
Z6_NODE_0180	1306	Catch Basin
Z6_NODE_0181	1307	Catch Basin
Z7_NODE_0002	1308	Catch Basin

Unique ID	Index	Node Type
Z7_NODE_0003	1309	Catch Basin
Z7_NODE_0004	1310	Catch Basin
Z7_NODE_0005	1311	Catch Basin
Z7_NODE_0006	1312	Catch Basin
Z7_NODE_0007	1313	Catch Basin
Z7_NODE_0008	1314	Catch Basin
Z7_NODE_0009	1315	Catch Basin
Z7_NODE_0010	1316	Catch Basin
Z7_NODE_0011	1317	Catch Basin
Z7_NODE_0012	1318	Catch Basin
Z7_NODE_0014	1319	Catch Basin
Z7_NODE_0015	1320	Catch Basin
Z7_NODE_0017	1321	Catch Basin
Z7_NODE_0018	1322	Open Pipe
Z7_NODE_0019	1323	Catch Basin
Z7_NODE_0020	1324	Catch Basin
Z7_NODE_0021	1325	Catch Basin
Z7_NODE_0022	1326	Catch Basin
Z7_NODE_0023	1327	Catch Basin
Z7_NODE_0024	1328	Catch Basin
Z7_NODE_0025	1329	Catch Basin
Z7_NODE_0026	1330	Catch Basin
Z7_NODE_0027	1331	Catch Basin
Z7_NODE_0028	1332	Catch Basin
Z7_NODE_0029	1333	Catch Basin
Z7_NODE_0031	1334	Catch Basin
Z7_NODE_0032	1335	Catch Basin
Z7_NODE_0033	1336	Catch Basin
Z7_NODE_0034	1337	Catch Basin
Z7_NODE_0035	1338	Catch Basin
Z7_NODE_0037	1339	Catch Basin
Z7_NODE_0038	1340	Catch Basin
Z7_NODE_0041	1341	Catch Basin
Z7_NODE_0042	1342	Catch Basin
Z7_NODE_0043	1343	Catch Basin
Z7_NODE_0044	1344	Catch Basin
Z7_NODE_0045	1345	Catch Basin
Z7_NODE_0047	1346	Catch Basin
Z7_NODE_0049	1347	Catch Basin
Z7_NODE_0050	1348	Catch Basin
Z7_NODE_0051	1349	Catch Basin
Z7_NODE_0052	1350	Catch Basin
Z7_NODE_0053	1351	Catch Basin
Z7_NODE_0054	1352	Catch Basin
Z7_NODE_0056	1353	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z7_NODE_0057	1354	Catch Basin
Z7_NODE_0060	1355	Open Pipe
Z7_NODE_0061	1356	Catch Basin
Z7_NODE_0062	1357	Catch Basin
Z7_NODE_0063	1358	Catch Basin
Z7_NODE_0064	1359	Catch Basin
Z7_NODE_0065	1360	Catch Basin
Z7_NODE_0066	1361	Catch Basin
Z7_NODE_0066	1361	Manhole
Z7_NODE_0066	1362	Catch Basin
Z7_NODE_0066	1362	Manhole
Z7_NODE_0067	1363	Catch Basin
Z7_NODE_0069	1364	Catch Basin
Z7_NODE_0070	1365	Manhole
Z7_NODE_0071	1366	Catch Basin
Z7_NODE_0072	1367	Catch Basin
Z7_NODE_0076	1368	Catch Basin
Z7_NODE_0077	1369	Catch Basin
Z7_NODE_0078	1370	Catch Basin
Z7_NODE_0079	1371	Catch Basin
Z7_NODE_0080	1372	Catch Basin
Z7_NODE_0085	1373	Catch Basin
Z7_NODE_0086	1374	Catch Basin
Z7_NODE_0087	1375	Catch Basin
Z7_NODE_0088	1376	Catch Basin
Z7_NODE_0089	1377	Catch Basin
Z7_NODE_0093	1378	Catch Basin
Z7_NODE_0094	1379	Catch Basin
Z7_NODE_0095	1380	Catch Basin
Z7_NODE_0096	1381	Manhole
Z7_NODE_0097	1382	Catch Basin
Z7_NODE_0098	1383	Catch Basin
Z7_NODE_0099	1384	Catch Basin
Z7_NODE_0100	1385	Catch Basin
Z7_NODE_0104	1386	Catch Basin
Z7_NODE_0106	1387	Manhole
Z7_NODE_0107	1388	Catch Basin
Z7_NODE_0108	1389	Catch Basin
Z7_NODE_0109	1390	Catch Basin
Z7_NODE_0110	1391	Catch Basin
Z7_NODE_0111	1392	Open Pipe
Z7_NODE_0112	1393	Catch Basin
Z7_NODE_0115	1394	Catch Basin
Z7_NODE_0116	1395	Catch Basin
Z7_NODE_0117	1396	Catch Basin

Unique ID	Index	Node Type
Z7_NODE_0118	1397	Open Pipe
Z7_NODE_0119	1398	Catch Basin
Z7_NODE_0120	1399	Catch Basin
Z7_NODE_0121	1400	Catch Basin
Z7_NODE_0122	1401	Catch Basin
Z7_NODE_0124	1402	Open Pipe
Z7_NODE_0127	1403	Catch Basin
Z7_NODE_0128	1404	Catch Basin
Z7_NODE_0129	1405	Catch Basin
Z7_NODE_0130	1406	Catch Basin
Z7_NODE_0131	1407	Catch Basin
Z7_NODE_0132	1408	Manhole
Z7_NODE_0133	1409	Catch Basin
Z7_NODE_0134	1410	Catch Basin
Z7_NODE_0138	1411	Manhole
Z7_NODE_0140	1412	Catch Basin
Z7_NODE_0141	1413	Catch Basin
Z7_NODE_0142	1414	Catch Basin
Z7_NODE_0143	1415	Catch Basin
Z7_NODE_0145	1416	Catch Basin
Z7_NODE_0146	1417	Catch Basin
Z7_NODE_0147	1418	Catch Basin
Z7_NODE_0149	1419	Manhole
Z7_NODE_0150	1420	Catch Basin
Z7_NODE_0151	1421	Catch Basin
Z7_NODE_0154	1422	Open Pipe
Z7_NODE_0156	1423	Open Pipe
Z7_NODE_0157	1424	Catch Basin
Z7_NODE_0158	1425	Catch Basin
Z7_NODE_0161	1426	Catch Basin
Z7_NODE_0162	1427	Catch Basin
Z7_NODE_0167	1428	Catch Basin
Z7_NODE_0168	1429	Catch Basin
Z7_NODE_0169	1430	Catch Basin
Z7_NODE_0170	1431	Catch Basin
Z7_NODE_0174	1432	Catch Basin
Z7_NODE_0175	1433	Catch Basin
Z7_NODE_0179	1434	Catch Basin
Z7_NODE_0180	1435	Catch Basin
Z7_NODE_0183	1436	Catch Basin
Z7_NODE_0184	1437	Manhole
Z7_NODE_0185	1438	Catch Basin
Z7_NODE_0186	1439	Catch Basin
Z7_NODE_0187	1440	Catch Basin
Z7_NODE_0188	1441	Open Pipe

Table A.3

Unique ID	Index	Node Type
Z7_NODE_0189	1442	Catch Basin
Z7_NODE_0190	1443	Catch Basin
Z7_NODE_0191	1444	Catch Basin
Z7_NODE_0192	1445	Catch Basin
Z7_NODE_0193	1446	Catch Basin
Z7_NODE_0194	1447	Catch Basin
Z7_NODE_0195	1448	Manhole
Z7_NODE_0196	1449	Manhole
Z7_NODE_0201	1450	Open Pipe
Z7_NODE_0202	1451	Catch Basin
Z7_NODE_0203	1452	Catch Basin
Z7_NODE_0204	1453	Catch Basin
Z7_NODE_0205	1454	Catch Basin
Z7_NODE_0206	1455	Catch Basin
Z7_NODE_0208	1456	Catch Basin
Z7_NODE_0209	1457	Catch Basin
Z7_NODE_0210	1458	Catch Basin
Z7_NODE_0211	1459	Catch Basin
Z7_NODE_0213	1460	Manhole
Z7_NODE_0214	1461	Catch Basin
Z7_NODE_0215	1462	Manhole
Z7_NODE_0219	1463	Catch Basin
Z7_NODE_0220	1464	Catch Basin
Z7_NODE_0222	1465	Catch Basin
Z7_NODE_0223	1466	Catch Basin
Z7_NODE_0224	1467	Catch Basin
Z7_NODE_0226	1468	Catch Basin
Z7_NODE_0227	1469	Catch Basin
Z7_NODE_0230	1470	Catch Basin
Z7_NODE_0231	1471	Catch Basin
Z7_NODE_0233	1472	Catch Basin
Z7_NODE_0234	1473	Catch Basin
Z7_NODE_0236	1474	Catch Basin
Z7_NODE_0237	1475	Catch Basin
Z7_NODE_0241	1476	Catch Basin
Z7_NODE_0242	1477	Catch Basin
Z7_NODE_0243	1478	Catch Basin
Z7_NODE_0244	1479	Catch Basin
Z7_NODE_0245	1480	Catch Basin
Z7_NODE_0247	1481	Catch Basin
Z7_NODE_0248	1482	Catch Basin
Z7_NODE_0250	1483	Catch Basin
Z7_NODE_0251	1484	Catch Basin
Z7_NODE_0254	1485	Manhole
Z7_NODE_0255	1486	Catch Basin
Z7_NODE_0256	1487	Catch Basin
Z7_NODE_0261	1488	Catch Basin
Z7_NODE_0263	1489	Open Pipe
Z7_NODE_0264	1490	Manhole
Z7_NODE_0266	1491	Catch Basin
Z7_NODE_0267	1492	Catch Basin
Z7_NODE_0268	1493	Catch Basin
Z7_NODE_0269	1494	Catch Basin
Z7_NODE_0270	1495	Catch Basin
Z7_NODE_0278	1496	Catch Basin
Z7_NODE_0279	1497	Catch Basin
Z7_NODE_0280	1498	Catch Basin
Z7_NODE_0282	1499	Catch Basin
Z7_NODE_0282	1499	Catch Basin
Z7_NODE_0282	1500	Catch Basin
Z7_NODE_0282	1500	Catch Basin
Z7_NODE_0283	1501	Manhole
Z7_NODE_0284	1502	Manhole
Z7_NODE_0287	1503	Catch Basin
Z7_NODE_0289	1504	Catch Basin
Z7_NODE_0290	1505	Catch Basin
Z7_NODE_0291	1506	Catch Basin
Z7_NODE_0292	1507	Catch Basin
Z7_NODE_0293	1508	Catch Basin
Z7_NODE_0294	1509	Manhole
Z7_NODE_0296	1510	Catch Basin
Z7_NODE_0297	1511	Catch Basin
Z7_NODE_0298	1512	Catch Basin
Z7_NODE_0300	1513	Catch Basin
Z7_NODE_0301	1514	Catch Basin
Z7_NODE_0302	1515	Catch Basin
Z7_NODE_0303	1516	Catch Basin
Z7_NODE_0304	1517	Catch Basin
Z7_NODE_0305	1518	Open Pipe
Z7_NODE_0309	1519	Catch Basin
Z7_NODE_0310	1520	Catch Basin
Z7_NODE_0311	1521	Catch Basin
Z7_NODE_0312	1522	Catch Basin
Z7_NODE_0313	1523	Catch Basin
Z7_NODE_0314	1524	Catch Basin
Z7_NODE_0315	1525	Catch Basin
Z7_NODE_0316	1526	Catch Basin
Z7_NODE_0317	1527	Catch Basin
Z7_NODE_0318	1528	Catch Basin
Z7_NODE_0319	1529	Catch Basin

Table A.3

Unique ID	Index	Node Type
Z7_NODE_0320	1530	Open Pipe
Z7_NODE_0321	1531	Open Pipe
Z7_NODE_0324	1532	Open Pipe
Z7_NODE_0326	1533	Catch Basin
Z7_NODE_0327	1534	Catch Basin
Z7_NODE_0338	1535	Manhole
Z7_NODE_0339	1536	Catch Basin
Z7_NODE_0340	1537	Catch Basin
Z7_NODE_0344	1538	Open Pipe
Z7_NODE_0349	1539	Catch Basin
Z8_NODE_0006	1540	Manhole
Z8_NODE_0007	1541	Manhole
Z8_NODE_0008	1542	Manhole
Z8_NODE_0009	1543	Catch Basin
Z8_NODE_0010	1544	Catch Basin
Z8_NODE_0011	1545	Catch Basin
Z8_NODE_0013	1546	Catch Basin
Z8_NODE_0014	1547	Catch Basin
Z8_NODE_0015	1548	Catch Basin
Z8_NODE_0016	1549	Catch Basin
Z8_NODE_0017	1550	Catch Basin
Z8_NODE_0018	1551	Catch Basin
Z8_NODE_0020	1552	Catch Basin
Z8_NODE_0021	1553	Catch Basin
Z8_NODE_0022	1554	Catch Basin
Z8_NODE_0024	1555	Catch Basin
Z8_NODE_0025	1556	Catch Basin
Z8_NODE_0026	1557	Catch Basin
Z8_NODE_0027	1558	Catch Basin
Z8_NODE_0029	1559	Catch Basin
Z8_NODE_0030	1560	Catch Basin
Z8_NODE_0031	1561	Catch Basin
Z8_NODE_0032	1562	Catch Basin
Z8_NODE_0033	1563	Catch Basin
Z8_NODE_0034	1564	Catch Basin
Z8_NODE_0036	1565	Catch Basin
Z8_NODE_0037	1566	Catch Basin
Z8_NODE_0038	1567	Catch Basin
Z8_NODE_0040	1568	Catch Basin
Z8_NODE_0041	1569	Catch Basin
Z8_NODE_0042	1570	Catch Basin
Z8_NODE_0044	1571	Catch Basin
Z8_NODE_0045	1572	Catch Basin
Z8_NODE_0046	1573	Catch Basin
Z8_NODE_0047	1574	Catch Basin

Unique ID	Index	Node Type
Z8_NODE_0048	1575	Catch Basin
Z8_NODE_0050	1576	Manhole
Z8_NODE_0052	1577	Catch Basin
Z8_NODE_0053	1578	Catch Basin
Z8_NODE_0055	1579	Catch Basin
Z8_NODE_0056	1580	Catch Basin
Z8_NODE_0059	1581	Catch Basin
Z8_NODE_0060	1582	Manhole
Z8_NODE_0061	1583	Catch Basin
Z8_NODE_0062	1584	Catch Basin
Z8_NODE_0064	1585	Catch Basin
Z8_NODE_0065	1586	Catch Basin
Z8_NODE_0066	1587	Catch Basin
Z8_NODE_0068	1588	Catch Basin
Z8_NODE_0069	1589	Catch Basin
Z8_NODE_0070	1590	Catch Basin
Z8_NODE_0071	1591	Catch Basin
Z8_NODE_0073	1592	Catch Basin
Z8_NODE_0075	1593	Catch Basin
Z8_NODE_0076	1594	Catch Basin
Z8_NODE_0077	1595	Catch Basin
Z8_NODE_0078	1596	Manhole
Z8_NODE_0079	1597	Catch Basin
Z8_NODE_0080	1598	Catch Basin
Z8_NODE_0081	1599	Catch Basin
Z8_NODE_0082	1600	Catch Basin
Z8_NODE_0083	1601	Catch Basin
Z8_NODE_0091	1602	Catch Basin
Z8_NODE_0092	1603	Catch Basin
Z8_NODE_0096	1604	Catch Basin
Z8_NODE_0097	1605	Catch Basin
Z8_NODE_0098	1606	Open Pipe
Z8_NODE_0099	1607	Open Pipe
Z8_NODE_0100	1608	Catch Basin
Z8_NODE_0104	1609	Catch Basin
Z8_NODE_0110	1610	Manhole
Z8_NODE_0113	1611	Catch Basin
Z8_NODE_0114	1612	Catch Basin
Z8_NODE_0120	1613	Catch Basin
Z8_NODE_0121	1614	Open Pipe
Z8_NODE_0125	1615	Catch Basin
Z8_NODE_0127	1616	Catch Basin
Z8_NODE_0128	1617	Catch Basin
Z8_NODE_0129	1618	Catch Basin
Z8_NODE_0139	1619	Open Pipe

Table A.3

Unique ID	Index	Node Type
Z8_NODE_0141	1620	Catch Basin
Z8_NODE_0149	1621	Catch Basin
Z8_NODE_0150	1622	Manhole
Z8_NODE_0151	1623	Catch Basin
Z8_NODE_0152	1624	Catch Basin
Z9_NODE_0004	1626	Open Pipe
Z9_NODE_0008	1627	Catch Basin
Z9_NODE_0009	1628	Catch Basin
Z9_NODE_0010	1629	Catch Basin
Z9_NODE_0011	1630	Catch Basin

Table A.4

Unique ID	Index	Link Type
6_LINK_0048	1	Pipe
IMP_LINK_002	2	Pipe
L-0001	3	Pipe
L-0002	4	Pipe
L-0003	5	Pipe
L-0004	6	Pipe
L-0006	7	Pipe
L-0007	8	Pipe
L-0008	9	Pipe
L-0009	10	Pipe
L-0010	11	Pipe
L-0011	12	Pipe
L-0012	13	Pipe
L-0013	14	Pipe
L-0014	15	Pipe
L-0015	16	Pipe
L-0016	17	Pipe
L-0017	18	Pipe
L-0018	19	Pipe
L-0019	20	Pipe
L-0020	21	Pipe
L-0021	22	Culvert
L-0022	23	Culvert
L-0023	24	Pipe
L-0024	25	Pipe
L-0025	26	Pipe
L-0026	27	Culvert
L-0027	28	Pipe
L-0028	29	Pipe
L-0029	30	Pipe
L-0030	31	Pipe
L-0031	32	Culvert
L-0032	33	Pipe
L-0033	34	Pipe
L-0034	35	Pipe
L-0035	36	Pipe
L-0036	37	Pipe
L-0037	38	Pipe
L-0038	39	Pipe
L-0039	40	Pipe
L-0040	41	Pipe
L-0041	42	V-ditch
L-0042	43	Pipe
L-0043	44	Pipe
L-0044	45	Pipe

Unique ID	Index	Link Type
L-0045	46	V-ditch
L-0046	47	V-ditch
L-0047	48	Pipe
L-0048	49	Pipe
L-0049	50	Pipe
L-0050	51	Pipe
L-0051	52	Culvert
L-0052	53	Culvert
L-0053	54	Pipe
L-0054	55	Pipe
L-0055	56	Pipe
L-0056	57	Pipe
L-0057	58	Pipe
L-0058	59	Pipe
L-0059	60	Pipe
L-0060	61	Pipe
L-0061	62	Pipe
L-0062	63	Pipe
L-0063	64	Pipe
L-0064	65	Pipe
L-0065	66	Pipe
L-0066	67	Pipe
L-0067	68	Pipe
L-0068	69	Pipe
L-0069	70	Pipe
L-0070	71	Pipe
L-0071	72	Pipe
L-0072	73	Pipe
L-0073	74	Pipe
L-0074	75	Pipe
L-0075	76	Pipe
L-0076	77	Pipe
L-0077	78	Pipe
L-0078	79	Pipe
L-0079	80	Pipe
L-0080	81	Pipe
L-0081	82	Pipe
L-0082	83	Pipe
L-0083	84	Pipe
L-0084	85	Pipe
L-0085	86	Pipe
L-0086	87	Pipe
L-0087	88	Pipe
L-0088	89	Pipe
L-0089	90	Pipe

Table A.4

Unique ID	Index	Link Type
L-0090	91	Pipe
L-0091	92	Pipe
L-0092	93	Pipe
L-0093	94	Pipe
L-0094	95	Pipe
L-0095	96	Pipe
L-0096	97	Pipe
L-0097	98	Pipe
L-0098	99	Pipe
L-0099	100	Pipe
L-0100	101	Pipe
L-0101	102	Pipe
L-0102	103	Pipe
L-0103	104	Pipe
L-0104	105	Culvert
L-0105	106	Culvert
L-0106	107	Pipe
L-0107	108	Pipe
L-0108	109	Pipe
L-0109	110	Pipe
L-0110	111	Pipe
L-0111	112	Pipe
L-0112	113	Pipe
L-0113	114	Pipe
L-0114	115	Pipe
L-0115	116	Pipe
L-0116	117	Pipe
L-0117	118	Culvert
L-0118	119	Pipe
L-0119	120	Pipe
L-0120	121	Pipe
L-0121	122	Pipe
L-0122	123	Pipe
L-0123	124	Pipe
L-0124	125	Pipe
L-0125	126	Pipe
L-0126	127	Pipe
L-0127	128	Pipe
L-0128	129	Pipe
L-0129	130	Pipe
L-0130	131	Culvert
L-0131	132	Culvert
L-0132	133	Culvert
L-0133	134	Pipe
L-0134	135	Pipe

Unique ID	Index	Link Type
L-0135	136	Pipe
L-0136	137	Pipe
L-0137	138	Culvert
L-0138	139	Pipe
L-0139	140	Pipe
L-0140	141	Pipe
L-0141	142	Pipe
L-0142	143	Pipe
L-0143	144	Pipe
L-0144	145	Pipe
L-0145	146	Pipe
L-0146	147	Pipe
L-0147	148	Pipe
L-0148	149	Pipe
L-0149	150	Pipe
L-0150	151	Pipe
L-0151	152	Pipe
L-0152	153	Pipe
L-0153	154	Pipe
L-0154	155	Pipe
L-0155	156	Pipe
L-0156	157	Pipe
L-0157	158	Pipe
L-0158	159	Pipe
L-0159	160	Pipe
L-0160	161	Pipe
L-0161	162	Pipe
L-0162	163	Pipe
L-0163	164	Pipe
L-0164	165	Pipe
L-0165	166	Pipe
L-0166	167	Pipe
L-0167	168	Pipe
L-0168	169	Pipe
L-0169	170	Pipe
L-0170	171	V-ditch
L-0171	172	Pipe
L-0172	173	Pipe
L-0173	174	Pipe
L-0174	175	Pipe
L-0175	176	Pipe
L-0176	177	Pipe
L-0177	178	Pipe
L-0178	179	Pipe
L-0179	180	Pipe

Table A.4

Unique ID	Index	Link Type
L-0180	181	Pipe
L-0181	182	Pipe
L-0182	183	Pipe
L-0183	184	Pipe
L-0184	185	Pipe
L-0185	186	Pipe
L-0186	187	Pipe
L-0187	188	Pipe
L-0188	189	Pipe
L-0189	190	Pipe
L-0190	191	Pipe
L-0191	192	Pipe
L-0192	193	Pipe
L-0193	194	Pipe
L-0194	195	Pipe
L-0195	196	Pipe
L-0196	197	Pipe
L-0197	198	Culvert
L-0198	199	Pipe
L-0199	200	Pipe
L-0200	201	Culvert
L-0201	202	Culvert
L-0202	203	Pipe
L-0203	204	Pipe
L-0204	205	Pipe
L-0205	206	Culvert
L-0206	207	Pipe
L-0207	208	Pipe
L-0208	209	Pipe
L-0209	210	Pipe
L-0210	211	Pipe
L-0211	212	Pipe
L-0212	213	Pipe
L-0213	214	Pipe
L-0214	215	Pipe
L-0215	216	Pipe
L-0216	217	Pipe
L-0217	218	Pipe
L-0218	219	Ditch
L-0219	220	Pipe
L-0220	221	Pipe
L-0221	222	Pipe
L-0222	223	Pipe
L-0223	224	Pipe
L-0224	225	Pipe

Unique ID	Index	Link Type
L-0225	226	Pipe
L-0226	227	Pipe
L-0227	228	Pipe
L-0228	229	Pipe
L-0229	230	Pipe
L-0230	231	Pipe
L-0231	232	Pipe
L-0232	233	Pipe
L-0233	234	Culvert
L-0234	235	Pipe
L-0235	236	Culvert
L-0236	237	Pipe
L-0237	238	Pipe
L-0238	239	Pipe
L-0239	240	Pipe
L-0240	241	Pipe
L-0241	242	Pipe
L-0242	243	Pipe
L-0243	244	Pipe
L-0244	245	Pipe
L-0245	246	Pipe
L-0246	247	Ditch
L-0247	248	Pipe
L-0248	249	Pipe
L-0249	250	Pipe
L-0250	251	Pipe
L-0251	252	Pipe
L-0252	253	Pipe
L-0253	254	Pipe
L-0254	255	Pipe
L-0255	256	Pipe
L-0256	257	Pipe
L-0257	258	Pipe
L-0258	259	Pipe
L-0259	260	Pipe
L-0260	261	Pipe
L-0261	262	Pipe
L-0262	263	Pipe
L-0263	264	Pipe
L-0264	265	Pipe
L-0265	266	Pipe
L-0266	267	Pipe
L-0267	268	Pipe
L-0268	269	Pipe
L-0269	270	Pipe

Table A.4

Unique ID	Index	Link Type
L-0270	271	Pipe
L-0271	272	Pipe
L-0272	273	Pipe
L-0273	274	Pipe
L-0274	275	Pipe
L-0275	276	Pipe
L-0276	277	Pipe
L-0277	278	Pipe
L-0278	279	Pipe
L-0279	280	Pipe
L-0280	281	Pipe
L-0281	282	Pipe
L-0282	283	Pipe
L-0283	284	Pipe
L-0284	285	Pipe
L-0285	286	Pipe
L-0286	287	Pipe
L-0287	288	Pipe
L-0288	289	Pipe
L-0289	290	Pipe
L-0290	291	Pipe
L-0291	292	Pipe
L-0292	293	Pipe
L-0293	294	Pipe
L-0294	295	Pipe
L-0295	296	Pipe
L-0296	297	Pipe
L-0297	298	Pipe
L-0298	299	Pipe
L-0299	300	Culvert
L-0300	301	Culvert
L-0301	302	Pipe
L-0302	303	Pipe
L-0303	304	Pipe
L-0304	305	Pipe
L-0305	306	Pipe
L-0306	307	Pipe
L-0307	308	Culvert
L-0308	309	Pipe
L-0309	310	Pipe
L-0310	311	Pipe
L-0311	312	Pipe
L-0312	313	Pipe
L-0313	314	Pipe
L-0314	315	Pipe

Unique ID	Index	Link Type
L-0315	316	Pipe
L-0316	317	Culvert
L-0317	318	Culvert
L-0318	319	Culvert
L-0319	320	Pipe
L-0320	321	Pipe
L-0321	322	Pipe
L-0322	323	Pipe
L-0323	324	Pipe
L-0324	325	Pipe
L-0325	326	Pipe
L-0326	327	Pipe
L-0327	328	Pipe
L-0328	329	Pipe
L-0329	330	Pipe
L-0330	331	Pipe
L-0331	332	Pipe
L-0332	333	Pipe
L-0333	334	Pipe
L-0334	335	Pipe
L-0335	336	Pipe
L-0336	337	Pipe
L-0337	338	Pipe
L-0338	339	Pipe
L-0339	340	Culvert
L-0340	341	Pipe
L-0341	342	Pipe
L-0342	343	Pipe
L-0343	344	Pipe
L-0344	345	Pipe
L-0345	346	Pipe
L-0346	347	Pipe
L-0347	348	Culvert
L-0348	349	Pipe
L-0349	350	Pipe
L-0350	351	Pipe
L-0351	352	Pipe
L-0352	353	Pipe
L-0353	354	Culvert
L-0354	355	Culvert
L-0355	356	Pipe
L-0356	357	Pipe
L-0357	358	Pipe
L-0358	359	Pipe
L-0359	360	Culvert

Table A.4

Unique ID	Index	Link Type
L-0360	361	Culvert
L-0361	362	Pipe
L-0362	363	Culvert
L-0363	364	Pipe
L-0364	365	Pipe
L-0365	366	Pipe
L-0366	367	Pipe
L-0367	368	Pipe
L-0368	369	Culvert
L-0369	370	Pipe
L-0370	371	Pipe
L-0371	372	Pipe
L-0372	373	Pipe
L-0373	374	Pipe
L-0374	375	Pipe
L-0375	376	Pipe
L-0376	377	Pipe
L-0377	378	Pipe
L-0378	379	Pipe
L-0379	380	Pipe
L-0380	381	Pipe
L-0381	382	Pipe
L-0382	383	Pipe
L-0383	384	Pipe
L-0384	385	Pipe
L-0385	386	Pipe
L-0386	387	Pipe
L-0387	388	Pipe
L-0388	389	Pipe
L-0389	390	Pipe
L-0390	391	Pipe
L-0391	392	Pipe
L-0392	393	Pipe
L-0393	394	Ditch
L-0394	395	Pipe
L-0395	396	Pipe
L-0396	397	Pipe
L-0397	398	Pipe
L-0398	399	Pipe
L-0399	400	Pipe
L-0400	401	Pipe
L-0401	402	Pipe
L-0402	403	Pipe
L-0403	404	Pipe
L-0404	405	Pipe

Unique ID	Index	Link Type
L-0405	406	Pipe
L-0406	407	Pipe
L-0407	408	Pipe
L-0408	409	Pipe
L-0409	410	Pipe
L-0410	411	Pipe
L-0411	412	V-ditch
L-0412	413	Pipe
L-0413	414	Pipe
L-0414	415	Pipe
L-0415	416	Pipe
L-0416	417	Pipe
L-0417	418	V-ditch
L-0418	419	Pipe
L-0419	420	Pipe
L-0420	421	Pipe
L-0421	422	Pipe
L-0422	423	Pipe
L-0423	424	V-ditch
L-0424	425	V-ditch
L-0425	426	Pipe
L-0426	427	Pipe
L-0427	428	V-ditch
L-0428	429	V-ditch
L-0429	430	Pipe
L-0430	431	Pipe
L-0431	432	Pipe
L-0432	433	Pipe
L-0433	434	Pipe
L-0434	435	Pipe
L-0435	436	V-ditch
L-0436	437	V-ditch
L-0437	438	V-ditch
L-0438	439	Pipe
L-0439	440	V-ditch
L-0440	441	V-ditch
L-0441	442	V-ditch
L-0442	443	Pipe
L-0443	444	V-ditch
L-0444	445	Pipe
L-0445	446	V-ditch
L-0446	447	Pipe
L-0447	448	V-ditch
L-0448	449	Pipe
L-0449	450	V-ditch

Table A.4

Unique ID	Index	Link Type
L-0450	451	Pipe
L-0451	452	V-ditch
L-0452	453	Pipe
L-0453	454	Pipe
L-0454	455	Pipe
L-0455	456	V-ditch
L-0456	457	Pipe
L-0457	458	Pipe
L-0458	459	Pipe
L-0459	460	Pipe
L-0460	461	Pipe
L-0461	462	V-ditch
L-0462	463	V-ditch
L-0463	464	Pipe
L-0464	465	Pipe
L-0465	466	Pipe
L-0466	467	Pipe
L-0467	468	Pipe
L-0468	469	Pipe
L-0469	470	Pipe
L-0470	471	Pipe
L-0471	472	Pipe
L-0472	473	Pipe
L-0473	474	Pipe
L-0474	475	Pipe
L-0475	476	Pipe
L-0476	477	Pipe
L-0477	478	Pipe
L-0478	479	Pipe
L-0479	480	Pipe
L-0480	481	Pipe
L-0481	482	Pipe
L-0482	483	Pipe
L-0483	484	Pipe
L-0484	485	Pipe
L-0485	486	Pipe
L-0486	487	V-ditch
L-0487	488	V-ditch
L-0488	489	Pipe
L-0489	490	Pipe
L-0490	491	V-ditch
L-0491	492	V-ditch
L-0492	493	Pipe
L-0493	494	Pipe
L-0494	495	Pipe

Unique ID	Index	Link Type
L-0495	496	Pipe
L-0496	497	V-ditch
L-0497	498	V-ditch
L-0498	499	Pipe
L-0499	500	Pipe
L-0500	501	Pipe
L-0501	502	Pipe
L-0502	503	Pipe
L-0503	504	Ditch
L-0504	505	Pipe
L-0505	506	Pipe
L-0506	507	Ditch
L-0507	508	Pipe
L-0508	509	Pipe
L-0509	510	Pipe
L-0510	511	Pipe
L-0511	512	Pipe
L-0512	513	Pipe
L-0513	514	Pipe
L-0514	515	Culvert
L-0515	516	Pipe
L-0516	517	Pipe
L-0517	518	Pipe
L-0518	519	Pipe
L-0519	520	Pipe
L-0520	521	V-ditch
L-0521	522	Pipe
L-0522	523	V-ditch
L-0523	524	Pipe
L-0524	525	V-ditch
L-0525	526	V-ditch
L-0526	527	V-ditch
L-0527	528	V-ditch
L-0528	529	V-ditch
L-0529	530	V-ditch
L-0530	531	V-ditch
L-0531	532	V-ditch
L-0532	533	Pipe
L-0533	534	Pipe
L-0534	535	Pipe
L-0535	536	V-ditch
L-0536	537	V-ditch
L-0537	538	Pipe
L-0538	539	Pipe
L-0539	540	V-ditch

Table A.4

Unique ID	Index	Link Type
L-0540	541	V-ditch
L-0541	542	V-ditch
L-0542	543	Pipe
L-0543	544	Pipe
L-0544	545	Pipe
L-0545	546	Pipe
L-0546	547	Pipe
L-0547	548	Pipe
L-0548	549	Pipe
L-0549	550	Pipe
L-0550	551	Pipe
L-0551	552	V-ditch
L-0552	553	Pipe
L-0553	554	V-ditch
L-0554	555	V-ditch
L-0555	556	V-ditch
L-0556	557	V-ditch
L-0557	558	Pipe
L-0558	559	V-ditch
L-0559	560	Pipe
L-0560	561	Pipe
L-0561	562	V-ditch
L-0562	563	Pipe
L-0563	564	Pipe
L-0564	565	V-ditch
L-0565	566	V-ditch
L-0566	567	Pipe
L-0567	568	V-ditch
L-0568	569	V-ditch
L-0569	570	V-ditch
L-0570	571	Pipe
L-0571	572	Pipe
L-0572	573	Pipe
L-0573	574	V-ditch
L-0574	575	Pipe
L-0575	576	Pipe
L-0576	577	Pipe
L-0577	578	V-ditch
L-0578	579	Pipe
L-0579	580	V-ditch
L-0580	581	V-ditch
L-0581	582	Pipe
L-0582	583	V-ditch
L-0583	584	V-ditch
L-0584	585	Pipe

Unique ID	Index	Link Type
L-0585	586	Pipe
L-0586	587	V-ditch
L-0587	588	V-ditch
L-0588	589	V-ditch
L-0589	590	V-ditch
L-0590	591	Pipe
L-0591	592	Pipe
L-0592	593	V-ditch
L-0593	594	Pipe
L-0594	595	Pipe
L-0595	596	V-ditch
L-0596	597	Pipe
L-0597	598	Pipe
L-0598	599	V-ditch
L-0599	600	V-ditch
L-0600	601	Pipe
L-0601	602	Culvert
L-0602	603	Pipe
L-0603	604	V-ditch
L-0604	605	Pipe
L-0605	606	Pipe
L-0606	607	Pipe
L-0607	608	Pipe
L-0608	609	Pipe
L-0609	610	Pipe
L-0610	611	Pipe
L-0611	612	Pipe
L-0612	613	Pipe
L-0613	614	Pipe
L-0614	615	Culvert
L-0615	616	Pipe
L-0616	617	Pipe
L-0617	618	Pipe
L-0618	619	Pipe
L-0619	620	Pipe
L-0620	621	Pipe
L-0621	622	Pipe
L-0622	623	Pipe
L-0623	624	Pipe
L-0624	625	Pipe
L-0625	626	Pipe
L-0626	627	Pipe
L-0627	628	Pipe
L-0628	629	Pipe
L-0629	630	Pipe

Table A.4

Unique ID	Index	Link Type
L-0630	631	Pipe
L-0631	632	Pipe
L-0632	633	Pipe
L-0633	634	Pipe
L-0634	635	Pipe
L-0635	636	Pipe
L-0636	637	Pipe
L-0637	638	Pipe
L-0638	639	Pipe
L-0639	640	Pipe
L-0640	641	Culvert
L-0641	642	Pipe
L-0642	643	Pipe
L-0643	644	Pipe
L-0644	645	Pipe
L-0645	646	Pipe
L-0646	647	Pipe
L-0647	648	Pipe
L-0648	649	Pipe
L-0649	650	Pipe
L-0650	651	Pipe
L-0651	652	Pipe
L-0652	653	Pipe
L-0653	654	Pipe
L-0654	655	Pipe
L-0655	656	Pipe
L-0656	657	Pipe
L-0657	658	Pipe
L-0658	659	Pipe
L-0659	660	Pipe
L-0660	661	Pipe
L-0661	662	Pipe
L-0662	663	Pipe
L-0663	664	Pipe
L-0664	665	Pipe
L-0665	666	Pipe
L-0666	667	Pipe
L-0667	668	Pipe
L-0668	669	Pipe
L-0669	670	Pipe
L-0670	671	Pipe
L-0671	672	Pipe
L-0672	673	Pipe
L-0673	674	Pipe
L-0674	675	Pipe

Unique ID	Index	Link Type
L-0675	676	Pipe
L-0676	677	Pipe
L-0677	678	Pipe
L-0678	679	Pipe
L-0679	680	Pipe
L-0680	681	Pipe
L-0681	682	Pipe
L-0682	683	Pipe
L-0683	684	Pipe
L-0684	685	Pipe
L-0685	686	V-ditch
L-0686	687	V-ditch
L-0687	688	V-ditch
L-0688	689	V-ditch
L-0689	690	V-ditch
L-0690	691	V-ditch
L-0691	692	V-ditch
L-0692	693	Culvert
L-0693	694	Culvert
L-0694	695	V-ditch
Z1_LINK_0001	714	Pipe
Z1_LINK_0002	715	Pipe
Z1_LINK_0005	716	Pipe
Z1_LINK_0005a	717	Pipe
Z1_LINK_0007	718	Pipe
Z1_LINK_0012	719	Pipe
Z1_LINK_0013	720	Pipe
Z1_LINK_0014	721	Pipe
Z1_LINK_0015	722	Pipe
Z1_LINK_0016	723	Pipe
Z1_LINK_0017	724	Pipe
Z1_LINK_0018	725	Pipe
Z1_LINK_0019	726	Pipe
Z1_LINK_0020	727	Pipe
Z1_LINK_0021	728	Pipe
Z1_LINK_0024	729	Pipe
Z1_LINK_0026	730	Pipe
Z1_LINK_0027	731	Pipe
Z1_LINK_0028	732	Pipe
Z1_LINK_0029	733	Pipe
Z1_LINK_0030	734	Pipe
Z1_LINK_0031	735	Pipe
Z1_LINK_0032	736	Pipe
Z1_LINK_0033	737	Pipe
Z1_LINK_0034	738	Pipe

Table A.4

Unique ID	Index	Link Type
Z1_LINK_0035	739	Pipe
Z1_LINK_0036	740	Pipe
Z1_LINK_0039	741	Pipe
Z1_LINK_0040	742	Pipe
Z1_LINK_0041	743	Pipe
Z1_LINK_0043	744	Pipe
Z1_LINK_0044	745	Pipe
Z1_LINK_0045	746	Pipe
Z1_LINK_0046	747	Pipe
Z1_LINK_0047	748	Pipe
Z1_LINK_0048	749	Pipe
Z1_LINK_0049	750	Pipe
Z1_LINK_0049a	751	Pipe
Z1_LINK_0050	752	Pipe
Z1_LINK_0051	753	Pipe
Z1_LINK_0052	754	Pipe
Z1_LINK_0053	755	Pipe
Z1_LINK_0054	756	Pipe
Z1_LINK_0055	757	Pipe
Z1_LINK_0056	758	Pipe
Z1_LINK_0062	759	Pipe
Z1_LINK_0063	760	Pipe
Z1_LINK_0064	761	Pipe
Z1_LINK_0067	762	Pipe
Z1_LINK_0073	763	Pipe
Z1_LINK_0075	764	Pipe
Z1_LINK_0078	765	Pipe
Z1_LINK_0082	766	Pipe
Z1_LINK_0084	767	Pipe
Z1_LINK_0084a	768	Pipe
Z1_LINK_0085	769	Pipe
Z1_LINK_0087	770	Pipe
Z1_LINK_0088	771	Pipe
Z1_LINK_0089	772	Pipe
Z1_LINK_0091	773	Pipe
Z1_LINK_0092	774	Pipe
Z1_LINK_0094	775	Pipe
Z1_LINK_0096	776	Pipe
Z1_LINK_0097	777	Pipe
Z1_LINK_0098	778	Pipe
Z1_LINK_0099	779	Pipe
Z1_LINK_0100	780	Pipe
Z1_LINK_0101	781	Pipe
Z1_LINK_0102	782	Pipe
Z1_LINK_0103	783	Pipe

Unique ID	Index	Link Type
Z1_LINK_0104	784	Pipe
Z1_LINK_0105	785	Pipe
Z1_LINK_0106	786	Pipe
Z1_LINK_0107	787	Pipe
Z1_LINK_0109	788	Pipe
Z1_LINK_0110	789	Pipe
Z1_LINK_0113	790	Pipe
Z1_LINK_0115	791	Pipe
Z1_LINK_0116	792	Pipe
Z1_LINK_0118	793	Pipe
Z1_LINK_0119	794	Pipe
Z1_LINK_0120	795	Pipe
Z1_LINK_0121	796	Pipe
Z1_LINK_0124	797	Pipe
Z1_LINK_0125	798	Pipe
Z1_LINK_0126	799	Pipe
Z1_LINK_0127	800	Pipe
Z1_LINK_0128	801	Pipe
Z1_LINK_0130	802	Pipe
Z1_LINK_0131	803	Pipe
Z1_LINK_0132	804	Pipe
Z1_LINK_0133	805	Pipe
Z1_LINK_0134	806	Pipe
Z1_LINK_0135	807	Pipe
Z1_LINK_0136	808	Pipe
Z1_LINK_0137	809	Pipe
Z1_LINK_0139	810	Pipe
Z1_LINK_0140	811	Pipe
Z1_LINK_0141	812	Pipe
Z1_LINK_0141a	813	Pipe
Z1_LINK_0142	814	Pipe
Z1_LINK_0143	815	Pipe
Z1_LINK_0144	816	Pipe
Z1_LINK_0145	817	Pipe
Z1_LINK_0147	818	Pipe
Z1_LINK_0149	819	Pipe
Z1_LINK_0150	820	Pipe
Z1_LINK_0151	821	Pipe
Z1_LINK_0152	822	Pipe
Z1_LINK_0153	823	Pipe
Z1_LINK_0154	824	Pipe
Z1_LINK_0155	825	Pipe
Z1_LINK_0157	826	Pipe
Z1_LINK_0158	827	Pipe
Z1_LINK_0159	828	Pipe

Table A.4

Unique ID	Index	Link Type
Z1_LINK_0161	829	Pipe
Z1_LINK_0162	830	Pipe
Z1_LINK_0163	831	Pipe
Z1_LINK_0164	832	Pipe
Z1_LINK_0165	833	Pipe
Z1_LINK_0166	834	Pipe
Z1_LINK_0169	835	Pipe
Z1_LINK_0170	836	Pipe
Z1_LINK_0171	837	Pipe
Z1_LINK_0172	838	Pipe
Z1_LINK_0173	839	Pipe
Z1_LINK_0174	840	Pipe
Z1_LINK_0175	841	Pipe
Z1_LINK_0176	842	Pipe
Z1_LINK_0177	843	Pipe
Z1_LINK_0179	844	Pipe
Z1_LINK_0180	845	Pipe
Z1_LINK_0181	846	Pipe
Z1_LINK_0182	847	Pipe
Z1_LINK_0183	848	Pipe
Z1_LINK_0184	849	Pipe
Z1_LINK_0189	850	Pipe
Z1_LINK_0193	851	Pipe
Z1_LINK_0194	852	Pipe
Z1_LINK_0195	853	Pipe
Z1_LINK_0196	854	Pipe
Z1_LINK_0198	855	Pipe
Z1_LINK_0199	856	Pipe
Z1_LINK_0210	857	Pipe
Z1_LINK_0218	858	Pipe
Z1_LINK_0222	859	Pipe
Z1_LINK_0253	860	Pipe
Z1_LINK_0254	861	Pipe
Z2_LINK_0003	862	Pipe
Z2_LINK_0004	863	Pipe
Z2_LINK_0006	864	Pipe
Z2_LINK_0007	865	Pipe
Z2_LINK_0008	866	Pipe
Z2_LINK_0009	867	Pipe
Z2_LINK_0010	868	Pipe
Z2_LINK_0011	869	Pipe
Z2_LINK_0018	870	Pipe
Z2_LINK_0021	871	Pipe
Z2_LINK_0025	872	Pipe
Z2_LINK_0026b	873	Pipe

Unique ID	Index	Link Type
Z2_LINK_0027	874	Pipe
Z2_LINK_0028	875	Pipe
Z2_LINK_0032	876	Pipe
Z2_LINK_0033	877	Pipe
Z2_LINK_0034	878	Pipe
Z2_LINK_0036	879	Pipe
Z2_LINK_0038	880	Pipe
Z2_LINK_0039	881	Pipe
Z2_LINK_0040	882	Pipe
Z2_LINK_0047	883	Pipe
Z2_LINK_0048	884	Pipe
Z2_LINK_0049	885	Pipe
Z2_LINK_0050	886	Pipe
Z2_LINK_0052	887	Pipe
Z2_LINK_0053	888	Pipe
Z2_LINK_0054	889	Pipe
Z2_LINK_0055	890	Pipe
Z2_LINK_0057	891	Pipe
Z2_LINK_0063	892	Pipe
Z2_LINK_0063a	893	Pipe
Z2_LINK_0064	894	Pipe
Z2_LINK_0067	895	Pipe
Z2_LINK_0068	896	Pipe
Z2_LINK_0069	897	Pipe
Z2_LINK_0070	898	Pipe
Z2_LINK_0071	899	Pipe
Z2_LINK_0072	900	Pipe
Z2_LINK_0074	901	Pipe
Z2_LINK_0074a	902	Pipe
Z2_LINK_0075	903	Pipe
Z2_LINK_0087	904	Pipe
Z2_LINK_0088	905	Pipe
Z2_LINK_0105	906	Pipe
Z2_LINK_0107	907	Pipe
Z2_LINK_0108	908	Pipe
Z2_LINK_0109	909	Pipe
Z2_LINK_0110	910	Pipe
Z2_LINK_0113	911	Pipe
Z2_LINK_0119	912	Pipe
Z2_LINK_0124	913	Pipe
Z2_LINK_0125	914	Pipe
Z2_LINK_0130	915	Pipe
Z2_LINK_0134	916	Pipe
Z2_LINK_0137	917	Pipe
Z2_LINK_0138	918	Pipe

Table A.4

Unique ID	Index	Link Type
Z2_LINK_0140	919	Pipe
Z2_LINK_0143	920	Pipe
Z2_LINK_0156	921	Pipe
Z2_LINK_0158	922	Pipe
Z2_LINK_0166	923	Pipe
Z2_LINK_0170	924	Pipe
Z2_LINK_0173	925	Pipe
Z2_LINK_0183	926	Pipe
Z2_LINK_0184	927	Pipe
Z2_LINK_0188	928	Pipe
Z2_LINK_0190	930	Pipe
Z2_LINK_0192	931	Pipe
Z2_LINK_0194	932	Pipe
Z2_LINK_0198	933	Pipe
Z2_LINK_0199	934	Pipe
Z2_LINK_0200	935	Pipe
Z2_LINK_0201	936	Pipe
Z2_LINK_0204	937	Pipe
Z2_LINK_0206	938	Pipe
Z2_LINK_0207	939	Pipe
Z2_LINK_0210	940	Pipe
Z2_LINK_0211	941	Pipe
Z2_LINK_0212	942	Pipe
Z2_LINK_0213	943	Pipe
Z2_LINK_0214	944	Pipe
Z2_LINK_0223	945	Pipe
Z2_LINK_0226	946	Pipe
Z2_LINK_0227	947	Pipe
Z2_LINK_0228	948	Pipe
Z2_LINK_0230	949	Pipe
Z2_LINK_0234	950	Pipe
Z2_LINK_0235	951	Pipe
Z2_LINK_0237	952	Pipe
Z2_LINK_0239	953	Pipe
Z2_LINK_0240	954	Pipe
Z2_LINK_0245	955	Pipe
Z3_LINK_0002	956	Pipe
Z3_LINK_0003	957	Pipe
Z3_LINK_0006	958	Pipe
Z3_LINK_0007	959	Pipe
Z3_LINK_0008	960	Pipe
Z3_LINK_0012	961	Pipe
Z3_LINK_0013	962	Pipe
Z3_LINK_0015	963	Pipe
Z3_LINK_0016	964	Pipe

Unique ID	Index	Link Type
Z3_LINK_0018	965	Pipe
Z3_LINK_0019	966	Pipe
Z3_LINK_0020	967	Pipe
Z3_LINK_0022	968	Pipe
Z3_LINK_0024	969	Pipe
Z3_LINK_0025	970	Pipe
Z3_LINK_0025a	971	Pipe
Z3_LINK_0026	972	Pipe
Z3_LINK_0027	973	Pipe
Z3_LINK_0028	974	Pipe
Z3_LINK_0030	975	Pipe
Z3_LINK_0031	976	Pipe
Z3_LINK_0032	977	Pipe
Z3_LINK_0035	978	Pipe
Z3_LINK_0036	979	Pipe
Z3_LINK_0038	980	Pipe
Z3_LINK_0044	981	Pipe
Z3_LINK_0045	982	Pipe
Z3_LINK_0046	983	Pipe
Z3_LINK_0047	984	Pipe
Z3_LINK_0048	985	Pipe
Z3_LINK_0049	986	Pipe
Z3_LINK_0050	987	Pipe
Z3_LINK_0051	988	Pipe
Z3_LINK_0058	989	Pipe
Z3_LINK_0059	990	Pipe
Z3_LINK_0060	991	Pipe
Z3_LINK_0061	992	Pipe
Z3_LINK_0063	993	Pipe
Z3_LINK_0064	994	Pipe
Z3_LINK_0065	995	Pipe
Z3_LINK_0066	996	Pipe
Z3_LINK_0067	997	Pipe
Z3_LINK_0068	998	Pipe
Z3_LINK_0069	999	Pipe
Z3_LINK_0070	1000	Pipe
Z3_LINK_0071	1001	Pipe
Z3_LINK_0072	1002	Pipe
Z3_LINK_0073	1003	Pipe
Z3_LINK_0074	1004	Pipe
Z3_LINK_0075	1005	Pipe
Z3_LINK_0080	1006	Pipe
Z3_LINK_0086	1007	Pipe
Z3_LINK_0087	1008	Pipe
Z3_LINK_0088	1009	Pipe

Table A.4

Unique ID	Index	Link Type
Z3_LINK_0089	1010	Pipe
Z3_LINK_0090	1011	Pipe
Z3_LINK_0091	1012	Pipe
Z3_LINK_0092	1013	Pipe
Z3_LINK_0093	1014	Pipe
Z3_LINK_0094	1015	Pipe
Z3_LINK_0095	1016	Pipe
Z3_LINK_0098a	1017	Pipe
Z3_LINK_0098b	1018	Pipe
Z3_LINK_0099	1019	Pipe
Z3_LINK_0101	1020	Pipe
Z3_LINK_0102	1021	Pipe
Z3_LINK_0103	1022	Pipe
Z3_LINK_0106	1023	Pipe
Z3_LINK_0109	1024	Pipe
Z3_LINK_0113	1025	Pipe
Z3_LINK_0114	1026	Pipe
Z3_LINK_0115	1027	Pipe
Z3_LINK_0116	1028	Pipe
Z3_LINK_0118	1029	Pipe
Z3_LINK_0119	1030	Pipe
Z3_LINK_0121	1031	Pipe
Z3_LINK_0125	1032	Pipe
Z3_LINK_0126	1033	Pipe
Z3_LINK_0127	1034	Pipe
Z3_LINK_0129	1035	Pipe
Z3_LINK_0130	1036	Pipe
Z3_LINK_0131	1037	Pipe
Z3_LINK_0135	1038	Pipe
Z3_LINK_0139	1039	Pipe
Z3_LINK_0142	1040	Pipe
Z3_LINK_0143	1041	Pipe
Z3_LINK_0144	1042	Pipe
Z3_LINK_0145	1043	Pipe
Z3_LINK_0147	1044	Pipe
Z3_LINK_0148	1045	Pipe
Z3_LINK_0149	1046	Pipe
Z3_LINK_0150	1047	Pipe
Z3_LINK_0151	1048	Pipe
Z3_LINK_0152	1049	Pipe
Z3_LINK_0154	1050	Pipe
Z3_LINK_0155	1051	Pipe
Z3_LINK_0158	1052	Pipe
Z3_LINK_0159	1053	Pipe
Z3_LINK_0161	1054	Pipe
Z3_LINK_0163	1055	Pipe
Z3_LINK_0164	1056	Pipe
Z3_LINK_0165	1057	Pipe
Z3_LINK_0166	1058	Pipe
Z3_LINK_0167	1059	Pipe
Z3_LINK_0171	1060	Pipe
Z3_LINK_0172	1061	Pipe
Z3_LINK_0173	1062	Pipe
Z3_LINK_0174	1063	Pipe
Z3_LINK_0181	1064	Pipe
Z3_LINK_0182	1065	Pipe
Z3_LINK_0183	1066	Pipe
Z3_LINK_0184	1067	Pipe
Z3_LINK_0185	1068	Pipe
Z3_LINK_0186	1069	Pipe
Z3_LINK_0187	1070	Pipe
Z3_LINK_0188	1071	Pipe
Z3_LINK_0190	1072	Pipe
Z3_LINK_0192	1073	Pipe
Z3_LINK_0193	1074	Pipe
Z3_LINK_0194	1075	Pipe
Z3_LINK_0195	1076	Pipe
Z3_LINK_0197	1077	Pipe
Z3_LINK_0199	1078	Pipe
Z3_LINK_0200	1079	Pipe
Z3_LINK_0207	1080	Pipe
Z3_LINK_0208	1081	Pipe
Z3_LINK_0209	1082	Pipe
Z3_LINK_0210	1083	Pipe
Z3_LINK_0211	1084	Pipe
Z3_LINK_0212	1085	Pipe
Z3_LINK_0213	1086	Pipe
Z3_LINK_0214	1087	Pipe
Z3_LINK_0215	1088	Pipe
Z3_LINK_0217	1089	Pipe
Z3_LINK_0218	1090	Pipe
Z3_LINK_0219	1091	Pipe
Z3_LINK_0220	1092	Pipe
Z3_LINK_0221	1093	Pipe
Z3_LINK_0222	1094	Pipe
Z3_LINK_0223	1095	Pipe
Z3_LINK_0224	1096	Pipe
Z3_LINK_0225	1097	Pipe
Z3_LINK_0225a	1098	V-ditch
Z3_LINK_0226	1099	Pipe

Table A.4

Unique ID	Index	Link Type
Z3_LINK_0227	1100	Pipe
Z3_LINK_0228	1101	Pipe
Z3_LINK_0229	1102	Pipe
Z3_LINK_0230	1103	Pipe
Z3_LINK_0231	1104	Pipe
Z3_LINK_0233	1105	Pipe
Z3_LINK_0234	1106	Pipe
Z3_LINK_0236	1107	Pipe
Z3_LINK_0237	1108	Pipe
Z3_LINK_0239	1109	Pipe
Z3_LINK_0240	1110	Pipe
Z3_LINK_0241	1111	Pipe
Z3_LINK_0242	1112	Pipe
Z3_LINK_0259	1113	Pipe
Z3_LINK_0260	1114	Pipe
Z4_LINK_0003a	1115	Pipe
Z4_LINK_0003b	1116	Pipe
Z4_LINK_0011	1117	Pipe
Z4_LINK_0012	1118	Pipe
Z4_LINK_0016	1119	Pipe
Z4_LINK_0017	1120	Pipe
Z4_LINK_0018	1121	Pipe
Z4_LINK_0019	1122	Culvert
Z4_LINK_0021	1123	Pipe
Z4_LINK_0022	1124	Pipe
Z4_LINK_0023	1125	Pipe
Z4_LINK_0026	1126	Pipe
Z4_LINK_0027	1127	Pipe
Z4_LINK_0028	1128	Pipe
Z4_LINK_0029	1129	Pipe
Z4_LINK_0030	1130	Pipe
Z4_LINK_0031	1131	Pipe
Z4_LINK_0033	1132	Pipe
Z4_LINK_0035	1133	Pipe
Z4_LINK_0037	1134	Pipe
Z4_LINK_0041	1135	Pipe
Z4_LINK_0042	1136	Culvert
Z4_LINK_0050	1137	Pipe
Z4_LINK_0050	1137	Pipe
Z4_LINK_0050	1138	Pipe
Z4_LINK_0050	1138	Pipe
Z4_LINK_0051	1139	Pipe
Z4_LINK_0053	1140	Pipe
Z4_LINK_0054	1141	Pipe
Z4_LINK_0056	1142	Pipe

Unique ID	Index	Link Type
Z4_LINK_0057	1143	Pipe
Z4_LINK_0059	1144	Pipe
Z4_LINK_0061	1145	Pipe
Z4_LINK_0064	1146	Pipe
Z4_LINK_0065	1147	Pipe
Z4_LINK_0068	1148	Pipe
Z4_LINK_0068a	1149	Pipe
Z4_LINK_0071	1150	Pipe
Z4_LINK_0072	1151	Pipe
Z4_LINK_0074	1152	Pipe
Z4_LINK_0075	1153	Pipe
Z4_LINK_0076	1154	Pipe
Z4_LINK_0077	1155	Pipe
Z4_LINK_0078	1156	Pipe
Z4_LINK_0079	1157	Pipe
Z4_LINK_0080	1158	Pipe
Z4_LINK_0081	1159	Pipe
Z4_LINK_0082	1160	Pipe
Z4_LINK_0085	1161	Pipe
Z4_LINK_0086	1162	Pipe
Z4_LINK_0087	1163	Pipe
Z4_LINK_0088	1164	Pipe
Z4_LINK_0088b	1165	Pipe
Z4_LINK_0090	1166	Pipe
Z4_LINK_0091	1167	Pipe
Z4_LINK_0096	1168	Pipe
Z4_LINK_0097	1169	Pipe
Z4_LINK_0098	1170	Pipe
Z4_LINK_0100	1171	Pipe
Z4_LINK_0101	1172	Pipe
Z4_LINK_0102	1173	Pipe
Z4_LINK_0103	1174	Pipe
Z4_LINK_0104	1175	Pipe
Z4_LINK_0107	1176	Pipe
Z4_LINK_0108	1177	Pipe
Z4_LINK_0111	1178	Pipe
Z4_LINK_0112	1179	Pipe
Z4_LINK_0114	1180	Pipe
Z4_LINK_0115	1181	Pipe
Z4_LINK_0116	1182	Pipe
Z4_LINK_0120	1183	Pipe
Z4_LINK_0121	1184	Pipe
Z4_LINK_0122	1185	Pipe
Z4_LINK_0123	1186	Pipe
Z4_LINK_0124	1187	Pipe

Table A.4

Unique ID	Index	Link Type
Z4_LINK_0125	1188	Pipe
Z4_LINK_0128	1189	Pipe
Z4_LINK_0130	1190	Pipe
Z4_LINK_0131	1191	Pipe
Z4_LINK_0132	1192	Pipe
Z4_LINK_0135	1193	Pipe
Z4_LINK_0136	1194	Pipe
Z4_LINK_0137	1195	Pipe
Z4_LINK_0138	1196	Pipe
Z4_LINK_0139	1197	Pipe
Z4_LINK_0141	1198	Pipe
Z4_LINK_0142	1199	Pipe
Z4_LINK_0143	1200	Pipe
Z4_LINK_0144	1201	Pipe
Z4_LINK_0145	1202	Pipe
Z4_LINK_0146	1203	Pipe
Z4_LINK_0147	1204	Pipe
Z4_LINK_0149	1205	Pipe
Z4_LINK_0150	1206	Pipe
Z4_LINK_0151	1207	Pipe
Z4_LINK_0152	1208	Pipe
Z4_LINK_0156	1209	Pipe
Z4_LINK_0157	1210	Pipe
Z4_LINK_0158	1211	Pipe
Z4_LINK_0160	1212	Pipe
Z4_LINK_0161	1213	Pipe
Z4_LINK_0163	1214	Pipe
Z4_LINK_0164	1215	Pipe
Z4_LINK_0165	1216	Pipe
Z4_LINK_0166	1217	Pipe
Z4_LINK_0170	1218	Pipe
Z4_LINK_0171	1219	Pipe
Z4_LINK_0173	1220	Pipe
Z4_LINK_0174	1221	Pipe
Z4_LINK_0180	1222	Pipe
Z4_LINK_0181	1223	Pipe
Z4_LINK_0181a	1224	Pipe
Z4_LINK_0186	1225	Pipe
Z4_LINK_0188	1226	Pipe
Z4_LINK_0189	1227	Pipe
Z4_LINK_0191	1228	Pipe
Z4_LINK_0193	1229	Pipe
Z4_LINK_0195	1230	Pipe
Z4_LINK_0196	1231	Pipe
Z4_LINK_0197	1232	Pipe

Unique ID	Index	Link Type
Z5_LINK_0001	1233	Pipe
Z5_LINK_0002	1234	Pipe
Z5_LINK_0003	1235	Pipe
Z5_LINK_0006	1236	Pipe
Z5_LINK_0007	1237	Pipe
Z5_LINK_0011	1238	Pipe
Z5_LINK_0012	1239	Pipe
Z5_LINK_0013	1240	Pipe
Z5_LINK_0019	1241	Pipe
Z5_LINK_0020	1242	Pipe
Z5_LINK_0021	1243	Pipe
Z5_LINK_0027	1244	Pipe
Z5_LINK_0028	1245	Pipe
Z5_LINK_0029	1246	Pipe
Z5_LINK_0031	1247	Pipe
Z5_LINK_0032	1248	Pipe
Z5_LINK_0033	1249	Pipe
Z5_LINK_0034	1250	Pipe
Z5_LINK_0037	1251	Pipe
Z5_LINK_0038	1252	Pipe
Z5_LINK_0039	1253	Pipe
Z5_LINK_0040	1254	Pipe
Z5_LINK_0041	1255	Pipe
Z5_LINK_0042	1256	Pipe
Z5_LINK_0047	1257	Pipe
Z5_LINK_0048	1258	Pipe
Z5_LINK_0050	1259	Pipe
Z5_LINK_0051	1260	Pipe
Z5_LINK_0058	1261	Culvert
Z5_LINK_0060	1262	Pipe
Z5_LINK_0061	1263	Pipe
Z5_LINK_0062	1264	Pipe
Z5_LINK_0063	1265	Pipe
Z5_LINK_0064	1266	Pipe
Z5_LINK_0065	1267	Pipe
Z5_LINK_0066	1268	Pipe
Z5_LINK_0067	1269	Pipe
Z5_LINK_0069	1270	Pipe
Z5_LINK_0071	1271	Pipe
Z5_LINK_0072	1272	Pipe
Z5_LINK_0073	1273	Pipe
Z5_LINK_0074	1274	Pipe
Z5_LINK_0075	1275	Pipe
Z5_LINK_0078	1276	Pipe
Z5_LINK_0079	1277	Pipe

Table A.4

Unique ID	Index	Link Type
Z5_LINK_0080	1278	Pipe
Z5_LINK_0081	1279	Pipe
Z5_LINK_0082	1280	Pipe
Z5_LINK_0083	1281	Pipe
Z5_LINK_0089	1282	Pipe
Z5_LINK_0091	1283	Pipe
Z5_LINK_0092	1284	Pipe
Z5_LINK_0093	1285	Pipe
Z5_LINK_0095	1286	Pipe
Z5_LINK_0096	1287	Pipe
Z5_LINK_0098	1288	Pipe
Z5_LINK_0099	1289	Pipe
Z5_LINK_0100	1290	Pipe
Z5_LINK_0101	1291	Pipe
Z5_LINK_0107	1292	Pipe
Z5_LINK_0121	1293	Pipe
Z5_LINK_0122	1294	Pipe
Z5_LINK_0123	1295	Pipe
Z5_LINK_0124	1296	Pipe
Z5_LINK_0125	1297	Pipe
Z5_LINK_0126	1298	Pipe
Z5_LINK_0128	1299	Pipe
Z5_LINK_0129	1300	Pipe
Z5_LINK_0131	1301	Pipe
Z5_LINK_0133	1302	Pipe
Z5_LINK_0135	1303	Pipe
Z5_LINK_0136	1304	Pipe
Z5_LINK_0146	1305	Pipe
Z5_LINK_0152	1306	Pipe
Z5_LINK_0153	1307	Pipe
Z5_LINK_0154	1308	Pipe
Z5_LINK_0155	1309	Pipe
Z5_LINK_0156	1310	Pipe
Z5_LINK_0157	1311	Pipe
Z6_LINK_0001	1312	Pipe
Z6_LINK_0002	1313	Pipe
Z6_LINK_0003	1314	Pipe
Z6_LINK_0004	1315	Pipe
Z6_LINK_0005	1316	Pipe
Z6_LINK_0006	1317	Pipe
Z6_LINK_0006a	1318	Pipe
Z6_LINK_0008	1319	Pipe
Z6_LINK_0009	1320	Pipe
Z6_LINK_0010	1321	Pipe
Z6_LINK_0013	1322	Pipe

Unique ID	Index	Link Type
Z6_LINK_0014	1323	Pipe
Z6_LINK_0015	1324	Pipe
Z6_LINK_0019	1325	Pipe
Z6_LINK_0020	1326	Pipe
Z6_LINK_0023	1327	Pipe
Z6_LINK_0024	1328	Pipe
Z6_LINK_0025	1329	Pipe
Z6_LINK_0029	1330	Pipe
Z6_LINK_0030	1331	Pipe
Z6_LINK_0031	1332	Pipe
Z6_LINK_0032	1333	Pipe
Z6_LINK_0034	1334	Pipe
Z6_LINK_0036	1335	Pipe
Z6_LINK_0037	1336	Pipe
Z6_LINK_0045	1337	Pipe
Z6_LINK_0046	1338	Pipe
Z6_LINK_0047	1339	Pipe
Z6_LINK_0062	1340	Pipe
Z6_LINK_0063	1341	Pipe
Z6_LINK_0064	1342	Pipe
Z6_LINK_0065	1343	Pipe
Z6_LINK_0066	1344	Pipe
Z6_LINK_0067	1345	Pipe
Z6_LINK_0068	1346	Pipe
Z6_LINK_0069	1347	Pipe
Z6_LINK_007	1348	Pipe
Z6_LINK_0071	1349	Pipe
Z6_LINK_0072	1350	Pipe
Z6_LINK_0073	1351	Pipe
Z6_LINK_0074	1352	Pipe
Z6_LINK_0075b	1353	Pipe
Z6_LINK_0076	1354	Pipe
Z6_LINK_0077	1355	Pipe
Z6_LINK_0078	1356	Pipe
Z6_LINK_0081	1357	Pipe
Z6_LINK_0082	1358	Pipe
Z6_LINK_0083	1359	Pipe
Z6_LINK_0084	1360	Pipe
Z6_LINK_0090	1361	Pipe
Z6_LINK_0092	1362	Pipe
Z6_LINK_0093	1363	Pipe
Z6_LINK_0094	1364	Pipe
Z6_LINK_0096	1365	Pipe
Z6_LINK_0098	1366	Pipe
Z6_LINK_0099	1367	Pipe

Table A.4

Unique ID	Index	Link Type
Z6_LINK_0100	1368	Pipe
Z6_LINK_0101	1369	Pipe
Z6_LINK_0102	1370	Pipe
Z6_LINK_0103	1371	Culvert
Z6_LINK_0106	1372	Pipe
Z6_LINK_0107	1373	Pipe
Z6_LINK_0108	1374	Pipe
Z6_LINK_0110	1375	Pipe
Z6_LINK_0113	1376	Pipe
Z6_LINK_0114	1377	Pipe
Z6_LINK_0115	1378	Pipe
Z6_LINK_0125	1379	Pipe
Z6_LINK_0126	1380	Pipe
Z6_LINK_0130	1381	Pipe
Z6_LINK_0132	1382	Pipe
Z6_LINK_0133	1383	Pipe
Z6_LINK_0134	1384	Pipe
Z6_LINK_0135	1385	Pipe
Z6_LINK_0137	1386	Pipe
Z6_LINK_0138	1387	Pipe
Z6_LINK_0141	1388	Pipe
Z6_LINK_0142	1389	Pipe
Z6_LINK_0144	1390	Pipe
Z6_LINK_0146	1391	Pipe
Z6_LINK_0148	1392	Pipe
Z6_LINK_0182	1393	Pipe
Z6_Link_146	1394	Pipe
Z6_Link_147	1395	Pipe
Z6_Link_148	1396	Pipe
Z6_Link_149	1397	Pipe
Z6_Link_150	1398	Pipe
Z6_Link_151	1399	Pipe
Z6_Link_153	1400	Pipe
Z6_Link_154	1401	Pipe
Z6_Link_155	1402	Pipe
Z6_Link_157	1403	Pipe
Z6_Link_158	1404	Pipe
Z6_Link_159	1405	Pipe
Z6_Link_160	1406	Pipe
Z6_Link_161	1407	Pipe
Z6_Link_162	1408	Pipe
Z6_Link_163	1409	Pipe
Z6_Link_164	1410	Pipe
Z6_Link_166	1411	Pipe
Z6_Link_167	1412	Pipe

Unique ID	Index	Link Type
Z6_Link_168	1413	Pipe
Z6_Link_169	1414	Pipe
Z6_Link_170	1415	Pipe
Z6_Link_171	1416	Pipe
Z6_Link_173	1417	Pipe
Z6_Link_174	1418	Pipe
Z6_Link_175	1419	Pipe
Z6_Link_177	1420	Pipe
Z6_Link_178	1421	Pipe
Z6_Link_179	1422	Pipe
Z6_Link_180	1423	Pipe
Z6_Link_181	1424	Pipe
Z6_Link_182	1425	Pipe
Z6_Link_183	1426	Pipe
Z6_Link_184	1427	Pipe
Z6_Link_185	1428	Pipe
Z7_LINK_0003	1430	Pipe
Z7_LINK_0004	1431	Pipe
Z7_LINK_0005	1432	Pipe
Z7_LINK_0006	1433	Pipe
Z7_LINK_0008	1434	Pipe
Z7_LINK_0009	1435	Pipe
Z7_LINK_0010	1436	Pipe
Z7_LINK_0011	1437	Pipe
Z7_LINK_0012	1438	Pipe
Z7_LINK_0014	1439	Pipe
Z7_LINK_0015	1440	Pipe
Z7_LINK_0016	1441	Pipe
Z7_LINK_0017	1442	Pipe
Z7_LINK_0018	1443	Pipe
Z7_LINK_0019	1444	Pipe
Z7_LINK_0020	1445	Pipe
Z7_LINK_0021	1446	Pipe
Z7_LINK_0022	1447	Pipe
Z7_LINK_0023	1448	Pipe
Z7_LINK_0025	1449	Pipe
Z7_LINK_0026	1450	Pipe
Z7_LINK_0027a	1451	Pipe
Z7_LINK_0027b	1452	Pipe
Z7_LINK_0028	1453	Pipe
Z7_LINK_0030	1454	Pipe
Z7_LINK_0031	1455	Pipe
Z7_LINK_0034	1456	Pipe
Z7_LINK_0035	1457	Pipe
Z7_LINK_0036	1458	Pipe

Table A.4

Unique ID	Index	Link Type
Z7_LINK_0038	1459	Pipe
Z7_LINK_0039	1460	Pipe
Z7_LINK_0040	1461	Pipe
Z7_LINK_0041	1462	Pipe
Z7_LINK_0043	1463	Pipe
Z7_LINK_0044	1464	Pipe
Z7_LINK_0045	1465	Pipe
Z7_LINK_0046	1466	Pipe
Z7_LINK_0047	1467	Pipe
Z7_LINK_0048	1468	Pipe
Z7_LINK_0049	1469	Pipe
Z7_LINK_0050	1470	Pipe
Z7_LINK_0051a	1471	Pipe
Z7_LINK_0051b	1472	Pipe
Z7_LINK_0053	1473	Pipe
Z7_LINK_0054	1474	Pipe
Z7_LINK_0055	1475	Pipe
Z7_LINK_0056	1476	Pipe
Z7_LINK_0057	1477	Pipe
Z7_LINK_0058	1478	Pipe
Z7_LINK_0059	1479	Pipe
Z7_LINK_0061	1480	Pipe
Z7_LINK_0062	1481	Pipe
Z7_LINK_0063	1482	Pipe
Z7_LINK_0064	1483	Pipe
Z7_LINK_0065	1484	Pipe
Z7_LINK_0066	1485	Pipe
Z7_LINK_0067	1486	Pipe
Z7_LINK_0068	1487	Pipe
Z7_LINK_0070	1488	Pipe
Z7_LINK_0071	1489	Pipe
Z7_LINK_0072	1490	Pipe
Z7_LINK_0073	1491	Pipe
Z7_LINK_0075	1492	Pipe
Z7_LINK_0076	1493	Pipe
Z7_LINK_0078	1494	Pipe
Z7_LINK_0079	1495	Pipe
Z7_LINK_0080	1496	Pipe
Z7_LINK_0081	1497	Pipe
Z7_LINK_0082	1498	Pipe
Z7_LINK_0085	1499	Pipe
Z7_LINK_0087	1500	Pipe
Z7_LINK_0088	1501	Pipe
Z7_LINK_0089	1502	Pipe
Z7_LINK_0090	1503	Pipe

Unique ID	Index	Link Type
Z7_LINK_0093	1504	Pipe
Z7_LINK_0094	1505	Pipe
Z7_LINK_0095	1506	Pipe
Z7_LINK_0096	1507	Pipe
Z7_LINK_0097	1508	Pipe
Z7_LINK_0098	1509	Pipe
Z7_LINK_0099	1510	Pipe
Z7_LINK_0100	1511	Pipe
Z7_LINK_0102	1512	Pipe
Z7_LINK_0103	1513	Pipe
Z7_LINK_0104	1514	Pipe
Z7_LINK_0105	1515	Pipe
Z7_LINK_0106	1516	Pipe
Z7_LINK_0107	1517	Pipe
Z7_LINK_0110	1518	Pipe
Z7_LINK_0111	1519	Pipe
Z7_LINK_0112	1520	Pipe
Z7_LINK_0114	1521	Pipe
Z7_LINK_0116	1522	Pipe
Z7_LINK_0117	1523	Pipe
Z7_LINK_0118	1524	Pipe
Z7_LINK_0119	1525	Pipe
Z7_LINK_0122	1526	Pipe
Z7_LINK_0123	1527	Pipe
Z7_LINK_0124	1528	Pipe
Z7_LINK_0125	1529	Pipe
Z7_LINK_0126	1530	Pipe
Z7_LINK_0128	1531	Pipe
Z7_LINK_0129	1532	Pipe
Z7_LINK_0130	1533	Pipe
Z7_LINK_0131	1534	Pipe
Z7_LINK_0132	1535	Pipe
Z7_LINK_0133	1536	Pipe
Z7_LINK_0134	1537	Pipe
Z7_LINK_0135	1538	Pipe
Z7_LINK_0138	1539	Pipe
Z7_LINK_0139	1540	Pipe
Z7_LINK_0140	1541	Pipe
Z7_LINK_0143	1542	Pipe
Z7_LINK_0146	1543	Pipe
Z7_LINK_0147	1544	Pipe
Z7_LINK_0148	1545	Pipe
Z7_LINK_0149	1546	Pipe
Z7_LINK_0150	1547	Pipe
Z7_LINK_0151	1548	Pipe

Table A.4

Unique ID	Index	Link Type
Z7_LINK_0155	1549	Pipe
Z7_LINK_0156	1550	Pipe
Z7_LINK_0157	1551	Pipe
Z7_LINK_0158	1552	Pipe
Z7_LINK_0159	1553	Pipe
Z7_LINK_0161	1554	Pipe
Z7_LINK_0163	1555	Pipe
Z7_LINK_0166	1556	Pipe
Z7_LINK_0167	1557	Pipe
Z7_LINK_0168	1558	Pipe
Z7_LINK_0169	1559	Pipe
Z7_LINK_0170	1560	Pipe
Z7_LINK_0171	1561	Pipe
Z7_LINK_0172	1562	Pipe
Z7_LINK_0173	1563	Pipe
Z7_LINK_0174	1564	Pipe
Z7_LINK_0175	1565	Pipe
Z7_LINK_0176	1566	Pipe
Z7_LINK_0177	1567	Pipe
Z7_LINK_0180	1568	Pipe
Z7_LINK_0181	1569	Pipe
Z7_LINK_0182	1570	Pipe
Z7_LINK_0183	1571	Pipe
Z7_LINK_0184	1572	Pipe
Z7_LINK_0185	1573	Pipe
Z7_LINK_0186	1574	Pipe
Z7_LINK_0187	1575	Pipe
Z7_LINK_0188	1576	Pipe
Z7_LINK_0189	1577	Pipe
Z7_LINK_0191	1578	Pipe
Z7_LINK_0192	1579	Pipe
Z7_LINK_0193	1580	Pipe
Z7_LINK_0195	1581	Pipe
Z7_LINK_0196	1582	Pipe
Z7_LINK_0197	1583	Pipe
Z7_LINK_0198	1584	Pipe
Z7_LINK_0199	1585	Pipe
Z7_LINK_0200	1586	Pipe
Z7_LINK_0201	1587	Pipe
Z7_LINK_0206	1588	Pipe
Z7_LINK_0207	1589	Pipe
Z7_LINK_0208	1590	Pipe
Z7_LINK_0209	1591	Pipe
Z7_LINK_0210	1592	Pipe
Z7_LINK_0211	1593	Pipe
Z7_LINK_0212	1594	Pipe
Z7_LINK_0213	1595	Pipe
Z7_LINK_0214	1596	Pipe
Z7_LINK_0215	1597	Pipe
Z7_LINK_0217	1598	Pipe
Z7_LINK_0218	1599	Pipe
Z7_LINK_0220	1600	Pipe
Z7_LINK_0222	1601	Pipe
Z7_LINK_0223	1602	Pipe
Z7_LINK_0224	1603	Pipe
Z7_LINK_0225	1604	Pipe
Z7_LINK_0226	1605	Pipe
Z7_LINK_0228	1606	Pipe
Z7_LINK_0229	1607	Pipe
Z7_LINK_0231	1608	Pipe
Z7_LINK_0232	1609	Pipe
Z7_LINK_0234	1610	Pipe
Z7_LINK_0236	1611	Pipe
Z7_LINK_0241	1612	Pipe
Z7_LINK_0242	1613	Culvert
Z7_LINK_0243	1614	Pipe
Z7_LINK_0244	1615	Pipe
Z7_LINK_0245	1616	Pipe
Z7_LINK_0246	1617	Pipe
Z7_LINK_0247	1618	Pipe
Z7_LINK_0248	1619	Pipe
Z7_LINK_0249	1620	Pipe
Z7_LINK_0250	1621	Pipe
Z7_LINK_0251	1622	Pipe
Z7_LINK_0252	1623	Pipe
Z7_LINK_0253	1624	Pipe
Z7_LINK_0254	1625	Pipe
Z7_LINK_0255	1626	Pipe
Z7_LINK_0257	1627	Pipe
Z7_LINK_0258a	1628	Pipe
Z7_LINK_0258aa	1629	Pipe
Z7_LINK_0258b	1630	Pipe
Z7_LINK_0259	1631	Pipe
Z7_LINK_0260	1632	Pipe
Z7_LINK_0261	1633	Pipe
Z7_LINK_0262	1634	Pipe
Z7_LINK_0263	1635	Pipe
Z7_LINK_0264	1636	Pipe
Z7_LINK_0265	1637	Pipe
Z7_LINK_0266	1638	Pipe

Table A.4

Unique ID	Index	Link Type
Z7_LINK_0267	1639	Pipe
Z7_LINK_0268	1640	Pipe
Z7_LINK_0269	1641	Pipe
Z7_LINK_0270	1642	Pipe
Z7_LINK_0273	1643	Pipe
Z7_LINK_0274	1644	Pipe
Z7_LINK_0274a	1645	Pipe
Z7_LINK_0277	1646	Pipe
Z7_LINK_0278	1647	Pipe
Z7_LINK_0282	1648	Pipe
Z7_LINK_0283	1649	Pipe
Z7_LINK_0284	1650	Pipe
Z7_LINK_0285	1651	Pipe
Z7_LINK_0286	1652	Pipe
Z7_LINK_0288	1653	Pipe
Z7_LINK_0290	1654	Pipe
Z7_LINK_0291	1655	Pipe
Z7_LINK_0293	1656	Pipe
Z7_LINK_0295	1657	Pipe
Z7_LINK_0295a	1658	Pipe
Z7_LINK_0301	1659	Pipe
Z7_LINK_0302	1660	Pipe
Z7_LINK_0306	1661	Pipe
Z7_LINK_0307	1662	Pipe
Z7_LINK_0308	1663	Pipe
Z7_LINK_0310	1664	Pipe
Z7_LINK_3000	1665	Culvert
Z8_LINK_0005	1666	Pipe
Z8_LINK_0006	1667	Pipe
Z8_LINK_0007	1668	Pipe
Z8_LINK_0008	1669	Pipe
Z8_LINK_0009	1670	Pipe
Z8_LINK_0010	1671	Pipe
Z8_LINK_0011	1672	Pipe
Z8_LINK_0012	1673	Pipe
Z8_LINK_0013	1674	Pipe
Z8_LINK_0014	1675	Pipe
Z8_LINK_0015	1676	Pipe
Z8_LINK_0017	1677	Pipe
Z8_LINK_0018	1678	Pipe
Z8_LINK_0019	1679	Pipe
Z8_LINK_0022	1680	Pipe
Z8_LINK_0023	1681	Pipe
Z8_LINK_0025	1682	Pipe
Z8_LINK_0026	1683	Pipe

Unique ID	Index	Link Type
Z8_LINK_0028	1684	Pipe
Z8_LINK_0029	1685	Pipe
Z8_LINK_0030	1686	Pipe
Z8_LINK_0031	1687	Pipe
Z8_LINK_0032	1688	Pipe
Z8_LINK_0035	1689	Pipe
Z8_LINK_0036	1690	Pipe
Z8_LINK_0037	1691	Pipe
Z8_LINK_0039	1692	Pipe
Z8_LINK_0040	1693	Pipe
Z8_LINK_0041	1694	Pipe
Z8_LINK_0042	1695	Pipe
Z8_LINK_0048	1696	Pipe
Z8_LINK_0049	1697	Pipe
Z8_LINK_0050	1698	Pipe
Z8_LINK_0053	1699	Pipe
Z8_LINK_0053a	1700	Pipe
Z8_LINK_0054	1701	Pipe
Z8_LINK_0055	1702	Pipe
Z8_LINK_0056	1703	Pipe
Z8_LINK_0057	1704	Pipe
Z8_LINK_0063	1705	Pipe
Z8_LINK_0066	1706	Pipe
Z8_LINK_0067	1707	Pipe
Z8_LINK_0068	1708	Pipe
Z8_LINK_0069	1709	Pipe
Z8_LINK_0072	1710	Pipe
Z8_LINK_0075	1711	Pipe
Z8_LINK_0077	1712	Pipe
Z8_LINK_0078	1713	Pipe
Z8_LINK_0079	1714	Pipe
Z8_LINK_0081	1715	Pipe
Z8_LINK_0082	1716	Pipe
Z8_LINK_0083	1717	Pipe
Z8_LINK_0084	1718	Pipe
Z8_LINK_0087	1719	Pipe
Z8_LINK_0089	1720	Pipe
Z8_LINK_0091	1721	Pipe
Z8_LINK_0094	1722	Pipe
Z8_LINK_0097	1723	Pipe
Z8_LINK_0097a	1724	Pipe
Z8_LINK_0098	1725	Pipe
Z8_LINK_0100	1726	Pipe
Z8_LINK_0102	1727	Pipe
Z9_LINK_0003	1728	Pipe

Table A.4

Unique ID	Index	Link Type
Z9_LINK_0005	1729	Pipe
Z9_LINK_0005a	1730	Pipe
Z9_LINK_0006	1731	Pipe

Appendix B

2020 CCTV List

Town of Moraga
Operations Maintenance Program
2020 CCTV List

Unique ID	Link Type	Stub	Owner	Other Owner[1]	Link Material	CCTV Reason	Length (ft.)
Z3_LINK_0190	Pipe	Downstream Unknown	Private	Public (General)	RCP	Vanda 5	20.00
Z2_LINK_0237	Pipe	None	Private	Public (General)	RCP	Vanda 5	356.62
Z5_LINK_0155	Pipe	None	Private	Public (General)	RCP	Vanda 4	71.17
Z5_LINK_0098	Pipe	None	Public (General)		CMP	Public/Easement and CMP; Vanda 5	39.00
Z6_LINK_5000	Culvert	None	Public (General)		CMP	Public/Easement and CMP; Vanda 5	113.87
Z5_LINK_0058	Culvert	Other	Private	Public (General)	CMP	Public/Easement and CMP; Vanda 5	199.85
Z2_LINK_0189	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP; Vanda 5	241.74
Z3_LINK_0159	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP; Vanda 4 and 5	20.00
Z2_LINK_0140	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	9.23
L-0234	Pipe	None	Public (General)		CMP	Public/Easement and CMP	17.25
L-0231	Pipe	None	Public (General)		CMP	Public/Easement and CMP	18.74
Z2_LINK_0235	Pipe	Downstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
L-0615	Pipe	Downstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
L-0422	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0382	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0623	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z1_LINK_0001	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z7_LINK_0248	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0547	Pipe	PPC	Public (General)		CMP	Public/Easement and CMP	20.00
Z4_LINK_0050	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0683	Pipe	Other	Public (General)		CMP	Public/Easement and CMP	20.00
Z9_LINK_0003	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0618	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z3_LINK_0048	Pipe	Upstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
L-0500	Pipe	Upstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
L-0477	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0514	Culvert	Other	Public (General)		CMP	Public/Easement and CMP	20.00
Z5_LINK_0013	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0381	Pipe	Upstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
L-0656	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0549	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0624	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0638	Pipe	Other	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z2_LINK_0008	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0515	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0460	Pipe	PPC	Private	Easement	CMP	Public/Easement and CMP	20.00
L-0418	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0660	Pipe	Downstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
Z2_LINK_0130	Pipe	Downstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
Z3_LINK_0151	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z2_LINK_0075	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z7_LINK_0012	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
Z2_LINK_0074a	Pipe	Other	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0413	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0601	Culvert	Other	Public (General)		CMP	Public/Easement and CMP	20.00
L-0505	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0684	Pipe	Other	Public (General)		CMP	Public/Easement and CMP	20.00
L-0604	Pipe	PPC	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0682	Pipe	Downstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
Z2_LINK_0006	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0630	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0379	Pipe	Upstream Unknown	Public (General)		CMP	Public/Easement and CMP	20.00
Z2_LINK_0007	Pipe	Downstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0501	Pipe	Upstream Unknown	Private	Public (General)	CMP	Public/Easement and CMP	20.00
L-0448	Pipe	Upstream Unknown	Easement		CMP	Public/Easement and CMP	20.00
L-0681	Pipe	PPC	Public (General)		CMP	Public/Easement and CMP	20.00
Z2_LINK_0026b	Pipe	Other	Public (General)		CMP	Public/Easement and CMP	20.00
Z7_LINK_0288	Pipe	None	Public (General)		CMP	Public/Easement and CMP	22.59
Z2_LINK_0226	Pipe	None	Public (General)		CMP	Public/Easement and CMP	24.21
Z4_LINK_0195	Pipe	None	Public (General)		CMP	Public/Easement and CMP	29.71
L-0012	Pipe	None	Public (General)		CMP	Public/Easement and CMP	32.25
Z7_LINK_0295	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	32.54
L-0161	Pipe	None	Easement		CMP	Public/Easement and CMP	33.45
Z3_LINK_0103	Pipe	None	Public (General)		CMP	Public/Easement and CMP	36.06
L-0139	Pipe	None	Public (General)		CMP	Public/Easement and CMP	36.81
Z7_LINK_0251	Pipe	None	Public (General)		CMP	Public/Easement and CMP	37.32
Z2_LINK_0074	Pipe	None	Public (General)		CMP	Public/Easement and CMP	37.86
L-0232	Pipe	None	Public (General)		CMP	Public/Easement and CMP	39.23
L-0152	Pipe	None	Public (General)		CMP	Public/Easement and CMP	39.88
L-0230	Pipe	None	Public (General)		CMP	Public/Easement and CMP	50.06
L-0206	Pipe	None	Public (General)		CMP	Public/Easement and CMP	51.82
L-0104	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	55.92
Z3_LINK_0102	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	57.78
L-0105	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	61.96
Z3_LINK_0059	Pipe	None	Public (General)		CMP	Public/Easement and CMP	62.68
Z7_LINK_0266	Pipe	None	Public (General)		CMP	Public/Easement and CMP	68.77
Z7_LINK_0036	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	79.14
Z4_LINK_0042	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	83.16
Z7_LINK_0283	Pipe	None	Public (General)		CMP	Public/Easement and CMP	96.91
Z7_LINK_0242	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	98.28
L-0137	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	99.42
L-0316	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	107.27
Z7_LINK_0009	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	115.41
Z2_LINK_0212	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	119.94
Z7_LINK_0285	Pipe	None	Public (General)		CMP	Public/Easement and CMP	130.82
Z2_LINK_0053	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	134.66
Z7_LINK_0265	Pipe	None	Public (General)		CMP	Public/Easement and CMP	137.62
Z7_LINK_0284	Pipe	None	Public (General)		CMP	Public/Easement and CMP	138.59
L-0217	Pipe	None	Public (General)		CMP	Public/Easement and CMP	153.61
Z7_LINK_0270	Pipe	None	Public (General)		CMP	Public/Easement and CMP	187.22
Z7_LINK_3000	Culvert	None	Private	Public (General)	CMP	Public/Easement and CMP	200.07
L-0003	Pipe	None	Public (General)		CMP	Public/Easement and CMP	235.43
Z2_LINK_0049	Pipe	None	Private	Public (General)	CMP	Public/Easement and CMP	279.45

[1]Owner is the primary field for owner; Other Owner presents if a link segment has more than one owner.

Appendix C

2020 HYDROVAC LIST

Town of Moraga
Operations Maintenace Program
2020 Hydrovac List

Unique ID	Link Type	Stub	Owner	Other Owner[1]	Maintenance Condition	Length (ft.)
Z5_LINK_0154	Pipe	None	Public (General)		Poor	8.53
L-0457	Pipe	PPC	Private	Public (General)	Poor	20.00
L-0656	Pipe	Downstream Unknown	Private	Public (General)	Poor	20.00
L-0470	Pipe	Upstream Unknown	Private	Public (General)	Poor	20.00
Z4_LINK_0068a	Pipe	Upstream Unknown	Private	Public (General)	Poor	20.00
Z4_LINK_0085	Pipe	PPC	Private	Public (General)	Poor	20.00
L-0526	V-ditch	Upstream Unknown	Private	Public (General)	Poor	20.00
L-0604	Pipe	PPC	Private	Public (General)	Poor	20.00
L-0430	Pipe	Other	Private	Public (General)	Poor	20.00
Z4_LINK_0003a	Pipe	None	Public (General)		Poor	27.32
Z7_LINK_0264	Pipe	None	Public (General)		Poor	31.12
Z4_LINK_0082	Pipe	None	Public (General)		Poor	36.79
Z7_LINK_0251	Pipe	None	Public (General)		Poor	37.32
Z7_LINK_0063	Pipe	None	Public (General)		Poor	47.09
L-0104	Culvert	None	Private	Public (General)	Poor	55.92
L-0201	Culvert	None	Public (General)		Poor	60.34
Z4_LINK_0086	Pipe	None	Public (General)		Poor	61.95
Z9_LINK_0006	Pipe	None	Public (General)		Poor	68.15
L-0200	Culvert	None	Private	Public (General)	Poor	74.40
Z4_LINK_0021	Pipe	None	Private	Public (General)	Poor	136.59
Z7_LINK_0307	Pipe	None	Public (General)		Poor	213.01
Z7_LINK_0020	Pipe	None	Private	Public (General)	Poor	226.22
Z7_LINK_0119	Pipe	None	Private	Public (General)	Poor	316.34
Z7_LINK_0118	Pipe	None	Public (General)		Poor	632.27

[1]Owner is the primary field for owner; Other Owner presents if a link segment has more than one owner.

Appendix D

Inspection & Maintenance Tables

Stormwater Asset	Inspections			
	Type	Frequency	Description	Documentation
Catch Basins	Visual	Annually in the fall and during major storm events	"Windshield" survey to document maintenance condition and/or any other issues	No documentation necessary for routine visual inspections that do not require follow-up maintenance
	Emergency	As needed	More detailed investigation to address emergency concerns	Document in Collector if follow-up maintenance required
	New Construction	Within 1 year following construction	Verify asset is functioning as designed and constructed	Document in Collector if follow-up maintenance required
	CCTV	May be included in CCTV inspection for adjoining storm drain pipes; Up to 5,000 LF of SD pipe to receive CCTV inspection annually + up to 500 LF annually on an emergency basis	Condition assessment of storm drain asset	GIS Data Manager to update asset inventory following receipt of CCTV inspection report
Storm Drain Pipes or Culverts	Emergency	As needed on an emergency basis	More detailed investigation to address emergency concerns	Document in Collector if follow-up maintenance required
	New construction	Within 1 year following construction	Verify asset is functioning as designed and constructed	Document in Collector if follow-up maintenance required
	CCTV	Up to 5,000 LF of SD pipe to receive CCTV inspection annually + up to 500 LF annually on an emergency basis	Condition assessment of storm drain asset	GIS Data Manager to update asset inventory following receipt of CCTV Inspection report
M-Ditches	Visual	Annually in the fall and during major storm events	"Windshield" survey to document maintenance condition and/or any other issues	No documentation necessary for routine visual inspections that do not require follow-up maintenance
	Emergency	As needed on an emergency basis	More detailed investigation to address emergency concerns	Document in Collector if follow-up maintenance required
Nuisance Assets	Visual	Annually in the fall and during major storm events	"Windshield" survey to document maintenance condition and/or any other issues	No documentation necessary for routine visual inspections that do not require follow-up maintenance
	Emergency	As needed on an emergency basis	More detailed investigation to address emergency concerns	Document in Collector if follow-up maintenance required

Stormwater Asset	Maintenance			
	Type	Frequency	Description	Equipment
Catch Basins	Town maintenance	As necessary during annual visual inspections	Town maintenance might include removing sediment or debris from flow line or accessible storm drain assets	Truck and hand crew
	Hydrovac cleaning	Vendor conducted, as necessary, for up to 5 days per year	Town will hire a vendor to complete hydrovac cleaning	Vendor vactor truck
Storm Drain Pipes or Culverts	Town maintenance	As necessary during annual visual inspections	Town maintenance might include removing sediment or debris from flow line or accessible storm drain assets	Truck and hand crew
	Hydrovac cleaning	Vendor conducted, as necessary, for up to 5 days per year	Town will hire a vendor to complete hydrovac cleaning	Vendor vactor truck
M-Ditches	Town maintenance	As necessary during annual visual inspections	Town maintenance might include removing sediment or debris from flow line or accessible storm drain assets	Truck and hand crew
	Hydrovac cleaning	Vendor conducted, as necessary, for up to 5 days per year	Town will hire a vendor to complete hydrovac cleaning	Vendor vactor truck
Nuisance Assets	Town maintenance	As necessary during annual visual inspections	Town maintenance might include removing sediment or debris from flow line or accessible storm drain assets	Truck and hand crew
	Hydrovac cleaning	Vendor conducted, as necessary, for up to 5 days per year	Town will hire a vendor to complete hydrovac cleaning	Vendor vactor truck

ATTACHMENT 3

High Resolution Public Storm Drain System Map

Developed by NCE

Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
Zone 9

Legend

Town Limits
Maintenance Zone

Junction (Node) Type
- Catch Basin
- Manhole
- Open Pipe
- Legacy Node

Conveyance (Link) Type
- Pipe
- Culvert
- Ditch
- V-ditch
- M-Ditch
- Legacy Link
- Streams

TOWN OF MORAGA O&M PROGRAM

STORM DRAIN SYSTEM MAP (NODE)

N

1 in. = 800 ft.

0 1,000 2,000 ft.

ATTACHMENT

A.1

SOURCE	JOB NUMBER	DRAWN	DATE	REVISED	APPROVED
Bing Hybrid Basemap	576.15.55	cdavis, mcasterman	9/17/2019	11/4/19	drios

Legend

- Town Limits
- Maintenance Zone

Junction (Node) Type

- Catch Basin
- Manhole
- Open Pipe
- Legacy Node

Conveyance (Link) Type

- Pipe
- Culvert
- Ditch
- V-ditch
- M-Ditch
- Legacy Link
- Streams

TOWN OF MORAGA O&M PROGRAM

STORM DRAIN SYSTEM MAP (LINKS)

N

1 in. = 800 ft.

0 1,000 2,000 ft.

ATTACHMENT

A.2

SOURCE	JOB NUMBER	DRAWN	DATE	REVISED	APPROVED
Bing Hybrid Basemap	576.15.55	jhall, cdavis	9/17/2019	11/4/19	drios

ATTACHMENT 4

Project Tracking Matrix

(provided electronically to Town staff)

Town of Moraga SDMP 2019 Addendum - Total Public CIP List

Project ID	Project Name	Category	New Priority	2015 Prioroty	Private Pipe?	Approximate Construction Cost	Soft Costs - 35%	CIP Year	Total
C03	Campolindo	Capacity - Pipes	Low	Moderate	No	$ 721,000.00	$ 252,350.00	2020	$ 980,000.00
C07	Hazelwood	Capacity - Pipes	Low	Moderate	No	$ 33,000.00	$ 11,550.00	2020	$ 50,000.00
C09	Larch	Capacity - Pipes	Low	Moderate	No	$ 205,000.00	$ 71,750.00	2020	$ 280,000.00
C13	Scofield	Capacity - Pipes	Completed	Low	No	$ -	$ -		$ -
C14	Fernwood	Capacity - Pipes	Low	Low	No	$ 149,000.00	$ 52,150.00	2020	$ 210,000.00
C15	Camino Ricardo 2	Capacity - Pipes	Low	Low	No	$ 142,000.00	$ 49,700.00	2020	$ 200,000.00
C19	Deerfield	Capacity - Pipes	Low	Low	No	$ 297,000.00	$ 103,950.00	2020	$ 410,000.00
N02	Moraga and Dolores St	Nuisance	High		No	$ 160,000.00	$ 56,000.00	2020	$ 220,000.00
N03	Ascot and Moraga	Nuisance	High		No	$150,000.00	$ 52,500.00	2020	$ 210,000.00
N05	End of Camino Ricardo - Model	Nuisance	High		No			2020	$ 20,000.00
N07	Laguna Trib under St. Marys Rd	Nuisance	Moderate	Low	No	$ 205,000.00	$ 164,500.00	2020	$ 370,000.00
NO6	299 Corliss Dr	Nuisance	High	Low	No	$ 30,000.00	$ 164,500.00	2020	$ 40,000.00
N08	End of Camino Ricardo	Nuisance	Low		No				$ 750,000.00
S02	Buckingham Dr.	Condition	Moderate	Low	No	$ 20,000.00	$ 7,000.00	2020	$ 30,000.00
S10	Donald & Fernwood	Condition	Completed	Low	No	$ -	$ -		$ -
S11	Bollinger Canyon & Joseph	Condition	High	High	No	$ 50,000.00	$ 17,500.00	2020	$ 70,000.00
S12	Del Rio Way	Condition	Moderate	Low	No	$ 3,000.00	$ 1,050.00	2020	$ 5,000.00
S15	Rimer Dr.	Condition	Moderate	Low	No	$ 3,000.00	$ 1,050.00	2020	$ 5,000.00
S20	1528 St Marys Rd	Condition	Completed	High	No	$ -	$ -		$ -
S21	423 Canyon Rd	Condition	Completed	High	No	$ -	$ -		$ -
	CMP at Canyon Bridge	Condition	Completed			$ -	$ -		$ -
	Baitx Crive at Lakefield Place	Condition	Completed			$ -	$ -		$ -
	Canyon Road Outfall past Bridge	Condition	Completed			$ -	$ -		$ -
	Calle La Mesa at Campolindo	Condition	Completed			$ -	$ -		$ -
	Rheem Blvd. at St. Mary's	Condition	Completed			$ -	$ -		$ -
CC01- MC3	Moraga Creek	Capacity - Creeks	Low	High	No	$ 620,000.00	$ 217,000.00	2020	$ 840,000.00
CC02	South Moraga Creek	Capacity - Creeks	Low	High	No	$ 230,000.00	$ 80,500.00	2021	$ 320,000.00
CC04- LC5	Laguna Creek at Hacienda	Capacity - Creeks	Moderate	High	No	$ 950,000.00	$ 332,500.00	2020	GRANT FUNDED
CC05- MC1	Moraga Creek	Capacity - Creeks	Low	Moderate	No	$ 310,000.00	$ 108,500.00	2020	$ 420,000.00
CC06- STM2	St Marys Rd Trib	Capacity - Creeks	Low	Moderate	No	$ 190,000.00	$ 66,500.00	2020	$ 260,000.00
CC07- ID2	Ivy Drive Creek	Capacity - Creeks	Low	Moderate	No	$ 210,000.00	$ 73,500.00	2020	$ 290,000.00
CC08- CD1	Corliss Drive Trib	Capacity - Creeks	Low	Moderate	No	$ 180,000.00	$ 63,000.00	2020	$ 250,000.00
CC10- ID1	Ivy Drive Creek	Capacity - Creeks	Low	Moderate	No	$ 70,000.00	$ 24,500.00	2020	$ 100,000.00
CC12- RT1	Rheem Trib	Capacity - Creeks	Low	Moderate	No	$ 30,000.00	$ 10,500.00	2020	$ 50,000.00
CC13- STM1	St Marys Rd Trib	Capacity - Creeks	Low	Low	No	$ 140,000.00	$ 49,000.00	2020	$ 190,000.00
CC14- LC1	Laguna Creek	Capacity - Creeks	Low	Low	No	$ 430,000.00	$ 150,500.00	2020	$ 590,000.00
CC17- STM4	St Marys Rd Trib	Capacity - Creeks	Low	Low	No	$ 140,000.00	$ 49,000.00	2020	$ 190,000.00
CC18- RT2	Rheem Trib	Capacity - Creeks	Low	Low	No	$ 20,000.00	$ 7,000.00	2020	$ 30,000.00
H01	Update 2015 Hyraulic Model	Hydraulic Modeling	Moderate						$ 50,000.00
Total Cost (Estimated January 2020 Dollars)									**$ 7,430,000.00**

This estimate of construction cost is a professional opinion, based upon the engineer's experience with the design and construction of similar projects. It is prepared only as a guide, and is based upon incomplete information. The estimate is subject to change. Schaaf & Wheeler makes no warranty, whether expressed or implied, that the actual costs will not vary from these estimated costs, and assumes no liability for such variances. This estimate specifically excludes any costs associated with designing for, handling and disposal of hazardous wastes and contaminated materials. Costs associated with land, right-of-way, or easement purchase are approximate.

ATTACHMENT 5

Schedule and Capital Asset Replacement Fund Calculation

(developed by Town)

Town of Moraga Storm Drain CIP
Reserve Funding Strategy

ASSET DESCRIPTION	CURRENT REPLACEMENT COST (2019/20)	ESC RATE	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	TOTALS
High & Moderate CIP Projects														
Sedimentation Basin Study	$20,000	2.92%		$21,000										$21,000
Corliss Dr Drain Inlets	$40,000	2.92%		$42,000										$42,000
Moraga Drive Drainage	$220,000	2.92%				$269,000								$269,000
Ascot and Moraga Drain Inlet	$210,000	2.92%						$250,000						$250,000
Bollinger Clean/Replace	$70,000	2.92%							$86,000					$86,000
St Mary's Rd Culvert Replacement	$370,000	2.92%										$493,000		$493,000
Del Rio Way Cleaning	$5,000	2.92%											$7,000	$7,000
Rimer Dr. Cleaning	$5,000	2.92%											$7,000	$7,000
Update Hydraulic Modeling	$50,000	2.92%											$69,000	$69,000
GRAND TOTALS			**$0**	**$63,000**	**$0**	**$269,000**	**$0**	**$250,000**	**$86,000**	**$0**	**$0**	**$493,000**	**$83,000**	

Storm Drain CIP Replacement Fund	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Beginning Fund Balance	**$ -**	**$ -**	**$ 59,044**	**$ 182,422**	**$ 39,587**	**$ 162,526**	**$ 38,242**	**$ 75,150**	**$ 198,892**	**$ 325,432**	**$ (38,170)**
Deposits into Replacement Fund	$ -	$ 120,680	$ 120,680	$ 120,680	$ 120,680	$ 120,680	$ 120,680	$ 120,680	$ 120,680	$ 120,680	$ 120,680
Plus: Interest Income @ 2.26%	$ -	$ 1,364	$ 2,698	$ 5,486	$ 2,258	$ 5,037	$ 2,228	$ 3,062	$ 5,859	$ 8,718	$ 501
Less: Capital Asset Expenditures	$ -	$ 63,000	$ -	$ 269,000	$ -	$ 250,000	$ 86,000	$ -	$ -	$ 493,000	$ 83,000
Ending Fund Balance	**$ -**	**$ 59,044**	**$ 182,422**	**$ 39,587**	**$ 162,526**	**$ 38,242**	**$ 75,150**	**$ 198,892**	**$ 325,432**	**$ (38,170)**	**$ 11**