LTCWD

los trancos county water district

Storm Drainage Master Plan

Final

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LOS TRANCOS COUNTY WATER DISTRICT
STORM DRAIN MASTER PLAN

TABLE OF CONTENTS

CHAPTER 2: REGULATORY REQUIREMENTS

CHAPTER 3: COLLECTION SYSTEMS

CHAPTER 4: CAPITAL IMPROVEMENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Master planning has been undertaken to help guide the Los Trancos County Water District (District) to establish a prioritized capital improvement program to mitigate the impacts of stormwater runoff. A comprehensive Storm Drain Master Plan (SDMP) has never been done for the properties within the District jurisdiction. The existing system was not cohesively designed and passes through both County of San Mateo right-of-way and private properties. The District was established in 1954 to "furnish a system, plants, works and undertaking used for and useful in obtaining, conserving and disposing of water for public and private uses…". The District used to operate a potable drinking water system, but in 2006 it was sold to California Water Service Company. The District has now turned its attention to, among other things, improvement of the existing drainage system, rendered inadequate due to the substantial growth over the past 40 years, and significant changes to runoff characteristics, drainage system features, and regulatory requirements.

STUDY OBJECTIVES

The basic objectives of this storm drainage master plan document are to provide an examination of local flood risks, to identify improvements based on a "bottom to top" approach, to ensure regulatory compliance within District jurisdiction in unincorporated San Mateo County, and to recommend actions necessary to provide the appropriate level of service. It is the intent of this Master Plan to integrate the activities of multiple government agencies and private property owners to jointly solve the drainage problems. Several objectives have been accomplished:

- Assess the performance of storm drainage systems
- Identify capital improvements to reduce flood risk
- Prioritize said capital improvements based on risk reduction
- Identify regulatory requirements

BACKGROUND

Hydrologic and environmental settings, flood protection facilities, historic flooding and regulatory floodplain mapping efforts within the District are described in Chapter 1 of this report. A brief synopsis of the history of flooding analysis conducted prior to this master plan is provided below.

FEMA Flood Insurance Study, 2012

The Federal Emergency Management Agency (FEMA) prepared a Flood Insurance Study (FIS) Report for the City of Portola Valley and San Mateo County in 2012. The FIS concentrated on 100-year flooding from rainfall runoff, including portions of Corte Madera Creek. The limit of the detailed study of Corte Madera Creek ends at Willowbrook Drive, approximately 2 miles downstream from the District lands. Los Trancos Creek was not studied by FEMA.

SOURCES OF FLOODING

Local runoff is the major source of flooding that the District faces, further complicated by creek influences at each outlet point and sub-surface flow through saturated soils. This master plan focuses on how that runoff is conveyed by overland conveyance facilities. The District plans to work with San Mateo County and property owners to develop a regional system of conveyance facilities which will contain storm flows to prevent damage to property and threats to public safety.

Runoff generated within the District's boundary is conveyed through the County and privately owned storm drain system that outfalls to Los Trancos Creek and Corte Madera Creek and then to the San Francisco Bay via San Francisquito Creek. Portions of the District's watersheds drain directly to creek channels while a portion of the runoff ponds in two lakes known as Frog Pond and Water District Lake. Conveyance and capacity deficiencies within the District's storm drain system can contribute to flooding within the District. One key objective of the Storm Drain Master Plan is to address this risk.

WORK PRODUCTS

This master plan is intended to function as a multifaceted resource for the District. District Board Members responsible for evaluating and approving capital improvements should find that this document contains sufficient background information and data to serve as a basis for storm drainage CIP implementation and/or modification. For the District and other parties interested in a more in-depth examination of storm drain facilities within the District, the companion Geographic Information System (GIS) and Excel-based computer models are available. The following information is available via the GIS:

1. ***Inventory of Drainage Facilities.*** County and privately-owned drainage pipes at least 6 inches in diameter which have been located within the study area are entered into the GIS storm drain model. Information pertaining to each system component may be accessed graphically or through database spreadsheets which have been provided on CD and attached to this report.

2. ***Tributary Drainage Areas.*** Land areas used to generate local runoff are also available graphically in the storm drain model. Tributary area, factors related to land use and soil conditions and other basin morphology are included.

3. ***Storm Drain Flows.*** Storm drain flows are documented in the GIS-Excel model. For each drainage system, component peak discharge is computed. Based on capacity calculations the degree of surcharge (represented by excess flow values) is also determined. This determination is then used to assign priorities for system remediation.

STUDY FINDINGS

Several conclusions have been reached regarding Districts' storm drainage systems:

- Significant portions of the drainage system do not have 10-year capacity and resultant excess flow can potentially cause damage to structures or increase landslide risk.
- The existing system is heavily impacted by natural debris and flooding results from system clogging.
- Roadways within the District are generally pitched downhill with a valley gutter located on the uphill side, allowing flow to discharge downhill freely across private properties.
- Most of the drainage infrastructure is located on private property which is not maintained by the County and subject to change at the discretion of the owner.
- The existing drainage infrastructure was not designed or sized to provide conveyance from the top of the drainage basin to the Creeks but was installed in an ad-hoc nature.

From these conclusions, improvements are recommended to improve the system's performance so as to reduce the risk of flooding, slope saturation and resultant land sliding. The rural appeal of the community is partially imparted by the presence of non-standard roadways without six inch concrete curbs, uniform roadway widths or engineered sloping pavement connected to an underground drainage system. The goal of this Master Plan is not to fundamentally alter the character of the community but to enhance the drainage system currently in place while identifying ways and means to contain drainage on County right-of-way without causing adverse impacts to private properties.

While there are many areas within the District that provide adequate stormwater conveyance for a 100-year event, there are also known areas within each subsection of the District where flooding has occurred in the past and future flooding is anticipated. There are also regions of the District that lack a formal drainage system (usually where residents have installed non-engineered channels or culverts on private property) and require improvements. The existing system passes through private property and County of San Mateo right-of-way with no clear identification of ownership. Debris loading is common within the District system causing additional flooding which could be avoided with proper maintenance. The improvements recommended in this Master Plan should be considered a comprehensive Capital Improvement Program within the study area.

MASTER PLAN COSTS AND BENEFITS

Capital projects are needed to provide the benefits of reduced flood risk and relief from economic impacts during heavy stormwater runoff events. Failure to provide capital improvements or maintain the storm drain systems could interrupt vehicular access throughout the District, so all residents receive a benefit from a functional storm drain system regardless of whether their property is directly affected by said improvements and maintenance. A comprehensive map of all the recommended improvement projects is presented in Figure ES-1.

Table ES-1 summarizes recommended capital improvement costs for existing and future storm drains within District drainage basin sub areas (Figure 1-1), including the extension and upsizing of existing storm drain pipelines. Please refer to Chapters 3 and 4 for figures detailing the storm drain deficiencies and recommended improvements.

Table ES-1: Summary of Master Plan Costs

Basins	High Priority Projects to Meet the 10-year Standard	Medium Priority Projects to Meet the 100-year Standard	Low Priority Problem Spots	Total
A	$67,000			$67,000
B	$128,000			$128,000
C	$64,000			$64,000
D	$151,000			$151,000
E	$116,000			$116,000
F	$233,000	$251,000		$484,000
G			$89,000	$89,000
H	$633,000	$233,000	$99,000	$965,000
I	$24,000			$24,000
J		$191,000		$191,000
K		$99,000		$99,000
R		$134,000		$134,000
S			$27,000	$27,000
U	$345,000			$345,000
W		$132,000		$132,000
Z	$302,000	$54,000		$356,000
Total	**$2,063,000**	**$1,094,000**	**$215,000**	**$3,372,000**

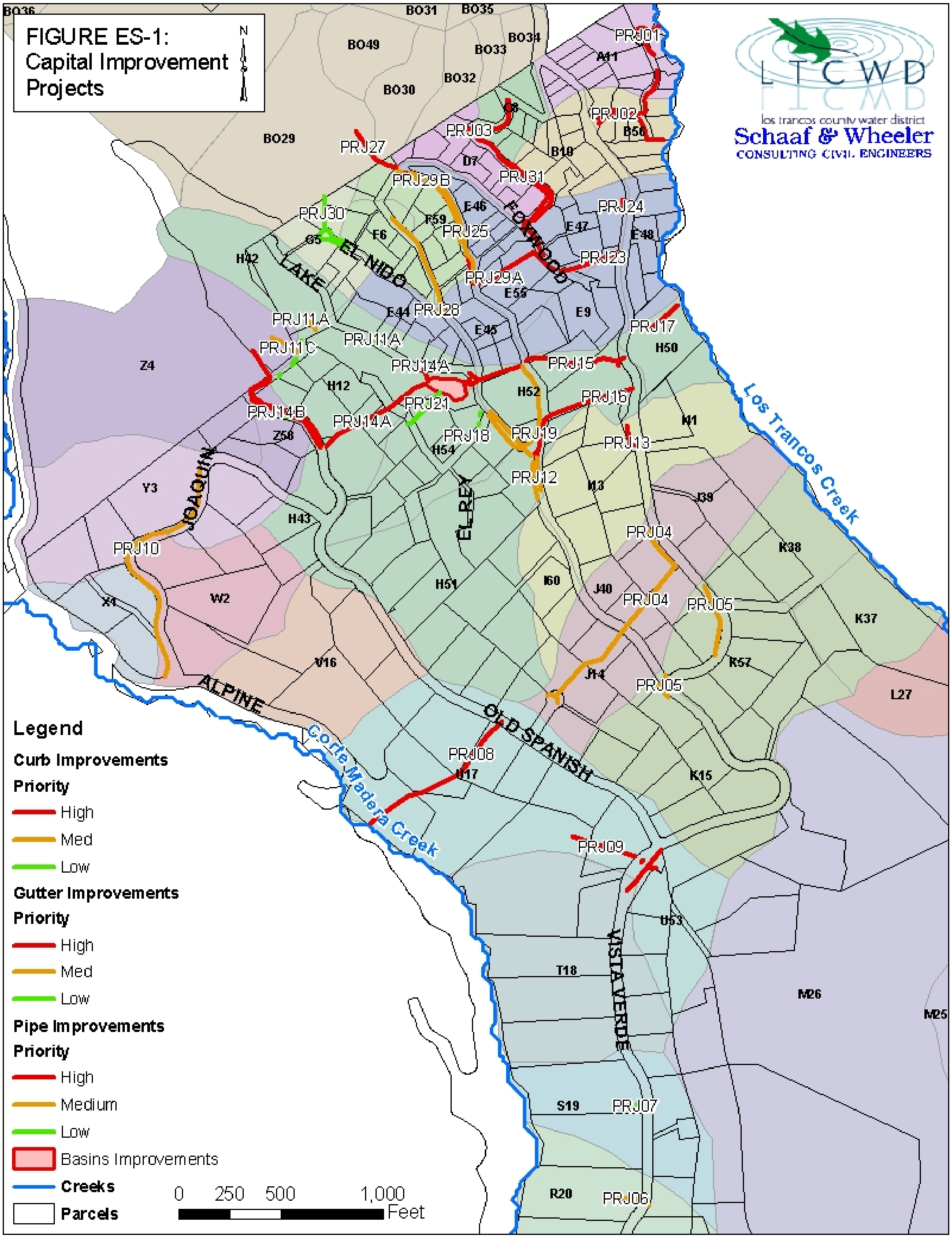
FIGURE ES-1:
Capital Improvement
Projects
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
Legend
Curb Improvements
Priority
High
Med
Low
Gutter Improvements
Priority
High
Med
Low
Pipe Improvements
Priority
High
Medium
Low
Basins Improvements
Creeks
Parcels
0 250 500 1,000
Feet
Los Trancos Creek
Corte Madera Creek
FOXWOOD
EL NIDO
LAKE
JOAQUIN
EL REY
ALPINE
OLD SPANISH
VISTA VERDE
PRJ01
PRJ02
PRJ03
PRJ04
PRJ05
PRJ06
PRJ07
PRJ08
PRJ09
PRJ10
PRJ11A
PRJ11C
PRJ12
PRJ13
PRJ14A
PRJ14B
PRJ15
PRJ16
PRJ17
PRJ18
PRJ19
PRJ21
PRJ23
PRJ24
PRJ25
PRJ27
PRJ28
PRJ29A
PRJ29B
PRJ30
PRJ31

RECOMMENDATIONS

Improving the quality of storm water runoff and reducing local flood risks by improving the District's storm drainage systems is a worthy objective. This Master Plan provides a tool for District residents and officials to use in their efforts to reduce the risk of serious local flood hazards — whether nuisance flooding or real hazards to property — by completing the identified capital improvement projects. Providing these improvements will ensure compliance with the new water quality permit and support healthier creeks and a cleaner San Francisco Bay. Increasing planning, engineering and implementation efforts will assure the residents of the District that this storm water program will provide a high-quality benefit to them.

CHAPTER 1
INTRODUCTION

This chapter provides a general background of flood management issues currently affecting the Los Trancos County Water District which include:

- Hydrologic and environmental settings,
- Flood protection and storm drain facility descriptions
- Historic flooding,
- Storm Drainage Master Plan objectives, and;
- Summary of data acquired.

SETTING

The Los Trancos County Water District and its governed communities are located at the southern end of the San Francisco Peninsula in San Mateo County. The District is bordered by Portola Valley to the north and unincorporated San Mateo County open space to the east, west and south.

The District encompasses mainly residential development and open space, which include Los Trancos Woods and Vista Verde, unincorprated areas within San Mateo County, and the Blue Oaks Subdivision within the Town of Portola Valley. The Los Trancos Woods area was originally developed as vacation homes which were converted to year round residences over subsequent years. The Vista Verde area was developed starting in the late 1960's as year round residences with modern storm drain features. Lot sizes range from 4,800 square feet to 13 acres with an average of 1 acre. Small areas within the District's jurisdiction (Oak Forest Court, Upper Alpine Road) were not included in this study because they are not part of the same drainage areas as the study area.

District lands are steep, with elevations ranging from 720 feet North American Vertical Datum (NAVD 88), to about 1880 feet NAVD. The San Andreas Fault line runs roughly through the middle of the District from northwest to southeast. This proximity to the fault line increases the risk of landslides. See Figure 1-2 for approximate fault line location.

SOILS

The Natural Resources Conservation Service (NRCS) has classified soils into four hydrologic soil groups (A, B, C, and D) according to their infiltration rates*. Appendix E shows the District has mostly group B moderate draining soils with very little D soils (very slow infiltration rate).

* *Hydrologic Soil Group* - NRCS Web Soil Survey National Cooperative Soil Survey. (2011).

Many landslide hazards are present within the District as shown on Figure 1-2 based on analysis by BAGG Engineers. Soil saturation due to stormwater subsurface flow coupled with the presence of the San Andreas Fault exacerbates the landslide and mudflow hazard. Additional soils information is available in reports prepared for the District by BAGG Engineers and are listed in the references section of this chapter. Reports are available on the District website and by request.

CLIMATE

The District's climate is marine-influenced with an average summertime high temperature of 87°F and an average low of 51°F, dropping to an average winter nighttime low temperature of 37°F and an average high of 62°F. Mean annual precipitation ranges from 15 to 55 inches,[†] with the majority of that precipitation falling from November through March. Precipitation occurs entirely as rainfall. Snowmelt is not a hydrologic process that significantly affects runoff in the District**.**

SEPTIC TANKS

There are roughly 200 existing septic tanks within the District. Leaking septic tanks result in near constant soil saturation in the vicinity of the tanks, regardless of the season. Saturated soils are more susceptive to landslides and mudflows during storms, making smaller rainfall events cause more damage than if the soil were dry before the rainfall. The presence of leaking septic tanks increases the risk of landslides and property damage during a rainfall event. See Figure 1-2 for known landslide risk areas within the District.

FLOOD PROTECTION FACILITIES

Precipitation that falls within the District generates stormwater runoff. This runoff is conveyed in a combination of manmade flood protection systems, uncontrolled overland release, and natural drainage channels that discharge to the creeks. Most of the manmade systems within separate drainage basins do not interact with one another, and potential improvements to one system should not impact the performance of other systems. The total study area is roughly 0.6 square mile (373 acres), not including the Blue Oaks neighborhood and other areas which are tributary to parcels within the District's jurisdiction. To maintain a rural aesthetic and allow for street parking, many of the streets in the District do not have traditional suburban curb and gutter lined streets. This layout provides some attenuation before runoff reaches a catch basin.

The drainage system and storm water flows generally run perpendicular to the alignment of the County roadways. There are no roadways or public lands which intersect with Los Trancos Creek; therefore it is generally necessary for drainage systems to pass through private property in order to convey flows to the Creeks.

† NOAA Rain Gauge Atlas 14, Volume 6, Version 2, Precipitation Depth, Palo Alto – DAHL Ranch

In addition to storm drains, flood protection is provided to the District by two creeks (Corte Madera and Los Trancos) that convey storm-generated runoff north to the San Francisco Bay. Figure 1-1 shows these facilities.

Storm Drain Network

Figure 1-1 delineates the District's 27 major drainage areas based on the existing pipe network, ground contours and discharge point; all of which are tributary to creeks or the neighboring community of Blue Oaks. None of the basins within the District drain onto each other, they have separate discharge points by definition. The study area is defined as nearly all properties within the jurisdiction of the District. A small number of parcels lie well outside the study area but are part of the District (Oak Forest Ct, upper Alpine Road). An alphanumeric system was employed within the District and downstream basins within the Blue Oaks Community Association Open Space (BO) areas which uses letters to identify the major drainage area and an ID number which represents smaller catchments within the drainage basins. The tributary areas for each drainage sub-area (Figure 1-1) and the total length of storm drain pipes (6 inches and larger in diameter) within each basin are shown in Table 1-1.

Table 1-1: Watershed Areas and Length of Storm Drain Pipe

Basin	Sub-Catch ID	Area (ac)	Pipe (ft)
A	11	5.3	213
B	10	3.7	127
B	56	3.2	0
BO	28	23.8	58
BO	29	12.4	0
BO	30	3.2	75
BO	31	4.5	347
BO	32	2.2	95
BO	33	1.0	83
BO	34	1.5	0
BO	35	4.5	800
BO	36	81.1	504
BO	49	3.4	170
C	8	2.5	72
D	7	3.6	68
E	46	2.1	104
E	9	3.6	0
E	44	2.6	58
E	45	2.2	71
E	47	3.6	158
E	48	3.6	0
E	55	3.4	325
F	6	2.9	144
F	59	3.7	172
G	5	2.9	57

Basin	Sub-Catch ID	Area (ac)	Pipe (ft)
H	12	10.6	344
H	42	6.0	0
H	43	3.6	199
H	50	3.3	0
H	51	16.6	66
H	52	6.6	392
H	54	7.5	111
I	13	7.5	255
I	41	4.1	0
I	60	3.2	518
J	14	5.4	0
J	39	5.8	0
J	40	5.4	86
K	15	11.6	470
K	37	6.2	0
K	38	6.5	0
K	57	10.7	483
L	27	5.2	0
M	25	36.5	0
M	26	87.9	0
N	23	51.5	0
O	24	13.9	0
P	22	19.3	0
Q	21	12.3	67
R	20	15.1	155
S	19	10.2	159
T	18	18.3	0
U	17	23.6	279
U	53	5.8	392
V	16	11.3	18
W	2	9.9	272
X	1	4.1	68
Y	3	14.5	204
Z	4	22.4	177
Z	58	2.3	26
Total		**632**	**8442**

Off-Site Discharges

There are several locations where the District's storm drainage network and overland flow enter surrounding communities (see Appendix G for Blue Oaks As-Built Plans and off-site discharge location map). Portions of the District's storm water runoff flows downhill with the natural terrain and discharge through the Blue Oaks open space stormwater conveyance infrastructure before entering the County system beneath Los Trancos Road and into Los Trancos Creek. BKF Engineers was responsible for the storm drainage design for the Blue Oaks Development. Schaaf & Wheeler obtained project plans and design information from BKF which include drainage paths and system sizing information. The Blue Oaks open space drainage system was designed to account for the run-on received from elevated property within the District. No run-off from District lands flows through individual private properties in Blue Oaks and is limited to the open space area. All other storm drainage discharged off-site occur to County owned drainage systems or directly to Corte Madera or Los Trancos Creeks.

HISTORY OF FLOODING WITHIN THE DISTRICT

Heavy rainfalls in the winter months can produce flood situations in the District. Historical flooding information can be valuable in highlighting areas of recurring problems, and prioritizing future improvements. Areas with known flooding problems have been identified by District staff and residents. The most common local flooding occurs as a result of branches and leaf litter in the system, which can plug inlets and significantly reduce the effectiveness of the system. Most inlets do not have grates or trash racks to prevent debris from entering the system. Areas of known drainage issues are highlighted on the map in Figure 1-2 and are detailed in Chapter 3, and Appendix A.

FEMA Flood Insurance Rate Maps delineate the 100-year flood resulting from insufficient creek capacity and do not consider local rainfall and associated drainage. The District is located in FEMA Flood Zone X (un-shaded), meaning that it is an area of minimal flood hazard, usually representing flood inundation above the 500-year flood level. Due to the steep slopes, it is likely that a detailed study of upper Corte Madera and Los Trancos Creeks by FEMA would still place all structures out of the 100-year and 500-year flood plains. This means that flooding from Corte Madera and Los Trancos Creeks will not likely compound with and increase flooding from local rainfall runoff.

Recent Flood Protection Measures Taken

The District, through contracting with professional engineering consultants, recognizes inadequacies in the existing storm drain system which are detailed in Chapter 3. In an effort to alleviate problems, the District has made some system improvements. Recent District activity has focused on:

- Documentation and evaluation of problem areas within the storm drain network;
- Replacement of failed and under-performing driveway culverts;
- Replacement of a failed pipe inlet and undergrounding of an incised channel on private property;
- Engaging specialized consultants to complete geotechnical studies and hydraulic engineering and coordinating with the San Mateo County Public Works Department and interested public parties to save Ramona Road from landslide;
- Engaging contractors to perform driveway culvert replacement demonstration projects.

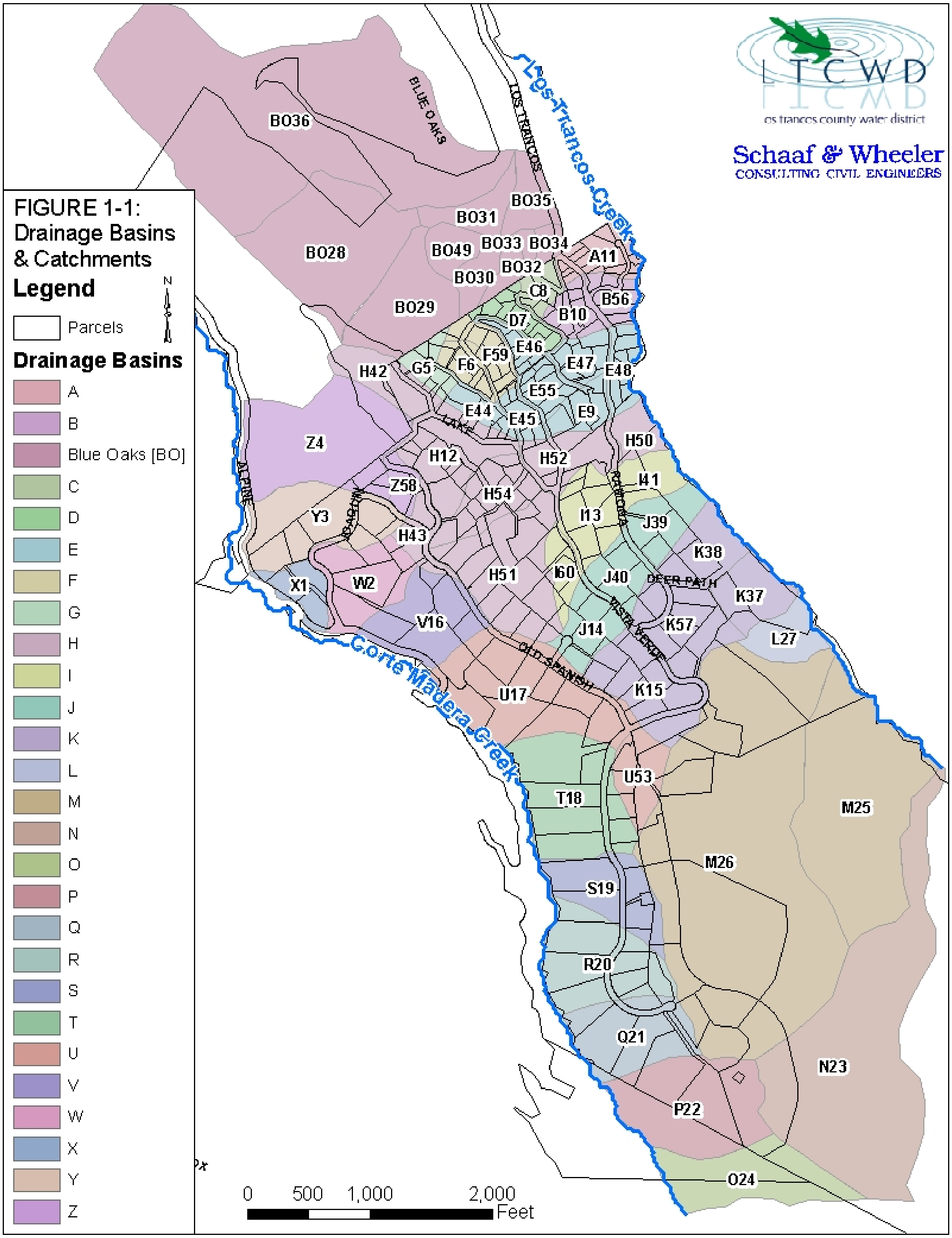
FIGURE 1-1:
Drainage Basins & Catchments
Legend
Parcels
Drainage Basins
A
B
Blue Oaks [BO]
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
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Los Trancos Creek
Corte Madera Creek
BLUE OAKS
LOS TRANCOS
ALPINE
LAKE
OLD SPANISH
VISTA VERDE
DEER PATH
0 500 1,000 2,000
Feet

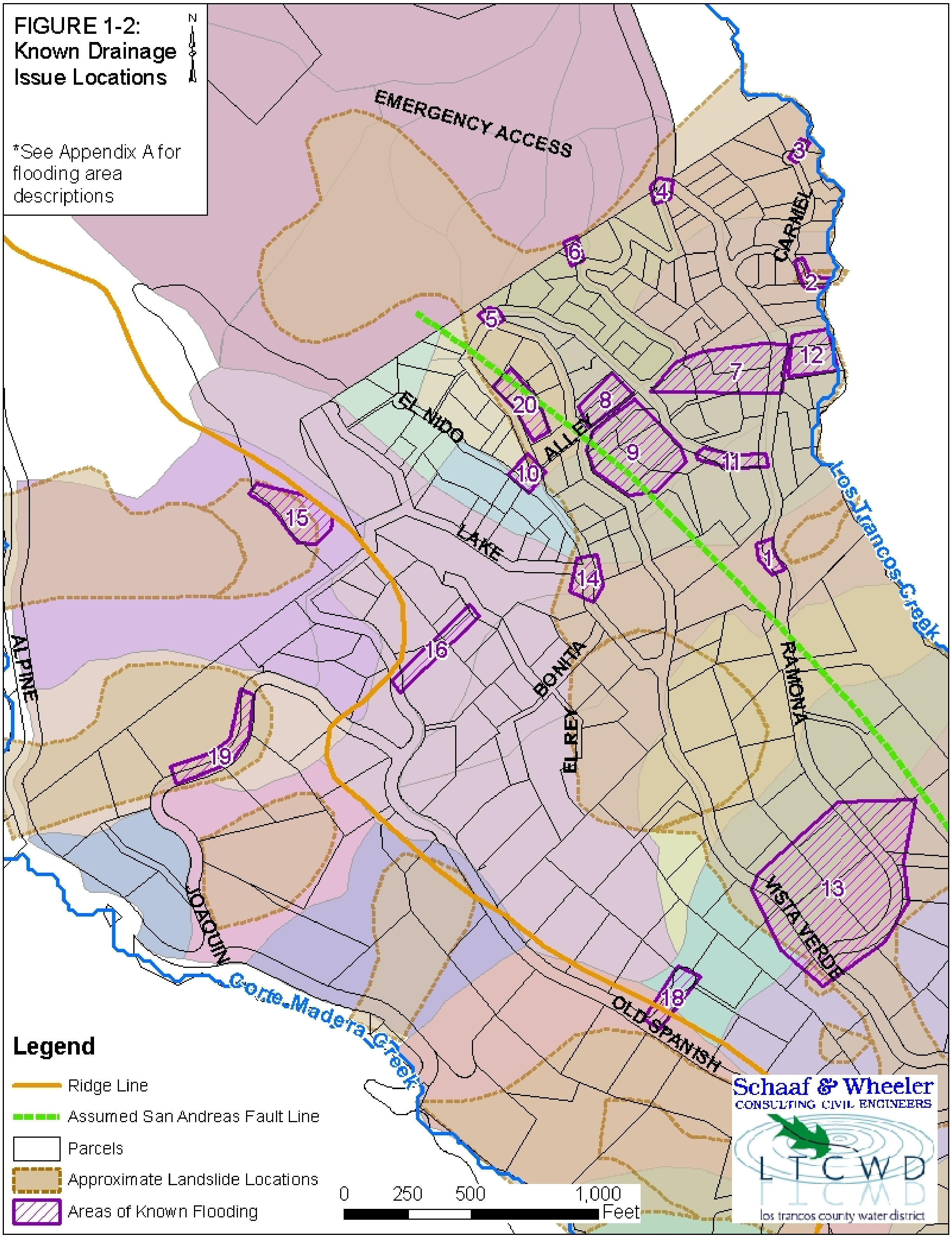
FIGURE 1-2:
Known Drainage
Issue Locations
N
*See Appendix A for
flooding area
descriptions
EMERGENCY ACCESS
CARMEL
EL NIDO
ALLEY
LAKE
BONITA
EL REY
RAMONA
ALPINE
JOAQUIN
VISTA VERDE
OLD SPANISH
Los Trancos Creek
Corte Madera Creek
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
18
19
20
Legend
Ridge Line
Assumed San Andreas Fault Line
Parcels
Approximate Landslide Locations
Areas of Known Flooding
0
250
500
1,000
Feet
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MASTER PLAN PROCESS

The basic process to complete this master plan document is to analyze the current District storm drain system and flow paths and determine the improvements necessary to safely convey 100-year storm water runoff without property damage. Several tasks have been completed to reach this goal. The following list is a summary of steps taken:

1. Built a geographical information system (GIS) project area and a storm drain system model for the District. This model includes: pipe and manhole invert and rim elevations, pipe diameter, natural and hardened culvert inverts and widths, and watershed runoff characteristics;

2. Established storm drainage analysis methodologies and criteria with District staff.

3. Performed an assessment of the general condition of the storm drainage system.

4. Completed a hydraulic analysis of the existing storm drain facilities throughout the District to evaluate the 100-year level of service. System deficiencies are categorized in terms of the risk to public safety.

5. Identified projects that will improve storm drain performance.

6. Established a prioritized Capital Improvement Program (CIP).

7. Projected capital improvement costs for the CIP.

DATA

Schaaf & Wheeler compiled storm drain system data within the District. Data limitations, assumptions and impacts to the SDMP are also summarized. All project data and results are in NAVD88 (feet). Any data found on the NGVD29 vertical datum was converted to NAVD using the following equation:

NGVD29 + 2.85 feet = NAVD88

Topography and Aerial Imagery

San Mateo County's digital elevation map (DEM) topography data (NAVD) with half-foot accuracy (plus or minus 0.5 foot) is converted into 1-foot contour shapefiles and utilized for ground surface information. Color digital aerial imagery (2011) for the entire study area was retrieved from United States Geological Survey (USGS) National Agricultural Imagery Program (NAIP). This imagery is used to validate land use assumptions and identify runoff characteristics.

AutoCAD and GIS

Schaaf & Wheeler developed GIS files based on non-geo-referenced information provided by BAGG Engineers (2011-2012) and geo-referenced AutoCAD topographic survey files from Kier & Wright Land Surveyors (dated 2012-2013) for use on this project. No GIS or AutoCAD information existed before this analysis and all survey information was obtained by Kier & Wright Surveyors and site walks performed by Schaaf & Wheeler and District staff. Parcel line work and assessor parcel numbers are based on GIS shapefiles obtained from the County. Parcel lines have not been verified in the field and a boundary survey would need to be conducted to accurately map the property boundaries. The District GIS attribute information includes: storm drain pipes, storm drain manholes and inlets, open channels, roadside valley gutters, approximate fault line, topographic contours, approximate landslide locations, parcel lines and existing roadways.

Regulatory

A key document governing the regulatory review of capital storm drainage projects is the California Regional Water Quality Control Board San Francisco Region Municipal Regional Stormwater NPDES Permit, Order R2-2009-0074, NPDES Permit No. CAS612008, October 14, 2009. Construction activity is subject to the General Permit for Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ. The California Environmental Quality Act (CEQA) requires that an environmental analysis be performed for all construction projects which require approval by State or Local government agencies. Construction activity within the creeks is subject to the jurisdiction of the U.S. Army Corp of Engineers Section 404 of the Clean Water Act; National Marine Fisheries Section 10(a)(1)(B) of the Endangered Species Act and the State of California Fish and Wildlife Sections 1601 and 1603 Streambed Alteration Permit.

Projects within the County right-of-way will require an encroachment permit which will include review and approval of the project by the County Public Works Department. Projects on private property will require rights-of-entry agreements from the Owners. This Master Plan assumes that all rights of entry and encroachment permits can be secured for the capital improvement projects described.

Additional regulatory bodies impacting the Plan area include the County of San Mateo, San Francisquito Creek Flood Control Zone (a zone of the San Mateo County Flood Control District), the West Bay Sanitary District (partial), the San Mateo County Resource Conservation District (portions in Vista Verde) and Town of Portola Valley (Blue Oaks)‡. Note that there are no planned

‡‡ Martha Poyatos, LAFco, November 2013.

improvements to the Town of Portola Valley drainage infrastructure and the proposed improvements have no negative impact to the existing system within the Town.

See Chapter 2 for details on regulatory compliance within the District.

Operations and Maintenance

The County is responsible for maintenance and cleaning of the storm drainage infrastructure within the County right-of-way (usually ending approximately 9 feet offset from the edge of pavement on both sides of County owned streets). Infrastructure located on private property is currently being maintained by the individual property owners, generally after flooding is observed. The County maintenance plan states that they will sweep public streets within the District on Thursday every first and third week of the month[§] which includes removal of debris from roadside valley gutters. This map and schedule is included as Appendix J. There is a noticeable presence of leaf debris within the existing public system between street sweepings, as well as the presence of debris in private systems with no maintenance schedule.

Due to the heavy presence of leaf litter the existing storm drainage system capacities can be severely diminished. Blocked driveway culverts and roadside gutters lead to flow exiting the system and travelling via the paved roadways. Since the roadways do not have standard curbs and gutter to contain flow and are often sloped away from the drainage network, stormwater is discharged uncontrolled downhill across private properties.

Land Use Data and Runoff Characteristics

Land use within the District is roughly 88% low to medium density residential, 8% street right-of-way and 4% parks and open space. Based on values published in the Santa Clara County Drainage Manual (2007, Schaaf & Wheeler) and validated with aerial photography, the average percent impervious for each land use type is listed in Table 3-1.

Rainfall

In order to determine the most conservative rainfall estimate for the project area, three methodologies have been compared for the 2-year, 10-year and 100-year 24-hour storm events; The Santa Mateo County IDF Curve, NOAA Atlas Rainfall Data, and the Santa Clara County Drainage Manual. For each of the three design storms, the Santa Clara County Drainage Manual produced the most conservative results, as detailed in Table 1-2. See Appendix I for a comparison of the three methodologies used. The Mean Annual Precipitation (MAP) of 32 inches for the project site was

§ *Los Trancos Street Sweeping Routes*. County of San Mateo Public Works. September 2011.

based on Figure A-2 of the Santa Clara County Drainage Manual (Appendix I).

Table 1-2: Rainfall Intensities and Depth

Storm Event	Rainfall Depth (in)	Rainfall Intensity (in/hr)
2-year, 24-hour	3.4	0.14
10-year, 24-hour	5.8	0.24
100-year, 24-hour	8.6	0.36

Data Quality

The quality and accuracy of the data collected for the District SDMP varies greatly. Storm drainage infrastructure has been recently surveyed or field located and therefore represents a high level of accuracy. Elevation information and parcel data were obtained directly from the County and have a lower level of accuracy. Data received from BAGG Engineers is not geo-referenced and entered into the GIS system based on visual assessment and areal imagery. Because this is a master planning exercise it is important that all data sources and assumptions be documented.

REFERENCES

- *General Construction Permit*. State Water Resources Control Board: Division of Water Quality. (Order 2009-0009-DWQ as amended by 2010-0014-DWQ). (2010).
- *Phase 1 Report Water Movement Control Initiative*. BAGG Engineers. (2010).
- *Los Trancos, Lots, Drains, Ridge, Notes, Map*. BAGG Engineers. (2010).
- *Blueprint for a Clean Bay*, BASMAA. (2003).
- *Point Precipitation Frequency Estimates Station ID 83-6024 Dahl Ranch*. NOAA Atlas, Volume 6, Version 2. (2011).
- *Hydrologic Soil Group - San Mateo Area, California; Eastern Part, and Santa Clara Area, Western Part - Los Trancos*, National Resources Conservation Service (NRCS) Web Soil Survey National Cooperative Soil Survey. (2011).
- *Municipal Regional Stormwater NPDES Permit No. CAS612008.* California Regional Water Quality Control Board: San Francisco Bay Region. (Order R2-2009-0074). (2009).
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- *Los Trancos Street Sweeping Routes*. County of San Mateo Public Works. September 2011.
- *San Mateo County Watershed Protection Program Maintenance Standards,* County of San Mateo Department of Public Works, April 2004.
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- *FEMA FIRM 06081C0405E*. Federal Emergency Management Agency, October 16, 2012.

- *San Mateo County Flood Insurance Study Community Number 060311*. Federal Emergency Management Agency (2012).
- *San Mateo County Rainfall Runoff Data*. San Mateo County Public Works Department.
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CHAPTER 2
REGULATORY REQUIREMENTS

This Master Plan assumes all rights-of-entry and encroachment permits will be granted by private landowners and/or San Mateo County. In order to activate the portion of their legislation which allows the District to undertake stormwater projects, authorization from the Local Agency Formation Commission (LAFco) must be obtained. The District has inquired about this process. After rights of entry, the most significant regulatory requirements for the District's stormwater management are found in State's Construction General Permit and the Municipal Regional Permit (MRP) under the National Pollutant Discharge Elimination System (NPDES) permit as well as environmental permitting under the California Environmental Quality Act (CEQA) and waters of the state permits through the US Army Corps of Engineers (JARPA). This chapter provides a general outline of the various legal and regulatory requirements of these permits. Note that permits will be pursued prior to construction, and permits are subject to change at any point. It is the intent of this Master Plan to integrate the activities of multiple agencies in order to fix the drainage problems.

CONSTRUCTION GENERAL PERMIT

The State of California requires dischargers within the County whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity - Construction General Permit Order 2009-0009-DWQ. Construction activity subject to this permit includes clearing, grading and disturbances to the ground such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of a facility.

The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) for projects which disturb greater than 1.0 acre of land. The SWPPP should contain site maps that show the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list Best Management Practices (BMPs) the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment.

Smaller projects beneath the land disturbance threshold of 1.0 acre are required to implement construction BMPs which limit the discharge of sediment and construction related stormwater pollutants to receiving water bodies and storm drainage systems. These BMPs should be at a minimum documented on an erosion control plan which shows existing storm drainage and project area drainage features and the placement of BMPs during the phases of construction. Stockpiles, staging areas, winterization and post construction stabilization should be taken into account. Compliance with the Construction General Permit should follow the recommendations of the San Mateo County Watershed Protection Program Maintenance Standards and the San Mateo Countywide Water Pollution Prevention Program (Flows to Bay) website.

MUNICIPAL REGIONAL PERMIT

The County of San Mateo is part of the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), an association of the twenty incorporated cities and towns in San Mateo County and the County of San Mateo, that share a common Municipal Regional Permit (MRP) to discharge stormwater to the San Francisco Bay. The District is required to meet all stormwater management practices required by the MRP. The MRP was adopted October 14, 2009 (Order no. R2-2009-0074), and is effective as of December 1, 2009. A copy of the permit is available on the San Francisco Bay Regional Water Quality Control Board website. The specific requirements of the MRP are outlined in Section C of the permit; with each 'C' section (i.e. C3) considered a provision.

Summary

In addition to general re-organization, the new effective 2009 NPDES permit is significantly more detailed and prescriptive than the previous 2001 permit. Instead of general water quality goals, the effective permit contains both required performance standards and, in many cases, proscribed methods to meet those standards. Permit requirements that are summarized herein focus on specific requirements in the new 2009 effective permit.

Requirements in the effective NPDES permit include the following items:

- Municipal operations, industrial and commercial site controls, illicit discharge detection and elimination, construction site control, and trash load reduction provisions that contain significant new requirements compared to the 2001 permit.
- Throughout the effective permit, language is generally more proscriptive than the previous 2001 permit. Unlike the 2001 permit, specific numbers of meetings, water quality monitoring locations, percentage reduction in trash loads, etc. are explicitly required.
- Increased reporting requirements.
- Increased requirements for public outreach and employee trainings.
- The effective permit has an increased emphasis on pilot projects. These pilot projects will be conducted either on a regional or programmatic (i.e. SMCWPPP) level. No pilot projects have been identified within the District.

As stated previously, the effective NPDES permit refers to actions which must be accomplished by ‘Permittees’. Privately owned infrastructure located on individual properties are exempt from NPDES requirements and are not considered permittees. In general, storm drainage infrastructure within the District is owned and maintained by the County, and therefore the County is responsible for compliance with the NPDES permit within the limits of the District. The unincorporated portions of the County (i.e. the District) are participating members of the SMCWPPP, which will undertake some of these activities on behalf of its members, while SMCWPPP will help the County on other activities. The District could be expected to assist with actions which are implemented by the Program or on a regional level. Activities may include: water quality monitoring to meet EPA Total Maximum Daily Loads (TMDLs), reporting of water quality levels, public outreach to reduce elicit and/or toxic discharges, construction site control, source control, site-design and stormwater treatment for new or re-development.

MRP Provisions

Each of the provisions in the effective MRP is generally described in Table 2-1.

Table 2-1: Municipal Regional Permit Provisions

MRP Provision	Description
C1: Compliance with Discharge Prohibitions and Receiving Water Limitations	Describes the process by which Permittees must respond to a determination that discharges are causing or contributing to an exceedance of an applicable WQS.
C2: Municipal Operations	Sets forth requirements which Permittees must meet for municipal projects and property, including activities such as street and sidewalk repair and maintenance.
C3: New Development and Redevelopment	Requires Permittees to use their planning authorities to include appropriate source control, site design, and stormwater treatment in all development projects to address stormwater runoff pollutant discharges.
C4: Industrial and Commercial Site Controls	Sets forth requirements for industrial and commercial site control implementation including inspections, annual reporting, and follow-up of non-compliance.
C5: Illicit Discharge Detection and Elimination	Sets forth the requirements to detect and control illicit discharges.
C6: Construction Site Control	Sets forth the requirements for a construction site inspection and control program, including follow-up and enforcement, at construction sites to prevent construction site discharges of pollutants to receiving waters.
C7: Public Information and Outreach	Sets forth requirements for public information and outreach to reduce and mitigate impacts of stormwater pollution on receiving waters.
C8: Water Quality Monitoring	Sets forth the requirements for water quality monitoring.
C9: Pesticides Toxicity Control	Sets forth the requirements for the development of a pesticides toxicity control program that address both City and others users of pesticides within the City jurisdiction.
C10: Trash Load Reduction	Sets forth the requirements for trash load reduction.
C11: Mercury Controls	Outlines notable activities specific to Mercury controls required in the effective NPDES permit.
C12: PCB Controls	Outlines notable activities specific to PCB controls required in the effective NPDES permit.
C13: Copper Controls	Outlines notable activities specific to Copper controls required in the effective NPDES permit.
C14: PBDE, Legacy Pesticides, and Selenium	Sets forth the control program requirements for PBDEs, legacy pesticides, and selenium.
C15: Exempted and Conditionally Exempted Discharges	Provides information for the exemption of non-stormwater discharges from Discharge Prohibition A.14 and conditionally exempts non-stormwater discharges that are potential sources of pollutants.
C16: Annual Reports	Sets forth the annual report requirements for Permittees.

SEPTIC TANKS

The Regional Water Quality Control Board (RWQCB), US Environmental Protection Agency (EPA) and the County of San Mateo all have programs to inventory and reduce impacts from septic tanks to ground and surface water quality. It is out of the scope of this Master Plan to discuss the impacts of septic leaching to water quality. Solutions to this problem are currently under review and associated water quality monitoring reports can be obtained directly from the District. Contact information can be found at the District website http://www.ltcwd.org/contactus.html.

CREEK PERMITS

When new outfalls are proposed to waters of the State, permits from the Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), the US Army Corps of Engineers (Corps), the US Fish and Wildlife Service (USFWS) and the Bay Conservation and Development Commission (BCDC) must be considered for applicability[1]. A Joint Aquatic Resource Permit Application (JARPA)[2] will be required and processed through the Army Corps which identifies which agencies have jurisdiction over the project and which permits are needed. The permits from the agencies may include but are not limited to; a 401 Water Quality Permit from the RWQCB, CDFW Streambed Alteration Agreement, Section 7 Consultation with the USFWS regarding endangered species, and/or an Army Corp Nationwide Permit. The JARPA permit application will be required for new outfalls to Corte Madera Creek and Los Trancos Creek. Separate from the JARPA process, the CEQA process must be completed before the JARPA permit can be issued.

The San Francisquito Creek Joint Powers Authority (SFCJPA) is an active government agency which focuses on flood control and environmental impacts to the San Franciscquito Creek watershed. All storm drainage projects should include notification and review by the SFCJPA.

ENVIRONMENTAL PERMITS

The local government agency (either San Mateo County or the District) makes the California Environmental Quality Act (CEQA) determination for the project and files all appropriate paperwork. This is based on the environmental impacts a project may have to waterways, wetlands, riparian habitat and biological species, among others. Depending on the level of impact of the project, it may be determined to be Categorically Exempt or qualify for a Negative Declaration or Mitigated Negative Declaration. It is assumed for the purpose of this Storm Drain Master Plan that only projects with creek or pond outfalls will require CEQA Initial Studies which result in either Negative Declarations or Mitigated Negative Declarations. All other projects are assumed to be Categorically Exempt.

[1] San Francisco Bay Area JARPA Instructions, SF Estuary Partnership.
[2] San Francisco Bay Area Creek and Riparian Area Permitting Guide, Association of Bay Area Governments.

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CHAPTER 3
STORM DRAIN COLLECTION SYSTEMS

Analyzing the District's collection system performance forms the essential core of this storm drain Master Plan. For each sub-basin area, this chapter describes major storm drain facilities, any historic problem areas, known drainage issues and storm drain capacity evaluation. Within each basin, areas requiring new systems or system improvements are identified and prioritized as high, medium or low. Detailed project prioritization and scheduling at the District-wide scale is presented in Chapter 4 while this chapter focuses on individual drainage basins. For the purposes of conciseness and readability, this Chapter presents only the 10- and 100-year predicted capacity deficiencies and those projects required to alleviate or minimize flooding based on the100-year standards. In many cases debris passage governs improvement pipe sizing and is greater than what is required for the 100-year storm event. Conversations and meetings with District representatives form the basis of the 'Historic Problem Areas' sections of this chapter.

EVALUATION OF STORM DRAIN CAPACITY

GIS Based Hydraulic Model

ArcMap software has been used to construct a geographic information system (GIS) containing the District's storm runoff collection system (storm drain pipes and channels) and their tributary watersheds. The GIS is compiled on the California State Plane Coordinate System (NAD 83), with elevation data stored in feet NAVD 88. Microsoft Excel spreadsheets based on the GIS are used to calculate the hydraulic capacity of each storm drain system (or open channel), and provide output data to be used in the GIS interface.

Some of the data available for retrieval through Excel or GIS software are listed below, and much of these data are presented graphically and in tabular form throughout Chapters 3 and 4:

Pipe, Gutter and Stream Information	**Node (Catch Basin and Outfall) Information**	**Basin Information**
▪ Length ▪ Diameter (or Width and Depth) ▪ Capacity ▪ Discharge • 10-year • 100-year ▪ Performance Evaluation	▪ Invert Elevation ▪ Basin Location	▪ Basin ID ▪ Tributary Area ▪ Weighted Runoff Coefficient ▪ Time of Concentration ▪ Rainfall Intensity • 2-year • 10-year • 100-year ▪ Discharge • 2-year • 10-year • 100-year

Runoff Characteristics

Storm runoff modeling requires some means of evaluating the amount (peak rate and volume) of runoff generated by the tributary watersheds. The methodologies used herein rely upon lumped parameters to convert precipitation into direct runoff. The lumped parameter models all of the natural watershed processes (*e.g.* infiltration, depression storage, vegetation, etc.) that cause a certain percentage of precipitation to flow off of an individual catchment as runoff. Estimated values of peak basin discharge and volume, therefore, are heavily influenced by the selection of runoff coefficients, which is based on the type of land uses within a watershed and the characteristics of the underlying soil.

Table 3-1 lists runoff coefficients (C-values) used in master plan analysis, which are generally consistent with runoff coefficients from the 2007 Santa Clara County Drainage Manual*. Each coefficient is a function of the underlying land use and soil type; more specifically, the NRCS "Hydrologic Soil Group" (HSG). A complete listing of the weighted runoff coefficients used for each basin is provided in the GIS model. It is important to remember that runoff coefficients are not necessarily equivalent to the percent of impervious surface within a basin.

Table 3-1: Land Use, C-Value and Imperviousness

Land Use	Estimated Percent Impervious	Assigned C-Value		
		Soil Group B	Soil Group C	Soil Group D
Low Density Residential	25%	0.30	0.40	0.45
Parks	10%	0.20	0.30	0.35
Streets	100%	0.85	0.85	0.85

Rational Method of Peak Flow Estimation

The Rational Method has been selected for the following reasons:

1. The method is simple to apply, and does not necessarily require the use of computer simulation.
2. Although the application of this seemingly simple methodology is subject to judgment and difficult to replicate among users, establishing standard parameters and equations in a master plan can promote reasonableness and design equity throughout the District. In other words, all potential storm drain system developments can be held to the same standard.

* The 2007 SCC Drainage Manual is the most current manual as of the writing of this report. San Mateo County does not currently have a drainage manual or specific drainage standards for estimating stormwater runoff. Due to proximity, the SCC Manual was used. See Appendix I for rainfall methodology comparisons.

3. Use of the Rational Method is generally limited to areas roughly one square mile in size (ASCE, 1996). All of the tributary drainage areas analyzed for the Master Plan fall within this limit.

The Rational Method estimates peak discharge based on the following formula:

$$Q_T = k\, C\, i_T\, A$$

where: Q_T = peak flow rate in cubic feet per second (cfs), for a return interval of T years;

k = 1.008 (often taken as 1.0);

C = a dimensionless runoff coefficient dependent upon land use (see Table 3-1);

i_T = the design rainfall intensity (inches per hour) for a return interval of T years, and a duration equal to the time of concentration for the basin; and

A = drainage area in acres.

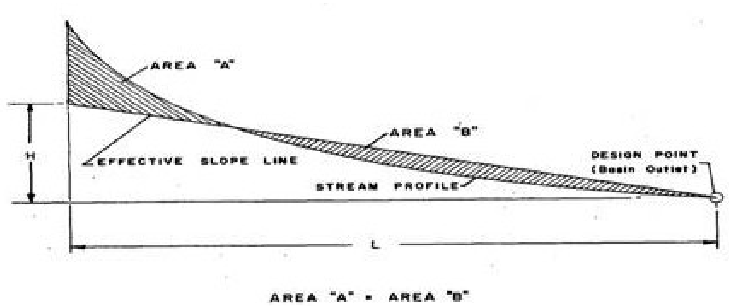
This methodology is based on the premise that under constant rainfall intensity, peak discharge will occur at the basin outlet when the entire area above the outlet contributes runoff. Known as the “time of concentration,” this value is defined as the time required for runoff to travel from the most hydraulically distant point (at a drainage divide such as a ridge) to the outlet.

Effective use of the Rational Formula depends upon the computation of the time of concentration, t_c. In this master plan, time of concentration estimation is based on overland flow only. For natural watersheds in hillside areas, the Kirpich formula is used (Santa Clara County, 2007):

$$T_c = 0.0078\left(\frac{L^2}{S}\right)^{0.385} + 10 \text{ minutes}$$

where: L is the length of maximum length of travel from headwater to outlet (feet); and

S is the effective slope along L (feet per foot) as illustrated below:



System Capacity Analysis

Detailed analyses of peak storm water discharge are performed in the Excel spreadsheets, which determine the flow condition in each collection system element. Flow is alternately carried in the street drainage channels and in the street cross sections. Flow ultimately reaches the small creeks within each drainage basin that discharge to either Los Trancos Creek, Corte Madera Creek or through the Blue Oaks development to Los Trancos Road. All drainage elements have been analyzed using the same method.

The depth of flow traveling down a street, drainage channel, pipe or creek is determined from Manning's formula for uniform depth in an open channel:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where: Q = peak flow rate in cubic feet per second (cfs);

n = Manning's coefficient (see table below for assumptions);

A = cross sectional area of flow (ft^2);

R = hydraulic radius of the flow (area/wetted perimeter in feet); and

S = longitudinal slope (feet/feet);

For each element assumptions have been made to create a uniform method for analyzing the unique drainage elements. Assumptions are listed below based on element type. Note that neither the Master Plan conclusions described in this document nor the proposed capital improvement plan is particularly sensitive to this set of assumptions.

Streams

Streams cross sections are assumed to be triangular due to the incised nature of mountain streams. The streams analyzed as part of the collection system are unnamed (besides local colloquial references) and are not under the jurisdiction of the Army Corp of Engineers, nor recognized by the Water Resources Control Board as regulated waters of the United States. One-foot stream contours used to determine stream width and depth are based on the San Mateo County aerial digital elevation map. Manning's roughness coefficient (n-value) is taken to be 0.1 for heavily vegetated and rocky bottomed channels. Due to the steep channel bed slope, a normal depth calculation is used to determine stream capacity. It has been found that all streams have the capacity to handle the 100-year discharge without flow exceeding their banks. Los Trancos Creek and Corte Madera Creek have not been analyzed for capacity since available FEMA flood hazard mapping indicates that they both contain their 100-year discharges.

Valley Gutters

Rounded gutters, generally located adjacent to the County roadways within the County Right-of-Way are assumed to be circular in shape based on observation. The smallest surveyed depth and width for each gutter reach are used to determine capacity. Where surveyed gutter widths are not available, a typical width of 2 feet is assumed. Where gutter depths have not been surveyed, a minimal depth of 0.25 foot is conservatively assumed. Gutter material is assumed to be asphalt with a Manning's n-value of 0.016 where no additional information is available. Concrete channels have been assigned a Manning's n-value of 0.013, while dirt gutters are given and n-value of 0.025 and brick gutters are assigned 0.015 as a roughness coefficient.

Pipes

Unless there is information to indicate otherwise, pipes are assumed to be corrugated steel with a Manning's roughness value of 0.02. Pipes are not allowed to surcharge and pressure flow conditions are not assumed. Where invert elevations are unknown, they are assumed to be 3 feet below surface grade.

Roads

Public and private roadways have been analyzed for flow capacity wherever they are adjacent to existing valley gutters. Roadways are assumed to be asphalt with a Manning's n-value of 0.016. A normal depth calculation is used due to the steep longitudinal slopes of the roadway. It is assumed that each roadway is capable of conveying a flow depth of 3 inches over half of the road's total width. Many of the roadways slope away from the valley gutters and discharge sheet-flow downhill, thereby reducing the total capacity of the roadway conveyance system.

Evaluation of Existing System

Criteria used throughout the Master Plan to evaluate how well individual storm drainage systems are functioning – and how best to improve that function – are based on the 10-year and 100-year design discharges. System pipes and open-channel drainage shall be considered insufficient if they do not meet the above criteria and result in un-controlled overland flow which has the potential to cause damage to life, structures, or property. The basis for flooding is not a defined storm return interval, but can occur at any storm event provided there is sufficient runoff volume or velocity to cause adverse impact to life, structures or property. Collection systems conditions are categorized per Table 3-2.

Table 3-2: Storm System Performance Categories

System Acceptable	*100-year* design discharge is carried within the existing collection system, drainage channels and street right-of-way without adjacent property damage.
Condition I	A condition exists that creates a significant annual risk of flood damage. Where the *10-year* design discharge is not carried within the existing drainage features or street right-of-way and would likely cause property damage.
Condition II	Where the *100-year* design discharge is not carried within the existing drainage features or street-right-of-way and would likely cause property damage.
Condition III	Where the *100-year* flow is not contained within the street right-of-way or existing drainage features but flooding causing property damage is not expected.

Storage Ponds

The existing ponds are located within drainage basins H and Z and can be seen on Appendix B-3 and B-7 and Figures 3-3 and 3-7. The District owns the pond known as Water District Lake while Frog Pond is owned by the Blue Oaks Homeowners Association (BOHA). Both of these ponds have been historically used for runoff detention and have aesthetic appeal. The ponds' inflows and discharges are not actively managed by the District, Town of Portola Valley, BOHA or San Mateo County. Since the ponds are all located near the ridge line, they accept groundwater and runoff from only the highest elevations within the District. A historic pond located on District property at the corner of Lake Road and Los Trancos Circle has been filled in and no longer serves as a detention basin. There is potential for the area around this historic pond to be re-established as a detention basin to lessen peak discharges from upstream properties onto downstream drainage networks.

Prioritizing Deficiencies and Needed Improvements

The storm drain system is broken into 27 drainage areas represented by letters with sixty sub-areas represented by numbers (Figure 1-1). The basins are organized around natural topographic boundaries and drainage facility boundaries or watersheds. It should be noted that private drainage systems that serve only one property have not been analyzed. Future refinement of the model could more precisely account for these site-specific drainage characteristics and more accurately represent the local drainage conditions if that proves to be necessary.

After removing private isolated systems from the model, there is no storm drainage infrastructure to analyze within Basins L, M, N, O, P or V. Therefore these basins are not considered for capital improvements. Streams located within these basins have been reviewed for capacity and have been found to be capable of containing the 100-year storm event.

Recommended master plan improvements, are shown in Figures 3-1 to 3-7 while existing system capacities are mapped in Appendix B. Improvements are identified by the naming convention Project # (PRJ#). This convention numbering is arbitrary and does not necessarily correspond to project priorities as discussed in Chapter 4. Historical flooding is based on anecdotal information provided by residents as described in Appendix A and are included by reference in brackets [#]. In some locations, the flooding predicted by the model at individual points in the system may differ from flooding that has occurred in the past, or may occur in the future. This is due to storm drain modeling limitations and the assumptions inherent in the collected data and method of calculation. In order to 'ground truth' model results, Schaaf & Wheeler discussed model results with District representatives, conducted field observations, and considered surrounding topography.

Locations for recommended system improvements are based on the results of this complete process, not solely on model results. The recommended improvements have been prioritized based on the results of the above process, combined with consideration of the anticipated severity of flooding at each location and the benefit/cost relationship of proposed improvements. The following color code is used to highlight project prioritization within each drainage area:

Pipe Color	**Improvement Priority**
Red	High Priority
Orange	Moderate Priority
Green	Low Priority

This section outlines the ultimate improvements needed to achieve a 100-year level of service by alleviating or minimizing predicted flooding within each of the sub-areas. A complete CIP with figures depicting storm drain network improvement pipes including pipe location, size requirements and costs for each improvement is available in Chapter 4. The improvements identified are intended as Master Planning level design and do not consider detailed impacts to driveway access or road widths. Detailed design drawings by a licensed Civil Engineer or Contractor should be developed prior to construction, and which address and mitigate these, and other, potential impacts.

DISTRICT BASINS

Basins A, B, C and D

Overview

The Basin A, B, C and D drainage area is a total of approximately 18 acres. These basins are some of the most densely populated in the District and include steep, narrow switchback roadways. Drainage is mostly conveyed in this area though roadside paved drainage swales and driveway culverts on public property. Basins A and B drain east to Los Trancos Creek while Basin C flows overland to Los Trancos Road to the north. Basin D drains overland to the north into Basin BO33 and eventually passes into existing storm drain infrastructure owned by the Blue Oaks residential development.

Historic Problem Areas*

**Refer to Appendix A for identified problem areas in numbered brackets.

According to the District there have been historical flooding problems at three particular locations in Basins A, B and C. The upslope adjacent to 120 Carmel Way in Basin B56 is characterized by incised erosion in a natural drainage channel which discharges to Los Trancos Creek [2]. There is flooding and a potential for erosion in Basin A11 downstream of the pipes and outfall near 144 and 151 Carmel Way [3]. During periods of heavy rainfall water flows through the road and sewer pipe backfill at the downstream point of Basin C8 before discharging to the ground through manholes [4]. The new relocated pipe outfall to the Blue Oaks Open Space at 1036 Los Trancos Road is undersized [6].

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins A, B, C and D for the 10-year storm event shows some flooding (pipes and/or valley gutters with "High" risk) occurring at two pipes and two valley gutters. The normal depth calculations predict flooding at three pipes during the 100-year storm event ("Med" risk). A map of the pipe capacity risks predicted by the model before improvements are made is presented in Appendix B, Figure B-1.

Prioritized Improvements

The Basin A, B, C and D prioritized improvements that are required to alleviate or minimize flooding during a 100-year storm event are shown in Figure 3-1 and include storm drainage piping

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

capacity improvements and new storm drains. High priority improvements should include the outfall downhill of the court on Carmel Way, the valley gutter from Ramona Road down Carmel Way to the unpaved drive adjacent to 120 Carmel Way, the diversion from the intersection of Los Trancos and Foxwood, and an increase in downhill gutter capacity.

- The Carmel Way outfall **PRJ01** should include increasing conveyance from the cul-de-sac at the end of Carmel Way through a 12” pipe and installing a 15” pipe and outfall down to Los Trancos Creek. Rolled curb and gutter with a new inlet should be placed on the down slope side of the road to increase conveyance into the system.

- Infrastructure on Ramona Road which concentrates flow and discharges to the valley gutter on Carmel Way necessitate increasing the valley gutter capacity or piping flow beneath the steep roadway and unpaved drive adjacent to 120 Carmel Way for project **PRJ02**. Containing the 100-year flow would require a 15” culvert and new 15” outfall to Los Trancos Creek with associated energy dissipation. Rolled curb and gutter should be placed on the opposite side of the roadway to contain runoff within the right-of-way.

- **PRJ03** includes increasing gutter capacity to a 24” wide, 12” deep semi-circle with curbs. An inlet should be placed in the uphill gutter to convey flow via a 12” pipe towards the downstream gutter where it will travel within the right-of-way before exiting District property and flowing north along County owned Los Trancos Road.

- In order to reduce flow to "VanHauser Creek" in Basin E, a diversion should be placed which allows flow down Los Trancos Road with **PRJ31**. The project would include adding a down slope curb and gutter, and piping the diverted water within a 12” pipe before discharging to the enlarged valley gutters in PRJ03.

These projects are summarized in Table 4-4, and shown in Appendix C.

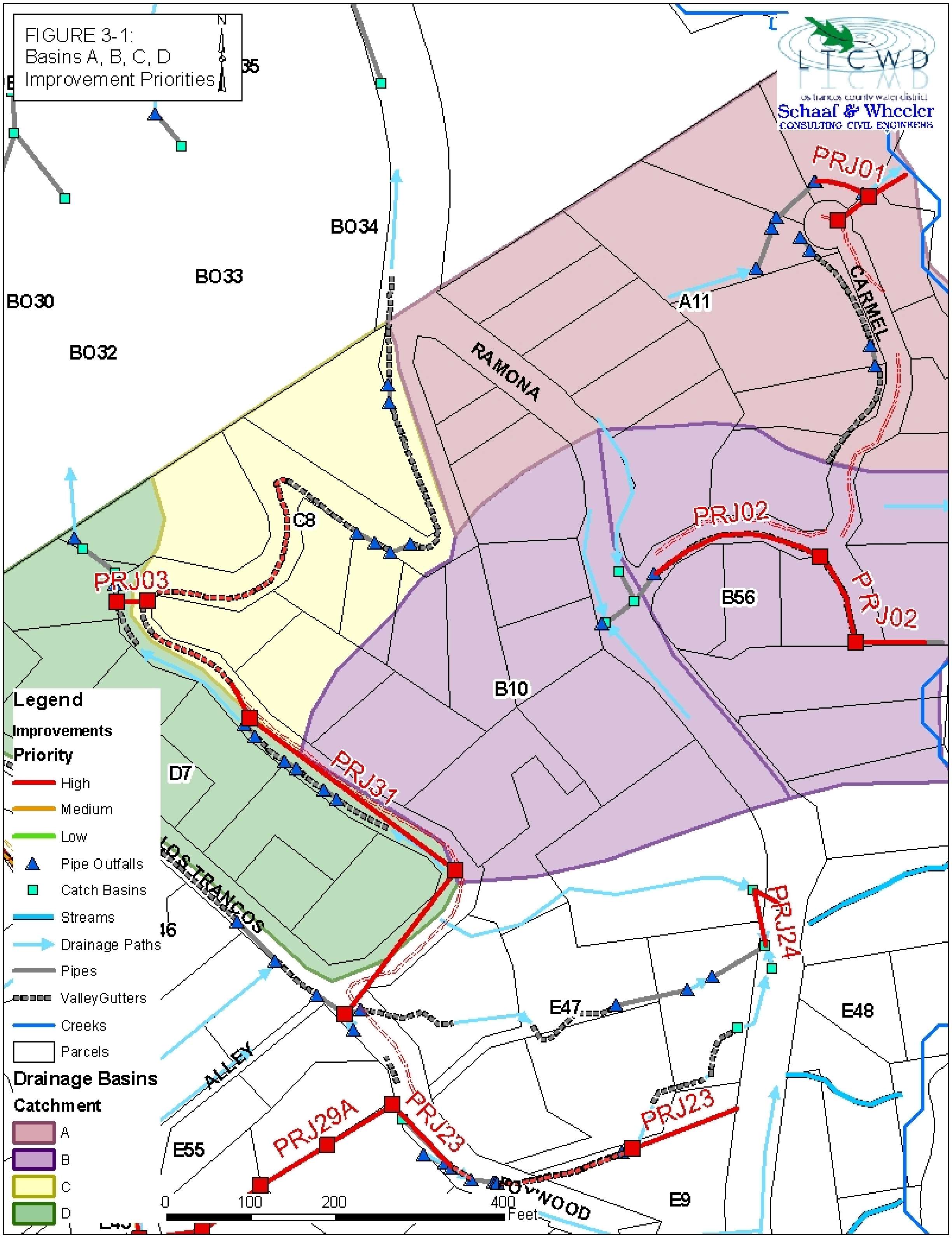


FIGURE 3-1:
Basins A, B, C, D
Improvement Priorities
N
LTCWD
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
PRJ01
CARMEL
A11
RAMONA
BO34
BO33
BO30
BO32
C8
PRJ02
PRJ02
B56
PRJ03
B10
PRJ31
D7
LOS TRANCOS
PRJ24
E47
E48
ALLEY
E55
PRJ29A
PRJ23
PRJ23
E9
Legend
Improvements
Priority
High
Medium
Low
Pipe Outfalls
Catch Basins
Streams
Drainage Paths
Pipes
ValleyGutters
Creeks
Parcels
Drainage Basins
Catchment
A
B
C
D
0
100
200
400
Feet

Basins E, F and G

Overview

Basins E, F and G drainage areas combine to cover approximately 30 acres. Basins G and F are densely populated with sinuous, narrow streets while most of Basin E contains lower density housing and forested lands close to the creek. Flow occurs both on the public streets and perpendicularly through private yards. Some residents have installed non-engineered drainage systems through their property to help channelize this flow. Systems located on only one property are not modeled for this study and runoff is assumed to sheet flow through these properties where it cannot be contained within the right-of-way. Basins F and G discharge through lands owned by Blue Oaks into basins BO29 and BO30 respectively. Basin E flows to the east towards Ramona Road and Los Trancos Creek.

Historic Problem Areas*

**Refer to Appendix A for identified problem areas in numbered brackets.

According to the District there have been historical flooding problems at eight particular locations in Basins E, F and G. Drainage from the Los Trancos Rd/Foxwood intersection in sub-basin E47 flows through 1091 Los Trancos Road, 113 Foxwood, 140/152 Ramona Road and floods existing structures without traditional drainage control measures before discharging down and across Ramona Road [7]. Uncontrolled flow through 143-151 Ramona Road in sub-basin E48 is received from the properties described above which results in flooding of existing structures before discharging overland to Los Trancos Creek [12]. Drainage through 1207, 1215, 1225 Los Trancos Road through 112-116 Foxwood in sub-basin E55 is contained in a corrugated plastic pipe placed on the surface, travelling along the existing property line between the parcels. Individual drainage infrastructure from each property is directed into the pipe. Due to the slope of the hillside, the flow occurs at high velocity through the pipe before discharging to smaller below grade piping and surface gutters [9]. Flow frequently escapes the above grade pipe and causes flooding downstream of the outlet catch basin to Foxwood road and the driveway of 131 Foxwood in sub-basin E9. After out-letting to the concrete driveway at 131 Foxwood, the water travels overland toward Ramona Road and eventually into Los Trancos Creek [11]. Drainage infrastructure for 1185-1203 Los Trancos Road through 1103-1111 Los Trancos Road in sub-basin E46 does not effectively convey flow which escapes the road right of way and travels through the private properties before entering surface drainage channels at the intersection with Foxwood. This unchecked flow travels through the yards and can cause localized, erosive flooding on the property [8]. Properties down-slope of the roadway in sub-basin F59, specifically 123, 127 and 135 Los Trancos Road, are subject to flooding by overflow from the street due to inadequate drainage on the road [20]. Soil from the hillside is

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

slumping down in sub-basin F6 and has resulted in blockage of the inlet at the intersection of El Nido and Los Trancos Road [10]. Flow coming down the roadway from drainage basin F6 discharges unchecked into 1144 Los Trancos Road before out-letting to the Blue Oaks Open Space sub-basin BO30 [5].

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins E, F and G for the 10-year storm event shows some flooding (pipes and/or valley gutters with "High" risk) occurring at five pipes and one valley gutters. The normal depth calculations predict flooding at three pipes and one valley gutter during the 100-year storm event ("Med" risk). For the culverts at 147, 1216 and1220 Los Trancos that were recently replaced, additional flow is conveyed by the street; therefore increases in culvert capacities are not necessary. A map of the pipe capacity risks predicted by the model with before improvements are made is presented in Appendix B, Figure B-2.

Prioritized Improvements

High priority improvements should include controlling flow from Basin F6 to Blue Oaks Open Space (PRJ27), the pipes conveying flows downhill on Foxwood (PRJ23), the culverts conveying flow across Ramona Road at 140, 151 & 152 Ramona (PRJ24) and the above grade culvert connecting Los Trancos to Foxwood (PRJ29A or B).

- Project **PRJ23** should include increasing capacity of pipes and valley gutters on Foxwood to 21" pipes and 30" wide by 15" deep semi-circle gutters. The driveway gutter off of Foxwood should be cleared and increased to 30" wide by 15" deep. Furthermore, this project requires adding a 30" diameter pipe from Foxwood to Ramona Road where the pipe will discharge onto the existing paved street.

- Improvements to the Ramona Road crossing in project **PRJ24** would require a new 36" pipe.

- Project **PRJ27** should include placing an existing meandering open channel within an 18" culvert and providing an outfall with energy dissipation at the discharge to Blue Oaks Basin BO30. A detention basin could be established at this discharge point to reduce peak flows and promote runoff infiltration, as well as reduce existing erosive forces to the Blue Oaks trail system.

- Project **PRJ29A** should include replacing the existing above grade plastic pipe with a 15" underground conduit from Los Trancos to Foxwood through properties 108-112 Foxwood and 1207 Los Trancos. Inlets should be placed along the pipe length and private drainage systems should be directly connected to the pipe to reduce slope saturation.

- As an alternate to PRJ29A, **PRJ29B** could be constructed to re-route flow from Basin E into

Basin F and ultimately into Blue Oaks Open Space. 15” pipes with associated inlets and manholes would be required to rout the flow down Los Trancos Road. Project PRJ27 would have to be constructed prior to PRJ29B.

Medium priority projects should include controlling downhill flow in properties 1111 and 1189 on Los Trancos (PRJ25) and the driveway culvert and absent downhill curb and gutters at 123-136 Los Trancos Road (PRJ28).

- The tributary upstream stretch of Los Trancos Road would require the construction of a down slope berm and increased upslope valley gutter capacity to 30” wide by 15” deep in order to prevent flow from overtopping the roadway and flowing uncontrolled through private properties in Basin E46 for project **PRJ25**. This project should also include the replacement of two driveway culverts with 14” ductile iron pipe (DIP).

- A new pair of inlets and down slope rolled curb and gutter should be placed along Los Trancos Road from the intersection with El Nido to reduce down hill saturation for project **PRJ28**. Flow would discharge though project PRJ27 to Blue Oaks Open Space.

The low priority project should include increasing the capacity of the cul-de-sac culvert at 144 El Nido.

- Project **PRJ30** should include installing a 24” wide, 12” deep upslope valley gutter and down slope rolled curb and gutter at the court on El Nido. The gutter would lead to an upsized 12” driveway culvert before connecting to a new inlet and a new 12” pipe. The Pipe would follow the property line before safely discharging to Blue Oaks Open Space. A detention basin could be established at this discharge point to reduce peak flows and promote runoff infiltration, as well as reduce existing erosive forces to the Blue Oaks trail system.

- As an alternative to PRJ30, **PRJ30B** would re-direct the downspout located on the uphill property in order to send the flow away from the cul-de-sac and down to the intersection of El Nido and Los Trancos Circle. This would include installing a 12" pipe at the discharge of the existing downhill drain which would lay within or beneath the valley gutter on the high side of El Nido, This pipe would eventually daylight to the valley gutter before flowing down through basin F6. Detailed design will determine at which elevation and location the downspout should be re-directed. In order for this re-route to occur, projects PRJ27 and PRJ28 must be constructed and sized to allow for this additional flow. This scenario highlights the importance of conducting a Master Plan, in order to prevent the exacerbation of flooding due to isolated projects which impact the direction of flow.

These projects are summarized in Table 4-5 and shown in Figure 3-2 below.

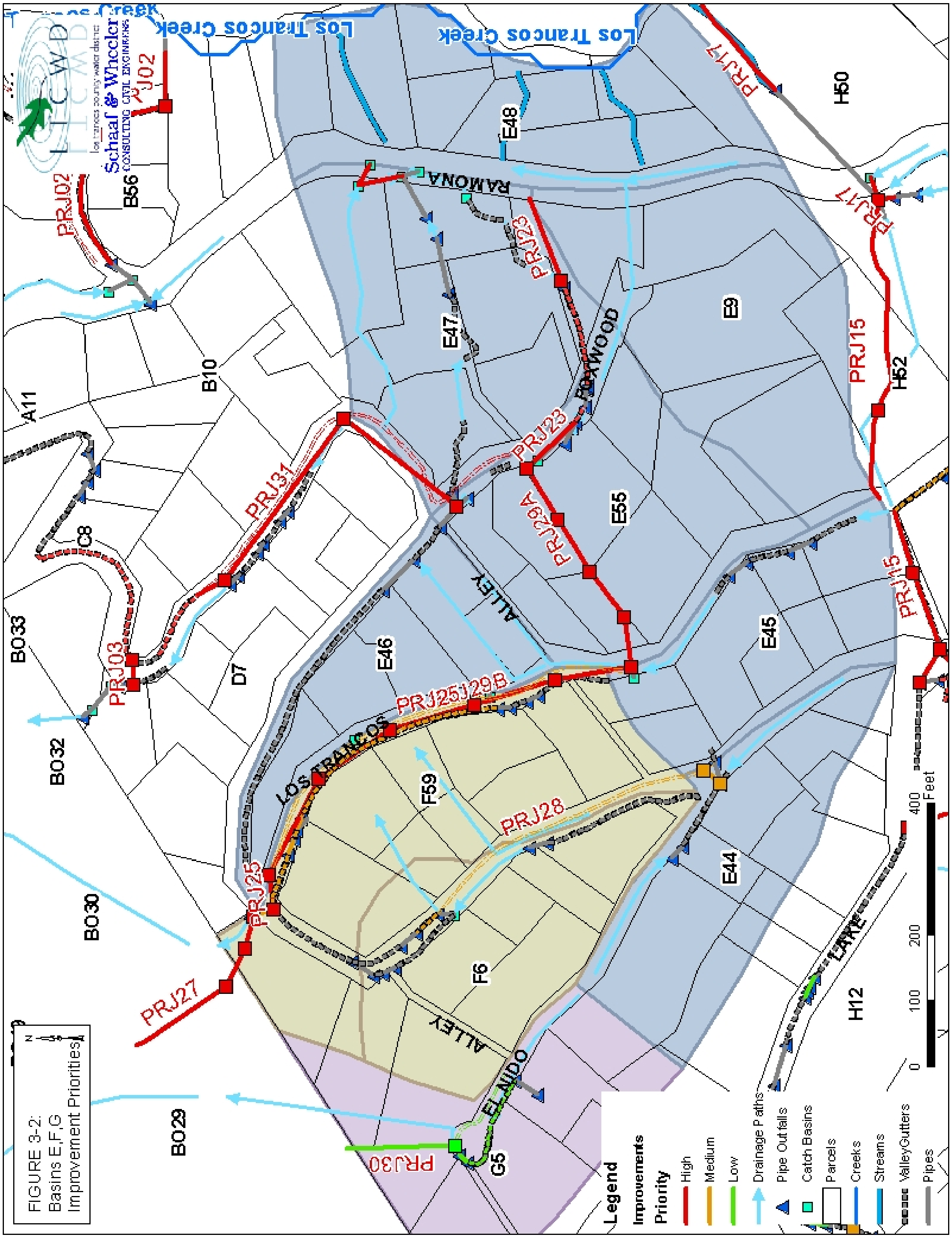


FIGURE 3-2:
Basins E,F,G
Improvement Priorities
Legend
Improvements
Priority
High
Medium
Low
Drainage Paths
Pipe Outfalls
Catch Basins
Parcels
Creeks
Streams
ValleyGutters
Pipes
0
100
200
400
Feet
Los Trancos Creek
Los Trancos Creek
RAMONA
FOXWOOD
LOS TRANCOS
ALLEY
ALLEY
EL NIDO
LAKE
PRJ02
PRJ03
PRJ15
PRJ15
PRJ17
PRJ17
PRJ23
PRJ23
PRJ29A
PRJ25
PRJ25J29B
PRJ27
PRJ28
PRJ30
PRJ31
A11
B10
B56
B029
B030
B032
B033
C8
D7
E9
E44
E45
E46
E47
E48
E55
F6
F59
G5
H12
H50
H52
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
LTCWD
los trancos county water district

Basins H and I

Overview

The Basins H and I drainage area is a total of approximately 69 acres. Basin H is the largest drainage area in the District, all contributing to "Spanish Creek" and the landslide below Ramona Road at 221 Ramona. Basins H and I contain slightly larger parcels than those previously discussed to the north. Drainage is mainly conveyed down Lake Road or overland through private properties before being collected in Vista Verde and Los Trancos Road infrastructure. This captured water is conveyed further downstream by locally named "Spanish Creek" before passing under Ramona Road and discharging to Los Trancos Creek to the east. Most flow within drainage Basin H is conveyed through valley gutters while flow in Basin I is mainly overland or through pipes.

Historic Problem Areas*

**Refer to Appendix A for identified problem areas in numbered brackets.

According to the District there have been historical flooding problems at three particular locations in Basins H and I. Subsurface and surface flow through "Spanish Creek" on 1243 Los Trancos Road has caused severe erosion downstream of Ramona Road at the downstream point of sub-basin H50 [1]. Due to the destabilization of Ramona Road by the downhill landslide, the County has recently installed a soldier beam and lagging retaining wall on the downslope side of the road. In addition, they have excavated the upstream drop inlet basin, placed concrete sacks along the edge of roadway above the existing inlet wing walls, and installed tethered boulders to act as a debris capture device. As of this report, no large storm had passed through Spanish Creek with the aforementioned improvements. Flooding occurs at the intersection of Lake and Los Trancos Road downstream of the Water District Pond in basin H12 [14]. Erosion and flooding occurs on properties from 205 Old Spanish Trail through 44 El Ray in sub-basin H12 [16].

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins H and I for the 10-year storm event shows some flooding (pipes and/or valley gutters with "High" risk) occurring at 12 pipes and 7 valley gutters. The normal depth calculations predict flooding at five pipes and three valley gutters during the 100-year storm event ("Med" risk). A map of the pipe capacity risks predicted by the model before improvements are made is presented in Appendix B, Figure B-3.

Prioritized Improvements

High priority improvements should include increasing the size of the pipe crossing under Ramona

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

Road for PRJ13 in Basin I13 and increasing capacity from Spanish Trail to the Water District property in PRJ14A as well as increasing conveyance downstream of the District Property to Ramona Road for PRJ15 and from the intersection of Vista Verde Road and Los Trancos Road down through "Spanish Creek" to Ramona Road and finally to Los Trancos Creek in PRJ12, PRJ16 & PRJ17 respectively.

- Two options exist with regards to reducing overall flow through "Spanish Creek" and the landslide downstream of Ramona Road, **PRJ14A** and **PRJ14B**. PRJ14A should include increasing conveyance from Spanish Trail to El Rey with a 15” pipe, before discharging to a re-established detention pond on District property. This pond could be excavated to provide storage and reduce peak discharges downstream. A new 18” pipe would connect to an inlet in the gutter on Lake to increase conveyance to the pond. PRJ14B would divert the water from Spanish Trail down into Frog Pond with a combination of a 12” conduit and outfall as well as a down slope rolled curb and gutter. The valley gutter at the road turn adjacent to Frog Pond would need to be increased to 24” wide by 12” deep.
- Downstream of the District property the infrastructure would need to be increased to a 30” pipe conveying flow directly from the upstream valley gutter to the earthen ditch conveying flow along the property line for **PRJ15**. This would allow the flow to travel smoothly downhill and avoid the existing 90 degree change in flow direction. A larger 15” pipe with increased inlet capacity would be added to accept flow from the PRJ14A pond and upslope gutters. Beneath the earthen ditch, a 15” pipe should be placed with top of pipe inlets along its length to accept flow from the ditch above and provide pipe cleanouts. This system would couple flow in an overland ditch and below grade conduit. The pipe should increase to 18” and continue beneath Los Trancos Road down towards Ramona Road. The conveyance from Los Trancos Road to Ramona Road can be a combination of increased stream capacity with appropriate bank stabilization or a minimum of an 18” pipe before connecting to PRJ17 and the inlet beneath Ramona Road.
- Increased conveyance downstream of the intersection of Vista Verde and Los Trancos should be provided in **PRJ16** by increasing gutter capacity to 48” wide by 24” deep (or equivalent pipe) on Los Trancos Road. The gutter down the driveway for 1243 Los Trancos should be increased to 36” wide by 18” deep before connecting to an 18” pipe to convey flow to Ramona Road where the pipe will outlet to the existing pavement.
- **PRJ17** involves inlet improvements and a new 15” pipe from the down slope inlet. The upslope CMP conduit should be continued in a new 15” pipe to connect directly with the improved inlet. The existing 21” RCP travelling beneath Ramona Road towards Los Trancos Creek has sufficient capacity to convey the flow but ends at a collapsed concrete outlet structure and the downstream side of a landslide. The location of the 21” pipe outlet should be excavated and a new 21” HDPE pipe should be anchored on the ground surface and continued downhill past the landslide to a new outlet on existing bedrock or engineered rip-

rap structure. PRJ17 has been designed in detail by Schaaf & Wheeler and construction drawings are available from the District.

Medium priority improvements should include diverting flow from Spanish Trail to the Water District Lake for PRJ11B, increasing the valley gutter capacity from Bonita Road across the intersection of Vista Verde and Los Trancos Road for PRJ12 and increasing gutter capacity and installing a driveway culvert around the intersection of Vista Verde and Los Trancos down to PRJ15.

- Installing an inlet in the existing valley gutter and a 15" pipe that discharges to the Water District Lake is **PRJ11B**. This project would require a new outlet with energy dissipation such as rock rip-rap. Depending on outfall elevation with respect to water surface, it may be possible to grade a grassy swale to convey water from the roadside to the pond. Environmental documentation may need to be done to prove no impacts to the existing habitat and vegetation around the lake. This diversion would reduce flow through Basin H to "Spanish Creek". Alternately, PRJ11C in Basin Z could be constructed to perform the same function.
- Project **PRJ12** should increase the upslope gutter capacities along Vista Verde and Los Trancos Roads to Bonita. The gutters should be increased to 30" wide by 15" deep on Vista Verde and 42" wide by 21" deep on Los Trancos to Bonita.
- In order to maintain flow within in the streets **PRJ19** would increase the gutter capacity on Los Trancos to 30" wide by 15" deep around the intersection with Vista Verde to PRJ15. This also includes a new 15" culvert beneath the driveway of 1244 Los Trancos.

Low priority projects should include increasing the culvert capacity on Bonita Road for project PRJ18, improving various driveway culverts from Old Spanish Road down Lake Road in PRJ11A, and increasing flow from El Rey downstream for PRJ21.

- **PRJ11A** would improve driveway culverts to 15" diameter pipes for properties 21, 27, 65 and 66 Spanish Trail and to 18" diameter for properties 125 and 127 Lake. Iron pipe should be used for all driveway culverts due to minimal cover placed above the pipe. If a diversion to either Frog Pond or Water District Lake is made in PRJ11B or PRJ11C, these culvert capacity increases would not be necessary as the flow would be decreased.
- The driveway culverts at 176 and 184 Bonita Road should be increased to 15" iron pipe to improve continuous conveyance in the gutters for **PRJ18**.
- **PRJ21** would increase capacity for flow to cross El Rey through a 15" diameter culvert with new upslope and down-slope inlets along the road. If PRJ14A is constructed, the flow should be piped down into the detention pond, or alternately an overland swale could be graded, with the capacity of a 15" diameter culvert.

These projects are summarized in Table 4-6 and below in Figure 3-3.

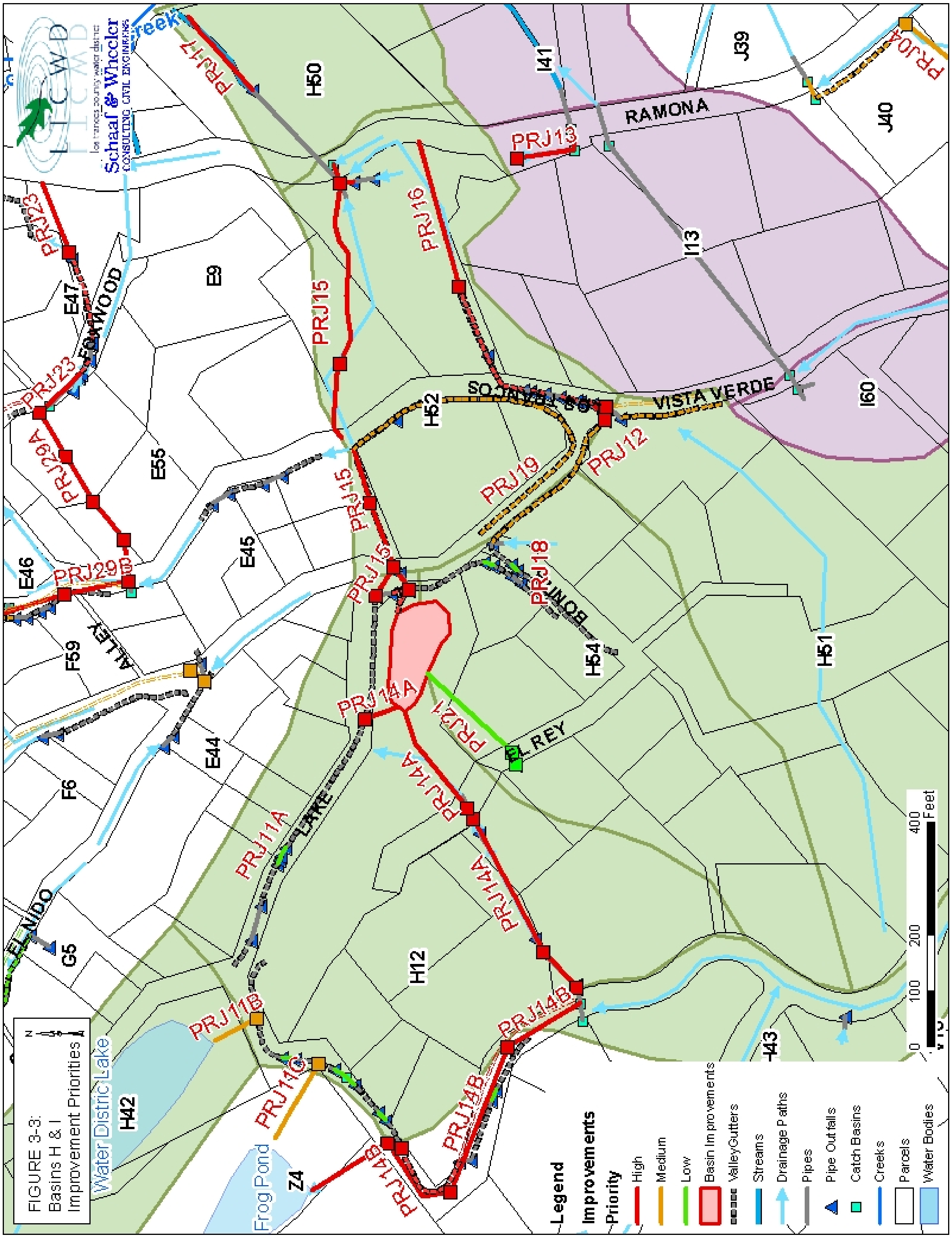


FIGURE 3-3:
Basins H & I
Improvement Priorities
Legend
Improvements
Priority
High
Medium
Low
Basin Improvements
ValleyGutters
Streams
Drainage Paths
Pipes
Pipe Outfalls
Catch Basins
Creeks
Parcels
Water Bodies
0 100 200 400 Feet
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
LTCWD
PRJ17
PRJ13
PRJ16
PRJ15
PRJ23
PRJ29A
PRJ29B
PRJ12
PRJ19
PRJ18
PRJ14A
PRJ21
PRJ11A
PRJ11B
PRJ11C
PRJ14B
PRJ04
RAMONA
VISTA VERDE
FOXWOOD
ALLEY
LAKE
EL NIDO
EL REY
BONITA
H50
H52
H54
H51
H12
H42
H43
I41
I13
I60
J39
J40
E9
E47
E55
E45
E46
E44
F59
F6
G5
Z4
Water District Lake
Frog Pond

Basins J, K and L

Overview

The Basin J, K and L drainage area is a total of approximately 57 acres. These parcels are some of the more gradually sloped and less densely developed in the District. There is little to no storm drainage infrastructure in these basins, with most flow occurring overland and through a few pipes that cross County roadways. Basins J, K and L flow to the northeast generally perpendicular to the roadways and through private properties before accumulating in small streams before the confluence with Los Trancos Creek.

Historic Problem Areas*

**Refer to Appendix A for identified problem areas in numbered brackets.

According to the District there have been historical flooding problems at two particular locations in basins J and K. Uncontrolled flow across properties between 348 Vista Verde Rd and 390-450 Ramona Road which span sub-basins J40 and K57 have caused landslides at those properties and downstream [13]. Since the landslides, which occurred last during the 1997-1998 rainfall season, a retaining wall and french drain with two 6" and 4" drain pipes have been installed to remediate the problem. The location is still experiencing land movement, as evidenced by the buckling of the asphalt pavement and the consistent need to repair the water line. A lack of drainage infrastructure has resulted in flooding and erosion at 25-35 Las Piedras at the top of sub-basin J14 [18].

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins J, K and L for the 10-year storm event shows some flooding (pipes and/or valley gutters with “High” risk) occurring at five pipes and one valley gutter. A map of the pipe capacity risks predicted by the model before improvements are made is presented in Appendix B, Figure B-4.

Prioritized Improvements

There are no high priority projects within the J, K and L Basins. Two medium priority projects exist.

- **PRJ04** should include installing a new 6” curb to direct flow into a new inlet at the court of Las Piedras. A 12” pipe with inlets at localized low points would convey flow downhill, the pipe increasing to 18” to cross Vista Verde. The pipe would continue through to just uphill of Ramona Road at parcel 354 where it would outlet into an existing vegetated swale along the roadway. This swale should be cleared of vegetated debris and increased to 36” wide by

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

18” deep. A new 18” culvert should be constructed under Ramona Road and connect to the existing pipe to remain in place at property 333 which outfalls down towards Los Trancos Creek. Pipes should be placed along property lines to the greatest extent practicable.

- Improvements are required at the intersection of Vista Verde and Ramona Road in **PRJ05** to increase surface capture and below grade conveyance downstream to the outfall beneath Ramona Road to Los Trancos Creek. The culvert beneath Ramona Road and the outfall are adequately sized, so only the upstream pipes need to be increased in diameter to 18”. A new inlet should be placed at the north corner of the intersection with a 15” pipe to connect to the existing manhole. The pipe through 400 Ramona Road should be located (exact pipe layout is unknown), increased to 18” and reconstructed in the street right of way as necessary.

These projects are summarized in Table 4-7 and Figure 3-4 below.

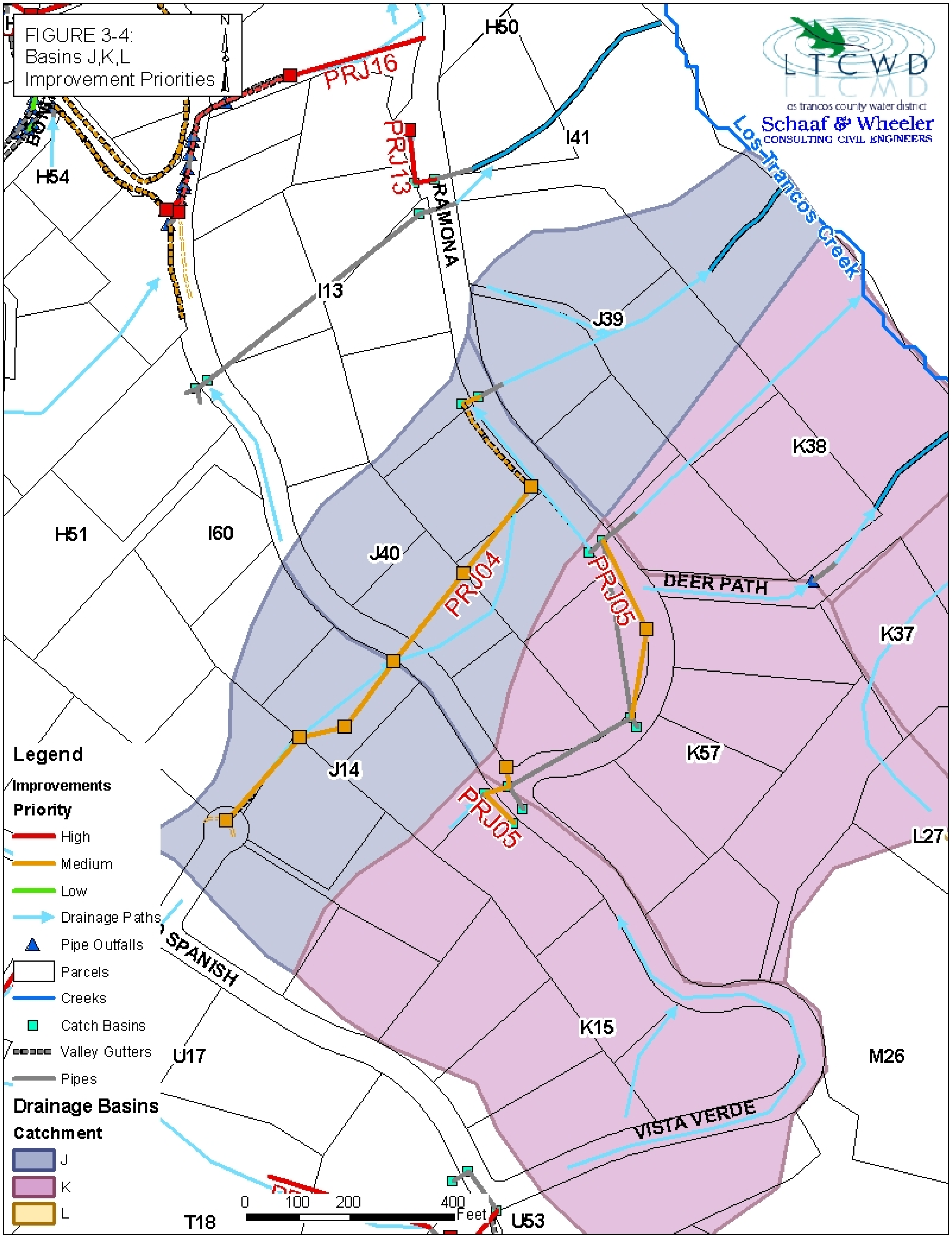


FIGURE 3-4:
Basins J,K,L
Improvement Priorities
N
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
PRJ16
PRJ13
PRJ04
PRJ05
PRJ05
H50
I41
H54
I13
J39
RAMONA
Los Trancos Creek
K38
H51
I60
J40
DEER PATH
K37
J14
K57
L27
SPANISH
K15
U17
M26
VISTA VERDE
T18
U53
0
100
200
400
Feet
Legend
Improvements
Priority
High
Medium
Low
Drainage Paths
Pipe Outfalls
Parcels
Creeks
Catch Basins
Valley Gutters
Pipes
Drainage Basins
Catchment
J
K
L

Basins Q, R and S

Overview

The Q, R and S drainage areas total approximately 37 acres, and are bounded by Corte Madera Creek on the west and a ridge line to the east. The only public infrastructure in these basins exists to transport flow across Vista Verde. Additional storm drainage structures vary and are located on private properties to convey flow onto the County right-of-way. The basins area characterized by the short distance between the ridge line and the creek which results in fast concentration times and higher peak flows. Streams have developed naturally to transport water from infrastructure on Vista Verde Road west to Corte Madera Creek.

Historic Problem Areas*

According to the District there are no known areas of flooding within these basins.

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins Q, R and S for the 10-year storm event shows some flooding (pipes and/or valley gutters with "High" risk) occurring at nine pipes. The normal depth calculations predict flooding at one pipe during the 100-year storm event ("Med" risk). A map of the pipe capacity risks predicted by the model before improvements are made is presented in Appendix B, Figure B-5.

Prioritized Improvements

Medium priority improvements should include increasing pipe diameters for culverts crossing Vista Verde Road and installing adequate erosion protection at the pipe outfalls to the open channels and overland flow paths to Corte Madera Creek in **PRJ06**. The culverts from 36 to 21 Vista Verde should be increased to 18" diameter. A new inlet with 6" curbs should be placed on the down-slope side of the roadway to capture flow from Vista Verde. This new inlet should be connected to the 18" system via a junction box. The outfall of the existing pipe which conveys water from the roadway to Corte Madera Creek should be located. The pipe should be upsized to 18" and a new outfall should be installed with appropriate rock rip-rap erosion protection.

These projects are summarized in Table 4-8 and below in Figure 3-5.

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

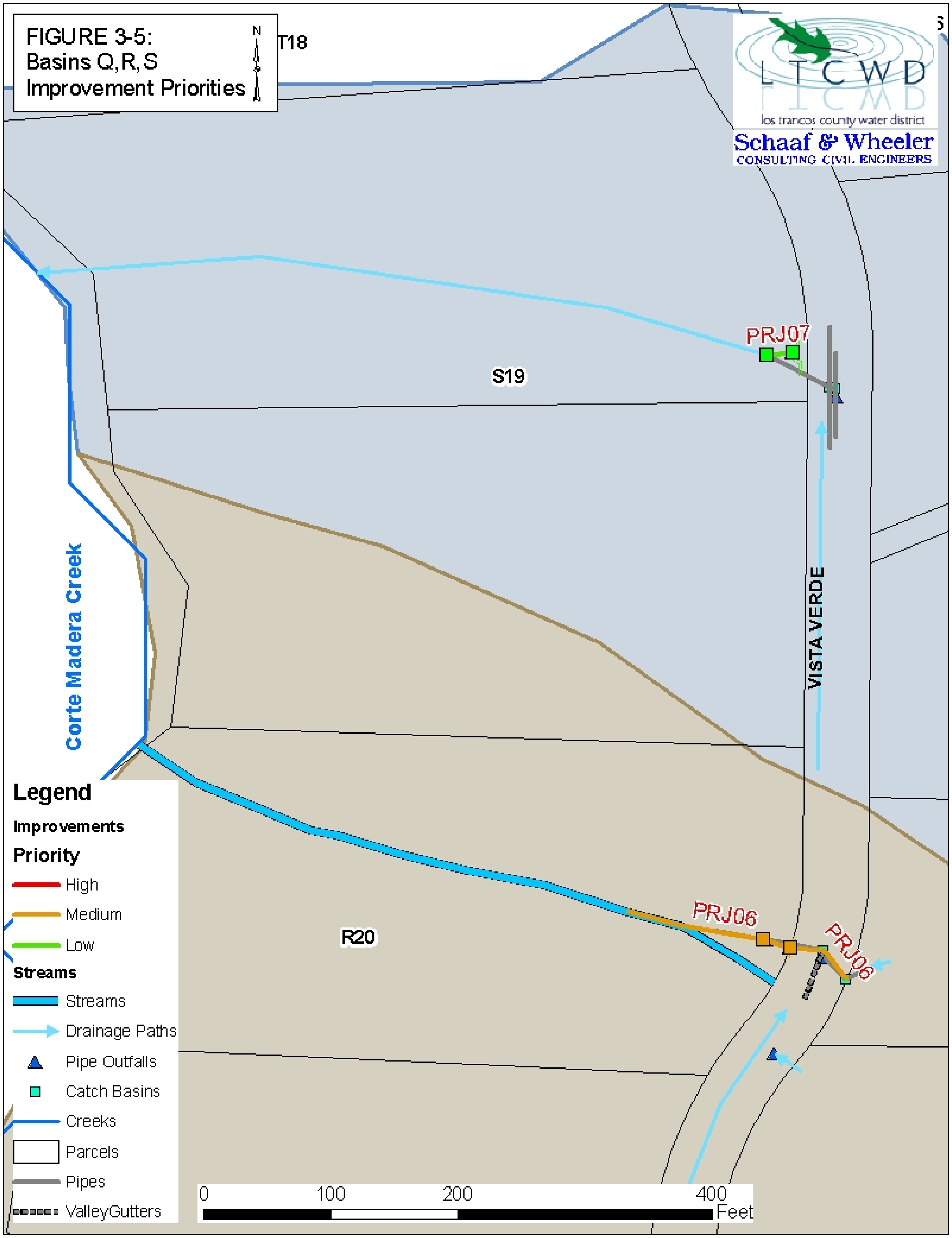


FIGURE 3-5:
Basins Q,R,S
Improvement Priorities
N
T18
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
S19
PRJ07
VISTA VERDE
Corte Madera Creek
R20
PRJ06
PRJ06
Legend
Improvements
Priority
High
Medium
Low
Streams
Streams
Drainage Paths
Pipe Outfalls
Catch Basins
Creeks
Parcels
Pipes
ValleyGutters
0
100
200
400
Feet

Basins T and U

Overview

The T and U drainage areas total approximately 48 acres. There is very little infrastructure in Basin T which is generally open forested land. Water is captured on Vista Verde before flowing westward overland to Corte Madera Creek. Basin U is generally open space with a few houses. This basin is one of the least vegetated in the District. Flow from sub-basin U53 travels north to the intersection of Old Spanish and Vista Verde before being collected in a system of unlined ditches and underground piping. These pipes discharge flow westward towards Corte Madera Creek. Additional flow is collected from Old Spanish Road near Las Piedras before combining with the flows basin U53 to the east and ultimately forming a stream which discharges to Corte Madera Creek.

Historic Problem Areas*

**Refer to Appendix A for identified problem areas in numbered brackets.

According to the District there have been historical flooding problems at one particular location in the U53 sub-area. An unlined drainage channel on the southeast side of Old Spanish trail accepts water from properties upstream and discharges via ground water and drainage infrastructure across the street and down the hillside towards Corte Madera Creek causing a landslide on the downhill properties [17].

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins T and U for the 10-year storm event shows some flooding (pipes and/or valley gutters with “High” risk) occurring at five pipes and two valley gutters. The normal depth calculations predict flooding at three pipes and one valley gutter during the 100-year storm event (“Med” risk). A map of the pipe capacity risks predicted by the model before improvements are made is presented in Appendix B, Figure B-6.

Prioritized Improvements

High priority improvements should include providing drainage piping from Old Spanish Road and Vista Verde Road to Corte Madera Creek through PRJ08 and PRJ09 to increase conveyance through downstream properties and reduce erosion.

- **PRJ08** would require new pipe with a diameter of 15” from Old Spanish Road until it passes through the driveway of 10 and 20 Ciervos. Inlets should be placed on the upstream and downstream side of the drive. The pipe should be 18” under the driveway and 24” downhill

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

of the existing house to Corte Madera Creek. The 24" pipe would require a new outfall with associated energy dissipation to the Creek.

- In order to reduce landslides on properties downstream of the intersection of Vista Verde and Old Spanish Road **PRJ09** should be constructed. The existing pipe inlet should be replaced with a curb inlet above the intersection at the private driveway to Pony Tracks Ranch. A pipe from this inlet should connect to the existing inlet in the valley gutter. The pipe across Vista Verde intersection should be increased to 18". An additional curb inlet should be placed on the downhill (northwest) side of the roadway and connect to the existing infrastructure and outfall pipe. The uphill dirt valley gutter should be increased to 36" wide by 18" deep and paved to reduce soil slope saturation. The valley gutter inlet pipes to the south should be removed and an asphalt gutter should be constructed directly from Vista Verde into the valley gutter. The existing pipe under Vista Verde has sufficient capacity. Where the existing pipe outlets, a new 21" pipe should connect and convey the flow downhill. A 21" pipe outlet with appropriate energy dissipation should be installed where the pipe daylights downstream of the existing landslide.

These projects are summarized in Table 4-9 and below in Figure 3-6.

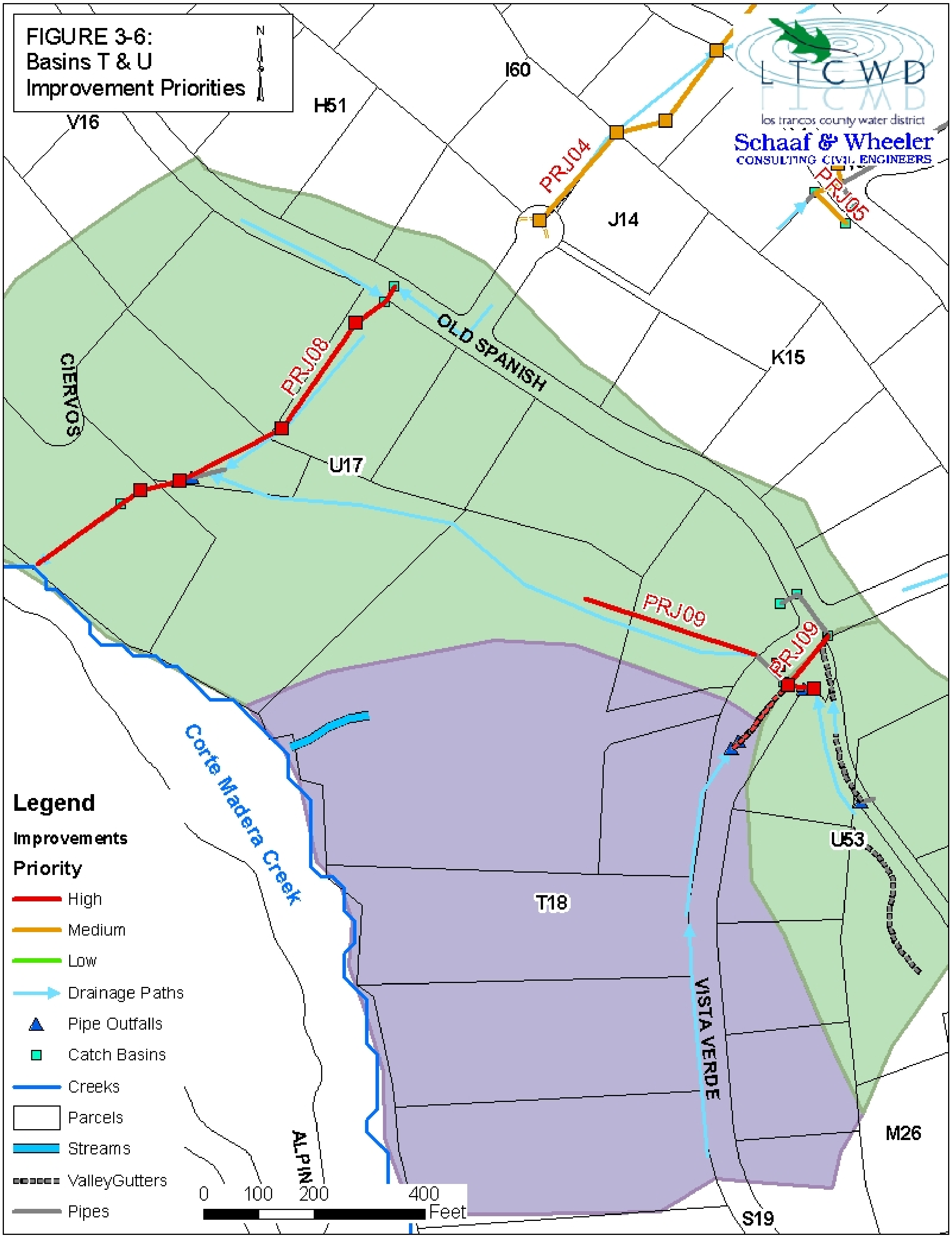


FIGURE 3-6:
Basins T & U
Improvement Priorities
N
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
V16
H51
I60
J14
K15
U17
U53
T18
M26
S19
PRJ04
PRJ05
PRJ08
PRJ09
PRJ09
OLD SPANISH
CIERVOS
VISTA VERDE
ALPINE
Corte Madera Creek
Legend
Improvements
Priority
High
Medium
Low
Drainage Paths
Pipe Outfalls
Catch Basins
Creeks
Parcels
Streams
ValleyGutters
Pipes
0
100
200
400
Feet

Basins W, X, Y and Z

Overview

The W, X, Y and Z drainage areas total approximately 53 acres. Basins X, Y and W are low density residential properties. Basin Z4 is open space with no infrastructure and receives water from Basin Z58 which is low density residential west of Old Spanish Trail. Basin Z4 include the Frog Pond which discharges westward towards Alpine Road before flowing into Corte Madera Creek. Basin W includes a small amount of storm drainage piping to capture flow from Joaquin and uphill properties and delivers it across Alpine Road and into Corte Madera Creek to the south. Basin X has valley gutters along Alpine Road which collect overland flow from the three properties uphill. Flow from properties and Joaquin Road in Basin Y is collected in a stream which discharges to a valley gutter before flowing over Alpine Road westward to Corte Madera Creek.

Historic Problem Areas*

**Refer to Appendix A for identified problem areas in numbered brackets.

According to the District there have been historical flooding problems at two particular locations in the Z4 and Y3 sub-areas. The existing pond has not been analyzed for capacity or overtopping conditions and impacts [15]. There are road failure concerns near 75 Joaquin Road where road fill may be transporting flow from upstream properties downhill [19].

Identified Deficiencies

Hydraulic analysis of the storm drainage systems within Basins W, X, Y and Z for the 10-year storm event shows some flooding (pipes and/or valley gutters with “High” risk) occurring at 2 pipes. The normal depth calculations predict flooding at 2 pipes during the 100-year storm event (“Med” risk). A map of the pipe capacity risks predicted by the model with no improvements is presented in Appendix B, Figure B-7.

Note that improvements to Alpine Road are not included because it is County owned and maintained and outside the scope of this study. Alpine Road runoff discharges directly to Corte Madera Creek and flooding on the road would overtop and flow into the Creek. Therefore it does not pose a threat to private property or structures. The County should continue to monitor the road for structural stability.

* Based on anecdotal information provided by residents. Historic problems are not based on calculations herein.

Prioritized Improvements

High priority improvements should include the diversion from Basin H through PRJ14B.

- **PRJ14B** should include routing flow from Basin H43 down Spanish Trail through a 12" culvert into Frog Pond. This culvert will require a new outlet and energy dissipation. An environmental analysis and permitting may be required for the new outfall to Frog Pond to determine impacts to habitat and existing vegetation. Also, as recommended by BAGG Engineers, a structural analysis should be performed on the existing earthen dam to determine the impacts of additional flow to the dam integrity. In addition to the outfall, a downhill rolled curb and gutter should be placed along Spanish Trail. The existing valley gutter on the inside of the roadway turn before Frog Pond should be increased to 24" width by 12" depth and a new inlet should be placed in the gutter to connect to the new outfall to Frog Pond. This project can be performed in lieu of PRJ14A to reduce the peak discharge through "Spanish Creek".

The medium priority improvements should include installing a curb and valley gutter along Joaquin Road in PRJ10 to transport flow from lot 80 to the intersection with Alpine Road and the PRJ11C diversion from Spanish trail to Frog Pond.

- **PRJ10** will require a 6" curb and gutter placed on the downhill side of the roadway. Rolled curb will be necessary at driveway entrances. At the intersection with Alpine Road, the paved approach to the inlet on the northwest corner should be increased to allow for greater interception of overland flow.

- An inlet placed within the uphill valley gutter on Spanish Trail would capture flow and convey it through a new 15" pipe to the Water District Lake in **PRJ11C**. The outfall would require an energy dissipation device and may necessitate environmental documentation to prove no adverse impacts to habitat or protected vegetation. PRJ11C could be constructed in lieu of PRJ11B or PRJ11A to reduce peak discharge to Spanish Creek and prevent overflow of driveway culverts on Lake Road.

These projects are summarized in Table 4-10 and are shown below in Figure 3-7.

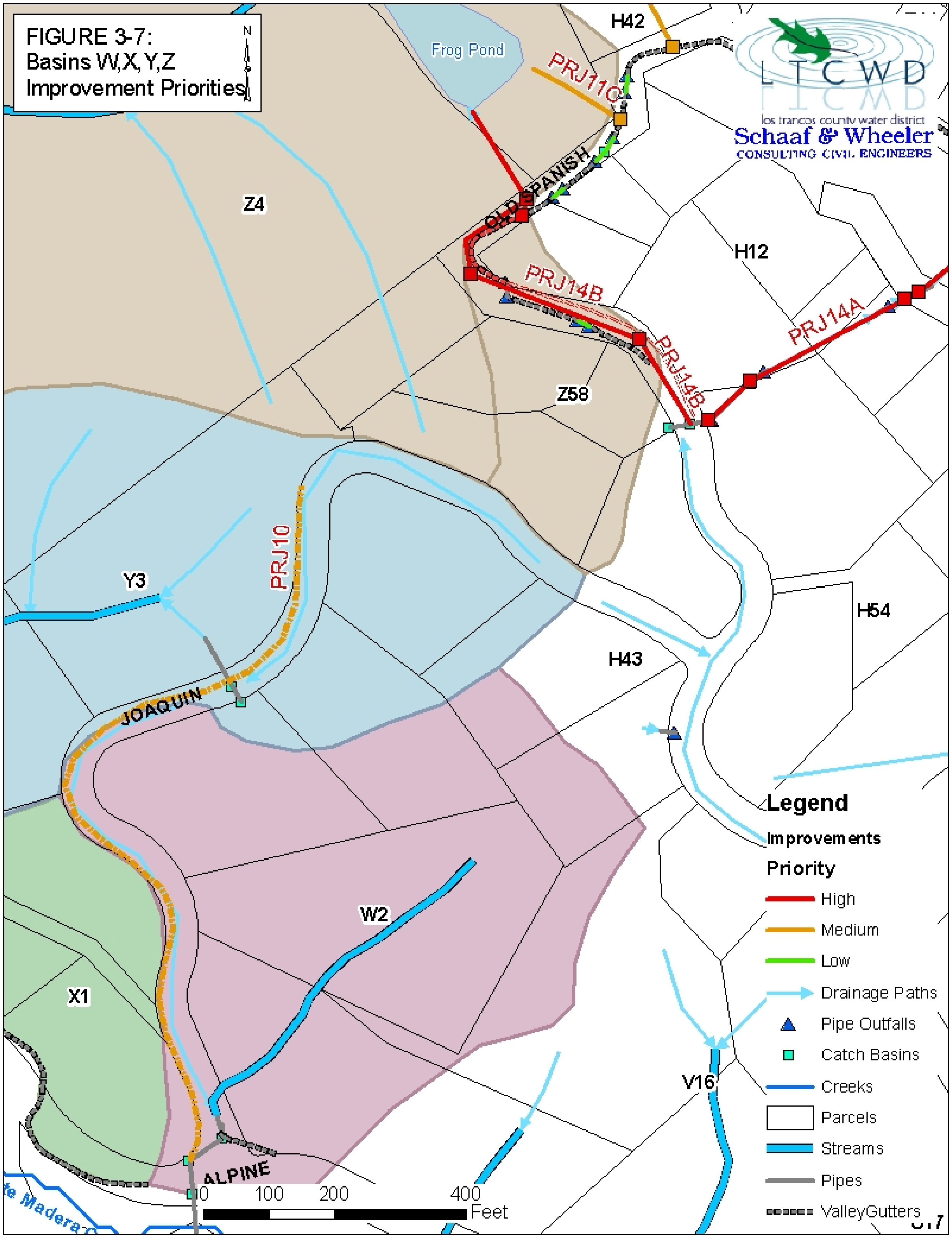


FIGURE 3-7:
Basins W,X,Y,Z
Improvement Priorities
N
Frog Pond
H42
PRJ11C
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
Z4
OLD SPANISH
H12
PRJ14B
PRJ14A
Z58
PRJ10
Y3
H54
H43
JOAQUIN
W2
X1
V16
ALPINE
0 100 200 400
Feet
Legend
Improvements
Priority
High
Medium
Low
Drainage Paths
Pipe Outfalls
Catch Basins
Creeks
Parcels
Streams
Pipes
ValleyGutters

Blue Oaks Basins

Overview

The Blue Oaks drainage areas total approximately 137 acres. Flow from each of the sub-basins travels east and north in an open channel alongside Los Trancos Road before crossing beneath the road and discharging to Los Trancos Creek. The entire infrastructure studied is within the open space of the Blue Oaks subdivision. No flow from the Los Trancos Woods portion of the study area travels through residential properties within Blue Oaks or threatens any structures.

Identified Deficiencies

Information about existing infrastructure within the Blue Oaks Open Space is based on as-built plans provided by BKF Engineers and is included in Appendix G. No survey was collected to verify pipe locations, inverts or sizes. According to the model, all of the pipes and streams are capable of conveying the 100-year flow from the Blue Oaks basins and run-on from the Los Trancos Woods area. This is depicted in Figure 3-8.

Each of the aforementioned projects identified within Los Trancos Woods area which affect waters flowing through the open space of the Blue Oaks community were analyzed for capacity and designed to ensure that there were no negative impacts to the existing system. No improvements will be required to the Blue Oaks community drainage system, or to any system under the jurisdiction of the Town of Portola Valley. Opportunities do exist to integrate the two systems and provide advantages in storm water retention and trail system maintenance.

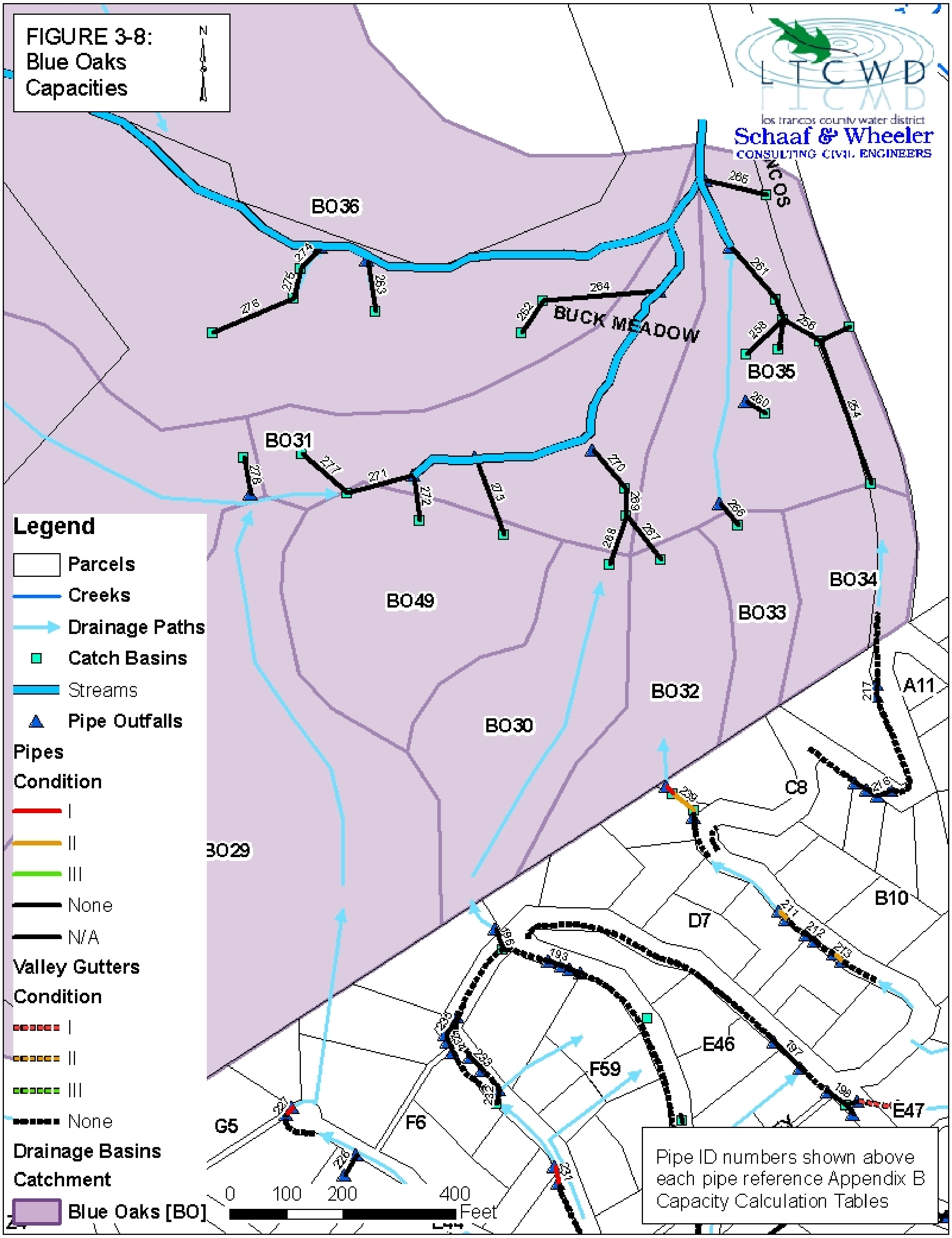


FIGURE 3-8:
Blue Oaks
Capacities
N
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
BO36
BO35
BO31
BO49
BO34
BO33
BO32
BO30
BO29
BUCK MEADOW
A11
C8
B10
D7
E46
F59
E47
G5
F6
Legend
Parcels
Creeks
Drainage Paths
Catch Basins
Streams
Pipe Outfalls
Pipes
Condition
I
II
III
None
N/A
Valley Gutters
Condition
I
II
III
None
Drainage Basins
Catchment
Blue Oaks [BO]
0
100
200
400
Feet
Pipe ID numbers shown above each pipe reference Appendix B Capacity Calculation Tables

OFF-SITE DISCHARGES

There are several connections between the District's storm drainage and surrounding communities of Blue Oaks and unincorporated San Mateo County. There are no hard piped connections to the Blue Oaks neighborhood and storm water only enters the Blue Oaks system via overland flow. There are several overland flow and storm system connections to the County system within Alpine Road and Los Trancos Road. These are listed in Table 3-2 and mapped in Appendix G.

Table 3-2: Connections with Neighboring Communities

Location	Connecting Community
Basin G5 – Pipe Outfall ID #4132	Blue Oaks Open Space
Basin F59 – Pipe Outfall ID #4087	Blue Oaks Open Space
Basin D7 – Pipe Outfall ID #4146	Blue Oaks Open Space
Basin Z4 – Gutter ID# 1001	Alpine Rd – County
Basin C8 – Gutter ID #1081	Los Trancos Road - County

Detention Ponds

There are opportunities at many of the discharge locations within the capital improvement plans to establish detention basins in order to reduce peak flow and volumes flowing downhill during storm events. These locations are identified for projects PRJ14A, PRJ21, PRJ27 and PRJ29 and are shown in the Appendix C figures for each of the improvements. If detention ponds are chosen for flood and erosion control, they should be sized appropriately to detain at minimum the 10-year storm event with appropriate overflow design considerations. In addition, vector control should be considered to prevent standing water habitat for mosquitoes. Ponds should be placed sufficiently far away from any structure foundation to prevent undermining and landslides. If ponds are located within a known landslide or near structures a lining should be installed over the entire bottom to reduce infiltration and further saturation of the unstable soils.

Two of the pond locations identified are within the Blue Oaks Open Space – specifically PRJ27 and PRJ29. Coordination will have to be done between Blue Oaks and the District to ensure proper pond maintenance and rights of access. Detention ponds placed within the Blue Oaks Open Space would provide the additional benefit of reducing erosion on the existing trail system. Currently over land flow becomes channelized in the trail system due to a lack of drainage infrastructure. This causes erosion and a resultant increase in trail maintenance. Detention ponds would reduce this impact.

There are concerns within the San Francisquito watershed regarding the increase in peak discharge to the creeks due to development and increase in impervious area. Hydromodification is used to reduce the peak flows from developed areas, thereby reducing channel erosion and peak floods.

Wherever possible, the detailed designs of the CIP should include hydromodification elements such as detention storage in order to reduce the peak flows and erosive capabilities of the discharge. Each individual project within the CIP has the potential of increasing the peak flow to Los Trancos and Corte Madera Creeks at nearly negligible amounts, but together with all of the development within the watershed, peak flows can be noticeably altered.

ADDITIONAL IMPROVEMENTS

Traffic Safety

Due to the rural nature of the study area, storm drainage is often contained within roadside ditches, both paved and unpaved. This presents a hazard to vehicles whereby they can drive into the ditches and cause damage to both the drainage infrastructure and their vehicle. In order to reduce this risk, it is recommended that reflective pavement striping be used to delineate where the edge of roadway is, especially where there is a curve in the road. Additional indicators could be added such as flexible traffic delineator posts which are adhered to the ground but can be driven over without damage.

Trash Racks

Another aspect of safety includes the risk associated with open catch basin or pipe inlets which are large enough for animals or people to enter. In order to prevent entry and associated injury from fall, trash racks should be installed at every large un-grated inlet. Trash racks with approximate 2" wide slotted openings will allow for the passage of water and smaller debris while preventing the passage of large woody debris and anthropomorphic trash which would clog the inlet. Placing the racks at an angle to the inlet would allow for debris to be pushed up the grate during storm events, reducing blockage of the inlet.

By placing trash racks, it is inherent that they will need to be maintained to prevent blockage of the inlet and associated overtopping and downstream erosion. However, this is merely a displacement of the maintenance and a preventative measure. If trash racks are not installed, maintenance will need to occur on the inlet or pipe it is protecting and to downstream inlets. Trash racks create a localized maintenance point which is easily accessible and have become a well-established best management practice in storm water control.

System Maintenance

Maintenance of the entire storm drainage system should occur periodically, before each rainy season, before forecasted events and after large storm events. Due to the heavy presence of leafy debris and high volume of runoff, the District system is more susceptible to failure due to a lack of maintenance than other systems throughout the County. Therefore, the system should be maintained and cleaned more frequently. Since the County accepts responsibility for the infrastructure along their right of way, it is the responsibility of individual home owners to ensure that the infrastructure on their property is clear of debris and able to accept the next storm event. System cleaning can occur through hydro-jetting the pipes and manual removal of debris from the inlets. It is our recommendation that a cleaning and maintenance schedule be adopted and adhered to in order to ensure continuous and frequent system cleaning. It is feasible and recommended that the District obtain the necessary property entry rights, establish a schedule, and/or provide funding to clean the existing infrastructure on private property.

Rip-Rap Outfalls

In many of the proposed improvements, rock rip-rap outfalls are specified to prevent erosion from occurring to existing creek or pond banks. There are many alternatives to standard rock rip-rap which can be vegetated, provide habitat, and which are more aesthetically pleasing. Here is a summary of a few of the alternatives which meet the need for energy dissipation while providing additional benefit:

Root Balls

Willow or cottonwood bundles (root balls) can be planted beneath the rock rip-rap, either vertical or at an angle.* The bundles are installed within a trench which is keyed into the sloping bank of the creek or pond. The rip-rap is placed above the bundles, with the stems long enough to reach through the rock layer.

Vegetated Gabion

Gabion is rock rip-rap which has been contained in a metal cage or other structural device. By containing the rip-rap, it will not alter due to stream forces, and can provide structural support of the bank. Many manufacturers provide gabion with planting media within, this allows for the establishment of vegetation throughout the rock. The gabion reduces the potential for the planting medium to wash out before establishment.

Another subset within this category is gabion GroSoxx by filtrexx†, which are biodegradable fabric tubes which have been filled with a planting media. The GroSoxx can provide erosion protection while allowing vegetation establishment when coupled with caged rocks.

Geosynthetics

Mechanically stabilized earth is a group of products which use synthetic materials to provide soil stabilization. This can come in the form of geo-grids or woven meshes‡. Both of these products can provide soil stabilization while allowing vegetation to establish between the voids in the geosynthetic.

* USDA Natural Resources Conservation Service, Technical Note Plant Materials No. 21, Planting Willow and Cottonwood Poles under Rock Rip-Rap, October 2007.
† GroSoxx Gabion, Filtrexx, 2010. http://www.filtrexx.com/green_gabion.htm
‡ TenCate Mirafi Products

CHAPTER 4
CAPITAL IMPROVEMENTS

Chapter 3 evaluates the District's storm drain collection system and recommends prioritized improvements to address deficiencies. This chapter details these prioritized improvements and places them together in a Capital Improvement Program (CIP). The CIP provides projected capital costs, a construction schedule, and an overall guideline for the District to use in preparing annual budgets. Exigent circumstances and future in-field experiences may necessitate deviations from the Storm Drain CIP. A master plan is intended to be just that; a tool for planning. Capital improvement priorities are not intended to be hard and fast.

The CIP does not include the cost of new facilities related to new development or subdivision (*e.g.*, pipeline extensions to serve properties that are currently undeveloped). These new facilities would be constructed as part of the new developments, and are not included in the District CIP.

CAPITAL IMPROVEMENT PRIORITIES

The proposed CIP for storm drainage in the District is broken into three priority levels for funding and implementation, as discussed in Chapter 3. The total cost summary for all CIP projects is shown for each priority level in Table 4-1. Each drainage basin includes the recommended capacity improvements, system extensions and improvements to localized drainage problems.

Table 4-1: Summary of CIP Costs Based on Priority Level

Priority Level	Cost
High Priority Capital Improvements	$2,063,000
Moderate Priority Capital Improvements	$1,094,000
Low Priority Capital Improvements	$215,000
Total Capital Improvement Program	**$3,372,000**

Table 4-1 costs include a 50% contingency to include design, administration, contractor mobilization, and the uncertainties inherent in construction projects.

COST OF IMPROVEMENTS

Costs have been estimated using information from other similar projects, cost estimating guides (*2013 Current Construction Costs*, Saylor Publications, Inc.), and engineering judgment and are in 2013 dollars. The cost per linear foot of improvement used for the cost estimates are given in Table 4-2 (note that these costs do not include the 50% contingency for design, administration, mobilization, and construction uncertainty included in all other tables). Manhole replacement cost estimates range from $11,770 to $13,270 depending on diameters. Catch basin cost estimates range from $2,100 to $3,000 based on pipe diameter. All estimates are based on the Engineering News-Record (ENR) May 2013 index #9515. Costs include open trenching in roadway up to ten feet in depth. The cost of new outfalls costs to detention ponds and lakes, Corte Madera Creek or Los Trancos Creek are estimated to be $10,000 per new outfall (not including contingency or permitting costs). Costs for permitting and environmental documentation are included only when an outfall to a creek or pond is recommended and are estimated to be $10,000 for each new outfall. Most of the remaining improvement projects are expected to be categorically exempt for CEQA and qualify for negative declarations from permitting agencies.

Mobilization for small projects can be a significant portion of the overall project construction cost. In order to reduce spending for mobilization, projects should be grouped to the greatest extent practicable. The grouping of projects should be based on project drainage basin. For example, all projects in Basin E could be constructed during the same contract, starting from the outlet and working up the drainage basin. This will ensure that the outlet has been properly sized before upstream improvements are made which increase conveyance downhill. In addition to maximizing the spending of mobilization costs, grouping the improvements could also allow for the consolidation of environmental investigations and permitting costs.

Table 4-2: Storm Drain Unit Costs

Diameter (inches)	2013 Dollar per Linear foot of Pipe	2013 Dollar Per Manhole
12	$76	$11,770
15	$88	$11,850
18	$100	$11,930
24	$129	$12,080
30	$215	$12,230
36	$256	$12,380
42	$309	$12,530
48	$363	$12,680
54	$407	$12,830
60	$468	$12,970
66	$540	$13,120
72	$634	$13,270

CAPITAL IMPROVEMENT PROGRAM

The proposed Storm Drain Capital Improvement Program pipeline improvement costs and pipe lengths based on priority level are summarized in Table 4-3. Tables 4-4 thru 4-10 outline the CIP cost allowances by project name and drainage basin. All cost estimates include an additional 20% for design and administration, 10% mobilization, and 20% percent miscellaneous contingency. Maps of the improvement priorities are shown on Figures 3-1 through 3-7 in Chapter 3. Maps of the proposed improvements showing pipe diameters are shown in Figures 4-1 through 4-7. Appendix C includes detailed maps of each improvements and Appendix F details the cost estimate for each project.

Table 4-3: Summary of 100-Year CIP Pipeline Project Costs

Basin	High		Medium		Low	
	Length*	**Cost**	**Length***	**Cost**	**Length***	**Cost**
A	290	$67,000				
B	869	$128,000				
C	434	$64,000				
D	1274	$151,000				
E	534	$116,000				
F	1046	$233,000	1997	$251,000		
G					489	$89,000
H	2537	$633,000	1259	$233,000	407	$99,000
I	141	$24,000		$0		
J			1211	$191,000		
K			525	$99,000		
R			564	$134,000		
S					59	$27,000
U	1496	$345,000				
W			1352	$132,000		
Z	2268	$302,000	155	$54,000		
Total:	10215	$2,063,000	7063	$1,094,000	955	$215,000

* Length refers to pipe or gutter linear improvements

Table 4-4: Basins A, B, C and D 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ01	High	290	2	1	$45,000	$67,000
PRJ02	High	869	2	1	$85,000	$128,000
PRJ03	High	434	2	0	$43,000	$64,000
PRJ31	High	1,274	3	0	$101,000	$151,000

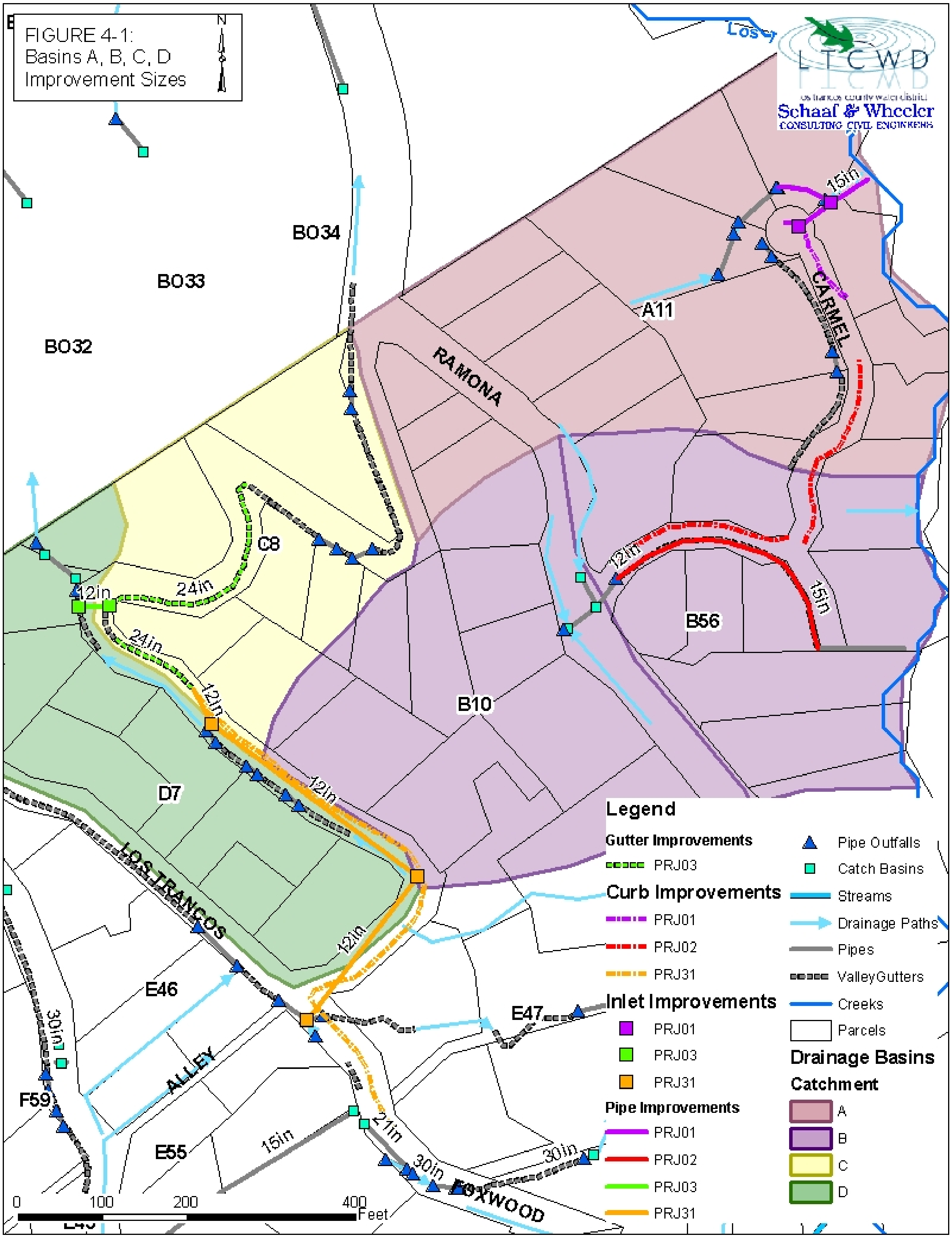


FIGURE 4-1:
Basins A, B, C, D
Improvement Sizes
N
LTCWD
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
BO34
BO33
BO32
A11
RAMONA
CARMEL
15in
C8
24in
12in
24in
12in
B56
12in
15in
B10
D7
12in
LOS TRANCOS
12in
E46
E47
ALLEY
F59
E55
15in
21in
30in
30in
30in
FOXWOOD
0
100
200
400
Feet
Legend
Gutter Improvements
PRJ03
Curb Improvements
PRJ01
PRJ02
PRJ31
Inlet Improvements
PRJ01
PRJ03
PRJ31
Pipe Improvements
PRJ01
PRJ02
PRJ03
PRJ31
Pipe Outfalls
Catch Basins
Streams
Drainage Paths
Pipes
ValleyGutters
Creeks
Parcels
Drainage Basins
Catchment
A
B
C
D

Table 4-5: Basins E, F & G 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ23	High	429	2	0	$65,000	$98,000
PRJ24	High	105	0	0	$12,000	$18,000
PRJ25	Med	1,432	1	0	$127,000	$190,000
PRJ27	High	319	4	1	$56,000	$85,000
PRJ28	Med	565	2	0	$41,000	$61,000
PRJ29A	High	345	4	0	$49,000	$73,000
PRJ29B	High	727	7	0	$99,000	$148,000
PRJ30	Low	489	1	1	$59,000	$89,000

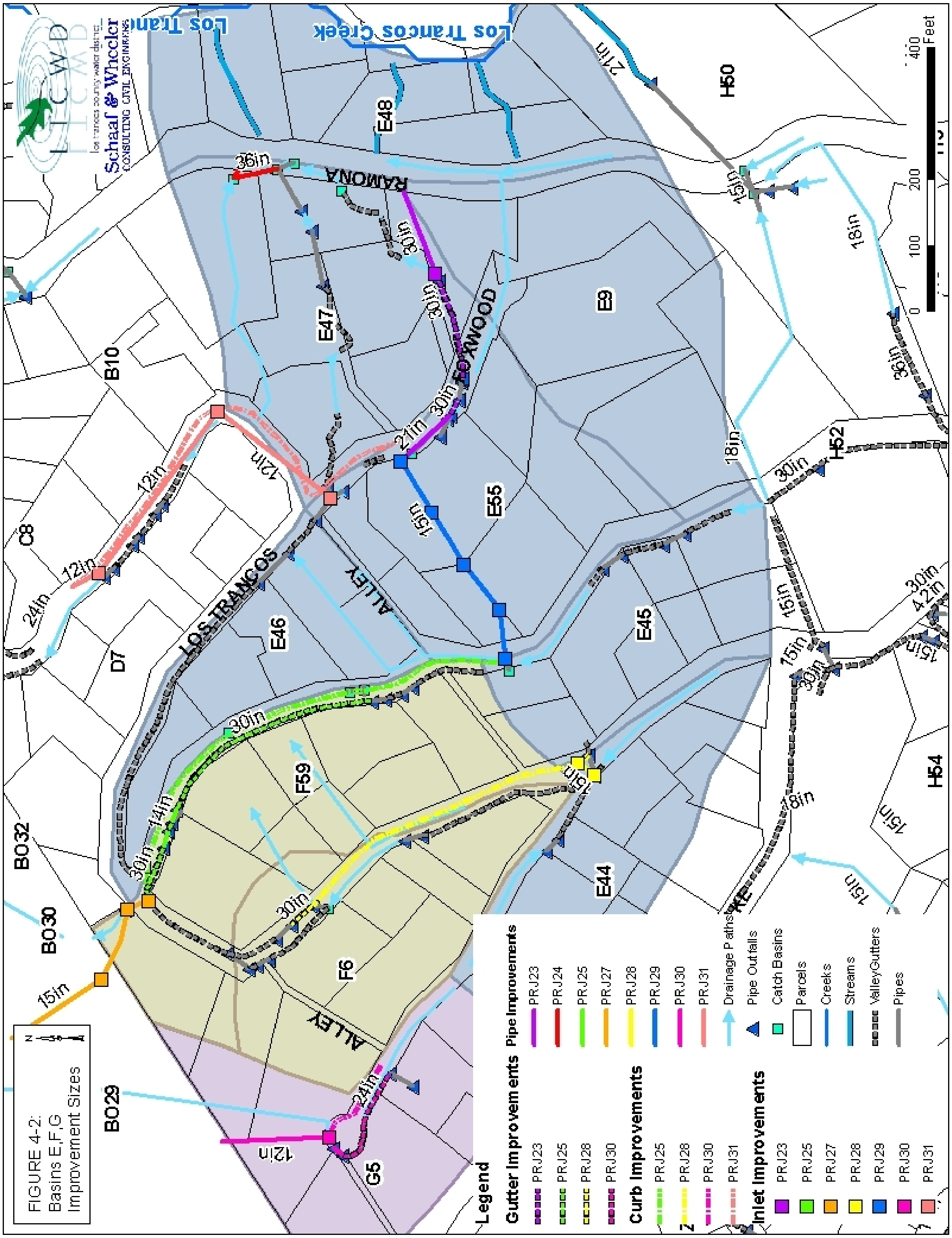


FIGURE 4-2:
Basins E,F,G
Improvement Sizes

Table 4-5: Basins H & I 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ11A	Low	144	0	0	$34,000	$51,000
PRJ11B	Med	86	1	1	$30,000	$44,000
PRJ12	Med	488	0	0	$51,000	$77,000
PRJ13	High	141	1	0	$16,000	$24,000
PRJ14A	High	694	5	1	$203,000	$305,000
PRJ15	High	799	5	0	$88,000	$131,000
PRJ16	High	811	3	0	$92,000	$137,000
PRJ17	High	233	1	1	$40,000	$60,000
PRJ18	Low	35	0	0	$8,000	$12,000
PRJ19	Med	685	0	0	$74,000	$112,000
PRJ21	Low	228	2	0	$24,000	$36,000

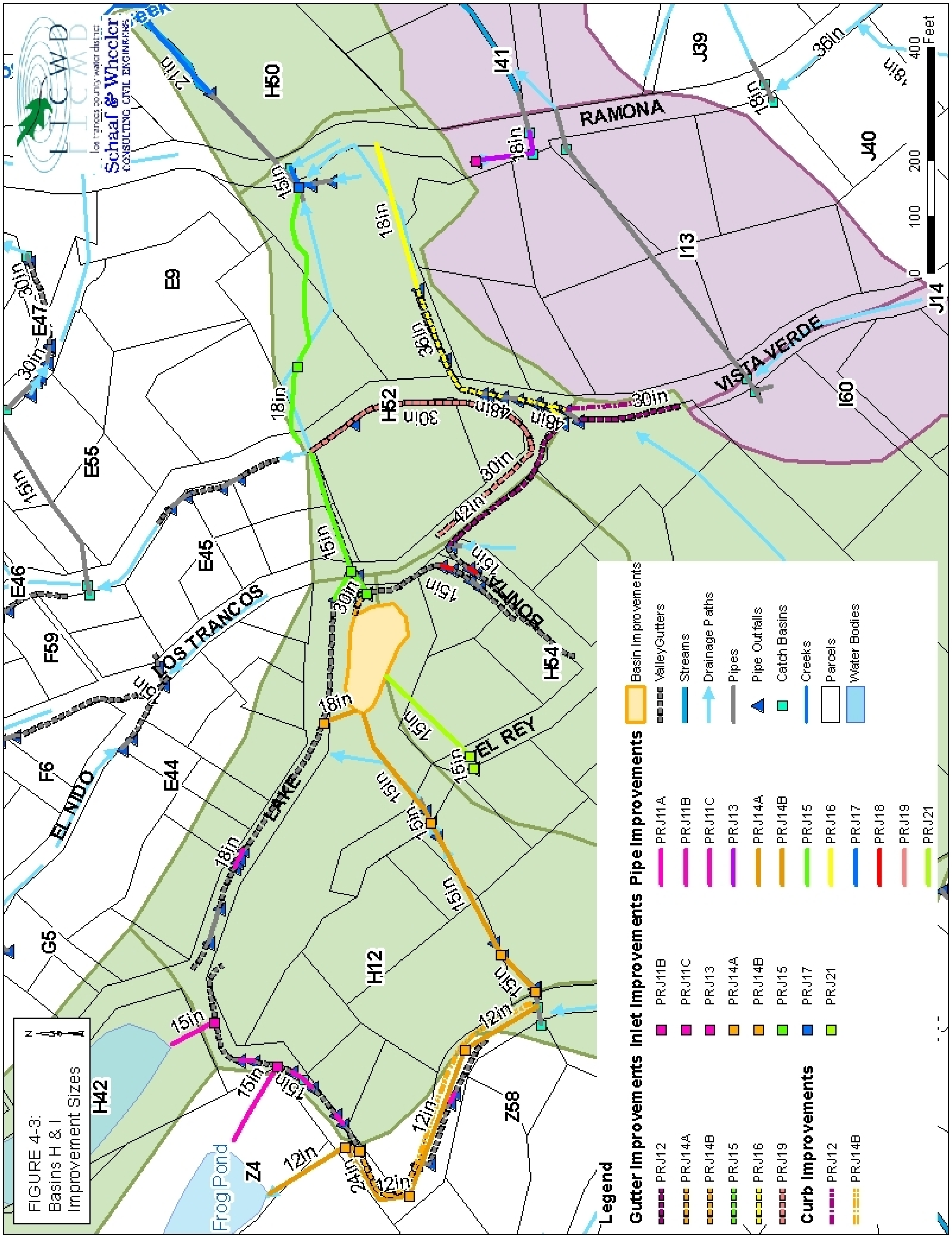


FIGURE 4-3:
Basins H & I
Improvement Sizes

Table 4-7: Basins J & K 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ04	Med	1,211	6	0	$127,000	$191,000
PRJ05	Med	525	2	0	$66,000	$99,000

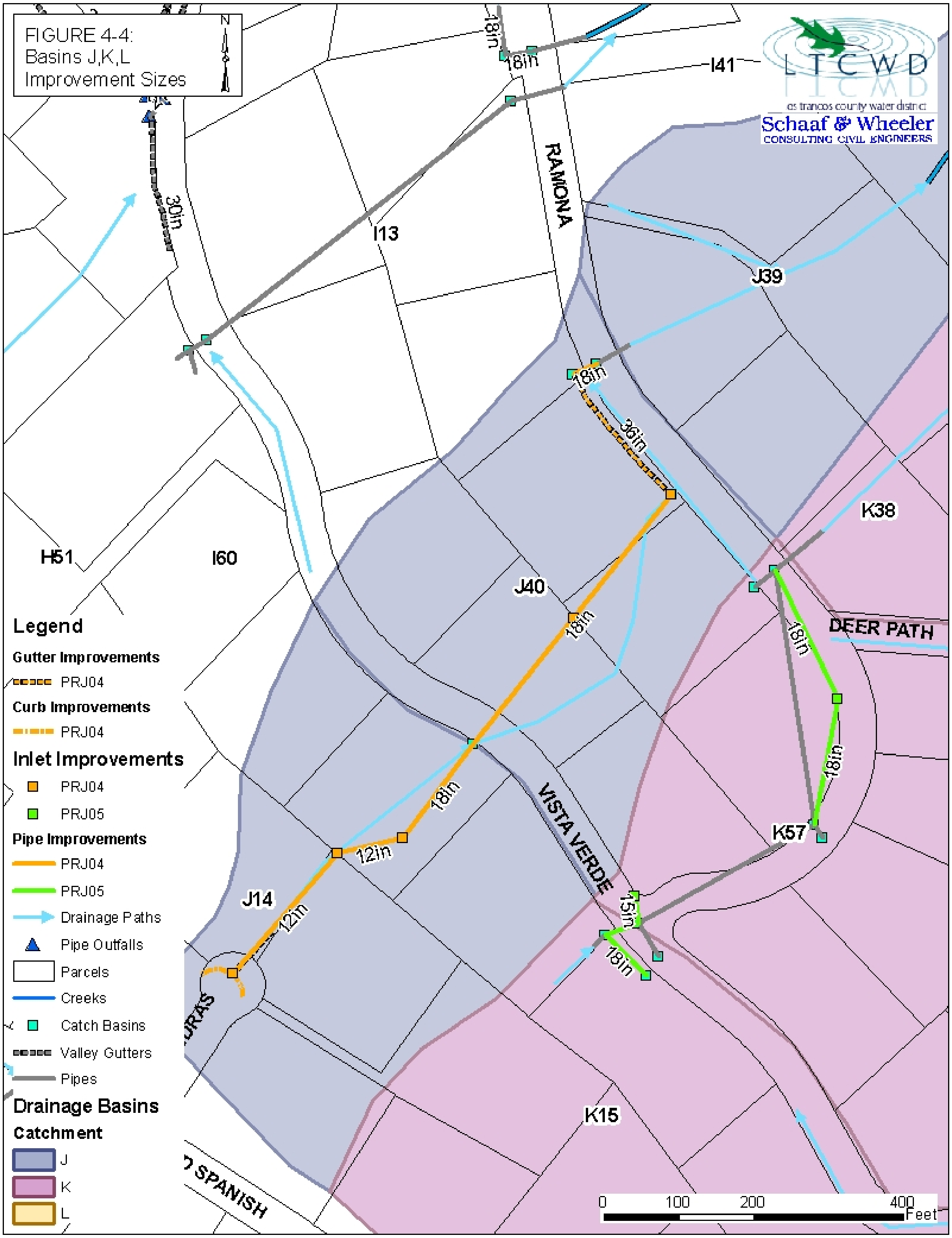


FIGURE 4-4:
Basins J,K,L
Improvement Sizes
N
LTCWD
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
RAMONA
VISTA VERDE
DEER PATH
SPANISH
I41
I13
I60
H51
J39
J40
J14
K38
K57
K15
18in
30in
36in
12in
15in
Legend
Gutter Improvements
PRJ04
Curb Improvements
PRJ04
Inlet Improvements
PRJ04
PRJ05
Pipe Improvements
PRJ04
PRJ05
Drainage Paths
Pipe Outfalls
Parcels
Creeks
Catch Basins
Valley Gutters
Pipes
Drainage Basins
Catchment
J
K
L
0
100
200
400
Feet

Table 4-8: R & S 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ06	Med	564	2	1	$90,000	$134,000
PRJ07	Low	59	2	0	$18,000	$27,000

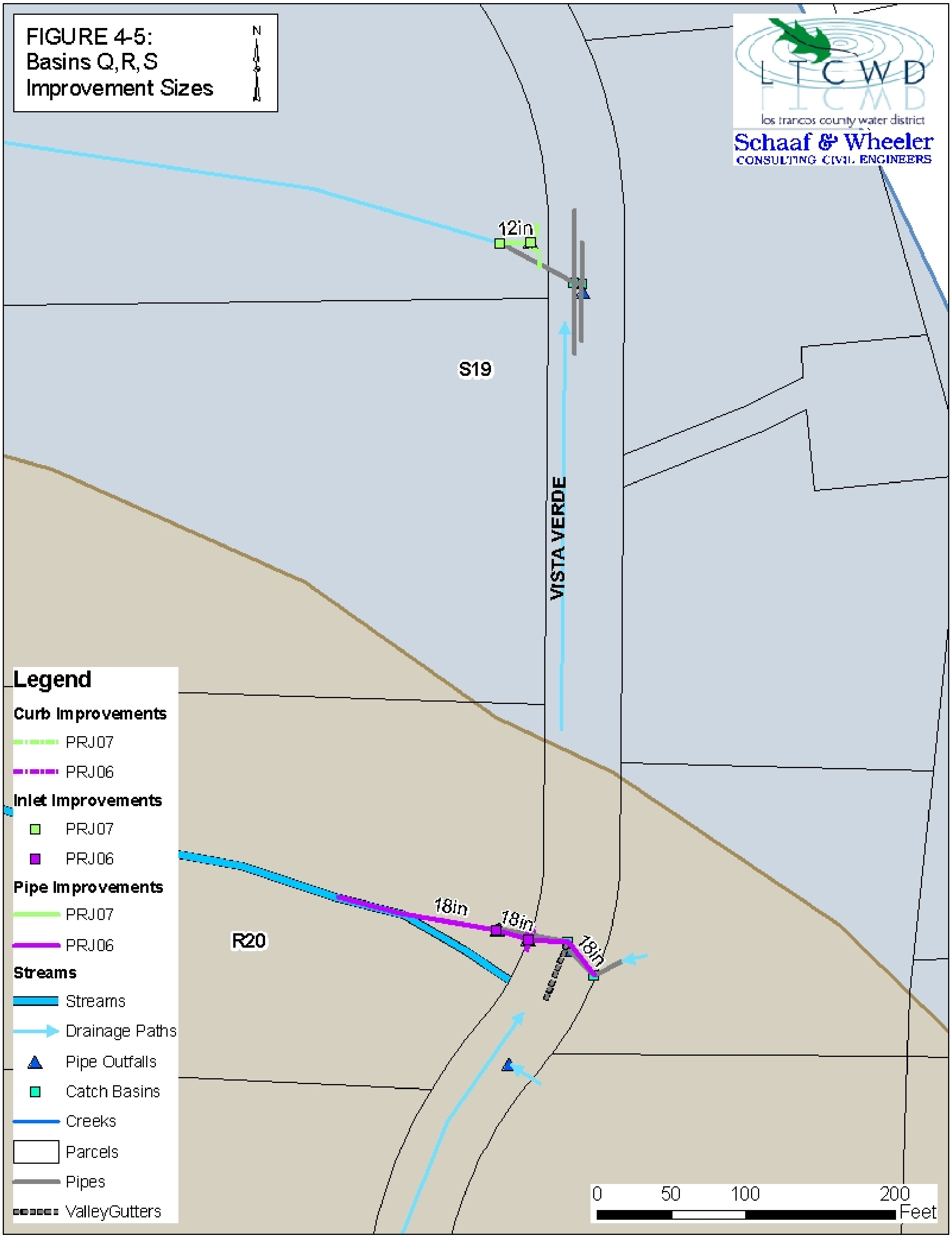


FIGURE 4-5:
Basins Q,R,S
Improvement Sizes
N
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
12in
S19
VISTA VERDE
R20
18in
18in
18in
Legend
Curb Improvements
PRJ07
PRJ06
Inlet Improvements
PRJ07
PRJ06
Pipe Improvements
PRJ07
PRJ06
Streams
Streams
Drainage Paths
Pipe Outfalls
Catch Basins
Creeks
Parcels
Pipes
ValleyGutters
0
50
100
200
Feet

Table 4-9: Basin U 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ08	High	841	4	1	$127,000	$190,000
PRJ09	High	655	3	1	$104,000	$155,000

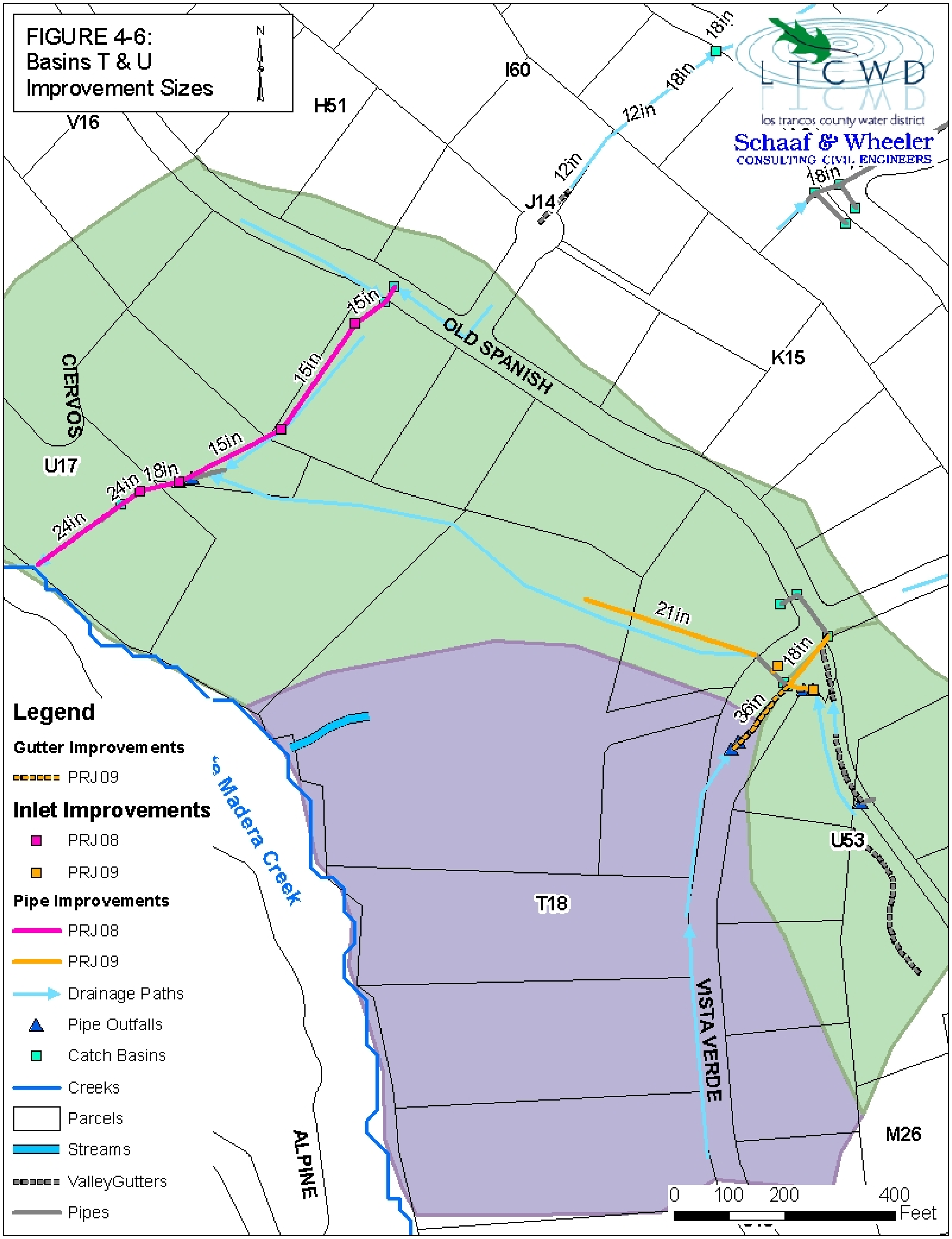


FIGURE 4-6:
Basins T & U
Improvement Sizes
N
V16
H51
I60
J14
K15
U17
T18
U53
M26
CIERVOS
OLD SPANISH
VISTA VERDE
ALPINE
Madera Creek
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
18in
12in
15in
24in
21in
36in
Legend
Gutter Improvements
PRJ09
Inlet Improvements
PRJ08
PRJ09
Pipe Improvements
PRJ08
PRJ09
Drainage Paths
Pipe Outfalls
Catch Basins
Creeks
Parcels
Streams
ValleyGutters
Pipes
0
100
200
400
Feet

Table 4-10: Basins W, Y & Z 100-Year Storm Protection CIP

Improvement Number	Priority Level	Pipe or Gutter Length (ft)	Connections (MH or CB)	Outfalls	Construction Allowance	Total Allowance w/ Contingencies
PRJ10	Medium	1,352	0	0	$88,000	$132,000
PRJ11C	Medium	155	1	1	$18,000	$54,000
PRJ14B	High	2,268	4	1	$202,000	$302,000

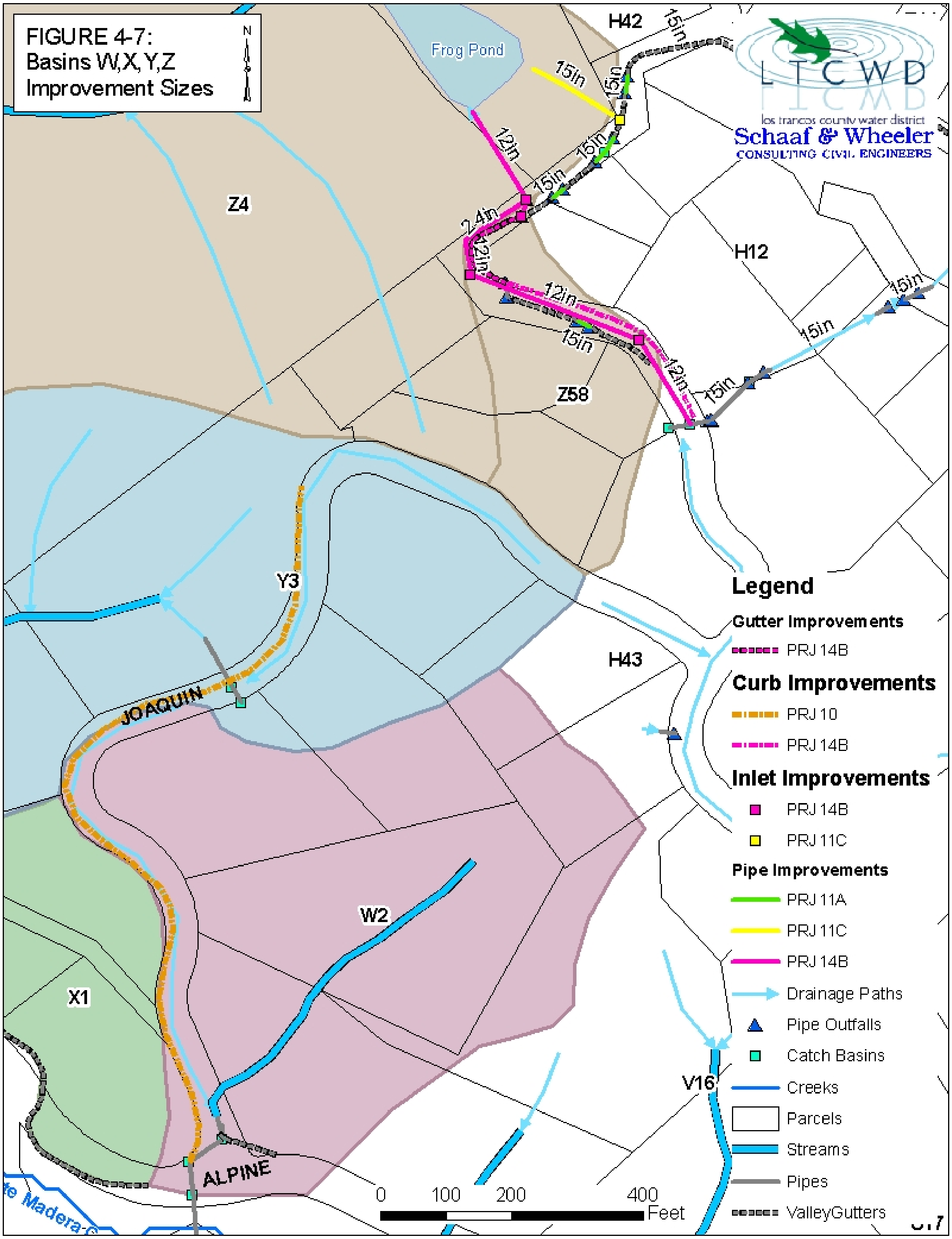


FIGURE 4-7:
Basins W,X,Y,Z
Improvement Sizes
N
Frog Pond
H42
15in
12in
24in
Z4
H12
Z58
Y3
H43
JOAQUIN
W2
X1
V16
ALPINE
LTCWD
los trancos county water district
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
0
100
200
400
Feet
Legend
Gutter Improvements
PRJ 14B
Curb Improvements
PRJ 10
PRJ 14B
Inlet Improvements
PRJ 14B
PRJ 11C
Pipe Improvements
PRJ 11A
PRJ 11C
PRJ 14B
Drainage Paths
Pipe Outfalls
Catch Basins
Creeks
Parcels
Streams
Pipes
ValleyGutters

CAPITAL IMPROVEMENT SCHEDULE

The proposed improvements project should be constructed as funding allows. The following schedule, Table 4-11, assumes high and medium priority projects will be built over a 10-year period. The first project is assumed to take a year to design and fund and should be constructed in Year 2. An inflation rate of 3.5% was used. This schedule can be revised as District priorities and funding changes.

Table 4-11: 10-Year CIP Schedule

Year of Construction	Drainage Basin	Priority	Project	2013 Cost	Escalated Cost
2	H	High	17	$60,000	$62,100
2	H	High	14A [or B]	$305,000	$315,700
2	H	High	15	$131,000	$135,600
3	E	High	23	$98,000	$104,900
3	C-D	High	3	$64,000	$68,500
3	D	High	31	$151,000	$161,600
4	U	High	9	$155,000	$171,300
4	U	High	8	$190,000	$210,000
5	B	High	2	$128,000	$145,900
5	A	High	1	$67,000	$76,400
6	F	High	27	$85,000	$99,900
6	F [or E]	High	29B [or A]	$148,000	$173,900
6	F	Medium	25	$190,000	$223,300
6	F	Medium	28	$61,000	$71,700
7	H	High	16	$137,000	$165,800
7	H	Medium	12	$77,000	$93,200
7	H	Medium	19	$112,000	$135,500
8	E	High	24	$18,000	$22,400
8	H [or Z]	Medium	11B [or C]	$44,000	$54,800
9	I	High	13	$24,000	$30,700
9	J	Medium	4	$191,000	$244,500
9	K	Medium	5	$99,000	$126,700
10	W & Y	Medium	10	$132,000	$173,600
10	R	Medium	6	$134,000	$176,200

ALTERNATIVE CAPITAL IMPROVEMENT PROJECT FUNDING MECHANISMS

This section explores typical funding mechanisms that may be available to the District as it moves forward with the CIP. The information contained herein is for general information only and should not be construed as financial or legal advice.

It is important to note that the State of California does not allow for stormwater systems to be practically treated as a utility; therefore the creation of a 'utility' is an organizational undertaking and does not abolish any of the legal requirements for establishing a fee, compared to simply using an existing enterprise fund for fee collection and management.

Voter approval is required to implement many of the available funding mechanisms. Depending on the funding mechanism sought, this could be a simple majority of property owners responding to a mail-in ballot, or a two-thirds majority of the electorate during an election. Because voter approval is required to establish a stormwater fee or special tax, early public outreach and involvement is recommended.

The actual proposed fee or special tax must be established and justified through engineering studies and a financial analysis. In addition to the CIP described in this document, a summary of annual costs and a detailed rate study would be required.

Overview

California does not treat stormwater as a utility the way every other western state does. In general, when one thinks of a utility, one assumes that a utility, such as the District, could set rates for users and collect money based on those rates to create a revenue stream. Since the passage of California State Proposition 218 in 1996, this is not the case. Sewage, solid waste, and water utilities may set user rates (through a process with the Public Utilities Commission that includes a public hearing, but does not require a public vote) and collect revenue. All other utilities, including stormwater, must go through a voter approval process to establish and collect fees. The District could go through the same voter approval process to establish and collect stormwater fees without taking the step of forming a utility, as subsequently described in more detail.

There is no mechanism in California to avoid property owner or voter approval for a stormwater property related fee or special tax. In general, the greater the flexibility needed for use of the funds collected, the higher the voter approval threshold is for establishing the fee. Understanding the willingness of District residents to support such a fee, and how high of a fee would be supported at the polls (in other words, the 'affordability' of the fee) should factor heavily in the determination of how to best proceed with garnering additional funds for stormwater management and improvements.

Generalized Legal Requirements

California cities can create a stormwater enterprise fund or a stormwater utility; however, funding them is much more complicated compared to solid waste, water and sewer utilities. California has strict laws for setting up fees and special taxes. The most notable is Proposition 218 (California Constitution Article XIII D) passed in 1996 (implemented in 1997). This voter approved measure requires a 2/3 voter approval on special taxes for various municipal functions including stormwater. It also requires a majority vote of responding property owners to pass a property related fee. Many stormwater fees were created prior to 1997 throughout the state of California. Cities with these fees or taxes 'on the books' must maintain the rate structure created (and generally limited) by the original ordinance – any changes to the pre-1997 fee program requires voter approval.

There are two methods for obtaining voter approval for stormwater fees: majority vote by mail-in ballot from individual property owners or two-thirds voter approval from the electorate. The majority of stormwater fees established after 1997 have utilized the first option – a simple majority via a mail-in ballot. If a special tax is used to create the stormwater utility (which allows excess funds to be collected and re-allocated) a two-thirds electoral vote is required.

The court system is active with cases arguing the legal nuances of Proposition 218 and the finer points of the establishment and as such the implementation of stormwater fees in California is in a state of constant flux.

Funding Mechanisms Not Requiring Voter Approval

There are various alternatives the District could further explore to either use existing tax revenue, or create new stormwater fees to help fund stormwater improvements and other stormwater management activities. Identifying financing mechanisms that do not require voter approval could be a first step in the creation of a stormwater funding program, since it eliminates or lowers the potential property related fee or tax. It is possible that property related fees and taxes could be avoided though funding by the District, County of San Mateo, other grant agencies, or imposing direct impact fees on developers.

County

The County of San Mateo owns the storm drainage infrastructure located within the right-of-way. They do not have jurisdiction nor ownership of the systems located on private property which are necessary to safely convey water downhill. In order for the County to be able to take control of the ownership of the District's system, the infrastructure would need to be re-located to the County right-of-way, or alternately storm drainage easements through private parcels would need to be established granting rights to the County to construct and maintain the system.

Construction of the projects identified in this CIP could occur by joint funding by the District and the County. Since County permits are required for work within their right-of-way, coordination will already be required for most of the recommended improvement projects which are located on both public and private property. It is a natural extension to allow for the County to fund a portion of each project. Projects located entirely within the right-of-way may be able to receive funding or be completed entire by the County. It is intended for this Storm Drainage Master Plan to be a document to facilitate construction projects by both the District and the County.

Approximately 50% of the CIP by length is located within County right-of-way. This results in an estimated 1.5 million dollars of work. Note that most projects require work which traverses the boundary between private and public, which will require integration of multiple agencies and the property owners.

District Funding

The District has the option of funding portions of the improvements through a property related or user fee. Securing a CIP bond using existing District tax revenue, solely or in conjunction with San Mateo County or other local resources and grants, to repay the bond over time presents the most direct means to accomplish projects defined within this master plan. Property owners or customers would pay into a fund based on some metric (property size, impervious area, number of units, etc). The District would administer the fund and set the rates. This structure could be subject to the restrictions under Proposition 218 which could require a vote of the property owners or electorate. The term of the fee would need to be set before the vote and would most likely be 10-30 years. The District should consider using a financial consultant to set the fee structure including rates, terms, debt financing, and proportionality. The California Special District Association Finance Corporation specializes in working with special districts to fund capital improvement projects (http://csdafinance.net/).

Grants

Several grants exist for storm water projects which are issued by the State of California, the US EPA and FEMA. Grants are highly competitive and would require significant work to develop a grant application. The following grants should be reviewed in further detail for applicability to the District:

- California State Proposition 84
- California State Proposition 1E
- EPA Water Quality Grant
- FEMA Pre-Disaster Mitigation & Flood Mitigation Assistance Grant

Impact Fees

Impact fees are corrected from the property owners of new developments to offset their impact to the District storm drain collection system. Generally the District would be required to show fair proportionality of any impact fee structure. That is, the District cannot charge impact fees to developers to improve flooding issues that the development does not cause or contribute. Development of an impact fee requires showing the relative cost of necessary improvements under existing and future land uses. As such, impact fees are not likely to be a viable funding mechanism for the District to use in CIP implementation.

Property Related Fees

Although the options outlined previously should be explored, it is unlikely that they will entirely offset the need for voter-approved, resident-based stormwater fees to complete the stormwater related management, infrastructure, and quality goals that the District wants (and in many cases is required by regulatory agencies) to implement. The shortfall may be filled by a voter-approved property related fees and/or special taxes.

Property related fees require either a majority vote of responding property owners or a two-thirds majority of the electorate potentially affected by the fee. Nearly every municipality that has successfully implemented a stormwater fee has utilized the majority vote of responding property owners' mechanism. This section focuses on that process – the two-thirds majority vote process is described in the 'Special Taxes' section below.

Fees must be proportioned for each property based on a quantifiable relationship to the perceived benefit (referred to as '*Proportionality*'). That is, the District must be able to show some relationship between the calculation of a particular property's fee, and the benefit that the property receives from the service provided through payment of the fee. For stormwater management, it is most common to relate the fee to the amount of runoff generated from a property. Since the 'benefit' that the owner receives is management of stormwater runoff, having the fee be proportional to the amount of runoff generated by the property is justifiable and technically sound. Total lot area, lot impervious area and runoff coefficients have all been used to relate stormwater runoff to proportional stormwater fees. Any of these methods capture a quantifiable relationship between lots with greater stormwater runoff generally paying a larger fee. The establishment of the fee itself is described in more detail below (see *Rate Study* section below).

Under a property related fee, the District would be required to pay their portion of the given fee calculated in the same way and on the same schedule as all property owners within the District. Capital improvements, operations and maintenance, and NPDES compliance (i.e. meeting water quality requirements set forth in NPDES permit) expenses are normally allowed under property related fees; however, there is limited flexibility in the projects these fees can fund. All projects must fit into the voter-approved fee description/justification. Fees can not be re-appropriated to unrelated projects.

Property related fees have become highly contested recently, and legal counsel familiar with recent and current legal cases regarding property related fees in California should be further consulted.

Special Taxes

Special taxes offer greater spending flexibility in that funds collected from the special tax may be re-allocated to other uses. A special tax requires a two-thirds voter approval during an election, and cannot be established with a simple majority of property owners as described previously. For this reason, the vast majority of cities in California have not attempted to establish a special tax for stormwater management activities. Utilizing a vote of the general electorate includes non-property owners (renters) in the process, and would exclude non-local property owners (landlords). Large-property owners are included only if they also reside within the District, and are not afforded 'weighted' votes. A special tax does not have to show proportionality.

If a special tax is approved, the District would generally issue bonds to fund projects and programs, and use the levied special taxes to repay the bonds. There are no District contribution requirements with a special tax.

To our knowledge, the City of Santa Cruz is the only municipality that has successfully created a special tax for stormwater management activities. Santa Cruz had a pre-1997 stormwater utility fee in place for many years. Being able to frame the new tax as an extension/revision of a current fee likely had significant impact on the ability to gather sufficient support to achieve the requisite two-thirds majority vote.

Special Assessment District

Another alternative funding mechanism is the creation of an assessment district. Typically a bond could be obtained which would amortize the CIP cost over a set time period, and would be paid back through the collected assessments. Property owners would pay into a fund based on some metric related to the need for improvement (property size, impervious area, number of units, etc). This fee structure could be subject to restrictions under California Proposition 218, which could require a vote of the property owners or electorate within the Assessment District. The term of the fee would need to be set before the vote and has typically been 10 to 30 years within similar assessment districts. If interested in this type of funding, the District should consider using a financial consultant to set the fee structure including rates, terms, debt financing, and proportionality. The County of San Mateo would likely be asked to administer the property assessments.

This approach does require the approval of responding property owners similar to the property related fee as described in detail above. These districts are often used for a single large improvement project or a series of projects in a sub-region of a community. It is anticipated that the Assessment District boundaries would be contiguous with District boundaries. The creation of an assessment district requires establishing that the properties within the district receive a specific benefit from payment of the fee, which is difficult to achieve without a project which reduces actual flood risk for a property.

The procedure for forming an assessment district begins with a petition signed by owners of the properties who want the public improvement. The proposed district will include all properties that will directly benefit from the improvements to be constructed. A public hearing is held, at which time property owners have the opportunity to protest the assessment district.

Once approved, property owners have the opportunity to prepay the assessment prior to bond issuance. After this cash payment period is over, a special assessment lien is recorded against each property with an unpaid assessment. Then, these parcels will pay their total assessment through annual installments on the county property tax bill. The property owners will have the right to prepay the remaining balance of the assessment at any time, including applicable prepayment fees.

Typical Steps Required to Fund a Stormwater CIP

If existing tax revenue is used to fund the CIP, the following is not necessary. For other funding mechanisms, there are numerous steps the District would need to take and decisions to be made. These steps are summarized and explained in detail below.

If a special tax is established (requiring two-thirds approval of the electorate), proportionality is not required. As such, the requirements of steps one and two below are significantly less stringent, although conducting a rigorous justification for the proposed tax may be necessary regardless to garner public support.

Step 1 - Determine Costs

The first step in developing a stormwater fee or special tax is to clearly define the costs and schedules to complete stormwater management programs and infrastructure improvements. This storm drain master plan document is the first step in addressing the funding required to implement the Capital Improvement Program.

Step 2 - Rate Study

A detailed rate study would analyze important financial components of a fee or special tax such as debt servicing, reserves, inflation, interest and project scheduling. There are various methods to establish the proportionality of the fee, but in general, metrics such as impervious area, land use, runoff coefficients will be used to determine potential rates for each parcel.

Step 3 - Determine Affordability

Knowing the 'affordability' of the potential fee payers is paramount to the success of establishing a stormwater fee. The 'affordability' refers to the amount that is likely to be considered reasonable and acceptable by District residents should they be asked to approve such a fee. For example, a $100 annual fee will not pass if the 'affordability' is $50. Establishing the 'affordability' of a proposed stormwater fee should consider the justification of the fee (i.e. a tangible benefit to those paying the fee), consideration of the populace (age, income, cost of living, etc.), historic trends of residents with relation to vote-based fees or taxes, and the results of efforts in neighboring communities. It will also be important to consider the timing of the fee request in context with cumulative fees residents already pay, and other fees that might be placed on the same ballot.

Step 4 - Public Education / Outreach

The District Board will need to understand its political climate and determine the best time to hold an election. Early public involvement and outreach will increase the likelihood of voter approval. This outreach is particularly key if the District decides to utilize a general election (2/3 majority) for a fee or special tax.

Step 5 - Establish Fee Administration

Some aspects of proposed fee administration should be determined prior to conducting the vote, as inclusion of this information in materials provided to voters is important. Other entities have included an appeals process by which property owners can appeal their assessed fee (for example a property owner may have less impervious area than what was used to establish the fee on a District-wide basis), rebates for runoff reducing practices (such as rainwater harvesting or other 'green' practices) and/or an assistance program for low-income or fixed-income residents.

Step 6- Conduct Vote

The District should consider the above-listed steps and how they may be relevant to voters considering the fee or special tax prior to conducting the vote. Proposition 218 provides detailed requirements for the various means of establishing a stormwater fee or special tax vote.

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