SANITARY DISTRICT NO. 5 OF MARIN COUNTY
2001 Paradise Drive
Tiburon, California 94920

AGENDA
Capital Improvement Program Committee Meeting
Tuesday, February 9th, 2021, 2:00 p.m.

CORONA VIRUS (COVID-19) ADVISORY NOTICE

Consistent with Executive Orders No. N-25-20 and No. N-29-20 from the Executive Department of the State of California, the Meeting will not be physically open to the public and all Board Members and Staff will be teleconferencing into the meeting.

How to Submit Public Comments:
Comments submitted prior to the commencement of the meeting will be presented to the Committee and included in the public record for the meeting.

Public Comments are to be submitted via email to rdohrmann@sani5.org.

In addition, members of the public who are calling-in will have the opportunity to provide public comments by following the steps below:

How to Participate in the Meeting:
Join Zoom Meeting by clicking on the following link:

https://us02web.zoom.us/j/6230620778

Meeting ID: 623 062 0778

or join by phone:

Call in number: (669) 900-9128 **Participant Code: 623 062 0778**

I. Roll Call

II. Public Comments

III. New Business

1. **Review 2020 Cove Rd Force Main Project, change order #10 re additional excavation & placement of 12" RCP, in the amount of $12,500.00 and change order #11, re multiple misc. items in the amount of $38,813.00, per bid item #27**
2. **Review and discuss SD5 Draft Collection System Master Plan**
3. **Review and discuss "Bay Area Sewage Systems at Risk as Seas Rise," published on February 2, 2021, by Stephen Stock, Robert Campos, Mark Villarreal, Michael Horn and Sean Myers (https://www.nbcbayarea.com/news/local/climate-in-crisis/bay-area-sewage-systems-at-risk-as-seas-rise/2456669/)**
4. **Discussion re office space availability in plant and future maintenance shop rehabilitation**

IV. Adjournment

This Committee may be attended by Board Members who do not serve on this committee. In the event that a quorum of the entire Board is present, this Committee shall act as a Committee of the Whole. In either case, any item acted upon by the Committee or the Committee of the Whole will require consideration and action by the full Board of Directors as a prerequisite to its legal enactment.

Accessible public meetings: *Any member of the public who needs accommodations should email the Office Manager, at rdohrmann@sani5.org, who will use her best efforts to provide as much accessibility as possible while also maintaining public safety.*

Project: Cove Road Sewer Rehab

Change Order No. 10

Date: January 12, 2021

Owner: Sanitary District No. 5 **Phone:** (415) 435-1501

Contractor: Maggiora & Ghilotti, Inc. **Phone:** (415) 435-4960

The following change is hereby made to the contract:

Description of Change:

Excavated, removed existing deteriorated pipe, graded and placed 12" RCP at Beach Road #5 per City and County standards. Grouted into existing drainage inlets, backfilled and paved back with City trench detail.

Reason for Change:

District agreed to have Contractor replace Town of Tiburon's storm drain on Beach Rd. Town of Tiburon will reimburse District.

Pricing Data: $12,500.00 (see attached invoice)

Requested by: District

Contract Time: Adds 0 calendar days to the Contract.

The Owner and the Contractor hereby agree that this change order constitutes full and mutual accord and satisfaction for all time, all costs, and all impacts related to this revision. In accepting this change order, the Contractor agrees that it represents a full and equitable adjustment to the Contract, and further agrees to waive all rights to file claim with respect to any difficulties arising from, or as a result of, this change.

Original Contract:	$1,971,971.00
Previous Additions:	$ 522,888.33
Previous Deductions:	($ 92,211.00)
This Change Order:	$ 12,500.00
Contract to Date:	$ 2,415,148.33

APPROVED:

_____
Engineer

_____
Owner

_____
Contractor

555 DUBOIS STREET
SAN RAFAEL, CA 94901

MAGGIORA & GHILOTTI INC.
ENGINEERING CONTRACTORS
MARIN COUNTY
CALIF LIC #226767

PHONE: (415) 459-8640
FAX: (415) 459-1475

SANITARY DIST #5
OF MARIN COUNTY
PO BOX 227
TIBURON, CA 94920

INVOICE: **11569**
DATE: **11/30/2020**

M&G JOB: 4630
STORM DRAIN

CUSTOMER: SANITD
CONTRACT/PO#:

Original Sum	$	12,500.00
Total Completed To Date	$	12,500.00
Less Previous Billings	$	-
Current Balance Due	$	12,500.00

CONTRACT BILLING SUMMARY		
Billed to Date:	$	12,500.00
Paid to Date:	$	-
Current Balance Due:	$	12,500.00

4630 - SANI DIST 5 STORM DRAIN.xlsx --- Progress #1

Bid Item	Bid Description	Bid Quantity	Units	Unit Price	Bid Total	Complete this Estimate	Total this Estimate	Previous Complete	Previous Total	Complete to Date	Total to Date
1	STORM DRAIN	1	LS	$ 12,500.00	$ 12,500.00	1.00	$ 12,500.00			1.00	$ 12,500.00
	TOTAL BASE BID				$ 12,500.00		$ 12,500.00				$ 12,500.00
	TOTAL BASE & CCO's				$ 12,500.00		$ 12,500.00				$ 12,500.00
						NOV. 2020 Billing Amount	$ 12,500.00			CONTRACT TOTAL	$ 12,500.00

MAGGIORA & GHILOTTI INC.
ENGINEERING CONTRACTORS
MARIN COUNTY
CALIF. LIC. #226767

Committed to Excellence

Maggiora & Ghilotti, Inc. 555 Du Bois Street, San Rafael, CA 94901 ph: (415) 459-8640 fax: (415) 459-2065

October 21, 2020 **RCO #**

Project: Replace 12" storm drain
To: Town of Tiburon **Email: pkerslake@townoftiburon.org**
Attn: Patrick Kerslake **ph: 415-435-7399**

Request for price for new 12" x 40' storm drain #5 Beach road

ITEM NO.	ITEM	EST QTY	UNIT	UNIT PRICE	ITEM TOTAL
1	Excavate and place 12"RCP	1	LS	$ 12,500.00	$ 12,500.00
	Proposal				**$12,500.00**

Scope of work

Excavate at Beach road #5, Remove deteriorated existing pipe, grade and place 12" RCP per city and county standards. Grout into existing drainage inlets, Backfill and pave back with city trench detail See attached drawing

Conditions/ Clarifications

M&G to get encroachment permit if needed at no cost
Proposal based on work hours 8:00pm -5:00pm
TCP will be from current work for sanitary district no.5

Standard Exclusions

Permits and Fees; Survey; Engineering; Design; Soils Engineering; Field Testing; Inspections; CQC;

Exclusions

New TCP
Fee for encroachment permit

Submitted: *Don Muns* Date: 10/21/20
Don Muns

Project: Cove Road Sewer Rehab

Change Order No. 11

Date: January 11, 2021

Owner: Sanitary District No. 5

Phone: (415) 435-1501

Contractor: Maggiora & Ghilotti, Inc.

Phone: (415) 435-4960

The following change is hereby made to the contract:

Description of Change:

The following changed field conditions will be applied to the Contract Changed Condition Allowance, Bid Item 27.

M&G Rpt #	Loc.	Perform Date	Description	Cost
61.0	Belv	11/17/2020	Additional shoring rental invoices which Contractor failed to submit for previous change orders 2,3 and 4	$15,346.36
62.0	Tib	11/11/2020	Sta 23 + 50, Discovery and removal of embedded, creosote wood 18 inch piers in force main trench line	$2,470.71
63.0	Tib	11/13/2020	Prepare creosote piers from item 62 above for hazardous waste disposal	$405.96
64.0	Tib	11/20/2020	Demo and remove existing MH 23+68	$3,297.43
65.0	Tib	11/24/2020	Approx. Sta 23+00, Discovery and removal of two more creosote wood 18 inch piers	$1,973.52
66.0	Tib	12/1/2020	Sta 23 + 50, Eight hour crew production delay due to large stone rip rap fill in trench line. Large stones had to be broken with jack hammer for removal.	$8,299.84
67.0	Tib	12/2/2021	Sta 23 +70, Two and one half hour crew production delay due to remaining large stone fill within trench line. Large stones had to be broken with jack hammer.	$3,671.97
68.0	Tib	12/9/2021	Approx. Sta 21+50, Removal of odorous, black stained fill for hazardous waste disposal.	$3,348.05
			TOTAL CO#1	**$38,813.84**

These changed field conditions will be applied to the Contract Changed Condition Allowance, Bid Item 27.

Reason for Change:

M&G Rpt #	Reason for Extra Work
61.0	These shoring rental invoices for work covered under Change Orders 2, 3 and 4 were submitted late by the contractors suppliers. The invoice dates have been cross checked against the original contractor time and material tags to verify they apply.
62.0	The buried, creosote wood piles, were in the way of the new pipeline and required removal.
63.0	Creosote piers were wrapped in plastic to protect workers from the creosote.
64.0	It was elected to construct new contract MH STA 23+53 at the location of existing MH STA 23+68 and remove MH STA 23+68, due to the concrete base not being in good condition for reuse
65.0	Two additional buried, embedded creosote 18 inch wooden piers were discovered within the trench line and in the way of new pipeline.
66.0	Contractor encountered within an approximate twenty feet trench distance deep fill consisting of large, hard rip rap stones. Some of these stones were too large to remove without jack hammer breaking. This delayed the excavation work by eight hours.
67.0	Contractor continued breaking and removal of large stones for 2 and one half hours.
68.0	Black stained fill was sampled and analyzed and found to need special disposal at landfill.

Pricing Data: $0.00
($38,813.84 will be deducted from Bid Item 27, Changed Condition Allowance)

Requested by: District

Contract Time: Adds 2 calendar days to the Contract.

The Owner and the Contractor hereby agree that this change order constitutes full and mutual accord and satisfaction for all time, all costs, and all impacts related to this revision. In accepting this change order, the Contractor agrees that it represents a full and equitable adjustment to the Contract, and further agrees to waive all rights to file claim with respect to any difficulties arising from, or as a result of, this change.

Original Contract:	$1,971,971.00
Previous Additions:	$ 535,388.33
Previous Deductions:	($ 92,211.00)
This Change Order:	$ 0.00
Contract to Date:	$2,415,148.33

APPROVED:

_____
Engineer

_____
Owner

_____
Contractor

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5
Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT
Work Performed By: Maggiora and Ghilotti, Inc.
Description of Work: ADDT'L INVOICES

Change Order	007
Billing Number	61.0
Report Date	11/18/2020
Perform Date	11/17/2020

Material/Specialist Work/Lump Sum or Unit Price Payment

	Number	Date	Vendor Name and Description	Units	Unit Price	Extended
M01	69974	11/17/2020	JIM-N-I RENTALS / SHORING	1.000 LS	647.88000	647.88
M02	69973	11/17/2020	JIM-N-I RENTALS / STEEL PLATES	1.000 LS	350.73000	350.73
M03	69928	11/17/2020	JIM-N-I RENTALS / SHORING	1.000 LS	1,542.22000	1,542.22
M04	69479	11/17/2020	JIM-N-I RENTALS / SHIELD	1.000 LS	568.31000	568.31
M05	69503	11/17/2020	JIM-N-I RENTALS / STEEL PLATES	1.000 LS	1,675.28000	1,675.28
M06	69059A	11/17/2020	JIM-N-I RENTALS / SPREADER BAR & STEEL PLATES	1.000 LS	288.70000	288.70
M07	69059B	11/17/2020	JIM-N-I RENTALS / SPREADER BAR & STEEL PLATES	1.000 LS	288.70000	288.70
M08	69476	11/17/2020	JIM-N-I RENTALS / SHIELD & SPREADER PIPE	1.000 LS	1,551.76000	1,551.76
M09	69477	11/17/2020	JIM-N-I RENTALS / STEEL PLATES	1.000 LS	1,282.11000	1,282.11
M10	69145A	11/17/2020	JIM-N-I RENTALS / STEEL PLATES	1.000 LS	1,818.60000	1,818.60
M11	69519A	11/17/2020	JIM-N-I RENTALS / STEEL PLATES	1.000 LS	142.46000	142.46
M12	69510A	11/17/2020	JIM-N-I RENTALS / SHORING	1.000 LS	732.76000	732.76
M13	69537A	11/17/2020	JIM-N-I RENTALS / STEEL PLATES	1.000 LS	213.69000	213.69
M14	39588	11/17/2020	Dutra / CUTBACK	1.000 LS	516.21000	516.21
M15	39647	11/17/2020	Dutra / DRAIN ROCK	1.000 LS	577.10000	577.10
M16	39682	11/17/2020	Dutra / DRAIN ROCK	1.000 LS	545.28000	545.28
M17	39725	11/17/2020	Dutra / DRAIN ROCK	1.000 LS	602.87000	602.87

Labor Charges

Equipment Charges

Material Charges

Subtotal		13,344.66
MU	15.00%	2,001.70
Material Total		**15,346.36**

Activity Total	**15,346.36**
Work Total	**15,346.36**
Bill Subtotal	**15,346.36**
Bill Total +	**15,346.36**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:
☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:
Customer: *Date:*
Contractor: *Date:*

DUTRA MATERIALS

2350 Kerner Boulevard, Suite 200 | San Rafael, CA 94901 | Tel: 415.459.7740 | Fax: 415.459.0727

INVOICE

Sold To: Maggiora & Ghilotti Inc.
555 Dubois Street
San Rafael, CA 94901

Invoice #:	39588
Date:	10/8/20
Customer No:	49900
Customer Job:	Cove Rd. Tiburon
Cust Job #:	
PO #:	7716

Sale Date	Ticket	Product	Loc	Units	UM	Unit Price	Matl Total	Tax Rate	Tax	Total
MATERIAL:	CUTBACK									
10/8/20	513528	606	20	3.780	TON	$125.0000	$472.50	9.25%	$43.71	$516.21
			Total Invoice:	**3.780**	**TON**		**$472.50**		**$43.71**	**$516.21**

Payment Type: On Account

Location: 10=San Rafael, 20=Richmond

DIS Pay Terms 10TH, NET 30	**$4.13 Discount Offered if Paid Before 10th of the Following Month**	**Total:**	**$516.21**

DUTRA MATERIALS

2350 Kerner Boulevard, Suite 200 | San Rafael, CA 94901 | Tel: 415.459.7740 | Fax: 415.459.0727

INVOICE

Sold To: Maggiora & Ghilotti Inc.
555 Dubois Street
San Rafael, CA 94901

Invoice #:	39647
Date:	10/12/20
Customer No:	49900
Customer Job:	COVE ROAD
Cust Job #:	
PO #:	7716

Sale Date	Ticket	Product	Loc	Units	UM	Unit Price	Matl Total	Tax Rate	Tax	Total
MATERIAL:	3/4X1/2 DRAIN VIR									
10/12/20	2238855	310	10	19.040	TON	$28.0000	$533.12	8.25%	$43.98	$577.10
			Total Invoice:	**19.040**	TON		**$533.12**		**$43.98**	**$577.10**

Payment Type: On Account

Location: 10=San Rafael, 20=Richmond

DIS Pay Terms 10TH, NET 30	**$5.15 Discount Offered if Paid Before 10th of the Following Month**	**Total:** **$577.10**

DUTRA MATERIALS

2350 Kerner Boulevard, Suite 200 | San Rafael, CA 94901 | Tel: 415.459.7740 | Fax: 415.459.0727

INVOICE

Sold To: Maggiora & Ghilotti Inc.
555 Dubois Street
San Rafael, CA 94901

Invoice #:	39682
Date:	10/13/20
Customer No:	49900
Customer Job:	COVE ROAD
Cust Job #:	
PO #:	7716

Sale Date	Ticket	Product	Loc	Units	UM	Unit Price	Matl Total	Tax Rate	Tax	Total
MATERIAL:	3/4X1/2 DRAIN VIR									
10/13/20	2238932	310	10	17.990	TON	$28.0000	$503.72	8.25%	$41.56	$545.28
			Total Invoice:	**17.990**	TON		**$503.72**		**$41.56**	**$545.28**

Payment Type: On Account

Location: 10=San Rafael, 20=Richmond

DIS Pay Terms 10TH, NET 30	**$4.87 Discount Offered if Paid Before 10th of the Following Month**	**Total:**	**$545.28**

DUTRA MATERIALS

2350 Kerner Boulevard, Suite 200 | San Rafael, CA 94901 | Tel: 415.459.7740 | Fax: 415.459.0727

INVOICE

Sold To: Maggiora & Ghilotti Inc.
555 Dubois Street
San Rafael, CA 94901

Invoice #:	39725
Date:	10/14/20
Customer No:	49900
Customer Job:	COVE ROAD
Cust Job #:	
PO #:	7716

Sale Date	Ticket	Product	Loc	Units	UM	Unit Price	Matl Total	Tax Rate	Tax	Total
MATERIAL:	3/4X1/2 DRAIN VIR									
10/14/20	2239025	310	10	19.890	TON	$28.0000	$556.92	8.25%	$45.95	$602.87
			Total Invoice:	**19.890**	TON		**$556.92**		**$45.95**	**$602.87**

Payment Type: On Account

Location: 10=San Rafael, 20=Richmond

DIS Pay Terms 10TH, NET 30	**$5.38 Discount Offered if Paid Before 10th of the Following Month**	**Total:**	**$602.87**

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69974
Invoice Date: Wed 11/11/2020
Date Out: Wed 10/14/2020 9:30AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

7/14

Ordered By: DALLAS 415 419-1181

Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
5	PS43455	P SHORE 4' 34-55 BLUE		Billed To	Wed 11/11/2020 9:30AM	$598.50
	1week $39.90 4weeks $119.70					
1	MARIN	DELIVERY MARIN CO		Sold		$0.00

Rental Contract

Rental:	$598.50
Subtotal:	$598.50
Marin 8.25%:	$49.38
Total:	$647.88
Paid:	$0.00
Amount Due:	$647.88

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69973
Invoice Date: Wed 11/11/2020
Date Out: Wed 10/14/2020 9:30AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
555 DUBOIS STREET
SAN RAFAEL,CA 94901

415-459-8640 Phone
415-459-4884 Fax

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: DALLAS 415 419-1181
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	STEPLA6101#0326	STEEL PLATE,6'X10'X1"	E326	Returned	Tue 10/20/2020 9:30AM	$28.00
	168Hrs $28.00 1week $28.00 4weeks $112.00 NON SKID					
1	STEPLA6101#0847	STEEL PLATE,6'X10'X1"	E847	Returned	Tue 10/20/2020 9:30AM	$28.00
	168Hrs $28.00 1week $28.00 4weeks $112.00 NON SKID					
1	STEPLA6101#0863	STEEL PLATE,6'X10'X1"	E863	Billed To	Wed 11/11/2020 9:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00 NON SKID					
1	STEPLA6101#0291	STEEL PLATE,6'X10'X1"	E291	Returned	Tue 10/20/2020 9:30AM	$28.00
	168Hrs $28.00 1week $28.00 4weeks $112.00 NON SKID					
1	STEPLA6101#0701	STEEL PLATE,6'X10'X1"	E701	Returned	Tue 10/20/2020 9:30AM	$28.00
	168Hrs $28.00 1week $28.00 4weeks $112.00 NON SKID					
1	MARIN	DELIVERY MARIN CO		Sold		$100.00

--

Rental Contract

Rental:	$224.00
Delivery Charge:	$100.00
Subtotal:	$324.00
Marin 8.25%:	$26.73
Total:	$350.73
Paid:	$0.00
Amount Due:	$350.73

Jim-n-i RENTALS

PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69928
Invoice Date: Mon 11/ 9/2020
Date Out: Mon 10/12/2020 11:30AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: ADAM 415 308-4958

Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
2	PS63455	P SHORE 6' 34-55 BLUE		Billed To	Mon 11/ 9/2020 11:30AM	$239.40
	1week $39.90 4weeks $119.70					
12	PS63455	P SHORE 6' 34-55 BLUE		Returned	Tue 10/20/2020 9:00AM	$574.56
	1week $39.90 4weeks $119.70					
7	PS63455	P SHORE 6' 34-55 BLUE		Returned	Tue 10/20/2020 9:00AM	$335.16
	1week $39.90 4weeks $119.70					
2	PS63455	P SHORE 6' 34-55 BLUE		Returned	Tue 10/27/2020 8:00AM	$175.56
	1week $39.90 4weeks $119.70					
1	MARIN	DELIVERY MARIN CO		Sold		$100.00

Rental Contract

Rental:	$1,324.68
Delivery Charge:	$100.00
Subtotal:	$1,424.68
Marin 8.25%:	$117.54
Total:	$1,542.22
Paid:	$0.00
Amount Due:	$1,542.22

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69479
Invoice Date: Tue 10/ 6/2020
Date Out: Tue 9/ 8/2020 12:30PM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

2716-X

Ordered By: ADAM 415 308-4958
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	SHI4124#618	SHIELD, 4'X12'X4"	M0805618	Billed To	Tue 10/ 6/2020 12:30PM	$525.00
	1week $175.00 4weeks $525.00					
8	PIN210	PIN, SHIELD ROUND 2"X10"		Billed To	Tue 10/ 6/2020 12:30PM	$0.00
4	SPRPIP830	SPREADER PIPE, 8"X30"		Billed To	Tue 10/ 6/2020 12:30PM	$0.00
1	MARIN	DELIVERY MARIN CO		Sold		$0.00

Rental Contract

Rental:	**$525.00**
Subtotal:	**$525.00**
Marin 8.25%:	**$43.31**
Total:	**$568.31**
Paid:	**$0.00**
Amount Due:	**$568.31**

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69503
Invoice Date: Tue 10/ 6/2020
Date Out: Tue 9/ 8/2020 12:30PM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

7216 -X

Ordered By: ADAM 415 308-4958
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	STEPLA8121#0031	STEEL PLATE,8'X12'X1"	J031	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0091	STEEL PLATE,8'X12'X1"	J091	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0188	STEEL PLATE,8'X12'X1"	J188	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0190	STEEL PLATE,8'X12'X1"	J190	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0249	STEEL PLATE,8'X12'X1"	J249	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0297	STEEL PLATE,8'X12'X1"	J297	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0003	STEEL PLATE,8'X12'X1"	J003	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0020	STEEL PLATE,8'X12'X1"	J020	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0043	STEEL PLATE,8'X12'X1"	J043	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0252	STEEL PLATE,8'X12'X1"	J252	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	STEPLA8121#0210	STEEL PLATE,8'X12'X1"	J210	Billed To	Tue 10/ 6/2020 12:30PM	$131.60
	1week $32.90 4weeks $131.60 W/ HOLE 12' SIDE					
1	|MARIN	DELIVERY MARIN CO		Sold		$100.00

Rental Contract

Rental:	**$1,447.60**
Delivery Charge:	**$100.00**
Subtotal:	**$1,547.60**
Marin 8.25%:	**$127.68**
Total:	**$1,675.28**
Paid:	**$0.00**
Amount Due:	**$1,675.28**

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69059A
Invoice Date: Mon 10/ 5/2020
Date Out: Mon 9/ 7/2020 8:00AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: ADAM 415 308-4958
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

7766

Qty	Key	Items	Ser#	Status	Billed To	Price
1	SPRBAR60	SPREADER BAR 60"		Billed To	Mon 10/ 5/2020 8:00AM	$31.50
	1day $3.50 1week $10.50 4weeks $31.50					
1	STEPLA481#0064	STEEL PLATE,4'X8'X1"	B064	Billed To	Mon 10/ 5/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					
1	STEPLA481#0066	STEEL PLATE,4'X8'X1" W/HOLES	B066	Billed To	Mon 10/ 5/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					
1	STEPLA481#0196	STEEL PLATE,4'X8'X1"	B196	Billed To	Mon 10/ 5/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					
1	STEPLA481#0121	STEEL PLATE,4'X8'X1"	B121	Billed To	Mon 10/ 5/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					

Rental Contract

Rental:	$266.70
Subtotal:	$266.70
Marin 8.25%:	$22.00
Total:	$288.70
Paid:	$0.00
Amount Due:	$288.70

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69059B
Invoice Date: Mon 11/ 2/2020
Date Out: Mon 10/ 5/2020 8:00AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: ADAM 415 308-4958

Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	SPRBAR60	SPREADER BAR 60"		Billed To	Mon 11/ 2/2020 8:00AM	$31.50
	1day $3.50 1week $10.50 4weeks $31.50					
1	STEPLA481#0064	STEEL PLATE,4'X8'X1"	B064	Billed To	Mon 11/ 2/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					
1	STEPLA481#0066	STEEL PLATE,4'X8'X1" W/HOLES	B066	Billed To	Mon 11/ 2/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					
1	STEPLA481#0196	STEEL PLATE,4'X8'X1"	B196	Billed To	Mon 11/ 2/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					
1	STEPLA481#0121	STEEL PLATE,4'X8'X1"	B121	Billed To	Mon 11/ 2/2020 8:00AM	$58.80
	1week $14.70 4weeks $58.80 W/ HOLE ON 4' SIDE					

Rental Contract

Rental:	$266.70
Subtotal:	$266.70
Marin 8.25%:	$22.00
Total:	$288.70
Paid:	$0.00
Amount Due:	$288.70

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69476
Invoice Date: Fri 10/ 2/2020
Date Out: Fri 9/ 4/2020 9:00AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

7716-X

Ordered By: ADAM 415 308-4958
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	SHI8204#332	SHIELD, 8'X20'X4"	N332	Billed To	Fri 10/ 2/2020 9:00AM	$1,260.00
	1week $420.00 4weeks $1,260.00					
8	PIN210	PIN, SHIELD ROUND 2"X10"		Billed To	Fri 10/ 2/2020 9:00AM	$0.00
4	SPRPIP842	SPREADER PIPE, 8"X42"		Billed To	Fri 10/ 2/2020 9:00AM	$0.00
1	SLI412	SLING,12' 4 LEG RED		Billed To	Fri 10/ 2/2020 9:00AM	$73.50
	1week $24.50 4weeks $73.50					
1	MARIN	DELIVERY MARIN CO		Sold		$100.00

Rental Contract

Rental:	$1,333.50
Delivery Charge:	$100.00
Subtotal:	$1,433.50
Marin 8.25%:	$118.26
Total:	$1,551.76
Paid:	$0.00
Amount Due:	$1,551.76

Jim-n-i RENTALS

PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69477
Invoice Date: Fri 10/ 2/2020
Date Out: Fri 9/ 4/2020 9:00AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

7716-X

Ordered By: ADAM 415 308-4958
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	STEPLA8121#0192	STEEL PLATE,8'X12'X1" W/HOLES	J192	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0064	STEEL PLATE,8'X12'X1"	J064	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0001	STEEL PLATE,8'X12'X1"	J001	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0150	STEEL PLATE,8'X12'X1"	J150	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0203	STEEL PLATE,8'X12'X1"	J203	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0149	STEEL PLATE,8'X12'X1" W/HOLES	J149	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0072	STEEL PLATE,8'X12'X1" W/HOLES	J072	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0157	STEEL PLATE,8'X12'X1"	J157	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	STEPLA8121#0146	STEEL PLATE,8'X12'X1"	J146	Billed To	Fri 10/ 2/2020 9:00AM	$131.60
	1week $32.90 4weeks $131.60 WITH HOLE IN 12' SIDE					
1	JMARIN	DELIVERY MARIN CO		Sold		$0.00

Rental Contract

Rental:	**$1,184.40**
Subtotal:	**$1,184.40**
Marin 8.25%:	**$97.71**
Total:	**$1,282.11**
Paid:	**$0.00**
Amount Due:	**$1,282.11**

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69145A
Invoice Date: Fri 10/ 9/2020
Date Out: Thu 9/10/2020 10:30AM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

7216

Ordered By: ADAM 415 308-4958

Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	STEPLA6101#0881	STEEL PLATE,6'X10'X1"	E881	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0359	STEEL PLATE,6'X10'X1"	E359	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0320	STEEL PLATE,6'X10'X1"	E320	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0421	STEEL PLATE,6'X10'X1"	E421	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0709	STEEL PLATE,6'X10'X1"	E709	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0590	STEEL PLATE,6'X10'X1"	E590	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0854	STEEL PLATE,6'X10'X1"	E854	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0182	STEEL PLATE,6'X10'X1"	E182	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0553	STEEL PLATE,6'X10'X1"	E553	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0156	STEEL PLATE,6'X10'X1"	E156	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0499	STEEL PLATE,6'X10'X1"	E499	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0044	STEEL PLATE,6'X10'X1" W/10' HOLE	E044	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0700	STEEL PLATE,6'X10'X1"	E700	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0266	STEEL PLATE,6'X10'X1"	E266	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					
1	STEPLA6101#0038	STEEL PLATE,6'X10'X1"	E038	Billed To	Thu 10/ 8/2020 10:30AM	$112.00
	168Hrs $28.00 1week $28.00 4weeks $112.00					

NON-SKID PLATES

Rental Contract

Rental:	$1,680.00
Subtotal:	$1,680.00
Marin 8.25%:	$138.60
Total:	$1,818.60
Paid:	$0.00
Amount Due:	$1,818.60

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Closed
Invoice #: 69519A
Invoice Date: Tue 11/ 3/2020
Date Out: Wed 10/ 7/2020 8:00AM

Operator: Jim Eaton
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
555 DUBOIS STREET
SAN RAFAEL,CA 94901

415-459-8640 Phone
415-459-4884 Fax

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: ADAM 415 308-4958

Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	STEPLA8121#0294	STEEL PLATE,8'X12'X1"	J294	Returned	Tue 10/20/2020 8:00AM	$65.80
	1week $32.90 4weeks $131.60					
	USED FOR 391					
1	STEPLA8121#0086	STEEL PLATE,8'X12'X1"	J086	Returned	Tue 10/20/2020 8:00AM	$65.80
	1week $32.90 4weeks $131.60					
	USED FOR 98					

Rental Contract

Rental:	$131.60
Subtotal:	$131.60
Marin 8.25%:	$10.86
Total:	$142.46
Paid:	$0.00
Amount Due:	$142.46

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Closed
Invoice #: 69510A
Invoice Date: Tue 11/ 3/2020
Date Out: Wed 10/ 7/2020 8:00AM

Operator: Jim Eaton
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
415-459-8640 Phone
415-459-4884 Fax

555 DUBOIS STREET
SAN RAFAEL,CA 94901

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: ADAM 415 308-4958
Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
9	SS53455	SHORE 5' 34-55 BLUE		Returned	Tue 10/27/2020 8:00AM	$453.60
	1day $7.70 1week $22.40 4weeks $67.20					
2	SS53455	SHORE 5' 34-55 BLUE		Returned	Wed 10/ 7/2020 8:00AM	$0.00
	1day $7.70 1week $22.40 4weeks $67.20					
23	SS53455	SHORE 5' 34-55 BLUE		Returned	Fri 10/ 9/2020 3:20PM	$223.31
	1day $7.70 1week $22.40 4weeks $67.20					

Rental Contract

Rental:	**$676.91**
Subtotal:	**$676.91**
Marin 8.25%:	**$55.85**
Total:	**$732.76**
Paid:	**$0.00**
Amount Due:	**$732.76**

Jim-n-i RENTALS
PO Box 4740
Santa Rosa, CA 95402
www.jimnirentals.com
707-569-1600 Phone
707-569-1700 Phone

Status: Continued
Invoice #: 69537A
Invoice Date: Wed 11/ 4/2020
Date Out: Wed 10/ 7/2020 2:00PM

Operator: Noa
Terms: Net 30

Customer #: 149

MAGGIORA & GHILOTTI INC
555 DUBOIS STREET
SAN RAFAEL,CA 94901

415-459-8640 Phone
415-459-4884 Fax

Job Descr: BELVEDERE, BEACH & COVE

Ordered By: ADAM 415 308-4958

Salesman: Matt Randall 707-495-8525 mrandall@jimnirentals.com

Qty	Key	Items	Ser#	Status	Billed To	Price
1	STEPLA8121#0243	STEEL PLATE,8'X12'X1"	J243	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0241	STEEL PLATE,8'X12'X1"	J241	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0142	STEEL PLATE,8'X12'X1" W/HOLES	J142	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0162	STEEL PLATE,8'X12'X1"	J162	Billed To	Wed 11/ 4/2020 2:00PM	$131.60
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0168	STEEL PLATE,8'X12'X1"	J168	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0189	STEEL PLATE,8'X12'X1"	J189	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0231	STEEL PLATE,8'X12'X1"	J231	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0254	STEEL PLATE,8'X12'X1"	J254	Returned	Tue 10/20/2020 2:00PM	$65.80
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0282	STEEL PLATE,8'X12'X1" W/HOLES	J282	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0090	STEEL PLATE,8'X12'X1" W/HOLES	J090	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0153	STEEL PLATE,8'X12'X1"	J153	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					
1	STEPLA8121#0321	STEEL PLATE,8'X12'X1"	J321	Returned	Wed 10/ 7/2020 4:00PM	$0.00
	1week $32.90 4weeks $131.60					

W/ HOLE 12' SIDE

Rental Contract

Rental:	$197.40
Subtotal:	$197.40
Marin 8.25%:	$16.29
Total:	$213.69
Paid:	$0.00
Amount Due:	$213.69

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5
Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT
Work Performed By: Maggiora and Ghilotti, Inc.
Description of Work: REMOVE 3 ROUND PIERS FROM TRENCH

Change Order	007
Billing Number	62.0
Report Date	11/24/2020
Perform Date	11/11/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	2.00			72.820			145.640
L02	OE G2	S Hubert	2.00			76.870			153.740
L03	LBR G3	J Anguiano	2.00			60.360			120.720
L04	LBR G3	G Velarde	2.00			60.470			120.940
L05	LBR G3	E Aaron	2.00			61.350			122.700
L06	TMS G3	R Westmoreland	2.00			64.640			129.280
L07	TMS G3	W Sanford	2.00			64.640			129.280
L08	TMS G3	B Garcia	1.00			69.440			69.440

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			2.00		31.000			62.000
E02	FT53	TRUCK	T&TT	20-28			2.00		42.490			84.980
E03	EX47	HCECL	CAT	315F			2.00		55.410			110.820
E04	L37	LDRRT	CAT	2070G	C2		2.00		89.110			178.220
E05	TT-TR	TRUON	TRUN	5AXL			2.00		90.060			180.120
E06	TT-TR	TRUON	TRUN	5AXL			2.00		90.060			180.120
E07	BT5	TRUON	TRUN	3AXL			1.00		71.550			71.550

Labor Charges

RT Labor		991.74
SC	10.00%	99.17
OT Labor		0.00
Subtotal Labor		1,090.91
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	381.82
Labor Total		**1,472.73**

Equipment Charges

Subtotal		867.81
MU	15.00%	130.17
Equipment Total		**997.98**

Material Charges

Activity Total	**2,470.71**
Work Total	**2,470.71**
Bill Subtotal	**2,470.71**
Bill Total +	**2,470.71**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:
☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:
Customer: *Date:*
Contractor: *Date:*

DAILY REPORT : 005366

MAGGIORA & GHILOTTI, INC.

DAY: Wednesday

DATE: 11-11-20

FOREMAN: Daglor

MAGGIORA & GHILOTTI INC. ENGINEERING CONTRACTORS MARIN COUNTY CALIF LIC #226767

FORCE ACCOUNT : YES ● NO ○

Owners (Representative) Signature

x

M&G Representative Signature

x

	EMPLOYEE NAME	TOTALS ST	TOTALS OT	JOB # 776 ST	JOB # 776 OT	JOB # 776-X ST	JOB # 776-X OT	JOB # 7676 ST	JOB # 7676 OT	JOB # 7710 ST	JOB # 7710 OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FINISH OUT
1.	Daglor	8	.5	6	.5	2						730	12	12:30	4:30
2.	Hubert	8		6		2						8	12	12:30	4:30
3.	Angulo	8	.5	6	.5	2						7:30	12	12:30	4:30
4.	Velarde	8		6		2						8	12	12:30	4:30
5.	Acorn	8		6		2						8	12	12:30	4:30
6.	Weatherhead	8	1	6	1	2						7:30	12	12:30	5
7.	Schlund	8	1.5	6	1.5	2						7:30	12:00	12:30	5
8.	Garcia	8	1				1	4		4		6:30	12:00	12:30	4:00
9.	Monteaux	8	1	4	.5			4	.5			6:00	12:00	12:30	3:30
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

	M&G EQUIPMENT ID#							
1.	PT-60	8		6		2		
2.	ET-53	8		6		2		
3.	EX-47	8		6		2		
4.	L-37	4		2		2		
5.	PT-28	8		6		2		
6.	ET-26	8		6		2		
7.	BT-5	1				1		
8.	TT-31/TRA-67	8					4	4
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								

	RENTED EQUIPMENT					
1.						
2.						
3.						
4.						

	MATERIALS					
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Meetings

Tailgate	Yes	●	No	○
J.H.A.	Yes	○	No	●
Onsite:	Yes	○	No	●

Notes: _____

Traffic

On Street	Yes	●	No	○
Control	Yes	●	No	○
Flagging	Yes	○	No	●
TCP	Yes	●	No	○
In Compliance	Yes	●	No	○

Type (Check all that apply)

Lane Shift	○
Lane Closure	○
Single Lane Alternating	○
Road Closed	●
Other (Describe)	○

Force Account Notes / Comments

Time to remove 3 round piers from trench - Strong oil smell and coating - to debris box brought to site to contain Hazardous waste

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5
Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT
Work Performed By: Maggiora and Ghilotti, Inc.
Description of Work: WRAP OIL COVERED POSTS IN PLASTIC

Change Order	007
Billing Number	63.0
Report Date	11/24/2020
Perform Date	11/13/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	1.00			72.820			72.820
L02	LBR G3	J Anguiano	1.00			60.360			60.360
L03	LBR G3	G Velarde	1.00			60.470			60.470

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			1.00		31.000			31.000
E02	BH34	LDRRT	DEER	2508J	C2		1.00		71.940			71.940

Labor Charges

RT Labor		193.65
SC	10.00%	19.37
OT Labor		0.00
Subtotal Labor		213.02
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	74.56
Labor Total		**287.58**

Equipment Charges

Subtotal		102.94
MU	15.00%	15.44
Equipment Total		**118.38**

Material Charges

Activity Total	**405.96**
Work Total	**405.96**
Bill Subtotal	**405.96**
Bill Total +	**405.96**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:
☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:
Customer: *Date:*
Contractor: *Date:*

DAILY REPORT : 005367

MAGGIORA & GHILOTTI, INC.

DAY: Friday

DATE: 11-13-20

FOREMAN: Dagler

MAGGIORA & GHILOTTI INC. ENGINEERING CONTRACTORS MARIN COUNTY CALIF LIC #226767

FORCE ACCOUNT : YES ● NO ○

Owners (Representative) Signature

x

M&G Representative Signature

x

	EMPLOYEE NAME	TOTALS ST	TOTALS OT	JOB # 7716 ST	JOB # 7716 OT	JOB # 7716-K ST	JOB # 7716-K OT	JOB # ST	JOB # OT	JOB # ST	JOB # OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FINISH OUT
1.	Dagler	5		4		1						7			12
2.	Hubert	4		4								8			12
3.	Angsiano	5		4		1						7			12
4.	Velarde	5		4		1						7			12
5.	Otten	5		5								7			12
6.	Westmoreland	5		5								7:30			12:30
7.															
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

	M&G EQUIPMENT ID#						
1.	Pt-60	5	4	1			
2.	Ft-53	5	5				
3.	Dt 36	5	5				
4.	Bt 47	2	2				
5.	L-37	4	4				
6.	BH-34	1		1			
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							

	RENTED EQUIPMENT					
1.						
2.						
3.						
4.						

	MATERIALS					
1.	Delta 5150 65 5120	✓				
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Meetings

Tailgate	Yes ○	No ●
J.H.A.	Yes ○	No ●
Onsite:	Yes ○	No ●

Notes: _____

Traffic

On Street	Yes ●	No ○
Control	Yes ●	No ○
Flagging	Yes ○	No ●
TCP	Yes ●	No ○
In Compliance	Yes ●	No ○

Type (Check all that apply)

Lane Shift	○
Lane Closure	○
Single Lane Alternating	○
Road Closed	●
Other (Describe)	○

Force Account Notes / Comments

Wrap oil cans pads in plastic to avoid rain getting on them

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5
Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT
Work Performed By: Maggiora and Ghilotti, Inc.
Description of Work: DEMO AND REMOVE MH ON TIBURON BLVD/ TEMP SEWER HOOKUP

Change Order	007
Billing Number	64.0
Report Date	11/24/2020
Perform Date	11/20/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	4.00			72.820			291.280
L02	OE G2	S Hubert	4.00			76.870			307.480
L03	LBR G3	J Anguiano	4.00			60.360			241.440
L04	LBR G3	J Otten	4.00			63.360			253.440
L05	LBR G3	J Ayala	4.00			58.360			233.440
L06	CMTMS A1	F Martinez	4.00			34.080			136.320

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			4.00		31.000			124.000
E02	FT53	TRUCK	T&TT	20-28			4.00		42.490			169.960
E03	DT48	TRUON	TRUN	2AXL			4.00		54.690			218.760
E04	EX47	HCECL	CAT	315F			4.00		55.410			221.640

Material/Specialist Work/Lump Sum or Unit Price Payment

	Number	Date	Vendor Name and Description	Units	Unit Price	Extended
M01	1672990	11/20/2020	Marin Resource Recovery / DUMP FEE	1.000 LS	86.00000	86.00
M02	30543207	11/20/2020	Water Components / COUPLING	1.000 LS	157.28000	157.28

Labor Charges

RT Labor		1,463.40
SC	10.00%	146.34
OT Labor		0.00
Subtotal Labor		1,609.74
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	563.41
Labor Total		**2,173.15**

Equipment Charges

Subtotal		734.36
MU	15.00%	110.15
Equipment Total		**844.51**

Material Charges

Subtotal		243.28
MU	15.00%	36.49
Material Total		**279.77**

Activity Total	**3,297.43**
Work Total	**3,297.43**
Bill Subtotal	**3,297.43**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment
☐ Resubmittal ☐ Returned for Correction

Date of Action:
Date Received:

Accepted:
Customer: *Date:*
Contractor: *Date:*

Bill Total + **3,297.43**

DAILY REPORT : 005373

MAGGIORA & GHILOTTI, INC.

DAY: Friday

DATE: 11-20-20

FOREMAN: Dagler

MAGGIORA & GHILOTTI INC. ENGINEERING CONTRACTORS MARIN COUNTY CALIF LIC #226767

FORCE ACCOUNT : YES ● NO ○

Owners (Representative) Signature

x

M&G Representative Signature

x

	EMPLOYEE NAME	TOTALS ST	TOTALS OT	JOB # 7716 ST	JOB # 7716 OT	JOB # 7716-X ST	JOB # 7716-X OT	JOB # ST	JOB # OT	JOB # ST	JOB # OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FINISH OUT
1.	Dagler	8		4		4						8	12	12:30	4:30
2.	Hubert	8		4		4						8	12	12:30	4:30
3.	Angilero	8		4		4						7:30	12	12:30	4
4.	Often	8		4		4						7:30	12	12:30	4:30
5.	Arcila	6.5		2.5		4						7:30			2
6.	Martinez	8		4		4						8	12	12:30	4:30
7.															
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

	M&G EQUIPMENT ID#						
1.	PT-60	8	4	4			
2.	FT-53	8	4	4			
3.	DT-48	8	4	4			
4.	ET-47	8	4	4			
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							

Meetings

Tailgate	Yes	○	No	●
J.H.A.	Yes	○	No	●
Onsite:	Yes	○	No	●

Notes: _____

Traffic

On Street	Yes	●	No	○
Control	Yes	●	No	○
Flagging	Yes	●	No	○
TCP	Yes	●	No	○
In Compliance	Yes	●	No	○

Type (Check all that apply)

Lane Shift	○
Lane Closure	○
Single Lane Alternating	●
Road Closed	○
Other (Describe)	○

	RENTED EQUIPMENT					
1.	#1 Valdivia	✓				
2.	#2 Valdivia		✓			
3.	no tags yet!					
4.						

	MATERIALS					
1.	MRRC 1672960		✓			
2.	WCBS 30543207		✓			
3.						
4.						
5.						
6.						
7.						
8.						

Force Account Notes / Comments

Demo and remove MH on Tiburon Blvd as directed by Mark Wilson - Temporary sewer hook up

WCBS

water components & building supply, inc.

P.O. Box 10007
San Rafael, CA 94912
www.watercomponents.com
Phone 415 451-1780
FAX 415 451-1786

INVOICE

30543207

BILL TO:
MAGGIORA GHILOTTI e
555 DUBOIS
SAN RAFAEL, CA 94901
Phone:415-459-8640

SHIP TO:
MAGGIORA GHILOTTI e
555 DUBOIS
SAN RAFAEL, CA 94901

INVOICE DATE	YOUR ORDER NO	TERMS	SALES PERSON
11/20/20	7716 -X	2% 10TH/NET 30 D	Pete

Quantity	Description	Price	Amount
1	MARMAC COUPLING 15"HDPE-15"CMP	144.286	144.29 T

INVOICE

THANK YOU

Received by:_____ Print Name:_____

Delivered by:_____ Date/Time:_____

Water Components & Building Supply, Inc. will not accept any product returns after the 90th day following the sale. Any returns within 90 days of sale will be subject to a restocking fee. Interest on accounts 30 days old accrues at the rate of 1.5% per month. Actual attorney's fees and cost shall be paid to the prevailing party in any action to collect any unpaid balance.

Sub-Total:	144.29
Shipping:	0.00
Tax:[9%]:	12.99 *
Total:	**157.28**
Paid:	0.00
Amount Due:	157.28

Adam

WEIGHMASTER CERTIFICATE

THIS IS TO CERTIFY that the following described commodity was weighed, measured, or counted by a weighmaster whose signature is on this certificate, who is a recognized authority of accuracy, as prescribed by Chapter 7 (commencing with Section 12700) of Division 5 of the California Business and Professions Code, administered by the Division of Measurement Standards of the California Department of Food and Agriculture.

SYSTEM GENERATED
Ticket# 1672990
Operator MSCARLOS

MARIN RESOURCE RECOVERY
565 JACOBY ST
SAN RAFAEL , CA 94901

Date: 11/20/20
In: 2:29 PM
Out: 2:29 PM

Cust# 02-0000342
MAGGIORA & GHILOTTI INC
555 DU BOIS ST
SAN RAFAEL CA 94901

Vehicle ID: MAG/GHILOTTI
Trailer/Box ID:
Driver:

Tare:
Tare:

Origin:MATB TIBURON

Comment: JOB 7716/DRVR JAY -X

Material	Qty	Gross Wgt	Tare Wgt	Net Wgt
MINIMUM	1.00	28380 LB B	14480 LB B	13900 LB

RECEIVED
NOV 23 2020

Tot 86.00

Maggiora & Ghilotti, Inc

Driver Signature _____ Weighmaster Signature _____

Weight Codes: M=Manual, T=Stored Tare, A/B = Scale

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5

Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT

Work Performed By: Maggiora and Ghilotti, Inc.

Description of Work: REMOVE 2 ROUND PIERS FROM PIPE ALIGNMENT

Change Order	007
Billing Number	65.0
Report Date	12/01/2020
Perform Date	11/24/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	2.00			72.820			145.640
L02	OE G2	S Hubert	2.00			76.870			153.740
L03	LBR G3	J Otten	2.00			63.360			126.720
L04	LBR G3	J Anguiano	2.00			60.360			120.720
L05	LBR G3	G Velarde	2.00			60.470			120.940
L06	LBR G3	E Aaron	2.00			61.350			122.700
L07	TMS G3	W Sanford	2.00			64.640			129.280

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			2.00		31.000			62.000
E02	FT53	TRUCK	T&TT	20-28			2.00		42.490			84.980
E03	DT35	TRUON	TRUN	4AXL			2.00		80.630			161.260
E04	EX47	HCECL	CAT	315F			2.00		55.410			110.820
E05	DT44	TRUON	TRUN	2AXL			2.00		54.690			109.380

Labor Charges

RT Labor		919.74
SC	10.00%	91.97
OT Labor		0.00
Subtotal Labor		1,011.71
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	354.10
Labor Total		**1,365.81**

Equipment Charges

Subtotal		528.44
MU	15.00%	79.27
Equipment Total		**607.71**

Material Charges

Activity Total	**1,973.52**
Work Total	**1,973.52**
Bill Subtotal	**1,973.52**
Bill Total +	**1,973.52**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:

☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:

Customer: *Date:*

Contractor: *Date:*

DAILY REPORT : 005375

MAGGIORA & GHILOTTI, INC.

DAY: Tuesday

DATE: 11-24-20

FOREMAN: Dagler

MAGGIORA & GHILOTTI INC.
ENGINEERING CONTRACTORS
MARIN COUNTY
CALIF LIC #226767

FORCE ACCOUNT : YES ● NO ○

Owners (Representative) Signature

x

M&G Representative Signature

x

	EMPLOYEE NAME	TOTALS ST	TOTALS OT	JOB # 7716 ST	JOB # 7716 OT	JOB # 7716-X ST	JOB # 7716-X OT	JOB # 7709 ST	JOB # 7709 OT	JOB # ST	JOB # OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FINISH OUT
1.	Dagler	8	.5	6	.5	2						730	12	1230	430
2.	Hubert	8		6		2						6	12	1230	430
3.	Otten	8	.5	6	.5	2						8	12	1230	5
4.	Angulano	8		6		2						8	12	1230	430
5.	Velarde	8	1	6	1	2						7	12	1230	430
6.	Aaron	8	1	3	1	2		3				7	12	1230	430
7.	Sanford	8	.5	6	.5	2						830	12	1230	5
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

	M&G EQUIPMENT ID#			
1.	PT-60	8	6	2
2.	ET-53	8	6	2
3.	DT-35	8	6	2
4.	ET-47	8	6	2
5.	DT-44	8	6	2
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				

	RENTED EQUIPMENT
1.	
2.	
3.	
4.	

	MATERIALS	
1.	WCBS 30543365	✓
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Meetings

Tailgate	Yes	○	No	●
J.H.A.	Yes	○	No	●
Onsite:	Yes	○	No	●

Notes: _____

Traffic

On Street	Yes	●	No	○
Control	Yes	●	No	○
Flagging	Yes	●	No	○
TCP	Yes	●	No	○
In Compliance	Yes	●	No	○

Type (Check all that apply)

Lane Shift	○
Lane Closure	○
Single Lane Alternating	●
Road Closed	○
Other (Describe)	○

Force Account Notes / Comment

Time to remove 2 round pins from pipe alignment

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5
Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT
Work Performed By: Maggiora and Ghilotti, Inc.
Description of Work: OPEN CUT OF 16" SSFM ON TIBURON BLVD

Change Order	001
Billing Number	66.0
Report Date	12/15/2020
Perform Date	12/01/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	8.00	0.50		72.820	96.325		630.723
L02	OE G2	S Hubert	8.00			76.870			614.960
L03	LBR G3	E Aaron	8.00	0.50		61.350	79.120		530.360
L04	LBR G3	J Anguiano	8.00	0.50		60.360	77.635		521.698
L05	LBR G3	J Ayala	8.00			58.360			466.880
L06	LBR G3	N Dexter	8.00			58.360			466.880
L07	TMS G3	W HANSEN	6.00	0.50		64.640	81.765		428.723

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			8.00		31.000			248.000
E02	FT50	TRUCK	T&TT	20-28			8.00		42.490			339.920
E03	EX47	HCECL	CAT	315F			8.00		55.410			443.280
E04	L37	LDRRT	CAT	2070G	C2		4.00		89.110			356.440
E05	BH34	LDRRT	DEER	2508J	C2		2.00		71.940			143.880
E06	EX42	HCECL	CAT	3055EC			4.00		36.570			146.280

Material/Specialist Work/Lump Sum or Unit Price Payment

	Number	Date	Vendor Name and Description	Units	Unit Price	Extended
M01	4548	12/01/2020	VALDIVIA TRUCKING / 53754	1.000 LS	813.00000	813.00

Labor Charges

RT Labor		3,492.80
SC	10.00%	349.28
OT Labor		167.42
SC	10.00%	16.74
Subtotal Labor		4,026.24
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	1,409.18
Labor Total		**5,435.42**

Equipment Charges

Subtotal		1,677.80
MU	15.00%	251.67
Equipment Total		**1,929.47**

Material Charges

Subtotal		813.00
MU	15.00%	121.95
Material Total		**934.95**

Activity Total	**8,299.84**
Work Total	**8,299.84**
Bill Subtotal	**8,299.84**
Bill Total +	**8,299.84**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:
☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:
Customer: *Date:*
Contractor: *Date:*

DAILY REPORT : 005379
MAGGIORA & GHILOTTI, INC.
DAY: Tuesday
DATE: 12/1/20
FOREMAN: Dagler

MAGGIORA & GHILOTTI INC.
ENGINEERING CONTRACTORS
MARIN COUNTY
CALIF LIC #226767

FORCE ACCOUNT : YES ● NO ○

Owners (Representative) Signature
x

M&G Representative Signature
x

	EMPLOYEE NAME	TOTALS ST	TOTALS OT	JOB # 776-X ST	JOB # 776-X OT	JOB # 776 ST	JOB # 776 OT	JOB # ST	JOB # OT	JOB # ST	JOB # OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FINIS OUT
1.	Dagler	8	.5	8	.5							730	12	12:30	430
2.	Hyber t	8		8								8	12	12:30	430
3.	Agrun	8	.5	8	.5							730	12	12:30	430
4.	Anguiano	8	.5	8	.5							730	12	12:30	430
5.	Ayala	8		8								8	12	12:30	430
6.	Dexter	8		8								8	12	12:30	430
7.	Hansen CS	8		8	.5							8	12	12:30	430
8.	Otten	8		8		8						8	12	12:30	3
9.															
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

	M&G EQUIPMENT ID#		
1.	PT-60	8	8
2.	FT-50	8	8
3.	EX-47	8	8
4.	L-37	4	4
5.	BH-34	2	2
6.	EX-42	4	4
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			

	RENTED EQUIPMENT	
1.	Valdivia 53754	✓
2.		
3.		
4.		

	MATERIALS		
1.	Dutra 515421	✓	
2.	Shamrock 192554		✓
3.			
4.			
5.			
6.			
7.			
8.			

Meetings

Tailgate	Yes ○	No ●
J.H.A.	Yes ○	No ●
Onsite:	Yes ○	No ●

Notes: _____

Traffic

On Street	Yes ●	No ○
Control	Yes ●	No ○
Flagging	Yes ●	No ○
TCP	Yes ●	No ○
In Compliance	Yes ●	No ○

Type (Check all that apply)

Lane Shift	○
Lane Closure	○
Single Lane Alternating	●
Road Closed	○
Other (Describe)	○

Force Account Notes / Comments

Open cut of 16" SSFM on Tiburon Blvd - Digging thru buried r.p-rap Type rock - Hamme rock and excavate - place shoring

Valdivia TRUCKING

CA 355395

254 Colgan Avenue Santa Rosa, CA 95404
Main Office: 707.836.4124
Billing: 707.478.8665 Fax: 707.837.2981

Invoice

Invoice #	Date
4548	12/15/20

Customer PO #	Salesman	Period Ending	Payment Terms	Job
		12/01/20	Net 30	6137-Blnkt.R 20 -Sonoma,Marin,Napa,

Date	Ticket #	Tractor	Qty	Units	Description	Rate	Amount	Tax
12/01	52468	RV20	6.80	Hours	Richmond -R2	$130.00	$884.00	☐
12/01	52468	RV20	1.00	Hours	Tolls 5	$26.00	$26.00	☐
12/01	53754	RV8	6.00	Hours	Richmond -R1	$125.00	$750.00	☐
12/01	53754	RV8	3.00	Hours	Tolls 4	$21.00	$63.00	☐

Totals
16.8 Hours

Tax: $0.00

Invoice Total $1,723.00

RECEIVED

DEC 18 2020

Please Pay $1,723.00

Maggiora & Ghilotti, Inc

Payment Due: 01/14/21

Bill to Customer	1039

Comments:

Maggiora & Ghilotti Inc.
555 DuBois Street
San Rafael, CA 94901

4548

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5

Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT

Work Performed By: Maggiora and Ghilotti, Inc.

Description of Work: DIGGING IN BURIED RIPRAP ON TIBURON BLVD

Change Order	001
Billing Number	67.0
Report Date	12/15/2020
Perform Date	12/02/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	2.50			72.820			182.050
L02	OE G2	S Hubert	2.50			76.870			192.175
L03	LBR G3	E Aaron	2.50			61.350			153.375
L04	LBR G3	J Anguiano	2.50			60.360			150.900
L05	LBR G3	J Otten	2.50			63.360			158.400
L06	LBR G3	J Ayala	2.50			58.360			145.900
L07	LBR G3	N Dexter	2.50			58.360			145.900
L08	LBR G3	J Lemar	2.50			58.360			145.900
L09	TMS G3	W Sanford	2.50			64.640			161.600
L10	TMS G3	R Westmoreland	2.50			64.640			161.600

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			2.50		31.000			77.500
E02	FT50	TRUCK	T&TT	20-28			2.50		42.490			106.225
E03	TT-TR	TRUON	TRUN	5AXL			2.50		90.060			225.150
E04	TT-TR	TRUON	TRUN	5AXL			2.50		90.060			225.150
E05	EX47	HCECL	CAT	315F			2.50		55.410			138.525
E06	L37	LDRRT	CAT	2070G	C2		2.50		89.110			222.775
E07	EX42	HCECL	CAT	3055EC			2.50		36.570			91.425
E08	H8	HAMMRNPK		0795			2.50		17.200			43.000

Labor Charges

RT Labor		1,597.80
SC	10.00%	159.78
OT Labor		0.00
Subtotal Labor		1,757.58
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	615.15
Labor Total		**2,372.73**

Equipment Charges

Subtotal		1,129.77
MU	15.00%	169.47
Equipment Total		**1,299.24**

Material Charges

Activity Total	**3,671.97**
Work Total	**3,671.97**
Bill Subtotal	**3,671.97**
Bill Total +	**3,671.97**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:

☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:

Customer: *Date:*

Contractor: *Date:*

DAILY REPORT : 005380
MAGGIORA & GHILOTTI, INC.
DAY: Wednesday
DATE: 12-2-26
FOREMAN: Dagler

MAGGIORA & GHILOTTI INC.
ENGINEERING CONTRACTORS
MARIN COUNTY
CALIF LIC #225767

FORCE ACCOUNT : YES ◉ NO
Owners (Representative) Signature
x
M&G Representative Signature
x

EMPLOYEE NAME		TOTALS ST	TOTALS OT	JOB # 7716 ST	JOB # 7716 OT	JOB # 7716-X ST	JOB # 7716-X OT	JOB # ST	JOB # OT	JOB # ST	JOB # OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FI
1.	Dagler	8	.5	5.5		2.5						7	12	12:30	
2.	Hubert	8		5.5		2.5						8	12	12:30	4
3.	Acrun	8	.5	5.5		2.5						7	12	12:30	
4.	Anguiano	8	.5	5.5		2.5						7	12	12:30	
5.	Otten	8		5.5		2.5						8	12	12:30	4
6.	Ayala	8		5.5		2.5						8	12	12:30	4
7.	Dexter	8		5.5		2.5						8	12	12:30	4
8.	Lemar	8		5.5		2.5						8	12	12:30	4
9.	Sanford	8		5.5		2.5						8:30	12	12:30	3
10.	Westmoreland	8		5.5		2.5						8	12	12:30	4
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

M&G EQUIPMENT ID#				
1.	PT-60	8	5.5	2.5
2.	FT-56	8	5.5	2.5
3.	TT 28	8	5.5	2.5
4.	TT 26	8	5.5	2.5
5.	EX-47	8	5.5	2.5
6.	L-37	4	1.5	2.5
7.	EX 42	2.5		2.5
8.	EX 42 hammer	2.5		2.5
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				

RENTED EQUIPMENT				
1.				
2.				
3.				
4.				

MATERIALS				
1.	WCBS 30543857		✓	
2.	30543578		✓	
3.				
4.				
5.				
6.				
7.				
8.				

Meetings

Tailgate	Yes	◉	No	
J.H.A.	Yes	○	No	
Onsite:	Yes	○	No	

Notes: _____

Traffic

On Street	Yes	◉	No
Control	Yes	◉	No
Flagging	Yes	◉	No
TCP	Yes	◉	No
In Compliance	Yes	◉	No

Type (Check all that apply)
Lane Shift
Lane Closure
Single Lane Alternating
Road Closed
Other (Describe)

Force Account Notes / Comments

Digging in buried r.p.r. on Tiburon Blvd @ the traffic circle - Hammer and excavator until 10:30am when we got out of it

DAILY EXTRA WORK REPORT

SANITARY DISTRICT #5
Contractor Job: 7716 - COVE RD FORCE MAIN REPLACEMENT
Work Performed By:. Maggiora and Ghilotti, Inc.
Description of Work: REMOVE BEACH GRAVEL

Change Order	001
Billing Number	68.0
Report Date	12/15/2020
Perform Date	12/09/2020

Labor Charges

	Craft/Level	Employee Name	RT Hrs	OT Hrs	Subs Units	RT Rate	OT Rate	Subs Rate	Extended
L01	LBR G3	A Dagler	2.00			72.820			145.640
L02	OE G2	S Hubert	2.00			76.870			153.740
L03	LBR G3	J Anguiano	2.00			60.360			120.720
L04	LBR G3	E Aaron	2.00			61.350			122.700
L05	LBR G3	G Velarde	4.00			60.470			241.880
L06	LBR G3	N Dexter	2.00			58.360			116.720
L07	TMS G3	M Gil	2.00			64.640			129.280
L08	LBR G3	J Lemar	2.00			58.360			116.720
L09	TMS G3	P Hanrahan	2.00			64.640			129.280

Equipment Charges

	Equipment ID	Class	Make	Model	A1	A2	RT Hrs	OT Hrs	RT Rate	OT Rate	Delay Factor	Extended
E01	PT60	TRUCK	T&TT	06-12			2.00		31.000			62.000
E02	FT50	TRUCK	T&TT	20-28			2.00		42.490			84.980
E03	EX47	HCECL	CAT	315F			2.00		55.410			110.820
E04	L37	LDRRT	CAT	2070G	C2		2.00		89.110			178.220
E05	DT44	TRUON	TRUN	2AXL			4.00		54.690			218.760

Material/Specialist Work/Lump Sum or Unit Price Payment

	Number	Date	Vendor Name and Description	Units	Unit Price	Extended
M01	30544468	12/09/2020	Water Components / VISQUEEN	1.000 LS	607.98000	607.98

Labor Charges

RT Labor		1,276.68
SC	10.00%	127.67
OT Labor		0.00
Subtotal Labor		1,404.35
Subsistence		0.00
Other Expenses		0.00
MU	35.00%	491.52
Labor Total		**1,895.87**

Equipment Charges

Subtotal		654.78
MU	15.00%	98.22
Equipment Total		**753.00**

Material Charges

Subtotal		607.98
MU	15.00%	91.20
Material Total		**699.18**

Activity Total	**3,348.05**
Work Total	**3,348.05**
Bill Subtotal	**3,348.05**
Bill Total +	**3,348.05**

For Owner/Resident Engineer's Use Only

☐ New Bill ☐ Approved for Payment Date of Action:
☐ Resubmittal ☐ Returned for Correction Date Received:

Accepted:
Customer: *Date:*
Contractor: *Date:*

DAILY REPORT : 005386

MAGGIORA & GHILOTTI, INC.

DAY: Wednesday

DATE: 12-9-20

FOREMAN: Daglor

MAGGIORA & GHILOTTI INC. ENGINEERING CONTRACTORS MARIN COUNTY CALIF LIC #226767

FORCE ACCOUNT : YES ● NO ○

Owners (Representative) Signature

x

M&G Representative Signature

x

	EMPLOYEE NAME	TOTALS ST	TOTALS OT	JOB # 7716 ST	JOB # 7716 OT	JOB # 7716-X ST	JOB # 7716-X OT	JOB # ST	JOB # OT	JOB # ST	JOB # OT	START IN	LUNCH BREAK OUT	LUNCH BREAK IN	FINISH OUT
1.	Daglor	8	1	6	1	2						7	12	1230	430
2.	Hubert	8		6		2						8	12	1230	430
3.	Angiano	8	1	6	1	2						7	12	1230	430
4.	Aaron	8	1	6	1	2						7	12	1230	430
5.	Velarde	8	.5	4	.5	4						730	12	1230	430
6.	Dexter	8		6		2						8	12	1230	430
7.	Gil	8		6		2						8	12	1230	430
8.	Lemar	8		6		2						8	12	1230	430
9.	Hansen	8		6		2						8	12	1230	430
10.															
11.															
12.															
13.															
14.															
15.															
16.															
17.															
18.															

	M&G EQUIPMENT ID#										
1.	PT-60	8		6		2					
2.	LT-50	8		6		2					
3.	EX-47	8		6		2					
4.	L-37	4		2		2					
5.	EX-42	4		4							
6.	DT-44	4				4					
7.											
8.											
9.											
10.											
11.											
12.											
13.											
14.											
15.											
16.											
17.											
18.											

	RENTED EQUIPMENT					
1.	JIM-N-I 70553	✓				
2.						
3.						
4.						

	MATERIALS					
1.	Dutra 515601	✓				
2.	WCBS 30544468		✓			
3.						
4.						
5.						
6.						
7.						
8.						

Meetings

Tailgate	Yes ○	No ●		
J.H.A.	Yes ○	No ●		
Onsite:	Yes ○	No ●		

Notes: _____

Traffic

On Street	Yes ●	No ○
Control	Yes ●	No ○
Flagging	Yes ●	No ○
TCP	Yes ●	No ○
In Compliance	Yes ●	No ○

Type (Check all that apply)

Lane Shift	○
Lane Closure	○
Single Lane Alternating	●
Road Closed	○
Other (Describe)	○

Force Account Notes / Comment

Time to remove beach gravel that seemed to be covered in oil. Gravel removed and Hauled to isolated location at Richmond yard and covered with plastic

W C B S

water components & building supply, inc.

P.O. Box 10007
San Rafael, CA 94912
www.watercomponents.com
Phone 415 451-1780
FAX 415 451-1786

INVOICE

30544468

BILL TO:

MAGGIORA GHILOTTI e
555 DUBOIS
SAN RAFAEL, CA 94901
Phone:415-459-8640

SHIP TO:

MAGGIORA GHILOTTI e
555 DUBOIS
SAN RAFAEL, CA 94901

INVOICE DATE	YOUR ORDER NO	TERMS	SALES PERSON
12/09/20	7716-X	2% 10TH/NET 30 D	Tom

Quantity	Description	Price	Amount
1	VISQUEEN 20mil Black 20'x 100'	479.217	479.22 T
20	BAG FILLED SAND POLY 50LB WHITE	3.467	69.34 T
1	KNIFE UTILITY RETRACTABLE	5.677	5.68 T
1	KNIFE BLADE 5pk	3.539	3.54 T

INVOICE

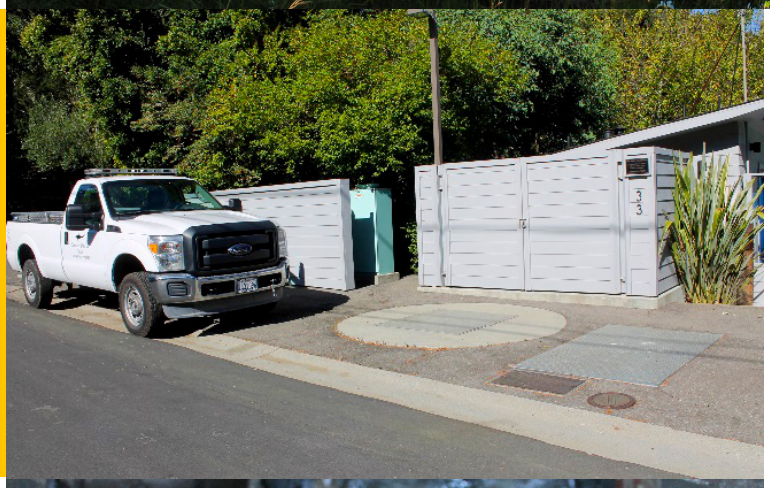
THANK YOU

Received by:_____ Print Name:_____

Delivered by:_____ Date/Time:_____

Water Components & Building Supply, Inc. will not accept any product returns after the 90th day following the sale. Any returns within 90 days of sale will be subject to a restocking fee. Interest on accounts 30 days old accrues at the rate of 1.5% per month. Actual attorney's fees and cost shall be paid to the prevailing party in any action to collect any unpaid balance.

Sub-Total:	557.78
Shipping:	0.00
Tax:[9%]:	50.20 *
Total:	**607.98**
Paid:	0.00
Amount Due:	607.98



Draft Collection System Master Plan

Sanitation District No.5 of Marin County

Sanitary District no5

Tiburon & Belvedere, California

January, 2021

HDR

This page is left intentionally blank.

Contents

List of Figures

List of Tables

Executive Summary

Introduction

Located on the Tiburon Peninsula north of San Francisco, Sanitary District No. 5 of Marin County (SD5) provides wastewater services to Tiburon, Belvedere, and the surrounding unincorporated areas. The population in SD5's service area is about 8,400, has stabilized, and significant future growth is not anticipated. Land use changes and additional build-out development is unlikely because of stringent building and planning requirements. Most of SD5's current service area is expected to remain unchanged into the future, except for continued low-level expansion in the unincorporated northeastern part of its service area.

SD5 completed a sanitary sewer investigation study in 2005 (Harris and Associates, 2005) that produced a set of recommendations for capital improvements to its collection systems (i.e., pipelines) and supporting facilities (i.e., lift stations). Since that time, SD5 has implemented many of the recommendations and made considerable investment in its wastewater collection system infrastructure. SD5 believes that it is time to reassess its collection system infrastructure to determine its current condition and identify rehabilitation priorities.

HDR Engineering, Inc. (HDR) was retained by SD5 to develop a Collection System Master Plan (Master Plan) that will support its objectives of continuing to meet regulatory requirements and service-level goals for the communities it serves. Prior engineering reports and studies, including CCTV inspection videos, construction as-built drawings, and GIS database information, served as the basis for developing the Master Plan. Data collected during recent in-field inspections/assessments, along with the prior work, were used to develop recommendations for system performance improvements, as well as a list of recommended capital improvements (i.e., 15-year Capital Improvement Plan or CIP), recommended timing or prioritization of the improvements, and estimated costs of the improvements.

Approach and Workflow

Figure 1 provides the approach to developing the Master Plan. The three primary components of the collection system - gravity mains, lift stations, and force mains - were each evaluated using existing information from SD5 and new data developed for this study. Evaluation of the gravity mains consisted of developing a risk model from the available CCTV inspection data and a rehabilitation decision model that also incorporated findings from the evaluation of the 2010-2011 flow monitoring study (E2 Consulting Engineers Inc., 2011) and sea level rise assessment (BVB Consulting LLC, 2017). The lift station evaluation incorporated existing data from SD5 as well as new data from physical inspections and interviews of operations staff. The force mains were evaluated using available data from the GIS and sample analysis results of four pipe samples from 2018 Visual Condition Assessment Report (V&A Consulting Engineers, 2018). Each of these three primary components was evaluated separately to identify prioritized recommendations, which were then integrated into a comprehensive 15-year capital improvement plan (CIP).

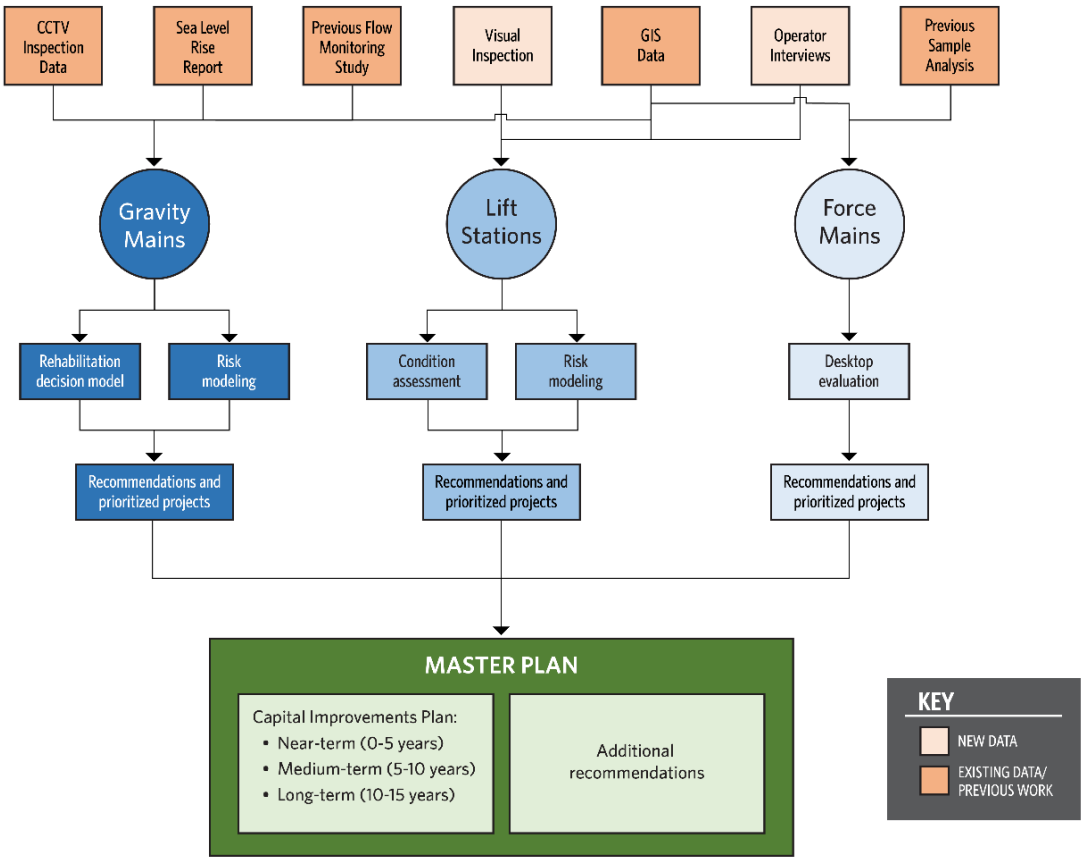


Figure 1. Master plan project approach

Key conclusions

The primary findings from these analyses are as follows:

- Gravity Mains (Section 4.1.5)
  - The collection system is relatively old and has not been inspected recently and will need additional inspection.
  - Depending upon the addition inspection results, more rehabilitation actions may be identified for the near term (0-5 years).
  - Based on the available data, 2.2 miles of mains should be rehabilitated within the next 5 years (approximately 7 percent of system).
  - Some areas of the system have significant I&I issues that allow excess stormwater and ground water (and possibly tidal flow) to enter the system, which may cause odor, capacity problems, and impacts wastewater treatment plant operations (Section 4.2.11). The previous study evaluated approximately 50 percent of the SD5 collection system and there may be more areas that have not been evaluated that are significant contributors of excess flow to

the system. This issue could be magnified by medium- and long-term (greater than 30 years) sea level rise.

- Lift Stations (Section 4.3.5)
  - 50 percent of the 24 lift stations evaluated are found to be in fair to poor condition.
  - Four of these stations should be rehabilitated within the next 5 years and another four in 5 to 10 years.
- Force Mains (Section 5.3)
  - Based on desktop review of available force main information, 4 of the 28 force mains should have a detailed condition assessment within the next 5 years.
  - Depending upon the results of these assessment, additional assessments and capital projects may be needed.

A summary of each of the analyses is provided below, followed by a discussion of the 15-year CIP.

Gravity Mains

The main objective of the gravity main analysis was to identify and prioritize rehabilitation and reinspection actions based on available inspection data. This analysis also included evaluation of the 2010-2011 flow monitoring study (E2 Consulting Engineers Inc., 2011) to characterize inflow and infiltration issues within the system, and incorporation of findings from the regional Marin Shoreline Sea Level Rise Vulnerability Assessment (BVB Consulting LLC, 2017).

Gravity Main Risk Modeling

To develop rehabilitation recommendations for the collection system, a risk model was constructed to calculate a relative risk score for every sewer main (e.g., gravity pipeline) based on likelihood of failure (LoF) and consequence of failure (CoF) criteria. The relative risk score was used to prioritize rehabilitation and reinspection recommendations for the gravity mains.

The LoF and CoF scores are comprised of several components based on physical characteristics of the system, CCTV inspection results, regulatory history and customer service. These were tabulated for every gravity main to develop the final risk score. The risk model for the system, summarized in Figure 2. Risk modeling results for gravity mains, shows that about 27 percent (8.18 miles) of the gravity mains have a relatively high risk compared to the rest of the system. However, these pipes do not all require rehabilitation.

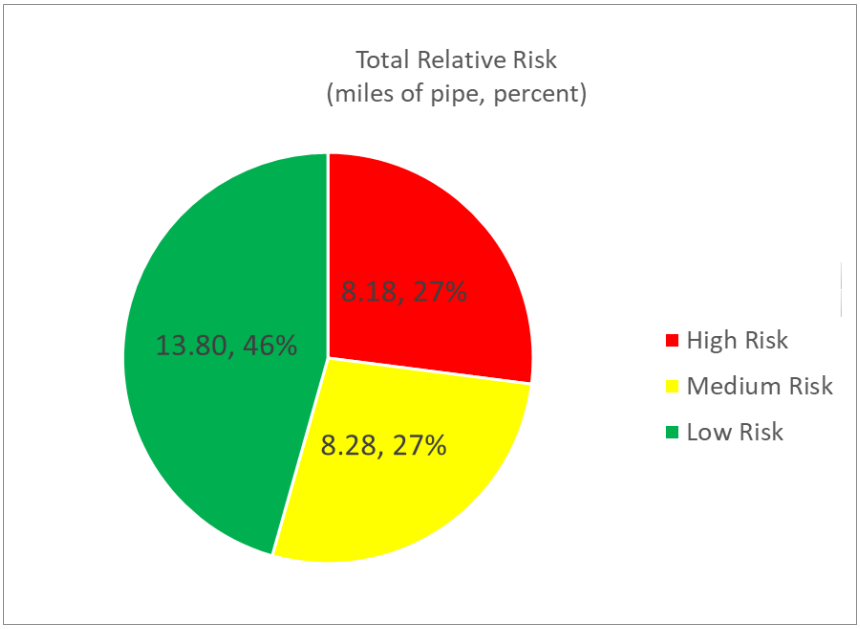


Figure 2. Risk modeling results for gravity mains

Inflow and Infiltration

The 2010-2011 flow monitoring study (E2 Consulting Engineers Inc., 2011) was then analyzed to identify additional factors that should be considered when developing rehabilitation recommendations for the gravity mains. This previous study was reviewed and analyzed to determine which of the basins studied where the largest contributors to excess flow that enters the system from groundwater or stormwater events. The analysis revealed that Peninsula Boulevard in Belvedere and the basin at the south end of the Tiburon Peninsula along Paradise Drive are the biggest contributors to inflow and infiltration (I&I) should be further investigated to identify and eliminate specific I&I sources. There are other basins that may be significant contributors to I&I as well. In addition, the gravity mains in these areas are given additional consideration when prioritizing and planning annual rehabilitation work.

Rehabilitation Decision Model

Each of the sewer mains was then processed through a rehabilitation decision support model that identified the most appropriate rehabilitation or reinspection action for each gravity main depending on its physical characteristics, previous CCTV inspection results (SD5 2020a), and additional input from a prior I&I evaluation (E2 Consulting Engineers Inc., 2011). This model uses the risk model results as well as additional parameters to select the best rehabilitation or reinspection options for each pipe according to SD5 decision criteria. By applying unit cost information derived from previous SD5 construction bid tables and regional experience, costs for each of the rehabilitation actions was calculated for each pipe.

Recommendations

The results from the modeling and prioritization are summarized in Table 1 below.

Table 1. Gravity main capital improvement recommendations

Tier	Timeframe	Number of gravity mains	Sum of miles	Gravity main costs
1	0–5 years	58	2.2	$2,994,847
2	5–10 years	61	2.7	$3,628,794
3	10–15 years	43	1.9	$2,655,865
4	15+ years	18	0.8	$895,311
Grand total		**180**	**7.6**	**$10,174,817**

Lift Stations

A visual condition assessment of the lift stations was conducted as part of the planning effort. The assessment included review of available documentation and reference material, visual inspection of the lift stations, and interviews of SD5 staff. The information collected was analyzed to develop recommendations for needed improvements, which were considered in the development of the overall CIP. To prioritize the recommendations, a risk analysis was conducted to determine the relative criticality of each lift station.

Condition Assessment

Overall, the condition of the lift stations varied, with the Tiburon and Seafirth lift stations generally being in better overall condition than the Belvedere lift stations. Actual station age and capacity assessment were not determined because of limited data; therefore, the assessments relied on interviews with SD5 staff for historical knowledge, visual condition assessment based on experience evaluating similar assets evaluated at other utilities, and comparison to industry best practices. None of the stations received a very poor rating. The most significant issues were identified at Tiburon PS-4, Tiburon PS-9, Belvedere PS-1, and Belvedere PS-7. These results are summarized in Table 2.

This page is intentionally left blank.

Table 2. Lift station condition assessment results

Service area	Lift station criticality	Lift station location	Description	Very good (New or excellent condition)	Good (Minor defects only)	Fair (Moderate deterioration)	Poor (Significant deterioration)	Very poor (Virtually unserviceable)
Tiburon	1	PS-5	Mar W St.	✓				
Tiburon	2	PS-3	Paradise Dr. & Solano St.			✓		
Tiburon	2	PS-4	Paradise Dr. near Lyford's Tower				✓	
Tiburon	2	PS-6	Tiburon Blvd. and Beach Rd.			✓	✓	
Tiburon	2	PS-9	Paradise Dr. near Shoreline Park				✓	
Tiburon	3	PS-2	Mar E St. near Agreste Way			✓		
Tiburon	3	PS-7	Tiburon Blvd. near Ned's Way			✓		
Tiburon	3	PS-8	Beach Rd. and Lagoon Vista Rd.			✓		
Tiburon	4	PS-1	Mar E St. near Mar E Dr.			✓		
Belvedere	1	PS-1	Cove Rd. & Barn Rd.				✓	
Belvedere	2	PS-7	Peninsula Rd. and Beach Rd.			✓	✓	
Belvedere	3	PS-2	San Rafael Ave. & Teal Rd.			✓	✓	
Belvedere	4	PS-3	San Rafael Ave. and Golden Gate Ave.			✓	✓	
Belvedere	4	PS-9	Lagoon Rd. (south)			✓	✓	
Belvedere	5	PS-5	San Rafael Ave. and Windward Rd.			✓	✓	
Belvedere	5	PS-10	Lagoon Rd. near Maybridge Rd.			✓	✓	
Belvedere	5	PS-13	West Shore Rd. (north)			✓		
Belvedere	6	PS-8	Windward Rd.			✓		
Belvedere	6	PS-11	Lagoon Rd. (north)			✓	✓	
Belvedere	6	PS-12	San Rafael Ave. & Edgewater Rd.			✓	✓	
Belvedere	6	PS-14	West Shore Rd. (south)			✓		
Belvedere	6	PS-15	Beach Rd. near Embarcadero Dr.			✓		
Seafirth	1	CF-PS1	Seafirth Pl.			✓		
Seafirth	1	CF-PS2	Seafirth Rd.			✓		

This page is intentionally left blank.

The outcome of each assessment was a list of rehabilitation and repair recommendations for each lift station. Costs for these recommendations was calculated using an industry standard cost estimating database (RS Means).

Lift Station Risk Modeling

Risk assessment was also used to prioritize lift station rehabilitation and develop the prioritized CIP. Risk was determined based on each lift stations pumping capacities, impact on the District if it fails and is taken out of service, and the potential for flooding or causing environmental damage. Based on these characteristics, four of the pump stations were identified to be the most critical (Tiburon LS-5, Belvedere LS-1, Seafirth LS-1, and Seafirth LS-2) and five others have been determined to be the next highest priority (Tiburon LS-3, Tiburon LS-4, Tiburon LS-6, Tiburon LS-9 and Belvedere LS-7). These criticality ratings were used to prioritize the rehabilitation recommendations.

Recommendations

The capital improvement recommendations and priorities for SD5 lift stations is provided in Table 3.

Table 3. Lift station capital improvement recommendations

Service area	Lift station number	Lift station location	Rehabilitation schedule			
			0-5 years	5-10 years	10-15 years	15+ years
Tiburon	PS-1	Mar E St. near Mar E Dr.				$11,154
Tiburon	PS-2	Mar E St. near Agreste Way			$99,725	
Tiburon	PS-3	Paradise Dr. and Solano St.			$129,910	
Tiburon	PS-4	Paradise Dr. near Lyford's Tower	$386,515			
Tiburon	PS-5	Mar W St.				$50,833
Tiburon	PS-6	Tiburon Blvd. and Beach Rd.		$431,013		
Tiburon	PS-7	Tiburon Blvd. near Ned's Way			$91,464	
Tiburon	PS-8	Beach Rd. and Lagoon Vista Rd.			$40,631	
Tiburon	PS-9	Paradise Dr. near Shoreline Park	$400,747			
Belvedere	PS-1	Cove Rd. and Barn Rd.	$668,323			
Belvedere	PS-2	San Rafael Ave. and Teal Rd.		$498,934		
Belvedere	PS-3	San Rafael Ave. and Golden Gate Av		$500,590		
Belvedere	PS-5	San Rafael Ave. and Windward Rd.			$418,832	
Belvedere	PS-7	Peninsula Rd. and Beach Rd.	$411,031			
Belvedere	PS-8	Windward Rd.				$53,473
Belvedere	PS-9	Lagoon Rd. (south)		$83,478		
Belvedere	PS-10	Lagoon Rd. near Maybridge Rd.			$48,632	
Belvedere	PS-11	Lagoon Rd. (north)			$48,632	
Belvedere	PS-12	San Rafael Ave. and Edgewater Rd.			$36,050	
Belvedere	PS-13	West Shore Rd. (north)				$70,896
Belvedere	PS-14	West Shore Rd. (south)				$31,165
Belvedere	PS-15	Beach Rd. near Embarcadero Dr.				$58,054
Seafirth	CF-PS1	Seafirth Pl.				$50,833
Seafirth	CF-PS2	Seafirth Rd.				$0
Total			**$1,866,617**	**$1,514,016**	**$913,877**	**$326,408**

Force Mains

A detailed assessment of SD5's force mains was not part of the master plan scope however available information was reviewed to develop recommendations for further evaluation. From the information available, the Tiburon force mains PS-5-14 and PS-6-621, and Belvedere force mains PS1-TIB and PS3-ND5 - PS3-ND5.1.1, should be prioritized first for condition assessment. This is mostly due to their lengths, their associated pump station criticality, and their ages.

The most common assessment technologies for these force mains range between $12 thousand and $60 thousand per force main depending upon the technology used. These costs are based on previous project experience but would need to be refined with a quote from each vendor. For the

purposes of this analysis, middle-range cost estimates were applied, which total approximately $215 thousand to assess all four pipelines.

Capital Improvement Plan

Table 4 provides a summary of the gravity main, lift station and force main recommendations and costs prioritized for the CIP. These recommendations have been divided into near-term (0-5 years), mid-term (5-10 years), and long-term (10-15 years) actions. These actions include additional condition assessments as well as rehabilitations, which could identify additional rehabilitation actions to these identified costs and could also impact CIP priorities.

Table 4. Summary of SD5 capital improvement plan

	Total	Tiburon	Belvedere	Yearly average
Short-term (0-5 years)				
Gravity main rehabilitation and inspection	$ 3,085,308	$ 2,066,086	$ 1,019,222	$ 617,062
Lift station rehabilitation	$ 1,881,617	$ 802,263	$ 1,079,354	$ 376,323
Force main inspection	$ 216,000	$ 108,000	$ 108,000	$ 43,200
Short-term total	**$ 5,182,925**	**$ 2,976,349**	**$ 2,206,576**	**$ 1,036,585**
Mid-term (5-10 years)				
Gravity main rehabilitation and inspection	$ 3,726,491	$ 2,330,252	$ 1,396,239	$ 745,298
Lift station rehabilitation	$ 1,514,016	$ 431,013	$ 1,083,002	$ 302,803
Force main inspection	$ -	$ -	$ -	$ -
Mid-term total	**$ 5,240,507**	**$ 2,761,266**	**$ 2,479,242**	**$ 1,048,101**
Long-term (10-15 years)				
Gravity main rehabilitation and inspection	$ 2,803,172	$ 2,217,901	$ 585,270	$ 560,634
Lift station rehabilitation	$ 913,877	$ 361,730	$ 552,147	$ 182,775
Force main inspection	$ -	$ -	$ -	$ -
Long-term total	**$ 3,717,049**	**$ 2,579,632**	**$ 1,137,417**	**$ 743,410**

Figure 3 shows a graph of the expected CIP expenditures over time for the next 15 fiscal years. Each of the bars represents a specific type of activity on either the gravity mains, lift stations, or force mains, while the total cost by fiscal year is shown as the green line. Annual expenditures are expected to average just over $1 million over the next 10 years.

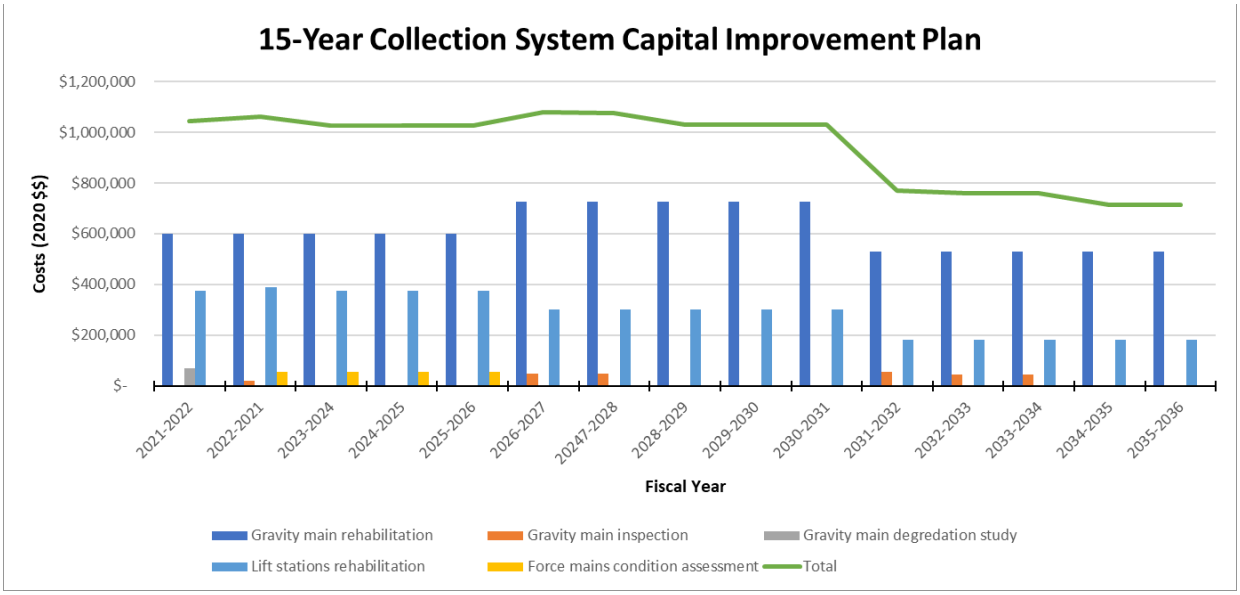


Figure 3. Recommended 15-year CIP

Figure 4 compares the existing SD5 capital plan as provided in the FY 2020-2021 Final Budget report (SD5, 2020b) to the recommendations from this master plan. The planned budget averages approximately $1.2 million whereas the recommended projects from this Master Plan average approximately $1.0 million over the same time period.

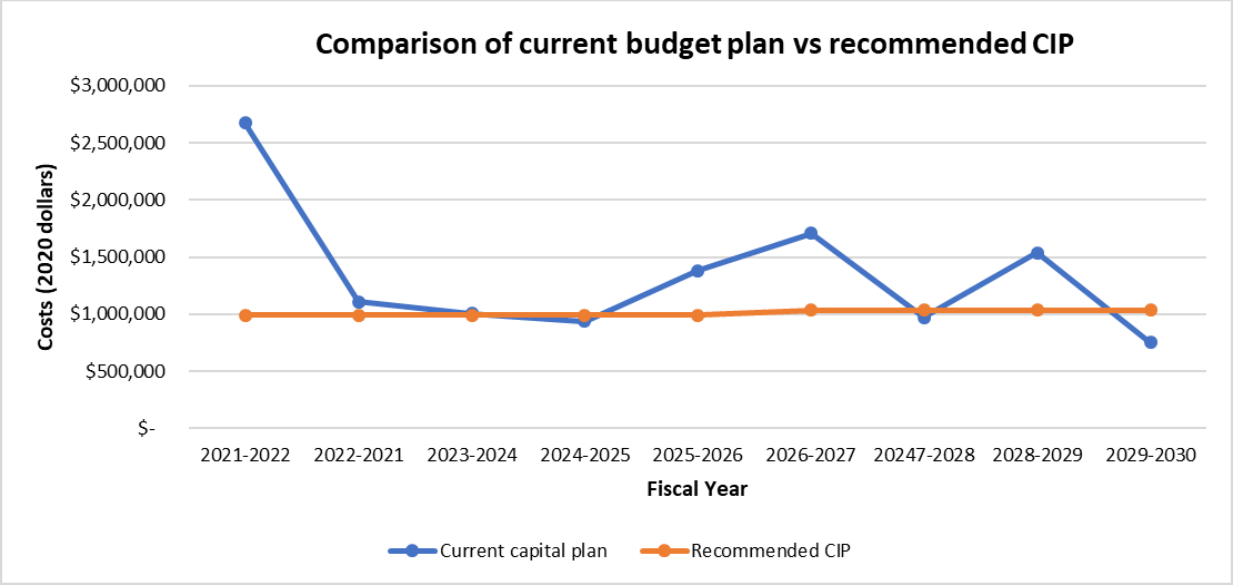


Figure 4. Comparison of the recommended CIP and the SD5 fiscal plan

1.0 Introduction

This section provides an overview of the project and describes the goals and objectives.

1.1 Project Background

Sanitary District No. 5 of Marin County (SD5) has developed this Collection System Master Plan (Master Plan) to better understand the current conditions of its collection systems, anticipate future needs, and identify potential items for operational improvement and capital investment. This Master Plan covers both the Main Treatment Plant collection system, which consists of 28.5 miles of gravity sewer line, 2.4 miles of force mains, and 22 pump stations, and the Paradise Cove collection system, which consists of 1.4 miles of gravity sewer line, 1.7 miles of force mains, and two pump stations within its service area. The Master Plan describes the assessment of these facilities, provides a 15-year capital improvement plan (CIP), and presents other system performance improvement recommendations.

SD5 previously completed a study in 2005 that produced a set of recommendations for capital improvements (Harris and Associates, 2005). Since that time, SD5 has implemented many of the recommendations and made considerable investment in the wastewater collection system infrastructure. SD5 believes that it is time to reassess the system to determine its current condition and identify rehabilitation priorities. This master planning effort provides an updated road map for capital investment and operational improvements that accounts for anticipated growth and demographic changes and identifies rehabilitation and renewal needs that will enable SD5 to continue to meet regulatory and service-level goals for the community.

1.2 Goals and Objectives

This Master Plan is intended to achieve the following goals and objectives:

- Assess the current condition of the sewer gravity system and lift stations
- Provide recommendations for capital improvement and infiltration and inflow (I&I) reduction
- Review available information on force mains and provide condition assessment recommendations
- Identify operational improvements for odor control
- Develop a 15-year collection system CIP
- Discuss potential system vulnerabilities, such as sea level rise (SLR), and support other potential changes including environmental, social and economic conditions that could present challenges to SD5.

SD5 is a special district that serves a small population with a limited rate payer base. This Master Plan is structured to align with SD5's needs and must balance out prioritized strategic capital investment with affordability.

1.3 Report Purpose and Organization

SD5 will use this Master Plan as a reference and baseline for implementing capital improvements and other recommendations necessary to continue to meet expected service levels to the community and regulatory requirements for the next 15 years.

The following sections are included in the Master Plan:

1. Introduction: documents the project background, goals and objectives, the purpose and structure of the Master Plan, assumptions and dependencies, acronyms and abbreviations and a summary of data sources used or reviewed.
2. Service Area Description: describes the service areas served by SD5 and specific characteristics including geography, climate, land use, and population; both current and anticipated in the future.
3. Existing System Description: presents the physical and operational characteristics for SD5's Main Treatment Plant and Paradise Cove collection systems.
4. Facility and Infrastructure Assessment: discusses the assessments completed for SD5s assets, including the gravity mains and lift stations including the need to reduce I&I.
5. Capital Improvement Plan: lists the specific capital improvement recommendations and describes the methodology for establishing implementation priorities and costs.

1.4 Assumptions and Dependencies

The analyses and recommendations in this Master Plan are based on the following assumptions and dependencies:

- The information, data and interpretations obtained from the data sources and reports provided are assumed to be accurate and correct. No attempt has been made to verify these sources of information.
- Rehabilitation decision modeling used to evaluate the closed-circuit television (CCTV) inspection results (Harris and Associates, 2005) is based on existing models used at other utilities. Only minor customizations have been made specific to SD5's needs.
- This Master Plan also relies on institutional knowledge from Nute Engineering based on its history of capital improvement and design work for SD5

1.5 Abbreviations and Definitions

The following abbreviations and definitions are used in this report:

ADWF	Average dry weather flow.
BSF	Base sanitary flow.
CCTV	Closed-circuit television video. Used to inspect gravity sewer pipe.
CIP	Capital improvement plan.
CIPP	Cured-in-place pipe. A pipe rehabilitation method.
CIWQS	California Integrated Water Quality System. Website used for reporting sewer system overflows.
CoF	Consequence of failure. A measure indicating the impact if an asset fails.
District	Sanitary District No. 5 of Marin County
EUL	Estimated useful life. The average service life of an asset.
Flow monitoring hydrograph	A graph that shows the rate of flow over time for a specific location in the sewer system.
FOG	Fats, oils, and grease.

Force main	A pressurized sewer pipe that conveys wastewater under pressure from the discharge side of a pump.
FY	Fiscal year.
GIS	Geographic information system.
gpm	Gallon(s) per minute.
Gravity main	A sewer main that conveys wastewater via gravity.
GWI	Groundwater infiltration.
H2S	Hydrogen sulfide.
HDR	HDR Engineering, Inc.
hp	Horsepower.
I&C	Instrumentation and controls.
I&I	Inflow and infiltration. Non-wastewater-related flow in a sewer pipe that causes excess flow and dilution.
in.	inch(es).
Infiltration	Water entering a sewer pipe through defects in the pipe or joints.
Inflow	Water entering a sewer pipe from inappropriate connections.
InfoAsset Planner	Spatial software that is used to model risk in the collection system and to plan for and estimate rehabilitation actions.
KPI	Key performance indicator.
lb	Pound(s).
LF	Linear foot/feet.
Lift station	A pumping station in the collection system used to move wastewater from a lower elevation to a higher elevation.
LoF	Likelihood of failure. A measure indicating how soon an asset is likely to fail.
Master Plan	Collection System Master Plan
mi	Mile(s).
MWLS	Miscellaneous water level sag.
N/A	Not applicable.
NASSCO	National Association of Sewer Service Companies. NASSCO provides the standard for inspection and assessment of gravity mains using CCTV.
NPDES	National Pollutant Discharge Elimination System.
O&M	Operations and maintenance.
PACP	Pipeline Assessment and Certification Program. Defines standards and conventions for assessing sewer pipe.
Peak structural defect score	The highest (most severe) score identified on a pipe segment.
Rainfall hyetograph	A graphical representation of the distribution of rainfall over time.

RDI/I	Rain-dependent infiltration and inflow.
Risk score	The numeric score calculated for a pipe segment based on the likelihood of failure and consequence of failure grading.
SLR	Sea level rise.
Smoke testing	An assessment method using smoke that is pumped into the sewer system to determine locations where the system could be leaking to determine connectivity and potential problems in the system. Used to identify I&I vulnerabilities.
SSMP	Sewer System Management Plan. A plan required of all organizations that manage collections systems that defines how the system is managed and maintained, and how the organization responds to overflows.
SSO	Sewer system overflow.
TDH	Total dynamic head.
V	Volt(s).
WWTP	Wastewater treatment plant.

1.6 Data Sources and Review

Many data sources were reviewed and analyzed during the development of this Master Plan. The following key data sources and documents used were:

1. BVB Consulting LLC (2017). Marin Shoreline Sea Level Rise Vulnerability Assessment
2. E2 Consulting Engineers Inc. (2011). Sanitary District No. 5 of Marin County Flow Monitoring Report
3. Harris and Associates (2005). City of Belvedere Sanitary Sewer Investigation and GIS Program Report
4. Nute Engineering (2017). Pump Station No. 5 Improvements – Phase 2
5. Nute Engineering (2016a). Belvedere Pump Station Assessment Project
6. Nute Engineering (2016b). Tiburon Pump Station Assessment Project
7. Nute Engineering (2014). Pump Station No. 5 Improvements – Phase 1
8. Sanitary District No. 5 of Marin County (2020a). Geodatabases for Tiburon and Belvedere, including previous CCTV inspection results.
9. Sanitary District No. 5 of Marin County (2020b). FY 2020 – 2021 Final Budget,
10. Sanitary District No. 5 of Marin County (2020c). Updated Strategic Plan
11. Sanitary District No. 5 of Marin County (2018a). Main Plant Sewer System Management Plan
12. Sanitary District No. 5 of Marin County (2018b). Paradise Cove Sewer System Management Plan
13. Sanitary District No. 5 of Marin County (2018c). Succession Plan
14. Sanitary District No. 5 of Marin County (2017). Emergency Response Plan
15. Sanitary District No. 5 of Marin County (2015). Minimum Staffing Requirements
16. V&A Consulting Engineers (2018). Sanitary District No.5 of Marin County Four Pipe Samples Visual Condition Assessment Letter Report

Additional information was obtained from various websites including the Town of Tiburon, City of Belvedere, US Census Bureau, the California State Water Resources Control Board, and the National Oceanic and Atmospheric Administration.

2.0 Service Area Description

Sanitary District No. 5 of Marin County is a special district established in 1922 that has been providing wastewater collection and treatment services to parts of the Tiburon Peninsula and the City of Belvedere since the early 1940s (SD5, 2020c). It currently provides services to more than 3,500 households and covers approximately 2,550 acres. Commercial interests include downtown Tiburon, which is composed mostly of small boutiques, hotels, marinas, and restaurants supporting local tourism, and commuter ferry services to San Francisco.

SD5 has consistently been in compliance with state and federal regulations under a National Pollutant Discharge Elimination System (NPDES) Permit that regulates sanitary agencies (SD5, 2020c). SD5's mission as stated on the District website is as follows:

> *Sanitary District No.5 of Marin County is a special District, which while meeting or exceeding all applicable local, state and federal laws and regulations, is dedicated to the protection of public health and the environment through effective and economical collection, conveyance, treatment and disposal of wastewater*

2.1 Service Area and Population Served

Located on the Tiburon Peninsula north of the city of San Francisco and on the San Francisco Bay, SD5 serves a population of approximately 8,400 people in the town of Tiburon, the city of Belvedere, and the surrounding, unincorporated areas (Figure 5). SD5's Main Treatment Plant collection system consists of 28.9 miles of gravity sewer line, 2.1 miles of force main, and 22 pump stations. The treatment plant provides secondary treatment of residential and commercial wastewater.

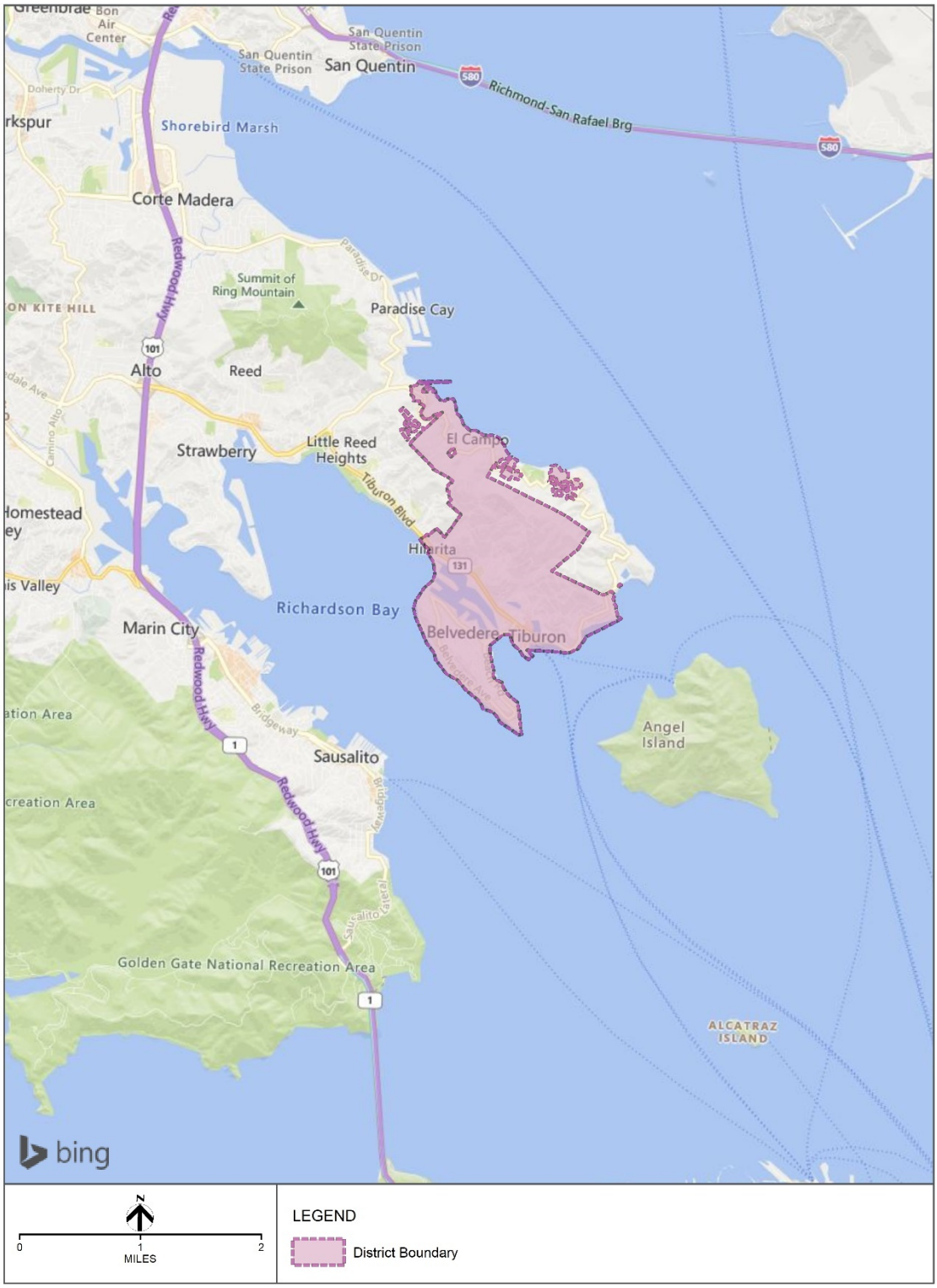


Figure 5. Location map showing SD5 service area

The Town of Tiburon, which was incorporated in 1964, had an estimated population of 9,084 in 2019 (www.census.gov). It is bordered on the south-west by the City of Belvedere and Corte Madera to the north, but otherwise is surrounded by San Francisco Bay. It has a total area of about 13.2 square miles of which about 66 percent is water. SD5 serves approximately the southern half of the town.

The City of Belvedere, which was incorporated in 1896, had an estimated population of 2,104 in 2019 (www.census.gov). It consists of two islands and is connected to the Town of Tiburon by two causeways. It is an entirely residential community of about 2.42 square miles of which about 78 percent is water. SD5 provides wastewater collection and treatment for the entire city.

The remaining District service area on the Tiburon Peninsula is unincorporated serving residences and small communities throughout the hills and along the peninsula coastline. Topography within the service area ranges from sea level to about 740 feet above sea level along the peninsula ridgeline.

2.2 Climate

The weather in the service area is very moderate with average temperatures ranging from the mid-70's in summer to the low 40's in winter. Rainfall averages about 29 inches per year, with most of it falling in the winter months. Monthly averages range from 6.2 inches per month in January to less than 1 inch of rain in July. On average, it rains only 80 days throughout the year.

2.3 Land Use

The land use in SD5's service area is designated predominantly as low-density residential and open space or parklands. Commercial property makes up a very small percentage and is concentrated primarily in downtown Tiburon. The city of Belvedere is almost entirely built out and future changes in its land use designations are not likely. Future development will primarily be renovations or replacement of existing homes. The town of Tiburon has more undeveloped land and could continue to build out based on the current land use designations; however, General Plan policies on open space, safety, and conservation make it unlikely that significant changes will occur in the future. Land use and development in the unincorporated areas that SD5 services fall under the Town of Tiburon's sphere of influence and are also unlikely to change in the future. There are no current or anticipated industrial activities within SD5's service area.

SD5's service area is bordered on its northern side by Richardson Bay Sanitary District and Sanitary District No. 2 and is unlikely to spread farther to the north. The remainder of the service area is surrounded by water. Some parts of the unincorporated areas, mostly within SD5 boundaries, are still on individual septic systems.

2.4 Future Conditions

As discussed previously, the population within the service area has stabilized and significant future increases are not anticipated. Land use changes and additional build-out development is unlikely because of stringent building and planning requirements. Therefore, most of the current service area is expected to remain unchanged into the future. However, SD5 will likely continue to incorporate the individual residences that are currently on stand-alone septic systems and development projects in the eastern and northern unincorporated areas as the individual septic systems fail or the properties get developed. Currently another 25-50 connections are expected between residential conversions and new development. In addition, the San Francisco State Estuary and Ocean Science Center is connected to SD5 collection system in this area through a special outside service agreement. This property has potential for significant development and increased wastewater flows. These impacts may be able to be accommodated with the existing infrastructure, but additional expansion and improvements could be

required in the future. Studies or assessments have not currently been completed and are not part of the scope of this Master Plan as they are typically performed during the property development process.

3.0 Existing System Description

SD5 collection system infrastructure is divided into two systems as shown in Figure 6: (1) the Main Treatment Plant collection system, which services all of the City of Belvedere and the southeastern and central portion of the Tiburon peninsula and (2) the Paradise Cove collection system, which services the northern portion of the Tiburon peninsula along the coast. In these two systems, SD5 manages about 30 miles of gravity pipelines, which include 772 manholes, 98 rodholes, and 19 cleanouts (Figure 7). Where gravity flow is not viable, SD5 pumps wastewater to its treatment plants through 24 lift stations and about 4.5 miles of force mains. Each of these systems is described in more detail in the following paragraphs. Information provided is based on SD5s geographic information system (GIS) database (SD5, 2020a).

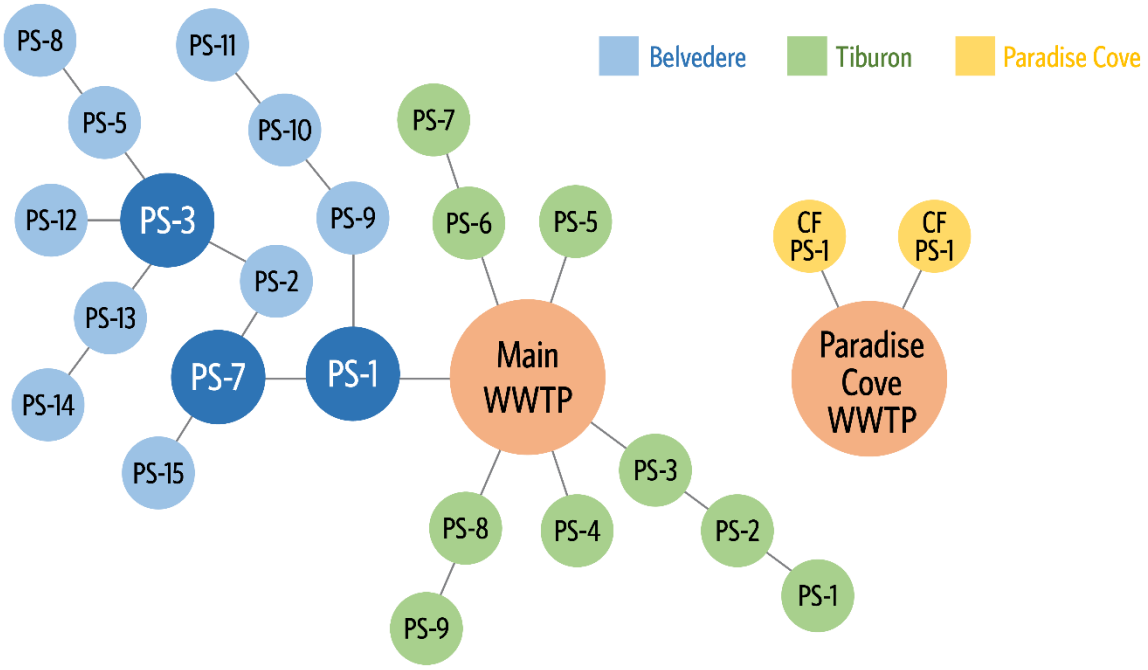


Figure 6. SD5 collection system schematic

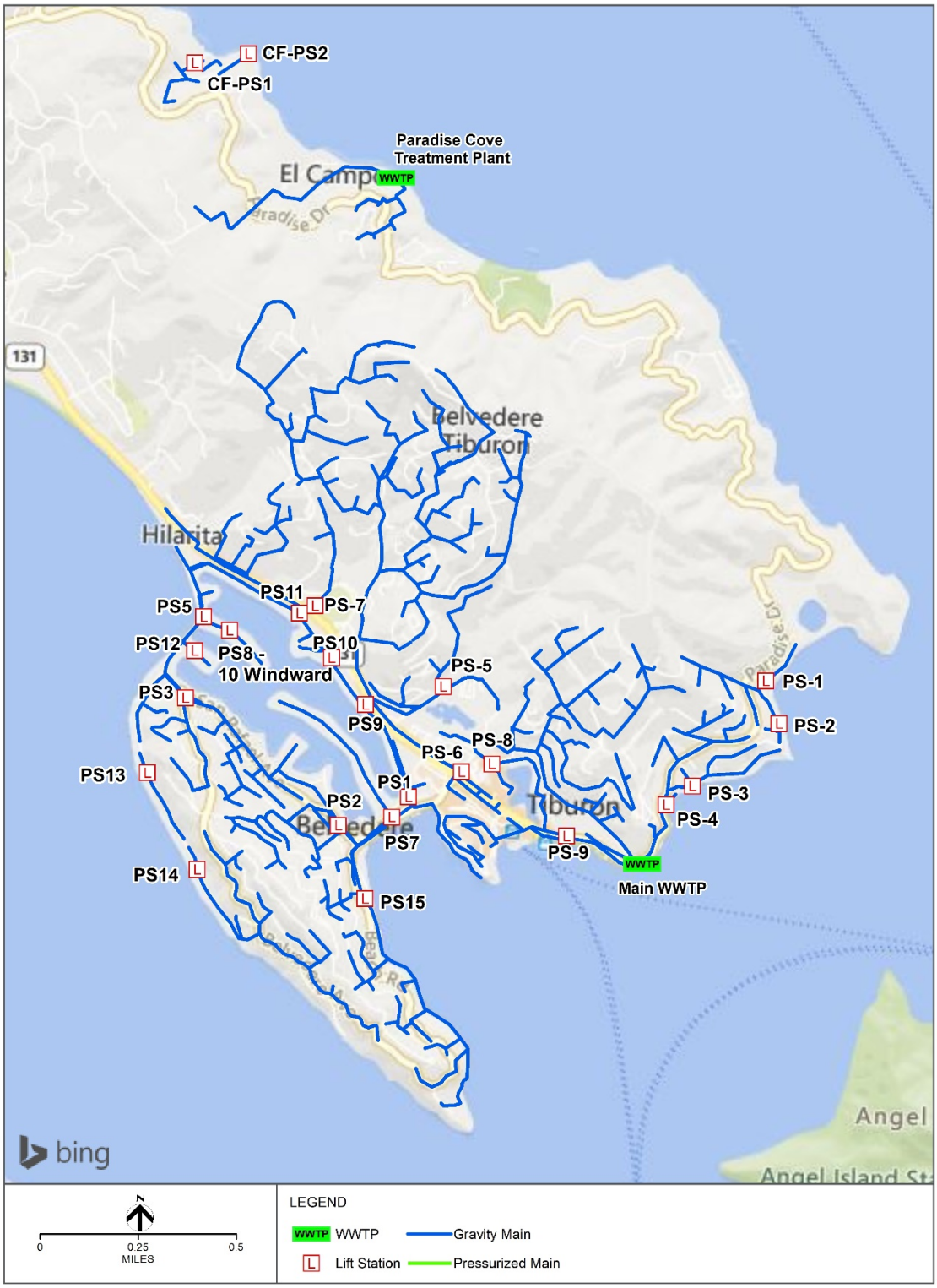


Figure 7. District 5 collection system

3.1 Collection System Gravity Pipelines

The collection system gravity pipelines consist of various diameters and materials installed at various times since the 1940's. Fifty-seven percent of the systems is comprised of 6-inch diameter vitrified clay pipe; pipe diameters range from 4 inches to 18 inches and the remaining portion of the system is comprised of pipes made from a variety of materials. Pipeline sizes are shown in Table 5, and material characteristics are provided in Table 6. The system has been constructed over the past 70 years based on the data provided in the GIS. System installation data are shown in Table 7. Almost 80 percent of the collection system pipes are over 50 years old, as shown in Figure 8.

Table 5. Pipe diameters and lengths in SD5's service areas

Diameter (in.)	Paradise Cove (mi.)	Main Collection System (mi.)	Grand total (mi.)	Percent of total length
4	0.0	0.5	0.5	2%
5	0.0	0.0	0.0	0%
6	1.4	23.3	24.7	82%
8	0.1	3.0	3.2	10%
10	0.0	0.3	0.3	1%
12	0.0	0.6	0.6	2%
14	0.0	0.0	0.0	0%
15	0.0	0.3	0.3	1%
18	0.0	0.3	0.3	1%
Unknown	0.0	0.2	0.2	1%
Grand total	**1.5**	**28.7**	**30.2**	**100%**

Table 6. Summary of collection system pipe material

Material	Paradise Cove (mi)	Main Collection System (mi)	Grand total (mi)	Percent of total length
Asbestos cement	0.4	0.2	0.5	2%
Cast iron	0.0	0.2	0.2	1%
Corrugated metal pipe	0.0	0.0	0.0	0%
Concrete pressure pipe or corrugated plastic pipe	0.0	1.4	1.4	5%
Clay tile	0.0	0.1	0.1	0%
Orangeburg/pitch fiber	0.0	0.1	0.1	0%
Polyethylene	0.0	4.5	4.5	15%
Polyethylene	0.0	0.2	0.2	1%
Polypropylene	0.0	0.0	0.0	0%
Polyvinyl chloride	0.9	1.3	2.2	7%
Transite	0.0	0.0	0.0	0%
Vitrified clay pipe	0.2	20.7	20.9	69%
Unknown	0.0	0.1	0.1	0%
Grand total	**1.5**	**28.7**	**30.2**	**100%**

Table 7. Installation decade of collection system pipes

Installation Decade	Paradise Cove (mi)	Main Collection System (mi)	Grand total (mi)	Percent of total length
Unknown	0.3	0.7	1.0	3%
1950-1959	0.2	12.3	12.5	41%
1960-1969	0.0	10.0	10.1	33%
1970-1979	0.2	1.0	1.2	4%
1980-1989	0.2	1.1	1.4	4%
1990-1999	0.6	1.3	1.9	6%
2000-2009	0.0	1.9	1.9	6%
2010-2019	0.0	0.4	0.4	1%
Grand total	**1.5**	**28.7**	**30.2**	**100%**

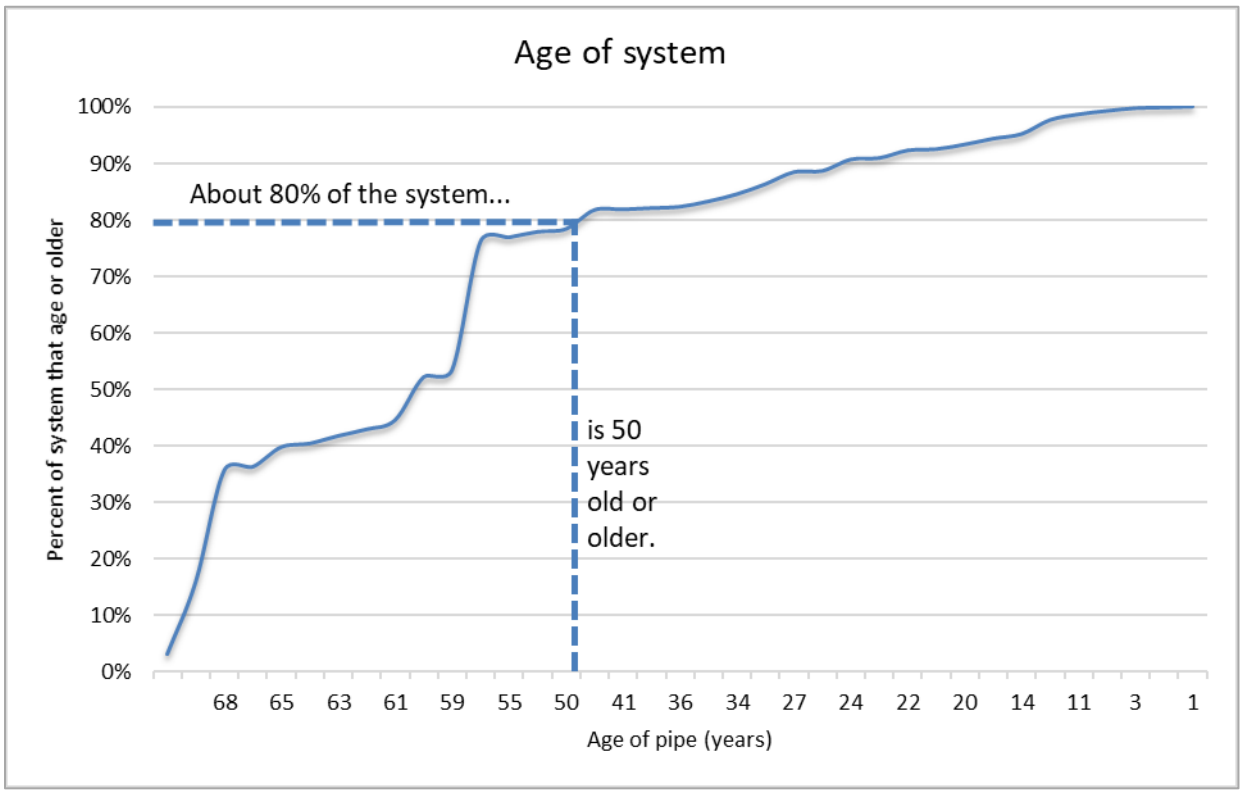


Figure 8. Age as a percentage of collection system pipes

3.2 Force Mains

There are about 4.4 miles of force main throughout the collection system. The Tiburon and Belvedere service areas contain about 2.1 miles and the Paradise Cove service area has about 2.3 miles. Force main sizes are shown in Table 8 and force main materials are provided in Table 9.

Table 8. Force mains by diameter

Diameter (in.)	Paradise Cove (mi)	Main Collection System (mi)	Grand total (mi)
4	1.2	0.4	1.6
6	1.1	0.8	1.9
8	-	0.5	0.5
10	-	0.4	0.4
Unk.	-	0.1	0.1
Grand total	**2.3**	**2.1**	**4.4**

Table 9. Force mains by material

Material	Paradise Cove (mi)	Main Collection System (mi)	Grand total (mi)
Asbestos cement	-	0.8	0.8
Cast iron	-	0.3	0.3
Polyethylene	1.9	0.4	2.3
Polyvinyl chloride	0.3	0.2	0.5
Vitrified clay pipe	0.2	0.4	0.6
Grand total	**2.3**	**2.1**	**4.4**

3.3 Lift Stations

SD5 operates 24 lift stations that convey wastewater flow from the collection system to the treatment plants. These lift stations and their known characteristics are provided in Table 10 and their locations are shown in Figure 9. Overall lift station capacities and total dynamic head (TDH), which are typical attributed to describe lift stations, were not available, so other key characteristics are shown. The Tiburon service area has nine lift stations that pump wastewater to the Main Treatment Plant. In the Belvedere service area, SD5 operates 13 lift stations that also convey wastewater into the Main Treatment Plant. The Paradise Cove treatment plant receives wastewater from the two Seafirth lift stations. Each of these service areas operate independently of each other.

All of the lift stations except for Tiburon PS-1 contain multiple pumps to achieve pumping capacity and for redundancy. These pumps generally range from 3 hp to 5 horsepower (hp), however Tiburon PS-5 and Belvedere PS-1 have larger pumps as they convey water from about 25 percent and 37 percent of the collection system mains in the service area (by linear miles) respectively.

Table 10. Summary of District lift stations

Service Area	Lift station number	Lift station location	Number of pumps	Largest motor (hp)	Collection system serviced (mi of main)	Collection of system serviced (percentage of main)
Tiburon	PS-1	Mar E St. near Mar E Dr.	1	3	0.1	0.3%
Tiburon	PS-2	Mar E St. near Agreste Way	2	3	0.7	2.3%
Tiburon	PS-3	Paradise Dr. and Solano St.	2	5	1.2	4.0%

Service Area	Lift station number	Lift station location	Number of pumps	Largest motor (hp)	Collection system serviced (mi of main)	Collection of system serviced (percentage of main)
Tiburon	PS-4	Paradise Dr. near Lyford's Tower	2	5	0	0.0%
Tiburon	PS-5	Mar W St.	2	60	7.7	25.5%
Tiburon	PS-6	Tiburon Blvd. and Beach Rd.	2	5	2.3	7.6%
Tiburon	PS-7	Tiburon Blvd near Ned's Way	2	5	1.6	5.3%
Tiburon	PS-8	Beach Rd. & Lagoon Vista Rd.	2	3	1.2	4.0%
Tiburon	PS-9	Paradise Dr. near Shoreline Park	2	5	0.8	2.6%
Belvedere	PS-1	Cove Rd. and Barn Rd.	2	10/15	11.1	36.8%
Belvedere	PS-2	San Rafael Ave. and Teal Rd.	2	3	5.1	16.9%
Belvedere	PS-3	San Rafael Ave. and Golden Gate Ave.	3	5	3.7	12.3%
Belvedere	PS-5	San Rafael Ave and Windward Rd.	2	5	0.6	2.0%
Belvedere	PS-7	Peninsula Rd. and Beach Rd.	2	3	7.3	24.2%
Belvedere	PS-8	Windward Rd.	2	3	0.1	0.3%
Belvedere	PS-9	Lagoon Rd. (south)	2	3	0.9	3.0%
Belvedere	PS-10	Lagoon Rd. near Maybridge Rd.	2	3	0.4	1.3%
Belvedere	PS-11	Lagoon Rd. (north)	2	3	0.2	0.7%
Belvedere	PS-12	San Rafael Ave. & Edgewater Rd.	2	3	0.1	0.3%
Belvedere	PS-13	West Shore Rd. (north)	2	3	1.8	6.0%
Belvedere	PS-14	West Shore Rd (south)	2	3	1.6	5.3%
Belvedere	PS-15	Beach Rd. near Embarcadero Dr.	2	3	1.8	6.0%
Seafirth	CF-PS1	Seafirth Pl.	2	Unk.	0.3	1.0%
Seafirth	CF-PS2	Seafirth Rd.	2	Unk.	0.1	0.3%

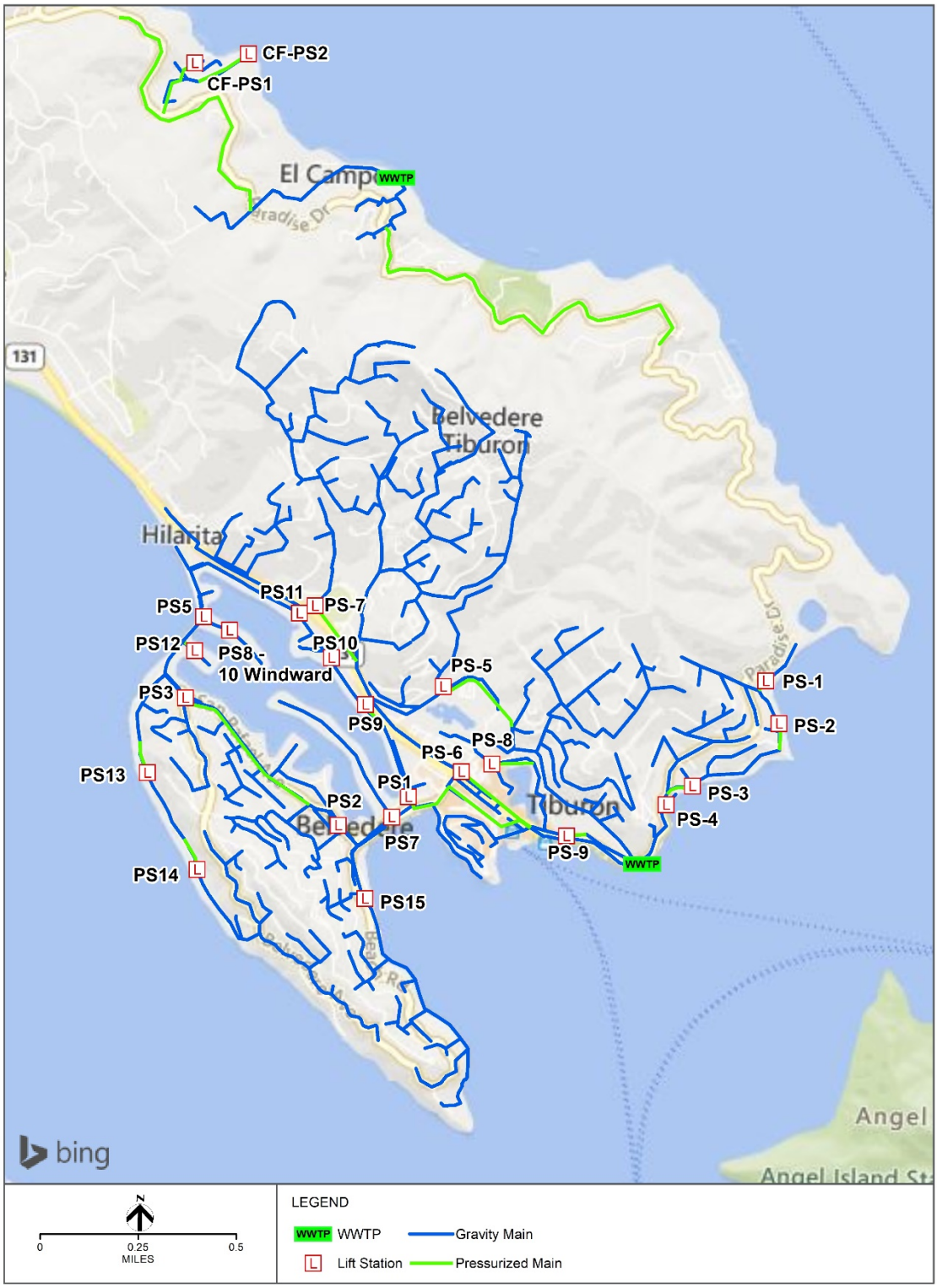


Figure 9. Approximate locations of Tiburon and Belvedere lift stations

A schematic of the lift stations and how they pump water to the treatment plants is shown on Figure 6. Tiburon lift stations PS-3, PS-5, PS-6, and PS-8 are main collection points in the Tiburon service areas, receiving wastewater from other lift stations and a large part of the collection system, constituting about 41 percent of SD5's system by sewer pipe miles (Table 10). In the Belvedere service area, all flows are received at PS-1, which conveys flows from about 37 percent of SD5's system by sewer pipe miles. Other important Belvedere lift stations include PS-2, PS-3, and PS-7 which collect wastewater from 17 percent, 12 percent, and 24 percent of SD5's system by miles respectively.

4.0 Facility and Infrastructure Assessment

An assessment of SD5's collection system infrastructure was performed to identify repair, replacement, and rehabilitation actions that will help SD5 continue to provide reliable wastewater collection and conveyance and meet customer and stakeholder expectations. The following activities were performed as part of this planning effort:

- Condition assessment of the gravity mains using existing CCTV data (SD5 2020a), collected over the last 15 years to identify and prioritize structural improvements to the gravity mains and recommendations for future CCTV inspections
- Analysis of the 2010 Flow Monitoring Study (E2 Consulting Engineers Inc., 2011) results to determine recommendations to reduce I&I in selected drainage basins
- Evaluation of the Marin Shoreline Sea Level Rise Vulnerability Assessment report (BVB Consulting LLC, 2017) (https://www.marinwatersheds.org/sites/default/files/2019-04/BAYWAVE%20final.pdf) to assess the potential impact and provide recommendations to mitigate future SLR within the SD5's services area
- Visual inspection of SD5's 24 lift stations to develop capital improvement recommendations
- Evaluation of odor control issues occurring at some of the lift stations and recommendations for mitigation

This section describes how these analyses were conducted and the recommended actions identified.

4.1 Condition Assessment of Gravity Mains

The available CCTV inspection information was completed using the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) inspection standard for coding defects observed. NASSCO PACP is the North American standard for pipeline defect identification and assessment, which provides standard codes for conditions and defects observed through televised pipe inspection (i.e., CCTV). Approximately 85 percent of the system was inspected. SD5 has used these data to guide its gravity main rehabilitation program and repair many of the defective pipes. Since 2006, about 20,500 linear feet (LF) of pipe have been replaced or rehabilitated and SD5 has added more than 200 additional inspections to its database. These data have been used as the basis for the new assessment.

The assessment was performed using InfoAsset Planner from Innovyze. The software uses readily available sewer system data extracted from SD5's GIS database, applies risk modeling to calculate a relative risk score for each pipe, and identifies rehabilitation and/or inspection recommendations based on inspection data, pipe characteristics, and spatial analysis.

The risk model (i.e., InfoAsset Planner) considers two major factors:

- Likelihood of failure (LoF): a numerical score related to the condition of the pipe and a determination of how soon it may fail, and
- Consequence of failure (CoF): a numerical score that quantifies the impact on SD5 and the community if the pipe does fail.

Both the LoF and CoF scores are a product of calculation using additional scoring criteria. These criteria and how they are applied are described in Section 4.1.3. The LoF and CoF scores are then added together to produce the relative risk score for the pipe. This relative risk score is used to prioritize rehabilitation and reinspection actions.

InfoAsset Planner also processes each pipe through a rehabilitation decision support model to determine appropriate actions based on pipe characteristics. This model, which is based on SD5's criteria (described in Section 4.1.4), uses a decision tree to determine the most appropriate action and assigns it to each respective pipe. The end result is a rehabilitation or reinspection recommendation for every pipe based on its unique characteristics and risk profile. The model also applies planning-level cost factors to develop estimated costs, which can then be used as input into a CIP. The outcomes of these models have been verified though workshops and discussions with SD5 to make sure that the actions assigned are appropriate.

The remainder of this section describes the details the data used and the assessment itself. The findings of the assessment are provided in Section 4.1.5. For the assessment details, please refer to the following:

- Summary of data from the previous inspection: Section 4.1.1
- Characteristics of the inspection results: Section 4.1.2
- Development of the risk model formula and factors used: Section 4.1.3
- Discussion of the rehabilitation decision support analysis: Section 4.1.4

4.1.1 Previous Inspection

The InfoAsset Planner analysis was performed using sewer and inspection data provided by SD5, as well as other published local and regional data sources. The provided data were reviewed, processed, and mapped as InfoAsset Planner facility types. GIS data were provided in geodatabase format. Two geodatabase files, FacilityBelvedere.mdb and FacilityTiburon.mdb, were copied and converted into an InfoAsset Planner database. By using the existing database, all of the required information could be provided from SD5's GIS data fields and feature classes to perform the InfoAsset Planner analysis. The GIS feature classes representing the sewer mains and how they were assigned in InfoAsset Planner's Facility and Asset Type Manager Tool are shown in Table 11.

Table 11. GIS data – feature classes

Feature class	Source	Application
SS_LINK	FacilityBelvedere.mdb	InfoAsset Planner Gravity Main
SS_LINK	FacilityTiburon.mdb	InfoAsset Planner Gravity Main

The sewer main feature class in both of these geodatabases contained both force mains and gravity mains. Table 12 summarizes the sanitary sewer collection system pipe type breakdown. For the purposes of this facility assessment, the force mains were removed from the analysis.

Table 12. GIS data – gravity main breakdown

Area	Type	Count	Total length (mi)
Belvedere	Force Main	17	1.2
	Gravity Main	337	11.4
Tiburon	Force Main	21	3.3
	Gravity Main	548	18.9
Total	Force Main	38	4.5
	Gravity Main	885	30.3

The previous gravity main CCTV inspection data were also provided in the "FacilityBelvedere.mdb" and "FacilityTiburon.mdb" geodatabases. In both databases, the "PACP_Inspections" table contains the general CCTV inspection data and the "PACP_Conditions" table contains the defect data.

Table 13 shows the number of records provided in each geodatabase. Of the total 1,102 records, 1,022 of them could be imported into InfoAsset Planner. The 80 records that were not imported into InfoAsset Planner failed to import because of a geocoding mapping failure. The inspection's Pipe Segment Reference and Upstream Manhole and Downstream Manhole references do not match the pipe data and therefore could not be used.

Table 13. CCTV inspection data summary

Source	Source CCTV inspections	Imported CCTV inspections
FacilityBelvedere.mdb	414	352
FacilityTiburon.mdb	688	670
Total	**1,102**	**1,022**

The 1,022 imported CCTV inspections were successfully linked to 793 gravity mains with a unique CCTV inspection, as shown in Table 14. Roughly 90 percent of the gravity main system has been inspected. Only 92 of the 885 gravity main segments have not been inspected since 2004. These mains will be recommended for CCTV inspection during the modeling and scheduled based on risk score.

Table 14. Gravity mains with CCTV data

Area	Type	Total gravity mains	Gravity mains w/ CCTV	Percent CCTV
Belvedere	Gravity main	337	283	84%
Tiburon	Gravity main	548	510	93%
Total		**885**	**793**	**90%**

Table 15 shows the number of inspections completed each year. Only the most recent inspection for any given pipe is counted. Most of the CCTV inspections were completed in 2004 and 2005 as part of the comprehensive Sewer System Evaluation by Harris & Associates (Harris and Associates, 2005).

Table 15. Most recent CCTV inspection

Most recent inspection year	Count of gravity mains
Not Inspected	92
2004	200
2005	386
2006	1
2008	22
2009	8
2010	53
2011	66
2013	2
2014	37
2015	2
2017	13
2018	3
Grand total	**885**

4.1.2 Characterization of Existing CCTV Findings

A review of the existing CCTV findings was performed to understand the primary issues found during the CCTV inspections. These findings were not verified against the actual CCTV videos as part of this study. It is assumed that the coding provided by SD5 is accurate and complete. A list of the top 10 structural or operational (O&M) PACP defects and the number of times that they occur in the data are shown in Table 16. This indicates that the primary defects found in the gravity main system are roots, sags, joint offsets, cracks, and fractures. The defect codes were used to develop the decision logic to identify rehabilitation and reinspection recommendations.

Table 16. PACP defect code summary for SD5's CCTV database

PACP defect code	Description	Count
RFJ	Roots fine joint	1842
MWLS	Sag	453
RMJ	Roots medium joint	406
JOM	Joint offset medium	372
CL	Longitudinal crack	288
CC	Circumferential crack	278
FC	Circumferential fracture	153
FL	Longitudinal fracture	123
JOL	Joint offset large	89
RBJ	Root ball joint	79

4.1.3 Risk Model Development

Risk is the combination of an asset's LoF and CoF. It is a numerical score that gets calculated for each asset to quantify the assets relative risk. Both the LoF and CoF components are based on other factors used for scoring. To develop a risk model, it is critical to understand all of the LoF and CoF factors that contribute to risk. Risk scoring was developed and reviewed with SD5 both graphically and spatially on a map, to enable District staff to understand the model results and determine if it makes sense based on what has been experienced in the field. This understanding of the risk model will help SD5 evaluate and communicate the tradeoffs of various investment options and to gain consensus amongst staff, stakeholders, and decision-makers during the capital improvement planning process.

The risk score is calculated as the weighted summation of the LoF and CoF values. The formula used is shown in Figure 10. For each pipe, numerical values assigned for each of the CoF and LoF categories are multiplied by the weighting factor shown in parentheses. The LoF scores are summed together, the CoF scores are summed together, and the total values for each are added together to obtain the final risk score. The LoF represents the majority of the risk score (70 percent) to identify pipes that can be rehabilitated to drive down the risk. In other words, if more emphasis is placed on CoF values, pipes that are in good condition that have a high CoF (e.g., large pipes next to schools or hospitals with no structural problems) may consistently show higher risk scores than pipes that are more likely to fail (e.g., smaller-diameter pipes with structural problems that could cause a sewer system overflow [SSO]).

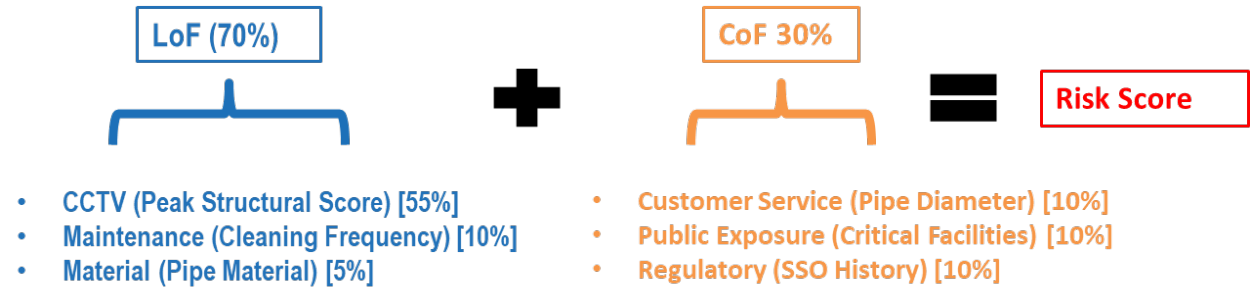


Figure 10. Gravity main risk formula

The components and the scoring for the CoF and LoF values are described below.

4.1.3.1 Consequences of Failure

CoF refers to the relative magnitude of the impact that the failure of a gravity main would have on the system or the community. For example, pipes that potentially produce larger spills or are close to schools will likely have a greater consequence if they fail compared to a smaller pipe that services a small cul-de-sac. The consequences evaluated for this analysis consider customer service, public exposure, and regulatory components.

The CoF criteria makes up 30 percent of the overall Risk Score and the breakdown of the weighting for each criterion is shown in Table 17 and discussed below.

Table 17. CoF criteria weighting

CoF criterion	Risk weighting
Customer Service (diameter)	10%
Public Exposure (critical facilities)	10%
Regulatory (SSO category)	10%

4.1.3.2 Customer Service

Customer service represents the relative impact on customers if a given pipe experiences an SSO. In general, larger diameter sewer pipes that have an SSO will potentially cause larger spills, in busier areas of the community and will be more difficult to clean up and repair. Therefore, larger diameter pipes will receive a higher score than smaller diameter pipes. This criterion uses diameter data from the SS_Link feature class with criteria and scoring developed by HDR for use in the risk analysis. Table 18 shows how this CoF was created and scored.

Table 18. CoF1: customer service

Category	Data source	Target field	Criteria	Score
Customer Service	SS_Link Feature Class	Diameter	> 15"	10
			12" < × <= 15"	9
			10" < × <= 12"	7
			8" < × <= 10"	6
			6" < × <= 8" or null	5
			4" < × <= 6"	4
			<= 4"	2

4.1.3.3 Public Exposure

Public Exposure represents the potential impact on critical facilities around SD5 should a given sewer pipe experience an SSO. Critical facilities represent locations where an SSO may have a greater safety impact on the community. This category uses the distance from the pipe to the closest critical facility to assign a score. Proximity to Schools, Fire Stations, and Park data from the various Marin County shapefiles was used and the criteria and scoring developed by HDR for the risk analysis. Table 19 shows how this CoF was created and scored.

Table 19. CoF2: public exposure

Category	Data Source	Target Field	Criteria	Score
Public Exposure	Marin County School Shapefile, Marin County Park Shapefile, and Marin County Fire Station Shapefile	School, fire station, park	<= 200’	10
			200’ < x <= 500’	7
			500’ < x <= 1000’	5
			1000’ < x <= 2000’ or Null	3
			> 2000’	0

4.1.3.4 Regulatory

The Regulatory category considers previous spill information as an indicator of the size of potential future SSOs. Historically, if a previous spill on a given pipe was large, was difficult to clean up, or reached the storm system it is reasonable to assume that future spills could have the same impact. This category uses the SSO category criteria provided by the California State Water Resources Control Board and generally applies as defined in SD5’s Sewer System Management Plan (SSMP)[SD5, 2018a]:

- Category 1: any spill that reaches a surface water body or the storm system and is not fully recovered and disposed of properly
- Category 2: spills of over 1000 gallons that do not reach a surface water body or the storm system that are not fully recovered and disposed of properly
- Category 3: all other discharges from the sanitary sewer system

The higher the category is, the greater the score is for this criterion. The analysis for SD5 uses the designated SSO category from the SSO data reported to the California Integrated Water Quality System (CIWQS) website with criteria and scoring developed by HDR for use in the risk analysis. Table 20 shows how this consequence of failure was created and scored.

Table 20. CoF3: regulatory

Category	Data source	Target field	Criteria	Score
Regulatory	CIWQS	SSO Category	Category 1	10
			Category 2	8
			Category 3	6
			No historical SSOs	0

4.1.3.5 Likelihoods of Failure

LoF represents an estimate of how soon a given sewer main may fail based on evidence of its condition, its maintenance requirements, and expected useful life. For this analysis, failure represents the likelihood that a sewer main could cause an SSO. Typically, sewer pipes that are likely to fail sooner should be rehabilitated or replaced sooner than pipes that do not show evidence of potential failure.

A higher importance has been placed on the LoF score than the CoF because of the high confidence in SD5's condition data. Therefore, it was determined that the LoF criteria would make up 70 percent of the overall risk score. The LoF criterion makes up 70 percent of the overall risk score and the breakdown of the weighting for each criterion is shown in Table 21. Each of these criteria are discussed below.

Table 21. LoF criteria weighting

LoF criterion	Risk weighting
CCTV observed defects (peak structural defect score)	55%
Maintenance (cleaning frequency)	10%
Material (pipe material)	5%

4.1.3.6 CCTV-Observed Defects

CCTV-observed defects uses the peak structural defect score assigned to each sewer main from the most recent PACP CCTV inspection. Each of the defect scores is based on condition grades assigned using NASSCO PACP methodology. These grades range from 1 to 5, with 5 being the most severe. The peak structural defect score represents the highest-grade structural defect observed on the pipe during the inspection. For this analysis, the higher the peak structural defect score for a given sewer pipe, the higher the score is for this LoF category. Table 22 shows how these scores were assigned.

Table 22. LoF1: CCTV

Category	Data source	Target field	Criterion	Score
CCTV	PACP CCTV inspections	Peak structural defect score	Grade 5	10
			Grade 4	8
			Grade 3 or no CCTV	6
			Grade 2	4
			Grade 1	2
			No structural defects	0

4.1.3.7 Maintenance

The Maintenance category uses SD5's cleaning history for a given pipe to identify pipes that require higher maintenance to prevent SSOs. In general, pipes that require more frequent cleaning tend to more quickly build up conditions that cause blockages and potentially SSOs. In addition, more frequent cleaning can cause more rapid pipe deterioration depending on pipe materials and cleaning techniques. SD5 assigns each sewer pipe to a cleaning frequency and schedule based on how quickly buildup has historically been observed in the pipe and other factors. This analysis uses the current cleaning frequency assigned for each pipe from the GIS data with criteria and scoring developed by HDR. Higher cleaning frequencies have received higher scores for this category. Table 23 shows how this LoF was created and scored.

Table 23. LoF2: maintenance

Category	Data source	Target field	Criterion	Score
Maintenance	SS_Link Feature Class	MaintFreq	4 months or more	10
			Semi-annual	8
			Yearly	6
			Two years	4
			None	0

4.1.3.8 Material

The Material category represents the manufactured characteristics of a given pipe. Some types of pipe are expected to last longer than others before they begin to degrade. Material uses the pipe material information for each pipe from the GIS data with criteria and scoring developed by HDR for use in the Risk analysis. Table 24 shows how this LoF was created and scored.

Table 24. LoF3: material

Category	Data source	Target field	Criterion	Score
Maintenance	SS_Link Feature Class	Material	Cast Iron or Concrete (CAS or CMP)	10
			Clay, fiber, polyethylene, polypropylene, transite, or asbestos (VCP, CT, OB, PLP, PP, TTE, AC, or null)	8
			Polyvinyl chloride (PVC)	5
			Plastic (CPP)	2

4.1.3.9 Relative Risk Scoring

The focus of this analysis is assessment and mitigation of risk in order to prevent SSOs. Risk was calculated using the formula shown in Figure 10, above, which yielded a relative risk score for each gravity sewer main. The risk scores are relative to SD5's collection system as a whole, meaning that they are used to determine priorities within the system, not to quantify potential failure. The risk results are shown on the pie chart in Figure 7 which shows the percentage in each category by linear footage. For the gravity pipes in SD5, the risk scores ranged from 5 to 78 out of a total possible score of 100. A risk score of 100 represents the highest possible risk (e.g., the maximum scores for each category assigned to a given pipe). A risk score of 0 represents the lowest possible risk. The risk scores represent a score relative to the calculated risk for other pipes in the system and not an absolute risk score and is a general indication of which pipes should be rehabilitated or replaced first according to the criteria.

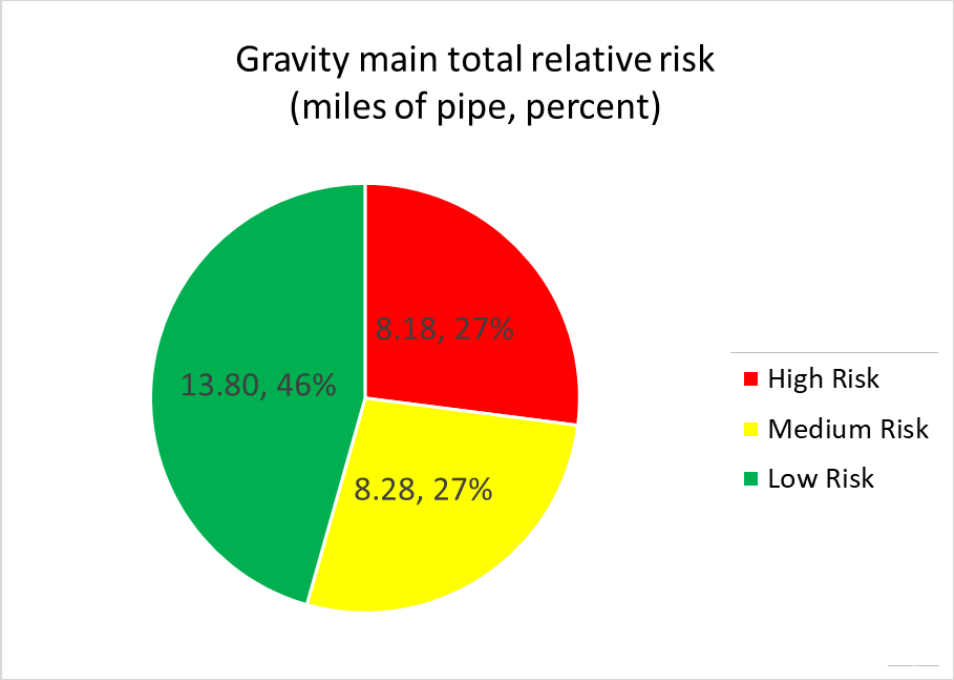


Figure 11. Risk results showing percentage of relative risk categories

The risk scores have been divided into “high,” “medium,” and “low” categories based on discussions with SD5 and natural cutoff points in some of the risk categories (e.g., structural defects). Approximately eight miles (27 percent) of SD5’s pipes fall into the high category, while almost 14 miles (46 percent) are considered relatively low risk. Figure 12 shows the general risk for each of the gravity sewer mains in SD5. Green gravity mains are considered “low risk” and red gravity mains are considered “high risk.” Appendix A provides a listing of each pipe and its respective LoF, CoF, and total risk scores.

These relative risk scores are used for prioritizing replacement or rehabilitation actions during the capital improvement planning process, which is described in more detail in the sections below.

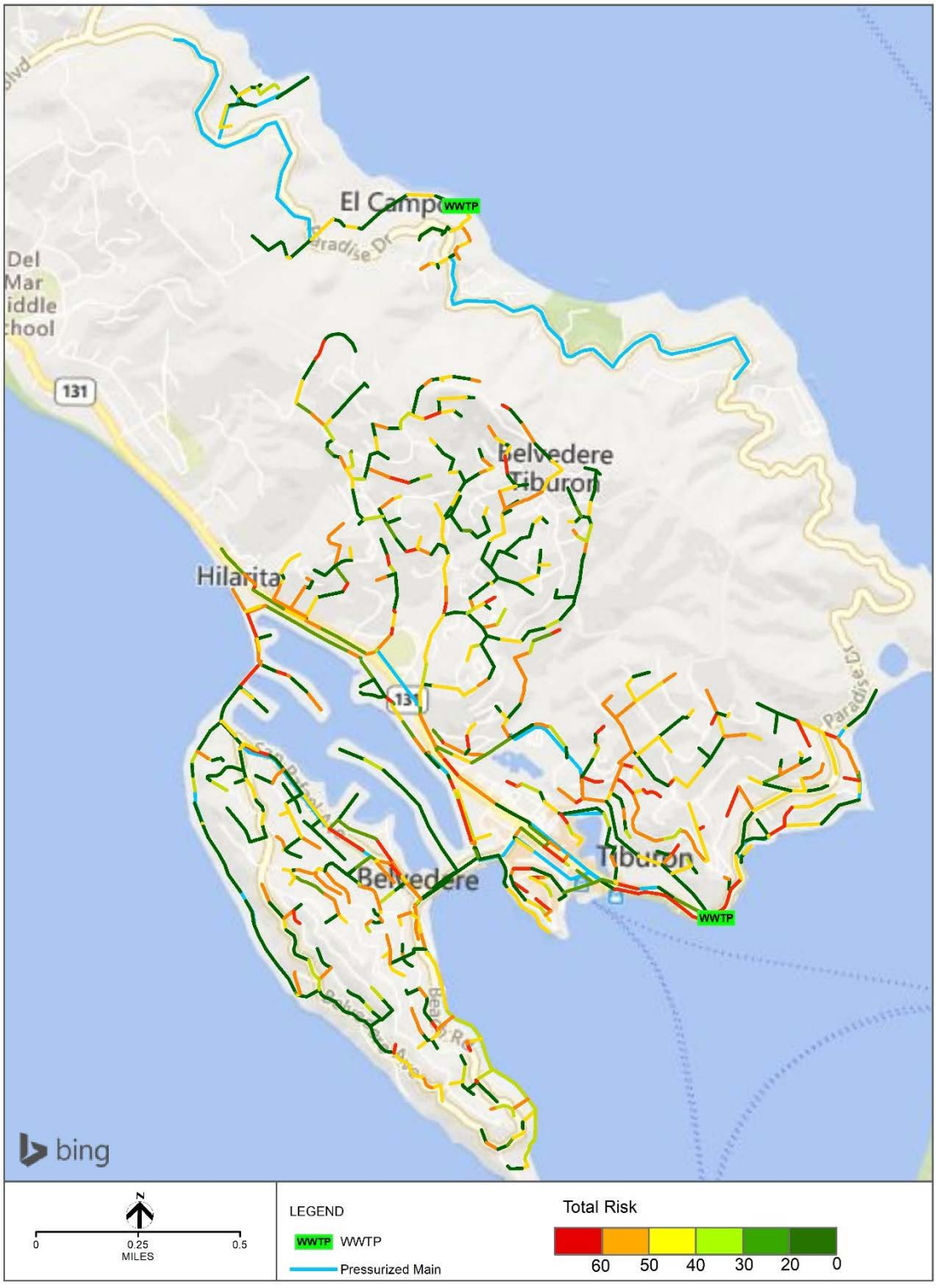


Figure 12. Risk model results

4.1.4 Rehabilitation Decision Support Analysis

This section summarizes the methodology for determining the appropriate rehabilitation recommendation for each gravity main. This was performed by developing a decision support model and rehabilitation plan based on industry experience, input from District and Nute Engineering staff, and the gravity sewer main risk modeling. Once the decision logic and initial rehabilitation plan were generated, a sensitivity analysis was performed to calibrate the model and verify that the actions identified in the model reflect what SD5 would normally do given the information provided.

The model will be provided to SD5 so that it can be updated and maintained by District staff or other consultants who use the Innovyze InfoAsset Planer software. The risk score thresholds that trigger specific risk mitigation actions may be adjusted by SD5 over time to balance budget and level-of-service targets, as additional condition assessment data are gathered, and the program is refined.

4.1.4.1 Rehabilitation Methods

The model is based on a decision tree that uses data developed for each gravity main to determine a rehabilitation or replacement action. The path that a given pipe follows in the model is based on specific data thresholds in the decision logic. A workshop was held with SD5 to review and edit the initial decision logic. The decision logic aggregates the information from the inspections and risk score and provides an automated identification of a primary action to address the identified risks within the gravity mains. The primary action documents the primary risk management action for the gravity mains. The following primary actions were included in the decision logic:

- **Replacement:** complete open-trench replacement of the pipe
- **Pipe bursting:** a trenchless method of sewer construction that uses the path of the existing pipe as a guide for constructing the new pipe
- **Full CIPP lining:** a trenchless construction process that installs a cured-in-place-pipe (CIPP) liner within an existing pipe that repairs structural defects
- **Point repair:** a trenchless process that uses a liner to repair a small section of pipe
- **CCTV inspections:** if no repairs are required, a future-scheduled reinspection of the entire pipe using a CCTV camera

4.1.4.2 Decision Logic Development

The decision logic is modeled in a flow chart that shows the basic planning strategy for identifying defects and the subsequent recommended action. The flow chart for SD5 was first modeled in Microsoft Visio to capture accurate decision points and actions and was then converted into a decision logic algorithm in Innovyze's InfoAsset Planner software. This enables the software to automate the process of recommending rehabilitation and reinspection actions for each gravity main.

This method provides a transparent, defensible, and repeatable approach that decision makers can use to consistently develop recommended actions and timing for capital planning. The process makes it easy to correlate desired level-of-service goals to justify actions, determine priorities, communicate risk, and identify anticipated costs to stakeholders. The logic is used to develop highly confident and defensible renewal forecasts.

The gravity main rehabilitation decision logic flow chart developed for SD5 is shown in Figure 13. The process starts in the upper left corner of the figure and first identifies if the given pipe has the potential to improve I&I issues identified during the I&I analysis (discussed in detail in Section 4.2), which can be used for additional prioritization if a repair action can help mitigate known areas of I&I. Note that the I&I mitigation potential does not determine a specific rehabilitation method but it can be used as additional background information to determine final priorities during the last stages of capital planning. Therefore, the potential impact is noted for each pipe. Next, if the miscellaneous water level sag (MWLS) is greater than 50 percent, this indicates the presence of one or more sags on the pipe, which is applied as another note for planning purposes (e.g., does not dictate the rehabilitation method). If the pipe does not have any

CCTV inspection data, it is routed to be scheduled for an inspection with the priority determined by the pipe relative risk score. If the pipe does contain inspection results and shows at least one structural defect related to rehabilitation, it is routed to the main section of the decision process.

The PACP defects that have been selected for rehabilitation are shown in Table 25.

Table 25. Significant defects identified in SD5 CCTV inspections

Defect code	Description	Severity (5 = worst)	Count of occurrences
BVV	Broken void visible	5	28
SRP	Surface reinforcement projecting	5	27
SMWM	Surface missing wall mechanical	5	17
BSV	Broken soil visible	5	11
HVV	Hole void visible	5	10
SMW	Surface damage missing wall	5	9
HSV	Hole soil visible	5	9
XP	Collapsed pipe sewer	5	5
SRC	Surface damage reinforcement cement	5	2
DI	Dropped invert	5	2
OBI	Obstruction intruding through wall	5	1
IG	Infil gusher	5	1
SRVM	Surface reinforcement visible mechanical	5	1
RBB	Roots ball barrel	5	1
MCU	Miscellaneous camera underwater	4	99
JOL	Joint offset large	4	89
RBJ	Roots ball joint	4	79
FM	Fracture multiple	4	68
B	Broken	4	47
JSL	Joint separated large	4	28
IR	Infil runner	4	16
RBL	Roots ball lateral	4	6
RMB	Roots medium barrel	4	5
JAL	Joint angular large	4	3
RPRD	Point repair replacement defective	4	1
RBC	Roots ball connection	4	1
RMJ	Roots medium joint	3	406
JOM	Joint offset medium	3	369
FL	Fracture longitudinal	3	116
JSM	Joint separated medium	3	57
ID	Infil dripper	3	44
JAM	Joint angular medium	3	23
CM	Crack multiple	3	20
SAVC	Surface aggregate visible chemical	3	18
SCP	Surface corrosion metal pipe	3	16

Defect code	Description	Severity (5 = worst)	Count of occurrences
TBD	Tap break-in defective	3	13
RMC	Roots medium connection	3	6
FH2	Fracture longitudinal hinge, 2	3	5
RML	Roots medium lateral	3	5
LFB	Lining feature blistered	3	4
MMM	Missing mortar medium	3	2
SRPM	Surface reinforcement projecting	3	2
FS	Fracture spiral	3	1
SAP	Surface damage aggregate projecting	3	1

Each of the rehabilitation methods that SD5 may perform are shown as colored columns in the flow chart. Depending upon the characteristics of the defect, the configuration of the pipe, the relative risk score, and the repair history on the pipe the type of rehabilitation will be identified. These results can be used to plan capital improvement actions discussed in more detail below.

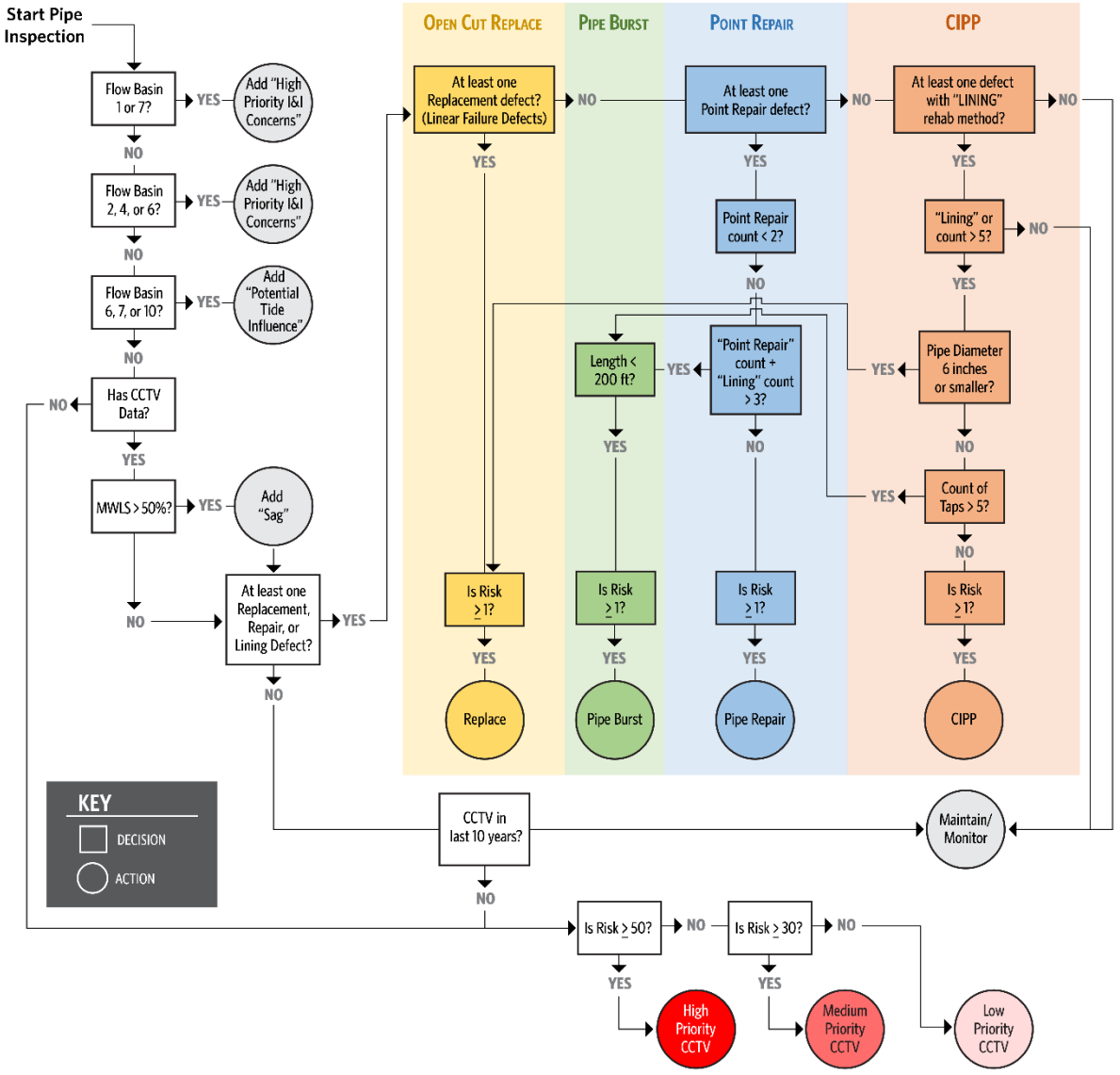


Figure 13. Gravity main decision logic

4.1.5 Assessment and Recommendations

Based on the risk model, decision logic, and rehabilitation unit costs, a rehabilitation or condition assessment recommendation was assigned to each gravity main in the Tiburon and Belvedere systems. A summary of the rehabilitation recommendations is shown in Figure 14. This figure summarizes the results of the different recommended actions showing total estimated cost and length of pipe for each alternative. This view includes all the pipes in the collection system for SD5; however, it is unlikely that all of these actions will need to take place in the next 15 years. SD5 can select the amount of work that is appropriate to do based on the pipe risk scores, available budgets, and consideration of other necessary capital work. The capital planning section of this Master Plan discusses these topics in more detail. A listing of each District gravity main and the recommended rehabilitation action is provided in Appendix B. The cost basis for developing the rehabilitation estimates is provided in Appendix C.

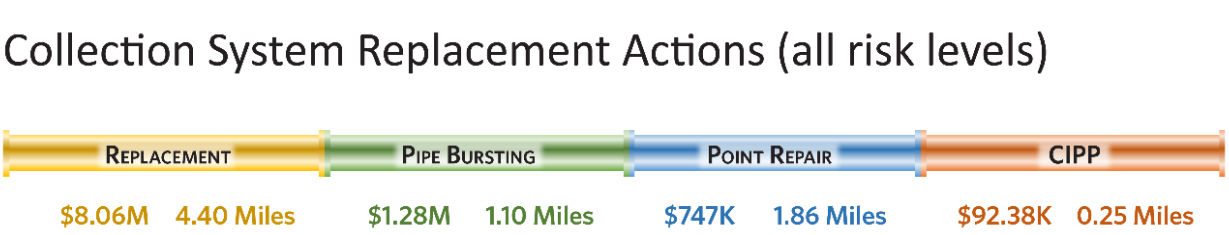


Figure 14. Rehabilitation model results: no risk threshold

Figure 15 provides a similar summary for all future pipe inspections identified in the model. These inspections are categorized as high, medium, and low priority based on pipe risk scores and the established cutoff values. The cost and total sewer main length is provided for each category, as well as category percentages (shown in the pie chart). Gravity mains are identified for future inspections if they meet one of the following criteria:

- No historical CCTV data
- No structural PACP defects on the most recent CCTV
- Does not meet the required criteria to receive a rehabilitation recommendation

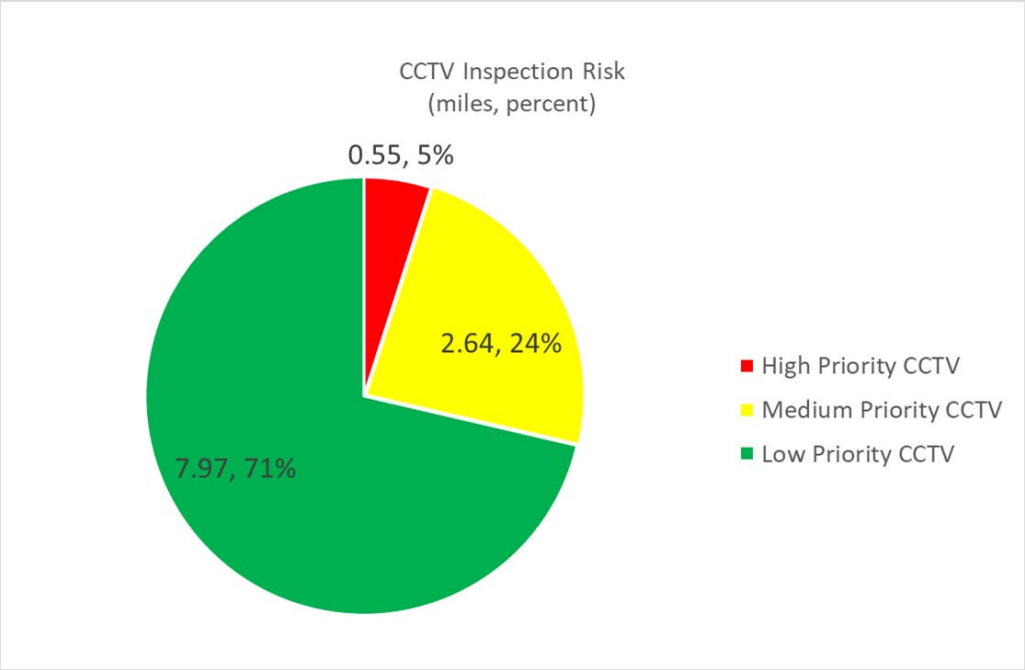


Figure 15. CCTV model results – no risk threshold

A breakdown of the previously uninspected gravity mains based on their risk is shown in Table 26. It is recommended that the high-priority uninspected pipes to be inspected as soon as possible.

Table 26. Uninspected gravity main recommendations

CCTV recommendations	Count of uninspected pipes
High priority CCTV	12
Medium priority CCTV	79
Low priority CCTV	1
Grand total	**92**

Based on the risk modeling only a relatively small amount of gravity main has been identified as high priority for reinspection, even though the last inspection for most of the system is over 15 years old. However, it is important for SD5 to determine if additional deterioration has occurred in the lower risk pipes over that time period. In order to verify that these lower-grade issues have not become more urgent repairs, a degradation analysis is recommended. The degradation analysis selects several pipes for another CCTV inspection. By comparing the current CCTV results with the original results, SD5 will be able to determine the amount of degradation that has occurred, which types of defects degrade the fastest, and if there are any additional pipes that require urgent rehabilitation.

4.1.5.1 Rehabilitation

SD5 can use the pipe risk scores to select the highest-risk rehabilitation recommendations that fit within its resource constraints. To demonstrate this, three scenarios are presented here corresponding to different risk levels calculated for each pipe. An overview of the three scenarios is provided in Table 27, below.

Table 27. Summary rehabilitation scenarios for collection system pipes

Scenario number	Risk level	Percentage of system	Total		Replacement		Point repair		Pipe bursting		CIPP	
			Cost ($ thousands)	Length (mi)	Cost ($ thousands)	Length (mi)	Cost ($ thousands)	Length (mi)	Cost ($ thousands)	Length (mi)	Cost ($ thousands)	Length (mi)
0	All risk levels	25%	$10,174	7.6	$8,055	4.4	$747	1.9	$1,280	1.1	$92	0.3
1	50 or greater	16%	$6,624	4.9	$5,070	2.8	$389	1.0	$1,080	0.9	$81	0.2
2	60 or greater	7%	$2,843	2.1	$2,080	1.1	$153	0.5	$559	0.4	$48	0.1
3	70 or greater	2%	$999	0.7	$590	0.3	$82	0.3	$327	0.2	$0	0.0

This page is left intentionally blank.

Scenario 0 shows all rehabilitation recommendations regardless of risk. This is shown for comparison purposes. Scenario 1 is the most conservative rehabilitation strategy of the remaining three scenarios. It selects rehabilitation actions on pipes that have a risk level of 50 or greater. It addresses rehabilitation on 16 percent of the system for a total of $6.6 million. Scenario 2 provides rehabilitation for pipes with a risk score of 60 or greater, or about 7 percent of the system. Total cost for Scenario 2 is $2.8 million. The highest-risk scenario is Scenario 3, which addresses rehabilitation on pipes with a risk level of 70 or greater. This comprises only 2 percent of the pipes and will cost approximately 1.0 million.

The amount of sewer main rehabilitation and reinspection that SD5 desires to accomplish in the coming years will depend on funding availability, completion with other capital needs, and SD5's strategy on mitigating risk. These are discussed in detail in the Section 5.0 below.

4.2 Inflow and Infiltration Analysis

This section describes the I&I analysis of the 2012-2011 flow monitoring study (E2 Consulting Engineers Inc., 2011) and provides a discussion of the potential impacts of sea level rise based on the analysis from the Marin Shoreline Sea Level Rise Vulnerability Assessment report (BVB Consulting LLC, 2017). The results of these analyses have been incorporated into the gravity main rehabilitation decision support analysis described in Section 4.1.4, as well as additional recommendations described in more detail in Sections 4.2.11 and 4.2.12 below. The detailed analysis is described here in Sections 4.2.1 through 4.2.10.

4.2.1 Background and Previous Study

I&I is excess water that flows into the collection system from groundwater, stormwater, and other non-sewage sources. I&I causes dilution at the treatment plant, which makes the treatment process less efficient and may even damage some of the treatment processes. Excess flow in the system may cause surcharging and lead to SSOs.

I&I has been recognized as a problem for SD5 and was studied during the 2010–2011 wet season to determine where it might be originating from. A flow monitoring study was performed in selected areas to measure wet weather and dry weather flows for a 3-month period. As part of this Master Plan, HDR was asked to review the report and evaluate the data provided to determine the impact on I&I on the basins monitored and develop recommendations for mitigation. This section summarizes SD5's current system conditions and anticipated future needs from an I&I perspective. Recommendations are provided to help improve the system, inform the capital improvement planning process, and ensure a resilient sewer system for present and future customers.

Infiltration is extraneous flow that enters the sanitary sewer through cracks and holes in sewer pipe below the ground and can take many forms. Infiltration can occur from groundwater when the water table rises above the level of the sewer because of storms or other factors, including rising tidewater. Stormwater can also cause infiltration when rainwater percolates into the ground and enters the sewer through pipe cracks and other structural defects where the sewer is located above the groundwater table. Stormwater infiltration begins during storm events and may continue for several days after the rain event ends.

Inflow occurs where rainwater runs directly into the sewer from other direct connections such as catch basins, street inlets, roof downspouts, yard drains, foundation drains, and manhole lids. Typically, inflow enters the system rapidly during rain events and ceases quickly once the rain event ends. Once located, inflow sources can be disconnected at usually a relatively low cost. Inflow can be recognized by a sharp increase in flow during and immediately after a rain event.

4.2.2 The Impact of I&I

During dry weather, the impact of I&I is usually less of an issue while wet weather conditions produce a much larger problem by introducing stormwater into the system from existing I&I sources. As the wet season progresses, soils become saturated and the groundwater table rises, further magnifying the problem. Available flow capacity for sewage is reduced during storms and during the wet season, which can lead to damaging and costly SSOs when the combined I&I and sewage flows can exceed conveyance capacity, resulting in overflows from low-lying manholes or backups into basements of low-lying homes.

I&I can also impact a treatment plant's ability to treat domestic and industrial wastewater. During periods of high I&I, wastewater treatment processes are forced to process higher flows, which can exceed design capacity and potentially upset the treatment process. As a result, wastewater agencies may also face violation of their regulatory discharge limits because the extraneous flow stress treatment units and processes and degrades their performance.

4.2.3 Inflow and Infiltration Mitigation

Efforts to mitigate I&I vary depending upon the causes. Inflow can be relatively easy to mitigate by locating and disconnecting inappropriate connections to the system (in the case of private sector sources) or repairing or improving the system at the point of inflow (in the case of public sector sources). . Infiltration is more difficult to eliminate because it can potentially travel through any defects in the system and thus may not be eliminated until all the defects are repaired (often including repairs on private sewer laterals).

A key differentiator between infiltration and inflow is that peak wet weather flow can take several days to return to dry weather state if the increased flow is caused by infiltration, while inflow-related flow increase will likely return to dry weather levels within a couple of days of the end of a storm event.

4.2.4 Summary of 2010-2011 Study

SD5 previously conducted a flow monitoring program to measure the magnitude and components of flow that enter into the sewer collection system. The flow monitoring program lasted from December 21, 2010, to March 31, 2011. Flow monitors were installed at the lowest point in 10 sewer basins in the system. In addition, four rain gauges were installed to continuously record rainfall data for the monitoring period. This program was conducted only on the selected basins within SD5's collection system and approximately 50 percent of the system was evaluated as measured by miles of pipe. Figure 16 shows the rain gauge and flow meter locations and Figure 17 shows the basins monitored. It is important to note that, because the I&I study was limited, a significant portion of the collection system was not monitored. The logic for selecting the I&I basins for the study is unknown; however, there may be additional I&I issues in some of the unmonitored low-lying areas where larger-diameter pipe is present. These areas may also contain undetected significant I&I issues.

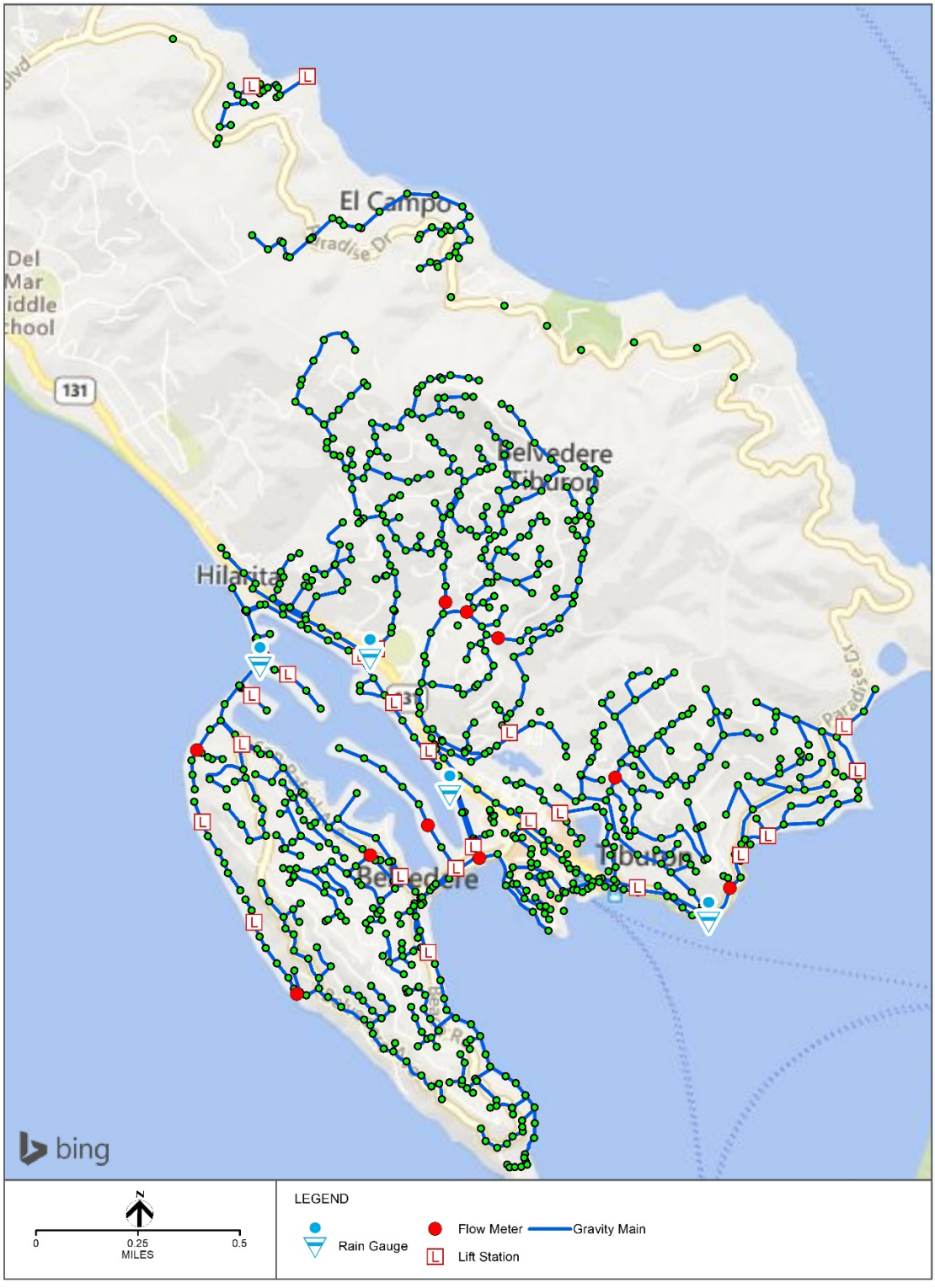


Figure 16. Rain gauge and flow meter locations

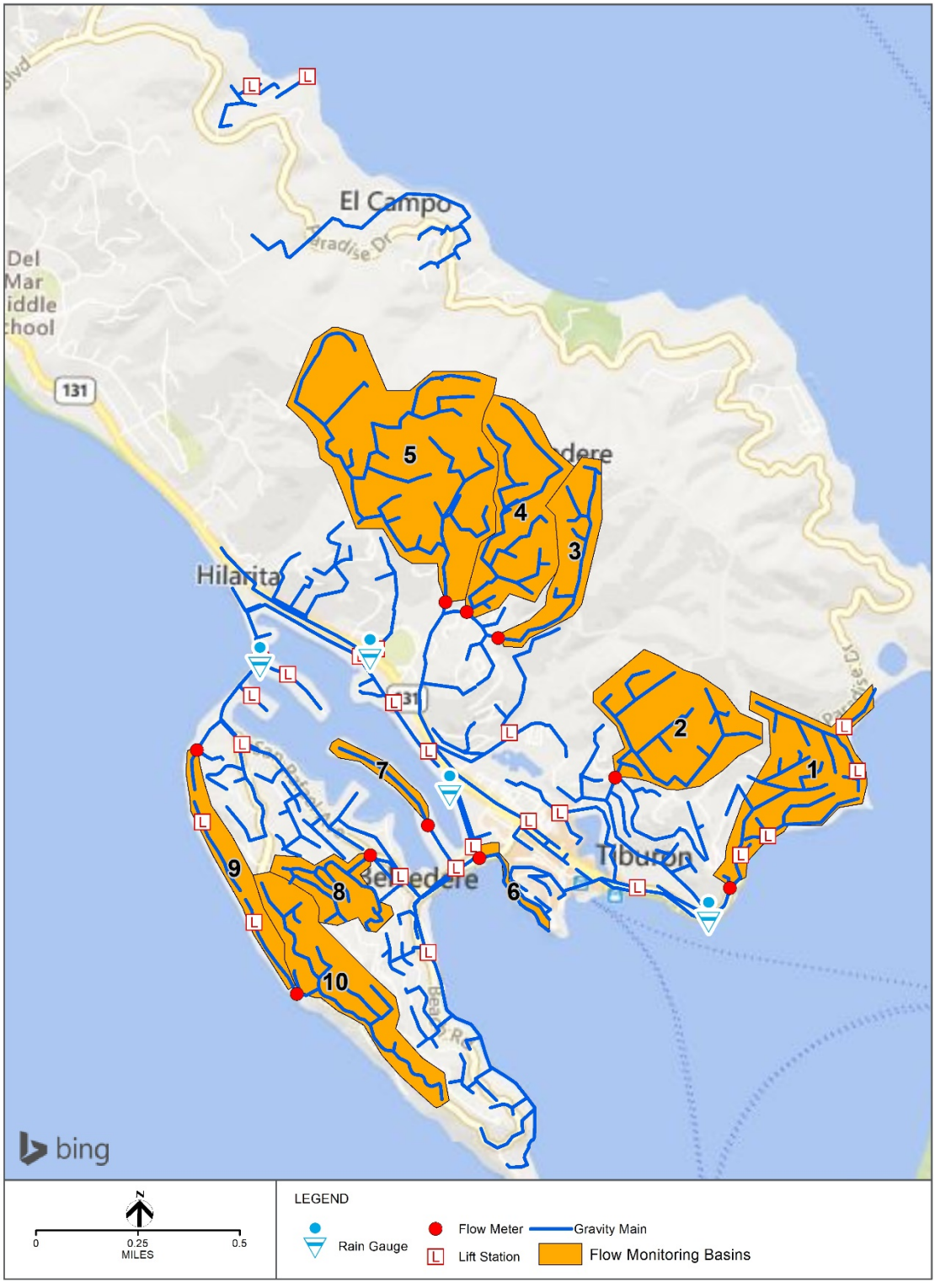


Figure 17. Flow monitoring basins established for the study

During the 93 days of the study, rainfall occurred on 40 of those days totaling 17 inches. The study provided hydrographs for the 10 flow monitors and rainfall data at each of the rain gauges. The study identified four of the basins with high rain-dependent infiltration and inflow (RDI/I), and offered recommendations on additional flow monitoring, smoke testing, and CCTV inspection.

4.2.5 Current evaluation

For this Master Plan HDR analyzed the results of the previous study to further refine the results and identify specific mitigation actions. Although the raw data were unavailable, the hydrographs produced from the work were used as well as the summary tables for each basin in the report. The primary analyses performed included:

- Comparison of the flow monitoring hydrographs to rainfall hyetographs to try to distinguish between inflow and infiltration contributions in each basin
- Comparison of flow monitoring metrics between basins to determine which are most impacted by I&I and to further understand inflow versus infiltration impacts
- Analysis of tide fluctuations during the study period in comparison to the hydrographs to determine if there was evidence of tidal influence on infiltration occurring in the near-shore basins
- Evaluation of the flow monitoring hydrographs to identify unusual flow anomalies not explained by wet weather events and to determine if there are any potential pipe capacity issues

Through these analyses, HDR has provided recommendations for mitigation of I&I in the system as well as actions for further study to better understand how I&I is impacting the system. These analyses have been completed assuming that the data and calculations provided in the original report are accurate and representative of the original study. Analytical quality review of the original analysis or confirmation of calculations has not been performed.

In addition to the evaluation of the previous flow monitoring study, an analysis of the potential impacts of SLR on SD5 were evaluated by reviewing the Tiburon and Belvedere sections of the Marin Shoreline Sea Level Rise Vulnerability Assessment. This report, prepared by the Marin County Department of Public Works in 2017, modeled several SLR scenarios and their impacts around the county. This Master Plan also provides a summary of potential impacts to SD5 based on the scenarios modeled and offers recommendations for mitigation.

4.2.6 Flow Basin Data Analysis

The following definitions are used for this analysis:

- Base sanitary flow (BSF): the contribution of sewer flow that is composed of sewage (i.e. not inflow or infiltration). BSF can be calculated by subtracting groundwater infiltration from the average dry weather flow.
- Groundwater Infiltration (GWI): the contribution of sewer flow that is due to infiltration by groundwater. This is usually determined from the average low nighttime flows measured during dry periods.
- Average dry weather flow (ADF): the portion of sewer flow not related to RDI/I primarily composed of both BSF and GWI. This is usually calculated by averaging flow data measured during dry periods.
- Rain dependent inflow and infiltration (RDI/I): extraneous flow that enters the sewer system in response to intensive rainfall events. RDI/I is calculated by subtracting the ADF from the total measured flows.
- Peak I&I flow: the largest RDI/I flow each basin experiences throughout the monitoring period

These values are used to calculate the basin performance metrics described below.

4.2.7 Inflow vs. Infiltration

Review of the flow monitoring results and hydrographs from the study (E2 Consulting Engineers Inc, 2011) suggest that the system is predominantly impacted by inflow as opposed to infiltration. Evaluation of flow monitoring hydrographs during storm events throughout the monitored basins show that the flow mostly returns to dry weather conditions within one to two days after each of the recorded rain events. Figure 18 shows a typical example of this behavior during the February 24, 2011, storm event. The rainfall throughout the storm is depicted by the bar hyetograph shown at the top, and the response in the system is shown by the flow line below. As shown, the measured flow increased sharply upon initiation of the storm event, then dropped significantly within a day after the rainfall stopped, indicating that inflow has more influence on the system than infiltration. Flow predominantly impacted by RDI/I would show a prolonged period after the wet weather event where the flow level gradually returns to pre-storm levels only after several days. There is some infiltration influence observed in the graph in the somewhat higher peaks after the end of the storm event, but these are relatively small.

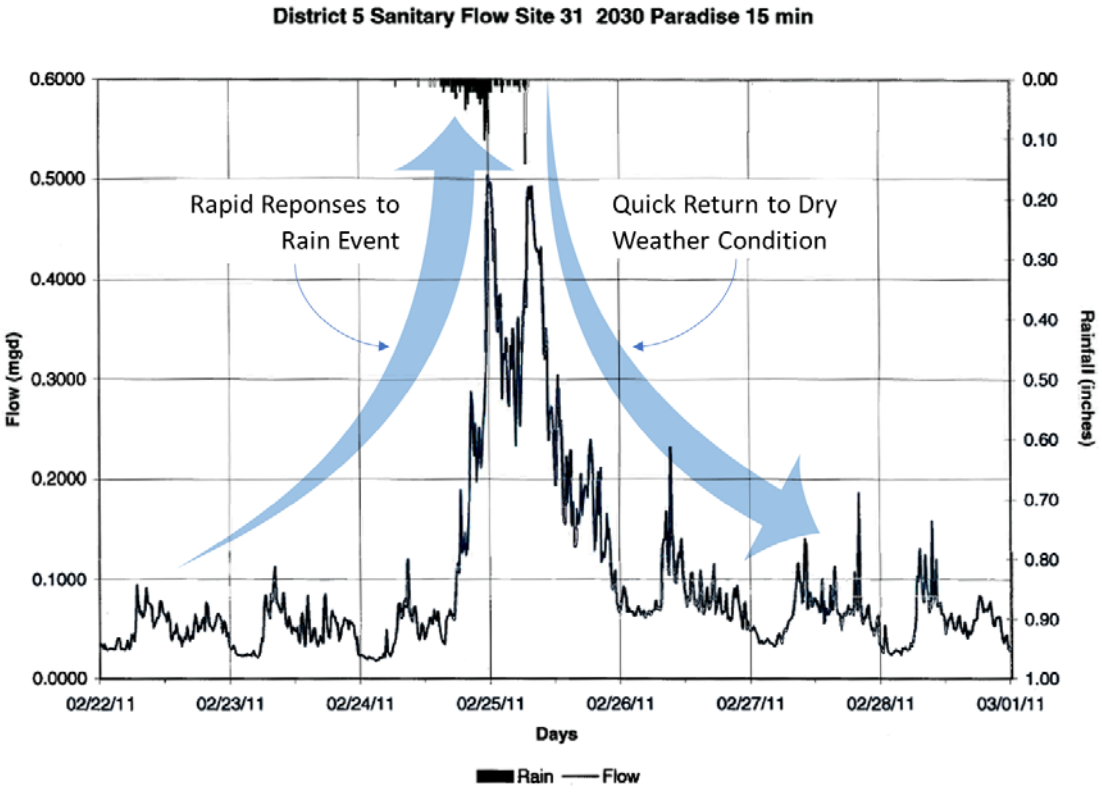


Figure 18. Typical example of the system response to rain events

The flow patterns during and after rain events materially increases peak flow in other flow monitoring basins as well. Some areas are impacted severely while others show only a minor increase. The nearly instantaneous increase in peak flow is indicative of inflow rather than RDI/I as driving the storm-related flow response. In addition, the other flow hydrographs typically show a rapid decline in flow after each storm ends, indicating that water is quickly entering the sewer system rather than slowly filtering through the soil and entering the system through defects in sewer pipes.

Groundwater infiltration does not appear to be significant within SD5 sewer system. However, summer dry weather flow measurements were not obtained during the study. It is possible that the actual dry weather flow is even lower during the driest times of the year. The difference between summer dry

weather flow and the observed dry weather flow during the study would be a good indicator of groundwater (seasonal) infiltration. In addition, no groundwater level data were provided in the study, which can be used to determine if the water table is high enough to cause groundwater infiltration. If all the sewers are located above the ground-water table, the groundwater infiltration can be eliminated as an infiltration source. If SD5 observes evidence of water leakage into manholes during dry flow periods, it is likely that the sewer is below the water table.

4.2.8 Basin Comparisons

To understand how each basin responded to rainfall, flow data from the monitoring program were used to calculate four key performance indicators (KPIs). Each of the flow monitoring basins differs in characteristics such as area served, length of pipe, and size of pipe. This makes it difficult to compare flow results between the basins to understand how well they are performing related to I&I. These KPIs provide normalized metrics that enable a more consistent comparison to help SD5 prioritize where to focus its I&I reduction efforts. In addition, the four KPIs can be used to provide additional insight on the influence of inflow versus infiltration in each basin. The KPIs calculated are:

- R-factor: This number represents the percentage of rainfall by volume that enters each basin during rainstorms. These values were calculated for each basin during the original study. It is one measure of the impact of rainfall-induced flow increase and is a good indicator of where the system is leaking. The R-factor reflects the percentage of rainfall getting into the system and does not convert directly to the actual amount of I&I entering the system.
- Peak I&I per acre served: This metric calculates the peak I&I flow divided by the number of acres in the basin.
- Peak I&I per mile of pipe: This is the calculation of the peak I&I flow divided by the number of miles of sewer main contained in the basin
- Peak I&I per inch diameter mile of pipe: This measurement is the calculation of the peak I&I flow divided by the surface area of the sewer mains contained in the basin

The R-factor and the peak I&I per acre served are better indicators of inflow while the peak I&I per mile of pipe and the peak I&I per inch diameter mile of pipe are better indicators of infiltration.

The abovementioned four KPIs were calculated for each monitored basin as shown in Table 28. Figure 17 above shows the flow monitoring basins area and their number.

This page is left intentionally blank.

Table 28. Flow data metrics by basin

Basin no.	Monitor site	Basin name	Basin area (acres)	Length of gravity main (miles)	R-factor	Peak I&I per gross acre (gallon/acre/day)	Peak I&I per mile of pipe (gallon/mile/day)	Peak I&I per inch diameter mile of pipe (gallon/inch-mile/day)
1	31	2030 Paradise Dr.	52.3	2.60	**20%**	**14,000**	**282,000**	**48,000**
2	73	Raccoon at Central	57.0	1.62	5%	**10,000**	**351,000**	**58,000**
3	132	80 Lyford Dr.	27.5	0.84	9%	8,000	262,000	43,000
4	129	Marinero Circle	52.0	2.24	**11%**	5,000	116,000	19,000
5	215	Round Hill at Lyford	127.0	3.66	3%	3,000	104,000	17,000
6	NA2	Beach at Cole	3.5	0.87	**11%**	**29,000**	117,000	15,000
7	H2	17 Peninsula	6.4	0.30	**60%**	**52,000**	**1,100,000**	**183,000**
8	ND5	Laurel Ave. and San Rafael	19.8	1.16	6%	3,000	51,000	8,000
9	CA2	15 West Shore	19.9	0.96	4%	**10,000**	208,000	31,000
10	F7	End of West Shore	45.6	1.59	4%	6,000	172,000	27,000

This page is left intentionally blank.

Based on the calculated KPIs, the following two sewer basins warrant further inflow investigation and remediation:

- **Basin 7 – 17 Peninsula:** This basin has substantially higher metrics in all categories than the other basins. Because it covers a very small area and a has a low pipe mileage, it is potentially the most cost-effective opportunity to reduce a significant amount of inflow into the system.
- **Basin 1 – 2030 Paradise Dr.:** This is one of the larger basins monitored. It has the second highest R-factor and has high numbers in every category. This basin likely contributes a significant amount of I&I to the system because of its large size and high metrics.

The following sewer basins should also be considered due to unusual metrics:

- **Basin 6 – Beach at Cole:** This is the smallest basin in the study but produced a notable R-factor and very high peak I&I per gross acre. Because of its small size, it may be very cost-effective to target inflow reduction; however, the total volume reduction to the system will be much lower than for Basins 1 or 7.
- **Basin 2 – Raccoon at Central:** Even though this basin has a low R-factor, it has significantly high numbers in all categories and could provide significant reduction in I&I in the system.
- **Basin 4 – Marinero Circle:** This basin also has a notable R-Factor and could provide some reduction in overall I&I, but would not make as large an impact as the other basins because of comparably lower peak I&I numbers.

In general, basins with R-factors below 10 percent or that have I&I rates under 5,000 gallons per acre per day are not likely to show significant improvement in I&I reduction in the system. Among the basins described above, the actual conditions for Basins 6 and 7 may be worse than what the metrics indicate as they may possibly be having capacity issues during peak flow periods. This is discussed in more detail below.

The investigation and remediation should concentrate on inflow rather than infiltration as inflow is likely the bigger issue, as shown on the hydrographs. Inflow is usually easier to identify and more cost-effective to remediate than infiltration (however it can be more challenging politically). By identifying and eliminating illicit connections to the system, a significant impact on I&I can be achieved. In contrast, it is possible that SD5 may not achieve a material reduction in infiltration until many of the sewer main, service laterals, manholes, and other structures are rehabilitated or replaced.

4.2.9 Tidal Impacts on Flow

Tides are the sea level changes caused by the combined effects of the gravitational forces exerted by the moon and the sun, and the rotation of the earth. The tidal change in sea level can also temporarily elevate the groundwater table near shorelines, which increases the amount of groundwater infiltration as more of the sewer infrastructure is covered by groundwater. When sea water gets into the sanitary sewer system, it not only reduces collection system capacity to carry sanitary flow, but it also disrupts wastewater treatment process because of the higher-than-normal wastewater salinity.

Tide level could have a significant impact on the collection system because much of SD5 is located adjacent to the coastline where tidal fluctuations would be observed. Tide analyses were performed on basins located near the coastline (i.e., Basins 1, 6, 7, 8, 9, and 10). Basins 2, 3, 4, and 5 are located farther inland along the spine of the Tiburon Peninsula and are thus far enough away from the coastline to not be affected by the tides.

To analyze tidal influence, tidal data were compared to the flow captured on the flow monitoring hydrographs to determine if there was any correlation between measured flow and tide level. Two approaches were evaluated: (1) an hourly tidal analysis to determine if measured flow levels fluctuate under the influence of tide on an hourly basis and (2) a daily tidal analysis where the normalized daily

peak flow is compared to normalized daily peak tide level to determine if there are any longer-term correlations or trends.

7.1 Hourly Tide Analysis

In basins monitored near the bay, the flow data generally do not show an increase that corresponds to the time of high tide during non-rain days. Figure 19 below presents an example of flow data from Basin 10 compared to tide level changes on an hourly basis (E2 Consulting Engineers Inc, 2011). The example period is chosen as there were no wet weather events to influence the data. As shown, measured flows are at the minimum level around midnight and gradually increase after around 6 a.m. Measured flows fluctuate through the daytime and gradually decrease after around 11 p.m. Such a flow pattern is typical for most monitored basins and is an indication that the hourly flow is driven mainly by diurnal sanitary flow when dry weather conditions are present. High tides in the bay occur approximately every 12 hours and 25 minutes and are shown on the graph in the bottom of the figure. The daily changes in flow do not appear to correlate with the tidal fluctuations shown for the same period. The lowest flow periods are consistently in the early morning hours of each day whereas the lowest tides are occurring around sunrise and sunset. There may be a daily contribution from tidal changes; however, it is not significant enough to be reflected in the flow monitoring hydrographs. Similar results were also observed in other basins reviewed.

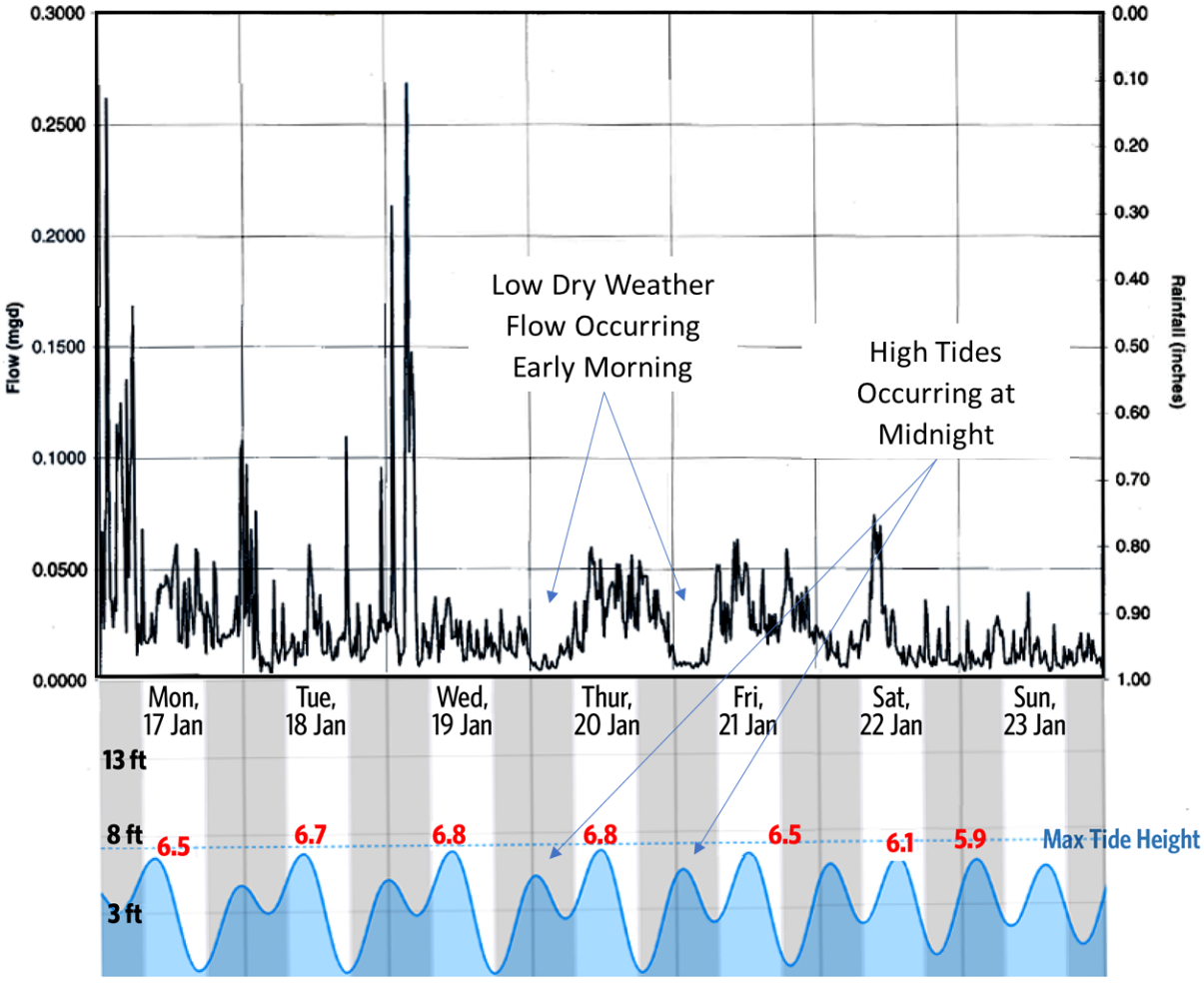


Figure 19. Measured flow correlated to hourly tides

7.2 Daily Tide Analysis

Tidal changes occur not only daily; they also change in magnitude over longer periods in response to many factors including weather and the relative positions of the sun and moon. This results in variations in the high- and low-water levels over time. To determine if there were any long-term tidal impacts from the highest tides during the study, an additional analysis was conducted. Daily high tide data along with daily peak flow data were normalized to a 0–1 scale and plotted against monitoring dates to observe longer-term trends. Rainfall data were also plotted into the graph to indicate when storm events occurred. To better understand the correspondence between flow and tide and avoid interference from storm events, the analysis considered the period between early January and mid-February 2011 when storm events were at a minimum.

Observations in Basin 10, as shown in Figure 20, indicate a consistency between normalized high flow data and normalized high tide data from early January to mid-February 2011. This suggests that Basin 10 flow may be influenced by high tides that exceed a certain height which cause infiltration or inflow. Smaller high tides may not be sufficient to enter the system. **This is not likely to be a major impact on I&I overall; however, it could become worse as sea level rises.**

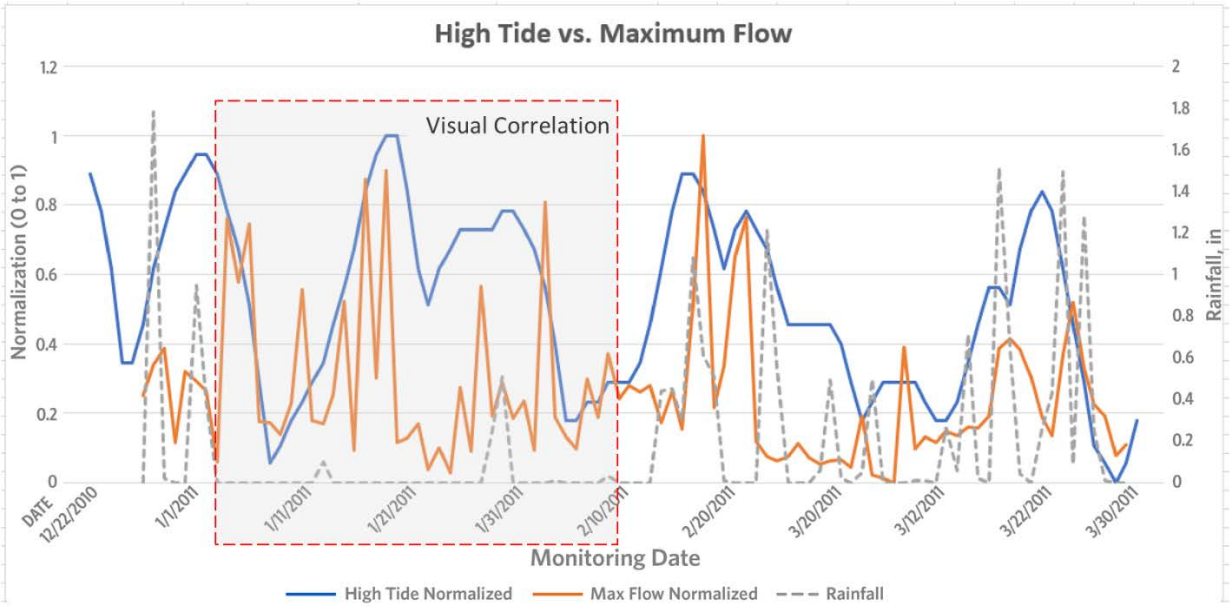


Figure 20. Peak flow data correlated to maximum tides in Basin 10

For comparison, Figure 21 shows a similar plot for Basin 1, where most of the basin collection area is sufficiently far from or higher than the coastline and is thus not impacted by high tides. The normalized peak flow value remains at a low level from early January to mid-February 2011 despite the high tide event occurring at the same time.

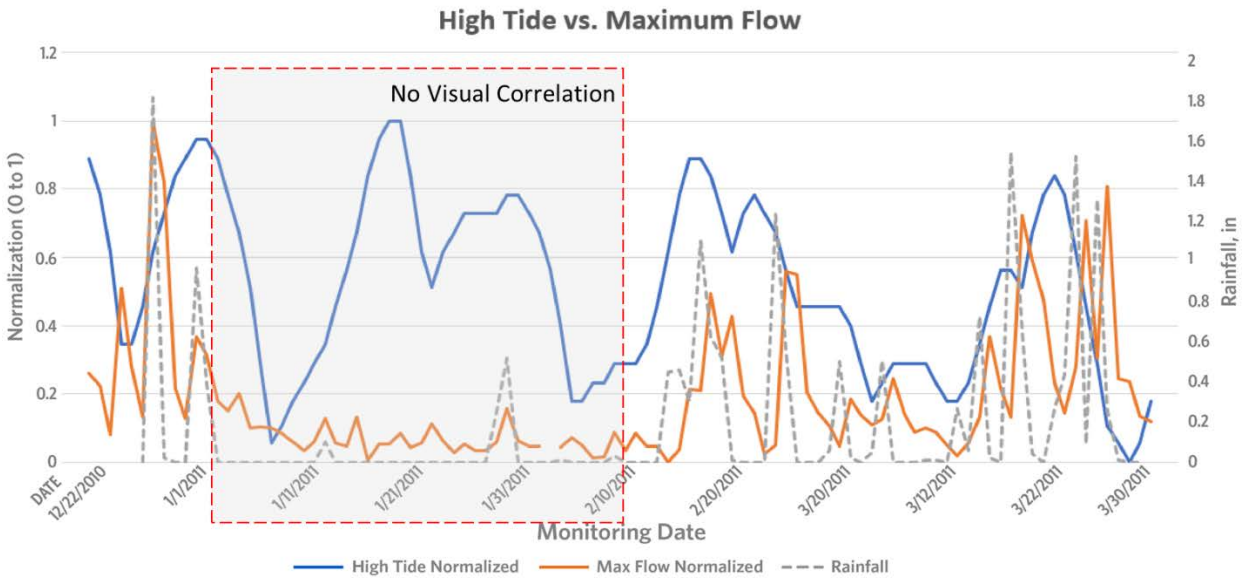


Figure 21. Peak flow data correlated to maximum tides in Basin 1

Other basins suspected to be influenced by longer-term high tide trends are Basin 6 and Basin 7. However, their correlations cannot be confirmed because of missing flow data in part of January 2011. Basin 6 and 7 peak flow versus high tide charts are presented in Figure 22 and Figure 23, respectively.

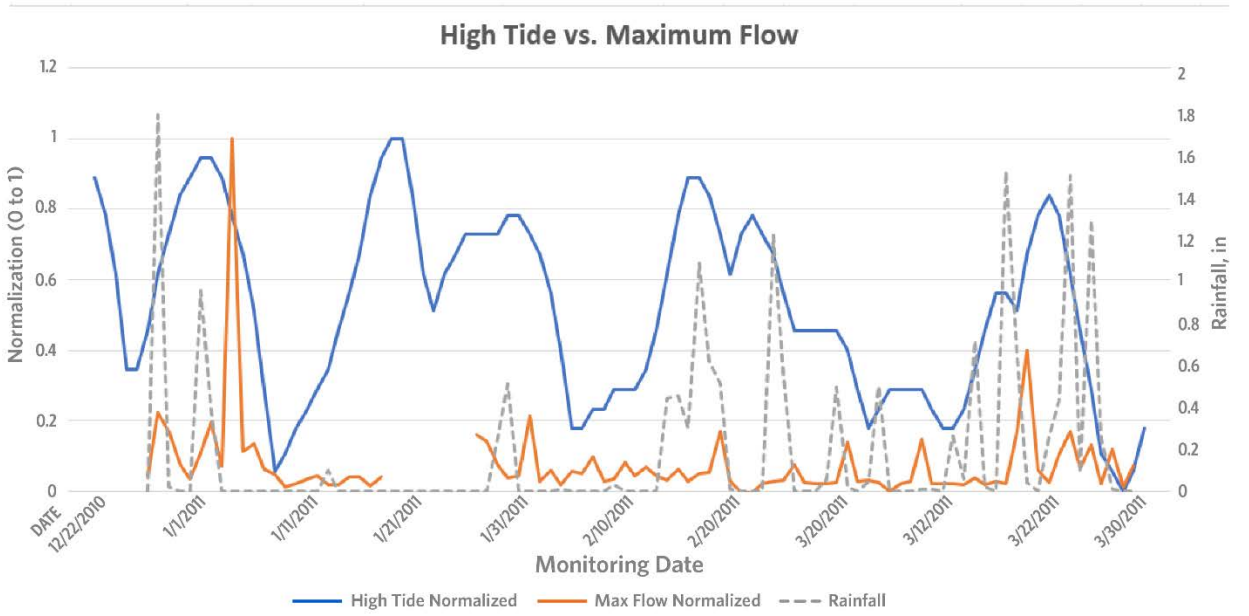


Figure 22. Peak flow data correlated to maximum tides in Basin 6

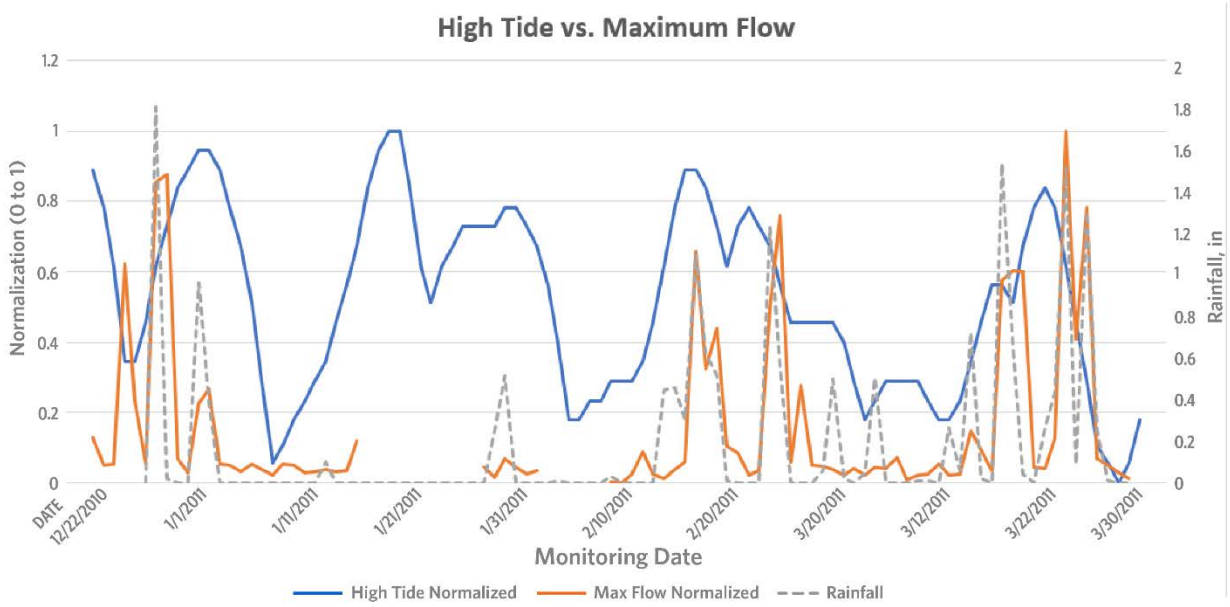


Figure 23. Peak flow data correlated to maximum tides in Basin 7

4.2.10 Flow Anomalies

In reviewing the monitoring program flow data, large flows were observed that were not correlated to rainfall events. These anomalies indicate that unusual flow is entering the system from an unknown source. Two examples occurred on March 24 and March 26, 2011 in Basin 7 as shown in Figure 24 (E2 Consulting Engineers Inc, 2011). This basin along Peninsula Boulevard contains a single sewer main about 1,500 feet long in a residential area. No commercial activities are occurring in this basin; therefore, the expected flow pattern in this basin should reflect typical diurnal residential flow. These anomalies are difficult to explain without additional data; however, the two most likely causes are that (1) a swimming pool or other large water body was drained into the system or (2) I&I provided contributions from tidal changes.

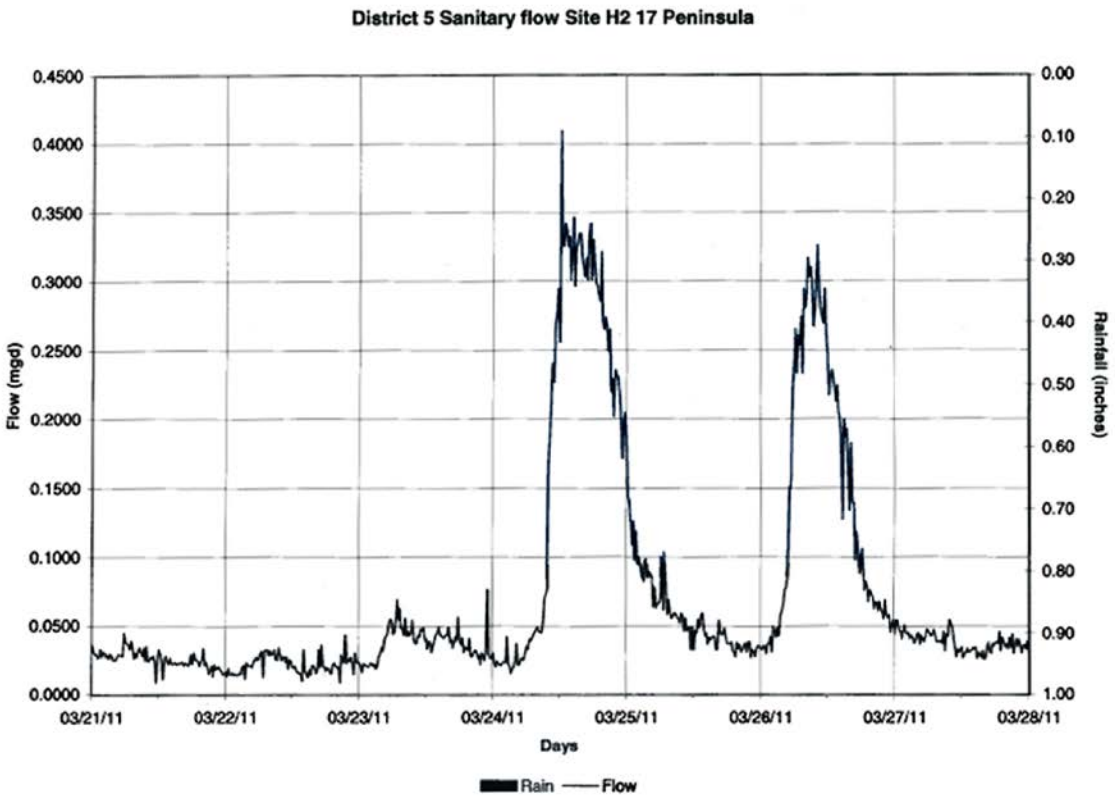


Figure 24. Anomalous flow surges without rainfall in Basin 7

There are other unexplained flow surges not related to rainfall observed in other basins throughout the flow monitoring period. A summary of these instances is recorded in Table 29 below.

Table 29. Counts of flow surges without correlated rain events by basin

Basin No.	Basin name	No. of flow surge events without rainfall
10	End of West Shore	13
6	Beach at Cole	13
7	17 Peninsula	9
1	2030 Paradise Dr.	0
2	Raccoon at Central	0
3	80 Lyford Dr.	0
4	Marinero Circle	0
5	Round Hill at Lyford	0
8	Laurel Ave and San Rafael	0
9	15 West Shore	0

Basins 6, 7, and 10 all show several of these anomalous flows. These basins could be good candidates for further I&I investigation. They are also the basins that potentially show long-term tidal influence, which could indicate that larger high tides are causing these flows.

The hydrographs were also reviewed to determine if the height of any of the wet weather flow surges exceeded the pipe diameter. ***This may indicate a potential capacity issue at the monitoring site. This condition was observed in Basins 6 and 7.*** Two examples are shown in Figure 25, which captures two storm events that occurred on March 24 and 26, 2011 in Basin 7 (E2 Consulting Engineers Inc, 2011). The count of these instances observed by basin is recorded in Table 30 below. The peaks of these flow surges are sharp, which suggests that they did not overflow the manhole. SD5 can estimate the surge elevation in the manhole if the total depth from the top of the manhole to the bottom of the pipe is known; however, this information was not available for this analysis. It is also not possible to determine the behavior of the flow in upstream or downstream manholes that were unmonitored, which could be experiencing worse surcharging. ***It is recommended that SD5 monitor Basins 6 and 7 manholes during peak storm events to determine capacity risks and consider installing remote sewer monitoring (e.g., SmartCovers) if necessary.***

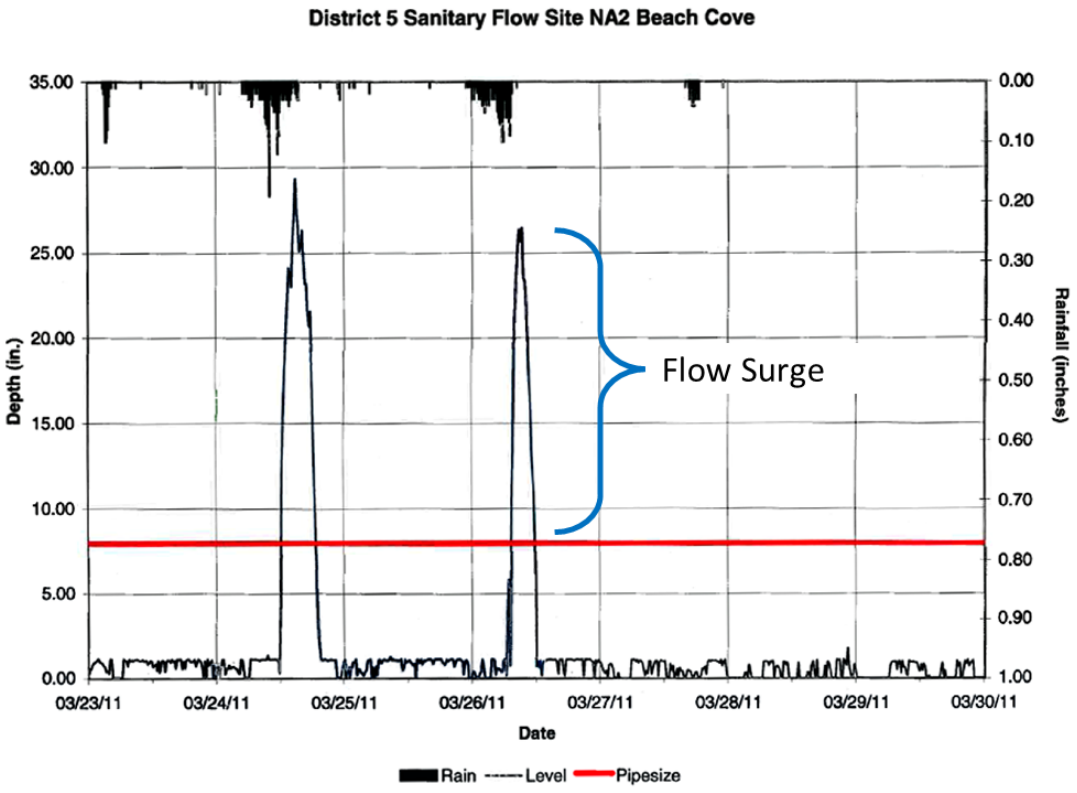


Figure 25. Example of flow surges larger than pipe diameter in Basin 7

Table 30. Count of flow surges larger than pipe diameter by basin

Basin no.	Basin name	No. of flow surge height larger than pipe diameter
7	17 Peninsula	11
6	Beach at Cole	6
1	2030 Paradise Dr.	0
2	Raccoon at central	0
3	80 Lyford Dr.	0
4	Marinero Circle	0
5	Round Hill at Lyford	0

Basin no.	Basin name	No. of flow surge height larger than pipe diameter
8	Laurel Ave and San Rafael	0
9	15 West Shore	0
10	End of West Shore	0

The exact mechanism causing these dry weather flow surges and wet weather surcharges is unknown and could be related to either inflow or infiltration. However, this excess flow appears to be contributing to capacity issues in Basins 6 and 7, which could potentially lead to SSOs during stronger high tides or rain events. It is also possible that the anomalous flows are being caused by other factors (e.g., draining a swimming pool). Additional insight may be gained by checking the salinity of the wastewater flowing through these basins to determine if it indicates that sea water is getting into the sewer system.

4.2.11 Recommendations for I&I Mitigation

Table 31 summarizes the key concerns observed in the analysis of the 2010–2011 flow monitoring study. **The most problematic basins are Basin 7 along Peninsula Boulevard and Basin 1 along the southern portion of Paradise Drive, which exhibit very high values in all of the categories evaluated.** Overall, the predominant issue within these study areas appears to be inflow. The most direct evidence for this comes from the flow monitoring hydrographs, which show that generally flows from wet weather events quickly return to dry level conditions once the event ends. I&I mitigation in Basins 2, 4, and 6 may also reduce excess flow in the system, but not to the extent that improvements in Basins 1 and 7 will likely have because of performance metrics and system configuration. This section discusses recommendations for inflow mitigation as well as additional options for addressing the other concerns.

Table 31. Summary of I&I findings

Basin no.	Basin name	High priority I&I concerns	Medium priority I&I concerns	Tidal correlations	Anomalous flow surges	Potential capacity issues
1	2030 Paradise Dr.	✓				
2	Raccoon at Central		✓			
3	80 Lyford Dr.					
4	Marinero Circle		✓			
5	Round Hill @ Lyford					
6	Beach at Cole		✓	?	✓	✓
7	17 Peninsula	✓		?	✓	✓
8	Laurel Ave and San Rafael					
9	15 West Shore					
10	End of West Shore			✓	✓	

? Insufficient information available

Addressing these concerns falls into two types of mitigation for the purposes of this Master Plan: inflow control and infiltration control. Tidal-related flow and anomalous flow surges are addressed as either inflow or infiltration problems and will therefore be covered under those mitigation types. The capacity issues observed in the flow monitoring graphs may be able to be addressed by removing I&I from the flow as well or through monitoring (either physical inspection or remote monitoring) if SD5 determines that there is sufficient risk for an SSO in these areas. This would be more cost-effective than system modifications to accommodate extraneous flow. If I&I reduction measures do not sufficiently reduce the flow in the system, then it may be appropriate to consider more costly system modifications to increase capacity.

4.2.11.1 Inflow Control

When attempting to reduce I&I from a collection system, focusing on inflow as a first step is usually very cost-effective and can produce immediate, tangible results. Disconnecting the flow source and directing elsewhere will likely solve the problem. For instance, flow from roof downspouts can be directed to the yard. The challenge with inflow is finding sources. Controlling and eliminating inflow sources is also more cost-effective than developing additional sewer system capacity and treatment plant capacity. The following outlines specific steps to start an inflow control program:

- **Manhole inspection**: Manhole inspection is probably the most cost-effective I&I reduction activity that SD5 can do since the manholes are directly in its control. Inspect all manholes in the system that could be inundated. Look for holes in the sides of the structures and manhole frames and lids that could allow water to flow in. Manhole frame and lid testing at other utilities shows that some frames and lids can leak up to 70 gallons per minute (gpm) with only 3 inches of water covering the lid while well-performing frames and lids leak less than 1 gpm. Manholes in creek corridors or

near gutters in streets should be inspected regularly to identify candidates for frame and lid replacement. Consider replacing or rehabilitating the frame and lid on leaky manholes.

- **Pipeline inspection**: Inspect any sewer that are laid in a creek channel where erosion could have exposed the pipe or pulled pipe joints apart. Repair pipes and make improvements as necessary.
- **Smoke testing**: Consider smoke testing the four target basins (Basins 1, 4, 6, and 7). Follow up on inflow sources identified. Disconnect sources where possible. Smoke testing is effective in locating inflow sources as the smoke comes out at the source. Smoke testing is conducted by blowing smoke from a smoke generator into the sewer with a blower and then following the smoke through the system. This inexpensive process can be done quickly. The entire District could be possibly smoke tested within 2 or 3 months.
- **Flow analysis:** Conduct an analysis for the plant influent flow to see how the system is performing as a whole. This could lead to the identification of other areas outside of the flow monitoring study where inflow control strategies could mitigate I&I in the system.

After inflow sources are identified, remediation options are available to disconnect them. Table 32 lists the types of sources and ways to remediate.

Table 32. Remediation options for various inflow sources

Source	Remediation
Downspouts	Redirect flow to yards, storm system, or other safe discharge point
Yard drains	Remove and plug the connection and regrade the yard so that drain is not needed Connect yard drain to storm system
Inundated manholes	Replace lids with watertight lids
Holes in manholes and structures	Rehabilitate the manhole and structure so it is watertight
Foundation drains	Redirect flow to the storm system or street, if possible
Other sources	Redirect flow to the storm system or street
Street catch basins	Disconnect and direct flow to storm system or other surface water discharge point

Many of these remediation actions can be easily accomplished while some of them may be more difficult, especially for those connections on private properties. However, the benefits in reduced peak flow can be significant. Downspout and yard drain disconnection requires property owner cooperation to complete. The City of Portland, Oregon, conducted an extensive downspout disconnection program that was quite successful in reducing peak flow from its combined storm/sanitary system that it was separating. Portland offered property owners a discount on their sewer bills if they disconnected. The City provided materials and engaged Boy Scout troops to help property owners complete the disconnection. Citizens were very supportive of the program because they understood that it would help reduce sewage discharges to the river.

SD5 may want to consider an outreach effort to work with property owners to generate their support. This has been found to be effective in other communities where the agency funds the work but allows the property owner to direct it. SD5 will need to be able to explain the problem, the choices and the benefits in financial terms so that customers will be able to understand the situation. The community will be more motivated to work with SD5 if they understand why it is necessary, what will be saved, and the impacts if they do not collaborate. The most difficult position for SD5 to take is to mandate the property owners improve their system at their cost, which will generate the least amount of motivation in the community.

4.2.11.2 Infiltration Control

The primary method of reducing infiltration is to repair all cracks, holes, and other defects in the basin. However, this may not be cost-effective if taken as the primary objective. Although rehabilitation of old sewers can reduce infiltration in the defective pipe, overall infiltration reduction is not usually found because the groundwater level may just rise and find other defects in adjacent mains or in-service lines and still get in. Some agencies have not achieved a material reduction in infiltration until most or all of the pipe, manholes, and structures have been substantially rehabilitated or replaced including service lines all the way to the building they serve. One public utility replaced its existing system with a new sanitary sewer system and service line to the property line. The work resulted in cutting the infiltration rate from extremely high values to about 3,000 gallons per acre served per day, which is about the best that can be expected from a watertight system (this is the current performance of Basins 5 and 6 in SD5's I&I study). Additionally, spending public dollars replacing the pipe owned by a property owner can be difficult to justify to stakeholders and the community, and it is intrusive to the property. Therefore, work on privately owned sewers is difficult to accomplish. However, without it, infiltration becomes very difficult to reduce.

However, it is always recommended to repair, rehabilitate, or replace sewers that are structurally failing even though the work may not materially reduce infiltration. As part of the CCTV investigation, defective pipes have been selected and prioritized for rehabilitation and replacement. The general results of this I&I evaluation were incorporated into the decision-support modeling. The recommendations identified for each basin in Table 32 above, were annotated to each of the basin pipes so that pipe repairs that would impact infiltration issues can be more effectively planned and prioritized.

While it may not be practical to spend District resources on repairs on private laterals, it may be possible to identify poor laterals through smoke testing or by leveraging SD5's sewer lateral inspection program. Smoke testing is a low-cost method to identify problematic issues in most cases with minimal impact to the customer. SD5's lateral inspection program will produce more direct evidence of lateral problems. SD5's Sanitary Sewer Code authorizes SD5 to require property owners to conduct a sewer lateral inspection whenever the significant property improvements, property transfer, road surfacing, or sewer main repairs occur (Section 3.05.350, Events requiring a lateral sewer inspection – All properties). SD5 may consider putting more focus on reviewing inspection results and required lateral repairs in areas where it believes that infiltration issues exist.

4.2.12 Potential Impacts of Sea Level Rise

To understand the potential impacts of SLR on SD5, the Tiburon and Belvedere sections of the Marin Shoreline Sea Level Rise Vulnerability Assessment were reviewed (BVB Consulting LLC, 2017). This report used a statewide SLR model developed by the United States Geological Survey that modeled several SLR scenarios and their impacts around the county. Six scenarios were modeled to determine the near-, medium-, and long-term impacts of projected SLR and the combined impact of these conditions with a 100-year storm (Table 33).

Table 33. The six sea level rise scenarios modeled in the vulnerability assessment

Term	Timeframe	Sea level rise	Sea level rise with a 100-year storm
Near term	By 2030	10 inches	46 inches
Medium term	By 2050	20 inches	56 inches
Long term	By 2100	60 inches	96 inches

The report described significant potential impacts across the county to transportation, emergency services, water, sewer, and other utilities, as well as many neighborhoods, commercial areas, and public areas (e.g., beaches, wetlands, and access to the water). A summary of potential impacts to SD5 based on the scenarios modeled is presented here and recommendations for mitigation are provided.

Based on the modeling analysis, the bay shoreline is vulnerable to SLR and intensifying storm patterns with the projected range of SLR of 4.7 to 24.0 inches by 2050 and 16.6 to 65.8 inches by 2100. Therefore, it is critical for SD5 to understand the impact from SLR to ensure a resilient sewer system for present and future generations.

4.2.12.1 Potential District Impacts

SLR could potentially affect multiple components of SD5's sanitary system including the lift stations, collection system, treatment plant, and utility users. General vulnerabilities are increased flow and water quality, which could lead to SSOs; damaged infrastructure, which could potentially cause SSOs; and system accessibility, which can delay emergency response, repairs, and maintenance. The following are specific vulnerabilities identified in the report that SD5 may experience:

- The wastewater treatment plant (WWTP) could be impacted from flooding. However, direct flooding is unlikely because the WWTP is at a slightly higher elevation than downtown Tiburon. There will more likely be indirect impacts from higher head in effluent pumps.
- Flow into the WWTP could be subject to increasing saltwater infiltration which may cause capacity and treatment problems.
- Lift stations could be overburdened by increased flow from saltwater infiltration into the collection system if influent flows exceed pump capacities. Equipment corrosion may also be accelerated. Lift stations located within the impacted SLR zone (e.g., Tiburon Lift Stations PS-4 and PS-6) may be inundated from high tides.
- Metallic force mains could be corroded at a faster pace because of increased saltwater exposure.
- Subsidence could cause underlying sewer pipes in low-lying areas to sag and settle in the near and medium terms, creating alignment issues, maintenance problems, and possibly SSOs.
- Increased I&I from SLR and larger storm events may cause an increase in SSOs and potentially additional regulatory actions.
- Downtown Tiburon and marine facilities can be flooded in the near term, creating accessibility problems, increased I&I, and increased maintenance.
- The steep shoreline bluffs around the Tiburon Peninsula may be subject to increased erosion and collapse during storm events, which could destroy utility infrastructure and damage homes.
- Access to Belvedere could be compromised or blocked because of flooding of access roads in the near and medium terms.
- The ability of utility works to access infrastructure and maintain the system may become difficult and may be blocked at times.
- U.S. Highway 101 and other primary access roads into the SD5 service area may be subject to increased flooding, which may delay or prevent critical services and supplies needed by SD5.

4.2.12.2 Vulnerable Assets

According to the Marin Shoreline Sea Level Rise Vulnerability Assessment, the Paradise Cove WWTP would be minorly impacted under the storm-related long-term SLR scenario (a sea level increase of 60 inches plus a 100-year storm surge). ***The most vulnerable asset owned by SD5 according to the SLR report is Lift Station PS-6 in Tiburon and the nearby manholes around Beach Road and Tiburon Boulevard, where flooding already occurs occasionally*** (Figure 26). The electrical system has already been upgraded to prevent flood damage and it is recommended that structural repairs be completed as described in the capital improvement recommendations. ***Tiburon Lift Station PS-4 is also currently subjected to tidal flooding, although it is not identified in the SLR report.*** As discussed in Section 5.2, this lift station will need significant structural improvements, which should incorporate flooding resilience when these improvements are designed. Other sewer main and manhole assets may also be vulnerable; however, further investigation will be needed to identify them. A study of the groundwater table and the elevation of manhole lids and other buried infrastructure should be completed to identify these additional vulnerabilities.

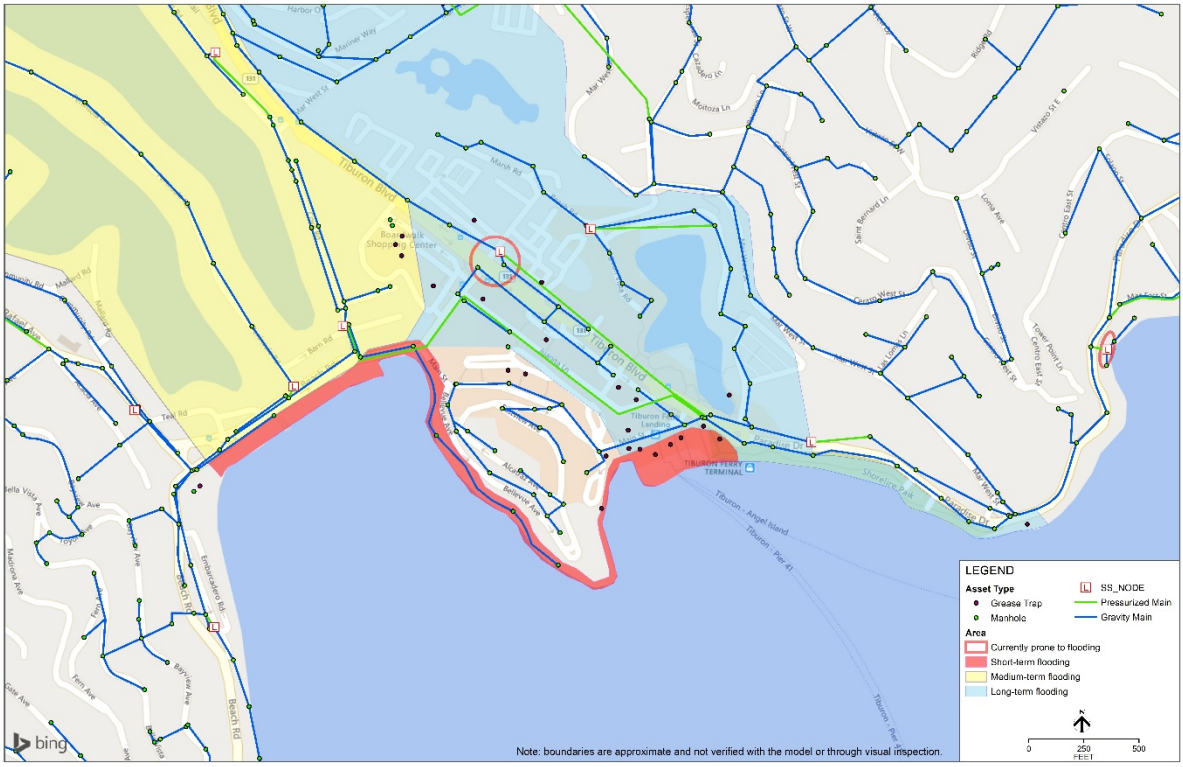


Figure 26. Tiburon vulnerable utility assets

It is also noted in the report that flooding during this scenario could reach the parking lot at the main treatment facility during storm surges, which may create access issues for employees and accelerate wear and tear on facility vehicles and equipment. The installation of berms may help mitigate this, but proper design and installation may not be cost-effective because of the potential geotechnical issues with managing the impacts of berm installation to overland and groundwater flow.

Table 34 provides a summary of vulnerabilities and recommendations based on the short-term, medium-term, and long-term modeled scenarios.

Table 34. Summary of sea level vulnerabilities and recommendations

Time period	Projected range	Key vulnerabilities	SLR mitigation recommendations
By 2030	1.6 – 11.8 inches	• Main street shoreline, hotels, shops and restaurants • Manholes and infrastructure near Tiburon Blvd and Beach Rd subject to flooding, including Tiburon Lift Station 6 • I&I along West Shore and Beach roads • Residential flooding along Beach Rd • Tidal flooding at Tiburon Lift Station 4 already occurring (through local knowledge)	• Incorporate SLR into decision-making process Keep up to date with science and policy to identify additional recommendations regarding SLR-related activities and threats as new information develops • Review standard District planning level assumptions and design guidelines to consider SLR • Rehabilitate Tiburon Lift Stations PS-4 and PS-6 to minimize environmental impact from flooding • Address high-priority I&I mitigation recommendations, especially those subjected to tidal influence and coastal flooding • Conduct a District-specific Sea Level Rise Vulnerability Assessment toward end of period that includes a detailed study of tidal influence on the groundwater table
By 2050	4.7 – 24 inches	• Yacht Club storm damage and flooding • Flooding and compromised access to town of Tiburon and Cove Shopping Center • San Rafael Ave access to Belvedere may be blocked • Residences in flat areas and the lagoon could be vulnerable to flooding	• Implement priority capital improvements as a result of Sea Level Rise Vulnerability Assessment • Continue collection system and lift station CIP, incorporating SLR mitigation strategies and design improvements • Phased adaptation to address groundwater, hydraulic impacts, and storm surge as required
By 2100	16.6 – 65.8 inches	• Vehicular access along Tiburon Blvd and downtown • Municipal buildings flooding • Minor flooding and erosion during storm surge at Paradise Cove Treatment Plant • Saltwater intrusion along sewer lines that run along the beach • Possible flooding in parking lot of Main WWTP during storm surges • Access roads to Belvedere flooded • Erosion and bluff collapse during storm surges damaging residences and infrastructure	• Incorporate effects of SLR and storm surges on emergency operations planning as required • Phased adaptation to address groundwater, hydraulic impacts, and storm surge as required

4.3 Lift Stations

A condition assessment was performed on each of SD5's lift stations to evaluate current conditions and identify rehabilitation recommendations to maintain service levels and to identify operational recommendations to reduce odor complaints. The assessment included a review of available documentation and reference material on the lift stations, visual inspection of the stations, and interviews with District operations staff. This information was analyzed to develop recommendations to be incorporated into the CIP. To prioritize these recommendations, a risk analysis was conducted to determine the relative criticality of each lift station in terms of area served, pumping capacity, potential environmental impacts, and likelihood of flooding.

4.3.1 Information Review

To start the assessment, SD5 provided available documentation and reference materials to describe the configuration and operations of the lift stations. Additional data were provided by Nute Engineering, which has historically performed many of the previous lift station upgrades and repairs. Key documents evaluated are described in the introduction of this report.

There were no available lift station as-built documents or other documents stating lift station flow rates and TDHs with the exception of Tiburon Lift Station 5.

4.3.2 Site Visit and Visual Condition Assessment

HDR visited each of SD5's lift stations to perform an inspection and visual condition assessment on October 14 and 15, 2020. SD5 provided a lead operator to guide the HDR engineer through the stations. All 24 lift stations were visited and assessed over these 2 days.

During the field visit, the following potential issues were visually assessed:

- Condition of the wet well lining
- Condition of the wet well concrete
- Fats, oils, and grease (FOG) accumulation
- Inlet and outlet pipe configuration
- Electrical panel
- Telemetry panel
- Condition of pumps, valves, and other components, including estimating remaining useful life
- General lift station condition

The condition of each of the stations was documented and photographs were taken to note key features observed. These are provided in Appendix E.

4.3.3 Operations Interviews

During the site visits, the lead operator provided additional insight and commentary on the history, performance, and operation of each facility. Topics addressed included:

- Recent lift station upgrades
- Odor and other operational concerns
- Facility configuration and design issues encountered
- Operation and condition history
- Discussion of necessary rehabilitation or operational improvements identified by O&M staff

Additional details and context have been provided through discussions with the District Manager. This information has been documented and incorporated into the analysis.

4.3.4 Approach to Assessing Criticality

The criticality of each lift station needs to be determined to understand how to prioritize rehabilitation work through the 15-year capital planning horizon. Criticality can then be combined with the condition of each station to make objective decisions about which repairs to make first and which can be scheduled further in the future.

Criticality is mainly a function of the impact of the failure of each of the facilities. To assess criticality each lift station needs to be evaluated based on the impact to SD5 and the community if it were unable to function. The lift station criticalities have been determined by the following:

- **Pumping capacities of each station:** Each of the lift stations is responsible for pumping wastewater from different parts of SD5's service area. The greater the amount of water that flows through a given lift station, the greater the impact to SD5 and the community if it cannot perform its function. Because flow data were not readily available for all the lift stations, the total length of system pipe that contributes flow to each lift station was used. This factor combined with the contribution from other lift stations that also convey flow to each station were used as an indicator of flow.
- **Impact on SD5's service area:** Some lift stations can be more critical than others, depending upon their location and the amount of wastewater that must flow through them. For example, a lift station serving downtown businesses and restaurants is usually more critical than a lift station serving a small residential area because the loss of the downtown lift station is likely to have a greater impact on the community through citizen inconveniences and business revenue loss. Also, lift stations that convey water from other stations would have a greater impact should they fail.
- **Potential for environmental damage:** Environmental damage can be caused by a lift station pump or power failure if the flow to the station exceeds its storage capacity before bypass pumping or other mitigations can be put into place. This may cause SSOs. A lift station more prone to pump or power failure will be more critical than a lift station less prone to pump or power failure. In general, SD5's vulnerabilities to overflows at the lift station are generally low and lift station failure can be addressed by standby pumps, on-site or portable backup power generation, and portable backup pumps.
- **Potential for lift station flooding due to tides and storms:** Flooding is the likelihood of a lift station being flooded by high or king tides and storm surges. This factor was considered to be for current conditions and did not incorporate the potential impacts of future SLRs because SLR impacts are anticipated to be minimal during the capital planning period.

Of these four criteria, the most significant related to criticality are the pumping capacities of each station and the impact on SD5's service area. These two components had the most influence on the criticality level assignment and analyses of these components are described in more detail below. Only one station in SD5 exhibited relatively high vulnerability to cause environmental damage or station flooding (Tiburon PS-4). This station is located directly adjacent to the shoreline, is already prone to tidal flooding, and has difficult accessibility to implement repairs or bypass pumping should the facility fail. These concerns were incorporated into the analysis and increased the station's criticality level assignment.

4.3.4.1 Station Pumping Capacities

The pumping capacity is the design flow rate and TDH of the lift station. For example, Belvedere PS-1 conveys much higher wastewater flows than Belvedere PS-11 and thus would be considered more critical. Design flow rates and TDH for each lift station were unavailable for analysis; therefore, available electrical service sizes and collection system pipe length contributing to the station were used for comparing the lift station capacities instead. Table 35 shows the electrical service characteristics for each

lift station. The lift stations are all 240-volt (V) services with mostly three-phase power and two pumps. Because the lift stations' electrical service sizes are very similar, additional metrics have been considered.

Table 35. Lift station electrical service sizes for capacity comparison

Service area	Lift station number	Number of pumps	Voltage (V)	Phase	Largest motor (hp)
Tiburon	PS-1	1	240	1	3
Tiburon	PS-2	2	240	3	3
Tiburon	PS-3	2	240	3	5
Tiburon	PS-4	2	240	3	5
Tiburon	PS-5	2	240	3	60
Tiburon	PS-6	2	240	3	5
Tiburon	PS-7	2	240	3	5
Tiburon	PS-8	2	240	3	3
Tiburon	PS-9	2	240	3	5
Belvedere	PS-1	2	208	3	10/15
Belvedere	PS-2	2	240	3	3
Belvedere	PS-3	3	240	3	5
Belvedere	PS-5	2	240	3	5
Belvedere	PS-7	2	Unk.	Unk.	3
Belvedere	PS-8	2	220	1	3
Belvedere	PS-9	2	240	3	3
Belvedere	PS-10	2	240	1	3
Belvedere	PS-11	2	240	1	3
Belvedere	PS-12	2	240	1	3
Belvedere	PS-13	2	240	3	3
Belvedere	PS-14	2	240	3	3
Belvedere	PS-15	2	240	1	3
Seafirth	CF-PS-1	2	240	3	Unk.
Seafirth	CF-PS-2	2	240	1	Unk.

Table 36 shows the system sewer main pipe lengths associated with each pipe in the system. This metric uses the pipe length as an indicator of the size of flow conveyed through each station. In general, the greater the length of sewer mains that contribute wastewater to the lift station, the more flow will be received. This can be generally applied because SD5's service area land use is almost entirely residential, which indicates that almost all parts of the system will exhibit similar flow characteristics.

Table 36. Lift station collection system pipeline lengths for capacity comparison

Service Area	Lift station number	Collection length (mi.)
Tiburon	PS-1	0.1
Tiburon	**PS-2**	**0.6**
Tiburon	PS-3	0.5
Tiburon	**PS-4**	**0**

Service Area	Lift station number	Collection length (mi.)
Tiburon	PS-5	7.7
Tiburon	**PS-6**	**0.7**
Tiburon	PS-7	1.6
Tiburon	**PS-8**	**0.4**
Tiburon	PS-9	0.8
Belvedere	PS-1	2.9
Belvedere	PS-2	1.4
Belvedere	PS-3	1.2
Belvedere	PS-5	0.5
Belvedere	PS-7	0.4
Belvedere	PS-8	0.1
Belvedere	PS-9	0.5
Belvedere	PS-10	0.2
Belvedere	PS-11	0.2
Belvedere	PS-12	0.1
Belvedere	PS-13	0.2
Belvedere	PS-14	1.6
Belvedere	PS-15	1.8
Seafirth	CF-PS-1	0.3
Seafirth	CF-PS-2	0.1

4.3.4.2 Impact on SD5's Service Area

For this part of the assessment, each station was ranked based on impact to the service area if the station was taken out of service. In general, lift stations that receive wastewater conveyed from other lift stations upstream in the collection system will have a greater impact if they are unable to pump water. Table 37 shows the assessment of impact based on the number of lift stations linked to each station. The lift stations are sorted in descending order within each of the three service areas. These relationships can be seen in detail in the lift station schematic diagram in Figure 6, above, and in Table 37, below.

Table 37. Lift station hierarchy showing the number of stations that convey wastewater to each station

Service area	Lift station number	Lift station location	Number of stations
Tiburon	PS-3	Paradise Dr. and Solano St.	2
Tiburon	PS-6	Tiburon Blvd. and Beach Rd.	1
Tiburon	PS-2	Mar E St. near Agreste Way	1
Tiburon	PS-8	Beach Rd. and Lagoon Vista Rd.	1
Tiburon	PS-5	Mar W St.	0
Tiburon	PS-9	Paradise Dr. near Shoreline Park	0
Tiburon	PS-4	Paradise Dr. near Lyford's Tower	0
Tiburon	PS-7	Tiburon Blvd. near Ned's Way	0
Tiburon	PS-1	Mar E St. near Mar E Dr.	0
Belvedere	PS-1	Cove Rd. and Barn Rd.	12

Service area	Lift station number	Lift station location	Number of stations
Belvedere	PS-7	Peninsula Rd. and Beach Rd.	7
Belvedere	PS-2	San Rafael Ave. and Teal Rd.	5
Belvedere	PS-3	San Rafael Ave. And Golden Gate Av.	4
Belvedere	PS-9	Lagoon Rd. (south)	2
Belvedere	PS-5	San Rafael Ave. and Windward Rd.	1
Belvedere	PS-10	Lagoon Rd. near Maybridge Rd.	1
Belvedere	PS-13	West Shore Rd. (north)	1
Belvedere	PS-15	Beach Rd. near Embarcadero Dr.	0
Belvedere	PS-14	West Shore Rd. (south)	0
Belvedere	PS-8	Windward Rd.	0
Belvedere	PS-11	Lagoon Rd. (north)	0
Belvedere	PS-12	San Rafael Ave. and Edgewater Rd.	0
Seafirth	CF-PS1	Seafirth Pl.	0
Seafirth	CF-PS2	Seafirth Rd.	0

4.3.4.3 Criticality Ranking

Table 38 shows a summary of the criticality ranking information and the interpreted ranking. Rather than developing an individual ranking for each station, the stations were grouped into criticality levels to indicate repair priorities. Each of the service areas – Tiburon, Belvedere, and Paradise Cove – was ranked individually because each area operates independently from the others.

Table 38. Summary of criticality ranking data

Service area	Lift station number	Lift station location	Pipeline lengths	Lift station hierarchy (no. of linked)	Environ-mental	Flooding	Criticality level
Tiburon	PS-5	Mar W St.	7.7	0	No	No	L1
Tiburon	PS-6	Tiburon Blvd and Beach Rd.	0.7	1	No	No	L2
Tiburon	PS-9	Paradise Dr. near Shoreline Park	0.8	0	No	No	L2
Tiburon	PS-3	Paradise Dr. and Solano St.	0.5	2	No	No	L2
Tiburon	PS-4	Paradise Dr. near Lyford's Tower	0	0	Yes	Yes	L2
Tiburon	PS-7	Tiburon Blvd. near Ned's Way	1.6	0	No	No	L3
Tiburon	PS-2	Mar E St. near Agreste Way	0.6	1	No	No	L3
Tiburon	PS-8	Beach Rd. and Lagoon Vista Rd.	0.4	1	No	No	L3
Tiburon	PS-1	Mar E St. near Mar E Dr.	0.1	0	No	No	L4
Belvedere	PS-1	Cove Rd. and Barn Rd.	2.9	12	No	No	L1
Belvedere	PS-7	Peninsula Rd. and Beach Rd.	0.4	7	No	No	L2

Service area	Lift station number	Lift station location	Pipeline lengths	Lift station hierarchy (no. of linked)	Environ-mental	Flooding	Criticality level
Belvedere	PS-2	San Rafael Ave. & Teal Rd	1.4	5	No	No	L3
Belvedere	PS-3	San Rafael Ave. & Golden Gate Ave.	1.2	4	No	No	L4
Belvedere	PS-9	Lagoon Rd. (south)	0.5	2	No	No	L4
Belvedere	PS-5	San Rafael Ave. & Windward Rd.	0.5	1	No	No	L5
Belvedere	PS-10	Lagoon Rd. near Maybridge Rd.	0.2	1	No	No	L5
Belvedere	PS-13	West Shore Rd. (north)	0.2	1	No	No	L5
Belvedere	PS-15	Beach Rd. near Embarcadero Dr.	1.8	0	No	No	L6
Belvedere	PS-14	West Shore Rd. (south)	1.6	0	No	No	L6
Belvedere	PS-8	Windward Rd.	0.1	0	No	No	L6
Belvedere	PS-11	Lagoon Rd. (north)	0.2	0	No	No	L6
Belvedere	PS-12	San Rafael Ave. & Edgewater Rd.	0.1	0	No	No	L6
Seafirth	CF-PS1	Seafirth Pl.	0.3	0	No	No	L1
Seafirth	CF-PS2	Seafirth Rd.	0.1	0	No	No	L1

The lift station priority is shown in the criticality level column, which was interpreted based on the information provided in the other columns in the table.

Figure 29 shows a graphical view of this determination for the Tiburon service area. Based on the information provided, Tiburon PS-5 is the most critical lift station. Even though there are no other lift stations dependent upon it, it captures wastewater from 62 percent of the Tiburon service area by linear miles of sewer main. Lift Stations PS-3, PS-4, PS-6, and PS-9 are the next level priority. Lift Stations PS-3, PS-6, and PS-9 convey wastewater from other lift stations. Lift Station PS-4 is located near the shoreline, with the potential for environmental damage, susceptibility to flooding, low capacity, and difficulty for bypass pumping. The third level of priority (Lift Stations PS-2, PS-7, and PS-8) is assigned to stations that are lower in the lift station hierarchy and capture smaller areas of the service area. Finally, Lift Station PS-1 is assigned to the fourth priority level as it services only a small part of the system.

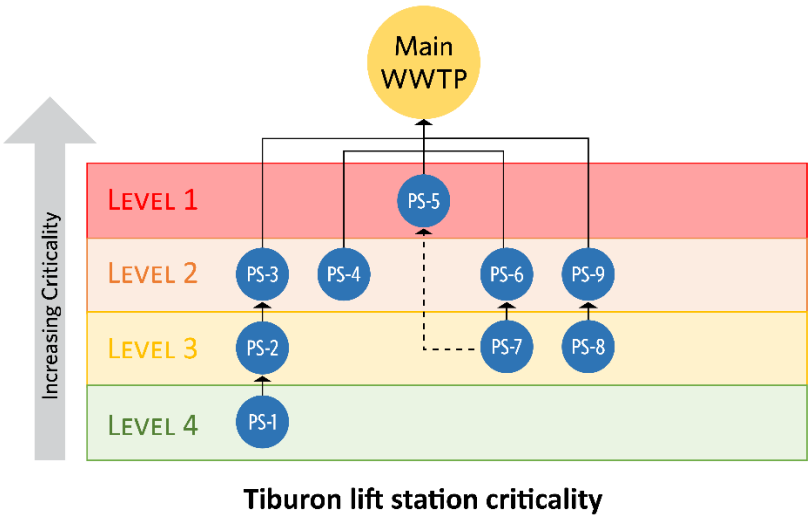


Figure 27. Tiburon lift station assigned criticality levels
(Arrows illustrate flow path to the WWTP. Dashed arrow indicates bypass flow.)

Figure 30 shows the lift station priority levels for the Belvedere service area. Lift Station PS-1 is the highest-ranking lift station as the entire service area flows into it. Lift Station PS-7 is assigned to the second-level priority because it receives wastewater from eight other stations and collects water from about 78 percent of the Belvedere system. Next in priority is Lift Station PS-2, which captures 55 percent of the system, then Lift Stations PS-9 and PS-3 are assigned to level 4, because they both convey water from multiple stations. Lift Stations PS-5, PS-10, and PS-13 also receive flow from upstream stations, and finally, Lift Stations PS-8, PS-11, PS-12, PS-14, and PS-15 are assigned the lowest priority: level 6.

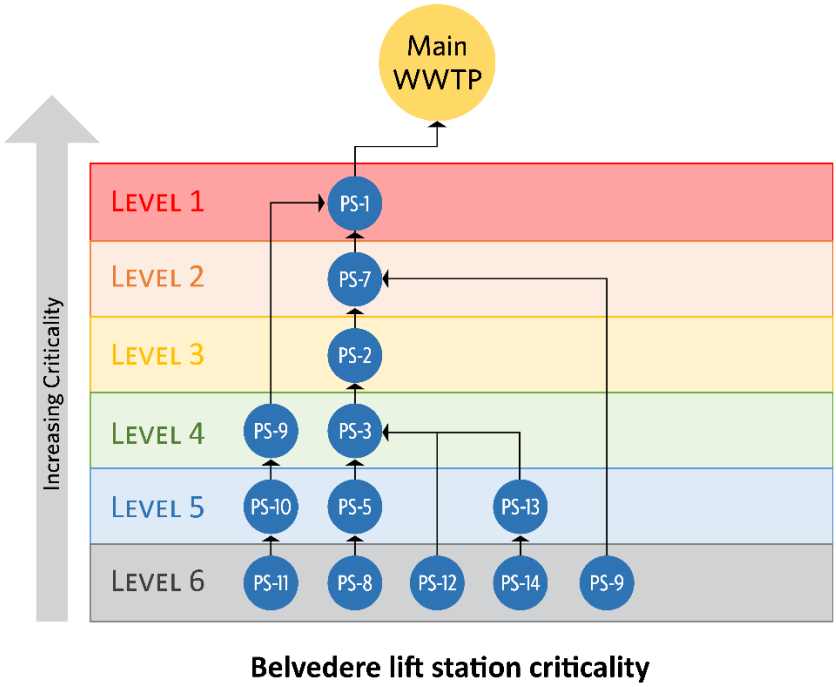


Figure 28. Belvedere lift station criticality
(Arrows illustrate flow path to the WWTP)

Figure 31 shows the criticality of the Seafirth lift stations. Both are assigned the same priority since they have similar criticality characteristics.

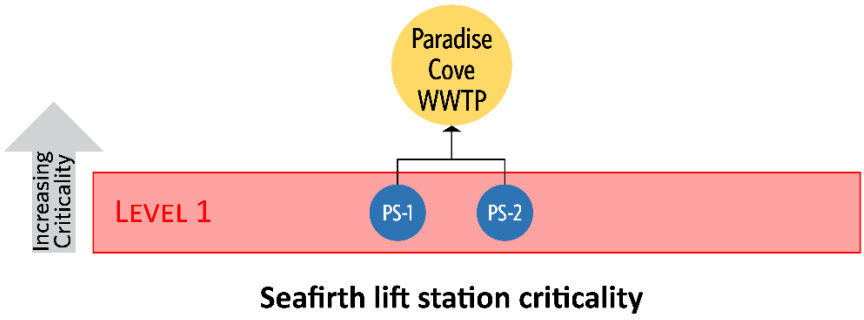


Figure 29. Seafirth lift stations criticality

4.3.5 Condition Assessment

This section summarizes the visual condition assessment of the lift stations. Each lift station was assigned an overall condition rating based on the summary of conditions observed. Table 44 summarizes these ratings.

Table 39. Visual condition assessment rating terminology

CR	Condition	EUL	Description	General recommendation
1	Very good	100% of EUL	New or excellent condition	Normal preventive maintenance
2	Good	75% of EUL	Minor defects only	Normal preventive maintenance, minor corrective maintenance
3	Fair	50% of EUL	Moderate deterioration	Normal preventive maintenance, major corrective maintenance
4	Poor	25% of EUL	Significant deterioration	Rehabilitation, if possible
5	Very poor	5% of EUL	Virtually unserviceable	Replace

Notes: EUL = estimated useful life

Table 40 presents a summary of the condition assessment findings for each station sorted by criticality.

Table 40. Summary of condition assessment findings

Service area	Criticality level	Lift station number	Lift station location	Overall condition	Recent upgrades	Odor issues	Backup power	Notes
Tiburon	1	PS-5	Mar W St.	Very good	Completely upgraded in 2019. Electrical and I&C upgraded in 2015.		Backup power provided by Tiburon 3 generator.	No significant issues observed or reported.
Tiburon	2	PS-3	Paradise Dr. and Solano St.	Fair	Electrical and I&C upgraded in 2015.		Portable generator on site	Wet well is in adjacent private property driveway. Some access issues. Generator had several radiator failures and provides backup power to Tiburon 3 and 4.
Tiburon	2	PS-4	Paradise Dr. near Lyford's Tower	Poor			Backup power provided by Tiburon 3.	There is no dedicated or adjacent street parking. Lift station accessed through private property narrow stairs. Stairs are cracked and with uneven rises and runs. Access difficult. Susceptible to high tides and overflows into the bay. Deteriorated concrete. Corrosion and deterioration in wet well.
Tiburon	2	PS-6	Tiburon Blvd. and Beach Rd.	Fair–poor	Natural gas generator, electrical, and I&C upgraded in 2018.			Wet well concrete in poor condition with exposed aggregate and H_2S attack.
Tiburon	2	PS-9	Paradise Dr. near Shoreline Park	Poor	The check valves were recently replaced because of failure. Electrical and I&C upgraded in 2015.		Backup power provided by portable generator.	Wet well concrete with exposed aggregate and H2S corrosion and in poor condition. Wet well upper concrete cylinder sections leaning toward shoreline. Offset cylinders show evidence of sealing. Submersible pumps are difficult to remove because of leaning. Standing water was pumped out with manually operated sump pump.
Tiburon	3	PS-2	Mar E St. near Agreste Way	Fair	Electrical and I&C upgraded recently.		Generator recently upgraded.	Wet well concrete and hatch in fair conditions. Check valves have not been upgraded.
Tiburon	3	PS-7	Tiburon Blvd. near Ned's Way	Fair	Electrical and I&C upgraded in 2017. Recently upgraded natural gas backup generator.			Heavy FOG exhibited during inspection.
Tiburon	3	PS-8	Beach Rd. and Lagoon Vista Rd.	Fair	Electrical and I&C upgraded in 2018.		Backup power provided by portable generator.	Hatch and wet well concrete in fair condition. Check and isolation valve in fair to poor condition.
Tiburon	4	PS-1	Mar E St. near Mar E Dr.	Good	Electrical and I&C upgraded in 2014.		Backup power provided by Tiburon 2.	Serves only several residential homes.
Belvedere	1	PS-1	Cove Rd. and Barn Rd.	Poor	New parallel force main was being installed during inspection.	Odor issues reported.		Wet well access hatches in fair condition. High ground water exhibited in the new parallel force main trench. Wet well lined with membrane sealant. It was reported that the membrane is delaminating near the floor. Heavy FOG exhibited during inspection. Older electrical, I&C, and backup generator beyond their useful life. Odor control disconnected. Building roof in very poor condition.
Belvedere	2	PS-7	Peninsula Rd. and Beach Rd.	Fair–poor	Electrical and I&C recently upgraded.	Odor issues reported.		Pipeline settling issues reported. Wet well concrete aggregate exposed, exhibiting softness, and H_2S corrosion. Check valves in poor condition with operational issues reported.

Service area	Criticality level	Lift station number	Lift station location	Overall condition	Recent upgrades	Odor issues	Backup power	Notes
Belvedere	3	PS-2	San Rafael Ave. and Teal Rd	Fair–poor	New generator, electrical, I&C, and automatic transfer switch are being upgraded during the time of the inspection.			Access hatches to wet well in fair condition. Wet well in fair condition and appeared to be coated with coal tar.
Belvedere	4	PS-3	San Rafael Ave. and Golden Gate Ave.	Fair–poor	Natural gas backup generator, electrical and I&C upgraded in 2017 and in very good condition.	Odor issues reported.		Currently utilizing manhole odor control inserts. Wet well access hatches in fair condition exhibiting corrosion. Wet well concrete in poor condition/corrosion. Isolation and check valves are in fair to poor condition.
Belvedere	4	PS-9	Lagoon Rd. (south)	Fair–poor	Electrical and I&C recently upgraded.		Backup power provided by portable generator	Wet well concrete top cracked and in poor condition. Standing water in valve vault causing piping surface corrosion. Isolation and check valves are in fair and poor conditions, respectively.
Belvedere	5	PS-5	San Rafael Ave. and Windward Rd.	Fair–poor	Electrical and I&C recently upgraded.		Backup power provided by portable generator	Wet well hatch, wet well concrete in poor condition and exhibiting exposed aggregate and H_2S corrosion. Isolation and check valves in fair and poor conditions, respectively. Check valves were stuck.
Belvedere	5	PS-10	Lagoon Rd. near Maybridge Rd.	Fair–poor	Electrical and I&C recently upgraded.			Wet well concrete top cracked and in poor condition. Wet well grout cracking and in fair condition. Isolation and check valves are in fair and poor conditions, respectively.
Belvedere	5	PS-13	West Shore Rd. (north)	Fair	Electrical and I&C recently upgraded.		Backup power provided by portable generator.	Wet well grout cracking and is in fair condition. Isolation and check valves are in fair and poor conditions, respectively
Belvedere	6	PS-8	Windward Rd.	Fair	Older I&C scheduled to be upgraded.			Wet well access hatch in very poor condition. Excessive corrosion might be caused by brackish water. Wet well concrete in poor condition; exposed aggregate, softness and corrosion. Check valve issues reported.
Belvedere	6	PS-11	Lagoon Rd. (north)	Fair–poor	Electrical and I&C recently upgraded.		Backup power provided by portable generator.	Wet well concrete top cracked and in poor condition. Isolation and check valves are in fair and poor conditions, respectively.
Belvedere	6	PS-12	San Rafael Ave. and Edgewater Rd.	Fair–poor	Electrical and I&C recently upgraded.		Backup power provided by portable generator.	Wet well grout exhibiting cracking.
Belvedere	6	PS-14	West Shore Rd. (south)	Fair	Electrical and I&C upgraded in 2018.		Backup power provided by portable generator.	Wet well concrete is in fair condition. Access ladder is in very poor condition, extremely corroded, and should not be used
Belvedere	6	PS-15	Beach Rd. near Embarcadero Dr.	Fair			Backup power provided by portable generator.	Electrical and I&C recently upgraded and in very good condition.
Seafirth	1	CF-PS1	Seafirth Pl.	Fair	Natural gas backup generator, electrical and I&C upgraded in 2009.	Odor issues reported.		
Seafirth	1	CF-PS2	Seafirth Rd.	Fair		Odor issues reported.	Electrical and I&C upgraded in 2009 and is in good condition	

4.3.5.1 Overall

Overall, the condition of the lift stations varied, with the Tiburon and Seafirth lift stations generally being in better overall condition than the Belvedere lift stations. Actual station age and capacity assessment were not determined because of limited data; therefore, the assessments relied on interviews with District staff for historical knowledge, visual condition assessment based on experience evaluating similar assets evaluated at other utilities, and comparison to industry best practices.

In general, the lift stations were well maintained. None of the stations received a very poor rating. The most significant issues identified were as follows:

- **Tiburon PS-4:** Access to the lift station is difficult. Access is on private property down steep, narrow, and degrading stairs. This lift station is also subject to tidal flooding and bay contamination. The Tiburon PS-4 force main may not lie within the dedicated easement, but instead could be on adjacent private property. However, the evaluation, legality, relocation, or replacement of force mains were not within the scope of this study.
- **Tiburon PS-9:** This station is in poor condition. The wet well upper concrete cylinder sections are leaning toward the shoreline, making it difficult to remove or maintain the submersible pumps.
- **Belvedere PS-1:** This station is in poor condition overall, with high groundwater infiltration likely. Poor structural condition of the facilities and the electrical, instrumentation and controls (I&C) and backup generator are beyond their useful life.
- **Belvedere PS-7:** This station is in poor condition. Wet well concrete is in poor condition and exhibiting exposed aggregate and hydrogen sulfide (H_2S) corrosion. The station check valve is in poor condition with operational issues reported.

4.3.5.2 Operational Issues

Odor issues were reported in several lift stations in the Belvedere and Seafirth service areas as shown in Table 40, above. Options for odor control include the following:

1. Install passive airtight and watertight gasketed access hatches and manholes that prevent foul air from escaping uncontrolled and infiltration water flow from entering the system. However, this eliminates the wet wells and manholes ability to breathe and might adversely affect hydraulic performance. The trapped foul air will escape at the exit unsealed upstream or downstream opening.
2. Install a passive a 10 to 12 foot high gooseneck pipe, 4 to 6 inches in diameter, that connects the annular space to the exterior. The height of the pipe may allow for air dispersal.
3. Install passive manhole inserts with activated carbon units, as shown in Figure 30.
4. Install passive external activated carbon units, as shown in Figure 31.
5. Implement active chemical injection such as Bioxide® calcium nitrate solution to control H_2S or other similar chemical injection methods.
6. Install a combination of airtight and watertight gasketed access hatches and gooseneck piping described in alternative 2.
7. Install an active exhaust fan with odor control unit.
8. Eliminate upstream pipeline belly, sag, and low area causing stagnation and putrefaction. This strategy would eliminate the cause of the odor, however, it is also the costliest.

Figure 30. The Mole™ manhole insert with 20 lb. activated carbon to eliminate odors or equivalent device

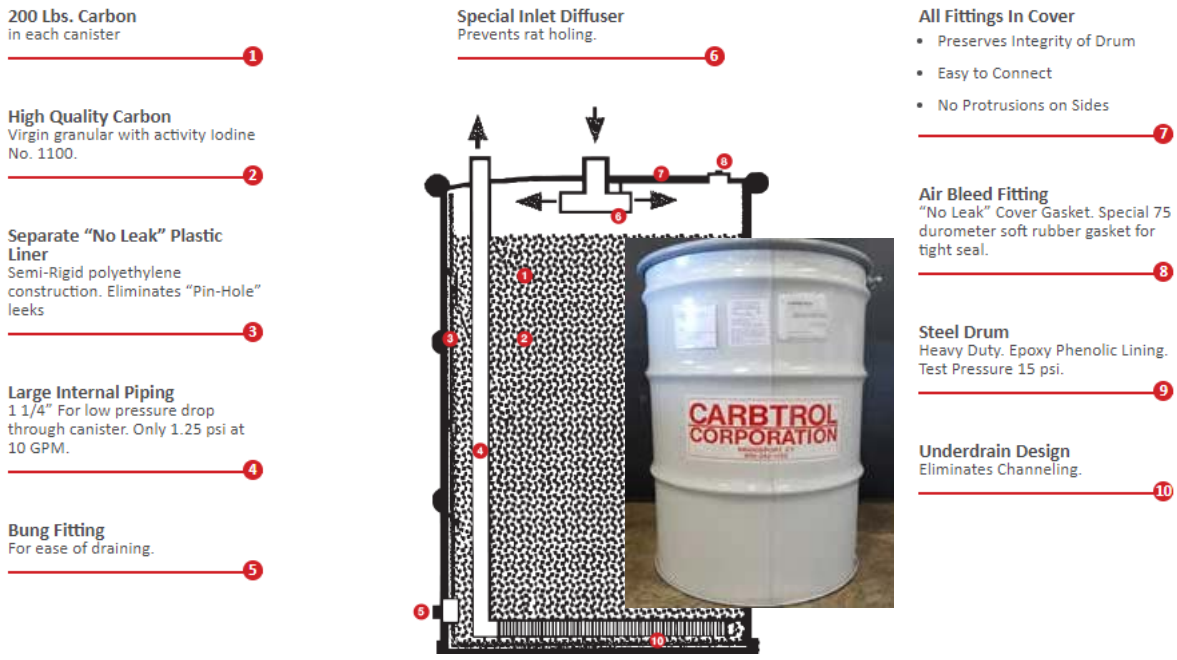


Figure 31. The Carbtrol® L-1 Canister with 200 lb. activated carbon to eliminate odors or equivalent device

5.0 Capital Improvement Plan

This section summarizes of the results of the gravity main and lift station assessments and presents SD5's 15-year CIP and planning-level cost estimates for each project.

5.1 Summary of Gravity Main Recommendations

The analysis of the gravity mains generated rehabilitation recommendations for all designated rehabilitation-related defects observed in the CCTV inspection data and other characteristics as defined in the rehabilitation decision logic in the previous section. Addressing all of these recommendations is both impractical and unnecessary because of District resource constraints and because some of the defects observed do not present a risk for SSOs or pipe failure at their current condition level. This CIP focuses on the most severe defects and highest-risk pipes for near-term capital improvements. However, because the inspections of many of these pipes were completed more than 15 years ago, it is assumed that many of the pipes with moderate defects (grades 3 and 4) continued to degrade and may currently be in worse physical condition. Therefore, these pipes (or a representative sample) should be re-inspected soon to determine if continued deterioration has occurred.

5.1.1 Rehabilitation

SD5's approach to selecting pipes for rehabilitation is based on the risk values calculated for each pipe and the overall severity of defects observed. Calculation of the risk values has been described in detail in the Section 4.1.3 above. The severity of the defects observed is based on the highest PACP defect grade observed on each pipe.

The PACP inspection process assigns a grade number for each defect observed. This grade is a 1 through 5 score that identifies the severity:

- **5:** immediate attention needed
- **4:** poor; will become Grade 5 in near future
- **3:** fair; moderate
- **2:** good; has not begun to deteriorate
- **1:** excellent; minor defects

It is common industry practice to use these defect grades to determine remaining useful life of the pipe. The most common application is:

- **5:** pipe has failed or will likely fail within 5 years
- **4:** pipe will probably fail in 5 to 10 years
- **3:** pipe may fail in 10 to 20 years
- **2:** pipe unlikely to fail for at least 20 years
- **1:** failure unlikely in foreseeable future

This is a general guideline and is applicable for SD5 based on the information available. However, NASSCO has revised the grading of its defects since the original District inspections were completed based in lessons learned in the industry (which could reclassify some of the original observations) and other PACP defect studies have shown that some defects deteriorate at a faster rate than others. Therefore, it is recommended that the pipes with grade 5 defects be addressed as soon as possible (e.g., within 5 years) and that pipes with grade 4 and grade 3 defects be reevaluated to determine the amount of degradation that has taken place since the original inspection. Some of these may now be grade 5 defects. Re-inspection is discussed further, below.

SD5 pipeline rehabilitation plan has been divided into the following four tiers for prioritization:

- 1 – Peak structural grade 5 defects or risk score greater than or equal to 58
- 2 – Peak structural grade 4 defects or risk score between 50 and 57.5
- 3 – Peak structural grade 3 defects or risk score between 36 and 49.5
- 4 – Others

Table 41 shows a summary of rehabilitation recommendations and costs per tier.

Table 41. Summary of pipeline rehabilitation recommendations

Tier	Timeframe	Number of gravity mains	Sum of miles	Gravity main costs
1	0–5 years	58	2.2	$2,994,847
2	5–10 years	61	2.7	$3,628,794
3	10–15 years	43	1.9	$2,655,865
4	15+ years	18	0.8	$895,311
Grand total		**180**	**7.6**	**$10,174,817**

Within the Tier 1 collection of pipes, additional refinement and prioritization can be applied by considering I&I and road paving. Based on the I&I study, pipes that fall within a basin that has I&I issues is noted in the model. While this does not impact the quantitative analysis, it can influence the annual priorities for rehabilitation. Road paving information from the Town of Tiburon (and any other data available) may also be used to determine the schedule for rehabilitation over the next five years.

5.1.2 Reinspection

The gravity mains recommended for CCTV inspection are a combination of pipes that have never been inspected, pipes that have inspection results showing inconsequential or no PACP defects, and pipes that have been previously inspected that should be reevaluated.

The decision support model relies on CCTV captured for analysis from about 15 years ago and therefore, it is likely that the system has continued to age and degrade after the analysis was completed, which is not accounted for in the model. In order to verify that these lower-grade issues have not become more urgent repairs, a degradation analysis is recommended. For the analysis, several pipes should be selected for another CCTV inspection. By comparing the current CCTV results with the original results, SD5 will be able to determine the amount of degradation that has occurred, which types of defects degrade the fastest, and if there are any that require urgent rehabilitation. SD5 can use this information to prioritize additional work for the remaining lower priority defects as well as more effectively plan future inspections.

There is approximately 40,000 feet of pipe in the system that has grade 4 and grade 3 defects. A degradation analysis can be performed on about 10 to 15 percent of these pipes, preferably selecting pipes with more than one defect. This analysis would cost between $50,000 and $75,000 to complete**.**

A breakdown of these gravity mains and their prioritized CCTV inspection recommendations by timeframe is shown in Table 42. Risk priority thresholds were assigned qualitatively based on the distribution of the results and represent relative priorities. Roughly 37 percent of the gravity main system is being recommended for CCTV inspections with varying priorities and time frames**.**

Table 42. Summary of prioritized CCTV inspection recommendations

Tier	Timeframe	Strategy	Count of gravity mains	Sum of miles	Follow up CCTV costs
1	0–5 years	Decision model	20	0.55	$20,461
		Degradation analysis		1.0 - 1.5	$75,000 (approx.)
2	5–10 years	Decision model	100	2.64	$97,697
3	10–15 years	Decision model	115	3.99	$147,307
4	15+ years	Decision model	115	3.99	$147,307
Grand total			**349**	**12.17 (approx.)**	**$487,772**

5.2 Summary of Lift Station Recommendations

This section describes the aggregation of the condition assessment findings into recommended improvement projects. Key assumptions that were considered to develop the lift station recommendations were applied based on industry knowledge and District-specific considerations. These are:

- Generators have fifteen (15) year estimated useful life based on District experience because of deterioration from sea air corrosion, usage, and age. Although Tiburon 5, Belvedere 3, and other standby generators were recently upgraded, they will still require one replacement cycle within the next 15 years. Therefore, all standby generators will require one replacement cycle within the next 15 years.
- SD5 has an ongoing pump preventive maintenance replacement program for the lift stations which is tracked in their maintenance management database, If there is no record in the database for replacement of a given pump and its age unknown, then it will be assumed that the it will require one replacement cycle within the next 15 years. The pumps estimated useful life is assumed to be 30 years.

Overall, the lift stations were in varying condition with Tiburon and Seafirth lift stations in better overall condition than the Belvedere lift stations***. Three of the stations that are in poor condition will require additional investigation to determine the best alternatives to fully address issues observed:***

- **Tiburon PS-4** requires additional investigation because of its sensitive location and force main easement issues. The resulting redesign, repairs, upgrades, and costs are not accounted for in this Master Plan.
- **Tiburon PS-9** requires additional investigation because of the leaning wet well concrete sections. The investigation and technical memorandum to provide recommended repairs and upgrades is estimated at approximately $15,000. The resulting repairs, upgrades, and costs are not accounted for in this document.
- **Belvedere PS-1** requires additional investigation because of its system criticality, age, and conditions. The resulting redesign, repairs, upgrades, and costs are not accounted for in this Master Plan.

Odor control will be required for Belvedere Lift Stations PS-1, PS-3, and PS-7. Belvedere PS-1 and PS-3 are generally not near residential or public spaces and can apply odor controls that focus on

efficiency and familiarity of operation. Chemical injection is recommended for these stations. Belvedere PS-7 is located next to residential property and will need a solution that is both aesthetic and functional. It is recommended that this station incorporate an exterior activated carbon odor control unit.

The overall condition summary of each lift station is shown in Table 43.

Table 43. Condition assessment summary for lift stations sorted by criticality level

Service area	Lift station criticality	Lift station location	Description	Very good (New or excellent condition)	Good (Minor defects only)	Fair (Moderate deterioration)	Poor (Significant deterioration)	Very poor (Virtually unserviceable)
Tiburon	1	PS-5	Mar W St.	✓				
Tiburon	2	PS-3	Paradise Dr. & Solano St.			✓		
Tiburon	2	PS-4	Paradise Dr. near Lyford's Tower				✓	
Tiburon	2	PS-6	Tiburon Blvd. and Beach Rd.			✓	✓	
Tiburon	2	PS-9	Paradise Dr. near Shoreline Park				✓	
Tiburon	3	PS-2	Mar E St. near Agreste Way			✓		
Tiburon	3	PS-7	Tiburon Blvd. near Ned's Way			✓		
Tiburon	3	PS-8	Beach Rd. and Lagoon Vista Rd.			✓		
Tiburon	4	PS-1	Mar E St. near Mar E Dr.			✓		
Belvedere	1	PS-1	Cove Rd. & Barn Rd.				✓	
Belvedere	2	PS-7	Peninsula Rd. and Beach Rd.			✓	✓	
Belvedere	3	PS-2	San Rafael Ave. & Teal Rd.			✓	✓	
Belvedere	4	PS-3	San Rafael Ave. and Golden Gate Ave.			✓	✓	
Belvedere	4	PS-9	Lagoon Rd. (south)			✓	✓	
Belvedere	5	PS-5	San Rafael Ave. and Windward Rd.			✓	✓	
Belvedere	5	PS-10	Lagoon Rd. near Maybridge Rd.			✓	✓	
Belvedere	5	PS-13	West Shore Rd. (north)			✓		
Belvedere	6	PS-8	Windward Rd.			✓		
Belvedere	6	PS-11	Lagoon Rd. (north)			✓	✓	
Belvedere	6	PS-12	San Rafael Ave. & Edgewater Rd.			✓	✓	
Belvedere	6	PS-14	West Shore Rd. (south)			✓		
Belvedere	6	PS-15	Beach Rd. near Embarcadero Dr.			✓		
Seafirth	1	CF-PS1	Seafirth Pl.			✓		
Seafirth	1	CF-PS2	Seafirth Rd.			✓		

This page is intentionally left blank.

5.2.1 Lift Station Improvement Projects

Recommended improvements for the SD5 lift stations fall into the following categories:

- **Additional investigation:** A few stations have unique issues that require a more detailed engineering analysis as described previously.
- **Concrete repair:** Repair of the wet well and other concrete structures is needed.
- **Epoxy coating:** Application of an epoxy coating to the wet well should be applied to slow down observed corrosion and extend the wet well useful life.
- **Epoxy coating (optional):** Optional epoxy coatings are recommended on stations where minor concrete deterioration or wear in the existing coating has been observed. The cost to recoat these structures is relatively low; however, the cost of mobilization and required bypass pumping is significant. Therefore, these recommendations should be applied as cost-effective opportunities allow.
- **Check valve:** Poor check valve condition is one of the more predominant issues observed in the lift stations. These should be replaced.
- **Pump replacement:** Pump replacement program in effect—$25,000 each zone. Replace as needed. Most pumps are 5 years old or newer.
- **Standby backup generator:** Generator replacement is assumed to be required every 15 years because of the corrosive marine conditions on the Tiburon Peninsula.
- **Access hatch replacement:** Replacement of access hatches that are in poor condition.
- **Access hatch repair:** Rehabilitation of access hatches in fair condition.
- **Fall protection safety grate:** Many of the older fall protection nets are deteriorated or approaching the end of their expected lives.
- **Odor control:** Odor control recommendations as described earlier.
- **Preventive maintenance:** Current preventive maintenance procedures and frequencies are sufficient and appropriate for proper maintenance and continued implementation is recommended. Note that these costs are considered operational and are not incorporated into the CIP.

Tables 49, 50, and 51 summarize the lift station recommended improvements for Tiburon, Belvedere, and Seafirth within the next 15 years, respectively.

Table 44. Tiburon lift station recommended improvements within the next 15 years

		Tiburon lift stations								
	Improvements	PS-1	PS-2	PS-3	PS-4	PS-5	PS-6	PS-7	PS-8	PS-9
1	Additional investigation				✓					✓
2	Concrete repair				✓					✓
3	Epoxy coating				✓		✓			✓
4	Epoxy coating (optional)	✓	✓	✓				✓	✓	
5	Check valve	✓	✓	✓			✓	✓	✓	
6	Pump replacement		✓	✓	✓					✓
7	Standby backup generator		✓	✓		✓	✓	✓	✓	
8	Access hatch replacement			✓	✓		✓	✓	✓	✓
9	Access hatch repair									

		Tiburon lift stations								
	Improvements	PS-1	PS-2	PS-3	PS-4	PS-5	PS-6	PS-7	PS-8	PS-9
10	Fall protection safety grate		✓	✓	✓		✓	✓	✓	
11	Odor control									
12	Preventive maintenance	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 45. Belvedere lift station recommended improvements within the next 15 years

		Belvedere lift stations												
	Improvements	PS-1	PS-2	PS-3	PS-5	PS-7	PS-8	PS-9	PS-10	PS-11	PS-12	PS-13	PS-14	PS-15
1	Additional investigation	✓												
2	Concrete repair	✓	✓	✓	✓	✓		✓	✓	✓	✓			
3	Epoxy coating	✓	✓	✓	✓	✓								
4	Epoxy coating (optional)						✓	✓	✓	✓	✓	✓	✓	✓
5	Check valve	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
6	Pump replacement	✓	✓						✓	✓	✓			
7	Standby backup generator	✓		✓										
8	Access hatch replacement	✓	✓	✓	✓	✓		✓	✓	✓				✓
9	Access hatch repair						✓				✓	✓	✓	
10	Fall protection safety grate	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
11	Odor control	✓	✓	✓		✓								
12	Preventive maintenance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 46. Seafirth lift station recommended improvements within the next 15 years

		Seafirth lift stations	
	Improvements	LS-1	LS-2
1	Additional investigation		
2	Concrete repair		
3	Epoxy coating		
4	Epoxy coating (optional)	✓	✓
5	Check valve		
6	Pump replacement	✓	✓
7	Standby backup generator	✓	
8	Access hatch replacement		
9	Access hatch repair		

		Seafirth lift stations	
10	Fall protection safety grate		
11	Odor control		
12	Preventive maintenance	✓	✓

These recommended rehabilitations have been prioritized into the same tier structure used for prioritizing pipeline replacements and is based on the criticality analysis described above. ***Table 47 provides the recommended schedule and opinion of costs for each lift station.*** Detailed cost basis for these estimates can be found in Appendix D.

Table 47. Recommended lift station schedule and rehabilitation costs

Service area	Lift station number	Lift station location	Rehabilitation schedule			
			0-5 years	5-10 years	10-15 years	15+ years
Tiburon	PS-1	Mar E St. near Mar E Dr.				$11,154
Tiburon	PS-2	Mar E St. near Agreste Way			$99,725	
Tiburon	PS-3	Paradise Dr. and Solano St.			$129,910	
Tiburon	PS-4	Paradise Dr. near Lyford's Tower	$386,515			
Tiburon	PS-5	Mar W St.				$50,833
Tiburon	PS-6	Tiburon Blvd. and Beach Rd.		$431,013		
Tiburon	PS-7	Tiburon Blvd. near Ned's Way			$91,464	
Tiburon	PS-8	Beach Rd. and Lagoon Vista Rd.			$40,631	
Tiburon	PS-9	Paradise Dr. near Shoreline Park	$400,747			
Belvedere	PS-1	Cove Rd. and Barn Rd.	$668,323			
Belvedere	PS-2	San Rafael Ave. and Teal Rd.		$498,934		
Belvedere	PS-3	San Rafael Ave. and Golden Gate Av		$500,590		
Belvedere	PS-5	San Rafael Ave. and Windward Rd.			$418,832	
Belvedere	PS-7	Peninsula Rd. and Beach Rd.	$411,031			
Belvedere	PS-8	Windward Rd.				$53,473
Belvedere	PS-9	Lagoon Rd. (south)		$83,478		
Belvedere	PS-10	Lagoon Rd. near Maybridge Rd.			$48,632	
Belvedere	PS-11	Lagoon Rd. (north)			$48,632	
Belvedere	PS-12	San Rafael Ave. and Edgewater Rd.			$36,050	
Belvedere	PS-13	West Shore Rd. (north)				$70,896
Belvedere	PS-14	West Shore Rd. (south)				$31,165
Belvedere	PS-15	Beach Rd. near Embarcadero Dr.				$58,054
Seafirth	CF-PS1	Seafirth Pl.				$50,833
Seafirth	CF-PS2	Seafirth Rd.				$0
Total			**$1,866,617**	**$1,514,016**	**$913,877**	**$326,408**

Notes:

Costs are in 2020 dollars from RS Means (a publication and database for construction industry materials, equipment, labor, etc. cost estimating.

Detailed cost basis for these estimates can be found in Appendix D.

5.3 Force Main Recommendations

A detailed assessment of SD5's force mains was not part of the master plan scope, however available information was reviewed to develop recommendations on further evaluation. This analysis considered both prioritizing the force mains to determine which ones should be evaluated first and identifying appropriate technologies to be used for the condition assessment. To simplify the analysis, the force main segments in the GIS were aggregated based on the upstream and downstream connectivity with

other segments, similar materials, and similar diameters. The resulting force main records is provided in Table 48, below. There are six pipe materials found in the SD5 force mains. Those include: asbestos cement (AC), vitrified clay pipe (VCP), cast iron (CAS), polyethylene (PE), poly-vinyl chloride (PVC), and steel. The pipe diameters in this system range from 4 inches to 10 inches.

Accurately prioritizing SD5's force mains would require a full risk analysis with LoF and CoF scoring for each pipe to determine the criticality of each (similar to what was performed on the gravity mains). Lacking such a study but based on experience and information available in the SD5's GIS database, the following recommendations are provided. It should be noted that a full risk analysis may identify different priorities.

From the information available, the Tiburon force mains PS-5-14 and PS-6-621, and Belvedere force mains PS1-TIB and PS3-ND5 - PS3-ND5.1.1, should be prioritized first for condition assessment. This is mostly due to their lengths, their associated pump station criticality, and their ages.

The possible assessment technologies for each force main is also shown in Table 48. The available technologies and vendors for assessment of these pipes is provided in Table 49. A more detailed description of each assessment technology can be found in Appendix F. The estimated cost for different assessment tools for each higher priority force main is provided in Table 50. These costs are based on previous project experience but would need to be refined with a quote from each vendor.

This page is intentionally left blank.

Table 48. Summary of District force mains and recommendations including sample results from V&A Consulting Engineers, 2018

Force main ID	Pump station	Pump station priority	Percent service area of collection system covered	Diameter (in.)	Material	Length (ft.)	Installation year	GIS comment	Sample material	Vanda rating	Metal loss	Possible assessment technologies
PS1-TIB	**(B)PS1[1]**	**1**	**36.8%**	**10**	**AC**	**2,107**	**1950**	**FORCEMAIN 10""**				**Acoustic**
PS7-NB2	(B)PS7	2	24.2%	4	VCP	57	1950	FORCEMAIN 4""				Acoustic
PS2-ND2	(B)PS2	3	16.9%	6	CAS	16		FORCEMAIN				Acoustic
PS3-ND5 - PS3-ND5.1.1	**(B)PS3**	**4**	**12.3%**	**6**	**PE**	**2,258**	**1950**	**FORCEMAIN 7.5"" NEAR CURB**	**Steel**	**2 (minor)**	**23.68%**	**Acoustic, electromagnetic**
PS9-N7	(B)PS9	4	3.0%	4	PVC	397	1952	FORCEMAIN 4""				Acoustic
PS5-C5	(B)PS5	5	2.0%	6	CAS	72	1952	FORCEMAIN				Acoustic
PS10-M5	(B)PS10	5	1.3%	6	VCP	35	1950	FORCEMAIN				Acoustic
PS13-CA5.1	(B)PS13	5	6.0%	4	AC	438	1956	FORCEMAIN 4""				Acoustic
PS12-C6	(B)PS12	6	0.3%	6	VCP	179	1955	FORCEMAIN				Acoustic
PS15-NF3	(B)PS15	6	6.0%	6	VCP	69	1959	FORCEMAIN				Acoustic
PS8 - 10 Windward-A7A	(B)PS8	6	0.3%	6	VCP	53	1952	FORCEMAIN 6"" VC				Acoustic
PS11-K4	(B)PS11	6	0.7%	6	VCP	49	1950	FORCEMAIN 4""				Acoustic
PS14-E6.1	(B)PS14	6	5.3%	4	AC	458	1950	FORCEMAIN 4""				Acoustic
PS-5-14	**(T)PS5[2]**	**1**	**25.5%**	**8**	**VCP**	**1,303**	**1960**		**Cast iron**	**3 (moderate to significant)**	**18.95%**	**Acoustic, electromagnetic**
PS-9-642	(T)PS9	2	2.6%	10	VCP	235	1962					Acoustic
PS-6-621	**(T)PS6**	**2**	**7.6%**	**8**	**AC**	**1,168**	**1960**					**Acoustic**
PS-3-33	(T)PS3	2	4.0%	6	VCP	379	1952					Acoustic
PS-4-608	(T)PS4	2	0.0%	4	PVC	100	1960					Acoustic
PS-7-121	(T)PS7	3	5.3%	6	CAS	903	1962		Cast iron	2 (minor)	11.95%	Acoustic, electromagnetic
PS-2-38	(T)PS2	3	2.3%	6	CAS	357	1952		Cast iron	4 (severe)	22.12%	Acoustic
PS-8-808	(T)PS8	3	4.0%	4	PVC	565	1987					Acoustic
PS-1-41	(T)PS1	4	0.3%	4	CAS	140	1970					Acoustic
4185 Paradise Dr.-Valve Box - End of Sewer Line Extension	PCN[3]	N/A	38%	4	PE	4,603	2008					Acoustic
626-473	PCS[4]	N/A	6%	6	PE	778	2003					Acoustic
473-474	PCS	N/A	5%	6	PVC	562	2003					Acoustic
627-626	PCS	N/A	37%	6	PE	4,437	2003	PREVIOUSLY MH-9-MH-10				Acoustic
CF-PS1-	(SF)PS1[5]	2	1.0%	4	VCP	870	NA					Acoustic
SF5-CF-PS2	(SF)PS2	2	0.3%	4	PVC	772	NA					Acoustic

[1](B) – Belvedere service area
[2](T) – Tiburon service area
[3]PCN – Paradise Cove Force Main north of the treatment plant
[4]PCS – Paradise Cove Force Main south of the treatment plant
[5](SF) – Seafirth lift stations

This page is left intentionally blank.

Table 49. Possible condition assessment technologies and vendors

Technology description	Vendor	Name
Acoustic • Leak detection • Gas pocket detection • Any pipe material • Pipe diameters 4" and up • Free-swimming • Pipe online	Pure	SmartBall[1]
	PICA	Recon +[1]
Electromagnetic • Wall loss • Metallic pipes • Pipe diameters 4" and up • Free-swimming or tethered • Pipe online or offline	Pure	PipeDiver[1]
	PICA	SeeSnake[1]
Multi-sensor attachments • CCTV • LIDAR • 3D scanning • Elevation profiling	Various	Robotic Surveyor[2]

[1]Suitability of these tools for this system is contingent upon a review of the pipeline records by the vendor, and possible access improvements and cleaning.
[2]Not likely to be suitable for these force mains as the line needs to be offline, drained, and cleaned.

Table 50. Estimated assessment cost

Force main	Diameter (in.)	Length (ft.)	Pipe material	Possible assessment tools	Estimated cost
PS1-TIB	10	2,107	AC	Recon + SmartBall[1]	$12,000 $60,000
PS3-ND5 - PS3-ND5.1.1	6	2,258	PE	Recon + SmartBall[1]	$12,000 $60,000
PS-5-14	8	1,303	Cast iron[2] (VCP)	Recon + SmartBall[1] SeeSnake	$12,000 $55,000 $250,000
PS-6-621	8	1,168	AC	Recon + SmartBall[1]	$12,000 $55,000

[1]There is potential cost savings if all the force mains are inspected under a single mobilization and single inspection report, about $140,000 deduction.
[2]GIS shows the force main as VCP, but the recent sample analysis by V&A Consulting Engineers showed a cast iron pipe.

5.4 CIP Budgeting

SD5's overall income is around $6.5 million based on information from the fiscal year (FY) 2020-2021 Budget Report. Previous capital expenditures have ranged between $1.3 million and $2.6 million over the past 5 years, which include collection system, lift station, and WWTP improvements and upgrades, as well as current debt service. Because significant improvements have already been completed on the SD5 WWTPs it is assumed that priorities can be shifted to the collection system and lift stations.

Planned capital expenditures for the next 9 years average about $1.2 million per year totaling approximately $11 million for the lift stations and gravity mains based on SD5's financial plan. This CIP is structured to conform to this target budget.

5.5 CIP Summary

This section provides a summary of the comprehensive CIP for the collection system. Table 51 shows the expenditures by asset category: gravity mains, pump stations, and force mains. These expenditures are categorized into near-term, mid-term, and long-term expenses covering the next 15 to 20 years. Each of the categories is further divided by service area and finally, a 5-year annual average cost is calculated.

Table 51. Summary of CIP expenses for gravity mains and lift stations

	Total	Tiburon	Belvedere	Yearly average
Short-term (0-5 years)				
Gravity main rehabilitation and inspection	$ 3,085,308	$ 2,066,086	$ 1,019,222	$ 617,062
Lift station rehabilitation	$ 1,881,617	$ 802,263	$ 1,079,354	$ 376,323
Force main inspection	$ 216,000	$ 108,000	$ 108,000	$ 43,200
Short-term total	**$ 5,182,925**	**$ 2,976,349**	**$ 2,206,576**	**$ 1,036,585**
Mid-term (5-10 years)				
Gravity main rehabilitation and inspection	$ 3,726,491	$ 2,330,252	$ 1,396,239	$ 745,298
Lift station rehabilitation	$ 1,514,016	$ 431,013	$ 1,083,002	$ 302,803
Force main inspection	$ -	$ -	$ -	$ -
Mid-term total	**$ 5,240,507**	**$ 2,761,266**	**$ 2,479,242**	**$ 1,048,101**
Long-term (10-15 years)				
Gravity main rehabilitation and inspection	$ 2,803,172	$ 2,217,901	$ 585,270	$ 560,634
Lift station rehabilitation	$ 913,877	$ 361,730	$ 552,147	$ 182,775
Force main inspection	$ -	$ -	$ -	$ -
Long-term total	**$ 3,717,049**	**$ 2,579,632**	**$ 1,137,417**	**$ 743,410**

These costs and schedule are also shown on the graph in Figure 32. This graph shows the average expenditures annually by fiscal year. The gravity main rehabilitation and inspection category is further broken out int gravity main rehabilitation (dark blue bars), gravity main inspection (orange bars), and gravity main degradation study (grey bars). The gravity main degradation study is described in more detail in the additional recommendations in Section 5.6, below.

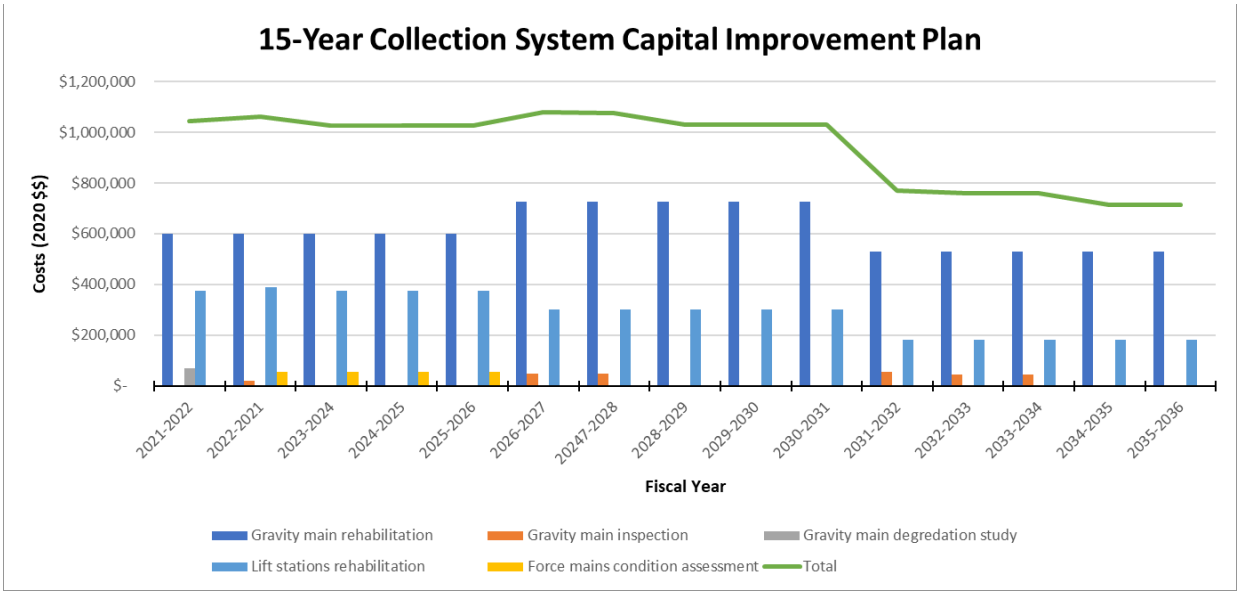


Figure 32. Collection system capital improvement plan

The proposed CIP is also compared to SD5's planned capital expenditures as provided in the FY 2020–2021 Final Budget report (Figure 33) [SD2, 2020b]. The blue line represents the capital budget planned in the Budget Report and the orange line represents the planned expenditures from the proposed CIP. ***The total planned budget from FY 2020–2021 to FY 2028–2029 is $11 million and the proposed budget for the same period is approximately $9 million, which shows strong alignment between the planned budget in the Budget Report and the proposed CIP.***

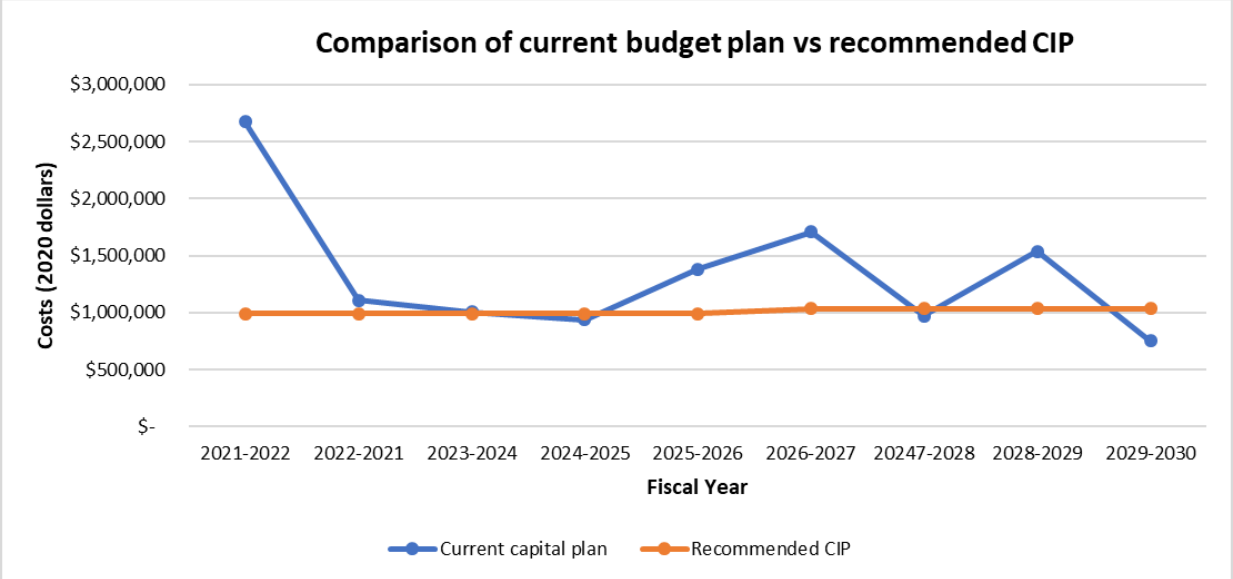


Figure 33. Comparison of planned capital expenditures in comparison to the proposed CIP

Figure 34, Figure 35, and Figure 36 provide maps of the proposed capital improvement projects in the near-term, mid-term, and long-term respectively.

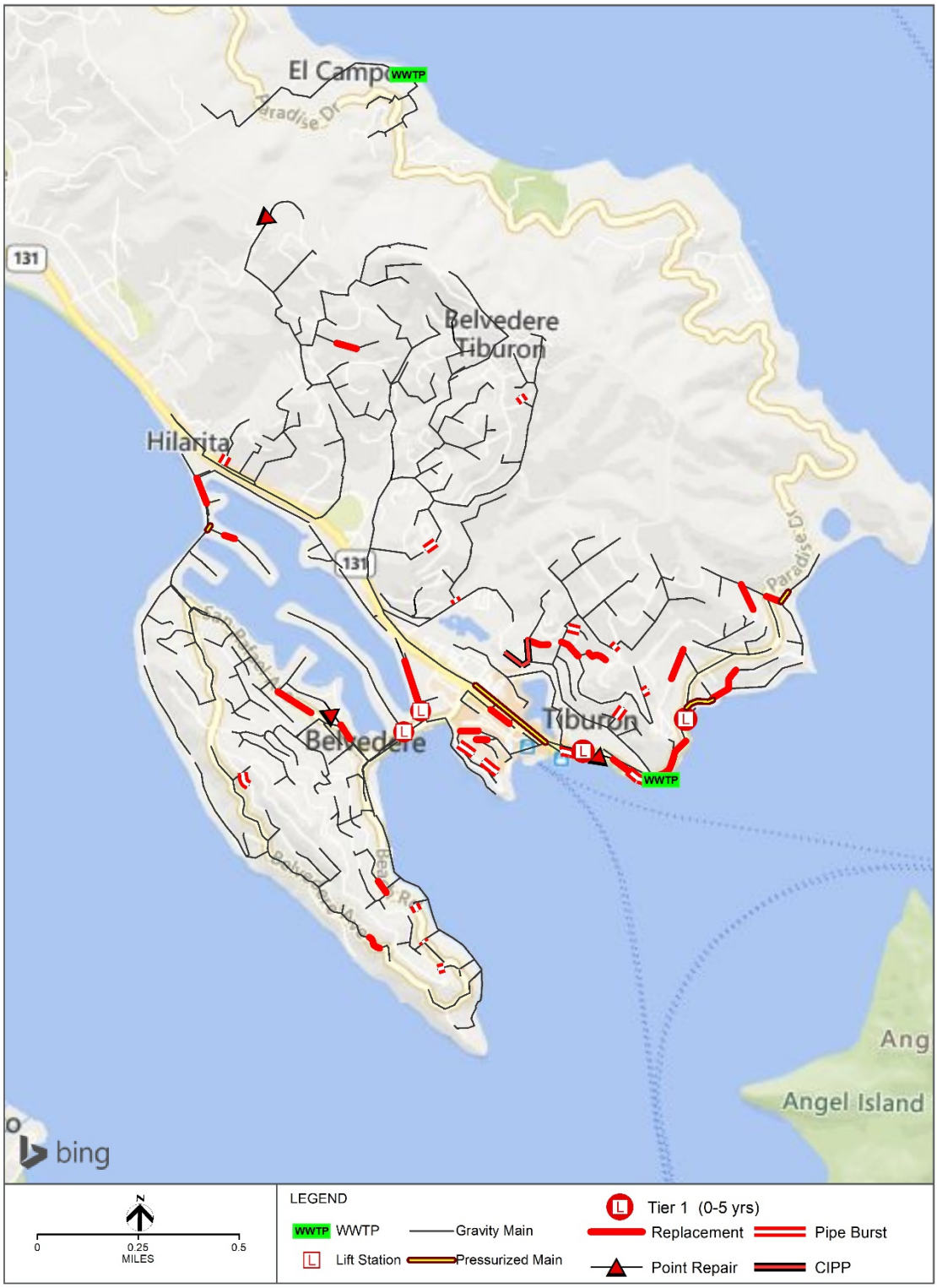


Figure 34. Near-term collection system capital plan

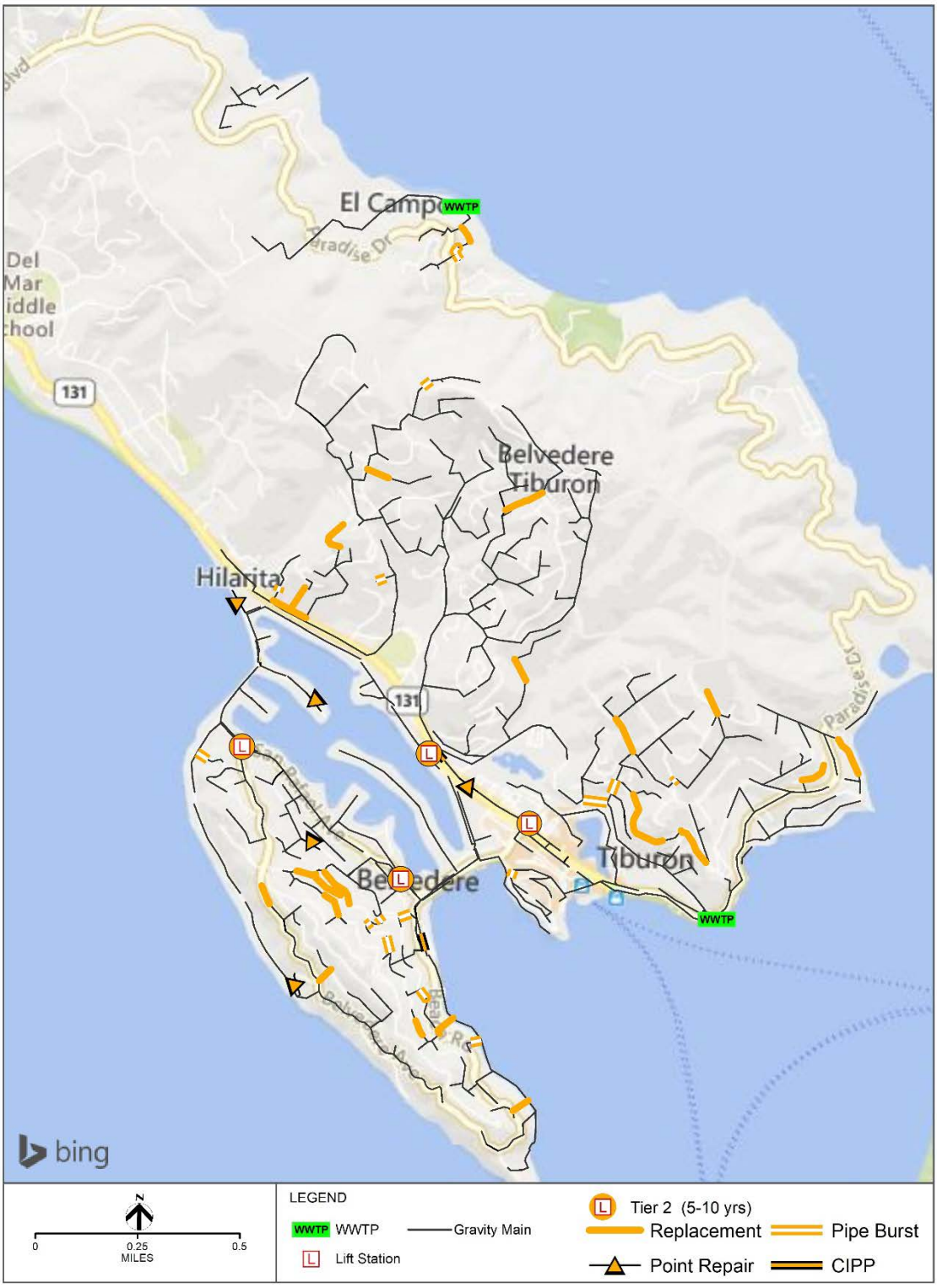


Figure 35. Mid-term collection system capital plan

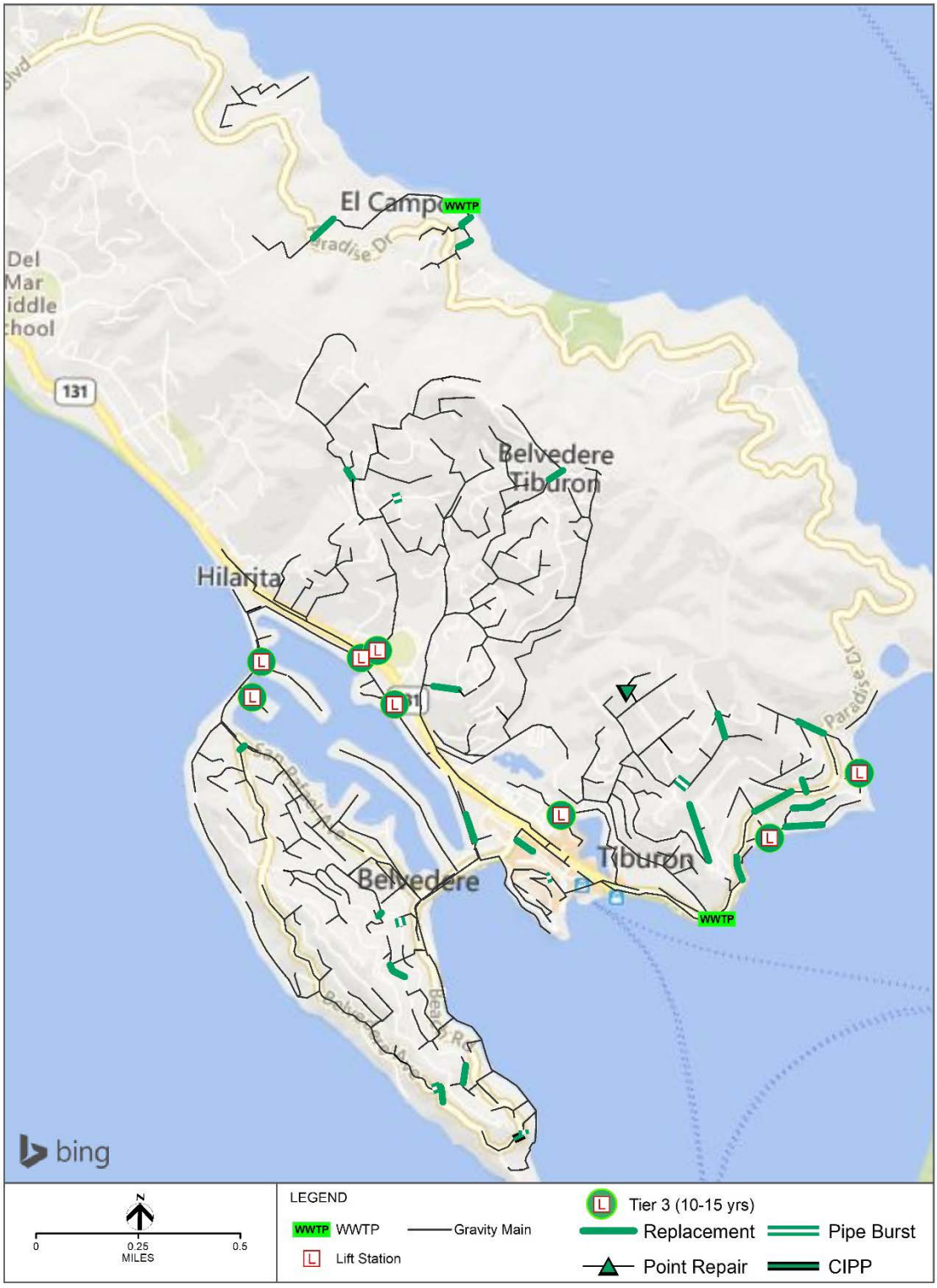


Figure 36. Long-term collection system capital plan

5.6 Additional recommendations

Recommendations identified in this Master Plan that were not incorporated into the capital plan area summarized below.

5.6.1 Gravity Mains

The capital plan identifies specific rehabilitation and reinspection actions based on the CCTV data collected previously. In general, grade 5 defects should be addressed in the next 5 years and are incorporated into the capital plan. Grade 4 and grade 3 defects typically do not require immediate attention and therefore have been designated to be repaired between 5 and 15 years, which assumes that they will continue to degrade.

However, most of the CCTV captured for analysis is about 15 years old and therefore, it is expected that the system continued to age and degrade after the analysis was completed. ***In order to verify that these lower-grade issues have not become more urgent repairs, a degradation analysis is recommended.*** For the analysis, several pipes will be selected for another CCTV inspection. By comparing the current CCTV results with the original results, SD5 will be able to determine the amount of degradation that has occurred, which types of defects degrade the fastest, and if there are any that require urgent rehabilitation. SD5 can use this information to prioritize additional work for the remaining lower priority defects as well as more effectively plan future inspections.

There is approximately 40,000 feet of pipe in the system that has grade 4 and grade 3 defects. A degradation analysis can be performed on about 10% of these pipes, preferably selecting pipes with more than one defect. This analysis would cost between $75,000 and $100,000 to complete.

5.6.2 Inflow and Infiltration

The 2010-2011 flow monitoring study captured flow information for about 50 percent of SD5's collection system. ***A general qualitative review of the available data indicates that there may be additional areas where I&I are significant.*** From the information available in the flow monitoring study and flow data for the Main WWTP during that time period, it appears that the average daily dry weather flow from the monitored basins makes up about 50 percent of the flow to the plant, but only about 30 to 40 percent during wet weather events. For example, average flow on February 3, 2011 totaled about 0.32 MGD from the monitored basins and 0.62 MGD at the plant. This accounts for about half the flow. During a rain event on February 24, 2011, the average daily flow from the monitored area averaged about 0.51 MGD, and the average daily flow at the plant ranged from 0.69 MGD to 1.61 MGD over the following three days. This suggests that the flow contributed from the monitored areas contributed about 30 to 40 percent of the total flow to the plant instead of the expected 50 percent, therefore additional analysis is recommended. Areas to monitor may be prioritized by additional inspection of manholes and pipes that could be susceptible to surface flow or potential damage in creek channels.

General investigation for inflow reduction is recommended for Basins 1 and 7, and possibly for Basins 2, 4, and 6. SD5 may consider a variety of strategies for identifying and removing illicit connections including smoke testing, public outreach, offering of rebates, and community assistance from local organizations (e.g. Scout troops helping residence disconnect downspouts from the sewer system), and augmenting the sewer lateral inspection program to prioritize higher I&I areas.

SD5 may wish to consider other options for Peninsula Boulevard which has the greatest issues related to I&I. Because this line has many sags and is located in the lagoon, it may become a bigger issue if additional settling occurs or sea level continues to rise. Options for addressing the line itself are varied and the most cost-effective solution depends upon the impacts of I&I, need for odor control,

amount of regular and emergency maintenance required and other factors. Table 52 summarizes potential options, their advantages and disadvantages

Table 52. Summary of options to address Peninsula Boulevard I&I

Option	Advantages	Disadvantages
Maintain the line as is	Low capital cost	Won't improve I/I. costly for maintenance.
CIPP the main line	May reduce callouts for blockages. May reduce I/I slightly.	Does not remedy the sags, will likely not reduce I/I significantly
Pipe Burst Main line	May reduce callouts for blockages. May reduce I/I slightly.	May reduce some sags. Will not improve the grade of the line.
Open cut main replacement	Sags are fixed. May reduce I/I slightly. Could improve grade of the main.	Services lines may need to be replaced because the new main may be higher in elevation. Susceptible to sagging in the future. Capital cost would be high. Excavation would be extensive.
Replace main line and services	I/I would be reduced. Sags could be fixed. Maintenance cost would be reduced	Costly for construction. Requires cooperation from property owners. Excavation is extensive.
Replace the main in the street with a vacuum sewer system.	Future settlement would not affect the system. Excavation could be minimized. I/I from the public system would be eliminated.	Need a site for the vacuum system/lift station. Capital cost would be high. I/I from private property would not be reduced. Maintenance activities would be new and require training.
Construct vacuum system and replace services	The greatest reduction in I/I. fixes the system so that future settlement does not harm the system.	Capital cost would be high. Excavation would be extensive. Private property owner support is required. Maintenance activities would be new and require training.

5.6.3 Sea Level Rise

SD5 currently experiences local impacts from the bay, storm surges, and high tides, and it is likely that these will become a greater issue in the next 20 to 30 years. It is difficult to determine how great these current impact are and therefore difficult to predict how much they significant they will be in the future. ***SD5 has done a good job of improving its lift stations to be more resilient to flooding or SLR and should continue to evaluate Tiburon lift stations PS-4 and PS-6 as they appear to be the most susceptible to current flooding and future SLR impacts.***

Over the next 10 to 15 years, it would be useful for SD5 to conduct a Sea Level Rise Vulnerability Assessment to determine how and where the most significant SLR impacts will occur. This should include further evaluation of tidal influences and the behavior of the local groundwater table to identify areas where additional I&I could be introduced. This will enable SD5 to develop system design, maintenance and emergency response plans that account for future SLR impacts.

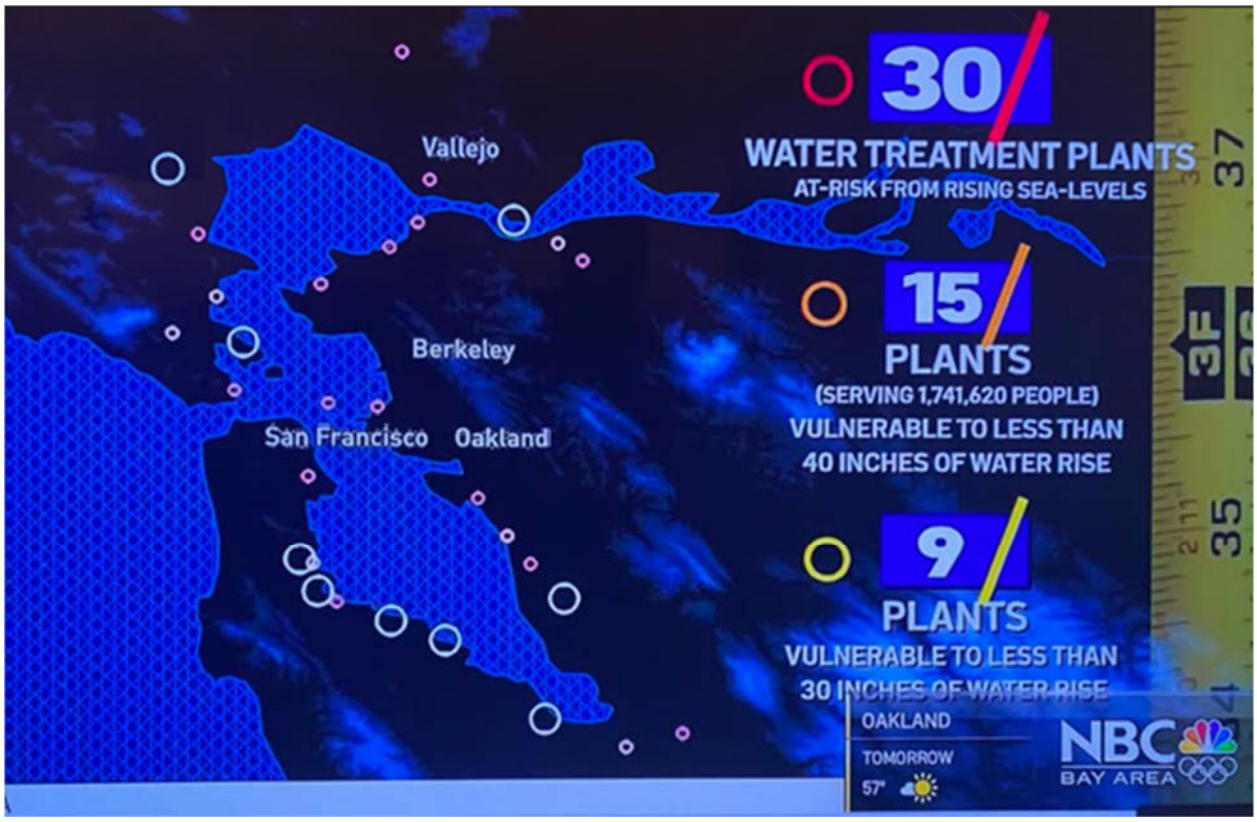
NBC BAY AREA INVESTIGATIVE

Bay Area Sewage Systems at Risk as Seas Rise

When sewage spewed out of a shower in a San Francisco home, climate change experts say it may be a sign of things to come as sea levels rise around the Bay. An NBC Bay Area investigation reveals how low-lying sewage treatment plants could fail in the coming years, four of those facilities are vulnerable to flooding within the next decade.

By Stephen Stock, Robert Campos, Mark Villarreal, Michael Horn and Sean Myers • Feb 2, 2021

An NBC Bay Area investigation found 30 out of 39 sewage treatment plants located around San Francisco Bay Area are at risk of flooding as sea levels rise due to climate change. Four of those plants could flood with as little as 9.84 inches of sea level rise. That's an amount that state analysts say is a possibility by 2030. If and when that happens, toilets won't flush, and in some cases, sewage could back up into homes, whether residents live in the hills or along the coast.



Map: Sean Myers/NBC Bay Area

Sewage treatment plants in the San Francisco Bay Area were built on low lying areas along the bay so that wastewater from homes could flow downhill to the facilities using nature's gravity rather than more expensive machine-driven pumping stations.

“There is a lot of vulnerability of these systems and we really need to start considering them and how we might adapt to future sea level rise,” said Dr. Michelle Hummel, lead author of a UC Berkeley study that analyzed the sewage plants. “Even if your home itself is not flooding, you could lose access and wastewater service. So, there's a lot of potential impacts that we'll see as an entire region. And it won't just be restricted to folks who live right along the shoreline.” “The goal of this study was to just highlight the magnitude of this potential threat. And most of us don't think about wastewater on a daily basis when we flush out toilets,” Dr. Hummel said.

NBC Bay Area’s Investigative Unit reviewed data from both the UC Berkeley study and from another independent study conducted by the Bay Area Clean Water Agencies. The combined data show that 30 out of 39 Bay Area sewage plants are at risk of failing as sea levels rise. The list below shows the water level at which each plant is expected to flood.

Sea Level Rise Risk at Bay Area Sewage Treatment Plants

Thirty Bay Area sewage treatment pla could be impacted by sea level rise, according to an analysis by NBC Bay Area's Investigative Unit. Together, those 30 facilities serve 6,132,646 people.

Page 1 of 3 ›

AGU Plant Name	City	First SLR Threat (Inches)	Service Population
Palo Alto WQCP	Palo Alto	9.84	233,005
Paradise Cove WWTP	Tiburon	9.84	400
San Mateo WWTP	San Mateo	9.84	143,649
Benicia WWTP	Benicia	9.84	13,682
Silicon Valley Clean Water WWTP	Redwood City	19.69	211,108
Alvarado WWTP	Union City	19.69	337,560
Millbrae WPCP	Millbrae	29.53	21,500
Novato WWTP	Novato	29.53	56,251
South San Francisco-San Bruno SQCP	South San Francisco	29.53	122,538
Sunnyvale WPCP	Sunnyvale	39.37	174,000
Mt. View Sanitary District WWTP	Martinez	39.37	29,000
San Francisco International Airport WWTP	San Francisco	39.37	80,000
Central Marin Sanitation Agency WWTP	San Rafael	39.37	111,927
Sewerage Agency of Southern Marin WWTP	Mill Valley	39.37	25,000
Oro Loma-Castro Valley WWTP	San Lorenzo	39.37	182,000

** Modeling does not give specific threat in inches but predicts it will be impacted within 30 years*

Table: Sean Myers/NBC Bay Area • Source: Bay Area Clean Water Agencies and UC Berkeley • Created with Datawrapper

Source: Bay Area Clean Water Agencies and UC Berkeley

“The level of the bay will rise,” said Zach Wasserman, Chairman of the Bay Conservation and Development Commission (BCDC). “If we do not start acting, do not start figuring out very specifically the ways that we can adapt to this and how we’re going to pay for it,” said Wasserman, “then life in the Bay Area will look and feel very different that it does today. And even people in the hills who will not be directly affected by rising waters will be indirectly affected by it because their transportation systems will be disrupted and the level of groundwater will increase, which could easily make it difficult to flush their toilets.”

Len Materman agrees. Materman is CEO of One Shoreline in San Mateo, also known as the San Mateo County Flood and Sea Level Rise Resiliency District, an agency dedicated to combating rising waters across the Bay Area.

Materman says everyone living in this region, no matter their address, will be affected by rising sea levels. “It’s [local water treatment plants and infrastructure] at risk. And it's at greater risk as time goes on with sea level rise,” Materman said. “Even if you live in the hills, I mean, if you're in Hillsboro or Woodside or whatnot, you depend on [the plant]. If you flush your toilet you depend on a functioning water treatment plant.”

For an example of how that can affect daily life look no further than the story of Sara and Peter Glover. During a heavy rainstorm, the Glovers suddenly found themselves knee deep in sewage. “The sewage was coming up out of this bathroom,” said Sarah Glover, pointing to a shower on the ground floor of her home in San Francisco’s West Portal neighborhood. They lost the first floor of their home to the sewage backup, even though they live miles away from the water. “We’ve lived here for twenty-five years and had no problems,” said Peter Glover, “then in the span of the last, you know, five years, it happened twice. “Our garbage cans were in the garage. The water was so high they were floating,” said Peter, “I couldn't find my boots because they were underwater. So, the only thing I could grab to remotely even cover my feet with some safety were crocs. And, you know, that's basically walking barefoot through the sewage.”

Repairs to the home cost the Glovers $90,000. Even though insurance covered the damage, they say they never recovered from the shock - and the stench. "The odor was horrific," said Sarah. Dozens of other neighboring homes in West Portal flooded during that heavy rainstorm in December of 2019 because their sewer pipes aren’t wide enough to accommodate rain runoff and sewage, which share the same path to the Bay. But as sea levels rise, experts say this same scenario could play out across the Bay Area.

Without accounting for storms, King Tides and other weather events, the State of California predicts seas will likely rise about half a foot by 2030. In what scientists say is an extreme scenario - sea level could increase by one foot by 2030. By the middle of this century, the low figure is 1.1 feet, with an extreme high of nearly 3 feet.

One reason for concern that experts point to is what happening to the waters in the Arctic. “The temperatures in the Arctic are warming up three times faster than they’re warming up in the rest of the planet,” said Dr. Mayra Oyola, an atmospheric scientist for NASA. In the past decade, NASA and the European Space Agency launched satellites to accurately measure sea levels. Their data shows a potential for seas to rise as much as eight feet by the end of the century. “Obviously this is of concern if we’re thinking about people living near the coast,” said Dr. Oyola.

Of the 30 sewage treatment plants at risk in the Bay Area, The Investigative Unit identified four plants, serving 390,736 people, that are most at risk: Palo Alto, Paradise Cove in Tiburon, San Mateo and Benicia. Because of their location and height data modeling shows those treatment plants could flood within a decade if scientist’s worst predictions come true. If seas rise 20 inches, which some models say could happen by 2040, Silicon Valley Clean Water in Redwood City ad Alvarado Wastewater Treatment Plant in Union City are also at high risk.

“There needs to be some big picture thinking,” said Jim McGrath, Chair of the San Francisco Bay Regional Waterboard. “You’re going to have to think about, okay, are we going to have to

reconstruct some of these facilities as force managers, which means you pump them rather than go by gravity, which is more expensive to operate, certainly very expensive and disruptive."

Over the next six to nine months, the Waterboard will ask all the sewage treatment plants in the Bay Area to submit their plans to protect their facilities from flooding. The agency will review the answers they receive, prioritize the plants based on risk, and work with them on potential solutions.

After sewage caused $90,000 worth of damage to her house, the Glovers worry about both her and her neighbors' future. "Until the city and the state and the country take climate change seriously," Sarah said, "and I'm hopeful as we move forward that they are (taking it seriously), we're going to continually be in this position - and it's a shame, especially in a country with all these resources."

DECISION/ACTION ITEM LOG
CIP Committee: February 9, 2021
Sanitary District No. 5 of Marin County
ACTIVE ITEMS SHEET

No.	Item	Submission Date	Responsible Party	DECISION ONLY Due	DECISION ONLY / Completed	ACTION REQUIRED Due	ACTION REQUIRED / Completed	Comment/Reference Document
29	Cove Rd. Force Main Replacement Project	3.12.19	Nute/TR/CIP					Nute Preparing Bid Docs, as of 3.12.19; Waiting for CalTrans response re horizontal drilling, as of 5.14.19; Still working w/ CalTrans, waiting for approval, as of 11.12.19; Design Review from Nute, 12.10.19, 1.14.19, 2.11.20; Received Caltrans Permit, 3.9.2020; Notice for Sealed Bid @ Marin IJ on 4.28.2020 w/ Bids due 5.19.2020; Posted RFP at SD5 Wesbite, (http://www.sani5.org/ about/contracts-proposals-bidding), 5.5.2020; Project granted to Maggiora & Ghilotti, Inc.; Work to begin on 7.27.2020; Job well underway and progressing smoothly, as of 10.13.2020; **Job is 70% complete, as of 11.10.2020**
31	FY2020-2021 Sewer Rehab Project		CIP/TR					**Small project for Paradise Cove; Enginnering to begin in ~~Dec 2020, as of 7.14.2020~~; Jan 2021, as of 12.8.2020**
32	SD5 Collection Sytsem Master Plan		CIP/TR					Posted RFP at SD5 Wesbite, (http://www.sani5.org/ about/contracts-proposals-bidding), 5.5.2020; Revised RFP from HDR, as of 7.14.2020; **Underway, as of 11.10.2020**