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- The public may also watch, listen to, or participate in the meeting live by visiting <https://us02web.zoom.us/j/89255646791> or by telephoning 1-253-215-8782 and entering Meeting ID 892 5564 6791.
- The public is encouraged to comment via email to cityclerk@cityofanacortes.org or via written comment addressed to City Clerk, P.O. Box 547, Anacortes, WA 98221. Public comments received by the [City Clerk](#) prior to 3:00 p.m. the day of the meeting will become part of the record for the meeting, just as if presented in person.
- Complete guidelines for virtual participation in Anacortes City Council meetings are available [here](#). View the quick video example for connecting to the meeting [here](#).



Anacortes City Council
Municipal Building Council Chambers
904 6th Street

January 27, 2025
6:00 PM

PRELIMINARY AGENDA
[Packet Materials](#) / [Watch Meeting](#)

1. **Call to Order**
2. **Pledge of Allegiance**
3. **Announcements and Committee Reports**
 - a. Planning Committee (Report)
4. **Public Comment**
5. **Consent Agenda**
 - a. Minutes of January 21, 2025 (Action)
 - b. Approval of claims in the amount of \$2,118,939.99 (Action)
 - c. Special Event: Open Streets (Action)
6. **Other Business**
 - a. * Stormwater Master Plan (Presentation)
7. **Adjournment**

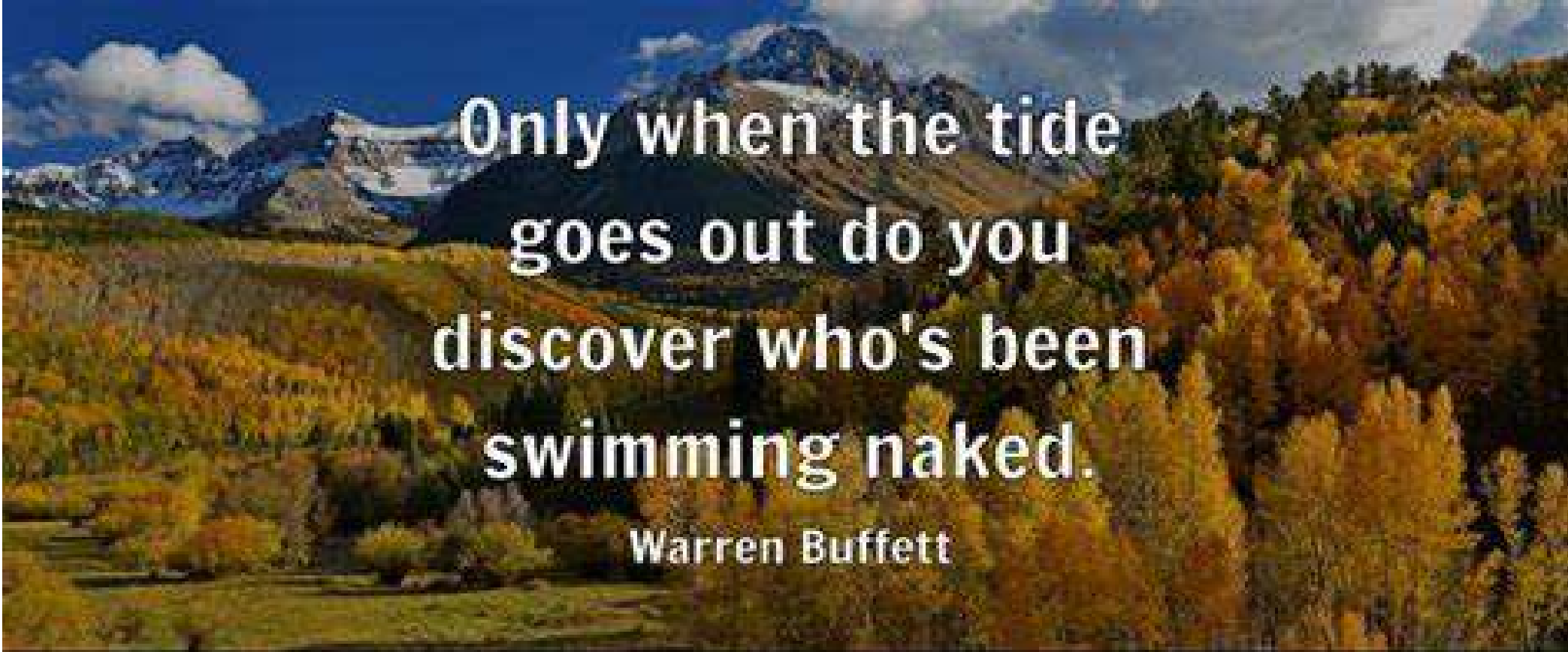
Per the council rules of procedure, a person who wishes to provide public comment at this meeting may do so:

- *On matters pertaining to a particular agenda item at the invitation of the chair at the time the City Council takes up discussion of that agenda item. Items open for public comment are indicated with an asterisk (*)*
- *On any other matter specifically pertaining to the City of Anacortes during the Public Comment agenda item.*

The City of Anacortes is committed to making public meetings available and accessible to all members of the community. For assistance with special needs, please contact the City Clerk at 360-299-1960 in advance of the meeting.

FOOD FOR THOUGHT
for the
ANACORTES CITY COUNCIL
BUDGET RETREAT 2025





Only when the tide
goes out do you
discover who's been
swimming naked.

Warren Buffett

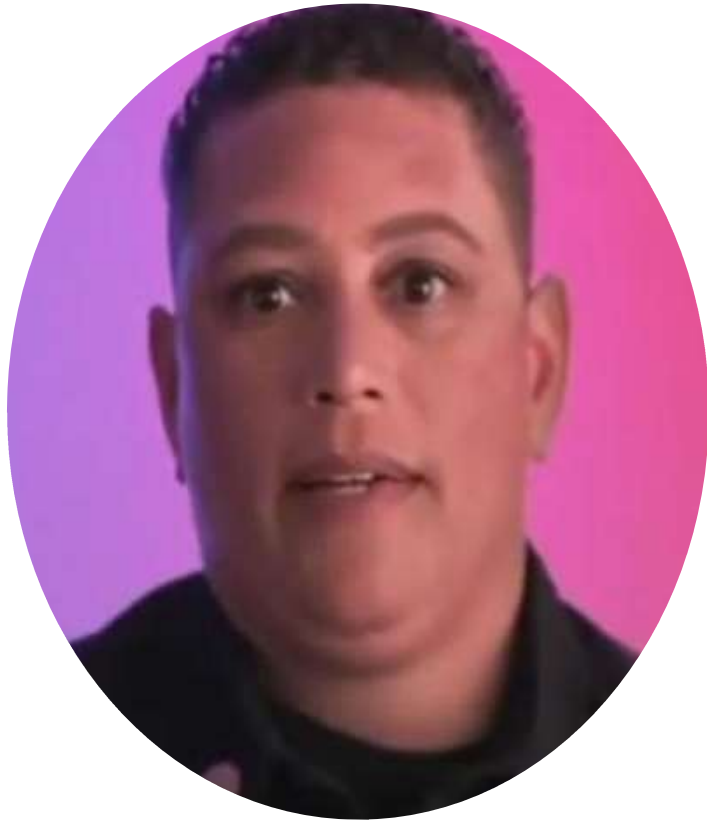
BrainyQuote



DEATH AND DESTRUCTION – SO FAR

- **28 KNOWN DEAD**
- **NEARLY 17,000 STRUCTURES GONE**
- **TENS OF THOUSANDS HAVE LOST THEIR HOMES**
- **THE MOST EXPENSIVE AND DESTRUCTIVE WILDFIRE
IN HISTORY**

\$400,000 a Year FOR THIS?



- LA's Dep. Fire Chief Is \$400k/Year DEI Hire
([The Western Journal](#))
- In a video defending the department's DEI hiring practices, Deputy Chief Kristine Larson — who heads the Equity and Human Resources Bureau — addressed accusations that female firefighters aren't strong enough to carry a man out of a burning building by saying:
- if you need to be rescued, it's your fault: "You were in the wrong place."¹ Her response: "He got himself in the wrong place if I have to carry him out of a fire."²

[NY Post](#)

FIRE TRUCKS AND EQUIPMENT OUT OF SERVICE, NOT ENOUGH MECHANICS

- LA fire chief Kristin Crowley said in an interview with CNN: **'We have over 100 fire apparatus out of service. Having these apparatus, and the proper amount of mechanics would have helped.'**

THE DAILY MAIL

\$750,000 a Year for FOR THIS?

- **LA's \$750k-a-year water chief Janisse Quiñones 'knew about empty reservoir and broken hydrants' months before fires**

- By JOSH BOSWELL and DANIEL GUSS FOR DAILYMAIL.COM
- **PUBLISHED:** 17:38 EST, 10 January 2025 | **UPDATED:** 08:36 EST, 13 January 2025

THE DAILY MAIL

FIRST OF **MANY MORE LAWSUITS** TO COME?

- On 14 January, Reuters reported that a group of residents and others affected by the blaze were filing a lawsuit against the Los Angeles Department of Water and Power (LADWP). The plaintiffs accuse the department of failing to adequately manage water supplies, leaving firefighters unable to tackle the fires
- **ABC NEWS**

HOME > NEWS > **LOCAL NEWS**

L.A. Wildfires Turn Political: Karen Bass, Gavin Newsom Draw Heat Over Response

L.A.'s mayor and California's governor, respectively, are coming under fire as the out-of-control inferno rages across the Southland.

BY JAMES HIBBERD  JANUARY 9, 2025 7:33AM



SHOPPING WITH THR



Princess Diana's Iconic
Eagles Jacket Is Prime
Inspiration for Elevated

Anacortes City Council Minutes - January 21, 2025

Call to Order

Mayor Matt Miller called to order the Anacortes City Council meeting of January 21, 2025, at 6:00 p.m. Councilmembers TJ Fantini, Ryan Walters, Anthony Young, Christine Cleland-McGrath, Carolyn Moulton, and Bruce McDougall were present. Councilmember Amanda Hubik participated in the meeting remotely via Zoom.

Pledge of Allegiance

The assembly joined in the Pledge of Allegiance.

Announcements and Committee Reports

Mayor Miller provided a statement regarding the fire and associated response that occurred January 19th at 2011 Cove Place.

Civil Service Commission Reappointments

Mayor Miller announced the re-appointment of Vicki Stasch and Mary Ann Gutierrez to the Civil Service Commission for a three-year term effective through December 31, 2027.

Public Works Committee

Ms. Moulton reported from the Public Works Committee meeting held earlier in the evening. The topics discussed included the Commercial Avenue re-signalization project between 11th Street and 13th Street, the Commercial Avenue re-surfacing project between 14th Street and 34th Street, and coming crosswalks and traffic calming improvements on Q Avenue near Safeway and on 32nd Street between M Avenue and Commercial Avenue.

Economic Development Committee

Mr. Young reported from the Committee meeting held January 14th. The topics discussed included a discussion of the rough draft from Western Washington Institute of Economic Development that included survey results and other stakeholder input. The committee asked for more specificity on each of the issues, summaries of the data, and how the committee would like the information presented as the draft report is finalized with the goal of producing tangible ideas and solutions. The next phase after the report is finalized would be implementation.

Public Safety Committee

Ms. Cleland-McGrath reported from the Public Safety Committee meeting held January 7th. Police topics discussed included a training and recruiting update, the award of a \$20,000 boat safety grant from the state for public safety courses and crew training for the new fire boat, and the canine program. Fire topics included the cost estimate for new medic units and if they need to be included in the equipment rental and replacement schedule.

Ms. Cleland-McGrath also addressed the imminent departure of the Public Defender, reminding the Council that a staff position for a public defender is in the budget as well as a second position approved for the 2025 budget that could be filled or contracted out depending on demand and policy. She asked that the Council be updated regarding the direction that staff is considering regarding the position in the near term.

Mr. Fantini announced that he and Port Commissioner Bonnie Bowers would hold a joint town hall meeting on February 25th at 6pm at the library.

Public Comment

Mayor Miller invited the public to comment on any item not on the agenda.

Public comment was given as follows:

Xuhua Mu of Anacortes spoke about financial sustainability and fiscal responsibility as it relates to the 2025 city operating budget, referring to a slide presentation that was added to the packet materials for the meeting.

Pat Gardner of Anacortes spoke about proposed safety measures for pedestrians crossing on Q Avenue between Anthony's and Safeway, in school zones, and enforcement and associated penalties for traffic infractions.

Consent Agenda

Ms. Moulton moved, seconded by Mr. Young, to approve the following Consent Agenda items. The motion carried unanimously by voice vote.

a. Minutes of January 13, 2025

b. Approval of claims in the amount of \$811,145.08

The following vouchers/checks were approved for payment:

EFT numbers: 111451 through 111504, total \$481,762.61

Check numbers: 111505 through 111535, total \$305,752.87

Wire transfer numbers: 361750 through 361818, total \$23,629.60

Other Business

Finance Update

Finance Director Steve Hoglund presented a finance update, referring to a slide presentation that was included in the packet materials for the meeting.

Discussion topics included:

- Revenues for street maintenance
 - Pending real estate excise tax (REET) transfers
- REET transfer periodicity.
- Impact fees spent on R Avenue improvement project were matching funds for the Washington State Department of Transportation (WSDOT) grant funding.
- Breaking impact fees into separate funds for clarity and budgeting purposes (e.g. streets, fire and parks)
- Reasons for fluctuation in fire impact fee collection.
- Cottage permit fees
 - Per individual cottage or per project?
- Reason for drop in impact fee collection
 - Slowing building market.
 - Understanding where potential bottlenecks are that are limiting impact fee collection.
- Property tax budgeted versus actual revenue.
- Increase in property value does not correspond to an increase in property tax revenue.
- Focus on revenue options during annual Council - Mayor retreat.
- Invite the County Assessor to speak to the Council prior to April.
- Broader conversation about how to generate additional sales tax revenue.
 - Look back at years prior to the COVID pandemic for a better trend analysis.
- Annual revenue for transportation benefit district tax.
 - Approximately \$1.3 million.
- Update in development regulations encouraged more building.
- Pending changes to permitting regulations awaiting resolution of appeal.
- Creating affordable housing and encouraging demand for market rate housing.

Mayor Miller invited members of the audience to comment on this agenda item. No one present wished to address the Council.

Police Department Canine Program Update

Police Chief Dave Floyd provided a recruiting update on the addition of two new officers. He then introduced Sergeant Terrence Clifford and Officer Tyler Hatcher, who provided an update on the Police Department Canine Program, referring to a slide presentation that was added to the packet materials for the meeting.

Discussion topics included:

- New canine breed is German Shepherd
- Any limitations on where the canine can be deployed?
 - Handler conducts risk assessment prior to deployment.
- Other canine units in Skagit County.
- Name for new canine - Zeke.
- How T-Bone is handling retirement and new canine.
- Deployment for assisting with lost individuals?
 - Drones more likely to be used or county search and rescue dogs.
- Different perceptions by breed - hopeful for continued positive public interaction.
 - Vendor selection made based on breeder that has a dog with the proper temperament and skill aptitude.

Mayor Miller invited members of the audience to comment on this agenda item. No one present wished to address the Council.

Commercial Ave Phase I and II Project Update

Public Works Director Andrew Rheume provided a Commercial Avenue project update for phase I and phase II, referring to a slide presentation that was added to the packet materials for the meeting.

Discussion topics included:

Phase I

- Buffered bike lanes with barriers at the intersections of 14th, 13th and 12th Street and Commercial Avenue.
- Add design drawings to the city's website for public access.
- No opportunity for edits to design.
- Increase acceptance and comfort level of the Council and the public with the design.
- Change from the roundabout design to a signalized intersection.
- 6-month construction timeline for the intersection.
- Less disruptive than a roundabout.

Phase II

- Use of transportation benefit district funds versus REET.
 - Transportation benefit district funds are budgeted for \$1.1 million for 2025.
 - \$3 million in fund balance for REET.
 - \$1.5 million in REET in Capital Facilities Plan
 - Invest 2 years of pavement management fund at the expense of overlaying other areas.
- WSDOT offered to contribute \$365,000 to the project.
- What is the return on investment for resurfacing the project area?
- Condition of water line and connectors underneath and in the vicinity of Commercial Avenue.

- Third-party assurance of condition prior to going out to bid for overlaying Commercial Avenue.
 - Guarantee that the water line will not break during construction.
- Budgeting for resurfacing Commercial Avenue every 20 years.
- Improvement of bike lanes and accessibility.
- Breakdown of funding sources to clarify project costs.
- Requirement to assume maintenance of a state highway based on local population.

Mayor Miller invited members of the audience to comment on this agenda item. No one present wished to address the Council.

Adjournment

There being no further business, at approximately 8:18 pm the Anacortes City Council meeting of January 21, 2025, was adjourned.

The following claims against the City of Anacortes have been preaudited and certified by the Clerk-Treasurer as ready for City Council approval at the January 27, 2025 City Council meeting:
[Download this file in OpenDocument spreadsheet format.](#)

Invoice Doc #	Invoice Date	Invoice #	Vendor Full Name	Description	Total Amount	Approval Queue
362309	8/14/2024	1101194705	INSIGHT PUBLIC SECTOR, INC	NEOGOV WEB BASED RECRUITING SOFTWARE - 7/31/24-7/31/25	\$ 11,967.79	hr
362323	8/22/2024	000090	HUNTER, JOSHUA	BLS OTEP TRAINER - 11/15/2023-06/17/2024	\$ 1,320.00	medic
362285	9/12/2024	E3896501	N C POWER SYSTEMS CO	WTP GENERATOR CONTROL UPGRADE	\$ 668,681.69	dwtpt
362304	9/26/2024	07-240996316	CUMMINS, INC.	WWTP PUMP STATION 14 GENERATOR REPLACEMENT PROJECT - GENERATOR PURCHASE	\$ 75,410.92	pw1
362289	11/18/2024	BI-0374908	BECKWITH & KUFFEL	WTP HSPS #5 MECHANICAL SEAL REPLACEMENT	\$ 11,968.05	dwtpt
362322	11/30/2024	217246	VANTAGE POINT SOLUTIONS, INC.	CALEA TRUSTED THIRD PARTY SERVICES - NOVEMBER 2024	\$ 275.00	fiber
362255	11/30/2024	Pay App 6	STRIDER CONSTRUCTION CO, INC	WWTP OUTFALL RELOCATION - MARINE AND UPLAND	\$ 714,658.24	pw1
362317	12/3/2024	1st Installment	WESTERN DISPLAY FIREWORKS, LTD	2025 FOURTH OF JULY FIREWORKS DISPLAY	\$ 11,000.00	parks1
362327	12/3/2024	304.0002019.240 - 40	ALTA PLANNING AND DESIGN, INC	COMMERCIAL AVE CORRIDOR - 11TH ST TO 13TH ST DESIGN - THROUGH NOV 22, 2024	\$ 113,962.10	pw1
362306	12/9/2024	135559	RAINBOW ENTERPRISES	HEART LAKE PIT TOILETS PUMP OUT	\$ 870.40	parks1
362332	12/16/2024	B19160731	SHI INTERNATIONAL CORP.	SCHALGE THIN FOB CREDENTIAL	\$ 17,046.82	infosys
362273	12/16/2024	RE-313-ATB41216126	WASHINGTON STATE DEPARTMENT	R AVENUE PROJECT CONSTRUCTION ENGINEERING - WSDOT LA09912R	\$ 40.47	pw1
362330	12/18/2024	128437	VECA ELECTRIC & TECHNOLOGIES	UNIT-PRICED ELECTRICAL SERVICES 2024 - WASHINGTON PARK REPAIRS	\$ 15,832.58	parks1
362324	12/23/2024	PS-INV111016	WHITNEY EQUIPMENT CO INC	WWTP NUTRIENT REDUCTION IMPROVEMENT PROJECT - AERATION BASIN EQUIPMENT	\$ 168.64	dwwtp

Invoice Doc #	Invoice Date	Invoice #	Vendor Full Name	Description	Total Amount	Approval Queue
362303	12/25/2024	15-241210819	CUMMINS, INC.	ANNUAL CUMMINS GENERATOR TESTING AND SERVICING - PMA-WWLS #5 7-920	\$ 1,241.19	pw1
362296	12/25/2024	15-241210820	CUMMINS, INC.	ANNUAL CUMMINS GENERATOR TESTING AND SERVICING - PMA-WWLS #17 7-923	\$ 1,102.45	pw1
362325	12/30/2024	24-64595L	ENVIRO-CLEAN EQUIPMENT INC	STREET SWEEPER RENTAL - 12/30/24-1/29/25	\$ 12,001.00	pw1
362326	12/30/2024	P0001-104	QCC QUALITY CONTROLS CORP.	WWTP 2024 ON-CALL TECHNICAL SUPPORT AND INTEGRATION SERVICES - DEC 2024	\$ 362.50	dwwtp
361916	12/31/2024	090087001-1224	KIMLEY-HORN AND ASSOCIATES, IN	PASS LAKE 10-INCH WATERMAIN REPLACEMENT PROJECT - DESIGN - THROUGH 12/31/24	\$ 927.50	pw1
361832	12/31/2024	1-15-2025	LYNDEN YOGA COLLECTIVE	OCTOBER, NOVEMBER, DECEMBER CLASSES	\$ 1,125.00	medic
362305	12/31/2024	219079	VANTAGE POINT SOLUTIONS, INC.	CALEA TRUSTED THIRD PARTY SERVICES - DECEMBER 2024	\$ 275.00	fiber
362272	12/31/2024	237852	BLYTHE MECHANICAL, INC	HVAC ON-CALL REPAIR SERVICES TROUBLESHOOT FTUS AT LIBRARY	\$ 4,836.60	pw1
362265	12/31/2024	2599	SKAGIT CONSERVATION DISTRICT	NPDES II OUTREACH & EDUCATION - NOVEMBER & DECEMBER 2024	\$ 1,566.75	pw1
361915	12/31/2024	30521880	KIMLEY-HORN AND ASSOCIATES, IN	MARCH'S POINT ROAD WATER MAIN AND BIKE LANE PROJECT - DESIGN - THROUGH 12/31/24	\$ 41,550.70	pw1
362264	12/31/2024	30682059	KIMLEY-HORN AND ASSOCIATES, IN	SAFE STREETS AND ROADS FOR ALL (SS4A) SAFETY ACTION PLAN THROUGH 12/31/24	\$ 5,797.89	pw1
362274	12/31/2024	32551-3	OMEGA MEDICAL MECHTRONICS	WWTP GLASSWARE WASHER MAINTENANCE	\$ 2,365.68	dwwtp
362331	12/31/2024	B19212932	SHI INTERNATIONAL CORP.	SCHLAGE PURE IP PIGTAIL CABLE, 25FT	\$ 1,053.01	infosys
362263	12/31/2024	CDBG.2024.PS.15%	ANACORTES FAMILY CENTER	15% PUBLIC SERVICE FUNDING 2024 CDBG GRANT ANACORTES FAMILY CENTER	\$ 15,941.85	plan

Invoice Doc #	Invoice Date	Invoice #	Vendor Full Name	Description	Total Amount	Approval Queue
362321	12/31/2024	IN960582	NOANET	PRIMARY DIA SERVICE - DEC 2024	\$ 3,450.00	fiber
362319	1/1/2025	2919	SKAGIT COUNCIL OF GOVERNMENTS	SCOG DUES 2025	\$ 18,180.00	finance
362258	1/2/2025	0002266963	CENTRAL WELDING SUPPLY CO, INC	O2 FOR AMBULANCES	\$ 125.62	medic
362011	1/7/2025	237936	BLYTHE MECHANICAL, INC	HVAC ON-CALL REPAIR SERVICES PUBLIC SAFETY BUILDING LOCKER ROOM FAN REPAIR	\$ 3,396.08	pw1
362010	1/7/2025	237989	BLYTHE MECHANICAL, INC	HVAC ON-CALL REPAIR SERVICES PUBLIC LIBRARY COMPRESSOR REPAIR	\$ 620.71	pw1
362009	1/7/2025	238582	BLYTHE MECHANICAL, INC	HVAC ON-CALL REPAIR SERVICES PUBLIC SAFETY BUILDING FAN UNIT REPAIR	\$ 3,970.64	pw1
362008	1/7/2025	239531	BLYTHE MECHANICAL, INC	HVAC ON-CALL REPAIR SERVICES TROUBLESHOOT BOILER AT PUBLIC SAFETY BUILDING	\$ 853.40	pw1
362007	1/7/2025	239621	BLYTHE MECHANICAL, INC	HVAC ON-CALL REPAIR SERVICES LIBRARY BOILER REPAIR	\$ 461.73	pw1
361304	1/7/2025	INV0012832	CORE & MAIN LP	SUPPLIES FOR WATER MAINTENANCE	\$ 1,257.62	wdist
361833	1/8/2025	0002270568	CENTRAL WELDING SUPPLY CO, INC	O2 FOR AMBULANCES	\$ 88.29	medic
362300	1/8/2025	29764	IRONCLAD COMPANY	PARTS- STREET SWEEPER	\$ 3,302.09	dshop
361827	1/9/2025	1200686279	HDR ENGINEERING, INC	COMBINED SEWER OVERFLOW PUMP STATION DESIGN - 8/25/24-12/28/24	\$ 47,109.23	pw1
362267	1/9/2025	1200686651	HDR ENGINEERING, INC	WASHINGTON PARK TRAIL REPAIR PROJECT - DESIGN - 2/24/24-12/28/24	\$ 167.28	pw1
362315	1/9/2025	INV0264	GR8 STAYS LLC	ROCHELLE & CRAIG NELSON RELOCATION ASSISTANCE FOR WWTP OUTFALL PROJECT	\$ 9,590.00	pw1
362288	1/10/2025	317982846	DEPT OF LABOR & INDUSTRIES	L&I CITATION WATER TREATMENT PLANT	\$ 3,000.00	hr
361914	1/10/2025	FB61265	CAROLLO ENGINEERS, INC.	WATER SYSTEM PLAN UPDATE - THROUGH 12/31/2024	\$ 6,160.00	pw1
361826	1/11/2025	301749	LAKESIDE INDUSTRIES, INC.	DUMP FEES- STREET DEPT	\$ 370.40	dshop
361825	1/11/2025	301797	LAKESIDE INDUSTRIES, INC.	ASPHALT- WATER DEPT	\$ 1,056.98	wdist

Invoice Doc #	Invoice Date	Invoice #	Vendor Full Name	Description	Total Amount	Approval Queue
361836	1/13/2025	1545053	LIFE ASSIST, INC	EXAM GLOVES, GREENLINE F/O	\$ 416.16	medic
361835	1/13/2025	300000290019	PUGET SOUND ENERGY INC	ALL STATIONS 12/7-1/6/25	\$ 1,392.75	medic
361993	1/13/2025	300000290035	PUGET SOUND ENERGY INC	MUSEUM 12/7-1/6/2025	\$ 479.14	museum
362302	1/13/2025	50755	ZUMAR INDUSTRIES, INC.	PARTS- STREET DEPT	\$ 542.91	dshop
362301	1/13/2025	50757	ZUMAR INDUSTRIES, INC.	PART- STREET DEPT	\$ 489.60	dshop
362329	1/13/2025	P56466	NELSON, ROCHELLE & CRAIG	WWTP OUTFALL RELOCATION PROJECT - SELF-MOVE SCHEDULED PAYMENT	\$ 400.00	pw1
362257	1/14/2025	128814	VECA ELECTRIC & TECHNOLOGIES	WASHINGTON PARK POLE LIGHTS INSTALLATION	\$ 6,617.22	parks1
361837	1/14/2025	1545597	LIFE ASSIST, INC	II-GEL RESUS, MEGAMOVERS, SAFETY	\$ 1,274.02	medic
361831	1/14/2025	20250057	SYSTEMS DESIGN WEST, LLC	AMBULANCE SERVICE BILLING 12/2024	\$ 4,224.38	finance
362328	1/14/2025	304.0002019.240 - 41	ALTA PLANNING AND DESIGN, INC	COMMERCIAL AVE CORRIDOR PLAN PHASE 1 - 11TH-13TH ST DESIGN - THROUGH 12/27/24	\$ 101,915.25	pw1
362279	1/14/2025	372331	BAY CITY SUPPLY	OPERATING SUPPLIES-FACILITIES	\$ 636.07	dshop
362294	1/14/2025	ReimbKorterud	KORTERUD, WAYNE D	DENTAL COPAY LEOFF 1 RETIREE, KORTERUD	\$ 144.00	hr
362256	1/15/2025	1546250	LIFE ASSIST, INC	ADULT BVMS W/ MASK & MANOMETER	\$ 360.35	medic
361830	1/15/2025	17008	ANACORTES CHAMBER OF COMMERCE	CHAMBER OF COMMERCE ANNUAL DUES	\$ 2,400.00	executive
362299	1/15/2025	250046	T-SHIRTS BY DESIGN	WORK WEAR- STREET DEPT	\$ 2,085.70	dshop
362013	1/15/2025	77191	UNDERWOOD & ASSOCIATES, LLC	LIBRARY TEEN AREA REMODEL: DESIGN	\$ 4,470.00	publib
362318	1/15/2025	8488992	OVIVO USA, LLC	WWTP HIGH EFFICIENCY DIFFUSER SYSTEM EQUIPMENT PURCHASE	\$ 81,280.13	dwwtp
362266	1/15/2025	90192392	CHEMTRADE CHEMICALS US LLC	ALUMINUM SULFATE	\$ 6,285.64	dwwtp
362310	1/15/2025	9340480364	GRAYBAR ELECTRIC COMPANY, INC	OPTICS FOR FIBER NETWORK CORE	\$ 865.11	fiber
362259	1/15/2025	978 800 0000 1	CASCADE NATURAL GAS CORP.	STA 3: 12/12 - 1/14	\$ 269.30	medic
362261	1/16/2025	0002277704	CENTRAL WELDING SUPPLY CO, INC	O2 FOR AMBULANCES	\$ 125.94	medic
362283	1/16/2025	0332040-IN	NELSON-REISNER DISTRIBUTOR INC	DIESEL #90006	\$ 34,168.51	dshop
362262	1/16/2025	128884	VECA ELECTRIC & TECHNOLOGIES	WWTP 20FT SHIPPING CONTAINERS - ELECTRICAL	\$ 11,968.00	dwwtp

Invoice Doc #	Invoice Date	Invoice #	Vendor Full Name	Description	Total Amount	Approval Queue
361994	1/16/2025	1406	FIDALGO CLEANING	MUSEUM CLEANING 1/2-1/16/25	\$ 200.00	museum
361995	1/16/2025	1407	FIDALGO CLEANING	HERITAGE CTR CLEANING 1/2-1/16/25	\$ 140.00	museum
362290	1/16/2025	17371	NATIONAL TESTING NETWORK, INC	NATIONAL TESTING NETWORK 2025 MEMBERSHIP	\$ 750.00	hr
361997	1/16/2025	25-01202	EUROFINS ENVIRONMENT TESTING	WATER ANALYSIS - TCR SOUTH	\$ 110.00	dwtpt
361999	1/16/2025	25-01204	EUROFINS ENVIRONMENT TESTING	WATER ANALYSIS - TCR 00932	\$ 38.00	dwtpt
362000	1/16/2025	25-01298	EUROFINS ENVIRONMENT TESTING	WATER ANALYSIS - BACT FINISHED	\$ 22.00	dwtpt
361919	1/16/2025	250047	T-SHIRTS BY DESIGN	TEAM SHIRTS FOR GIRLS YTH BBALL	\$ 2,322.88	pkrec
361839	1/16/2025	5142	DEPARTMENT OF ECOLOGY	INCINERATOR RENEWAL FEE FOR JR	\$ 200.00	dwwtpt
362282	1/16/2025	56089	DALCO INC	PARTS #9009	\$ 443.99	dshop
362308	1/16/2025	9340498652	GRAYBAR ELECTRIC COMPANY, INC	OPTICS FOR FIBER NETWORK CORE	\$ 339.67	fiber
361990	1/16/2025	INV2945939	COPIERS NORTHWEST, INC	CANON COPIERS CITY WIDE 12/15-1/14/25	\$ 217.76	finance
361920	1/16/2025	LAU-WA-W683-24	DEPARTMENT OF ECOLOGY	RENEWAL FOR ANACORTES WASTEWATER TREATMENT PLANT LABORATORY	\$ 2,100.00	dwwtpt
362001	1/16/2025	MFA0010	EUROFINS ENVIRONMENT TESTING	WATER ANALYSIS - BACT RAW	\$ 63.00	dwtpt
362002	1/16/2025	MFA0041	EUROFINS ENVIRONMENT TESTING	WATER ANALYSIS - BACT RAW	\$ 63.00	dwtpt
362316	1/17/2025	1/17/2025	ANACORTES FAMILY CENTER	SOCIAL WORKER AGREEMENT - JANUARY	\$ 5,000.00	apd
362006	1/17/2025	18298190	DICK'S TOWING, INC	TOWING; APD CASE 25-A00119	\$ 856.80	apd
361923	1/17/2025	8498 30 017 0319913	COMCAST	LIBRARY INTERNET ACCESS 1/9-2/8/25	\$ 185.11	finance
361991	1/17/2025	INV2946494	COPIERS NORTHWEST, INC	COURT & ASC COPIES 12/16-1/15/25	\$ 510.27	finance
362254	1/18/2025	00005W5A83035	UNITED PARCEL SERVICE, INC	UPS SHIPPING CHARGES; WEEK ENDING 1-18-25	\$ 26.60	apd
362312	1/19/2025	SI502255	AMERICAN REGISTRY FOR	ANNUAL ARIN MEMBERSHIP, 2025	\$ 1,050.00	fiber
362314	1/21/2025	1756006	WALTON BEVERAGE COMPANY, INC	OPS: BREAKROOM SUPPLIES	\$ 120.50	dshop
362280	1/21/2025	238798	BLYTHE MECHANICAL, INC	HVAC MAINTENANCE ON-CALL REPAIR SERVICES - CITY HALL EXHAUST FAN REPAIR	\$ 461.73	pw1

Invoice Doc #	Invoice Date	Invoice #	Vendor Full Name	Description	Total Amount	Approval Queue
362277	1/21/2025	239455	BLYTHE MECHANICAL, INC	HVAC MAINTENANCE ON-CALL REPAIR SERVICES - WTP HVAC REPAIR	\$ 817.54	dwtp
362298	1/21/2025	3520-000475109	IDENTIFIX	FLEET SOFTWARE	\$ 4.18	dshop
362293	1/21/2025	INV2947535	COPIERS NORTHWEST, INC	S/N 2YJ30356 LIBRARY FL1 TECH SERVICES COPIER 12/18-1/17/25	\$ 184.82	finance
362336	1/22/2025	2990	SKAGIT COUNCIL OF GOVERNMENTS	SCOGS GMA ADMIN SERVICES 10/1-12/31/24	\$ 3,248.14	plan
362333	1/22/2025	8498 30 030 0111230	COMCAST	WTP 14489 RIVER BEND RD. - 1/19-2/18/25	\$ 143.93	finance
	Total				\$ 2,118,939.99	



City Council Agenda Bill

Meeting Date: January 27, **Agenda Item:** 5.c.
2025

Agenda Item Title: Special Event: Open Streets

Staff Contact(s): Stephanie Snyder

Approved for Submittal to Council by **Action Type**

Greg Francioch
John Coleman

Motion

Item Summary: This annual muscle powered event allows for carefree walking, biking and skateboarding along our downtown main street corridor. Buskers, pet parades, and information booths enhance the family friendly experience. This year's event is scheduled for August 24th from 11am - 3pm on Commercial Avenue from 4th to 10th Streets and on 5th, 6th and 7th Streets halfway from Commercial to O Avenue and Q Avenue respectively.

Budget Impact:

Previous Action: Approved for 2024

Recommended Motion: Approve or modify

Alternative Actions: disapprove

Attachments (listed in order presented):

1. Open Streets CC
2. Open Streets Map



Special Event Application Processing

Administrator adds this event to the City Council agenda, creates the agenda bill, downloads the reviewed application and any attachments using the link in the email, and uploads those attachments in CivicClerk to go into the City Council packet.

View Anacortes Municipal Code Chapter 7.04, Special Events

Application

Application Date *

1/8/2025

Event Name *

Open Streets

Event Type

- ☒ Street Fair / Festival
☐ Athletic Event
☐ Parade
☐ Rally / Demonstration
☐ Filming
☐ Other identified in AMC 7.04.010

Applicant/Organization Name *

Anacortes Parks & Recreation

Mailing Address *

PO Box 547

Event Contact Person *

Bob Vaux

Event Contact Email *

bobv@anacorteswa.gov

Event Contact Phone *

360/293-1918

Event Website

Estimated Number of Participants/Attendees*

Several Hundred

Event Description*

this annual muscle powered event allows for care free walking, biking, skate boarding, etc, along our downtown main street corridor. Buskers, pet parades, information booths, etc, enhance the family friendly experience.

Will food vendors participate in this event?*

All Food Vendors must be inspected by the Fire Marshall on site prior to the start of the event.

☐ Yes ☒ No

Date Event Starts*

8/24/2025

Time Event Starts*

11:00:00 AM ▾

Date Event Ends*

8/24/2025

Time Event Ends*

3:00:00 PM ▾

Date Street Closure Starts*

Include requested closures before and after the event hours if required for set up and tear down.

8/24/2025

Time Street Closure Starts*

10:00:00 AM ▾

Date Street Closure Ends*

8/24/2025

Time Street Closure Ends*

3:00:00 PM ▾

Event Location*

List end points of each street that will be closed (e.g. 6th Street from O Ave to Q Ave). Also include location and dimensions of any structures that will be erected and locations of the event that will not be on city street right of way.

Commercial Ave from 4th to 10th Streets.
5th, 6th and 7th Streets halfway from Commercial to O and Q Ave's respectively

Parking Location

List any public parking areas that the event requests to use for dedicated event parking, including handicapped parking.

Event Map (optional)

Upload one or more maps of the event

Upload

Open Streets 2025.png

7.7MB

Indemnification Agreement*

Upload scan of SIGNED indemnification agreement

Upload

City Sponsored Event.docx

12.99KB

Download the Indemnification Agreement [here](#).

Signage

Street closure signs will be provided by the City of Anacortes. Applicants must contact City staff one week prior to the event to arrange sign delivery. Event sponsor personnel are responsible for placing street closure signs, which may not be posted more than 72 hours prior to the approved closure, must be removed immediately following the event, and must be returned to city staff the first business day following the event.

Insurance

The applicant is required to provide public liability insurance subject to the provisions of AMC 7.04.100 unless the applicant can demonstrate that the event meets an exemption in that section. Applicants will be notified following application approval of insurance requirements for the specific event.

Electronic Signature Agreement

By checking the "I agree" box below, you agree and acknowledge that 1) your application will not be signed in the sense of a traditional paper document, 2) by signing in this alternate manner, you authorize your electronic signature to be valid and binding upon you to the same force and effect as a handwritten signature, and 3) you may still be required to provide a traditional signature at a later date.

I state that I am over the age of 18, that I agree to assume responsibility for the above-described event and to abide by all conditions stipulated by the approval of the application.*

☒ Yes

Signature

ROBERT W. VAUX

Admin Review

Council Meeting Date*

Target date for presentation to City Council; no later than 30 days prior to event

1/20/2025

Staff Review Deadline*

Staff review/approval required no later than 7 days prior to City Council meeting to allow packet preparation

1/13/2025

Administrator comments and conditions of approval

Insurance Certificate

Upload

Insurance certificate may be required by staff or as a condition of Council approval

Departmental Review

Building Department will provide the following services for this event:

Building Department concerns, objections, or conditions of approval *

None

Fire Department will provide the following services for this event:

Fire Department concerns, objections, or conditions of approval *

None

Parks Department will provide the following services for this event:

Parks Department concerns, objections, or conditions of approval *

None

Police Department will provide the following services for this event:

potential bicycle patrol officers (staffing dependent)

Police Department concerns, objections, or conditions of approval*

None

Public Works Department will provide the following services for this event:

Public Works Department concerns, objections, or conditions of approval*

None

Departmental attachments

Upload any staff memos, guidelines, or requirements that will be in effect for this event.

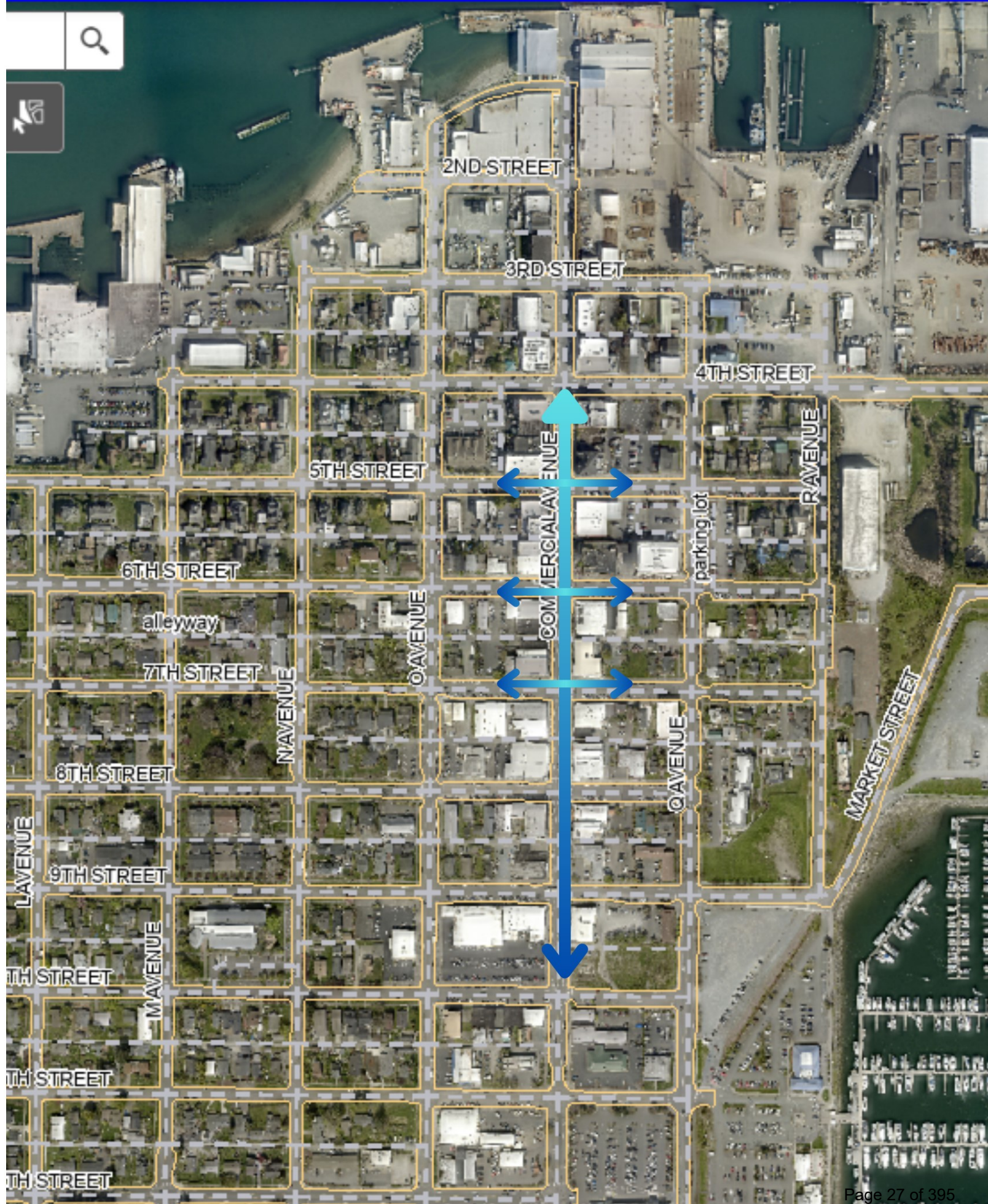
Upload

Comments

2000 characters left

Council Packet Complete

Cancel Application





City Council Agenda Bill

Meeting Date: January 27, **Agenda Item:** 6.a.
2025

Agenda Item Title: Stormwater Master Plan

Staff Contact(s): Aaron Esterholt, Andrew Rheäume

<u>Approved for Submittal to Council by</u>	<u>Action Type</u>
Andrew Rheäume	Presentation

Item Summary: The City of Anacortes is updating its 2025 Stormwater Master Plan to develop a comprehensive approach to managing stormwater. This plan will address the evolving requirements of the MS4 Phase II Permit and account for projected growth in infrastructure and customer needs.

Key actions include:

- Updating the 2007 Stormwater Comprehensive Plan.
- Providing stormwater management guidance and evaluating new permit requirements.
- Documenting the City's stormwater infrastructure and reviewing asset inventories.
- Establishing a program for pipe repair and replacement.
- Identifying system deficiencies using a hydrologic and hydraulic model.
- Assessing stream habitats and related infrastructure.
- Documenting the current capital facilities program.
- Supporting future operations, maintenance, and capital improvements.
- Developing a multi-year execution plan.

The updated plan will outline capital improvements to address drainage issues and comply with the MS4 Phase II Permit requirements.

Budget Impact:
None

Previous Action: Council approved contract 24-103-STM-001 with Osborn Consulting on 3/21/24.

Recommended Motion: None

Alternative Actions:

Attachments (listed in order presented):

1. SW Master Plan Presentation
2. SW Master Plan DRAFT
3. PDF SW Master Plan DRAFT with Appendices

2025 Stormwater Master Plan

City of Anacortes | January 27, 2025

Aaron Esterholt – Stormwater Program Manager

Andrew Rheume – Director of Public Works

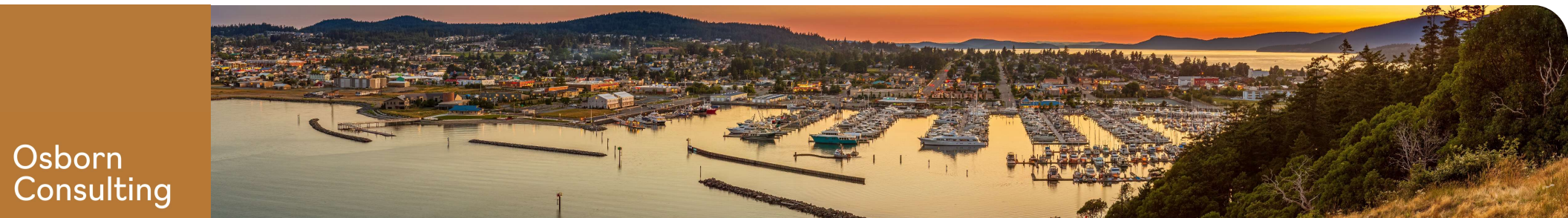
Tarelle Osborn, PE – Project Manager, Osborn Consulting

Jessica Christofferson – Senior Stormwater Planner, Osborn Consulting

Dave Jacobs, PE – Senior Stormwater Modeler, Osborn Consulting



ANACORTES
WASHINGTON

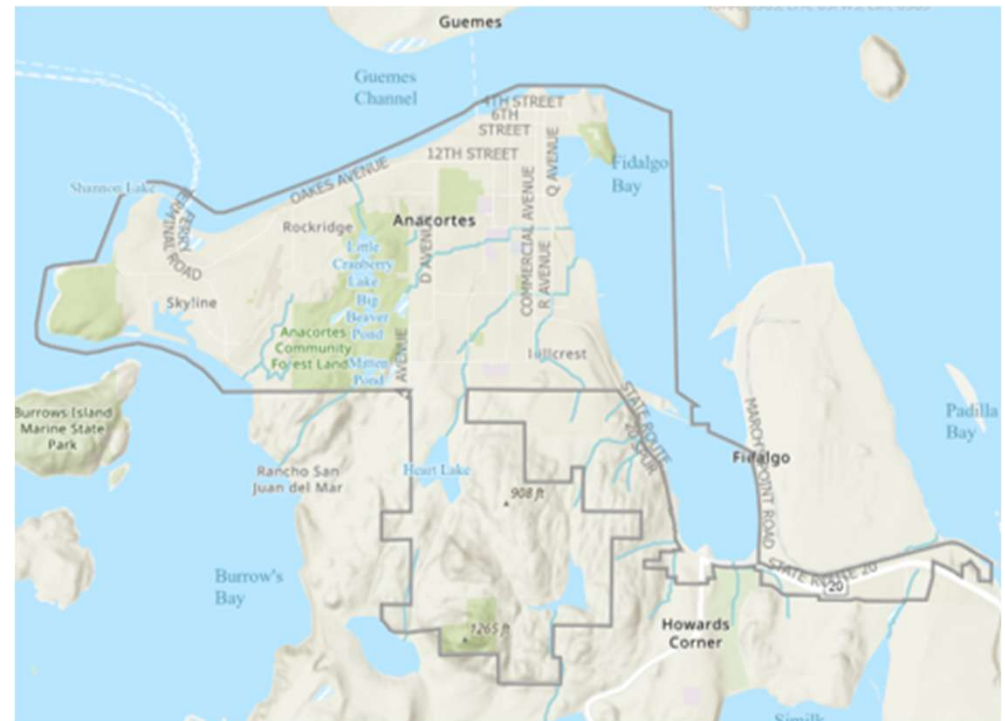


Osborn
Consulting



Agenda

- Project Scope of Work
- 2025 Stormwater Master Plan Overview
- Stormwater Pipe Repair and Replacement Program
- Physical and Biological Basin Characteristics
- Hydrologic and Hydraulic Modeling, Assumptions and Results
- NPDES Phase II Permit Compliance
- Capital Facility Projects
- Implementation Plan
- Public Outreach





Project Scope of Work

Task	Application to Project Goal
100. Project Management & Administration	Manage and direct the team in the successful completion of tasks
200. Data Collection	Data informed SW R/R Program and System Evaluation
300. Stormwater Pipe Repair and Replacement Program	Inspect, perform condition assessments Make repair and replacement recommendations
400. Model Development	Identify system deficiencies of stormwater infrastructure
500. Physical and Biological Basin Assessment	Field stream assessments cataloged streams and associated wetlands and identified future potential restoration projects.
600. Draft and Final Stormwater Master Plan	Report findings from evaluation and incorporate City feedback.
700. Develop Education and Outreach Materials	Public Outreach, City Council Presentation
800. Implementation Strategy	Implementation summary will consider scheduling and budgeting



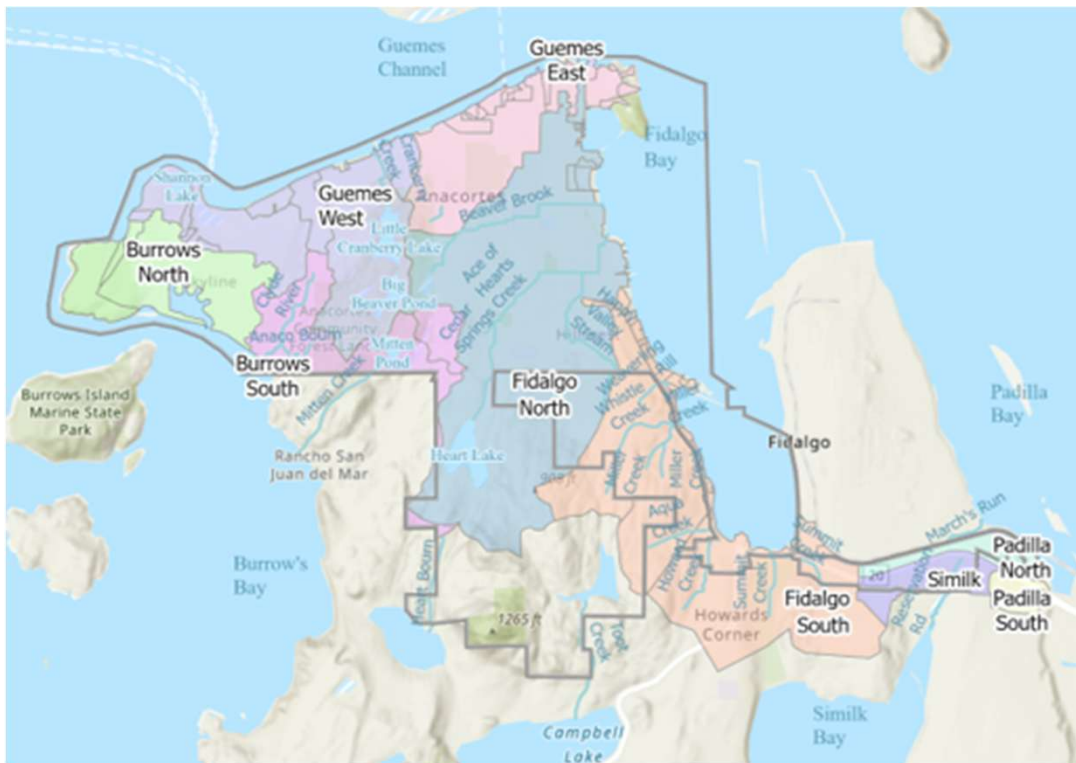
2025 Stormwater Master Plan Overview

- Updated the City's 2007 Stormwater Management Plan.
- Assessed NPDES Phase II Permit requirements and programs.
- Documented the City's stormwater infrastructure.
- Reviewed the City's existing stormwater asset inventory and establish a pipe repair and replacement program.
- Identified stormwater system deficiencies through a citywide H&H model.
- Assessed stream, habitat, and conveyance infrastructure conditions.
- **Prioritizing Stormwater Capital Facilities Projects and Programs.** *Where We Need Your Help.*
- **Providing a multi-year stormwater implementation plan to achieve.** *Where We Need Your Help.*





Stormwater Drainage Basins



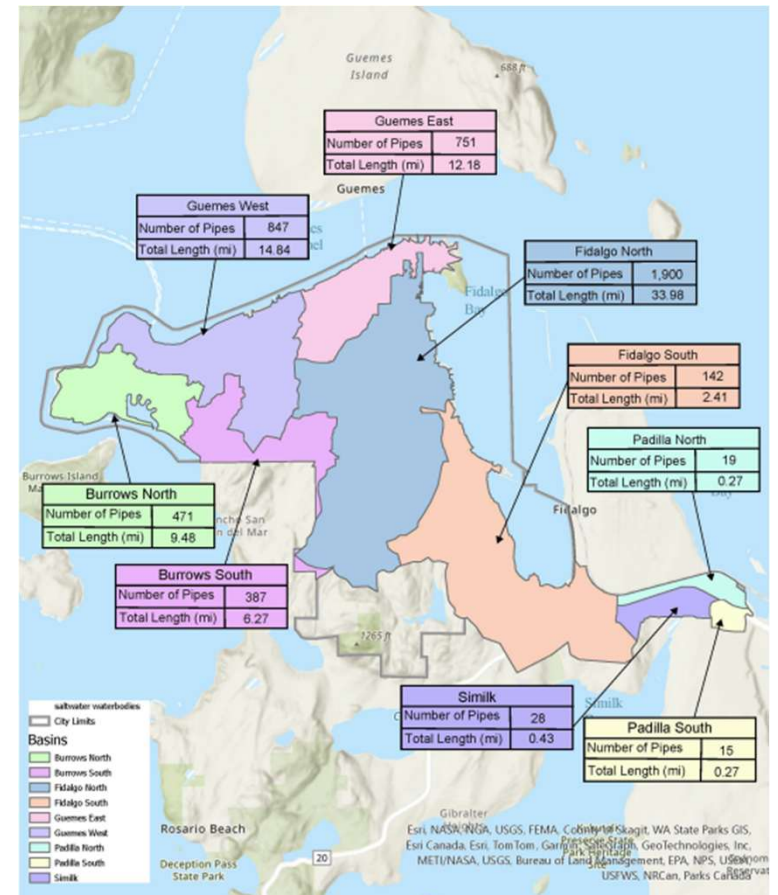
- Fidalgo North
- Fidalgo South
- Guemes West
- Guemes East
- Burrows North
- Burrows South
- Padilla North
- Padilla South
- Similk



Stormwater Pipe Repair and Replacement Program (New)

- Purpose
 - Capacity and Age
- Approach (Risk Based)
- Program
 - Closed-circuit television (CCTV) inspections
 - Likelihood of Failure (LoF)
 - Consequence of Failure (CoF)
 - Separate program from capacity

Number of Pipes	Length of Pipes (miles)
4,560	80.13

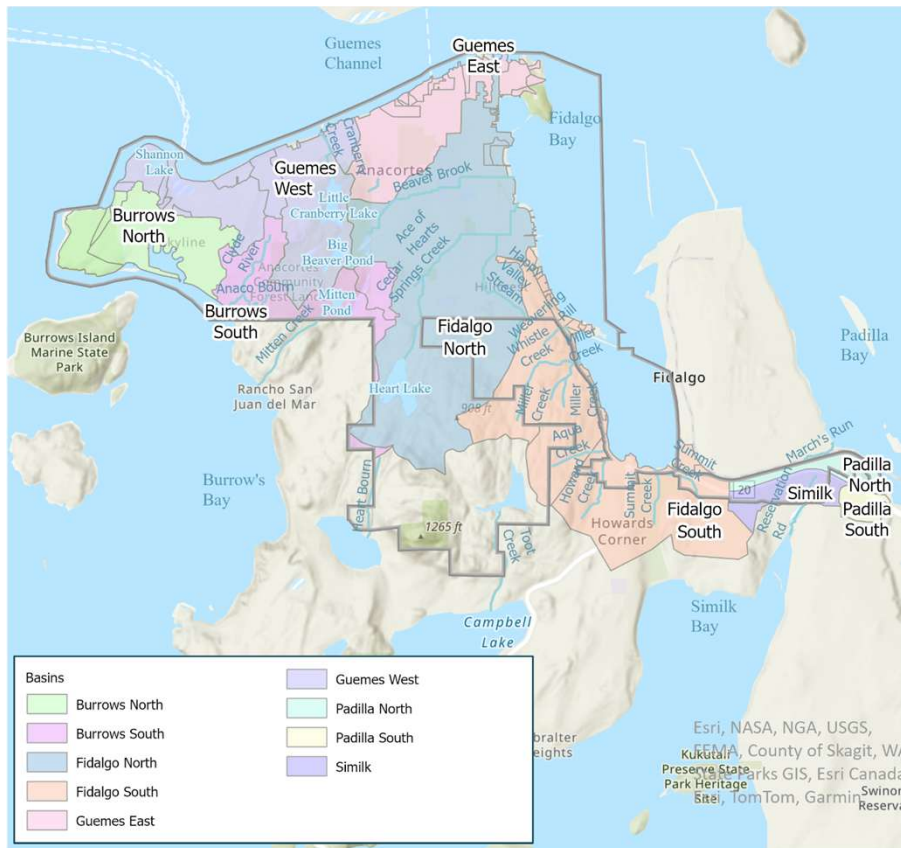




- [illegible]



Physical and Biological Stream Assessment



- Ace of Hearts Creek
- Aqua Creek
- Beaver Brook
- Clyde Creek
- Cranberry Creek
- Happy Valley Stream

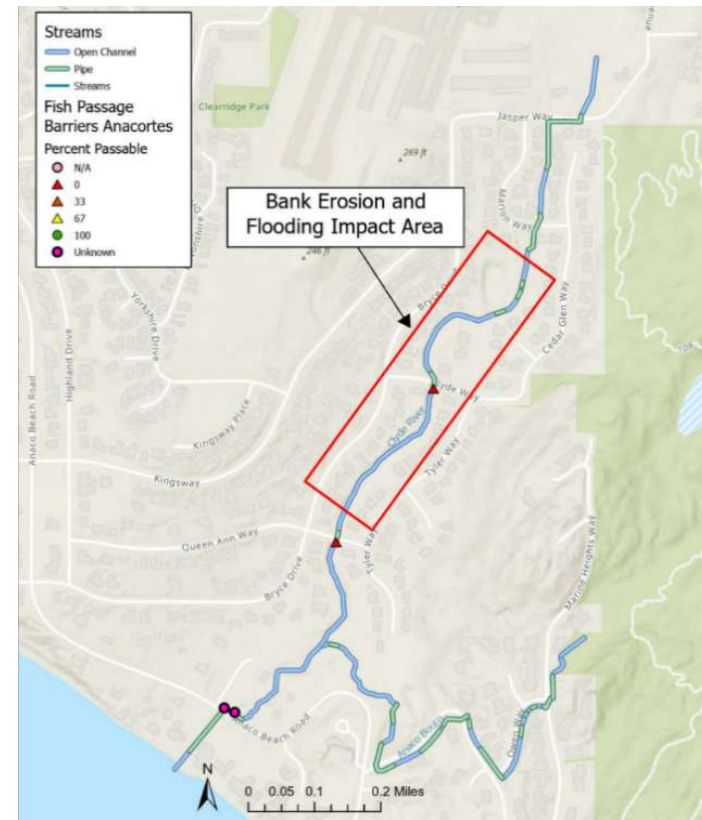


Clyde Creek Capital Facility Project

- Erosion
- Flooding
- Risk of Failing Trees



Exposed tree bases and roots, high water debris line exceeding bankfull width upstream of Clyde Way





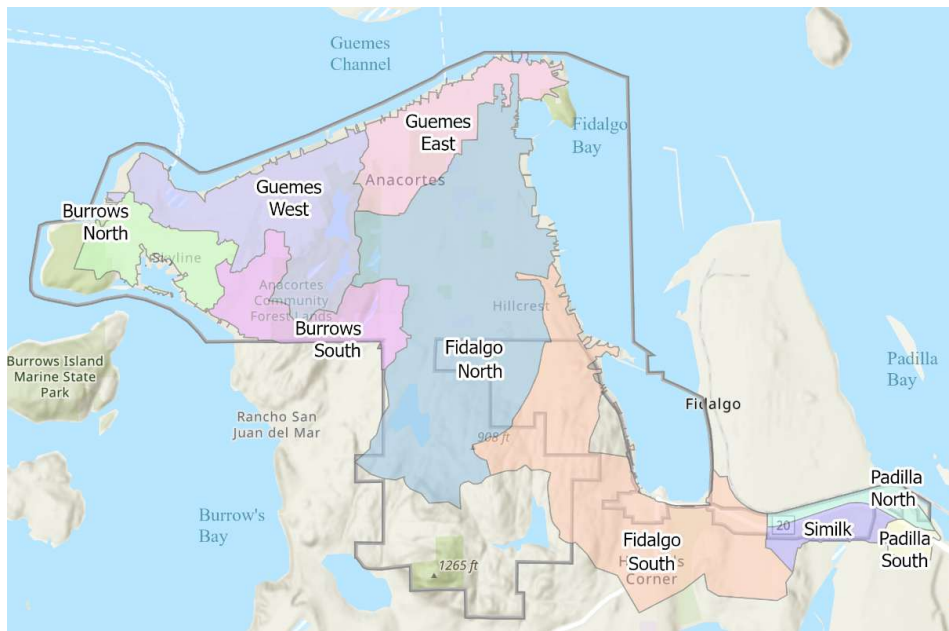
Fish Passage Barrier Inventory



Ownership	Number of Identified Barriers	Number of Unknown Barriers
City	21	3
County	1	0
WSDOT	7	0
Private	8	2
Total	37	5



H&H Modeling Background

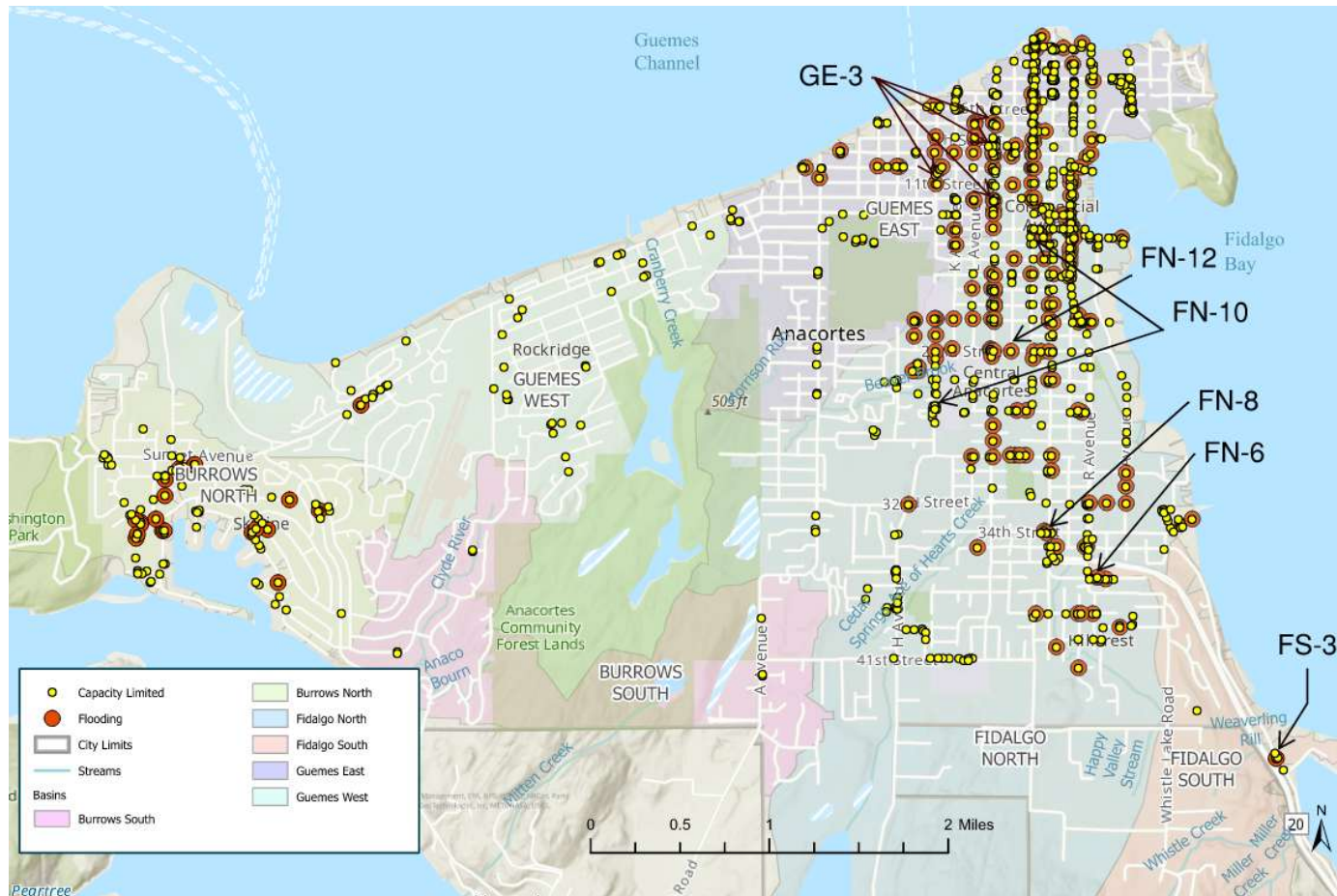


Purpose: identify system surcharging and ponding

- Model: PCSWMM – User Friendly Version for the Free EPA SWMM software
 - Used City GIS impervious area and stormwater network
 - Impervious areas: Buildings, roadways, sidewalks, driveways, patios
- Utilized “Effective Impervious Area” Scaling factors
- 25-year 24-hr design storm

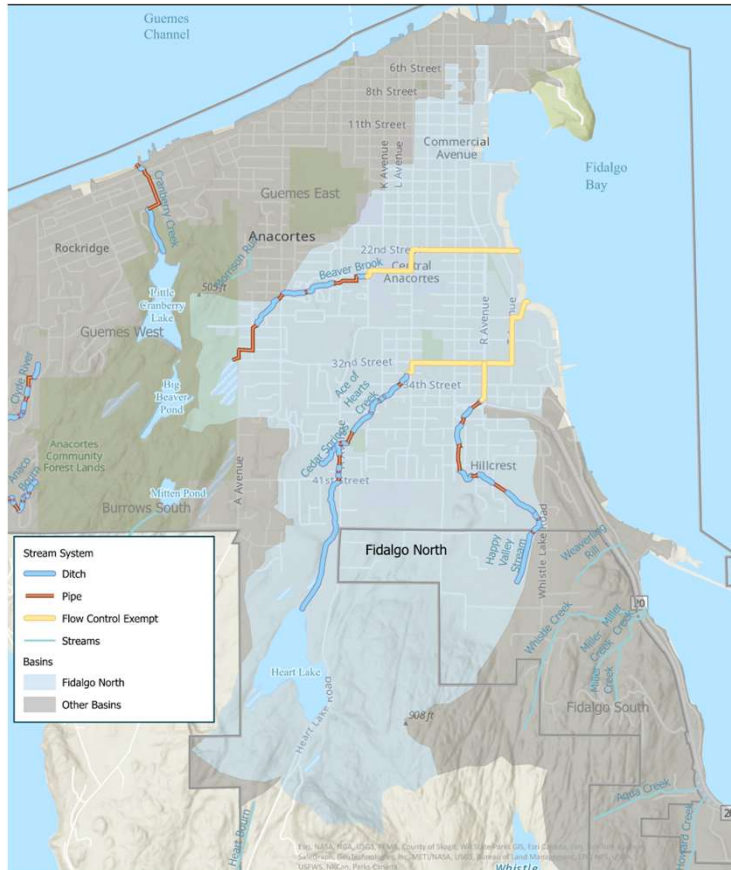


H&H Modeling – High Priority Areas





H&H Modeling Results – Flow Control Exemption



Fidalgo North piped creek systems meet Ecology's requirement for requesting a flow control exemption.

An exemption request can be made for:

- Ace of Hearts Creek
- Happy Valley Creek
- Beaver Brook Creek



NPDES Permit Compliance - New

- Cost by Program Element
- **Tree Canopy**
- Stormwater Management Action Plan
- **New MS4 Mapping Requirements**
- **Addressing PCBs in O&M**
- Source Control/IDDE Code Update
- **Public Involvement for Overburdened Communities**
- Stormwater Management for Existing Development
- Maintenance Standards
- Street Sweeping

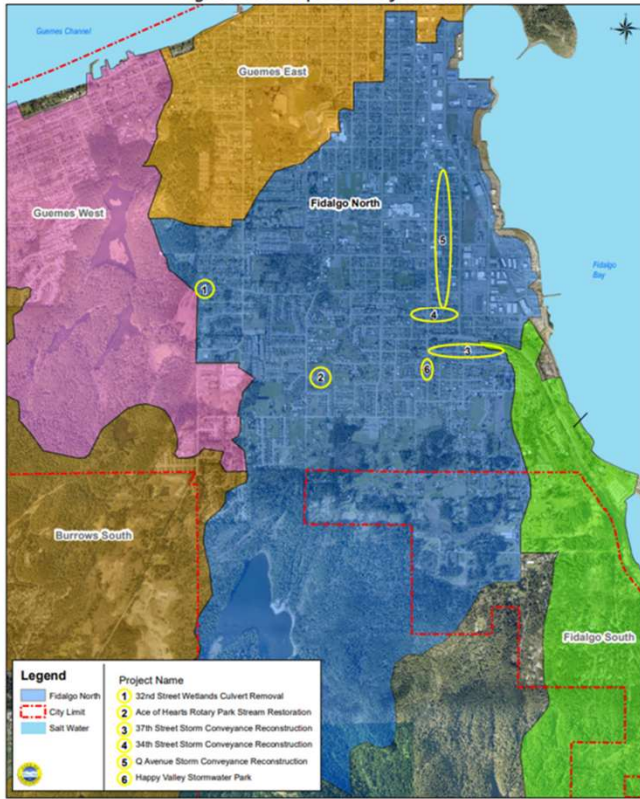


Example Tree Canopy Mapping

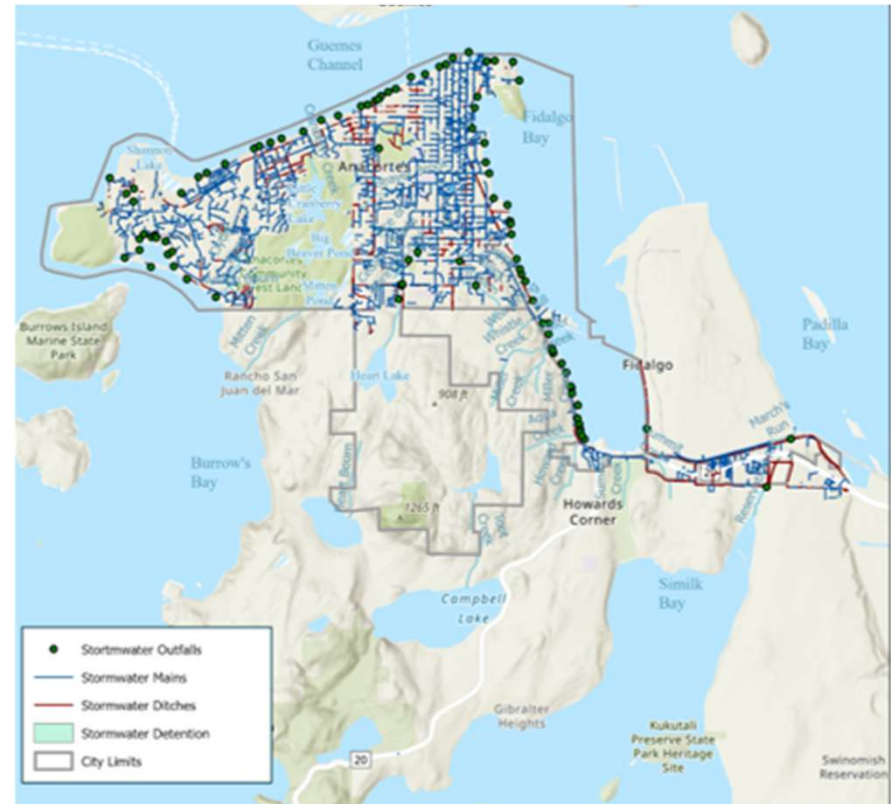


NPDES Permit Compliance

Figure 3-1. Proposed Project Sites.



Fidalgo North SMAP

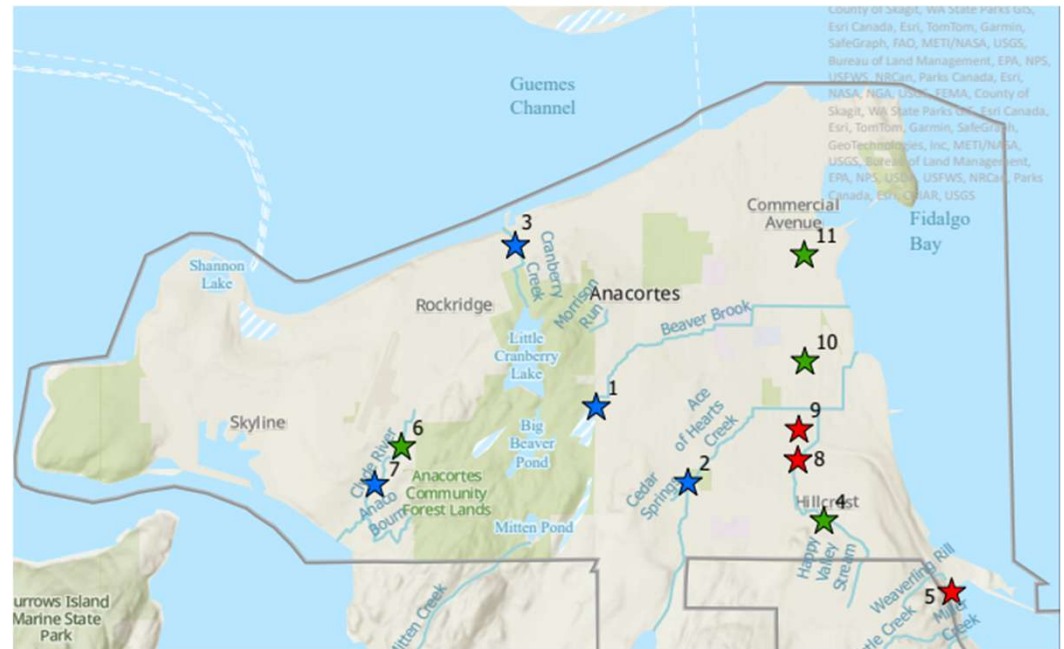


MS4 GIS Mapping



Capital Facilities Projects

CFP Number	Capital Facilities Projects
1	32nd Street Wetlands Culvert Removal
2	Ace of Hearts Rotary Park Stream Restoration
3	Cranberry Creek Restoration and Habitat Improvement
4	Saint Mary's Drive Culvert Replacement
5	Fidalgo Bay Road Flood Mitigation
6	Marion Pond Water Quality Retrofit
7	Clyde Creek Streambank Stabilization and Flooding Mitigation
8	37th Street Storm Conveyance Reconstruction
9	34th Street Storm Conveyance Reconstruction
10	Q Avenue Storm Conveyance Reconstruction
11	17th St Stormwater Pipe and Outfall Repair



Capital Facility Projects

- ★ H&H Modeling
- ★ Habitat
- ★ Other

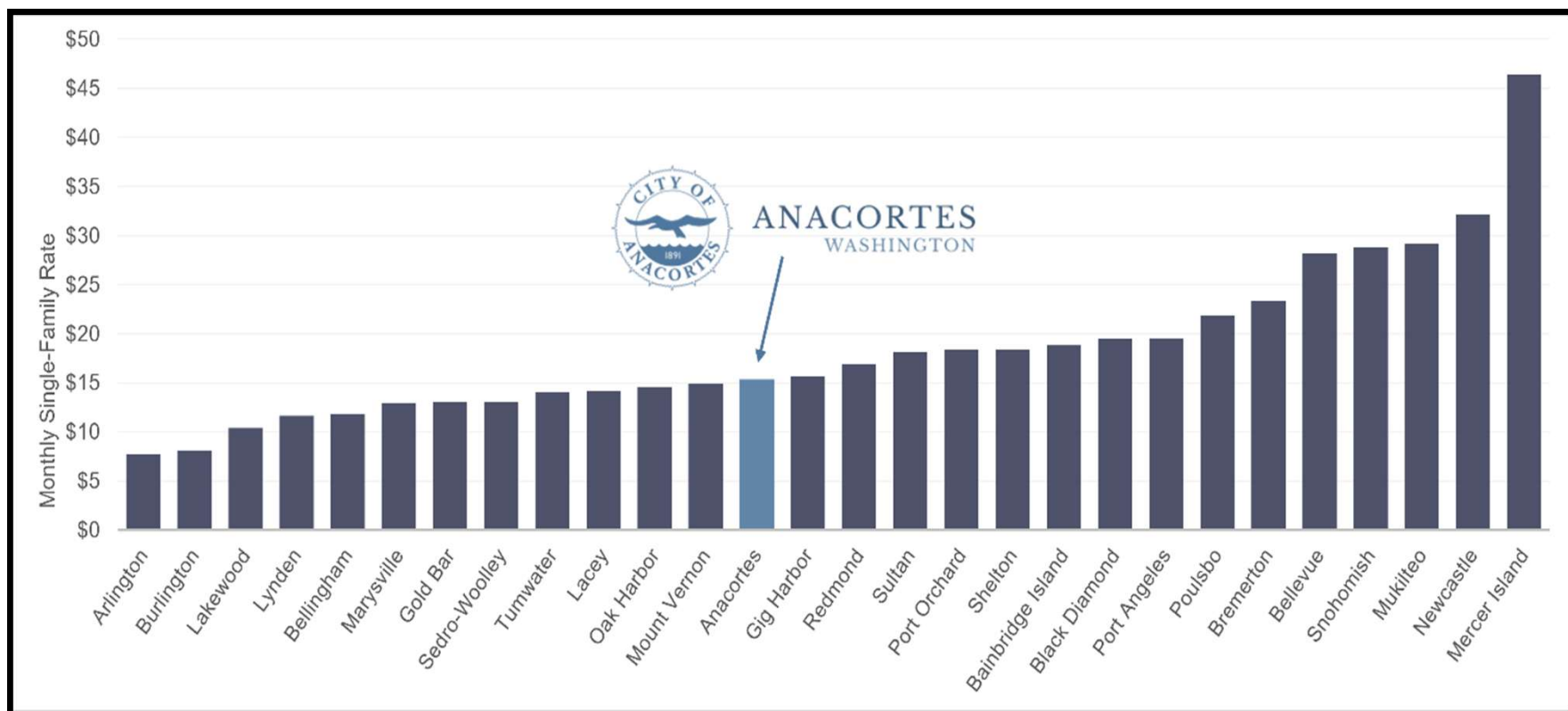


Capital Facilities – Citywide Programs

Program Name	Program Type	Source	Program Description
1. Stormwater Pipe Repair and Replacement (New)	Ongoing Small Works Program	2025 Stormwater Master Plan	Program will address repair and replacement of aging for failing stormwater pipes throughout the City.
2. Outfall Evaluation and Rehabilitations (Ongoing)	Ongoing Small Works Program	City's 2024-29 Capital Facilities Plan	- Program will address degraded conditions of the City's 73 Storm system outfalls to recommend a rehabilitation plan. - Many outlets throughout the City were below the ordinary high-water line, which resulted in saltwater intrusion into the storm system, degrading conditions of the outfall.
3. Storm System Facility Upgrades, Restoration and Maintenance (Ongoing)	Ongoing Small Works Program	City's 2024-29 Capital Facilities Plan	- Program will address upgrading, restoring and maintaining the City's existing stormwater infrastructure. These projects included or involved the following: - Storm pond cleaning - Repair fencing at stormwater ponds - Separation of combined storm and sanitary sewer system
4. Storm System Capacity Upgrades (New)	Ongoing Small Works Program	2025 Stormwater Master Plan	Program will address needed stormwater capacity upgrades that are identified in the H&H modeling results in this plan.

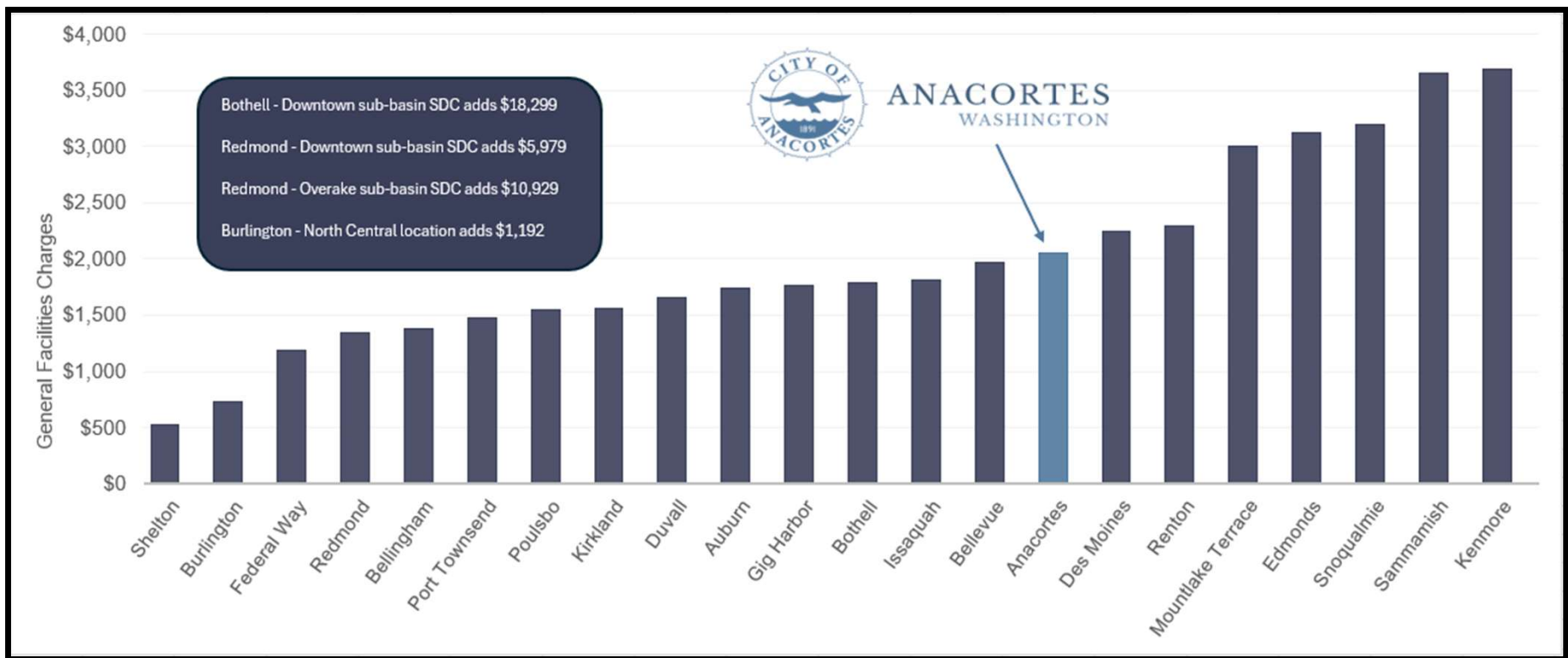


Stormwater Utility – Monthly SFR





Stormwater Utility – GFC





Stormwater Utility Revenue

Breakdown	'25 Budget	Current Activities
Administration	\$479,211	Salaries, Benefits, Professional Services, Insurance
Engineering Plans and Services	\$849,758	Salaries, Overtime, Benefits, Professional Services, Communication, Travel & Training, Other
Street Cleaning – Storm Drainage	\$180,145	Storm Drainage funds that supports the Street Cleaning Program
Storm Drainage System – Dedicated (Admin, Maintenance and Natural Resources)	\$1,676,654	Support overall City Administration, Maintenance and Natural Resources. <i>Includes \$731K for: Storm System Facility Upgrades, Restoration and Maintenance Program, Fidalgo Bay Road Flood Mitigation CFP #5, 17th St SW Pipe/Outfall Repair CFP #11</i>
Annual Operating Budget	\$3,185,768	

For 2025, the Storm Utility has increased \$766K (+32%) over 2024 for Capital Facilities Spending. Average CFP Budget (2025-2029) of \$581K.



Public Outreach Next Steps

- Stormwater problem areas in the City
- Public's satisfaction level with the stormwater program, including O&M
- Stormwater Program Priorities



Clyde Creek southwest of Queen Ann Way



Next Steps

- Prioritize Capital Facility Projects
- Develop Programs
 - Outfall Evaluation and Rehabilitations
 - Pipe Repair and Replacement Program
 - Storm System Facility Upgrades, Restoration, and Maintenance
 - Storm System Capacity Upgrades Program
- NPDES Permit Compliance Approach and Execution
- Public Input
 - Inform Prioritization
 - Confirm Results of the Plan
- The Stormwater Utility's Future
- Redevelopment and Development Implications

Questions

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ANACORTES
WASHINGTON

Thank you for attending.

Osborn
Consulting



ANACORTES
WASHINGTON

DRAFT STORMWATER MASTER PLAN

CITY OF ANACORTES STORMWATER MASTER PLAN

Prepared for:



ANACORTES
WASHINGTON

**Aaron Esterholt, Stormwater Program Manager
City of Anacortes
904 6th Street
Anacortes, Washington 98221**

Prepared by:



**Osborn Consulting, Inc.
1800 112th Avenue Northeast, 220E
Bellevue, Washington 98004**

January 2025

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Appendix E: Summary of Constrained Drainage Systems Findings
Appendix F: Stream and Habitat Assessment Field Notes and Recommended Restoration CFPs
Appendix G: Fish Passage Barrier Maps and List
Appendix H: 2025 Stormwater Capital Facilities Plan Projects and Programs

LIST OF ABBREVIATIONS

ACFL	Anacortes Community Forest Lands
AMC	Anacortes Municipal Code
BMP, BMPs	Best Management Practice, Best Management Practices
CAO	Critical Areas Ordinance
CCTV	closed-circuit television
Census	U.S. Census Bureau
CFP	Capital Facilities Plan, Capital Facility Project
City	City of Anacortes
CoF	consequence of failure
CWA	Federal Clean Water Act
DTM	North Puget Sound Digital Terrain Model
Ecology	Washington State Department of Ecology
ERU	equivalent residential unit
EPA	U.S. Environmental Protection Agency
FPDSI	Fish Passage Diversion Screening Inventory
GFC	General Facilities Charge
GIS	geographic information system
GMA	Growth Management Act
GPS	geographic positioning system
H&H model	hydrologic and hydraulic model
IDDE	Illicit Discharge Detection and Elimination
LID	low impact development
LiDAR	light detection and ranging
LoF	likelihood of failure
MS4	municipal separate storm sewer system
N/A	Non-applicable
NAD 83	North American Datum of 1983
NASSCO	National Association of Sewer Service Companies
NAVD 88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
NWIFC	Northwest Indian Fisheries Commission
OFM	Office of Financial Management
O&M	operations and maintenance
Osborn	Osborn Consulting, Inc.
PACP	Pipeline Assessment Certification Program
PAHs	polyaromatic hydrocarbons
PCB, PCBs	polychlorinated biphenyls
PCSWMM	Personalized Compute Stormwater Management Model
Permit	NPDES MS4 Phase II Permit
Phase II Permit	Phase II Municipal Stormwater Permit
Plan	2025 Stormwater Master Plan
QSR, QSRs	Quick Structural Ratings
RCW	Revised Code of Washington
R/R	Repair and Replacement
SCD	Skagit Conservation District
SCS	Natural Resources Conservation Service
SMAP	Stormwater Management Action Plan
SMED	Stormwater Management for Existing Development

Osborn
Consulting

SR	State Route
SR Cutthroat	Sea Run Cutthroat
SWM	surface water management
SWMMWW	Stormwater Management Manual for Western Washington
SWMP	Stormwater Management Program
SWPRRP	Stormwater Pipe Repair and Replace Program
TMDL, TMDLs	Total maximum daily load, total maximum daily loads
UGA, UGAs	Urban Growth Area, Urban Growth Areas
USDA	U.S. Department of Agriculture
WDFW	Washington State Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WS Drop	water surface drop
WSDOT	Washington State Department of Transportation

1 INTRODUCTION AND PLANNING CRITERIA

The City of Anacortes (City), Washington, is a small waterfront community located in western Skagit County on Fidalgo Island. The City is home to an estimated population of 18,270 people and covers approximately 11.7 square miles of land area¹. Anacortes is known as a working town. Fidalgo Island was home to the Coast Salish people (Samish and Swinomish Tribes) for thousands of years prior to the arrival of Spanish and British explorers in the late 1700s. Settlement in Anacortes by white pioneers began as early as the 1850s, with the City of Anacortes eventually becoming incorporated in 1891. Over the past century, Anacortes has proven prolific in a variety of industries from seafood harvesting and processing to resource refining, boat building and maintenance, shipping, and ferry and port tourism. Through the first half of the 20th century, the local economy was dominated by the lumber industry and local fisheries, and in the 1950s Shell and Texaco refineries broke ground at March Point forever changing the City's economic landscape. In the last few decades, tourism and marina businesses have added an additional dimension to the local economy, as have the industries of ship and boat building and repair.

In 1999, the City adopted its first storm and surface water utility charges to fund the Stormwater Management Program (SWMP). Since then, the City has continually strengthened its municipal services over time, including steady improvements to its surface water management (SWM) systems as a result of close departmental and community partner collaboration. In 2007, the City became a Federal Clean Water Act National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit (Phase II Permit) holder, allowing the City to discharge stormwater to the surface waters of the state. The City has maintained Phase II Permit compliance and implemented its own SWMP. The City has also taken responsibility for maintaining the municipal stormwater infrastructure, mitigating area flooding risk, and protecting surface water quality. This 2025 Stormwater Master Plan (Plan) is intended to guide related activities for the next 20 years, address current challenges in City stormwater management, and inform the City's overall 2025 Comprehensive Plan update.

The Washington State Legislature enacted the Growth Management Act (GMA) (RCW Chapter 36.70A) in 1990 to address rapid population growth and concerns with suburban sprawl, environmental protection, quality of life, and related issues. The GMA provides a framework for regional coordination of land development. Under the GMA, local comprehensive plans, such as the City's 2025 Comprehensive Plan, must include the following elements: utilities, capital facilities, land use, housing, transportation, economic development, parks, and recreation, and, for counties, a rural element. In 2023, through House Bill 1181, a climate element requirement was added to the State's planning framework to improve Washington State's response to climate change. City master planning documents, such as this Plan, are coordinated with the City's comprehensive planning process through an annual Comprehensive Plan amendment process. During this amendment process, the Plan and capital projects therein are integrated with the capital facilities element of the City's overall 2025 Comprehensive Plan.

1.1 STORMWATER MASTER PLAN SUMMARY

The City's 2025 Stormwater Master Plan includes six major sections:

- **Section 1** – An overview of the City's SWMP, including the stormwater utility rate and budget, the local climate, basin descriptions, existing land use, population growth and relevant regulations.

¹ Population data from the Washington State Office of Financial Management (April 1, 2024). Land area data from the 2021 Census. City GIS data shows land and water areas together total 15.53 square miles (<https://www.anacorteswa.gov/635/GIS-Mapping>).

- **Section 2** – A description of the City's Stormwater Pipe Repair/Replacement Program (R/R Program) including the stormwater asset inventory, the current R/R Program, and the future R/R Program needs.
- **Section 3** – An overview of the Citywide Hydrologic and Hydraulic Modeling (H&H Modeling), including the model results, existing condition assessment, stormwater system deficiencies, and evaluation of capital project solutions.
- **Section 4** – A description of stream and habitat conditions within six streams located within the city limits, and an inventory of culverts and fish passage barrier locations in these and other waterways.
- **Section 5** – An overview of the City's Capital Facilities Projects and Programs (CFPs).
- **Section 6** – The Plan's Conclusion, which covers the execution plan, recommendations, and next steps for implementing the Plan.

1.2 2007 STORMWATER MANAGEMENT PLAN

The *2007 Stormwater Management Plan for the City of Anacortes* was developed with the goal of preserving water quality and the hydraulic systems within the City's drainage basin and the receiving waters of Guemes Channel, Burrows Bay, and Fidalgo Bay². The plan provided guidance to minimize the adverse effects of stormwater and surface runoff on both surface and ground water and identified water quality and quantity problems, including stormwater capital facility projects (CFPs). The plan also provided recommendations for specific stormwater management improvements and programs as well as a cost analysis and implementation schedule.

In the plan, drainage areas were determined according to the local topography and stormwater conveyance facilities and identified specific structural and nonstructural solutions to conveyance and water quality problems within the City. To assess the capacity of the stormwater drainage system, a numeric computer model was developed for the plan using existing GIS data, as-built maps of developments, local surveys for specific areas such as the historical downtown core and the assumed build-out development. Nearly all the identified CFPs in the 2007 have been completed or are no longer relevant.

The plan found that there were 12 locations that flood during 25-year storm events based on the modeling assumptions used. The plan was developed to meet the requirements of the 2005 Department of Ecology (Ecology) Stormwater Management Manual for Western Washington (SWMMWW) and provided an overview of the 2007-2013 Phase II Permit stormwater requirements.

1.3 PURPOSE AND OBJECTIVE

The goal of this project is to develop a stormwater master plan for the City of Anacortes. The City owns, operates, and maintains a Stormwater Utility, which includes infrastructure governed by the Phase II Permit.

This Plan addresses the new and increased requirements of the Phase II Permit and the updated projections for future customer and infrastructure growth and development.

The Plan incorporates the following actions:

² The *2007 Stormwater Management Plan for City of Anacortes* is available online at anacorteswa.gov/DocumentCenter/View/4403/2007-Storm-Water-Comprehensive-Plan-PDF.

- Updating the City's 2007 Stormwater Comprehensive Plan.
- Providing guidance for stormwater management.
- Evaluating upcoming Phase II Permit requirements and programs.
- Providing documentation of the City's stormwater infrastructure.
- Reviewing the City's existing stormwater asset inventory and establishing a Pipe Repair and Replacement Program.
- Identifying stormwater system deficiencies through a citywide hydrologic and hydraulic model (H&H model).
- Assessment of stream habitat and surrounding infrastructure.
- Documenting the current Capital Improvement Program.
- Supporting future capital, operation, and maintenance activities.
- Providing a multi-year Stormwater Execution Plan to achieve.

1.4 CITY OVERVIEW

The City of Anacortes is located in western Skagit County on Fidalgo Island in the Puget Sound region of Western Washington. The City is bordered by Fidalgo and Padilla Bays to the east, Guemes Channel to the north, and Burrows Bay and the Rosario Strait to the west. To the south, Deception Pass separates the southern edge of Fidalgo Island from Whidbey Island, and to the east the Swinomish Channel separates Fidalgo Island from the mainland. Development on Fidalgo Island is spread along the west, east, and north shorelines, with urbanized areas in Anacortes located in the northeastern section of the island.

Anacortes is a popular destination for boaters in Washington state and is known locally for the Washington State Ferries dock and terminal that serves the San Juan islands. The waters off Anacortes and Fidalgo Island are also home to a rich variety of marine life, most notably resident orca pods, and the general vicinity is renowned for whale watching.

In addition, the City boasts many other recreational amenities. According to the Anacortes Chamber of Commerce and Visitor Information, around 40 percent of the City's total land area consists of city parks, community forest lands, and other recreational areas. The community forest lands alone cover almost 2,800 acres within the City, encompassing a mixture of forest, wetlands, lakes, and meadows with 50 miles of multiuse mountain biking and hiking trails.

A vicinity map is provided in **Figure 1.1**.

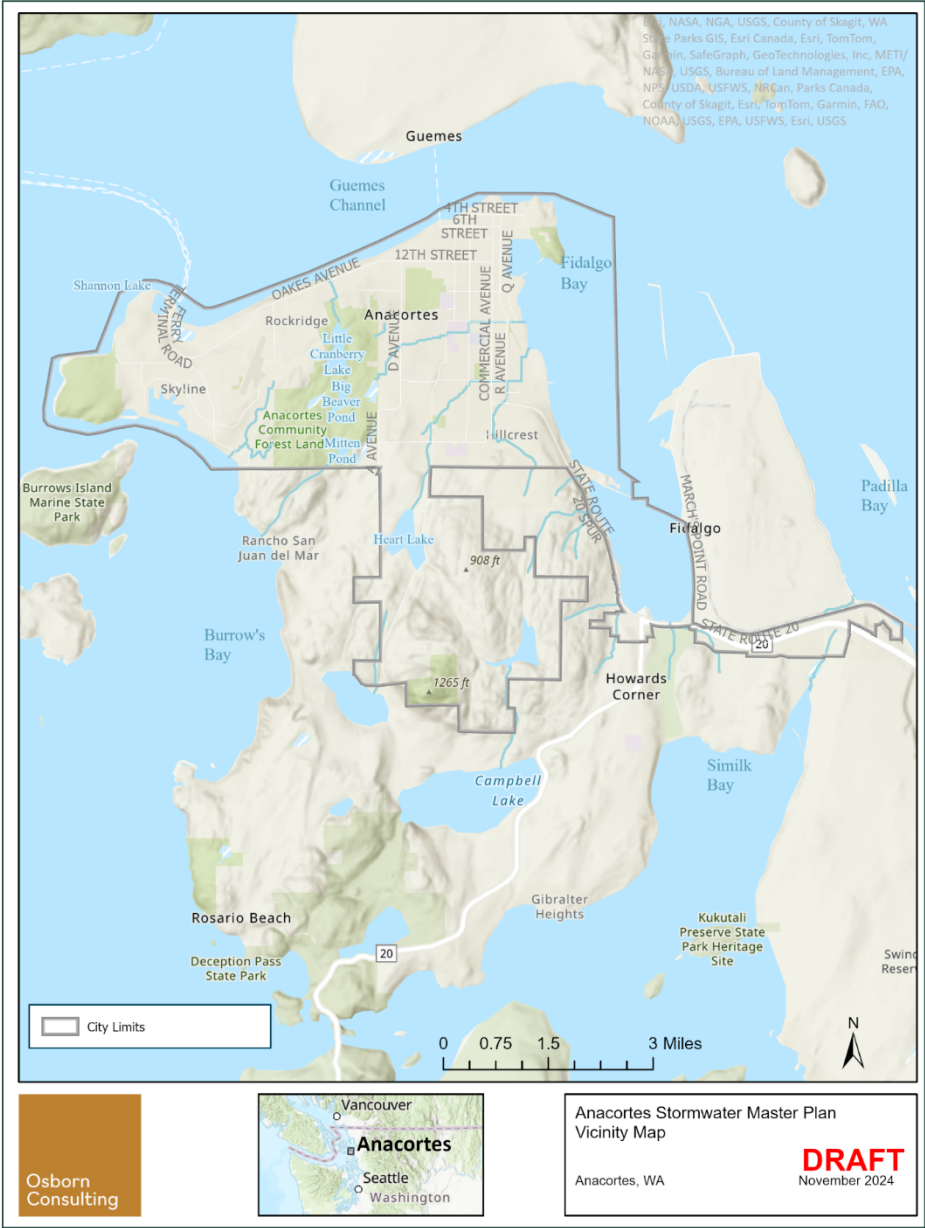


Figure 1.1. Vicinity Map

According to Skagit County's *Population, Housing, and Employment Growth Allocations Methodology Report*³, the estimated population for the City for 2025 is 18,686 people. The City of Anacortes is one of two principal cities included in the Mount Vernon-Anacortes Metropolitan Statistical Area. Located next to the City, March Point is a large industrial area that is located outside of the City but within the Anacortes Urban Growth Area (UGA). The March Point area is not included as part of the City's Phase II Permit.

1.5 STORMWATER UTILITY RATE AND BUDGET

The stormwater utility's first rate was established in 1999. Regular storm rates are indexed annually by the City treasurer to reflect 100 percent of any change from the Consumer Price Index for Seattle-Tacoma-Bellevue All Urban Wage Earners (CPI – Seattle-Tacoma-Bellevue-All Urban Wage Earners (CPI-U) (October 2022–October 2023) at 4.791 percent. The amount billed includes a fee or tax up to 7 percent calculated on the gross revenue of the storm utility.

The current rate is \$15.34 for a single-family residence per month, which roughly occupies the mid-to-low end range compared to other jurisdictions in Western Washington, as shown in **Figure 1.2**. Single-Family Monthly Stormwater Rates.

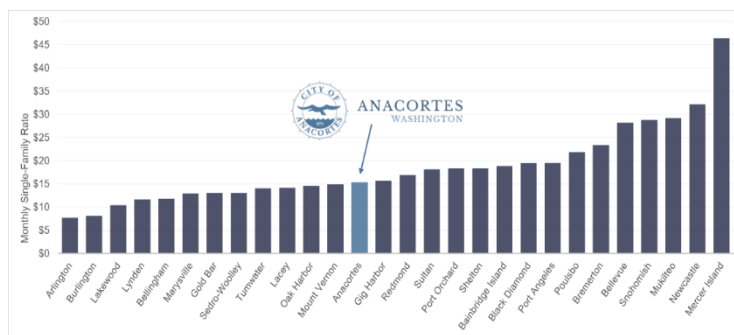


Figure 1.2. Single-Family Monthly Stormwater Rates (2024)

Single-family properties are charged a flat rate every month and are considered one equivalent residential unit (ERU) according to the City. This rate was set based on aerial photo surveys, which have shown the average amount of impervious surface on a single-family parcel in Anacortes is 3,600 square feet.

The monthly stormwater rate per ERU for both commercial and multifamily properties is \$15.34. Commercial properties are assessed based on the actual amount of impervious surface area that they contain from structures such as buildings or parking lots on property and are assessed at a minimum of one ERU. The monthly fixed charges for properties in the heavy manufacturing (HM) and light manufacturing (LM) zones is \$7.67 for single family properties, multifamily properties, and commercial properties as of 2024. In addition, the City has a Storm General Facilities Charge (GFC) for any new residential, industrial, or commercial development connections effective January 1, 2023, with a rate of \$2,056 per ERU. As shown in **Figure 1.3** Figure 1.3. Stormwater General Facilities Charges (GFC) for New Connections to City Storm System (2024), the City GFC is similar to that of other jurisdictions in the Puget Sound region of Western Washington.

³ Published December 12, 2023.

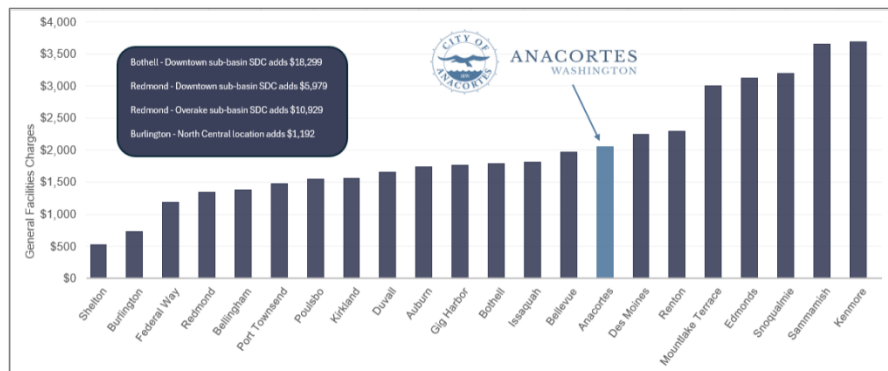


Figure 1.3. Stormwater General Facilities Charges (GFC) for New Connections to City Storm System (2024)⁴

The current annual budget (2025) for the stormwater utilities in Anacortes is \$3,185,768, which includes the four expense category breakdowns and an annual capital facilities budget. **Table 1.1** provides a summary of the total expenses for each portion of the stormwater utility, and the total capital facilities budget.

The City recently discovered a billing issue concerning the undercharging of commercial properties. The City has been gradually increasing the stormwater fee to these impacted properties each year and will reach the full amount of the intended charge by 2029. Accounting for these additional fees, along with the anticipated CPI increases (3%), would increase the annual budget to approximately \$223,179 from 2025 to 2029.

Table 1.1. 2025 Stormwater Utility Expense Categories in Anacortes

2025 Expense Categories		Expense
Administration – Storm Drainage		\$479,211
Engineering Plans and Services – Storm Drainage		\$849,758
Street Cleaning – Storm Drainage		\$180,145
Storm Drainage - Dedicated		\$817,309
Expense Subcategories	Administration	\$309,947
	Maintenance	\$634,707
	Natural Resources {includes 2025 Stormwater Capital Facility Projects and Programs}	\$732,000
2025 Storm Drainage Operating Budget		\$3,185,768

⁴ Source: FCS Group, A Bowman Company received via email on 11/25/24

1.6 EXISTING DATA REVIEW SUMMARY

Significant data related to the City's stormwater system has been gathered as part of this project. The Data Summary Matrix is provided in **Appendix A** and includes a summary by topic of the data and reports reviewed, including the document or package title, date obtained from the City where applicable, lead reviewer and date reviewed, author, published date, and a brief description of the content or review findings.

The existing documents and data reviewed covered the following topics:

- Stormwater Utility Assets
- Stormwater Plans and Studies
- Stormwater Permits
- Asset and Facility Inspection and Maintenance Reports
- Completed Stormwater Projects
- As-Builts
- Inspection Summary Reports and Videos
- Stormwater Infrastructure GIS
- Hydrologic and Hydraulic Modeling Files
- Preliminary Capital Facility Project (CFP) List
- Rainfall Data
- Stream and Fish Passage Data and Reports
- Sea Level Rise Documentation
- Other Miscellaneous Data and Reports

1.7 LOCAL CLIMATE

Anacortes, like much of the Western Washington lowlands, has a warm-summer climate, characterized by cool, rainy winters and warm, dry summers. According to the National Oceanic and Atmospheric Administration (NOAA), the annual high temperatures in Anacortes on average range from as low as 47 degrees Fahrenheit in December to a warm 75 degrees Fahrenheit in August, and annual low temperatures range from 36 degrees Fahrenheit in December to 54 degrees Fahrenheit in August (2021).

The wet winter season typically starts in October and lasts until May after which time the summer dry season begins, which tends to peak around July. Snowfall is rare in Anacortes and the average annual snowfall is approximately 2.76 inches per year. On average, the wettest months of the year are November, December, and January, and the driest months of the year are June, July, and August (NOAA 2021). The annual rainfall in Anacortes fluctuates with the average rainfall for a 30-year period (1991–2020) estimated at 28.96 inches. Data regarding the 2-year, 25-year, and 100-year storm events with a 24-hour duration were obtained from isopluvial maps in the 2024 SWMMWW, published by Ecology. In addition to the Ecology isopluvial maps, the City provided local rainfall data that showed significantly less rainfall than the isopluvials. Other localized climate data collected included sea level rise documentation. **Section 3** describes how this data was interpreted and used for the modeling effort.

1.8 BASIN DESCRIPTIONS

Stormwater runoff in Anacortes flows to five major waterbodies: Fidalgo Bay, Guemes Channel, Burrows Bay, Padilla Bay, and Similk Bay, each of which correspond to five separate and distinct drainage basins that contribute to stormwater pipes. A visual depiction of the drainage basin locations, including the areas outside of the delineated drainage basins, are shown **Figure 1.4. Drainage Basin**, and a detailed summary of the characteristics unique to each basin is provided in **Table 1.2..** To maintain consistency with previous stormwater planning work completed by the City, the drainage basins are the same in terms of both their naming and general delineation. However, the boundaries were updated to inform the stormwater system capacity modeling.

Commented [DH1]: 1.8 Basin Descriptions:
Section to be updated in Final to address Libby Grage's comments on the Draft.



Table 1.2. Drainage Basin Characteristics

Drainage Basin (Including Stormwater Pipes)	Total Area (Acres) (Percentage in the City)	Catchments for System Capacity modeling	Number of Outfalls	Location and Topography	Perennial Streams, Lakes, Channels, or Bays
Fidalgo North	2,596 (89%)	423	21	- Flat in the downtown area and along the eastern shoreline, steep slopes in the interior. Slopes range from 0% to 65%, some slopes as steep as 90% by the subbasin tributary to Heart Lake. - Stormwater conveyance mostly consists of ditches. - The basin includes Heart Lake.	Ace of Hearts Creek, Beaver Brook, Cedar Springs, Happy Valley Stream, Heart Lake, Fidalgo Bay
Fidalgo South	1,953 (30%)	86	24 <i>(8 of these are private)</i>	- Flat along the eastern shoreline, steep slopes in the interior. Slopes range from 0% to 65%, some slopes as steep as 90%. - Stormwater conveyance mostly consists of ditches.	Aqua Creek, Howard Creek, Miller Creek, Summit Creek, Weaverling Rill, Whistle Creek, Fidalgo Bay
Guemes West	1,191 (100%)	194	11 <i>(1 of these are private)</i>	- Slopes in the subbasin average from approximately 0% to 20% but slopes local to Little Cranberry Lake are as high as approximately 90%. - Concrete and corrugated metal pipes are used in the developed area, and ditches are used in the residential areas. - A large portion of the drainage basin is Anacortes Community Forest Lands (ACFL).	Cranberry Creek, Big Beaver Pond, Little Cranberry Lake, Guemes Channel
Guemes East	699 (100%)	120	20	- Slopes in subbasin average from approximately 0% to 20%. - Concrete and corrugated metal pipes are used in the developed area⁵, and ditches are used in the residential areas. - The drainage basin includes Volunteer Park.	Morrison Run, Guemes Channel

⁵ Per AMC 13.10.010, developed area means an artificial change to property, including but not limited to, building or other structures, mining, dredging, filling, all land-disturbing activities, clearing, grading, landscaping, paving, excavation, or drilling operations.

Drainage Basin (Including Stormwater Pipes)	Total Area (Acres) (Percentage in the City)	Catchments for System Capacity modeling	Number of Outfalls	Location and Topography	Perennial Streams, Lakes, Channels, or Bays
Burrows North	648 (100%)	162	16	- Slopes range from approximately 0% to 60% in the subbasin. - The stormwater conveyance in the subbasin mostly consists of concrete and corrugated metal pipe and ditches. - Basin includes Washington Park.	Burrows Bay
Burrows South	635 (100%)	94	1	- Slopes range from approximately 0% to 60% in the subbasin. - The stormwater conveyance in the subbasin mostly consists of concrete and corrugated metal pipe and ditches.	Burrows Bay, Anaco Bourn, Clyde River, Mitten Creek, Mitten Pond
Padilla North	157 (80%)	16	1	- The local topography in the subbasin is mostly flat. - The stormwater conveyance system within the basin mostly consists of concrete pipes. - This basin is north of Simik and Padilla Bay South Drainage Basins.	Padilla Bay, March's Run
Padilla South	83 (0%)	Not applicable (Discharges directly to Padilla Bay, not modeled.)	—	- The local topography in the subbasin is mostly flat. - The stormwater conveyance system within the basin mostly consists of concrete pipes. - The majority of this basin is outside the City limits.	Padilla Bay
Similk	213 (72%)	45	1	- The local topography in the subbasin is mostly flat. - The local stormwater conveyance mainly consists of ditches. Drainage flows first go through unincorporated Skagit County where ditches constitute the majority of the conveyance system.	Similk Bay, Reservation Road Creek, Turner's Creek

Local streams in the area include, but are not limited to, Ace of Hearts Creek, Aqua Creek, Beaver Brook, Clyde Creek, Cranberry Creek, and Happy Valley Stream. For a condition assessment of these streams and associated infrastructure that was completed as part of the stormwater master plan, see **Section 4**.

The City of Anacortes has several miles of saltwater shoreline, and there are four freshwater lakes located within the City—Little Cranberry Lake, Shannon Lake, Whistle Lake, and Heart Lake. Many wetland areas are located in and around the Anacortes UGA, the largest of which are located south of Little Cranberry Lake and southeast of Shannon Lake. Stormwater and surface runoff in Anacortes flows into the Puget Sound by way of Guemes Channel, Burrows Bay, Fidalgo Bay, Padilla Bay, and Similk Bay. Throughout the area, drainage has been accomplished along the streets through a number of open ditches, culverts, various sized pipes and catch basins, detention ponds, and vaults.

The total number of stormwater assets in the City are included in **Table 1.3**.

Table 1.3. Public Stormwater Assets

Public Stormwater Assets Type	Total Number
Catch Basins ¹	3,418
Maintenance Holes ¹	1,050
Outfalls ²	95
Open Ditches and Channels ²	27.8 miles
Culverts ²	6.8 miles
Pipe ¹	85.3 miles
Green Stormwater Infrastructure (GSI) ²	126

¹Data sourced on May 22, 2024.

²Data sourced on March 21, 2024.

1.9 EXISTING LAND USE AND SOILS

Development on Fidalgo Island is spread along the west, east, and north shorelines of the island, with downtown Anacortes located in the northeastern section of the island. The City of Anacortes contains a mix of development and in total encompasses a land area of approximately 11.7 square miles (Census 2021).

The existing land uses within the City are summarized in **Table 1.4** and shown graphically in **Figure 1.5**.

Commented [DH2]: 1.9 Existing Land Use and Soils:
Section to be updated in Final to address Libby Grage's comments on the Draft.

Table 1.4. Existing Land Use Data

Existing Land Use Type	Total Area (acres)
Aeronautical Zone (AZ)	118.7
Commercial (C)	148.4
Central Business District (CBD)	58.5
Commercial Marine (CM)	589.98
Heavy Manufacturing (HM)	2111.8
Industrial (I)	170.3
Light Manufacturing (LM)	1,009.1
Marine Mixed Use (MMU)	248.3
Manufacturing and Shipping (MS)	54.9
Old Town (OT)	156.5
Public Use (P)	3,550.3
Residential (R)	43.3
Residential High Density 4A (R4)	22.1
X (RHD)	183.9
X (RHD Mixed)	86.1
X (RHD 1)	296.5
X (RHD 2)	1987.62
X (RMD)	489.6
Total	9,346.8¹

¹ The total area 14.6 square miles is less than the total area of the city limits because land use data (received from the City in November 2024) does not include the water that is included in the total city limits. There is also a portion of the zoning data that is outside of the City limits.

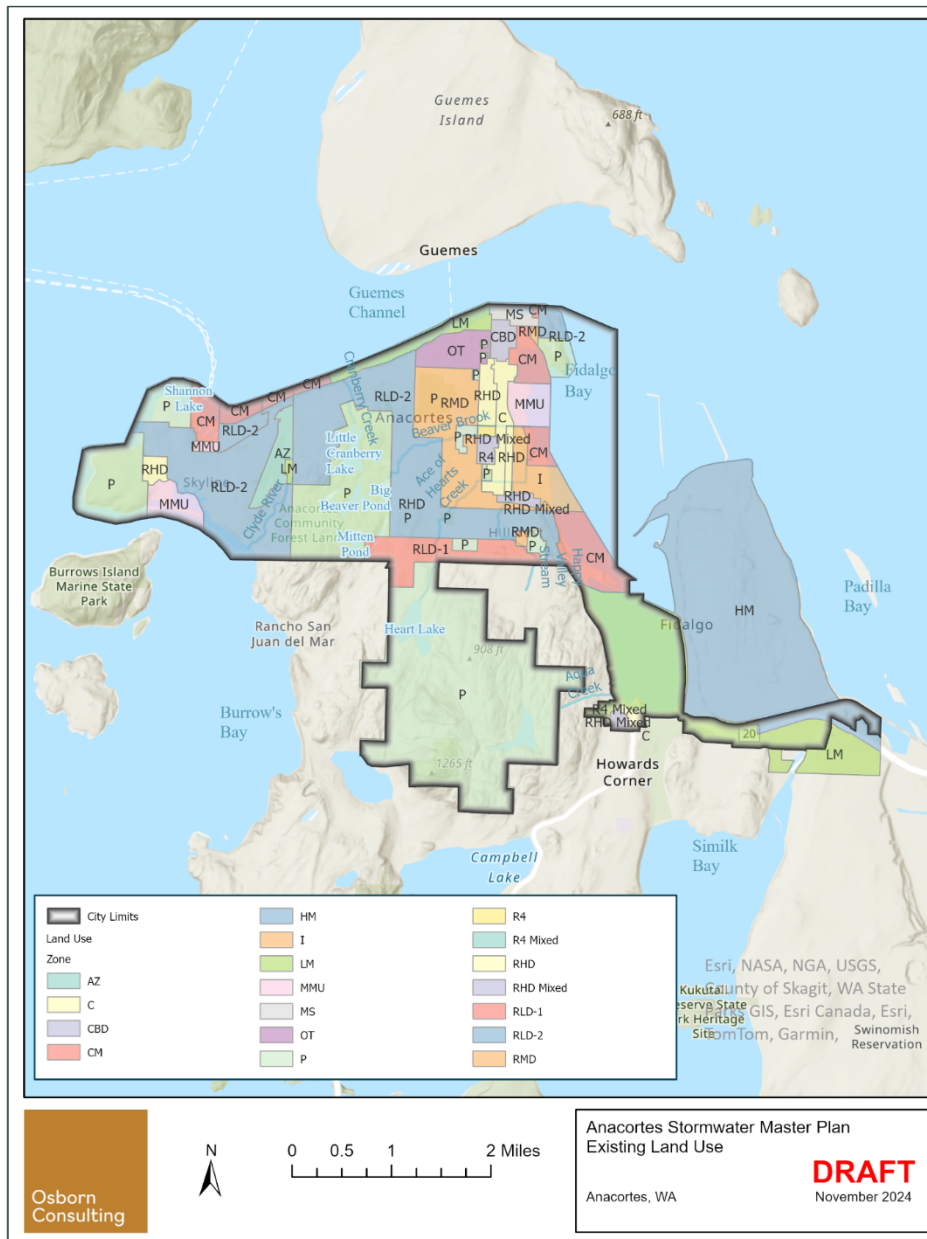


Figure 1.5. Existing Land Use

The existing land use and soil types greatly influence stormwater runoff, infiltration potential, and depth to groundwater. For this plan, the soils within the City have been grouped according to the U.S. Soil Conservation Service's Hydrologic Soil Group (HSG) classification system, which provides a general indication of stormwater runoff potential. The HSG system classifies soils based on their infiltration rates when bare of vegetation. Slope and plant cover are not considered in the groupings and are separate factors in predicting runoff.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

Following the HSG classification system, soils in the United States are assigned to four groups (A, B, C, or D) and three dual class groups (A/D, B/D, or C/D). The four primary soil groups are defined as follows:

- **Group A** – Soils that have a high infiltration rate and low runoff potential when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B** – Soils that have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained, or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C** – Soils that have a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **Group D** – Soils that have a very slow infiltration rate and high runoff potential when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

For soils assigned to a dual class hydrologic soil group (A/D, B/D, or C/D), the first letter applies to the drained soil condition and the second to the undrained soil condition of the location so categorized. Only soils, which in their natural condition fall under Group D (wet soils) but that can also be adequately drained (as represented by either Group A, B, or C designations), are assigned to dual classes.

Most soil types found in Anacortes are hydrologic soil groups C and D. The other major soil groups inside the City are found in smaller areas and include hydrologic soil groups A and B. The City's soil types are shown in **Figure 1.6**. Anacortes Soils and described in **Table 1.5**.

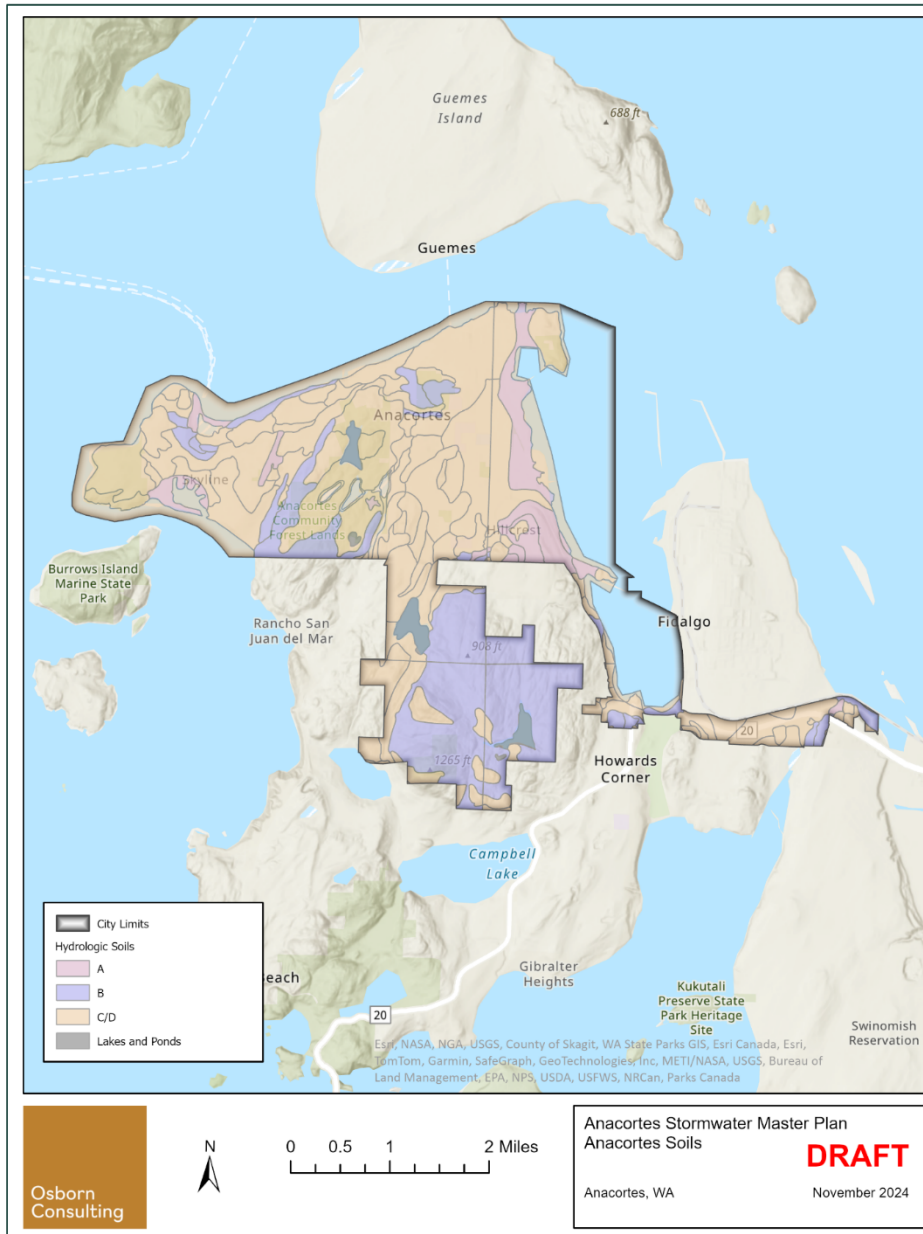


Figure 1.6. Anacortes Soils

Table 1.5. Existing Soils Data

Soils Type	Hydraulic Soil Group Type	Total Area (acres)
Bellingham mucky silt loam	Groups C/D	89.4
Bellingham silt loam	Groups C/D	22.8
Bow-Urban land complex	Groups C/D	547.2
Bow gravelly loam	Groups C/D	6.6
Bow gravelly loam, dry	Groups C/D	586.5
Catla gravelly fine sandy loam	Group D	562.8
Clallam-Urban land complex	Group C	493.9
Clallam gravelly loam	Group C	428.2
Coveland-Bow complex	Groups C/D	55.3
Coveland gravelly loam	Groups C/D	372.2
Dystric Xerochrepts	Group B	65.2
Fidalgo-Lithic Xerochrepts-Rock outcrop complex	Group C	335.1
Hydraquents, tidal	Groups B/D	43.0
Keystone loamy sand	Group A	216.5
Lacconner very gravelly loamy sand	Group B	150.9
Lithic Haploxerolls-Rock outcrop complex	Group D	246.2
Mukilteo muck	Groups B/D	36.5
Norma silt loam	Groups B/D	66.5
Pits	—	21.3
Swinomish-Fidalgo-Rock outcrop complex	Group C	761.4
Swinomish gravelly loam	Group C	101.3
Tacoma silt loam	Groups C/D	0.4
Tacoma silt loam, drained	Group C	7.5
Terric Medisaprists	Groups C/D	59.9
Water ¹	—	166.6
Whistle-Fidalgo-Rock outcrop complex	Group B	1,770.2
Xerorthents	Group A	399.4
Total		7,612.9

¹The city limit boundary includes a portion of Puget Sound.

1.10 POPULATION GROWTH

The Skagit County *Population, Housing, and Employment Growth Allocation Methodology Report*, published December 12, 2023, estimates the population of Anacortes in 2022 to be 17,882 people, with an additional 101 people living in the unincorporated UGA, as shown in **Table 1.6**.

Table 1.6. Anacortes Population Growth Allocation, 2022–2045

Urban Growth Area	2022 Population	2025 Population	2045 Population Targets	2022–2045 Population Growth	
				Amount	Percent of Total Growth
Incorporated Anacortes	17,882	18,686	22,843	4,921	17%
Unincorporated	101	105	127	26	26%

According to this report, the total population of the City of Anacortes is projected to grow by 17 percent between the years 2022 and 2045. The 2025 projected population is 18,686 people and is projected to increase to 22,843 people by 2045. Provided by the City's GIS Department, there are a total number of 501 parcels in the City.

The Anacortes Capital Facilities Plan (CFP) projected the rate of population growth and the rate of commercial, industrial, and multifamily residential development. The rates of growth and development are two significant factors in estimating the relevant expenditures and timing for developing city stormwater management facilities. The UGA planning area of the City of Anacortes was sized to accommodate the entire projected planning area for a build-out population of 19,300.

The CFP has not contemplated expanding the UGA boundary to accommodate the suggested 2024 population allocation. The Growth Management Act allows annual revision of the CFP. The UGA Plan includes provision for annual review of development. This allows the projected rate and the CFP to be revisited if the projected development rate varies significantly from the actual rate. The population and development projections in the CFP are the basis for projections of impervious surface and stormwater runoff.

1.11 MS4 REGULATORY REQUIREMENTS

The City has a robust SWMP that is driven by the local regulatory requirements described in detail in Section 1.11. It is important for the City to remain in compliance. The Federal Clean Water Act (CWA) established the basic structure for regulating discharges of pollutants into the waters of the United States and regulating water quality standards for surface waters. The CWA's primary objective was to restore and maintain the integrity of the nation's waters.

The objective translates into two fundamental national goals:

1. To eliminate the discharge of pollutants into the nation's waters.
2. To achieve water quality levels that are fishable and swimmable.

Commented [DH3]: 1.10 Population Growth:
Section to be updated in Final to address Libby Grage's comments on the Draft.

The U.S. Environmental Protection Agency (EPA) regulates stormwater under Section 402(p) of the CWA, including regulating discharges from municipal separate storm sewer systems.

The NPDES permitting program regulates point sources that discharge pollutants to the waters of the United States. EPA delegated NPDES permit authority to Ecology.

Under Washington's Water Pollution Control Act, Ecology issued Municipal Separate Storm Sewer System (MS4) general permits in two phases. The Phase I Permit was first issued in 1995 to cover incorporated cities with a population of more than 100,000 people and unincorporated counties with a population of more than 250,000 people. Two Phase II Permits were first issued in 2007: one for Western Washington and one for Eastern Washington. Both cover MS4s serving less than 100,000 persons and construction sites disturbing more than one acre.

The City of Anacortes is a permittee under the NPDES Phase II Municipal Stormwater Permit for Western Washington issued by Ecology. The most recent permit was issued on July 1, 2024, and became effective on August 1, 2024. Previous permits were issued in 2007, 2013, and 2019.

The Phase II Permit allows municipalities to discharge stormwater runoff from their municipal drainage systems into Washington State bodies of water, including streams, rivers, lakes, and wetlands, under conditions specified in the Phase II Permit. Municipalities must implement programs to protect water quality by reducing the discharge of pollutants to the maximum extent practicable by applying all known, available, and reasonable treatments. Stormwater pollution reduction is accomplished through the application of structural and nonstructural BMPs.

The Phase II Permit also requires compliance with established total maximum daily loads (TMDLs), as described in Section S7 of the permit. As of 2024, Anacortes has not established any TMDLs.

On March 31 of each year, the Phase II Permit requires the City to submit a report to Ecology on the City's status of compliance with the permit. The City must also submit a SWMP Plan each year that describes the activities for the coming year. The stormwater management activities specified in the Phase II Permit are documented in a SWMP Plan and typically compiled by City staff. For more information on the existing program, see **Section 1.12**. Implementation of specific Phase II Permit conditions are staggered throughout the 5-year Phase II Permit term.

In the 2024 Phase II Permit, there were changes and updates from the 2019 Phase II Permit. Significant changes are summarized in **Table 1.7** with an estimated level of effort for implementation as low (\$), medium (\$\$) or high (\$\$\$) based on professional judgement.

Table 1.7. New or Increased Requirements of the 2024 NPDES Phase II Permit

Section Reference	Requirement	Requirement Description	Programmatic Activities	Level of Effort	Due By Date
S5.A.3.a	Cost by Stormwater Management Plan (SWMP) Element	- Track the cost or estimated cost of development and implementing each component of the SWMP. - Provide average annual costs in the Annual Report to implement the TMDL and SWMP.	- Review budget tracking and timesheets system with the city's finance department for required updates to track time and costs per SWMP element. - Update the timesheet system, as needed, for ease of reporting.	\$	March 31, 2027
S5.C.1.iii	Tree canopy goals and policies	Adopt or implement tree canopy goals and policies to support stormwater management and water quality improvements in receiving waters.	- Review all City tree canopy goals and policies, including the Anacortes Municipal Code (AMC). Collaborate with the city's planning services, as needed. - Identify needed updates to support stormwater management and water quality improvements.	\$\$	December 31, 2028
S5.C.1.d.i	Stormwater Management Action Plan (SMAP)	Complete a SMAP for at least one new priority catchment area or additional actions for an existing SMAP. Address transportation-related runoff such as projects that address tire wear runoff.	- Determine if the city wants to write another SMAP or develop additional actions for the existing Fidalgo North SMAP. - New SMAP or additional actions need to address tire wear and 6PPD.	\$\$\$	March 31, 2027
S5.C.4	New Municipal Separate Storm Sewer System (MS4) Mapping Requirements	- Submit the known locations, size, and materials of all known MS4 outfalls according to the standard templates and format. - Map the tree canopy cover on Permittee-owned or operated properties. - Map and assess the acreage of MS4 tributary basins to outfalls or discharge points that have stormwater treatment and flow control BMPs that are owned or operated by the Permittee.	- Review MS4 outfall locations to determine if any updates to the mapping need to occur. Locate additional outfall information, as needed, to fill the gaps. - Submit the MS4 outfall mapping requirements per Ecology's templates. - Determine a process for mapping tree canopy in GIS for City owned-operated properties. Collaborate with the city's planning services. - Map tree canopy and produce data inputs for the Annual Report.	\$\$\$	March 31, 2026 March 31, 2026 March 31, 2028
S5.C.5.c	Illicit Discharge Detection and Elimination (IDDE) Ordinance or Code	Update the IDDE Ordinance or Code to include PCB regulations around building washdown and procedures for post-emergency clean-up of firefighting activities.	- Review the AMC's existing IDDE code and update to address PCB regulations and firefighting activities, as needed. - Adopt new IDDE code.	\$	July 1, 2027

Section Reference	Requirement	Requirement Description	Programmatic Activities	Level of Effort	Due By Date
S5.C.7	Stormwater Management for Existing Development (SMED)	• <u>New SMED Program</u>: Implement a program to contract and reduce stormwater discharges to the waters of the state from areas of existing development. The amount of treated area required varies by jurisdiction (8 acres for every 50,000 people). • The City of Anacortes is required to treat 2.9 acres of existing impervious area.	• The City has met the SMED requirement, see Sections 1.11.4 and 1.12.7.	\$\$\$	March 31, 2028 (<i>Fund and start construction date</i>)
S5.C.8.a	Source Control Ordinance or Code	• Update source control ordinances or other enforceable documents, if needed. Applicable operational source control BMPs are required for all pollutant-generating sources. If the operational source control BMPs do not prevent illicit discharges or violations of surface water, groundwater, or sediment management standards because of inadequate stormwater control, either structural source control BMPs or treatment BMPs or both are required.	• Review the AMC's existing source control codes. Update as needed to meet new permit requirements. • Adopt new Source Control Code.	\$	August 1, 2027
S5.C.8.d	Source Control Enforcement Policy	• Develop and implement a progressive source control enforcement policy that requires sites to comply with the stormwater requirements within a reasonable period.	• Research other Phase II source control escalating enforcement policies. • Development and implement a policy. Work with local source control inspectors to implement the new policy.	\$\$	August 1, 2027
S5.C.9.a	Maintenance Standards	• Update maintenance standards as needed to comply with the 2024 SWMMWW. • Maintenance inspections are required to be conducted by qualified personnel or qualified third parties.	• Update maintenance standards, as needed, in the AMC and other procedural documents including SWPPPs. Address PCBs for building (built 1950–1980) washdown. Create an inventory of buildings built between 1950–1980.	\$\$	June 30, 2027
S5.C.9.e	Street Sweeping	• Develop and implement a municipal street sweeping program to target high-priority areas and times during the year that are reasonably expected to result in the maximum water quality benefits to receiving waters.	• Identify high priorities for street sweeping including for curbed streets that discharge to outfalls. Consider high traffic streets and streets that serve commercial or industrial land use areas. • Implement new street sweeping locations and updated frequencies.	\$\$\$	July 1, 2027

Through discussions with City staff, Osborn learned that the City wants to focus its NPDES compliance efforts on Tree Canopy Goals and Policies, addressing PBCs in Operations and Maintenance, reaching and engaging the overburdened communities, and addressing the requirements for the new SMED program. Based on the request of City staff, details for both the Phase II Permit requirements and suggestions on next steps for the City to meet those requirements were documented and are included in **Sections 1.11.1 and 1.11.4**. **Section 1.11.4** describes the City's recent compliance activities for the SMED program.

1.11.1 Tree Canopy Goals and Policies

In accordance with the Phase II Permit specifications in S5.C.1.iii, the City is required to implement a Stormwater Planning Program, which will be used to inform and assist in the development of water quality management policies and strategies. The City's SWMP program will need to adopt and implement tree canopy goals and policies that consider how both existing and future tree canopies can support stormwater management and water quality improvements in the receiving waters including Guemes Channel, Burrows Bay, Padilla Bay, Similk Bay, and Fidalgo Bay by December 31, 2028.

The program is also mandated to implement a long-term goal based on the existing and future projections for tree canopies spanning five to ten years, or longer. Special attention should be directed toward maintaining or increasing the span of tree canopies in overburdened communities and maintaining existing mature tree canopies. Long-term goals refer to goals that are five to ten years or longer for tree canopy policies, for existing or future projections, to be used for stormwater management that is appropriate for the local jurisdiction. Specific considerations for stormwater management on City-owned or operated lands shall include maintaining or increasing tree canopy in overburdened communities and maintaining existing mature tree canopies.

In addition, the City's SWMP is required to establish new mapping of tree canopies on City owned or operated properties, particularly areas recognized as overburdened communities. The SWMP must also develop a system for identifying tree canopies for stormwater management purposes, which should be updated annually or as needed.

To address this Phase II Permit requirement, the City will need to review all City tree canopy goals and policies, including the AMC. This may require collaboration with the City's planning services. The City will identify needed updates to support stormwater management and water quality improvements through updating tree canopy goals and policies.

1.11.2 Addressing PCBs in Operation and Maintenance

The City is required to perform updated operation and maintenance activities for exterior building washdown to address PCBs per S5.C.5.e and S5.C.9.d.xv of the Phase II Permit. Commercial, industrial, and multistory residential structures constructed or renovated between the years 1950 and 1980—that is, those buildings that most likely to have PCB-containing building materials—shall be assessed for PCB-containing materials consistent with *How to find and address PCBs in building materials* (Ecology, 2024, Publication No. 22-04-024) prior to routine building washdown to the City's MS4 system. Structures confirmed or suspected to have PCB-containing materials shall not discharge washdown to the MS4. Single-family residents are exempt from this requirement.

To address this Phase II Permit requirement, the City will need to develop a comprehensive inventory of buildings built between 1950 and 1980 that will be impacted by this new requirement. Easy-speak public education requirements will need to be developed for property owners or property management companies who own buildings built in that timeframe. If the City's maintenance yard has buildings built in

this time period, an update to their Stormwater Pollution Prevention Plan (SWPPP) may be necessary to address PCB management in exterior building washdown.

In addition, the City may need to update their IDDE code in AMC 18.30.050 along with other policies and practices to address PCBs in external building washdown. This may include adding source control BMPs to minimize PCBs from entering the MS4 during routine external building washdown and the use of detergents for buildings built between 1950 and 1980.

1.11.3 Public Involvement for Overburdened Communities

The City is required to provide public involvement and participation opportunities to overburdened communities according to S5.C.4.a of the Phase II Permit. *Overburdened communities* can be defined as geographic areas or communities where vulnerable populations face adverse socioeconomic factors that expose them to a higher risk of environmental harms or disparate health outcomes. These populations include racial and ethnic minorities, low-income populations, and populations otherwise disproportionately exposed to and impacted by environmental harms or health risks. To this end, the City must create opportunities for the public to participate in decision making processes involving development, implementation, and updating the City's SMAP and SWMP documents. Moreover, to address this Phase II Permit requirement more specifically, the City should take clear steps towards creating these opportunities for overburdened communities and is required to annually document how it engages with overburdened communities.

1.11.4 Stormwater Management for Existing Development

The City is required to implement a new Stormwater Management for Existing Development (SMED) Program per S5.C.7 and Appendix 12 of the Phase II Permit. The SMED program requires the City to implement a program to contract and reduce stormwater discharges to the waters of the state from areas of existing development. The amount of treated area that is required varies by jurisdiction, but the consistent standard of 8 acres for every 50,000 people applies everywhere. By March 31, 2028, the City must have funded and started construction on projects for water quality treatment of 2.9 acres per Appendix 12 of the Permit.⁶

The City is in compliance with the new SMED requirement. In a recent project (*projects completed after January 1, 2023 are eligible*), the City added additional treatment of approximately 2.9 acres along R Avenue that meets this Permit requirement. As a result of this project, the City is in compliance with the new SMED requirement.⁷

1.12 EXISTING STORMWATER MANAGEMENT PROGRAM

Under the Phase II Permit, the City of Anacortes is required to develop and implement a Stormwater Management Program (SWMP), which is a set of actions and activities required under the Permit. Successful implementation and management of the City's stormwater program demand a clear understanding of the Phase II Permit requirements. To better understand how the City is in compliance, a summary of the City's SWMP is provided in this section.

The SWMP is administered through an effort with multiple departments overseen by the Stormwater Program Manager and Stormwater Division staff. Other departments involved include but are not limited to the following:

⁶ [App12_WWAPhaselI](#)

⁷ Project information received on 10/23/24 from the City regarding this project meeting SMED requirements.

- Public Works Department
- Planning, Community, and Economic Development Department
- City Attorney's Office
- Finance Department
- Information Services
- Parks and Recreation Department
- Police and Fire Departments

Coordination is conducted between the City departments, with the neighboring jurisdictions, and community partners. Community partners include the following parties:

- Skagit County Conservation District
- Samish Indian Nation
- Port of Anacortes
- Skagit Marine Resources Committee
- Skagit Watershed Council
- Friends of Skagit Beaches
- The Salish Sea School
- Stormwater Action Monitoring

The following are required components of the SWMP and associated Permit reference:

- Stormwater Planning (S5.C.1)
- Public Education and Outreach (S5.C.2)
- Public Involvement and Participation (S5.C.3)
- MS4 Mapping and Documentation (S5.C.4)
- Illicit Discharge Detection and Elimination (S5.C.5)
- Controlling Runoff from New Development, Redevelopment, and Construction Sites (S5.C.6)
- Stormwater Management for Existing Development (S5.C.7)
- Source Control for Existing Development (S5.C.8)
- Operation and Maintenance (S5.C.1)

This section has provided an overview of the City's existing program. The City's SWMP documentation is available on the City's website.⁸

⁸ The City's SWMP can be accessed at anacorteswa.gov/DocumentCenter/View/26405/2024-SWMP-Plan.

1.12.1 Stormwater Planning

The City is active in stormwater planning and conducts regular interdepartmental meetings concerning topics in Citywide stormwater management and planning activities. In 2019, the City passed an ordinance that includes guidelines and regulations around low impact development (LID), illicit discharge detection and elimination (IDDE), operations and maintenance (O&M), and clearing and grading stormwater standards. In 2022, the code was amended to address the Permit's requirements to implement a local source control program. In 2023, the City completed the Fidalgo North SMAP with actions to improve water quality in this high priority basin for the City.

1.12.2 Public Education and Outreach

Over the past several years, the City has made a commitment to providing a variety of public education and outreach activities and educational opportunities for local residents and visitors to Anacortes. These activities collectively have helped to either reduce or eliminate behaviors or practices that may cause or contribute to adverse stormwater impacts and encourage the public to participate in stormwater-related activities. The City has partnered with Skagit Conservation District (SCD), Skagit County, the City of Mount Vernon, City of Burlington, and the City of Sedro-Woolley in several public education and outreach projects.

1.12.3 Public Involvement and Participation

The City's SWMP involves the public in decision-making processes and provides opportunities for increased participation. The City plans multiple activities a year for the public to provide input and participate in City Council meetings, documentation on the City website, community events, in addition to the *City's Permit Annual Report*, which is publicly available.

1.12.4 MS4 Mapping and Documentation

The City began a stormwater utility mapping program in 2006. Mapping of the stormwater system has been vital to helping the City manage resources and plan for development and redevelopment projects. Mapping has also aided tracing stormwater pollution from sources to receiving waters, serves as a tool for IDDE investigations, and can be used in public education activities.

The mapping of the system's inventory has been achieved through utilizing a variety of GPS equipment in the field to collect spatial and attributional information about drainage assets. The City has a comprehensive mapping of the municipal separate storm sewer system (MS4), including stormwater conveyance, infrastructure, treatment, and flow control BMPs, all known outfalls, receiving waters, drainage areas, land uses, wetlands, and other components.

The City has used the Cartegraph asset management system for Public Works, including the Stormwater Division, which allows City staff to access detailed information relating to the storm system both out in the field and at the office. Field staff can verify stormwater asset information for catch basins, pipes, storm ponds, or outfalls, and record the inspection findings and the maintenance activities conducted.

The City's MS4 System is shown in Figure 1.7. Municipal Separate Storm Sewer System (MS4). The mapping data is updated on a continuous basis in collaboration with the Street/Sewer Department, the Stormwater Division, and the GIS Division.

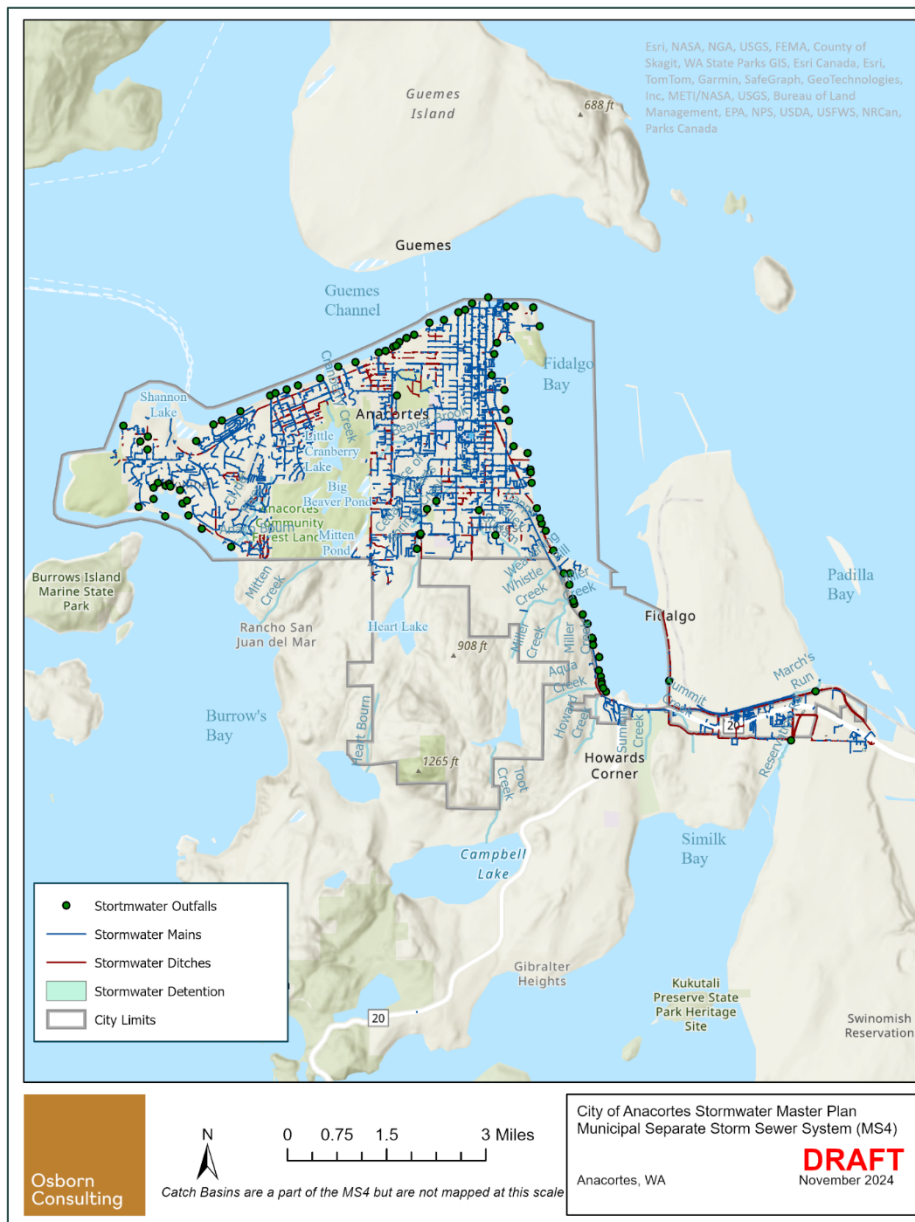


Figure 1.7. Municipal Separate Storm Sewer System (MS4)

1.12.5 Illicit Discharge Detection and Elimination

The City's illicit discharge detection and elimination (IDDE) program consists of activities to detect, identify, address, and eliminate spills and other illicit discharges and connections to the MS4 based on the requirements described in code section *AMC 18.30 Illicit Discharges and Connections to the Stormwater Drainage System*.

The program involves such procedures as field screening, stormwater monitoring, spills, and complaint response and construction inspections. The City conducts stormwater outfalls monitoring with a partnership with Friends of Skagit Beach, a nonprofit organization, and shares outfall sampling data and IDDE investigation reports with the Samish Indian Nation, a federally recognized tribe in Washington state.

1.12.6 Controlling Runoff from New Development, Redevelopment and Construction Sites

The City's SWMP includes a program that aims to reduce pollutants in stormwater runoff from new development, redevelopment, and construction site activities. The City's Public Works and Planning, Community and Economic Development Departments are responsible for permitting, site plan review, inspections, and code enforcement actions, and work with the Stormwater Division. The City currently requires all projects to comply with the standards of the 2019 edition of the Stormwater Management Manual for Western Washington (SWMMWW), published by Ecology.

1.12.7 Stormwater Management for Existing Development

This is a new element of the SWMP in the new Phase II Permit. According to Appendix 12 of the Permit, the City will be required to provide water quality treatment for 2.9 acres of existing impervious surfaces to meet the new SMED requirements. The City has completed a recent project (see Section 1.12) and has met the requirements.

1.12.8 Source Control for Existing Development

In 2022, the City passed Ordinance 4023 with the amended *Chapter 18.30 Illicit Discharges and Connections to the Stormwater Drainage System* that added the requirement for source control BMPs to be implemented for pollutant-generating sources at businesses. The City maintains an inventory of businesses, which is actively updated, that have the potential to generate pollutants that may enter the City stormwater drainage system. The City's goal is to conduct source control inspections for 20 percent of the local businesses in the City each year.

1.12.9 Operation and Maintenance

The City's O&M Division, within Public Works, is responsible for the stormwater system inspections, cleaning, and maintenance. This includes catch basin inspection and cleaning, street sweeping, facility cleaning and maintenance, spill response and control, and flood response and repair. The City maintenance standards are found within the 2019 SWMMWW.

The City requires all privately owned permanent stormwater facilities to have a maintenance agreement on file with the City. The City conducts annual inspections of all treatment and flow control facilities that discharge to the MS4 and that were permitted pursuant to the City's process for permitting, site plan review, and inspections. Existing permanent stormwater facilities are inspected to review whether ongoing maintenance is being completed. City staff records all inspections.

1.13 COMMUNITY AND CITY COUNCIL INPUT

Work on the Plan began in March of 2024 and an initial draft was submitted to staff in November 2024. The City's Public Works staff and Consultant team presented the initial findings to City Council on January 27, 2025.

Commented [DH4]: 1.13 Community and City Council Input:
Section to be updated in Final to address work with City Council to refine the capital facilities cost and implementation planning and the process for engaging the public on the Plan Update.

2 STORMWATER PIPE REPAIR AND REPLACEMENT PROGRAM

As part of the development of this Stormwater Master Plan, the City created the framework for a new Stormwater Pipe Repair and Replacement Program. This program will enable the City to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing stormwater pipes. This risk and asset-management based approach for O&M of stormwater pipes increases resource efficiency, helps achieve level of service goals, allows limited resources to be focused on critical assets, and provides an understanding of the impact on decision making.

2.1 STORMWATER PIPE REPAIR AND REPLACEMENT

The City is developing a program to assess the condition of stormwater pipes that will enable the City's Stormwater Management team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing these assets. The program will include closed-circuit television (CCTV) inspections of stormwater pipes in the City and determine the Likelihood of Failure (LoF) and Consequence of Failure (CoF) for each pipe inspected. The program will also provide maintenance, rehabilitation, and replacement recommendations to improve the effectiveness of the stormwater management program. This initiative will benefit the City's residents and protect local waterways from pollution and flooding. For more information about this new stormwater pipe repair and replacement program, see **Section 5** and **Appendix B**.

The program framework includes a cyclical process of understanding and inspecting the system, performing condition assessment, and scheduling repair, replacement, or maintenance based on the condition and a consequence-based risk assessment. The City completed the inventory of known assets and prioritized pipes for inspection based on drainage basin priority. The City has inspection data for 237 pipes that were inspected between 2018 and 2024 and plans to kick off the new program by inspecting 2.5 miles of pipe in the Fidalgo South Basin in 2025. This first year will help the City work through the program and establish ongoing staffing, methodology, and processes. Starting in 2025, the City plans to inspect 4 miles of pipe, ramping up to a goal of 5.3 miles of pipe per year in 2027 and beyond. Consistently inspecting 5.3 miles of pipe per year will equate to approximately a 15-year inspection cycle.

Figure 2.1 illustrates the stormwater pipes that have been inspected to date and their corresponding National Association of Sewer Service Companies (NASSCO) Quick Structural Ratings (QSRs). A QSR that begins with a 5 corresponds to the most significant defects, whereas a QSR that begins with a 1 corresponds to minor defects. A QSR with a score of 0000 indicates that no defects were present during inspection. QSRs are described in more detail in *Section 2.1 Likelihood of Failure of the Stormwater Pipe Repair and Replacement Program Technical Memorandum* provided in **Appendix B**. This technical memorandum describes the program framework in detail and includes workflow diagrams for inspection, data management, and condition assessment.

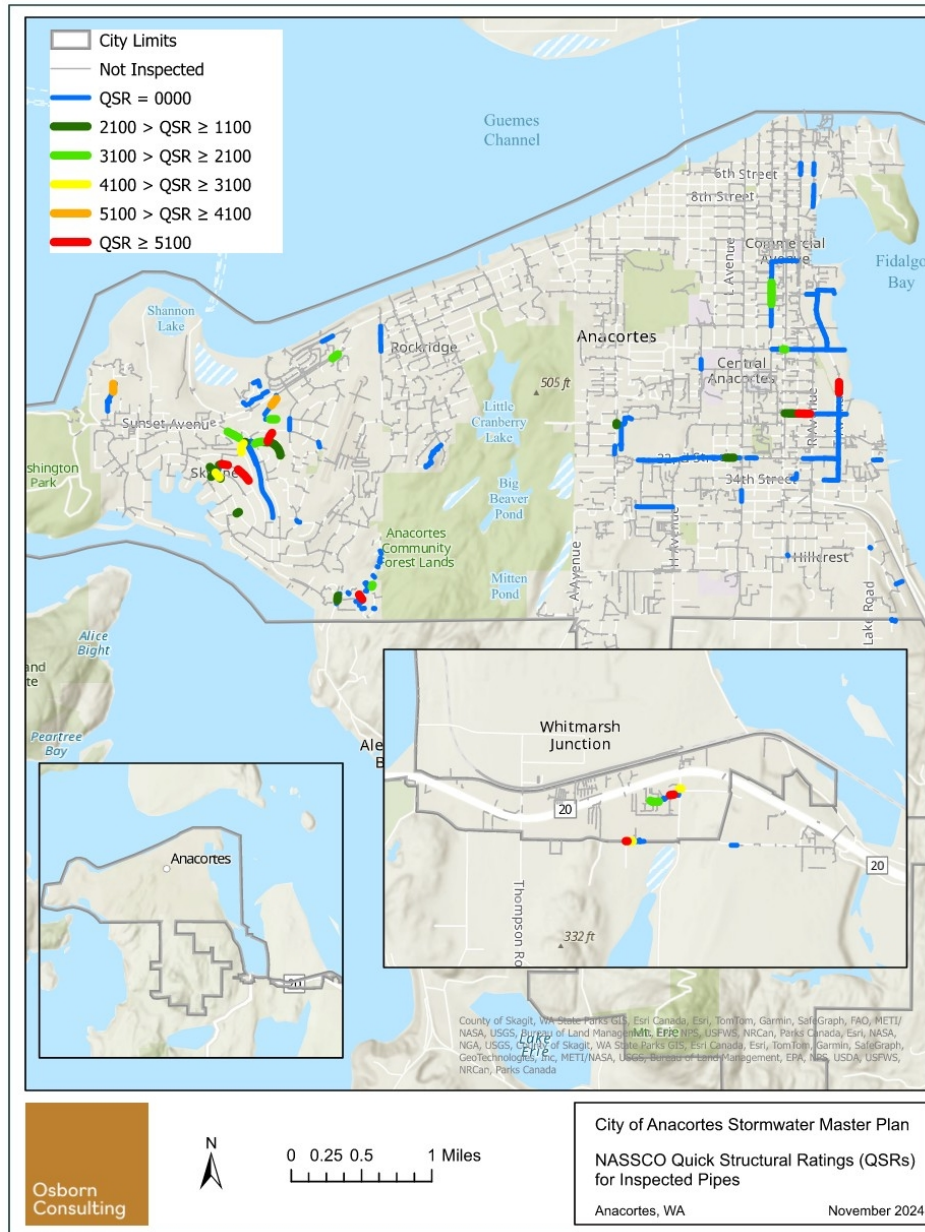


Figure 2.1. NASSCO Quick Structural Ratings (QSRs) for Inspected Pipes

3 CITYWIDE HYDROLOGIC AND HYDRAULIC MODELING

This section provides an overview of the citywide hydrologic and hydraulic modeling and covers the methodology, study design storms, model results, and potential CFPs. The analysis performed in this section is intended to support the development of Capital Facility Projects and Program needs within the City. The model is built to support future analysis of the system for different planning scenarios.

3.1 BACKGROUND

Previous hydraulic modeling conducted in 2007 utilized the Mike-Urban modeling platform. This platform is no longer supported and no longer available to City staff. Moreover, the previous models were created using data that was collected nearly two decades ago.

Osborn created updated models using newer data in the modeling software PCSWMM, which serves as a user-friendly analysis toolbox for the EPA Stormwater Management Model (SWMM) program. These models will better simulate rainfall as it travels through both the natural and built environment and represent the physical attributes of the City's streams and piped systems. Further, the results can be used to identify drainage system surcharging and flooding and to verify the MS4 permitting exemptions that are applicable.

The modeling that Osborn conducted assumed that the drainage network was in good condition. However, during the field investigations, the team observed evidence of pipes and ditches that are in need of maintenance or repair. One example is the ditch and culvert system along Q Avenue near 25th Street where the driveway culverts appear to have blockages that were not included in the model. These maintenance issues were not considered in the model because the purpose of the modeling was to identify system capacity constraints that would require capital investments or maintenance.

3.2 MODELING DATA AND SOURCES

Osborn utilized the City's topographic survey data, GIS data, and record drawings to perform calculations and develop hydrologic and hydraulic models. This data was collected in part to ensure that the resulting models represent the existing field conditions.

The following data was collected and referenced in this study:

- Urban Hydrology for Small Watersheds, TR-55, United States Department of Agriculture, dated June 1986.
- Stormwater Management Manual for Western Washington (SWMMWW), Washington State Department of Ecology (Ecology), published 2024.
- 2017 North Puget Digital Terrain Model (DTM), Department of Natural Resources.
- 20-foot contours, ESRI World Topographic Map.
- GIS data, CAD data, and as-builts provided by the City of Anacortes.
- Site visits conducted by Osborn and City staff.

3.3 EXISTING CONDITIONS

The City's stormwater infrastructure consists of ditches and pipes, with some pipes that were installed as early as the 1900s. The local topography varies greatly throughout the City of Anacortes, with flat terrain

in and around the downtown core of the City and steep hillside topography with 90-percent slopes near Heart Lake and Little Cranberry Lake. All the drainage basins eventually drain into their namesake bays or out into forested areas and wetlands towards the center of the city. Figures of each model broken down by basin can be found in **Appendix C**. Many parts of the stormwater system contain 8-inch-diameter pipes, which were installed based on the contemporary development conditions at the time. These pipes have been identified as undersized.

This study evaluated the existing storm system throughout the City, as shown in **Figure 3.1**. For more information about the City's drainage system and basins, see **Section 1.8**.

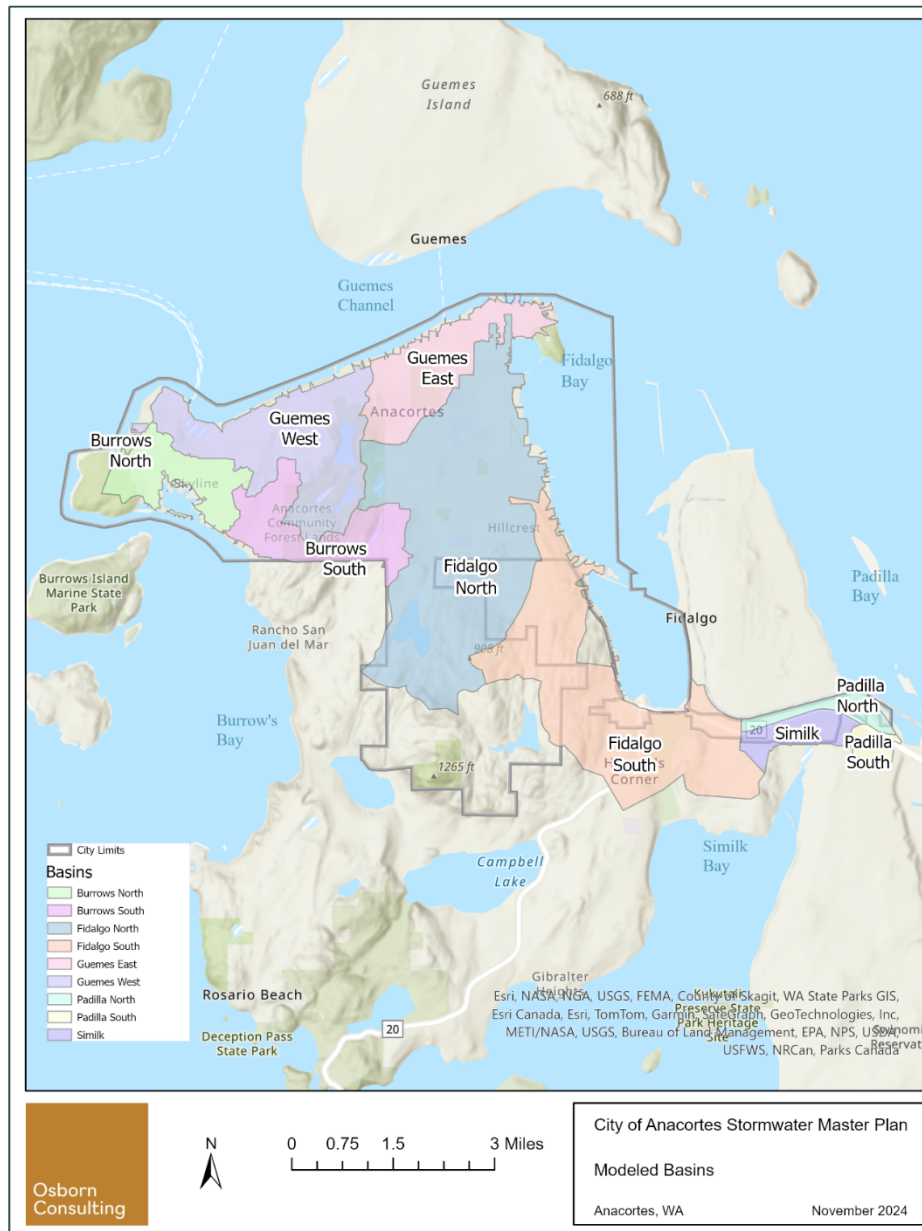


Figure 3.1. Modeled Basins

3.4 MODELING METHODOLOGY

Hydrologic and hydraulic modeling was conducted using PCSWMM version 5.2.4, the EPA SWMM modeling engine, and the standard drainage attributed criteria ranges set outlined in the Storm Water Management Model User's Manual Version 5.2 (EPA/600/R-22/030, February 2022). All elevations in this project are tied to NAVD 88. Maps, GIS data, and LiDAR in this study are spatially referenced to NAD 83 State Plane Washington North FIPS 4601 (in U.S. Feet). Features studied included in the model for each respective basin include junctions like maintenance holes, conduits like pipes and ditches, storages like ponds or vaults, and outfalls. A more detailed description of the hydrologic methodology and of the parameters used in the PCSWMM model is provided in **Appendix D**.

3.4.1 Design Storms

Hydrologic modeling of the existing conditions was developed to evaluate the capacity and expected flows through the system. The three following design storms were used to analyze the system capacity.

A **25-year 3-hour design storm** was utilized to understand how the system performs in atmospheric River conditions.

For this design storm, a conversion factor of 1.06, determined from Appendix F of the 2017 *Seattle Public Utilities Stormwater Manual*, was used to convert the 25-year 2-hour precipitation depth to the 3-hour storm depth.

A **25-year 24-hour design storm** is the standard storm utilized by the City's design guidelines. The total volumes for this design storm are derived from the department of Ecology's Isopleth maps. The maps indicate that the City is on the border of a 2.5-inch to 3-inch isopleth range.

Osborn reviewed the City's daily rainfall records taken at the Anacortes Wastewater Treatment Plant from 1992 to 2024 to support the development of an accurate design storm volume. The data was not suitable to be used as a design storm because it is lacking 5-minute rain volumes.

The highest 24-hour rainfall that occurred in this period was approximately 2 inches—33 percent lower than the rainfall depth of 3.0 inches published in the report "Washington 24-hour Isopleth Maps" by the Washington State Department of Transportation. Based on this information, a 25-year 24-hour rainfall depth of 2.5 inches was used as it was the low end of the isopleth range. A review of a longer data set spanning over 50 years is required if a lower volume design storm is to be used than is on the published Isopleths.

A **25-year 24-hour climate perturbed design storm** provides insights into how the system is predicted to perform when higher intensity storms occur in the region. To develop this storm event, it is necessary to determine the climate precipitation extremes to account for future increases or decreases in precipitation rates.

Based on data from *Changes in Climate Extremes and their Impacts on the Natural Physical Environment*, an increase of 15 percent increase in volume for the existing 25-year 24-hour precipitation rate is predicted to occur between the years 2081 and 2100. This value was determined by reviewing the median precipitation rates for Western North America for a midrange greenhouse gas emission scenario where a hot day experienced once in 20-years becomes a day experienced once in three years.

The SCS Type 1A rainfall distribution was selected as the hyetograph, which is the suggested distribution for the Pacific Northwest. The design storms were input into the PCSWMM model to simulate the rainfall

and the runoff response of each basin. A summary of the rainfall depths used for the design storms is shown in **Table 3.1**.

Table 3.1. Design Storm Magnitude Summary

Design Storms	Magnitude (in/day)
25-year 3-hour	1.070
25-year 24-hour	2.500
25-year 24-hour climate perturbed	2.875

3.4.2 Drainage Area Delineation

The model consists of 1,110 catchments that were delineated into building sub-catchments, right-of-way (ROW) sub-catchments, and C sub-catchments. The amount of impervious and pervious area for each land type was accounted for to accurately predict peak flow runoff collected by the drainage system.

3.4.3 Sea Level Rise Considerations

The hydraulic model utilized the local mean higher-high water (MHHW) surface elevation as the tailwater condition at all outfalls to the associated bays. The hydraulic model employed a tailwater condition of 10.0 feet NAVD88, corresponding to the local MHHW elevation.

Osborn reviewed the sea level rise identified in the *City of Anacortes Critical Areas Ordinance Update: Frequently Flooded Areas - Draft Update* (October 19, 2021). This ordinance update predicts 2.1 feet (medium 50 percent exceedance) and 4.9 feet (high 1 percent exceedance) for sea level rise within the bays around Anacortes, which would result in a tail water condition at the outfalls of 12.1 feet to 14.9 feet, respectively.

After reviewing the findings in the prior study, Osborn determined that the tailwater conditions would result in similar inundation as identified within the Flooded Areas-draft update maps. Osborn did not model the sea level rise in the models. The flooding and inundation identified in the 2021 study is more accurate because it is based on a 2D surface rather than the PCSMM models that utilize a 1D surface.

3.5 MODEL RESULTS

The flooded maintenance holes for each of the modeled basins are summarized in **Table 3.2** for each of the three design storms. The results indicate the order of magnitude of system surcharging and flooding. *Surcharging* indicates that the pipes are at capacity, but flooding is not occurring, whereas *flooding* indicates that there is no more capacity and stormwater may be leaving the maintenance holes and catch basins.

Additional tables that detail the specific modeled maintenance holes that were identified as either surcharging or flooding for each of the design storms are provided in **Appendix E**.

Commented [DH5]: 3.5 Model Results:
Section to be updated in Final to address Libby Grage's comments on the Draft.

Table 3.2. Flooding and Surcharging Maintenance Holes and Conduits by Drainage Basin

Drainage Basin	Total Length of Pipe (LF)	Total Number of Maintenance Holes	Design Storm	Number of Maintenance Holes Surcharging	Percent of Total Maintenance Holes Surcharging	Number of Maintenance Holes Flooding	Percent of Total Maintenance Holes Flooding	Number of Pipes Surcharging	Percent of Pipes Flooding
Fidalgo North	210,337	1,860	25-year, 24-hour	311	16.78	52	2.81	163	8.62
			25-year, 3-hour	437	23.58	113	6.10	280	14.80
			25-year, 24-hour Climate Perturbed	424	22.88	97	5.23	226	11.95
Fidalgo South	46,235	316	25-year, 24-hour	14	4.44	1	0.32	6	1.85
			25-year, 3-hour	9	2.86	1	0.32	8	2.46
			25-year, 24-hour Climate Perturbed	15	4.76	1	0.32	7	2.15
Guemes East	82,161	1,175	25-year, 24-hour	239	20.36	28	2.39	77	6.50
			25-year, 3-hour	346	29.47	54	4.60	126	10.63
			25-year, 24-hour Climate Perturbed	276	23.51	35	2.98	93	7.85
Guemes West	104,296	1,063	25-year, 24-hour	15	1.41	0	0	27	2.50
			25-year, 3-hour	42	3.95	1	0.09	63	5.84
			25-year, 24-hour Climate Perturbed	27	2.54	1	0.09	45	4.17

Drainage Basin	Total Length of Pipe (LF)	Total Number of Maintenance Holes	Design Storm	Number of Maintenance Holes Surcharging	Percent of Total Maintenance Holes Surcharging	Number of Maintenance Holes Flooding	Percent of Total Maintenance Holes Flooding	Number of Pipes Surcharging	Percent of Pipes Flooding
Padilla North	18,270	98	25-year, 24-hour	1	1.02	0	0	10	9.43
			25-year, 3-hour	7	7.14	4	4.08	13	12.26
			25-year, 24-hour Climate Perturbed	1	1.02	0	0	12	11.32
Similk	22,121	131	25-year, 24-hour	1	0.77	0	0	7	5.38
			25-year, 3-hour	3	2.31	0	0	10	7.69
			25-year, 24-hour Climate Perturbed	3	2.31	0	0	11	8.46
Burrows North	55,000	403	25-year, 24-hour	48	11.91	4	0.99	15	3.71
			25-year, 3-hour	84	20.84	15	3.72	41	10.15
			25-year, 24-hour Climate Perturbed	66	16.38	12	2.98	28	6.93
Burrows South	61,721	467	25-year, 24-hour	5	1.07	0	0	8	1.68
			25-year, 3-hour	7	1.50	0	0	12	2.52
			25-year, 24-hour Climate Perturbed	13	2.79	4	0.86	11	2.31
Citywide	600,141	5,513	25-year, 24-hour	634	11.53	85	1.55	313	5.59
			25-year, 3-hour	935	17.00	188	3.42	553	9.88
			25-year, 24-hour Climate Perturbed	825	15.00	150	2.73	433	7.74

3.5.1 Existing Conditions Assessment

This section provides a detailed assessment of the existing conditions within each of the drainage basins. The 25-year 24-hour storm and 25-year 3-hour storm flooding and surcharging results are summarized and analyzed in the following sections. Maps are provided for all three design storms.

3.5.1.1 Fidalgo North

The 25-year 3-hour design storm resulted in more flooding than the 25-year 24-hour design storm. A majority of the flooding in Fidalgo North is a result of undersized pipes and backwatering from outfalls. Areas with high flooding and surcharging are summarized in **Table 3.3**, **Figure 3.2.**, and **Figure 3.3.**

Table 3.3. Capacity Constrained Areas in Fidalgo North

Map ID Number	Location Description	Cause of Flooding and Surcharging
FN-1	The outfall closest to Seafarers Way.	The system surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
FN-2	The pipe segment from the intersection of I Avenue 41st Street heading west, then north up I Avenue, and west through 39th Street and ending at the intersection of H Avenue and 39th Street.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
FN-3	The pipe system on H Avenue from Down Jones Way to 37th Street.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
FN-4	The two smaller pipe systems connecting to Happy Valley Stream.	The system floods due to backwatering from the stream.
FN-5	The pipe system at the intersection of Hillcrest Drive and Stankus Place on Hillcrest Drive, heading southwest until the intersection of Hillcrest Drive and Fidalgo Avenue.	This area floods due to the limited capacity of the 8-inch-diameter pipes.
FN-6	The pipe system along 37th Street and S Avenue heading west until the intersection at R Avenue and 37th Street where the pipe system then heads north along R Avenue until the intersection of 32nd Street and R Avenue.	This area surcharges due to the limited capacity of the 6-inch and 8-inch diameter pipes.
FN-7	The pipe segment heading north along Commercial Avenue between 35th Street and 36th Street before heading east on 35th Street until Q Avenue.	This area surcharges due to the limited capacity of the 8-inch and 1-foot-diameter pipes.
FN-8	The pipe system starting at the intersection of O Avenue and 34th Street heading crossing Commercial to Q Avenue.	This area floods due to the 8-inch pipe restriction at Commercial Avenue.
FN-9	Pipe segments connecting to the trunkline on 22nd Street and K Avenue to the outfall.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.

Map ID Number	Location Description	Cause of Flooding and Surcharging
FN-10	The pipe segment starting at the intersection of J Avenue and 25th Street heading north to the intersection of J Avenue and 20th Street, then heading east to the intersection of M Avenue and 20th Street and M Avenue, then heading north to the intersection of M Avenue and 16th Street and ending at the intersection of 15th Street and O Avenue.	This area surcharges due to limited capacity of the downstream 15-inch diameter pipes.
FN-11	The outfall north of 11th Street and R Avenue.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
FN-12	The area along 22nd Street from M Avenue to R Avenue and south of 22nd Street on Commercial Avenue.	This area surcharges due to the limited capacity of the 8-inch-diameter pipes.

3.5.1.2 Fidalgo South

The 25-year 24-hour design storm and the 25-year 3-hour design storm saw approximately the same amount of flooding. Most of the flooding is caused by undersized pipes, high tailwater, which is leading to backflow, and undersized storage facilities. Areas with high flooding and surcharging are summarized in **Table 3.4**, **Figure 3.5.**, and **Figure 3.6.**

Table 3.4. Capacity Constrained Areas in Fidalgo South

Map ID Number	Location Description	Cause of Flooding
FS-1	At Fidalgo Bay Road near South Fidalgo Bay Road.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall. Additionally, there are capacity limitations due to varying sizes of ditches and pipes.
FS-2	Upstream of the outfall at the intersection of Marchs Point Road and S March Point Road.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
FS-3	Upstream of a dry well at the intersection of Fidalgo Bay Road and Fidalgo Bay Road.	Junctions flood likely because of the underperforming dry well that lacks adequate storage.

3.5.1.3 Guemes East

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. A majority of the flooding in Guemes East is a result of inadequate pipe capacity and backwatering upstream of the area outfalls. Areas with high flooding and surcharging are summarized in **Table 3.5**, **Figure 3.2.**, and **Figure 3.3.**

Table 3.5. Capacity Constrained Areas in Guemes East

Map ID Number	Location Description	Cause of Flooding
GE-1	Along D Avenue starting at 17th Street and ending at the intersection of 15th Avenue.	The area surcharges due to the limited capacity of the 2-foot-diameter trunkline which also results in backwatering into the farther upstream systems.
GE-2	Heading northwest at Volunteer Park near Kiwanis Meadows.	This area surcharges due the limited capacity of the 2-foot-diameter pipe causing backwatering between 13th Street and 14th Street near D Avenue.
GE-3	Along 10th Street from G Avenue to M Avenue, on 14th Street heading north along K Avenue to where it connects to 12th Street, 12th Street heading west to M Avenue, the intersection of M Avenue and 14th Street heading north to 11th street, 11th Street from J Avenue to K Avenue, 9th Street from I Avenue to M Avenue, 8th Street from I Avenue to L Avenue, 7th Street from L Avenue to M Avenue, and M Avenue from 9th Street to 4th Street.	This area floods due to the limited capacity of the 8-inch-diameter pipes.
GE-4	Along 6th street and J Avenue heading east toward O Avenue and ultimately discharging into Guemes Channel.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
GE-5	The outfall at O Avenue discharging to Guemes Channel.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.

3.5.1.4 Guemes West

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. Most of the flooding in Guemes West is a result of undersized pipes and backwatering. Areas with high flooding and surcharging are summarized in **Table 3.6**, **Figure 3.8.**, and **Figure 3.9.**

Table 3.6. Capacity Constrained Areas in Guemes West

Map ID Number	Location Description	Cause of Flooding
GW-1	Along Oakes Avenue between Allen Court, heading north underneath the neighborhood on Schooner Drive, and discharging out on Edwards Way to Fidalgo Bay.	This area floods due to the limited capacity of the 1-foot-diameter pipes.

Map ID Number	Location Description	Cause of Flooding
GW-2	Along Copper Pond Place heading northwest towards Anacopper Mine Road.	This area floods due to the limited capacity of the 1-foot-diameter pipes.
GW-3	Along West 3rd Street between Idaho Avenue and Georgia Avenue.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
GW-4	Along Oakes Avenue between Kansas Avenue and Georgia Avenue.	This area floods due to the limited capacity of the 1-foot-diameter pipes.

3.5.1.5 Padilla North

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. Most of the flooding in Padilla North is a result of undersized pipes. Areas with high flooding and surcharging are summarized in **Table 3.7**, **Figure 3.11.**, and **Figure 3.12.**

Table 3.7. Capacity Constrained Areas in Padilla North

Map ID Number	Location Description	Cause of Flooding
PN-1	Along South March Point Road starting at the Money Saver Mini Storage heading east to Miles Sand and Gravel.	This area floods due to the limited capacity of the 1-foot-diameter pipes.

3.5.1.6 Similk

The 25-year 3-hour storm resulted in more surcharging than the 25-year 24-hour storm. Similk contains ditches and pipes, which are surcharging due to undersized pipes. Areas with high flooding and surcharging are summarized in **Table 3.8**, **Figure 3.11.**, and **Figure 3.12.**

Table 3.8. Capacity Constrained Areas in Similk

Map ID Number	Location Description	Cause of Flooding
S-1	Along Molly Lane flowing east and connecting to the larger system at Reservation Road.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
S-2	Along Reservation Road between Molly Lane and Stevenson Road.	This area surcharges due to the limited capacity of the 2-foot-diameter pipes.

3.5.1.7 Burrows North

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. Most of the flooding in Burrows North was a result of undersized trunklines and high tailwaters leading to backflow. Areas with high flooding and surcharging are summarized in **Table 3.9**, **Figure 3.8.**, and **Figure 3.9.**

Table 3.9. Capacity Constrained Areas in Burrows North

Map ID Number	Location Description	Cause of Flooding
BN-1	On Sunset Avenue connecting to Parkside Drive and ending at the intersection of Parkside Drive and Sands Way.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall.
BN-2	Starting at the intersection of Skyline Point Road and Sunset Avenue heading east and connecting south to the neighborhood along Rosario Way before going southwest along Skyline Way and discharging into Flounder Bay.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall.
BN-3	Starting at the intersection of Piper Circle and Highland Drive heading northwest towards the intersection of Anaco Beach Road.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
BN-4	Starting at the intersection of Bradley Drive and Sterling Drive heading southwest and discharging to Flounder Bay through Windsor Street.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall.

3.5.1.8 Burrows South

The 25-year 24-hour storm resulted in more surcharging than the 25-year 3-hour storm. The conduits and junctions are surcharging in Burrows South due to a capacity issue from undersized pipes. Areas with high flooding and surcharging are summarized in **Table 3.10**, **Figure 3.8.**, and **Figure 3.9.**

Table 3.10. Capacity Constrained Areas in Burrows South

Map ID Number	Location Description	Cause of flooding
BS-1	Along A Avenue starting halfway between 41st and ending halfway between 39th Court and Forest Park Lane.	This area floods due to the limited capacity of the 8-inch and 1-foot-diameter pipes.
BS-2	Heading north at the intersection of A Avenue and 42nd Place.	This area surcharges due to the limited capacity 1-foot-diameter pipes.

3.5.2 Modeling Figures

The following figures provide an illustration for the design storms for each of the drainage basins. For more information about the flooding and surcharging by drainage basin, see **Section 3.5.1** and **Error! Reference source not found.**

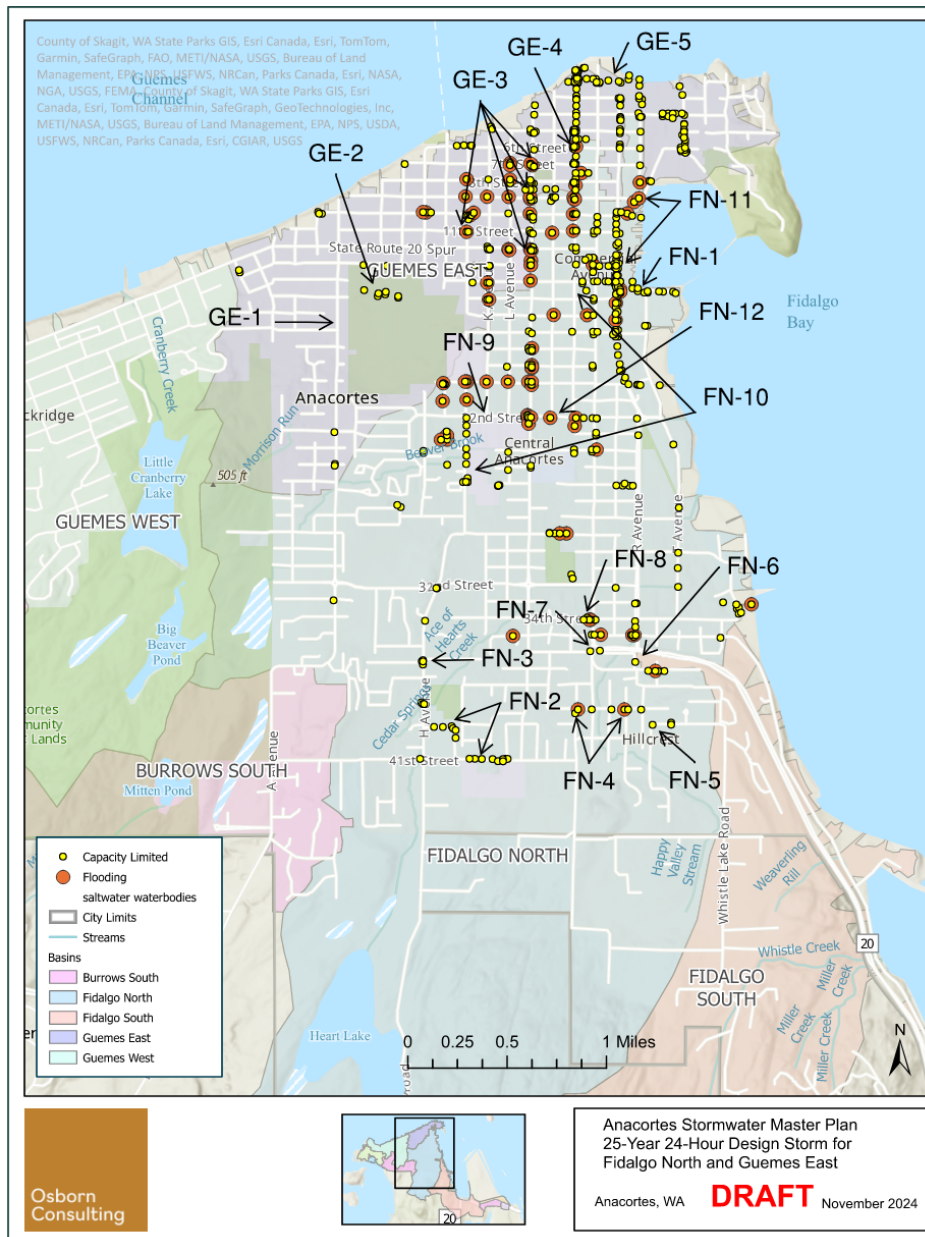


Figure 3.2. 25-Year 24-Hour Design Storm for Fidalgo North and Guemes East

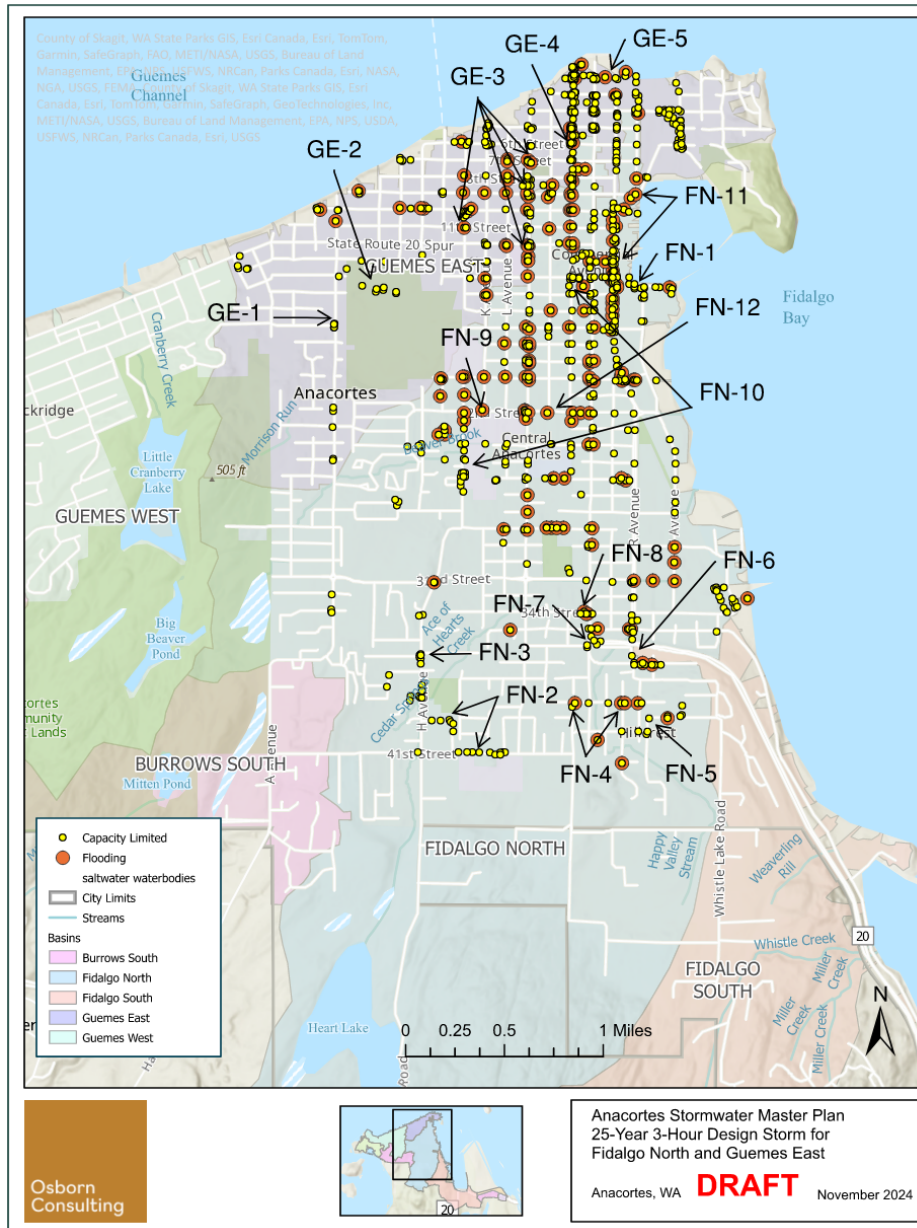


Figure 3.3. 25-Year 3-Hour Design Storm for Fidalgo North and Guemes East

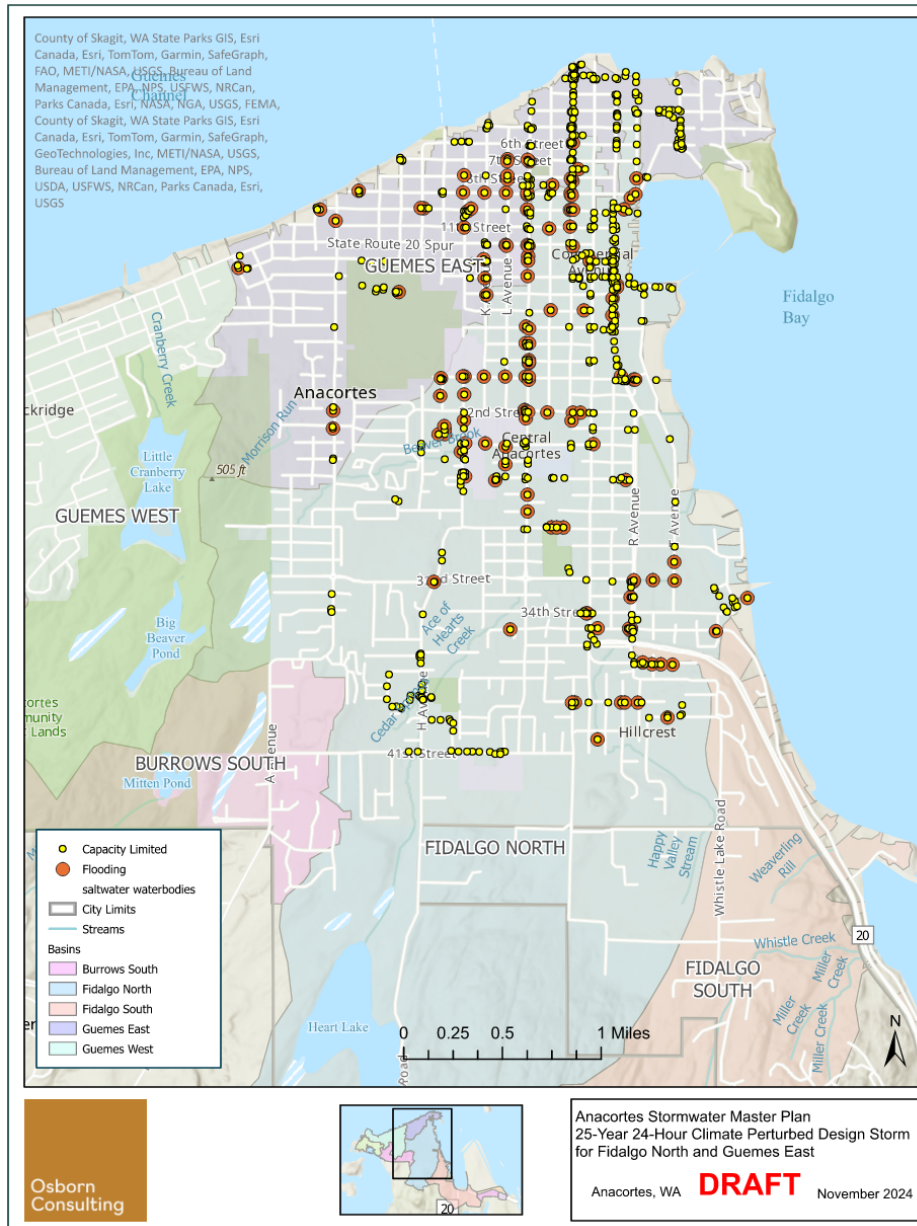


Figure 3.4. 25-Year 24-Hour Climate Perturbed Design Storm for Fidalgo North and Guemes East

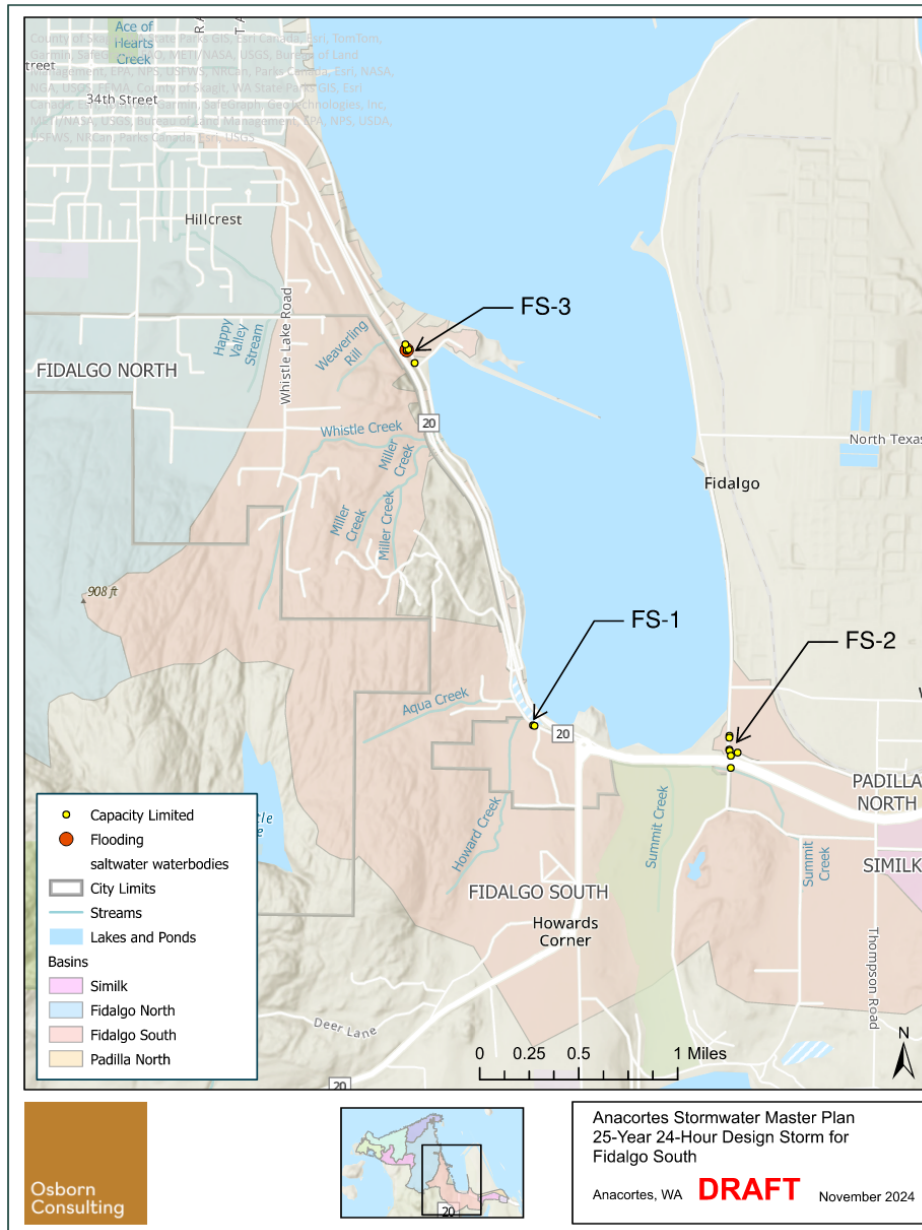


Figure 3.5. 25-Year 24-Hour Design Storm for Fidalgo South

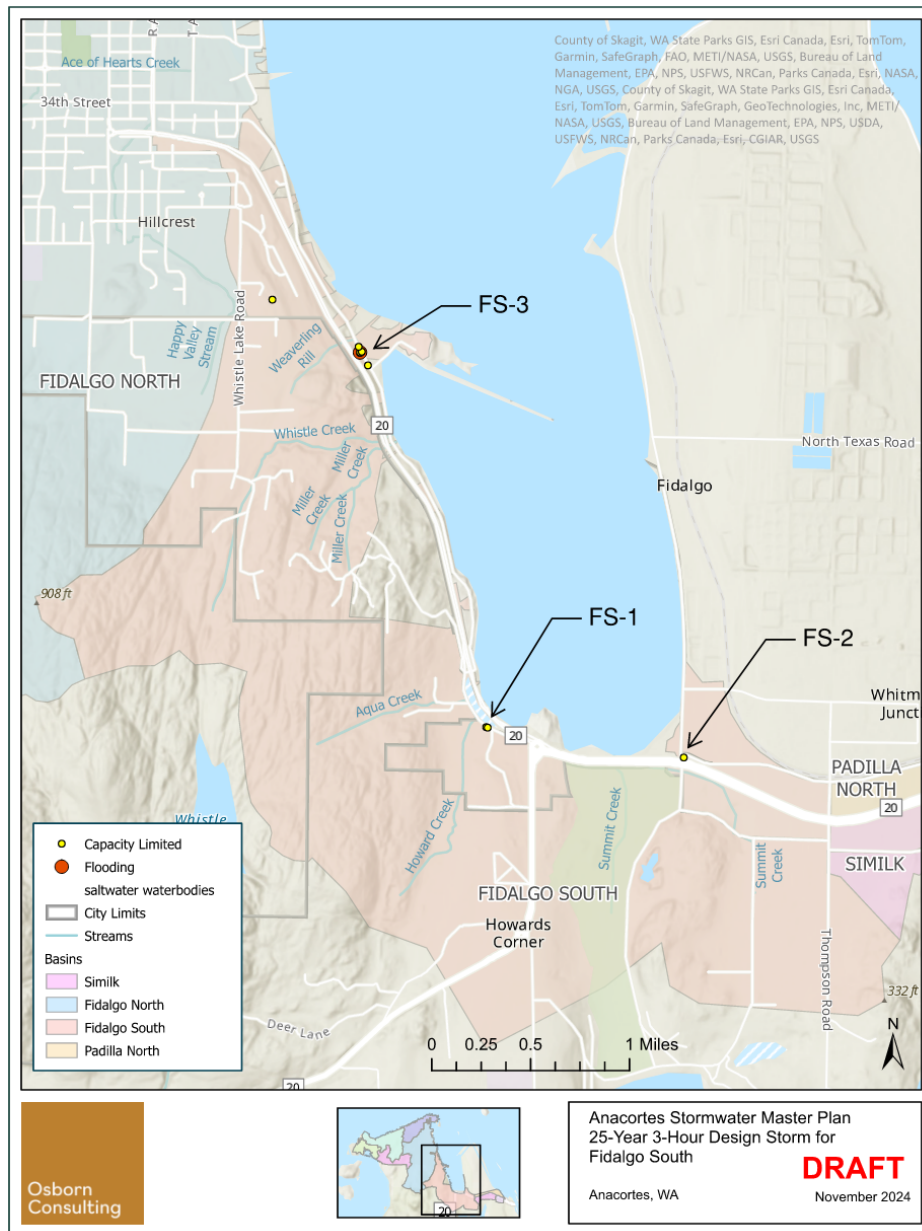


Figure 3.6. 25-Year 3-Hour Design Storm for Fidalgo South

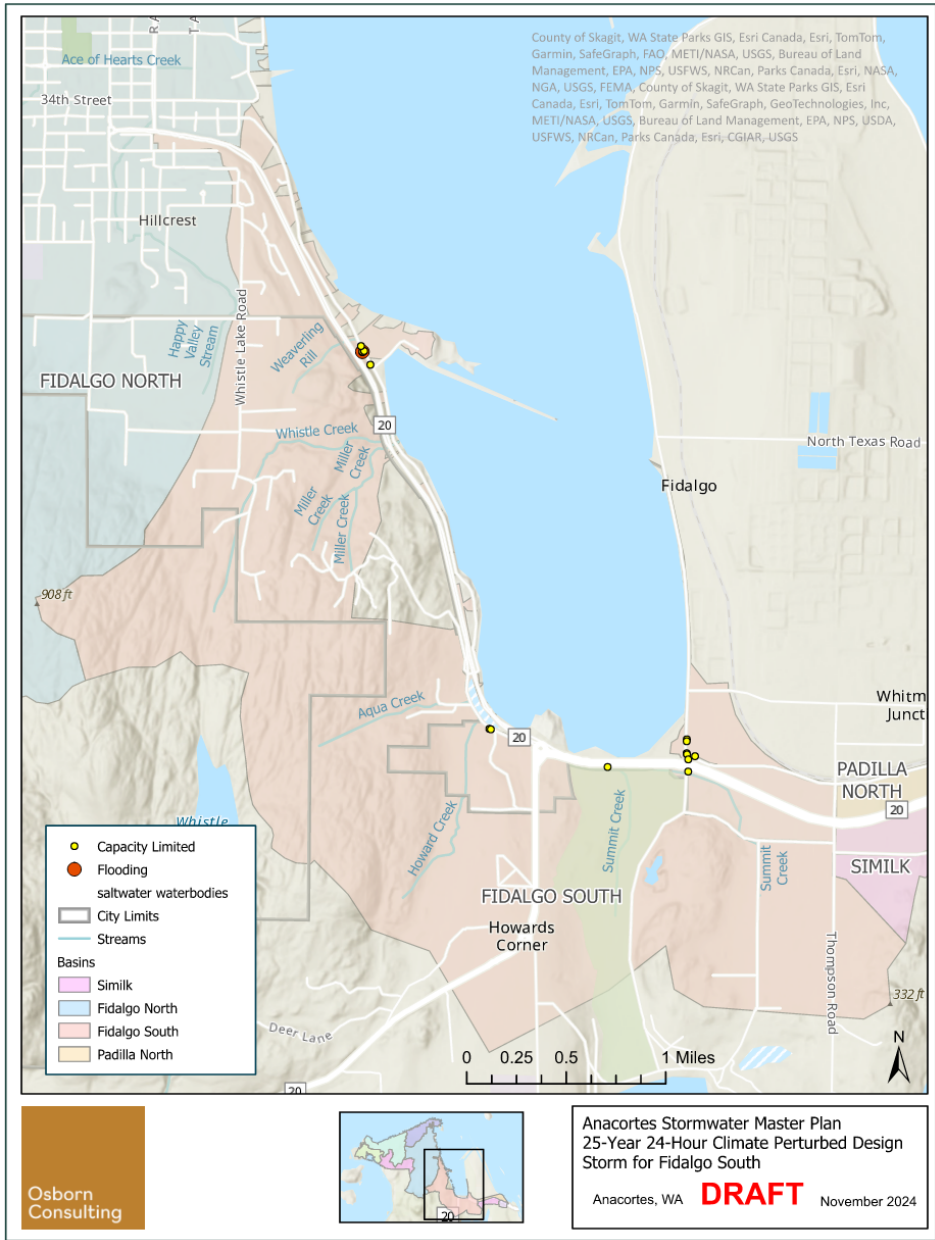


Figure 3.7. 25-Year 24-Hour Climate Perturbed Design Storm for Fidalgo South



Figure 3.8. 25-Year 24-Hour Design Storm for Burrows North, Burrows South, and Guemes West



Figure 3.9. 25-Year 3-Hour Design Storm for Burrows North, Burrows South, and Guemes West

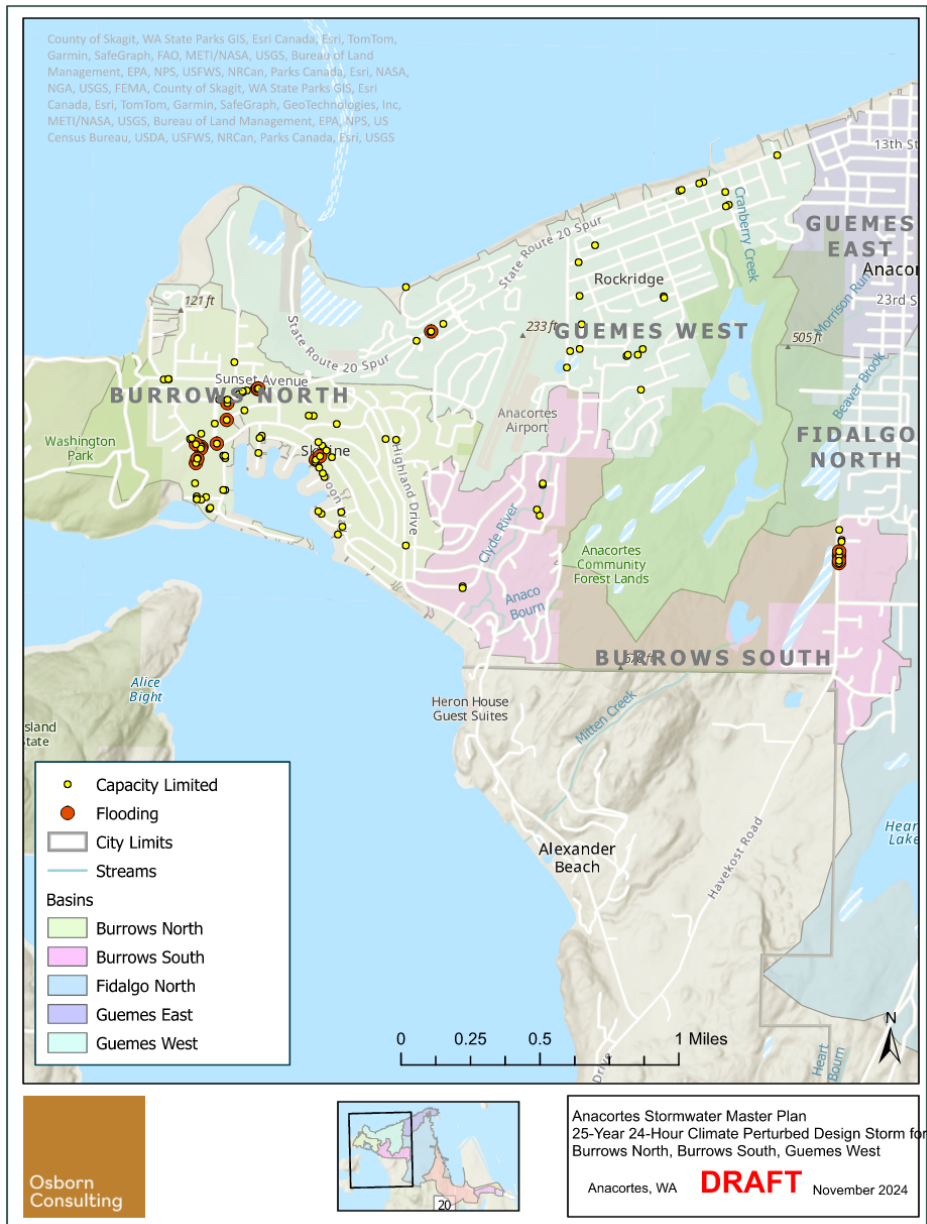


Figure 3.10. 25-Year 24-Hour Climate Perturbed Design Storm for Burrows North, Burrows South, and Guemes West

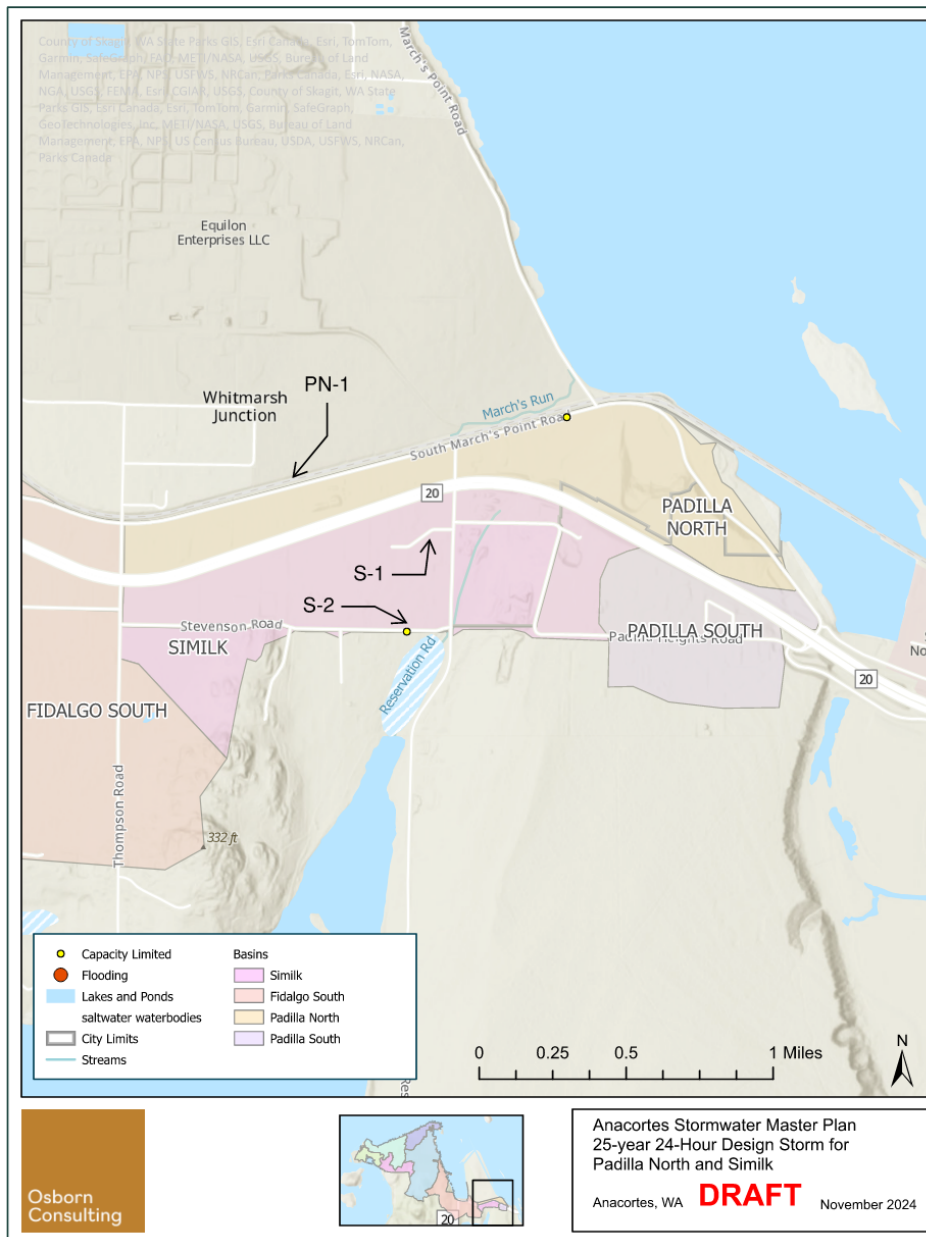


Figure 3.11. 25-Year 24-Hour Design Storm for Padilla North and Similk

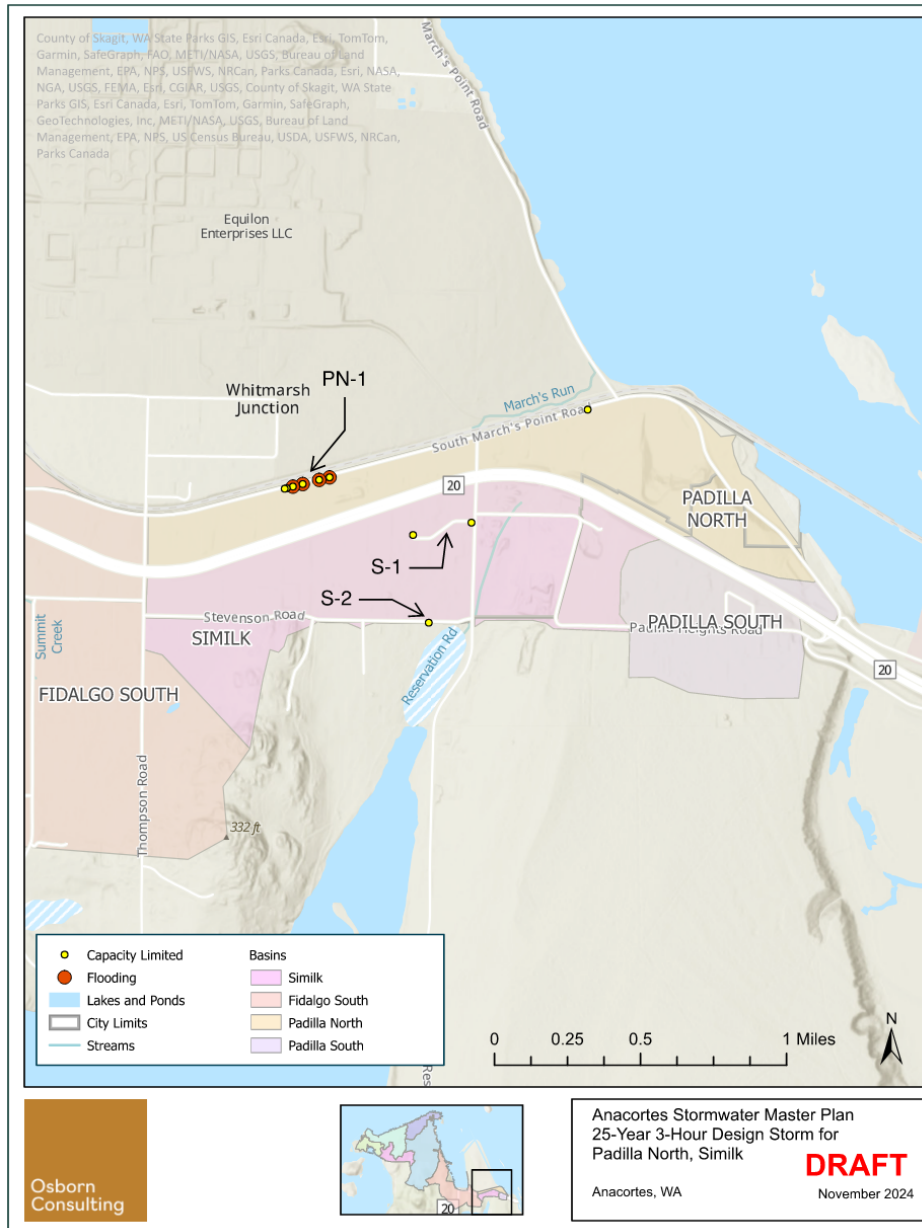


Figure 3.12. 25-Year 3-Hour Design Storm for Padilla North and Similk

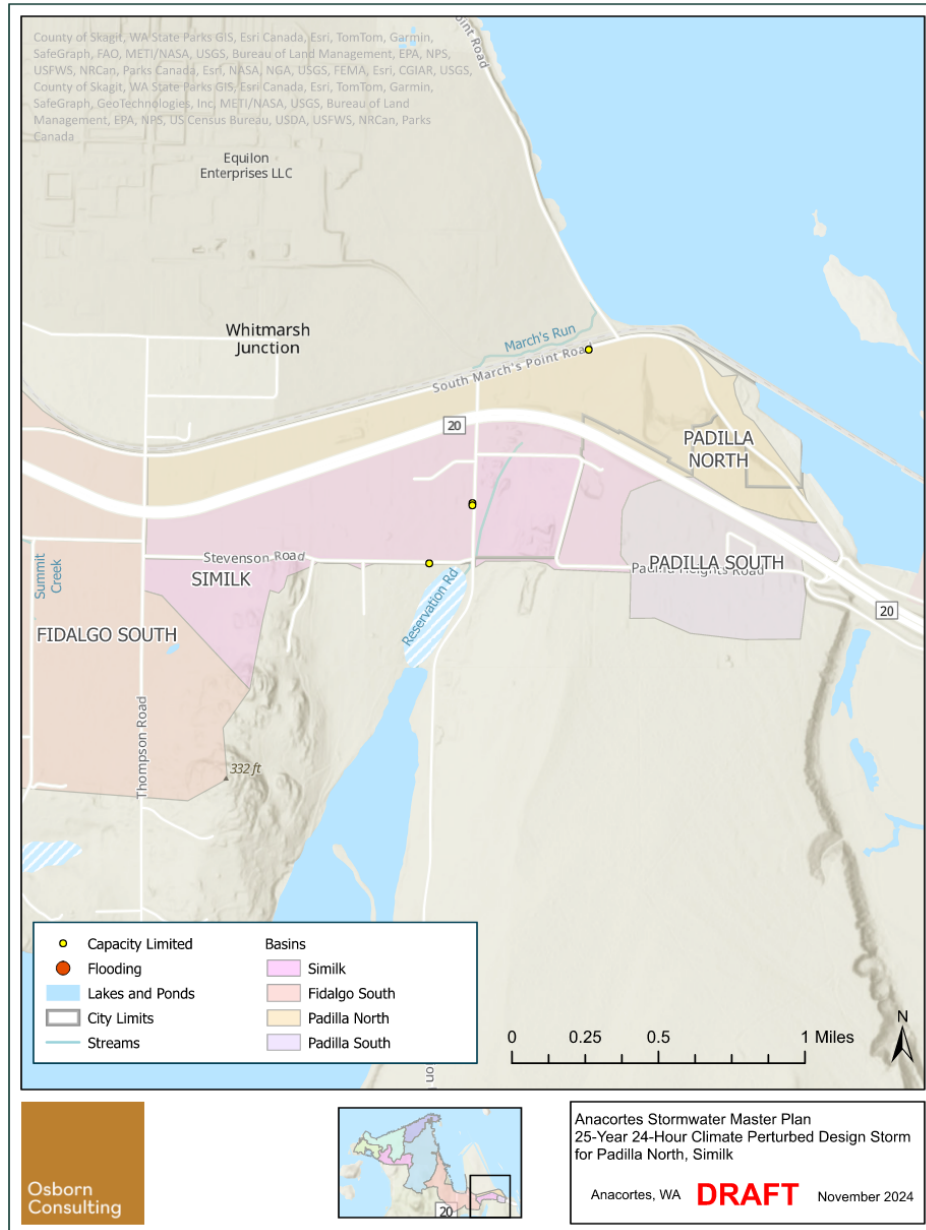


Figure 3.13. 25-Year 24-Hour Climate Perturbed Design Storm for Padilla North and Similk

3.5.3 Stormwater System Deficiencies

Most of the flooding in the City was caused by small diameter pipes that lack adequate capacity to pass runoff from high intensity rainfall. Many of these pipes are also past their expected lifespan and need repair or maintenance.

Stormwater CFPs should focus on the flatter areas in the City's historical core. Flooding shown by the model in the City's steeper areas is of a lesser concern because runoff in these areas typically disperses by sheet flows down the streets and is collected when there is available capacity in the network. However, prioritization should be taken where there is an impact to life and safety associated with major arterial roadways.

In addition, areas identified as flooding due to backwater effects from a combination of high rainfall and the high tidal condition were considered less of a priority. The City should develop a strategy for addressing the impacts of the high tidal conditions on the local drainage system.

The following are the high priority areas by drainage basin:

- **Fidalgo North** – The following areas in Fidalgo North are high priority areas.
 - (FN-10) – There is considerable flooding along 20th Street and M Avenue near Anacortes High School. The 8-inch and 1-foot-diameter pipes in this area do not have adequate capacity according to the modeling results.
 - (FN-8) – The model is showing flooding where 34th, 35th, and 36th Streets cross Commercial Avenue. The flooding is caused by undersized pipes at these locations. There is also flooding further west on 35th Street that should be considered a higher priority.
 - (FN-12) – The area along 22nd Street from M Avenue to R Avenue and south of 22nd Street on Commercial Avenue have a series of undersized pipes that are causing flooding.
 - (FN-6) – The system on 37th street west to R Avenue and north under SR 20 to Commercial Avenue has a series of undersized pipes that are causing flooding. This area was also identified in the Fidalgo North Basin Stormwater Management Action Plan and is listed in **Section 5** as project number 8.
- **Fidalgo South (FS-3)** – The junctions upstream of a dry well at the intersection of Fidalgo Bay Road and Fidalgo Bay Road are flooding upstream, likely caused by the underperforming dry well without adequate storage. This area was also identified in the City's 2024–29 Capital Facilities Plan and is listed in **Section 5** as CFP project number 5.
- **Guemes East (GE-3)** – The 1.5-foot-diameter stormwater pipe on M Avenue is at capacity, and the model shows significant flooding and surcharging in the upstream tributary system from 7th Street to 14th Street. It is recommended that this area be a focus of stormwater improvements.
- **Guemes West** – None.
- **Padilla North** – None.
- **Padilla South** – Not modeled.
- **Similk** – None.
- **Burrows North** – None.
- **Burrows South** – None.

A detailed listing of the constrained drainage systems findings is provided in **Error! Reference source not found.**, which contains tables of the flooded and surcharged maintenance holes and pipes based on the modeling results.

3.5.4 Relevant Requirements and Exemptions

The H&H model developed as part of this plan, was used to understand the feasibility of petitioning Ecology for flow control exemptions for piped streams. Per the 2024 SWMMWW, Ecology allows for flow control exemptions for development if they discharge to prior approved flow control exempt water bodies. For Anacortes, the surrounding bays are all considered flow control exempt. However, Section 1-3.4.7 of the SWMMWW indicates that pipes that contain rerouted or reconstructed streams are not considered flow control exempt because they are not a prior approved flow control exempt water body.

There is a provision in the section that allows for local governments to petition Ecology for exemption status:

A petition must justify the proposed exemption, based upon a hydrologic analysis, which demonstrates that the potential stormwater runoff from the exempted area will not significantly increase the erosion forces on the stream channel nor have near field impacts.

Based on the modeling results the piped systems that carry the Ace of Hearts, Happy Valley and Beaver Brook streams have sufficient capacity to pass flows without impacting the stream channel and flooding within the system. Based on these findings the City does meet the requirements for a flow control exemption. A separate flow control exemption memorandum will be prepared to support the City with this request.

3.6 STORM SYSTEM CAPACITY UPGRADES CAPITAL FACILITIES PROGRAM

A new capital facilities program called *Storm System Capacity Upgrades* has been identified. The intent of this new program is to set aside funds on an annual basis that can be used to address high priority capacity upgrades, including those noted in **Section 3.5.2**. This would be a citywide program that would need further development to plan, prioritize, design and construct projects addressing the capacity constraints identified through the modeling results. This program has been included in **Section 5**.

4 STREAM AND HABITAT ASSESSMENT

The City of Anacortes exhibits unique natural characteristics given its location on Fidalgo Island in Puget Sound. Bordered by Rosario Strait to the west and separated from Whidbey Island by Deception Pass to the south and from the mainland by the Swinomish Channel to the east, there are around a dozen miles of shoreline along the multiple surrounding bays. The city parks, the 2,875-acre Anacortes Community Forest Land (ACFL) of the Cranberry Lake and Whistle Lake areas, and other forested recreational areas, encompass approximately 40 percent of the City's area. Numerous large freshwater lakes also exist within the City and several wetland areas are found in and around the Anacortes urban growth area.

Even with this abundance of natural water systems, the freshwater fish habitat on the island is limited compared to similarly located Puget Sound region cities given the area topography, among other factors. For example, although the overall topography of the City is gently sloping and the downtown area in the northeastern portion of the City is relatively flat, various quadrants exhibit steeply sloped areas and bluffs, as well as various categories of unstable areas (City of Anacortes 2007). Generally, area streams largely originate from the inland freshwater lakes and wetland complexes on the island and flow through protected, undeveloped, or lightly developed areas initially. Farther out, including closer to the surrounding marine waters, the stream systems are either more frequently piped or piped for longer distances, accounting for both varying topography and increased levels of residential, commercial, and industrial development, in addition to road networks such as State Route 20.

With the current statewide multi-agency focus on salmonid population health, habitat restoration, and correction of fish passage barriers, the City implemented a planning-level assessment of local streams to gain insight into City systems and potential opportunities for improving fish habitat. The assessment focused on stream habitat and associated drainage infrastructure conditions, specifically culverts, mostly within those City streams documented to have historically or currently inhabited fish species according to the Statewide Washington Integrated Fish Distribution (SWIFD) dataset (NWIFC/WDFW 2018).

4.1 STREAM AND HABITAT CHARACTERISTICS

Based on the SWIFD dataset, stream and habitat assessment areas included open stream channel portions located upstream of closed piped systems in Ace of Hearts Creek, Aqua Creek, Beaver Brook, Clyde Creek, Cranberry Creek, and Happy Valley Stream. The stream and habitat assessment focused on observable instream conditions, the conditions of the associated infrastructure and immediate surroundings, and characteristics such as erosion, flooding, stream canopy cover, invasive species presence, stream channel widths, and salmonid spawning and rearing habitat.

Overall, most fish-bearing streams within City boundaries flow through urban and residential areas with relatively small bankfull widths compared to many of those in other parts of the state. However, several streams exhibit adequate spawning and rearing potential with access to rearing wetlands such as those at Heart Lake and Little Cranberry Lake, which are especially beneficial to anadromous and residential trout species. Whereas most of the fish-bearing waterbodies within the City may provide a smaller amount of lineal gain than many other municipalities streams within the state, the proximity of Anacortes to Puget Sound and Fidalgo Bay provides an opportunity for lower migration time to potential spawning and rearing ground. Currently, streams within the City of Anacortes like Cranberry Creek, Ace of Hearts Creek, and Happy Valley Stream have large sections of underground piped segments but offer adequate spawning and rearing potential upstream of these sections, with a mix of lake habitat, access to seasonal wetlands, and occasional forested canopy and instream cover with spawning ground substrate.

The following subsections provide a general description of the six streams of focus in the City of Anacortes. Included in the descriptions is the location of each stream relative to the mapped drainage basins described in **Table 1.2.** and whether each is classified as a fish-bearing or non-fish-bearing

stream. A more detailed account of conditions observed is contained within **Appendix F**, along with potential opportunities for restoration CFPs based on the current assessment. **Appendix G** contains maps of the six assessed streams.

4.1.1 Ace of Hearts Creek

Located within the Fidalgo North Drainage Basin, Ace of Hearts Creek is a fish-bearing stream that conveys flows from Heart Lake within the Whistle Lake ACFL, into the City stormwater system at 33rd Street before discharging into Fidalgo Bay. Through its course, the channel varies between wetland, ditches, and natural channel morphology. Among other tributaries, Happy Valley Stream flows into Ace of Hearts Creek.

4.1.2 Aqua Creek

Aqua Creek is a fish-bearing stream within the Fidalgo South Drainage Basin. Aqua Creek flows from forested areas of the Whistle Lake ACFL northeast of Whistle Lake, to Fidalgo Bay. The upper watershed is forestland, whereas residential development exists in the lower watershed. The stream passes through Skagit County and City jurisdictions before crossing Aqua Lane and Fidalgo Bay Road and ultimately entering a wetland area on the south side of State Route 20. From there, multiple culverts convey flows under State Route 20 to Fidalgo Bay.

4.1.3 Beaver Brook

Beaver Brook is within the Fidalgo North Drainage Basin and has an unclassified fish bearing status, meaning it has not been determined to be fish-bearing or non-fish-bearing. The stream flows from forested wetlands in the Cranberry Lake ACFL area at the western end of the 32nd Street, along urban neighborhood ditches and natural channels, through various culverts and other short pipe segments, into the City's approximately 4,500-foot-long stormwater system until its Fidalgo Bay outfall at the Anacortes Marina.

4.1.4 Clyde Creek

Clyde Creek, within the Burrows South Drainage Basin, is classified as a potentially fish-bearing stream. Originating east of the Anacortes Regional Airport, Clyde Creek flows from a wetland north of Jasper Way/33rd Street, through ditches and swales as wetlands, through a residential area in open swales and culverts, before crossing under Anaco Beach Road into Burrows Bay. Anaco Bourn, which originates near the southwest side of the ACFL – Cranberry Lake area, is a tributary of Clyde Creek that connects approximately 550-feet upstream of Anaco Beach Road.

4.1.5 Cranberry Creek

Cranberry Creek is within the Guemes West Drainage Basin and classified as a potentially fish-bearing stream. Cranberry Creek flows from Little Cranberry Lake, through a forested riparian corridor of the Cranberry Lake ACFL area, and into a piped system at Cranberry Lake Road. The pipe network continues across and then along Georgia Avenue at steep grades before crossing under State Route 20 and daylighting for a short span before becoming piped again to Guemes Channel.

4.1.6 Happy Valley Stream

Located within the Fidalgo South Drainage Basin, City records show Happy Valley Stream starting south of Haddon Road in Skagit County within a shrub and forest wetland complex. The stream is listed as potentially fish bearing and consists of wetland, ditched stream, and natural stream channel as it flows northwest between Whistle Lake Road and Commercial Avenue towards State Route 20. The stream

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Section to be updated in Final to address Libby Grage's comments on the Draft.

crosses State Route 20 before becoming a piped system along R Avenue. The R Avenue system converges with the Ace of Hearts Creek piped conveyance system at 32nd Street, from where it continues for a total distance of approximately 4,000 feet before reaching Fidalgo Bay. During the 2024 assessment, the stream was recorded as seasonal because there was no flow observed within the stream channel upstream of Saint Mary's Drive. Per City records, Happy Valley Stream is piped under and upstream of Saint Mary's Drive for approximately 473 feet.

4.2 FISH PASSAGE BARRIER INVENTORY

As a second component to the stream and habitat assessment, a desktop study was completed to analyze the stream culvert inventory and identify all fish passage barriers within the City limits currently documented in the WDFW Fish Passage Diversion Screening Inventory (FPDSI) database. This database identifies all fish passage barriers, including those owned by the City, Skagit County, State (WSDOT), or that are privately owned, and includes a variety of parameters related to fish use, barrier status, and existing conditions metrics (WDFW 2021).

Figure 4.1 shows all the barriers, and their corresponding owners, identified within the City limits, **Table 4.1** lists the total number of barriers by owner and barrier status, and **Appendix G** provides maps of the barriers within each assessed stream and the detailed WDFW inventory results for all the barriers throughout the city.

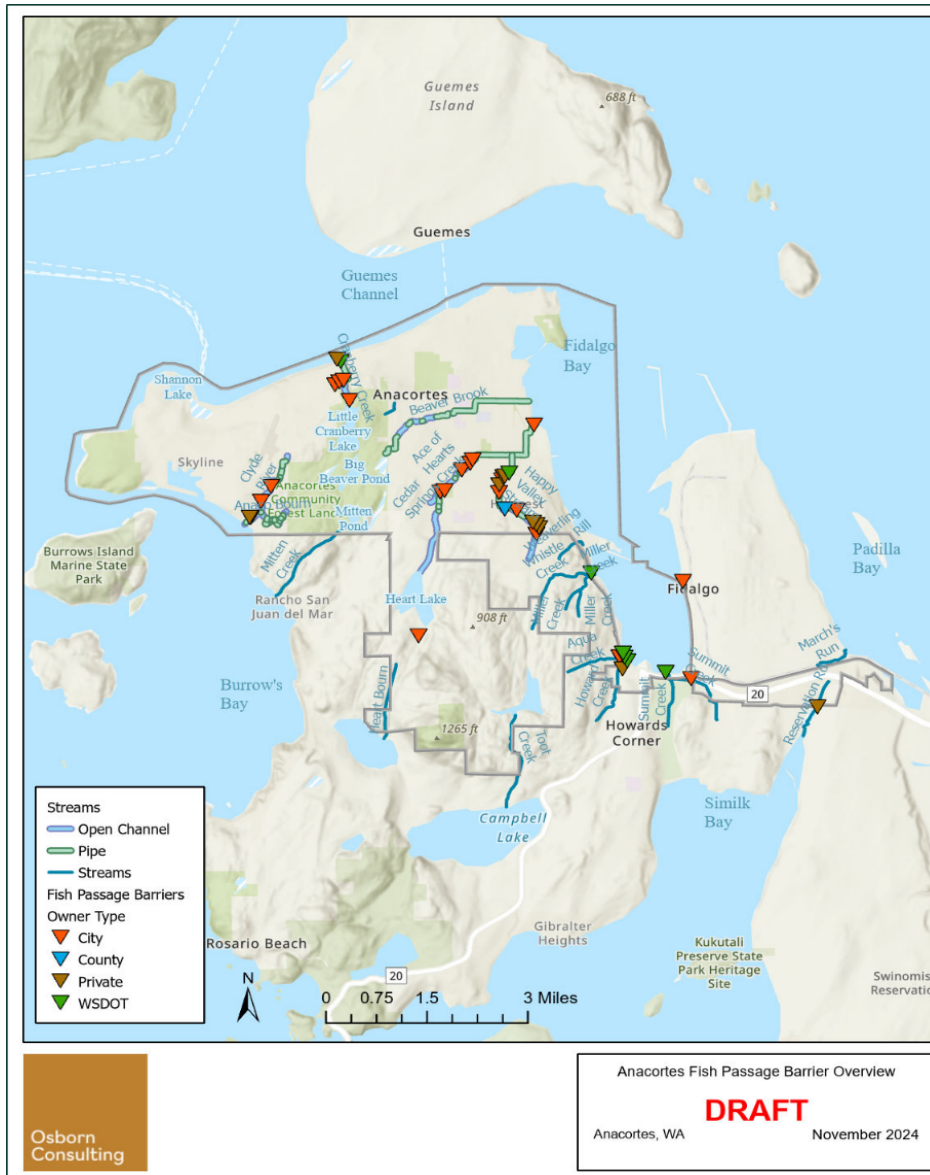


Figure 4.1. Overview of Fish Passage Barriers within City Limits

Table 4.1. Fish Passage Barriers within the Anacortes City Limits

Ownership	Number of Identified Barriers	Number of Unknown Barriers
City	21	3
County	1	0
WSDOT	7	0
Private	8	2
Total	37	5

Thirty-seven fish passage barriers have been identified within the city limits, with twenty-one under City ownership, one under County ownership, seven under WSDOT ownership, and eight privately owned. There are also a total of five barriers of unknown status, with three City-owned and two privately-owned barriers. Crossings identified within the city limits were cross-referenced with the City's closed conveyance database. The inventory was found to be complete, with no additional barriers identified during the field assessments.

Although the total number of fish passage barriers within the City of Anacortes is not as high as other similar sized municipalities, prioritization for correcting fish passage barriers in City-owned assets is an important process to help ensure the most efficient environmental and fiscal actions are being made to restore historical fish habitat.

4.2.1 Prioritization for Fish Passage Barrier Correction

Several public agencies within Washington state, on state, county, and city levels, have made collaborative efforts to develop assessment and scoring criteria to help identify and prioritize the correction of fish passage barriers. The criteria are based on various environmental factors to restore historical or beneficial salmon spawning and rearing habitat by the most efficient means practicable.

Some of the environmental metrics used to score barrier priority include individual barrier passability ranking, lineal gain upstream, habitat quality, number of species benefitting, multi-benefit remediation potential, and the number of barriers upstream and downstream of each crossing. These types of scoring tools can be altered or adjusted based on agency need and their relevant timeline. Many of the common broader-scale scoring metrics can be simplified to target smaller-scale and more local needs, including multi-benefit use, project costs and timelines, and grant funding opportunities.

The City's Comprehensive Plan identifies protection and enhancement of fish and wildlife habitat and improvement of functional integrity of watercourses as important goals. Development of a prioritization program for fish passage barrier correction for Anacortes-owned assets would need to consider these and other goals. The City could begin the prioritization process by identifying the most important categories of environmental and fiscal factors specific to Anacortes and forming a ranked scoring system that can be applied to each fish passage barrier crossing.

4.3 RECOMMENDED CAPITAL FACILITIES PROJECT FOR HABITAT PRESERVATION AND RESTORATION

Opportunities for preserving and improving fish habitat and prioritizing fish barrier correction were examined based on the findings of the stream and habitat assessment conducted for this Plan. The new recommended capital facilities projects (CFPs) for restoration include the Cranberry Creek Restoration and Habitat Improvement and Clyde Creek Bank Stream Bank Stabilization projects. The assessment also identified an opportunity to expand a CFP already identified by the City. Following this assessment, the CFP for daylighting Ace of Hearts Creek through Rotary Park has been expanded to include the removal or replacement of roadway cross-culverts and native planting and invasive species removal in adjacent parts of the stream. The updated CFP is now titled the Ace of Hearts Rotary Park Stream Restoration project. More information about these restoration CFPs is provided in **Appendix F**.

An initial review of the fish passage barrier list did not identify any barriers that should be included as a CFP for barrier removal. However, the inventory of City-owned barriers needs further investigation and prioritization to evaluate the environmental and community benefits of addressing these barriers for consideration with other projects and future updates to this Plan. Although no CFPs were identified specifically for barrier removal, one barrier within Happy Valley Stream is the subject of the Saint Mary's Drive Culvert Replacement CFP discussed in **Section 5**. The culvert is an identified fish-passage barrier (WDFW ID 930933). In addition, replacement of this culvert is needed to address current roadway infrastructure issues within the City right-of-way and the CFP does not address the full length of the barrier, which reaches upstream from Saint Mary's Drive into private property.

5 CAPITAL FACILITIES PROJECTS AND PROGRAMS

One of the primary objectives in developing this plan is to develop an updated list of current capital facilities projects (CFPs), as the previous list of Stormwater CFPs developed as part of the 2007 *Stormwater Management Plan* had all been completed or been deemed obsolete. In addition to CFPs, it was determined that funding was needed for ongoing annual stormwater Capital Programs. This section provides an overview of the projects and programs.

The projects and programs included in this plan were identified from or identified by (1.) City's planning documents, (2.) analysis conducted as part of this plan development, and (3.) City staff.

The list of City planning documents include the following:

- 2024–2029 Six-Year Capital Facilities Plan, listed as “STORM” projects
- 2023 Stormwater Management Action Plan (SMAP) for Fidalgo North Basin
- 2007 Stormwater Management Plan

The eleven stormwater CFPs and four citywide stormwater programs are summarized in **Table 5.1** and **Table 5.2**. The name, location and subbasin, a short description of the stormwater CFPs can be found in these tables. The mapped location of projects can be found on **Figure 5.1**, following these tables.

Following input from City staff and the City of Anacortes City Council, project and program prioritization and schedule will be determined. In addition, City staff will need to ensure that all citywide program efforts are coordinated between the stormwater program efforts as well as other City programs such as the Asphalt Overlay Program and work being completed by the Transportation Benefit District. For a table that details all the CFPs and stormwater programs, see **Appendix H**.

Commented [DH7]: 5 Capital Facilities Projects and Programs:
Section to be updated in Final to address Libby Grage's comments on the Draft.

Table 5.1. Stormwater Capital Facilities Projects

Project Name	Project Type	Location and Drainage Basin	Source	Project Description
1. 32nd Street Wetlands Culvert Removal	Habitat	2400 block of 32nd Street Fidalgo North	<i>Fidalgo North Basin SMAP</i>	Removal of a culvert and restoration of the streambank at the outlet at the 2400 block of the 32nd Street where local wetlands flow into Beaver Brook.
2. Ace of Hearts Rotary Park Stream Restoration	Habitat	3817 H Avenue Fidalgo North	<i>Fidalgo North Basin SMAP</i> <i>2025 Stormwater Master Plan</i>	- Daylighting a stretch of Ace of Hearts Creek where it passes through Ace of Hearts Rotary Park and enhancing the adjacent storm pond and wetland area. - Restoration of open stream channel and removal or replacement of cross-culverts in the park.
3. Cranberry Creek Restoration and Habitat Improvement	Habitat	Cranberry Creek at Cranberry Creek Road Guemes West	<i>2025 Stormwater Master Plan</i>	- Daylighting a stretch of Cranberry Creek along Cranberry Lake Road within the Anacortes Community Forest Land just west of Georgia Avenue. - Enhancement and protection of current riparian and other habitat.
4. Saint Mary's Drive Culvert Replacement	Infrastructure Repair	Saint Mary's Drive (700 41st Place) Fidalgo North	<i>City's 2024-29 Capital Facilities Plan</i>	Replacing the existing 36-inch culvert in Happy Valley Stream. The stream currently passes in and around the culvert and through the roadway subgrade. The project is needed to prevent future damage to the roadway. The project may be required to meet fish passage requirements.
5. Fidalgo Bay Road Flood Mitigation	Flooding	Fidalgo Bay road and Samish RV Park Fidalgo South	<i>City's 2024-29 Capital Facilities Plan</i> <i>2025 Stormwater Master Plan – Modeling Results</i>	- Flood mitigation at Fidalgo Bay to ensure that Fidalgo Bay Road is not flooded during rain events, reducing the risk of vehicle crashes and collisions. Flooding is due to underperforming dry wells that have inadequate storage. - The project has already been designed and will add a new pipe to bypass flows to an existing ditch during storm events.
6. Marion Pond Water Quality Retrofit	Water Quality	Cedar Glen Way Burrows South	<i>2007 Stormwater Management Plan Capital Facilities Project List</i>	- Replacing a faulty 4,900 square foot detention pond with a 7-foot-by-13-foot treatment filter vault. - This project has been designed.

Project Name	Project Type	Location and Drainage Basin	Source	Project Description
7. Clyde Creek Streambank Stabilization and Flooding Mitigation	Flooding, Streambank Stabilization, and Habitat	Clyde Creek, approximately between Marion Way and Queen Ann Way Burrows South	<i>2025 Stormwater Master Plan</i>	Replacing the undersized culvert and/or the culvert armoring, felling specific trees with rotted root systems, bioengineering for streambank stabilization, and planting native shrubs and tree species to mitigate current flooding issues and restore or enhance riparian habitat.
8. 37th Street Storm Conveyance Reconstruction	Flooding and Water Quality	37th Street east of Commercial Avenue Fidalgo North	<i>Fidalgo North Basin SMAP</i> <i>2025 Stormwater Master Plan – Modeling Results</i>	- Upgrading the existing undersized storm drainage along 37th Street, which involves: - Adding water quality treatment - Adding new system structures - Upsizing the storm drainage conveyance system
9. 34th Street Storm Conveyance Reconstruction	Flooding and Water Quality	34th Street from R Avenue to O Avenue Fidalgo North	<i>Fidalgo North Basin SMAP</i>	Installing bioswales in the 34th Street stormwater conveyance system to improve water quality and flow in the local vicinity.
10. Q Avenue Storm Conveyance Reconstruction	Flooding and Water Quality	22nd Street to 34th Street Fidalgo North	<i>Fidalgo North Basin SMAP</i>	- Upgrading the existing undersized storm drainage along Q Avenue, which involves: - Adding water quality treatment - Adding 12 new system structures - Upsizing the storm drainage conveyance system
11. 17th Street Stormwater Pipe and Outfall Repair	Flooding and Infrastructure Repair	Q Avenue and 17th Street Fidalgo North	<i>City's 2024-29 Capital Facilities Plan</i>	- Add a stormwater pipe in place of the existing ditch to eliminate flooding on Q Avenue caused by sedimentation build up in the ditch. - Lower the downstream outfall to facilitate the continuation of the shoreline trail and eliminate the need for a bridge.

Table 5.2. Stormwater Capital Facilities Programs

Program Name	Program Type	Location	Source	Program Description
1. Stormwater Pipe Repair and Replacement	Ongoing Small Works Program	Citywide	<i>2025 Stormwater Master Plan</i>	Program will address repair and replacement of aging for failing stormwater pipes throughout the City.
2. Outfall Evaluation and Rehabilitations	Ongoing Small Works Program	Citywide	<i>City's 2024-29 Capital Facilities Plan</i>	- Program will address degraded conditions of the City's 73 Storm system outfalls to recommend a rehabilitation plan. - Many outlets throughout the City were below the ordinary high-water line, which resulted in saltwater intrusion into the storm system, degrading conditions of the outfall.
3. Storm System Facility Upgrades, Restoration and Maintenance	Ongoing Small Works Program	Citywide	<i>City's 2024-29 Capital Facilities Plan</i>	- Program will address upgrading, restoring, and maintaining the City's existing stormwater infrastructure. These projects included or involved the following: - Storm pond cleaning - Repair fencing at stormwater ponds. - Separation of combined storm and sanitary sewer system
4. Storm System Capacity Upgrades	Ongoing Small Works Program	Citywide	<i>2025 Stormwater Master Plan</i>	Program will address needed stormwater capacity upgrades that are identified in the H&H modeling results in this plan.

6 EXECUTION PLAN AND NEXT STEPS

This section provides a general overview of the execution plan and next steps for this 2025 Stormwater Master Plan. The City's Stormwater Utility prepared this Plan to guide related activities for the next 20 years, address current challenges in City stormwater management, and inform the City's overall 2025 Comprehensive Plan update.

City master planning documents, such as this Plan, are coordinated with the City's 2025 Comprehensive Planning process through an annual Comprehensive Plan amendment process. During this amendment process, this Plan and capital projects therein are integrated with the capital facilities element of the City's overall citywide 2025 Comprehensive Plan.

The 2025 Plan incorporates the following actions:

- Updating the City's 2007 Stormwater Management Plan.
- Providing guidance for stormwater management.
- Evaluating Upcoming Phase II Permit requirements and programs.
- Providing documentation of the City's stormwater infrastructure.
- Reviewing the City's existing stormwater asset inventory and establish a pipe repair and replacement program.
- Identifying stormwater system deficiencies through a citywide hydrologic and hydraulic model (H&H model).
- Assessment of stream, habitat, and conveyance infrastructure conditions.
- Documenting the current Stormwater Capital Facilities Program.
- Supporting future capital, operation, and maintenance activities.
- Providing a multi-year stormwater execution plan to achieve.

From the actions listed above a series of policy, program and capital recommendations were developed and summarized in **Sections 1** through **5**. A summary of those recommendations is included in **Sections 6.1** and **6.2**.

6.1 POLICY AND NON-CAPITAL PROGRAM RECOMMENDATIONS

This 2025 Stormwater Master Plan includes a series of findings regarding the City's growing need for stormwater program and policy enhancements required to meet Permit requirements as the City's population and number of stormwater assets grows. The City has maintained Phase II Permit compliance and implemented its own Stormwater Management Program (SWMP). Over the next five years, the city will need to review its SWMP and ensure compliance with the new Phase II Permit.

SWMP related policy, programs, and projects needs are detailed in **Section 1** and will include the following:

- Tracking cost for each SWMP element.
- Adopting and implementing tree canopy goals and policies.
- Drafting a new SMAP or develop additional actions in Fidalgo North Basin, including addressing wear in land management strategies and stormwater retrofits.

- Reviewing and updating MS4 outfall mapping and submitting data to Ecology.
- Reviewing the Anacortes Municipal Code (AMC) and reviewing and updating IDDE code to address PCB regulations and firefighting activities.

6.2 STORMWATER CAPITAL FACILITIES PROJECTS AND PROGRAMS

As part of the City's Plan development, a list of CFPs was compiled from numerous sources, including the 2023 Fidalgo North SMAP, the 2007 Stormwater Comprehensive Plan, and the City's 2024-29 Capital Facilities Plan, which are detailed in **Section 5**.

The City has also taken responsibility for maintaining the municipal stormwater infrastructure, mitigating area flooding risk, and protecting surface water quality. The final list includes eleven projects and four citywide stormwater programs. The programs include addressing the long-term needs of storm pipe repair and replacement, outfall evaluation and rehabilitations, storm system facility upgrades, restoration, and maintenance, and storm system capacity upgrades.

6.3 CONCLUSION AND NEXT STEPS

< Discuss with City staff recommendations of next steps for the 2025 Stormwater Master Plan Adoption and Implementation. Include a summary of the workshops with City Council to refine the capital facilities cost (magnitude) and implementation planning. Also include a summary of the process for engaging the public on the Plan Update. >

Commented [DH8]: 6.3 Conclusion and Next Steps:
Section to be updated in Final to address next steps for the 2025 Stormwater Master Plan adoption and implementation. This includes work with the City Council to refine the capital facilities cost and implementation planning and the process for engaging the public on the Plan Update.

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**APPENDIX A:
DATA SUMMARY MATRIX**

APPENDIX B: STORMWATER PIPE REPAIR AND REPLACEMENT PROGRAM TECHNICAL MEMORANDUM

**APPENDIX C:
SYSTEMWIDE HYDRAULIC MODEL**

APPENDIX D: SUMMARY OF MODEL DEVELOPMENT AND EXECUTION

APPENDIX E: SUMMARY OF CONSTRAINED DRAINAGE SYSTEMS FINDINGS

APPENDIX F: STREAM AND HABITAT ASSESSMENT FIELD NOTES AND RECOMMENDED RESTORATION CFPS

**APPENDIX G:
FISH PASSAGE BARRIER MAPS AND LIST**

APPENDIX H: 2025 STORMWATER CAPITAL FACILITIES PLAN PROJECTS AND PROGRAMS

DRAFT STORMWATER MASTER PLAN

CITY OF ANACORTES STORMWATER MASTER PLAN

Prepared for:



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LIST OF ABBREVIATIONS

ACFL	Anacortes Community Forest Lands
AMC	Anacortes Municipal Code
BMP, BMPs	Best Management Practice, Best Management Practices
CAO	Critical Areas Ordinance
CCTV	closed-circuit television
Census	U.S. Census Bureau
CFP	Capital Facilities Plan, Capital Facility Project
City	City of Anacortes
CoF	consequence of failure
CWA	Federal Clean Water Act
DTM	North Puget Sound Digital Terrain Model
Ecology	Washington State Department of Ecology
ERU	equivalent residential unit
EPA	U.S. Environmental Protection Agency
FPDSI	Fish Passage Diversion Screening Inventory
GFC	General Facilities Charge
GIS	geographic information system
GMA	Growth Management Act
GPS	geographic positioning system
H&H model	hydrologic and hydraulic model
IDDE	Illicit Discharge Detection and Elimination
LID	low impact development
LIDAR	light detection and ranging
LoF	likelihood of failure
MS4	municipal separate storm sewer system
N/A	Non-applicable
NAD 83	North American Datum of 1983
NASSCO	National Association of Sewer Service Companies
NAVD 88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
NWIFC	Northwest Indian Fisheries Commission
OFM	Office of Financial Management
O&M	operations and maintenance
Osborn	Osborn Consulting, Inc.
PACP	Pipeline Assessment Certification Program
PAHs	polyaromatic hydrocarbons
PCB, PCBs	polychlorinated biphenyls
PCSWMM	Personalized Compute Stormwater Management Model
Permit	NPDES MS4 Phase II Permit
Phase II Permit	Phase II Municipal Stormwater Permit
Plan	2025 Stormwater Master Plan
QSR, QSRs	Quick Structural Ratings
RCW	Revised Code of Washington
R/R	Repair and Replacement
SCD	Skagit Conservation District
SCS	Natural Resources Conservation Service
SMAP	Stormwater Management Action Plan
SMED	Stormwater Management for Existing Development

SR	State Route
SR Cuthroat	Sea Run Cutthroat
SWM	surface water management
SWMMWW	Stormwater Management Manual for Western Washington
SWMP	Stormwater Management Program
SWPRRP	Stormwater Pipe Repair and Replace Program
TMDL, TMDLs	Total maximum daily load, total maximum daily loads
UGA, UGAs	Urban Growth Area, Urban Growth Areas
USDA	U.S. Department of Agriculture
WDFW	Washington State Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WS Drop	water surface drop
WSDOT	Washington State Department of Transportation

1 INTRODUCTION AND PLANNING CRITERIA

The City of Anacortes (City), Washington, is a small waterfront community located in western Skagit County on Fidalgo Island. The City is home to an estimated population of 18,270 people and covers approximately 11.7 square miles of land area¹. Anacortes is known as a working town. Fidalgo Island was home to the Coast Salish people (Samish and Swinomish Tribes) for thousands of years prior to the arrival of Spanish and British explorers in the late 1700s. Settlement in Anacortes by white pioneers began as early as the 1850s, with the City of Anacortes eventually becoming incorporated in 1891. Over the past century, Anacortes has proven prolific in a variety of industries from seafood harvesting and processing to resource refining, boat building and maintenance, shipping, and ferry and port tourism. Through the first half of the 20th century, the local economy was dominated by the lumber industry and local fisheries, and in the 1950s Shell and Texaco refineries broke ground at March Point forever changing the City's economic landscape. In the last few decades, tourism and marina businesses have added an additional dimension to the local economy, as have the industries of ship and boat building and repair.

In 1999, the City adopted its first storm and surface water utility charges to fund the Stormwater Management Program (SWMP). Since then, the City has continually strengthened its municipal services over time, including steady improvements to its surface water management (SWM) systems as a result of close departmental and community partner collaboration. In 2007, the City became a Federal Clean Water Act National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit (Phase II Permit) holder, allowing the City to discharge stormwater to the surface waters of the state. The City has maintained Phase II Permit compliance and implemented its own SWMP. The City has also taken responsibility for maintaining the municipal stormwater infrastructure, mitigating area flooding risk, and protecting surface water quality. This 2025 Stormwater Master Plan (Plan) is intended to guide related activities for the next 20 years, address current challenges in City stormwater management, and inform the City's overall 2025 Comprehensive Plan update.

The Washington State Legislature enacted the Growth Management Act (GMA) (RCW Chapter 36.70A) in 1990 to address rapid population growth and concerns with suburban sprawl, environmental protection, quality of life, and related issues. The GMA provides a framework for regional coordination of land development. Under the GMA, local comprehensive plans, such as the City's 2025 Comprehensive Plan, must include the following elements: utilities, capital facilities, land use, housing, transportation, economic development, parks, and recreation, and, for counties, a rural element. In 2023, through House Bill 1181, a climate element requirement was added to the State's planning framework to improve Washington State's response to climate change. City master planning documents, such as this Plan, are coordinated with the City's comprehensive planning process through an annual Comprehensive Plan amendment process. During this amendment process, the Plan and capital projects therein are integrated with the capital facilities element of the City's overall 2025 Comprehensive Plan.

1.1 STORMWATER MASTER PLAN SUMMARY

The City's 2025 Stormwater Master Plan includes six major sections:

- **Section 1** – An overview of the City's SWMP, including the stormwater utility rate and budget, the local climate, basin descriptions, existing land use, population growth and relevant regulations.

¹ Population data from the Washington State Office of Financial Management (April 1, 2024). Land area data from the 2021 Census. City GIS data shows land and water areas together total 15.53 square miles (<https://www.anacorteswa.gov/635/GIS-Mapping>).

- **Section 2** – A description of the City's Stormwater Pipe Repair/Replacement Program (R/R Program) including the stormwater asset inventory, the current R/R Program, and the future R/R Program needs.
- **Section 3** – An overview of the Citywide Hydrologic and Hydraulic Modeling (H&H Modeling), including the model results, existing condition assessment, stormwater system deficiencies, and evaluation of capital project solutions.
- **Section 4** – A description of stream and habitat conditions within six streams located within the city limits, and an inventory of culverts and fish passage barrier locations in these and other waterways.
- **Section 5** – An overview of the City's Capital Facilities Projects and Programs (CFPs).
- **Section 6** – The Plan's Conclusion, which covers the execution plan, recommendations, and next steps for implementing the Plan.

1.2 2007 STORMWATER MANAGEMENT PLAN

The *2007 Stormwater Management Plan for the City of Anacortes* was developed with the goal of preserving water quality and the hydraulic systems within the City's drainage basin and the receiving waters of Guemes Channel, Burrows Bay, and Fidalgo Bay². The plan provided guidance to minimize the adverse effects of stormwater and surface runoff on both surface and ground water and identified water quality and quantity problems, including stormwater capital facility projects (CFPs). The plan also provided recommendations for specific stormwater management improvements and programs as well as a cost analysis and implementation schedule.

In the plan, drainage areas were determined according to the local topography and stormwater conveyance facilities and identified specific structural and nonstructural solutions to conveyance and water quality problems within the City. To assess the capacity of the stormwater drainage system, a numeric computer model was developed for the plan using existing GIS data, as-built maps of developments, local surveys for specific areas such as the historical downtown core and the assumed build-out development. Nearly all the identified CFPs in the 2007 have been completed or are no longer relevant.

The plan found that there were 12 locations that flood during 25-year storm events based on the modeling assumptions used. The plan was developed to meet the requirements of the 2005 Department of Ecology (Ecology) Stormwater Management Manual for Western Washington (SWMMWW) and provided an overview of the 2007-2013 Phase II Permit stormwater requirements.

1.3 PURPOSE AND OBJECTIVE

The goal of this project is to develop a stormwater master plan for the City of Anacortes. The City owns, operates, and maintains a Stormwater Utility, which includes infrastructure governed by the Phase II Permit.

This Plan addresses the new and increased requirements of the Phase II Permit and the updated projections for future customer and infrastructure growth and development.

The Plan incorporates the following actions:

² The *2007 Stormwater Management Plan for City of Anacortes* is available online at anacorteswa.gov/DocumentCenter/View/4403/2007-Storm-Water-Comprehensive-Plan-PDF.

- Updating the City's 2007 Stormwater Comprehensive Plan.
- Providing guidance for stormwater management.
- Evaluating upcoming Phase II Permit requirements and programs.
- Providing documentation of the City's stormwater infrastructure.
- Reviewing the City's existing stormwater asset inventory and establishing a Pipe Repair and Replacement Program.
- Identifying stormwater system deficiencies through a citywide hydrologic and hydraulic model (H&H model).
- Assessment of stream habitat and surrounding infrastructure.
- Documenting the current Capital Improvement Program.
- Supporting future capital, operation, and maintenance activities.
- Providing a multi-year Stormwater Execution Plan to achieve.

1.4 CITY OVERVIEW

The City of Anacortes is located in western Skagit County on Fidalgo Island in the Puget Sound region of Western Washington. The City is bordered by Fidalgo and Padilla Bays to the east, Guemes Channel to the north, and Burrows Bay and the Rosario Strait to the west. To the south, Deception Pass separates the southern edge of Fidalgo Island from Whidbey Island, and to the east the Swinomish Channel separates Fidalgo Island from the mainland. Development on Fidalgo Island is spread along the west, east, and north shorelines, with urbanized areas in Anacortes located in the northeastern section of the island.

Anacortes is a popular destination for boaters in Washington state and is known locally for the Washington State Ferries dock and terminal that serves the San Juan islands. The waters off Anacortes and Fidalgo Island are also home to a rich variety of marine life, most notably resident orca pods, and the general vicinity is renowned for whale watching.

In addition, the City boasts many other recreational amenities. According to the Anacortes Chamber of Commerce and Visitor Information, around 40 percent of the City's total land area consists of city parks, community forest lands, and other recreational areas. The community forest lands alone cover almost 2,800 acres within the City, encompassing a mixture of forest, wetlands, lakes, and meadows with 50 miles of multiuse mountain biking and hiking trails.

A vicinity map is provided in **Figure 1.1**.

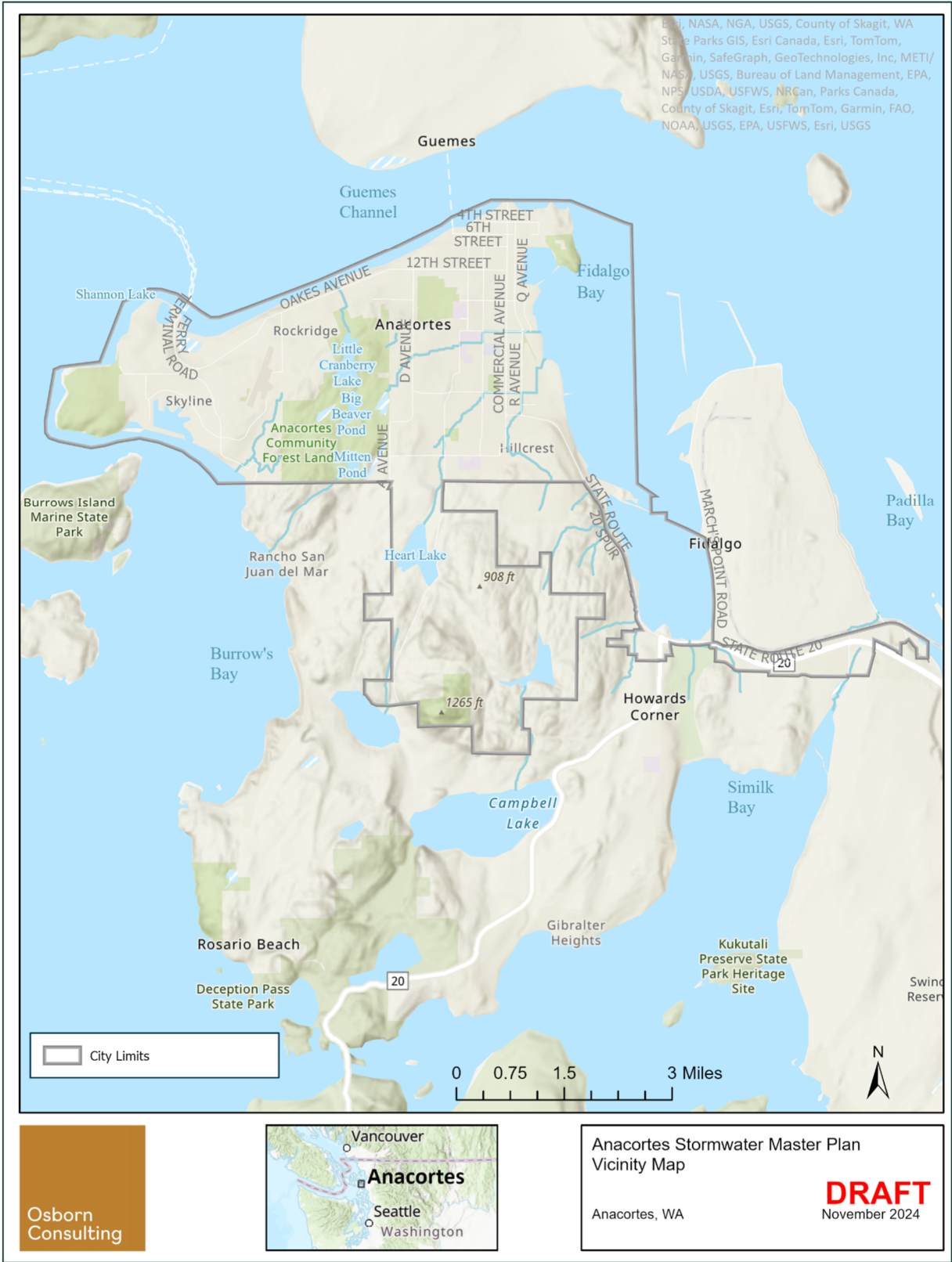


Figure 1.1. Vicinity Map

According to Skagit County's *Population, Housing, and Employment Growth Allocations Methodology Report*³, the estimated population for the City for 2025 is 18,686 people. The City of Anacortes is one of two principal cities included in the Mount Vernon-Anacortes Metropolitan Statistical Area. Located next to the City, March Point is a large industrial area that is located outside of the City but within the Anacortes Urban Growth Area (UGA). The March Point area is not included as part of the City's Phase II Permit.

1.5 STORMWATER UTILITY RATE AND BUDGET

The stormwater utility's first rate was established in 1999. Regular storm rates are indexed annually by the City treasurer to reflect 100 percent of any change from the Consumer Price Index for Seattle-Tacoma-Bellevue All Urban Wage Earners (CPI – Seattle-Tacoma-Bellevue-All Urban Wage Earners (CPI-U) (October 2022–October 2023) at 4.791 percent. The amount billed includes a fee or tax up to 7 percent calculated on the gross revenue of the storm utility.

The current rate is \$15.34 for a single-family residence per month, which roughly occupies the mid-to-low end range compared to other jurisdictions in Western Washington, as shown in **Figure 1.2**. Single-Family Monthly Stormwater Rates.

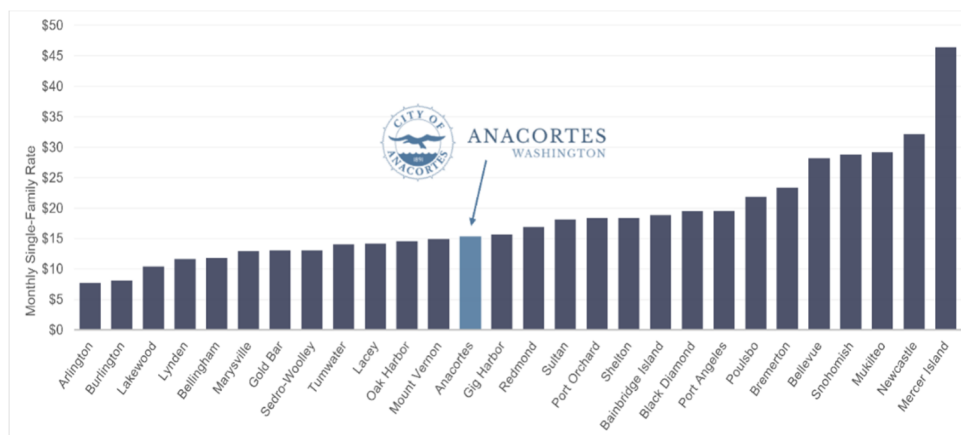


Figure 1.2. Single-Family Monthly Stormwater Rates (2024)

Single-family properties are charged a flat rate every month and are considered one equivalent residential unit (ERU) according to the City. This rate was set based on aerial photo surveys, which have shown the average amount of impervious surface on a single-family parcel in Anacortes is 3,600 square feet.

The monthly stormwater rate per ERU for both commercial and multifamily properties is \$15.34. Commercial properties are assessed based on the actual amount of impervious surface area that they contain from structures such as buildings or parking lots on property and are assessed at a minimum of one ERU. The monthly fixed charges for properties in the heavy manufacturing (HM) and light manufacturing (LM) zones is \$7.67 for single family properties, multifamily properties, and commercial properties as of 2024. In addition, the City has a Storm General Facilities Charge (GFC) for any new residential, industrial, or commercial development connections effective January 1, 2023, with a rate of \$2,056 per ERU. As shown in **Figure 1.3**. Stormwater General Facilities Charges (GFC) for New Connections to City Storm System (2024), the City GFC is similar to that of other jurisdictions in the Puget Sound region of Western Washington.

³ Published December 12, 2023.

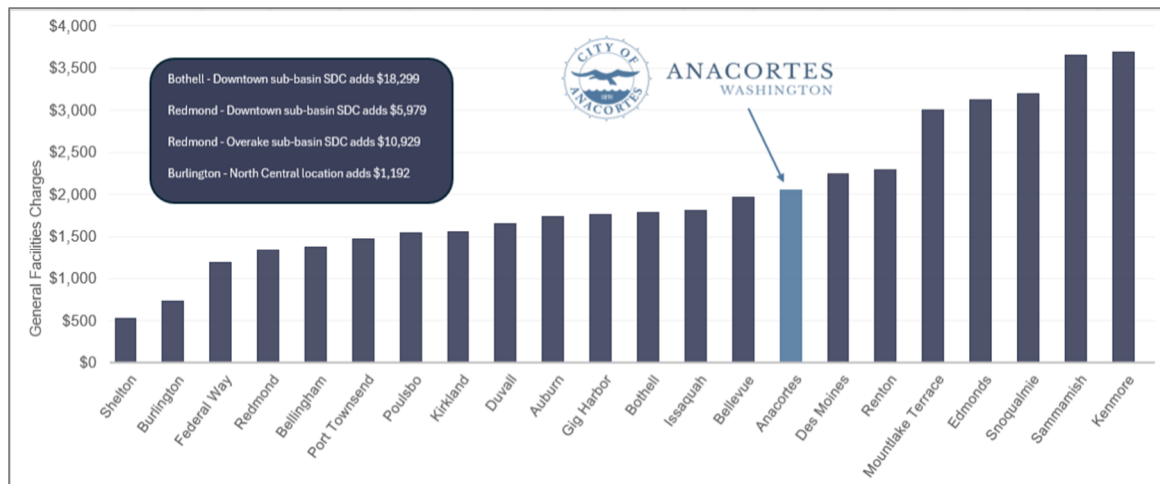


Figure 1.3. Stormwater General Facilities Charges (GFC) for New Connections to City Storm System (2024)⁴

The current annual budget (2025) for the stormwater utilities in Anacortes is \$3,185,768, which includes the four expense category breakdowns and an annual capital facilities budget. **Table 1.1** provides a summary of the total expenses for each portion of the stormwater utility, and the total capital facilities budget.

The City recently discovered a billing issue concerning the undercharging of commercial properties. The City has been gradually increasing the stormwater fee to these impacted properties each year and will reach the full amount of the intended charge by 2029. Accounting for these additional fees, along with the anticipated CPI increases (3%), would increase the annual budget to approximately \$223,179 from 2025 to 2029.

Table 1.1. 2025 Stormwater Utility Expense Categories in Anacortes

2025 Expense Categories		Expense
Administration – Storm Drainage		\$479,211
Engineering Plans and Services – Storm Drainage		\$849,758
Street Cleaning – Storm Drainage		\$180,145
Storm Drainage - Dedicated		\$817,309
Expense Subcategories	Administration	\$309,947
	Maintenance	\$634,707
	Natural Resources {includes 2025 Stormwater Capital Facility Projects and Programs}	\$732,000
2025 Storm Drainage Operating Budget		\$3,185,768

⁴ Source: FCS Group, A Bowman Company received via email on 11/25/24

1.6 EXISTING DATA REVIEW SUMMARY

Significant data related to the City's stormwater system has been gathered as part of this project. The Data Summary Matrix is provided in **Appendix A** and includes a summary by topic of the data and reports reviewed, including the document or package title, date obtained from the City where applicable, lead reviewer and date reviewed, author, published date, and a brief description of the content or review findings.

The existing documents and data reviewed covered the following topics:

- Stormwater Utility Assets
- Stormwater Plans and Studies
- Stormwater Permits
- Asset and Facility Inspection and Maintenance Reports
- Completed Stormwater Projects
- As-Builts
- Inspection Summary Reports and Videos
- Stormwater Infrastructure GIS
- Hydrologic and Hydraulic Modeling Files
- Preliminary Capital Facility Project (CFP) List
- Rainfall Data
- Stream and Fish Passage Data and Reports
- Sea Level Rise Documentation
- Other Miscellaneous Data and Reports

1.7 LOCAL CLIMATE

Anacortes, like much of the Western Washington lowlands, has a warm-summer climate, characterized by cool, rainy winters and warm, dry summers. According to the National Oceanic and Atmospheric Administration (NOAA), the annual high temperatures in Anacortes on average range from as low as 47 degrees Fahrenheit in December to a warm 75 degrees Fahrenheit in August, and annual low temperatures range from 36 degrees Fahrenheit in December to 54 degrees Fahrenheit in August (2021).

The wet winter season typically starts in October and lasts until May after which time the summer dry season begins, which tends to peak around July. Snowfall is rare in Anacortes and the average annual snowfall is approximately 2.76 inches per year. On average, the wettest months of the year are November, December, and January, and the driest months of the year are June, July, and August (NOAA 2021). The annual rainfall in Anacortes fluctuates with the average rainfall for a 30-year period (1991–2020) estimated at 28.96 inches. Data regarding the 2-year, 25-year, and 100-year storm events with a 24-hour duration were obtained from isopluvial maps in the 2024 SWMMWW, published by Ecology. In addition to the Ecology isopluvial maps, the City provided local rainfall data that showed significantly less rainfall than the isopluvials. Other localized climate data collected included sea level rise documentation. **Section 3** describes how this data was interpreted and used for the modeling effort.

1.8 BASIN DESCRIPTIONS

Stormwater runoff in Anacortes flows to five major waterbodies: Fidalgo Bay, Guemes Channel, Burrows Bay, Padilla Bay, and Similk Bay, each of which correspond to five separate and distinct drainage basins that contribute to stormwater pipes. A visual depiction of the drainage basin locations, including the areas outside of the delineated drainage basins, are shown **Figure 1.4**. Drainage Basin, and a detailed summary of the characteristics unique to each basin is provided in **Table 1.2**. To maintain consistency with previous stormwater planning work completed by the City, the drainage basins are the same in terms of both their naming and general delineation. However, the boundaries were updated to inform the stormwater system capacity modeling.

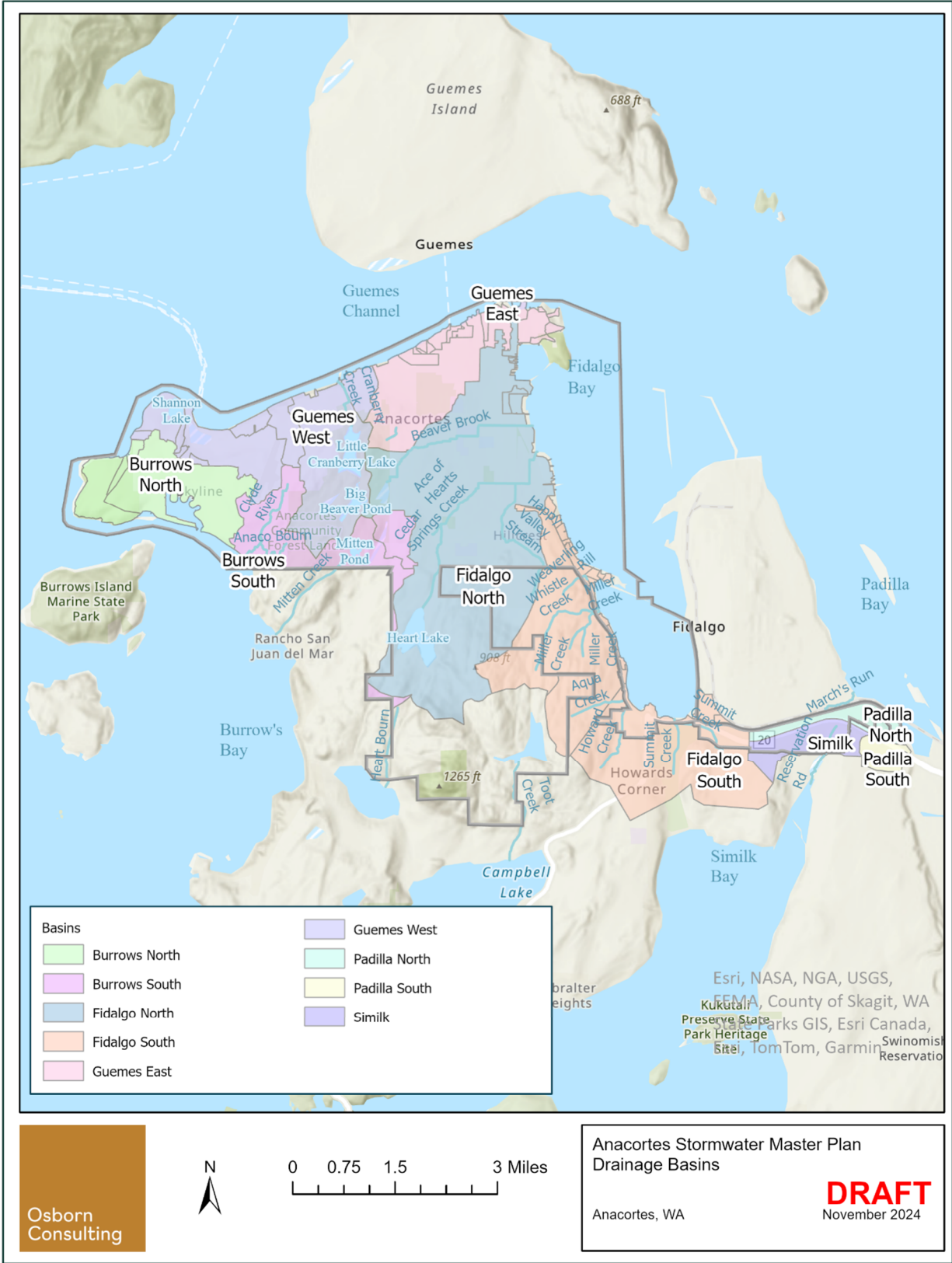


Figure 1.4. Drainage Basin

Table 1.2. Drainage Basin Characteristics

Drainage Basin (Including Stormwater Pipes)	Total Area (Acres) (Percentage in the City)	Catchments for System Capacity modeling	Number of Outfalls	Location and Topography	Perennial Streams, Lakes, Channels, or Bays
Fidalgo North	2,596 (89%)	423	21	- Flat in the downtown area and along the eastern shoreline, steep slopes in the interior. Slopes range from 0% to 65%, some slopes as steep as 90% by the subbasin tributary to Heart Lake. - Stormwater conveyance mostly consists of ditches. - The basin includes Heart Lake.	Ace of Hearts Creek, Beaver Brook, Cedar Springs, Happy Valley Stream, Heart Lake, Fidalgo Bay
Fidalgo South	1,953 (30%)	86	24 <i>(8 of these are private)</i>	- Flat along the eastern shoreline, steep slopes in the interior. Slopes range from 0% to 65%, some slopes as steep as 90%. - Stormwater conveyance mostly consists of ditches.	Aqua Creek, Howard Creek, Miller Creek, Summit Creek, Weaverling Rill, Whistle Creek, Fidalgo Bay
Guemes West	1,191 (100%)	194	11 <i>(1 of these are private)</i>	- Slopes in the subbasin average from approximately 0% to 20% but slopes local to Little Cranberry Lake are as high as approximately 90%. - Concrete and corrugated metal pipes are used in the developed area, and ditches are used in the residential areas. - A large portion of the drainage basin is Anacortes Community Forest Lands (ACFL).	Cranberry Creek, Big Beaver Pond, Little Cranberry Lake, Guemes Channel
Guemes East	699 (100%)	120	20	- Slopes in subbasin average from approximately 0% to 20%. - Concrete and corrugated metal pipes are used in the developed area⁵, and ditches are used in the residential areas. - The drainage basin includes Volunteer Park.	Morrison Run, Guemes Channel

⁵ Per AMC 13.10.010, developed area means an artificial change to property, including but not limited to, building or other structures, mining, dredging, filling, all land-disturbing activities, clearing, grading, landscaping, paving, excavation, or drilling operations.

Drainage Basin (Including Stormwater Pipes)	Total Area (Acres) (Percentage in the City)	Catchments for System Capacity modeling	Number of Outfalls	Location and Topography	Perennial Streams, Lakes, Channels, or Bays
Burrows North	648 (100%)	162	16	- Slopes range from approximately 0% to 60% in the subbasin. - The stormwater conveyance in the subbasin mostly consists of concrete and corrugated metal pipe and ditches. - Basin includes Washington Park.	Burrows Bay
Burrows South	635 (100%)	94	1	- Slopes range from approximately 0% to 60% in the subbasin. - The stormwater conveyance in the subbasin mostly consists of concrete and corrugated metal pipe and ditches.	Burrows Bay, Anaco Bourn, Clyde River, Mitten Creek, Mitten Pond
Padilla North	157 (80%)	16	1	- The local topography in the subbasin is mostly flat. - The stormwater conveyance system within the basin mostly consists of concrete pipes. - This basin is north of Simik and Padilla Bay South Drainage Basins.	Padilla Bay, March's Run
Padilla South	83 (0%)	Not applicable (Discharges directly to Padilla Bay, not modeled.)	—	- The local topography in the subbasin is mostly flat. - The stormwater conveyance system within the basin mostly consists of concrete pipes. - The majority of this basin is outside the City limits.	Padilla Bay
Similk	213 (72%)	45	1	- The local topography in the subbasin is mostly flat. - The local stormwater conveyance mainly consists of ditches. Drainage flows first go through unincorporated Skagit County where ditches constitute the majority of the conveyance system.	Similk Bay, Reservation Road Creek, Turner's Creek

Local streams in the area include, but are not limited to, Ace of Hearts Creek, Aqua Creek, Beaver Brook, Clyde Creek, Cranberry Creek, and Happy Valley Stream. For a condition assessment of these streams and associated infrastructure that was completed as part of the stormwater master plan, see **Section 4**.

The City of Anacortes has several miles of saltwater shoreline, and there are four freshwater lakes located within the City—Little Cranberry Lake, Shannon Lake, Whistle Lake, and Heart Lake. Many wetland areas are located in and around the Anacortes UGA, the largest of which are located south of Little Cranberry Lake and southeast of Shannon Lake. Stormwater and surface runoff in Anacortes flows into the Puget Sound by way of Guemes Channel, Burrows Bay, Fidalgo Bay, Padilla Bay, and Similk Bay. Throughout the area, drainage has been accomplished along the streets through a number of open ditches, culverts, various sized pipes and catch basins, detention ponds, and vaults.

The total number of stormwater assets in the City are included in **Table 1.3**.

Table 1.3. Public Stormwater Assets

Public Stormwater Assets Type	Total Number
Catch Basins ¹	3,418
Maintenance Holes ¹	1,050
Outfalls ²	95
Open Ditches and Channels ²	27.8 miles
Culverts ²	6.8 miles
Pipe ¹	85.3 miles
Green Stormwater Infrastructure (GSI) ²	126

¹Data sourced on May 22, 2024.

²Data sourced on March 21, 2024.

1.9 EXISTING LAND USE AND SOILS

Development on Fidalgo Island is spread along the west, east, and north shorelines of the island, with downtown Anacortes located in the northeastern section of the island. The City of Anacortes contains a mix of development and in total encompasses a land area of approximately 11.7 square miles (Census 2021).

The existing land uses within the City are summarized in **Table 1.4** and shown graphically in **Figure 1.5**.

Table 1.4. Existing Land Use Data

Existing Land Use Type	Total Area (acres)
Aeronautical Zone (AZ)	118.7
Commercial (C)	148.4
Central Business District (CBD)	58.5
Commercial Marine (CM)	589.98
Heavy Manufacturing (HM)	2111.8
Industrial (I)	170.3
Light Manufacturing (LM)	1,009.1
Marine Mixed Use (MMU)	248.3
Manufacturing and Shipping (MS)	54.9
Old Town (OT)	156.5
Public Use (P)	3,550.3
Residential (R)	43.3
Residential High Density 4A (R4)	22.1
X (RHD)	183.9
X (RHD Mixed)	86.1
X (RHD 1)	296.5
X (RHD 2)	1987.62
X (RMD)	489.6
Total	9,346.8¹

¹ The total area 14.6 square miles is less than the total area of the city limits because land use data (received from the City in November 2024) does not include the water that is included in the total city limits. There is also a portion of the zoning data that is outside of the City limits.

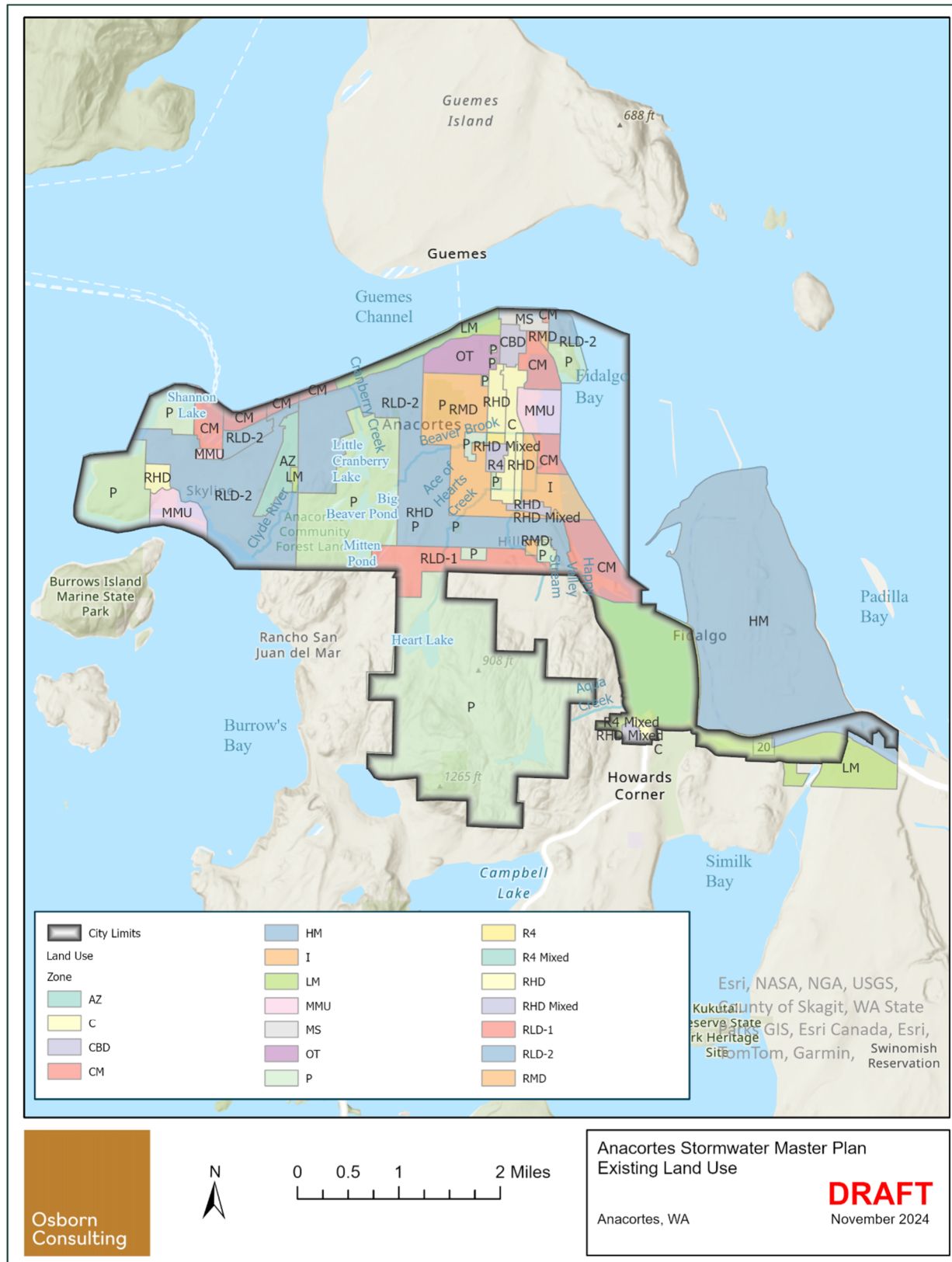


Figure 1.5. Existing Land Use

The existing land use and soil types greatly influence stormwater runoff, infiltration potential, and depth to groundwater. For this plan, the soils within the City have been grouped according to the U.S. Soil Conservation Service's Hydrologic Soil Group (HSG) classification system, which provides a general indication of stormwater runoff potential. The HSG system classifies soils based on their infiltration rates when bare of vegetation. Slope and plant cover are not considered in the groupings and are separate factors in predicting runoff.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

Following the HSG classification system, soils in the United States are assigned to four groups (A, B, C, or D) and three dual class groups (A/D, B/D, or C/D). The four primary soil groups are defined as follows:

- **Group A** – Soils that have a high infiltration rate and low runoff potential when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B** – Soils that have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained, or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C** – Soils that have a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **Group D** – Soils that have a very slow infiltration rate and high runoff potential when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

For soils assigned to a dual class hydrologic soil group (A/D, B/D, or C/D), the first letter applies to the drained soil condition and the second to the undrained soil condition of the location so categorized. Only soils, which in their natural condition fall under Group D (wet soils) but that can also be adequately drained (as represented by either Group A, B, or C designations), are assigned to dual classes.

Most soil types found in Anacortes are hydrologic soil groups C and D. The other major soil groups inside the City are found in smaller areas and include hydrologic soil groups A and B. The City's soil types are shown in **Figure 1.6**. Anacortes Soils and described in **Table 1.5**.

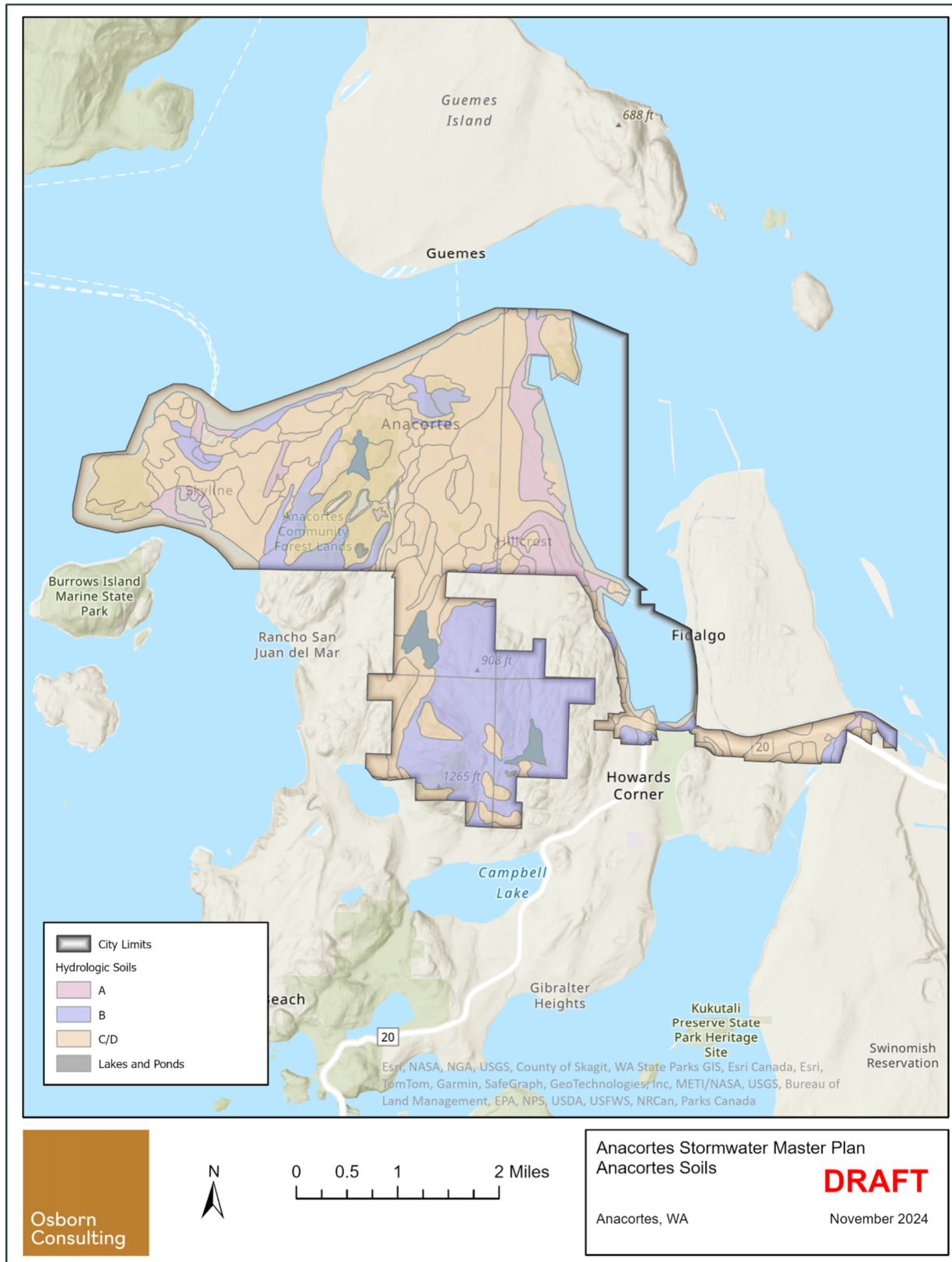


Figure 1.6. Anacortes Soils

Table 1.5. Existing Soils Data

Soils Type	Hydraulic Soil Group Type	Total Area (acres)
Bellingham mucky silt loam	Groups C/D	89.4
Bellingham silt loam	Groups C/D	22.8
Bow-Urban land complex	Groups C/D	547.2
Bow gravelly loam	Groups C/D	6.6
Bow gravelly loam, dry	Groups C/D	586.5
Catla gravelly fine sandy loam	Group D	562.8
Clallam-Urban land complex	Group C	493.9
Clallam gravelly loam	Group C	428.2
Coveland-Bow complex	Groups C/D	55.3
Coveland gravelly loam	Groups C/D	372.2
Dystic Xerochrepts	Group B	65.2
Fidalgo-Lithic Xerochrepts-Rock outcrop complex	Group C	335.1
Hydraquents, tidal	Groups B/D	43.0
Keystone loamy sand	Group A	216.5
Laconner very gravelly loamy sand	Group B	150.9
Lithic Haploxerolls-Rock outcrop complex	Group D	246.2
Mukilteo muck	Groups B/D	36.5
Norma silt loam	Groups B/D	66.5
Pits	—	21.3
Swinomish-Fidalgo-Rock outcrop complex	Group C	761.4
Swinomish gravelly loam	Group C	101.3
Tacoma silt loam	Groups C/D	0.4
Tacoma silt loam, drained	Group C	7.5
Terric Medisaprists	Groups C/D	59.9
Water ¹	—	166.6
Whistle-Fidalgo-Rock outcrop complex	Group B	1,770.2
Xerorthents	Group A	399.4
Total		7,612.9

¹The city limit boundary includes a portion of Puget Sound.

1.10 POPULATION GROWTH

The Skagit County *Population, Housing, and Employment Growth Allocation Methodology Report*, published December 12, 2023, estimates the population of Anacortes in 2022 to be 17,882 people, with an additional 101 people living in the unincorporated UGA, as shown in **Table 1.6**.

Table 1.6. Anacortes Population Growth Allocation, 2022–2045

Urban Growth Area	2022 Population	2025 Population	2045 Population Targets	2022–2045 Population Growth	
				Amount	Percent of Total Growth
Incorporated Anacortes	17,882	18,686	22,843	4,921	17%
Unincorporated	101	105	127	26	26%

According to this report, the total population of the City of Anacortes is projected to grow by 17 percent between the years 2022 and 2045. The 2025 projected population is 18,686 people and is projected to increase to 22,843 people by 2045. Provided by the City's GIS Department, there are a total number of 501 parcels in the City.

The Anacortes Capital Facilities Plan (CFP) projected the rate of population growth and the rate of commercial, industrial, and multifamily residential development. The rates of growth and development are two significant factors in estimating the relevant expenditures and timing for developing city stormwater management facilities. The UGA planning area of the City of Anacortes was sized to accommodate the entire projected planning area for a build-out population of 19,300.

The CFP has not contemplated expanding the UGA boundary to accommodate the suggested 2024 population allocation. The Growth Management Act allows annual revision of the CFP. The UGA Plan includes provision for annual review of development. This allows the projected rate and the CFP to be revisited if the projected development rate varies significantly from the actual rate. The population and development projections in the CFP are the basis for projections of impervious surface and stormwater runoff.

1.11 MS4 REGULATORY REQUIREMENTS

The City has a robust SWMP that is driven by the local regulatory requirements described in detail in Section 1.11. It is important for the City to remain in compliance. The Federal Clean Water Act (CWA) established the basic structure for regulating discharges of pollutants into the waters of the United States and regulating water quality standards for surface waters. The CWA's primary objective was to restore and maintain the integrity of the nation's waters.

The objective translates into two fundamental national goals:

1. To eliminate the discharge of pollutants into the nation's waters.
2. To achieve water quality levels that are fishable and swimmable.

The U.S. Environmental Protection Agency (EPA) regulates stormwater under Section 402(p) of the CWA, including regulating discharges from municipal separate storm sewer systems.

The NPDES permitting program regulates point sources that discharge pollutants to the waters of the United States. EPA delegated NPDES permit authority to Ecology.

Under Washington's Water Pollution Control Act, Ecology issued Municipal Separate Storm Sewer System (MS4) general permits in two phases. The Phase I Permit was first issued in 1995 to cover incorporated cities with a population of more than 100,000 people and unincorporated counties with a population of more than 250,000 people. Two Phase II Permits were first issued in 2007: one for Western Washington and one for Eastern Washington. Both cover MS4s serving less than 100,000 persons and construction sites disturbing more than one acre.

The City of Anacortes is a permittee under the NPDES Phase II Municipal Stormwater Permit for Western Washington issued by Ecology. The most recent permit was issued on July 1, 2024, and became effective on August 1, 2024. Previous permits were issued in 2007, 2013, and 2019.

The Phase II Permit allows municipalities to discharge stormwater runoff from their municipal drainage systems into Washington State bodies of water, including streams, rivers, lakes, and wetlands, under conditions specified in the Phase II Permit. Municipalities must implement programs to protect water quality by reducing the discharge of pollutants to the maximum extent practicable by applying all known, available, and reasonable treatments. Stormwater pollution reduction is accomplished through the application of structural and nonstructural BMPs.

The Phase II Permit also requires compliance with established total maximum daily loads (TMDLs), as described in Section S7 of the permit. As of 2024, Anacortes has not established any TMDLs.

On March 31 of each year, the Phase II Permit requires the City to submit a report to Ecology on the City's status of compliance with the permit. The City must also submit a SWMP Plan each year that describes the activities for the coming year. The stormwater management activities specified in the Phase II Permit are documented in a SWMP Plan and typically compiled by City staff. For more information on the existing program, see **Section 1.12**. Implementation of specific Phase II Permit conditions are staggered throughout the 5-year Phase II Permit term.

In the 2024 Phase II Permit, there were changes and updates from the 2019 Phase II Permit. Significant changes are summarized in **Table 1.7** with an estimated level of effort for implementation as low (\$), medium (\$\$) or high (\$\$\$) based on professional judgement.

Table 1.7. New or Increased Requirements of the 2024 NPDES Phase II Permit

Section Reference	Requirement	Requirement Description	Programmatic Activities	Level of Effort	Due By Date
S5.A.3.a	Cost by Stormwater Management Plan (SWMP) Element	- Track the cost or estimated cost of development and implementing each component of the SWMP. - Provide average annual costs in the Annual Report to implement the TMDL and SWMP.	- Review budget tracking and timesheets system with the city's finance department for required updates to track time and costs per SWMP element. - Update the timesheet system, as needed, for ease of reporting.	\$	March 31, 2027
S5.C.1.iii	Tree canopy goals and policies	Adopt or implement tree canopy goals and policies to support stormwater management and water quality improvements in receiving waters.	- Review all City tree canopy goals and policies, including the Anacortes Municipal Code (AMC). Collaborate with the city's planning services, as needed. - Identify needed updates to support stormwater management and water quality improvements.	\$\$	December 31, 2028
S5.C.1.d.i	Stormwater Management Action Plan (SMAP)	Complete a SMAP for at least one new priority catchment area or additional actions for an existing SMAP. Address transportation-related runoff such as projects that address tire wear runoff.	- Determine if the city wants to write another SMAP or develop additional actions for the existing Fidalgo North SMAP. - New SMAP or additional actions need to address tire wear and 6PPD.	\$\$\$	March 31, 2027
S5.C.4	New Municipal Separate Storm Sewer System (MS4) Mapping Requirements	- Submit the known locations, size, and materials of all known MS4 outfalls according to the standard templates and format. - Map the tree canopy cover on Permittee-owned or operated properties. - Map and assess the acreage of MS4 tributary basins to outfalls or discharge points that have stormwater treatment and flow control BMPs that are owned or operated by the Permittee.	- Review MS4 outfall locations to determine if any updates to the mapping need to occur. Locate additional outfall information, as needed, to fill the gaps. - Submit the MS4 outfall mapping requirements per Ecology's templates. - Determine a process for mapping tree canopy in GIS for City owned-operated properties. Collaborate with the city's planning services. - Map tree canopy and produce data inputs for the Annual Report.	\$\$\$	March 31, 2026 March 31, 2026 March 31, 2028
S5.C.5.c	Illicit Discharge Detection and Elimination (IDDE) Ordinance or Code	Update the IDDE Ordinance or Code to include PCB regulations around building washdown and procedures for post-emergency clean-up of firefighting activities.	- Review the AMC's existing IDDE code and update to address PCB regulations and firefighting activities, as needed. - Adopt new IDDE code.	\$	July 1, 2027

Section Reference	Requirement	Requirement Description	Programmatic Activities	Level of Effort	Due By Date
S5.C.7	Stormwater Management for Existing Development (SMED)	<u>New SMED Program</u>: Implement a program to contract and reduce stormwater discharges to the waters of the state from areas of existing development. The amount of treated area required varies by jurisdiction (8 acres for every 50,000 people). - The City of Anacortes is required to treat 2.9 acres of existing impervious area.	The City has met the SMED requirement, see Sections 1.11.4 and 1.12.7.	\$\$\$	March 31, 2028 (<i>Fund and start construction date</i>)
S5.C.8.a	Source Control Ordinance or Code	Update source control ordinances or other enforceable documents, if needed. Applicable operational source control BMPs are required for all pollutant-generating sources. If the operational source control BMPs do not prevent illicit discharges or violations of surface water, groundwater, or sediment management standards because of inadequate stormwater control, either structural source control BMPs or treatment BMPs or both are required.	- Review the AMC's existing source control codes. Update as needed to meet new permit requirements. - Adopt new Source Control Code.	\$	August 1, 2027
S5.C.8.d	Source Control Enforcement Policy	Develop and implement a progressive source control enforcement policy that requires sites to comply with the stormwater requirements within a reasonable period.	- Research other Phase II source control escalating enforcement policies. - Development and implement a policy. Work with local source control inspectors to implement the new policy.	\$\$	August 1, 2027
S5.C.9.a	Maintenance Standards	- Update maintenance standards as needed to comply with the 2024 SWMMWW. - Maintenance inspections are required to be conducted by qualified personnel or qualified third parties.	Update maintenance standards, as needed, in the AMC and other procedural documents including SWPPPs. Address PCBs for building (built 1950–1980) washdown. Create an inventory of buildings built between 1950–1980.	\$\$	June 30, 2027
S5.C.9.e	Street Sweeping	Develop and implement a municipal street sweeping program to target high-priority areas and times during the year that are reasonably expected to result in the maximum water quality benefits to receiving waters.	- Identify high priorities for street sweeping including for curbed streets that discharge to outfalls. Consider high traffic streets and streets that serve commercial or industrial land use areas. - Implement new street sweeping locations and updated frequencies.	\$\$\$	July 1, 2027

Through discussions with City staff, Osborn learned that the City wants to focus its NPDES compliance efforts on Tree Canopy Goals and Policies, addressing PBCs in Operations and Maintenance, reaching and engaging the overburdened communities, and addressing the requirements for the new SMED program. Based on the request of City staff, details for both the Phase II Permit requirements and suggestions on next steps for the City to meet those requirements were documented and are included in **Sections 1.11.1 and 1.11.4. Section 1.11.4** describes the City's recent compliance activities for the SMED program.

1.11.1 Tree Canopy Goals and Policies

In accordance with the Phase II Permit specifications in S5.C.1.iii, the City is required to implement a Stormwater Planning Program, which will be used to inform and assist in the development of water quality management policies and strategies. The City's SWMP program will need to adopt and implement tree canopy goals and policies that consider how both existing and future tree canopies can support stormwater management and water quality improvements in the receiving waters including Guemes Channel, Burrows Bay, Padilla Bay, Similk Bay, and Fidalgo Bay by December 31, 2028.

The program is also mandated to implement a long-term goal based on the existing and future projections for tree canopies spanning five to ten years, or longer. Special attention should be directed toward maintaining or increasing the span of tree canopies in overburdened communities and maintaining existing mature tree canopies. Long-term goals refer to goals that are five to ten years or longer for tree canopy policies, for existing or future projections, to be used for stormwater management that is appropriate for the local jurisdiction. Specific considerations for stormwater management on City-owned or operated lands shall include maintaining or increasing tree canopy in overburdened communities and maintaining existing mature tree canopies.

In addition, the City's SWMP is required to establish new mapping of tree canopies on City owned or operated properties, particularly areas recognized as overburdened communities. The SWMP must also develop a system for identifying tree canopies for stormwater management purposes, which should be updated annually or as needed.

To address this Phase II Permit requirement, the City will need to review all City tree canopy goals and policies, including the AMC. This may require collaboration with the City's planning services. The City will identify needed updates to support stormwater management and water quality improvements through updating tree canopy goals and policies.

1.11.2 Addressing PCBs in Operation and Maintenance

The City is required to perform updated operation and maintenance activities for exterior building washdown to address PCBs per S5.C.5.e and S5.C.9.d.xv of the Phase II Permit. Commercial, industrial, and multistory residential structures constructed or renovated between the years 1950 and 1980—that is, those buildings that most likely to have PCB-containing building materials—shall be assessed for PCB-containing materials consistent with *How to find and address PCBs in building materials* (Ecology, 2024, Publication No. 22-04-024) prior to routine building washdown to the City's MS4 system. Structures confirmed or suspected to have PCB-containing materials shall not discharge washdown to the MS4. Single-family residents are exempt from this requirement.

To address this Phase II Permit requirement, the City will need to develop a comprehensive inventory of buildings built between 1950 and 1980 that will be impacted by this new requirement. Easy-speak public education requirements will need to be developed for property owners or property management companies who own buildings built in that timeframe. If the City's maintenance yard has buildings built in

this time period, an update to their Stormwater Pollution Prevention Plan (SWPPP) may be necessary to address PCB management in exterior building washdown.

In addition, the City may need to update their IDDE code in AMC 18.30.050 along with other policies and practices to address PCBs in external building washdown. This may include adding source control BMPs to minimize PCBs from entering the MS4 during routine external building washdown and the use of detergents for buildings built between 1950 and 1980.

1.11.3 Public Involvement for Overburdened Communities

The City is required to provide public involvement and participation opportunities to overburdened communities according to S5.C.4.a of the Phase II Permit. *Overburdened communities* can be defined as geographic areas or communities where vulnerable populations face adverse socioeconomic factors that expose them to a higher risk of environmental harms or disparate health outcomes. These populations include racial and ethnic minorities, low-income populations, and populations otherwise disproportionately exposed to and impacted by environmental harms or health risks. To this end, the City must create opportunities for the public to participate in decision making processes involving development, implementation, and updating the City's SMAP and SWMP documents. Moreover, to address this Phase II Permit requirement more specifically, the City should take clear steps towards creating these opportunities for overburdened communities and is required to annually document how it engages with overburdened communities.

1.11.4 Stormwater Management for Existing Development

The City is required to implement a new Stormwater Management for Existing Development (SMED) Program per S5.C.7 and Appendix 12 of the Phase II Permit. The SMED program requires the City to implement a program to contract and reduce stormwater discharges to the waters of the state from areas of existing development. The amount of treated area that is required varies by jurisdiction, but the consistent standard of 8 acres for every 50,000 people applies everywhere. By March 31, 2028, the City must have funded and started construction on projects for water quality treatment of 2.9 acres per Appendix 12 of the Permit.⁶

The City is in compliance with the new SMED requirement. In a recent project (*projects completed after January 1, 2023 are eligible*), the City added additional treatment of approximately 2.9 acres along R Avenue that meets this Permit requirement. As a result of this project, the City is in compliance with the new SMED requirement.⁷

1.12 EXISTING STORMWATER MANAGEMENT PROGRAM

Under the Phase II Permit, the City of Anacortes is required to develop and implement a Stormwater Management Program (SWMP), which is a set of actions and activities required under the Permit. Successful implementation and management of the City's stormwater program demand a clear understanding of the Phase II Permit requirements. To better understand how the City is in compliance, a summary of the City's SWMP is provided in this section.

The SWMP is administered through an effort with multiple departments overseen by the Stormwater Program Manager and Stormwater Division staff. Other departments involved include but are not limited to the following:

⁶ [App12 WWAPhasell](#)

⁷ Project information received on 10/23/24 from the City regarding this project meeting SMED requirements.

- Public Works Department
- Planning, Community, and Economic Development Department
- City Attorney's Office
- Finance Department
- Information Services
- Parks and Recreation Department
- Police and Fire Departments

Coordination is conducted between the City departments, with the neighboring jurisdictions, and community partners. Community partners include the following parties:

- Skagit County Conservation District
- Samish Indian Nation
- Port of Anacortes
- Skagit Marine Resources Committee
- Skagit Watershed Council
- Friends of Skagit Beaches
- The Salish Sea School
- Stormwater Action Monitoring

The following are required components of the SWMP and associated Permit reference:

- Stormwater Planning (S5.C.1)
- Public Education and Outreach (S5.C.2)
- Public Involvement and Participation (S5.C.3)
- MS4 Mapping and Documentation (S5.C.4)
- Illicit Discharge Detection and Elimination (S5.C.5)
- Controlling Runoff from New Development, Redevelopment, and Construction Sites (S5.C.6)
- Stormwater Management for Existing Development (S5.C.7)
- Source Control for Existing Development (S5.C.8)
- Operation and Maintenance (S5.C.1)

This section has provided an overview of the City's existing program. The City's SWMP documentation is available on the City's website.⁸

⁸ The City's SWMP can be accessed at anacorteswa.gov/DocumentCenter/View/26405/2024-SWMP-Plan.

1.12.1 Stormwater Planning

The City is active in stormwater planning and conducts regular interdepartmental meetings concerning topics in Citywide stormwater management and planning activities. In 2019, the City passed an ordinance that includes guidelines and regulations around low impact development (LID), illicit discharge detection and elimination (IDDE), operations and maintenance (O&M), and clearing and grading stormwater standards. In 2022, the code was amended to address the Permit's requirements to implement a local source control program. In 2023, the City completed the Fidalgo North SMAP with actions to improve water quality in this high priority basin for the City.

1.12.2 Public Education and Outreach

Over the past several years, the City has made a commitment to providing a variety of public education and outreach activities and educational opportunities for local residents and visitors to Anacortes. These activities collectively have helped to either reduce or eliminate behaviors or practices that may cause or contribute to adverse stormwater impacts and encourage the public to participate in stormwater-related activities. The City has partnered with Skagit Conservation District (SCD), Skagit County, the City of Mount Vernon, City of Burlington, and the City of Sedro-Woolley in several public education and outreach projects.

1.12.3 Public Involvement and Participation

The City's SWMP involves the public in decision-making processes and provides opportunities for increased participation. The City plans multiple activities a year for the public to provide input and participate in City Council meetings, documentation on the City website, community events, in addition to the *City's Permit Annual Report*, which is publicly available.

1.12.4 MS4 Mapping and Documentation

The City began a stormwater utility mapping program in 2006. Mapping of the stormwater system has been vital to helping the City manage resources and plan for development and redevelopment projects. Mapping has also aided tracing stormwater pollution from sources to receiving waters, serves as a tool for IDDE investigations, and can be used in public education activities.

The mapping of the system's inventory has been achieved through utilizing a variety of GPS equipment in the field to collect spatial and attributional information about drainage assets. The City has a comprehensive mapping of the municipal separate storm sewer system (MS4), including stormwater conveyance, infrastructure, treatment, and flow control BMPs, all known outfalls, receiving waters, drainage areas, land uses, wetlands, and other components.

The City has used the Cartegraph asset management system for Public Works, including the Stormwater Division, which allows City staff to access detailed information relating to the storm system both out in the field and at the office. Field staff can verify stormwater asset information for catch basins, pipes, storm ponds, or outfalls, and record the inspection findings and the maintenance activities conducted.

The City's MS4 System is shown in **Figure 1.7. Municipal Separate Storm Sewer System (MS4)** The mapping data is updated on a continuous basis in collaboration with the Street/Sewer Department, the Stormwater Division, and the GIS Division.

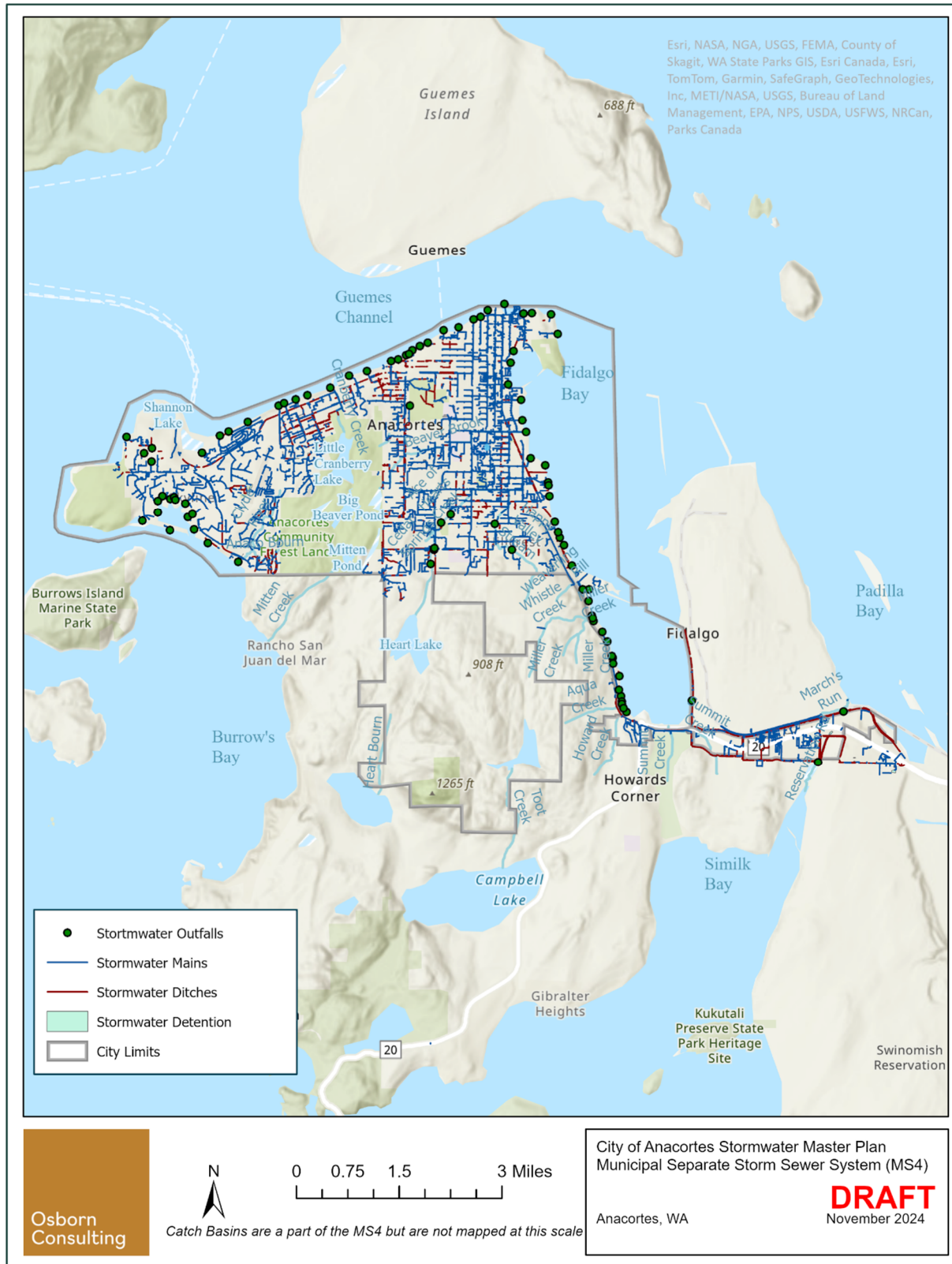


Figure 1.7. Municipal Separate Storm Sewer System (MS4)

1.12.5 Illicit Discharge Detection and Elimination

The City's illicit discharge detection and elimination (IDDE) program consists of activities to detect, identify, address, and eliminate spills and other illicit discharges and connections to the MS4 based on the requirements described in code section *AMC 18.30 Illicit Discharges and Connections to the Stormwater Drainage System*.

The program involves such procedures as field screening, stormwater monitoring, spills, and complaint response and construction inspections. The City conducts stormwater outfalls monitoring with a partnership with Friends of Skagit Beach, a nonprofit organization, and shares outfall sampling data and IDDE investigation reports with the Samish Indian Nation, a federally recognized tribe in Washington state.

1.12.6 Controlling Runoff from New Development, Redevelopment and Construction Sites

The City's SWMP includes a program that aims to reduce pollutants in stormwater runoff from new development, redevelopment, and construction site activities. The City's Public Works and Planning, Community and Economic Development Departments are responsible for permitting, site plan review, inspections, and code enforcement actions, and work with the Stormwater Division. The City currently requires all projects to comply with the standards of the 2019 edition of the Stormwater Management Manual for Western Washington (SWMMWW), published by Ecology.

1.12.7 Stormwater Management for Existing Development

This is a new element of the SWMP in the new Phase II Permit. According to Appendix 12 of the Permit, the City will be required to provide water quality treatment for 2.9 acres of existing impervious surfaces to meet the new SMED requirements. The City has completed a recent project (see Section 1.12) and has met the requirements.

1.12.8 Source Control for Existing Development

In 2022, the City passed Ordinance 4023 with the amended *Chapter 18.30 Illicit Discharges and Connections to the Stormwater Drainage System* that added the requirement for source control BMPs to be implemented for pollutant-generating sources at businesses. The City maintains an inventory of businesses, which is actively updated, that have the potential to generate pollutants that may enter the City stormwater drainage system. The City's goal is to conduct source control inspections for 20 percent of the local businesses in the City each year.

1.12.9 Operation and Maintenance

The City's O&M Division, within Public Works, is responsible for the stormwater system inspections, cleaning, and maintenance. This includes catch basin inspection and cleaning, street sweeping, facility cleaning and maintenance, spill response and control, and flood response and repair. The City maintenance standards are found within the 2019 SWMMWW.

The City requires all privately owned permanent stormwater facilities to have a maintenance agreement on file with the City. The City conducts annual inspections of all treatment and flow control facilities that discharge to the MS4 and that were permitted pursuant to the City's process for permitting, site plan review, and inspections. Existing permanent stormwater facilities are inspected to review whether ongoing maintenance is being completed. City staff records all inspections.

1.13 COMMUNITY AND CITY COUNCIL INPUT

Work on the Plan began in March of 2024 and an initial draft was submitted to staff in November 2024. The City's Public Works staff and Consultant team presented the initial findings to City Council on January 27, 2025.

2 STORMWATER PIPE REPAIR AND REPLACEMENT PROGRAM

As part of the development of this Stormwater Master Plan, the City created the framework for a new Stormwater Pipe Repair and Replacement Program. This program will enable the City to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing stormwater pipes. This risk and asset-management based approach for O&M of stormwater pipes increases resource efficiency, helps achieve level of service goals, allows limited resources to be focused on critical assets, and provides an understanding of the impact on decision making.

2.1 STORMWATER PIPE REPAIR AND REPLACEMENT

The City is developing a program to assess the condition of stormwater pipes that will enable the City's Stormwater Management team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing these assets. The program will include closed-circuit television (CCTV) inspections of stormwater pipes in the City and determine the Likelihood of Failure (LoF) and Consequence of Failure (CoF) for each pipe inspected. The program will also provide maintenance, rehabilitation, and replacement recommendations to improve the effectiveness of the stormwater management program. This initiative will benefit the City's residents and protect local waterways from pollution and flooding. For more information about this new stormwater pipe repair and replacement program, see **Section 5** and **Appendix B**.

The program framework includes a cyclical process of understanding and inspecting the system, performing condition assessment, and scheduling repair, replacement, or maintenance based on the condition and a consequence-based risk assessment. The City completed the inventory of known assets and prioritized pipes for inspection based on drainage basin priority. The City has inspection data for 237 pipes that were inspected between 2018 and 2024 and plans to kick off the new program by inspecting 2.5 miles of pipe in the Fidalgo South Basin in 2025. This first year will help the City work through the program and establish ongoing staffing, methodology, and processes. Starting in 2025, the City plans to inspect 4 miles of pipe, ramping up to a goal of 5.3 miles of pipe per year in 2027 and beyond. Consistently inspecting 5.3 miles of pipe per year will equate to approximately a 15-year inspection cycle.

Figure 2.1 illustrates the stormwater pipes that have been inspected to date and their corresponding National Association of Sewer Service Companies (NASSCO) Quick Structural Ratings (QSRs). A QSR that begins with a 5 corresponds to the most significant defects, whereas a QSR that begins with a 1 corresponds to minor defects. A QSR with a score of 0000 indicates that no defects were present during inspection. QSRs are described in more detail in *Section 2.1 Likelihood of Failure of the Stormwater Pipe Repair and Replacement Program Technical Memorandum* provided in **Appendix B**. This technical memorandum describes the program framework in detail and includes workflow diagrams for inspection, data management, and condition assessment.

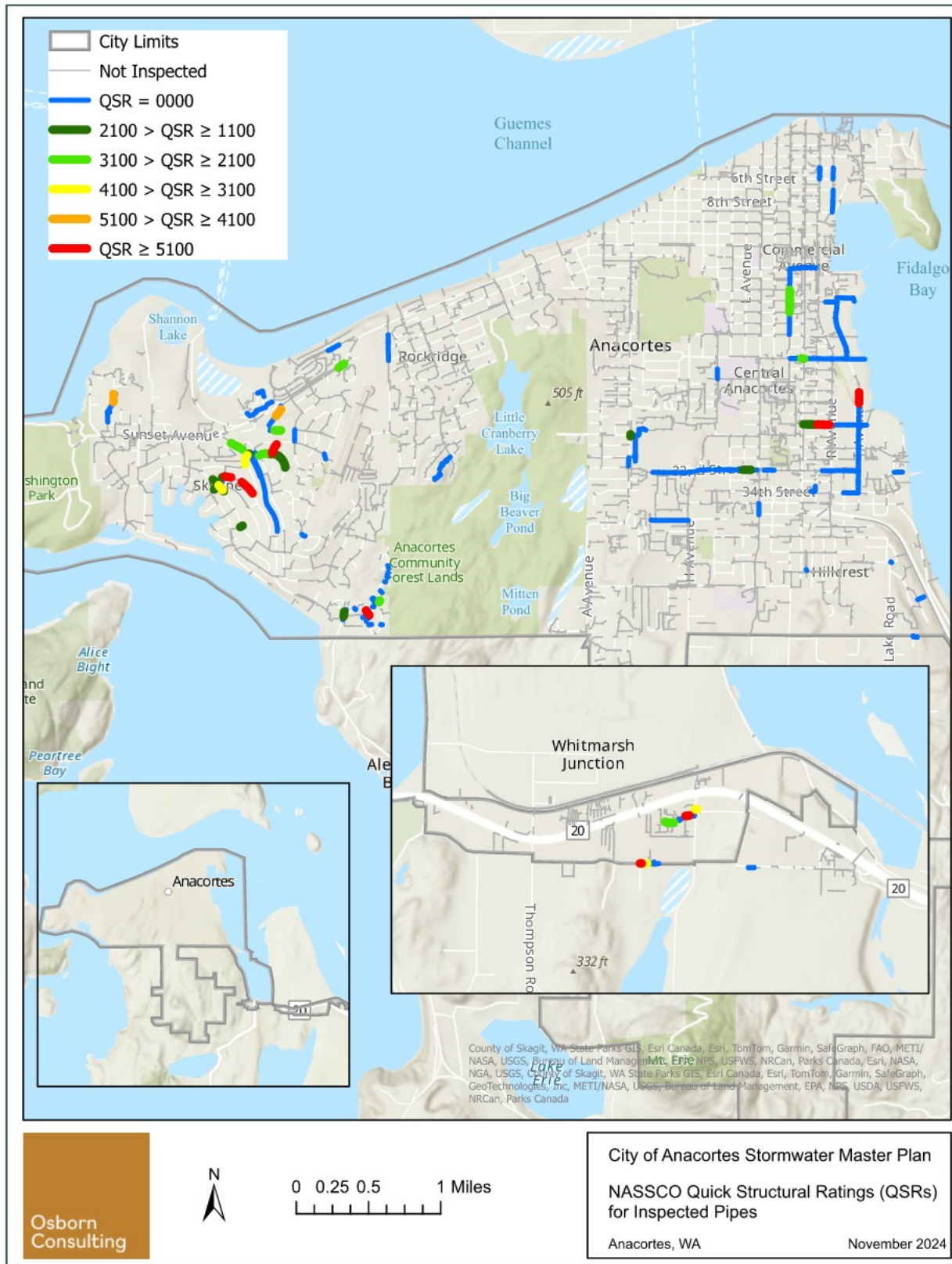


Figure 2.1. NASSCO Quick Structural Ratings (QSRs) for Inspected Pipes

3 CITYWIDE HYDROLOGIC AND HYDRAULIC MODELING

This section provides an overview of the citywide hydrologic and hydraulic modeling and covers the methodology, study design storms, model results, and potential CFPs. The analysis performed in this section is intended to support the development of Capital Facility Projects and Program needs within the City. The model is built to support future analysis of the system for different planning scenarios.

3.1 BACKGROUND

Previous hydraulic modeling conducted in 2007 utilized the Mike-Urban modeling platform. This platform is no longer supported and no longer available to City staff. Moreover, the previous models were created using data that was collected nearly two decades ago.

Osborn created updated models using newer data in the modeling software PCSWMM, which serves as a user-friendly analysis toolbox for the EPA Stormwater Management Model (SWMM) program. These models will better simulate rainfall as it travels through both the natural and built environment and represent the physical attributes of the City's streams and piped systems. Further, the results can be used to identify drainage system surcharging and flooding and to verify the MS4 permitting exemptions that are applicable.

The modeling that Osborn conducted assumed that the drainage network was in good condition. However, during the field investigations, the team observed evidence of pipes and ditches that are in need of maintenance or repair. One example is the ditch and culvert system along Q Avenue near 25th Street where the driveway culverts appear to have blockages that were not included in the model. These maintenance issues were not considered in the model because the purpose of the modeling was to identify system capacity constraints that would require capital investments or maintenance.

3.2 MODELING DATA AND SOURCES

Osborn utilized the City's topographic survey data, GIS data, and record drawings to perform calculations and develop hydrologic and hydraulic models. This data was collected in part to ensure that the resulting models represent the existing field conditions.

The following data was collected and referenced in this study:

- Urban Hydrology for Small Watersheds, TR-55, United States Department of Agriculture, dated June 1986.
- Stormwater Management Manual for Western Washington (SWMMWW), Washington State Department of Ecology (Ecology), published 2024.
- 2017 North Puget Digital Terrain Model (DTM), Department of Natural Resources.
- 20-foot contours, ESRI World Topographic Map.
- GIS data, CAD data, and as-builts provided by the City of Anacortes.
- Site visits conducted by Osborn and City staff.

3.3 EXISTING CONDITIONS

The City's stormwater infrastructure consists of ditches and pipes, with some pipes that were installed as early as the 1900s. The local topography varies greatly throughout the City of Anacortes, with flat terrain

in and around the downtown core of the City and steep hillside topography with 90-percent slopes near Heart Lake and Little Cranberry Lake. All the drainage basins eventually drain into their namesake bays or out into forested areas and wetlands towards the center of the city. Figures of each model broken down by basin can be found in **Appendix C**. Many parts of the stormwater system contain 8-inch-diameter pipes, which were installed based on the contemporary development conditions at the time. These pipes have been identified as undersized.

This study evaluated the existing storm system throughout the City, as shown in **Figure 3.1**. For more information about the City's drainage system and basins, see **Section 1.8**.

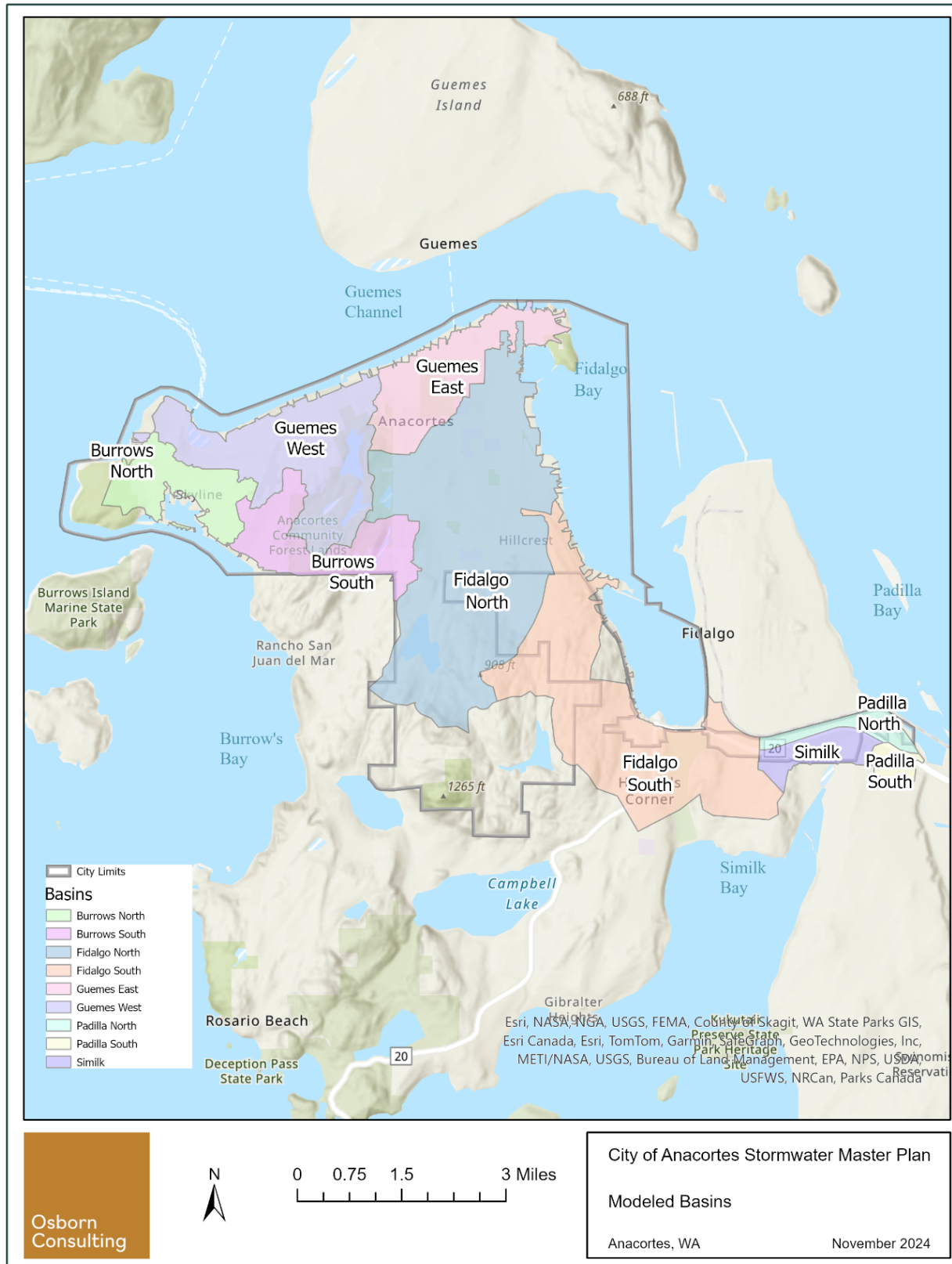


Figure 3.1. Modeled Basins

3.4 MODELING METHODOLOGY

Hydrologic and hydraulic modeling was conducted using PCSWMM version 5.2.4, the EPA SWMM modeling engine, and the standard drainage attributed criteria ranges set outlined in the Storm Water Management Model User's Manual Version 5.2 (EPA/600/R-22/030, February 2022). All elevations in this project are tied to NAVD 88. Maps, GIS data, and LiDAR in this study are spatially referenced to NAD 83 State Plane Washington North FIPS 4601 (in U.S. Feet). Features studied included in the model for each respective basin include junctions like maintenance holes, conduits like pipes and ditches, storages like ponds or vaults, and outfalls. A more detailed description of the hydrologic methodology and of the parameters used in the PCSWMM model is provided in **Appendix D**.

3.4.1 Design Storms

Hydrologic modeling of the existing conditions was developed to evaluate the capacity and expected flows through the system. The three following design storms were used to analyze the system capacity.

A **25-year 3-hour design storm** was utilized to understand how the system performs in atmospheric River conditions.

For this design storm, a conversion factor of 1.06, determined from Appendix F of the 2017 *Seattle Public Utilities Stormwater Manual*, was used to convert the 25-year 2-hour precipitation depth to the 3-hour storm depth.

A **25-year 24-hour design storm** is the standard storm utilized by the City's design guidelines. The total volumes for this design storm are derived from the department of Ecology's Isopluvial maps. The maps indicate that the City is on the border of a 2.5-inch to 3-inch isopluvial range.

Osborn reviewed the City's daily rainfall records taken at the Anacortes Wastewater Treatment Plant from 1992 to 2024 to support the development of an accurate design storm volume. The data was not suitable to be used as a design storm because it is lacking 5-minute rain volumes.

The highest 24-hour rainfall that occurred in this period was approximately 2 inches—33 percent lower than the rainfall depth of 3.0 inches published in the report "Washington 24-hour Isopluvial Maps" by the Washington State Department of Transportation. Based on this information, a 25-year 24-hour rainfall depth of 2.5 inches was used as it was the low end of the isopluvial range. A review of a longer data set spanning over 50 years is required if a lower volume design storm is to be used than is on the published Isopluvials.

A **25-year 24-hour climate perturbed design storm** provides insights into how the system is predicted to perform when higher intensity storms occur in the region. To develop this storm event, it is necessary to determine the climate precipitation extremes to account for future increases or decreases in precipitation rates.

Based on data from *Changes in Climate Extremes and their Impacts on the Natural Physical Environment*, an increase of 15 percent increase in volume for the existing 25-year 24-hour precipitation rate is predicted to occur between the years 2081 and 2100. This value was determined by reviewing the median precipitation rates for Western North America for a midrange greenhouse gas emission scenario where a hot day experienced once in 20-years becomes a day experienced once in three years.

The SCS Type 1A rainfall distribution was selected as the hyetograph, which is the suggested distribution for the Pacific Northwest. The design storms were input into the PCSWMM model to simulate the rainfall

and the runoff response of each basin. A summary of the rainfall depths used for the design storms is shown in **Table 3.1**.

Table 3.1. Design Storm Magnitude Summary

Design Storms	Magnitude (in/day)
25-year 3-hour	1.070
25-year 24-hour	2.500
25-year 24-hour climate perturbed	2.875

3.4.2 Drainage Area Delineation

The model consists of 1,110 catchments that were delineated into building sub-catchments, right-of-way (ROW) sub-catchments, and C sub-catchments. The amount of impervious and pervious area for each land type was accounted for to accurately predict peak flow runoff collected by the drainage system.

3.4.3 Sea Level Rise Considerations

The hydraulic model utilized the local mean higher-high water (MHHW) surface elevation as the tailwater condition at all outfalls to the associated bays. The hydraulic model employed a tailwater condition of 10.0 feet NAVD88, corresponding to the local MHHW elevation.

Osborn reviewed the sea level rise identified in the *City of Anacortes Critical Areas Ordinance Update: Frequently Flooded Areas - Draft Update* (October 19, 2021). This ordinance update predicts 2.1 feet (medium 50 percent exceedance) and 4.9 feet (high 1 percent exceedance) for sea level rise within the bays around Anacortes, which would result in a tail water condition at the outfalls of 12.1 feet to 14.9 feet, respectively.

After reviewing the findings in the prior study, Osborn determined that the tailwater conditions would result in similar inundation as identified within the Flooded Areas-draft update maps. Osborn did not model the sea level rise in the models. The flooding and inundation identified in the 2021 study is more accurate because it is based on a 2D surface rather than the PCSMM models that utilize a 1D surface.

3.5 MODEL RESULTS

The flooded maintenance holes for each of the modeled basins are summarized in **Table 3.2** for each of the three design storms. The results indicate the order of magnitude of system surcharging and flooding. *Surcharging* indicates that the pipes are at capacity, but flooding is not occurring, whereas *flooding* indicates that there is no more capacity and stormwater may be leaving the maintenance holes and catch basins.

Additional tables that detail the specific modeled maintenance holes that were identified as either surcharging or flooding for each of the design storms are provided in **Appendix E**.

Table 3.2. Flooding and Surcharging Maintenance Holes and Conduits by Drainage Basin

Drainage Basin	Total Length of Pipe (LF)	Total Number of Maintenance Holes	Design Storm	Number of Maintenance Holes Surcharging	Percent of Total Maintenance Holes Surcharging	Number of Maintenance Holes Flooding	Percent of Total Maintenance Holes Flooding	Number of Pipes Surcharging	Percent of Pipes Flooding
Fidalgo North	210,337	1,860	25-year, 24-hour	311	16.78	52	2.81	163	8.62
			25-year, 3-hour	437	23.58	113	6.10	280	14.80
			25-year, 24-hour Climate Perturbed	424	22.88	97	5.23	226	11.95
Fidalgo South	46,235	316	25-year, 24-hour	14	4.44	1	0.32	6	1.85
			25-year, 3-hour	9	2.86	1	0.32	8	2.46
			25-year, 24-hour Climate Perturbed	15	4.76	1	0.32	7	2.15
Guemes East	82,161	1,175	25-year, 24-hour	239	20.36	28	2.39	77	6.50
			25-year, 3-hour	346	29.47	54	4.60	126	10.63
			25-year, 24-hour Climate Perturbed	276	23.51	35	2.98	93	7.85
Guemes West	104,296	1,063	25-year, 24-hour	15	1.41	0	0	27	2.50
			25-year, 3-hour	42	3.95	1	0.09	63	5.84
			25-year, 24-hour Climate Perturbed	27	2.54	1	0.09	45	4.17

Drainage Basin	Total Length of Pipe (LF)	Total Number of Maintenance Holes	Design Storm	Number of Maintenance Holes Surcharging	Percent of Total Maintenance Holes Surcharging	Number of Maintenance Holes Flooding	Percent of Total Maintenance Holes Flooding	Number of Pipes Surcharging	Percent of Pipes Flooding
Padilla North	18,270	98	25-year, 24-hour	1	1.02	0	0	10	9.43
			25-year, 3-hour	7	7.14	4	4.08	13	12.26
			25-year, 24-hour Climate Perturbed	1	1.02	0	0	12	11.32
Similk	22,121	131	25-year, 24-hour	1	0.77	0	0	7	5.38
			25-year, 3-hour	3	2.31	0	0	10	7.69
			25-year, 24-hour Climate Perturbed	3	2.31	0	0	11	8.46
Burrows North	55,000	403	25-year, 24-hour	48	11.91	4	0.99	15	3.71
			25-year, 3-hour	84	20.84	15	3.72	41	10.15
			25-year, 24-hour Climate Perturbed	66	16.38	12	2.98	28	6.93
Burrows South	61,721	467	25-year, 24-hour	5	1.07	0	0	8	1.68
			25-year, 3-hour	7	1.50	0	0	12	2.52
			25-year, 24-hour Climate Perturbed	13	2.79	4	0.86	11	2.31
Citywide	600,141	5,513	25-year, 24-hour	634	11.53	85	1.55	313	5.59
			25-year, 3-hour	935	17.00	188	3.42	553	9.88
			25-year, 24-hour Climate Perturbed	825	15.00	150	2.73	433	7.74

3.5.1 Existing Conditions Assessment

This section provides a detailed assessment of the existing conditions within each of the drainage basins. The 25-year 24-hour storm and 25-year 3-hour storm flooding and surcharging results are summarized and analyzed in the following sections. Maps are provided for all three design storms.

3.5.1.1 Fidalgo North

The 25-year 3-hour design storm resulted in more flooding than the 25-year 24-hour design storm. A majority of the flooding in Fidalgo North is a result of undersized pipes and backwatering from outfalls. Areas with high flooding and surcharging are summarized in **Table 3.3**, **Figure 3.2.**, and **Figure 3.3.**

Table 3.3. Capacity Constrained Areas in Fidalgo North

Map ID Number	Location Description	Cause of Flooding and Surcharging
FN-1	The outfall closest to Seafarers Way.	The system surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
FN-2	The pipe segment from the intersection of I Avenue 41st Street heading west, then north up I Avenue, and west through 39th Street and ending at the intersection of H Avenue and 39th Street.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
FN-3	The pipe system on H Avenue from Down Jones Way to 37th Street.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
FN-4	The two smaller pipe systems connecting to Happy Valley Stream.	The system floods due to backwatering from the stream.
FN-5	The pipe system at the intersection of Hillcrest Drive and Stankus Place on Hillcrest Drive, heading southwest until the intersection of Hillcrest Drive and Fidalgo Avenue.	This area floods due to the limited capacity of the 8-inch-diameter pipes.
FN-6	The pipe system along 37th Street and S Avenue heading west until the intersection at R Avenue and 37th Street where the pipe system then heads north along R Avenue until the intersection of 32nd Street and R Avenue.	This area surcharges due to the limited capacity of the 6-inch and 8-inch diameter pipes.
FN-7	The pipe segment heading north along Commercial Avenue between 35th Street and 36th Street before heading east on 35th Street until Q Avenue.	This area surcharges due to the limited capacity of the 8-inch and 1-foot-diameter pipes.
FN-8	The pipe system starting at the intersection of O Avenue and 34th Street heading crossing Commercial to Q Avenue.	This area floods due to the 8-inch pipe restriction at Commercial Avenue.
FN-9	Pipe segments connecting to the trunkline on 22nd Street and K Avenue to the outfall.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.

Map ID Number	Location Description	Cause of Flooding and Surcharging
FN-10	The pipe segment starting at the intersection of J Avenue and 25th Street heading north to the intersection of J Avenue and 20th Street, then heading east to the intersection of M Avenue and 20th Street and M Avenue, then heading north to the intersection of M Avenue and 16th Street and ending at the intersection of 15th Street and O Avenue.	This area surcharges due to limited capacity of the downstream 15-inch diameter pipes.
FN-11	The outfall north of 11th Street and R Avenue.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
FN-12	The area along 22nd Street from M Avenue to R Avenue and south of 22nd Street on Commercial Avenue.	This area surcharges due to the limited capacity of the 8-inch-diameter pipes.

3.5.1.2 Fidalgo South

The 25-year 24-hour design storm and the 25-year 3-hour design storm saw approximately the same amount of flooding. Most of the flooding is caused by undersized pipes, high tailwater, which is leading to backflow, and undersized storage facilities. Areas with high flooding and surcharging are summarized in **Table 3.4**, **Figure 3.5**, and **Figure 3.6**.

Table 3.4. Capacity Constrained Areas in Fidalgo South

Map ID Number	Location Description	Cause of Flooding
FS-1	At Fidalgo Bay Road near South Fidalgo Bay Road.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall. Additionally, there are capacity limitations due to varying sizes of ditches and pipes.
FS-2	Upstream of the outfall at the intersection of Marchs Point Road and S March Point Road.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
FS-3	Upstream of a dry well at the intersection of Fidalgo Bay Road and Fidalgo Bay Road.	Junctions flood likely because of the underperforming dry well that lacks adequate storage.

3.5.1.3 Guemes East

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. A majority of the flooding in Guemes East is a result of inadequate pipe capacity and backwatering upstream of the area outfalls. Areas with high flooding and surcharging are summarized in **Table 3.5**, **Figure 3.2**, and **Figure 3.3**.

Table 3.5. Capacity Constrained Areas in Guemes East

Map ID Number	Location Description	Cause of Flooding
GE-1	Along D Avenue starting at 17th Street and ending at the intersection of 15th Avenue.	The area surcharges due to the limited capacity of the 2-foot-diameter trunkline which also results in backwatering into the farther upstream systems.
GE-2	Heading northwest at Volunteer Park near Kiwanis Meadows.	This area surcharges due the limited capacity of the 2-foot-diameter pipe causing backwatering between 13th Street and 14th Street near D Avenue.
GE-3	Along 10th Street from G Avenue to M Avenue, on 14th Street heading north along K Avenue to where it connects to 12th Street, 12th Street heading west to M Avenue, the intersection of M Avenue and 14th Street heading north to 11th street, 11th Street from J Avenue to K Avenue, 9th Street from I Avenue to M Avenue, 8th Street from I Avenue to L Avenue, 7th Street from L Avenue to M Avenue, and M Avenue from 9th Street to 4th Street.	This area floods due to the limited capacity of the 8-inch-diameter pipes.
GE-4	Along 6th street and J Avenue heading east toward O Avenue and ultimately discharging into Guemes Channel.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
GE-5	The outfall at O Avenue discharging to Guemes Channel.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.

3.5.1.4 Guemes West

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. Most of the flooding in Guemes West is a result of undersized pipes and backwatering. Areas with high flooding and surcharging are summarized in **Table 3.6**, **Figure 3.8.**, and **Figure 3.9.**

Table 3.6. Capacity Constrained Areas in Guemes West

Map ID Number	Location Description	Cause of Flooding
GW-1	Along Oakes Avenue between Allen Court, heading north underneath the neighborhood on Schooner Drive, and discharging out on Edwards Way to Fidalgo Bay.	This area floods due to the limited capacity of the 1-foot-diameter pipes.

Map ID Number	Location Description	Cause of Flooding
GW-2	Along Copper Pond Place heading northwest towards Anacopper Mine Road.	This area floods due to the limited capacity of the 1-foot-diameter pipes.
GW-3	Along West 3rd Street between Idaho Avenue and Georgia Avenue.	The area surcharges due to backwatering from the assumed mean higher-high tide levels at the outfall.
GW-4	Along Oakes Avenue between Kansas Avenue and Georgia Avenue.	This area floods due to the limited capacity of the 1-foot-diameter pipes.

3.5.1.5 Padilla North

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. Most of the flooding in Padilla North is a result of undersized pipes. Areas with high flooding and surcharging are summarized in **Table 3.7**, **Figure 3.11.**, and **Figure 3.12.**

Table 3.7. Capacity Constrained Areas in Padilla North

Map ID Number	Location Description	Cause of Flooding
PN-1	Along South March Point Road starting at the Money Saver Mini Storage heading east to Miles Sand and Gravel.	This area floods due to the limited capacity of the 1-foot-diameter pipes.

3.5.1.6 Similk

The 25-year 3-hour storm resulted in more surcharging than the 25-year 24-hour storm. Similk contains ditches and pipes, which are surcharging due to undersized pipes. Areas with high flooding and surcharging are summarized in **Table 3.8**, **Figure 3.11.**, and **Figure 3.12.**

Table 3.8. Capacity Constrained Areas in Similk

Map ID Number	Location Description	Cause of Flooding
S-1	Along Molly Lane flowing east and connecting to the larger system at Reservation Road.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
S-2	Along Reservation Road between Molly Lane and Stevenson Road.	This area surcharges due to the limited capacity of the 2-foot-diameter pipes.

3.5.1.7 Burrows North

The 25-year 3-hour storm resulted in more flooding than the 25-year 24-hour storm. Most of the flooding in Burrows North was a result of undersized trunklines and high tailwaters leading to backflow. Areas with high flooding and surcharging are summarized in **Table 3.9**, **Figure 3.8.**, and **Figure 3.9.**

Table 3.9. Capacity Constrained Areas in Burrows North

Map ID Number	Location Description	Cause of Flooding
BN-1	On Sunset Avenue connecting to Parkside Drive and ending at the intersection of Parkside Drive and Sands Way.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall.
BN-2	Starting at the intersection of Skyline Point Road and Sunset Avenue heading east and connecting south to the neighborhood along Rosario Way before going southwest along Skyline Way and discharging into Flounder Bay.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall.
BN-3	Starting at the intersection of Piper Circle and Highland Drive heading northwest towards the intersection of Anaco Beach Road.	This area surcharges due to the limited capacity of the 1-foot-diameter pipes.
BN-4	Starting at the intersection of Bradley Drive and Sterling Drive heading southwest and discharging to Flounder Bay through Windsor Street.	The area floods due to backwatering from the assumed mean higher-high tide levels at the outfall.

3.5.1.8 Burrows South

The 25-year 24-hour storm resulted in more surcharging than the 25-year 3-hour storm. The conduits and junctions are surcharging in Burrows South due to a capacity issue from undersized pipes. Areas with high flooding and surcharging are summarized in **Table 3.10**, **Figure 3.8.**, and **Figure 3.9.**

Table 3.10. Capacity Constrained Areas in Burrows South

Map ID Number	Location Description	Cause of flooding
BS-1	Along A Avenue starting halfway between 41st and ending halfway between 39th Court and Forest Park Lane.	This area floods due to the limited capacity of the 8-inch and 1-foot-diameter pipes.
BS-2	Heading north at the intersection of A Avenue and 42nd Place.	This area surcharges due to the limited capacity 1-foot-diameter pipes.

3.5.2 Modeling Figures

The following figures provide an illustration for the design storms for each of the drainage basins. For more information about the flooding and surcharging by drainage basin, see **Section 3.5.1** and Error! Reference source not found..

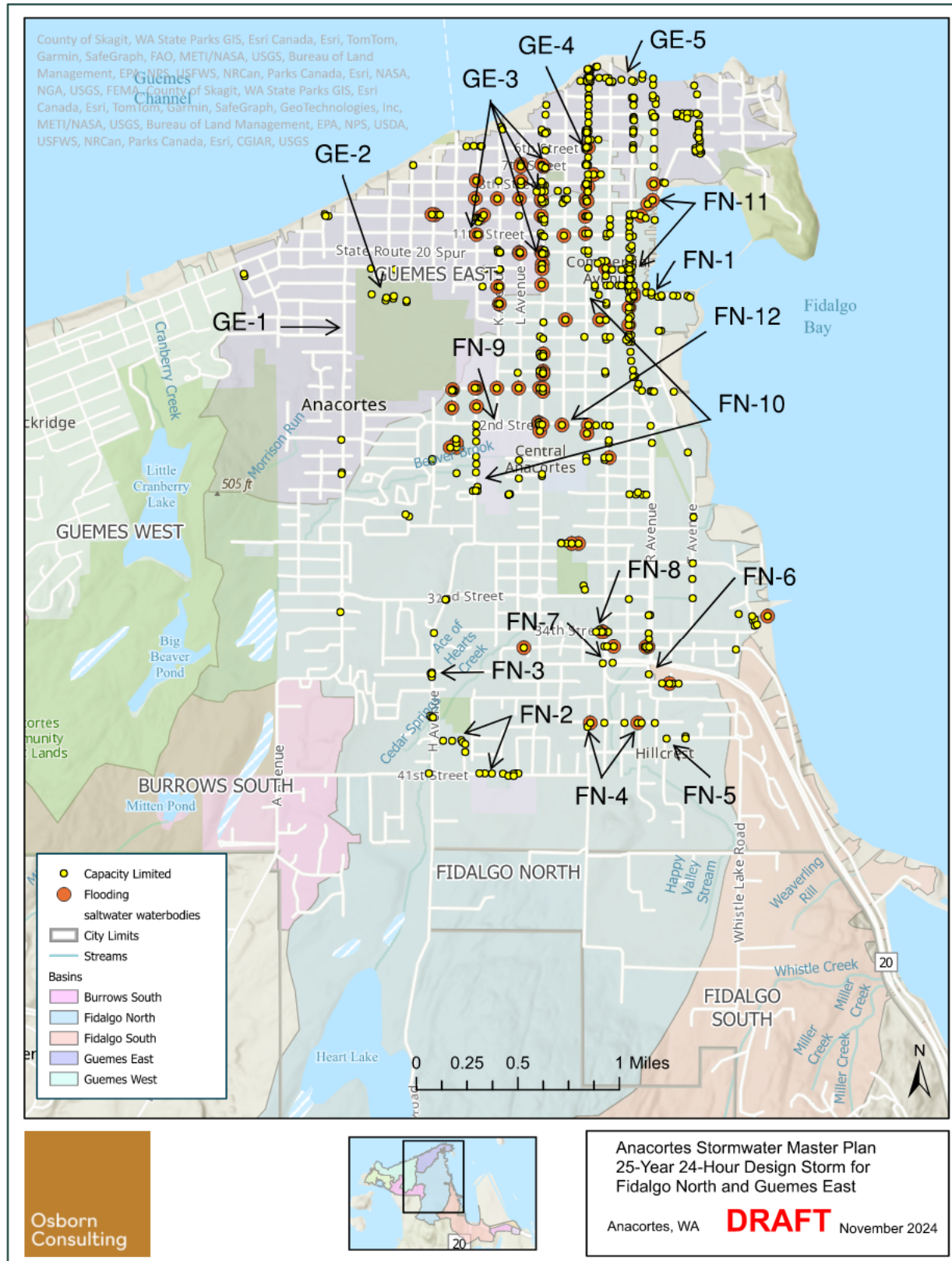


Figure 3.2. 25-Year 24-Hour Design Storm for Fidalgo North and Guemes East

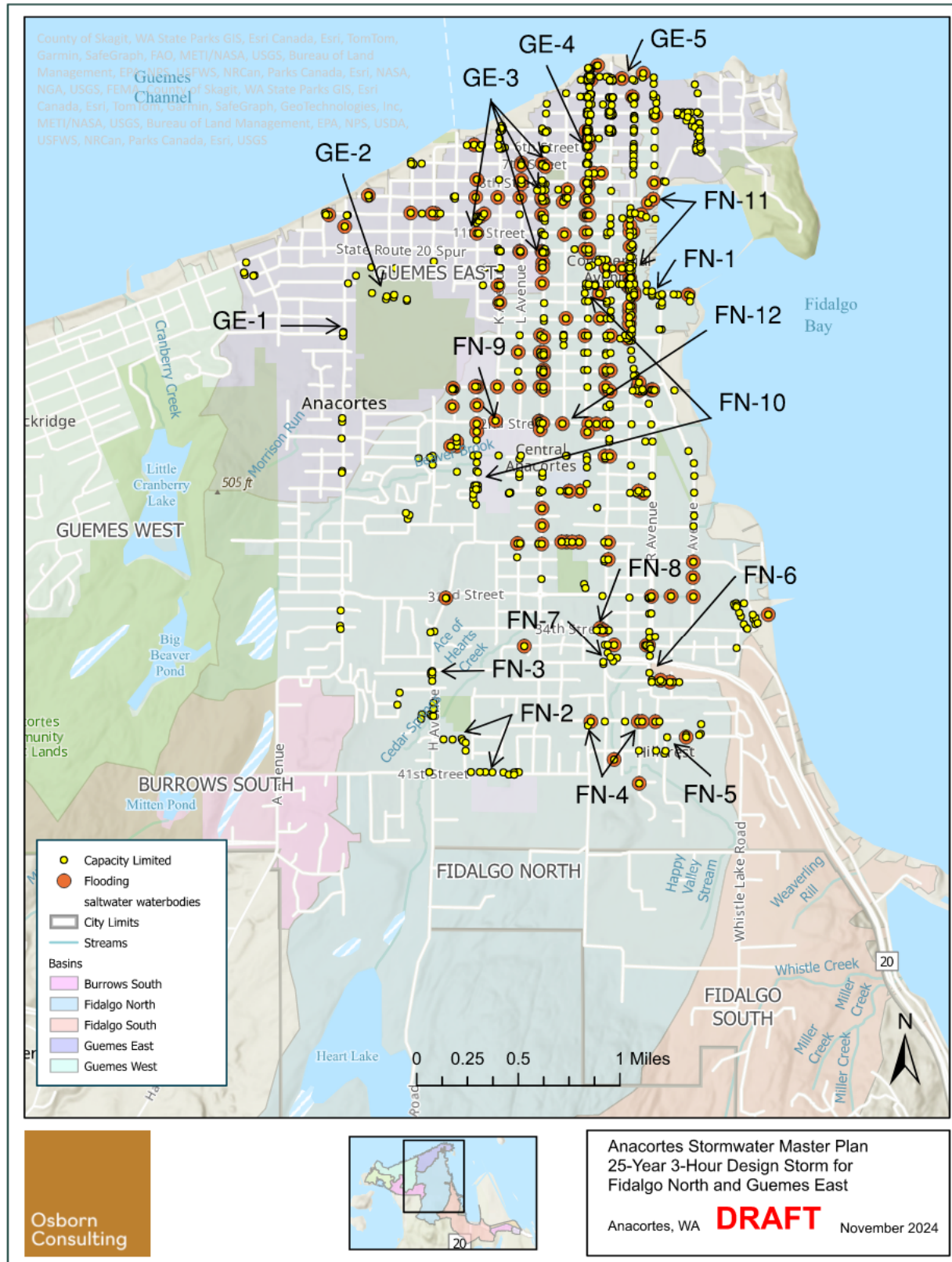


Figure 3.3. 25-Year 3-Hour Design Storm for Fidalgo North and Guemes East

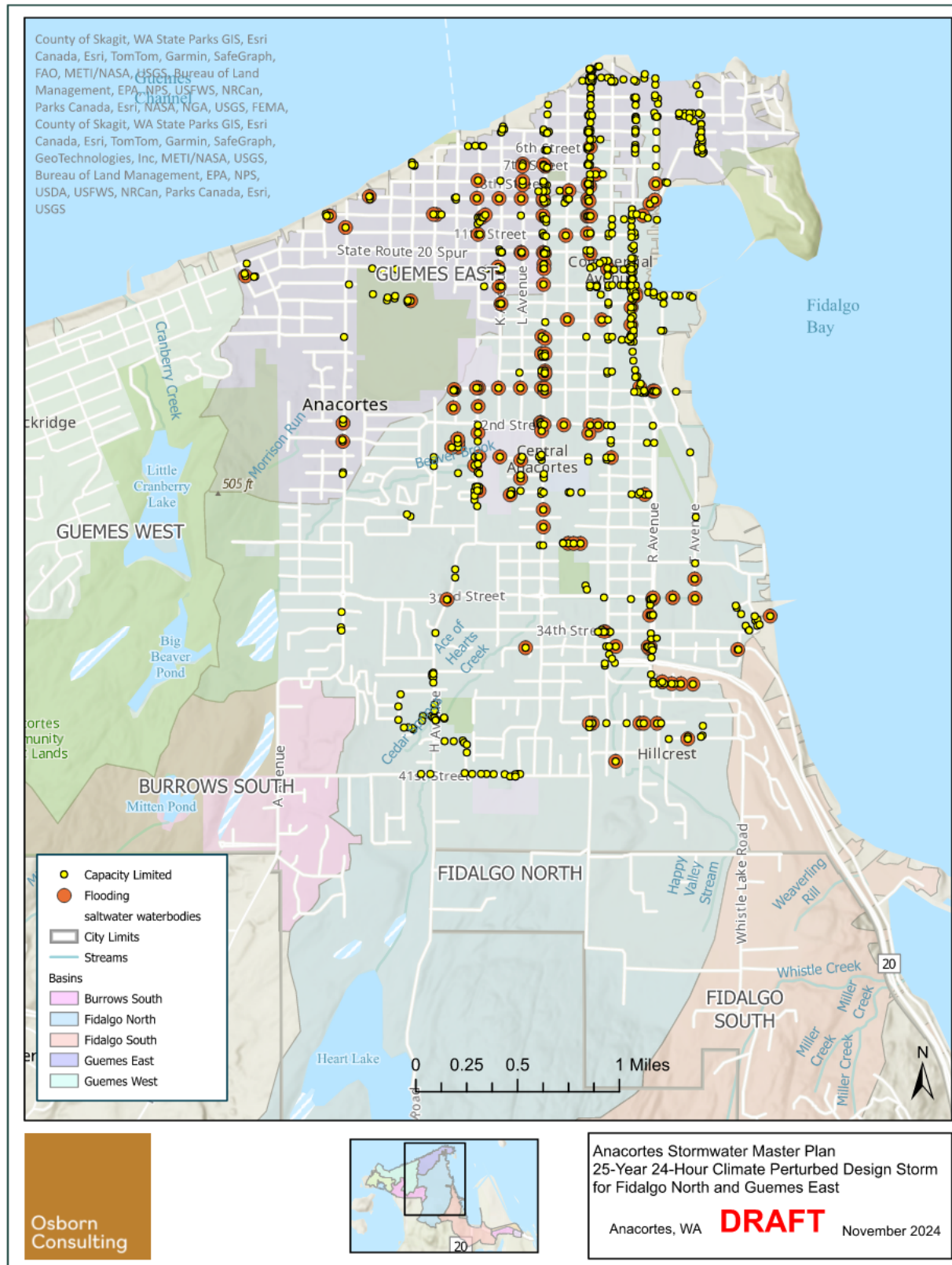


Figure 3.4. 25-Year 24-Hour Climate Perturbed Design Storm for Fidalgo North and Guemes East

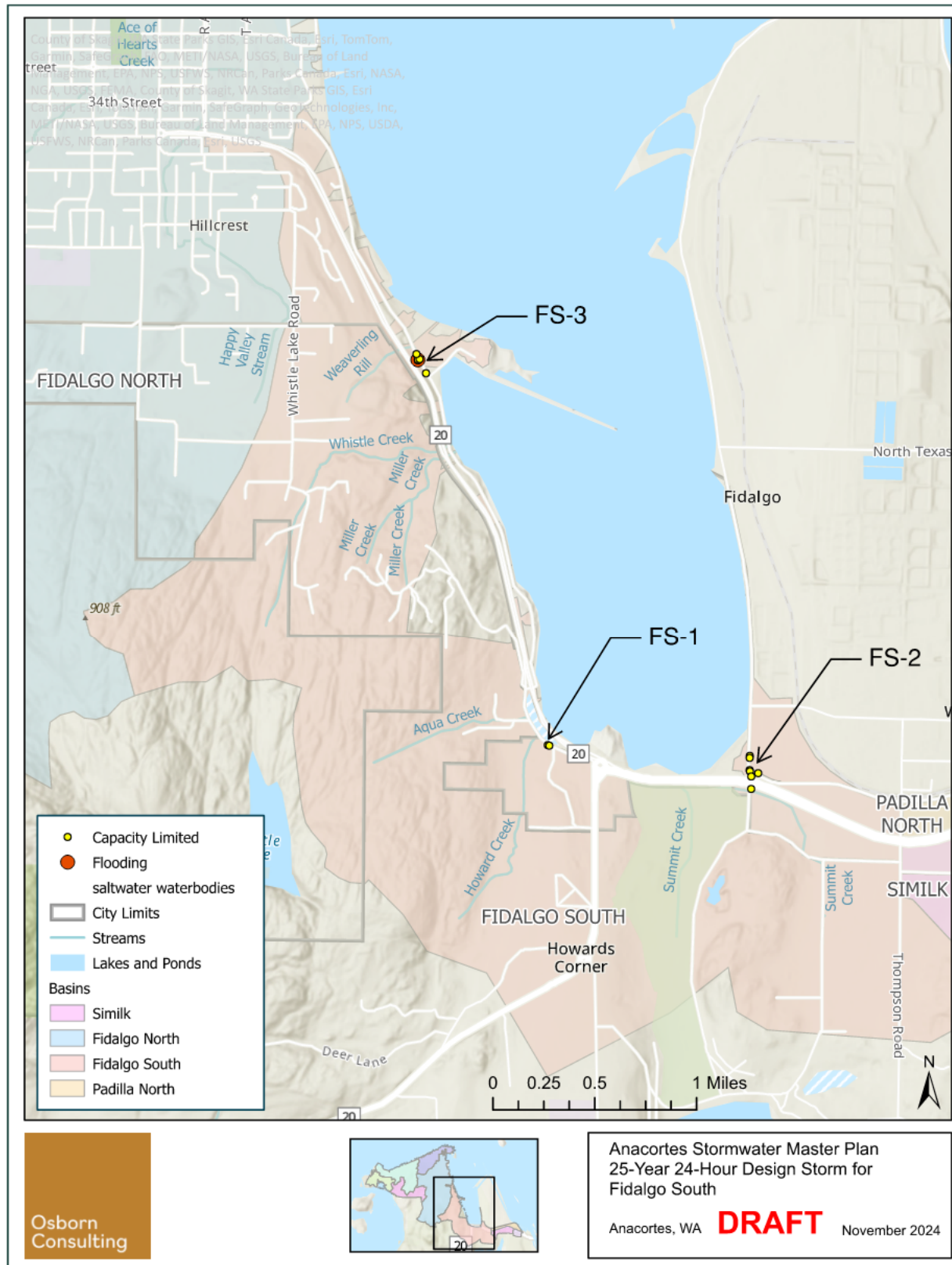


Figure 3.5. 25-Year 24-Hour Design Storm for Fidalgo South

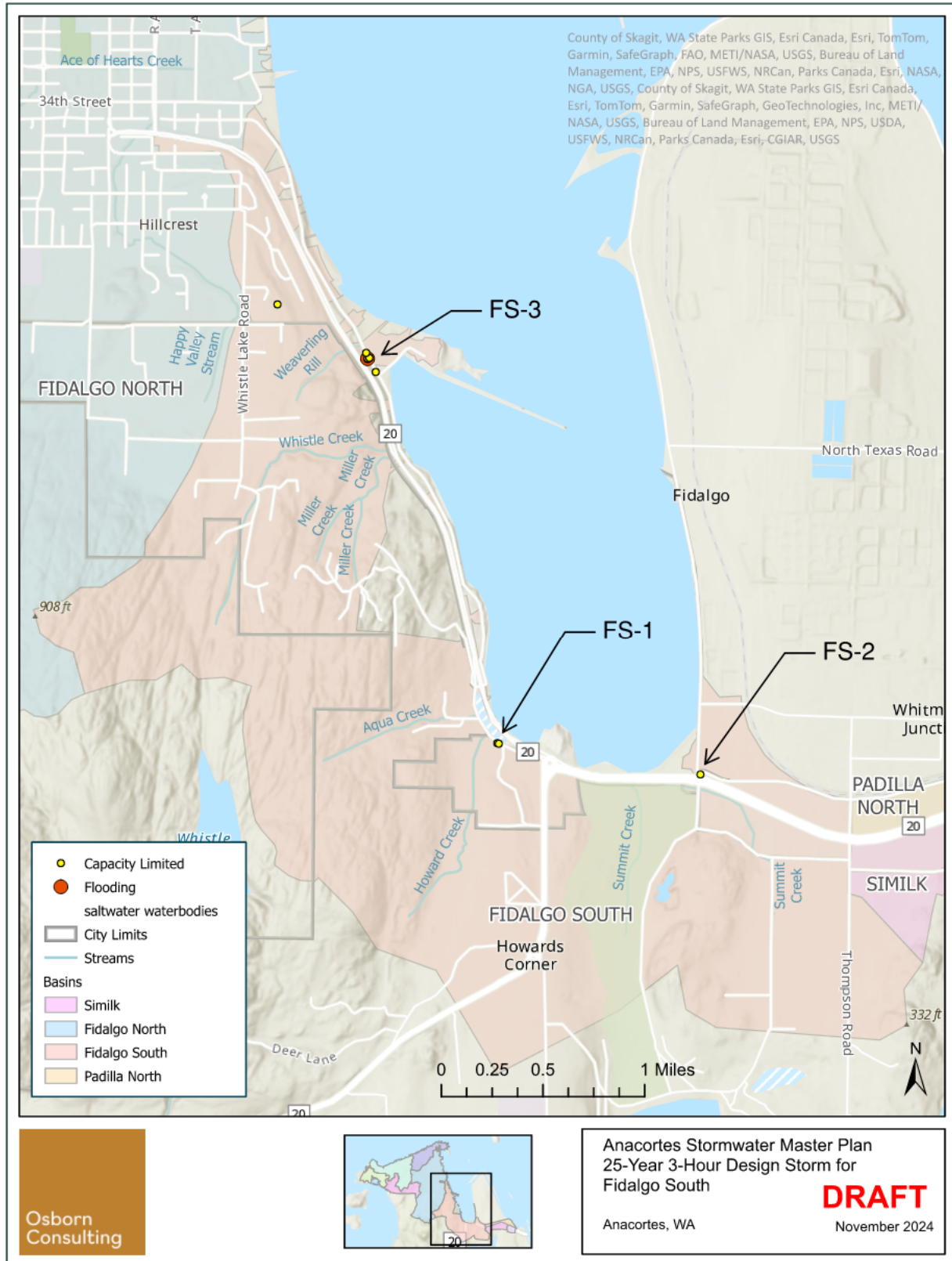


Figure 3.6. 25-Year 3-Hour Design Storm for Fidalgo South

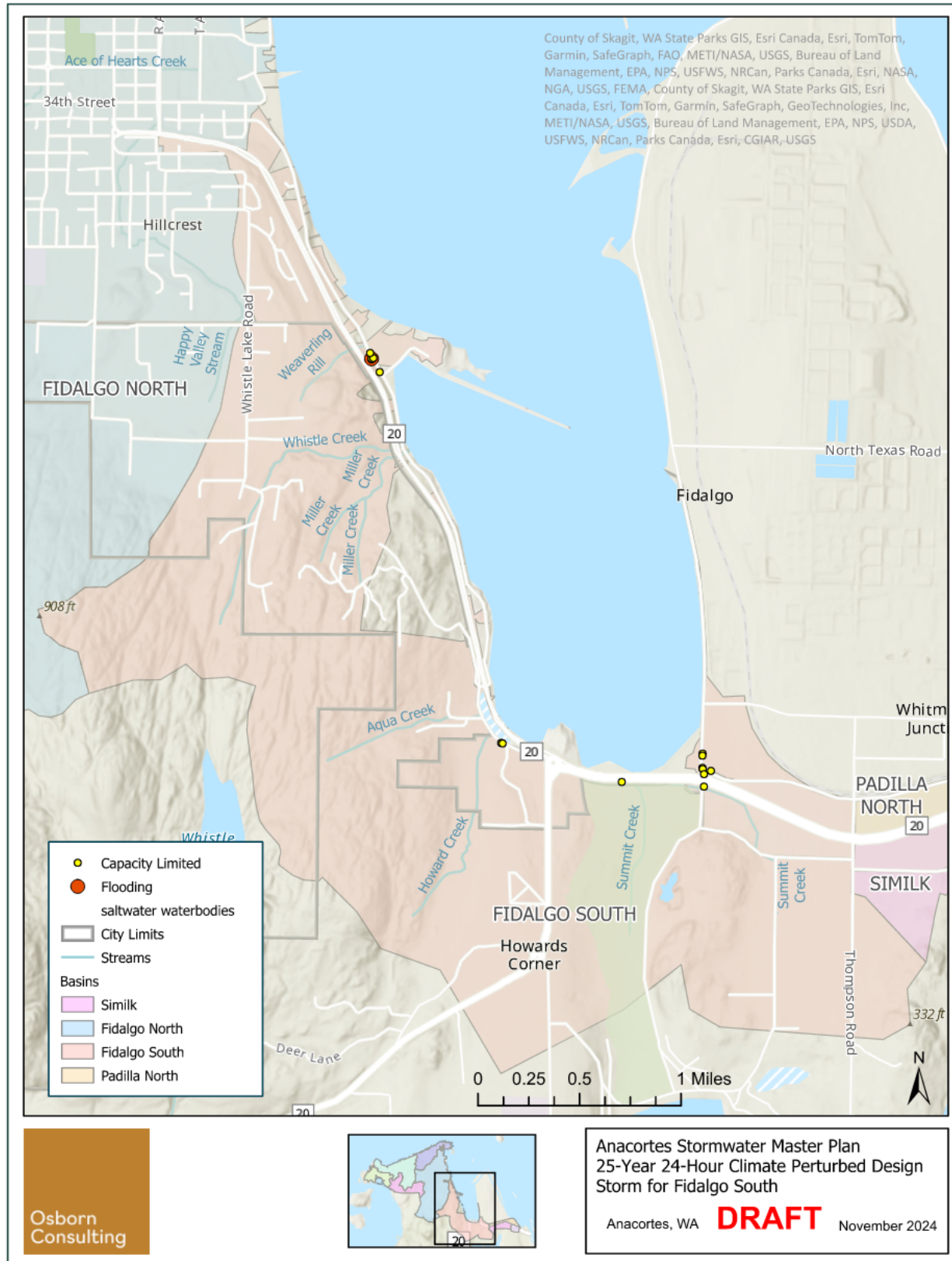


Figure 3.7. 25-Year 24-Hour Climate Perturbed Design Storm for Fidalgo South



Figure 3.8. 25-Year 24-Hour Design Storm for Burrows North, Burrows South, and Guemes West

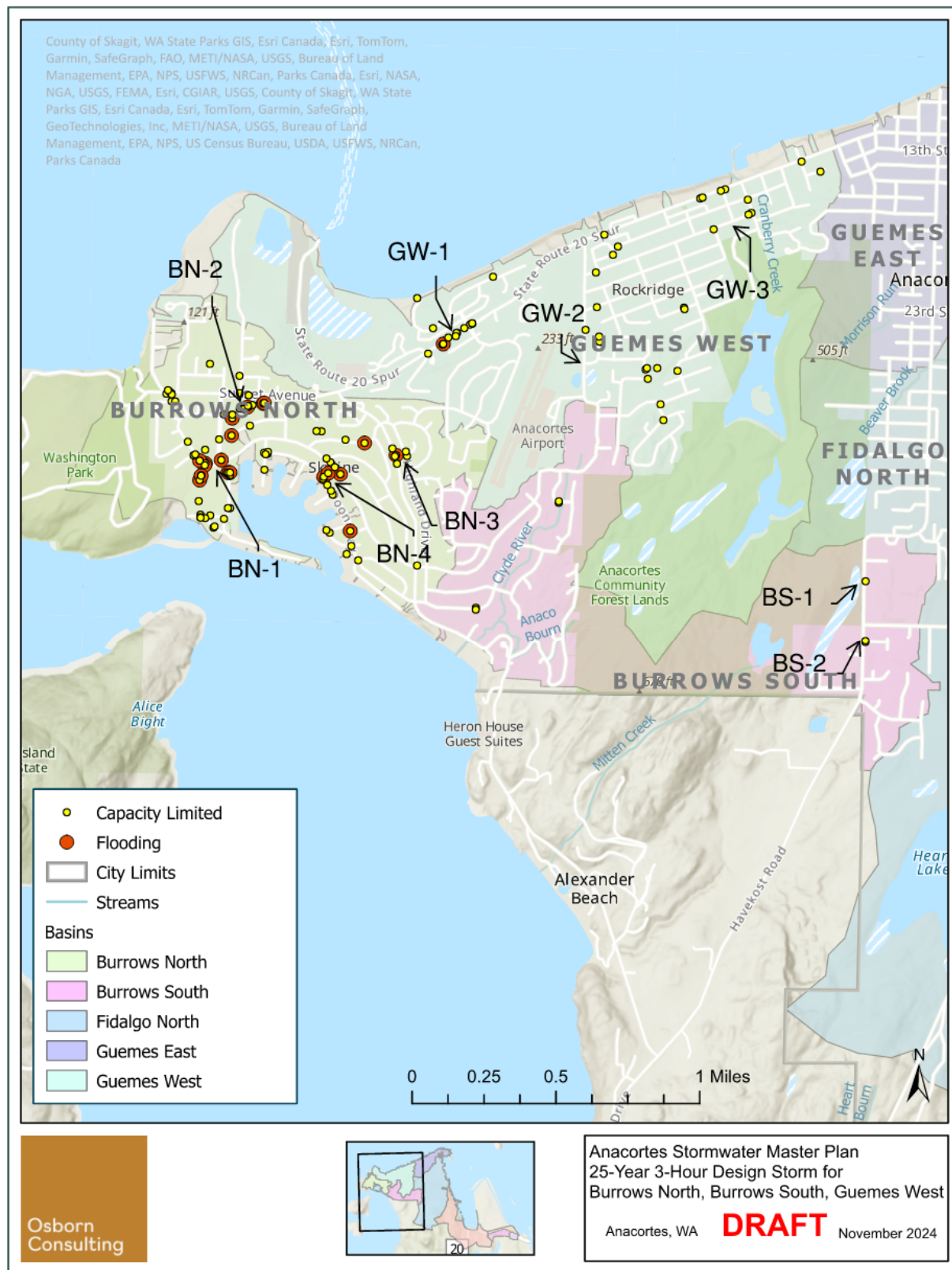


Figure 3.9. 25-Year 3-Hour Design Storm for Burrows North, Burrows South, and Guemes West

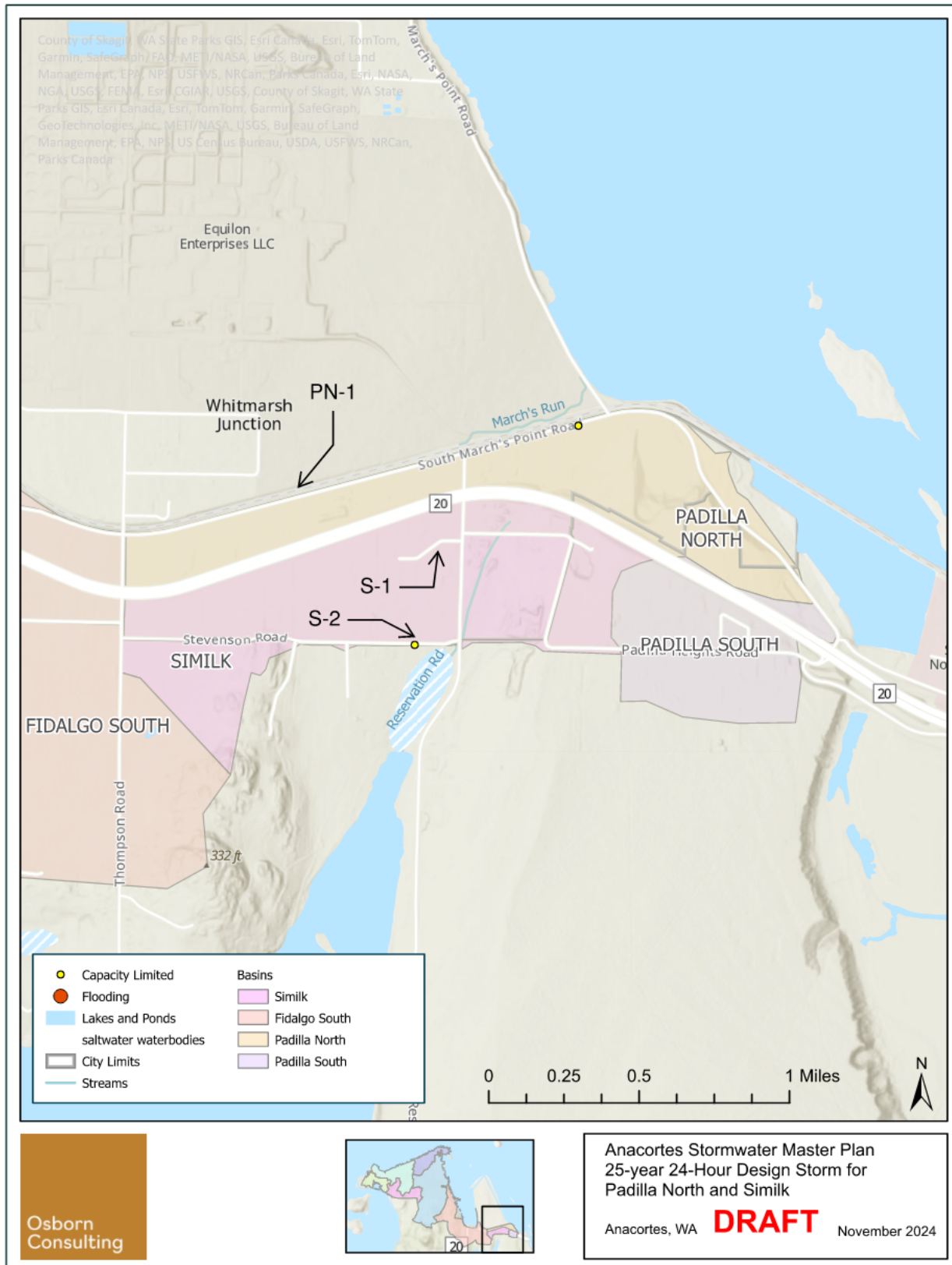


Figure 3.11. 25-Year 24-Hour Design Storm for Padilla North and Similk

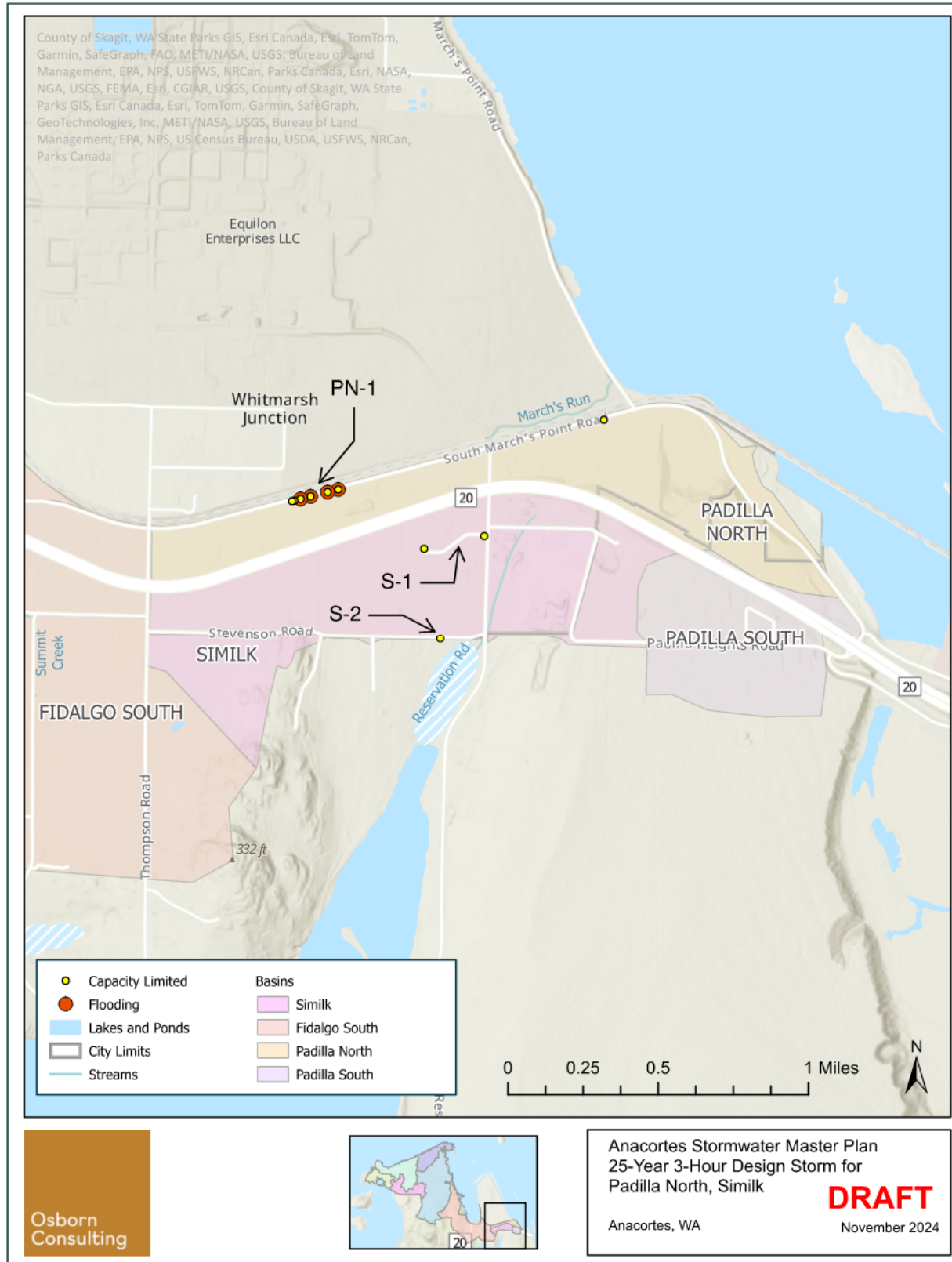


Figure 3.12. 25-Year 3-Hour Design Storm for Padilla North and Similk

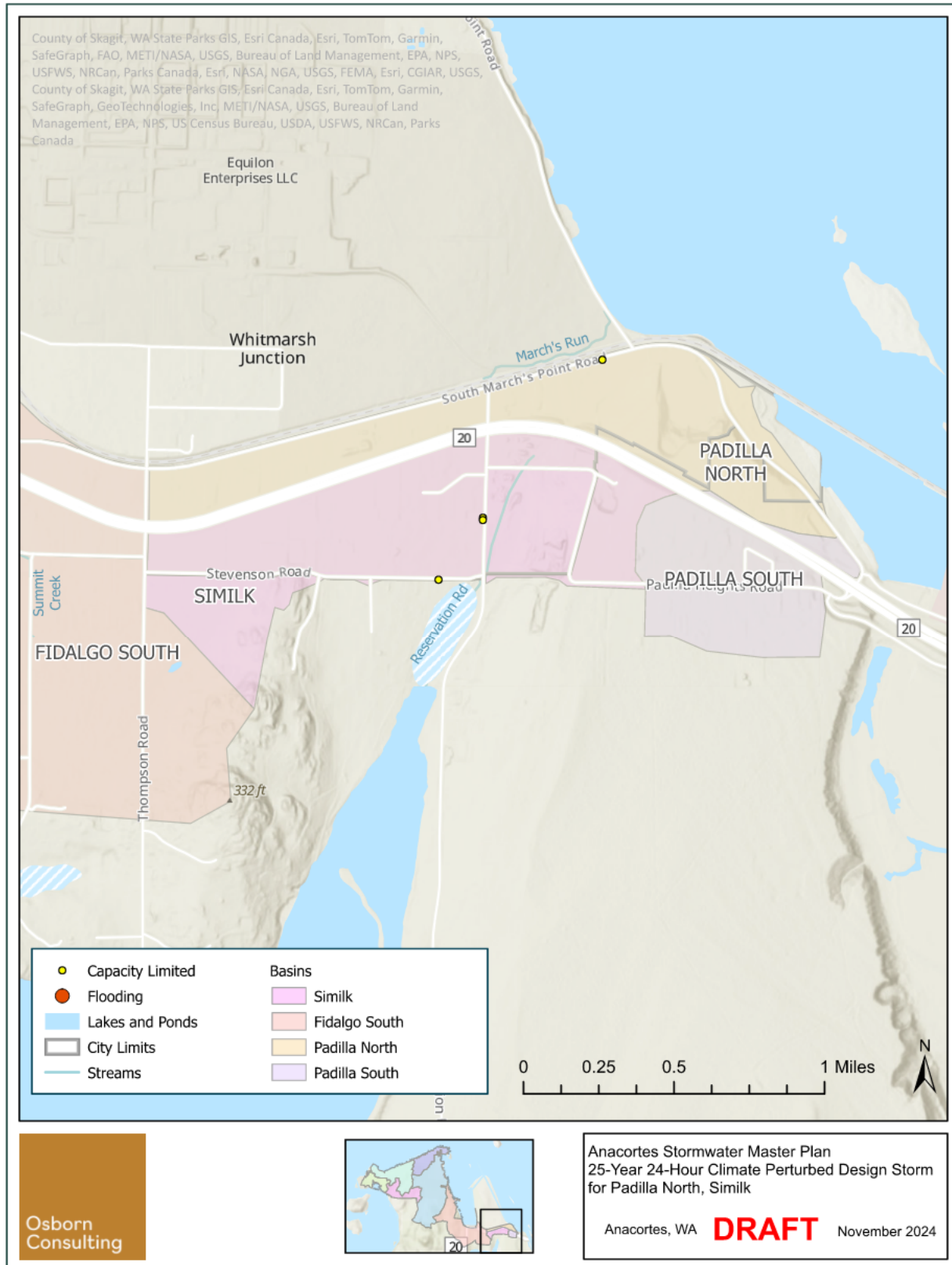


Figure 3.13. 25-Year 24-Hour Climate Perturbed Design Storm for Padilla North and Similk

3.5.3 Stormwater System Deficiencies

Most of the flooding in the City was caused by small diameter pipes that lack adequate capacity to pass runoff from high intensity rainfall. Many of these pipes are also past their expected lifespan and need repair or maintenance.

Stormwater CFPs should focus on the flatter areas in the City's historical core. Flooding shown by the model in the City's steeper areas is of a lesser concern because runoff in these areas typically disperses by sheet flows down the streets and is collected when there is available capacity in the network. However, prioritization should be taken where there is an impact to life and safety associated with major arterial roadways.

In addition, areas identified as flooding due to backwater effects from a combination of high rainfall and the high tidal condition were considered less of a priority. The City should develop a strategy for addressing the impacts of the high tidal conditions on the local drainage system.

The following are the high priority areas by drainage basin:

- **Fidalgo North** – The following areas in Fidalgo North are high priority areas.
 - (**FN-10**) – There is considerable flooding along 20th Street and M Avenue near Anacortes High School. The 8-inch and 1-foot-diameter pipes in this area do not have adequate capacity according to the modeling results.
 - (**FN-8**) – The model is showing flooding where 34th, 35th, and 36th Streets cross Commercial Avenue. The flooding is caused by undersized pipes at these locations. There is also flooding further west on 35th Street that should be considered a higher priority.
 - (**FN-12**) – The area along 22nd Street from M Avenue to R Avenue and south of 22nd Street on Commercial Avenue have a series of undersized pipes that are causing flooding.
 - (**FN-6**) – The system on 37th street west to R Avenue and north under SR 20 to Commercial Avenue has a series of undersized pipes that are causing flooding. This area was also identified in the Fidalgo North Basin Stormwater Management Action Plan and is listed in **Section 5** as project number 8.
- **Fidalgo South (FS-3)** – The junctions upstream of a dry well at the intersection of Fidalgo Bay Road and Fidalgo Bay Road are flooding upstream, likely caused by the underperforming dry well without adequate storage. This area was also identified in the City's 2024–29 Capital Facilities Plan and is listed in **Section 5** as CFP project number 5.
- **Guemes East (GE-3)** – The 1.5-foot-diameter stormwater pipe on M Avenue is at capacity, and the model shows significant flooding and surcharging in the upstream tributary system from 7th Street to 14th Street. It is recommended that this area be a focus of stormwater improvements.
- **Guemes West** – None.
- **Padilla North** – None.
- **Padilla South** – Not modeled.
- **Similk** – None.
- **Burrows North** – None.
- **Burrows South** – None.

A detailed listing of the constrained drainage systems findings is provided in Error! Reference source not found., which contains tables of the flooded and surcharged maintenance holes and pipes based on the modeling results.

3.5.4 Relevant Requirements and Exemptions

The H&H model developed as part of this plan, was used to understand the feasibility of petitioning Ecology for flow control exemptions for piped streams. Per the 2024 SWMMWW, Ecology allows for flow control exemptions for development if they discharge to prior approved flow control exempt water bodies. For Anacortes, the surrounding bays are all considered flow control exempt. However, Section 1-3.4.7 of the SWMMWW indicates that pipes that contain rerouted or reconstructed streams are not considered flow control exempt because they are not a prior approved flow control exempt water body.

There is a provision in the section that allows for local governments to petition Ecology for exemption status:

A petition must justify the proposed exemption, based upon a hydrologic analysis, which demonstrates that the potential stormwater runoff from the exempted area will not significantly increase the erosion forces on the stream channel nor have near field impacts.

Based on the modeling results the piped systems that carry the Ace of Hearts, Happy Valley and Beaver Brook streams have sufficient capacity to pass flows without impacting the stream channel and flooding within the system. Based on these findings the City does meet the requirements for a flow control exemption. A separate flow control exemption memorandum will be prepared to support the City with this request.

3.6 STORM SYSTEM CAPACITY UPGRADES CAPITAL FACILITIES PROGRAM

A new capital facilities program called *Storm System Capacity Upgrades* has been identified. The intent of this new program is to set aside funds on an annual basis that can be used to address high priority capacity upgrades, including those noted in **Section 3.5.2**. This would be a citywide program that would need further development to plan, prioritize, design and construct projects addressing the capacity constraints identified through the modeling results. This program has been included in **Section 5**.

4 STREAM AND HABITAT ASSESSMENT

The City of Anacortes exhibits unique natural characteristics given its location on Fidalgo Island in Puget Sound. Bordered by Rosario Strait to the west and separated from Whidbey Island by Deception Pass to the south and from the mainland by the Swinomish Channel to the east, there are around a dozen miles of shoreline along the multiple surrounding bays. The city parks, the 2,875-acre Anacortes Community Forest Land (ACFL) of the Cranberry Lake and Whistle Lake areas, and other forested recreational areas, encompass approximately 40 percent of the City's area. Numerous large freshwater lakes also exist within the City and several wetland areas are found in and around the Anacortes urban growth area.

Even with this abundance of natural water systems, the freshwater fish habitat on the island is limited compared to similarly located Puget Sound region cities given the area topography, among other factors. For example, although the overall topography of the City is gently sloping and the downtown area in the northeastern portion of the City is relatively flat, various quadrants exhibit steeply sloped areas and bluffs, as well as various categories of unstable areas (City of Anacortes 2007). Generally, area streams largely originate from the inland freshwater lakes and wetland complexes on the island and flow through protected, undeveloped, or lightly developed areas initially. Farther out, including closer to the surrounding marine waters, the stream systems are either more frequently piped or piped for longer distances, accounting for both varying topography and increased levels of residential, commercial, and industrial development, in addition to road networks such as State Route 20.

With the current statewide multi-agency focus on salmonid population health, habitat restoration, and correction of fish passage barriers, the City implemented a planning-level assessment of local streams to gain insight into City systems and potential opportunities for improving fish habitat. The assessment focused on stream habitat and associated drainage infrastructure conditions, specifically culverts, mostly within those City streams documented to have historically or currently inhabited fish species according to the Statewide Washington Integrated Fish Distribution (SWIFD) dataset (NWIFC/WDFW 2018).

4.1 STREAM AND HABITAT CHARACTERISTICS

Based on the SWIFD dataset, stream and habitat assessment areas included open stream channel portions located upstream of closed piped systems in Ace of Hearts Creek, Aqua Creek, Beaver Brook, Clyde Creek, Cranberry Creek, and Happy Valley Stream. The stream and habitat assessment focused on observable instream conditions, the conditions of the associated infrastructure and immediate surroundings, and characteristics such as erosion, flooding, stream canopy cover, invasive species presence, stream channel widths, and salmonid spawning and rearing habitat.

Overall, most fish-bearing streams within City boundaries flow through urban and residential areas with relatively small bankfull widths compared to many of those in other parts of the state. However, several streams exhibit adequate spawning and rearing potential with access to rearing wetlands such as those at Heart Lake and Little Cranberry Lake, which are especially beneficial to anadromous and residential trout species. Whereas most of the fish-bearing waterbodies within the City may provide a smaller amount of lineal gain than many other municipalities streams within the state, the proximity of Anacortes to Puget Sound and Fidalgo Bay provides an opportunity for lower migration time to potential spawning and rearing ground. Currently, streams within the City of Anacortes like Cranberry Creek, Ace of Hearts Creek, and Happy Valley Stream have large sections of underground piped segments but offer adequate spawning and rearing potential upstream of these sections, with a mix of lake habitat, access to seasonal wetlands, and occasional forested canopy and instream cover with spawning ground substrate.

The following subsections provide a general description of the six streams of focus in the City of Anacortes. Included in the descriptions is the location of each stream relative to the mapped drainage basins described in **Table 1.2.** and whether each is classified as a fish-bearing or non-fish-bearing

stream. A more detailed account of conditions observed is contained within **Appendix F**, along with potential opportunities for restoration CFPs based on the current assessment. **Appendix G** contains maps of the six assessed streams.

4.1.1 Ace of Hearts Creek

Located within the Fidalgo North Drainage Basin, Ace of Hearts Creek is a fish-bearing stream that conveys flows from Heart Lake within the Whistle Lake ACFL, into the City stormwater system at 33rd Street before discharging into Fidalgo Bay. Through its course, the channel varies between wetland, ditches, and natural channel morphology. Among other tributaries, Happy Valley Stream flows into Ace of Hearts Creek.

4.1.2 Aqua Creek

Aqua Creek is a fish-bearing stream within the Fidalgo South Drainage Basin. Aqua Creek flows from forested areas of the Whistle Lake ACFL northeast of Whistle Lake, to Fidalgo Bay. The upper watershed is forestland, whereas residential development exists in the lower watershed. The stream passes through Skagit County and City jurisdictions before crossing Aqua Lane and Fidalgo Bay Road and ultimately entering a wetland area on the south side of State Route 20. From there, multiple culverts convey flows under State Route 20 to Fidalgo Bay.

4.1.3 Beaver Brook

Beaver Brook is within the Fidalgo North Drainage Basin and has an unclassified fish bearing status, meaning it has not been determined to be fish-bearing or non-fish-bearing. The stream flows from forested wetlands in the Cranberry Lake ACFL area at the western end of the 32nd Street, along urban neighborhood ditches and natural channels, through various culverts and other short pipe segments, into the City's approximately 4,500-foot-long stormwater system until its Fidalgo Bay outfall at the Anacortes Marina.

4.1.4 Clyde Creek

Clyde Creek, within the Burrows South Drainage Basin, is classified as a potentially fish-bearing stream. Originating east of the Anacortes Regional Airport, Clyde Creek flows from a wetland north of Jasper Way/33rd Street, through ditches and swales as wetlands, through a residential area in open swales and culverts, before crossing under Anaco Beach Road into Burrows Bay. Anaco Bourn, which originates near the southwest side of the ACFL – Cranberry Lake area, is a tributary of Clyde Creek that connects approximately 550-feet upstream of Anaco Beach Road.

4.1.5 Cranberry Creek

Cranberry Creek is within the Guemes West Drainage Basin and classified as a potentially fish-bearing stream. Cranberry Creek flows from Little Cranberry Lake, through a forested riparian corridor of the Cranberry Lake ACFL area, and into a piped system at Cranberry Lake Road. The pipe network continues across and then along Georgia Avenue at steep grades before crossing under State Route 20 and daylighting for a short span before becoming piped again to Guemes Channel.

4.1.6 Happy Valley Stream

Located within the Fidalgo South Drainage Basin, City records show Happy Valley Stream starting south of Haddon Road in Skagit County within a shrub and forest wetland complex. The stream is listed as potentially fish bearing and consists of wetland, ditched stream, and natural stream channel as it flows northwest between Whistle Lake Road and Commercial Avenue towards State Route 20. The stream

crosses State Route 20 before becoming a piped system along R Avenue. The R Avenue system converges with the Ace of Hearts Creek piped conveyance system at 32nd Street, from where it continues for a total distance of approximately 4,000 feet before reaching Fidalgo Bay. During the 2024 assessment, the stream was recorded as seasonal because there was no flow observed within the stream channel upstream of Saint Mary's Drive. Per City records, Happy Valley Stream is piped under and upstream of Saint Mary's Drive for approximately 473 feet.

4.2 FISH PASSAGE BARRIER INVENTORY

As a second component to the stream and habitat assessment, a desktop study was completed to analyze the stream culvert inventory and identify all fish passage barriers within the City limits currently documented in the WDFW Fish Passage Diversion Screening Inventory (FPDSI) database. This database identifies all fish passage barriers, including those owned by the City, Skagit County, State (WSDOT), or that are privately owned, and includes a variety of parameters related to fish use, barrier status, and existing conditions metrics (WDFW 2021).

Figure 4.1 shows all the barriers, and their corresponding owners, identified within the City limits, **Table 4.1** lists the total number of barriers by owner and barrier status, and **Appendix G** provides maps of the barriers within each assessed stream and the detailed WDFW inventory results for all the barriers throughout the city.

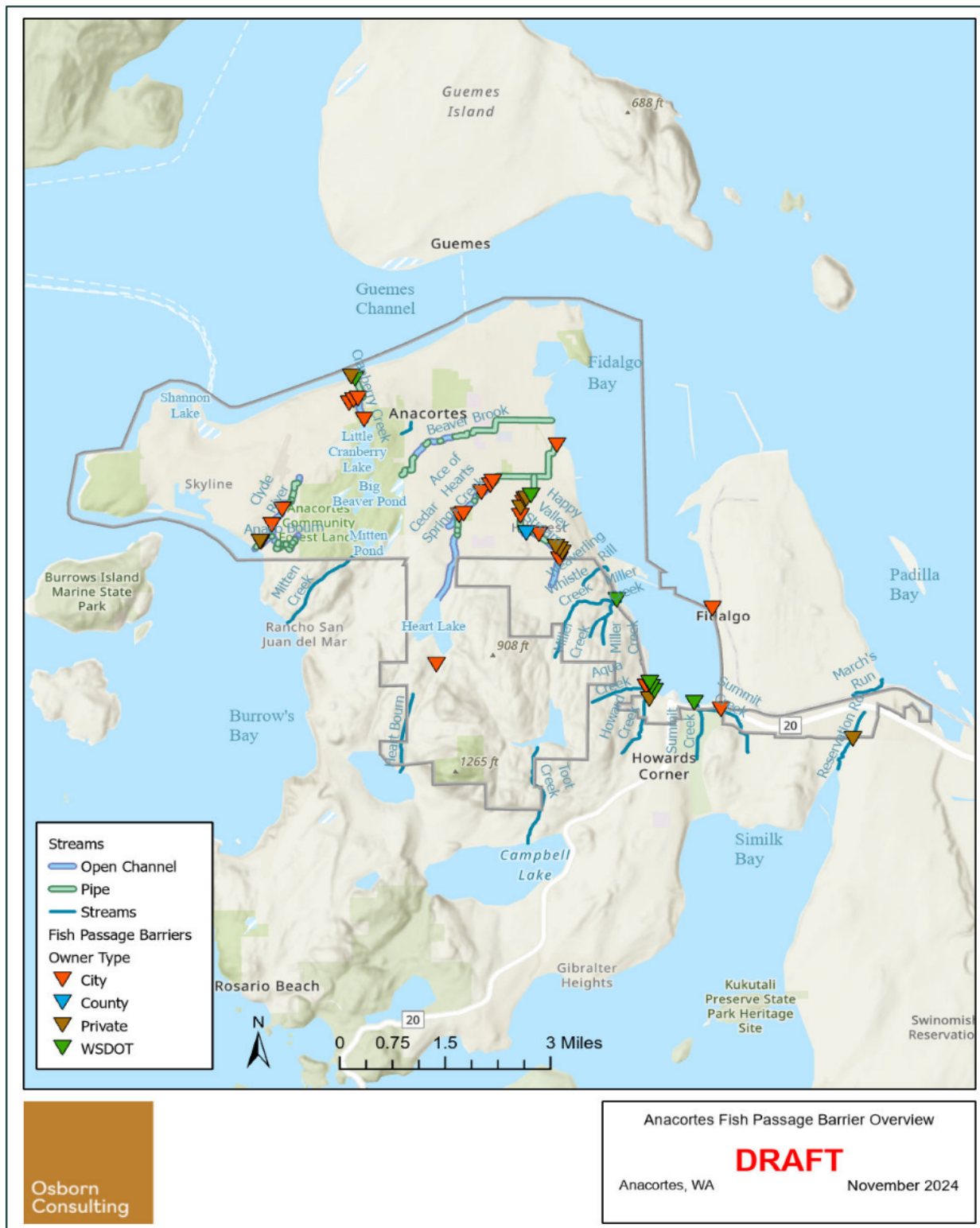


Figure 4.1. Overview of Fish Passage Barriers within City Limits

Table 4.1. Fish Passage Barriers within the Anacortes City Limits

Ownership	Number of Identified Barriers	Number of Unknown Barriers
City	21	3
County	1	0
WSDOT	7	0
Private	8	2
Total	37	5

Thirty-seven fish passage barriers have been identified within the city limits, with twenty-one under City ownership, one under County ownership, seven under WSDOT ownership, and eight privately owned. There are also a total of five barriers of unknown status, with three City-owned and two privately-owned barriers. Crossings identified within the city limits were cross-referenced with the City's closed conveyance database. The inventory was found to be complete, with no additional barriers identified during the field assessments.

Although the total number of fish passage barriers within the City of Anacortes is not as high as other similar sized municipalities, prioritization for correcting fish passage barriers in City-owned assets is an important process to help ensure the most efficient environmental and fiscal actions are being made to restore historical fish habitat.

4.2.1 Prioritization for Fish Passage Barrier Correction

Several public agencies within Washington state, on state, county, and city levels, have made collaborative efforts to develop assessment and scoring criteria to help identify and prioritize the correction of fish passage barriers. The criteria are based on various environmental factors to restore historical or beneficial salmon spawning and rearing habitat by the most efficient means practicable.

Some of the environmental metrics used to score barrier priority include individual barrier passability ranking, lineal gain upstream, habitat quality, number of species benefitting, multi-benefit remediation potential, and the number of barriers upstream and downstream of each crossing. These types of scoring tools can be altered or adjusted based on agency need and their relevant timeline. Many of the common broader-scale scoring metrics can be simplified to target smaller-scale and more local needs, including multi-benefit use, project costs and timelines, and grant funding opportunities.

The City's Comprehensive Plan identifies protection and enhancement of fish and wildlife habitat and improvement of functional integrity of watercourses as important goals. Development of a prioritization program for fish passage barrier correction for Anacortes-owned assets would need to consider these and other goals. The City could begin the prioritization process by identifying the most important categories of environmental and fiscal factors specific to Anacortes and forming a ranked scoring system that can be applied to each fish passage barrier crossing.

4.3 RECOMMENDED CAPITAL FACILITIES PROJECT FOR HABITAT PRESERVATION AND RESTORATION

Opportunities for preserving and improving fish habitat and prioritizing fish barrier correction were examined based on the findings of the stream and habitat assessment conducted for this Plan. The new recommended capital facilities projects (CFPs) for restoration include the Cranberry Creek Restoration and Habitat Improvement and Clyde Creek Bank Stream Bank Stabilization projects. The assessment also identified an opportunity to expand a CFP already identified by the City. Following this assessment, the CFP for daylighting Ace of Hearts Creek through Rotary Park has been expanded to include the removal or replacement of roadway cross-culverts and native planting and invasive species removal in adjacent parts of the stream. The updated CFP is now titled the Ace of Hearts Rotary Park Stream Restoration project. More information about these restoration CFPs is provided in **Appendix F**.

An initial review of the fish passage barrier list did not identify any barriers that should be included as a CFP for barrier removal. However, the inventory of City-owned barriers needs further investigation and prioritization to evaluate the environmental and community benefits of addressing these barriers for consideration with other projects and future updates to this Plan. Although no CFPs were identified specifically for barrier removal, one barrier within Happy Valley Stream is the subject of the Saint Mary's Drive Culvert Replacement CFP discussed in **Section 5**. The culvert is an identified fish-passage barrier (WDFW ID 930933). In addition, replacement of this culvert is needed to address current roadway infrastructure issues within the City right-of-way and the CFP does not address the full length of the barrier, which reaches upstream from Saint Mary's Drive into private property.

5 CAPITAL FACILITIES PROJECTS AND PROGRAMS

One of the primary objectives in developing this plan is to develop an updated list of current capital facilities projects (CFPs), as the previous list of Stormwater CFPs developed as part of the *2007 Stormwater Management Plan* had all been completed or been deemed obsolete. In addition to CFPs, it was determined that funding was needed for ongoing annual stormwater Capital Programs. This section provides an overview of the projects and programs.

The projects and programs included in this plan were identified from or identified by (1.) City's planning documents, (2.) analysis conducted as part of this plan development, and (3.) City staff.

The list of City planning documents include the following:

- 2024–2029 Six-Year Capital Facilities Plan, listed as “STORM” projects
- 2023 Stormwater Management Action Plan (SMAP) for Fidalgo North Basin
- 2007 Stormwater Management Plan

The eleven stormwater CFPs and four citywide stormwater programs are summarized in **Table 5.1** and **Table 5.2**. The name, location and subbasin, a short description of the stormwater CFPs can be found in these tables. The mapped location of projects can be found on **Figure 5.1**, following these tables.

Following input from City staff and the City of Anacortes City Council, project and program prioritization and schedule will be determined. In addition, City staff will need to ensure that all citywide program efforts are coordinated between the stormwater program efforts as well as other City programs such as the Asphalt Overlay Program and work being completed by the Transportation Benefit District. For a table that details all the CFPs and stormwater programs, see **Appendix H**.

Table 5.1. Stormwater Capital Facilities Projects

Project Name	Project Type	Location and Drainage Basin	Source	Project Description
1. 32nd Street Wetlands Culvert Removal	Habitat	2400 block of 32nd Street Fidalgo North	<i>Fidalgo North Basin SMAP</i>	Removal of a culvert and restoration of the streambank at the outlet at the 2400 block of the 32nd Street where local wetlands flow into Beaver Brook.
2. Ace of Hearts Rotary Park Stream Restoration	Habitat	3817 H Avenue Fidalgo North	<i>Fidalgo North Basin SMAP</i> <i>2025 Stormwater Master Plan</i>	- Daylighting a stretch of Ace of Hearts Creek where it passes through Ace of Hearts Rotary Park and enhancing the adjacent storm pond and wetland area. - Restoration of open stream channel and removal or replacement of cross-culverts in the park.
3. Cranberry Creek Restoration and Habitat Improvement	Habitat	Cranberry Creek at Cranberry Creek Road Guemes West	<i>2025 Stormwater Master Plan</i>	- Daylighting a stretch of Cranberry Creek along Cranberry Lake Road within the Anacortes Community Forest Land just west of Georgia Avenue. - Enhancement and protection of current riparian and other habitat.
4. Saint Mary's Drive Culvert Replacement	Infrastructure Repair	Saint Mary's Drive (700 41st Place) Fidalgo North	<i>City's 2024-29 Capital Facilities Plan</i>	Replacing the existing 36-inch culvert in Happy Valley Stream. The stream currently passes in and around the culvert and through the roadway subgrade. The project is needed to prevent future damage to the roadway. The project may be required to meet fish passage requirements.
5. Fidalgo Bay Road Flood Mitigation	Flooding	Fidalgo Bay road and Samish RV Park Fidalgo South	<i>City's 2024-29 Capital Facilities Plan</i> <i>2025 Stormwater Master Plan – Modeling Results</i>	- Flood mitigation at Fidalgo Bay to ensure that Fidalgo Bay Road is not flooded during rain events, reducing the risk of vehicle crashes and collisions. Flooding is due to underperforming dry wells that have inadequate storage. - The project has already been designed and will add a new pipe to bypass flows to an existing ditch during storm events.
6. Marion Pond Water Quality Retrofit	Water Quality	Cedar Glen Way Burrows South	<i>2007 Stormwater Management Plan Capital Facilities Project List</i>	- Replacing a faulty 4,900 square foot detention pond with a 7-foot-by-13-foot treatment filter vault. - This project has been designed.

Project Name	Project Type	Location and Drainage Basin	Source	Project Description
7. Clyde Creek Streambank Stabilization and Flooding Mitigation	Flooding, Streambank Stabilization, and Habitat	Clyde Creek, approximately between Marion Way and Queen Ann Way Burrows South	<i>2025 Stormwater Master Plan</i>	Replacing the undersized culvert and/or the culvert armoring, felling specific trees with rotted root systems, bioengineering for streambank stabilization, and planting native shrubs and tree species to mitigate current flooding issues and restore or enhance riparian habitat.
8. 37th Street Storm Conveyance Reconstruction	Flooding and Water Quality	37th Street east of Commercial Avenue Fidalgo North	<i>Fidalgo North Basin SMAP</i> <i>2025 Stormwater Master Plan – Modeling Results</i>	- Upgrading the existing undersized storm drainage along 37th Street, which involves: – Adding water quality treatment – Adding new system structures – Upsizing the storm drainage conveyance system
9. 34th Street Storm Conveyance Reconstruction	Flooding and Water Quality	34th Street from R Avenue to O Avenue Fidalgo North	<i>Fidalgo North Basin SMAP</i>	Installing bioswales in the 34th Street stormwater conveyance system to improve water quality and flow in the local vicinity.
10. Q Avenue Storm Conveyance Reconstruction	Flooding and Water Quality	22nd Street to 34th Street Fidalgo North	<i>Fidalgo North Basin SMAP</i>	- Upgrading the existing undersized storm drainage along Q Avenue, which involves: – Adding water quality treatment – Adding 12 new system structures – Upsizing the storm drainage conveyance system
11. 17th Street Stormwater Pipe and Outfall Repair	Flooding and Infrastructure Repair	Q Avenue and 17th Street Fidalgo North	<i>City's 2024-29 Capital Facilities Plan</i>	- Add a stormwater pipe in place of the existing ditch to eliminate flooding on Q Avenue caused by sedimentation build up in the ditch. - Lower the downstream outfall to facilitate the continuation of the shoreline trail and eliminate the need for a bridge.

Table 5.2. Stormwater Capital Facilities Programs

Program Name	Program Type	Location	Source	Program Description
1. Stormwater Pipe Repair and Replacement	Ongoing Small Works Program	Citywide	<i>2025 Stormwater Master Plan</i>	Program will address repair and replacement of aging for failing stormwater pipes throughout the City.
2. Outfall Evaluation and Rehabilitations	Ongoing Small Works Program	Citywide	<i>City's 2024-29 Capital Facilities Plan</i>	- Program will address degraded conditions of the City's 73 Storm system outfalls to recommend a rehabilitation plan. - Many outlets throughout the City were below the ordinary high-water line, which resulted in saltwater intrusion into the storm system, degrading conditions of the outfall.
3. Storm System Facility Upgrades, Restoration and Maintenance	Ongoing Small Works Program	Citywide	<i>City's 2024-29 Capital Facilities Plan</i>	- Program will address upgrading, restoring, and maintaining the City's existing stormwater infrastructure. These projects included or involved the following: - Storm pond cleaning - Repair fencing at stormwater ponds. - Separation of combined storm and sanitary sewer system
4. Storm System Capacity Upgrades	Ongoing Small Works Program	Citywide	<i>2025 Stormwater Master Plan</i>	Program will address needed stormwater capacity upgrades that are identified in the H&H modeling results in this plan.

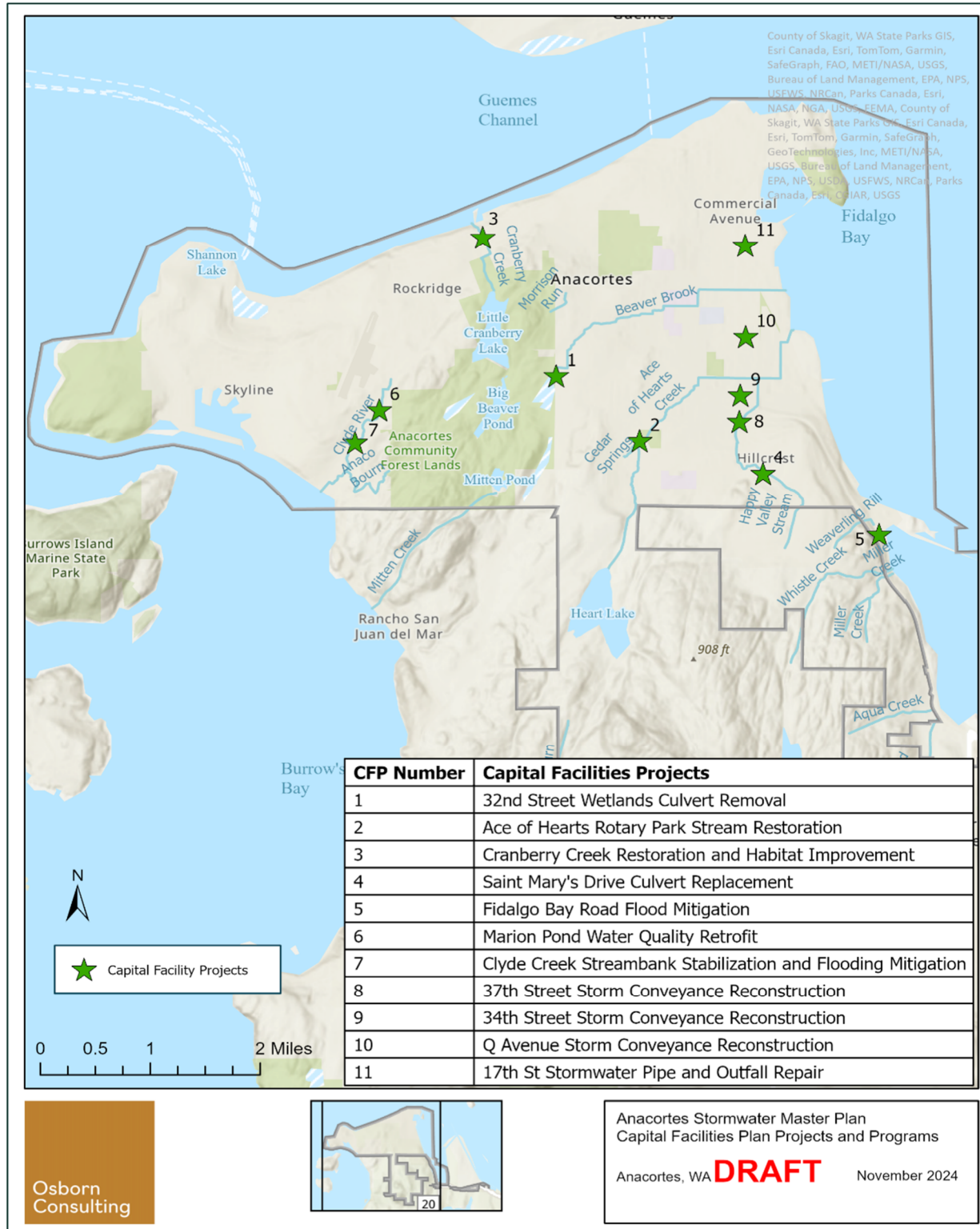


Figure 5.1. Capital Facilities Plan (CFP) Projects and Programs

6 EXECUTION PLAN AND NEXT STEPS

This section provides a general overview of the execution plan and next steps for this 2025 Stormwater Master Plan. The City's Stormwater Utility prepared this Plan to guide related activities for the next 20 years, address current challenges in City stormwater management, and inform the City's overall 2025 Comprehensive Plan update.

City master planning documents, such as this Plan, are coordinated with the City's 2025 Comprehensive Planning process through an annual Comprehensive Plan amendment process. During this amendment process, this Plan and capital projects therein are integrated with the capital facilities element of the City's overall citywide 2025 Comprehensive Plan.

The 2025 Plan incorporates the following actions:

- Updating the City's 2007 Stormwater Management Plan.
- Providing guidance for stormwater management.
- Evaluating Upcoming Phase II Permit requirements and programs.
- Providing documentation of the City's stormwater infrastructure.
- Reviewing the City's existing stormwater asset inventory and establish a pipe repair and replacement program.
- Identifying stormwater system deficiencies through a citywide hydrologic and hydraulic model (H&H model).
- Assessment of stream, habitat, and conveyance infrastructure conditions.
- Documenting the current Stormwater Capital Facilities Program.
- Supporting future capital, operation, and maintenance activities.
- Providing a multi-year stormwater execution plan to achieve.

From the actions listed above a series of policy, program and capital recommendations were developed and summarized in **Sections 1** through **5**. A summary of those recommendations is included in **Sections 6.1** and **6.2**.

6.1 POLICY AND NON-CAPITAL PROGRAM RECOMMENDATIONS

This 2025 Stormwater Master Plan includes a series of findings regarding the City's growing need for stormwater program and policy enhancements required to meet Permit requirements as the City's population and number of stormwater assets grows. The City has maintained Phase II Permit compliance and implemented its own Stormwater Management Program (SWMP). Over the next five years, the city will need to review its SWMP and ensure compliance with the new Phase II Permit.

SWMP related policy, programs, and projects needs are detailed in **Section 1** and will include the following:

- Tracking cost for each SWMP element.
- Adopting and implementing tree canopy goals and policies.
- Drafting a new SMAP or develop additional actions in Fidalgo North Basin, including addressing wear in land management strategies and stormwater retrofits.

- Reviewing and updating MS4 outfall mapping and submitting data to Ecology.
- Reviewing the Anacortes Municipal Code (AMC) and reviewing and updating IDDE code to address PCB regulations and firefighting activities.

6.2 STORMWATER CAPITAL FACILITIES PROJECTS AND PROGRAMS

As part of the City's Plan development, a list of CFPs was compiled from numerous sources, including the 2023 Fidalgo North SMAP, the 2007 Stormwater Comprehensive Plan, and the City's 2024-29 Capital Facilities Plan, which are detailed in **Section 5**.

The City has also taken responsibility for maintaining the municipal stormwater infrastructure, mitigating area flooding risk, and protecting surface water quality. The final list includes eleven projects and four citywide stormwater programs. The programs include addressing the long-term needs of storm pipe repair and replacement, outfall evaluation and rehabilitations, storm system facility upgrades, restoration, and maintenance, and storm system capacity upgrades.

6.3 CONCLUSION AND NEXT STEPS

< Discuss with City staff recommendations of next steps for the 2025 Stormwater Master Plan Adoption and Implementation. Include a summary of the workshops with City Council to refine the capital facilities cost (magnitude) and implementation planning. Also include a summary of the process for engaging the public on the Plan Update. >

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APPENDIX A: DATA SUMMARY MATRIX

Appendix A - Data Summary Matrix

	Data to be Collected, Supplied, and Reviewed (Package or Document Title)	Date Received	Electronic Copy	Lead Reviewer	Date Reviewed	Author or Source	Date Published	Description and Review Notes
1	Stormwater Utility Assets							
1.1	City GIS Data (Storm Drain Manholes, SDMH - GIS)	03/21/24	X	Modeling and SWPRRP Teams	04/01/24	City of Anacortes	Various	Reviewed for use in modeling and Stormwater Pipe Repair and Replacement Program (SWPRRP) tasks, where applicable.
1.2	City GIS Data (Storm Drain Outfalls, SD_Outfalls - GIS)	03/22/24	X		04/01/24	City of Anacortes	Various	Reviewed for use in modeling and SWPRRP tasks, where applicable.
1.3	City GIS Data (Storm Drain Mains, SD_Mains - GIS)	03/23/24	X		04/01/24	City of Anacortes	Various	Reviewed for use in modeling and SWPRRP tasks, where applicable.
2	Stormwater Plans and Studies							
2.1	Fidalgo North Stormwater Management Action Plan (SMAP)		X	J. Christofferson	09/16/24	City of Anacortes	3/31/2023; updated 7/9/2024	Reviewed information for the previous Capital Facility Projects (CFPs). Six projects of interest involved culvert removal, stream restoration, conveyance reconstruction, and the development of a stormwater park. Applicable projects were carried forward into the 2025 Stormwater Master Plan (Plan).
2.2	City of Anacortes 2007 Stormwater Management Plan (SWMP)		X	J. Christofferson	09/16/24	Grey and Osborne, Inc.	09/01/07	Reviewed information on previous CFPs. Twenty-four stormwater CFPs were identified, twelve of which were planned to be finished by 2011. Applicable projects were carried forward into the Plan.
2.3	City of Anacortes 2024 Stormwater Management Plan (SWMP)		X	J. Christofferson	09/18/24	City of Anacortes	03/31/24	The Federal Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) compliance document summarizes the City's existing stormwater program and future planned compliance activities.
2.4	Schedule-CompPlanTimeline.pdf (2025 Comprehensive Plan Update)	04/15/24	X	J. Christofferson	09/18/24	City of Anacortes	04/12/24	Valuable as this Plan update task and resulting recommendations will feed into the Plan update, which will also be referenced in this current Plan update. Schedule shows Draft Utility Plans are due end of October 2024. The final overall Plan is due to be adopted in August 2025.
3	Asset and Facility Inspection and Maintenance Reports							
3.1	Asset and Facility Inspection and Maintenance Reports			Modeling Team	03/28/24, 06/11/24, 09/03/24			Relevant information was gathered through various workshops with City staff.
4	Completed Stormwater Projects							
4.1	See 2.1 and 9.1.	09/20/24		J. Christofferson	09/24/24	City of Anacortes	NA	The City added CFPs from the current Capital Facilities Plan and noted where CFPs from the 2007 Stormwater Management Plan had been completed.
5	As-Builts							
5.1	As-builts pond_swale_bioretention_infiltr trench (38 PDFs, 1 Excel)	03/29/24	X	T. Spangenberg	05/09/24	Various	Various	Reviewed for use in modeling efforts, if applicable.
5.2	As-builts pond_swale_bioretention_infiltr trench (7 PDFs added)	04/12/24	X	T. Spangenberg	05/09/24	Various	Various	Reviewed for use in modeling efforts, if applicable.
6	Inspection Data Worksheets							
6.1	Inspection Data Worksheets			Modeling and SWPRRP Teams		workshops		Relevant information was gathered through various workshops with City staff.
7	Inspection Summary Reports and Videos							
7.1	Storm Videos (4 videos and 4 reports)	05/03/24	X	A. Bryant	05/06/24	City of Anacortes	Various	Four closed-circuit television (CCTV) videos and inspection reports reviewed. Existing inspection data determined to be NASSCO's Pipeline Assessment Certification Program (PACP) compliant.
8	Stormwater Infrastructure GIS							
8.1	CompPlan_data.mpk	03/21/24	X	H. Spates	03/28/24	City of Anacortes	Various	Reviewed for use in modeling and SWPRRP tasks, if applicable.
8.2	CompPlan_data_B.mpk	04/01/24	X	H. Spates	04/08/24	City of Anacortes	Various	Reviewed for use in modeling and SWPRRP tasks, if applicable.
8.3	CompPlan_data3.mpk	04/08/24	X	H. Spates	04/15/24	City of Anacortes	Various	Reviewed for use in modeling and SWPRRP tasks, if applicable.
8.4	Storm-GeometricNetwork.gdb	04/08/24	X	K. Tang	04/15/24	City of Anacortes	Various	Reviewed for use in modeling and SWPRRP tasks, if applicable.
9	Preliminary Capital Facilities Project (CFP) List							
9.1	2007 Stormwater Management Plan	09/16/24	X	J. Christofferson	09/16/24	Grey and Osborne, Inc.	09/01/07	As requested on September 16, 2024, the City reviewed 2007 Plan CFP list for projects completed to date and provided an updated list with CFPs remaining (CFPs S and X).
10	Land Use/Cover (Structures) Data							
10.1	Land Use/Cover (Structures) GIS Data			Modeling Team				Specific data was not used in the Plan process.
10.2	Land Use	11/08/24	x	H. Spates	11/08/24	City of Anacortes	2017	Figure Creation and informing Section 1 content.
11	Zoning Data							
11.1	Zoning Data			Modeling Team				Specific data was not used in the Plan.
12	Traffic Data							
12.1	Traffic Data			Modeling Team				Specific data was not used in the Plan.
13	Other Data							
13.1	2019 - 2024 Rainfall Data (2019-2024 Rainfall and Influent.xlsx)	04/12/24	X	Modeling Team	09/05/24	City of Anacortes	04/12/24	Rainfall data could not be used because of the period on record was too short.
13.2	1992 - 2024 Rainfall Data (1992-2024 Daily Rain Data.csv)	09/05/24	X	Modeling Team	09/05/24	City of Anacortes	09/05/24	Rainfall data could not be used to create a design storm for modeling efforts but could be used to compare to isopluvial heights.
13.3	CAD Data from Anacortes for Building footprints	05/23/24	x	Modeling Team	05/29/24	City of Anacortes	05/29/24	Data was used to create the building footprints within the city limits.
13.4	Skagit GIS Data for parcels and rights-of-way	05/31/24	x	Modeling Team	05/31/24	Skagit County		Data was used to create the right-of-way (ROW) layer inside and outside of the city limits.
13.5	2017 North Puget LIDAR data	05/30/24	x	Modeling Team	05/30/24	DNR Lidar Portal	09/29/17	Data was used to gather elevations.
13.6	NOAA C-CAP High Resolution Land Cover data for Impervious Surface (1m)	06/04/24	x	Modeling Team	06/04/24	NOAA	09/30/23	Data was used to create the impervious surfaces layer.
13.7	CompPlan_Data.mpk	03/21/24	X	H. Spates	03/28/24	City of Anacortes	Various	The background GIS data was used to create figures.

Data to be Collected, Supplied, and Reviewed (Package or Document Title)		Date Received	Electronic Copy	Lead Reviewer	Date Reviewed	Author or Source	Date Published	Description and Review Notes
14	Skagit County Population Growth Data							
14.1	Skagit County Population, Housing and Employment Growth Allocations Methodology (...2023-12-23.pdf)	03/25/24	X	J. Christofferson	09/18/24	CAI	12/12/23	Report forecasted countywide population growth between 2022 and 2045 based on the medium population projection published by the Office of Financial Management (OFM) for the county. The 2025 population is estimated at 18,686 people (incorporated population is 105), 2045 population is projected at 22,843 people (incorporated population is 127), 2022-2045 population growth projection for Anacortes is 17 percent. Future housing unit growth and countywide projections of total employment by sector for the city of Anacortes was also provided.
14.2	Resolution 2023-02 (...SIGNED 2023-12-20.pdf)	03/25/24	X	J. Christofferson	09/18/24	City of Anacortes	12/20/23	Skagit County's Resolution 2023-01 was to approve initial 2045 allocations for population, housing, and employment in Skagit County. The projections are similar to the 2023 report by CAI.
15	Operations and Maintenance Data							
15.1	Operations and Maintenance Data			SWPRRP Team				Relevant information was gathered through various workshops with City staff.
16	Hydrologic/Hydraulic Modeling Files							
16.1	GandO modeling files/2007 Mike Urban Anacortes modeling files.zip	04/05/24	X	D. Jacobs	06/25/24	Grey and Osborne, Inc.	10/24/06	Reviewed for use in modeling efforts, where applicable.
16.2	GandO modeling files/Anacortes Basin B2 2023.3.23_v30.3 Revised.zip	04/05/24	X	D. Jacobs	06/25/24	Grey and Osborne, Inc.	10/24/06	Reviewed for use in modeling efforts, where applicable.
16.3	GandO modeling files/Anacortes Basin F4 rev.zip	04/05/24	X	D. Jacobs	06/25/24	Grey and Osborne, Inc.	10/24/06	Reviewed for use in modeling efforts, where applicable.
16.4	WASKAG23-MOSAICS-SID-3INCH (FGDC Metadata Folder, 6 loose files)	03/21/24	X	D. Jacobs	06/25/24	Grey and Osborne, Inc.	10/24/06	Reviewed for use in modeling efforts, where applicable.
17	Stream and Fish Passage Data/Reports							
17.1	Revised Stream Buffer Best Available Science Review and Buffer Recommendations	03/21/24	X	B. Helwig		GeoEngineers	06/29/22	Reviewed for relevant information related to stream and buffer conditions for the systems examined as part of the stream and habitat review tasks for the Plan.
17.2	Washington State Department of Wildlife (WDFW) Fish Passage Statewide Inventory			B. Helwig		WDFW	11/09/20	The GIS dataset of fish passage barrier assessments and locations. This dataset was used to conduct and prioritize stream and habitat reviews and in consideration in the development of CFP recommendations.
17.3	Statewide Washington Integrated Fish Distribution (WDFW)			B. Helwig		WDFW & NWIFC	04/02/18	GIS dataset of fish distribution for the state of Washington, for use in management, conservation, and restoration of the state's fish habitat and fishery resources, including various anadromous species, resident salmonids, and other game fish. This dataset is used to conduct and prioritize stream and habitat reviews.
18	Final 2024-2028 Phase II Municipal Stormwater Permit							
18.1	Final Western Washington Phase II Municipal Stormwater Permit	07/01/24	X	D. Halladay	09/15/24	Ecology	07/01/24	The NPDES municipal stormwater permit requiring local governments to manage and control stormwater runoff so that the runoff does not pollute downstream waters.
19	Sea Level Rise Documentation Report							
19.1	Memorandum: Anacortes CAO Ordinance Update: Frequently Flooded Areas - DRAFT Update	03/21/24	X	J. Christofferson	09/18/24	Coastal Geologic Services, Inc.	10/19/21	Sea level rise is important to City planning because much of the local floodplain within the City limits lies within the coastal zone. The memorandum documents how projected sea level rise was incorporated into the City's Critical Areas Ordinance (CAO). This memorandum also documents the reasons behind sea level rise in the Puget Sound region. These reasons were thermal expansion of the world's oceans, rapid melting of ice caps and glaciers, local atmospheric impacts such as wind, and local vertical land motion related to plate tectonics. Based on tidal gauges, the rise if projected to be 6.6 inches by 2100.
20	Volunteer Gathered Stream Data							
20.1	Salish Sea Stormwater Monitoring Anacortes Report 2024-03-07.xlsx	03/21/24	X	J. Christofferson	09/16/24	City of Anacortes	03/07/24	Reviewed testing results for several parameters including water temperature, dissolved oxygen, pH, conductivity (specifically, conductance/specific conductance or SPC), turbidity, E. coli, enterococcus, color, visual observations, and odor. Based on the comments in the report, there are some issues that could be solved by CFPs or Source Control measures that would address high water temperatures and odor issues as well as submerged outfalls or outfalls that have been buried. No solutions or CFPs were specifically identified in the report. However, it might be worth reviewing the report with the City to see what else they may want added to the CFP summary table to include in the Plan.
20.2	Salish Sea Stormwater Monitoring - Anacortes Data 2024-03-07.pdf	03/21/24	X	J. Christofferson	09/16/24	City of Anacortes	03/07/24	Data was used to create the other Monitoring and the Test Strip Reports listed here.
20.3	Salish Sea Stormwater Monitoring Anacortes Test Strips Report.pdf	03/21/24	X	J. Christofferson	09/16/24	City of Anacortes	02/20/24	Reviewed testing results for several parameters including pH, Hardness CaCO3, Copper, Lead, Total Chlorine, Total Fluoride, Nitrate, Nitrite, Zinc, Mercury, and Total Alkalinity.

Notes:

CAO = Critical Areas Ordinance
CCTV = closed-circuit television
CFP = capital facility program
City = City of Anacortes
CWA = Federal Clean Water Act
GIS = geographic information system
NPDES = National Pollutant Discharge Elimination System
OFM = Office of Financial Management
PACP = Pipeline Assessment Certification Program
ROW = right-of-way
SMAP = Stormwater Management Action Plan
SPC = conductance/specific conductance
SWMP = Stormwater Management Plan
SWPRRP = Stormwater Pipe Repair and Replacement Program

APPENDIX B: STORMWATER PIPE REPAIR AND REPLACEMENT PROGRAM TECHNICAL MEMORANDUM



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TECHNICAL MEMORANDUM

Date: November 13, 2024

Project: City of Anacortes 2024 Stormwater Master Plan
To: Andrew Rheaume, Public Works Director | City of Anacortes
Aaron Esterholt, Stormwater Program Manager | City of Anacortes
From: Ann Bryant, PE | Osborn Consulting
Subject: Stormwater Pipe Repair and Replacement Program TM

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BACKGROUND

The Stormwater Management team for the City of Anacortes (City) is responsible for managing and maintaining the City's stormwater infrastructure. To ensure that the stormwater system functions properly, the City has been developing a program to assess the condition of stormwater pipes and prioritize repair, replacement, and maintenance projects. This Stormwater Pipe Repair and Replacement (R/R) Program (Program) will enable the City's stormwater team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing assets. The Program will include closed-circuit television (CCTV) inspections of stormwater pipes in the City of Anacortes, as well as the determination of likelihood of failure (LoF) and consequence of failure (CoF) for each asset inspected. The Program will also provide maintenance, rehabilitation, and replacement recommendations to improve the effectiveness of the City's stormwater management program. This initiative will benefit the City's residents and protect the local waterways from pollution and flooding. This memorandum documents the near-term and ongoing framework for the Program, which was developed during a series of workshops with City staff.

SECTION 1 EXISTING ASSET INVENTORY

To prioritize the pipe sizes and types for inspection under the Program, data from existing inspections were reviewed and an existing asset inventory was created using the City's available Geographic Information System (GIS) data. The City's stormwater pipe geodatabase (*Storm_Mains3.shp*) was obtained from the City on May 21, 2024, and was used to develop an existing asset inventory. Pipe attributes contained within the database, including total number and length, diameter, age, ownership, and status, were analyzed to prioritize assets for inspection.

1.1 Existing Inspection Data

The City began inspecting stormwater pipes in 2018 and has inspected 237 pipes to date, with the number of inspections ramping up each year. Some of these pipes were inspected as part of a previous project or in areas of concern, but the City is also proactively inspecting stormwater pipes, prioritizing pipes that are 12 inches and larger that carry the most flow in the City's system. In 2023, the City pre-cleaned and inspected just over two (2) miles of pipe. City inspection crews currently use POSM inspection software, which generates National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) compliant videos and pdf reports. **Figure 1** illustrates the stormwater pipes that have been inspected to date and their corresponding NASSCO Quick Structural Ratings (QSR). A QSR that begins with a 5 corresponds to the most significant defects, while a QSR that begins with a 1 corresponds to minor defects. A QSR score of 0000 indicates that no defects were present during inspection. QSRs are described in more detail in Section 2.1 Likelihood of Failure (LoF).

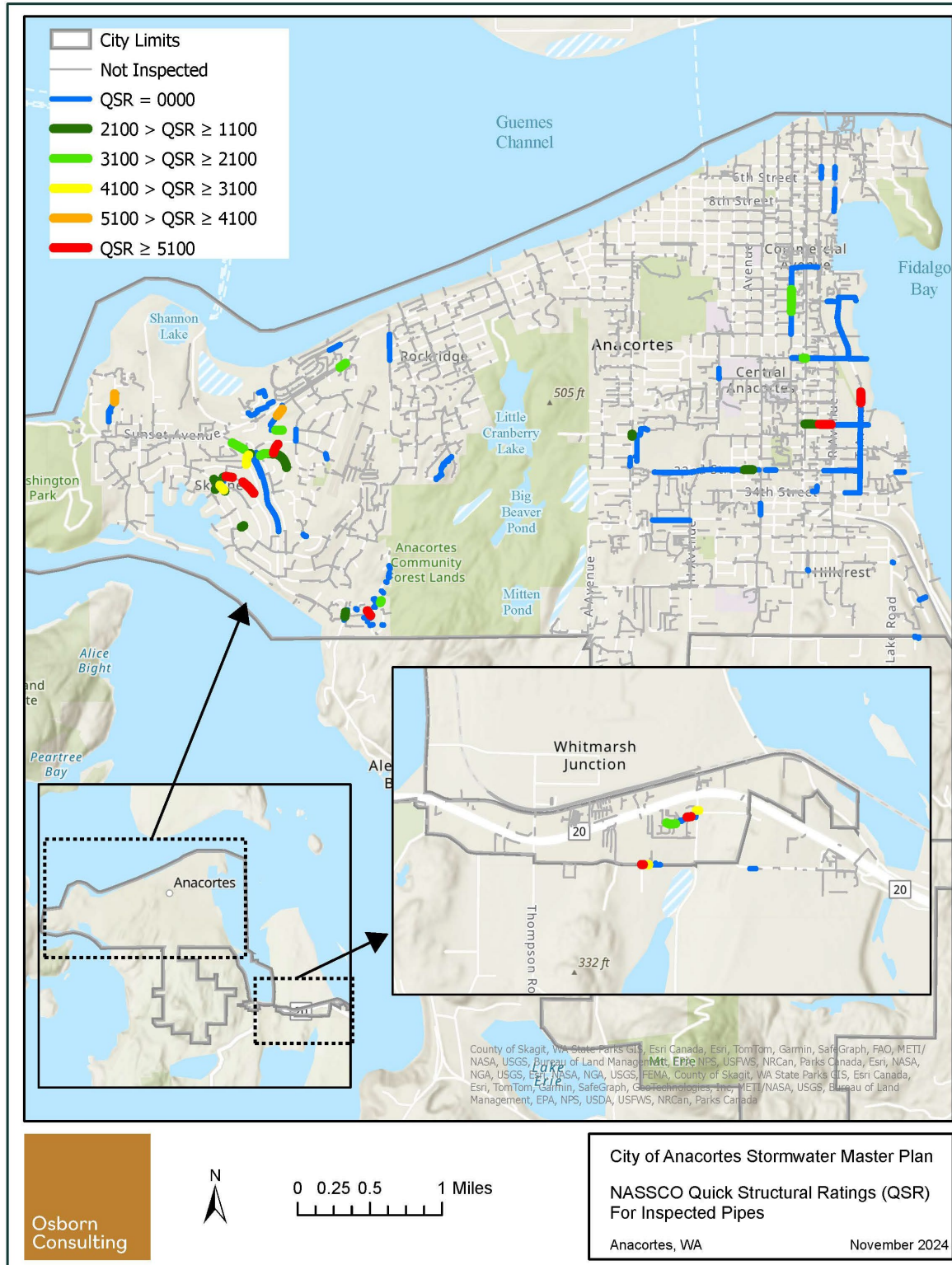


Figure 1. NASSCO Quick Structural Ratings for Inspected Pipes

1.2 Assets Prioritized for Inspection

Based on an analysis of the City's GIS data and discussion with the City, the pipes prioritized for inspection include those with the following attributes:

- **Ownership:** Public
- **Status:** Active
- **Diameter:** 8 inches and larger, 99, and Zero (0)
- **Class:** Branch, Culvert, Interceptor, Outfall, Trunk, and Blank
- **Install Year:** All
- **Material:** All
- **Length:** All

The analysis resulted in 4,560 pipes to be prioritized, with a total length of 80.13 miles, for the inspection and condition assessment under the City Program, as detailed in **Table 1**.

Table 1. Assets Prioritized for Inspection

Number of Pipes	Length of Pipes (miles)
4,560	80.13

At this time, pipes with the following attributes will not be prioritized for inspection under the Program:

- **Ownership:** Private
- **Status:** Abandoned, Inactive, and Removed
- **Diameter:** Less than 8 inches
- **Class:** Force Main

1.3 Frequency of Inspection

The City is currently inspecting about 2 miles of pipe per year and plans to inspect about 2.5 miles in 2025. Starting in 2026, the City plans to inspect 4 miles per year, ramping up to a goal of 5.3 miles per year in the long term. Consistently inspecting 5.3 miles of pipe per year will equate to approximately a 15-year inspection cycle. That is, if the City inspects 5.5 miles of pipe every year for 15 years, then all 80.13 miles of pipe currently prioritized for inspections under this program would be inspected within 15 years. The number of pipes inspected per year or the time to inspect all pipes will increase as the City's stormwater pipe network expands and new pipes are installed.

Table 2 provides an illustration of a potential concept for the City's near-term and ongoing inspection goals. After the initial inspection is complete for each pipe that is prioritized for inspection, the City can then refine the inspection frequency based on its future needs and evidence from previous inspections.

Table 2. City Near-Term and Ongoing Inspection Goals

Year	Inspection Cycle (years)	Number of Pipes per Year	Miles per Year
2025	32	143	2.5
2026	20	228	4
2027 and Beyond	15	304	5.3

1.4 Order of Inspection

Inspections will be prioritized by drainage basin to efficiently clean, inspect, and catalog existing assets to align with current and future basin planning efforts. Basins will be prioritized based on the City's 2023 Stormwater Management Action Plan (SMAP). This plan identifies the Fidalgo North Basin as the City's high priority basin, followed by the Guemes East Basin. Because the Fidalgo South Basin's size aligns with the City's 2025 inspection goal of 2.5 miles of pipe, the City plans to start with the Fidalgo South Basin as the City's Pilot Basin before starting inspections in the Fidalgo North Basin. Inspections within each basin may be prioritized based on pipe size, class, age, material, and unknown or blank data. **Table 3** provides the distribution of pipes prioritized for inspected by basin. An annotated map of the City's drainage basins is shown in **Figure 2**.

Table 3. Pipes Prioritized for Inspection by Basin

Drainage Basin	Number of Pipes	Length of Pipes (miles)
Fidalgo South	142	2.41
Fidalgo North	1,900	33.98
Guemes East	751	12.18
Burrows North	471	9.48
Padilla North	19	0.27
Padilla South	15	0.27
Similk	28	0.43
Burrows South	387	6.27
Guemes West	847	14.84
Total	4,560	80.13

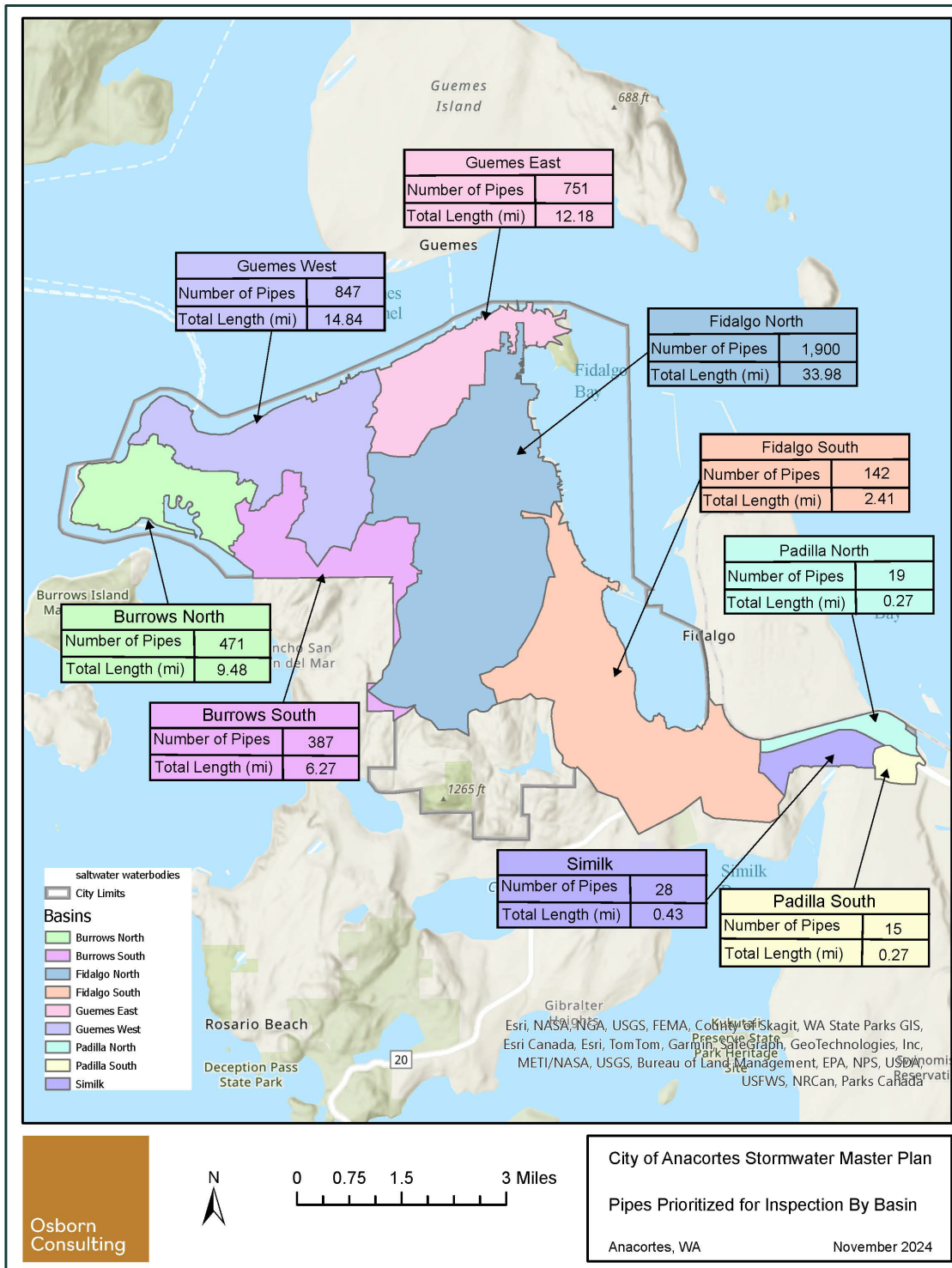


Figure 2. Pipes Prioritized for Inspection by Basin

SECTION 2 CRITICALITY AND RISK FOR STORMWATER PIPES

Risk in the context of this pipe risk management strategy includes two components:

- Likelihood of Failure (LoF)
- Consequence of Failure (CoF)

The LoF represents the condition of the pipe and how likely it is that the pipe might fail due to defects or condition. The CoF represents the impacts to people and property if a pipe fails. Together, these two factors can be used to direct resources based on a relative comparison of overall risk.

2.1 Likelihood of Failure (LoF)

Pipe LoF information will be obtained from condition assessment data collected during CCTV inspections using the standardized NASSCO PACP protocol.

Typical pipe defects observed in stormwater pipes include structural defects such as collapses, deformations, breaks, fractures, cracks, joint offsets at the point where two pipes come together, holes, sags, and crossbores from other pipes or utilities. Maintenance defects include excessive debris that impedes the flow of water, roots, intruding laterals, or blockages that need to be cleared. Both the number of defects and severity of the defects are used in the NASSCO PACP protocol to develop numerical condition grades.

Through inspection, numerical condition grades are assigned for both structural and maintenance defects ranging from 1 (minor) to 5 (most significant). Pipe ratings are based on the number of occurrences for each condition grade within individual pipes and are separately calculated for structural defects and Operational and Maintenance (O&M) defects.

Quick structural ratings (QSR) and quick maintenance ratings (QMR) use the NASSCO PACP numerical condition grades to provide an indication of the severity and number of defects within a pipe. This yields a more comprehensive representation of pipe condition than what a singular value would provide.

QSR and QMR values consist of a 4-digit score that is compiled as follows:

- First digit (XXXX) represents the highest severity defect grade occurring along the pipe length.
- Second digit (XXXX) represents the number defects with the highest severity grade.
- Third digit (XXXX) represents the second highest severity defect grade occurring along the pipe length.
- Last digit (XXXX) represents the number of defects with the second highest severity grade.

For example, a pipe with a QSR of 5231 would indicate that there are two instances of defects that have a grade of 5 (most significant), no instances of a defect with a grade of 4 (significant), and one instance of a defect with a grade of 3 (moderate).

The first digit of the pipe's quick rating will be used to assign each pipe a default structural LoF score and a defect maintenance LoF score ranging from 1 to 5 unless the quality assurance and quality control (QA/QC) process indicates a need for revision. During the condition assessment and QA/QC review, the reviewer will have the opportunity to upgrade or downgrade the LoF score as appropriate based on observed defects to ensure that all actionable defects are dealt with in a timely manner (for example, a small hole compared to a large hole). These LoF scores will be used in the Risk Matrix.

The default LoF scores for QSR/QMR ranges are provided for reference in **Table 4**.

Table 4. Default LoF Scores for QSR/QMR Ranges

Default LoF Score	QSR/QMR
5	≥5100
4	≥4100
3	≥3100
2	≥2100
1	≥0000

2.2 Consequence of Failure (CoF)

The CoF will be different depending on where the pipe is located relative to the constructed features in the landscape, such as critical facilities (for example, fire stations and schools), road networks, the diameter of the pipe, and its location relative to sensitive areas, such as landslide and erosion hazard areas.

An analysis of pipe CoF was conducted in GIS using the following features described in **Table 5** as indicators of potential consequences to people or property.

Table 5. Consequence of Failure Data

Category	Feature	GIS Data Source	Date Received
Size	Pipe Diameter	<i>Storm_Mains3.shp</i>	05/21/2024
Transportation	Arterials	<i>Streets.shp</i>	05/21/2024
Surface Condition	Paved Right-of-Way	<i>Streets.shp</i>	05/21/2024
Miscellaneous	Streams	<i>Streams.shp</i>	05/21/2024
	Critical Areas - Wetlands	<i>Wetlands.shp</i>	05/21/2024

Category	Feature	GIS Data Source	Date Received
	Critical Areas – NWI Wetlands	<i>NWI_Wetlands.shp</i>	05/21/2024
	Critical Areas - Shoreline Unstable Slope	<i>Shoreline_slope_stability.shp</i>	05/21/2024
	Critical Areas – Shoreline Erosion	<i>ErosionShoreline.shp</i>	05/21/2024
	Critical Areas – Erosion Hazard Soils	<i>Erosion_Hazard_soils.shp</i>	05/21/2024
	Critical Areas – Lakes and Ponds	<i>Lakes_and_Ponds.shp</i>	05/21/2024
	Critical Infrastructure – Fire Stations, Schools, Police Stations, City Hall, and Libraries	<i>CriticalFacilities.shp</i>	05/21/2024

Using the criteria described in **Table 6**, numeric values were assigned to each feature and weighted according to presumed importance. Cumulative scores were then calculated for each pipe, with a minimum CoF score of 1 and a maximum CoF score of 5.

Table 6. Consequence of Failure Criteria and Scoring

Category	Feature	Criteria	Maximum Score
Size	Pipe Diameter	Diameter > 12 inches = 1 point	1
Transportation	Arterials	Pipe intersects with either principal or minor arterial 30-foot buffer = 2 points	2
Surface Conditions	Paved Right-of-Way	Pipe intersects with streets with surface type asphalt with 25-foot buffer = 1 point	1
Miscellaneous	Critical Areas - Streams	Pipe intersects with stream (no buffer) = 1 point	1
	Critical Areas - Wetlands	Pipe intersects with critical area 5-foot buffer = 1 point	
	Critical Areas - National Wetlands Inventory Wetlands		
	Critical Areas - Shoreline Unstable Slope		
	Critical Areas - Shoreline Erosion		
	Critical Areas - Erosion Hazard Soils		
	Critical Areas - Lakes and Ponds		

Category	Feature	Criteria	Maximum Score
	Critical Infrastructure - Fire Stations, Schools, Police Stations, City Hall, and Libraries	Pipe intersects with critical infrastructure 20-foot buffer = 1 point	

For example, an 18-inch pipe crossing an arterial that is next to a school would receive one point for the diameter being greater than 12 inches, two points for being within the 30-foot buffer of an arterial, one point for being within five feet of the edge of pavement, and one point for being adjacent to a school (critical infrastructure) for a total CoF Score of 5.

2.3 Risk Matrix

As described above, pipe risk in this context is determined using a pipe's LoF classification combined with the consequence of failure analysis results. By using both the LoF and the CoF information, the pipes can be ranked.

The matrix below identifies a strategy to rank the pipes based on pipe condition relative to all other pipes in the system. A matrix has the benefit of incorporating the rating of both LoF and CoF and is better suited at identifying the "first priority" pipes for more immediate action. **Figure 2** shows the risk matrix for the City pipes.

		Consequence of Failure (CoF)				
		1	2	3	4	5
Likelihood of Failure (LoF)	5	First Priority Rehabilitation or Maintenance Program				
	4					
	3	Monitoring				
	2					
	1					

Figure 2. Risk Matrix

SECTION 3 CONDITION ASSESSMENT

The condition assessment process for the City's Program will involve collecting and processing CCTV inspection data, performing condition assessments, and determining repair, replacement, and maintenance recommendations.

3.1 Pipe Inspection Protocol

The City's stormwater pipe inspections are being performed using CCTV technology and standardized NASSCO PACP pipe condition grading. The overall goal of the pipe inspection process is to obtain quality inspection data to understand the condition of stormwater pipes to support the City's near-term and ongoing planning and allocation of resources for pipe maintenance, repair, and replacement.

3.1.1 Inspection Roles and Responsibilities

The implementation of the pipe inspection protocol will include City roles that may change over time. For the near-term and ongoing Program, the City plans to perform the cleaning and inspection work (pipe inspector, vactor operator, sediment disposal, and traffic control), as well as management, data reviewer, and operations roles. The following roles and job responsibilities are recommended to implement the pipe inspection program:

- **Inspection Project Manager (PM):** The Inspection PM will oversee the pipe inspections and ensure progression towards established near-term and ongoing inspection completion targets. The PM will review weekly reports, resolve outstanding issues that arise, assure coordination between departments, and recommend adaptations to address unexpected situations.
- **Data Reviewer:** The Data Reviewer will be responsible for various inspection data management tasks, including conducting QA/QC reviews on the pipe inspection data and ensuring data is acceptable and complete before being allowed to progress to the condition assessment process.
- **Asset Manager:** The Asset Manager will conduct updates to GIS applications based on data collected during the inspection process, and resolve mapping issues, including managing GIS data for newly discovered assets.
- **Pipe Inspector:** All pipe inspectors must be NASSCO PACP certified. They will be responsible for collecting pipe inspection data with CCTV equipment and identifying and coding defects according to the NASSCO PACP protocol. They will be responsible for delivering high-quality pipe image files, and a NASSCO PACP-certified database that documents the pipe inspection data. Additionally, they will be responsible for notifying the PM in the event of an emergency and when new assets are located in the field.
- **Vactor Operator:** The Vactor Operator will clean pipes as requested by the Inspection PM.
- **Sediment Disposal:** Sediment Disposal, specifically the disposal of liquids and soils that were generated during the pipe cleaning operations, will be taken care of by the Vactor Operators.
- **Traffic Control:** Traffic Control may be necessary in some areas of the City or for nighttime work. Traffic control will be subject to City review and approval and comply with all local and state laws to ensure a safe workspace for the Pipe Inspectors and Operations Support.
- **Miscellaneous Operations Support:** Miscellaneous Operations Support may be required to assist Pipe Inspectors with field operations issues that arise at any time during the inspection process, such as clearing obstructed maintenance or access holes, and installing "no parking" signs.

3.1.2 Inspection Data, Reports, Tracking, and Storage

The pipe inspection condition data collected by the Pipe Inspectors and accessory reports will be delivered to the Inspection PM at different times and in different formats. The organization, visualization, tracking, and storage of inspection data will be supported by software tools such as ArcGIS and Cartegraph.

- **Inspection Data:** Unless there is an urgent situation, all reports and data will be submitted to the PM on a weekly basis. The Pipe Inspector will collect the following data and reports:
 - **NASSCO PACP Compliant Inspection Database:** The POSM database file that includes asset attributes and pipe condition data, including the number and type of defects.
 - **Videos:** CCTV camera video of inspection in .mp4 format. Videos will have the following standard naming convention where SDXXXXXXXXXXXX is the GIS asset ID:
 - ◆ SDXXXXXXXXXXXX _YYYYMMDD.mp4 (inspection video – full inspection)
 - SDXXXXXXXXXXXX _YYYYMMDD_US.mp4 (inspection video – partial inspection in upstream direction)
 - SDXXXXXXXXXXXX _YYYYMMDD_DS.mp4 (inspection video – partial inspection in downstream direction)
 - ◆ At a minimum, the video shall include the following information:
 - Date and Time
 - Street Name or Location
 - Upstream and Downstream Structure ID
 - Pipe Size
 - Pipe Length
 - Pipe Material Type
 - **Photographs:** Digital photographs of any defects in .jpg format. The photographs will have the following standard naming convention where SDXXXXXXXXXXXX is the GIS asset ID:
 - ◆ SDXXXXXXXXXXXX _YYYYMMDD_##.jpg (photo)
 - **Inspection Report:** The NASSCO PACP compliant report that is generated by the Pipe Inspector's inspection software for each asset. This report summarizes the observed asset attributes and inspection in .pdf format. The naming convention for these reports is as follows, where SDXXXXXXXXXXXX is the GIS asset ID:
 - ◆ SDXXXXXXXXXXXX _YYYYMMDD.pdf (inspection report – full inspection)
 - SDXXXXXXXXXXXX _YYYYMMDD_US.pdf (inspection report – partial inspection in upstream direction)
 - SDXXXXXXXXXXXX _YYYYMMDD_DS.pdf (inspection report – partial inspection in downstream direction)
 - ◆ At a minimum, the inspection report should include the following information:
 - Inspector's name
 - Inspector's NASSCO PACP certificate number
 - System owner (the City of Anacortes)
 - Inspection date and time
 - Weather during inspection
 - Pre-cleaning status
 - Direction of inspection (upstream, downstream)

- Inspection status
 - Drainage basin
 - Asset ID
 - Location of inspection (nearest address)
 - Pipe type (for example, storm or sanitary pipe)
 - Pipe size
 - Pipe shape
 - Pipe material
 - Length of inspection
 - Upstream structure ID
 - Downstream structure ID
 - Upstream rim to invert, rim to grade, and grade to invert
 - Downstream rim to invert, rim to grade, and grade to invert
 - Observed defect codes, descriptions, locations, and grades
 - Pipe ratings
 - Photos of significant defects
- **Urgent Situations:** Immediate phone call to Inspection PM.
- **ArcGIS:** The City's stormwater pipe inventory is currently housed in an ArcGIS geodatabase. This ArcGIS data will be the source data for identifying pipes to assess, their locations, and their assumed characteristics, including pipe diameter, age, material, length, and upstream and downstream structures and types. The CoF analysis will be conducted using ArcGIS, and the videos and photos from the inspection will be uploaded to ArcGIS. ArcGIS is integrated into and can be accessed directly from the City's Cartegraph software.
 - **POSM Inspection Software:** The City's Pipe Inspectors are currently using POSM CCTV inspection software that creates PACP-compliant reports and a database that is compatible with Cartegraph.
 - **Cartegraph:** The Inspection PM will be tracking the status and actions associated with a pipe inspection such as cleaning and providing access in Cartegraph. The pipe inspection data will be uploaded to Cartegraph. Cartegraph is the City's current asset management software and will be used to track and store the final inspection data.

3.1.3 Inspection Workflow

Pipe inspections will be performed by Pipe Inspectors using CCTV equipment and will utilize NASSCO PACP condition grades and ratings. CCTV pipe inspections and the corresponding data management protocol involves multiple lateral and sequential steps for various City departments to perform. The pipe inspection workflow is illustrated in detailed workflow diagrams included in **Appendix A. Step 1 – Annual CCTV Pipe Inspection Flow Chart** and **Step 2 – Pipe Inspection Data Management Flow Chart** outline the process required to complete pipe inspections and properly manage the resulting data, respectively.

Following **Step 1 – Annual CCTV Pipe Inspection Flow Chart** in **Appendix A**, the City Stormwater Department will complete the following to ensure the physical completion of pipe inspections:

- Select pipes for inspection.

Following *Step 1 – Annual CCTV Pipe Inspection Flow Chart* in **Appendix A**, the City O&M Department will complete the following to ensure the physical completion of pipe inspections:

- Create cleaning and inspection work orders.
- Clean pipes.
- Measure upstream and downstream rim to invert, rim to grade, and grade to invert.
- Inspect pipes.
- Clean pipes as needed based on condition and accessibility.
- Make any necessary GIS attribute and geometry updates for existing and new assets.
- Coordinate with and report to the Inspection PM any issues, including those pertaining to pipe access and discovery of critical defects.
- Implement the appropriate actions for various scenarios such as inaccessible pipes or the discovery of critical defects.
- Track volume and composition of sediment removed during cleaning.

Following *Step 1 – Annual CCTV Pipe Inspection Flow Chart* in **Appendix A**, the City GIS Division of Public Works will complete the following to ensure the physical completion of pipe inspections:

- Assign asset ID to new assets.
- Upload PACP report to Cartegraph and submit video and photos to City GIS Division of Public Works.

Following *Step 2 – Pipe Inspection Data Management Flow Chart* in **Appendix A**, the City GIS Division of Public Works will complete the following to properly manage the resulting inspection data:

- Conduct inspection data quality assurance and quality control (QA/QC) in Cartegraph.
- Determine acceptability and completeness of the data.
- Issue re-inspection work orders if the data is not acceptable or if missing data cannot be obtained without re-inspection.
- Make any necessary GIS attribute and geometry updates.
- Upload inspection data determined to be thorough and complete to Cartegraph.
- Calculate the CoF scores for all inspected assets. This scoring represents the impacts to people and property if a pipe fails and will be used in the next step in the process: Condition Assessment.

3.2 Condition Assessment Protocol

Condition assessments will be performed for each pipe inspected. During the condition assessment process, the LoF scores, along with risk scores calculated using a combination of CoF and LoF results, will be assigned, and repair, replacement, and maintenance recommendations will be determined. The goal of the condition assessment process is to provide prioritized pipe repair, replacement, and maintenance recommendations to enable the City's stormwater team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, or replacing assets.

3.2.1 Condition Assessment Roles and Responsibilities

As with the inspection protocol, the division of roles for the condition assessments may change over time. For the near term, the condition assessment work will be performed by City staff. As the volume of annual inspections increases and depending on City staff availability, the City may explore hiring a consultant to manage or perform the condition assessments. These roles may be covered by the same person and not be a full-time responsibility in the near term, but this may change as the on-going scope of this program increases. The following additional job responsibilities will be needed to implement the condition assessment protocol:

- **Condition Assessment Project Manager (PM):** The Condition Assessment PM will oversee the condition assessment process and review repair, replacement, and maintenance recommendations assigned by the Data Reviewer. The Condition Assessment PM will assign work orders to City crews or prepare contract packages to address recommended repair, replacement, and maintenance actions.
- **Data Reviewer:** For the condition assessment process, the Data Reviewer will ensure inspection and GIS data is complete and up to date. The Data Reviewer will also review inspection data and use the CoF previously assigned in association with the NASSCO PACP pipe ratings to determine the LoF for all inspected assets and the identify first and second priority status. Based on those determinations, pipes will be evaluated, and repair, replacement, and maintenance recommendations will be assigned by the reviewer. This role requires NASSCO PACP certification or equivalent knowledge.

3.2.2 Condition Assessment Data, Tracking, and Storage

Condition assessment data consists of a CoF score, a structural and maintenance LoF score, a priority (such as first, second, or monitoring), and a repair, replacement, or maintenance recommendation. GIS and Cartegraph, as described previously, will also be used to complete the condition assessment protocol. Cartegraph will be used to track and store the final inspection data, which includes CoF and LoF scores and prioritized repair, replacement, maintenance, and monitoring recommendations.

3.2.3 Condition Assessment Workflow

Condition assessment workflow involves multiple lateral and sequential steps for the City to perform and is illustrated in a detailed workflow diagram included in **Appendix A**. The flow chart *Step 3 – Pipe Condition Assessment Flow Chart* outlines the process required to complete the pipe condition assessment.

Following *Step 3 – Pipe Condition Assessment Flow Chart* in **Appendix A**, the City Stormwater Department will complete the following to properly implement the pipe condition assessment process:

- Conduct QA/QC reviews to ensure the inspection and GIS data uploaded to Cartegraph is complete and up to date. The City Stormwater Department can update GIS attributes and geometry, address inspection data issues, and redirect the workflow back to Step 2 if the condition assessment cannot be completed with the current data.
- Review CCTV data and assign LoF scores.
- Determine if review is needed by the City Engineering Department.
- Determine pipe risk based on the combination of CoF and LoF scores in the risk matrix.
- For pipes determined to be First Priority risk where immediate action is needed:
 - Determine and schedule repair, replacement, or maintenance action.

- Determine if review is needed by the City Engineering Department.
- Create work orders and contract bundles.
- For pipes determined to be either First Priority risk where immediate action is not needed, or Second Priority risk:
 - Determine repair, replacement, or maintenance recommendation.
 - Determine if review is needed by the City Engineering Department.
 - Conduct QA/QC on the recommendation.
 - Create work orders and contract bundles.
- Pipes that are neither First nor Second Priority risk are categorized as either Regular or Increased Monitoring.

Following *Step 3 – Pipe Condition Assessment Flow Chart* in **Appendix A**, the City Engineering Department will complete the following to properly implement the pipe condition assessment process:

- Review CCTV data flagged by the City Stormwater Department.
- Assign LoF Scores.
- Determine repair, replacement, or maintenance recommendations.

3.3 Repair, Replacement, and Maintenance Recommendations

The condition assessment data will provide information about the severity of the structural and maintenance defects as well as the location and number of defects in each pipe segment. Depending on the condition of each asset, a range of options will be available for restoring pipe functionality.

3.3.1 Spot Repairs

Spot repairs are repairs that can be conducted on a portion of the pipe without replacing the entire pipe segment. These repairs can be made for pipes that have one severe defect or many defects that are confined to a short segment of pipe. Spot repairs can be open cut or trenchless.

3.3.2 Trenchless Repair

Trenchless repairs, such as cured-in-place (CIPP) lining, slip lining, fold and form lining, spiral wound lining, spray applied polymer lining, or other trenchless repair types, are appropriate for pipes that have multiple defects but are generally intact without large offsets or voids. These pipes can be effectively repaired with trenchless technology. Trenchless repair is typically the default repair method, whereas open cut replacement is reserved as a last resort for pipes that have failed or deteriorated beyond the limits of trenchless repair.

3.3.3 Full Replacement

Full pipe replacement is warranted for pipes that have multiple severe defects or voids that trenchless repair technology cannot appropriately address. Additionally, full replacement may be necessary if pipes are not sized correctly or have other physical attributes such as position, slope, or change in pipe diameter that warrant replacement in addition to the pipe's condition.

3.3.4 Maintenance

Pipes will be cleaned before each inspection and as needed to attempt to complete the CCTV inspection. However, there are instances where sediment, debris, roots, and other maintenance obstructions, such as intruding laterals, will not be cleared with this light cleaning. These maintenance condition observations will be noted in the CCTV report and represented in the maintenance ratings. The maintenance ratings can be used to identify and prioritize the necessary maintenance activities.

3.3.5 Special Situations

The condition assessment will identify special situations that require City decisions for repair or replacement actions. These include but are not limited to illicit connections and utility crossings. Most of these situations require coordination with other entities to resolve the issues.

3.3.5.1 Illicit Connections

Condition assessment will identify illicit connections where pipes have been tapped into the City's drainage pipes. Connections to the storm system should be made at the upstream and downstream structures. Some illicit connections may have been installed using appropriate construction technique and cause no damage to the mainline. However, most illicit connections cause issues, such as protruding laterals or damage to the mainline where the connection was made. These situations will be included and evaluated as part of the pipe's inspection findings.

If a lateral connection is determined to be a sanitary sewer lateral, the City will follow its National Pollution Discharge Elimination System (NPDES) Phase II Permit requirements for removing the lateral. If lateral connections are stormwater laterals such as roof drains or groundwater laterals such as footing drains or sump pump drains, they are generally left alone until the mainline pipe needs repair or replacement.

3.3.5.2 Utility Crossings

New utility lines are often constructed using trenchless technology, which can result in drainage pipes occasionally being intersected by other utilities. These crossbores will be picked up during CCTV inspection and must be remedied to ensure the proper functionality and safety of the drainage system and the utility that crosses the City's drainage network. Some utilities, such as gas line crossings, should be immediately resolved. Other utilities should be notified of the problem and a request should be made to move their line.

3.3.6 Monitoring

Pipes that are neither first nor second priority risk based on their CoF and LoF scores are categorized as either Regular or Increased Monitoring.

3.3.7 Packaging Repair, Replacement, and Maintenance Activities

The Risk Matrix (visualized in **Figure 2**) provides a framework for prioritizing future repairs, replacement, and maintenance actions. Similar types of repairs, replacement, and maintenance actions should be bundled together for a contractor to perform. Additionally, work that the City wants to perform in-house should be pulled from these bundles. However, there are other practical considerations that may factor into the prioritization scheme. These considerations include opportunities to partner with other capital projects and geographic project packaging.

Following both the completion of the condition assessments and the determination of repair, replacement, or maintenance recommendations, the City can identify pipes relative to planned capital projects and identify potential opportunities for repairs or replacements with other projects. When packaging similar types of repairs, replacements, and maintenance actions, second priority pipes located near first priority

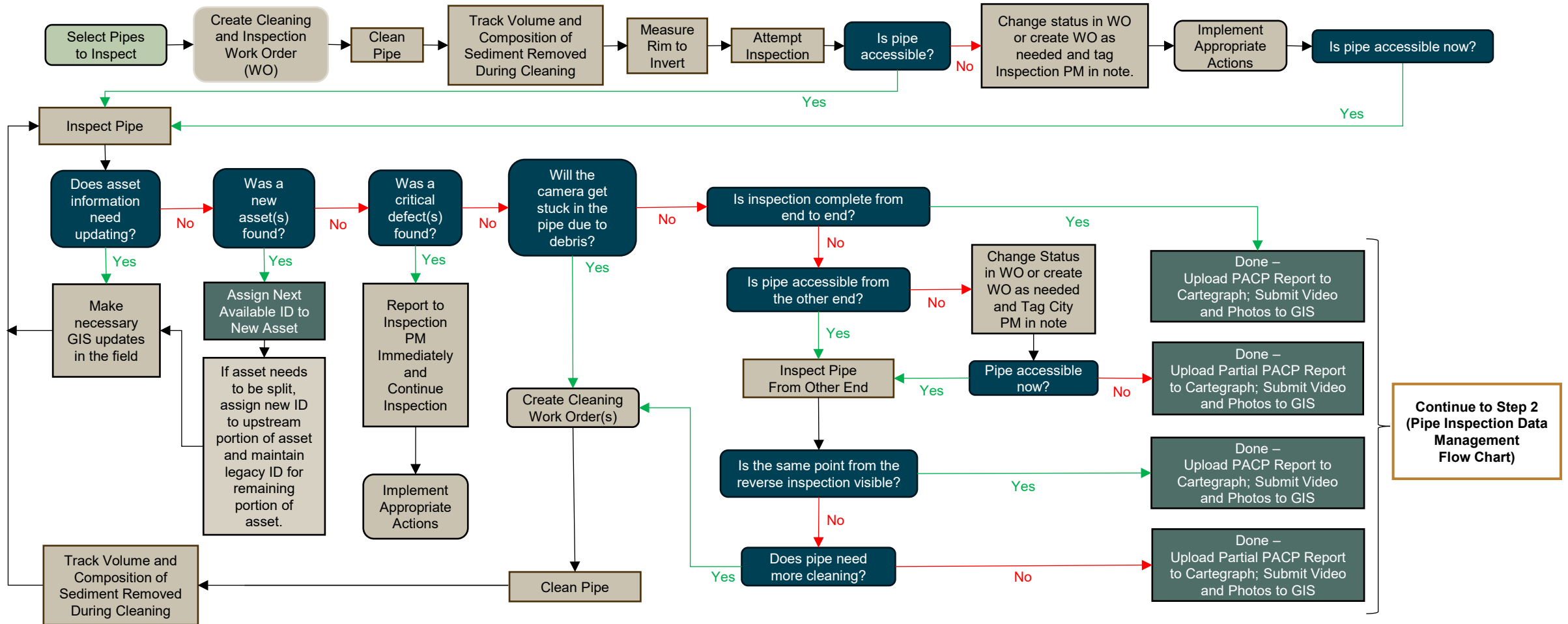
pipes should also be evaluated to bundle work located within the same neighborhood or relative geographic area within the City.

SECTION 4 CONCLUSION AND NEXT STEPS

This memorandum summarizes the framework for the City's Stormwater Pipe Repair and Replacement Program and includes near-term and ongoing program recommendations where applicable. With the framework defined, the City can continue inspecting the stormwater system, begin performing condition assessments, and undertake recommended repair, replacement, and maintenance projects.

APPENDIX A WORKFLOW DIAGRAMS

Step 1: Annual CCTV Pipe Inspection Flow Chart



Continue to Step 2
(Pipe Inspection Data Management Flow Chart)

LEGEND:

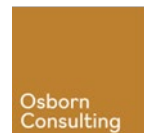
Evaluation

City – O&M

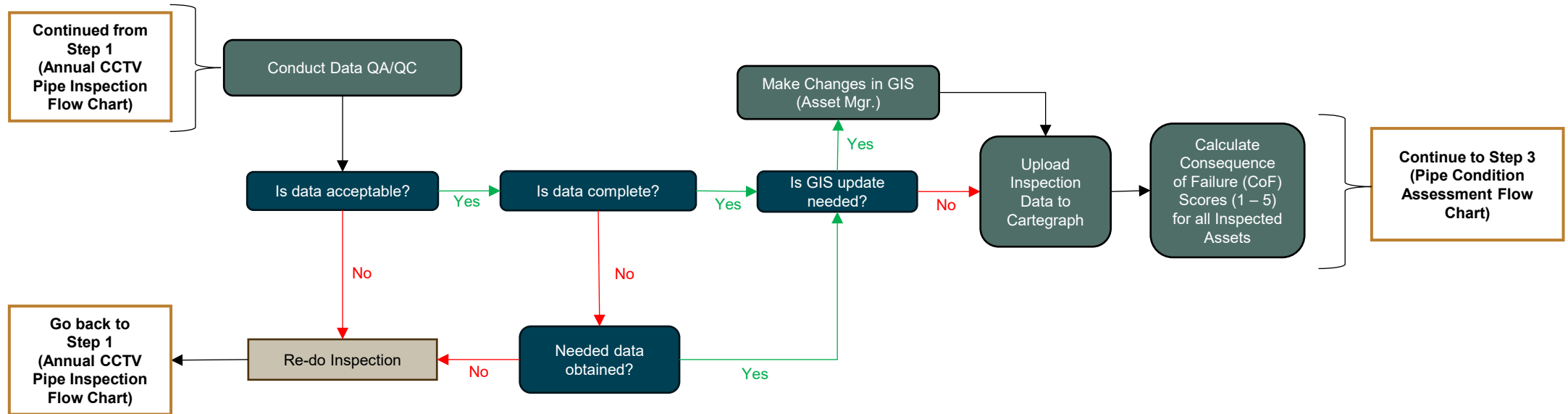
City – GIS/IT

City – Stormwater Department

City – Engineering



Step 2: Pipe Inspection Data Management Flow Chart



LEGEND:

Evaluation

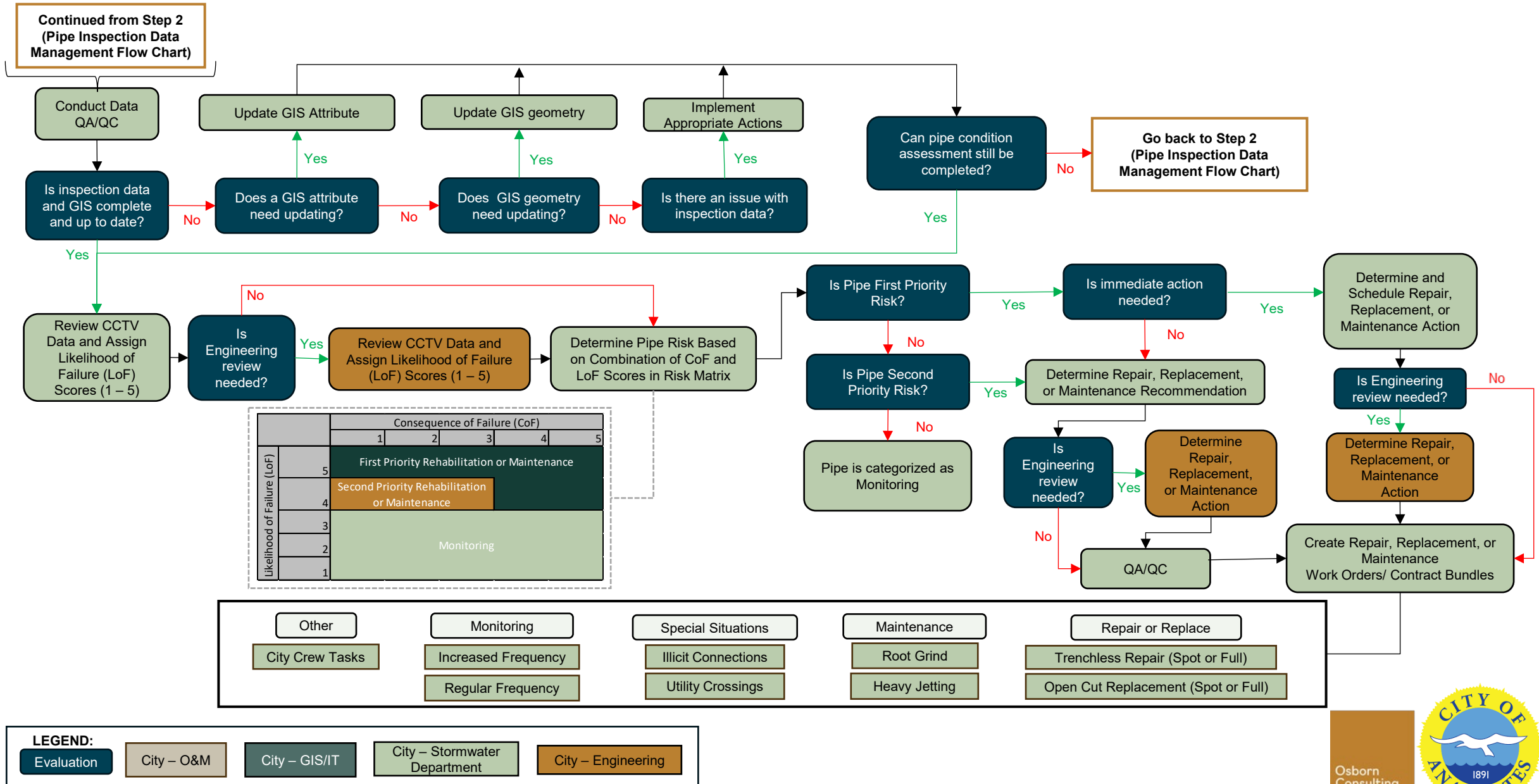
City – O&M

City – GIS/IT

City – Stormwater
Department

City – Engineering

Step 3: Pipe Condition Assessment Flow Chart



APPENDIX C: SYSTEMWIDE HYDRAULIC MODEL

TECHNICAL MEMORANDUM

Date: November 27, 2024

Project: City of Anacortes 2024 Stormwater Master Plan
To: Andrew Rheume, Public Works Director | City of Anacortes
Aaron Esterholt, Stormwater Program Manager | City of Anacortes
From: Dave Jacobs, PE | Osborn Consulting
Tom Spangenberg, PE | Osborn Consulting
Katrina Tang, EIT | Osborn Consulting
Subject: Systemwide Hydraulic Modeling

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Background 1

BACKGROUND

Osborn was contracted by the City of Anacortes to create a model of their stormwater system. The project area encompasses the entire City of Anacortes but was split into eight different basins. This section will provide figures for each basin and their maintenance holes, pipes, outfalls, and detention facilities.

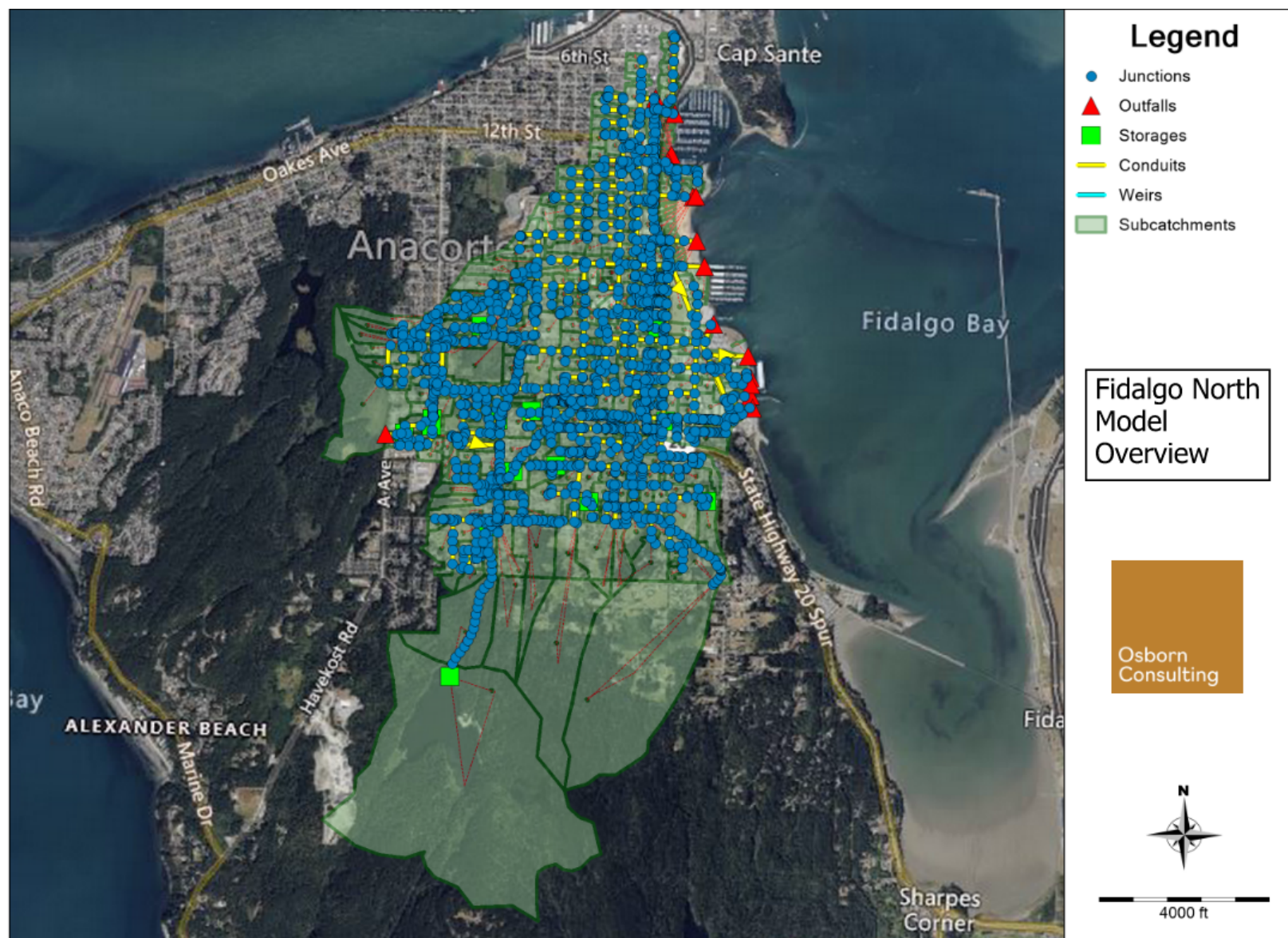


Figure 1. Fidalgo North Model Overview

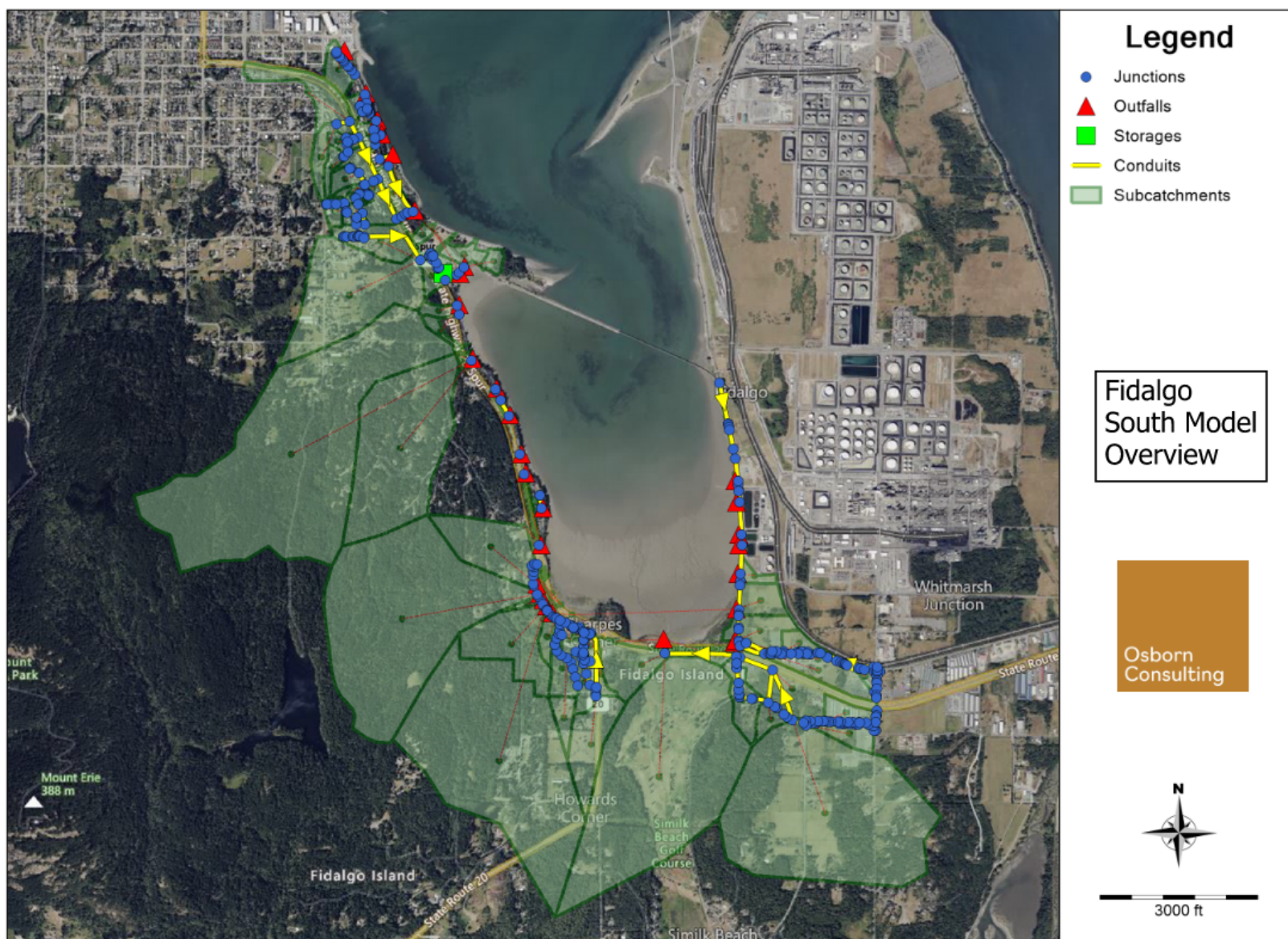


Figure 2. Fidalgo South Model Overview

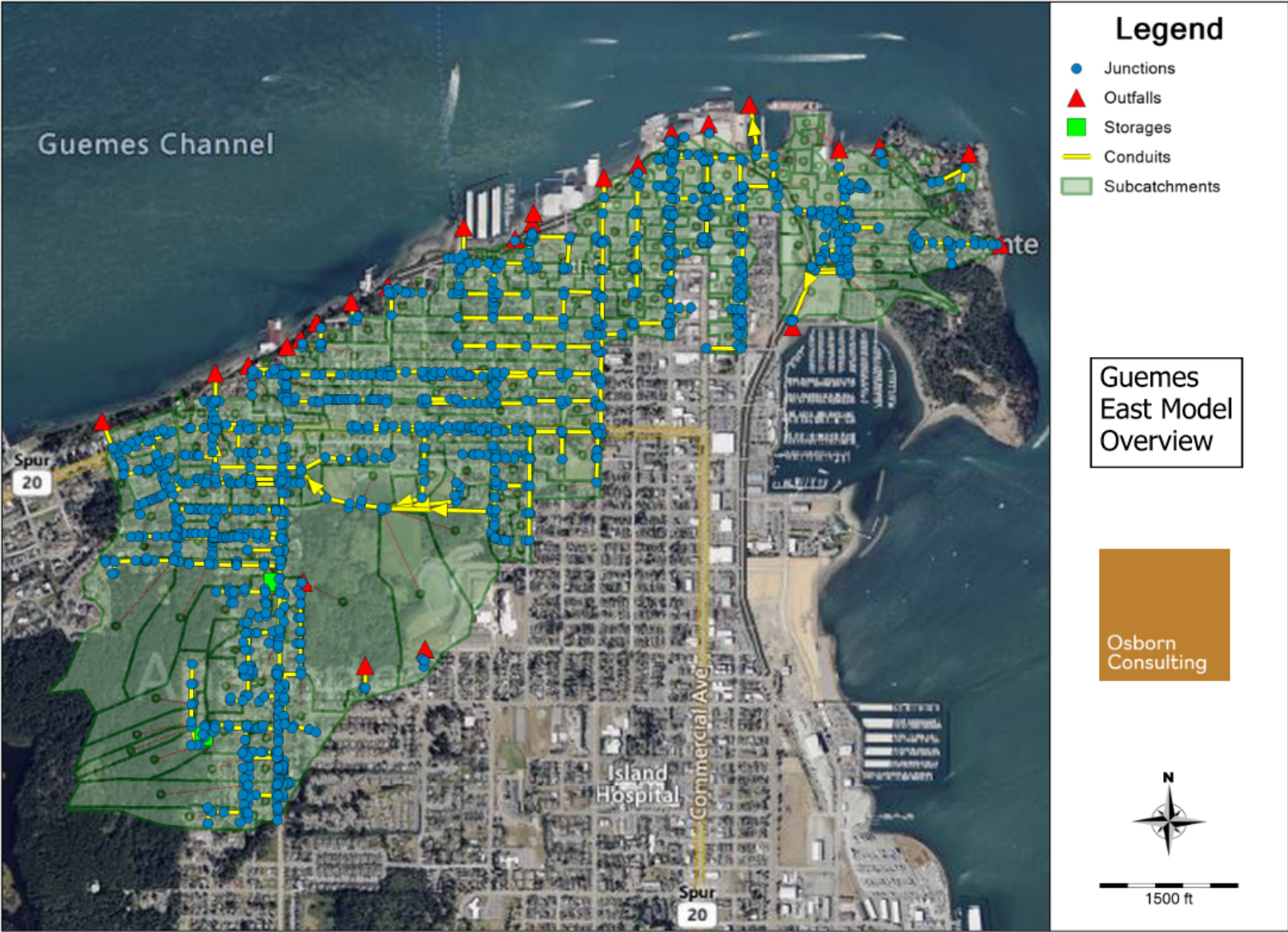


Figure 3. Guemes East Model Overview

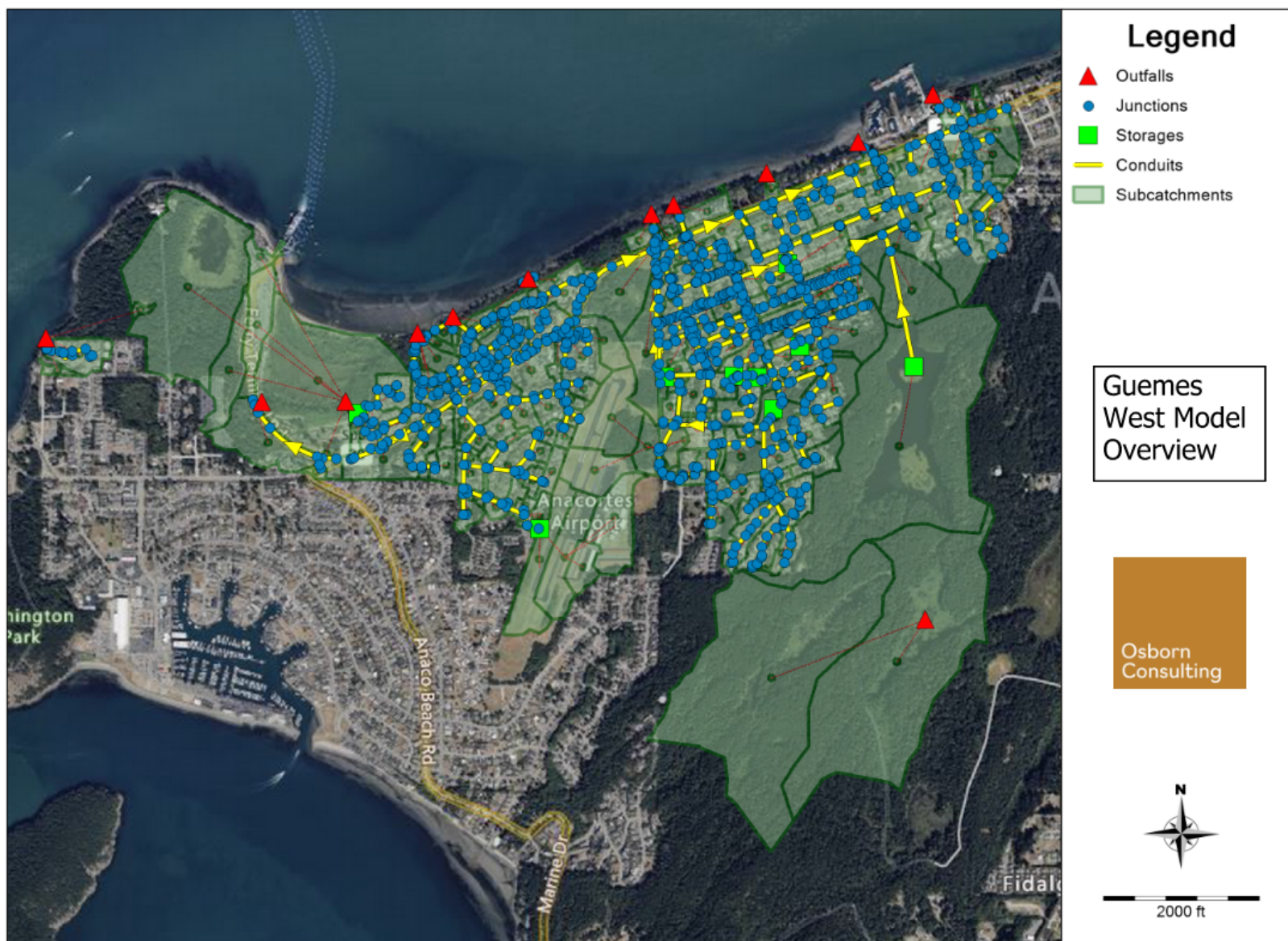


Figure 4. Guemes West Model Overview

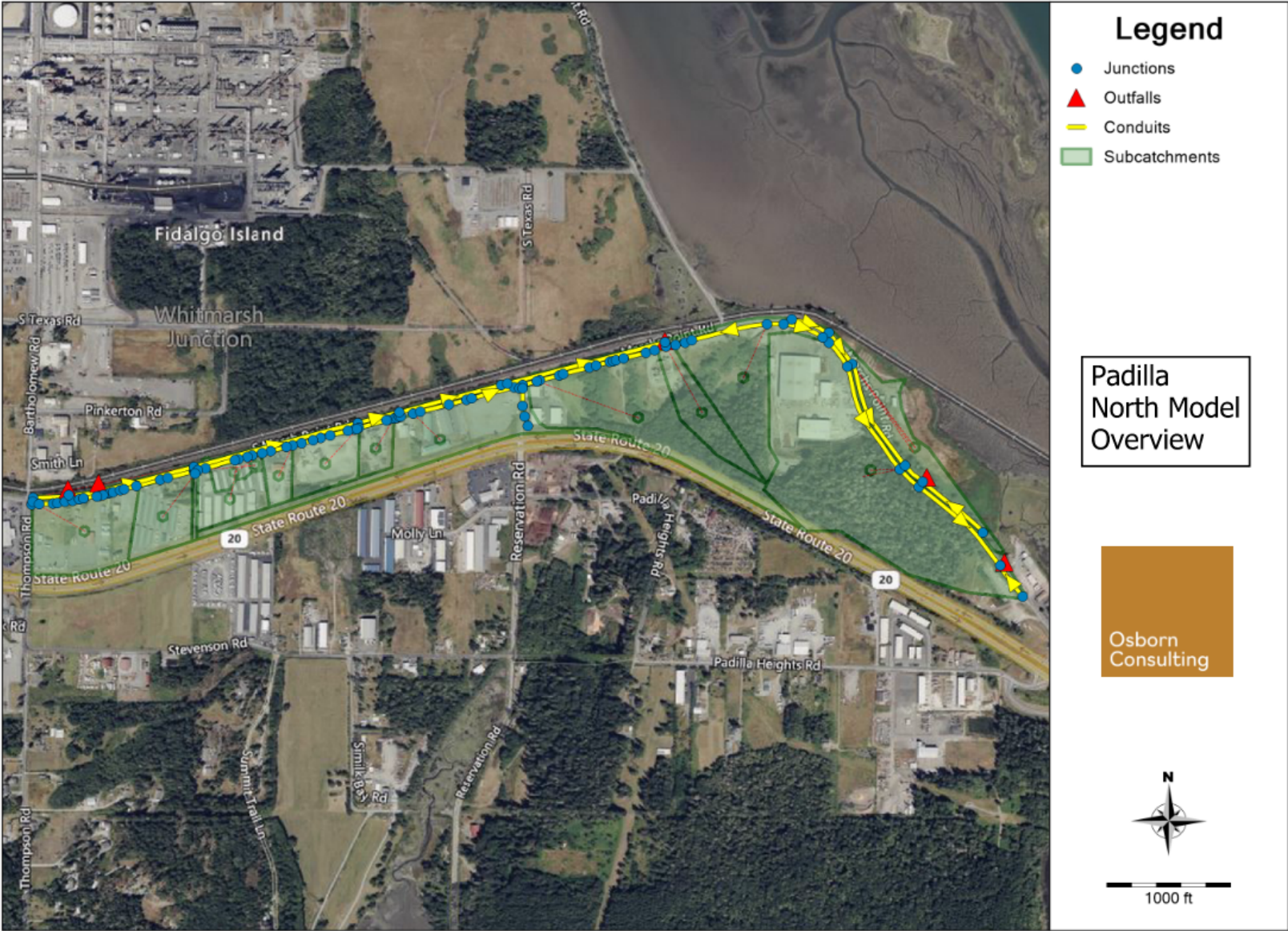


Figure 5. Padilla North Model Overview

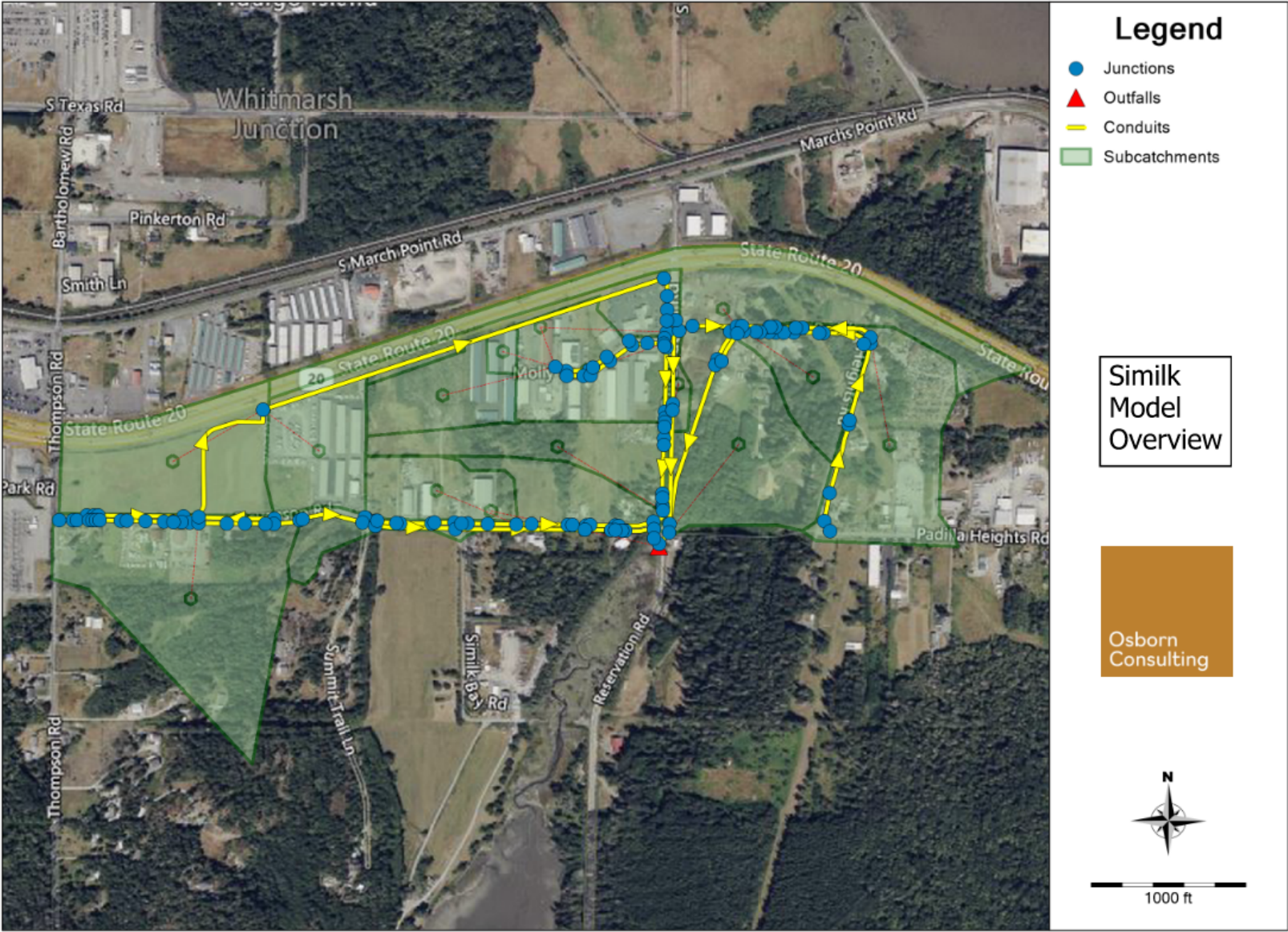


Figure 6. Similk Model Overview

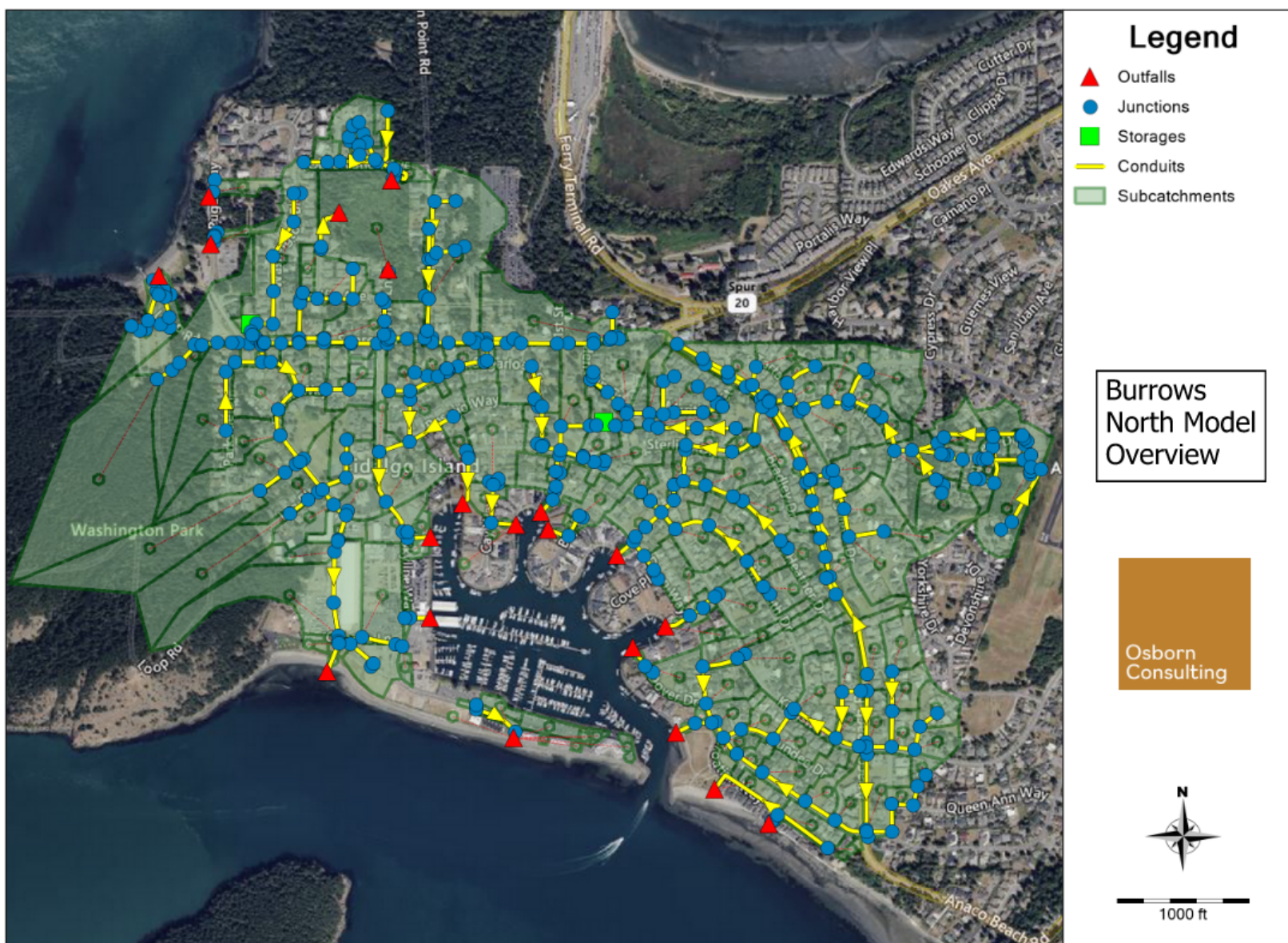


Figure 7. Burrows North Model Overview

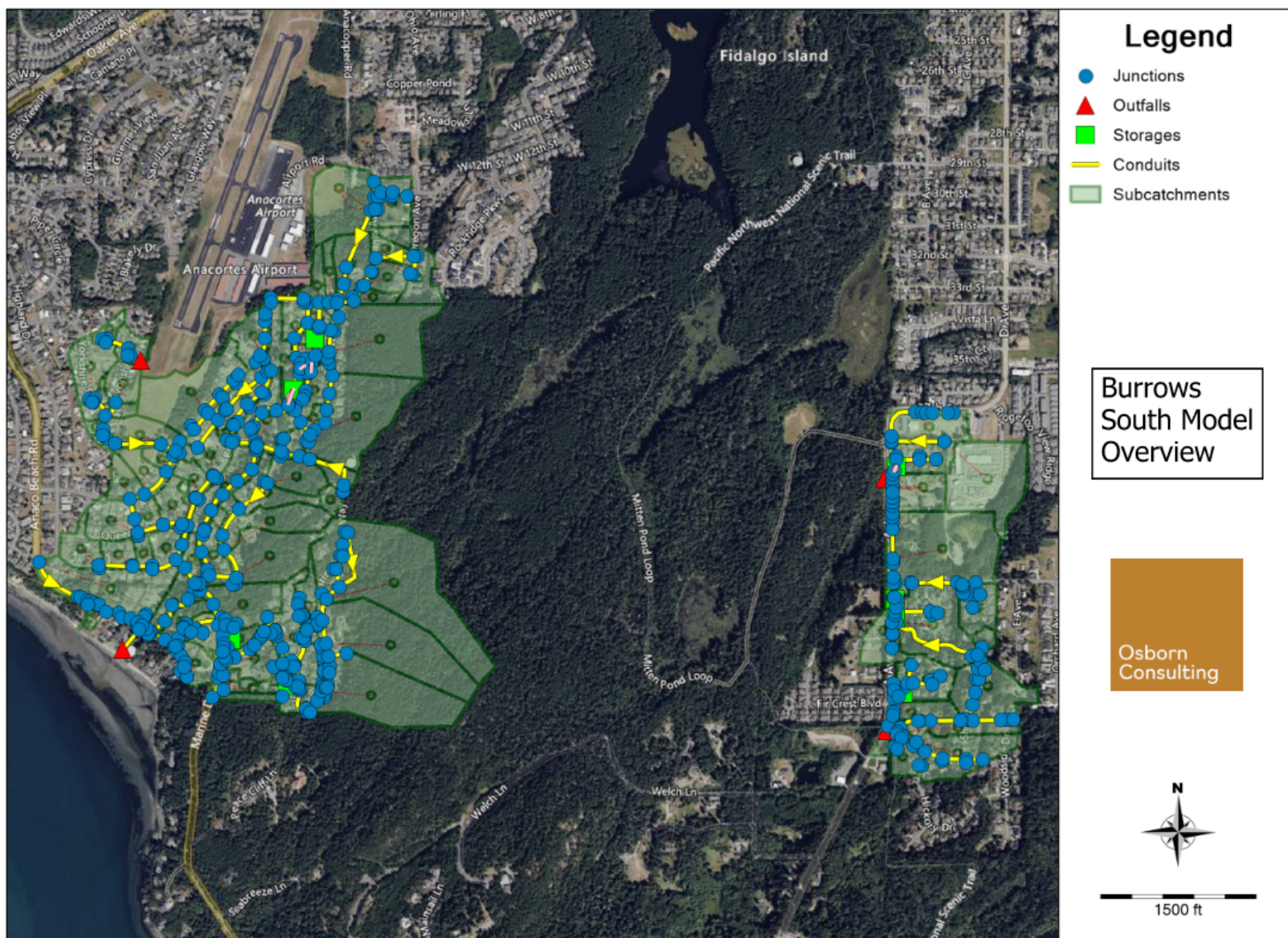


Figure 8. Burrows South Model Overview

APPENDIX D: SUMMARY OF MODEL DEVELOPMENT AND EXECUTION

TECHNICAL MEMORANDUM

Date: November 27, 2024

Project: City of Anacortes 2024 Stormwater Master Plan
To: Andrew Rheume, Public Works Director | City of Anacortes
Aaron Esterholt, Stormwater Program Manager | City of Anacortes
From: Dave Jacobs, PE | Osborn Consulting
Tom Spangenberg, PE | Osborn Consulting
Katrina Tang, EIT | Osborn Consulting
Subject: Summary of Model Development and Execution

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BACKGROUND

Osborn Consulting (Osborn) was contracted by the City of Anacortes to complete a stormwater evaluation study on the City’s storm pipe system. The project area encompasses the entire City of Anacortes. This section will detail the step-by-step process of how the models were developed and the parameters that were used.

SECTION 1 METHODOLOGY

The following sections describe the setup of the hydraulic and hydrologic portions of the model including the parameters and inputs.

1.1. Software

The modeling software for this project is PCSWMM Professional 2023, which utilizes the EPA SWMM version 5.2.4 computational engine

1.2. Model Extent

According to the City's watershed shapefile, there are eight drainage basins within the City limits: Burrows North, Burrows South, Fidalgo North, Fidalgo South, Guemes East, Guemes West, Padilla North, and Similk. After review of the basins it was determined that an additional basin, Padilla South, covered the pipes located outside of the city limits. However, this basin was not modeled because it was determined that the small section of pipe outside of the city limits discharges straight into Padilla Bay. **Figure 1** shows the model extent and basins.

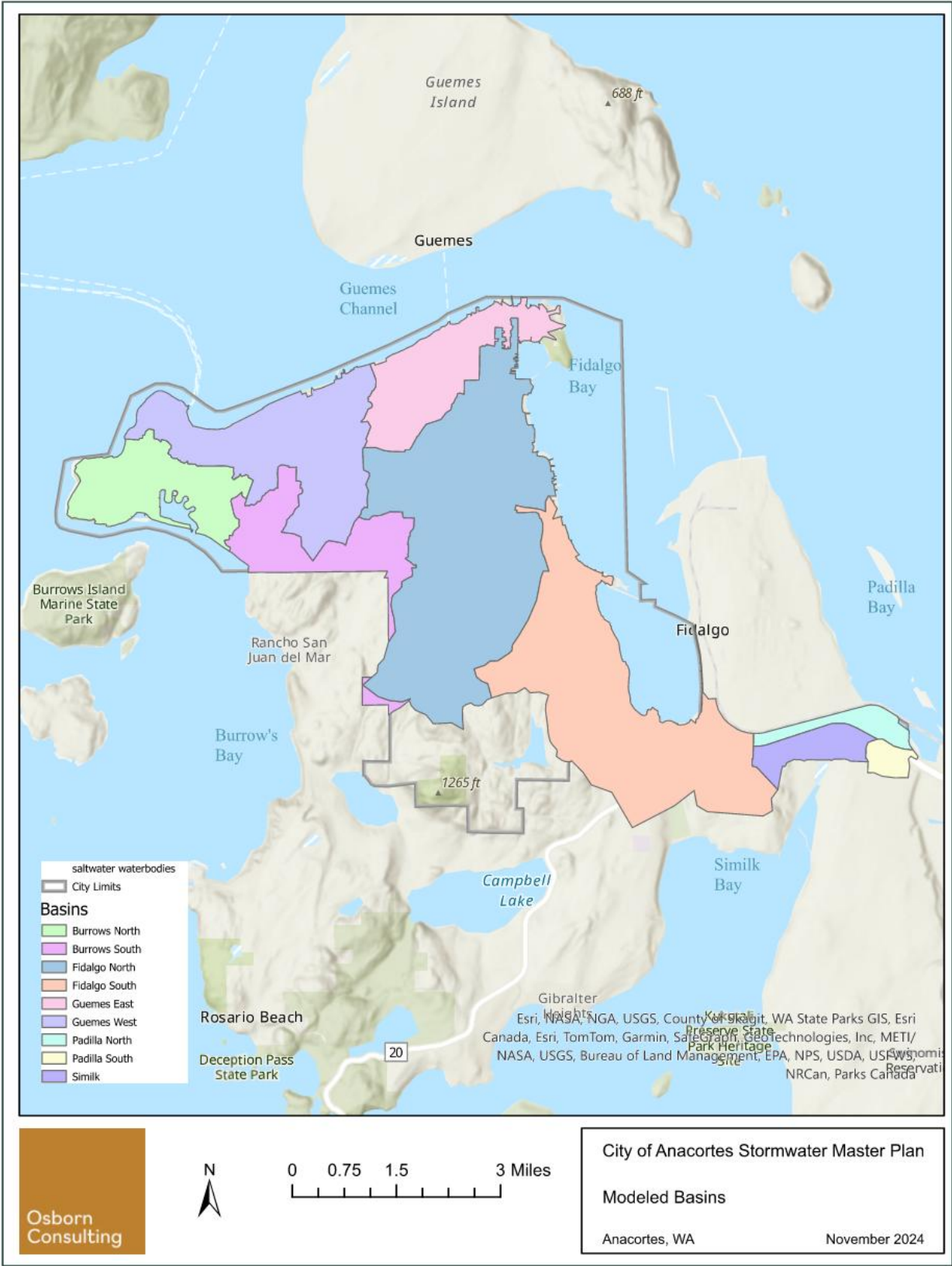


Figure 1. Modeled Basins

1.3. Boundary Conditions

One-hundred and twelve outfalls exist in the model. Outfalls that discharge to the Puget Sound are all set at an assumed High-High level of 10 feet. All outfalls in the model that discharge to wetlands or lakes are treated as free outfalls.

1.4. Hydrologic Methodology

The main hydrologic features include catchments, streams, and design storms. The following sections focus on how each of these features were developed to accurately replicate the rainfall and runoff response of the City's basins.

1.4.1. Drainage Area Delineations

The topographic survey data and two-foot contours were generated from the 2017 North Puget Digital Terrain Model (DTM) for use in drainage area delineations. The watershed boundary shapefiles provided by the City were verified using the two-foot contours and served as a basis for the basin delineations.

Additional areas outside of the city limits that are upstream of the delineated basins and drain into the city limits through streams or sheet flowing into City-owned drainage systems were delineated using 20-foot contours and included in their respective basins. The eight basins were divided into smaller catchments using the 2-foot contours, resulting in a total of 1,110 catchments. The catchments were developed based on surface area draining to downstream manholes. The sizes of the catchments ranged from 0.001 – 515.98 acres. Within urban areas the catchments were developed to not be larger than 10 acres.

A summary of the drainage basins and catchments used in developing the PCSWMM model is included in **Table 1**.

Table 1. Drainage Basins and Catchment Summary

Basin Name	Number of Catchments	Total Catchment Area (acres)
Fidalgo North	423	2571.75
Fidalgo South	86	1801.83
Guemes East	120	668.35
Guemes West	194	1147.75
Padilla North	16	148.75
Similk	15	212.56
Burrows North	162	440.37
Burrows South	94	573.91

The catchments were further broken down into three sub-catchments. The total area and percent impervious for each sub-catchment were determined using GIS. The following schematic in **Figure 3** shows how **Equation 1** was applied to maintain the total sub-catchment area.

- **Building (BLD) sub-catchments** – Building footprints were used to determine the building rooftop areas within each catchment. A polygon was then developed to represent the building areas in the PCSWMM model. These were represented by a hexagon-shaped polygon in the existing SWMM model.
- **Right-of-Way (ROW) sub-catchments** – The Skagit county parcels layer was used to delineate ROW catchments. A polygon was then developed to represent the right-of-way areas in the PCSWMM model. These were represented by a hexagon-shaped polygon in the existing SWMM model.
- **C sub-catchments** – The remaining area in each catchment, not categorized as right-of-way or buildings, was categorized as catchments. The original catchment delineation polygon was maintained for this catchment.

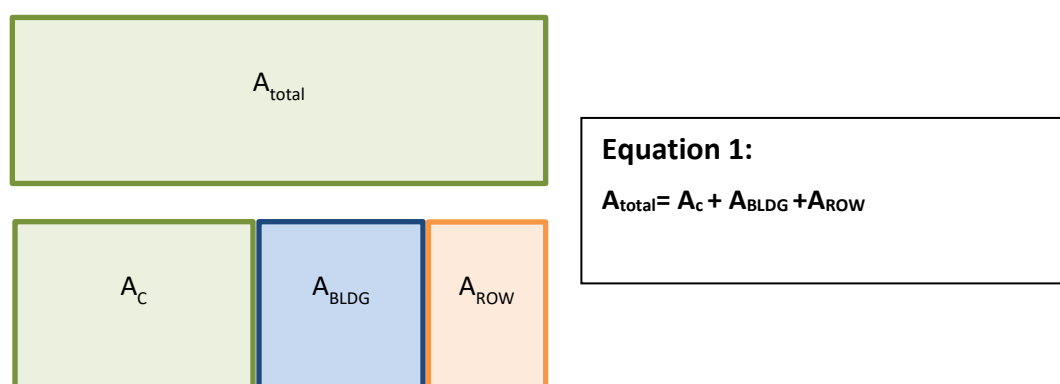


Figure 3. Conservation of Area Schematic

1.4.1.1. Catchment Inputs

Inputs into the sub-catchments included flow length, catchment slopes, curve numbers, percent routing, and impervious percentages.

- *Flow lengths* were calculated for the catchments from the highest topographic point in the catchments to the outlets, to indicate the longest flow path within each catchment.
- *Catchment slopes* were calculated by subtracting the contour elevation at the outlet from the contour elevation at the highest topographic point in the catchment, and then dividing the result by the flow length.
- *Percent routing* was set to pervious, meaning the routing percentages would determine the percent of runoff from impervious areas to pervious areas. Percent routing was assumed to be 85 percent for buildings, 15 percent for right-of-way, and 75 percent for catchments unless the area was particularly pervious or had treatment facilities.
- *Effective impervious area (EIA)*, was developed for each catchment to compute the runoff response more effectively for the modeled catchments. EIA is the portion of *total impervious area (TIA)* that is hydraulically connected to the drainage system, is a better parameter in the determination of actual urban runoff. To compute the EIA of each catchment, the TIA for each

basin was first computed from the impervious GIS coverage obtained from the 2021 National Oceanic and Atmospheric Administration (NOAA) layer.

A connection factor was then applied to the TIA. The connection factor reduced the TIA based on the type of impervious surface and how connected the impervious areas were to the drainage system. The connections factors are shown in **Figure 4**. This process was adopted based on the findings from the SPU *Curb and Gutter Conveyance Guidance* memorandum.

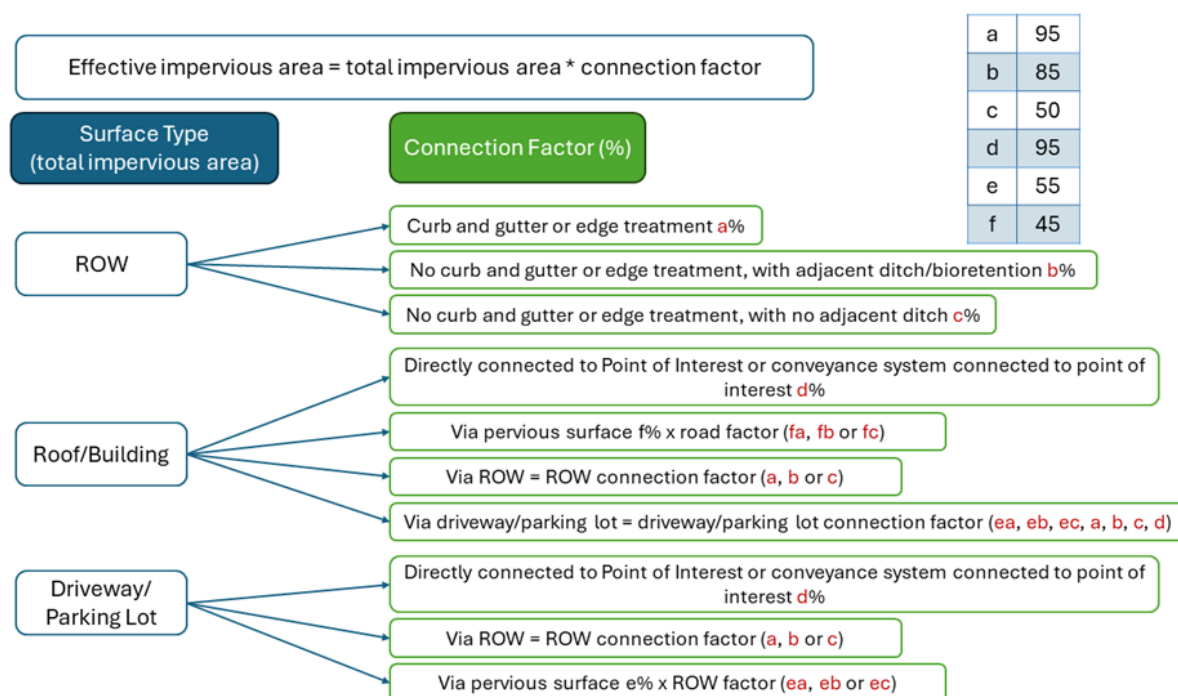


Figure 4. Connection Factors Used to Calculate Effective Impervious Surfaces

As an example, a building that had a TIA of 85 percent which drained onto a lawn and then into a curb or gutter in the street would have an EIA of 36 percent, which translates to the following:

$$(85 \text{ (TIA)}) \times .45 \text{ (connection factor f)} \times .95 \text{ (connection factor a)}.$$

1.4.2. Streams

Streams that connect into the City's piped systems were added into the models. The streams are modeled in the conduits layer as ditches with cross sections gathered from field visits to accurately model the bank height and width of the streams. During the field visits the flows were calculated based on a velocity measurement at each location. Each stream added into the model has an associated baseflow, which represents the existing water conditions in the stream before rainfall occurs. These baseflows are shown in **Table 2**.

Table 2. Streams Inputs and Baseflows

Stream Name	Basin Name	Sample Location	Flow (Ft ³ /s)
Morrison Run	Guemes East	23rd Street and Cascade Court	No Flow Observed
Cranberry Creek	Guemes West	Georgia Avenue	0.24
Clyde River	Burrows South	Clyde Way (North)	0.25
		Queen Anne Way (Middle)	0.13
		Beachwood Lane (South)	0.56
Ace of Hearts	Fidalgo North	34th Street between K and M Avenue (North)	1.60
		K Avenue and 34th Street (Middle)	1.12
		H Avenue (South)	0.11
Beaver Brook	Fidalgo North	29th Street and B Avenue (North)	4.29
		Creekside Lane (South)	1.94
Happy Valley	Fidalgo North	Whistle Lake Road	5.47

1.4.3. Design Storm

The design storms used in this study include the 25-year 3-hour, 25-year 24-hour, and 25-year 24-hour climate perturbed storms. The SCS Type 1A rainfall distribution was selected as the hyetograph for the design storms. The design storms are input into the PCSWMM model to simulate the rainfall and runoff response of each basin.

- **25-year 24-hour design storm:** The 25-year 24-hour design storm total volumes are derived from the department of Ecology’s Isopluvial maps.

The maps indicate that the City is on the boarder of a 2.5-inch to 3-inch Isopluvial. The team reviewed the City’s daily rainfall records taken at the Anacortes Wastewater Treatment Plant from 1992 to 2024 to support the development of an accurate design storm volume. The associated data is not suitable to develop a design storm because it lacks 5-minute rain volumes.

The highest 24-hour rainfall that occurred in this period was approximately 2 inches—33 percent lower than the rainfall depth of 3.0 inches published in the “Washington 24-hour Isopluvial Maps” by the Washington State Department of Transportation. Given this information, a 25-year, 24-hour rainfall depth of 2.5 inches was used because it was the low end of the isopluvial range. A review of a longer data set (50 years+) is required if a lower volume design storm was used.

- **25-year 3-hour design storm:** For the 3-hour design storm, a conversion factor of 1.06, determined from Appendix F of the 2017 Seattle Public Utilities Stormwater Manual, was used to convert the 25-year 24-hour precipitation depth to the 3-hour storm depth.

- **25-year 24-hour climate perturbed design storm:** To develop the 25-year, 24-hour climate perturbed rainfall event, it is necessary to determine the climate precipitation extremes to account for future increases or decreases in precipitation rates.

Based on data from *Changes in Climate Extremes and their Impacts on the Natural Physical Environment*, an increase of 15 percent in volume for the existing 25-year 24-hour precipitation is predicted to occur between the years 2081 and 2100. This value was determined by reviewing the median precipitation rates for Western North America for a mid-range greenhouse gas emission scenario where a hot day experienced once in 20 years becomes a day experienced once in every three years.

The rainfall depths used for the design storms can be found in **Table 3**.

Table 3. 25-Year Magnitude Design Storms

Duration	Magnitude (in/day)
3 hour	1.07
24 hour	2.50
24 hour climate perturbed	2.875

1.5. Hydraulic Methodology

Hydraulic modeling was intended to simulate rainfall as it travels through both the natural and built environment. Features included in the model for each respective basin include junctions, conduits, storages, and outfalls. All of these features were created based on GIS data, as broken down by **Table 4**.

Table 4. Layers in the Anacortes GIS Data

Layer Name	Layer Usage
<i>SDCB.shp</i>	Included as part of the junctions layer in PCSWMM.
<i>SD_Culverts.shp</i>	Included as part of the conduits layer in PCSWMM.
<i>SD_Detention.shp</i>	Included as part of the storage layer in PCSWMM.
<i>SD_Ditches.shp</i>	Included as part of the conduits layer in PCSWMM.
<i>SDMH.shp</i>	Included as part of the junctions layer in PCSWMM.
<i>SD_Outfalls.shp</i>	Included as part of the outfalls layer in PCSWMM.
<i>Storm_Mains3.shp</i>	Included as part of the conduits layer in PCSWMM.
<i>Streams.shp</i>	Included as part of the conduits layer in PCSWMM.

The city shapefiles were updated to fill in missing data and provide coverage for the entire study area. The modifications made to the City shapefiles are summarized below:

- **Conduits** – Conduits were created for the model based on existing GIS data provided by the city for ditches, pipes, and culverts. The storm mains layer was filtered to include only City owned active pipes larger than 8 inches in diameter.

Additional conduits, modeled as ditches, were added to connect any orphan conduits that were not connected to the larger to the stormwater system. Ditch rim elevations were based on LiDAR information obtained from the Department of Natural Resources. An assumption was made that the invert elevation for these ditches was assumed to be equal to the upstream and downstream rim elevations minus the ditch depth, which was estimated based on Google Maps. Conduit roughness of 0.013, 0.03, and 0.06 were assigned to pipes, ditches, and streams, respectively.
- **Junctions** – Junctions were created for the model using existing GIS data provided by the City for catch basins and maintenance holes. Only catch basin and maintenance holes within one foot of a modeled conduit were included in the model. Additional junctions were added to connect conduits which did not have existing catch basins or maintenance holes. Two-foot contours developed from the 2017 North Puget Digital Terrain Model (DTM) were used to assign rim elevations for junctions that were not included in the City's GIS data.
- **Storages** – The detention facilities GIS layer was used to create the storages layer in the model. The depth-area relationship for the storage curve was developed using the Spatial Analyst extension in ArcGIS. LiDAR information from the Department of Natural Resources was used to calculate the area for depth of the detention facility. This information was used as input for storage curves to assess the capacity of storage nodes.

1.5.1. Hydraulic Assumptions

In locations where the City's information did not have data, some assumptions were made to determine the invert and rim elevations for the PCSWMM model based on typical stormwater pipe design principles. The assumptions are as follows:

- Where rim elevation data were lacking, rim elevations were estimated from the topographic data.
- Where rim invert elevations data were lacking Invert elevations were assumed to be three feet below the rim elevation, plus the size of the largest pipe entering the junction. Three feet was chosen because it represents the typical cover depth found in stormwater pipes. Additionally, the invert elevation values were adjusted as needed to ensure a positive slope for the pipes. These adjustments are noted in the description section of each junction.
- Where detention ponds lacked as-builts, storage curves were developed from the DEM.
- In some areas, the topography was outdated and did not match what looked like recent development. Any missing information was filled in based on engineering judgment. Notes were added to the model regarding any assumptions that were made.
- The tailwater elevation at the outfalls that discharge into the various bays was assumed to be fixed at 10 feet, which is the Mean High Higher Water level. Outfalls with invert elevations greater than 10 feet were treated as free outfalls. Tide gates were also incorporated at the outfalls to restrict the amount of water entering the system.
- City as-builts were used to develop pipe slopes and MH depths. This approach was used only in areas of the model that indicated flooding.

1.6. Model Verification

Once the initial assumptions were made and the model was developed, the model was run to verify that desktop assumptions were accurately portraying real-world scenarios. After running the model, flow lengths, catchment slopes, curve numbers, and routing type were modified to improve the model predictions.

Catchment flow lengths were calculated by PCSWMM based on the area of the catchment and the catchment width. After running the model, it was determined that catchment widths were being overestimated, and therefore catchment flow lengths were estimated instead. Catchment flow lengths were calculated based on the distance between the highest topographic point in the catchment and the outlet of the catchment. Additional adjustments were made for areas of large pervious area draining to the system to account for additional attenuation in the catchments.

Initially, catchment slopes were going to be automatically calculated based off the DEM but were later manually calculated. Additional adjustments were made for areas of large pervious area draining to the system to account for additional attenuation in the catchments. The starting slope used the following approach: the elevation at the highest topographic point in the catchment was subtracted from the elevation at the outlet of the catchment and divided over the catchment flow length and multiplied by 100:

$$\text{Catchment Slope} = \frac{\text{Highest Topographic Elevation} - \text{Topographic Elevation at Outlet}}{\text{Catchment Flow Length}} \times 100$$

Curve numbers were calculated to provide a better estimate of runoff based on soil type. All building sub-catchments were assigned a curve number of 87 and all ROW sub-catchments were assigned a curve number of 85. Curve numbers for C sub-catchments were calculated using soil groups provided by the web soil survey from the USDA web soil survey. Curve numbers for soil groups C and D were assigned a curve number of 80, soil group A was assigned a curve number of 49, and soil group B was assigned a curve number of 69. Larger catchments were then adjusted based on land use and type of ground cover.

Subarea routing was initially set to outlet but was later changed to the parameters stated in **Section 1.4.1.1**. Subarea routing was changed to pervious to better estimate how much runoff from impervious areas flow to pervious areas. In addition, all BLDG were routed to the associated C sub-catchment to account for roofs draining to yards.

1.7. Model Recommendations/Next Steps

To improve the accuracy of the models, the following next steps are recommended:

- Calibrate the models to observed flow data. Flow meters could be installed at key locations within the City to collect data that could be used to calibrate the models.
- Fill in data gaps and verify assumptions as identified in the models.
- Verify the assumption made that all assets are in good condition and have no blockages.
- More in-depth review of known flooding areas could be utilized to help validate the models further.

APPENDIX E: SUMMARY OF CONSTRAINED DRAINAGE SYSTEMS FINDINGS



TECHNICAL MEMORANDUM

Date: November 27, 2024

Project: City of Anacortes 2024 Stormwater Master Plan
To: Andrew Rheume, Public Works Director | City of Anacortes
Aaron Esterholt, Stormwater Program Manager | City of Anacortes
From: Dave Jacobs, PE | Osborn Consulting
Tom Spangenberg, PE | Osborn Consulting
Katrina Tang, EIT | Osborn Consulting
Project: City of Anacortes 2024 Stormwater Master Plan
Subject: Summary of Constrained Drainage System Findings

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INTRODUCTION

Tables for the 25-year 24-hour design storm, 25-year 3-hour design storm, and the 25-year 24-hour climate perturbed design storm were created to summarize surcharging conduits and flooding nodes for each basin. The columns include the asset ID and the parameters that will be used in the flooding and surcharge analysis.

Fidalgo North

The 25-year 24-hour storm caused 1.405 million gallons of flooding in junctions, with the affected junctions remaining surcharged for about 2,845 hours. Approximately 9.04 percent of pipes in Fidalgo North were surcharged in this event. In comparison, the 25-year 3-hour storm caused 14.39 million gallons of flooding, with the affected junctions surcharging for about 4537 hours. 0.05 percent of the total pipes in Fidalgo North surcharged in this event. Additionally, the 25-year 24-hour climate perturbed storm caused 2.809 million gallons of flooding, with the affected junctions surcharging about 3260 hours. 12 percent of the total pipes in Fidalgo North surcharged in this event.

Table 1. Fidalgo North Surcharging Conduits for the 25-Year 24-Hour Design Storm

Conduit Asset ID	Max/Full Flow
SD003415002202_2	1.17
SD003515001226_1	1.48
SD003515001226_2	2.13
SD003812001228_1	1.9
SD003812001228_2	1.43
SD003912001229	1.25
SD004008001230	1.03
SD004108001231	1.07
SD004308001232	1.02
SD008508001190	1.32
SD010921000107	2.14
SD012936000277	1
SD015012000266	1.08
SD026512000259	1.43
SD036212001233	1.03
SD036608002319	1.25
SD046908002251	1.16
SD047908002234	1.12
SD048008001582	1.5
SD049018001249_1	1.57
SD049218001250	1.17
SD049715001248	1
SD052308003423	1.01
SD059512002379	1.98
SD059612002378	1.98
SD066108001439	1.13
SD067208001437	1.27
SD071421000046	1.37
SD071715000254	1.38
SD073327000256	1.01
SD074108002196	1.18
SD075212000281	1.1
SD075608002318	1.95
SD079312001307	2.84
SD079412001308	2.13
SD083108001395	1.21
SD088308002310	1.02
SD130930000057	1.02
SD141112001099	1.37
SD141206002653	1.2

Conduit Asset ID	Max/Full Flow
SD141808001276	3.27
SD145808002921	1.13
SD153112002886	1.01
SD155608002993	1.09
SD155927000045	1.15
SD156812001346	1.13
SD157206002654	2.15
SD158708001443	1.09
SD158808001442	1.03
SD160508002568	2.29
SD162408001769	1.79
SD163508001430	1.31
SD163808001429	1.06
SD164210001408	1.21
SD165018002332_1	1.7
SD165018002332_2	1.36
SD165415000102	1.37
SD166008002702	1.91
SD166912003259	1.28
SD167012003293	1.19
SD167630000040	2.68
SD167730000041	1.06
SD169818001553	1.35
SD170818003091	1.2
SD179208002508	1.43
SD182210001343	1.02
SD184142000083	1.24
SD184342000082	1.25
SD186408002992	1.74
SD187727000042	1.12
SD187927000044	1.07
SD188027000043	3.78
SD190408003157	1.21
SD190512000258	1.86
SD190512001885	1.83
SD191208001188	1.07
SD191312000260	1
SD193908003129	1.16
SD194008003130	1.14
SD199308002700	2.08
SD200312001098	1.42

Conduit Asset ID	Max/Full Flow
SD200610002838	1
SD200710002837	1.41
SD202118003089	1.92
SD202312002660	1.25
SD203515001247	1
SD219308001503	1.47
SD220212002637_2	1.09
SD220408002662	53.7
SD224212000125	1.01
SD224412001793	1.01
SD225812000135	2
SD226012000136	1.7
SD226212000140	2.04
SD226312000141	1.07
SD226812000146	1.08
SD227012000148	1.14
SD230312003019	1.85
SD234218002101	1.04
SD237148000086	1.08
SD239412001935	1.11
SD243312002769	1.22
SD243412002770	1.2
SD252436000278	1.05
SD253712000272	1.53
SD254112000271	1.27
SD254212000270	1.09
SD254412000269	1.06
SD254612000268	1.13
SD254812002478	1.08
SD255012000267	1.21
SD256612001176	1.56
SD257008002317	1.05
SD265910002709	1.21
SD272112002909	1.38
SD273510002675	1.95
SD276512001350	1.03
SD277518002766	1.1
SD279818000032	1.72
SD291621000029	1.14
SD304912002306	1.7
SD311412001910	1.39

Conduit Asset ID	Max/Full Flow
SD311512001911	1.08
SD319227001348	1.07
SD323810000121	1.08
SD329012001791	1.91
SD330012001820	1.01
SD330112001821	1.46
SD330212001822_2	1.61
SD333212003419	1.24
SD333612001772	1.11
SD333712001771	1.39
SD336108002834	1.9
SD336208002832	2.51
SD340108003027	1.14
SD347615002266	1.41
SD372612004103	1.34
SD372712004102	1.63
SD390712004301	2.6
SD391312004311	1.4
SD434008004781	1.69
SD445208004960	1.04
SD445308004962	1.83
SD955108004469	1
SD959612002387	2.12
SD960108003865_1	1.13
SD960308003863	1.41
SD970612003659	1.07
SD982308002861	2.09
SD986008002911	1.44
SD991924002608	1.09
SD993908001507	1.19
SD995515002385	1.18
SD996808002327	1.36
SD999908004998	1.19
SD999908005011	1.09
SDCLVRT0192	1.33
SDCLVRT0224	2.46
SDCLVRT0272	1.22
SDCLVRT0434	1.78
SDCLVRT0437_2	1.53
SDCLVRT0460	2.38
SDCLVRT0501	1.39

Table 2. Fidalgo North Flooding Junctions for the 25-Year 24-Hour Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
1	0.85	0
53	0.91	0
62	0.7	0
68	0.64	0
1373	1.13	0
1431	1.45	0
1550	0.8	0
1551	1.02	0
1552	1.06	0
3034	1.19	0.002
3069	0.36	0
FN7	0.38	0
J61	3.72	0
SDCBF01-1016	1.22	0
SDCBF01-1020	0.91	0
SDCBF01-1021	0.72	0
SDCBF01-1022	1.87	0
SDCBF01-1023	0.72	0
SDCBF01-1027	2.25	0
SDCBF01-1028	23.24	0.011
SDCBF01-1032	22.98	0.065
SDCBF01-1033	20.2	0.016
SDCBF01-1041	0.09	0
SDCBF01-1042	0.11	0
SDCBF01-1064	0.28	0
SDCBF01-1065	3.18	0
SDCBF01-1068	3.39	0
SDCBF01-1073	0.16	0
SDCBF01-1074	0.54	0
SDCBF01-1078	0.15	0
SDCBF01-1079	0.33	0
SDCBF01-1084	1.34	0
SDCBF01-1085	1.36	0
SDCBF01-1086	0.53	0
SDCBF01-1087	0.47	0
SDCBF01-1088	0.57	0
SDCBF01-1089	1.16	0
SDCBF01-1090	1.37	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF01-1091	1.37	0
SDCBF01-1092	47.76	0
SDCBF01-1093	1.86	0
SDCBF01-1094	47.78	0
SDCBF01-1095	48.01	0
SDCBF01-1096	47.87	0
SDCBF01-1097	33.97	0
SDCBF01-1098	47.99	0
SDCBF01-1099	47.87	0
SDCBF01-1100	47.86	0
SDCBF01-1101	4.36	0
SDCBF01-1102	48.07	0
SDCBF01-1103	48	0
SDCBF01-1104	48.09	0
SDCBF01-1105	47.95	0
SDCBF01-1106	47.83	0
SDCBF01-1113	47.89	0
SDCBF01-1114	47.8	0
SDCBF01-1115	1.59	0
SDCBF01-1116	28.12	0
SDCBF01-1117	2.66	0
SDCBF01-1118	1.62	0
SDCBF01-1119	0.76	0
SDCBF01-1120	0.87	0.001
SDCBF01-1121	4.29	0.002
SDCBF01-1122	4.89	0.004
SDCBF01-1128	2.71	0.007
SDCBF01-1130	1.76	0.01
SDCBF01-1132	0.51	0.001
SDCBF01-1136	0.37	0
SDCBF01-1143	3.44	0
SDCBF01-1145	1.43	0
SDCBF01-1149	0.02	0
SDCBF01-1151	42.29	0
SDCBF01-1152	0.37	0
SDCBF01-1153	42.25	0
SDCBF01-1154	0.52	0
SDCBF01-1165	15.74	0
SDCBF01-1167	3.15	0.009
SDCBF01-1170	0.11	0
SDCBF01-1181	0.35	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF01-1189	3.2	0.017
SDCBF01-1190	3.19	0.01
SDCBF01-1191	0.29	0
SDCBF01-1192	0.4	0
SDCBF01-1194	0.47	0
SDCBF01-1195	0.54	0
SDCBF01-1196	0.74	0.001
SDCBF01-1204	0.22	0
SDCBF01-1205	0.86	0
SDCBF01-1206	4.33	0.006
SDCBF01-1211	0.32	0
SDCBF01-1213	0.39	0
SDCBF01-1217	47.81	0
SDCBF01-1218	47.81	0
SDCBF01-1225	47.75	0
SDCBF02-1003	0.12	0
SDCBF02-1013	0.23	0
SDCBF02-1015	0.27	0
SDCBF02-1017	0.34	0
SDCBF02-1020	0.47	0
SDCBF02-1021	0.41	0
SDCBF02-1022	0.32	0
SDCBF02-1023	0.49	0
SDCBF02-1024	0.44	0
SDCBF02-1025	0.18	0
SDCBF02-1028	1.03	0
SDCBF02-1032	0.15	0
SDCBF02-1033	0.18	0
SDCBF02-1034	0.1	0
SDCBF02-1035	0.38	0
SDCBF02-1036	0.46	0
SDCBF02-1040	0.06	0
SDCBF03-1002	4.01	0.032
SDCBF03-1015	0.27	0
SDCBF03-1028	0.6	0
SDCBF03-1033	0.01	0
SDCBF03-1038	3.71	0.012
SDCBF03-1044	0.24	0
SDCBF03-1046	0.18	0
SDCBF03-1087	32.39	0
SDCBF03-1100	0.95	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF03-1108	0.41	0
SDCBF03-1109	0.44	0
SDCBF03-1110	1.8	0
SDCBF03-1137	1.64	0
SDCBF03-1188	0.16	0
SDCBF03-1278	0.31	0
SDCBF03-1289	3.95	0
SDCBF03-1314	0.09	0
SDCBF03-1318	0.72	0
SDCBF03-1339	3.8	0.02
SDCBF04-1001	0.21	0
SDCBF04-1081	0.09	0
SDCBF04-1083	0.17	0
SDCBF04-1097	0.51	0
SDCBF04-1125	1.5	0.009
SDCBF04-1126	0.38	0
SDCBF04-1144	0.42	0
SDCBF04-1146	3.88	0
SDCBF04-1147	4.06	0
SDCBF04-1148	0.89	0
SDCBF04-1218	1.78	0
SDCBF04-1219	0.68	0
SDCBF04-1220	2.28	0
SDCBF04-1223	2.61	0.043
SDCBF04-1224	2.83	0
SDCBF04-1225	2.64	0
SDCBF04-1276	1.22	0
SDCBF04-1277	2.01	0.002
SDCBF04-1280	1.65	0
SDCBF04-1310	2.27	0
SDCBF04-1311	2.7	0.012
SDCBF04-1312	2.3	0
SDCBF04-1335	3.78	0
SDCBF04-1340	1.58	0
SDCBF04-1361	2.77	0
SDCBF04-1362	1.82	0
SDCBF04-1366	1.6	0
SDCBF04-1394	0.11	0
SDCBF04-1397	0.15	0
SDCBF04-1398	0.16	0
SDCBF04-1406	0.01	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF04-1440	1.33	0
SDCBF04-1441	1.43	0
SDCBF04-1443	1.1	0
SDCBF04-1444	1.15	0
SDCBF04-1445	1.11	0
SDCBF04-1446	0.83	0
SDCBF04-1473	0.15	0
SDCBF04-1474	0.33	0
SDCBF04-1475	0.98	0
SDCBF04-1476	0.47	0
SDCBF04-1478	0.41	0
SDCBF04-1480	0.75	0
SDCBF04-1556	1.5	0.011
SDCBF04-1559	0.74	0
SDCBF04-1561	2.42	0
SDCBF04-1562	2.48	0.004
SDCBF04-1565	1.38	0
SDCBF04-1570	0.65	0
SDCBF06-1003	0.51	0
SDCBF06-1008	0.53	0
SDCBF06-1010	0.47	0
SDCBF06-1012	0.3	0
SDCBF07-1005	0.71	0
SDCBG19-1043	0.56	0
SDCBG20-1002	2.88	0
SDCBG20-1003	2.89	0
SDCBG20-1012	48.71	0
SDCBG20-1013	48.48	0
SDCBG20-1068	3.01	0
SDCBG20-1069	2.98	0
SDCBG20-1105	49.08	0
SDCBG20-1117	47.47	0.021
SDCBG21-1013	2.89	0
SDJCTF01-1001	0.14	0
SDJCTF01-1012	0.49	0
SDJCTF01-1013	0.93	0
SDJCTF01-1018	2.09	0.001
SDJCTF01-1019	18.78	0.008
SDJCTF01-1022	0.68	0.001
SDJCTF01-1026	47.89	0
SDJCTF01-1033	1.93	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDJCTF01-1034	0.53	0
SDJCTF03-1135	3.69	0
SDJCTF04-1117	13.57	0
SDJCTF04-1223	0.66	0.002
SDJCTF04-1225	1.98	0
SDJCTF04-1295	0.44	0
SDJCTF06-1002	0.54	0
SDJCTG20-1067	21.8	0
SDMHF01-1001	3.13	0
SDMHF01-1002	22.32	0.047
SDMHF01-1003	48.17	0
SDMHF01-1004	47.9	0
SDMHF01-1005	47.96	0
SDMHF01-1010	1.8	0
SDMHF01-1012	22.18	0
SDMHF01-1013	22.03	0.013
SDMHF01-1022	1.55	0
SDMHF01-1024	13.76	0
SDMHF01-1026	17.76	0
SDMHF01-1027	48.05	0
SDMHF01-1028	47.01	0
SDMHF01-1029	47.89	0
SDMHF01-1030	47.97	0
SDMHF01-1031	9.24	0
SDMHF01-1032	47.97	0.002
SDMHF01-1033	47.92	0.003
SDMHF01-1034	3.23	0
SDMHF01-1035	3.29	0
SDMHF01-1036	3.45	0
SDMHF01-1038	1.61	0.001
SDMHF01-1039	0.35	0
SDMHF01-1040	48.17	0
SDMHF01-1046	4.91	0
SDMHF01-1047	3.23	0
SDMHF01-1049	4.2	0
SDMHF01-1051	0.4	0
SDMHF01-1052	0.3	0
SDMHF01-1054	16.72	0
SDMHF01-1055	3.21	0.014
SDMHF01-1056	22.01	0.166
SDMHF01-1057	19.6	0.112

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF01-1058	19.49	0.036
SDMHF01-1059	19.5	0.062
SDMHF01-1063	4.26	0
SDMHF01-1065	42.08	0
SDMHF01-1066	47.8	0
SDMHF01-1068	47.84	0
SDMHF01-1069	3.01	0
SDMHF01-1070	0.7	0
SDMHF01-1071	2.29	0
SDMHF01-1072	1.04	0
SDMHF02-1001	0.38	0
SDMHF02-1003	0.06	0
SDMHF02-1004	0.45	0
SDMHF02-1006	0.49	0
SDMHF03-1001	4.05	0.071
SDMHF03-1002	4.95	0.256
SDMHF03-1007	0.5	0
SDMHF03-1014	0.5	0
SDMHF03-1015	0.43	0
SDMHF03-1018	0.9	0
SDMHF03-1019	0.68	0
SDMHF03-1020	0.54	0
SDMHF03-1026	0.2	0
SDMHF03-1027	4.12	0.005
SDMHF03-1028	4.25	0
SDMHF03-1029	4.98	0
SDMHF03-1030	2.11	0
SDMHF03-1032	0.25	0
SDMHF03-1034	2.59	0.015
SDMHF03-1035	0.36	0
SDMHF03-1042	1.02	0
SDMHF03-1047	1.81	0.011
SDMHF03-1052	3.61	0.05
SDMHF03-1057	4.06	0.158
SDMHF03-1067	0.2	0
SDMHF03-1073	3.97	0
SDMHF03-1074	3.76	0
SDMHF03-1080	0.07	0
SDMHF03-1088	4.59	0
SDMHF03-1097	2.52	0.007
SDMHF04-1044	1.44	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF04-1050	1.43	0
SDMHF04-1061	0.55	0
SDMHF04-1064	0.46	0.001
SDMHF04-1065	0.12	0
SDMHF04-1094	0.72	0
SDMHF04-1144	0.34	0
SDMHF04-1147	1.05	0
SDMHF04-1159	0.52	0
SDMHF04-1167	7.2	0
SDMHF04-1173	1.23	0
SDMHF04-1182	0.78	0
SDMHF04-1183	1.45	0
SDMHF05-1001	0.36	0
SDMHF06-1001	0.25	0
SDMHF06-1003	48.11	0.009
SDMHG20-1001	2.87	0
SDMHG20-1002	47.87	0.002
SDMHG20-1003	2.9	0
SDMHG20-1004	0.52	0
SDMHG20-1009	4.79	0
SDMHG20-1040	3.08	0
SDMHG20-1042	2.92	0
SDMHG20-1054	47.13	0.013
SDMHG20-1055	7.58	0
SDMHG20-1056	47	0.011
SDMHG20-1057	46.8	0
SDMHG20-1058	48.65	0

Table 3. Fidalgo North Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
2	1.02
SD003415002202_2	1.19
SD003515001226_1	1.51
SD003515001226_2	2.17
SD003715001227	1.07
SD003812001228_1	2.03
SD003812001228_2	1.49
SD003912001229	1.29
SD004008001230	1.01
SD004108001231	1.08

SD004308001232	1.02
SD005110001242_2	1.21
SD005210001243	1.01
SD005408002805	1.07
SD006121000053	1.04
SD006210001236	1.17
SD006321000052	1.02
SD008508001190	1.54
SD008818000024	1.7
SD010921000107	2.39
SD012936000277	1.13
SD015012000266	1.32
SD016018000003	1.39
SD016908002160	1.3
SD026512000259	1.6
SD035808001406	1.07
SD036212001233	1.06
SD036608002319	1.33
SD046908002251	1.17
SD047308003320	1
SD047908002234	1.82
SD048008001582	1.52
SD049018001249_1	1.61
SD049218001250	1.32
SD049715001248	1.1
SD050415001246	1.2
SD052308003423	1.04
SD056808003402	2.69
SD059412002380	1.8
SD059512002379	3.65
SD059612002378	3.67
SD064608000123	1.01
SD066108001439	1.13
SD066615001414	1.1
SD066808001434	1
SD067208001437	1.3
SD071421000046	1.39
SD071715000254	1.43
SD073327000256	1.25
SD073718000262	1.01
SD074108002196	1.78
SD074415000263	1.14
SD075212000281	1.31

SD075312000282	1.1
SD075412000283	1.08
SD075608002318	2.02
SD075808003693	1.13
SD078618001298	1
SD079312001307	3.59
SD079412001308	2.69
SD081112000788	1.08
SD081918000098	1.19
SD082612000094	1.26
SD083108001395	1.22
SD083508001396	1.01
SD083708001399	1.05
SD088308002310	1.32
SD129424001323	1
SD130930000057	1.21
SD132936001362	1.01
SD133127001379	1.07
SD133212001375	1.58
SD141012001097	1.11
SD141112001099	1.82
SD141206002653	1.53
SD141808001276	3.64
SD145808002921	1.64
SD149115000222	1.54
SD149612002661	1.15
SD153112002886	1.1
SD155008002920	1.07
SD155608002993	1.1
SD155927000045	1.2
SD156812001346	1.15
SD157206002654	2.15
SD158708001443	1.08
SD158808001442	1.03
SD159815001275	1.07
SD160508002568	2.31
SD160512004303	1.07
SD162408001769	1.61
SD163415001420	1.03
SD163508001430	1.62
SD163808001429	1.29
SD164210001408	1.44
SD165018002332_1	2.18

SD165018002332_2	1.75
SD165315000104	1.04
SD165415000102	1.69
SD165921000030	1.23
SD166008002702	2.03
SD166912003259	1.38
SD167012003293	1.27
SD167630000040	2.56
SD167730000041	1.1
SD169818001553	1.69
SD170818003091	1.54
SD179208002508	1.44
SD181408002485	1.13
SD181512000034	1.3
SD181608003002	1.21
SD181708003003	1.33
SD181812000035	1.1
SD182008002567	1
SD182210001343	1.02
SD182212004306	1.16
SD184142000083	1.39
SD184342000082	1.38
SD186408002992	1.97
SD186912003256	1.51
SD187012003253	1.01
SD187727000042	1.14
SD187927000044	1.11
SD188027000043	3.93
SD188236000251	1.28
SD189718003362	1.04
SD190208003769	1.22
SD190408003157	1.58
SD190512000258	2.06
SD190512001885	1.93
SD191208001188	1.34
SD191312000260	1.25
SD193908003129	1.37
SD194008003130	1.14
SD199208002701	1.05
SD199308002700	2.21
SD200312001098	1.89
SD200410002828	1.17
SD200610002838	1.11

SD200710002837	1.41
SD202118003089	2.49
SD202208003512	1.21
SD202312002660	1.42
SD203515001247	1.11
SD219308001503	2.34
SD220212002637_2	1.12
SD220408002662	57
SD220815001415	1.18
SD221808002704	1.48
SD223608003321	1.02
SD224012000126	1
SD224212000125	1.15
SD224412001793	1.12
SD225812000135	2.14
SD226012000136	1.82
SD226212000140	2.17
SD226312000141	1.14
SD226812000146	1.15
SD227012000148	1.27
SD230312003019	4.29
SD234118002768	1.23
SD234218002101	1.28
SD237148000086	1.29
SD239008002159	1.09
SD239412001935	1.14
SD240118004623	1.05
SD241718003025	1.03
SD243312002769	2.56
SD243412002770	1.49
SD245210000830	1.16
SD252436000278	1.25
SD253112000285	1.27
SD253412000284	1.33
SD253612002479	1.14
SD253712000272	1.97
SD254112000271	1.51
SD254212000270	1.22
SD254412000269	1.33
SD254612000268	1.38
SD254812002478	1.28
SD255012000267	1.38
SD256612001176	1.56

SD256908001894	1.28
SD257008002317	1.09
SD263208000110	1.07
SD265910002709	2.61
SD266318003093	1.02
SD266612002785	1.07
SD269618002935	1.13
SD269808001551	1.04
SD272112002909	1.71
SD273510002675	3.05
SD275708001389	1.09
SD275912000095	1
SD276512001350	1.05
SD277208001397	1
SD277518002766	1.72
SD278418002309	1.1
SD278812003251	1.14
SD279818000032	2.74
SD284208002311	1.2
SD291321000047	1
SD291621000029	1.91
SD293208003069	1.51
SD298418003090	1.28
SD304912002306	2.47
SD311412001910	1.37
SD311512001911	1.07
SD312612001846	1.28
SD312712001845	1.3
SD315608001898	1.02
SD319227001348	1.31
SD323810000121	1.24
SD329012001791	2.24
SD329215001799	1.23
SD330012001820	1.43
SD330112001821	2.05
SD330212001822_2	2.27
SD333212003419	1.37
SD333412001775	1.08
SD333612001772	1.3
SD333712001771	1.63
SD335115001423	1.05
SD336108002834	1.87
SD336208002832	2.26

SD340108003027	1.21
SD346712003056	1.03
SD347615002266	1.66
SD349218003352	1.18
SD349608003364	1.27
SD364308004031	1.23
SD365108004029	1.27
SD365208004030	1.01
SD372008004092	2.29
SD372612004103	1.58
SD372712004102	2.05
SD390712004301	3.76
SD391312004311	1.99
SD406708004466	1.04
SD406808004467	1.25
SD424008004660	1.43
SD424212004664	1.38
SD434008004781	1.8
SD445208004960	1.15
SD445308004962	1.98
SD446108005009	1.2
SD955108004469	1.78
SD958724000023	1.82
SD959612002387	2.53
SD960108003865_1	1.47
SD960308003863	1.81
SD970612003659	1.41
SD979512003431	1.07
SD981008002328	1.27
SD982308002861	1.87
SD985908002918	1.47
SD986008002911	2.01
SD988808001192_4	1.17
SD990812002657	1.11
SD991924002608	1.6
SD993908001507	2.62
SD995515002385	1.91
SD996808002327	1.34
SD999908004961	2.66
SD999908004998	1.73
SD999908005011	1.05
SDCLVRT0061	1.02
SDCLVRT0165	1.01

SDCLVRT0166	1.15
SDCLVRT0192	1.93
SDCLVRT0224	2.58
SDCLVRT0272	1.08
SDCLVRT0433	1.31
SDCLVRT0434	2.1
SDCLVRT0435	1.15
SDCLVRT0437_2	1.65
SDCLVRT0460	3.1
SDCLVRT0501	1.24
SDCLVRT0628	1.27

Table 4. Fidalgo North Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
1	1.14	0
53	4.63	0
55	0.59	0
62	1.29	0
63	0.02	0
68	0.92	0
75	2.42	0.06
1373	1.55	0
1381	0.27	0
1431	2.48	0
1550	1.28	0
1551	1.51	0
1552	1.54	0
1693	41.63	0.14
1694	41.8	0
1695	37.58	0
1733	42.34	0.225
1739	44.97	0.137
1740	47.1	0.138
1756	41.52	0.173
1757	42.17	0.169
1939	0.33	0.002
1971	1.06	0.006
3002	1.18	0.001
3034	2.55	0.01
3069	0.77	0
AH10	46.94	1.692

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
AH2	19.28	0.051
AH3	28.23	0.246
AH4	31.83	0.431
AH5	34.25	0.471
AH6	37.18	0.86
AH7	38.93	1.073
AH8	41.49	1.621
AH9	43.19	2.712
FN7	0.66	0
J61	6.55	0
SDCBF01-1016	1.63	0.003
SDCBF01-1020	1.39	0
SDCBF01-1021	1.07	0
SDCBF01-1022	2.94	0
SDCBF01-1023	1.16	0
SDCBF01-1027	3.72	0
SDCBF01-1028	25.5	0.016
SDCBF01-1032	25.13	0.082
SDCBF01-1033	22.63	0.027
SDCBF01-1041	0.47	0
SDCBF01-1042	0.5	0
SDCBF01-1063	0.41	0
SDCBF01-1064	0.61	0
SDCBF01-1065	4.79	0
SDCBF01-1068	4.85	0
SDCBF01-1073	0.41	0
SDCBF01-1074	0.71	0
SDCBF01-1078	0.41	0
SDCBF01-1079	0.55	0
SDCBF01-1084	1.68	0
SDCBF01-1085	1.7	0
SDCBF01-1086	0.79	0
SDCBF01-1087	0.79	0
SDCBF01-1088	0.89	0
SDCBF01-1089	1.52	0
SDCBF01-1090	1.74	0
SDCBF01-1091	1.74	0
SDCBF01-1092	47.98	0
SDCBF01-1093	2.66	0
SDCBF01-1094	47.99	0
SDCBF01-1095	48.2	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF01-1096	48.07	0
SDCBF01-1097	35.68	0
SDCBF01-1098	48.18	0
SDCBF01-1099	48.07	0
SDCBF01-1100	48.06	0
SDCBF01-1101	5.32	0.001
SDCBF01-1102	48.25	0
SDCBF01-1103	48.19	0
SDCBF01-1104	48.27	0
SDCBF01-1105	48.15	0
SDCBF01-1106	48.04	0
SDCBF01-1113	48.08	0
SDCBF01-1114	48.01	0
SDCBF01-1115	2.01	0
SDCBF01-1116	30.27	0
SDCBF01-1117	3.87	0.003
SDCBF01-1118	2.13	0
SDCBF01-1119	1.09	0
SDCBF01-1120	1.15	0.006
SDCBF01-1121	7.84	0.011
SDCBF01-1122	8.36	0.013
SDCBF01-1128	3.84	0.013
SDCBF01-1130	2.4	0.019
SDCBF01-1132	1.24	0.006
SDCBF01-1136	0.65	0
SDCBF01-1141	0.28	0
SDCBF01-1143	5.05	0.001
SDCBF01-1145	2.09	0
SDCBF01-1149	0.52	0
SDCBF01-1150	0.4	0
SDCBF01-1151	42.33	0
SDCBF01-1152	0.7	0
SDCBF01-1153	42.3	0
SDCBF01-1154	0.79	0
SDCBF01-1165	17.03	0
SDCBF01-1167	4.73	0.018
SDCBF01-1170	0.47	0
SDCBF01-1181	0.7	0
SDCBF01-1189	4.61	0.023
SDCBF01-1190	4.6	0.016
SDCBF01-1191	0.5	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF01-1192	0.63	0
SDCBF01-1194	1.24	0
SDCBF01-1195	1.29	0
SDCBF01-1196	1.38	0.005
SDCBF01-1204	0.63	0
SDCBF01-1205	1.4	0
SDCBF01-1206	7.88	0.015
SDCBF01-1211	0.89	0.004
SDCBF01-1213	0.73	0
SDCBF01-1216	0.23	0
SDCBF01-1217	48.02	0
SDCBF01-1218	48.01	0
SDCBF01-1225	47.97	0
SDCBF01-1234	0.13	0
SDCBF02-1002	0.48	0
SDCBF02-1003	0.44	0.002
SDCBF02-1004	0.34	0
SDCBF02-1005	0.31	0
SDCBF02-1013	0.49	0
SDCBF02-1015	0.51	0
SDCBF02-1017	0.55	0
SDCBF02-1020	0.68	0
SDCBF02-1021	0.62	0
SDCBF02-1022	0.56	0
SDCBF02-1023	0.71	0
SDCBF02-1024	0.66	0
SDCBF02-1025	0.54	0
SDCBF02-1026	0.4	0
SDCBF02-1028	1.38	0
SDCBF02-1031	0.24	0
SDCBF02-1032	0.44	0
SDCBF02-1033	0.45	0
SDCBF02-1034	0.42	0
SDCBF02-1035	0.78	0.003
SDCBF02-1036	0.83	0.003
SDCBF02-1039	0.42	0
SDCBF02-1040	0.43	0
SDCBF02-1050	0.03	0
SDCBF03-1002	4.61	0.047
SDCBF03-1015	0.6	0
SDCBF03-1026	0.55	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF03-1027	0.76	0
SDCBF03-1028	2.2	0
SDCBF03-1029	0.97	0
SDCBF03-1033	0.52	0
SDCBF03-1038	4.34	0.026
SDCBF03-1044	0.94	0
SDCBF03-1045	0.29	0
SDCBF03-1046	0.77	0
SDCBF03-1047	0.32	0
SDCBF03-1065	28.96	0
SDCBF03-1066	29.98	0
SDCBF03-1087	24.06	0
SDCBF03-1100	1.6	0
SDCBF03-1108	0.65	0
SDCBF03-1109	0.66	0
SDCBF03-1110	2.77	0
SDCBF03-1137	3.11	0.003
SDCBF03-1144	35.28	0
SDCBF03-1151	43.53	0.232
SDCBF03-1152	47.95	0.129
SDCBF03-1153	47.19	0.092
SDCBF03-1154	26.23	0
SDCBF03-1155	34.01	0
SDCBF03-1167	0.52	0
SDCBF03-1168	0.74	0
SDCBF03-1188	0.58	0
SDCBF03-1278	0.79	0
SDCBF03-1279	48.21	0.142
SDCBF03-1284	0.24	0
SDCBF03-1286	0.22	0
SDCBF03-1289	5.82	0
SDCBF03-1314	0.54	0
SDCBF03-1316	0.47	0
SDCBF03-1318	0.29	0
SDCBF03-1339	4.43	0.034
SDCBF03-1378	0.12	0
SDCBF04-1001	0.73	0
SDCBF04-1002	0.16	0
SDCBF04-1059	0.59	0
SDCBF04-1080	0.35	0
SDCBF04-1081	0.57	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF04-1083	0.63	0
SDCBF04-1084	0.38	0
SDCBF04-1085	0.26	0
SDCBF04-1086	0.22	0
SDCBF04-1096	0.27	0
SDCBF04-1097	0.95	0
SDCBF04-1125	2.4	0.02
SDCBF04-1126	0.85	0.002
SDCBF04-1144	4.33	0
SDCBF04-1146	6.69	0
SDCBF04-1147	6.88	0.007
SDCBF04-1148	0.65	0
SDCBF04-1177	0.79	0
SDCBF04-1178	0.68	0
SDCBF04-1218	3.57	0
SDCBF04-1219	1.45	0
SDCBF04-1220	4.01	0
SDCBF04-1223	4.36	0.065
SDCBF04-1224	4.53	0.002
SDCBF04-1225	4.38	0
SDCBF04-1226	0.24	0
SDCBF04-1256	0.48	0
SDCBF04-1270	0.07	0
SDCBF04-1276	2.28	0
SDCBF04-1277	2.94	0.011
SDCBF04-1280	2.26	0
SDCBF04-1310	3.68	0
SDCBF04-1311	4.17	0.023
SDCBF04-1312	3.71	0
SDCBF04-1327	0.23	0
SDCBF04-1335	6.55	0
SDCBF04-1340	3.14	0
SDCBF04-1361	4.29	0
SDCBF04-1362	2.97	0
SDCBF04-1366	1.41	0
SDCBF04-1394	0.86	0
SDCBF04-1397	0.68	0
SDCBF04-1398	0.69	0
SDCBF04-1399	0.08	0
SDCBF04-1404	0.06	0
SDCBF04-1406	0.56	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF04-1407	0.14	0
SDCBF04-1408	0.15	0
SDCBF04-1440	2.83	0
SDCBF04-1441	10.43	0
SDCBF04-1443	2.38	0
SDCBF04-1444	2.47	0
SDCBF04-1445	2.41	0
SDCBF04-1446	2.02	0
SDCBF04-1450	0.71	0
SDCBF04-1452	1.17	0
SDCBF04-1473	1.48	0
SDCBF04-1474	1.59	0
SDCBF04-1475	2.19	0
SDCBF04-1476	1.65	0
SDCBF04-1478	1.6	0
SDCBF04-1480	1.91	0
SDCBF04-1506	0.14	0
SDCBF04-1507	0.03	0
SDCBF04-1545	2.13	0
SDCBF04-1546	2.49	0
SDCBF04-1547	1.38	0
SDCBF04-1556	2.7	0.038
SDCBF04-1559	1.35	0
SDCBF04-1561	3.82	0
SDCBF04-1562	3.9	0.015
SDCBF04-1565	2.72	0
SDCBF04-1570	1.26	0
SDCBF06-1003	0.82	0
SDCBF06-1004	0.45	0
SDCBF06-1005	0.51	0
SDCBF06-1008	0.84	0
SDCBF06-1009	0.02	0
SDCBF06-1010	0.79	0
SDCBF06-1011	0.01	0
SDCBF06-1012	0.66	0
SDCBF07-1005	1.8	0
SDCBG19-1043	0.84	0
SDCBG20-1001	0.75	0
SDCBG20-1002	4	0
SDCBG20-1003	4.01	0
SDCBG20-1012	48.82	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG20-1013	48.61	0
SDCBG20-1068	4.34	0
SDCBG20-1069	4.27	0
SDCBG20-1105	49.16	0
SDCBG20-1117	47.73	0.028
SDCBG21-1013	4.01	0
SDJCTF01-1001	0.4	0
SDJCTF01-1012	0.75	0
SDJCTF01-1013	1.49	0
SDJCTF01-1018	3.24	0.006
SDJCTF01-1019	20.56	0.015
SDJCTF01-1022	1.1	0.01
SDJCTF01-1026	48.08	0
SDJCTF01-1033	2.6	0.002
SDJCTF01-1034	0.8	0
SDJCTF03-1086	42.4	0.089
SDJCTF03-1087	44.62	0.122
SDJCTF03-1103	44.94	0.306
SDJCTF03-1112	36.06	0.109
SDJCTF03-1132	0.11	0
SDJCTF03-1135	5.36	0.001
SDJCTF03-1192	31.42	0.08
SDJCTF04-1015	0.83	0
SDJCTF04-1067	1.23	0.003
SDJCTF04-1117	21.47	0
SDJCTF04-1191	0.24	0.001
SDJCTF04-1223	3.09	0.022
SDJCTF04-1225	3.71	0
SDJCTF04-1295	0.95	0
SDJCTF06-1002	0.79	0
SDJCTG20-1067	22.2	0
SDMHF01-1001	4.77	0
SDMHF01-1002	24.68	0.076
SDMHF01-1003	48.33	0
SDMHF01-1004	48.1	0
SDMHF01-1005	48.16	0
SDMHF01-1010	2.71	0
SDMHF01-1012	24.9	0.006
SDMHF01-1013	24.82	0.025
SDMHF01-1020	0.36	0
SDMHF01-1021	0.23	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF01-1022	2.31	0
SDMHF01-1024	16.14	0
SDMHF01-1026	19.33	0
SDMHF01-1027	48.23	0
SDMHF01-1028	47.72	0
SDMHF01-1029	48.09	0
SDMHF01-1030	48.17	0
SDMHF01-1031	10.58	0
SDMHF01-1032	48.16	0.012
SDMHF01-1033	48.13	0.013
SDMHF01-1034	4.7	0.002
SDMHF01-1035	4.86	0
SDMHF01-1036	5.06	0
SDMHF01-1038	2.11	0.004
SDMHF01-1039	0.67	0
SDMHF01-1040	48.33	0
SDMHF01-1043	0.1	0
SDMHF01-1046	6.49	0
SDMHF01-1047	4.72	0.001
SDMHF01-1048	0.42	0
SDMHF01-1049	7.76	0.001
SDMHF01-1051	0.73	0
SDMHF01-1052	0.5	0
SDMHF01-1054	17.81	0
SDMHF01-1055	4.61	0.021
SDMHF01-1056	24.13	0.205
SDMHF01-1057	21.46	0.138
SDMHF01-1058	21.31	0.063
SDMHF01-1059	21.32	0.083
SDMHF01-1063	5.78	0
SDMHF01-1065	42.18	0
SDMHF01-1066	48.01	0
SDMHF01-1068	48.04	0
SDMHF01-1069	4.89	0
SDMHF01-1070	1.07	0
SDMHF01-1071	3.3	0
SDMHF01-1072	1.36	0
SDMHF02-1001	0.62	0
SDMHF02-1002	0.4	0
SDMHF02-1003	0.53	0
SDMHF02-1004	0.82	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF02-1006	0.82	0
SDMHF03-1001	4.63	0.087
SDMHF03-1002	5.6	0.29
SDMHF03-1010	0.21	0
SDMHF03-1011	0.44	0
SDMHF03-1014	0.93	0
SDMHF03-1015	1.03	0
SDMHF03-1018	1.56	0
SDMHF03-1019	1.16	0
SDMHF03-1020	0.72	0.002
SDMHF03-1022	0.56	0.005
SDMHF03-1023	0.58	0.001
SDMHF03-1024	0.6	0
SDMHF03-1025	0.47	0
SDMHF03-1026	0.71	0
SDMHF03-1027	4.83	0.027
SDMHF03-1028	4.94	0.002
SDMHF03-1029	5.65	0
SDMHF03-1030	3.17	0
SDMHF03-1032	0.68	0
SDMHF03-1034	4.16	0.025
SDMHF03-1035	0.8	0
SDMHF03-1038	0.79	0
SDMHF03-1042	0.28	0
SDMHF03-1047	2.7	0.037
SDMHF03-1052	4.24	0.066
SDMHF03-1055	0.32	0
SDMHF03-1056	0.27	0
SDMHF03-1057	4.64	0.175
SDMHF03-1060	45.14	0.194
SDMHF03-1062	45.16	0.033
SDMHF03-1063	42.77	0
SDMHF03-1067	0.63	0
SDMHF03-1069	0.33	0
SDMHF03-1073	5.61	0
SDMHF03-1074	5.4	0
SDMHF03-1080	0.1	0
SDMHF03-1088	6.71	0
SDMHF03-1097	4.11	0.018
SDMHF04-1039	0.33	0
SDMHF04-1044	2.36	0.003

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF04-1045	0.72	0
SDMHF04-1050	2.35	0
SDMHF04-1061	4.8	0.002
SDMHF04-1064	0.61	0.01
SDMHF04-1065	0.38	0.002
SDMHF04-1074	0.11	0
SDMHF04-1077	0.23	0
SDMHF04-1091	0.45	0.015
SDMHF04-1094	4.33	0
SDMHF04-1098	0.29	0
SDMHF04-1100	0.47	0
SDMHF04-1122	0.18	0.001
SDMHF04-1124-1	1.85	0.001
SDMHF04-1144	0.49	0
SDMHF04-1147	1.15	0
SDMHF04-1149	0.27	0
SDMHF04-1159	1.73	0
SDMHF04-1167	17.26	0
SDMHF04-1173	1.05	0
SDMHF04-1178	0.18	0
SDMHF04-1179	0.1	0
SDMHF04-1182	1.96	0
SDMHF04-1183	2.67	0
SDMHF04-1215	0.06	0
SDMHF05-1001	0.54	0
SDMHF06-1001	0.61	0
SDMHF06-1002	0.11	0
SDMHF06-1003	48.29	0.014
SDMHG20-1001	3.97	0
SDMHG20-1002	48.08	0.007
SDMHG20-1003	4.06	0
SDMHG20-1004	0.75	0
SDMHG20-1009	6.31	0
SDMHG20-1040	4.43	0
SDMHG20-1042	4.17	0
SDMHG20-1054	47.43	0.021
SDMHG20-1055	11.55	0
SDMHG20-1056	47.32	0.019
SDMHG20-1057	47.15	0
SDMHG20-1058	48.77	0
SDOUTF04-1007	34.5	0.492

Table 5. Fidalgo North Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
SD003415002202_2	1.18
SD003515001226_1	1.5
SD003515001226_2	2.15
SD003715001227	1.01
SD003812001228_1	1.94
SD003812001228_2	1.44
SD003912001229	1.28
SD004008001230	1.03
SD004108001231	1.08
SD004308001232	1.02
SD005110001242_2	1.05
SD005408002805	1.05
SD006121000053	1.03
SD006321000052	1.05
SD008508001190	1.35
SD008818000024	1.11
SD010921000107	2.47
SD012936000277	1.07
SD015012000266	1.1
SD026512000259	1.47
SD036212001233	1
SD036608002319	1.25
SD046908002251	1.17
SD047908002234	1.25
SD048008001582	1.53
SD048308002230	1.03
SD049018001249_1	1.57
SD049218001250	1.26
SD049715001248	1.08
SD050415001246	1.08
SD052108003425	1
SD052208003424	1.07
SD052308003423	1.26
SD053918000219	1.13
SD056808003402	1.24
SD059412002380	1.24
SD059512002379	2.5
SD059612002378	2.51

Conduit Asset ID	Max/Full Flow
SD064608000123	1.19
SD065112001809	1.17
SD066108001439	1.15
SD066808001434	1
SD067208001437	1.3
SD071421000046	1.41
SD071715000254	1.4
SD073327000256	1.1
SD074108002196	1.41
SD075212000281	1.22
SD075312000282	1.02
SD075608002318	1.96
SD079312001307	3.58
SD079412001308	2.68
SD081918000098	1.02
SD083108001395	1.23
SD088308002310	1.17
SD130630000059	1.06
SD130830000058_1	1.05
SD130830000058_2	1.03
SD130930000057	1.29
SD132936001362	1.04
SD133127001379	1.02
SD133212001375	1.24
SD141112001099	1.63
SD141206002653	1.22
SD141808001276	3.66
SD145808002921	1.31
SD148818000218	1.21
SD149115000222	1.24
SD149612002661	1.07
SD153112002886	1.08
SD155608002993	1.14
SD155927000045	1.18
SD156812001346	1.15
SD157206002654	2
SD158708001443	1.09
SD158808001442	1.04
SD159815001275	1.05
SD160508002568	2.3
SD162408001769	2.34

Conduit Asset ID	Max/Full Flow
SD163508001430	1.44
SD163808001429	1.33
SD164210001408	1.27
SD165018002332_1	1.98
SD165018002332_2	1.58
SD165315000104	1.06
SD165415000102	1.57
SD166008002702	2.01
SD166912003259	1.32
SD167012003293	1.21
SD167630000040	2.69
SD167730000041	1.07
SD169818001553	1.55
SD170818003091	1.3
SD179208002508	1.44
SD181512000034	1.1
SD182008002567	1
SD182210001343	1.04
SD182212004306	1.12
SD184142000083	1.33
SD184342000082	1.31
SD186408002992	1.78
SD187727000042	1.13
SD187927000044	1.09
SD188027000043	3.86
SD188236000251	1.09
SD190208003769	1.08
SD190408003157	1.39
SD190512000258	1.9
SD190512001885	1.88
SD191208001188	1.14
SD191312000260	1.06
SD193908003129	1.25
SD194008003130	1.15
SD199208002701	1.04
SD199308002700	2.19
SD200312001098	1.69
SD200410002828	1.11
SD200610002838	1.18
SD200710002837	1.94
SD200908002835	1.05

Conduit Asset ID	Max/Full Flow
SD202118003089	2.1
SD202312002660	1.46
SD203515001247	1.08
SD219308001503	1.81
SD220212002637_2	1.11
SD220408002662	56.03
SD220815001415	1.03
SD221808002704	1.25
SD224012000126	1.09
SD224212000125	1.26
SD224312000124	1.08
SD224412001793	1.25
SD224612001792	1.03
SD225812000135	2.2
SD226012000136	1.87
SD226112000139	1.01
SD226212000140	2.24
SD226312000141	1.18
SD226812000146	1.19
SD227012000148	1.25
SD230312003019	2.14
SD234218002101	1.14
SD237148000086	1.2
SD239412001935	1.14
SD243312002769	1.66
SD243412002770	1.26
SD252436000278	1.14
SD253112000285	1.06
SD253412000284	1.1
SD253712000272	1.7
SD254112000271	1.43
SD254212000270	1.12
SD254412000269	1.09
SD254612000268	1.15
SD254812002478	1.1
SD255012000267	1.18
SD256612001176	1.57
SD257008002317	1.05
SD258721000051	1.05
SD265910002709	1.85
SD266612002785	1.06

Conduit Asset ID	Max/Full Flow
SD269808001551	1.05
SD272112002909	1.55
SD273510002675	2.52
SD276512001350	1.06
SD277518002766	1.22
SD279818000032	2.01
SD284208002311	1.01
SD291621000029	1.33
SD304912002306	1.88
SD311412001910	1.48
SD311512001911	1.16
SD312712001845	1.02
SD319227001348	1.31
SD323810000121	1.36
SD329012001791	2.34
SD329215001799	1.14
SD330012001820	1.24
SD330112001821	1.79
SD330212001822_2	1.97
SD333212003419	1.37
SD333412001775	1.08
SD333612001772	1.22
SD333712001771	1.52
SD336108002834	2.33
SD336208002832	3.71
SD340108003027	1.25
SD347615002266	1.38
SD372008004092	1.55
SD372612004103	1.35
SD372712004102	1.65
SD390712004301	3.33
SD391312004311	1.72
SD406808004467	1.43
SD424212004664	1.08
SD434008004781	1.69
SD445208004960	1.07
SD445308004962	1.94
SD955108004469	1.17
SD959612002387	2.31
SD960108003865_1	1.3
SD960308003863	1.49

Conduit Asset ID	Max/Full Flow
SD970612003659	1.26
SD981008002328	1.02
SD982308002861	2.72
SD985908002918	1.14
SD986008002911	1.55
SD988808001192_4	1.15
SD991924002608	1.38
SD993908001507	1.44
SD995312002393	1.05
SD995515002385	1.52
SD996808002327	1.45
SD999908004998	1.38
SD999908005011	1.09
SDCLVRT0166	1.09
SDCLVRT0192	1.58
SDCLVRT0224	2.71
SDCLVRT0272	1.23
SDCLVRT0319	1.09
SDCLVRT0433	1.02
SDCLVRT0434	1.89
SDCLVRT0437_2	1.62
SDCLVRT0446	1.24
SDCLVRT0460	2.52
SDCLVRT0501	1.81

Table 6. Fidalgo North Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
1	1.14	0
1373	1.55	0
1381	0.92	0
1431	2.48	0
1501	0.52	0.017
1550	1.28	0
1551	1.51	0
1552	1.54	0
1939	0.33	0.001
1971	1.06	0.006
3002	1.12	0.001
3034	2.55	0.01

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
3069	1.02	0
53	6.66	0
55	0.58	0
62	1.29	0
63	0.8	0
64	0.47	0
68	0.92	0
75	2.45	0.068
FN7	0.66	0
J61	6.55	0
SDCBF01-1016	1.63	0.003
SDCBF01-1020	1.39	0
SDCBF01-1021	1.08	0
SDCBF01-1022	2.94	0
SDCBF01-1023	1.16	0
SDCBF01-1027	3.72	0
SDCBF01-1028	26.1	0.016
SDCBF01-1032	25.75	0.082
SDCBF01-1033	22.69	0.027
SDCBF01-1041	0.47	0
SDCBF01-1042	0.5	0
SDCBF01-1063	0.41	0
SDCBF01-1064	0.61	0
SDCBF01-1065	4.79	0
SDCBF01-1068	4.85	0
SDCBF01-1073	0.41	0
SDCBF01-1074	0.71	0
SDCBF01-1078	0.41	0
SDCBF01-1079	0.55	0
SDCBF01-1084	1.68	0
SDCBF01-1085	1.71	0
SDCBF01-1086	0.8	0
SDCBF01-1087	0.79	0
SDCBF01-1088	0.89	0
SDCBF01-1089	1.52	0
SDCBF01-1090	1.73	0
SDCBF01-1091	1.75	0
SDCBF01-1092	47.97	0
SDCBF01-1093	2.66	0
SDCBF01-1094	47.99	0
SDCBF01-1095	48.2	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF01-1096	48.07	0
SDCBF01-1097	35.25	0
SDCBF01-1098	48.18	0
SDCBF01-1099	48.07	0
SDCBF01-1100	48.06	0
SDCBF01-1101	5.3	0.001
SDCBF01-1102	48.25	0
SDCBF01-1103	48.19	0
SDCBF01-1104	48.26	0
SDCBF01-1105	48.15	0
SDCBF01-1106	48.04	0
SDCBF01-1113	48.07	0
SDCBF01-1114	48	0
SDCBF01-1115	2	0
SDCBF01-1116	29.64	0
SDCBF01-1117	3.87	0.003
SDCBF01-1118	2.13	0
SDCBF01-1119	1.1	0
SDCBF01-1120	1.15	0.006
SDCBF01-1121	7.85	0.011
SDCBF01-1122	8.37	0.013
SDCBF01-1128	3.85	0.013
SDCBF01-1130	2.4	0.019
SDCBF01-1132	1.24	0.006
SDCBF01-1136	0.65	0
SDCBF01-1141	0.28	0
SDCBF01-1143	5.05	0.001
SDCBF01-1145	2.09	0
SDCBF01-1149	0.52	0
SDCBF01-1150	0.39	0
SDCBF01-1151	42.34	0
SDCBF01-1152	0.7	0
SDCBF01-1153	42.31	0
SDCBF01-1154	0.8	0
SDCBF01-1165	17.56	0.001
SDCBF01-1167	4.73	0.018
SDCBF01-1170	0.47	0
SDCBF01-1181	0.69	0
SDCBF01-1189	4.61	0.023
SDCBF01-1190	4.6	0.016
SDCBF01-1191	0.5	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF01-1192	0.63	0
SDCBF01-1194	1.24	0
SDCBF01-1195	1.29	0
SDCBF01-1196	1.38	0.005
SDCBF01-1204	0.63	0
SDCBF01-1205	1.4	0
SDCBF01-1206	7.89	0.015
SDCBF01-1211	0.89	0.004
SDCBF01-1213	0.73	0
SDCBF01-1216	0.23	0
SDCBF01-1217	48.02	0
SDCBF01-1218	48.02	0
SDCBF01-1225	47.97	0
SDCBF01-1234	0.14	0
SDCBF02-1002	0.48	0
SDCBF02-1003	0.44	0.002
SDCBF02-1004	0.34	0
SDCBF02-1005	0.31	0
SDCBF02-1013	0.49	0
SDCBF02-1015	0.51	0
SDCBF02-1017	0.55	0
SDCBF02-1020	0.67	0
SDCBF02-1021	0.62	0
SDCBF02-1022	0.56	0
SDCBF02-1023	0.71	0
SDCBF02-1024	0.66	0
SDCBF02-1025	0.54	0
SDCBF02-1026	0.4	0
SDCBF02-1028	1.38	0
SDCBF02-1031	0.24	0
SDCBF02-1032	0.44	0
SDCBF02-1033	0.45	0
SDCBF02-1034	0.42	0
SDCBF02-1035	0.78	0.003
SDCBF02-1036	0.83	0.003
SDCBF02-1039	0.42	0
SDCBF02-1040	0.43	0
SDCBF02-1050	0.03	0
SDCBF03-1002	7.45	0.107
SDCBF03-1015	0.6	0
SDCBF03-1025	0.31	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF03-1026	0.64	0
SDCBF03-1027	1.12	0
SDCBF03-1028	2.19	0.005
SDCBF03-1029	1.26	0
SDCBF03-1033	1.07	0
SDCBF03-1035	3.2	0
SDCBF03-1038	7.16	0.077
SDCBF03-1044	0.91	0
SDCBF03-1045	0.3	0
SDCBF03-1046	0.77	0
SDCBF03-1047	0.32	0
SDCBF03-1087	36.2	0
SDCBF03-1088	0.72	0
SDCBF03-1100	1.64	0
SDCBF03-1108	0.66	0
SDCBF03-1109	0.67	0
SDCBF03-1110	3.6	0
SDCBF03-1137	3.11	0.003
SDCBF03-1167	0.52	0
SDCBF03-1168	0.74	0
SDCBF03-1188	0.95	0
SDCBF03-1239	0.73	0
SDCBF03-1278	0.79	0
SDCBF03-1284	0.24	0
SDCBF03-1286	0.22	0
SDCBF03-1289	5.82	0
SDCBF03-1314	0.93	0
SDCBF03-1315	0.42	0
SDCBF03-1316	0.92	0
SDCBF03-1318	1.36	0
SDCBF03-1339	7.26	0.085
SDCBF03-1377	0.69	0
SDCBF03-1378	0.76	0
SDCBF04-1001	0.73	0
SDCBF04-1002	0.16	0
SDCBF04-1059	0.59	0
SDCBF04-1080	0.35	0
SDCBF04-1081	0.57	0
SDCBF04-1083	0.63	0
SDCBF04-1084	0.38	0
SDCBF04-1085	0.26	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF04-1086	0.22	0
SDCBF04-1096	0.27	0
SDCBF04-1097	0.95	0
SDCBF04-1125	2.4	0.02
SDCBF04-1126	0.81	0.002
SDCBF04-1144	4.33	0
SDCBF04-1146	6.69	0
SDCBF04-1147	6.88	0.007
SDCBF04-1148	1.91	0
SDCBF04-1177	0.79	0
SDCBF04-1178	0.68	0
SDCBF04-1218	3.59	0
SDCBF04-1219	1.45	0
SDCBF04-1220	4.01	0
SDCBF04-1223	4.36	0.065
SDCBF04-1224	4.53	0.002
SDCBF04-1225	4.38	0
SDCBF04-1226	0.24	0
SDCBF04-1256	0.48	0
SDCBF04-1270	0.81	0
SDCBF04-1272	0.78	0.023
SDCBF04-1276	2.16	0
SDCBF04-1277	2.94	0.011
SDCBF04-1280	2.27	0
SDCBF04-1310	3.68	0
SDCBF04-1311	4.17	0.023
SDCBF04-1312	3.71	0
SDCBF04-1327	0.23	0
SDCBF04-1335	6.54	0
SDCBF04-1340	3.14	0
SDCBF04-1361	4.29	0
SDCBF04-1362	2.97	0
SDCBF04-1366	3.68	0
SDCBF04-1394	0.86	0
SDCBF04-1397	0.68	0
SDCBF04-1398	0.69	0
SDCBF04-1399	0.08	0
SDCBF04-1404	0.06	0
SDCBF04-1406	0.56	0
SDCBF04-1407	0.14	0
SDCBF04-1408	0.15	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBF04-1440	2.83	0
SDCBF04-1441	10.44	0
SDCBF04-1443	2.38	0
SDCBF04-1444	2.47	0
SDCBF04-1445	2.41	0
SDCBF04-1446	2.02	0
SDCBF04-1450	0.71	0
SDCBF04-1452	1.18	0
SDCBF04-1473	1.48	0
SDCBF04-1474	1.59	0
SDCBF04-1475	2.18	0
SDCBF04-1476	1.65	0
SDCBF04-1478	1.6	0
SDCBF04-1480	1.91	0
SDCBF04-1506	0.14	0
SDCBF04-1507	0.03	0
SDCBF04-1545	2.13	0
SDCBF04-1546	2.49	0
SDCBF04-1547	1.38	0
SDCBF04-1556	2.7	0.038
SDCBF04-1559	1.35	0
SDCBF04-1561	3.82	0
SDCBF04-1562	3.9	0.015
SDCBF04-1565	2.72	0
SDCBF04-1570	1.26	0
SDCBF06-1003	0.83	0
SDCBF06-1004	0.45	0
SDCBF06-1005	0.51	0
SDCBF06-1008	0.85	0
SDCBF06-1009	0.01	0
SDCBF06-1010	0.79	0
SDCBF06-1011	0.01	0
SDCBF06-1012	0.66	0
SDCBF07-1005	1.8	0
SDCBG19-1043	0.84	0
SDCBG20-1001	0.74	0
SDCBG20-1002	4	0
SDCBG20-1003	4.01	0
SDCBG20-1012	48.82	0
SDCBG20-1013	48.61	0
SDCBG20-1068	4.34	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG20-1069	4.28	0
SDCBG20-1105	49.16	0
SDCBG20-1117	47.73	0.028
SDCBG21-1013	4.02	0
SDJCTF01-1001	0.4	0
SDJCTF01-1012	0.75	0
SDJCTF01-1013	1.49	0
SDJCTF01-1018	3.24	0.006
SDJCTF01-1019	20.6	0.015
SDJCTF01-1022	1.1	0.01
SDJCTF01-1026	48.07	0
SDJCTF01-1033	2.6	0.002
SDJCTF01-1034	0.79	0
SDJCTF03-1132	0.11	0
SDJCTF03-1135	5.36	0.002
SDJCTF03-1146	0.41	0.009
SDJCTF04-1015	0.8	0
SDJCTF04-1067	1.23	0.003
SDJCTF04-1117	21.47	0
SDJCTF04-1191	0.24	0.001
SDJCTF04-1223	3.09	0.022
SDJCTF04-1225	3.71	0
SDJCTF04-1295	0.95	0
SDJCTF06-1002	0.79	0
SDJCTG20-1067	22.2	0
SDMHF01-1001	4.77	0
SDMHF01-1002	25.29	0.077
SDMHF01-1003	48.33	0
SDMHF01-1004	48.1	0
SDMHF01-1005	48.16	0
SDMHF01-1010	2.71	0
SDMHF01-1012	25.18	0.006
SDMHF01-1013	25.1	0.025
SDMHF01-1020	0.36	0
SDMHF01-1021	0.23	0
SDMHF01-1022	2.31	0
SDMHF01-1024	17.03	0
SDMHF01-1026	19.96	0
SDMHF01-1027	48.23	0
SDMHF01-1028	47.55	0
SDMHF01-1029	48.09	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF01-1030	48.16	0
SDMHF01-1031	10.49	0
SDMHF01-1032	48.16	0.012
SDMHF01-1033	48.12	0.014
SDMHF01-1034	4.69	0.002
SDMHF01-1035	4.86	0
SDMHF01-1036	5.06	0
SDMHF01-1038	2.11	0.004
SDMHF01-1039	0.67	0
SDMHF01-1040	48.33	0
SDMHF01-1043	0.1	0
SDMHF01-1046	6.43	0
SDMHF01-1047	4.72	0.001
SDMHF01-1048	0.42	0
SDMHF01-1049	7.77	0.001
SDMHF01-1051	0.73	0
SDMHF01-1052	0.5	0
SDMHF01-1054	18.39	0
SDMHF01-1055	4.61	0.021
SDMHF01-1056	24.77	0.207
SDMHF01-1057	22.08	0.141
SDMHF01-1058	21.95	0.066
SDMHF01-1059	21.96	0.086
SDMHF01-1063	5.78	0
SDMHF01-1065	42.18	0
SDMHF01-1066	48.01	0
SDMHF01-1068	48.04	0
SDMHF01-1069	4.88	0
SDMHF01-1070	1.07	0
SDMHF01-1071	3.31	0
SDMHF01-1072	1.36	0
SDMHF02-1001	0.62	0
SDMHF02-1002	0.4	0
SDMHF02-1003	0.53	0
SDMHF02-1004	0.81	0
SDMHF02-1006	0.82	0
SDMHF03-1001	7.48	0.15
SDMHF03-1002	8.51	0.325
SDMHF03-1003	0.66	0
SDMHF03-1004	0.79	0.012
SDMHF03-1005	0.82	0.001

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF03-1006	2.5	0
SDMHF03-1007	1.08	0
SDMHF03-1010	0.21	0
SDMHF03-1011	0.44	0
SDMHF03-1014	1.1	0.002
SDMHF03-1015	1.32	0.001
SDMHF03-1016	0.86	0
SDMHF03-1018	1.6	0
SDMHF03-1019	1.17	0
SDMHF03-1020	0.72	0.002
SDMHF03-1022	0.61	0.005
SDMHF03-1023	0.64	0.002
SDMHF03-1024	0.68	0
SDMHF03-1025	0.98	0
SDMHF03-1026	1.67	0
SDMHF03-1027	7.27	0.029
SDMHF03-1028	7.57	0.004
SDMHF03-1029	8.61	0
SDMHF03-1030	3.98	0
SDMHF03-1032	0.69	0
SDMHF03-1034	4.16	0.025
SDMHF03-1035	0.8	0
SDMHF03-1038	1.14	0
SDMHF03-1042	2.2	0
SDMHF03-1045	0.71	0
SDMHF03-1047	3.37	0.038
SDMHF03-1052	7.08	0.134
SDMHF03-1055	0.32	0
SDMHF03-1056	0.27	0
SDMHF03-1057	7.49	0.24
SDMHF03-1067	0.96	0
SDMHF03-1069	0.73	0
SDMHF03-1073	5.61	0
SDMHF03-1074	5.4	0
SDMHF03-1080	0.14	0
SDMHF03-1088	6.71	0
SDMHF03-1094	0.37	0
SDMHF03-1097	4.11	0.018
SDMHF03-1098	0.02	0
SDMHF03-1099	3.25	0.001
SDMHF04-1039	0.33	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHF04-1044	2.36	0.003
SDMHF04-1045	0.72	0
SDMHF04-1050	2.35	0
SDMHF04-1061	4.79	0.002
SDMHF04-1064	1.26	0.026
SDMHF04-1065	0.99	0.022
SDMHF04-1074	0.82	0.04
SDMHF04-1075	0.75	0
SDMHF04-1077	0.23	0
SDMHF04-1088	0.22	0
SDMHF04-1091	0.42	0.014
SDMHF04-1094	4.32	0
SDMHF04-1098	0.29	0
SDMHF04-1100	0.47	0
SDMHF04-1122	0.86	0.013
SDMHF04-1124-1	1.88	0.001
SDMHF04-1144	0.49	0
SDMHF04-1147	1.81	0
SDMHF04-1149	0.27	0
SDMHF04-1159	1.73	0
SDMHF04-1167	17.27	0
SDMHF04-1173	2.46	0
SDMHF04-1178	0.18	0
SDMHF04-1179	0.1	0
SDMHF04-1182	1.96	0
SDMHF04-1183	2.67	0
SDMHF04-1215	0.21	0
SDMHF05-1001	1.15	0
SDMHF06-1001	0.61	0
SDMHF06-1002	0.12	0
SDMHF06-1003	48.28	0.014
SDMHG20-1001	3.97	0
SDMHG20-1002	48.08	0.007
SDMHG20-1003	4.07	0
SDMHG20-1004	0.75	0
SDMHG20-1009	6.3	0
SDMHG20-1040	4.44	0
SDMHG20-1042	4.17	0
SDMHG20-1054	47.43	0.021
SDMHG20-1055	11.57	0
SDMHG20-1056	47.32	0.019

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG20-1057	47.15	0
SDMHG20-1058	48.77	0

Fidalgo South

The 25-year 24-hour storm caused 0.011 million gallons of flooding, with the affected junctions remaining surcharged for about 573.53 hours. 1.8 percent of the total pipes in Fidalgo South surcharged. In comparison, the 25-year, 3-hour storm caused 0.011 million gallons of flooding, with the affected junctions surcharging for about 368.38 hours. 2.5 percent of the total pipes in Fidalgo South surcharged. Additionally, the 25-year 24-hour climate perturbed storm caused 0.012 million gallons of flooding, with the affected junctions surcharging about 583.6 hours. 2.2 percent of the total pipes in Fidalgo South surcharged.

Table 7. Fidalgo South Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
SD346212003792	1.42
SD999518002105	2.39
SDCLVRT0041	1.52
SDCLVRT0108	2
SDCLVRT0336	1.29
SDDITCH0902	1.58

Table 8. Fidalgo South Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
FS-18	39.28	0
FS-19	39.47	0
FS-20	41.44	0
FS-21	40.88	0
FS-22	42.66	0
FS-23	39.69	0
FS-96	13.11	0
J27	49.96	0
SDCBF10-1028	46.03	0
SDCBF10-1029	46.38	0.011
SDJCTF10-1003	44.41	0
SDJCTF15-1028	40.51	0
SDMHF10-1019	44.9	0
SDMHF10-1020	44.81	0

Table 9. Fidalgo South Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
SD346212003792	2.06
SD348910000803_2	1.38
SD999518002105	3.06
SDCLVRT0041	1.52
SDCLVRT0108	1.6
SDCLVRT0333	1.05
SDCLVRT0336	1.3
SDDITCH0902	1.58

Table 10. Fidalgo South Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
FS-22	48.01	0
J27	49.96	0
SDCBF10-1020	0.02	0
SDCBF10-1028	48.69	0
SDCBF10-1029	48.73	0.011
SDJCTF10-1003	48.54	0
SDJCTF15-1028	27.23	0
SDMHF10-1019	48.6	0
SDMHF10-1020	48.6	0

Table 11. Fidalgo South Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
AssumedFlowFS6_2	1.04
SD346212003792	1.72
SD999518002105	2.96
SDCLVRT0041	1.52
SDCLVRT0108	2.46
SDCLVRT0336	1.3
SDDITCH0902	1.58

Table 12. Fidalgo South Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
FS-100	1.24	0
FS-18	40.45	0
FS-19	40.59	0
FS-20	41.88	0
FS-21	41.53	0
FS-22	43.19	0
FS-23	40.74	0
FS-96	16.38	0
J27	49.96	0
SDCBF10-1028	46.44	0
SDCBF10-1029	46.76	0.012
SDJCTF10-1003	44.9	0
SDJCTF15-1028	38.87	0
SDMHF10-1019	45.38	0
SDMHF10-1020	45.29	0

Guemes East

The 25-year, 24-hour storm caused 0.41 million gallons of flooding, with the affected junctions remaining surcharged for about 110 hours. 6.5 percent of the total pipes in Guemes East surcharged. In comparison, the 25-year, 3-hour storm caused 0.516 million gallons of flooding, with the affected junctions surcharging for about 3561 hours. 10.6 percent of the total pipes in Guemes East surcharged. Additionally, the 25-year, 24-hour climate perturbed storm caused 0.804 million gallons of flooding, with the affected junctions surcharging about 3932 hours. 7.9 percent of the total pipes in Guemes East surcharged.

Table 13. Guemes East Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
SD025608003124	3.58
SDCLVRT0096	3.51
SD334412001661_2	3.5
SDCLVRT0098	2.91
SD009008001991_1	2.9
SD007510001196_4	2.62
SD270508003507	2.58
SD007310001197_1	2.41
SD021312001199	2.39
SD002908001220	2.26

Conduit Asset ID	Max/Full Flow
SD197812002034	2.23
SDCLVRT0081	2.11
SD393612002037	2.07
SD006912001198_1	2.06
AssumedFlowGE32	2.03
SD025708003123	1.96
SD007310001197_6	1.95
SD007310001197_2	1.93
SD025108003137	1.86
SD007510001196_3	1.81
SD004708001653	1.74
SD034708001866	1.73
SD007510001196_1	1.63
SD009008001991_2	1.59
SD992612002599	1.56
SD025208003139	1.53
SD006912001198_4	1.51
SD045608001874	1.43
SD292218002571	1.42
SD422218004678	1.42
SD000208002002_4	1.4
SD071808001647	1.37
SD032212002040	1.35
SD422118004677	1.35
SD247212001159	1.34
SD046008001222	1.33
SD000208002002_2	1.31
SD002608001654	1.29
SD394412004357	1.29
SD002118001214	1.28
SDCLVRT0547	1.28
SD021108002024	1.26
SD422518004682_2	1.26
SD028224000007_2	1.24
SD002708001645_2	1.23
SD006912001198_2	1.23
SD025008003136	1.23
SD423308004650_2	1.23
SD028224000007_4	1.22
SD024918001216	1.21

Conduit Asset ID	Max/Full Flow
SD028224000007_6	1.21
SD084708001998	1.21
SD998308002477	1.2
SD002018001215	1.19
SD422518004682_1	1.19
SD002318001212_1	1.18
SDCLVRT0082	1.16
AssumedFlowGE60	1.14
SD086008001742	1.13
AssumedFlowGE58	1.11
SDCLVRT0538	1.1
SD033008003122_1	1.09
SD988612004262	1.08
SD002218001213	1.07
AssumedFlowGE59	1.06
SD000308003237	1.06
SD000208002002_3	1.05
SD002808001644	1.05
SD235608003260_1	1.05
SD238218002094	1.05
SD000608003143	1.02
SD003012001219_2	1.02
SD026908001660	1.01
SD000408003140	1
SD031108002001	1
SD235424002728	1
SDCLVRT0093	1

Table 14. Guemes East Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-105	0.98	0
GE-111	0.58	0
GE-112	46.02	0
GE-116	3.1	0
GE-117	2.14	0
GE-120	2.2	0
GE-121	2.09	0
GE-122	2.07	0.004

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-124	5.66	0
GE-125	0.68	0
GE-160	1.43	0
GE-161	4.34	0
GE-163	45.64	0
GE-165	46.45	0
GE-167	46.1	0
GE-168	46.01	0
GE-170	45.8	0
GE-171	44.61	0
GE-177	5.99	0
GE-184	8.17	0.022
GE-186	45.33	0
GE-218	0.95	0
GE-384	0.32	0
GE-427	0.5	0
GE-443	3.36	0.043
GE-444	10.29	0
GE-449	8.34	0
GE-458	8.58	0
GE-460	7.79	0
GE-462	9.11	0.065
GE-463	9.28	0
GE-471	2.32	0.005
GE-495	0.01	0.024
GE-497	6.36	0.001
GE-498	1.83	0
GE-503	47.55	0
GE-506	47.55	0
GE-507	0.5	0
GE-512	3.92	0.004
GE-544	45.56	0
GE-549	4.02	0.008
GE-550	3.67	0
GE-559	1.35	0
GE-560	1.32	0.009
GE-561	1.51	0
GE-562	0.04	0
GE-564	4.19	0
GE-565	16.55	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-566	1.65	0
GE-78	1.14	0
GE-98	0.71	0
J1	2.68	0
J10	2.56	0
J11	0.97	0
J13	0.26	0
J14	4.11	0
J16	3.96	0
J21	1.57	0.009
J22	1.37	0
J25	47.47	0
J26	47.52	0
J3	0.51	0
J30	13.64	0
J37	45.25	0
J4	1.91	0.003
J44	0.47	0
J46	0.58	0
J47	0.82	0
J49	2.89	0
J5	0.85	0.005
J50	1.41	0
J51	0.61	0
J55	1.17	0
J57	47.73	0
J60	4.58	0.012
SDCBF01-1177	1.02	0
SDCBG10-1002	1.62	0
SDCBG11-1035	1.67	0
SDCBG11-1036	0.23	0
SDCBG11-1069	1.67	0
SDCBG12-1004	0.77	0
SDCBG15-1009	0.58	0
SDCBG15-1013	0.46	0
SDCBG16-1015	0.77	0
SDCBG16-1017	0.87	0
SDCBG17-1001	2.01	0
SDCBG17-1002	1.68	0
SDCBG17-1003	1.59	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG17-1004	1.49	0
SDCBG17-1007	0.47	0.002
SDCBG17-1014	3.69	0
SDCBG17-1015	10.77	0
SDCBG17-1016	12.8	0.003
SDCBG17-1017	1.59	0
SDCBG17-1018	0.83	0
SDCBG17-1019	0.8	0
SDCBG17-1020	1.12	0
SDCBG17-1022	6.65	0.006
SDCBG17-1023	6.62	0
SDCBG17-1025	1.23	0
SDCBG17-1029	4.72	0.035
SDCBG17-1033	2.81	0
SDCBG17-1034	2.37	0
SDCBG17-1035	2.71	0
SDCBG17-1036	5.84	0
SDCBG17-1037	5.12	0
SDCBG17-1039	4.06	0.003
SDCBG17-1040	0.94	0
SDCBG17-1041	0.95	0
SDCBG17-1051	4.81	0.004
SDCBG17-1052	4.71	0
SDCBG17-1056	2.39	0
SDCBG17-1058	1.8	0.001
SDCBG17-1059	0.16	0
SDCBG17-1060	2.64	0
SDCBG17-1061	0.54	0
SDCBG17-1062	0.4	0
SDCBG17-1071	8.92	0
SDCBG17-1072	2.64	0
SDCBG17-1073	1.75	0
SDCBG17-1074	0.35	0
SDCBG17-1078	1.8	0
SDCBG17-1079	4.26	0
SDCBG17-1080	2.67	0
SDCBG17-1081	2.3	0
SDCBG17-1084	1.61	0.029
SDCBG17-1086	2.67	0
SDCBG17-1087	2.23	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG17-1089	50	0
SDCBG19-1001	47.5	0
SDCBG19-1002	47.54	0
SDCBG19-1005	0.87	0
SDCBG19-1006	0.93	0
SDCBG19-1011	0.95	0
SDCBG19-1016	0.92	0
SDCBG19-1017	1.06	0
SDCBG19-1019	0.68	0
SDCBG19-1020	0.53	0
SDCBG19-1021	0.39	0
SDCBG19-1032	47.54	0
SDCBG19-1033	47.52	0
SDCBG19-1034	47.65	0
SDCBG19-1036	0.95	0
SDCBG19-1037	1.47	0
SDCBG19-1038	47.54	0
SDCBG19-1044	47.56	0
SDCBG19-1045	47.83	0
SDCBG19-1046	47.71	0
SDCBG19-1047	47.57	0
SDCBG19-1048	47.56	0
SDCBG20-1047	0.29	0
SDCBG20-1048	0.46	0
SDCBG20-1055	0.2	0
SDCBG21-1011	44.68	0
SDCBG21-1012	45.14	0
SDCBG21-1016	0.71	0
SDCBG21-1018	26.69	0
SDCBG21-1021	45.7	0
SDCBG21-1022	0.79	0
SDCBG21-1023	46.04	0
SDCBG21-1024	46.26	0
SDCBG21-1027	44.65	0
SDMHG11-1030	1.47	0
SDMHG17-1001	6.19	0
SDMHG17-1002	4.85	0
SDMHG17-1003	1.09	0
SDMHG17-1004	1.82	0.003
SDMHG17-1005	3.27	0.001

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG17-1007	8.42	0.002
SDMHG17-1008	1.26	0
SDMHG17-1009	1.77	0
SDMHG17-1011	4.55	0.077
SDMHG17-1013	2.64	0
SDMHG17-1014	0.52	0
SDMHG17-1015	0.53	0
SDMHG17-1016	0.8	0
SDMHG17-1018	0.4	0
SDMHG17-1019	1.39	0.014
SDMHG17-1020	4.03	0
SDMHG17-1021	4.77	0
SDMHG17-1024	1.63	0.016
SDMHG17-1027	14.56	0
SDMHG19-1002	47.57	0
SDMHG19-1003	47.56	0
SDMHG19-1005	47.6	0
SDMHG19-1006	47.48	0
SDMHG19-1009	1.55	0
SDMHG19-1013	2.69	0
SDMHG19-1014	0.43	0
SDMHG19-1015	0.58	0
SDMHG19-1016	2.43	0
SDMHG19-1018	1.12	0
SDMHG19-1020	1.95	0
SDMHG19-1021	1.05	0
SDMHG19-1022	1.67	0
SDMHG19-1023	0.88	0
SDMHG19-1024	1.22	0
SDMHG19-1027	0.31	0
SDMHG19-1028	47.55	0
SDMHG19-1029	47.62	0
SDMHG19-1030	47.76	0
SDMHG19-1031	47.64	0
SDMHG19-1032	48.01	0
SDMHG19-1034	47.55	0
SDMHG20-1013	0.79	0
SDMHG20-1014	45.65	0
SDMHG20-1015	0.61	0
SDMHG20-1028	0.19	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG20-1029	0.19	0
SDMHG20-1036	0.65	0
SDMHG20-1038	0.72	0
SDMHG20-1039	45.89	0
SDMHG20-1041	0.93	0
SDMHG20-1060	45.9	0
SDMHG20-1061	45.38	0
SDMHG20-1062	45.32	0
SDMHG20-1064	45.35	0
SDMHG20-1065	45.32	0
SDMHG21-1001	44.78	0
SDMHG21-1002	46.35	0
SDMHG21-1003	46.29	0
SDMHG21-1004	46.52	0
SDMHG21-1005	46.23	0
SDMHG21-1006	45.19	0
SDMHG21-1007	44.74	0
SDMHG21-1008	31.67	0
SDMHG21-1009	3.69	0
SDMHG21-1010	46.48	0
SDMHG21-1011	45.76	0
SDMHG21-1012	45.43	0
SDMHG21-1013	45.48	0
SDMHG21-1014	48.33	0
SDMHG21-1015	46.1	0
SDMHG21-1016	46.13	0
SDMHG21-1017	46.31	0
SDMHG21-1018	46.44	0
SDMHG21-1019	46.72	0
SDMHG21-1020	46.84	0
SDMHG21-1021	0.54	0

Table 15. Guemes East Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
SDCLVRT0098	4.62
SDCLVRT0096	4.49
SD334412001661_2	3.85
SDCLVRT0081	3.79

Conduit Asset ID	Max/Full Flow
SD025608003124	3.59
SD270508003507	3.16
SD197812002034	3.05
SD021312001199	2.94
SD009008001991_1	2.92
SD007310001197_1	2.64
SD393612002037	2.63
SD007510001196_4	2.62
SD006912001198_1	2.61
SD021108002024	2.51
SD002908001220	2.32
SD007310001197_2	2.12
AssumedFlowGE32	2.03
SD007310001197_6	2.03
SD992612002599	2.03
SD237312002020	1.98
SD025708003123	1.97
SD394412004357	1.97
SD034708001866	1.91
SD007510001196_3	1.86
SD032212002040	1.85
SD237512002019	1.82
SD025108003137	1.81
SD198212002548_2	1.81
SD028224000007_2	1.79
SD023508002527	1.77
SD004708001653	1.76
SD006912001198_4	1.76
SD028224000007_4	1.76
SD028224000007_6	1.75
SD292012000009	1.75
SD007510001196_1	1.7
SD196512000016_1	1.68
SD196512000016_2	1.68
SD009008001991_2	1.59
SD013312002180	1.59
SDCLVRT0082	1.58
SD021008002025	1.54
SD197408002547	1.54
SD998308002477	1.54

Conduit Asset ID	Max/Full Flow
SD391808004321	1.53
SD197112000015_4	1.52
SD247212001159	1.49
SD025208003139	1.48
SD292218002571	1.45
SD018712002168_1	1.44
SD045608001874	1.44
SD006912001198_2	1.43
SD391908004316	1.43
SD000208002002_4	1.42
SDCLVRT0538	1.39
SDCLVRT0641	1.38
SD071808001647	1.37
SD422218004678	1.37
SD009108002864	1.35
SD235424002728	1.35
SD235608003260_1	1.35
SD000208002002_2	1.33
SD046008001222	1.33
SD393908004351	1.32
SD002118001214	1.31
SD014012002176	1.31
SDCLVRT0547	1.31
SD002608001654	1.3
SD084308001656	1.3
SD233412001575	1.3
SD346812002038	1.3
SD422118004677	1.29
SD401912004417	1.28
AssumedFlowGE60	1.26
SD199112002041	1.25
SD002708001645_2	1.24
SD084708001998	1.24
SD423308004650_2	1.24
SD024918001216	1.23
SD9611110003850	1.23
SD002018001215	1.22
SD441208004891	1.21
SD025008003136	1.2
SD282508001989	1.2

Conduit Asset ID	Max/Full Flow
SD422518004682_1	1.2
SD249024001484	1.19
SD002318001212_1	1.18
SD000908003149_1	1.15
SD988612004262	1.15
SD218624001493	1.14
SD322208002085	1.14
SD422518004682_2	1.14
SD017827002162	1.12
SD086008001742	1.12
AssumedFlowGE58	1.11
SD000208002002_3	1.09
SD033008003122_1	1.09
SD318312002698	1.09
SD026908001660	1.08
SD281112003754	1.08
SD002218001213	1.07
SD250024001495	1.07
AssumedFlowGE59	1.06
SD002808001644	1.06
SD021424004318	1.06
SD216824001492	1.06
SD249824001489	1.06
SD988612001150	1.06
SDCLVRT0582	1.06
SD238218002094	1.05
SD412008004840	1.05
SD003012001219_2	1.04
SD006912001198_5	1.04
SD197112000015_1	1.04
SDCLVRT0428	1.04
SD031108002001	1.03
SD059012000878	1.03
SD984908003031	1.03
SD000308003237	1.02
SD000608003143	1.02
SD002318001212_2	1.02
SD002708001645_1	1.01
SD000408003140	1
SD031308003236	1

Conduit Asset ID	Max/Full Flow
SD983608003238	1
SDCLVRT0093	1

Table 16. Guemes East Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG17-1089	50	0
SDMHG21-1014	49.08	0
SDMHG19-1032	49.02	0
SDMHG19-1005	48.97	0.01
SDCBG19-1045	48.97	0
SDMHG19-1030	48.96	0
SDCBG19-1046	48.95	0
J57	48.94	0
SDCBG19-1034	48.94	0
SDMHG19-1029	48.93	0
SDMHG19-1031	48.93	0
GE-503	48.92	0
SDCBG19-1048	48.92	0.002
GE-506	48.92	0.002
SDCBG19-1044	48.92	0
SDCBG19-1047	48.92	0
SDMHG19-1002	48.92	0
SDMHG19-1003	48.92	0
SDMHG19-1028	48.92	0
SDMHG19-1034	48.92	0
SDCBG19-1032	48.91	0
J26	48.9	0
SDCBG19-1001	48.9	0
SDCBG19-1033	48.9	0
SDCBG19-1038	48.9	0
SDCBG19-1002	48.9	0
J25	48.89	0
SDMHG19-1006	48.89	0
SDMHG21-1004	48.78	0
GE-165	48.76	0
SDMHG21-1020	48.76	0.008
SDMHG21-1010	48.76	0
SDCBG21-1024	48.75	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG21-1002	48.75	0
SDMHG21-1019	48.75	0
SDMHG21-1003	48.74	0
SDMHG21-1005	48.74	0
SDCBG21-1023	48.73	0
GE-167	48.72	0
SDMHG21-1018	48.72	0
GE-168	48.71	0
GE-170	48.7	0
SDMHG21-1017	48.7	0
GE-163	48.69	0
SDCBG21-1012	48.69	0
SDMHG21-1011	48.69	0
SDMHG21-1016	48.69	0
SDMHG21-1006	48.69	0
SDMHG21-1001	48.68	0
SDMHG21-1013	48.68	0
SDMHG21-1015	48.68	0
GE-112	48.67	0
SDMHG20-1060	48.66	0.002
SDCBG21-1021	48.66	0
SDCBG21-1011	48.66	0
SDCBG21-1027	48.66	0
SDMHG20-1039	48.66	0
GE-171	48.65	0
SDMHG20-1014	48.65	0
SDMHG21-1007	48.65	0
GE-544	48.64	0
SDMHG20-1061	48.63	0
SDMHG21-1012	48.63	0
J37	48.62	0
SDMHG20-1062	48.62	0
SDMHG20-1064	48.62	0
SDMHG20-1065	48.62	0
GE-186	48.61	0
SDMHG21-1008	16.33	0
SDCBG21-1018	11.1	0
GE-444	3.31	0
SDMHG17-1001	3.01	0
SDCBG17-1036	2.77	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG17-1037	2.44	0
SDMHG17-1007	2.36	0.005
SDMHG17-1027	2.29	0
SDCBG17-1016	2.16	0.006
GE-463	2.09	0
SDCBG17-1022	2.07	0.005
SDCBG17-1071	2.07	0
GE-462	2.06	0.036
SDCBG17-1015	2.05	0
SDCBG17-1023	2.03	0
SDCBG17-1079	2.02	0
J30	1.99	0
SDMHG17-1002	1.98	0
GE-458	1.95	0
GE-177	1.94	0
GE-449	1.89	0.001
SDMHG17-1021	1.88	0
SDCBG17-1029	1.87	0.021
J60	1.86	0.018
SDMHG17-1020	1.78	0
GE-460	1.74	0
GE-497	1.74	0.01
SDCBG17-1051	1.72	0.012
GE-116	1.71	0
SDCBG17-1052	1.69	0.003
J49	1.69	0
SDCBG17-1039	1.67	0.007
SDMHG19-1013	1.67	0
GE-565	1.66	0
SDMHG17-1011	1.64	0.06
GE-184	1.63	0.017
SDCBG17-1033	1.63	0
SDMHG19-1016	1.6	0.001
SDCBG17-1035	1.6	0
GE-120	1.51	0
SDCBG17-1034	1.51	0
GE-117	1.49	0
GE-121	1.48	0
GE-122	1.48	0.023
GE-549	1.48	0.011

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-550	1.48	0.002
SDMHG19-1020	1.41	0
SDCBG17-1060	1.37	0
GE-498	1.34	0
J1	1.33	0
SDCBG17-1086	1.33	0
SDCBG17-1078	1.33	0
GE-124	1.32	0
SDMHG17-1005	1.32	0.001
SDCBG17-1072	1.32	0
GE-512	1.29	0.013
J10	1.28	0
SDMHG17-1013	1.28	0
SDCBG17-1056	1.25	0
SDCBG17-1081	1.23	0
SDMHG19-1022	1.23	0
J4	1.2	0.002
SDCBG17-1014	1.19	0
J21	1.18	0.019
SDCBG17-1087	1.18	0
SDMHG21-1009	1.18	0
SDCBG17-1001	1.16	0
SDCBG17-1058	1.15	0.001
SDMHG19-1009	1.15	0
GE-561	1.14	0
J16	1.12	0
SDCBG19-1037	1.11	0
SDMHG11-1030	1.1	0
J50	1.09	0
SDCBG17-1084	1.07	0.032
GE-443	1.07	0.025
SDMHG17-1004	1.07	0.007
GE-564	1.07	0
J14	1.07	0
J22	1.07	0.001
SDCBG17-1073	1.06	0
GE-559	1.06	0
SDMHG17-1009	1.05	0
GE-560	1.04	0.014
SDCBG11-1035	1.03	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG17-1002	1.03	0
SDCBG17-1004	1.02	0.002
SDMHG17-1024	1.01	0.017
SDMHG20-1041	1.01	0.006
SDCBG17-1003	0.99	0
GE-161	0.99	0
SDMHG19-1024	0.98	0
SDCBG17-1017	0.97	0
SDCBG17-1080	0.94	0
SDMHG19-1018	0.94	0
GE-160	0.91	0
SDCBG19-1017	0.91	0
SDMHG19-1021	0.91	0
GE-125	0.89	0
SDMHG17-1019	0.89	0.013
GE-78	0.89	0
SDCBG19-1006	0.88	0
SDCBG19-1011	0.88	0
SDCBG19-1036	0.88	0
SDMHG20-1038	0.88	0
SDCBG19-1016	0.87	0
SDMHG20-1015	0.87	0
SDMHG19-1023	0.86	0.006
J47	0.86	0
SDCBG19-1005	0.86	0
SDMHG17-1003	0.83	0.003
SDMHG17-1008	0.83	0
SDMHG20-1036	0.83	0
SDCBG17-1025	0.81	0
GE-471	0.8	0.002
SDCBG17-1020	0.8	0
SDMHG20-1013	0.8	0
GE-111	0.78	0.013
SDCBG17-1040	0.78	0
SDCBG17-1041	0.78	0
J55	0.77	0
SDCBG16-1017	0.77	0
SDCBG19-1019	0.76	0
GE-105	0.75	0
GE-98	0.74	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
J51	0.74	0
SDMHG17-1016	0.74	0
SDCBG10-1002	0.73	0
J46	0.72	0
SDCBG12-1004	0.72	0
SDCBG16-1015	0.71	0
GE-126	0.7	0
SDCBF01-1177	0.7	0
SDMHG19-1015	0.7	0
J44	0.69	0
SDCBG17-1018	0.69	0
SDCBG20-1048	0.69	0
GE-127	0.68	0
J5	0.68	0.009
J11	0.67	0
SDCBG19-1020	0.67	0.004
SDCBG17-1019	0.67	0
SDCBG21-1016	0.67	0
J3	0.61	0
SDCBG17-1061	0.61	0
SDCBG20-1047	0.61	0
SDMHG19-1014	0.61	0
SDMHG21-1021	0.61	0
SDMHG17-1015	0.6	0
SDMHG17-1014	0.6	0
SDCBG15-1009	0.59	0.005
GE-507	0.58	0
SDCBG19-1021	0.58	0
SDMHG20-1029	0.58	0
SDMHG20-1028	0.58	0
SDMHG19-1027	0.57	0.001
SDCBG20-1055	0.57	0
GE-128	0.56	0
SDCBG17-1007	0.56	0.016
SDCBG15-1013	0.52	0
SDCBG17-1062	0.52	0
SDMHG17-1018	0.51	0
SDCBG21-1022	0.5	0
SDCBG17-1074	0.49	0
SDCBG14-1005	0.48	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-218	0.47	0
SDMHG19-1012	0.47	0
GE-133	0.46	0
GE-384	0.46	0.008
GE-96	0.46	0
SDMHG19-1011	0.46	0
SDCBG19-1023	0.44	0
SDCBG19-1022	0.44	0
SDCBG19-1024	0.44	0
GE-131	0.43	0
GE-508	0.43	0
SDMHG20-1016	0.42	0
SDMHG20-1033	0.42	0
GE-500	0.41	0
J42	0.41	0
SDCBG17-1059	0.41	0
GE-132	0.4	0
SDMHG19-1010	0.4	0
SDMHG20-1045	0.4	0
GE-558	0.38	0
SDCBG19-1026	0.38	0
SDCBG21-1056	0.38	0
SDMHG20-1044	0.37	0
SDMHG20-1027	0.35	0
SDCBG11-1069	0.34	0
GE-38	0.32	0
SDCBG17-1054	0.32	0
SDCBG21-1017	0.32	0
SDMHG20-1034	0.32	0
SDCBG16-1008	0.31	0
SDCBG16-1019	0.31	0
SDMHG19-1008	0.29	0
GE-427	0.27	0
SDCBG16-1012	0.27	0
SDCBG16-1014	0.27	0
SDMHG13-1001	0.26	0.003
J43	0.24	0
SDCBG19-1027	0.24	0
SDCBG19-1029	0.24	0
SDCBG19-1040	0.24	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-499	0.23	0
SDCBG16-1016	0.23	0
SDCBG13-1004	0.23	0
SDMHG19-1007	0.23	0
SDCBG11-1174	0.22	0
SDCBG11-1184	0.22	0
SDCBG20-1085	0.22	0.001
SDCBG17-1053	0.21	0
SDCBG20-1053	0.21	0
SDCBG21-1054	0.21	0
SDMHG20-1012	0.21	0
SDMHG20-1031	0.21	0
SDCBG13-1003	0.2	0
SDCBG16-1013	0.2	0
GE-447	0.2	0
SDCBG19-1030	0.2	0
SDCBG20-1016	0.2	0
GE-393	0.19	0.001
J36	0.19	0
SDCBG20-1056	0.19	0
SDMHG20-1010	0.19	0
SDMHG20-1011	0.19	0
GE-198	0.18	0
J53	0.18	0
SDCBG19-1041	0.18	0
SDCBG20-1015	0.18	0
SDCBG20-1017	0.18	0
SDCBG20-1052	0.18	0
SDMHG20-1035	0.18	0
SDCBG12-1001	0.17	0
SDCBG20-1014	0.17	0
SDCBG20-1116	0.17	0
SDCBG20-1128	0.17	0
SDCBG16-1006	0.16	0
SDCBG17-1044	0.16	0.001
SDCBG17-1045	0.16	0
SDCBG19-1028	0.16	0
J6	0.15	0
SDCBG20-1076	0.15	0
SDMHG20-1030	0.15	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-164	0.14	0
SDCBG11-1036	0.14	0
SDCBG16-1004	0.14	0
SDCBG20-1122	0.14	0
SDCBG20-1054	0.14	0
SDCBG10-1005	0.13	0
GE-217	0.12	0
GE-274	0.12	0.002
J13	0.12	0
SDCBG11-1117	0.11	0
GE-272	0.11	0.001
GE-403	0.11	0
SDMHG20-1032	0.1	0
SDCBG16-1005	0.09	0
SDCBG20-1050	0.09	0
SDCBG21-1055	0.08	0
SDMHG11-1020	0.08	0
GE-216	0.07	0
SDCBG21-1057	0.07	0
SDCBG19-1042	0.07	0
GE-494	0.06	0
GE-566	0.06	0
SDCBG20-1051	0.06	0
SDCBG21-1004	0.06	0
SDCBG20-1123	0.06	0
SDCBG11-1141	0.05	0
SDMHG11-1013	0.05	0
SDMHG11-1029	0.05	0
SDCBG16-1007	0.02	0
GE-37	0.02	0.001
GE-495	0.01	0.024
SDCBG18-1011	0.01	0
GE-562	0.01	0

Table 17. Guemes East Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
AssumedFlowGE32	2.03

Conduit Asset ID	Max/Full Flow
AssumedFlowGE58	1.11
AssumedFlowGE59	1.06
AssumedFlowGE60	1.19
SD000208002002_2	1.31
SD000208002002_3	1.04
SD000208002002_4	1.4
SD000308003237	1
SD000408003140	1
SD000608003143	1.02
SD000908003149_1	1.02
SD002018001215	1.2
SD002118001214	1.29
SD002218001213	1.07
SD002318001212_1	1.2
SD002318001212_2	1
SD002608001654	1.29
SD002708001645_1	1.01
SD002708001645_2	1.23
SD002808001644	1.05
SD002908001220	2.31
SD003012001219_2	1.03
SD004708001653	1.75
SD006912001198_1	2.11
SD006912001198_2	1.27
SD006912001198_4	1.56
SD007310001197_1	2.46
SD007310001197_2	1.96
SD007310001197_6	1.99
SD007510001196_1	1.66
SD007510001196_3	1.86
SD007510001196_4	2.62
SD009008001991_1	2.91
SD009008001991_2	1.59
SD021108002024	1.4
SD021312001199	2.56
SD024918001216	1.21
SD025008003136	1.18
SD025108003137	1.78
SD025208003139	1.46
SD025608003124	3.57
SD025708003123	1.96

Conduit Asset ID	Max/Full Flow
SD026908001660	1.05
SD028224000007_2	1.37
SD028224000007_4	1.34
SD028224000007_6	1.34
SD031108002001	1
SD031308003236	1
SD032212002040	1.51
SD033008003122_1	1.09
SD034708001866	1.72
SD045608001874	1.43
SD046008001222	1.32
SD056012002618	1.01
SD059012000878	1.06
SD071808001647	1.37
SD084708001998	1.24
SD086008001742	1.19
SD197812002034	2.59
SD199112002041	1.02
SD218624001493	1
SD235424002728	1.17
SD235608003260_1	1.24
SD238218002094	1.25
SD247212001159	1.73
SD249024001484	1.01
SD270508003507	3.32
SD292218002571	1.42
SD334412001661_2	3.69
SD346812002038	1.06
SD391808004321	1.03
SD393612002037	2.49
SD394412004357	1.5
SD422118004677	1.47
SD422218004678	1.5
SD422518004682_1	1.26
SD422518004682_2	1.25
SD423308004650_2	1.23
SD984908003031	1.03
SD988612001150	1.08
SD988612004262	1.18
SD992612002599	2.1
SD998308002477	1.42

Conduit Asset ID	Max/Full Flow
SDCLVRT0081	2.74
SDCLVRT0082	1.45
SDCLVRT0093	1
SDCLVRT0096	4.14
SDCLVRT0098	3.53
SDCLVRT0428	1.26
SDCLVRT0538	1.31
SDCLVRT0547	1.48
SDCLVRT0582	1.06
SDCLVRT0641	1.07

Table 18. Guemes East Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-105	1.69	0
GE-111	0.71	0
GE-112	46.42	0
GE-116	4.86	0
GE-117	2.83	0
GE-120	2.92	0
GE-121	2.74	0
GE-122	2.72	0.011
GE-124	8.19	0
GE-125	0.91	0
GE-126	0.35	0
GE-127	0.24	0
GE-160	1.89	0
GE-161	5.79	0
GE-163	46.13	0
GE-165	46.82	0
GE-167	46.5	0
GE-168	46.42	0
GE-170	46.23	0
GE-171	45.11	0
GE-177	8.88	0
GE-184	12.22	0.037
GE-186	45.79	0
GE-216	0.73	0
GE-217	0.93	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GE-218	1.7	0.001
GE-33	0.14	0.001
GE-37	2.99	0.041
GE-38	3.51	0
GE-384	0.68	0.005
GE-393	0.21	0
GE-425	0.1	0
GE-427	1.51	0
GE-443	4.98	0.075
GE-444	14.07	0
GE-447	0.4	0
GE-449	12.14	0
GE-458	12.38	0
GE-460	11.54	0
GE-462	12.94	0.118
GE-463	13.11	0
GE-471	3.9	0.009
GE-495	0.01	0.024
GE-497	9.92	0.006
GE-498	2.25	0
GE-503	47.79	0
GE-506	47.79	0
GE-507	0.76	0
GE-508	0.25	0
GE-512	5.83	0.011
GE-522	1.59	0.014
GE-544	46	0
GE-549	5.9	0.013
GE-550	5.04	0
GE-559	1.68	0
GE-560	1.65	0.014
GE-561	1.85	0
GE-562	5.56	0
GE-563	2.76	0.05
GE-564	12.93	0
GE-565	17.13	0
GE-566	8.74	0
GE-78	1.71	0
GE-96	0.32	0
GE-98	0.91	0
J1	3.95	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
J10	3.76	0
J11	1.47	0
J13	7.27	0
J14	12.57	0
J16	12.79	0
J21	1.91	0.015
J22	1.7	0
J25	47.72	0
J26	47.76	0
J3	0.76	0
J30	16.79	0
J37	45.72	0
J4	2.81	0.004
J44	0.61	0
J46	0.76	0
J47	1.17	0
J49	4.54	0
J5	1.36	0.014
J50	1.75	0
J51	0.8	0
J53	0.53	0
J55	1.64	0
J57	47.94	0
J6	0.46	0
J60	7.15	0.022
SDCBF01-1177	1.5	0
SDCBG10-1002	2.4	0
SDCBG10-1005	0.12	0
SDCBG11-1035	2.13	0
SDCBG11-1036	0.6	0
SDCBG11-1069	4.49	0
SDCBG11-1174	0.71	0
SDCBG11-1184	0.46	0
SDCBG12-1004	1.32	0
SDCBG13-1003	0.24	0
SDCBG13-1004	0.32	0
SDCBG14-1005	0.36	0
SDCBG15-1009	0.88	0
SDCBG15-1013	0.76	0
SDCBG16-1008	0.25	0
SDCBG16-1012	0.12	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG16-1015	1.2	0
SDCBG16-1017	1.34	0
SDCBG16-1019	0.19	0
SDCBG17-1001	2.82	0
SDCBG17-1002	2.22	0
SDCBG17-1003	2.07	0
SDCBG17-1004	1.96	0
SDCBG17-1007	0.72	0.008
SDCBG17-1014	5.46	0
SDCBG17-1015	14.61	0
SDCBG17-1016	16.31	0.006
SDCBG17-1017	2.09	0
SDCBG17-1018	1.36	0
SDCBG17-1019	1.34	0
SDCBG17-1020	1.58	0
SDCBG17-1022	9.36	0.01
SDCBG17-1023	9.32	0
SDCBG17-1025	1.65	0
SDCBG17-1029	7.29	0.051
SDCBG17-1033	4.15	0
SDCBG17-1034	3.66	0
SDCBG17-1035	4.03	0
SDCBG17-1036	8.07	0
SDCBG17-1037	7.31	0
SDCBG17-1039	6.18	0.009
SDCBG17-1040	1.57	0
SDCBG17-1041	1.57	0
SDCBG17-1044	0.47	0
SDCBG17-1045	0.48	0
SDCBG17-1051	7.92	0.014
SDCBG17-1052	7.69	0
SDCBG17-1053	0.13	0
SDCBG17-1054	0.33	0
SDCBG17-1056	3.43	0
SDCBG17-1058	2.64	0.001
SDCBG17-1059	0.44	0
SDCBG17-1060	3.88	0
SDCBG17-1061	0.79	0
SDCBG17-1062	0.65	0
SDCBG17-1071	13	0
SDCBG17-1072	3.89	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG17-1073	2.37	0
SDCBG17-1074	0.63	0
SDCBG17-1078	3.04	0
SDCBG17-1079	6.43	0
SDCBG17-1080	5.06	0
SDCBG17-1081	3.28	0
SDCBG17-1084	2.24	0.043
SDCBG17-1086	3.92	0
SDCBG17-1087	3.14	0
SDCBG17-1089	50	0
SDCBG19-1001	47.76	0
SDCBG19-1002	47.78	0
SDCBG19-1005	1.21	0
SDCBG19-1006	1.27	0
SDCBG19-1011	1.3	0
SDCBG19-1016	1.27	0
SDCBG19-1017	1.4	0
SDCBG19-1019	0.97	0
SDCBG19-1020	0.74	0
SDCBG19-1021	0.59	0
SDCBG19-1022	0.14	0
SDCBG19-1023	0.15	0
SDCBG19-1024	0.15	0
SDCBG19-1032	47.77	0
SDCBG19-1033	47.76	0
SDCBG19-1034	47.88	0
SDCBG19-1036	1.29	0
SDCBG19-1037	1.81	0
SDCBG19-1038	47.78	0
SDCBG19-1044	47.79	0
SDCBG19-1045	48.05	0
SDCBG19-1046	47.93	0
SDCBG19-1047	47.8	0
SDCBG19-1048	47.79	0
SDCBG20-1047	0.46	0
SDCBG20-1048	0.6	0
SDCBG20-1055	0.4	0
SDCBG21-1011	45.17	0
SDCBG21-1012	45.65	0
SDCBG21-1016	1.13	0
SDCBG21-1017	0.47	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG21-1018	27.03	0
SDCBG21-1021	46.12	0
SDCBG21-1022	1.38	0
SDCBG21-1023	46.44	0
SDCBG21-1024	46.66	0
SDCBG21-1027	45.14	0
SDCBG21-1056	0.38	0
SDMHG11-1030	2.2	0
SDMHG13-1001	0.38	0
SDMHG17-1001	8.48	0
SDMHG17-1002	7.03	0
SDMHG17-1003	1.69	0.002
SDMHG17-1004	2.52	0.008
SDMHG17-1005	4.52	0.001
SDMHG17-1007	12.7	0.01
SDMHG17-1008	1.72	0
SDMHG17-1009	2.45	0
SDMHG17-1011	7.42	0.109
SDMHG17-1013	3.89	0
SDMHG17-1014	0.81	0
SDMHG17-1015	0.78	0
SDMHG17-1016	1.24	0
SDMHG17-1018	0.66	0
SDMHG17-1019	1.78	0.023
SDMHG17-1020	6.07	0
SDMHG17-1021	7.34	0
SDMHG17-1024	2.1	0.024
SDMHG17-1027	17.6	0
SDMHG19-1002	47.81	0
SDMHG19-1003	47.8	0
SDMHG19-1005	47.84	0
SDMHG19-1006	47.74	0
SDMHG19-1009	1.89	0
SDMHG19-1011	0.2	0
SDMHG19-1012	0.25	0
SDMHG19-1013	3.99	0
SDMHG19-1014	0.63	0
SDMHG19-1015	0.78	0
SDMHG19-1016	3.23	0
SDMHG19-1018	1.46	0
SDMHG19-1020	2.49	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG19-1021	1.39	0
SDMHG19-1022	2.01	0
SDMHG19-1023	1.23	0
SDMHG19-1024	1.55	0
SDMHG19-1027	0.48	0
SDMHG19-1028	47.79	0
SDMHG19-1029	47.86	0
SDMHG19-1030	47.97	0
SDMHG19-1031	47.86	0
SDMHG19-1032	48.21	0
SDMHG19-1034	47.79	0
SDMHG20-1013	0.98	0
SDMHG20-1014	46.08	0
SDMHG20-1015	0.85	0
SDMHG20-1028	0.39	0
SDMHG20-1029	0.4	0
SDMHG20-1036	0.79	0
SDMHG20-1038	0.86	0
SDMHG20-1039	46.3	0
SDMHG20-1041	1.2	0
SDMHG20-1060	46.31	0
SDMHG20-1061	45.84	0
SDMHG20-1062	45.78	0
SDMHG20-1064	45.81	0
SDMHG20-1065	45.78	0
SDMHG21-1001	45.27	0
SDMHG21-1002	46.73	0
SDMHG21-1003	46.68	0
SDMHG21-1004	46.89	0
SDMHG21-1005	46.62	0
SDMHG21-1006	45.72	0
SDMHG21-1007	45.23	0
SDMHG21-1008	32.15	0
SDMHG21-1009	5.11	0
SDMHG21-1010	46.86	0
SDMHG21-1011	46.19	0
SDMHG21-1012	45.88	0
SDMHG21-1013	45.94	0
SDMHG21-1014	48.47	0
SDMHG21-1015	46.5	0
SDMHG21-1016	46.52	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG21-1017	46.69	0
SDMHG21-1018	46.81	0
SDMHG21-1019	47.05	0
SDMHG21-1020	47.16	0
SDMHG21-1021	0.87	0

Guemes West

The 25-year, 24-hour storm caused no flooding in junctions, with the affected junctions remaining surcharged for about 190.24 hours. Approximately 2.5 percent of pipes in Guemes West were surcharged. In comparison, the 25-year, 3-hour storm caused 0.003 million gallons of flooding, with the affected junctions surcharging for about 70.83 hours. 5.8 percent of the total pipes in Guemes West surcharged. Additionally, the 25-year, 24-hour climate perturbed storm caused 0.003 million gallons of flooding, with the affected junctions surcharging about 238.99 hours. 4.2 percent of the total pipes in Guemes West surcharged.

Table 19. Guemes West Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
C1	1.37
SD040515000334	1.14
SD040908000373	1.03
SD067812000926	1.35
SD089012001668	1
SD089312001669	1.09
SD089808001079	1.06
SD102724000352	1.14
SD127212001670	1.15
SD176608002126	1.1
SD188424002072	1.18
SD234612003648	1.51
SD250615000331	1.03
SD305612001633	1.91
SD325018002753	1.15
SD352524003909	1.15
SD356408003919	1.17
SD356508003921	1.87
SD383312004219	1.03
SD395008004365	1.05
SD958012004177	1.03
SD959208003632	1.11
SD966912003734	1.24
SD968912003700	1.34

Conduit Asset ID	Max/Full Flow
SD969612003690	4.31
SD972008003627_3	1.01
SDCLVRT0085	1.52

Table 20. Guemes West Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG06-1015	3.46	0
SDCBG07-1035	0.53	0
SDCBG07-1047	0.21	0
SDCBG08-1043	0.13	0
SDCBG08-1120	1.81	0
SDCBG08-1121	1.83	0
SDCBG08-1125	1.67	0
SDCBG08-1129	26.03	0
SDCBG08-1138	32.79	0
SDCBG08-1139	35.24	0
SDJCTG08-1014	36.25	0
SDMHG05-1030	0.34	0
SDMHG05-1032	0.3	0
SDMHG05-1050	49.32	0
SDMHG05-1053	0.33	0

Table 21. Guemes West Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
C1	1.65
SD040908000373	1.71
SD067812000926	1.03
SD068012000929	1.55
SD068212000936	1.18
SD089012001668	1.09
SD089312001669	1.1
SD089508001725	1.03
SD089808001079	1.37
SD102724000352	1.55
SD127212001670	1.15
SD135812002432	1.05
SD138312000997	1.18
SD173012003594	1.74
SD173812001085	1.41
SD174012002761	1.22

Conduit Asset ID	Max/Full Flow
SD176608002126	1.22
SD188424002072	1.57
SD234612003648	1.77
SD246615000949	1.01
SD258524002411	1.16
SD268615000958	1.3
SD283108001727	1.38
SD285812003262	1.06
SD288118003286	1.02
SD288218003287_1	1.03
SD288318003288	1.05
SD288418003289	1.06
SD288518003290_1	1.15
SD288518003290_2	1.06
SD305612001633	2.19
SD325018002753	2
SD352018003905	1.44
SD352524003909	1.62
SD355212003929	1.1
SD356408003919	1.26
SD356508003921	2.01
SD356518003920	1.13
SD375818004143	1.27
SD379712004178	1.12
SD380212004189	1.03
SD380312004188	1.07
SD380512004186	1.01
SD380812004183	1.6
SD380912004181	1.17
SD383312004219	1.28
SD388712004274	1.15
SD395008004365	1.05
SD433512004745	1.03
SD958012004177	1.25
SD959208003632	1.11
SD966912003734	1.41
SD968912003700	1.28
SD969612003690	3.68
SD971312003643	1.09
SD972008003627_1	1.08
SD972008003627_3	1.35
SD972008003627_5	1

Conduit Asset ID	Max/Full Flow
SD978012001632	1.07
SD982512003049	1.11
SD988212002779	1.12
SDCLVRT0066	1.2
SDCLVRT0085	1.29

Table 22. Guemes West Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
GW64	0.08	0
J15	0.06	0
SDCBG05-1093	0.1	0
SDCBG05-1094	0.18	0
SDCBG05-1095	0.21	0
SDCBG05-1096	0.12	0
SDCBG05-1118	0.11	0
SDCBG06-1008	0.02	0
SDCBG06-1009	0.12	0
SDCBG06-1030	0.25	0
SDCBG06-1032	0.07	0
SDCBG07-1035	0.63	0
SDCBG07-1047	0.56	0
SDCBG07-1063	0.06	0
SDCBG07-1072	0.06	0
SDCBG08-1043	0.32	0
SDCBG08-1092	0.11	0
SDCBG08-1120	1.31	0
SDCBG08-1121	1.33	0
SDCBG08-1123	0.13	0
SDCBG08-1125	1.28	0
SDCBG08-1129	2.12	0
SDCBG08-1132	0.17	0
SDCBG08-1138	3.41	0
SDCBG08-1139	6.59	0
SDCBG08-1205	0.08	0
SDCBG09-1011	0.02	0
SDCBG09-1017	0.02	0
SDJCTG08-1092	0.11	0
SDMHG05-1011	0.13	0
SDMHG05-1030	0.33	0
SDMHG05-1032	0.27	0
SDMHG05-1040	0.12	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHG05-1050	49.36	0
SDMHG05-1053	0.32	0.003
SDMHG05-1058	0.07	0
SDMHG07-1004	0.01	0
SDMHG08-1005	0.13	0
SDMHG08-1014	0.06	0
SDMHG08-1020	0.17	0
SDMHG08-1028	0.05	0
SDMHG08-1033	0.18	0

Table 23. Guemes West Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
C1	1.64
SD040515000334	1.44
SD040908000373	1.27
SD067812000926	1.46
SD068012000929	1.15
SD071212000332	1.19
SD089012001668	1.08
SD089312001669	1.14
SD089808001079	1.25
SD102724000352	1.4
SD127212001670	1.17
SD173012003594	1.08
SD173812001085	1.1
SD174012002761	1.14
SD176608002126	1.38
SD188424002072	1.44
SD234612003648	1.71
SD250615000331	1.3
SD258524002411	1.09
SD268615000958	1.16
SD283108001727	1.08
SD288418003289	1
SD288518003290_1	1.04
SD288518003290_2	1
SD305612001633	2.11
SD321512003701	1.2
SD325018002753	1.59

Conduit Asset ID	Max/Full Flow
SD352018003905	1.25
SD352524003909	1.53
SD356408003919	1.21
SD356508003921	1.93
SD379712004178	1.1
SD380812004183	1.04
SD383312004219	1.24
SD395008004365	1.07
SD958012004177	1.24
SD959208003632	1.25
SD966912003734	1.65
SD968912003700	1.56
SD969612003690	4.87
SD972008003627_3	1.28
SD978012001632	1.03
SD982512003049	1.1
SD988212002779	1.22
SDCLVRT0085	2.03

Table 24. Guemes West Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG06-1015	16.56	0
SDCBG06-1019	0.96	0
SDCBG06-1030	1.16	0
SDCBG06-1043	14.59	0
SDCBG07-1035	1.6	0
SDCBG07-1047	1.42	0
SDCBG07-1072	0.48	0
SDCBG08-1043	0.59	0
SDCBG08-1092	0.13	0
SDCBG08-1120	3.2	0
SDCBG08-1121	3.22	0
SDCBG08-1123	0.64	0
SDCBG08-1125	3.09	0
SDCBG08-1129	30.76	0
SDCBG08-1132	0.28	0
SDCBG08-1138	33.35	0
SDCBG08-1139	35.75	0
SDCBG09-1011	0.22	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDJCTG08-1014	38.58	0
SDMHG05-1011	0.24	0
SDMHG05-1030	0.74	0
SDMHG05-1032	0.71	0
SDMHG05-1050	49.38	0
SDMHG05-1053	0.73	0.003
SDMHG08-1005	0.18	0
SDMHG08-1020	0.27	0
SDMHG08-1033	0.16	0

Padilla North

The 25-year, 24-hour storm caused no flooding in junctions, with the affected junctions remaining surcharged for about 49.91 hours. 9.4 percent of the total pipes in Padilla North were surcharged. In comparison, the 25-year, 3-hour storm caused 0.027 million gallons of flooding, with the affected junctions surcharging for about 2.14 hours. 12.3 percent of the total pipes in Padilla North surcharged. Additionally, the 25-year, 24-hour climate perturbed storm caused no flooding in junctions, with the affected junctions surcharging about 49.91 hours. 11.3 percent of the total pipes in Padilla North surcharged.

Table 25. Padilla North Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
SD966724003738_2	1.21
SDCLVRT0031	1.2
SDCLVRT0033	1.3
SDCLVRT0119	1.27
SDCLVRT0120	1.27
SDCLVRT0128	1.95
SDCLVRT0135	1.1
SDCLVRT0136	1.1
SDCLVRT0138	1.23
SDCLVRT0142	1.89

Table 26. Padilla North Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBP02-1001	49.91	0.000

Table 27. Padilla North Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
SD966724003738_2	1.21

Conduit Asset ID	Max/Full Flow
SDCLVRT0031	1.35
SDCLVRT0033	1.47
SDCLVRT0119	1.27
SDCLVRT0120	1.35
SDCLVRT0125	1
SDCLVRT0128	2.48
SDCLVRT0135	1.44
SDCLVRT0136	1.4
SDCLVRT0138	2.29
SDCLVRT0139	1.35
SDCLVRT0142	3.69
SDCLVRT0146	1.31

Table 28. Padilla North Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
P22	0.81	0.014
P24	0.58	0.008
P28	0.44	0.003
P26	0.31	0.002
P29	0.26	0
P30	0.08	0
SDCBP02-1001	49.91	0

Table 29. Padilla North Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
SD966724003738_2	1.21
SDCLVRT0031	1.43
SDCLVRT0033	1.45
SDCLVRT0119	1.27
SDCLVRT0120	1.51
SDCLVRT0121	1.16
SDCLVRT0128	2.2
SDCLVRT0135	1.26
SDCLVRT0136	1.25
SDCLVRT0138	1.44
SDCLVRT0142	2.22
SDCLVRT0146	1.23

Table 30. Padilla North Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBP02-1001	49.91	0

Similk

The 25-year, 24-hour storm caused no flooding in junctions, with the affected junctions remaining surcharged for about 24 hours. Approximately 5.4 percent of pipes in Similk were surcharged. In comparison, the 25-year, 3-hour storm caused no flooding, with the affected junctions surcharging for about 24.18 hours. 7.7 percent of the total pipes in Similk surcharged. Additionally, the 25-year, 24-hour climate perturbed storm caused no flooding in junctions, with the affected junctions surcharging about 25.87 hours. 8.5 percent of the total pipes in Similk surcharged.

Table 31. Similk Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
SD290612003669	1.07
SDCLVRT0050	1.21
SDCLVRT0243	1.07
SDCLVRT0331	12.98
SDCLVRT0601	1.03
SDCLVRT0675	1.09
SDCLVRT0720	1.89

Table 32. Similk Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
76	24	0

Table 33. Similk Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
SD290212003674	1.24
SD290612003669	1.34
SD392312004325	1.41
SD970212003668	1.04
SDCLVRT0050	1.41
SDCLVRT0243	1.26
SDCLVRT0331	14.05
SDCLVRT0601	1.12
SDCLVRT0675	1.35

Conduit Asset ID	Max/Full Flow
SDCLVRT0720	2.16

Table 34. Similk Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
76	24	0
SDCBS01-1016	0.14	0
SDCBS01-1003	0.04	0

Table 35. Similk Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
SD290612003669	1.25
SDCLVRT0050	1.4
SDCLVRT0243	1.19
SDCLVRT0331	16.16
SDCLVRT0332	1.06
SDCLVRT0601	1.3
SDCLVRT0675	1.46
SDCLVRT0720	2.11
SDDITCH0895	1.01
SDDITCH1113	1
SDDITCH1114	1

Table 36. Similk Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
76	24	0
S43	0.79	0
S44	1.08	0

Burrows North

The 25-year, 24-hour storm caused 0.27 million gallons of flooding in junctions, with the affected junctions remaining surcharged for about 1,310 hours. Approximately 3.7 percent of pipes in Burrows North were surcharged. In comparison, the 25-year, 3-hour storm caused 0.397 million gallons of flooding, with the affected junctions surcharging for about 1,296 hours. 10.2 percent of the total pipes in Burrows North surcharged. Additionally, the 25-year, 24-hour climate perturbed storm caused 0.578 million gallons of flooding, with the affected junctions surcharging about 1348 hours. 6.9 percent of the total pipes in Burrows North surcharged.

Table 37. Burrows North Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
SD110724000418	1.46
SD111012000580	1.08
SD115712000528	1.17
SD116712000541	1.04
SD117312001831	1.3
SD118212000523	1.46
SD118624000724	1.09
SD124424000725	1.46
SD208012000527	1.04
SD212012000245	1.04
SD213212000404	1.19
SD216112000624	1.1
SD216912000692	1.13
SD361512003995	2.28
SD361612003996	1.51

Table 38. Burrows North Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
BN13	20.75	0
SDCBB02-1006	1	0.01
SDCBB02-1019	46.72	0.95
SDCBB03-1007	0.64	0
SDCBB03-1008	0.35	0.17
SDCBB03-1011	0.3	0
SDCBB03-1015	49.21	0
SDCBB03-1053	0.34	0
SDCBB03-1054	0.56	0
SDCBB03-1055	0.43	0
SDCBB04-1004	47.52	0
SDCBB04-1005	47.68	0
SDCBB04-1008	46.78	0
SDCBB04-1009	46.87	0
SDCBB07-1001	28.64	0
SDCBB07-1002	44.46	0
SDCBB09-1038	2.99	0
SDCBB10-1001	47.9	0
SDJCTB09-1022	50	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHB02-1001	46.8	0
SDMHB02-1002	2.65	0.01
SDMHB02-1003	1.01	0
SDMHB02-1013	47.37	0
SDMHB02-1014	47.07	0.95
SDMHB02-1015	46.92	0.01
SDMHB02-1016	46.94	0.03
SDMHB03-1001	0.23	0
SDMHB03-1003	0.19	0
SDMHB03-1004	48.83	0
SDMHB03-1005	49.04	0
SDMHB03-1006	48.34	14.97
SDMHB03-1007	1.75	1.71
SDMHB03-1008	1.82	0.01
SDMHB03-1009	0.14	0
SDMHB03-1010	0.43	0
SDMHB04-1001	47.5	0
SDMHB04-1002	46.96	0
SDMHB04-1004	47.39	0
SDMHB04-1005	47.13	0
SDMHB04-1006	47.45	0
SDMHB06-1001	0.2	0
SDMHB09-1004	4.94	0
SDMHB09-1005	48.78	0
SDMHB09-1006	48.81	0
SDMHB09-1007	1.97	0
SDMHB09-1038	0.48	0
SDMHB10-1003	47.94	0
SDMHB11-1030	48.43	0

Table 39. Burrows North Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
SD106818000302	1.09
SD106918000605	1.28
SD107224000602	1.12
SD107912001977	1.33
SD110224000417	1.2
SD110724000418	1.75
SD110812000578	1.22

Conduit Asset ID	Max/Full Flow
SD111012000580	1.52
SD114518000661	1.4
SD115712000528	1.4
SD115812000533	1.07
SD116312000536	1
SD116712000541	1.06
SD117312001831	1.98
SD118212000523	1.47
SD118624000724	1.11
SD118924000721	1.03
SD124424000725	1.49
SD124608000704	1.43
SD208012000527	1.24
SD210612002278	1
SD211812003585	1.03
SD211912003586	1.2
SD212012000245	1.46
SD212212000243	1.36
SD213212000404	1.36
SD215224000594	1
SD215812002068	1.08
SD216112000624	1.23
SD216912000692	1.84
SD217012003975	1.01
SD257518001602	1.18
SD257612002249	1.38
SD268718000663	1.4
SD288912000525	1.04
SD358712003970	1.01
SD358912003994	1.16
SD359112003973	1.06
SD361512003995	2.85
SD361612003996	1.91
SD366012004042	1.39

Table 40. Burrows North Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
BN13	4	0
BN14	0.2	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBB02-1006	0.97	0
SDCBB02-1019	48.48	0.027
SDCBB02-1024	0.24	0
SDCBB02-1036	0.2	0
SDCBB02-1050	0.11	0
SDCBB02-1052	0.39	0
SDCBB02-1067	0.2	0
SDCBB03-1007	0.86	0
SDCBB03-1008	0.74	0.011
SDCBB03-1009	0.48	0
SDCBB03-1011	0.57	0
SDCBB03-1013	0.07	0
SDCBB03-1015	49.33	0
SDCBB03-1026	0.03	0
SDCBB03-1044	0.02	0
SDCBB03-1053	0.57	0
SDCBB03-1054	0.62	0
SDCBB03-1055	0.6	0
SDCBB03-1060	0.03	0
SDCBB04-1004	48.99	0
SDCBB04-1005	49.02	0
SDCBB04-1006	0.11	0
SDCBB04-1008	48.73	0
SDCBB04-1009	48.8	0
SDCBB06-1001	0.12	0
SDCBB06-1002	0.03	0
SDCBB06-1003	0.1	0
SDCBB07-1001	7.44	0
SDCBB07-1002	34.79	0
SDCBB09-1038	1.33	0
SDCBB09-1062	0.37	0
SDCBB09-1063	0.32	0
SDCBB09-1064	0.21	0
SDCBB09-1065	0.16	0
SDCBB09-1068	0.46	0
SDCBB10-1001	49.06	0
SDJCTB09-1022	50	0
SDMHB02-1001	48.8	0.02
SDMHB02-1002	1.45	0.014
SDMHB02-1003	1.07	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHB02-1008	0.15	0
SDMHB02-1009	0.14	0
SDMHB02-1013	48.88	0
SDMHB02-1014	48.84	0.06
SDMHB02-1015	48.82	0
SDMHB02-1016	48.83	0.003
SDMHB02-1017	0.06	0
SDMHB02-1018	0.13	0
SDMHB03-1001	0.73	0
SDMHB03-1002	0.53	0
SDMHB03-1003	0.55	0.006
SDMHB03-1004	49.2	0.001
SDMHB03-1005	49.27	0
SDMHB03-1006	49.04	0.154
SDMHB03-1007	1.4	0.042
SDMHB03-1008	1.43	0
SDMHB03-1009	0.54	0.005
SDMHB03-1010	0.6	0
SDMHB04-1001	48.9	0
SDMHB04-1002	48.83	0
SDMHB04-1004	48.89	0
SDMHB04-1005	48.84	0
SDMHB04-1006	48.9	0
SDMHB06-1001	0.21	0
SDMHB06-1002	0.18	0
SDMHB09-1004	1.61	0
SDMHB09-1005	49.21	0
SDMHB09-1006	49.22	0
SDMHB09-1007	1.13	0.014
SDMHB09-1008	0.39	0
SDMHB09-1012	0.41	0
SDMHB09-1014	0.22	0
SDMHB09-1016	0.15	0.001
SDMHB09-1032	0.45	0.001
SDMHB09-1037	0.1	0
SDMHB09-1038	0.65	0.037
SDMHB10-1003	49.07	0
SDMHB11-1004	0.03	0
SDMHB11-1013	0.21	0
SDMHB11-1017	0.36	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHB11-1029	0.18	0
SDMHB11-1030	49.14	0

Table 41. Burrows North Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
SD106918000605	1.15
SD107912001977	1.24
SD110224000417	1.09
SD110724000418	1.71
SD110812000578	1.25
SD111012000580	1.36
SD114518000661	1.12
SD115712000528	1.33
SD116312000536	1
SD116712000541	1.07
SD117312001831	1.69
SD118212000523	1.5
SD118624000724	1.1
SD118924000721	1.04
SD124424000725	1.48
SD208012000527	1.18
SD210612002278	1.15
SD211912003586	1.05
SD212012000245	1.25
SD212212000243	1.17
SD213212000404	1.44
SD216112000624	1.13
SD216912000692	1.35
SD257612002249	1.04
SD268718000663	1.13
SD358912003994	1
SD361512003995	2.46
SD361612003996	1.63

Table 42. Burrows North Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
BN13	22.02	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
BN14	0.18	0
SDCBB02-1006	1.85	0
SDCBB02-1019	46.67	0.024
SDCBB02-1036	0.16	0
SDCBB02-1052	0.62	0
SDCBB02-1067	0.16	0
SDCBB03-1007	2.37	0
SDCBB03-1008	1.31	0.014
SDCBB03-1009	0.76	0
SDCBB03-1011	1.02	0
SDCBB03-1015	49.28	0
SDCBB03-1053	1.01	0
SDCBB03-1054	1.45	0
SDCBB03-1055	1.23	0
SDCBB04-1004	47.77	0
SDCBB04-1005	47.92	0
SDCBB04-1008	47.09	0
SDCBB04-1009	47.2	0
SDCBB06-1001	0.42	0
SDCBB06-1003	0.3	0
SDCBB07-1001	29	0
SDCBB07-1002	44.94	0
SDCBB09-1038	4.47	0
SDCBB09-1062	0.26	0
SDCBB09-1068	0.42	0
SDCBB10-1001	48.12	0
SDJCTB09-1022	50	0
SDMHB02-1001	47.14	0.007
SDMHB02-1002	4.23	0.01
SDMHB02-1003	2.03	0
SDMHB02-1013	47.63	0
SDMHB02-1014	47.36	0.064
SDMHB02-1015	47.23	0
SDMHB02-1016	47.26	0.002
SDMHB03-1001	1.26	0
SDMHB03-1002	0.77	0
SDMHB03-1003	0.86	0.004
SDMHB03-1004	48.93	0
SDMHB03-1005	49.13	0
SDMHB03-1006	48.44	0.365
SDMHB03-1007	3.5	0.067

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDMHB03-1008	3.56	0
SDMHB03-1009	0.8	0.001
SDMHB03-1010	1.24	0
SDMHB04-1001	47.74	0
SDMHB04-1002	47.27	0
SDMHB04-1004	47.65	0
SDMHB04-1005	47.42	0
SDMHB04-1006	47.71	0
SDMHB06-1001	1.03	0
SDMHB06-1002	0.69	0
SDMHB09-1004	8.44	0
SDMHB09-1005	48.89	0
SDMHB09-1006	48.92	0
SDMHB09-1007	2.85	0.003
SDMHB09-1008	0.2	0
SDMHB09-1012	0.26	0
SDMHB09-1014	0.09	0
SDMHB09-1032	0.4	0
SDMHB09-1038	0.78	0.017
SDMHB10-1003	48.15	0
SDMHB11-1013	0.45	0
SDMHB11-1017	0.39	0
SDMHB11-1029	0.29	0
SDMHB11-1030	48.56	0

Burrows South

The 25-year, 24-hour storm caused no flooding in junctions, with the affected junctions remaining surcharged for about 126.74 hours. Approximately 1.7 percent of pipes in Burrows South were surcharged. In comparison, the 25-year, 3-hour storm caused no flooding, with the affected junctions surcharging for about 96.89 hours. 2.5 percent of the total pipes in Burrows South surcharged. Additionally, the 25-year, 24-hour climate perturbed storm caused 0.02 million gallons of flooding, with the affected junctions surcharging about 174.08 hours. 2.3 percent of the total pipes in Burrows South surcharged.

Table 43. Burrows South Surcharging Conduits for the 25-year, 24-hour design storm

Conduit Asset ID	Max/Full Flow
SD041312000159	1.38
SD041912001761	1
SD093812000556	1.35
SD111412000448	1.19
SD244012000196	1.83

Conduit Asset ID	Max/Full Flow
SD244112000152	1.06
SD978312003471	2.06
SDCLVRT0199	1.06
SDCLVRT0201	3.43
SDCLVRT0202	2.02
SDCLVRT0414	1.18
SDCLVRT0451	1.01

Table 44. Burrows South Flooding Junctions for the 25-year, 24-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBB13-1036	27.94	0
SDCBB13-1047	42.65	0
SDCBB13-1048	42.36	0
SDCBG08-1045	3.11	0
SDCBG08-1046	10.68	0

Table 45. Burrows South Surcharging Conduits for the 25-year, 3-hour design storm

Conduit Asset ID	Max/Full Flow
SD041312000159	1.38
SD041912001761	1
SD093812000556	1.35
SD111412000448	1.19
SD244012000196	1.83
SD244112000152	1.06
SD978312003471	2.06
SDCLVRT0199	1.06
SDCLVRT0201	3.43
SDCLVRT0202	2.02
SDCLVRT0414	1.18
SDCLVRT0451	1.01

Table 46. Burrows South Flooding Junctions for the 25-year, 3-hour design storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
BS98	0.09	0
SDCBB13-1047	48.38	0
SDCBB13-1048	48.21	0
SDCBG08-1157	0.03	0

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
SDCBG08-1158	0.05	0
SDMHB13-1036	0.04	0
SDMHB13-1037	0.09	0

Table 47. Burrows South Surcharging Conduits for the 25-year, 24-hour Climate Perturbed Design Storm

Conduit Asset ID	Max/Full Flow
ClydeRiver6	1.16
SD041312000159	1.02
SD111412000448	1.26
SD244012000196	1.57
SD978312003471	2.14
SDCLVRT0199	1.02
SDCLVRT0201	3.2
SDCLVRT0202	1.8
SDCLVRT0414	1.17
SDCLVRT0451	1.39
SDCLVRT0712	1.19

Table 48. Burrows South Flooding Junctions for the 25-year, 24-hour Climate Perturbed Design Storm

Junction Asset ID	Hours Surcharged	Total Flood Volume 10 ⁶ gal
BS100	2.71	0.004
BS102	2.16	0.003
BS106	2.24	0
BS97	1.16	0.001
BS98	3.36	0.012
SDCBB13-1003	20.65	0
SDCBB13-1036	32.69	0
SDCBB13-1047	43.19	0
SDCBB13-1048	42.74	0
SDCBG08-1045	8.04	0
SDCBG08-1046	14.64	0
SDMHB13-1036	0.22	0
SDMHB13-1037	0.28	0

APPENDIX F: STREAM AND HABITAT ASSESSMENT FIELD NOTES AND RECOMMENDED RESTORATION CFPS

Stream and Habitat Assessment Field Notes and Recommended Restoration CFPs

Date: November 26, 2024

Project: City of Anacortes 2025 Stormwater Master Plan
To: Aaron Esterholt, Stormwater Program Manager | City of Anacortes

From: Brennan Helwig, Fisheries Biologist | Osborn Consulting
Isaac Fournier, P.E. | Osborn Consulting

Subject: Stream and Habitat Assessment Field Notes and Recommended CFPs

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PROJECT SUMMARY

Purpose: As part of developing the 2025 Stormwater Master Plan (Plan), Osborn Consulting (Osborn) performed a planning-level condition assessment of area streams and associated drainage infrastructure for the City of Anacortes (City). With the current statewide multi-agency focus on salmonid population health, habitat restoration, and correction of fish passage barriers, the City wanted to gain insight into City systems and potential opportunities for improving fish habitat through future implementation of the Plan.

Objective: Conducted field surveys in streams within the City limits to achieve the following:

- Verify the current Washington State Department of Fish and Wildlife (WDFW) fish passage barrier dataset.
- Assess stream, fish habitat, and riparian conditions.
- Assess conditions of stream conveyance infrastructure.
- Identify potential stream and wetland habitat restoration opportunities to include in Capital Facilities Project (CFP) planning.

Assessed Streams: The study area included the accessible reaches of streams conveyed through City-owned culverts and open channel sections within the City limits that are documented to have historically or currently inhabited fish species as identified in the Statewide Washington Integrated Fish Distribution (SWIFD). The surveyed streams were the following:

- Ace of Hearts Creek
- Aqua Creek
- Beaver Brook
- Clyde Creek
- Cranberry Creek
- Happy Valley Stream

Documentation Review: In preparation for the field assessments, Osborn reviewed the following information for area streams and the surrounding infrastructure:

- City Geographic Information System (GIS) data (City of Anacortes 2024)
- Fish passage barrier maps and dataset from WDFW (WDFW 2024)
- Fish species distribution data from the SWIFD dataset (NWIFC and WDFW 2018)
- Stormwater management action plans (City of Anacortes 2023)
- Habitat review and recommendation reports (GeoEngineers 2022)

Assessment Staff: The field assessments were performed by Osborn professionals B. Helwig (fish biologist) and I. Fournier, P.E. (hydraulic engineer).

Assessment Dates: Field assessments were performed on June 14 and June 18, 2024.

OBSERVATIONS AND FINDINGS

Ace of Hearts Creek



Ace of Hearts Creek at Ace of Hearts Rotary Park

Ace of Hearts Creek is a historically fish-bearing stream that spans approximately 2.6 miles. The field assessment for Ace of Hearts Creek was conducted from the headwaters at Heart Lake to the outfall to Fidalgo Bay. From its headwaters at Heart Lake, which is located within the 2,137-acre Whistle Lake Anacortes Community Forest Lands (ACFL), the stream flows north as an open channel through dense forested areas of the ACFL and then through the more developed properties outside of the ACFL. The stream is conveyed beneath 41st Street through a culvert then continues as open channel along the west side of H Avenue before the next culvert crossing at H Avenue, where the stream enters a City park, Ace of Hearts Rotary Park, as a roadside ditch. Heavy sedimentation and invasive species, such as Himalayan blackberry (*Rubus armeniacus*) and reed canarygrass (*Phalaris arundinacea*), were observed within this reach at the southern park entrance. The stream is piped for most of its length through the park but does daylight again for approximately 1,000 feet per City GIS data before entering a series of culverts and open ditches as it flows northeast towards 33rd Street. At the southwest corner of 33rd Street and M Avenue, the stream enters a 4,990-foot underground pipe network that runs north beneath M Avenue, west beneath 32nd Avenue, north beneath T Avenue to 28th Street, and then east into the Pacific Marine Center property where it discharges to Fidalgo Bay.

Overall, Ace of Hearts Creek is conveyed through nine identified roadway or other culvert crossings between the ACFL and the stream's entrance into the subsurface pipe network. In the stream's upper-

most reaches, the open channel segments generally contain suitable spawning cobble-gravel substrate for fish, and adequate canopy and instream cover throughout. Rearing habitat potential exists within the stream as well as in the headwaters of Heart Lake, most suitably for coastal cutthroat and resident trout, and to a lesser extent chinook salmon. Throughout the entire length of the stream, WDFW has identified three complete fish passage barrier crossings (WDFW ID 920991 at 34th Street, 920951 at 35th Street/Mallard Court, and 920994 at H Avenue) and three crossings with unknown barrier status (WDFW ID 920992 at 33rd Street, 920993 in Ace of Hearts Rotary Park, and 995449 at Fidalgo Bay). All three complete barriers, in addition to the unknown barrier in Ace of Hearts Rotary Park, are owned by the City.

Stream reaches and culverts requiring access through private property, along with the 4,990-foot-long buried pipe network, were not assessed. This included the final pipe inlet at 33rd Street and M Avenue, which is located on fenced private property. The full pathway of the pipe network was traversed to identify any potential open reaches of stream.

Potential opportunities identified for CFPs or programs on Ace of Hearts Creek are discussed in **Section 2.0**.

Aqua Creek



Aqua Creek upstream of South Fidalgo Bay Road

Aqua Creek is a short 0.62-mile fish-bearing (Type F) stream located in the southeastern portion of Anacortes. The headwaters of the stream appear to form on the hillside area southwest of South Fidalgo Bay Road and State Route 20 (SR 20). Given Aqua Creek's short length and limited access to private property, the stream assessment focused on the short open channel reaches upstream and downstream of its culvert crossing at South Fidalgo Bay Road immediately north of Aqua Lane (WDFW ID 933575) and the surrounding area. Upstream of the City-owned crossing, the stream is generally unconfined with no discernible channel and could be categorized as wetland. No spawning habitat potential was observed. The stream primarily flows subsurface under matted reed canarygrass. There were no indicators of past flooding or culvert condition issues observed. Downstream of the City-owned crossing, the stream flows into an apparent wetland complex that is densely vegetated with reed canarygrass and appears to be part of the WSDOT right-of-way. Overall, canopy cover is minimal to non-existent throughout the majority of the short stream reach, outside of the potential wetland complexes.

The Aqua Creek culvert at South Fidalgo Bay Road, along with three other culverts to the south (WDFW ID 933574, 933573, and 955576) are all categorized as fish barriers and flow into the wetland complex located between South Fidalgo Bay Road and SR 20. Flow from the wetland appears to discharge to Fidalgo Bay through any one of the three separate WSDOT-owned culverts located beneath SR 20 that are also categorized as barriers (WDFW ID 995423, 9954224, and 995425).

Beaver Brook



Beaver Brook west of 28th Street

Beaver Brook flows approximately 1.65 miles in a southwest to northeast direction through the east side of Anacortes. Beaver Brook was surveyed from upstream to downstream, beginning at the headwaters where the stream flows from a wetland complex within the 738-acre Cranberry Lake ACFL at the west terminus of 32nd Street and ending at its outlet into Fidalgo Bay at the Anacortes Marina.

From ACFL, Beaver Brook is conveyed through a pipe network for several blocks from the west end of 31st Street before returning to an open channel flow at the northeast corner of B Avenue and 29th Street. The open channel reach continues through private properties from 29th Street to D Avenue, where the stream crosses into a private community through a PVC culvert. This open stream reach contained native vegetation and moderate canopy cover. Culvert pipe conditions appeared to be intact, and evidence of erosion was not observed.

Downstream of the D Avenue crossing, the stream flows within an open channel through a private community except for one crossing under Creekside Lane. The stream is conveyed within a pipe again west of the private community entrance at Creekside Place and H Avenue. Except for a short open channel section west of J Avenue, stream flows are conveyed east from H Avenue within a subsurface pipe network for approximately 4,500 feet to the outfall at Fidalgo Bay.

No immediate signs of failure, flooding, or erosion issues associated with culvert crossings were observed at 29th Street, D Avenue, Creekside Place, H Avenue, or J Avenue. Assessment for fish passage status at these crossings has not been completed by WDFW because of Beaver Brook's unclassified fish bearing status according to SWIFD. Based on the visual inspections completed for the entire reach of Beaver Brook, there were no notable findings related to stormwater infrastructure or environmental issues. Notable rearing potential for fish exists in the upper reach of Beaver Brook near the headwaters west of B Street, and occasional spawning habitat throughout the upper reach west of H Avenue.

Clyde Creek



Clyde Creek southwest of Queen Ann Way

Clyde Creek is an approximately 0.9-mile-long stream on the west side of Anacortes that originates near the Anacortes Regional Airport and flows south-southwest to Burrows Bay. Generally, the stream has an open channel morphology that flows through a residential neighborhood, with several crossings through short pipe culverts. The stream is then conveyed within a pipe beneath Anaco Beach Road and continues through a private residence to the outfall to Burrows Bay. SWIFD identifies Clyde Creek as potentially fish bearing (type F stream).

Clyde Creek was assessed from upstream to downstream, beginning at Jasper Way/33rd Street. At 33rd Street, flow from a wetland complex to the north ties into the stormwater system, where it combines with roadway runoff and is conveyed southwest within a pipe between private residences and then discharges through an outfall to a stormwater pond south of Marion Way. The culvert at Marion Way was not visible, but there were no drainage issues observed in this reach and no visible signs of erosion or flooding at Marion Way. The end of potential fish use in Clyde Creek has been mapped and is verified to be at or near this culvert crossing. Overall, the majority of Clyde Creek has potential to support adequate rearing habitat, with moderate canopy and instream cover and occasional forced pools. Spawning ground potential is occasionally present, but the stream sediment is mostly dominated by fines and small gravels.

The stream flows through an open channel to the culvert crossing beneath Clyde Way (WDFW ID 921001). Large boulders were observed within the channel upstream of and blocking most of the culvert inlet. The boulders appear to have fallen into the channel from the roadway embankment. Significant aggradation and debris accumulation was observed at the culvert inlet and immediately upstream of the boulders. Evidence of significant backwater and potential flooding suggest the culvert is potentially undersized resulting in sediment and debris buildup. Dislodged boulders from the roadway embankment have encroached beyond the top of the culvert and appear to have damaged the structure. Evidence of erosion on the side of the culvert suggests the stream is undermining the embankment. Further failure of the embankment may result in additional boulders falling into the channel, increasing the potential for

further inlet blockage, backwater, and flooding. Tree root exposure and fallen trees with wood rot were noted as well. Downstream, the channel is incised with evidence of significant bank erosion and undercutting.

The stream continues through an open channel to the crossing beneath Queen Anne Way (WDFW ID 921000). Aggradation and debris accumulation were observed upstream of this culvert inlet, along with evidence of potential flooding, erosion, and wood rot at tree bases and root systems. Downstream of the culvert, significant bank erosion, undercutting, root scour, and rot were observed. Trees growing on the near-vertical banks had exposed roots and were leaning over the channel. There is concern for potential bank failure immediately downstream of the culvert based on this combination of observed conditions.

The stream continues southwest through an open channel, crosses through a culvert beneath a driveway along Anaco Beach Road (WDFW ID FD47), enters a pipe crossing under Anaco Beach Road (WDFW ID FD46), and discharges to Burrows Bay. There was moderate vegetative canopy cover upstream of the driveway culvert. For both culverts, there no visible signs of failure or potential erosion or flooding issues. Trees growing on the near-vertical banks had exposed roots and were leaning over the channel but did not seem to pose immediate threat to property.

Potential opportunities identified for CFPs or programs on Clyde Creek are discussed in **Section 2.0**.

Cranberry Creek



Cranberry Creek in Cranberry Lake ACFL

Cranberry Creek flows for approximately 0.52-miles on the northwest side of Anacortes from Little Cranberry Lake to Guemes Channel. The SWIFD database lists the stream as type F and potentially fish bearing. There are currently four total fish passage barriers inventoried throughout Cranberry Creek.

The assessment team walked the stream system from upstream to downstream beginning within the Cranberry Lake ACFL at the outlet of Little Cranberry Lake. Previously in 2015, WDFW assessed the flow control structure at the lake outfall to determine its fish passage status and determined it to be a total barrier caused by a water surface drop (WDFW ID 920999). There were no erosion control or flooding issues noted at the flow control structure. Downstream of the flow control structure, the stream maintains an average bankfull width of around 20 feet while it meanders through a forested area for approximately 700 feet. The area exhibits a high amount of canopy cover with adequate spawning and rearing substrate within the open stream section immediately downstream of Little Cranberry Lake.

At Cranberry Lake Road, the stream bottlenecks into a City-owned fish passage barrier culvert (WDFW ID 920998). From this inlet, the stream is conveyed entirely through multiple connecting pipe systems along Georgia Avenue and then across SR 20, before daylighting north of SR 20 as a ditch (for 113 feet) and entering another section of pipe (for 114 feet, WDFW ID 935678; privately-owned) before discharging to Guemes Channel. The consecutively piped section of Cranberry Creek is approximately 1,318 feet long and extends from City of Anacortes owned pipe to the Washington State Department of Transportation (WSDOT) owned assets. In particular, WSDOT owns the SR 20 culvert crossing (WDFW ID 933175).

Potential opportunities identified for CFPs or programs on Cranberry Creek are discussed in **Section 2.0**.

Happy Valley Stream



Happy Valley Stream north of Longview Avenue

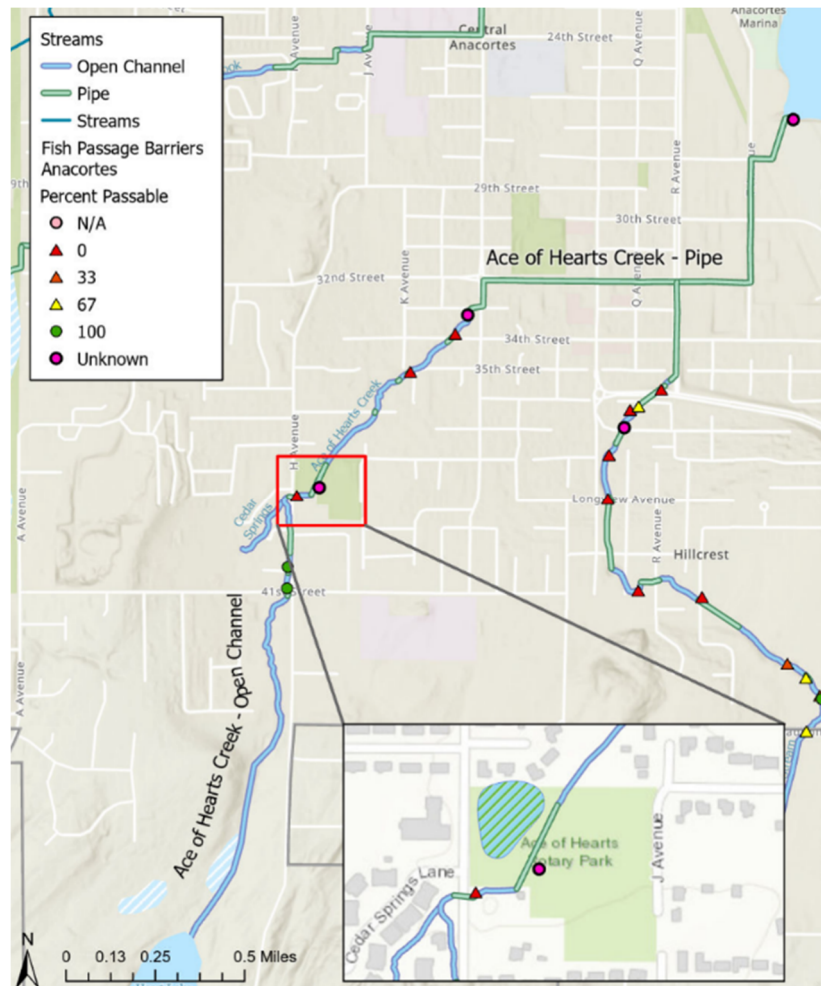
Happy Valley Stream is an approximately 1.6-mile-long stream located on the east side of Anacortes and serves as a tributary to Ace of Hearts Creek. The stream connects to Ace of Hearts Creek at the intersection of R Avenue and 32nd Street, where both systems are fully piped. The SWIFD lists the stream as a type F stream and potentially fish bearing. In 2009, WDFW performed an upstream habitat survey where they inventoried 11 fish passage barriers with 8 designated as complete fish passage barriers. In their assessment, they determined the stream headwaters to be a wetland complex south of Haddon Road and observed limited spawning ground throughout the stream.

Osborn surveyed Happy Valley Stream from its downstream end to its upstream end. South of its connection to Ace of Hearts Creek, most of the stream is contained within a piped system under Avenue R. South of SR 20, the stream is mostly open channel with culvert crossings at SR 20 (WDFW ID 995430; WSDOT-owned) and multiple residential streets. The open channel portions of the stream south of SR 20 flow through primarily private residential properties with little canopy cover. The middle portions of the stream have increased instream cover and pass through several barriers, including City-owned barriers (WDFW ID 995447 at 37th Street, 930835 at Longview Avenue, and 930933 at Saint Mary's Drive). There is potential for a stream channel at the Hadron Road crossing (WDFW ID 930842), but no flow was observed at the time of the site assessment. At the time of the survey, flows within Happy Valley Stream were observed downstream of the Saint Mary's Drive crossing.

The stream generally had narrow bankfull widths, with occasional widening and incising parallel to Commercial Avenue. There were very low amounts of spawning gravel material, so the stream could be characterized as providing primarily rearing habitat. Noticeable signs of culvert failure, flooding, or erosion issues associated with culvert crossings along Happy Valley Stream were not observed.

POTENTIAL CAPITAL FACILITIES PROJECT OPPORTUNITIES

Ace of Hearts Rotary Park Stream Restoration



Overview and location of Ace of Hearts Creek within Ace of Hearts Rotary Park

In 2023, the City completed the Fidalgo North Stormwater Management Action Plan, which included actions to improve water quality in this high priority basin for the City. One of those actions included the riparian restoration of Ace of Hearts Creek as it passes through Ace of Hearts Rotary Park by daylighting an approximately 1,000-foot-long piped section of stream. Part of this action would also be improving the adjacent storm pond and wetland area. The open stream channel on the north end of this pipe receives input from the park's adjacent storm pond and wetland complex. This project should remain on the list of recommended CFPs because of its focus on fish barrier removal and replacement, and stream channel restoration and creation, and native planting.

Based on the current stream assessment completed in 2024, the project could be enhanced further by including the restoration of all open channel areas and the removal or replacement of all cross-culverts in Ace of Hearts Creek within the park. These areas include where the stream enters the park at H Avenue as a roadside ditch, which exhibits heavy sedimentation and invasive species, and the culverted section starting at the park's entrance road. Opportunities also exist to connect the stream and wetland area to create a larger, more functional riparian-wetland complex. Overall, there are potential long-term solutions to improve stream health in this area, with the added benefit of it being in a public park.



Ace of Hearts Creek culvert inlet, east side of entrance road to Ace of Hearts Rotary Park from H Avenue



Ace of Hearts Creek culvert outlet on the north end of Ace of Hearts Rotary Park



Ace of Hearts Creek, looking north along the east side of the park entrance road

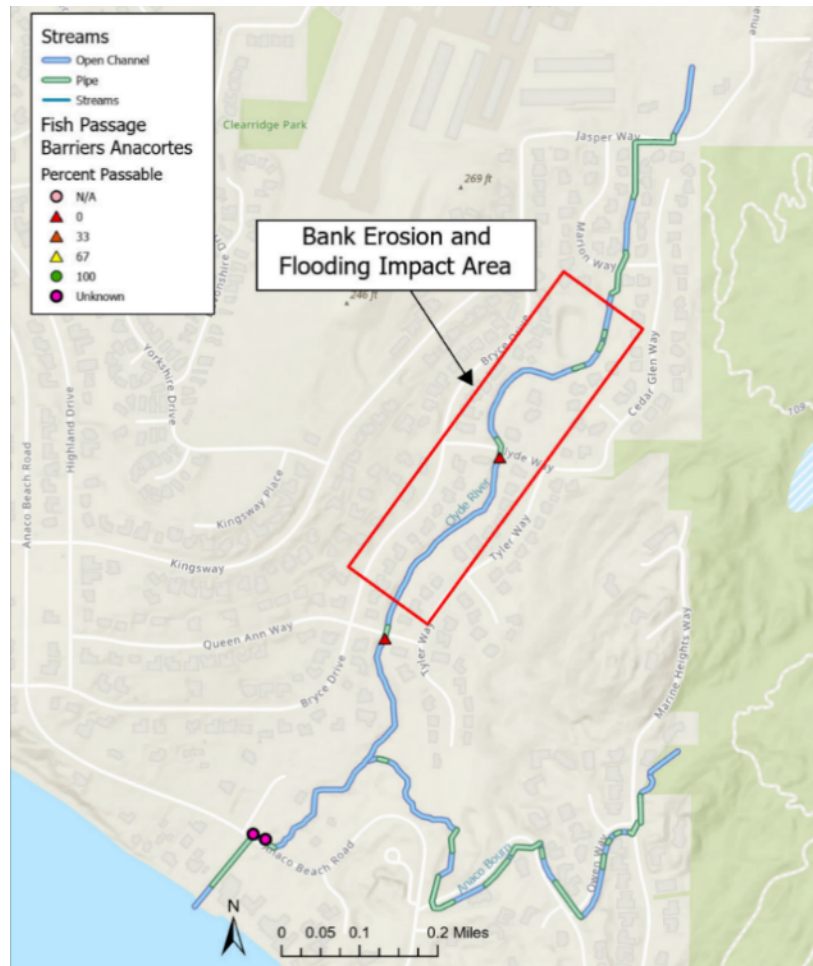


Ace of Hearts Creek, looking south along the east side of the park entrance road towards H Avenue



Vegetation conditions in Ace of Hearts Creek at park entrance

Clyde Creek Streambank Stabilization and Flooding Mitigation



Overview of impacted erosion and flooding area withing Clyde Creek

Potential environmental concerns within and along Clyde Creek include erosion, flooding, and risk of falling trees. Even though fallen trees in stream systems, known as recruitment of large woody material, is good for fish habitat and creating natural sinuosity in streams, the urbanized location could create a risk to nearby properties. At the crossing of Clyde Way, the high-water debris line exceeds the height of the bankfull width, which indicates flooding issues most likely caused by an undersized culvert and failing bank armoring at the culvert inlet creating a debris blockage.

A capital facility project for Clyde Creek could focus on replacement of the culvert or culvert armoring, felling specific trees with rotten bases and root systems, and planting native shrubs and trees.



Failed roadway embankment blocking culvert inlet at Clyde Way



Exposed tree bases and roots, high water debris line exceeding bankfull width upstream of Clyde Way



Native tree with base wood rot from regular exposure to high water



Erosion, exposed tree roots, falling trees, and high-water line upstream of culvert at Clyde Way

Cranberry Creek Restoration and Habitat Improvement



Overview of Cranberry Creek Potential Restoration

In its current state, Cranberry Creek flows in an open channel from Little Cranberry Lake through a forested riparian area in the Cranberry Lake ACFL before entering a City-owned fish barrier pipe at Cranberry Lake Road (WDFW ID 920998). The subsurface pipe network continues east towards Georgia Avenue and then turns downhill to the north at steep slopes towards SR 20 for approximately 1,318 feet.

A CFP for Cranberry Creek could focus on the following restoration and habitat improvements:

1. Daylighting the piped upper reach of Cranberry Creek along Cranberry Lake Road to help expand fish habitat by creating newly open reaches of stream channel with proper streambed material and planting native shrub and tree species.
2. Maintenance or enhancement of the forested riparian areas within the Cranberry Lake ACFL that helps support Cranberry Creek. Efforts could include invasive species removal and native species planting in specific areas to be identified.

Enact policies or develop programs to further enhance and protect the natural areas associated with Cranberry Creek and Little Cranberry Lake.



Cranberry Creek flows from left to right along Cranberry Creek Road prior to its inlet to the piped system



Cranberry Creek at culvert inlet to piped system at Cranberry Lake Road



Inlet to the piped Cranberry Creek system at Cranberry Creek Road

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City of Anacortes. 2023. Fidalgo North Stormwater Management Action Plan. March 31.

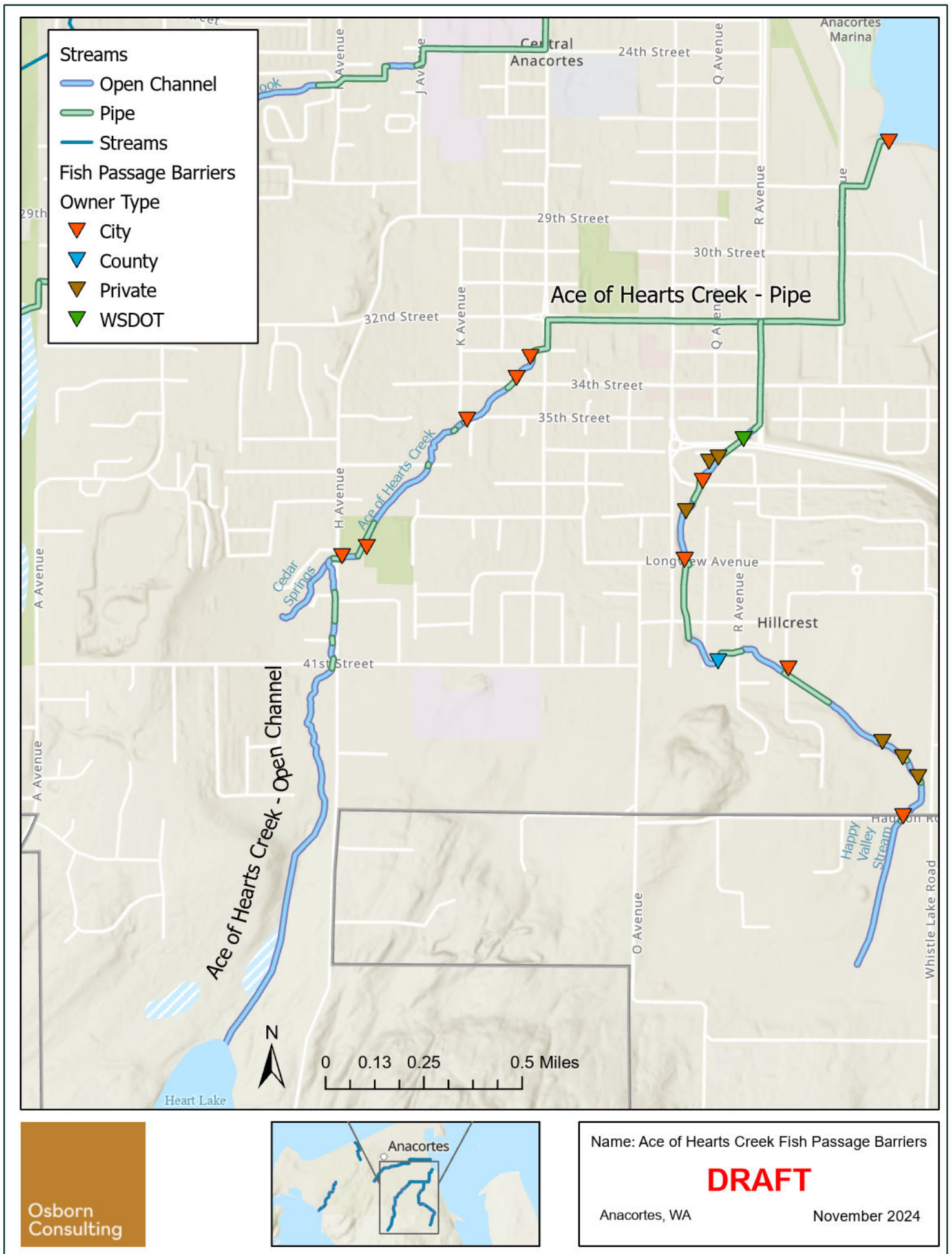
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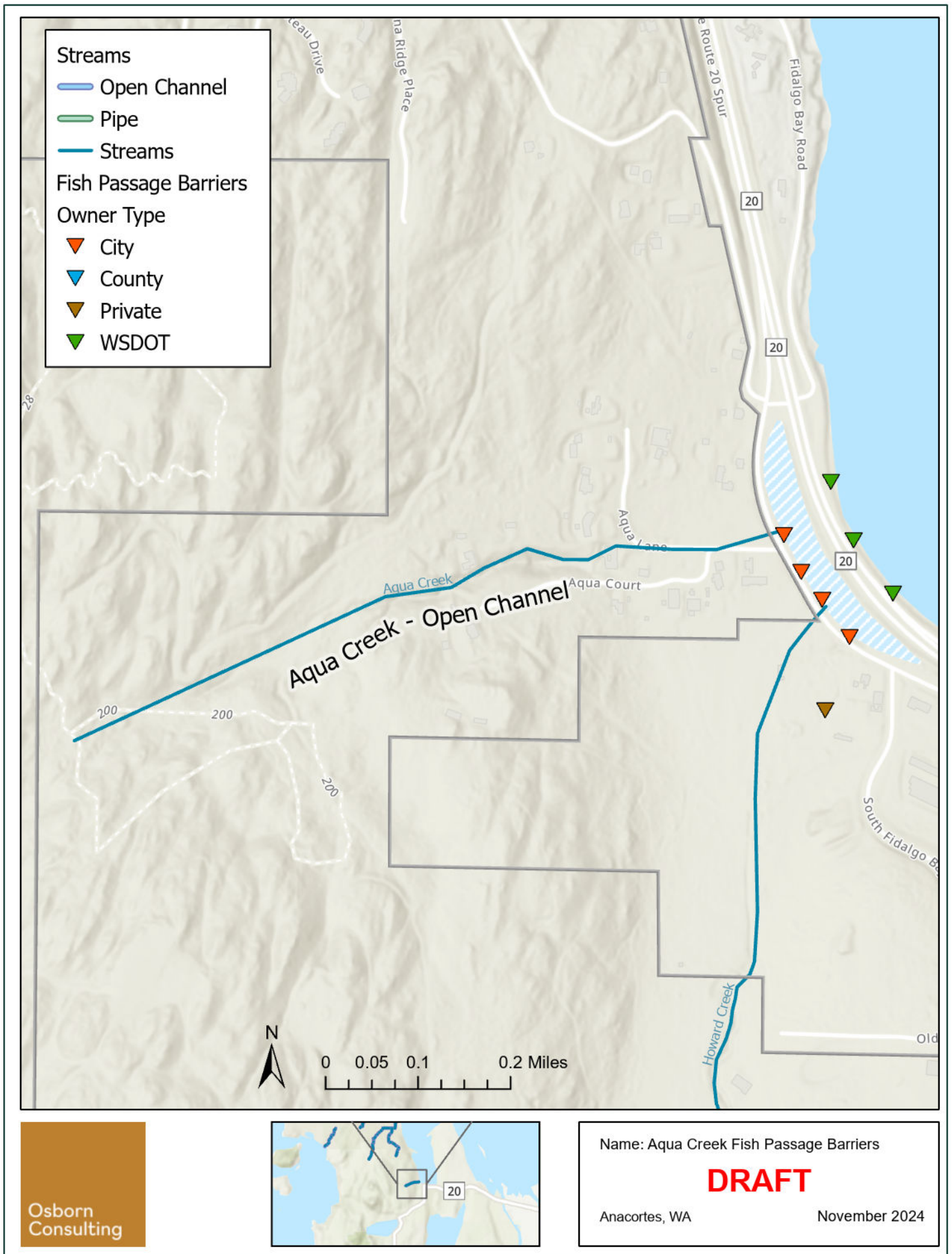
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APPENDIX G: FISH PASSAGE BARRIER MAPS AND LIST







Appendix G - Fish Passage Barrier List (City-Owned Barriers)

Number	Asset ID	WDFW Site ID	Site Location ¹ (Latitude/Longitude)		Fish Passage Feature Type	Stream Name ²	Drainage Basin Name ³	Tributary To	Fish Use	Fish Use Criteria ⁴	Road Name	Fish Passage Barrier Status ⁵	Fish Passage Barrier Reason	Percent Fish Passable ⁶ (%)	Significant Reach ⁷	Owner Type	Data Source	Survey Date	Lineal Gain Measurement ⁸ (meters)	Priority Index Score ⁹	Potential Fish Species ¹⁰
1	18327	FD11	48.458256	-122.544158	Culvert	Turner's Creek	Similk	Skagit Bay	Yes	Biological	Stevenson Road	No	N/A	100	Yes	City	WDFW	05/18/2015			Coho, SR Cutthroat, Resident Trout
2	18328	FD12	48.461770	-122.542120	Culvert	Turner's Creek	Similk	Skagit Bay	No	Physical	Padilla Heights Road	N/A	N/A	N/A	N/A	City	Skagit System CoOp	04/15/1999			
3	75891	920949	48.462490	-122.571135	Culvert	Summit Creek	Fidalgo South	Fidalgo Bay	Yes	Physical	Christianson Road	Yes	Debris	Unknown	Unknown	City	WDFW	03/22/2023			Pink, Coho, Steelhead, SR Cutthroat, Resident Trout
4	106484	933576	48.464717	-122.585508	Culvert	Howard Creek	Fidalgo South	Fidalgo Bay	Yes	Physical	S Fidalgo Bay Road	Yes	Slope	67	Yes	City	WDFW	10/27/2015			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
5	106481	933573	48.465103	-122.585936	Culvert	Howard Creek	Fidalgo South	Fidalgo Bay	Yes	Physical	S Fidalgo Bay Road	Yes	Slope	0	No	City	WDFW	10/27/2015			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
6	106482	933574	48.465392	-122.586263	Culvert	Howard Creek	Fidalgo South	Fidalgo Bay	Yes	Physical	S Fidalgo Bay Road	Yes	Slope	33	No	City	WDFW	10/27/2015			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
7	106483	933575	48.465774	-122.586533	Culvert	Aqua Creek	Fidalgo South	Fidalgo Bay	Yes	Physical	S Fidalgo Bay Road	Yes	Slope	0	Yes	City	WDFW	10/27/2015			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
8	106490	933584	48.466087	-122.586710	Dam	Aqua Creek	Fidalgo South	Fidalgo Bay	No	Physical	S Fidalgo Bay Road	N/A	N/A	N/A	N/A	City	WDFW	10/27/2015			
9	106489	933583	48.466184	-122.586758	Culvert	Aqua Creek	Fidalgo South	Fidalgo Bay	No	Physical	S Fidalgo Bay Road	N/A	N/A	N/A	N/A	City	WDFW	10/27/2015			
10	75892	920997	48.468926	-122.629694	Culvert	Unnamed	Fidalgo North	Heart Lake	Yes	Physical	Heart Lake Road	Yes	Slope	0	Unknown	City	WDFW	05/19/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
11	75893	920950	48.477119	-122.572904	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	Yes	Physical	March's Point Road	Yes	Tidegate	0	Unknown	City	WDFW	05/18/2015			Pink, Chinook, Coho, Steelhead, SR Cutthroat, Resident Trout
12	40144	930842	48.484240	-122.604374	Culvert	Happy Valley Stream	Fidalgo North	Ace of Hearts Creek	Yes	Physical	Hadron Road	Yes	Depth	67	Yes	City	WDFW	02/09/2023	1198	8.11	Coho, Steelhead, SR Cutthroat, Resident Trout
13	18361	FD47	48.486715	-122.665764	Culvert	Clyde Creek	Burrows South	Burrows Bay	Yes	Physical	Anaco Beach Road	Unknown	Insufficient Data	Unknown	Unknown	City	WDFW	05/20/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
14	40149	930933	48.487840	-122.608597	Culvert	Happy Valley Stream	Fidalgo North	Ace of Hearts Creek	Yes	Physical	Saint Marys Drive	Yes	Other	0	Yes	City	WDFW	12/07/2009	1687	12.91	Coho, SR Cutthroat, Resident Trout
15	75894	920996	48.488077	-122.625406	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	41st Street	No	N/A	100	Unknown	City	WDFW	05/19/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
16	75895	920995	48.488650	-122.625373	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	40th Court	No	N/A	100	Unknown	City	WDFW	05/19/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
17	75896	921000	48.489188	-122.663551	Culvert	Clyde Creek	Burrows South	Burrows Bay	Yes	Mapped	Queen Ann Way	Yes	Slope	0	Unknown	City	WDFW	05/20/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
18	40029	930835	48.490492	-122.612410	Culvert	Happy Valley Stream	Fidalgo North	Ace of Hearts Creek	Yes	Physical	Longview Avenue	Yes	WS Drop	0	Yes	City	WDFW	05/19/2015	2170	13.21	Coho, Steelhead, SR Cutthroat, Resident Trout
19	75897	920994	48.490580	-122.625011	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	H Avenue	Yes	Slope	0	Unknown	City	WDFW	05/19/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
20	75898	920993	48.490802	-122.624100	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	H Avenue (driveway)	Unknown	Level B Required	Unknown	Unknown	City	WDFW	05/19/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
21	75899	921001	48.491419	-122.661427	Culvert	Clyde Creek	Burrows South	Burrows Bay	Yes	Mapped	Clyde Way	Yes	Slope	0	Unknown	City	WDFW	05/20/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
22	16274	995447	48.492369	-122.611723	Culvert	Happy Valley Stream	Fidalgo North	Ace of Hearts Creek	Yes	Physical	37th Street	Yes	Other	Unknown	Yes	City	WDFW	05/19/2015	2561	11.23	Coho, Steelhead, SR Cutthroat, Resident Trout
23	75900	920951	48.493906	-122.620412	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	35th Street	Yes	Slope	0	Unknown	City	WDFW	05/19/2015			Pink, Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
24	75901	920991	48.494923	-122.618591	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	34th Street	Yes	Slope	0	Unknown	City	WDFW	05/19/2015			Pink, Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
25	75902	920992	48.495435	-122.618083	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	33rd Street	Unknown	Insufficient Data	Unknown	Unknown	City	WDFW	05/19/2015			Coho, Steelhead, SR Cutthroat, Resident Trout
26	16276	995449	48.500678	-122.604900	Culvert	Ace of Hearts Creek	Fidalgo North	Fidalgo Bay	Yes	Physical	T Avenue	Yes	Rack	Unknown	Yes	City	WDFW	05/18/2015	2817		Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
27	75903	920999	48.504364	-122.644546	Dam	Cranberry Creek	Guemes West	Guemes Channel	Yes	Physical	Cranberry Lake Road (footpath)	Yes	WS Drop	0	Yes	City	WDFW	05/20/2015	1780	20.34	Resident Trout
28	127341	933822	48.506731	-122.647642	Culvert	Cranberry Creek	Guemes West	Guemes Channel	Yes	Physical	Illinois Avenue	Yes	Slope	67	No	City	WDFW	06/01/2016	30		Resident Trout
29	127342	933821	48.507162	-122.646727	Culvert	Cranberry Creek	Guemes West	Guemes Channel	Yes	Physical	Cranberry Lake Road	Yes	WS Drop	33	No	City	WDFW	06/01/2016	123		Resident Trout
30	75904	920998	48.507390	-122.645810	Culvert	Cranberry Creek	Guemes West	Guemes Channel	Yes	Physical	W 4th Street	Yes	WS Drop	0	No	City	WDFW	05/19/2015			Resident Trout

Notes:

N/A = not applicable

WDFW = Washington State Department of Fish and Wildlife

WRIA = Water Resource Inventory Area (Washington is divided into 62 WRIs based on natural watersheds)

SR = State Route

SR Cutthroat = Sea Run Cutthroat

WS Drop = Water Surface Drop

1. Site Location data sources include WDFW and Skagit System Cooperative (CoOp).

2. Stream names from Revised Stream Buffer Best Available Science Review and Buffer Recommendations (City of Anacortes, June 29, 2022).

3. Basin names from City of Anacortes 2024 Stormwater Master Plan Update.

4. Fish Use Criteria definitions: Biological = Fish Observed; Physical = Meets physical stream criteria for fish use; Mapped = Presumed Fish Use

5. Fish Passage Barrier Status source: WDFW Fish Passage Statewide Inventory Database

6. Fish Passage Barrier Percent Fish Passable definitions: 100% = Not a barrier; 67% = Moderate Barrier; 33% = Severe Barrier; 0% = Total Barrier

7. Significant Reach definition: Stream contains at least 200 linear meters of usable habitat without natural barriers upstream and downstream

8. Lineal Gain Measurement: The potential habitat gain for a barrier correction, measured from the upstream end of the barrier, until the mainstem and each tributary becomes non fish-bearing according to physical criteria, or have a total natural barrier.

9. Priority Index Score: A weighted numeric scoring model indicator of the relative priority of a fish passage barrier correction project derived from an equation with multiple variables (i.e., an objective value for prioritizing fish passage barrier correction projects based on potential species benefit, potential habitat gain, cost of project, etc.).

10. Potential Fish Species Present data source: Statewide Washington Integrated Fish Distribution (SWIFD) Database

Appendix G - Fish Passage Barrier List (State and Private Owned Barriers)

Number	Asset ID	WDFW Site ID	Site Location ¹ (Latitude/ Longitude)		Fish Passage Feature Type	Stream Name ²	Drainage Basin Name ³	Tributary To	Fish Use	Fish Use Criteria ⁴	Road Name	Fish Passage Barrier Status ⁵	Fish Passage Barrier Reason	Percent Fish Passable ⁶ (%)	Significant Reach ⁷	Owner Type	Data Source	Survey Date	Lineal Gain Measurement ⁸ (meters)	Priority Index Score ⁹	Potential Fish Species ¹⁰
1	17102	996337	48.454486	-122.63532	Culvert	Unnamed		Lake Erie	Yes	Physical	Driveway	No	N/A	100	Unknown	Private	WDFW	12/18/2003			
2	18326	FD10	48.45818	-122.54397	Culvert	Turner's Creek	Similk	Skagit Bay	Unknown	Unknown	Reservation Road	Unknown	N/A	Unknown	Unknown	Private	Skagit System CoOp	04/15/1999			
3	413741	936263	48.463439	-122.576643	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	Yes	Physical	State Route (SR) 20	Yes	Tidegate	0	Yes	State	WDFW	03/22/2023			Pink, Chum, Coho, Steelhead, SR Cutthroat, Resident Trout, Bull Trout
4	106485	933577	48.463958	-122.585888	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	Yes	Physical	Unnamed	Yes	Slope	33	Unknown	Private	WDFW	10/28/2015			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
5	16251	995423	48.465126	-122.584809	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	Yes	Biological	SR 20	Yes	Depth	Unknown	Yes	State	WDFW	07/17/2017			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
6	16252	995424	48.465678	-122.585425	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	Yes	Biological	SR 20	Yes	Depth	Unknown	Yes	State	WDFW	07/17/2017			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
7	16253	995425	48.466284	-122.58578	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	Yes	Biological	SR 20	Yes	Depth	Unknown	Yes	State	WDFW	07/17/2017			Chum, Coho, Steelhead, SR Cutthroat, Resident Trout
8	16254	995426	48.478028	-122.592326	Culvert	Miller Creek	Fidalgo South	Fidalgo Bay	No	Physical	SR 20	N/A	N/A	N/A	N/A	State	WDFW	06/18/2003			
9	16255	995427	48.478338	-122.592564	Culvert	Whistle Creek	Fidalgo South	Fidalgo Bay	Yes	Physical	SR 20	Yes	Slope	0	No	State	WDFW	06/18/2003	79		SR Cutthroat, Resident Trout
10	16256	995428	48.483081	-122.595504	Culvert	Weaverling Rill	Fidalgo South	Fidalgo Bay	No	Physical	SR 20	N/A	N/A	N/A	N/A	State	WDFW	06/18/2003			
11	40145	930841	48.48511	-122.603755	Non Culvert	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	Whistle Lake Rd	No	N/A	100	Yes	Private	WDFW	12/07/2009			
12	40146	930840	48.485194	-122.603824	Culvert	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	Whistle Lake Rd	Yes	Slope	33	Yes	Private	WDFW	12/07/2009	1348	11.14	Coho, SR Cutthroat, Resident Trout
13	40147	930839	48.485677	-122.604387	Culvert	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	Whistle Lake Rd	Yes	Slope	67	Yes	Private	WDFW	12/07/2009	1414	9.53	Coho, SR Cutthroat, Resident Trout
14	16257	995429	48.485902	-122.597768	Culvert	Unnamed	Fidalgo South	Fidalgo Bay	No	Physical	SR 20	N/A	N/A	N/A	N/A	State	WDFW	06/18/2003			
15	40148	930838	48.486052	-122.605139	Dam	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	Whistle Lake Rd	Yes	WS Drop	33	Yes	Private	WDFW	12/07/2009	1497	12.67	Coho, SR Cutthroat, Resident Trout
16	18360	FD46	48.486778	-122.665992	Culvert	Clyde Creek	Burrows South	Burrows Bay	Unknown	Unknown	Anaco Beach Road	Unknown	N/A	Unknown	Unknown	Private	Skagit System CoOp	03/23/2000			
17	40028	930836	48.488016	-122.61118	Culvert	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	R Ave	Yes	Slope	0	Yes	County	WDFW	11/18/2009	1971	12.98	Coho, SR Cutthroat, Resident Trout
18	16275	995448	48.491633	-122.612343	Culvert	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical		Yes	WS Drop	0	Yes	Private	WDFW	07/09/2003	2518	13.32	Coho, SR Cutthroat, Resident Trout
19	16273	995446	48.492841	-122.611488	Dam	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical		Yes	WS Drop	0	Yes	Private	WDFW	05/19/2015	2663	14.71	Coho, SR Cutthroat, Resident Trout
20	16272	995445	48.492939	-122.611146	Dam	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	36th Street	Yes	WS Drop	67	Yes	Private	WDFW	05/19/2015	2668	11.23	Coho, SR Cutthroat, Resident Trout
21	16258	995430	48.493389	-122.610225	Culvert	Happy Valley Stream	Fidalgo North	Fidalgo Bay	Yes	Physical	SR 20	Yes	Slope	0	Yes	State	WDFW	06/18/2003	2702	9.34	Coho, SR Cutthroat, Resident Trout
22	75905	933175	48.510232	-122.646417	Culvert	Cranberry Creek	Guemes West	Guemes Channel	Yes	Physical	SR 20	Yes	WS Drop	0	No	State	WDFW	11/09/2021	2382	5.74	Resident Trout
23	301302	935678	48.510575	-122.647223	Culvert	Cranberry Creek	Guemes West	Guemes Channel	Yes	Physical	Private; Guemes Chnl Trail	Yes	Slope	0	Unknown	Private	WDFW	11/09/2021			Coho, Steelhead, SR Cutthroat, Resident Trout

- Notes:
- N/A = not applicable
- WDFW = Washington State Department of Fish and Wildlife
- WRIA = Water Resource Inventory Area (Washington is divided into 62 WRIAs based on natural watersheds)
- SR = State Route
- SR Cutthroat = Sea Run Cutthroat
- Site Location data sources include WDFW and Skagit System Cooperative (CoOp).
 - Stream names from Revised Stream Buffer Best Available Science Review and Buffer Recommendations (City of Anacortes, June 29, 2022).
 - Basin names from City of Anacortes 2024 Stormwater Master Plan Update.
 - Fish Use Criteria definitions: Biological = Fish Observed; Physical = Meets physical stream criteria for fish use; Mapped = Presumed Fish Use
 - Fish Passage Barrier Status source: WDFW Fish Passage Statewide Inventory Database
 - Fish Passage Barrier Percent Fish Passable definitions: 100% = Not a barrier; 67% = Moderate Barrier; 33% = Severe Barrier; 0% = Total Barrier
 - Significant Reach definition: Stream contains at least 200 linear meters of usable habitat without natural barriers upstream and downstream
 - Lineal Gain Measurement: The potential habitat gain for a barrier correction, measured from the upstream end of the barrier, until the mainstem and each tributary becomes non fish-bearing according to physical criteria, or have a total natural barrier.
 - Priority Index Score: A weighted numeric scoring model indicator of the relative priority of a fish passage barrier correction project derived from an equation with multiple variables (i.e., an objective value for prioritizing fish passage barrier correction projects based on potential species benefit, potential habitat gain, cost of project, etc.).
 - Potential Fish Species Present data source: Statewide Washington Integrated Fish Distribution (SWIFD) Database

APPENDIX H: 2025 STORMWATER CAPITAL FACILITIES PLAN PROJECTS AND PROGRAMS

Appendix H: DRAFT 2025 Stormwater Capital Facilities Plan Projects and Programs

Capital Facilities Project or Program Name	Capital Facilities Project Source	Type of Issue or Program (2)	Location and City Drainage Basin	Capital Facilities Project Description	Estimated CFP Cost Magnitude (3)	Year Planned (4)	City Priority (Low, Medium, High) (5)
Projects							
1. 32nd Street Wetlands Culvert Removal	Fidalgo North Basin Stormwater Management Action Plan (1)	Habitat	2400 block of 32nd Street, Fidalgo North	This project will remove the existing culvert and restore the streambank at the outlet of the 32nd St. wetlands, which flows into Beaver Brook.	\$		
2. Ace of Hearts Rotary Park Stream Restoration	Fidalgo North Basin Stormwater Management Action Plan, 2025 Stormwater Master Plan	Habitat	3817 H Avenue, Fidalgo North	This project will daylight a stretch of Ace of Hearts Creek where it passes through Ace of Hearts Rotary Park and enhance the adjacent storm pond and wetland area. The project will include restoration of an open stream channel and removal or replacement of cross-culverts in the park.	\$\$\$		
3. Cranberry Creek Restoration and Habitat Improvement	2025 Stormwater Master Plan	Habitat	Cranberry Creek at Georgia Avenue, Guemes West	In its current state, Cranberry Creek flows in an open channel from Cranberry Lake through a forested riparian area in the Cranberry Lake ACFL before entering a City-owned fish barrier pipe at Cranberry Lake Road (WDFW ID 920998). The subsurface pipe network continues east towards Georgia Avenue and then turns downhill to the north at steep slopes towards State Route 20 for approximately 1,318 feet. A capital facilities project for Cranberry Creek could focus on restoration and habitat improvements including: 1. Daylighting the piped upper reach of Cranberry Creek along Cranberry Lake Road to help expand fish habitat by creating newly open reaches of stream channel with proper streambed material and planting native shrub and tree species. 2. Maintenance and/or enhancement of the forested riparian areas within the Cranberry Lake ACFL that help support Cranberry Creek. Efforts could include invasive species removal and native species planting in specific areas to be identified. 3. Enact policies and/or develop programs to further enhance/protect the natural areas associated with Cranberry Creek and Cranberry Lake.	\$\$\$		
4. Saint Mary's Drive Culvert Replacement	City's 2024-29 Capital Facilities Plan	Habitat and Infrastructure Repair	St. Mary's Drive (700 41st Place), Fidalgo North	This project will include replacing an existing 36" concrete culvert on a fish bearing stream and repair damaged areas of the road. The culvert replacement will prevent the road from collapsing.	\$\$		
5. Fidalgo Bay Road Flood Mitigation	City's 2024-29 Capital Facilities Plan, 2025 Stormwater Master Plan Modeling Results	Flooding	Fidalgo Bay road & Samish RV Park, Fidalgo South	There is ongoing flooding issues on Fidalgo Bay Road due to an undersized dry well. This project will include flood mitigation at Fidalgo Bay to ensure that Fidalgo Bay Road is not flooded during rain events, reducing the risk of vehicle crashes and collisions. Flooding is due to underperforming dry wells that have inadequate storage. The project has already been designed and will add a new pipe to bypass flows to an existing ditch during storm events.	\$\$		
6. Marion Pond Water Quality Retrofit	2007 Stormwater Management Plan (CIP S)	Water Quality	Cedar Glen Way, Burrows South	This project replaces an existing 4,900 sqft stormwater pond with a 7'X13' water quality filter vault. Due to downstream detention, water quality is only needed to treat the existing Cedar Glen Plat (built in 2005). This project is designed and needs to be constructed.	\$\$		
7. Clyde Creek Streambank Stabilization	2025 Stormwater Master Plan	Flooding and Habitat	Approximately between Queen Ann Way and Jasper Way on Clyde Creek, Burrows South Drainage Basin	Environmental concerns within and along Clyde Creek include erosion, flooding, and risk of falling trees. This project includes replacing the undersized culvert and/or the culvert armoring, felling specific trees with rotted root systems, and planting native shrubs and tree species to mitigate current flooding issues and restore/enhance riparian habitat.			
8. 37th Street Storm Conveyance Reconstruction	Fidalgo North Basin Stormwater Management Action Plan, 2025 Stormwater Master Plan Modeling Results	Flooding and Water Quality	37th Street east of Commercial Avenue, Fidalgo North	Upgrade the existing undersized stormwater system along 37th Street by installing water quality treatment, new structures and upsizing the storm drainage conveyance system. The system further downstream along R Avenue is also undersized and will need to be upsized as well.	\$\$\$		
9. 34th Street Storm Conveyance Reconstruction	Fidalgo North Basin Stormwater Management Action Plan	Flooding and Water Quality	34th Street from R Avenue to O Avenue, Fidalgo North	This project includes the installations of bioswales on 34th Street from R Avenue to O Avenue to improve water quality and flow.	\$\$\$\$		
10. Q Avenue Storm Conveyance Reconstruction	Fidalgo North Basin Stormwater Management Action Plan	Flooding and Water Quality	22nd Street to 34th Street, Fidalgo North	Upgrade the existing undersized storm drainage along Q Avenue by installing water quality treatment, twelve (12) new structures and upsizing the storm drainage conveyance system.	\$\$\$\$		

Capital Facilities Project or Program Name	Capital Facilities Project Source	Type of Issue or Program (2)	Location and City Drainage Basin	Capital Facilities Project Description	Estimated CFP Cost Magnitude (3)	Year Planned (4)	City Priority (Low, Medium, High) (5)
11. 17th St Stormwater Pipe and Outfall Repair	City's 2024-29 Capital Facilities Plan	Flooding and Infrastructure Repair	West of Q Ave & 17th St intersection, Fidalgo North	A local developer plans to develop the property to the west of Q Ave and 17th Street, which would eliminate the City's access to maintain an existing ditch, which the City has an easement for. The existing ditch is just to the west of Q Ave and 17th Street along private property. This project will add a stormwater pipe in place of the existing ditch, which will also eliminate flooding on Q Ave that is caused by sedimentation build up in the ditch. In addition, the project will lower the downstream outfall will facilitate the continuation of the trail along the shoreline, eliminating the need for a bridge.	\$\$		
Programs							
1. Storm Pipe Repair and Replacement	2025 Stormwater Master Plan	Citywide Program	Citywide	The new "Stormwater Pipe Repair and Replacement" program will include cleaning, inspecting, performing condition assessments, assigning repair, replacement, and maintenance recommendations, and creating stormwater small works projects to repair and replace aging or failing stormwater pipe throughout the City. Repairs and replacements will occur as funding is available. City staff will perform cleaning, inspections, condition assessments, assign repair, replacement, and maintenance actions, and prioritize the pipe repairs and replacement.	\$\$ annually		
2. Outfall Evaluation and Rehabilitations	City's 2024-29 Capital Facilities Plan	Citywide Program	Citywide	The City has 73 existing stormwater outfalls. The new "Outfall Evaluation and Rehabilitations" program will address degraded conditions of many outfalls that are below the ordinary high water line into the salt water resulting in saltwater intrusion into the storm system. Outfall evaluations and rehabilitations will occur as fundings is available. City staff will prioritize the outfall evaluations and rehabilitation locations.	\$ annually		
3. Storm System Facility Upgrades, Restoration and Maintenance	City's 2024-29 Capital Facilities Plan	Citywide Program	Citywide	The new "Storm System Upgrades, Restoration and Maintenance" program will identify small works projects to upgrade, restore and maintain the City's existing stormwater system facilities. This program may include storm pond cleaning, repair fencing at stormwater ponds, and the separation of combined storm/sanitary sewer system. City staff will prioritize the upgrades, restoration and maintenance projects.	\$\$ annually		
4. Storm System Capacity Upgrades	2025 Stormwater Master Plan	Citywide Program	Citywide	The new "Storm System Capacity Upgrades" program is to address needed stormwater capacity upgrades that are identified in the H/H modeling results in this plan. City staff will prioritize the system capacity upgrade projects. In addition, City staff will need to coordinate both internally between the stormwater program and this program, as well as other City programs such as the Asphalt Overlay Program and the Transportation Benefit District.	\$\$\$ annually		

Notes:

(1) Fidalgo North SMAP was updated July 2024.

(2) Types of Issues : Flood Mitigation, Water Quality, Maintenance, Capacity, Habitat, Outfall Rehabilitation, Infrastructure Repair

(3) Magnitude of Costs to Complete the Project or Annual Program: \$ = \$0 to \$100K, \$\$ = \$100K to \$250K, \$\$\$ = \$250K to \$1M, \$\$\$\$ = \$1M +

(4) Year Implementation will be determined through a workshop with the City Council.

(5) Project Prioritization will be determined through a workshop with the City Council.