5100-1		5.46	163.95	66.00	97.95	42.44
5110-1		15.05	162.22	37.00	125.22	54.26
5120-1		4.34	161.13	39.00	122.13	52.92
5130-1		2.45	157.56	63.00	94.56	40.98
5140-1		15.19	156.23	45.00	111.23	48.20
5150-1		2.84	157.54	59.00	98.54	42.70
5160-1		3.92	157.53	83.00	74.53	32.29
5170-1		0.67	157.52	103.00	54.52	23.63
5180-1		0.77	157.50	143.00	14.50	6.28
5190-1	RHODY	1.89	262.35	175.00	87.35	37.85
5200-1	RHODY	0.70	262.35	213.00	49.35	21.38
5210-1	RHODY	0.56	262.34	199.00	63.34	27.45
5220-1	RHODY	0.94	262.34	213.00	49.34	21.38
5230-1	RHODY	1.68	262.34	253.00	9.34	4.05
5240-1	RHODY	1.33	262.34	217.00	45.34	19.65
5250-1	RHODY	1.33	262.34	197.00	65.34	28.31
5260-1	RHODY	1.68	262.34	163.00	99.34	43.05
5270-1	RHODY	0.46	262.33	251.00	11.33	4.91
5280-1	RHODY	8.30	262.33	253.00	9.33	4.04
5290-1		15.54	163.64	55.00	108.64	47.08
5300-1		1.64	163.54	59.00	104.54	45.30
5310-1		1.15	163.50	53.00	110.50	47.88
5320-1		12.01	163.48	65.00	98.48	42.67
5330-1		21.17	163.41	85.00	78.41	33.98
5340-1		44.06	163.39	85.00	78.39	33.97
5350-1	OCEAN DUNES	36.12	210.78	41.00	169.78	73.57
5360-1	OCEAN DUNES	5.70	210.77	37.00	173.77	75.30
5370-1		8.44	157.44	71.00	86.44	37.46
5380-1		3.43	157.51	70.00	87.51	37.92
5390-1		2.56	157.60	65.50	92.10	39.91
5400-1		1.79	157.02	54.30	102.72	44.51
5410-1		4.69	157.03	58.55	98.48	42.67
5420-1		4.83	157.41	63.10	94.31	40.87
5430-1		1.23	157.70	66.20	91.50	39.65
5440-1		4.38	157.73	69.00	88.73	38.45
5520-1		4.66	157.74	58.89	98.85	42.83
5530-1		1.19	157.73	66.20	91.53	39.66
5540-1		1.61	157.81	64.00	93.81	40.65
5550-1		2.00	157.88	59.00	98.88	42.85
5560-1		2.66	157.92	63.20	94.72	41.05
5570-1		0.84	158.06	64.30	93.76	40.63
5580-1		0.98	157.75	58.89	98.86	42.84
5590-1		6.72	157.81	45.00	112.81	48.88
5600-1		3.15	157.88	61.40	96.48	41.81
5610-1		2.07	157.99	49.00	108.99	47.23
5620-1		0.81	158.02	63.60	94.42	40.92
5630-1		1.50	158.13	57.00	101.13	43.82
5640-1		0.94	158.27	64.80	93.47	40.50
5650-1		1.37	158.35	59.00	99.35	43.05
5660-1		2.69	450.01	49.00	401.01	173.77
5700-1		1.75	450.00	47.00	403.00	174.63
5710-1		1.33	449.99	45.00	404.99	175.50
5720-1		2.90	449.97	59.00	390.97	169.42
5730-1		19.92	449.96	49.00	400.96	173.75
5760-1		2.00	450.04	69.00	381.04	165.12
5770-1		23.69	450.05	67.00	383.05	165.99
5780-1		13.34	450.07	75.00	375.07	162.53
5790-1		2.87	450.06	69.50	380.56	164.91
5800-1		2.13	450.06	70.53	379.53	164.46
5810-1		3.74	450.06	71.55	378.51	164.02

5820-1	3.15	450.06	63.00	387.06	167.72
5830-1	1.79	450.06	68.00	382.06	165.56
5850-1	2.52	450.06	68.00	382.06	165.56
5860-1	6.09	450.11	63.00	387.11	167.75
5910-1	3.85	449.68	78.00	371.68	161.06
5920-1	1.61	449.55	79.00	370.55	160.57
5930-1	2.69	449.35	95.20	354.15	153.46
5940-1	5.70	449.23	85.20	364.03	157.74
5950-1	8.82	449.17	93.00	356.17	154.34
5960-1	2.03	449.11	98.10	351.01	152.11
5970-1	35.49	449.02	107.50	341.52	147.99
5980-1	25.86	449.00	114.90	334.10	144.78
5990-1	1.79	449.74	77.00	372.74	161.52
6000-1	0.94	450.03	74.10	375.93	162.91
6010-1	1.61	449.64	77.10	372.54	161.43
6020-1	2.35	449.64	69.00	380.64	164.94
6030-1	2.13	449.54	78.50	371.04	160.78
6040-1	1.64	449.44	83.00	366.44	158.79
6050-1	6.68	449.45	83.00	366.45	158.79
6060-1	9.77	449.47	89.00	360.47	156.20
6070-1	1.01	449.36	84.00	365.36	158.32
6080-1	2.20	449.28	81.00	368.28	159.59
6090-1	3.29	449.27	78.00	371.27	160.88
6100-1	2.69	449.26	63.00	386.26	167.38
6110-1	4.34	449.26	75.20	374.06	162.09
6120-1	1.15	449.26	75.20	374.06	162.09
6130-1	1.92	449.26	74.10	375.16	162.57
6140-1	1.86	449.22	79.00	370.22	160.43
6150-1	2.52	449.15	80.50	368.65	159.75
6160-1	10.15	449.15	79.00	370.15	160.40
6170-1	5.22	449.10	81.80	367.30	159.16
6180-1	1.33	449.06	81.00	368.06	159.49
6190-1	0.91	449.05	81.00	368.05	159.49
6200-1	7.98	449.05	75.00	374.05	162.09
6210-1	4.27	449.03	81.30	367.73	159.35
6220-1	19.08	449.02	79.00	370.02	160.34
6230-1	22.33	147.85	33.72	114.13	49.46
6240-1	2.59	450.03	65.00	385.03	166.85
6250-1	4.72	136.09	51.00	85.09	36.87
6260-1	4.06	136.11	33.00	103.11	44.68
6270-1	4.62	135.82	70.00	65.82	28.52
6280-1	14.24	141.20	49.00	92.20	39.95
6290-1	3.61	181.41	53.69	127.72	55.34
6300-1	4.24	181.41	28.36	153.05	66.32
6310-1	3.88	184.08	71.26	112.82	48.89
6320-1	2.41	184.50	69.00	115.50	50.05
6330-1	19.22	177.27	61.30	115.97	50.25
6340-1	26.77	171.27	52.75	118.52	51.36
6350-1	94.85	169.93	65.25	104.68	45.36
6360-1	36.82	170.01	61.00	109.01	47.24
6370-1	45.67	166.18	67.00	99.18	42.98
6380-1	27.79	164.38	69.00	95.38	41.33
6390-1	10.81	163.62	67.00	96.62	41.87
6400-1	203.84	162.83	75.00	87.83	38.06
6410-1	87.50	162.92	75.00	87.92	38.10
6420-1	15.61	163.56	65.00	98.56	42.7
6430-1	16.98	163.52	65.00	98.52	42.69
6440-1	11.59	163.47	69.00	94.47	40.94
6450-1	4.97	163.45	71.00	92.45	40.06
6460-1	53.20	163.35	65.00	98.35	42.62

6470-1	7.52	163.46	71.00	92.46	40.07
6480-1	10.11	163.59	73.00	90.59	39.26
6490-1	5.01	163.66	71.00	92.66	40.15
6500-1	5.32	163.77	69.00	94.77	41.07
6520-1	15.57	163.91	81.00	82.91	35.93
6530-1	50.19	164.13	85.00	79.13	34.29
6540-1	9.98	164.13	97.00	67.13	29.09
6550-1	14.77	164.13	99.00	65.13	28.22
6560-1	9.73	163.48	95.00	68.48	29.67
6570-1	145.49	162.96	97.00	65.96	28.58
6580-1	7.88	162.96	89.00	73.96	32.05
6590-1	8.61	163.08	95.00	68.08	29.50
6600-1	14.63	163.04	89.00	74.04	32.08
6610-1	23.98	162.97	101.00	61.97	26.85
6620-1	135.90	163.25	65.00	98.25	42.57
6630-1	7.18	163.75	69.00	94.75	41.06
6640-1	6.44	163.78	69.00	94.78	41.07
6650-1	114.97	185.87	105.00	80.87	35.04
6660-1	19.00	188.15	103.00	85.15	36.90
6680-1	62.72	183.91	109.00	74.91	32.46
6690-1	42.63	177.19	101.00	76.19	33.02
6700-1	22.78	174.04	105.00	69.04	29.92
6710-1	43.51	169.58	101.00	68.58	29.72
6720-1	2.13	168.47	101.00	67.47	29.24
6730-1	3.78	166.90	99.00	67.90	29.42
6740-1	23.27	165.41	111.00	54.41	23.58
6750-1	6.61	168.47	101.00	67.47	29.24
6760-1	8.68	166.89	99.00	67.89	29.42
6770-1	15.36	164.93	119.00	45.93	19.90
6780-1	22.23	165.40	95.00	70.40	30.50
6790-1	2.90	165.40	91.00	74.40	32.24
6800-1	27.16	165.70	91.00	74.70	32.37
6810-1	2.63	165.24	89.00	76.24	33.04
6820-1	28.77	165.23	89.00	76.23	33.03
6830-1	7.91	165.24	93.00	72.24	31.30
6840-1	10.43	165.13	87.00	78.13	33.85
6850-1	51.90	167.13	95.00	72.13	31.25
6860-1	152.53	165.18	97.00	68.18	29.54
6870-1	29.65	163.84	69.00	94.84	41.10
6880-1	5.53	163.84	73.00	90.84	39.36
6890-1	17.71	163.52	75.00	88.52	38.36
6900-1	15.68	163.47	83.00	80.47	34.87
6910-1	19.92	163.94	73.00	90.94	39.41
6920-1	23.03	164.37	79.00	85.37	36.99
6930-1	54.28	164.35	73.00	91.35	39.58
6940-1	175.60	165.16	75.00	90.16	39.07
6950-1	10.01	164.84	55.00	109.84	47.60
6960-1	8.44	164.84	53.00	111.84	48.46
6970-1	13.37	164.83	45.00	119.83	51.93
6980-1	80.18	164.78	29.00	135.78	58.84
6990-1	14.91	164.89	39.00	125.89	54.55
7000-1	5.99	164.98	43.00	121.98	52.86
7010-1	9.63	165.90	49.00	116.90	50.66
7020-1	5.36	165.04	51.00	114.04	49.42
7030-1	7.00	165.32	53.00	112.32	48.67
7040-1	8.54	165.60	49.00	116.60	50.53
050-1	10.89	165.16	37.00	128.16	55.54
7060-1	7.28	165.06	39.00	126.06	54.63
7070-1	13.09	165.40	49.00	116.40	50.44
7080-1	10.64	164.94	49.00	115.94	50.24

7090-1	9.10	164.35	53.00	111.35	48.25
7100-1	7.88	163.71	59.00	104.71	45.38
7120-1	16.83	165.01	35.00	130.01	56.34
7130-1	13.65	164.99	39.00	125.99	54.60
7140-1	9.90	164.99	35.00	129.99	56.3[illegible]
7150-1	7.66	163.17	65.00	98.17	42.5[illegible]
7160-1	11.73	162.41	71.00	91.41	39.61
7170-1	6.37	160.77	51.00	109.77	47.57
7180-1	42.94	160.58	41.00	119.58	51.82
7190-1	11.41	160.57	57.00	103.57	44.88
7200-1	5.01	160.36	59.00	101.36	43.92
7210-1	11.97	160.03	63.00	97.03	42.05
7220-1	179.41	159.08	79.00	80.08	34.70
7230-1	7.59	160.35	75.00	85.35	36.99
7240-1	45.50	191.21	107.00	84.21	36.49
7250-1	70.25	194.29	115.00	79.29	34.36
7260-1	72.49	189.56	119.00	70.56	30.57
7270-1	36.44	185.92	121.00	64.92	28.13
7280-1	26.11	183.07	113.00	70.07	30.37
7290-1	5.14	183.07	99.00	84.07	36.43
7300-1	1.23	183.04	99.00	84.04	36.42
7310-1	10.47	183.01	109.00	74.01	32.07
7320-1	34.76	182.99	119.00	63.99	27.73
7330-1	1.50	183.04	111.00	72.04	31.22
7340-1	3.61	183.06	91.00	92.06	39.89
7350-1	0.24	183.05	119.00	64.05	27.76
7360-1	48.83	200.04	115.00	85.04	36.85
7370-1	6.68	203.94	115.00	88.94	38.54
7380-1	40.35	187.07	87.00	100.07	43.36
7390-1	23.27	188.56	99.00	89.56	38.81
7400-1	0.91	189.43	95.00	94.43	40.9
7410-1	34.13	189.68	95.00	94.68	41.03
7420-1	7.52	191.74	109.00	82.74	35.85
7430-1	0.24	194.13	109.00	85.13	36.89
7440-1	6.13	191.78	105.00	86.78	37.60
7450-1	25.02	189.42	115.00	74.42	32.25
7460-1	20.37	189.26	115.00	74.26	32.18
7470-1	13.82	188.15	103.00	85.15	36.90
7490-1	0.00	179.32	75.00	104.32	45.20
7500-1	0.00	155.17	79.00	76.17	33.01

R E G U L A T I N G   V A L V E   R E P O R T

VALVE TYPE	POSITION NODE	CONTROLLED PIPE	VALVE SETTING (ft or gpm)	VALVE STATUS	UPSTREAM GRADE (ft)	DOWNSTREAM GRADE (ft)	THROUGH FLOW (gpm)
PRV-2	2570	2880	167.00	BOOSTED	163.56	159.02	785.35
PRV-2	2570	2880	167.00	BOOSTED	163.56	159.02	785.35
PRV-2	4270	4920	167.00	BOOSTED	160.82	158.55	1540.41

S U M M A R Y   O F   I N F L O W S   A N D   O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM BOUNDARY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO BOUNDARY NODES

PIPE NUMBER	FLOWRATE (gpm)
8860	1902.36
8870	3961.11
8890	2888.46
8900	-854.56
8910	1466.10

NET SYSTEM INFLOW = 10218.04
NET SYSTEM OUTFLOW = -854.56
NET SYSTEM DEMAND = 9363.38

**** CYBERNET SIMULATION COMPLETED ****

DATE: 9/29/1997
TIME: 14:01:25

EXHIBIT F

City of Florence, Oregon

Storm Water Management Plan

Final Report

October 2000

A Complete Copy of This Document Can Be Viewed In Florence At City Hall, And At The County Administration Office Or The Land Management Division Office, Both Located At:
125 E 8th Avenue, Eugene

BROWN AND CALDWELL

This Master Plan was made possible through the dedication and support of the citizens of Florence and the Stakeholder Advisory Committee (SAC), working together with City of Florence staff.

Mayor: Alan Burns

Councilor President: Lonnie Iholts

Councilors: Dave Braley
Dianne Burch
Della Weston

Public Works Director: Ken Lanfear

Community Development Director: Sandi Young

Stakeholder Advisory Committee

Chair: Ron Latham[1], Mariners Village

Members:
Don Darby, Willow Dunes
Darrell Fields, Sandpines Golf Course
Lloyd Frach[2]/Joyce Phillips[2], Creekside Pines
Dave Franzen, Wild Winds/City Planning Commission
Robert (Bob) Friedman, Sea Watch
Jay Goodwin, Old Town
Tom Kartrude[1], Siuslaw Soil and Water Conservation District/Port of Siuslaw
Ralph (Bud) Meyers, Idylewood
Arolf Salo, Heceta South/City Planning Commission
Ramon (Ray) Street, Greentrees
Richard (Dick) Walker, Florentine Estates
Rob Ward, Representative at Large
Frank Williams, Shelter Cove

1 Tom Kartrude was the SAC Chair from April 1999 through February 2000. Ron Latham assumed the Chair in March 2000.

2 Joyce Phillips was added to the committee in November 1999 to replace Lloyd Frach who was no longer available to participate.

LIST OF FIGURES

(an * indicates figure immediately follows page listed)

ABBREVIATIONS

BMP	Best Management Practice
B&W	Barney and Worth
cfs	Cubic Feet per Second
CNPCP	Coastal Nonpoint Pollution Control Program
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act of 1977
CZARA	Coastal Zone Act Reauthorization Amendments of 1990
CZMA	Coastal Zone Management Act of 1972
DEQ	Oregon Department of Environmental Quality
DLCD	Oregon Department of Land Conservation and Development
DSL	Oregon Division of State Lands
EIA	Effective Impervious Area
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
EQC	Oregon Environmental Quality Commission
ESA	Endangered Species Act of 1973
ESU	Evolutionarily Significant Unit
F	Fahrenheit
FBFM	Flood Boundary and Floodway Map
FEMA	Federal Emergency Management Agency
FIA	Federal Insurance Administration
FIRM	Flood Insurance Rate Map
FR	Federal Register
HCP	Habitat Conservation Plan
ITP	Incidental Take Permit
LCOG	Lane County Council of Governments
LID	Local Improvement District
MEP	Maximum Extent Practicable
mg/L	Milligrams per liter
MIA	Mapped Impervious Area
mL	Milliliter
MODFLOW	Ground water model
MS4	Municipal Separate Storm Sewer System
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
OCMP	Oregon Coastal Management Program
PUD	Planned Unit Development
RUNOFF	Hydrologic model
SAC	Stakeholder Advisory Committee
SCS	U.S. Soil Conservation Service
SDC	System Development Charge
SDWA	Safe Drinking Water Act
SSWCD	Siuslaw Soil and Water Conservation District
SWMP	Storm Water Management Plan
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
UGB	Urban Growth Boundary
UIC	Underground Injection Control

EXECUTIVE SUMMARY

The City of Florence (City) worked with a 14-member Stakeholder Advisory Committee to develop the *City of Florence, Storm Water Management Plan (SWMP).* The committee members were appointed by the mayor and met over an 18-month period to support preparation of the plan. The SWMP makes recommendations for addressing flooding problems, improving water quality, and protecting the quantity and quality of the aquifer and valuable natural resources (e.g., wildlife habitat). It is intended to guide upgrades and expansion of the storm water conveyance system to meet the area's needs over the next 20 years.

The recommendations will affect the City's capital improvement and operating programs, including the development of a storm water utility for collecting rates and fees as required to support the storm water program. In addition, new City code, ordinance, and development standards are recommended that will affect the way future development is conducted within the area.

The SWMP's study area is defined by the natural drainage basins within the area. The area crosses city boundaries and extends into, and in some locations, beyond the current Urban Growth Boundary (UGB), which represents the potential future boundary of the City, as shown in Figure EX-1. Recommended improvements for areas outside the current City limits will not be implemented until those areas are incorporated into the City.

The SWMP includes recommendations for reducing the potential for flooding in some privately owned and maintained urban developments; however, the City does not have the authority or responsibility for implementing them.

The City and its technical consultants (Brown and Caldwell) worked closely with citizens, Lane County, and relevant regulatory agencies to develop the SWMP. Implementation of the SWMP will require active involvement of all City departments, state and federal agencies, and local property owners.

PUBLIC INVOLVEMENT

The successful implementation of the SWMP requires community support for the overall program. A comprehensive public involvement program was included in the planning process to ensure the SWMP addresses community values and concerns. The public involvement program included the following elements:

- A **Stakeholder Advisory Committee (SAC)** to provide ongoing review and guidance. SAC members were appointed by the mayor to represent a broad range of community interests. They played an integral role in each aspect of the planning process. The recommendations in the SWMP have been endorsed by all SAC members.

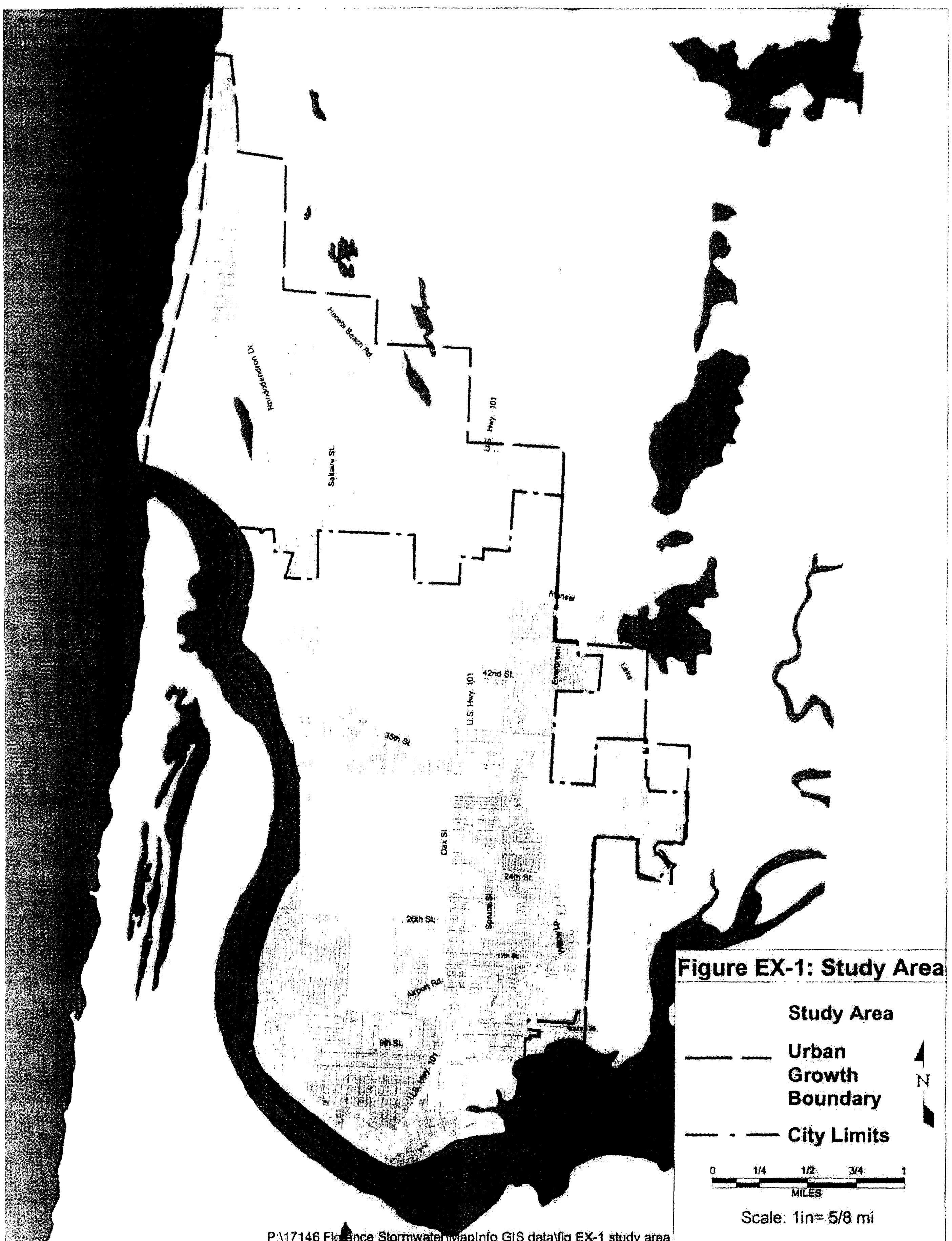


Figure EX-1: Study Area

P:\17146 Florence Stormwater\MapInfo GIS data\fig EX-1 study area

An implementation plan for the recommended projects. The SAC and consultant team used a priority ranking analysis to determine the order in which projects should be designed and constructed. The implementation plan also includes recommendations for funding, ordinance adoption, and future regulations. (See Chapter 6 for additional detail.)

RECOMMENDED PROJECTS

The SWMP recommends 5 high priority projects at a total cost of nearly $1 million, and 8 unranked projects at a cost of approximately $3.6 million to address identified deficiencies. Although the City intends to ultimately implement all of the projects, funding and other resource limitations prohibit implementation all at one time. The project team and the SAC therefore ranked the projects in terms of their ability to meet both technical and value-based criteria. The five most critical projects are identified in Table EX-1 in order of priority, and the location of the projects are shown in Figure EX-2.

The recommended projects consist of structural improvements that will improve storm water runoff and surface water flooding conditions throughout the City. Several projects can be designed to provide additional benefits, such as water quality and riparian fish/wildlife habitat improvements.

Table EX-1. Priority Projects

Priority ranking	Project identifier/description	Study region	Estimated capital cost ($)
1	**CEN-A/Rhododendron channel:** Construction of permanent lined channel along Rhododendron Drive, terminating at 35th St.; flow then piped to large ravine to west. Would improve hydraulic capacity of collection system and lessen flooding potential.	Central	331,000
2	**NE-A/Munsel Lake Road drainage and diversion:** ~~Creation of vegetated swale along north side of Munsel Lake Road to divert flows to the east; culvert under road; pipe along portion of the route near junction with Munsel Creek.~~ See *Stormwater Design Report for Spruce Street LID*, July 2006, Florence Realization 2020 Comprehensive Plan Appendix 11.	Northeast	~~249,000~~ 800,000.
3	**SE-A/Pine Court pump station:** Pump intake set at elevation to maintain health of existing wetlands. When groundwater level exceeds this elevation, pump activated and flow discharged into Munsel Creek.	Southeast	157,000
4	**SW-A/Greentrees ditch:** Construction of new channel to intercept runoff from property east of Greentrees development.	Southwest	37,000
5	**NW-A/Rhododendron Dr. and North Jetty Rd. improvements:** Pump station, pipe, and ditch improvements to protect property in flood area and downstream. (Project is outside City limits; implementation would require cooperative effort of developers, neighborhood associations, homeowners, and Lane County.)	Northwest	209,000
Subtotal			**983,000**

FUNDING

The City has historically funded storm water management through its Street Department. The revenue demands of the capital, operation, and maintenance recommendations made by the SWMP go well beyond what can be funded by the Street Department, and a separate funding source dedicated to storm water management is required. **The SWMP recommends that the City develop a storm water utility to manage, operate, and fund storm water management activities.**

The SWMP also recommends that the City initiate a rate study to determine the initial user fees to be charged by the utility and identify what costs can be funded by other revenue sources. The rate study should determine system development charges (SDCs) for funding growth-related storm water improvements; examine community participation in local improvement districts (LIDs) where relevant; and explore the range of alternative funding possibilities, including federal and state grant programs.

CODE, ORDINANCES, AND DEVELOPMENT STANDARDS

This comprehensive storm water management plan requires City codes, ordinances, and development standards to support overall stormwater management activities. **The SWMP recommends City adoption of a new storm water ordinance, including minimum development standards.** This local regulatory framework would provide clear direction to developers and contractors concerning the minimum standards and controls required for managing storm water quantity and quality. In addition, the code and ordinances would provide the City with the authority and responsibility for implementing and enforcing the required stormwater management activities. (Appendix D presents the recommended code, ordinance, and development standards.)

FUTURE REGULATIONS

New regulations will impact how storm water and surface water are managed. To address the new regulations, the City should **develop a formal response to the requirements of the Endangered Species Act (ESA)** by implementing a program to bring the City into complete compliance with the ESA. In addition, the City should **develop a wellhead protection plan to ensure the local aquifer remains a source of high-quality water.**

RECOMMENDATIONS

The City should initiate the following activities to support the SWMP:

- adopt the storm water ordinance presented in Appendix D,
- initiate a rate study to determine rate structure required for supporting program, and
- establish a storm water utility for managing and operating storm water management activities.

CHAPTER 1

INTRODUCTION

The Storm Water Management Plan (SWMP) for the City of Florence (City) identifies recommendations formulated to address flooding problems, improve water quality, protect the quantity and quality of the aquifer, and preserve valuable natural resources (e.g., wildlife habitat). The recommendations will affect the City's capital improvement and operating programs, including the development of a storm water utility for collecting rates and fees required to support storm water management activities. In addition, new City code, ordinance, and development standards have been recommended that will affect the way future development is conducted within the area. Implementation of the SWMP will require active involvement of all City departments, state and federal agencies, and local property owners.

AUTHORIZATION

In September 1998, the City entered into an agreement with Brown and Caldwell to prepare a SWMP for guiding upgrades and expansion of the storm water conveyance system to meet the area's needs over the next 20 years. The SWMP recommends improvements within the study area as defined by the shaded area shown in Figure 1-1. Some of the improvements lie outside the current city limits and will not be implemented until the unincorporated area is incorporated into the city.

The street and storm drainage systems in some of the planned urban developments within the study area are privately owned and maintained by the developments. The SWMP includes recommendations for reducing the potential for flooding in some of these areas, though the City does not have the authority or responsibility for implementing them.

OBJECTIVES

The City's long-term management of storm water related activities shall be guided by the overall objectives established for the SWMP. The objectives were developed early in the planning process to define the purpose and focus of the planning effort.

Meetings were held between spring and fall of 1999 with the Stakeholder Advisory Committee (SAC) to develop the objectives. The meetings included selected representatives from the community, the public at large, City representatives, and a representative from the consultant team. The specific objectives developed by this joint effort are defined as follows:

- Protect private and public property from storm water and groundwater related damage.
- Maintain public access to critical facilities at all times.

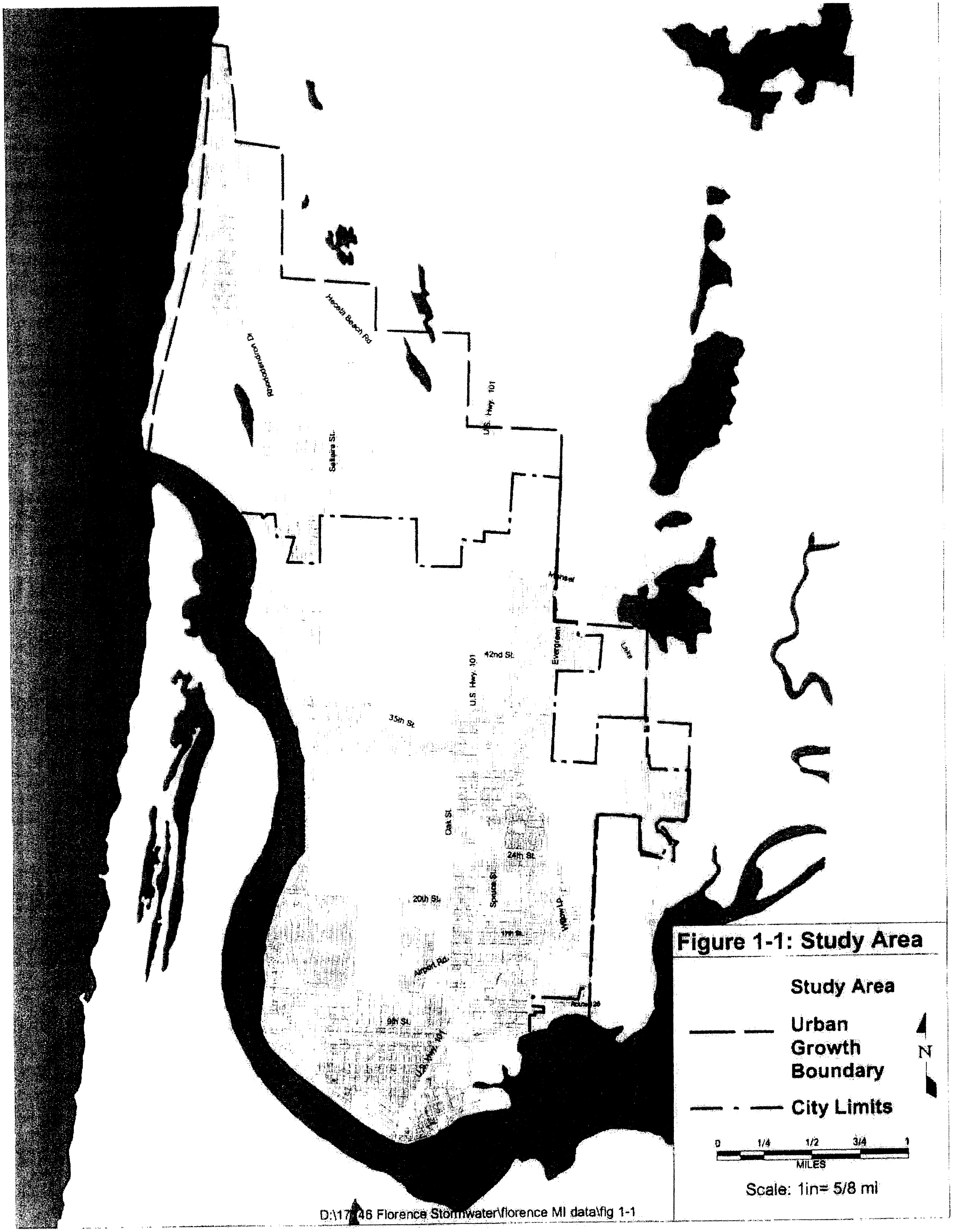
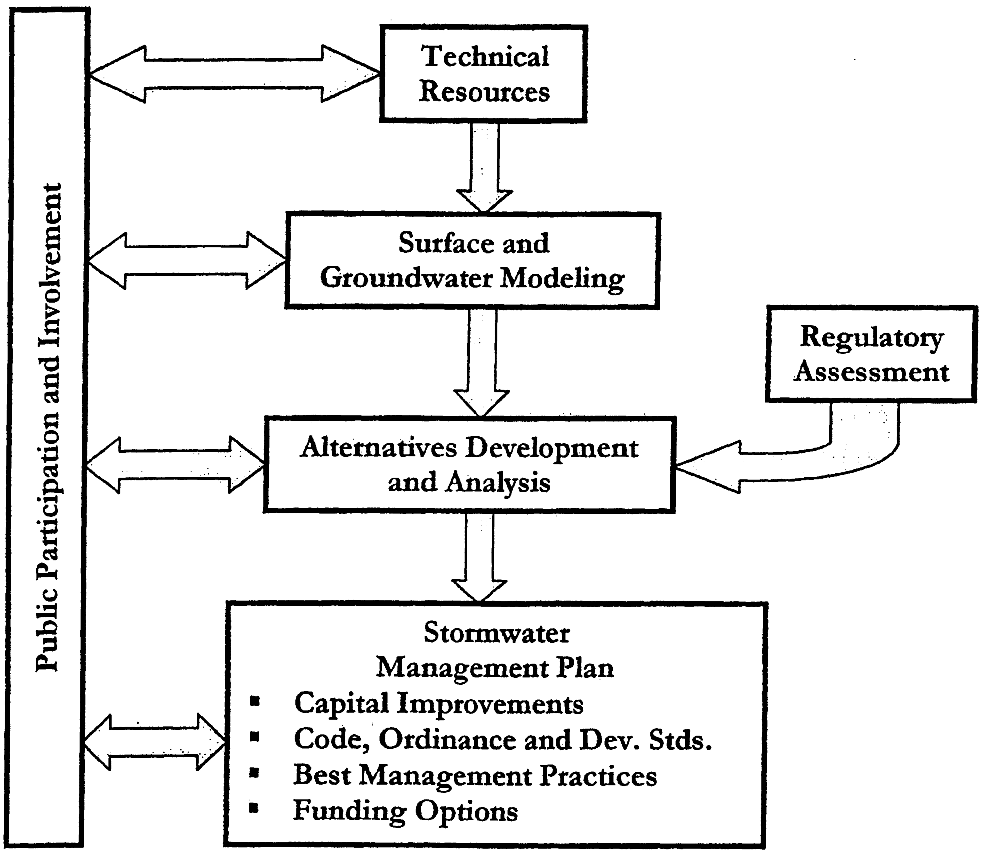


Figure 1-1: Study Area

PROCESS FOR DEVELOPING THE MANAGEMENT PLAN

The development of the SWMP involved a number of diverse activities spanning several technical disciplines and including a public involvement process. The consultant team worked closely with the City and the SAC to ensure that the various components of the planning process came together in the SWMP. The various planning activities and sequence of events conducted during the SWMP planning process generally followed the flowchart shown as Figure 1-2.

Figure 1-2. Activity Flowchart



Technical Resource Management

The primary focus of the technical resource management task was to gather information to be used in a physical characterization of the study area. In a separate task, the physical data was used to develop the hydrologic/hydraulic model of the surface water system and the hydrogeologic (groundwater) model. The data collected included information on topography, hydrologic conditions (rainfall quantity, intensity, and duration in relation to the frequency of storm events), groundwater levels, land use and zoning, existing collection system data (pipe diameter, pipe length, depth to invert, and construction material), soil types, and locations of natural resources. This information was provided by a variety of sources including City as-built files; actual survey data as provided by the City and Lane County Council of Governments (LCOG); National Weather Service;

A copy of the PIP is included in Appendix A.

Stakeholder Involvement. The purpose of the SAC was to provide public input and feedback into the planning process. B&W recommended candidates for the SAC based on the results of interviews with community leaders. The mayor and City Council considered the recommendations and appointed the final roster for the committee. Table 1-1 lists the SAC membership and the communities or organizations that each person represents.

Table 1-1. SAC Membership

Name	Community/Organization
Don Darby	Willow Dunes
Darrell Fields	Sandpines Golf Course
Lloyd Frach[1]/Joyce Phillips	Creekside Pines
Dave Franzen	Wild Winds/City Planning Commission
Robert (Bob) Friedman	Sea Watch
Jay Goodwin	Old Town
Tom Kartrude – SAC Chair[2]	Siuslaw Soil and Water Conservation District/Port of Siuslaw
Ron Latham – SAC Chair[2]	Mariners Village
Ralph (Bud) Meyers	Idylewood
Arolf Salo	Heceta South/City Planning Commission
Ramon (Ray) Street	Greentrees
Richard (Dick) Walker	Florentine Estates
Rob Ward	Representative at Large
Frank Williams	Shelter Cove

[1] Joyce Phillips was added to the committee in November 1999 to replace Lloyd Frach who was no longer available to participate.

[2] Tom Kartrude was the SAC Chair from April 1999 through February 2000. Ron Latham assumed the Chair in March 2000.

The stakeholders who formed the SAC were selected to represent the community and to help guide the planning process. Specifically, the SAC was charged with the following tasks:

- Approve a work plan for the Committee, including a planned schedule of committee meetings.
- Review the City's storm water and drainage history, current status, and associated issues.
- Identify the need and benefits of a storm water management plan for the community.

Public Surveys. Maps of known problem areas were displayed at the Public Library and at City Hall. The public was invited to submit information about flooding problems in their neighborhoods through the completion of a *Problem Response Form* which was available at each map display location. Information provided in the submitted forms was used to update the problem description maps.

In September 1999, a newsletter was prepared and distributed to residents within the study area through direct mail. The publication informed the public about the planning process, answered frequently asked questions, provided information on how to participate in the process, identified dates of upcoming SAC and Public Workshop meetings, and provided a *Problem Response Form* to be completed if the reader wished to identify a storm water related problem or remain on the mailing list.

A copy of the *Problem Response Form* and the newsletter are included in Appendix A. The public's response to the surveys and public meetings are tabulated in Appendix A.

Public Workshop. A Public Workshop was held in December 1999 to share the results of the modeling process with the community and to receive input on the draft recommended solutions. The SAC played a major role in this meeting by assisting in workshop facilitation. Committee members described to the public the work that had been completed and the nature of the proposed alternatives. Maps and a fact sheet were prepared showing each of the major drainage areas, along with associated problems, identified through modeling or by the public involvement process. The fact sheet explained the planning process and presented a "toolbox" of solutions that would be considered for managing storm water in the area. A copy of the fact sheet is included in Appendix A.

Other Activities. In June 1999, KCST radio station held a community forum to discuss the project and to answer questions from the public. Tom Kartrude, chair of the SAC, and James Hansen, project manager for the consultant team, represented the City's project team during the forum. In addition, Tom Kartrude and Ron Latham presented the major features and highlights of the SWMP to the Florence Rotary on July 25, 2000.

Hydrologic/Hydraulic Modeling and Analysis

Hydrologic/hydraulic models were constructed using the information collected during the technical resources management task. The hydrologic models determined the quantity of storm water runoff to be conveyed by the drainage systems. The hydraulic models determined if the capacity of the existing drainage system was adequate.

Hydrologic/hydraulic models were developed to analyze both existing conditions and future flows based on full build-out of the area as derived from land use as shown in Proposed Florence Comprehensive Plan Map (January 19, 2000). An understanding of the problems associated with both the existing and future conditions is necessary for developing funding mechanisms that require the differences between current system deficiencies and growth related deficiencies.

Code, Ordinances, and Development Standards

City codes, ordinances, and development standards provide direction and support for the SWMP. A new storm water ordinance was developed for the City, including new minimum development standards. This local regulatory framework provides clear direction to developers and contractors concerning the minimum standards and controls required for managing storm water quantity and quality. In addition, the code and ordinances provide the City with the authority and responsibility for implementing and enforcing the program. The recommended code, ordinance, and development standards are described in a technical memorandum, provided in Appendix D.

Best Management Practices

The code, ordinance, and development standards recommended as part of the overall storm water program require that certain types of controls, or BMPs, be implemented to reduce flow rates and/or improve water quality. BMPs are available for controlling flow rate and water quality. Appendix E identifies a list of BMPs that are acceptable for use on projects within the study area. The list should be considered a toolbox that local developers and the City can use to meet the requirements of the SWMP.

Financial Assessment

A key element for implementing a successful storm water management plan is establishing the framework for funding the recommended activities. The consultant team has worked with the City to develop a list of potential funding sources for implementing all facets of the SWMP. In addition, advantages and disadvantages of the various sources were investigated. The technical memorandum in Appendix F summarizes the results of this task.

Storm Water Management Plan

The final task of the overall project was to prepare the SWMP. Development occurred in stages as described by the above text. A draft SWMP was prepared and submitted to the City and the SAC for review. Review comments were incorporated into the text, and a final SWMP prepared and submitted to the City.

CHAPTER 2

BASIS OF PLANNING

This chapter describes the resources used to develop the Storm Water Management Plan (SWMP). The technical basis for the hydrologic and hydraulic modeling is defined, along with a discussion on the relationship between surface water and groundwater in the study area. The engineering standards used to develop recommendations are presented.

SERVICE AREA CHARACTERISTICS

The physical characteristics of a drainage basin establish the quantity and quality of storm water discharges. Topography, including man-made features such as raised roads, irrigation and drainage systems, and natural conveyance systems, determines the area drained by a basin. The runoff volume and rate are dependent on land use, soils, and existing vegetation within each basin. The slope of the drainage basin establishes the time of concentration—the period of time it takes for runoff from the most remote point in a drainage basin to flow to the outlet. All of these factors must be considered during the storm water management planning study.

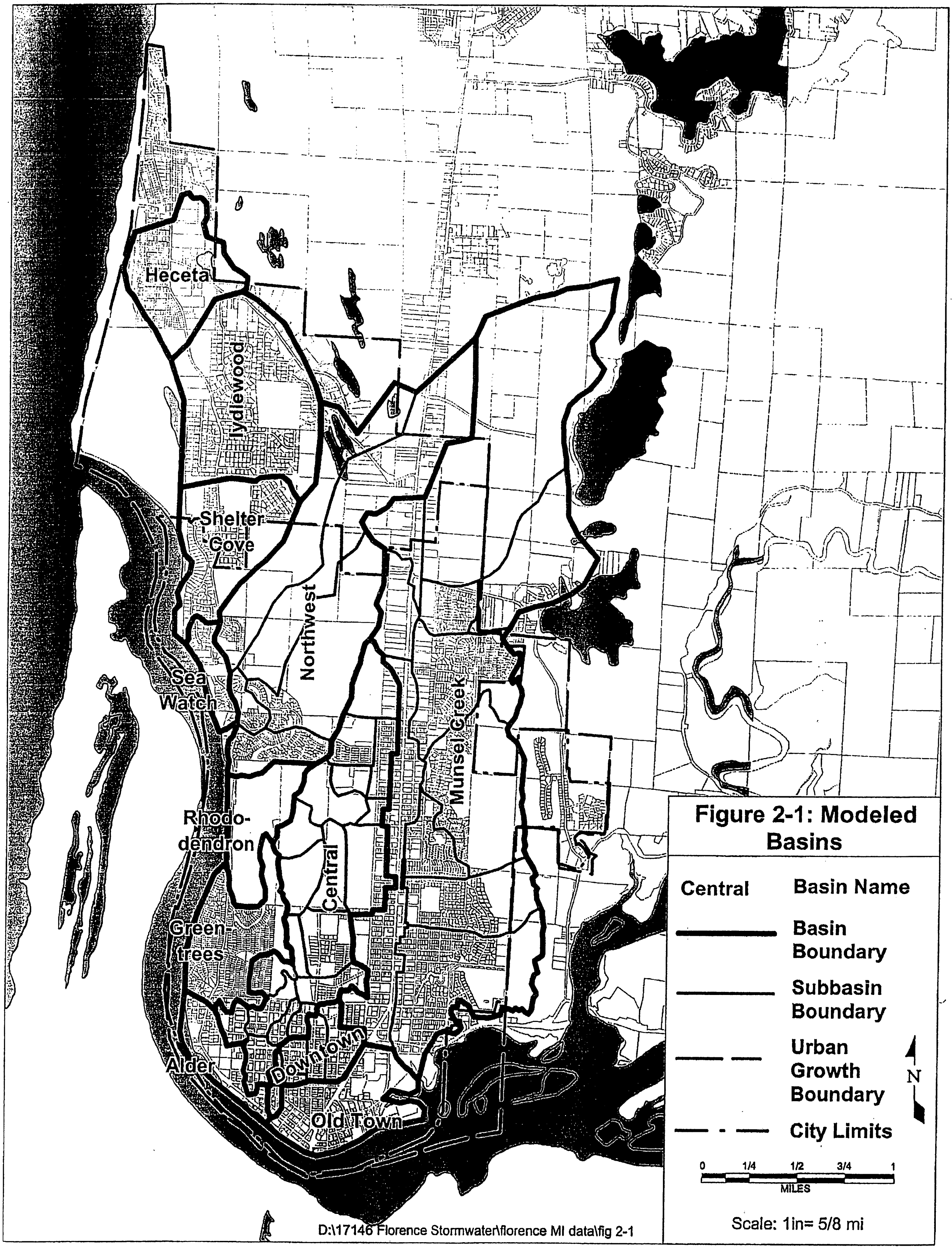
Topography

The study area is determined by the local topography and often extends beyond political boundaries such as city limits and the urban growth boundaries.

Elevations were taken from maps showing 2-foot contour lines supplied by the City of Florence (City) or estimated from United States Geological Survey (USGS) maps where the city maps did not provide coverage. The City's contour lines were 20 years old, but they were verified with recently surveyed data points, where possible.

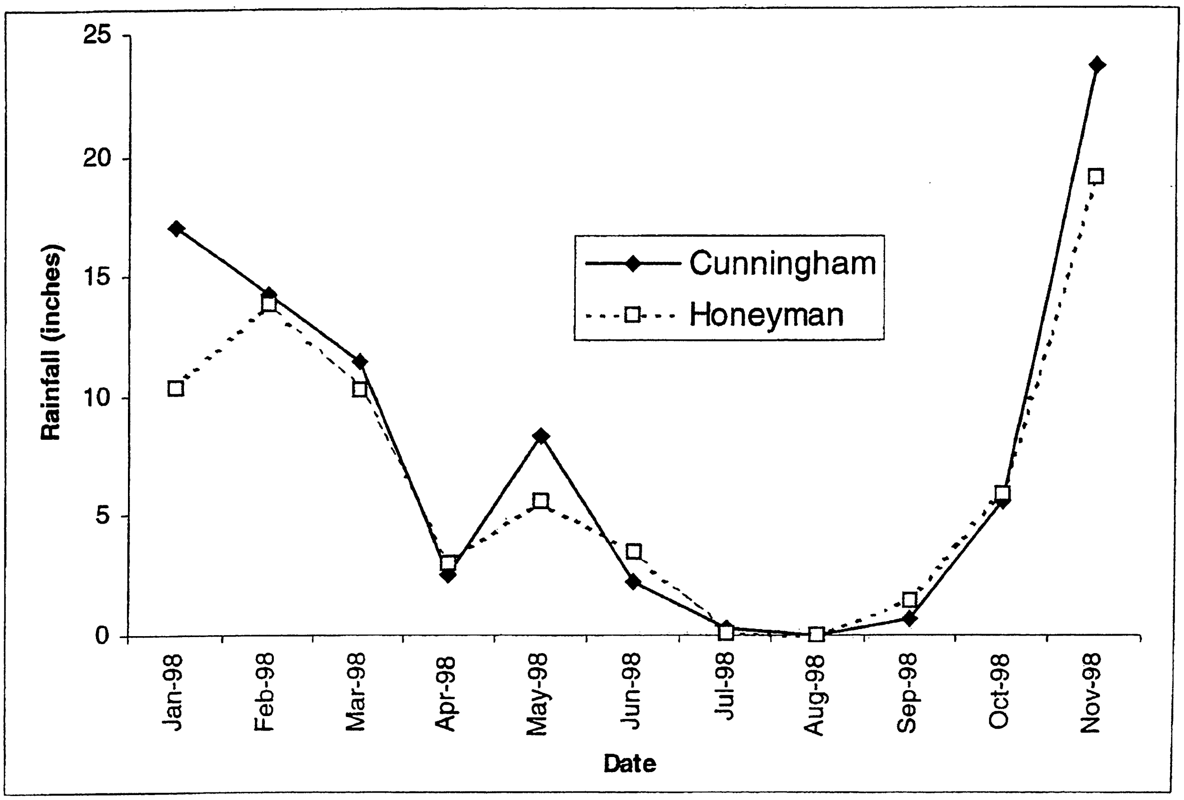
The study area includes roughly 7.6 square miles of drainage, as shown in Figure 2-1. The area was divided into four major drainage basins for modeling: Munsel Creek, the downtown area, a central basin that includes the airport and lands west of Highway 101, and a northwest basin that includes Sandpines Golf Course and Siuslaw Village. Each of the major basins consists of more than one hydrologically distinct drainage areas that were subdivided into smaller subbasins for more accurate modeling. The study area also included eight smaller basins (with no subbasins) along the western edge of the city that drain directly to the Siuslaw River. The smaller drainage basins were defined differently from the five geographic regions (Northwest, Northeast, Central, Southwest, and Southeast) that are discussed under Results (Chapter 4) and Recommendations (Chapter 5). The geographic regions may include more than one of the drainage basins shown in Figure 2-1.

Table 2-1 lists sizes and number of subbasins in each basin. In areas with more complex conveyance systems, smaller subbasins were delineated to improve model accuracy.



Heceta
Iydlewood
Shelter Cove
Northwest
Sea Watch
Munsel Creek
Rhodo-dendron
Central
Green-trees
Alder
Downtown
Old Town
Figure 2-1: Modeled Basins
Central
Basin Name
Basin Boundary
Subbasin Boundary
Urban Growth Boundary
City Limits
N
0
1/4
1/2
3/4
1
MILES
Scale: 1in= 5/8 mi
D:\17146 Florence Stormwater\florence MI data\fig 2-1

Figure 2-2. Florence Monthly Average Rainfall



Precipitation on the Oregon coast appears to follow a 20-year cycle from cool/wet periods to warm/dry periods (*Long-Term Wet-Dry Cycles in Oregon*, George H. Taylor, March 1999, Oregon Climate Service). Figure 2-3 shows that the last warm/dry period may have ended with the floods of 1996, and a cooler, wetter cycle now predominates.

Table 2-3. Land Use Classifications and Impervious Percentages

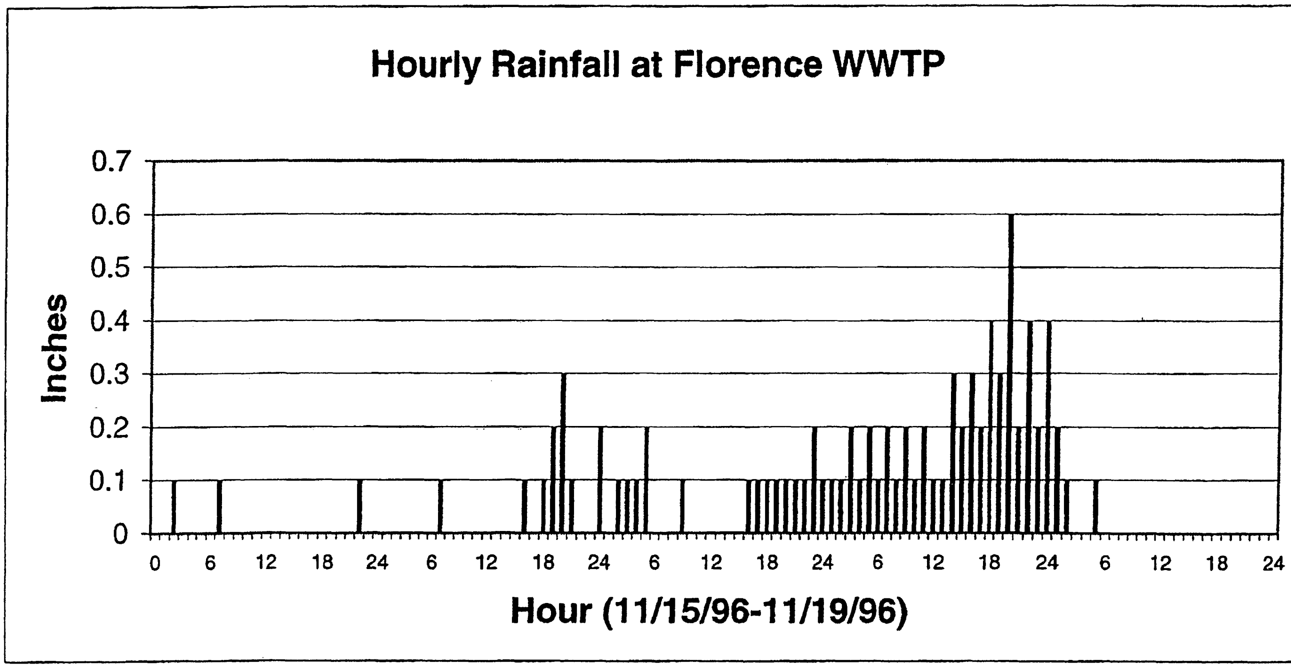
Land use classification	Percent impervious area
Agricultural (AGR)	30
Commercial (COM)	75
Educational Facility (EDU)	50
Surface Water: Lake, stream, etc.(H_2O)	100
Industrial (IND)	90
Multi-Family Residential (MFR)	60
Parks/Open Space (POS)	5
Single Family Residential (SFR)	35
Utility (UTL)	90
Vacant (VAC)	5
Streets (STR)	100

Table 2-4 lists the number of acres of each land use designation assumed for this study. Present land uses were computed from a digital version of the Florence tax lot map, updated in February 1999. Lane County and City land use codes were consolidated into the 11 general categories shown above. Each of roughly 7,000 tax lots within the study area was assigned one of these categories, and the total area of each land use was computed for each of the drainage basins.

Future land uses were based on the latest available version of the Proposed Florence Comprehensive Plan Map (January 19, 2000). This map describes land uses on a coarser scale with fewer categories than the tax lot map. The Florence Comprehensive Plan did not include agricultural or utility land uses, and the scale was too broad to compute land reserved for streets. The scale also produced some unrealistic discrepancies between the present and future land uses, such as decreases in commercial land use in some of the basins. These problems were addressed during development of the models, as explained in the subsection titled "Effective Impervious Area."

The event representing peak rainfall was chosen as November 18, 1996. The Florence WWTP recorded 5.4 inches of rain in that 24-hour period. While a storm of this volume has a return frequency of roughly 50 years, it was only part of a larger system that spanned longer than 24 hours. Consequently, to more accurately predict soil saturation and runoff conditions, the model included rainfall data from November 1, 1996, through November 19, 1996. Total rainfall during this 19-day design storm was 10.1 inches. Figure 2-4 shows the rainfall pattern (hyetograph) for the selected storm.

Figure 2-4. Design Storm Hyetograph



The total rainfall volume of the design storm was increased or decreased using the multipliers in Table 2-5 to simulate storms of different return frequencies. Storm volumes were obtained from the 1973 National Oceanic and Atmospheric Administration Precipitation - Frequency Atlas of the Western United States, Volume X – Oregon.

Table 2-5. Design Storm Multipliers

Return frequency, years	Storm volume, inches	Design storm multiplier percent of Nov. 1996 (5.4-inch storm)
2	3.46	64
10	4.48	83
25	5.06	94
100	5.95	110

The quantity and quality of storm water available to recharge the Florence aquifer depend on a number of factors, one of which is the amount of impervious surface area directly connected to a piped collection system. Impervious areas provide little opportunity for infiltration. Storm water discharged to a stream or ditch may or may not infiltrate depending on the channel lining. Another factor is the area soils. Florence's soils are mostly sands, so most storm water that falls onto or runs over sandy areas will infiltrate. Lenses of organic material may significantly reduce the rate of infiltration, and saturated soil may reduce the infiltration rate during high rainfall and/or high groundwater conditions.

The model simulates the recharge due to precipitation by using a value for rainfall and recharge as well as a value for evapotranspiration. The values for rainfall were obtained from the 1982 North Florence Dunal Aquifer Study and estimates of evapotranspiration and runoff were based on vegetation type. Higher runoff/evapotranspiration values were used for urban and forested areas where runoff and higher evapotranspiration were more likely to occur, respectively. Lower values were used for open sand areas where infiltration would be the highest. The difference between the recharge/rainfall and runoff/evapotranspiration was the amount of water recharged to the aquifer.

Simulations were performed for dry, average, and wet years by varying the annual precipitation. The wet year was set at approximately 177 percent of the average year volume. Table 2-6 lists average rainfall for three different years, dry, average, and wet. The dry year was set at 68 percent of the average year. The simulations were performed for steady-state simulations to provide a conservative "worst case simulation." The year chosen to exemplify a wet year, 1996, contained the large storm event used in the storm water modeling.

Table 2-6. Annual Florence Precipitation

Type of year	Example	Rainfall inches
Dry	1988	47
Average	1987	69
Wet	1996	122

MODELING PARAMETERS AND ASSUMPTIONS

Construction of surface water and groundwater models requires the entry of a large amount of data to "set up" the model. Most of the data include physical parameters such as pipe size, channel slope, or land use, that have been measured from maps or in the field. The modeler establishes the remaining data, which are not directly measured. These parameters and assumptions are discussed in this section.

Runoff

The quantity of storm water runoff was modeled using the RUNOFF module of the XP-SWMM computer model. XP-SWMM is a graphical version of the Environmental Protection Agency's (EPA's) SWMM urban storm water model. Subbasin slope was calculated as the average slope of two to four flow lines, as measured against mapped contour lines. Subbasin width was assumed to be the subbasin area divided by the length of the longest flowline. Infiltration in the pervious portion of each subbasin was described using the Horton equation, which states that the infiltration rate approaches, but never quite reaches, a minimum value during the course of the storm. Maximum and minimum infiltration rates used in this study were 6 and 4 inches per 1 hour, respectively, and exponential decay was set to a low rate, 10^{-6}/sec.

Conveyance System

The modeled conveyance system contains 115 conduits (pipes, culverts, channels, etc.) with a total length of 10.5 miles. Table 2-7 lists the five types of conduits used in the model.

Table 2-7. Modeled Conduit Types

Conduit type	Number of conduits	Total length	Manning's Roughness coefficient, "n"
Pipe	67	3.3 miles	0.013
Culvert	8	483 feet	0.025
Natural Channel	11	1.7 miles	0.03 in channel, 0.06 overbank
Trapezoidal Channel	28	5.4 miles	0.03 in channel, 0.06 overbank
Bridge	1	38 feet	0.03 in channel, 0.06 overbank

The roughness coefficient distinguishes conduit types within the hydraulic model. The rougher the lining of the conduit, the higher the roughness coefficient. For example, corrugated metal culverts are rougher than pipes with smooth linings. Natural channels with surfaces covered with rock and vegetation are rougher still. The banks of natural and man-made channels are usually more heavily vegetated than the main channel. Therefore, when a stream spills over the top of its banks, the overbank flow area is assigned a higher roughness. All things being equal, the higher the roughness coefficient, the lower the capacity of a conduit.

There are two types of channels listed in Table 2-7. Man-made channels are typically modeled as trapezoids with a flat bottom and constant side slopes. Natural channels have a more irregular cross section than man-made channels. Natural channels were modeled using actual cross sections where this topographic information existed. Lengths, diameters, and elevations of conduits were taken from the City of Florence Storm Drain Map, with updates provided by Ken Lanfear in the fall of 1999. Missing elevation data were estimated from topographic maps and surrounding survey points. City geographic information system topographic coverages were used to determine channel profiles. The model includes pipes and culverts 12 inches diameter and larger.

above the local ground surface elevation. The extent and duration of flooding depends on the amount of available storage within the system. Surcharging is noted when it occurs in the modeling, but upgrading the conveyance system was not recommended except in these situations:

- Flooding is indicated by complaints or through modeling
- Surcharging is threatening the integrity of the system
- Increased flows from replacing a pipe/culvert upstream require replacing a downstream facility

Allowable Headwater for Culverts

Headwater depth is defined as the depth at which water backs up behind culverts. Many culverts in Florence are located behind deep roadfills. At these locations, if the culvert is undersized, a substantial amount of water can be detained upstream. If the roadway and adjacent property are not at risk from flooding or erosion, the facilities are not recommended for expansion or replacement. These situations are recognized as increasing water storage in the system. The storage provides downstream benefits, such as smaller peak flows and less erosion. It also allows the use of smaller and less expensive culverts and bridges.

Replacement Pipe/Culvert Parameters

If the open channel located above and below an undersized culvert is wide enough, installation of a parallel culvert is generally considered more desirable than replacement with a larger culvert, due to cost. If the open channel is too narrow to allow this, or if other concerns are present (buried utility lines, maintenance issues), the culvert may need to be replaced with a larger culvert or a bridge. For undersized pipes, only pipe replacement was considered, because utility lines and other sewers surrounding the pipe make it cost prohibitive to run a parallel pipe.

Detention Assumptions

Detention facilities in the Florence area not lined with an impermeable layer were considered to function as infiltration facilities.

Channel Velocities

The risk of water erosion of sandy soils in Florence is relatively small due to the rapid infiltration rate. However, erosion can occur in channels with good vegetative cover and channels without cover with flows in excess of 3 feet per second and 1.5 feet per second, respectively. The rills and fluvial fans found in areas throughout the City provide evidence of the erosive force of water on sandy soils. If erosive forces start to cut down a channel, the sand can be washed away quite rapidly.

CHAPTER 3

REGULATORY OVERVIEW

A number of state and federal regulations will influence or directly determine how the City of Florence (City) manages its surface and storm water collection system. These regulations impact nearly all facets of storm water management, including planning, design, construction, and maintenance activities. It is crucial that the City develops and implements storm water management activities in accordance with state and federal regulations. The purpose of this chapter is to provide a brief overview of the major requirements of the state and federal programs that affect storm water management within the study area. A technical memorandum that provides additional information on the impacts of the regulations is provided as Appendix C.

This chapter is divided into two major sections: general permitting requirements, and Endangered Species Act (ESA) requirements. The general permitting section describes state and federal permitting programs that affect storm water management. The ESA will also affect storm water management within the City, but it has much broader influence that will impact activities throughout all of City government. Therefore, a separate section is included that defines the requirements of ESA legislation and its affect upon the City.

GENERAL PERMITTING REQUIREMENTS

There are three types of permits which will have a direct impact on activities in Florence. They are state and federal "removal and fill" permits, National Pollutant Discharge Elimination System (NPDES) permits for construction activities, and the permits required for infiltration facilities. The purpose of and requirements for the three types of permits are described in the following sections. Other types of permits that may impact the management of the storm water system are defined and explained in Appendix C.

Removal/Fill Permits

Removal/fill permits were developed to protect the state's water resources. Permits are required for certain types of construction activities which involve the removal or fill of materials within "waters of the state". The State of Oregon (State) defines waters of the state as "natural waterways including all tidal and nontidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, navigable and non-navigable, including that portion of the Pacific Ocean which is in the boundaries of this state". The State's jurisdiction covers any activity that proposes removing or altering 50 cubic yards or more of material within the bed or banks of the waters of the state. The Oregon Division of State Lands (DSL) administers the program for the State.

Federal jurisdiction covers "navigable waters" and includes all removal and fill activities located therein. The federal government's definition of navigable waters is at least as broad as the State's "waters" definition. In addition, the federal permitting program is not limited to activities involving a specific volume of material, but applies to all removal and fill activities within navigable waters. The United States Army Corps of Engineers (COE) administers the permitting program for the federal government. Many of the public projects undertaken by the City or on behalf of the City, will fall under the requirements of one of the COE's nationwide general permits. These were developed to reduce the permitting effort for both the applicant and the federal reviewing agency while providing the required level of protection to the environment.

A joint state/federal permit application package has been developed by the agencies to help streamline the permitting process. A copy of the permit application package should be prepared and submitted to each agency since each has its own review and approval process. If the application is approved, DSL and the COE will each issue their own permits. Applicants should allow between 60 to 90 days for the permit process.

Many of the proposed projects defined by the Storm Water Master Plan (SWMP) will require removal and fill permits due to the projects' proximity to wetlands or other water bodies. A thorough field investigation by a state-approved wetland delineator should be conducted early in the design phase. Designs should be developed and sized to avoid or minimize impacts to wetlands and water bodies. Field work should be performed at an early stage of the design process to determine if removal and fill permits will be required. This will save time and money.

NPDES Permits

The national storm water permitting program was initiated by the NPDES Phase I requirements promulgated in 1990. Phase I requirements focused on cities greater than 100,000 population, industrial facilities, and construction sites disturbing five acres or more of land. The Phase II requirements, published in December 1999, extended the permitting program to include "small" cities and construction sites that disturb lands from one to five acres in size.

Phase II requirements significantly increase the number of municipalities participating in the permitting program. However, Florence is *not* directly impacted by this latest rulemaking. By EPA definition, small cities are areas with greater than 50,000 residents, and population densities of at least 1,000 people per square mile. Because Florence does not meet the criteria, the City will not require an NPDES permit for municipal storm water discharges at this time. The City could be brought into the permitting program if the Oregon Department of Environmental Quality (DEQ) or the Environmental Protection Agency (EPA) determine that the City's participation would be crucial for maintaining good water quality, or the health of natural resources in the area. The technical memorandum included as Appendix C defines the minimum activities that would be required to comply with the rule.

Construction site NPDES permits will impact both private development and City capital improvement projects. DEQ manages the permitting of construction sites without involving the City. Elements of the permit requirements will be consistent with the proposed new development standards recommended to augment this management plan.

Injection Well Permits

In many areas of the state, and in particular the Florence area, storm water is disposed using methods that allow infiltration into the soil. Federal regulations have been developed to address the pollution potential of this practice. The federal Underground Injection Control (UIC) program is being implemented by the DEQ. The State is currently developing rules for implementing the program that will be submitted to the EPA for approval. Implementation and enforcement of the program is expected to begin in 2001. The rules will effect Class V injection wells defined according to the DEQ as: "1) any bored, drilled or driven shaft; 2) a dug hole whose depth is greater than its largest surface dimension; 3) an improved sinkhole; or 4) a subsurface fluid distribution system (an assemblage of perforated pipes or drain tiles used to distribute fluids below the surface of the ground)."

Existing privately-owned Class V facilities were to have been registered with the state by December 31, 1999. Municipal agencies have until December 31, 2000 to register existing facilities, while new facilities will be expected to apply for DEQ Water Pollution Control Facilities (WPCF) permits. Although wells located in non-sensitive areas will be covered by a general WPCF permit, wells located in sensitive areas will require individual WPCF permits. Sensitive areas include land adjacent to wetlands, sites within 500 feet of domestic and/or public wells, delineated wellhead protection areas, delineated source water areas, sole source aquifers, groundwater management areas, areas adjacent to endangered species spawning grounds, areas adjacent to water quality limited water bodies or water bodies with set total maximum daily loads, flood plains, and DEQ listed cleanup sites. By the definition, most areas within the Urban Growth Boundary (UGB) will be considered sensitive. The individual permits will require: periodic monitoring, sampling and analysis of the discharge; an operation and maintenance plan; a spill contingency plan, and in many instances, pre-treatment requirements.

ENDANGERED SPECIES ACT REQUIREMENTS

The focus of this section is to review how the ESA regulations will impact City's storm water management activities, and to recommend a strategy for complying with the requirements.

ESA Background

The Endangered Species Act was enacted to prevent extinction of certain species of fish, wildlife, and plants that have seen significant declines in their populations within a defined geographic range, or Evolutionarily Significant Unit (ESU). The rules prohibit a "take", which the ESA defines as "harass, harm, pursue, hunt, shoot, wound, trap, capture, or collect, or attempt to engage in any such conduct". The rules go into effect immediately upon listing by the government. The term "harass" is further defined as any intentional or negligent act that creates the likelihood of injuring wildlife by disrupting normal behavior such as breeding, feeding, or sheltering, whereas "harm" is an act that either kills or injures a listed species. By definition, take and harm can include any habitat modification or degradation that significantly impairs the essential behavioral patterns of fish or wildlife.

The National Marine Fisheries Service (NMFS), a section within the National Oceanic and Atmospheric Administration has responsibility for administering the ESA rules as they apply to marine fish species. Freshwater fish and all other animal and plant species are protected by the U.S. Fish and Wildlife Service (USFWS).

The ESA requirements apply to any activity that could result in a take of an endangered species. According to NMFS, "Any government body authorizing an activity that specifically causes take may be found to be in violation of the Section 9 take prohibitions." State and City governments manage a number of activities that could potentially impact, directly or indirectly, endangered species, including:

- Planning and zoning
- Development permitting
- Erosion and sediment control
- Floodplain management
- Water use
- Storm water discharge
- Wastewater discharge
- Road and bridge construction and maintenance
- Pesticide, herbicide, fertilizer, and other chemical use
- Riparian area protection, alteration, or development
- Wetland protection, alteration, or development
- Estuarine shorelands protection, alteration, or development

In addition, NMFS and the USFWS have a policy to identify specific activities considered likely to result in take. As indicated in the Federal Register "Notice of Threatened Status for Two ESUs of Steelhead in Washington and Oregon" (64 FR 14517), such activities include, but are not limited to:

1. Destroying or altering the habitat of listed salmonids (through activities such as removal of large woody debris or riparian shade canopy, dredging, discharge of fill material, draining, ditching, diverting, blocking, or altering stream channels or surface or ground water flow).

2. Discharging or dumping toxic chemicals or other pollutants into waters or riparian areas supporting listed salmonids.

3. Violating federal or state Clean Water Act discharge permits.

4. Applying pesticides and herbicides in a manner that adversely affects the biological requirements of the species.

5. Introducing non-native species likely to prey on listed salmonid species or to displace them from their habitat.

ESA Enforcement

Enforcement of ESA rules will be by NMFS under Section 9 of ESA. Also, third parties may bring suit under Section 9 against the entity or person alleged to have committed a take. A take permit or a 4(d) take limit is not required if a take does not occur. However, an entity or person will be at risk of violating the rules unless a certainty of compliance is provided as offered under Section 4(d), Section 10 or the federal nexus.

Listed Wildlife and Plants

Four marine fish species have been listed for the Oregon coast from just north of Gold Beach to Astoria, and inland to the coastal range divide. Listings define the status of the species as being one of the following: endangered, threatened, or not warranted. Endangered is defined as, "in danger of extinction throughout all or a significant portion of its range", while threatened means, "likely to become endangered within the foreseeable future throughout all or a significant portion of its range." The candidate classification means the ESA listing status has not yet been determined. The four listed fish species, include:

- Coho Salmon: Threatened
- Cutthroat Trout: Candidate
- Steelhead: Candidate
- Chinook Salmon Not warranted

The USFWS has listed 28 species of plants and animals as endangered or threatened. According to the Oregon Natural Heritage Program records, none of these have been identified in the Florence area. Regardless, the determination of whether or not any of the listed species is present in the Florence area will be a responsibility of the owner/developer of the land. In addition, listings can change; therefore, it is imperative that the owner/developer of a property determine the applicable listings at the time of the proposed activity.

Complying with ESA

The final rules defining NMFS' requirements for conserving the listed steelhead and salmonid ESUs were adopted by NMFS in June 2000, and published in the *Federal Register* on July 10, 2000 (50CFR Part 223). The discussion presented in this document is based on the final rules and on information gathered through discussions with NMFS and others involved in the 4(d) exemption process. In general, three approaches are available to municipalities for complying with the proposed rules: federal nexus, development of a Habitat Conservation Plan (HCP), or qualification for a 4(d) exemption. These options are described in more detail below.

The final 4(d) rules for the different ESUs have different effective dates. The effective date for the steelhead ESU is September 8, 2000. The effective date for the salmon ESUs is January 8, 2001.

Federal Nexus. Activities requiring federal permits (Section 10/404 permits) or projects funded by federal monies require federal agency review and approval. The COE will consult with NMFS or USFWS, as appropriate, through an ESA Section 7 consultation when the project is located within the geographic range of a listed species. Federal approval of the project provides a mechanism for limiting the local jurisdiction's exposure to the take provisions.

HCP. Section 10 of the ESA identifies a process that could result in the issuance of an Incidental Take Permit (ITP). The permit would authorize the incidental take of a listed species, but not authorize the activities that result in take. The value of the ITP is that it provides long-term coverage even if the rules are changed in the future.

To be considered for an ITP, an HCP must be prepared and submitted to either NMFS or USFWS, depending on the listed species. The HCP planning process helps ensure that any potential incidental take would be minimized and mitigated. The HCP process includes an assessment of a specified habitat and the identification of activities required to protect and restore that habitat. Most HCPs approved to date have been for projects that would impact less than 1,000 acres. However, the HCP process is evolving, such that it may be possible to use the HCP approach to provide coverage for broad-based planning and follow-on field and construction activities, while achieving the desired long-term biological and regulatory goals.

The applicant must decide whether to pursue an ITP. While service personnel provide detailed guidance and technical assistance throughout the process, the applicant drives the development of an HCP. The applicant is responsible for submitting a completed permit application, the necessary components of which include: a standard application form, an HCP, an implementation agreement (if required), and, if appropriate, a draft National Environmental Policy Act (NEPA) analysis.

4(d) Exemption

For species listed as threatened, Section 4(d) of the ESA provides that the appropriate service issue regulations deemed "necessary and advisable to provide for the conservation of the species." NMFS issued the proposed 4(d) rules for Oregon coast Coho among with other species in the January 3, 2000 Federal Register. Following public hearings and a public comment period, the final rule adopted in June 2000.

Limits have been established on the take prohibition for certain programs that NMFS has deemed adequate to help conserve the listed species. A 4(d) exemption may be used to allow certain activities to proceed without the additional protection of the federal "take" prohibitions if NMFS finds that the activities are adequately protective of the species. Thus, a local government can apply for a 4(d) limitation to the take prohibitions and once granted, individual activities to implement the plan would be exempt from the take rule. Activities would still need to be implemented in a way that minimizes impact; e.g., timing an activity to not affect spawning or passage during migration. The proposed 4(d) rule lists 13 activities or programs that NMFS considers protective enough to warrant an exception or a limit to the basic rule. These are listed as follows:

1. Activities conducted in accordance with ESA incidental take authorization under Section 10 or Section 7 of ESA.

2. Scientific research activities for a period of up to six months after final rule.

3. Emergency actions to rescue or salvage listed salmonids.

4. Approved fishery management activities.

5. Approved hatchery and genetic management programs.

6. Joint tribal/state resource management plans for tribal treaty fishing activities.

7. Approved state scientific research activities.

8. State, local and private habitat restoration activities as approved by NMFS.

9. Screened water diversion devices meeting NPFS criteria.

10. Road maintenance activities in Oregon conducted in accordance with Oregon Department of Transportation's (ODOT) Road Maintenance Guide.

11. City of Portland park activities in compliance with the Integrated Management Plan.

12. Certain development activities within urban areas meeting a "12-step" integrated urban development plan as approved by NMFS.

13. Forest management activities in Washington.

Several public agencies are negotiating with NMFS to define the programs that would be required to provide eligibility for the 4(d) exemption. For example as cited above, the City of Portland, Oregon, Parks and Recreation Department has received approval of its integrated pest management program, as has the road maintenance plan developed by ODOT. The goal of the City of Portland program is to reduce the use of herbicides and pesticides in routine park maintenance. Other agencies are working to develop programs that they hope will be accepted by NMFS.

In the Portland metropolitan area, the regional government Metro is working to develop an exception or limitation for development occurring within the area's Urban Growth Boundary. Metro is preparing an Urban Growth Management Functional Plan that will define plans and development activities for complying with ESA listings of salmon and steelhead. If approved by NMFS, take prohibitions will not apply to municipal, residential, commercial, and industrial development and redevelopment (MRCI) within the Metro regional area. NMFS will consider the following 12 evaluation criteria when evaluating if proposed MRCI development ordinances or plans adequately conserve the listed species:

1. Avoid inappropriate areas such as steep slopes, wetlands, and areas of high habitat value.

2. Avoid impacts to stream water quality and quantity, and maintain the historic hydrograph, including peak and base flows.

3. Require minimum width riparian buffers around all wetlands and streams.

4. Avoid stream crossings by roads, utilities, and other linear development.

5. Protect historic stream meander patterns, flood plains and channel migration zones.

6. Protect wetlands and wetland functions.

7. Preserve the hydrologic capacity of all intermittent and perennial streams to pass peak flows.

8. Landscape to reduce need for watering and application of herbicides, pesticides and fertilizer.

9. Prevent erosion and sediment runoff during and after construction to prevent discharge of sediment.

10. Assure that water supply demands for new development can be met without impacting flows needed for threatened salmonids.

11. Provide necessary enforcement, funding, and reporting to manage the plan.

12. Comply with all other state and federal environmental or natural resource laws.

While the Metro plan has not yet been approved by NMFS, the broad range of topics included in the plan provides insight to NMFS's expectations. All other cities and public agencies should expect that they will have to submit a comparable plan for NMFS approval.

Other agencies that are attempting to develop broad-based programs acceptable to NMFS include a joint effort by King, Pierce, and Snohomish counties in Washington. While progress has been made in defining a complete 4(d) exemption, the program has not yet been approved. While much of the Washington tri-county effort has been spent negotiating an agreement with NMFS that would be acceptable to the jurisdictions, there is still no indication as to whether NMFS will adopt any or all of the tri-county recommendations. As a result, prudent planning would stress program development consistent with the components described in the July 10, 2000 rule.

NMFS recommends a "plug and play" approach to meeting the 4(d) requirements. Jurisdictions would produce plans to be reviewed by NMFS. If approved, the plans would be published in the Federal Register and be available for others to adopt. While adoption in this manner would save new applicants considerable time and effort in developing compliance plan, the plan must still be "tailored" to meet the specific needs of the listed species within the applicant's jurisdiction. NMFS must review and approve the modified plan before it can provide protection against take.

While there is currently no prototype format for a storm water management plan to serve as a 4(d) limitation on the take prohibitions, NMFS is requesting cities meet with them to discuss ways in which their program can serve as an application for a 4(d) limitation on the take prohibitions. Other than applicable Section 7 consultation requirements, NMFS does not have authority to require review of a city's storm water management plan. However, receiving a limit on the take prohibitions under section 4(d) would provide legal assurance to the city that it would not be subject to a NMFS enforcement action or a third-party lawsuit.

Recommended Strategy

The City should perform a "gap analysis" to determine if, and where, the City may have exposure under the ESA rules. The scope and nature of follow-on activities would be based on the results of the gap analysis.

Where exposure is defined, the City should pursue the plug and play approach identified by NMFS to gain the 4(d) exemption. This approach will provide a certainty of compliance, while not requiring the level of City effort and cost that would be required to prepare a HCP. Projects that fall under the federal nexus would be covered through the federal permitting process.

A disadvantage of the plug and play approach is that the required plans have not been developed or approved by NMFS. The City should adopt the plug and play plans as they become available and if they are applicable to the area; however, the City would be exposed to liability if the plans are not made available in a timely manner. The City should coordinate with Lane County Council of Governments to see if coverage under a cooperative plan would be a possibility.

CHAPTER 4

ANALYSIS RESULTS

This chapter presents the results of the analysis process, including a summary of the public information developed during the involvement process, the hydrologic and hydraulic modeling output, and the groundwater modeling findings. Chapter 5 presents the recommendations made to address the deficiencies identified during the analysis process.

REGION BY REGION SUMMARY

The Florence study area was divided into five regions for public presentation purposes. The regions are referred to by geographic location: Northwest, Northeast, Central, Southwest, and Southeast, as shown in Figure 4-1. For consistency, the same regions are used in discussing the results of the analysis in this chapter and the recommendations in Chapter 5. The regions may include portions of one or more of the hydrologically defined drainage basins presented in Chapter 2.

Problems reported by the public and City staff are presented for each region. The reported problems are derived from verbal and written input from the public, as detailed in Appendix A. City staff and Lane County personnel noted additional problems. Existing reports were examined and the applicable information was used in this study.

The surface water modeling and groundwater modeling were conducted as reported in Chapter 2. A complete listing of the hydrologic and hydraulic modeling results is provided at the end of this chapter for each of the modeled elements in the conveyance system. In addition, an oversized map at the end of this chapter, Figure 4-6, shows the modeled surface water elements and identified problem areas. An explanation of the overall groundwater modeling results follows the regional discussions.

Northwest Region

The Northwest Region lies outside the Florence city limits. It is made up of largely residential neighborhoods south of Heceta Beach Road. The region is characterized by small, rolling dunes that end in steep bluffs overlooking the North Jetty Recreation Area and Heceta Beach. Storm water runoff flows generally east to west in this area.

Natural resources of the region include a large number of wetlands. Most wetlands are found in depressions between the dunes that lie at or below the usual surface of the groundwater table. Many of the wetlands are obvious to the untrained eye and tend to be deep with open water. Shallow wetlands tend to be forested and are often not obvious.

Native vegetation in the area is mainly shore pine, Sitka spruce, salal, evergreen huckleberry, and Pacific rhododendron. In areas exposed to the ocean, high winds limit the size of trees.

Reported Problems

Problems reported in the Northwest Region mostly involve localized flooding of low-lying areas between the dunes. Gullsettle Court and Sandrift Street are low areas along the eastern edge of the Idylewood development, as shown in Figure 4-6. For years, flooding has been reported from this area. During the wetter than average winter of 1981, the intersection of Oceana Drive and Sandrift Street was under 2 feet of water.

Recently, the return to a wet climatic cycle and construction of new homes in low areas have increased the number of flooding complaints. During the past several years, local residents have pumped water out of their neighborhood to keep streets passable and prevent homes from flooding. Unfortunately, the pumped water has allegedly caused problems in neighborhoods surrounding Gullsettle Court and Sandrift Street. In response to this, residents along Saltaire Street at the west end of Sandrift Street have created a small, concrete-lined channel to convey the flow. The channel feeds into an existing 12-inch-diameter pipe running to the west between Seapine Drive and Saltaire Street. The pipe terminates at a short segment of roadside ditch along Rhododendron Drive, where it is joined by another 12-inch culvert running along Rhododendron Drive. The ditch runs to the south about 20 feet and appears to have experienced some erosion. Flows then enter a 12-inch corrugated metal pipe culvert running west under Rhododendron. This culvert appears to be in poor condition, and there is no obvious discharge point from the limited length of ditch along North Jetty Road.

Modeling Results

The storm water and groundwater modeling did not show storm water runoff or a high groundwater table to be a problem in the Idylewood development. However, since the neighborhood lies at a low elevation in relation to the lakes to the east, it is possible that seepage through the intervening sand dunes when lake levels are high is responsible for the flooding. Flooding at the lowest elevation in the area, Gullsettle Court, will continue to be a problem during years with high lake levels.

A number of areas in this region do not have clearly defined drainage paths, or they drain directly to the Pacific Ocean or Siuslaw River. Examples include the Driftwood Shores and Heceta South areas. Runoff quantities from the areas were calculated, but the absence of a defined conveyance system precluded the need for a hydraulic model. As a result, no conveyance facilities were evaluated.

Northeast Region

The Northeast Region covers an area extending from north of Munsel Lake Road to south of Florentine Estates to about 32nd Street, and from the ridge just to the west of Highway 101 to Munsel Creek to the east. The area contains commercial development along Highway 101 from 42nd Street north to Heceta Beach Road, the Florentine Estates residential development, an auto salvage yard north of Munsel Lake Road, and undeveloped property north of the salvage yard and west of Florentine Estates.

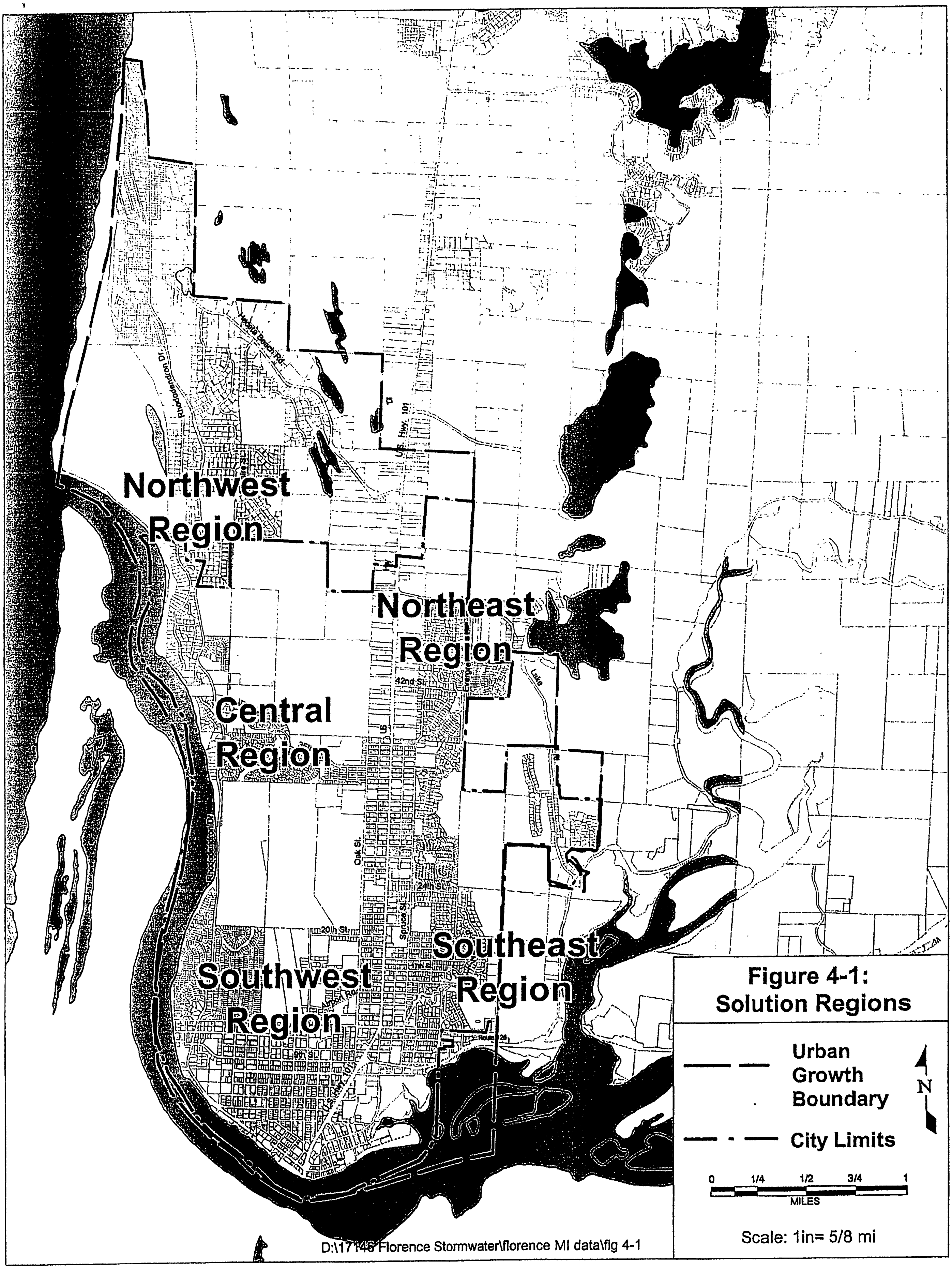


Figure 4-1: Solution Regions

The property along Highway 101 drains into roadside ditches, where most of the water infiltrates before it can leave the basin. If large enough flows occur, the topography of the area would direct flow southeast toward Munsel Creek.

Most of the area north of Munsel Lake Road drains to the southwest, where it enters the northwest corner of Florentine Estates. It flows through a combination of ponds and pipes through the Florentine Estates development and joins Munsel Creek near 45th Court.

Natural resources of the northeast region include Munsel Lake, Munsel Creek, wetlands, and undeveloped upland areas. Munsel Lake covers over 100 acres, and is deeper than most coastal lakes with depths reaching more than 70 feet. The lake is used for recreation, including fishing for trout and warm-water gamefish. Munsel Creek provides good riparian habitat, especially in undeveloped areas such as Greenway Park.

Native vegetation in the area is mainly shore pine, scattered Sitka spruce, Pacific rhododendron, salal, and evergreen huckleberry. The soil surface in undeveloped areas is covered with a thin mat of grass, sedges, needles, and twigs.

Reported Problems. Reported problems include extensive flooding of streets throughout the western third of Florentine Estates, as shown in Figure 4-6. There are also citizen concerns about the impact of storm water infiltration from commercial properties along Highway 101. The concern focuses on the potential for degradation of the aquifer from pollutants discharged from commercial areas.

Modeling Results. Modeling did not show groundwater to be a major factor within Florentine Estates, although extensive areas of high groundwater are located to the north and to the south. The ponds and wetlands resulting from the high groundwater to the north of Munsel Lake Road overflow into Florentine Estates during large storm events. Modeling indicates that the existing conveyance system through Florentine Estates is undersized for the 25-year storm. This causes flooding along streets from the small pond in the northwest corner of Florentine Estates through the twin 18-inch-diameter pipes running along the west edge, to the pond at the junction with Munsel Creek, as shown in Table 4-1.

Table 4-1. Northeast Region Pipes Identified as Undersized

Name	Location	Existing capacity (cfs)	Present flow (cfs)				Future flow (cfs)			
			2	10	25	100	2	10	25	100
MUN330L	Florentine Estates	**3.5**	**4.6**	**5.9**	**6.7**	**7.7**	**8.0**	**8.9**	**8.9**	**8.9**
MUN350L	Sherwood Loop to 45th Ct.	6.1	4.6	5.9	6.7	7.7	8.0	8.9	8.9	8.9
MUN410L	Spruce St. to Munsel Creek	23.0	6.7	9.0	10.2	12.1	20.0	**26.0**	**28.5**	**29.5**
MUN420L	Spruce St. from 40th St.	24.0	6.8	9.0	10.2	12.1	19.9	**26.0**	**28.5**	**29.5**

Note: Numbers shown in bold font indicate flows exceed the capacity of the existing conveyance system.

Modeling also revealed that culverts along Spruce Street south of Florentine Estates may be slightly undersized under future conditions, due to reported negative pipe slopes (the end-to-end slope of the pipe is in the wrong direction) and increases in commercial development along Highway 101. The existing culverts are 36-inch diameter and should be increased to 42-inch diameter culverts in order to pass the 25-year future flows without surcharging. See Figure 4-6 for location of undersized facilities.

Central Region

The Central Region extends from 32nd Street to approximately the city limits to the north and is bounded to the east by the ridge of dunes just west of Highway 101. The region contains large expanses of undeveloped property to the north (most of it publicly owned), a golf course to the south and east, and partially developed, single-family residential development to the south and west. Surface water flows are generally from the northeast to southwest in this area, in part through a chain of lakes located south of Heceta Beach Road. In addition, a culvert under Highway 101 near Heceta Beach Road adds some flows from east of the highway.

Native vegetation in the area includes shore pine, Sitka spruce, salal, Pacific rhododendron, evergreen huckleberry, and a limited amount of Douglas fir and western hemlock in areas sheltered from high winds. Many of the dunes in the area have been planted with beach grass, which stabilizes the sand. Scotch broom has become established near Mariners Village. This European native is an ornamental shrub that likes sun, tolerates drought, and fixes nitrogen. It is considered invasive and can outcompete native vegetation in disturbed areas.

Reported Problems. Problems reported in the Central Region include flooding in Mariners Village, the Sandpines Golf Course area, and along portions of Royal Saint Georges Drive, as shown in Figure 4-6. There are also concerns about the potential groundwater effects on erosion along the bluffs overlooking the Siuslaw River to the west in the Shelter Cove and Sea Watch developments.

A number of investigations have shown that erosion has been occurring for decades at the river bluff. The investigations have concluded that erosion is causing a variety of factors, including runoff at the top of the bluff, wave action at the base of the bluff, and groundwater seepage. The rate seems to vary over time, but no clear cause has emerged that allows prediction of erosion rates.

Modeling Results. Investigation and modeling indicated that an old powerline service road through a relatively flat area to the northeast conveys excess runoff to Mariners Village. Mariners Village has constructed an internal drainage system to carry flows from the northeast corner of the development to a retention facility in the southern corner of the development. The arrangement is a temporary one and has no defined outlet from the pond.

The Sandpines Golf Course receives surface water flows from the northeast. Two large ponds have been constructed on the golf course which provide some detention. Some of the flow across the golf course is routed to the east end of Royal Saint Georges Drive, then south to a culvert and ditch system connecting with Rhododendron Creek. The remainder of the flow travels through a ditch along the west edge of the Sandpines Golf Course property to an area behind the houses along Siano Loop. At that point, the flow enters a long culvert that runs southwest, then northwest to connect to a deep ravine leading to the Siuslaw River. The problems in the area of the golf course include general flooding on the course, and water flowing through properties along Royal Saint Georges Drive.

A number of previous studies have focused on the erosion occurring along the Siuslaw River. This study did not attempt to replicate that work. Due to the concerns of local residents, however, additional infiltration was not considered as a viable alternative for the Central Region.

The modeling also indicated the presence of several surcharged pipes along Oak Street between 25th and 20th Streets. The undersized pipes are listed in Table 4-2.

Table 4-2. Central Region Pipes Identified as Undersized

Name	Location	Existing capacity (cfs)	Present flow (cfs)				Future flow (cfs)			
			2	10	25	100	2	10	25	100
CEN510L	Oak Street from 36th St. to 35th St.	4.6	**8.5**	**9.1**	**9.1**	**9.1**	**8.5**	**9.1**	**9.1**	**9.1**
NRW005L	Rhododendron Dr. to Siuslaw River	25.0	**35.3**	**35.3**	**35.3**	**35.3**	**35.3**	**35.3**	**35.3**	**35.3**
NRW030L	35th Street between Wecoma and Siano	21.0	**29.5**	**29.5**	**29.5**	**29.5**	**29.5**	**29.5**	**29.5**	**29.5**

Note: Numbers shown in bold font indicate flows exceed the capacity of the existing conveyance system.

Southwest Region

The Southwest Region stretches from 32nd Street to the north, to the Siuslaw River to the south and west, and to Highway 101 to the east. It includes the Florence Airport and the Greentrees development. The central portion of this study area drains directly to a ditch that runs south between the airport and the Greentrees development with approximately 700 feet of the ditch in an easement with Greentrees. The ditch continues south of 9th Street past the Florence Wastewater Treatment Plant to the Siuslaw River. The other major drainage system in this region is a series of pipes that run along Kingwood Street, cross the airport south of the runway, reemerge as a channel running south from the runway, and then are piped along 9th Street to the drainage ditch south of the Greentrees development. The Greentrees development lacks an internal drainage system.

Native vegetation in the Southwest Region is mainly shore pine, scattered Sitka spruce, Pacific rhododendron, salal, and evergreen huckleberry. The soil surface in undeveloped areas is covered with a thin mat of grass, sedges, needles, and twigs.

Reported Problems. Reported problems include flooding along Kingwood Street, flooding at a pipe/bubbler link south of the runway, and flooded property and roads in the Greentrees development, as shown in Figure 4-6. Although residents feel most of the latter problems result from the lack of an internal drainage system within the Greentrees development, there have been some complaints about the runoff entering into the Greentrees development from an adjoining, undeveloped property to the east. A few roads in the downtown area also undergo flooding, notably near the Public Library.

Modeling Results. The modeling results showed undersized pipes along Kingwood and Oak Streets. It confirmed that the pipe/bubbler link south of the airport runway is a source of problems. Modeling was not done on smaller downtown pipes, such as those by the library, but larger pipes in the area appeared to be surcharging.

Surcharging along Kingwood Street results from water backing up in a relatively flat section of pipe (CEN230) south of Airport Road. Flat pipes cannot pass the same amount of water as pipes with a steeper slope such as those just upstream; therefore, water backs up. Although the pipes are surcharging, surface flooding does not appear to be a significant issue.

Along Oak Street, the model showed that surcharging occurs from 29th to 21st Streets during storms, but the undersized pipes do not appear to be causing flooding problems.

Subsequent to the modeling the City replaced the pipe/bubbler line south of the airport runway with a larger pipe section. No further action is recommended at this location.

Modeling indicated a number of surcharged pipes in the downtown system. These included pipes along Hemlock Street between 1st and 6th Streets (DTN20L, DTN30L, DTN40L), and along 6th Street between Kingwood and Maple Streets (DTN90L and DTN100L). The larger pipes appeared to surcharge even during the 10-year storm, and smaller tributary pipes have been reported as causing flooding problems; however, the smaller pipes were not modeled. The undersized pipes for the Southwest Region are listed in Table 4-3.

Table 4-3. Southwest Regional Pipes Identified as Undersized

		Existing capacity	Present flow (cfs)				Future flow (cfs)			
Name	Location	(cfs)	2	10	25	100	2	10	25	100
CEN040L	Pipe under 9th St.	82.0	69.0	**85.8**	**94.4**	**108.0**	76.4	**93.4**	**105.0**	**119.0**
CEN080L	N Kingwood St.	30.0	22.2	28.3	**31.2**	**35.4**	25.8	**32.9**	**36.4**	**41.5**
CEN230L	SE Airport Rd.	10.0	**15.0**	**15.7**	**16.0**	**16.4**	**15.0**	**15.7**	**16.0**	**16.4**
CEN250L	Intersection Kingwood St. and Airport Rd.	12.0	**15.0**	**15.7**	**16.0**	**16.4**	**15.0**	**15.7**	**16.0**	**16.4**
CEN260L	Kingwood St. from 17th Pl. to Airport Rd	9.5	8.5	**10.8**	**10.6**	**10.3**	8.5	**10.8**	**10.6**	**10.3**
CEN270L	Airport Wy. from 18th St. to 17th Pl.	9.8	8.4	**11.0**	**12.5**	**14.6**	8.4	**11.0**	**12.5**	**14.6**
CEN290L	N of Airport	7.6	**11.7**	**14.2**	**16.0**	**18.1**	**11.6**	**14.4**	**15.8**	**18.3**
CEN310L	N of Airport	5.9	**12.4**	**15.0**	**16.1**	**18.1**	**11.9**	**14.4**	**15.6**	**18.1**
CEN340L	Oak St. from 21st St. to midblock	15.0	10.9	14.2	**16.0**	**18.8**	10.9	14.2	**16.0**	**18.8**
CEN380L	Oak St. from N of 23rd St. to 23rd St.	14.0	10.9	**14.2**	**16.0**	**18.8**	10.9	**14.3**	**16.1**	**18.9**
CEN390L	Oak St. from midblock to N of 23rd St.	14.0	10.9	**14.2**	**16.0**	**18.8**	10.9	**14.3**	**16.1**	**18.9**
CEN400L	Oak St. from 25th St. to midblock	15.0	10.9	14.2	**16.1**	**18.8**	10.9	14.3	**16.1**	**18.9**

Table 4-3. Southwest Regional Pipes Identified as Undersized (continued)

Name	Location	Existing capacity (cfs)	Present flow (cfs)				Future flow (cfs)			
			2	10	25	100	2	10	25	100
DTN020L	Hemlock St. from 4th St. to 1st St.	15.0	**16.9**	**19.0**	**19.3**	**19.7**	**18.5**	**19.5**	**19.7**	**20.0**
DTN030L	Hemlock St. from Rhododendron to 4th	14.0	**15.4**	**17.1**	**17.1**	**17.6**	**16.9**	**17.6**	**16.9**	**17.6**
DTN040L	Hemlock St. from 6th St. to Rhododendron	12.0	**15.3**	**17.2**	**17.1**	**17.5**	**16.9**	**17.6**	**17.6**	**17.6**
DTN090L	6th St. from Laurel St. to Kingwood St.	6.5	6.5	**9.1**	9.2	9.9	7.8	**11.0**	**10.9**	**10.5**
DTN100L	6th St. from Maple St. to Laurel St.	8.1	6.5	**8.5**	9.3	9.8	7.82	**9.1**	9.6	9.2

Note: Numbers shown in bold font indicate flows exceed the capacity of the existing conveyance system.

Southeast Region

The Southeast Region lies between 32nd Street to the north, the Siuslaw River to the south, Highway 101 to the west, and the hills to the east. Munsel Creek is its most defining feature, along with the large wetland area between the hills and the creek. The wetland has formed in a deflation plain, where the sand was scoured away by the wind. There is no natural drainage outlet for the area.

Native vegetation in the area is mainly shore pine, scattered Sitka spruce, Pacific rhododendron, salal, and evergreen huckleberry. The soil surface in undeveloped areas is covered with a thin mat of grass, sedges, needles, and twigs. Many of the young shore pines to the north of the delineated wetland areas became established during the relatively dry 1980s, and will probably not survive the current wet cycle and elevated groundwater table.

Reported Problems. Local residents and City staff have reported flooding problems on streets and around home foundations in low-lying areas next to the wetlands, as shown in Figure 4-6. The problems are widespread and often persist for weeks at a time.

Modeling Results. Modeling confirmed that a high groundwater table exists in the area. During the past several years, the water table has been exceptionally high, exacerbating the flooding problem. Lowering surface water elevations to more normal levels should solve most of the reported problems.

Modeling also indicated that the Siuslaw River causes about 3 feet of water to back up Munsel Creek. This extends as far as 10th Street, but the surcharging occurs only at the culvert under State Highway 126. Table 4-4 lists undersized pipes for the Southeast Region.

Table 4-4. Southeast Region Pipes Identified as Undersized

Name	Location	Existing capacity (cfs)	Present flow (cfs)				Future flow (cfs)			
			2	10	25	100	2	10	25	100
MUN020L	Highway 126	1.9	27.9	33.5	38.5	43.8	33.8	41.9	43.6	44

Note: Numbers shown in bold font indicate flows exceed the capacity of the existing conveyance system.

GROUNDWATER MODELING

The modeling used to predict groundwater elevations for dry, average and wet scenarios is shown in Table 4-5.

Table 4-5. Annual Rainfall Scenarios

Type of year	Example	Rainfall (inches)
Dry	1988	47
Average	1987	69
Wet	1996	122

The results of the modeling are shown as Figures 4-2 through 4-4. The groundwater elevation increased by roughly 15 feet between dry and average years and between average and wet years. By superimposing groundwater elevations with maps of ground contours, the results showed that during dry years, very few areas contained emergent groundwater, manifested as lakes or wetlands. A moderate number of these areas are present during years of average rainfall. During wet years, such as 1996-1998 or the early 1980s, large areas of Florence undergo flooding from the high groundwater table.

Plotting monthly groundwater elevations during the modeled time period, July 1996 through March 1997, showed that the month with the highest groundwater elevation was February, which is also when the most rain fell, as shown in Figure 4-5. Groundwater elevations in March were almost as high, even though the rainfall volume was substantially less. July showed relatively high groundwater levels, even though rainfall was almost nonexistent. Although rainfall increased sharply in September, the effect on groundwater was not seen for several more months.

Groundwater elevations are affected by rainfall. The relationship between rainfall volume, groundwater elevations, and the extent and duration of flooding in the area can be explained by the rate at which water moves through the soil. Water moves both horizontally and vertically through the soil at a significantly lower rate than water movement on the ground surface. As a result, groundwater conditions always lag behind the rainfall events to the extent that single rainfall events have little effect on the groundwater elevations. Instead, rainfall volume that is accumulated over the course of months or years affects groundwater elevations. For this reason, the flooding due to high groundwater conditions in Florence lasts for extended periods of time, unlike the flooding associated with undersize pipes or culverts. It also indicates that groundwater solutions need to be designed based on the long-term conditions.

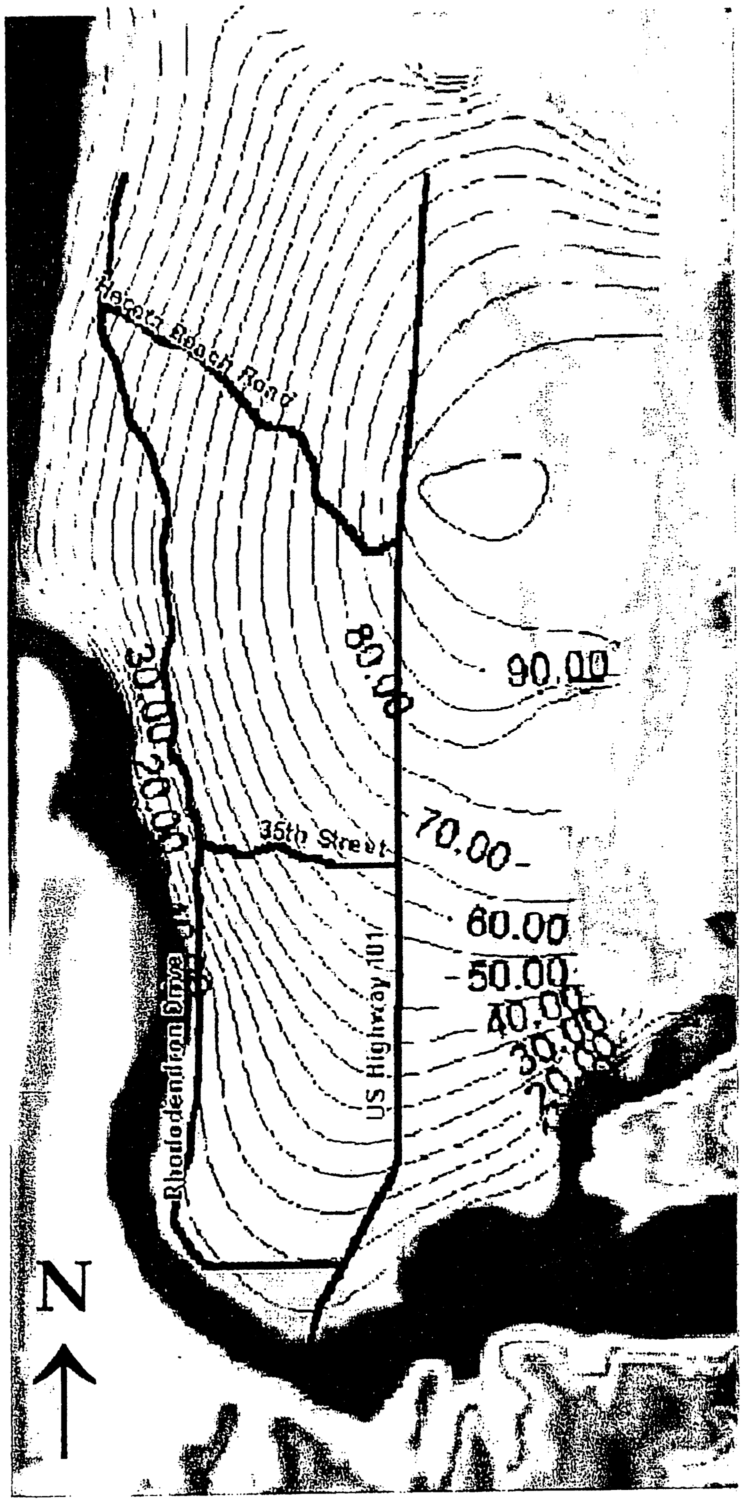


Figure 4-2. Groundwater Elevation, Dry Year

Note: Water elevations shown are above mean sea level.

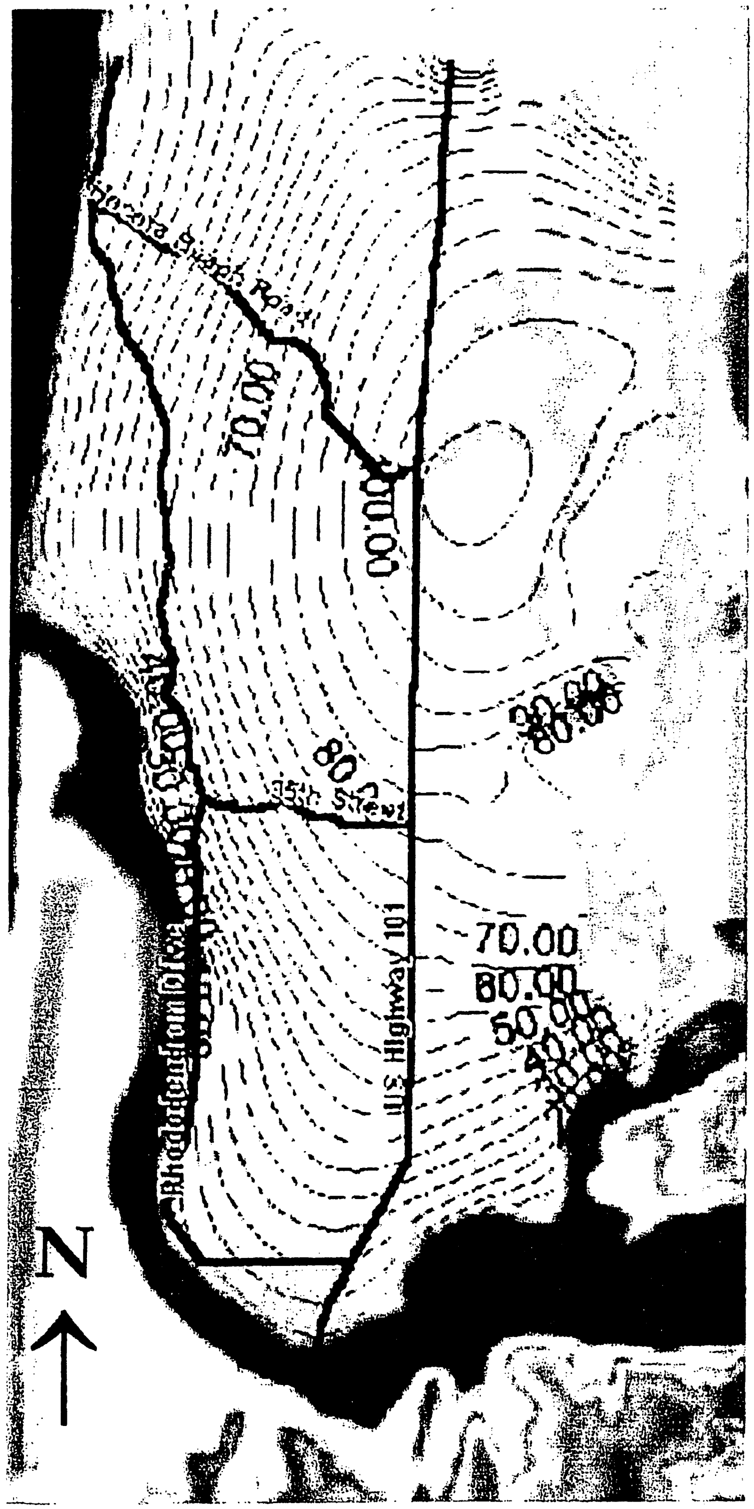


Figure 4-3. Groundwater Elevation, Normal Year

Note: Water elevations shown are above mean sea level.

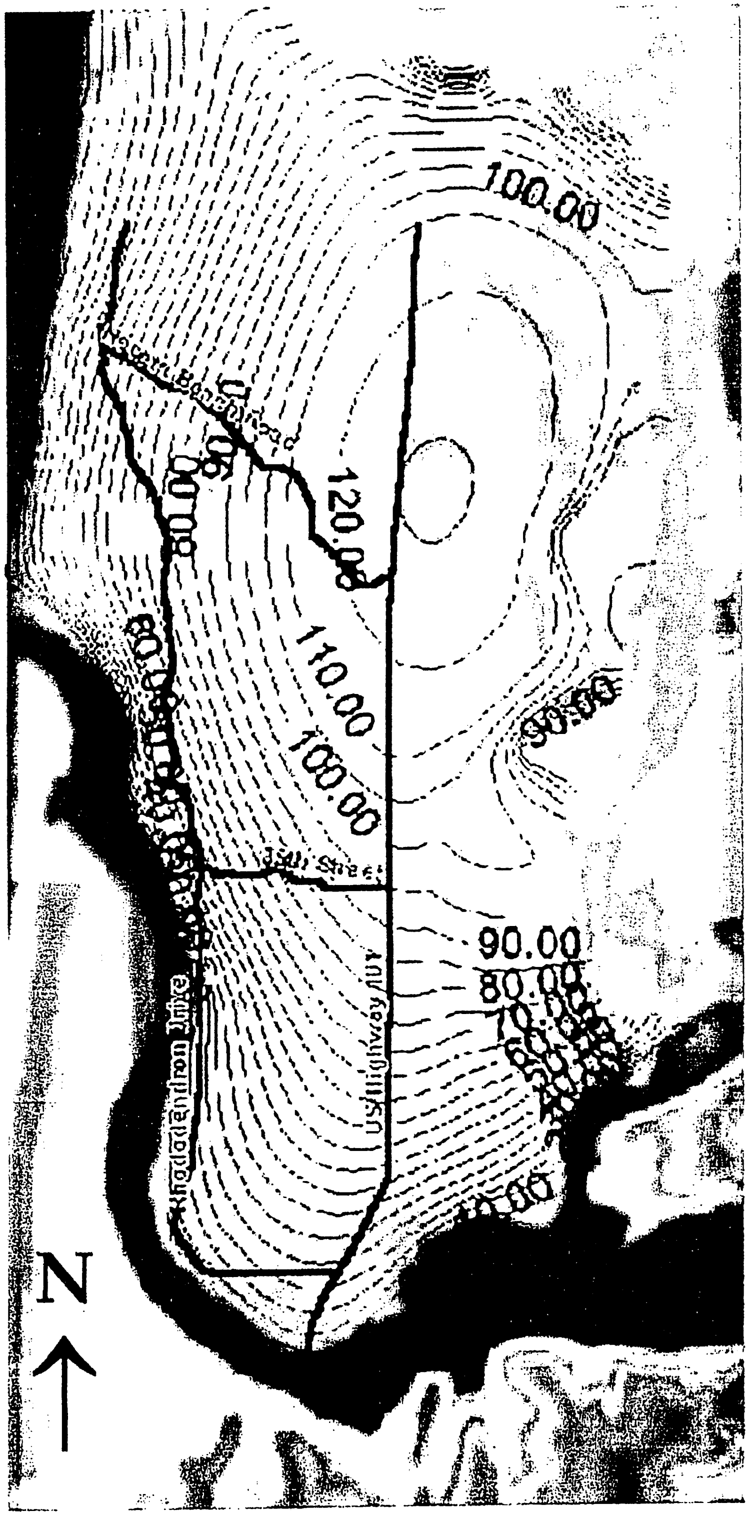
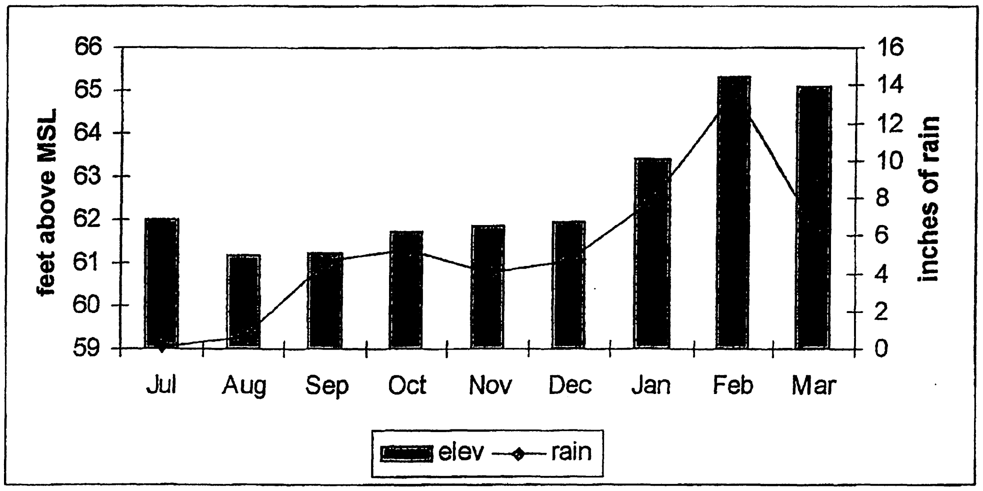


Figure 4-4. Groundwater Elevation, Wet Year

Note: Water elevations shown are above mean sea level.

Figure 4-5. Monthly Groundwater Elevations



HYDROLOGIC AND HYDRAULIC MODELING FINDINGS

The results of the hydrologic and hydraulic modeling of the surface storm water system are shown in Table 4-6. The model segments identified in the table correspond to the elements shown in Figure 4-6. The results are shown for existing (present) and future conditions for the full range of design storms (2-, 10-, 25-, and 100-year return events).

EROSIVE VELOCITIES IN CHANNELS

The flow velocities in open channels were compared to the criteria listed in Chapter 2 to determine areas of potential erosion. Only five modeled segments exceeded 3 feet per second. Four of the segments, MUN060L, MUN110L, MUN120L, and MUN190L, along Munsel Creek had velocities between 3 and 4.5 feet per second during the 2 year storm. This is probably not enough to warrant further action at this point. The fifth segment, NWR015L, is the section of Rhododendron Creek downstream of Skookum Drive. The velocity here was reported as 6.7 feet per second and the area should be inspected to see if bank stabilization measures are needed. Table 4-7 lists channel velocities for the 2-year storm for both the existing and future flow scenarios.

Table 4-6. Conveyance Modeling Elements

(See Figure 4-6 for model segment locations)

Name	Location	Length (ft)	Diameter (in)	Slope	Design flow (cfs)	Present Flow (cfs)				Future Flow (cfs)				Freeboard (feet)
						2	10	25	100	2	10	25	100	
CEN010L	Rhododendron Dr. to Siuslaw River W of downtown	268	TC	0.00687	650	70.0	87.5	93.3	106.0	77.2	93.2	102.0	117.0	2.2
CEN020L	Pipe under Rhododendron Dr.	114	36	0.02158	98	70.0	87.5	93.3	***106.0***	77.2	93.0	*102.0*	***117.0***	1.6
CEN030L	Channel from 9th St S to Rhododendron Dr.	1398	TC	0.00837	581	68.8	85.6	94.2	108.0	76.3	93.3	104.0	119.0	7.6
CEN040L	Pipe under 9th St	69	60	0.00362	82	69.0	***85.8***	***94.4***	***108.0***	76.4	***93.4***	***105.0***	***119.0***	5.6
CEN050L	Channel from Greentrees to 9th St.	1334	TC	0.01115	149	64.5	64.7	72.4	84.7	63.9	72.4	83.0	96.2	6.3
CEN053L	Channel SE of Greentrees	833	TC	0.00224	91	47.9	59.9	67.3	78.6	54.8	68.9	78.9	90.7	4.2
CEN056L	Channel between Airport and Greentrees	799	TC	0.00234	203	43.7	57.6	65.4	76.4	51.7	68.1	77.7	89.2	4.4
CEN060L	Channel W of Airport	1511	NC	0.00207	313	41.4	53.6	60.4	70.1	49.6	64.5	73.2	87.8	2.4
CEN065L	Channel along N Kingwood Dr.	2329	TC	0.00442	410	26.9	35.1	39.2	45.1	32.7	42.6	47.8	55.1	6.2
CEN070L	Channel along N Kingwood Dr.	733	NC	0.00266	512	22.1	28.1	31.0	35.3	25.6	32.7	36.3	41.3	5.4
CEN080L	N Kingwood Dr.	96	48	0.00156	30	22.2	28.3	***31.2***	***35.4***	25.8	***32.9***	***36.4***	***41.5***	2.1
CEN090L	Channel NW of LCC	1684	NC	0.00433	142	16.3	20.0	21.6	23.9	18.4	22.6	24.6	27.5	1.8
CEN100L	Channel N of LCC	623	TC	0.00140	259	13.0	15.1	15.9	17.1	13.4	15.6	16.5	17.8	3.3
CEN110L	Oak St. from 32nd St. to discharge point	158	30	0.00696	34	13.3	15.2	16.0	17.2	13.6	15.7	16.6	17.9	2.8
CEN120L	Oak St. from midblock to 32nd St.	265	27	0.00445	21	13.3	15.2	16.0	17.2	13.6	15.7	16.6	17.9	2.5
CEN130L	Oak St. from 34th St. to midblock	340	27	0.00438	21	13.3	15.2	16.0	17.2	13.6	15.7	16.6	17.9	3.0
CEN140L	Oak St. from 35th St. to 34th St.	242	24	0.00227	11	8.5	9.1	9.1	9.2	8.5	9.1	9.1	9.2	3.4
CEN150L	Intersection of 35th St. and Oak St.	59	24	0.03034	39	8.5	9.1	9.1	9.1	8.5	9.1	9.1	9.1	2.0
CEN180L	9th St. from Driftwood St.	512	18	0.00555	8	3.0	3.5	3.9	4.6	2.9	3.5	3.9	4.6	9.0
CEN190L	9th St. from Greenwood	493	42	0.00160	40	16.5	19.0	19.9	20.5	17.0	19.6	20.2	21.0	7.2
CEN200L	9th St. from Ivy St. to Greenwood St.	668	42	0.00219	47	15.5	17.5	18.2	18.5	16.1	18.1	18.4	19.0	13.7
CEN210L	Channel from Airport to 9th St.	1028	TC	0.01089	5510	16.6	17.8	18.4	19.2	17.1	18.5	19.1	20.1	9.9
CEN220L	12th St. S of Airport	54	33.96	0.03333	104	15.0	15.7	16.0	16.4	15.0	15.7	16.0	16.4	7.5

Abbreviations: TC = trapezoidal channel
NC = natural channel

Table 4-6. Conveyance Modeling Elements (continued)

(See Figure 4-6 for model segment locations)

Name	Location	Length (ft)	Diameter (in)	Slope	Design flow (cfs)	Present Flow (cfs)				Future Flow (cfs)				Freeboard (feet)
						2	10	25	100	2	10	25	100	
CEN230L	SE Airport	431	24	0.00195	10	***15.0***	***15.7***	***16.0***	***16.4***	***15.0***	***15.7***	***16.0***	***16.4***	2.3
CEN240L	SE Airport	84	24	0.00786	20	15.0	15.7	16.0	16.4	15.0	15.7	16.0	16.4	6.4
CEN250L	Intersection of Airport Wy and Airport Rd.	180	24	0.00267	12	***15.0***	***15.7***	***16.0***	***16.4***	***15.0***	***15.7***	***16.0***	***16.4***	1.8
CEN260L	Airport St. from 17th Pl to Airport Rd	828	24	0.00178	10	8.5	***10.8***	***10.6***	***10.3***	8.5	***10.8***	***10.6***	***10.3***	***0.0***
CEN270L	Airport Wy from 18th St. to 17th Pl	411	24	0.00187	10	8.4	***11.0***	***12.5***	***14.6***	8.4	***11.0***	***12.5***	***14.6***	1.2
CEN290L	N of Airport	179	24	0.00112	8	***11.7***	***14.2***	***16.0***	***18.1***	***11.6***	***14.4***	***15.8***	***18.3***	2.7
CEN300L	N of Airport	382	TC	0.00079	173	11.8	14.1	15.3	17.2	11.1	13.6	14.9	17.5	5.7
CEN310L	N of Airport	148	24	0.00068	6	***12.4***	***15.0***	***16.1***	***18.1***	***11.9***	***14.4***	***15.6***	***18.1***	5.1
CEN320L	Channel N of 20th St.	752	TC	0.00093	387	9.7	11.9	13.0	14.8	9.4	11.6	12.8	14.9	7.1
CEN330L	Oak Street west to discharge	675	36	0.00080	19	10.9	14.1	15.8	18.4	10.9	14.1	15.8	18.5	4.2
CEN340L	Oak St. from 21st St. to midblock	71	30	0.00141	15	10.9	14.2	***16.0***	***18.8***	10.9	14.2	***16.0***	***18.8***	3.9
CEN350L	Oak St. at 21st St.	63	30	0.00159	16	10.9	14.2	16.0	***18.8***	10.9	14.2	16.0	***18.8***	4.0
CEN360L	Oak St. from 22nd St. to 21st St.	275	30	0.01513	50	10.9	14.2	16.0	18.8	10.9	14.2	16.1	18.9	3.8
CEN370L	Oak St. from 23rd St. to 22nd St.	320	30	0.00172	17	10.9	14.2	16.0	***18.8***	10.9	14.3	16.1	***18.9***	4.3
CEN380L	Oak St. from N of 23rd St. to 23rd St.	132	24	0.00371	14	10.9	***14.2***	***16.0***	***18.8***	10.9	***14.3***	***16.1***	***18.9***	3.9
CEN390L	Oak St. from midblock to N of 23rd St.	215	24	0.00377	14	10.9	***14.2***	***16.0***	***18.8***	10.9	***14.3***	***16.1***	***18.9***	3.9
CEN400L	Oak St. from 25th St. to midblock	275	24	0.00451	15	10.9	14.2	***16.1***	***18.8***	10.9	14.3	***16.1***	***18.9***	3.8
CEN410L	Oak St. from 26th St. to 25th St.	330	21	0.00458	11	1.6	2.1	2.9	4.3	1.6	2.1	2.9	4.3	5.5
CEN420L	Oak St. from 27th St. to 26th St.	288	21	0.00455	11	1.6	2.1	2.3	3.4	1.6	2.1	2.3	3.5	6.1
CEN430L	Oak St. from 28th St. to 27th St.	313	18	0.00447	7	1.6	2.1	2.3	2.8	1.6	2.1	2.3	2.8	6.1
CEN440L	Oak St. from 29th St. to 28th St.	313	18	0.00476	7	1.6	2.1	2.3	2.7	1.6	2.1	2.3	2.7	5.8
CEN450L	Oak St. from 30th St. to 29th St.	282	15	0.00287	4	1.6	2.1	2.3	2.7	1.6	2.1	2.3	2.7	3.7
CEN455L	S of Laurelwood Ln.	402	TC	0.00694	634	2.3	3.0	3.4	3.9	4.0	5.2	5.9	6.9	4.3
CEN460L	Between Laurelwood Ln and Myrtle Lp.	287	42	0.00160	40	2.3	3.0	3.4	3.9	4.0	5.2	5.9	6.9	3.8

Abbreviations: TC = trapezoidal channel
NC = natural channel

Table 4-6. Conveyance Modeling Elements (continued)

(See Figure 4-6 for model segment locations)

Name	Location	Length (ft)	Diameter (in)	Slope	Design flow (cfs)	Present Flow (cfs)				Future Flow (cfs)				Freeboard (feet)
						2	10	25	100	2	10	25	100	
CEN470L	34th Pl. to Myrtle Lp.	157	42	0.00064	25	2.3	3.0	3.4	3.9	4.0	5.2	5.9	6.9	3.3
CEN480L	Laurelwood St. from 35th St. to 35th Pl.	349	36	0.00544	49	2.3	3.0	3.4	3.9	4.0	5.2	5.9	6.9	3.8
CEN490L	35th St. at Laurelwood	68	36	0.00529	49	2.3	3.0	3.4	3.9	4.0	5.2	5.9	6.9	3.3
CEN500L	35th St. at Laurelwood	64	36	0.00297	36	2.3	3.0	3.4	3.9	4.0	5.2	5.9	6.9	2.7
CEN510L	Oak St. from 36th St. to 35th St.	319	18	0.00194	5	***8.5***	***9.1***	***9.1***	***9.1***	***8.5***	***9.1***	***9.1***	***9.1***	***0.0***
DTN010L	1st St. to Siuslaw River	273	24	0.02388	35	16.9	19.0	19.2	19.7	18.5	19.5	19.7	20.0	1.6
DTN020L	Hemlock St. from 4th St. to 1st St.	365	24	0.00433	15	***16.9***	***19.0***	***19.3***	***19.7***	***18.5***	***19.5***	***19.7***	***20.0***	3.5
DTN030L	Hemlock St. from Rhododendron Dr. to 4th St.	355	24	0.00377	14	***15.4***	***17.1***	***17.1***	***17.6***	***16.9***	***17.6***	***17.6***	***17.6***	5.2
DTN040L	Hemlock St. from 6th St. to Rhododendron Dr.	304	24	0.00286	12	***15.3***	***17.2***	***17.1***	***17.5***	***16.9***	***17.6***	***17.6***	***17.6***	1.1
DTN050L	6th St. from Ivy St. to Hemlock St.	282	24	0.00649	18	14.2	16.1	16.0	16.3	15.5	17.0	16.9	16.8	***0.0***
DTN060L	6th St. from Juniper St. to Ivy St.	357	24	0.00504	16	10.3	13.0	13.2	13.6	11.6	12.9	12.9	13.5	0.1
DTN070L	6th St. from Kingwood St. to Juniper St.	346	24	0.00465	15	10.3	13.0	13.2	13.7	11.6	12.8	13.7	13.5	0.5
DTN080L	Ivy St. from 7th St. to 6th St.	320	24	0.00403	14	3.1	4.2	4.6	5.4	3.2	4.2	4.7	5.4	0.7
DTN090L	6th St. from Laurel St. to Kingwood St.	390	18	0.00382	7	***6.5***	***9.1***	***9.2***	***9.9***	***7.8***	***11.0***	***10.9***	***10.5***	***0.0***
DTN100L	6th St. from Maple St. to Laurel St.	320	18	0.00594	8	6.5	***8.5***	***9.3***	***9.8***	7.8	***9.1***	***9.6***	***9.6***	***0.0***
MUN010L	Hwy 126 to Siuslaw River	949	TC	***-0.00062***	85	83.5	***101.0***	***115.0***	***131.0***	***101.0***	***126.0***	***131.0***	***131.0***	10.5
MUN020L	Hwy 126	126	30	0.00008	2	***27.9***	***33.5***	***38.5***	***43.8***	***33.8***	***41.9***	***43.6***	***44.0***	5.3
MUN030L	10th St. to Hwy 126	292	NC	0.00712	235	67.2	86.8	101.0	112.0	87.0	110.0	113.0	114.0	***0.0***
MUN040L	Spruce St. to 10th St.	882	TC	0.00724	115	69.0	88.5	98.9	108.0	86.5	108.0	106.0	112.0	***0.0***
MUN050L	Spruce St. downtown	121	84	0.00760	290	69.9	91.4	100.0	127.0	87.8	119.0	129.0	149.0	0.9
MUN060L	15th Pl. to Spruce St.	1003	TC	0.00527	532	56.8	81.3	90.9	108.0	80.2	107.0	116.0	124.0	7.5
MUN090L	18th St. to 15th Pl.	2794	TC	0.00304	404	57.6	82.5	91.8	109.0	81.3	108.0	116.0	125.0	2.8
MUN100L	18th St.	60	54	0.01000	102	19.2	28.1	30.6	36.9	26.9	36.1	38.7	42.1	7.3
MUN110L	E of Park Dr. to 18th St.	821	NC	0.00542	1630	55.6	75.4	85.4	102.0	78.8	102.0	109.0	117.0	13.9

Abbreviations: TC = trapezoidal channel
NC = natural channel

Table 4-6. Conveyance Modeling Elements (continued)

(See Figure 4-6 for model segment locations)

Name	Location	Length (ft)	Diameter (in)	Slope	Design flow (cfs)	Present Flow (cfs)				Future Flow (cfs)				Freeboard (feet)
						2	10	25	100	2	10	25	100	
MUN120L	23rd St. to E of Park Dr.	961	NC	0.00349	5140	55.7	74.7	85.7	102.0	78.8	102.0	110.0	118.0	14.0
MUN130L	23rd St.	68	72	0.00147	162	55.7	74.7	85.8	102.0	78.9	102.0	110.0	118.0	2.6
MUN140L	Outer Dr. to 23rd St.	457	NC	0.00635	678	55.8	74.8	85.9	102.0	79.0	102.0	110.0	118.0	2.7
MUN150L	Munsel Ck Greenway Pk	224	NC	***-0.00402***	560	53.3	71.5	82.0	97.6	76.4	98.4	105.0	112.0	4.2
MUN160L	Munsel Ck Greenway Pk	40	84	***-0.02000***	470	53.3	71.5	82.0	97.6	76.4	98.4	105.0	112.0	3.4
MUN170L	Munsel Ck Lp. to Munsel Ck Greenway Pk	3715	TC	0.00585	1270	38.7	51.6	59.0	69.9	62.2	77.9	81.1	81.1	5.5
MUN180L	Munsel Ck Lp. bridge	38	0	0.02737	424	40.1	53.3	60.9	71.9	64.1	78.6	81.2	81.3	3.4
MUN190L	Munsel Ck Lp.	999	TC	0.00461	130	40.1	53.4	60.9	72.0	64.1	78.7	81.3	81.3	***0.0***
MUN200L	Munsel Ck E of Munsel Ck Dr.	1508	TC	0.00460	175	35.0	46.1	52.4	61.5	46.0	58.3	63.9	78.6	2.9
MUN210L	Culvert under 42nd St.	40	60	0.01450	163	35.5	46.6	53.0	62.0	46.5	58.7	64.4	72.7	2.9
MUN220L	Florentine Estates to 42nd St.	1308	TC	0.00142	275	18.8	24.7	27.9	32.6	25.5	31.1	32.8	35.9	5.1
MUN230L	Munsel Ck SE of Sherwood Lp.	694	NC	0.00810	534	10.3	13.4	15.2	17.8	10.3	13.4	15.2	17.8	7.2
MUN240L	Florentine Estates	39	60	0.01538	168	10.3	13.4	15.2	17.8	10.3	13.4	15.2	17.8	5.9
MUN250L	Florentine Estates	675	NC	0.00443	868	10.3	13.5	15.2	17.8	10.3	13.5	15.2	17.8	5.3
MUN260L	Florentine Estates	36	60	0.02000	192	10.3	13.4	15.2	17.8	10.3	13.4	15.2	17.8	5.0
MUN270L	Munsel Lk Rd to Florentine Estates Rd.	802	TC	0.00582	321	10.4	13.5	15.3	17.9	10.4	13.5	15.3	17.9	7.5
MUN280L	Culvert under Munsel Lk Rd.	107	60	0.01131	277	10.4	13.5	15.3	17.9	10.4	13.5	15.3	17.9	7.9
MUN290L	Nordahl Rd to Munsel Lk Rd.	785	TC	0.00414	196	10.4	13.5	15.3	17.9	10.4	13.5	15.3	17.9	6.6
MUN300L	Outlet of Munsel Lk	21	36	***-0.00143***	13	10.4	***13.5***	***15.3***	***17.9***	10.4	***13.5***	***15.3***	***17.9***	6.0
MUN320L	Discharge from Florentine Estates pond 2	48	18	0.11458	36	3.0	3.9	4.5	5.1	5.4	5.9	5.9	6.0	3.1
MUN330L	Florentine Estates	155	18	0.00110	4	***4.6***	***5.9***	***6.7***	***7.7***	***8.0***	***8.9***	***8.9***	***8.9***	1.2
MUN340L	N of 45th Ct	48	18	0.00917	10	4.6	5.9	6.7	7.7	8.0	8.9	8.9	8.9	1.3
MUN350L	Sherwood Lp. to 45th Ct.	326	18	0.00337	6	4.6	5.9	***6.7***	***7.7***	***8.0***	***8.9***	***8.9***	***8.9***	***0.0***
MUN360L	SW part of Sherwood Lp.	579	18	0.00475	7	2.1	2.7	3.1	4.2	4.9	5.8	5.8	5.6	5.2

Abbreviations: TC = trapezoidal channel
NC = natural channel

Table 4-6. Conveyance Modeling Elements (continued)

(See Figure 4-6 for model segment locations)

Name	Location	Length (ft)	Diameter (in)	Slope	Design flow (cfs)	Present Flow (cfs)				Future Flow (cfs)				Freeboard (feet)
						2	10	25	100	2	10	25	100	
MUN370L	W of Florentine Estates	838	18	0.00451	7	2.1	2.7	3.1	4.0	4.5	5.2	5.3	5.2	1.9
MUN380L	NW of Florentine Estates	76	TC	***-0.02513***	504	4.2	5.5	6.2	7.8	9.0	10.8	11.2	11.6	***0.0***
MUN390L	NW of Florentine Estates	207	TC	0.00676	360	4.2	5.5	6.2	7.5	9.0	12.2	13.9	16.3	1.8
MUN400L	Culvert under Munsel Lk Rd.	53	24	0.03283	41	4.2	5.4	6.2	7.2	9.0	11.6	13.2	15.4	3.2
MUN410L	Spruce St. to Munsel Ck.	324	36	0.00123	23	6.7	9.0	10.2	12.1	20.0	***26.0***	***28.5***	***29.5***	4.4
MUN420L	Spruce St. from 40th St.	682	36	0.00132	24	6.8	9.0	10.2	12.1	19.9	***26.0***	***28.5***	***29.5***	3.2
MUN430L	40th St.	186	36	0.01871	91	7.0	9.1	10.3	12.1	20.0	26.0	28.5	29.5	2.9
MUN440L	W end of 40th St.	44	24	0.02545	36	7.0	9.1	10.3	12.1	20.0	26.1	28.5	29.5	0.2
MUN450L	42nd St. to 40th St.	607	TC	0.01255	59	7.0	9.1	10.3	12.1	20.0	26.3	38.2	39.8	0.4
MUN470L	Willow St. to Munsel Ck	93	TC	0.05516	75	6.8	8.8	9.9	11.6	7.0	9.1	15.2	20.5	1.5
MUN480L	Willow St. and Outer Dr.	55	24	0.04182	46	6.8	8.8	9.9	11.6	7.0	9.1	10.4	12.2	1.6
NRW005L	Rhodo. Dr. to Siuslaw River S of Siuslaw Village	100	24	0.01270	25	***35.3***	***35.3***	***35.3***	***35.3***	***35.3***	***35.3***	***35.3***	***35.3***	***0.0***
NRW010L	Rhododendron Dr. S of Siuslaw Village	69	36	0.02014	95	39.5	41.9	43.6	46.0	39.5	41.9	43.6	46.0	1.3
NRW015L	Channel from Skookum Dr. to Rhododendron Dr.	1075	TC	0.02719	50	40.0	42.0	43.6	46.1	40.0	42.0	43.6	46.1	2.9
NRW020L	Skookum Dr.	153	36	0.03209	119	39.7	42.0	43.7	46.2	39.7	42.0	43.7	46.2	3.9
NRW025L	Channel from 35th to Skookum Dr. at Siuslaw Village	1023	NC	0.01719	1660	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	4.7
NRW030L	35th St. between Wecoma Dr. and Siano Lp.	79	24	0.00873	21	***29.5***	***29.5***	***29.5***	***29.5***	***29.5***	***29.5***	***29.5***	***29.5***	***0.0***

Abbreviations: TC = trapezoidal channel
NC = natural channel

Table 4-7. Channel Velocities

Segment name	Location	Velocity, feet per second	
		Present	Future
CEN010L	Rhododendron Drive to Siuslaw River west of downtown	1.54	1.69
CEN030L	Channel from 9th Street south to Rhododendron Drive	2.90	2.96
CEN050L	Channel from Greentrees to 9th Street	***3.67***	***3.66***
CEN053L	Channel southeast of Greentrees	2.57	2.69
CEN056L	Channel between Airport and Greentrees	2.31	2.48
CEN060L	Channel west of Airport	2.91	***3.06***
CEN065L	Channel along north Kingwood Drive	0.74	0.85
CEN070L	Channel along north Kingwood Drive	2.70	2.84
CEN090L	Channel northwest of Lane Community College	1.64	1.65
CEN100L	Channel north of Lane Community College	0.63	0.61
CEN210L	Channel from Airport to 9th Street	1.04	1.06
CEN300L	North of Airport	0.32	0.29
CEN320L	Channel north of 20th Street	0.29	0.27
CEN455L	South of Laurelwood Lane	0.36	0.36
MUN010L	Highway 126 to Siuslaw River	-2.07	-2.49
MUN030L	10th Street to Highway 126	1.85	2.40
MUN040L	Spruce Street to 10th Street	***3.53***	***3.89***
MUN060L	15th Place to Spruce Street	***4.37***	***4.82***
MUN090L	18th Street to 15th Place	***3.61***	***3.94***
MUN110L	East of Park Drive to 18th Street	***4.13***	***4.45***
MUN120L	23rd Street to east of Park Drive	***3.19***	***3.61***
MUN140L	Outer Drive to 23rd Street	2.92	***3.23***
MUN150L	Munsel Creek Greenway Park	-1.94	-2.32
MUN170L	Munsel Creek Loop to Munsel Creek Greenway Park	1.11	1.55
MUN190L	To Munsel Creek Loop	***4.16***	***4.77***
MUN200L	Munsel Creek east of Munsel Creek Drive	1.89	2.19
MUN220L	Florentine Estates to 42nd Street	1.76	1.94
MUN230L	Munsel Creek southeast of Sherwood Loop	2.53	2.09
MUN250L	Florentine Estates	2.39	2.39
MUN270L	Munsel Lake Road to Florentine Estates Road	1.30	1.30
MUN290L	Nordahl Road to Munsel Lake Road	1.71	1.71
MUN310L	Highway 101 to Munsel Creek (not used)	0.00	0.00
MUN380L	Northwest of Florentine Estates	0.35	-0.44
MUN390L	Northwest of Florentine Estates	0.42	0.48
MUN450L	42nd Street to 40th Street	2.01	2.99
MUN470L	Willow Street to Munsel Creek	2.83	2.18
NRW015L	Channel from Skookum Drive to Rhododendron Drive	***6.70***	***6.70***
NRW025L	Channel from 35th to Skookum Drive at Siuslaw Village	1.82	1.82

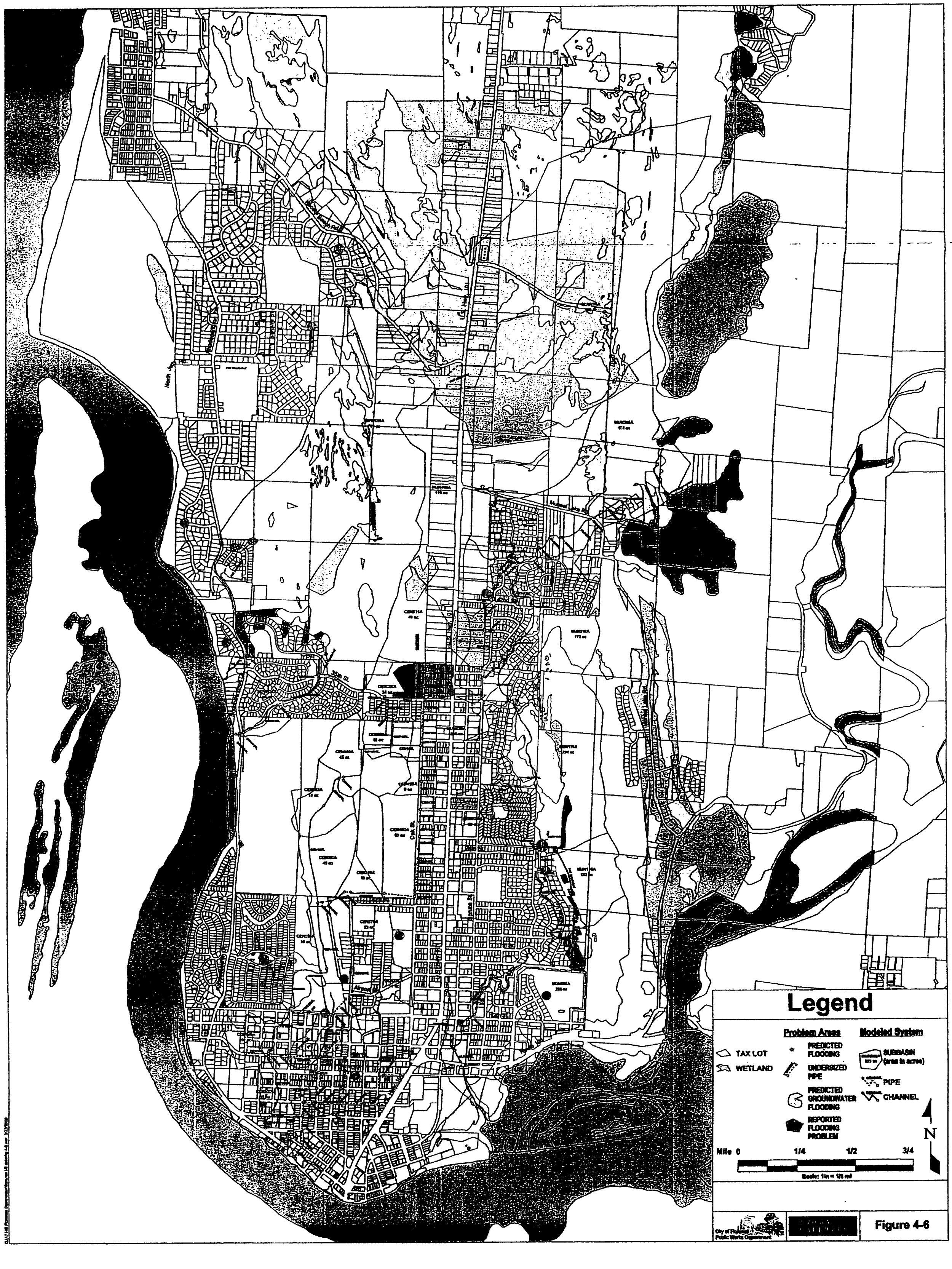

Legend
Problem Areas
Modeled System
TAX LOT
WETLAND
PREDICTED FLOODING
UNDERSIZED PIPE
PREDICTED GROUNDWATER FLOODING
REPORTED FLOODING PROBLEM
SUBBASIN (area in acres)
PIPE
CHANNEL
N
Mile 0
1/4
1/2
3/4
Public Works Department

Figure 4-6

CHAPTER 5

PROJECT RECOMMENDATIONS

Recommended projects were formulated based on the analysis results discussed in Chapter 4. The recommendations are presented by geographic region: Northwest, Northeast, Central, Southwest, and Southeast. They include maps of each region, as shown in Figures 5-1 through 5-6, and include both the recommendations and specific steps that should be undertaken for implementation. Within each region, the recommendations have been divided into projects. Each region may have one or more projects. The projects are named using a naming convention consisting of the initials for the region, followed by a letter, e.g., NW-A. Table 5-1, at the end of this chapter, contains brief descriptions and costs for all of the recommendations within the study area. Figure 5-7 shows the recommendations for the entire project area.

NORTHWEST REGION

The Northwest Region lies outside of the Florence city limits.. It is made up of largely residential neighborhoods south of Heceta Beach Road. The region is characterized by small, rolling dunes that end in steep bluffs overlooking the North Jetty Recreation Area and Heceta Beach. Stormwater flows generally east to west in this area.

Recommendations

The main objective in this region is to protect private and public property in both the immediate flooding area and along the downstream conveyance route. Recommendations for the NW-A project, shown in Figure 5-1, include the addition of a pumping facility to evacuate water from the Gullsettle Court area. This will be required for the long-term solution, however, it is not the City of Florence's (City's) responsibility to design and construct a pump station in this area. The 12-inch-diameter culvert under Rhododendron Drive should be replaced with a box culvert that connects to a channel that receives the two incoming 12-inch diameter pipes. This improvement would lessen maintenance problems and increase hydraulic capacity in this area. The ditch, which leads west from Rhododendron Drive along the North Jetty Road, needs to be improved, and should be extended to the west. A pipe will be required at the west end of the ditch to provide a positive grade to the edge and down the face of the bluffs. A flow dissipater (large riprap) should be placed at the bottom end of this pipe to prevent erosion.

Table 5-1 lists the details of the improvements recommended for the Northwest Region conveyance system. The capital cost of Project NW-A is estimated at $209,000. Currently, the City cannot implement these improvements since the study area lies outside of the city limits. The City recommends that the improvements be made through a cooperative effort involving local developers, neighborhood associations, individual homeowners, and Lane County.

Next Steps

Planning is underway to develop a large parcel of property south of Saltaire Street within the next few years. The developer needs to work with Lane County and the City to determine where to discharge the resulting runoff in order to ensure compatibility with the overall plan for the area.

NORTHEAST REGION

The Northeast Region covers an area extending from north of Munsel Lake Road to south of Florentine Estates, and from the ridge just to the west of Highway 101 to Munsel Creek to the east. Its southern boundary ends at approximately 35th Street. The area contains the Florentine Estates residential development, an auto salvage yard north of Munsel Lake Road, and undeveloped property north of the salvage yard and west of Florentine Estates.

Most of the area north of Munsel Lake Road drains to the southwest, where it enters the northwest corner of Florentine Estates. It flows through a combination of ponds and pipes through the Florentine Estates development and joins Munsel Creek near 45th Court.

STORMWATER DESIGN

For the design of the stormwater system in this region, refer to the Stormwater Design Report for Spuce Street LID, Florence OR. July 2006, and Appendices A through C, Approved by the Florence City Council on September 5, 2006 and incorporated into Appendix 11 of The Florence Realization 2020 Comprehensive Plan in March 2008.

CENTRAL REGION

The Central Region extends from the northern city limits to approximately 35th Street. It is bounded to the west by the Siuslaw River and to the east by the ridge of dunes that lie west of Highway 101. It contains large expanses of undeveloped property to the north (most of it publicly owned), Sandpines Golf Course to the south and east, and partially developed, single-family residential development to the south and west. Surface water flows are generally from the northeast to southwest in this area.

Recommendations

The recommended plan for the Central Region consists of two projects, as shown in Figure 5-3. The first project, CEN-A, consists of construction of a permanent channel to the west of the Sandpines Golf Course. The channel should be lined to limit the infiltration of stormwater into the ground. The channel would run along Rhododendron Drive in an easement acquired by the City, and would terminate at the corner of 35th Street and Rhododendron Drive. At that point, flows would enter a pipe passing underneath Rhododendron Drive and connect with the large ravine to the west. The ravine's side slopes should be reinforced, as necessary, to stabilize the natural slopes and prevent erosion. This recommendation would improve the hydraulic capacity of the collection system, which will help lessen the potential for flooding. The system should be sized to include flows carried in the channel described as Project CEN-B.

Project CEN-B is a concrete-lined channel extending along the east side of Mariners Village to the northeast corner of the development. Construction of this channel is recommended to provide a pathway for flows originating from public land to the northeast. Project CEN-B should be undertaken only after the downstream improvements are completed. The existing temporary detention pond should be removed from service and flows routed to this new channel.

Project CEN-C is a concrete-lined channel extending from Project CEN-A eastward across the Sandpines Golf Course. This channel would intercept flows before they cause flooding along Royal Saint Georges Drive. Project CEN-C should be undertaken only after the downstream improvements in Project CEN-A are completed.

Table 5-1 lists the details of the improvements recommended for the Central Region conveyance system. The estimated capital costs are $331,000 for Project CEN-A, $171,000 for Project CEN-B, and $115,000 for Project CEN-C

Next Steps

A predesign investigation is required to better define the most cost-effective solutions available for the Central Region. Specifically, additional survey information is required along the route of the Project CEN-A channel, as well as information regarding the condition of the ravine near the downstream end. During the predesign phase, opportunities for detention/wetland facilities north of Sandpines Golf Course and Mariners Village should be investigated. Such facilities could decrease flooding and improve water quality downstream. Much of the land is public, so land acquisition costs are not a barrier. Emphasis should be placed on restoring or enhancing degraded habitat. However, wetlands should not be created at the expense of upland habitat that is in good condition.

Another opportunity may exist for a detention facility in the vacant lot at the corner of 35th Street and Rhododendron Drive that could enhance water quality or moderate peak flows downstream in the ravine.

SOUTHWEST REGION

The Southwest Region stretches from 35th Street to the north, to the Siuslaw River to the south and west, and to Highway 101 to the east. It includes the Florence Airport and the Greentrees development. The central portion of this region drains directly to a ditch that runs south between the Florence airport and the Greentrees development. The ditch continues south of 9th Street past the Florence Wastewater Treatment Plant to the Siuslaw River. The other major drainage system in this region is a series of pipes that run along Kingwood Street, cross the airport south of the runway, reemerge as a channel running south from the runway, and then are piped along 9th Street to the drainage ditch south of the Greentrees development. The Greentrees development lacks an internal drainage system.

Recommendations

Two projects are recommended for the Southwest Region, as shown in Figures 5-4 and 5-5. Project SW-A involves construction of a new channel to intercept runoff from the property to the east of the Greentrees development. The channel would be located near the point where the drainage ditch turns and runs south along the Greentrees development property line

Project SW-B requires upsizing of the pipes along Kingwood Street to accommodate both existing and projected flows from the 25-year storm.

Project SW-C is proposed to alleviate frequent flooding that has been reported. The project includes the replacement of a number of pipes along the main drainage pipe and several smaller pipes located near the library. The pipes should be replaced from downstream to upstream to avoid causing flooding. (Pipes DTN020L, DTN030L, and DTNO40L are at a lesser risk for flooding than pipes further upstream. Depending on pipe condition and the amount of surcharging that the City will allow, these pipes could probably be left as is to lessen the total project cost.

Table 5-1 lists the details of the improvements recommended for the Southwest Region conveyance system. The capital cost of Project SW-A is estimated at $37,000. The estimated capital cost of Project SW-B is $448,000, and the estimated capital cost of Project SW-C is $779,000 ($564,000 if downstream pipes are not upsized).

Next Steps

The pipes in the downtown area should be inspected for signs of surcharging, but they do not need to be replaced unless they are in poor condition or the surcharging results in flooding. Coordination with regulatory agencies should be encouraged to ensure that regular maintenance of the drainage ditch continues.

The pipes along Oak Street, CEN400L, CEN390L, CEN380L, and CEN340L should be inspected for signs of surcharging and replaced, as necessary.

SOUTHEAST REGION

The Southeast Region lies between 35th Street to the north, the Siuslaw River to the south, Highway 101 to the west, and the hills to the east. Munsel Creek is the most dominant physical feature within the region. There is also a large wetland area between the hills and the creek. The wetland has formed in a deflation plain, where sand was scoured away by the wind. There is no natural drainage outlet for the area.

Recommendations

The Southeast Region contains one recommended project, SE-A, as shown in Figure 5-6. Project SE-A recommends a pump station installation at the east end of Pine Court. The pump intake would be set at an elevation to maintain the health and vitality of the existing wetlands. When the groundwater level exceeds this elevation, the pump would be activated and discharge the flow into Munsel Creek.

Table 5-1 lists the details of the improvements recommended for the Southeast Region conveyance system. The capital cost of Project SE-A is estimated at $158,000.

Next Steps

The delineated wetlands that exist in the Southeast Region are somewhat degraded. Opportunities to work with local residents to enhance or restore the wetlands should be pursued.

The area along Munsel Creek upstream of Highway 126 should be investigated for damage due to backwater conditions created by the undersized culvert at the intersection of Munsel Creek and Highway 126.

Recommendations

The Southeast Region contains one recommended project, SE-A, as shown in Figure 5-6. Project SE-A recommends a pump station installation at the east end of Pine Court. The pump intake would be set at an elevation to maintain the health and vitality of the existing wetlands. When the groundwater level exceeds this elevation, the pump would be activated and discharge the flow into Munsel Creek.

Table 5-1 lists the details of the improvements recommended for the Southeast Region conveyance system. The capital cost of Project SE-A is estimated at $158,000.

Next Steps

The delineated wetlands that exist in the Southeast Region are somewhat degraded. Opportunities to work with local residents to enhance or restore the wetlands should be pursued.

The area along Munsel Creek upstream of Highway 126 should be investigated for damage due to backwater conditions created by the undersized culvert at the intersection of Munsel Creek and Highway 126.