CHAPTER 6
DEVELOPMENT OF CAPITAL IMPROVEMENT PROGRAM

6.1 STORMWATER INFRASTRUCTURE PLANNING PROCESS

6.1.1 City's Stormwater Planning Vision

In developing this updated Stormwater Comprehensive Plan (SCP), the City's two main objectives are to identify and resolve drainage and flooding problems, and to conduct a regulatory gap analysis to determine what is needed to achieve compliance with a future NPDES Phase II Municipal Stormwater Permit (Permit). Although not under a Permit at this time, the City wants to take a proactive approach in order to plan ahead and phase in the required future Permit activities at their own pace. This approach allows the City to gradually raise the needed revenue in advance of when it would be annually required for Permit compliance. The results of the regulatory compliance analysis are combined with the drainage Capital Improvement Plan (CIP) presented in this chapter to develop the City's updated SCP. Results of the modeling are presented in Chapters 5 and the capital facility analyses here in Chapter 6.

This chapter presents the City's process to identify and resolve existing and projected future flooding problems. Identified drainage problems were reviewed, rated and ranked for severity, and the top ten (10) most significant problems were studied, and alternative design solutions were developed and evaluated. The result of each alternative analysis is a preferred design solution that is developed and presented to the City in the form of a recommended capital improvement project. It has been assumed for the purpose of this study that the City's existing type and amount of impervious surfaces will be similar to future built out conditions, because the current drainage code requires any new and/or re-development within the City to have no net increase in runoff leaving the site after a site has been developed.

6.1.2 Assumption Regarding the Irvine Slough Stormwater Separation Project

This chapter also gathers information to support the City's future alternative flood design study, the Irvine Slough Stormwater Separation Project (ISSSP). This regional flood reduction study will investigate the separation of stormwater from the City's discharges into Irvine Slough and evaluate options to reduce flooding within the lower reaches of the Stillaguamish River and floodplains. (Note: The proposed CIP assumes that the ISSSP will be developed or that some type of positive conveyance enhancement improvement will be constructed to remove excess stormwater from within the most western parts of the City.)

Without this type of improved conveyance enhancement and removal of excess drainage within the most western part of the City, the proposed capital projects would not have the in-line capacity for storage or the "hydraulic drop" needed to continue to drain the interior of the City by gravity.

For all of the drainage CIP projects that are located in subbasins draining to Irvine Slough, it is assumed that the ISSSP project will be completed. It is also recognized that the ISSSP design may affect the performance of the recommended CIPs, depending on how well the ISSSP controls water levels in the drainage collection system. To address this uncertainty, these CIP solutions were sized to meet two different ISSSP design conditions, each with a different level of performance. The better performing design was assumed to keep water levels in the ISSSP nearly dry, allowing the outfalls to be modeled with a free outfall condition, i.e., draining undetained via gravity at the design capacity of the system (corresponding to an ISSSP water level of approximately zero feet NAVD 1988). The slightly lower performing ISSSP design was assumed to have a higher water level in the ISSSP of 4' NAVD 1988 (corresponding to about 4 feet of water in the slough).

In only two cases (Projects #5 and #8), the identified CIP solution does not fully mitigate flooding with this higher ISSSP water level condition. It is also possible that an ISSSP design that controls water levels to even a 4' threshold may be too costly for construction. If that is the case, then the recommended CIP solutions will not provide 25-year capacity. As a result, these CIP solutions should be considered the minimum needs, assuming the ISSSP meets the design assumptions.

6.1.3 Identifying Problems and Developing Solutions: The City's Updated Stormwater Capital Improvement Plan

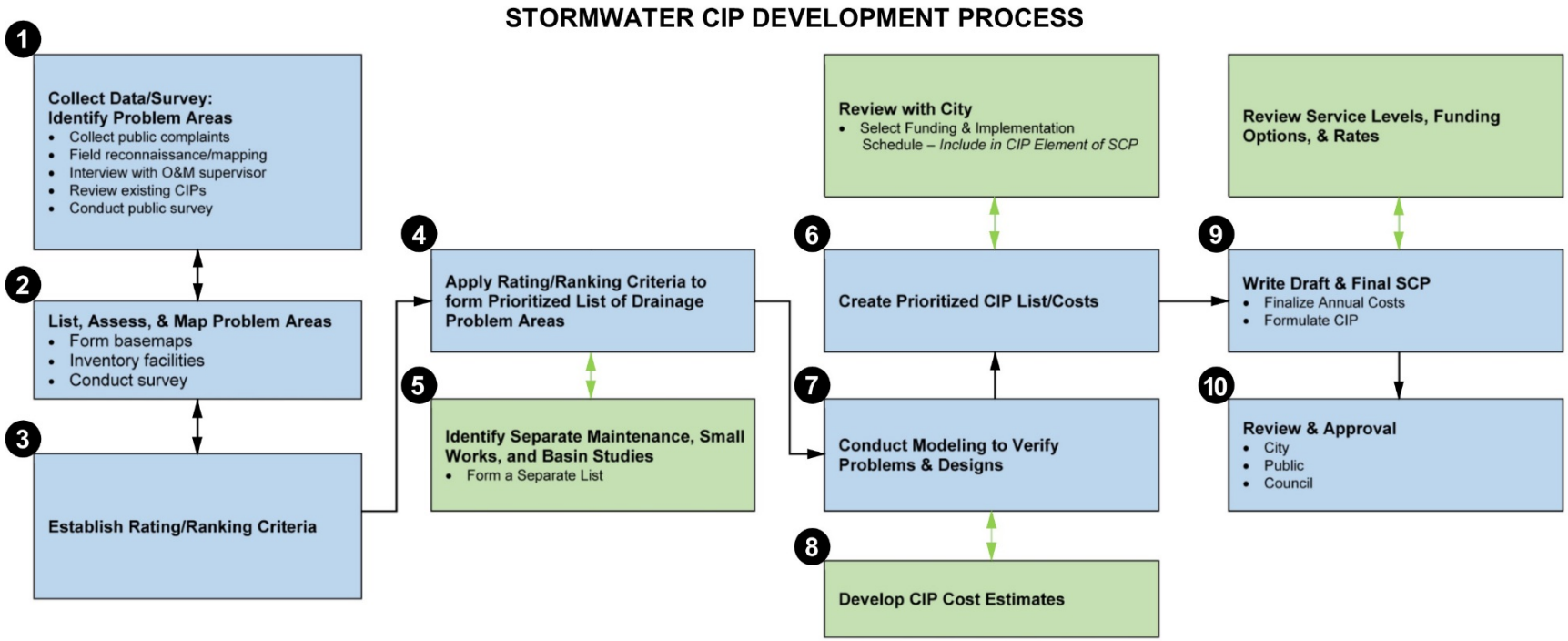
The primary product of Chapter 6 is a prioritized list of the 54 (fifty-four) drainage problems or drainage concerns identified throughout the City. Each of the identified drainage problems has gone through a thorough review, ranking, and evaluation. As part of this evaluation, each of the problems was rated and ranked using criteria reviewed and approved in advance by the City. Once this master list was assembled, the top ten (10) highest priority drainage problems, that is, the most severe drainage problems, were selected for further engineering analysis. The results of these analyses included a review of alternative solutions and the selection of one preferred design for each problem, allowing cost estimates to be performed. All ten of these projects were combined to form the City's updated CIP for future funding and implementation. This stormwater capital facility planning process is graphically displayed in the schematic diagram presented below in Figure 6-1.

The City's stormwater capital facility planning process consists of the following activities:

1. Collection of data and identification of drainage problems
2. List, assess, and map drainage problem areas
3. Establish rating and ranking criteria, and receive City approval
4. Apply criteria and form prioritized list of drainage problem areas
5. Separate out O&M, small works, and basin studies
6. Create a master prioritized list of drainage problems
7. Select top ten ranked problem areas and conduct modeling

8. Conduct engineering flow capacity analysis, prepare and evaluate design options, and select the preferred designs
9. Finalize drainage CIP designs and develop cost estimates
10. Integrate preferred capital projects into the City's CIP list
11. Integrate the resulting drainage CIP list into the City's updated SCP

Figure 6-1: Schematic Diagram of the City's Stormwater Capital Facilities Planning Process



6.2 COLLECT DATA AND IDENTIFY DRAINAGE PROBLEMS (STEP #1)

6.2.1 Stormwater Program and Flooding Data from the City

The first step in the development of the City's stormwater CIP was to collect existing data, formulate a GIS geodatabase, and develop an electronic drainage basemap of the study area. An initial set of needed data was identified by PACE and Northwest Hydraulic Consultants (NHC), and transmitted to the City early in the stormwater planning process. This initial data request included requests for programmatic information as well as documentation of drainage problem areas, including the data needed for the programmatic regulatory compliance gap analysis. This list, which includes the responses from the City, is shown in Appendix A.9.

Mapping data of the City's drainage system was also collected in the form of electronic files that were acquired from the City, the City's consulting engineer, Snohomish County, and Northwest Hydraulic Consultants, Inc. All resulting system inventory and facility information was synthesized and integrated to form the electronic basemap for this drainage study. This map became the background image that was used throughout the planning, modeling, CIP, and SCP development processes, as seen on the numerous maps and figures presented throughout this report. This map and a discussion of the City's existing drainage system have been included earlier in Chapter 2, Section 3.

6.2.2 Additional Drainage Data from the Public

The location, nature, frequency, and impacts of the drainage problems throughout the City were collected by conducting interviews with City staff and by developing and sending out a drainage survey to the public. The public survey is presented in Appendix A.11. A total of 39 public survey responses were collected; 21 were hand written and mailed in, a selection of which are attached in Appendix A.12, and another 18 were filled out electronically and mailed into the City via the City's website, as shown in Appendix A.13. A statistical analysis was performed by PACE correlating the results of the electronic responses, and is shown in Appendix A.14.

6.3 LIST, ASSESS, AND MAP DRAINAGE PROBLEM AREAS (STEP #2)

6.3.1 Formation of the Master List of Drainage Concerns/Problems

With the completion of the staff interviews and compilation of the public surveys, a total of 54 different drainage problem areas or drainage concerns were identified, including over 20 drainage problems identified by City staff. This compilation of 54 drainage problems identified throughout the City included those in both the low lying, older areas of the City to the west, as well as the more recent developments on the upland areas of the City lying to the east, east of the railroad tracks and east of the Pioneer Highway. The list, location and ranking of the problems is shown in the following documents:

- Table 6-1: Master List and Ranking of Identified Drainage Concerns/Problems
- Figure 6-2: Location of Identified Drainage Concerns by Type of Concern/Problem
- Figure 6-3: Location of Identified Drainage Concerns by Source of the Information

6.3.2 Discussion of Master List and Ranking of Identified Drainage Concerns/Problems

The Master List and Ranking of Identified Drainage Concerns/Problems (Master Drainage List), presented in Table 6-1, contains a considerable amount of information and summarizes the field, mapping and engineering analyses. See Appendix A.16 for additional information on each reported drainage complaint, including all the data received from the Public Survey. The table contains the following:

- *Column 1:* is the name of the proposed CIP Project; only those drainage concerns/issues that were most significant were selected to become a CIP project and were given a name; the rest of the drainage concerns were only given identification numbers, which is presented in the third column over from the left.
- *Column 2:* contains the CIP Ranking Number, only the top ten most severe drainage problems were selected for the design of a capital drainage solution and given a corresponding CIP number, based on the previous master ranking and rating process.
- *Column 3:* lists the individual project identification number.
- *Column 4:* displays the source of the problem, and whether it was from the public, the City, the modeling analysis, the field survey, or from other studies and analyses that NHC had done within the region, primarily related to their ongoing study of Douglas Creek for the County.
- *Column 5:* contains the approximate address and/or geographic location of the identified drainage problem.
- *Column 6:* provides a brief description of the problem.
- *Column 7:* categorizes the problem as to type of problem, including; flooding, erosion, standing water, failed infrastructure, undersized pipe, etc.
- *Column 8:* provides, where applicable, appropriate contact personnel.
- *Column 9:* categorizes the project solution as to type of project, including: CIP, small works, private, study, etc.
- *Columns ten through twenty one (10-21):* show the point score for each of the individual ranking and rating criteria.
- *Column 22:* shows the total score of the rating and ranking process for each identified drainage problem; they are presented in order of priority with the worst problem being number #1 and located at the top of this list.

6.3.3 Results and Review of Master Drainage List

This resulting Master List of drainage problem areas was reviewed and refined during the study, and the net result was a total of 54 identified drainage problem areas that became the technical basis for this planning study. This Master List of problems was used to identify and develop the top ten capital facility projects for future funding and implementation. The top ten drainage projects address the City's most significant drainage and flooding problems and include the ISSSP Study, as well as nine other capital projects, that are discussed below.

(Note: In the tables and figures of this report, the identification number of each of the drainage concerns/problems and the proposed CIP project are all correlated and identified by the same drainage concern/problem/project identification number, as presented on the left side of Table 6-1. The top ten most severe drainage problems ranked high enough to be included as the top ten projects in the City's updated Capital Improvement Plan. (Each of the top ten problems/capital projects is discussed in detail below and are presented with supporting descriptions, diagrams, and cost estimates.))

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Table 6-1: Drainage Concerns / CIP Correlation Table

Name (1)	CIP Ranking (2)	ID (3)	Source (4)	Address or Location (5)	Description (6)	Categori-zation of Problem (7)	Contact (8)	Project Type (9)	Improves Infrastructure (10)	Flood Source (11)	Flood Duration (12)	Flood Frequency (13)	Water Quality (14)	Stream Bank Erosion (15)	Hillside Erosion (16)	Instream Habitat (17)	Economic Impact (18)	Complaint History (19)	Aesthetics (20)	Public Perception (21)	TOTAL SCORE (22)
Irvine Slough Stormwater Separation Project (ISSSP)	1	57	City Staff	Irvine Slough	Irvine Slough. Evaluate stormwater collection system on the north side of SR532 to augment or replace Irvine Slough as flood conveyance. ($300,000 *(2014 Dollars)* Irvine Slough/Stormwater Separation Study)	Flooding	Kevin Hushagen (City)	Study	15	15	15	15	1	0	0	3	10	10	2	10	96
		4	City Staff	96th NW & 271 St NW	House on 96th next to the library, the yard floods during a flood event. When we have a flood the water in this area will not drain because Irvine Slough is backed up, so 2 houses next to library have their yards flooded.	Flooding	Trevor Harrison (City)	CIP	15	15	15	15	1	0	0	3	10	10	2	10	96
92nd Ave @ SR 532 Pipe Replacement	2	63	Survey	9326 271st St NW	Standing water in property when it rains.	Standing Water	Public Survey – No name provided	CIP	15	15	15	15	0	0	0	0	10	10	3	10	93
271st Street NW, 102nd Avenue, and 270th St. Trunk Upsize	3	64	Modeling	271st and 102nd Trunk	ID' d with model (addresses City complaint RE 100th and 101st), related to #62 and possibly #42	Improperly Sized Pipe	Derek Stuart (NHC)	CIP	15	15	15	15	0	0	0	0	10	10	3	6	89
85th and Pioneer Hwy Drainage Improvements (Ditch Work)	4	6	City Staff	Pioneer Hwy & 85th Dr. NW	Water runoff from the street in heavy rain events washes the shoulder of the roadway down the hill on 85th Dr. NW into Pioneer Hwy. Water rushes the hill and washes out the shoulder of the road when it rains, need to add 1 or 2 catch basins.	Erosion	Trevor Harrison (City)	CIP	15	15	15	15	0	0	0	0	8	10	2	8	88
		58	City Staff	85th Street NW	85th Street NW Drainage - Collect and convey runoff.	Flooding	Kevin Hushagen (City)	CIP	15	15	15	15	0	0	0	0	8	10	2	8	88
270th Street NW Improvements, Between 88th Ave and Florence/ Resurfacing	5	18	City Staff	90th Ave NW & 271 St NW	270th St drain pipe under roadway is collapsed. Drainage pipe that runs from a catch basin on the north to the south of 270th is collapsed under the roadway.	Failed Infrastructure	Trevor Harrison (City)	CIP	15	15	15	15	0	0	0	0	8	10	2	8	88
Augusta Street Pipe Upsize	6	65	Modeling	Augusta Street	ID' d with model, related to #62 and City complaint on 100th and 101st	Improperly Sized Pipe	Derek Stuart (NHC)	CIP	15	15	12	15	0	0	0	0	10	10	3	6	86
101st Ave, 102nd Drive, and 103rd Drive Road Improvements and 271st Street NW Pipe Upsize	7	66	Modeling	27218 103rd Dr. NW	ID' d with model, related to #62	Improperly Sized Pipe	Jan Williamson (Citizen)	CIP	15	15	12	15	0	0	0	0	8	10	3	6	84
271st Street NW @ Florence Drive Pipe Upsize	8	34	Survey	8622 270th St NW	Standing water on roadway	Flooding	Public Survey – No name provided	CIP	15	15	15	15	0	0	0	0	10	2	2	8	82
7 Tiny Tubes; Old Stillaguamish Flood Release Culvert Slip Line	9	17	City Staff	92nd Ave NW & 268th St NW	Seven Tubes - 1 gate is completely gone and needs to be replaced. All other 6 tubes need to be replaced due to hold in pipes and gates are old. We have seven flood gates, the hippes are old and have holes in them. One pipe is missing a flood gate and all gates are old.	Failed Infrastructure	Trevor Harrison (City)	CIP	12	15	12	12	0	0	0	0	8	10	2	8	79
85th Street NW Drainage Improvements	10	54	Survey	27832 85th Dr.. NW	Water flowing onto private property from city street	Standing Water	Carol Covert (Citizen)	CIP	15	15	15	15	0	0	0	0	6	2	3	8	79
		40	Survey	Pioneer Hwy & 86th Dr. NW	Water flowing across 86th Dr. and down to Pioneer Hwy.	Flooding	Charles R. (Bob) Hitz (Citizen)	CIP	15	15	15	12	0	0	0	0	10	0	2	8	77
		21	NHC	102nd Ave NW & 268th St NW	Irvine Slough pump station capacity is limited	Flooding	Derek Stuart (NHC)	CIP	15	15	12	3	0	4	0	0	10	10	1	6	76
		33	WSDOT	SR 532 & 270th St NW	"Pumps not keeping up" at Irvine Slough.	Failed Infrastructure	Kim Glass (WSDOT)	CIP	15	15	12	3	0	4	0	0	10	10	1	6	76
		25	NHC	88th Ave NW & 268th ST NW	Flow from Stillaguamish River can cross SR 532 and flood downtown Stanwood.	Flooding	Derek Stuart (NHC)	CIP	15	15	9	3	0	3	0	0	10	10	1	10	76

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		26	NHC	88th Ave NW & Marine Dr.	Flow from Stillaguamish River can flood park and ride	Flooding	Derek Stuart (NHC)	CIP	15	15	9	3	0	3	0	0	10	10	1	10	76
		55	City Staff	Irvine Slough	Irvine Slough Electrical & Controls Rehab (no pump upgrades). Replacing the entire electrical and control panels	Failed Infrastructure	Kevin Hushagen (City)	CIP	9	15	15	3	0	1	0	1	10	10	0	10	74
		56	City Staff	ISPS	ISPS New Pumps (two each)	Failed Infrastructure	Kevin Hushagen (City)	CIP	9	15	15	3	0	1	0	1	10	10	0	10	74
		20	NHC	268th ST NW & 1-4th Dr. NW	Outfall from this Douglas Creek Outfall is limited.	Flooding	Derek Stuart (NHC)	CIP	15	15	12	12	0	5	0	0	2	6	1	6	74
		24	NHC	92nd Ave NW & 268th St NW	Larsen Dam restricts drainage of flow from east side of 92nd Ave following Stillaguamish River floods	Flooding	Derek Stuart (NHC)	CIP	15	15	9	3	0	3	0	0	10	10	1	6	72
		51	Survey	27126 96th Ave NW	Water flowing onto private property from city street	Flooding	Andy and Julie Johnson (Citizens)	CIP	15	15	9	9	0	0	0	0	8	6	2	8	72
		1	City Staff	76th Dr. NW & 272nd St NW	Backyards on 76th Dr. NW Flood from Water runoff from 272nd St NW. The water from the street on 272nd runs into backyard and forms a puddle; house on corner of 272nd and 76th.	Flooding	Trevor Harrison (City)	CIP	15	15	9	9	0	0	0	0	8	0	2	8	66
		2	City Staff	76th Dr. NW & 276th St NW	Backyards on 76th Dr. NW Flood During Heavy Rain. There are three to four houses that get flooded out in their backyards in heavy rain due to a hill from the school behind their house homeowners say it used to drain.	Flooding	Trevor Harrison (City)	CIP	15	15	9	9	0	0	0	0	8	0	2	8	66
		5	City Staff	Lovers Rd/276th St NW	Lovers Lane 276th water ponds up on side of roadway across from Heritage Park on the north side of the road. Huge puddle forms into the roadway when it rains needs a catch basin.	Flooding	Trevor Harrison (City)	Small Works Project	15	15	9	9	0	0	0	0	8	0	2	8	66
		45	Survey	27327 76th Dr. NW	Non-functioning storm drainage	Standing Water	Carol E. Reed (Citizen)	CIP or Private	15	15	9	15	0	0	0	0	6	0	0	6	66
		37	Survey	271st St NW & 84th Ave NW	Standing water on roadway	Flooding	Ralph H. Nichols (Citizen)	CIP or Small Works Project	15	15	9	15	0	0	0	0	6	0	0	4	64
		38	Survey	7720 Stauffer Rd	Water flowing onto private property from city street	Flooding	Doug Chandler (Citizen)	CIP	15	15	9	15	0	0	0	0	6	0	0	4	64
		39	Survey	7710 Stauffer Rd	Water flowing onto private property from city street	Flooding	Helene Watkins (Citizen)	CIP or Private	15	15	9	15	0	0	0	0	6	0	0	4	64
		43	Survey	27008 90th Ave NW	Non-functioning storm drainage	Flooding	Bill Lenz (Citizen)	CIP	15	15	9	15	0	0	0	0	6	0	0	4	64

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		47	Survey	72nd Ave NW	Water flowing onto private property from city street	Standing Water	Wallace Middleton (Citizen)	CIP	15	15	9	15	0	0	0	0	6	0	0	4	64
		48	Survey	272nd St NW & 81st Dr. NW	Standing water on roadway	Standing Water	Hendrick Husby (Citizen)	CIP	15	15	9	15	0	0	0	0	6	0	0	4	64
		50	Survey	8600 Cedarhome Drive	Standing water on roadway	Standing Water	Thad Nelson (Citizen)	CIP	15	15	9	15	0	0	0	0	6	0	0	4	64
		52	Survey	26920 94TH Drive NW	Water flowing onto private property from city street	Flooding	Paul I. Kalmakoff (Citizen)	CIP	15	15	9	15	0	0	0	0	6	0	0	4	64
		35	Survey	27616 84th Drive NW	Water flowing onto private property from city street	Flooding	Marilyn Stone (Citizen)	CIP	15	15	9	9	0	0	0	0	8	0	2	4	62
		36	Survey	27813 80th Ave NW	Non-functioning storm drainage	Standing Water	Rod Sundberg (Citizen)	CIP or Small Works Project	15	15	9	12	0	0	0	0	6	0	0	4	61
		62	Survey	27218 103rd Dr. NW	Standing water in property when it rains	Standing Water	Jan Williamson (Citizen)	CIP	15	15	9	9	0	0	0	0	6	0	2	4	60
		30	NHC	102nd Dr. NW & 271 St NW	Aged stormwater pipes allow infiltration into the stormwater system	Failed Infrastructure	Derek Stuart (NHC)	CIP	15	0	15	15	0	0	0	0	0	6	0	6	57
		42	Survey	27030 102nd Dr. NW	Yard floods during heavy rains.	Flooding	James Coleman (Citizen)	CIP or Private	15	0	15	15	0	0	0	0	0	6	0	6	57
		60	City Staff	Citywide	Major maintenance, including Lindstrom pond at Haggens	Flooding	Kevin Hushagen (City)	CIP	9	0	0	0	5	0	5	3	6	10	3	10	51
		22	NHC	102nd Ave NW & 268th St NW	Risk of Flooding at WWTP	Flooding	Derek Stuart (NHC)	CIP	15	15	3	3	0	0	0	0	0	6	1	6	49
		23	NHC	102nd Ave NW & 268th St NW	The sanitary sewer routes stormwater runoff from storms to WWTP.	Failed Infrastructure	Derek Stuart (NHC)	CIP	15	15	3	3	0	0	0	0	0	6	1	6	49
		27	NHC	92nd Ave NW & 271st SW	Adverse Slope Pipe near 92nd Ave	Failed Infrastructure	Derek Stuart (NHC)	Small Works Project	15	15	3	3	0	0	0	0	2	0	1	2	41
		19	City Staff	Lund Hill Rd & Nordic Way	Pioneer Hills south pond control structure is broke and is need of repair. Control structure in the pond has broken parts, the outlet pipe is separated, pipe supports are broken.	Failed Infrastructure	Trevor Harrison (City)	Small Works Project	15	0	0	0	0	0	0	0	0	6	1	6	28
		31	NHC	Nordic Way & Pioneer Hwy	Pioneer Hills pond is not providing the designed level of flow control	Failed Infrastructure	Derek Stuart (NHC)	Small Works Project	15	0	0	0	0	0	0	0	0	6	1	6	28
		32	NHC	287th St NW & 72nd Dr. NW	Kylie Park I detention pond is not providing the designed level of flow control	Failed Infrastructure	Derek Stuart (NHC)	CIP	15	0	0	0	0	0	0	0	0	6	1	6	28
		61	City Staff	Citywide	Comp Plan City - land use, goals and policies, 20140 projected needs, CIP and funding strategies.	Not Applicable	Kevin Hushagen (City)	Study	9	0	0	0	0	0	0	0	0	0	0	0	9

Table 6-1: Drainage Concerns / CIP Correlation Table

Name (1)	CIP Ranking (2)	ID (3)	Source (4)	Address or Location (5)	Description (6)	Categori-zation of Problem (7)	Contact (8)	Project Type (9)	Improves Infrastructure (10)	Flood Source (11)	Flood Duration (12)	Flood Frequency (13)	Water Quality (14)	Stream Bank Erosion (15)	Hillside Erosion (16)	Instream Habitat (17)	Economic Impact (18)	Complaint History (19)	Aesthetics (20)	Public Perception (21)	TOTAL SCORE (22)
		44	Survey	27334 Village Pl NW	1998 heard lots of frogs, now only silence. Frogs are good indicator of environmental health.	Habitat	Public Survey – No name provided	Study	0	0	0	0	0	0	0	5	0	0	0	0	5
		59	City Staff	Citywide	Miscellaneous drainage improvements.	Flooding	Kevin Hushagen (City)	CIP	9	15	15	0	5	5	5	3	10	10	0	10	0
		46	Survey	9332 271st Street NW	Non-functioning storm drainage	Flooding	Terry Greer (Citizen)	CIP	15	15	15	15	0	0	0	0	10	10	3	10	0
		3	City Staff	268th St NW & Floe Rd	The dike is low in this area and needs to be built up, there are sand bags in place now. On a really high tide the water will spill over in this area next to the smoke stack need to build dike up.	Flooding	Trevor Harrison (City)	CIP	15	15	15	15	0	5	0	0	10	0	3	8	0
		28	NHC	Lovers Rd & Lane Rd	Flooding limits agriculture	Flooding	Derek Stuart (NHC)	CIP	15	15	15	3	0	5	0	0	10	10	3	10	0
		29	NHC	Lovers Rd & 102nd Ave NW	Lover's Lane culvert grades and channel limit capacity	Failed Infrastructure	Derek Stuart (NHC)	CIP	15	15	15	3	0	5	0	0	10	10	3	6	0
		53	Survey	27901 86th Drive NW	Water flowing onto private property from city street	Flooding	John J. Shaffer (Citizen)	CIP	15	15	15	15	0	0	0	0	6	2	2	10	0

6.3.3.1 *Types of Various Drainage Concerns/Problems*

Figure 6-2 shows the locations of the problem areas and identifies each drainage problem/concern by type of problem. The drainage issues have been characterized by the following types of problems: CIP (Public/City), CIP (Private), CIP (Small Works or O&M Project), Modeling, O&M, Private, and Study.

6.3.3.2 *Sources of the Various Drainage Concerns/Problems*

Figure 6-3 presents the source of each problem/concern and whether it came from the City, from NHC, from the modeling analysis, or from the results of the public survey. In total, the 54 problems that appear in the Master Drainage List of Problems/Concerns were identified as coming from these five sources:

- City staff – 16
- Modeling analysis – 3
- Northwest Hydraulic Consultants and their knowledge and prior work with Snohomish County on Douglas Creek – 13
- Public survey regarding the City's drainage system – 21
- Washington State Department of Transportation – 1

These sources total 54 projects; upon evaluation and ranking of the original list of 66 problems/concerns, 12 of the projects from the master list were minor and were addressed in the field by the City's maintenance crew. Thus, the master list of drainage concerns/problems has a total of 54 entries.

As an example: *CIP Project Ranking #1, entitled Irvine Slough Stormwater Separation Project (ISSSP)* is represented by two drainage problem areas in the column to the right of the CIP Rating; those two drainage problems areas are ***Problem #57*** entitled **Irvine Slough** and ***Problem #4*** entitled **96th NW and 271st Street NW.** The project has a *Total Score of 96 points* in the column to the far right under Total Score.

6.3.3.3 *Drainage Problems Identified by City Staff*

City staff has been particularly effective during this study in their response to the various drainage concerns raised by the public. Through this stormwater planning process, the City staff has developed a special list of both internal and public drainage concerns and problem areas. Those drainage concerns/problems identified and included in this study by City staff are summarized in Table 6-2, entitled List of Drainage Concerns/Problems from City Staff, and Figure 6-4, entitled Map of Drainage Issues Identified by City Staff. (Note: The 19 drainage issues identified by City staff in Table 6-2 and Figure 6-4 have been reviewed and 3 have been omitted or combined to form the resulting 16 problems listed as being identified by City staff in Table 6-1.)

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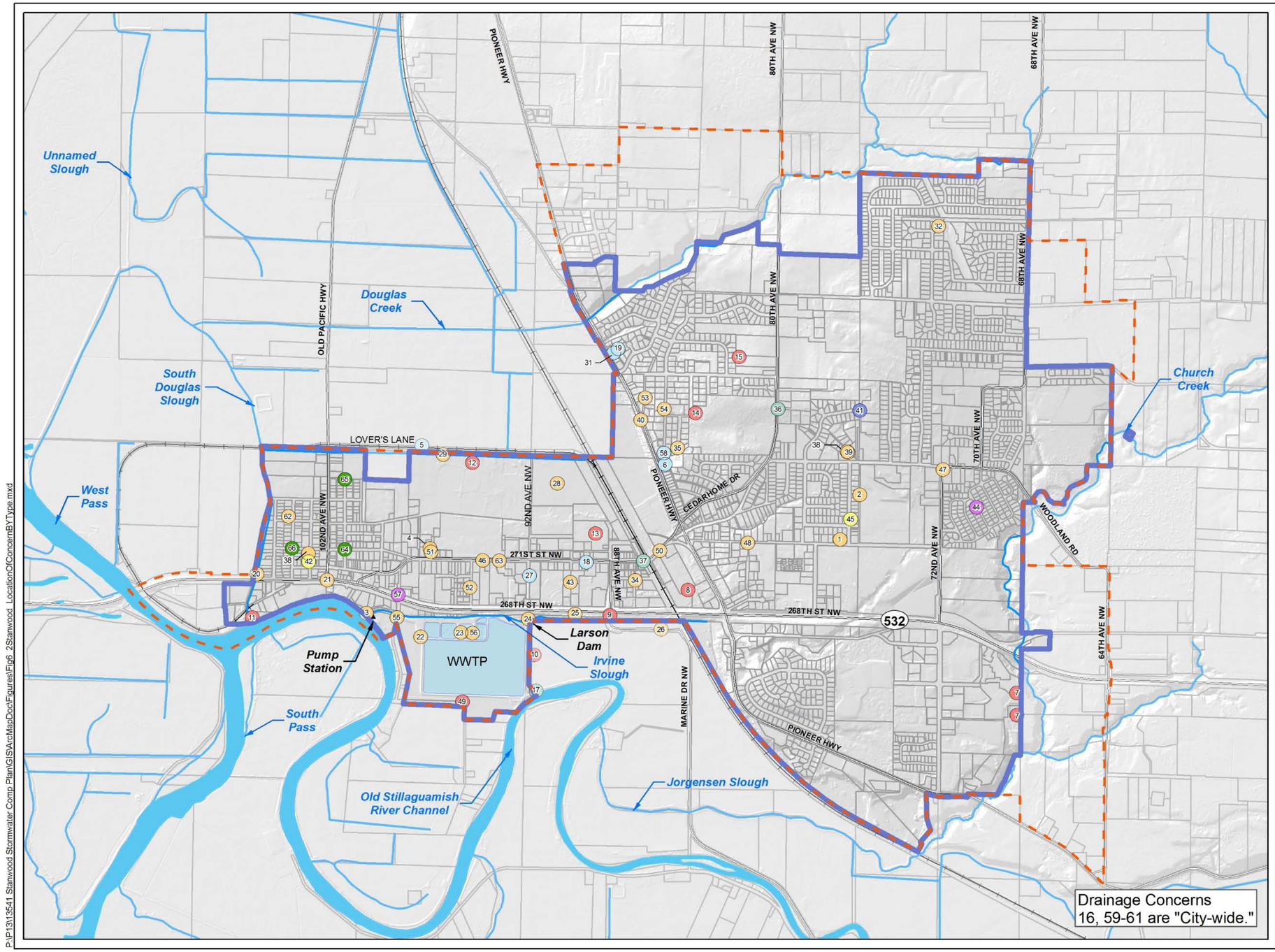

PACE
nhc

0 750 1,500
Feet

City Boundary
Urban Growth Area
Watercourse

Type of Instance
- CIP
- CIP, Private
- CIP, Small Works Project
- Modeling
- O & M
- Private
- Small Works Project
- Study

Figure 6-2
Location of Drainage Concerns By Type

Stormwater Comprehensive Plan

P:\P13\13541 Stanwood Stormwater Comp Plan\GIS\ArcMapDoc\Figures\Fig6_2Stanwood_LocationOfConcernBYType.mxd

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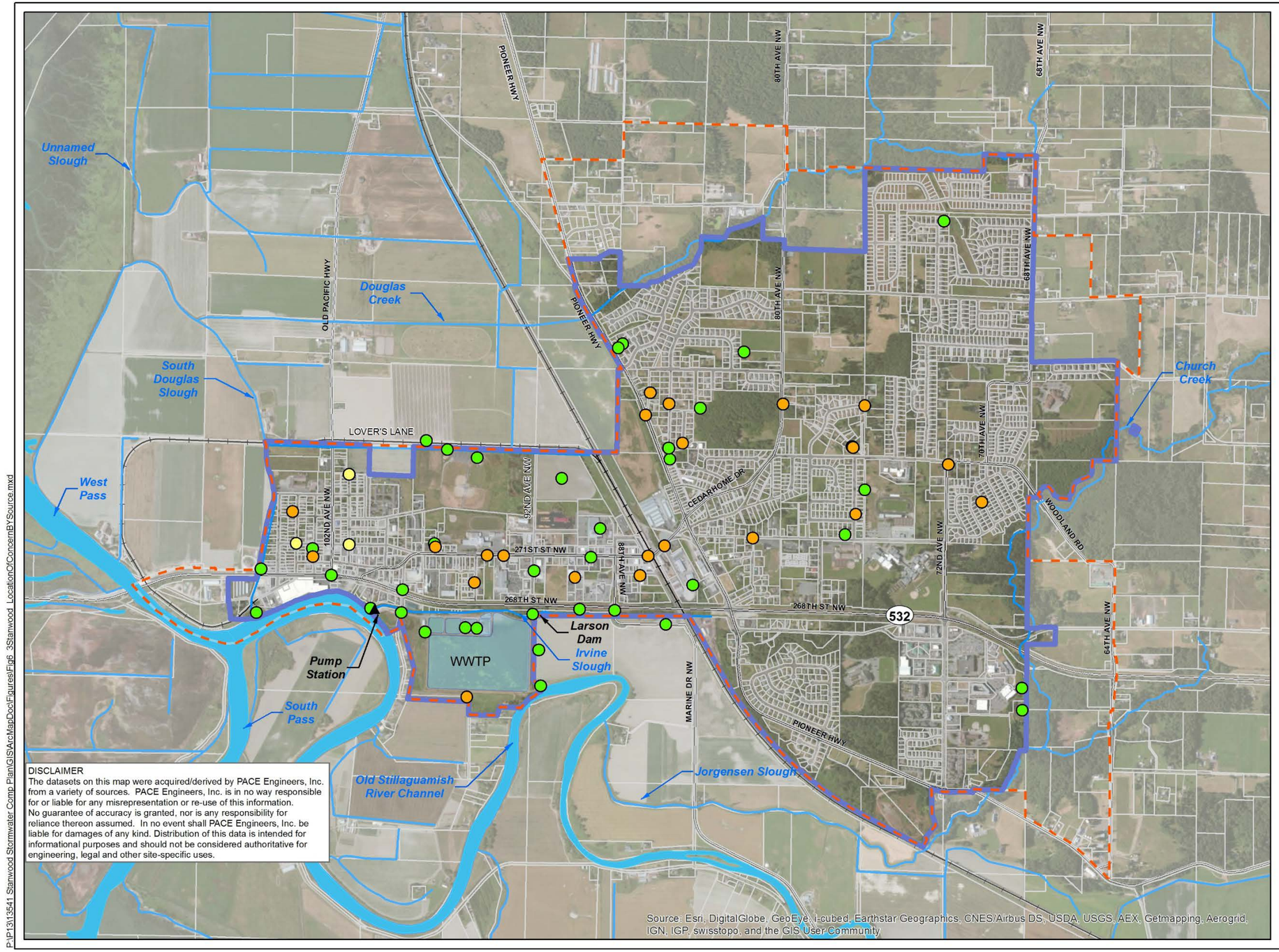

Figure 6-3
Location of Drainage Concerns by Source

Stormwater Comprehensive Plan

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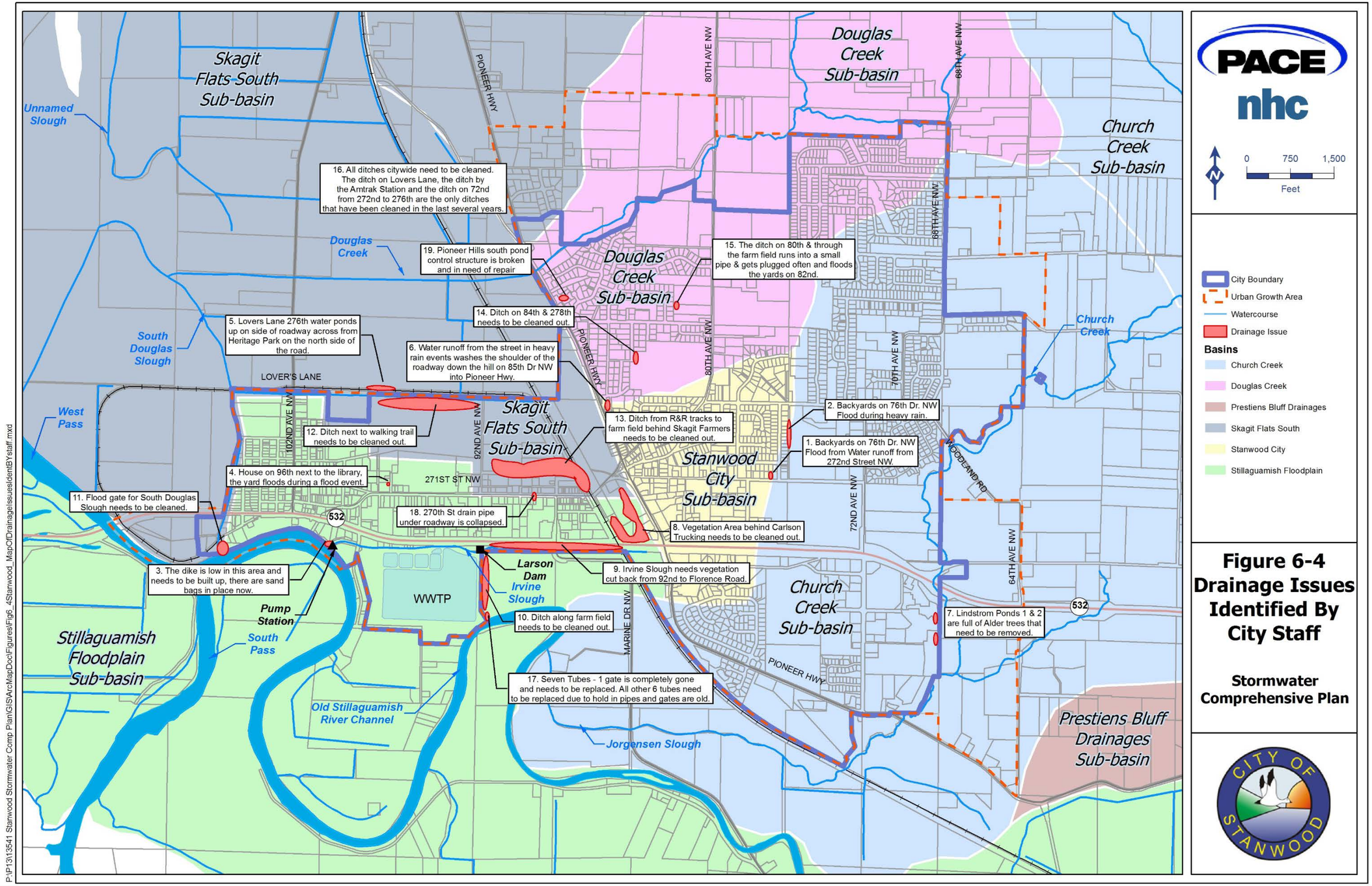
Table 6-2: List of Drainage Concerns/Problems from City Staff

ID	Address	Description	Problem Type	Project Type
1	76th Dr NW & 272nd St NW	Backyards on 76th Dr. NW Flood from Water runoff from 272nd St NW	Flooding	CIP
2	76th Dr NW & 276th St NW	Backyards on 76th Dr. NW Flood During Heavy Rain	Flooding	CIP
3	268th St NW & Floe Rd	The dike is low in this area and needs to be built up, there are sand bags in place now.	Flooding	CIP
4	96th NW & 271st St NW	House on 96th next to the library, the yard floods during a flood event.	Flooding	CIP
5	Lovers Rd/276th St NW	Lovers Lane 276th water ponds up on side of roadway across from Heritage Park on the north side of the road.	Flooding	CIP
6	Pioneer Hwy & 85th Dr. NW	Water runoff from the street in heavy rain events washes the shoulder of the roadway down the hill on 85th Dr. NW into Pioneer Hwy	Erosion	CIP
7	276th St NW & 265th St NW	Lindstrom Ponds 1 & 2 are full of Alder Trees that need to be removed.	O&M Referral	O&M Referral
8	Cedarhome Dr. & Triangle Dr.	Vegetation Area behind Carlson Trucking need to be Cleaned	O&M Referral	O&M Referral
9	88th Ave NW & 268th St NW	Irvine Slough needs vegetation cut back from 92nd to Florence Drive	O&M Referral	O&M Referral
10	92nd Ave NW & 268th St NW	Ditch along farm field needs to be cleaned	O&M Referral	O&M Referral
11	Camano Gateway Bridge & Saratoga Dr	Flood gate for south Douglas Slough needs to be cleaned.	O&M Referral	O&M Referral
12	99th Ave NW & 272nd Pl NW	Ditch next to walking trail needs to be cleaned.	O&M Referral	O&M Referral

Table 6-2: List of Drainage Concerns/Problems from City Staff

ID	Address	Description	Problem Type	Project Type
13	271st St NW & Marine Dr	Ditch from R&R tracks to farm field behind Skagit farmers needs to be cleaned	O&M Referral	O&M Referral
14	84th Ave NW & 278th St NW	Ditch on 84th & 278th needs to be cleaned out.	O&M Referral	O&M Referral
15	82nd Dr NW & 282st St NW	The ditch on 80th & through the farm field runs into a small pipe & gets plugged often and flood the yards on 82nd.	O&M Referral	O&M Referral
16	Citywide	All ditches citywide need to be cleaned. The ditch on Lovers Lane, the ditch by the Amtrak Station and the ditch on 72nd from 272nd to 276th are the only ditches that have been cleaned in the last several years.	O&M Referral	O&M Referral
17	92nd Ave NW & 268th St NW	Seven Tubes - 1 gate is completely gone and needs to be replaced. All other 6 tubes need to be replaced due to hold in pipes and gates are old.	Small Works Project	Small Works Project
18	90th Ave NW & 271st St NW	270th St drain pipe under roadway is collapsed	Failed Infrastructure	Small Works Project
19	Lund Hill Rd & Nordic Way	Pioneer Hills south pond control structure is broke and is need of repair.	Failed Infrastructure	Small Works Project

Note: Drainage concerns noted on 1/14/2014.


Skagit Flats South Sub-basin
Douglas Creek Sub-basin
Church Creek Sub-basin
Stanwood City Sub-basin
Prestiens Bluff Drainages Sub-basin
Stillaguamish Floodplain Sub-basin
Unnamed Slough
Douglas Creek
South Douglas Slough
West Pass
South Pass
Old Stillaguamish River Channel
Jorgensen Slough
Irvine Slough
Larson Dam
Pump Station
WWTP
Church Creek
PIONEER HWY
LOVER'S LANE
271ST ST NW
80TH AVE NW
68TH AVE NW
102ND AVE NW
92ND AVE NW
88TH AVE NW
76TH AVE NW
72ND AVE NW
64TH AVE NW
MARINE DR NW
WOODLAND RD
532
16. All ditches citywide need to be cleaned. The ditch on Lovers Lane, the ditch by the Amtrak Station and the ditch on 72nd from 272nd to 276th are the only ditches that have been cleaned in the last several years.
19. Pioneer Hills south pond control structure is broken and in need of repair
15. The ditch on 80th & through the farm field runs into a small pipe & gets plugged often and floods the yards on 82nd.
14. Ditch on 84th & 278th needs to be cleaned out.
5. Lovers Lane 276th water ponds up on side of roadway across from Heritage Park on the north side of the road.
6. Water runoff from the street in heavy rain events washes the shoulder of the roadway down the hill on 85th Dr NW into Pioneer Hwy.
12. Ditch next to walking trail needs to be cleaned out.
13. Ditch from R&R tracks to farm field behind Skagit Farmers needs to be cleaned out.
2. Backyards on 76th Dr. NW Flood during heavy rain.
1. Backyards on 76th Dr. NW Flood from Water runoff from 272nd Street NW.
4. House on 96th next to the library, the yard floods during a flood event.
11. Flood gate for South Douglas Slough needs to be cleaned.
18. 270th St drain pipe under roadway is collapsed.
8. Vegetation Area behind Carlson Trucking needs to be cleaned out.
3. The dike is low in this area and needs to be built up, there are sand bags in place now.
9. Irvine Slough needs vegetation cut back from 92nd to Florence Road.
10. Ditch along farm field needs to be cleaned out.
7. Lindstrom Ponds 1 & 2 are full of Alder trees that need to be removed.
17. Seven Tubes - 1 gate is completely gone and needs to be replaced. All other 6 tubes need to be replaced due to hold in pipes and gates are old.
PACE
nhc
0
750
1,500
Feet
City Boundary
Urban Growth Area
Watercourse
Drainage Issue
Basins
Church Creek
Douglas Creek
Prestiens Bluff Drainages
Skagit Flats South
Stanwood City
Stillaguamish Floodplain
Figure 6-4
Drainage Issues Identified By City Staff
Stormwater Comprehensive Plan
CITY OF STANWOOD
P:\P13\135411 Stanwood Stormwater Comp Plan\GIS\ArcMap Doc\Figures\Fig6_4Stanwood_MapOfDrainageIssuesIdentBYstaff.mxd

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These entries from City staff (from Table 6-2 and Figure 6-4) were compiled and included in the Master List of Drainage Problems (presented previously in Table 6-1), then progressed into the ranking and rating process, as described below.

6.4 ESTABLISH RATING AND RANKING CRITERIA (STEP #3)

Discussions with City staff resulted in a set of criteria for the rating and ranking of drainage problems (as presented earlier in Table 6-1). The criteria consist of four general categories with each category being divided into one or more subcategories, as shown in Table 6-3 and listed below.

- *Nature of the Flood Hazard:* Damage to infrastructure (0-5 pts), flood source (0-5 pts), flood duration (0-5 pts) and flood frequency (0-5 pts); each of the four sub-criteria have a weight factor of 3, so that possible points for each sub-category would be 15 points; total points in this category is equal to 60 pts.
- *Environmental Impacts:* Water quality (0-5 pts), stream bank erosion (0-5 pts), hillside erosion (0-5 pts), and in-stream habitat (0-5 pts); each of these four sub-criteria have a weight factor of 1, so that the maximum possible points for each sub-category would be 5 points; total points in this category is equal to 20 pts.
- *Economic Impacts:* Various local and regional economic considerations worth 0-5 pts, with a weight factor of 2, for a total of 10 pts.
- *Community Considerations:* Complaint history (0-5 pts), aesthetics (0-5 pts), and public perception (0-5 pts); each of these three sub-criteria have a weight factor of 2, 1, and 2, respectively, for a total of 25 pts.

Total maximum points for each drainage problem is equal to 115 pts.

Table 6-3: Drainage Concerns - Ranking and Rating Criteria

Criteria Number	General Category	Specific Category	Score Range	Weight	Highest Potential Score
1	Flood Hazard Reduction	Impact to Infrastructure	0 = no impact, 3= impacts private property, 5 = impacts public streets in terms of traffic, infrastructure and public safety	3	15
		Flood Source	0 = no flooding, 3 = Private Water Contributing, 5 = Public Water	3	15
		Flood Duration	0 = 1-6 hours, 3 = 24 hours, 5 = More than 24-hours	3	15
		Flood Frequency	0 = 100-year storm, 3 = 25-year storm, 5 = 6-month storm	3	15
2	Environmental	Water Quality	0 = No Water Quality Concerns, 3 = Minor Water Quality Concerns, 5 = Measurable Water Quality Concerns	1	5
		Stream Bank Erosion	1 = Flood Condition Lasts less than 8 hours, 3 = Flood Condition Lasts 8 hours-24 hours, 5 = Flood Condition Lasts more than 24 hours	1	5
		Hillside Erosion	0 = No Hillside Erosion, 3 = Visible Hillside Erosion, 5 = Hillside Erosion with Impacts to Stream Channel and Downstream Capacity	1	5
		In-stream Habitat	0 = No Habitat impact, 3 = Moderate Impact of Habitats 5 = Heavy Impact of Habitats	1	5

Table 6-3: Drainage Concerns - Ranking and Rating Criteria

Criteria Number	General Category	Specific Category	Score Range	Weight	Highest Potential Score
3	Economic Impact	Economic Impact	0 = No Economic Impacts, 3 = Minor Economic Impacts, 5 = High Economic Impacts, such as Commercial and High Use Areas	2	10
4	Community Considerations	Complaint History	0 = No previous Citizen complaints, 3 = 1 or 2 other Citizen Complaints, 5 = More than 3 Citizen Complaints	2	10
		Aesthetics	0 = No Aesthetics Impacts, 3 = Occasional Negative Aesthetics Impacts (Seasonal), 5 = Constant Negative Aesthetic Impacts	1	5
		Public Perception	0 = No Public Perception this is a Problem, 3 = Public Perception of the Problem, 5 = Significant Public Interest	2	10
				Total	**115**

Additional CIP Project Considerations
1. Utility Responsibility and Ownership
2. Permitting
3. Property Acquisition
4. Design and Construction Feasibility and Challenges

6.5 APPLY RATING AND RANKING CRITERIA AND FORM PRIORITIZED LIST OF DRAINAGE ISSUES/PROBLEMS (STEP #4)

Using the criteria developed in Step 3 above, each of the 66 drainage issues/concerns/problems were rated and ranked; 54 were selected as drainage problem areas. Results of this rating and ranking process were shown previously in the numerically order projects presented in Table 6-1.

6.6 SEPARATE OUT SMALL WORKS, MAINTENANCE ACTIVITIES, AND STUDIES (STEP #5)

One of the outcomes of the rating and ranking process was the elimination of 12 minor drainage issues from the problem category to be addressed by the maintenance crew, leaving the 54 drainage problem areas, as listed in Table 6-1.

6.7 CREATE PRIORITIZED LIST OF RECOMMENDED CAPITAL IMPROVEMENT PROJECTS (STEP #6)

With the separation of the 12 maintenance projects from the list of Master List of Drainage Problems, the top ten CIP projects were identified. Again, this list is presented in Table 6-1 and consists of a total of 54 drainage problems. The problems are presented in a prioritized order based on the number of points assigned to each problem during the rating/rating process. Once again, the top ten problems were ranked high enough to be selected for further engineering analysis and the development of recommended drainage CIP projects.

6.8 CONDUCT MODELING TO VERIFY PROBLEMS AND PROPOSED DESIGNS (STEP #7)

The modeling analyses conducted in this stormwater planning process were specifically focused on the more difficult problem areas where in-depth engineering and flow analyses were needed to better define the problem and/or determine the capacity needed to meet the conveyance needs of the 25-year, 24-hour event. The modeling analyses, as described and presented earlier in Chapter 5, discovered three new problems that were not previously observed by the previous public surveys or staff input. These three drainage problems are listed as Drainage Problems #64, #65 and #66 in Table 6-1 above. Each of these were serious enough and ranked high enough to be included as CIP projects #3, #6, and #7, respectively.

6.9 DEVELOP CIP COST ESTIMATES (STEP #8)

Cost estimates were developed for each of the top ten recommended capital improvement projects. A standardized cost sheet with current unit costs from recent construction projects was prepared and then applied to each of the nine proposed CIP projects, with the tenth CIP project being the ISSSP. The highest priority project, the ISSSP Study Project, was estimated to cost over $1.7M and has been included in the City's updated drainage CIP.

6.10 FINALIZE CAPITAL PROJECTS AND INTEGRATE THEM INTO THE STORMWATER COMPREHENSIVE PLAN (STEP# 9)

This list of the top ten capital projects was finalized and integrated into the updated SWMP presented in Chapter 7. The total cost of the City's updated drainage CIP is estimated to be $8.31M, as summarized below in Section 6.11 and listed in Table 6-4. The cost of the ISSSP Project is unknown, and a result has not been included in the Master List of drainage CIP costs. Individual drainage CIP project sheets and costs have been included in the following section for the top nine projects.

(Note: Following the inclusion of the drainage CIP into the City's updated SWMP, this list of capital projects was presented to the City's outside financial consultant (FCSG) for an analysis and review of service levels, funding options, and rates, and will be presented to the City and public during the future SCP review and approval process.)

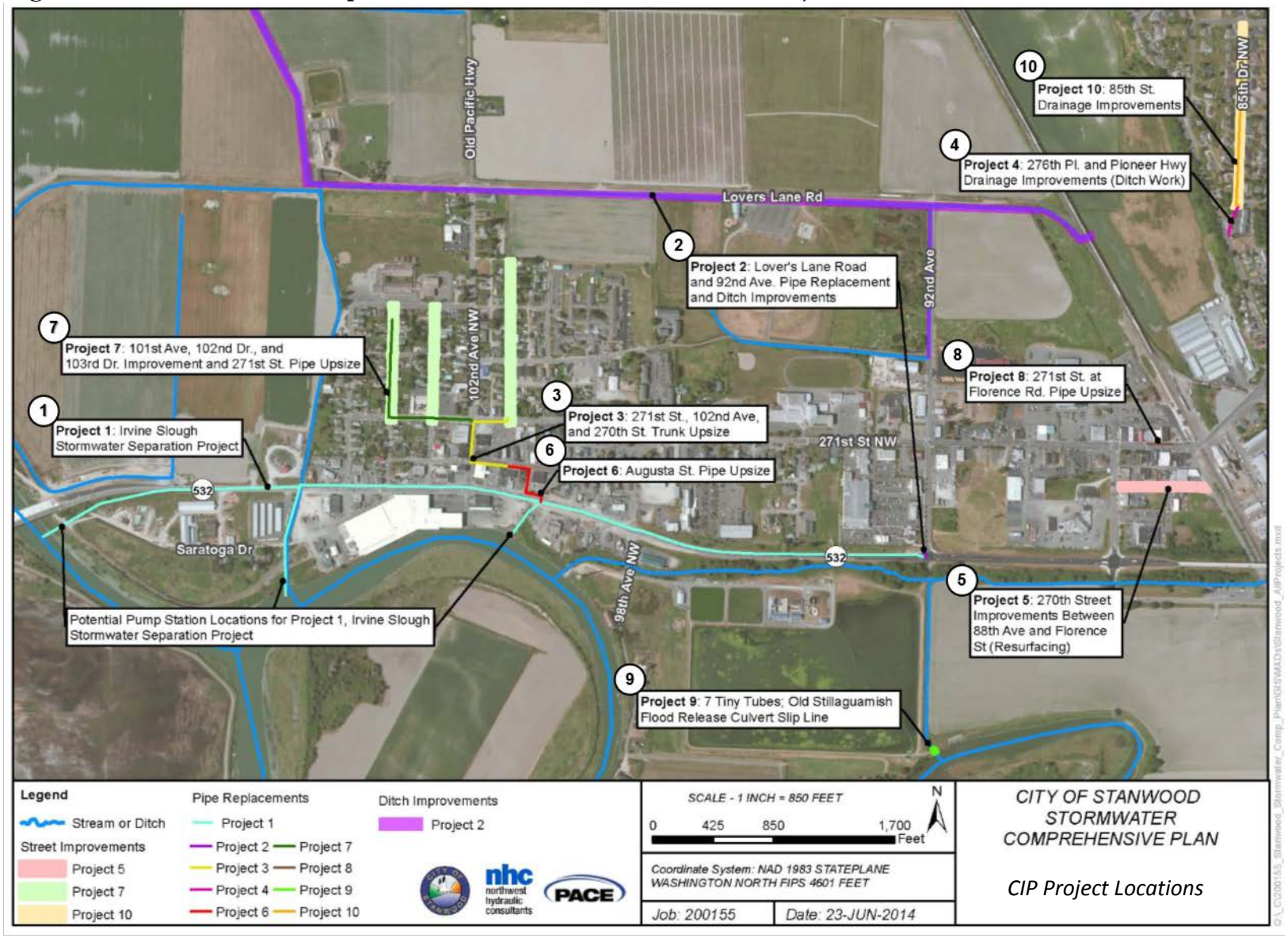
6.11 REVIEW AND APPROVE CAPITAL FACILITY IMPROVEMENTS AND COSTS (STEP #10)

The top ten drainage CIP projects were developed to solve the most significant drainage and flooding problems throughout the City. Each solution was designed to meet a level of service that prevents street flooding in storms more frequent that the 25-year return interval flood. The proposed engineering design options considered included the following: increasing system conveyance (e.g., pipe size), expanding the collection system network, and controlling flow volumes. Ultimately, all of the solutions developed as part of this plan will help to create increased conveyance capabilities within the City's drainage system, or will expand the drainage network into areas that currently either do not have a collection system or have an ineffective collection system.

A summary of the resulting projects and their estimated costs are provided in Table 6-4. The ten projects range in cost from $59,000 to nearly $3.2 million, with nine of the projects totaling $8.31M (all but the ISSSP). The final cost of drainage CIP #1, the ISSSP, will be determined as part of the ISSSP study, which is being funded by a grant in 2015 (project began in 2014). Figure 6-5 shows the location of the ten recommended drainage CIP projects. Within the figure, pipe replacements are shown as lines and street improvements are shown as a shaded right-of-way.

Table 6-4: City of Stanwood - Summary of Recommended CIP Projects and Costs		
CIP Project	**Project Name**	**Total Cost ($)**
#1	Irvine Slough Stormwater Separation Project	Unknown*
#2	92nd Ave at SR 532 Pipe Replacement & Lovers Lane Road Drainage Improvements	$637,366
#3	271st Street NW, 102nd Avenue, and 270th Street NW Trunk Upsize	$499,442
#4	276th Pl. and Pioneer Hwy Drainage Improvements (Ditch Work)	$58,791
#5	270th Street NW Improvements, between 88th Avenue NW and Florence/resurfacing	$373,138
#6	Augusta Street Pipe Upsize	$292,915
#7	101st Avenue, 102nd Drive and 103rd Drive Improvement	$2,111,928
	(Optional) with 271st Street NW Pipe Upsize	$3,248,524
#8	271st Street NW at Florence Rd. Pipe Upsize	$158,642
#9	7 Tiny Tubes; Old Stillaguamish Flood Release Culvert Slip Line	$144,190
#10	85th Drive Drainage Improvements	$788,635
	TOTAL:	**$8,313,571**
Total CIP Cost: $ 8.31M for CIPs #2 through #10, without the ISSSP (CIP #1)		

Figure 6-5: Location of Top Ten Recommended Stormwater CIP Projects



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6.11.1 Incorporation of the ISSSP into the Sizing of CIP Projects #2 through #10

To achieve the desired 25-year conveyance capacity within those areas draining to the Irvine Slough, a project similar to the proposed ISSSP is needed. The proposed ISSSP-type of project would allow the City to lower water levels at the City's outfalls relative to those currently resulting from the operation of the Irvine Slough Pump Station. Dropping the water level in the slough would allow the City's gravity drains to operate much more effectively and reduce flooding within the low-lying parts of the City

The ISSSP type of project would also have a direct impact on the size and performance of all of CIP projects that serve areas currently draining to Irvine Slough. If the ISSSP is not constructed, many of the flooding problems within the City would be more difficult to mitigate. For example, at the City Library site shown in Figure 6-6 at right, the ground elevation is similar to that of the water level in Irvine Slough during flood conditions. Without lowering the water levels at the outfall, mitigation of the flooding at this site would require a complex and expensive solution.

Thus, for all of the CIP projects that are located in subbasins draining to Irvine Slough, it has been assumed that the ISSSP project will be completed. It is also recognized that the ISSSP design may affect the performance of the recommended CIPs, depending on how well the ISSSP controls water levels in the drainage collection system.

Figure 6-6: Area of Flooding Adjacent to Library

Low area adjacent to Library that floods due to limited Irvine Slough capacity.

6.12 PROJECT SUMMARY SHEETS

Project Summary Sheets are provided for each of the developed CIP projects #2 through #10. Each sheet includes a listing of the drainage problem ID numbers (that are addressed by the proposed CIP), a problem description, a project description, design assumptions, project benefits, a project illustration map, and a tabulation of project quantities and costs. Cost estimates in each summary sheet include all costs needed for design and construction. (Per WAC 458-20-171 (Rule 171), Washington State Sales Tax has not been included for Roadway-related storm drainage.)

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6.13 CIP PROJECT #1
IRVINE SLOUGH STORMWATER SEPARATION PROJECT

Drainage Problem ID(s): 4, 57, and others are related.

Problem Description: Since 1990, Irvine Slough has been protected from Stillaguamish River flood waters by a dam at 92nd Avenue NW, the Larson Dam. This dam restricts the volume of floodwater that can enter the slough, allowing only a relatively small amount of water through the dam via a single 36-inch diameter culvert. While the dam helps reduce the amount of floodwater affecting the City's stormwater system, it also causes an increase in flood levels and duration of flooding in the Stillaguamish River floodplain. Additionally, while the dam at 92nd Avenue NW does reduce the volume of floodwaters reaching Irvine Slough, there is still a significant volume of water that reaches the Slough from the river. This volume of floodwater increases water levels in Irvine Slough, limits the capacity of the City's stormwater system to drain into Irvine Slough, and incurs additional pumping costs because river flood waters have to be pumped back into the Old Stillaguamish River channel via the Irvine Slough Pump Station.

Project Description: The Irvine Slough Stormwater Separation Project (ISSSP) is a major capital improvement project that was identified by the 2004 Stillaguamish River Flood Hazard Mitigation Plan as the preferred alternative to reduce flooding from the Stillaguamish River, and also to increase the capacity of the City's stormwater system in areas currently draining to Irvine Slough. The City has secured a grant to study this project and develop alternative and preferred conceptual designs. That work is expected began in 2014. The current objectives for the project are the following:

- Separate the City's stormwater system from Irvine Slough by constructing a new conveyance system on the north side of SR 532 that will route the City's stormwater east to a new pump station and outfall on the east or west side of Twin City Foods. Three potential pump station locations are identified in Figure 6-5 and photos of two of the sites are shown in Figure 6-7 below.
- Improve the capacity of Irvine Slough to convey Stillaguamish River floodwaters.

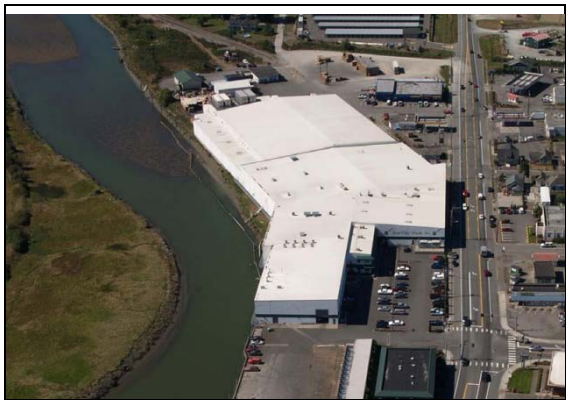
Solutions that are likely to achieve these objectives may include removing the existing dam in Irvine Slough at 92nd Avenue NW (Larson Dam). Since 1990, this dam has restricted the conveyance of floodwaters in the Stillaguamish River floodplain. Other possible solutions may also include reconstructing Irvine Slough as a high-flow bypass channel, and/or removing or modifying the Irvine Slough Pump Station.

The ISSSP is intended to provide a major improvement to the City's stormwater system by reducing the water levels at the City's outfalls, thereby allowing the system to discharge via gravity more freely. The degree of improvement will vary depending on how the ISSSP is designed and operated. For example, a larger pump station and higher capacity channel will be more effective in keeping water levels at the outfalls of the City's drainage system lower than would a smaller pump or

conveyance system. These aspects will need to be determined as part of the ISSSP design and evaluation process.

Figure 6-7: CIP Project #1 – Site of Potential ISSSP Pump Station

Potential ISSSP Pump Station Site to the west of Twin City Foods, taken from the west.



Twin City Foods taken from the east (Photos from Stanwood, 2010).

Design Assumptions:

- Pre-design phase will include an evaluation of various conveyance and flood reduction alternatives, and will be completed as part of the grant in 2014-2015. (Note: Design and construction costs are difficult to predict and have not been estimated at this time.)

Project Benefits: There are many potential benefits from a well-designed and well-operated ISSSP. The ISSSP project aims to reduce the duration of elevated water levels and flooding in the Stillaguamish River floodplain. It will likely accomplish this by increasing the conveyance capacity of the City's stormwater system and providing additional robustness to the City's stormwater system by moving the outfall further west into or nearer to West Pass, rather than continuing to discharge into the Old Stillaguamish Channel where it discharges now. The increases in the capacity of the City's stormwater system will provide full 25-year conveyance to many of the existing systems within the City and address many of the City's existing drainage problems.

Project Illustration Map: Due to the large expanse of this project, CIP #1 is shown as a light blue line on Figure 6-5, the CIP Project Location Map.

Estimated Quantities and Costs: A cost estimate has not been provided for this project. The project is expected to include the construction of 5,000 to 8,000 lineal feet of high capacity pipe or ditch, a new pump station, and re-grading of the existing Irvine Slough channel. These costs are not known at this time. Estimates may be expected to be in the range of $1.5M to $3M, but could be much higher, depending on the selected design option and outfall type and location.

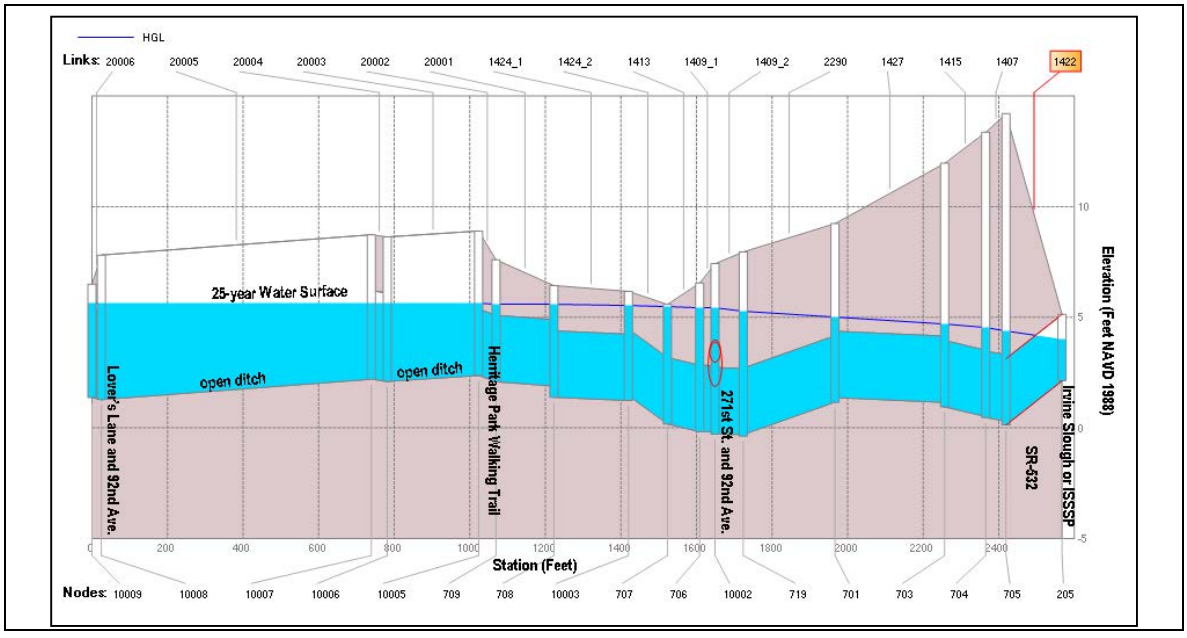
6.14 CIP PROJECT #2
LOVER'S LANE ROAD & 92ND AVENUE NW PIPE REPLACEMENT AND DITCH IMPROVEMENTS

Drainage Problem ID(s): 63, 34, 29, 28, 18, and five other complaints related to Douglas Creek from outside of the UGA.

Problem Description: The areas of flooding related to these two interconnected systems are widespread, and include both frequent flooding of Drainage and Diking District #7 (DD7) agricultural lands north of Lover's Lane Road and occasional street flooding within the 271st Street NW pipe network. Currently, when tide conditions prevent gravity discharge through the six gates that drain the Douglas Creek ditch system (a reversed flow condition), flows from Douglas Creek discharge to the south via the Lover's Lane Road ditch and the 92nd Avenue NW pipe system into Irvine Slough, and also into the South Douglas Slough. During some low tide conditions, the 92nd Avenue NW system does reverse direction and flow north, but the highest flows through the system flow to the south toward the City and Irvine Slough.

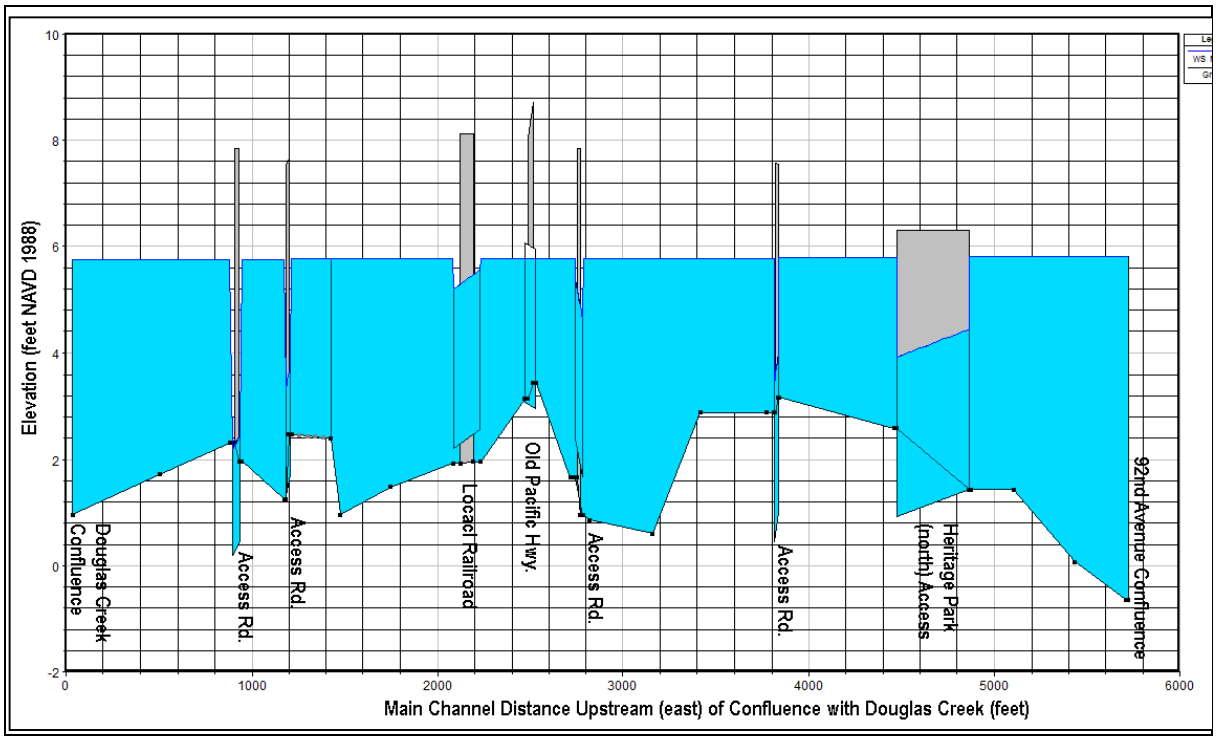
The capacities of the Lover's Lane Road and 92nd Avenue NW systems are both limited by poor ditch and pipe capacity and grades. Profile views of the 92nd Avenue NW system (SWMM model) and the Lover's Lane Road ditch system (HEC-RAS model) are shown in Figure 6-8 and Figure 6-9, respectively. The 25-year flood water surface is shaded blue in both figures.

Figure 6-8: CIP Project #2 – Hydraulic Profile Along 92nd Avenue NW



Hydraulic profile along 92nd Avenue NW between Lover's Lane Road and Irvine Slough, shows the pipe at SR 532 that needs to be replaced.

Figure 6-9: CIP Project #2 – Hydraulic Profile Along Lover's Lane Road



Hydraulic Profile along Lover's Lane Road between 92nd Avenue NW and Confluence with Douglas Creek, shows poorly graded channel and culverts.

The 92nd Avenue NW system (Figure 6-8) is currently graded in two directions. The ditch north of the Heritage Park walking trail near 273rd Street NW is sloped north toward Lover's Lane Road and the pipe system south of the walking trail has a slightly greater slope south toward Irvine Slough. The capacity of the system to flow south is limited by a poorly graded pipe crossing SR 532. That pipe, highlighted as ID 1422 in Figure 6-8, discharges at an elevation of 2.13 feet, while the inlet at the north end of the pipe is at an elevation of 0.13 feet. It is not clear why the pipe was installed with an adverse grade, but lowering the south end of this pipe at the outfall to Irvine Slough by 2.0 feet would increase the capacity of the entire system. In addition to the SR 532 pipe crossing, there is also a low point in the system in the vicinity of 271st Street NW, but model simulations indicate that this is less of a limitation than the SR 532 crossing. The primary concern with the low point near 271st Street NW is sediment accumulation. The system should be regularly cleaned to ensure sediment does not routinely reduce the capacity of the pipe.

The capacity of the Lover's Lane Road ditch system (Figure 6-9) is limited by poor grading and culverts that are either perched, partially buried, or of inadequate diameter.

Project Description: In the 92nd Avenue NW system, the 150-foot long 36-inch-diameter pipe under SR 532 will be replaced to align with the existing system on the north side of SR 532 and slope downward to the constructed ISSSP. This pipe will become the new outfall at the south end of the 92nd Avenue NW drainage system. In the Lover's Lane Road system, the ditch should be regraded and the culvert crossings adjusted to provide an adequate slope. The HEC-RAS model used to evaluate Lover's Lane and 92nd Avenue NW system assumed that sediment was removed from the culverts. It is beyond the scope of this project to determine the needed slope of the ditch and culverts, optimal flow direction, or the optimal volume of discharge that should be routed from Douglas Creek to Irvine Slough via the pipe/ditch system along 92nd Avenue NW. Additionally, there may be a limit to how much capacity can be added to Lover's Lane Road ditch without a major pipe replacement of the 92nd Avenue NW storm drain line. That limitation was not assessed and, aside from the SR 532 crossing, replacement of the pipe along 92nd Avenue NW has not been included in this CIP #2 cost estimate.

Project Benefits: Improving the grades of the ditches and pipes along the 92nd Avenue NW and Lover's Lane Road drainage systems will reduce the frequency of flooding both inside and outside of the City's UGA. The City should also be aware that: a) increasing the capacity of Lover's Lane Road and 92nd Avenue NW could increase the volume of flow that is routed to Irvine Slough (or the ISSSP) from Douglas Creek and increase pumping costs at the downstream pump station, and b) that increasing the capacity of Lover's Lane Road without increasing the capacity of 92nd Avenue NW could aggravate flooding problems in the 271st Street NW system.

Design Assumptions:

- 25-year design standard.
- The ISSSP will be constructed.
- The SR 532 crossing pipe will likely be replaced or eliminated as part of the ISSSP and the cost will vary depending on the design and where the ISSSP drainage system and outfall are located and constructed.
- The existing flap gate at the 92nd Avenue NW outfall to Irvine Slough will be reused.
- Sediment that accumulates in the 92nd Avenue NW pipe near the low point at 271st Street NW will be routinely removed as part of the City's regular maintenance program.
- Surveyed elevations of the Lover's Lane Road culvert inverts provided by Pacific Geomatic Services, Inc. are correct. Due to sediment accumulation in many of the culverts at the time of the survey, the surveyor had to estimate the sediment depth and culvert invert elevations. It is recommended that the Lover's Lane Road culverts be resurveyed prior to final design and more time be taken to confirm the elevation of the culvert inverts.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-10.

Estimated Quantities and Costs: See Table 6-5.

Figure 6-10: CIP Project #2 – Illustration Map

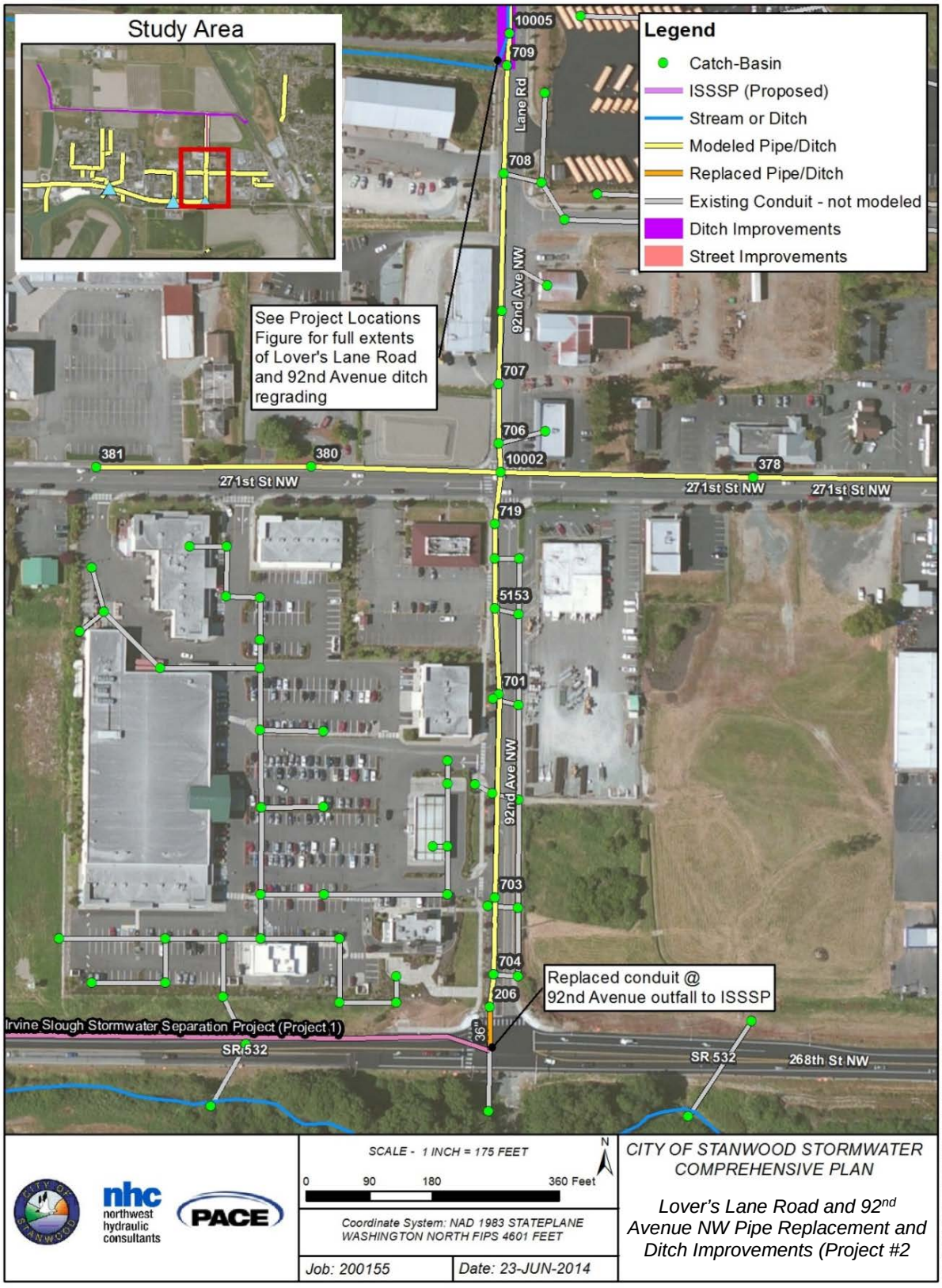


Table 6-5: CIP Project #2 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$5,000.00	$5,000.00
2	Temporary Traffic Control	1	LS	$20,000.00	$20,000.00
3	Mobilization	1	LS	$55,000.00	$55,000.00
4	Ditch Excavation	3100	CY	$30.00	$93,000.00
5	Fine Grading	9722	SY	$7.00	$68,055.56
6	Remove and Dispose of Existing Pavement	125	SY	$12.50	$1,562.50
7	Removal and Disposal of Existing Storm Sewer Pipe	150	LF	$15.00	$2,250.00
8	Crushed Surfacing Top Course	1300	TON	$25.00	$39,000.00
9	HMA Cl 1/2" PG-64–22 — 6" Depth	43	TON	$175.00	$7,473.96
10	Storm Sewer Pipe, 36" Diameter	150	LF	$140.00	$21,000.00
11	Culvert, 12" Diameter	108	LF	$75.00	$8,100.00
12	Culvert, 24" Diameter	602	LF	$120.00	$72,240.00
13	Culvert, 36" Diameter	214	LF	$200.00	$42,800.00
14	Type II Catch Basin-54" Diameter	1	EA	$4,500.00	$4,500.00
15	Connection to Existing Drainage Structure/Pipe	1	EA	$500.00	$500.00
16	Rip-Rap for Outfall Protection	5	Ton	$40.00	$200.00
17	Bank Run Gravel for Pipe Zone Backfill	512	Ton	$30.00	$15,369.06
18	Erosion Control and Water Pollution Control	1	LS	$15,000.00	$15,000.00

Subtotal	$471,051.07
Contingency (30%)	$141,315.32
TOTAL CONTRACT COST	$612,366.39
Engineering/Permitting/Construction Management	$25,000.00
Total Project Cost	**$637,366.39**

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6.15 CIP PROJECT #3
271ST STREET NW, 102ND AVENUE NW, AND 270TH STREET NW TRUNK UPSIZE

Drainage Problem ID(s): 64

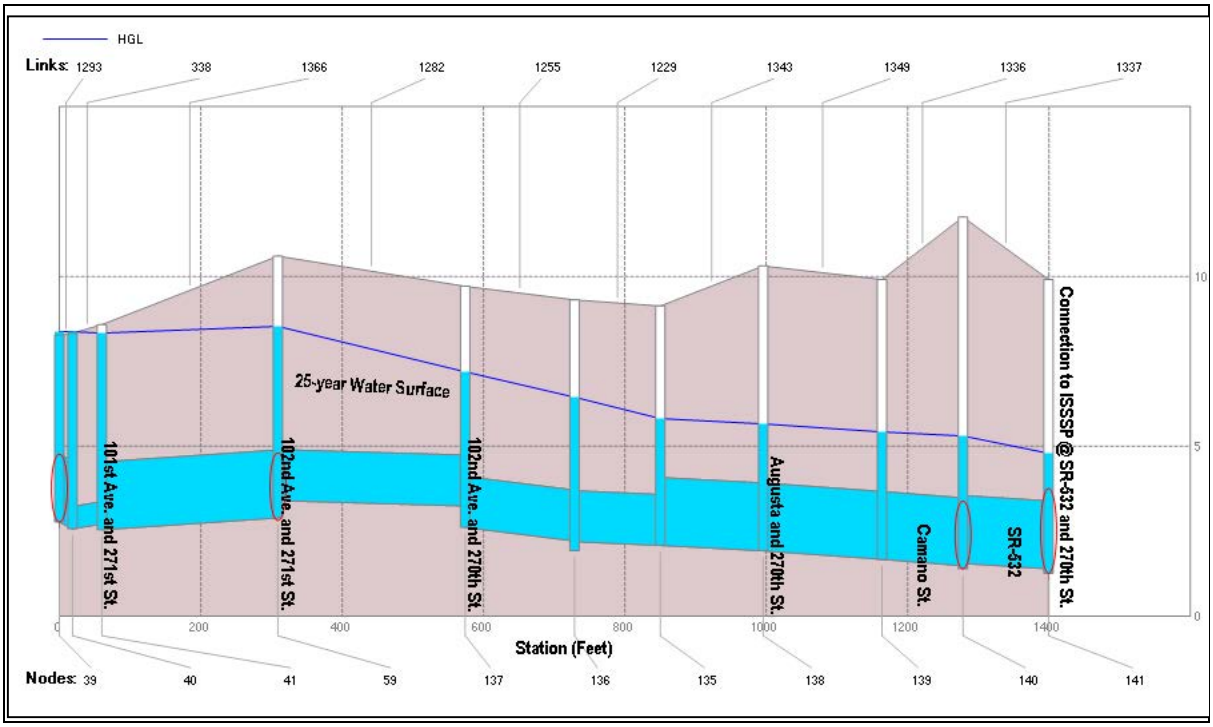
Problem Description: The stormwater system in the portion of the City within modeling Areas 1-3, north of 271st Street NW, is severely limited by an 8-inch pipe that crosses 271st Street NW at 101st Avenue NW (see Figure 6-11) and is partially limited by undersized pipes along 271st Street NW, 102nd Avenue NW, and 270th Street NW. As a result, water levels in the stormwater system back up along 100th Avenue NW, 101st Avenue NW, 102nd Drive NW, and 103rd Drive NW, causing flooding at many locations along these roads during the 25-year flood, including flooding at the intersection of 271st Street NW and 102nd Avenue NW. Figure 6-12 shows a profile view of this portion of the existing stormwater system. The profile begins at the intersection of 102st Avenue NW and 271st Street NW on the left side of the figure and ends at the outfall to the ISSSP on the right side of the figure. Flooding seen at node 39 on the figure extends further north, beyond the extents of the profile.

Figure 6-11 CIP Project #3 – 271st Street NW Photos

Photo looking south across 271st Street NW at 101st Avenue NW, location of 8" pipe limiting capacity.

Photo of catch basin ID #40 at intersection of 271st Street NW and 101st Avenue NW showing 24" and 8" pipe in same structure (May 26, 2014).

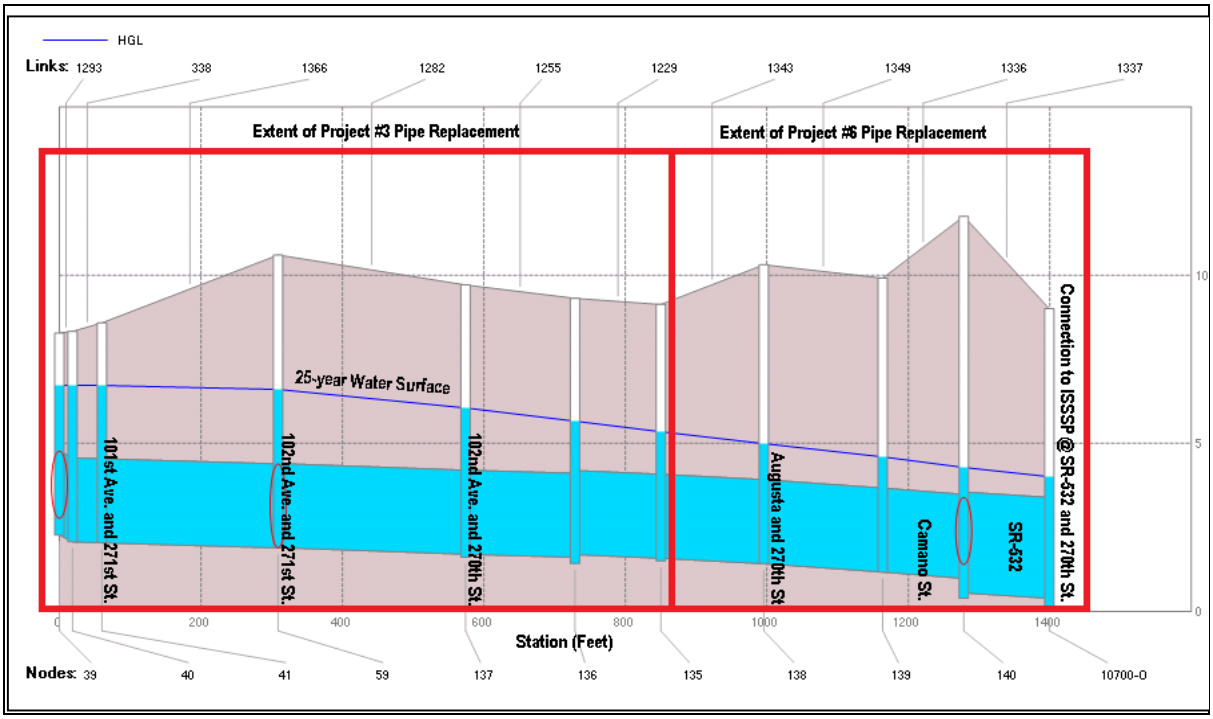
Figure 6-12: CIP Project #3 – Hydraulic Profile #1 Without System Improvements



Hydraulic profile along 271st Street NW, 102nd Avenue NW, and 270th Street NW, showing sections of stormwater system that need to be upsized to provide 25-year conveyance capacity.

Project Description: This project will increase conveyance by replacing pipes along 271st Street NW between 101st and 102nd Avenues NW, along 102nd Avenue NW between 270th and 271st Streets NW, and along 270th Street NW between 102nd Avenue NW and Augusta Street. (Note: Augusta Street is located between 270th Street NW and 268th Street NW, just to the west of the intersection of Camano Street with 268th Street NW.) The extents of this reach are included in the left red box on the profile in Figure 6-13 and are highlighted in orange in Figure 6-14. In total, this project will install about 832 feet of new 30-inch pipe and associated catch basins. The project will connect to Project #6 at its most downstream end.

Figure 6-13: CIP Project #3 – Hydraulic Profile #2 Following System Improvements



Hydraulic profile along 271st Street NW, 102nd Avenue NW, and 270th Street NW, showing improvements to stormwater system.

Project Benefits: If implemented with Projects #6 and #7, this project will eliminate flooding on 100th Avenue NW, 101st Avenue NW, 102nd Drive NW, and 103rd Drive NW during the 25-year flood. If Project #6 is not constructed, this project would reduce the frequency of flooding on 100th and 101st Avenues NW, but not eliminate it. Projects #3, #6, and #7 are all needed to eliminate flooding on 103rd Drive NW.

Design Assumptions:

- 25-year design standard.
- The ISSSP will be constructed.
- Curb, gutter, and sidewalk will need to be removed and replaced on 271st and 270th Streets NW.
- 3 feet of pipe cover will be provided.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-14.

Estimated Quantities and Costs: See Table 6-6.

Figure 6-14: CIP Project #3 – Illustration Map

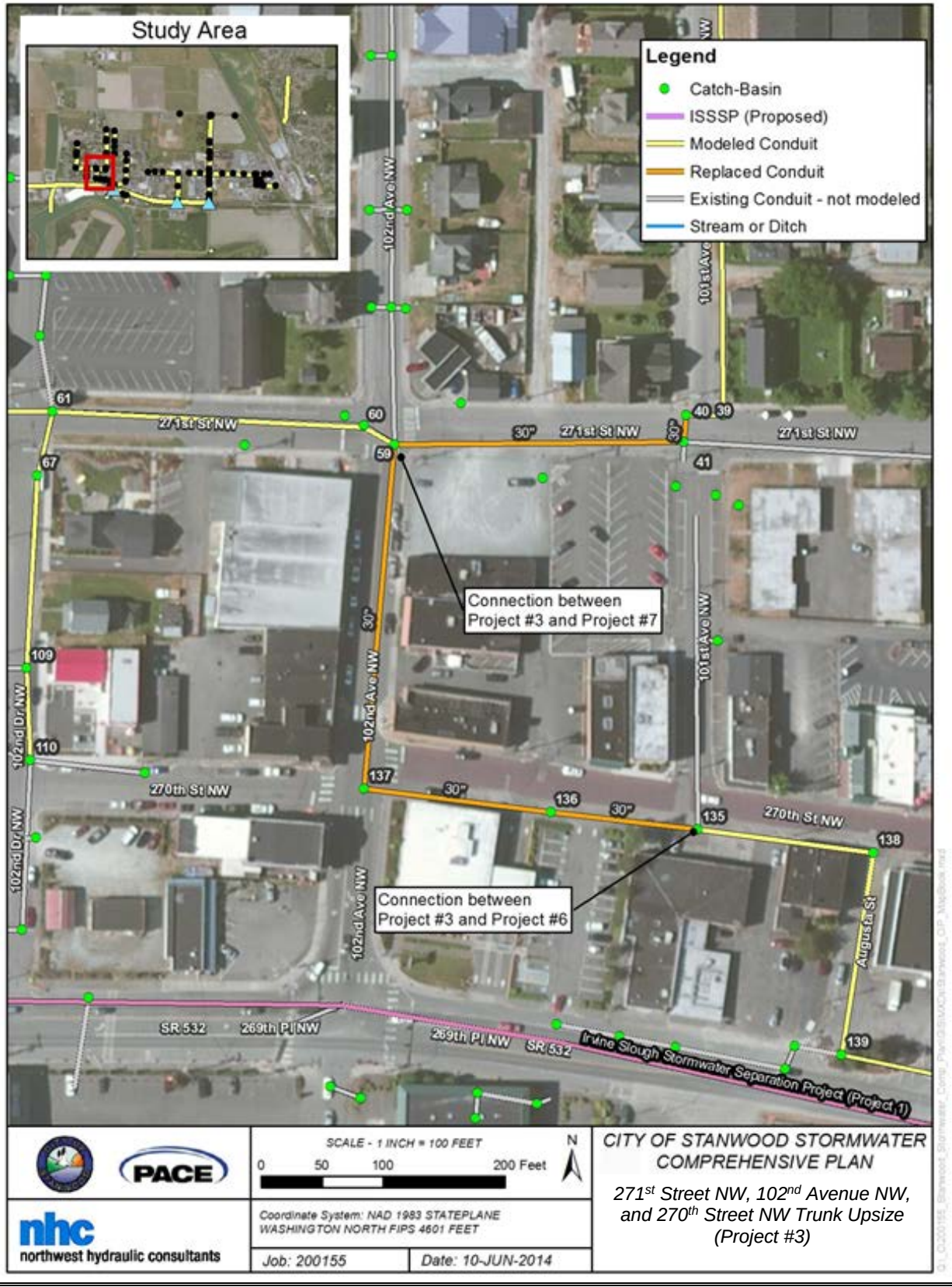


Table 6-6: CIP Project #3 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$1,000.00	$ 1,000.00
2	Temporary Traffic Control	1	LS	$15,000.00	$15,000.00
3	Mobilization	1	LS	$22,000.00	$22,000.00
4	Remove and Dispose of Existing Pavement	693	SY	$12.50	$ 8,666.67
5	Removal and Disposal of Existing Storm Sewer Pipe	832	LF	$15.00	$12,480.00
6	Removal and Disposal of Existing Curb and Gutter*	500	LF	$ 5.00	$2,500.00
7	Removal and Disposal of Existing Sidewalk*	278	SY	$12.50	$3,472.22
8	Crushed Surfacing Top Course**	1,081	TON	$30.00	$32,423.96
9	HMA Cl 1/2" PG-64–22 — 4" Depth	147	TON	$175.00	$25,757.72
10	Concrete Curb Ramps*	2	EA	$2,000.00	$4,000.00
11	Concrete Sidewalk*	278	SY	$40.00	$11,111.11
12	Storm Sewer Pipe, 30" Diameter	832	LF	$125.00	$104,000.00
13	Type II Catch Basin, 54" Diameter	6	EA	$4,500.00	$27,000.00
14	Connection to Existing Drainage Structure/Pipe	1	EA	$500.00	$500.00
15	Bank Run Gravel for Pipe Zone Backfill	437	Ton	$30.00	$13,120.64
16	Erosion Control and Water Pollution Control	1	LS	$2,500.00	$2,500.00
17	Concrete Curb and Gutter*	500	LF	$25.00	$12,500.00

Subtotal	$298,032.32
Contingency (30%)	$89,409.70
TOTAL CONTRACT COST	$387,442.02
Engineering/Permitting/Construction Management	$112,000.00
Total Project Cost	**$499,442.02**

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6.16 CIP PROJECT #4
276TH PLACE NW AND PIONEER HIGHWAY DRAINAGE IMPROVEMENTS (DITCH WORK)

Drainage Problem ID(s): 6 and 58

Problem Description: Runoff from 85th Drive NW flows south toward Pioneer Highway, collects on the east shoulder of 276th Place NW, and flows down the hill to Pioneer Highway. These uncontrolled flows often cause erosion on the shoulder of the road and icy road conditions during freezing weather. This erosion is recurrent and causes unnecessary maintenance costs. The collective water-quality impairment, maintenance concerns, and safety issues at this site make this a high priority CIP project.

Project Description: The project will construct approximately 250 feet of asphalt-lined ditch along the east side of 276th Place NW and will collect runoff at the intersection of 276th Place NW and 85th Drive NW. Collected water will be conveyed down the slope to the existing Pioneer Highway stormwater system and discharged. The alignment is shown in Figure 6-16, at the south end of other improvements along 85th Drive NW which are prescribed as part of Project #10.

The ditch will be connected to an existing catch basin on Pacific Highway via a short 10-foot-long, 18-inch-diameter inlet pipe. The photo in Figure 6-15 is looking down the slope where the new ditch will be constructed. There is an existing catch basin at the top of the slope, on the southeast corner of the intersection of 276th Place and 85th Avenue NW, about 10 feet off of the roadway. This catch basin will need to be integrated into the ditch alignment as part of final design of this solution.

Figure 6-15: CIP Project #4 – Looking South Along Proposed Ditch Alignment

Looking south along proposed ditch alignment on 276th Place NW from 85th Drive NW (April 25, 2014).

Project Benefits: This project will reduce maintenance costs associated with erosion, improve water-quality impairment associated with the transport of eroded material, and improve safety by keeping water and ice off of the traveled roadway. The project will also serve as the downstream conveyance path for Project #10 when constructed.

Design Assumptions:

- 25-year design standard.
- The ISSSP will be constructed.
- The constructed ditch will be 18" deep, with a 3' wide bottom width, and 3:1 side slopes.
- The ditch will be lined with 4" thick asphalt.
- 9-inch-high x 2-foot-wide check dams will be constructed at a 20-foot spacing.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-16.

Estimated Quantities and Costs: See Table 6-7.

Figure 6-16: CIP Projects #4 and #10 – Illustration Map

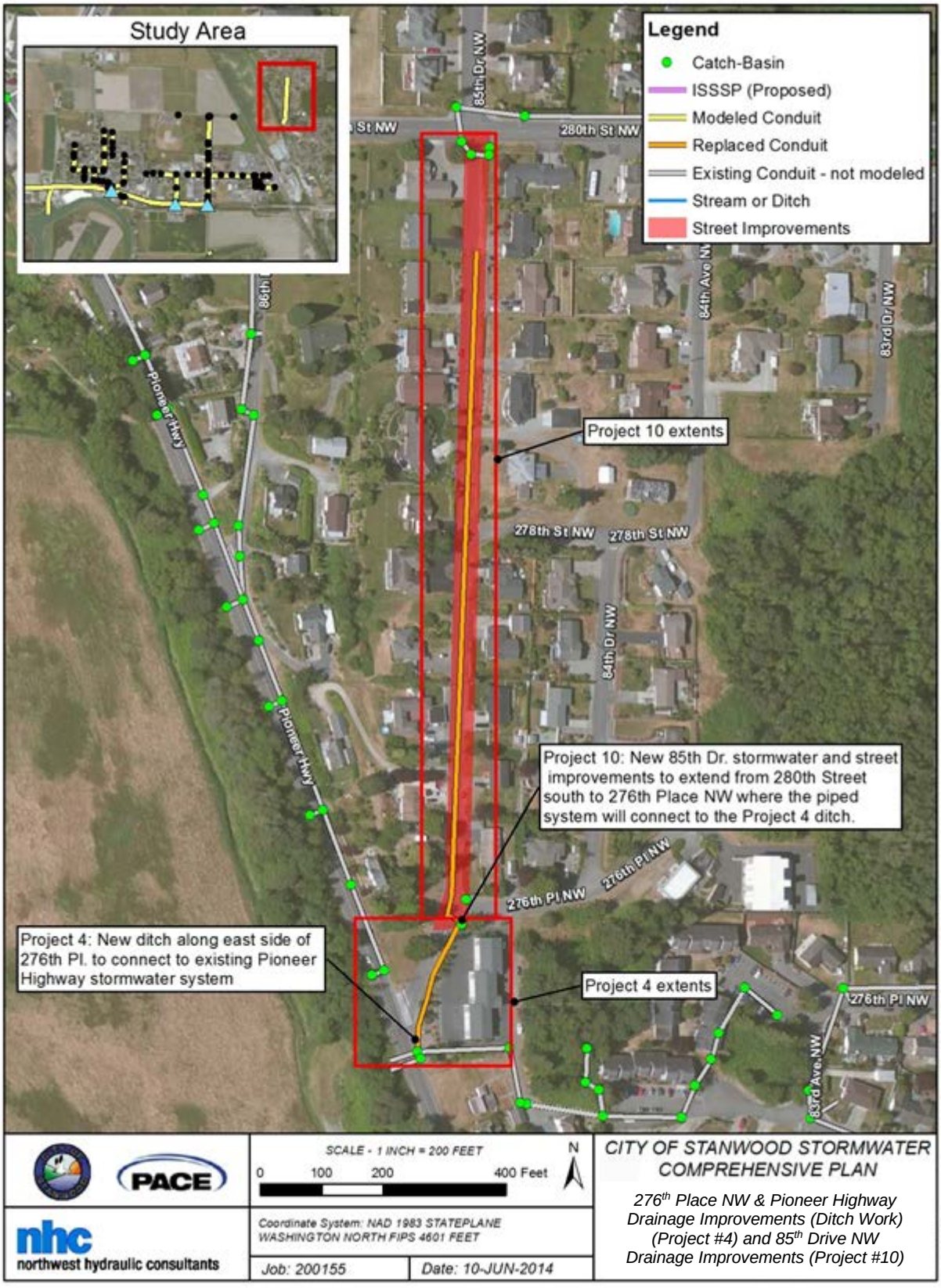


Table 6-7: CIP Project #4 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$5,000.00	$5,000.00
3	Mobilization	1	LS	$3,000.00	$3,000.00
4	Ditch Excavation	149	CY	$30.00	$4,472.22
5	Fine Grading	319	SY	$7.00	$2,236.11
6	Asphalt Ditch Lining w/ Check Dams	75	TON	$175.00	$13,129.98
7	Crushed Surfacing Top Course	36	TON	$30.00	$1,091.26
8	Connection to Existing Drainage Structure/Pipe	1	EA	$500.00	$500.00
9	Bank Run Gravel for Pipe Zone Backfill	2	Ton	$28.00	$56.00
10	Storm Sewer Pipe, 18-inch Diameter	10	LF	$70.00	$700.00
11	Erosion Control and Water Pollution Control	1	LS	$2,500.00	$2,500.00

Subtotal	$33,685.58
Contingency (30%)	$10,105.67
TOTAL CONTRACT COST	$43,791.25
Engineering/Permitting/Construction Management	$15,000.00
Total Project Cost	**$58,791.25**

6.17 CIP PROJECT #5
270TH STREET NW IMPROVEMENTS, BETWEEN 88TH AVENUE NW & FLORENCE DRIVE/RESURFACING

Drainage Problem ID(s): 18

Problem Description: The storm drainage system on 270th Street NW, between 88th Avenue NW and Florence Drive, is ineffective at collecting runoff from the right-of-way and surface ponding occurs frequently as a result (see an example of such ponding in Figure 6-17 below). Additionally, there is at least one pipe that is crushed and in need of replacement which crosses 270th Street NW near 87th Avenue NW.

Figure 6-17: CIP Project #5 – Looking West Showing Some Surface Ponding

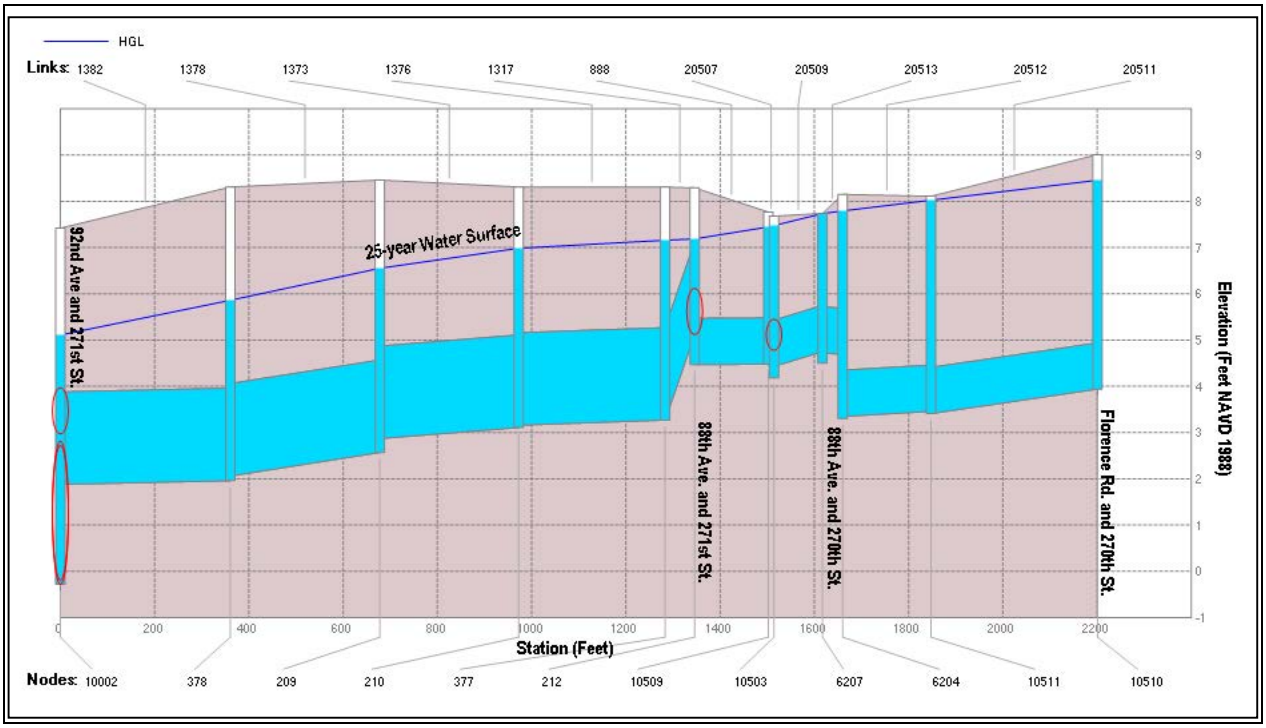
Photo looking west along 270th Street NW from Florence Drive, shows some surface ponding at shoulder of roadway (April 25, 2014).

Project Description: A separate City project is proposed to design street improvements along 270th Street NW that includes improved stormwater drainage elements. The extent of those street improvements are shaded in red in Figure 6-19. The 60% design drawings for the project, by the Blue Line Group, indicate that the stormwater system on 270th Street NW currently is graded to the west, but the intended outlet is not currently known. We recommend that the City select a drainage direction that is consistent with the designed ISSSP and other drainage needs in this portion of the City. The system could be designed to flow in three different directions: to the west; either north on 88th Avenue NW to 271st Street NW, or to the south on 88th Avenue NW to an extended version of the ISSSP; or east to Florence Drive and then south to Irvine Slough or the ISSSP.

For the purposes of this CIP estimate, we have assumed that 270th Street NW will continue to drain to the west and then north on 88th Avenue NW to 271st Street NW, as shown in Figure 6-19. There are some irregularities in the 88th Avenue NW profile, specifically where the system on 88th Avenue NW is higher than on 270th Street NW. However, even with this odd profile (shown in Figure 6-18), the existing system has capacity to convey flows from the 25-year storm, so no pipe replacements are included in this CIP project. While not included in the cost estimate for this

project, the pipes should be corrected if 88th Avenue NW is ever improved for reasons other than improving system capacity.

Figure 6-18: CIP Project #5 – Hydraulic Profile Along 270th Street NW



Hydraulic profile along 270st Street NW between Florence Drive and 88th Avenue NW, and 88th Avenue NW south of 271st Street NW, no pipe replacements are required to achieve conveyance of the 25-year storm.

Project Benefits: This project will improve the collection of drainage on 270th Street NW and correct existing failures in the system. The project has already reached 60% design under a separate City design contract.

Design Assumptions:

- 25-year design standard.
- The ISSSP will be constructed.
- No pipe replacements on 88th Avenue NW are needed to provide 25-year conveyance capacity for the system.
- Project activities will be limited to work on 270th Street NW.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-19.

Estimated Quantities and Costs: See Table 6-8.

Figure 6-19: CIP Project #5 and #8 – Illustration Map

Table 6-8: CIP Project #5 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$20,000.00	$20,000.00
3	Mobilization	1	LS	$9,000.00	$9,000.00
4	Remove and Dispose of Existing Pavement	2,500	SY	$12.50	$31,250.00
5	Removal and Disposal of Existing Storm Sewer Pipe	625	LF	$15.00	$9,375.00
8	Crushed Surfacing Top Course	751	TON	$30.00	$22,535.67
9	HMA Cl 1/2" PG-64–22 — 4" Depth	569	TON	$175.00	$99,553.13
13	Storm Sewer Pipe, 24" Diameter	625	LF	$90.00	$56,250.00
14	Type II Catch Basin, 48" Diameter	2	EA	$4,500.00	$9,000.00
15	Connection to Existing Drainage Structure/Pipe	1	EA	$500.00	$500.00
16	Bank Run Gravel for Pipe Zone Backfill	228	TON	$30.00	$6,834.72
17	Erosion Control and Water Pollution Control	1	LS	$2,500.00	$2,500.00

Subtotal	$267,798.52
Contingency (30%)	$80,339.56
TOTAL CONTRACT COST	$348,138.08
Engineering/Permitting/Construction Management	$25,000.00
Total Project Cost	**$373,138.08**

6.18 CIP PROJECT #6
AUGUSTA STREET PIPE UPSIZE

Drainage Problem ID(s): 65

Problem Description: This project is an extension of Project #3. Project #3 will improve the capacity of the system and eliminate some of the flooding along 100th and 101st Avenues NW, but some locations at the northern ends of 100th Avenue NW, 101st Avenue NW, and 103rd Drive NW will continue to flood during the 25-year flood. The existing hydraulic profile along this reach is shown in Figure 6-20, with Project #3.

Project Description: This project will construct a new 30-inch pipe along Augusta Street between 270th Street NW and the proposed outfall at the ISSSP along SR 532, extending the new 30-inch pipe placed as part of Project #3 to the north. The location of this project is shown adjacent to Project #3 in Figure 6-5.

Project Benefits: This project will eliminate flooding on 100th Avenue NW and 101st Avenue NW in the 25-year flood, but some flooding will still occur on 103rd Drive NW. That flooding along 103rd Drive NW will be addressed with Project #7.

Design Assumptions:

- 25-year design standard.
- The ISSSP and Project #3 will be constructed.
- It is assumed that curb, gutter, and sidewalk will need to be removed and replaced on 270th Street NW.
- 3 feet of pipe cover will be provided.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-20.

Estimated Quantities and Costs: See Table 6-9.

Figure 6-20: CIP Project #6 – Augusta Street Pipe Upsize

Table 6-9: CIP Project #6 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$5,000.00	$5,000.00
3	Mobilization	1	LS	$22,000.00	$22,000.00
4	Remove and Dispose of Existing Pavement	389	SY	$12.50	$4,866.67
5	Removal and Disposal of Existing Storm Sewer Pipe	470	LF	$15.00	$7,050.00
6	Removal and Disposal of Existing Curb and Gutter	150	LF	$5.00	$750.00
7	Removal and Disposal of Existing Sidewalk	83	SY	$12.50	$1,041.67
8	Crushed Surfacing Top Course	607	TON	$30.00	$18,200.27
9	HMA Cl 1/2" PG-64–22 — 3" Depth	67	TON	$175.00	$11,639.44
10	Concrete Curb Ramps	1	EA	$1,500.00	$1,500.00
11	Concrete Sidewalk	83	SY	$40.00	$3,333.33
12	Storm Sewer Pipe, 30" Diameter	428	LF	$125.00	$53,500.00
13	Storm Sewer Pipe, 36" Diameter	42	LF	$140.00	$5,880.00
14	Type II Catch Basin-54" Diameter	5	EA	$4,500.00	$22,500.00
15	Connection to Existing Drainage Structure/Pipe	2	EA	$500.00	$1,000.00
16	Bank Run Gravel for Pipe Zone Backfill	244	Ton	$30.00	$7,308.16
17	Erosion Control and Water Pollution Control	1	LS	$5,000.00	$5,000.00
18	Concrete Curb and Gutter	150	LF	$25.00	$3,750.00

Subtotal	$175,319.54
Contingency (30%)	$52,595.86
TOTAL CONTRACT COST	$227,915.40
Engineering/Permitting/Construction Management	$65,000.00
Total Project Cost	**$292,915.40**

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6.19 CIP PROJECT #7
101ST AVENUE NW, 102ND DRIVE NW, AND 103RD DRIVE NW IMPROVEMENT AND 271ST STREET NW PIPE UPSIZE

Drainage Problem ID(s): 66

Problem Description: The collection systems in several streets in the west end of downtown Stanwood (101st Avenue NW, 102nd Drive NW, and 103rd Drive NW) are not effective at preventing flooding of streets and yards because runoff cannot reach the stormwater system. Even in locations where the system has available capacity, a flow path does not exist for ponded water to get into the stormwater system. Figure 6-21 shows ponding on the shoulder of 101st Avenue NW and an example of a catch basin that is not able to capture runoff from the roadway. More substantial ponding than that shown in Figure 6-21 was observed in these areas by City staff during the January 2014 storm events.

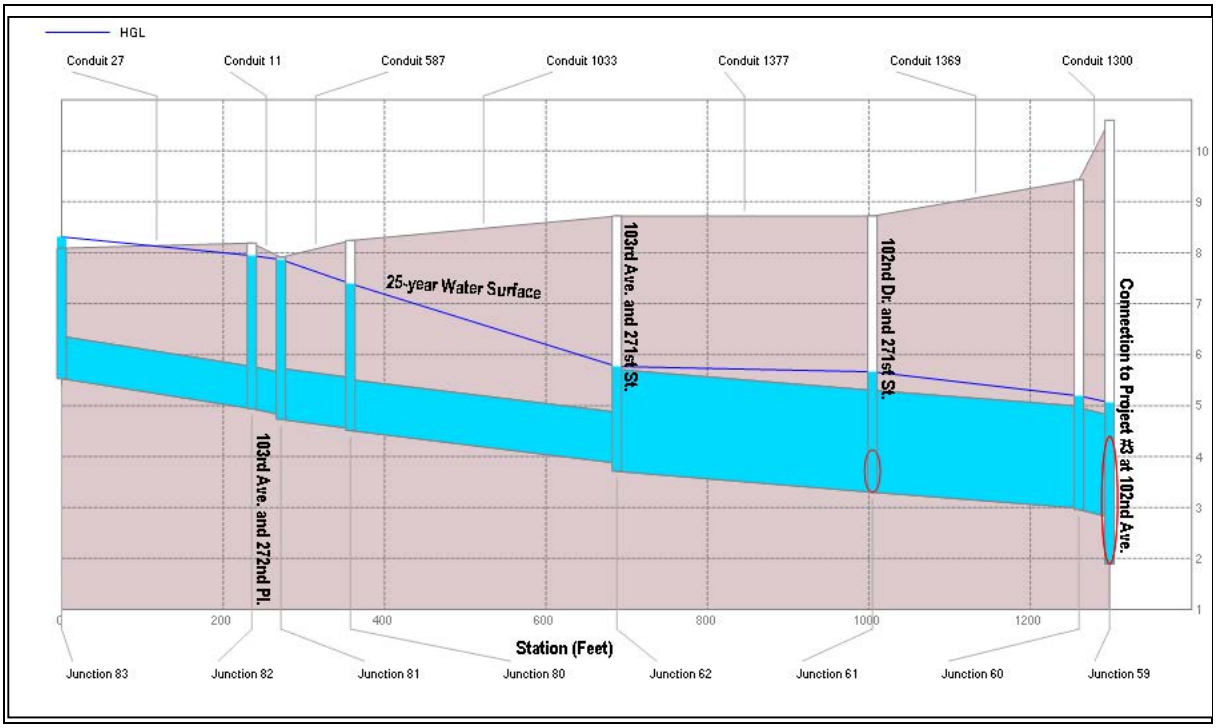
Figure 6-21: CIP Project #7 – Photos

Photo looking north on 101st Avenue NW from vicinity of 271st Street NW (April 25, 2014).

Photo looking south on 101st Avenue NW from 272nd Street NW (May 26, 2014).

Additionally, Project #3 will reduce flooding at 271st Street NW and 101st Avenue NW, and Project #6 will fully eliminate flooding along 100th and 101st Avenues NW. There is, however, simulated flooding at the north end of 103rd Avenue NW during the 25-year flood that is not mitigated by those projects. The existing hydraulic profile along this reach is shown in Figure 6-12, along with Project #3.

Figure 6-22: CIP Project #7 – Hydraulic Profile Along 103rd Avenue NW and 271st Street NW



Hydraulic profile along 103rd Avenue NW and 271st Street NW, showing sections of stormwater system that need to be upsized to provide 25-year conveyance capacity.

Project Description: Under this project, local drainage improvements and road resurfacing will be performed on 101st Avenue NW, 102nd Drive NW, and 103rd Drive NW. Modeling of these portions of the system shows that additional pipe replacement is also needed to provide capacity in the 103rd Drive NW conveyance system. Thus, pipe replacement would need to be performed along 103rd Drive NW between 273rd Street NW and 271st Street NW under all ISSSP designs. In addition to replacing the pipe on 103rd Drive NW, the existing pipe along 271st Street NW also needs to be replaced to prevent street flooding in the higher 4-foot water level ISSSP design scenario. (Note: The 271st Street NW pipe replacements are not needed if the ISSSP design keeps water levels below the pipe invert at the system outfall. Pipe replacements along 271st Street NW are included in the cost estimate as optional. The 103rd Drive NW and 271st Street NW pipe segments are highlighted in orange in Figure 6-23.)

The existing pipes on 101st Avenue NW and 102nd Drive NW provide adequate capacity, but new pipes are included in the project because they will likely need to be replaced to facilitate connections to yard drains on private properties and the grading changes associated with other street improvements.

Project Benefits: The street improvements will provide local drainage to 101st Avenue NW, 102nd Drive NW, and 103rd Drive NW. This project will compliment increases in conveyance capacity associated with Projects #3 and #6 by providing the same performance standard to all of the streets north of 271st Street NW.

Design Assumptions:

- 25-year design standard.
- The ISSSP, Project #3, and Project #6 will be constructed.
- It is assumed that curb, gutter, and sidewalk will need to be removed and replaced on 271st Street NW.
- 3 feet of pipe cover will be provided.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-23.

Estimated Quantities and Costs: See Tables 6-10A, 6-10B, 6-10C, and 6-10D.

Figure 6-23: CIP Project #7 – Illustration Map

Table 6-10: CIP Project #7 Costs					
Item	**Description**	**Estimated Quantity**	**Unit**	**Unit Cost**	**Total**
101st Avenue NW					
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$5,000.00	$5,000.00
3	Mobilization	1	LS	$45,000.00	$45,000.00
4	Grind Existing Pavement	3,767	SY	$10.00	$37,666.67
5	Removal and Disposal of Existing Storm Sewer Pipe	1,078	LF	$15.00	$16,170.00
6	Crushed Surfacing Top Course	948	TON	$30.00	$28,443.38
7	HMA Cl 1/2" PG 64-22 – 3" Depth	643	TON	$175.00	$112,607.64
8	Concrete Curb Ramps	6	EA	$1,500.00	$9,000.00
9	Concrete Sidewalk	1,256	SY	$40.00	$50,222.22
10	Storm Sewer Pipe, 12" Diameter	700	LF	$60.00	$42,000.00
11	Storm Sewer Pipe, 24" Diameter	378	LF	$90.00	$34,020.00
12	Yard Drain Stubs	26	EA	$200.00	$5,200.00
13	Type II Catch Basin, 48" Diameter	14	EA	$4,500.00	$63,000.00
14	Connection to Existing Drainage Structure/Pipe	5	EA	$500.00	$2,500.00
15	Bank Run Gravel for Pipe Zone Backfill	291	Ton	$30.00	$8,729.53
16	Erosion Control and Water Pollution Control	1	LS	$5,000.00	$5,000.00
17	Concrete Curb and Gutter	2260	LF	$25.00	$56,500.00
		Subtotal			**$522,059.44**
102nd Drive NW					
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$5,000.00	$5,000.00
3	Mobilization	1	LS	$30,000.00	$30,000.00
4	Grind Existing Pavement	2,667	SY	$10.00	$26,666.67
5	Removal and Disposal of Existing Storm Sewer Pipe	800	LF	$15.00	$12,000.00
6	Crushed Surfacing Top Course	618	TON	$30.00	$18,544.00
7	HMA Cl 1/2" PG 64-22 – 3" Depth	456	TON	$175.00	$79,722.22
8	Concrete Curb Ramps	4	EA	$1,500.00	$6,000.00
9	Concrete Sidewalk	889	SY	$40.00	$35,555.56
10	Storm Sewer Pipe, 12" Diameter	800	LF	$60.00	$48,000.00
11	Yard Drain Stubs	19	EA	$200.00	$3,800.00
12	Type II Catch Basin, 48" Diameter	13	EA	$4,500.00	$58,500.00
13	Connection to Existing Drainage Structure/Pipe	6	EA	$500.00	$3,000.00
14	Bank Run Gravel for Pipe Zone Backfill	175	Ton	$30.00	$5,252.44

Table 6-10: CIP Project #7 Costs					
Item	**Description**	**Estimated Quantity**	**Unit**	**Unit Cost**	**Total**
15	Erosion Control and Water Pollution Control	1	LS	$5,000.00	$5,000.00
16	Concrete Curb and Gutter	1600	LF	$25.00	$40,000.00
		Subtotal			**$378,040.89**
103rd Drive NW					
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$5,000.0.	$5,000.00
3	Mobilization	1	LS	$35,000.00	$35,000.00
4	Grind Existing Pavement	2,667	SY	$10.00	$26,670.00
5	Removal and Disposal of Existing Storm Sewer Pipe	678	LF	$15.00	$10,170.00
6	Crushed Surfacing Top Course	590	TON	$30.00	$17,712.90
7	HMA Cl 1/2" PG 64-22 – 3" Depth	456	TON	$175.00	$79,722.22
8	Concrete Curb Ramps	5	EA	$1,500.00	$7,500.00
9	Concrete Sidewalk	889	SY	$40.00	$35,555.56
10	Storm Sewer Pipe, 12" Diameter	236	LF	$60.00	$14,160.00
12	Storm Sewer Pipe, 18" Diameter	442	LF	$80.00	$35,360.00
13	Yard Drain Stubs	23	EA	$200.00	$4,600.00
14	Type II Catch Basin, 48" Diameter	14	EA	$4,500.00	$63,000.00
15	Connection to Existing Drainage Structure/Pipe	8	EA	$500.00	$4,000.00
16	Bank Run Gravel for Pipe Zone Backfill	180	Ton	$30.00	$5,393.89
17	Erosion Control and Water Pollution Control	1	LS	$5,000.00	$5,000.00
18	Concrete Curb and Gutter	1600	LF	$25.00	$40,000.00
		Subtotal			**$389,844.56**
271st Street NW – (Optional Project)					
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$15,000.00	$15,000.00
3	Mobilization	1	LS	$15,000.00	$15,000.00
4	Remove and Dispose of Existing Pavement	500	SY	$1,250.00	$625,000.00
5	Removal and Disposal of Existing Storm Sewer Pipe	600	LF	$15.00	$9,000.00
6	Removal and Disposal of Existing Curb and Gutter	255	LF	$5.00	$1,275.00
8	Crushed Surfacing Top Course	724	TON	$30.00	$21,723.33
9	HMA Cl 1/2" PG 64-22 – 3" Depth	80	TON	$175.00	$13,951.39
10	Storm Sewer Pipe, 30" Diameter	600	LF	$125.00	$75,000.00
11	Type II Catch Basin, 48" Diameter	6	EA	$4,500.00	$27,000.00
12	Connection to Existing Drainage Structure/Pipe	2	EA	$500.00	$1,000.00

Table 6-10: CIP Project #7 Costs					
Item	**Description**	**Estimated Quantity**	**Unit**	**Unit Cost**	**Total**
13	Bank Run Gravel for Pipe Zone Backfill	266	Ton	$30.00	$7,980.00
14	Erosion Control and Water Pollution Control	1	LS	$5,000.00	$5,000.00
15	Concrete Curb and Gutter	255	LF	$25.00	$6,375.00
		Subtotal			**$824,304.72**

Subtotal (All 3 Projects excluding Optional Project)	**$1,289,944.89**
Contingency (30%)	$386,983.47
TOTAL CONTRACT COST	$1,676,928.36
Engineering/Permitting/CM	$435,000.00
Total Project Cost	**$2,111,928.36**

Subtotal (All 3 Projects including Optional Project)	**$2,114,249.61**
Contingency (30%)	$634,274.88
TOTAL CONTRACT COST	$2,748,524.50
Engineering/Permitting/CM	$500,000.00
Total Project Cost	**$3,248,524.50**

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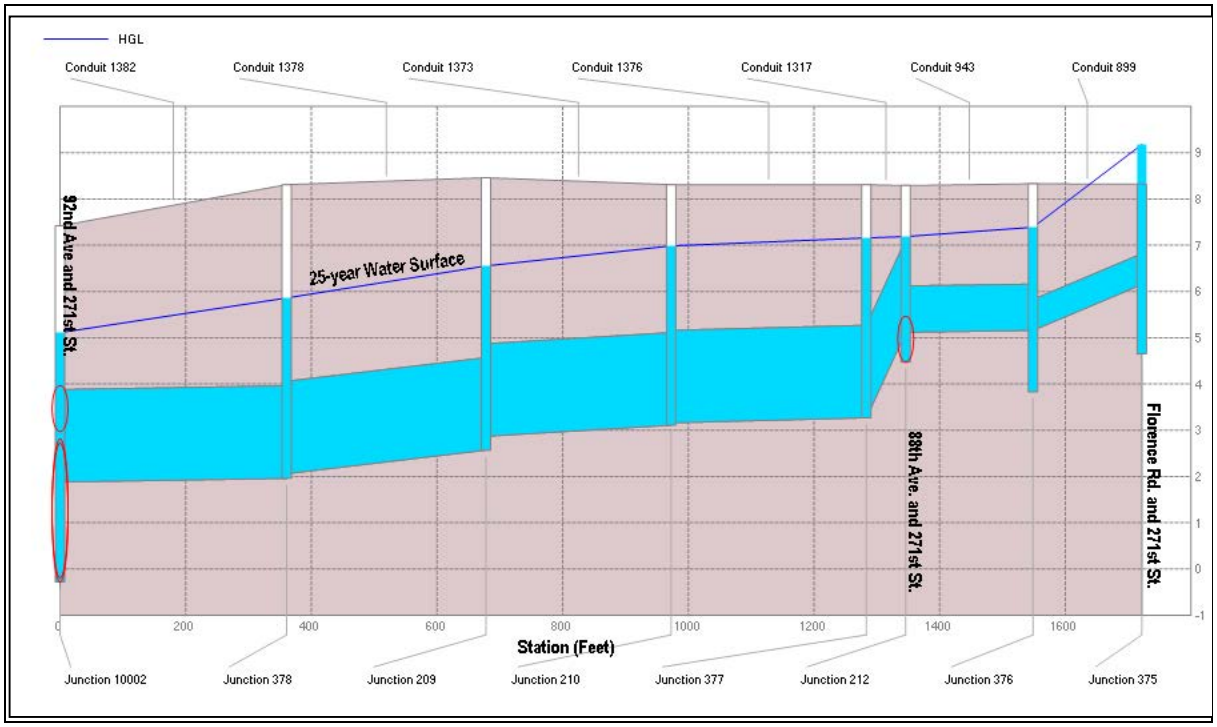
6.20 CIP PROJECT #8
271ST STREET NW AT FLORENCE DRIVE PIPE UPSIZE

Drainage Problem ID(s): 34

Problem Description: Drainage complaints have identified flooding problems on the west side of the BNSF railroad tracks on 271st Street NW at Florence Drive. This problem was confirmed with the stormwater model to be a problem, even after the ISSSP is constructed. A profile of the existing stormwater system is shown in Figure 6-24. The water level rising above the ground surface at Florence Drive can be seen at the right edge of the figure. The east end of 271st Street NW at Florence Drive, where the project is located, is also shown in Figure 6-19.

Figure 6-24: CIP Project #8 – Hydraulic Profile Along 271st Avenue NW – Existing System



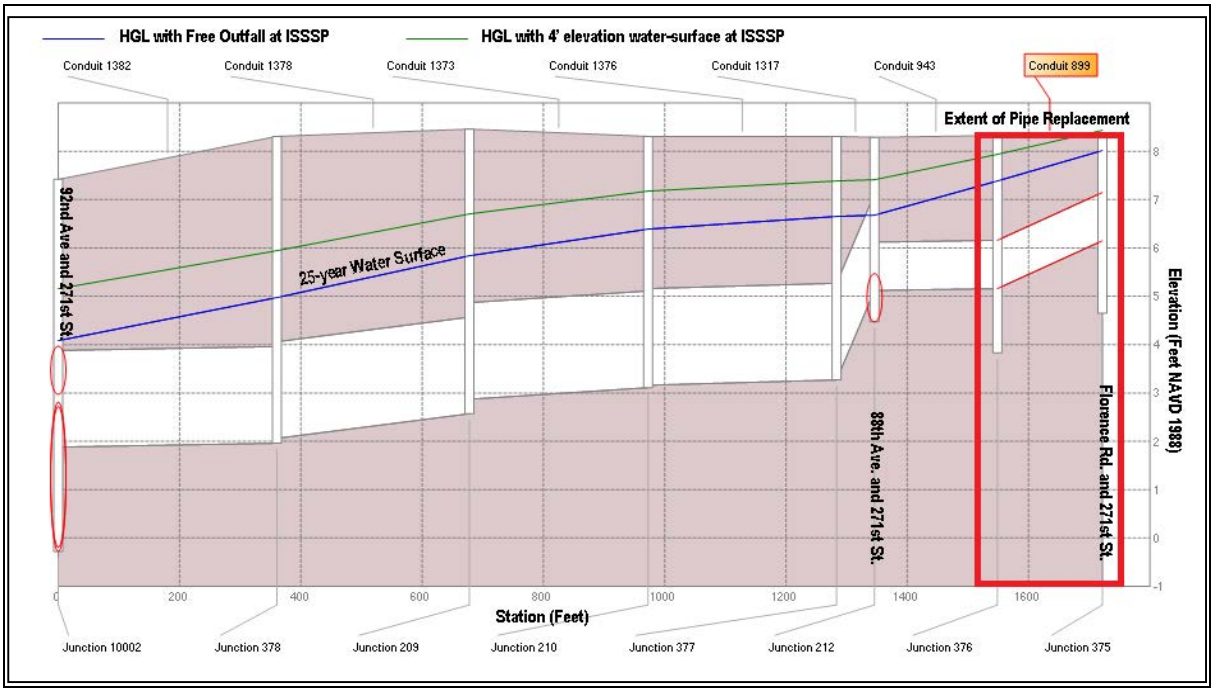
Hydraulic profile along 271st Street NW between Florence Drive and 92nd Avenue NW, showing the existing stormwater system.

Figure 6-25: CIP Project #8 – 271st Street NW (Main Street)

271st Street NW (Main Street), looking west from Florence Drive (Photo Courtesy of Joe Mabel).

Project Description: This CIP project will replace a single 8-inch-diameter pipe (conduit #899) on 271st Street NW, just west of Florence Drive, with a 12-inch-diameter pipe. The extent of the project is identified by the orange line in Figure 6-19 and the red box shown in Figure 6-26. The blue line shown in Figure 6-26 represents the water level in the system if the ISSSP keeps water levels below the invert of the outfall at 92nd Avenue NW. The green line shows the water level if the ISSSP only keeps water levels below an elevation of 4 feet at the system outfall. (Note: There is a very small amount of street ponding at Florence Drive in the case with the higher ISSSP water level.)

Figure 6-26: CIP Project #8 – Hydraulic Profile Along 271st Street NW – Simulated Flooding



Hydraulic Profile Along 271st Street NW showing simulated flooding at Florence Drive in the 25-year flood.

Project Benefits: When completed, this project will reduce the frequency of flooding at the intersection of 271st Street NW and Florence Drive. Simulated flooding is eliminated in the 25-year storm if the ISSSP lowers water levels below the outfall pipe invert (a free outfall condition*). Only a few inches of flooding is simulated in the case when the ISSSP controls water levels at the outfall to an elevation below 4'. (Note: A free outfall condition means that the stormwater runoff can flow directly to the river via gravity flow without any blockages or detention due to undersized facilities, reverse or inadequate grades, or lack of pumping capacity at the pump station.)

Design Assumptions:

- 25-year design standard.
- The ISSSP and Project #2 will be constructed.
- It is assumed that curb, gutter, and sidewalk will need to be removed and replaced on 271st Street NW.
- 3 feet of pipe cover will be provided.
- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-19, presented with Project #5.

Estimated Quantities and Costs: See Table 6-11.

Table 6-11: CIP Project #8 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$20,000.00	$20,000.00
3	Mobilization	1	LS	$9,000.00	$9,000.00
4	Remove and Dispose of Existing Pavement	104	SY	$12.50	$1,298.61
5	Removal and Disposal of Existing Storm Sewer Pipe	170	LF	$15.00	$2,550.00
6	Removal and Disposal of Existing Curb and Gutter*	170	LF	$5.00	$850.00
7	Removal and Disposal of Existing Sidewalk*	94	SY	$12.50	$1,180.56
8	Crushed Surfacing Top Course**	131	TON	$30.00	$3,940.60
9	HMA Cl 1/2" PG-64–22 — 4" Depth	23	TON	$175.00	$4,099.72
10	Concrete Sidewalk*	94	SY	$40.00	$3,777.78
11	Storm Sewer Pipe, 12" Diameter	170	LF	$60.00	$10,200.00
12	Type II Catch Basin-48" Diameter	5	EA	$4,500.00	$22,500.00
13	Connection to Existing Drainage Structure/Pipe	1	EA	$500.00	$500.00
14	Bank Run Gravel for Pipe Zone Backfill	37	Ton	$30.00	$1,116.14
15	Erosion Control and Water Pollution Control	1	LS	$5,000.00	$5,000.00
16	Concrete Curb and Gutter*	170	LS	$25.00	$4,250.00

Subtotal	$91,263.40
Contingency (30%)	$27,379.02
TOTAL CONTRACT COST	$118,642.43
Engineering/Permitting/Construction Management	$40,000.00
Total Project Cost	**$158,642.43**

6.21 CIP PROJECT #9
7 TINY TUBES; OLD STILLAGUAMISH FLOOD RELEASE CULVERT SLIP LINE

Drainage Problem ID(s): 17

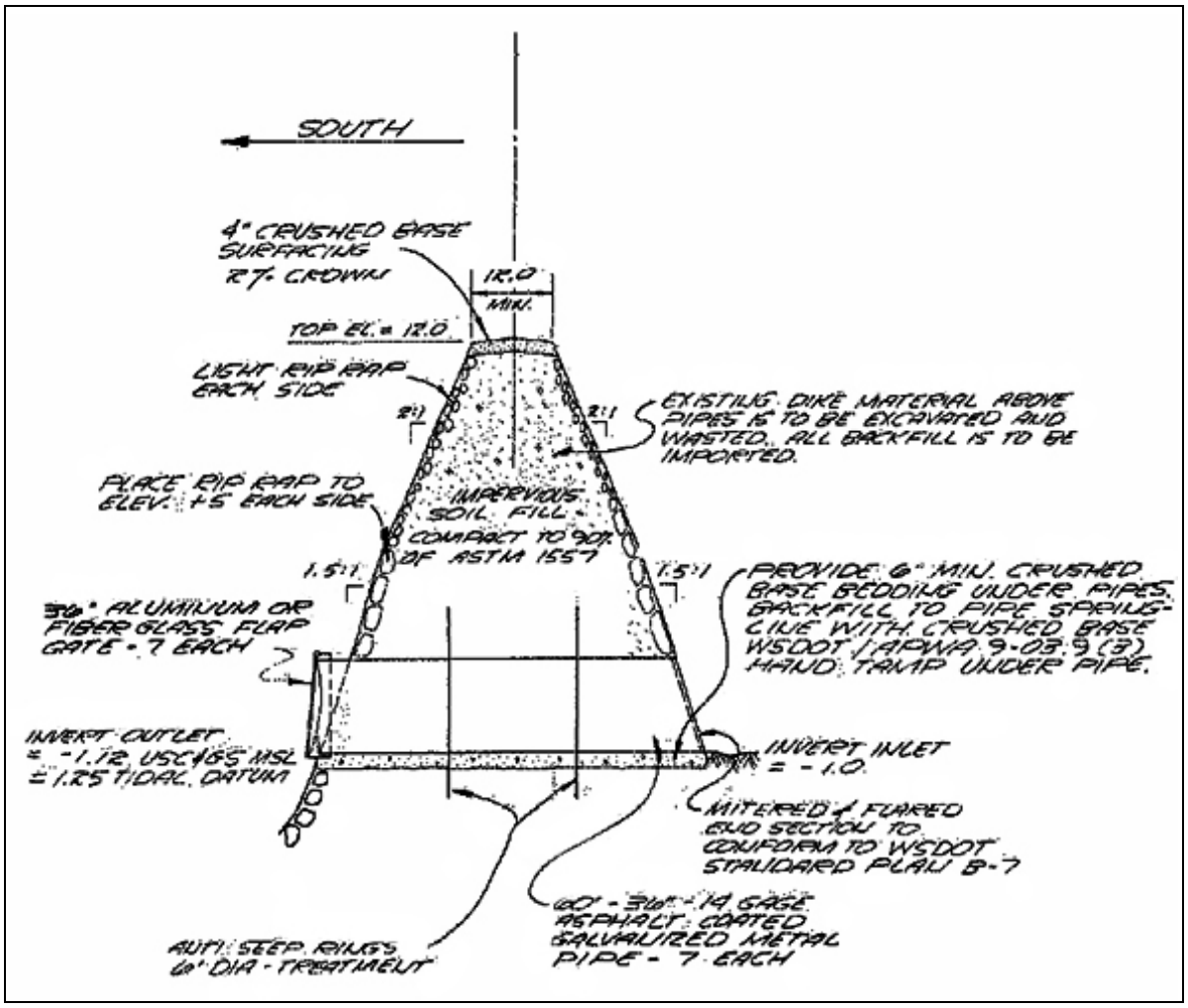
Problem Description: These seven "tiny" pipes, each 36 inches in diameter, are intended to allow the floodplain on the north side of the Stillaguamish River levee to drain back into the river after large floods. The pipes, commonly called the "7 tiny tubes", need to be replaced due to leakage and concerns regarding their integrity. Additionally, one of the pipes is missing a flood gate and all of the gates are degraded. Leakage through the pipes allows Stillaguamish River water to flow into Irvine Slough and that water must be pumped via the Irvine Slough Pump Station back into the Stillaguamish River. Photos of the existing pipes are shown in Figure 6-27 and the original design drawing is shown in Figure 6-28.

Figure 6-27: 7 Tiny Tubes – Photos

Outlet of 7 Tiny Tubes, Photo taken October 23, 2007 (Photo courtesy City staff).

Inlet of 7 Tiny Tubes, Photo taken January 8, 2013 (NHC).

Figure 6-28: CIP Project #9 – 7 Tiny Tubes Design Drawing, July 1990



Project Description: The seven pipes will be slip-lined with a smaller diameter pipe than the existing 36-inch diameter installed in the original design. Only one gate is missing, but all seven are included in the cost estimate because the other six are not functioning well.

Project Benefits: The CIP improvements will prevent leakage of Stillaguamish River water into the Irvine Slough system during high tide conditions, resulting in lower pumping costs at the Irvine Slough Pump Station. Repairing the pipes will also reduce the risk that they may collapse and lose their functionality at lowering water levels in the floodplain.

Design Assumptions:

- Right-of-way purchase and environmental studies are not included.

Project Illustration Map: See Figure 6-29.

Estimated Quantities and Costs: See Table 6-12.

Figure 6-29: CIP Project #9 – Illustration Map

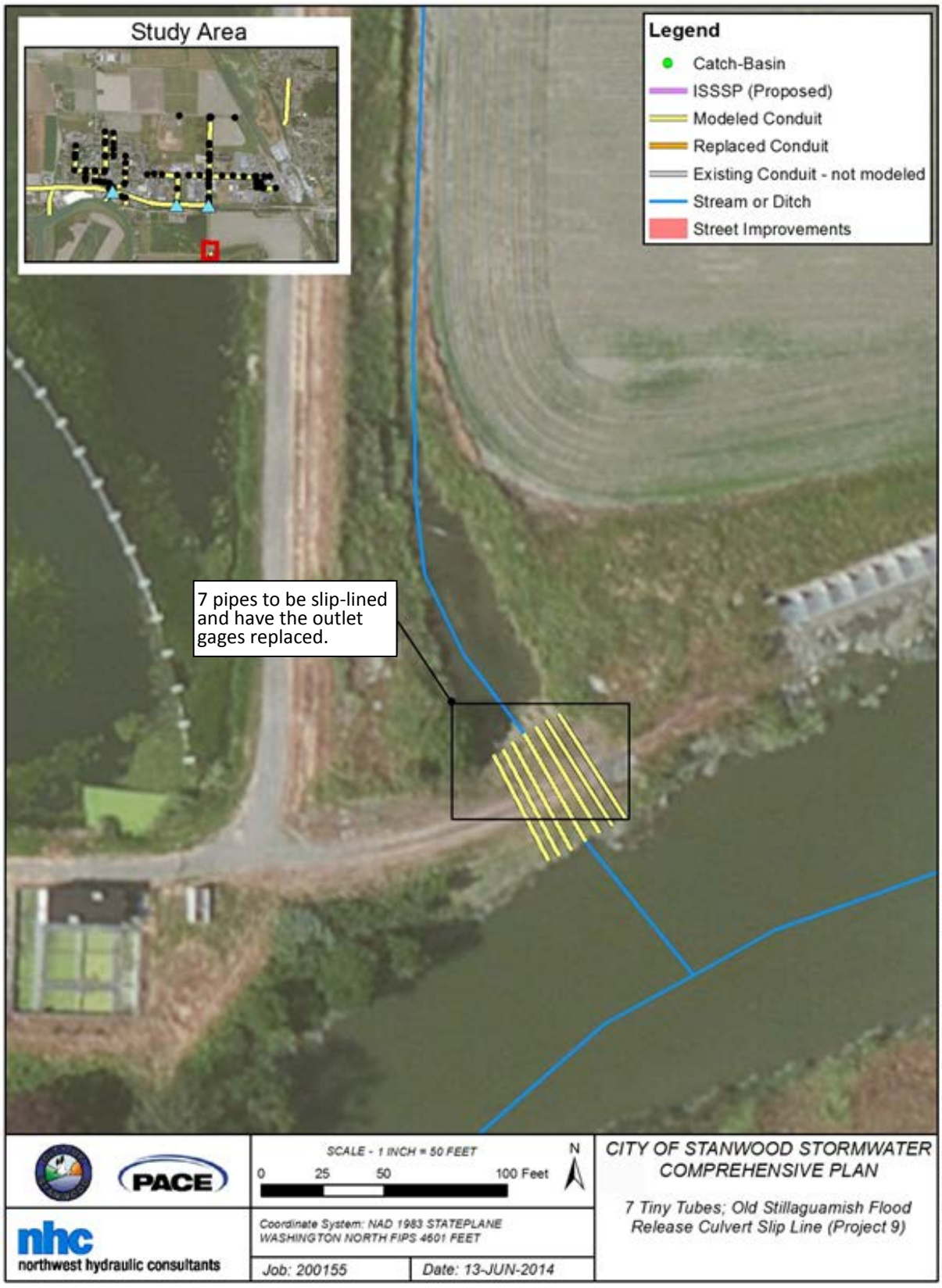


Table 6-12: CIP Project #9 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$5,000.00	$5,000.00
2	Mobilization	1	LS	$8,000.00	$8,000.00
3	Slip Lining Existing 36" Pipe	420	LF	$140.00	$58,800.00
4	36" Diameter Flap Gate	7	EA	$2,000.00	$14,000.00
5	Erosion and Water Pollution Control	1	LS	$5,000.00	$5,000.00

Subtotal	$90,800.00
WSST @ 8.8%	$7,990.40
TOTAL CONTRACT COST	$98,790.40
Engineering/Permitting/Construction Management	$45,400.00
Total Project Cost	**$144,190.40**

6.22 CIP PROJECT #10
85TH DRIVE NW DRAINAGE IMPROVEMENTS

Drainage Problem ID(s): 54

Problem Description: There is no formal drainage system along 85th Drive NW and drainage from the City street routinely floods a private residence at the 27800 block. Three photos of the street are shown in Figure 6-30.

Figure 6-30 CIP Project #10 – 85th Drive NW Photos

Photo looking south along 85th Drive NW from 27800 block.

Photo looking south along 85th Drive NW from 27800 block.

Photo looking north along 85th Drive NW from 276th Place NW.

Project Description: This CIP solution will provide street drainage and resurfacing on 85th Drive NW between 280th Street NW and 276th Place NW. As part of the CIP, a piped conveyance system will be constructed along 85th Drive NW that will flow south, connecting to the proposed ditch at 276th Place NW to be constructed as part of Project #4.

Design Assumptions:

- It was assumed that a 12-inch-diameter pipe will be adequate to convey a 25-year return period runoff from this street, but the needed pipe size should be confirmed during final design.

Project Benefits: Improved drainage along 85th Drive NW and potential to intercept groundwater affecting properties to the west on 86th Drive NW.

Project Illustration Map: See Figure 6-16, presented with Project #4.

Estimated Quantities and Costs: See Table 6-13.

Table 6-13: CIP Project #10 Costs

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	SPCC Plan	1	LS	$1,000.00	$1,000.00
2	Temporary Traffic Control	1	LS	$5,000.00	$5,000.00
3	Mobilization	1	LS	$40,000.00	$40,000.00
4	Grind Existing Pavement	4,000	SY	$10.00	$40,000.00
5	Removal and Disposal of Existing Storm Sewer Pipe	1,200	LF	$15.00	$18,000.00
6	Crushed Surfacing Top Course*	927	TON	$30.00	$27,816.00
7	HMA Cl 1/2" PG-64–22 — 3" Depth	569	TON	$175.00	$99,652.78
8	Concrete Curb Ramps	4	EA	$1,500.00	$6,000.00
9	Concrete Sidewalk	1,333	SY	$40.00	$53,333.33
10	Storm Sewer Pipe, 12" Diameter	1200	LF	$60.00	$72,000.00
13	Type I Catch Basin	13	EA	$2,500.00	$32,500.00
14	Connection to Existing Drainage Structure/Pipe	5	EA	$500.00	$2,500.00
15	Bank Run Gravel for Pipe Zone Backfill	263	Ton	$30.00	$7,878.67
16	Erosion Control and Water Pollution Control	1	LS	$2,500.00	$2,500.00
17	Concrete Curb and Gutter	2400	LF	$25.00	$60,000.00

Subtotal	$468,180.78
Contingency (30%)	$140,454.23
TOTAL CONTRACT COST	$608,635.01
Engineering/Permitting/Construction Management	$180,000.00
Total Project Cost	**$788,635.01**

References

Stanwood, 2010. City of Stanwood, Shoreline Master Program, Draft Shoreline Inventory and Analysis. Prepared by Parametrix. April 2010.