CITY OF TUMWATER

ANNEXATION AREA DRAINAGE STUDY

MAY 2011

Prepared for:

City of Tumwater
555 Israel Road SW
Tumwater, WA 98501

Prepared by:

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

DAVID S. BELL, PE Date: May 3, 2011

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1 EXECUTIVE SUMMARY

In 2007, a portion of Thurston County was annexed into the City of Tumwater (City). The annexation area is that part of the City located north of 80th Avenue SW, south of Sapp Road, west of Littlerock Road SW, and east of Black Lake-Belmore Road SW, encompassing approximately 2,500 acres.

The City engaged Skillings Connolly, Inc., Consulting Engineer to prepare a comprehensive Drainage Study to manage stormwater in the annexation area, including a comprehensive understanding of the existing stormwater system to determine existing stormwater runoff impacts. The study will also provide recommendations for runoff treatment, habitat protection, mitigation of flooding impacts, protection of surface water and considerations for future development.

Of the twenty-five (25) existing cross culverts evaluated as part of this study, twenty-one (21) were determined to be of insufficient capacity to carry the 25 year flow or provide enough headwater to prevent overtopping of the roadway for the 100 year flow. Recommendations are include in the report to upsize these culverts. All new culverts would be designed to accommodate fish passage, where required.

Two of these culvert upgrades would require roadway improvements and are recommended to also include water quality treatment as part of the project.

Some areas were identified as likely to be developed, but would be unsuitable for development under full build-out scenarios, as these sites appear to be unable to meet flow control, storage or water quality treatment requirements due to a high groundwater table, low infiltration rates or sufficient hydraulic grade capacity. These areas were separated from other "development likely" areas, and modeled as if flow control requirements were not provided or applied. It is our recommendation to the City, that these areas are allowed to be developed with a fee in lieu of flow control requirements. In addition to the fee, a complete downstream analysis should be required to ensure that the existing system is capable of additional flow from the areas without detention. If the downstream system is found to not have capacity, a retrofit of the existing system would be required.

The total recommended capital projects cost for the Annexation Area is 4.35 million dollars. With this investment, flooding of roadways would be eliminated throughout the annexation area, including improvements in water quality.

2 INTRODUCTION

2.1 Background

In 2007, a portion of Thurston County was annexed into the City of Tumwater (City). The annexation area is that part of the City located north of 80th Avenue SW, south of Sapp Road, west of Littlerock Road SW, and east of Black Lake-Belmore Road SW, encompassing approximately 2,500 acres. Figure 2-1 on the next page shows the annexation area.

This annexed area is known to have some flooding issues and a drainage study was recommended in the City's Capital Facilities Plan (2009). This Drainage Study was prepared to enable the City to manage stormwater in the annexation area and includes comprehensive understanding of the existing stormwater system and existing stormwater runoff impact characteristics.

2.2 Project Purpose

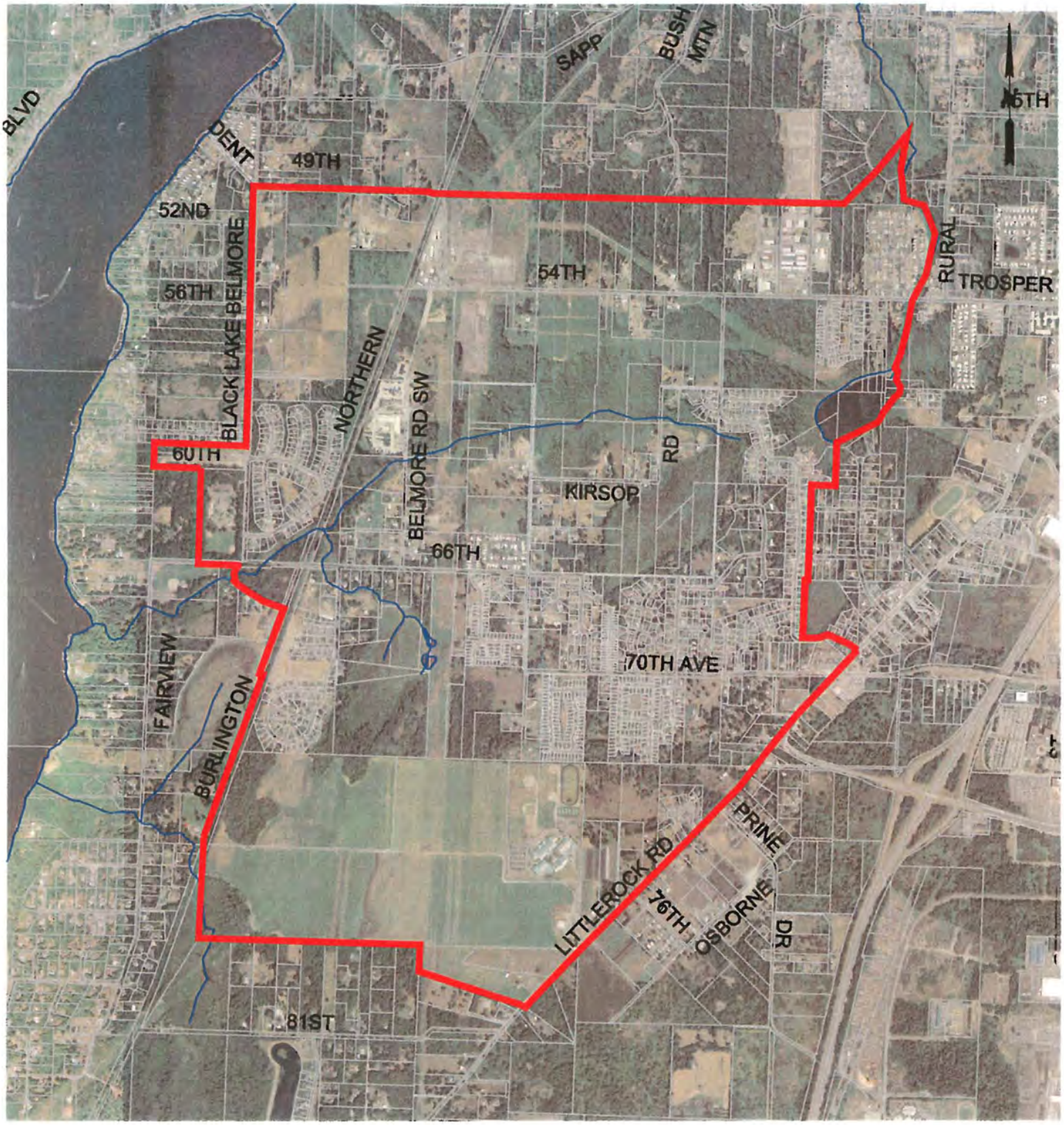
The purpose of this report is to catalog the existing drainage system, identify both current and potential flooding areas, and recommend and prioritize stormwater improvements that will alleviate those issues. This study also provides recommendations for stormwater runoff treatment, habitat protection, mitigation of flooding impacts, protection of surface water, and considerations for future development.

2.3 Project Description

The basic steps taken to compile this study are outlined below, with more detail for each step given in the following sections.

First, data was acquired about the existing drainage system through site visits, review of as-built information from the City and Thurston County, and a public meeting held on April 12th, 2010. The major drainage system within the study area was catalogued and obvious problem areas were identified (water over roadway, etc.). Drainage basins depicted in Figure 4-1 were delineated based on site visit observations and contours.

Calculations were made for both existing and future build-out conditions to evaluate which culverts were undersized and needed replacing due to lack of capacity. A prioritized list of recommended improvements was compiled, based on the severity of flooding and costs of each improvement. Conclusions were summarized to help the City manage and plan stormwater improvements.



1"=2000'

SKILLINGS CONNOLLY	CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY	ANNEXATION AREA FIGURE 2-1

Plotted By: Steven Egan on 5/3/11 2:58 PM
G:\Project\2009\09230-2 City of Tumwater Annexation Drainage Study\CAD\Exhibits\Annexation Area.dwg Tbrodley 2/24/11 11:54 AM

3 DATA COLLECTION & REVIEW

3.1 Existing Storm Drainage System

The existing public drainage system is comprised of cross culverts and roadside ditches, with stormwater flowing westerly into Black Lake, or northeasterly, where it discharges to Trosper Lake, then to Percival Creek and ultimately to Capitol Lake. Figure 3-1 shows the existing drainage features within the annexation area. Figures 3-2 and 3-3 are photos of the existing drainage features taken during the site investigations (May 2010).

There are numerous housing developments throughout the study area, each with their own drainage system. Records were unavailable for a majority of these systems, and are only known through field observation and knowledge provided by local residents. While some of these systems have detention ponds, the flow calculations for this study were determined as if the existing ponds were full. This assumption was made because these private storm detention facilities may not be properly maintained, or are undersized per new design standards. Recent developments that were designed to have 100% infiltration were modeled as working, with full infiltration.

The City should catalog each detention facility within the annexation area and record if the owners are submitting an annual report of the agreement to maintain stormwater facilities as outline in Volume 1, Appendix F of the Drainage Design Manual. If detention systems are not functioning correctly they could be contributing to downstream flooding conditions.

3.2 Sensitive Areas Inventory

The study area contains wetlands, flood plains, and high groundwater that primarily follows Fish Pond Creek flowing westerly through the center of the study area.

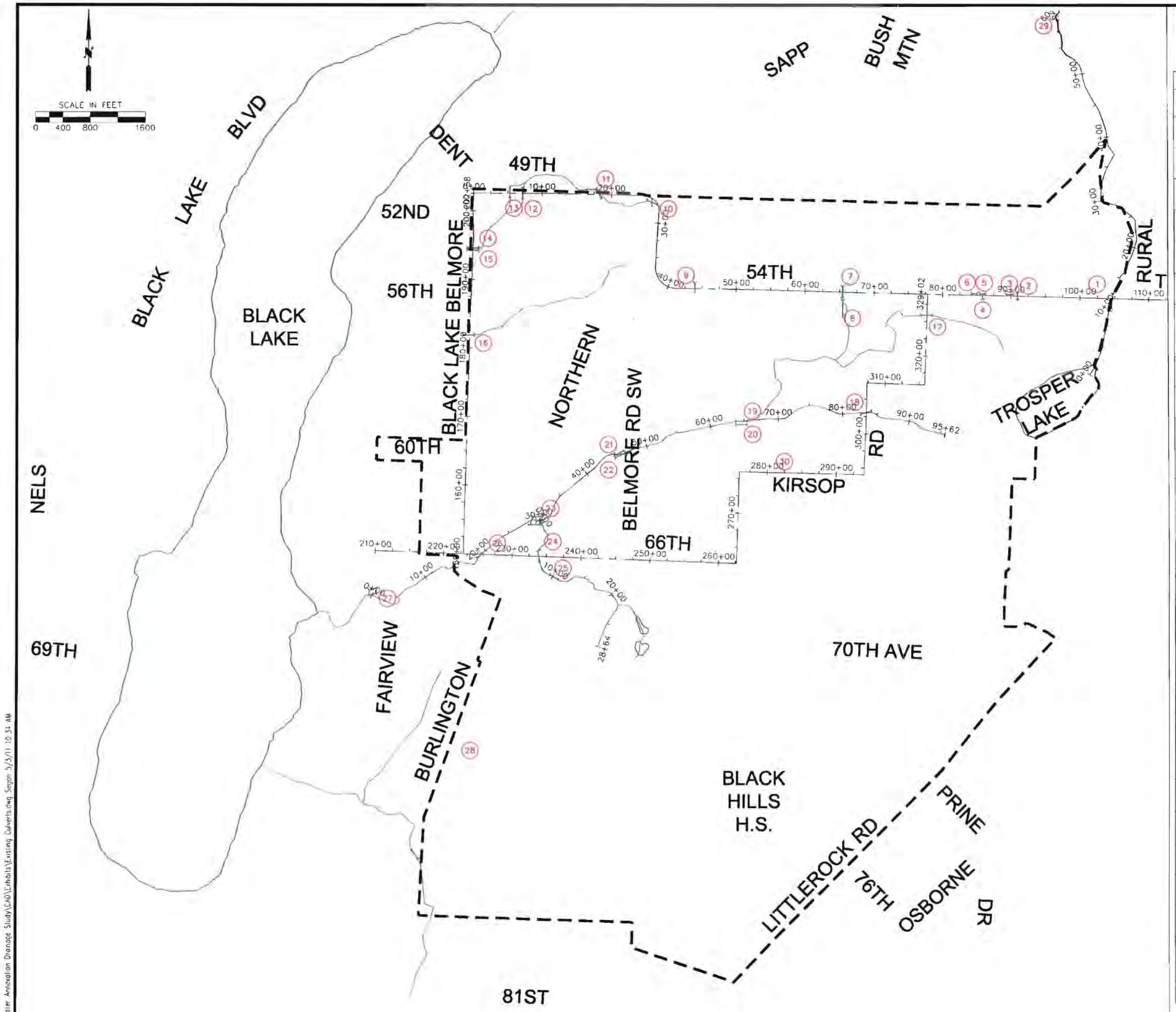
See Figures 3-4, 3-5, and 3-6 for wetlands and buffers, flood zones, and high groundwater areas, respectively.

3.3 Topography

The study area is relatively flat, ranging from elevation 135 to elevation 173. These elevations are field measurements of existing culvert inverts. The general slope of Fish Pond Creek, which flows through the center of the study area, is 0.3%.

3.4 Utility Information

Information was gathered for existing and proposed sanitary sewers in the project area. Generally, sanitary sewer currently runs along Trosper Rd SW, up to Lambskin St SW; along Miner Dr. SW to the southwest of Trosper Lake; throughout Mirasett, Countryside, Kirsop Village, and Black Hawk housing developments; and to Black Hills High School. Existing developed areas not currently served by City utilities are served by private water and septic services.



LEGEND:

STUDY AREA | WATER BODIES | (x) CULVERT NUMBER

EXISTING CULVERTS | STREAMS

EXISTING CULVERT DATA

CULVERT	SIZE (In.)	MATERIAL	LENGTH	SLOPE	I.E. ELEV.	WATER ELEV.	DATE OF WATER ELEV.	CONDITION
1	36	CONCRETE	53'	0.08%	154.57	155.67	6/10/2010	NORTH END ½ FILLED WITH CONCRETE PIECES
					154.62	155.62	6/10/2010	SOUTH END ½ FILLED WITH ROCK AND SAND
2	12	PVC	40'	1.9%	161.87	N/A	6/10/2010	NORTH END ½ FILLED WITH DIRT
					162.64	N/A	6/10/2010	SOUTH END IN CATCH BASIN, VISIBLE
3	30	CONCRETE	53'	0.03%	160.48	161.35	6/10/2010	EAST CLEAR OF DEBRIS
					160.46	161.19	6/10/2010	WEST CLEAR OF DEBRIS
4	24	PVC	40'	3.8%	158.68	161.60	6/10/2010	SOUTH IS SUBMERGED UNDER WATER
					160.21	161.51	6/10/2010	NORTH END IN CONCRETE BOX, 6" OF DEBRIS IN PIPE
5	30	CONCRETE	67'	0.3%	160.37	161.46	6/10/2010	EAST END CLEAR OF DEBRIS
					160.17	161.40	6/10/2010	WEST END CLEAR OF DEBRIS, ⅓ FULL OF WATER
6	30	CONCRETE	71'	1.9%	161.36	161.58	6/10/2010	EAST END ½ FULL OF WATER
					159.99	161.46	6/10/2010	WEST END CLEAR OF DEBRIS
7	18	CONCRETE	28'	1.7%	165.73	167.46	6/10/2010	NORTH END ¼ FULL OF DEBRIS
					166.21	167.03	6/10/2010	SOUTH END HAS DEBRIS IN DITCH
8	18	CMP	UNK	UNK	165.76	167.46	6/10/2010	NORTH END SUBMERGED, FILLED WITH DEBRIS AND PARTIALLY CRUSHED
9	18	CONCRETE	UNK	UNK	169.10	N/A	6/10/2010	NORTH END CLEAR OF DEBRIS
					UNK	N/A	6/10/2010	LOCATION OF SOUTH END UNKNOWN
10	30	CONCRETE	40'	1.6%	172.47	173.53	6/10/2010	EAST END ½ FULL OF WATER
					171.83	173.50	6/10/2010	WEST END ¾ FULL OF WATER
11	18	CONCRETE	40'	0.4%	157.98	159.51	6/10/2010	NORTHWEST END SUBMERGED UNDER WATER
					157.81	159.28	6/10/2010	SOUTHEAST END ½ FULL OF DEBRIS
12	12	CMP	30'	1.8%	147.24	148.44	6/10/2010	NORTH END SUBMERGED AND CLOGGED
					146.79	146.99	6/10/2010	SOUTH END CLEAR OF DEBRIS, VERY RUSTED
13	12	CMP	31'	1.4%	147.87	148.52	6/10/2010	NORTH END CLEAR
					147.44	148.49	6/10/2010	SOUTH END CLEAR
14	18	CMP	40'	0.9%	144.73	145.00	6/10/2010	EAST END SLIGHTLY CRUNCHED
					144.38	144.63	6/10/2010	WEST END CRUSHED HALF WAY
15	18	CMP	40'	1.2%	144.80	145.00	6/10/2010	EAST END SLIGHTLY CRUSHED
					144.32	144.63	6/10/2010	WEST END CRUSHED HALF WAY
16	12	CONCRETE	28'	2.6%	163.87	N/A	6/10/2010	EAST END CLEAR OF DEBRIS
					163.15	N/A	6/10/2010	WEST END CLEAR OF DEBRIS
17	18	CMP	31'	0.8%	161.02	162.92	6/10/2010	EAST END SUBMERGED, ¼ FULL OF DEBRIS
					161.27	162.97	6/10/2010	WEST END SUBMERGED
18	24	CONCRETE	37'	0.5%	161.07	163.27	6/10/2010	EAST END SUBMERGED UNDER WATER, CLEAR OF DEBRIS
					161.26	163.46	6/10/2010	WEST END SUBMERGED UNDER WATER, CLEAR OF DEBRIS
19	24	CMP	18'	1.2%	158.94	160.30	6/10/2010	EAST END COVERED WITH DEBRIS
					158.73	160.30	6/10/2010	WEST END FREE OF DEBRIS
20	18	CMP	18'	2.2%	159.04	160.10	6/10/2010	EAST END COVERED WITH DEBRIS AND BRUSH GUARD
					158.65	160.10	6/10/2010	WEST END COVERED IN DEBRIS
21	30	CMP	48'	0.4%	151.54	153.49	6/10/2010	EAST END 1/2 FULL OF FLOWING WATER
					151.73	153.54	6/10/2010	WEST END OPEN, 1/2 FULL OF WATER
22	30	CMP	48'	0.3%	151.66	153.49	6/10/2010	EAST END 1/2 FULL OF FLOWING WATER
					151.51	153.54	6/10/2010	WEST END OPEN, 1/2 FULL OF WATER
23	N/A	OPEN X-ING			148.79	149.92	6/10/2010	EXISTING RAILROAD BRIDGE, BEAVER DAM 80' EAST: TOP OF DAM=152.70, WATER ELEV EAST=152.70, SOUTH=150.40
24	48	CMP	80'	0.02%	149.40	151.40	6/10/2010	NORTH END ½ FULL OF WATER, SAGGING @ CENTER
					149.42	151.07	6/10/2010	SOUTH END ½ FULL OF WATER, SAGGING @ CENTER
25	48	CMP	60'	0.7%	149.59	152.59	6/10/2010	EAST END 1.6' CLEAR, FILLED OF RIP RAP AND SAND
					149.75	152.45	6/10/2010	WEST END 2.2' CLEAR, FILLED WITH RIP RAP AND SAND
26	72"WIDE 46"HIGH	CMP	123'	0.3%	144.50	145.50	6/10/2010	NORTHEAST END ARCH CULVERT CLEAR OF DEBRIS
					144.09	144.69	6/10/2010	SOUTHWEST END ARCH CULVERT CLEAR OF DEBRIS
27	14' WIDE 8' HIGH	CONCRETE CHANNEL	63'	0.9%	137.11	137.71	6/10/2010	EAST END CHANNEL BELOW EXISTING BRIDGE
					136.54	137.24	6/10/2010	WEST END CHANNEL BELOW EXISTING BRIDGE
28		OPEN X-ING					6/10/2010	EXISTING RAILROAD BRIDGE, 6.8' ABOVE GRADE, 0.2' STANDING WATER
29	60	CONCRETE	43'	2.3%	138.13	139.80	6/10/2010	NORTH END CLEAR
					139.16	139.08	6/10/2010	SOUTH END CLEAR
30					N/A	161.63	6/10/2010	STANDING WATER ON BOTH SIDES OF ROAD

*UNK = UNKNOWN

DATUM: NAD 83

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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

EXISTING CULVERTS

FIGURE 3-1

1(N)

1(S)

2(N)

3(E)

3(W)

4

5(E)

5(W)

6(E)

6(W)

7(N)

7(S)

8 (N)

8 (S) NOT FOUND

9 (N)

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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

EXISTING CULVERT PHOTOS (1)

FIGURE 3-2A

9 (S) NOT FOUND

10(E)

10(W)

11(N)

11(S)

12 (N)

12(S)

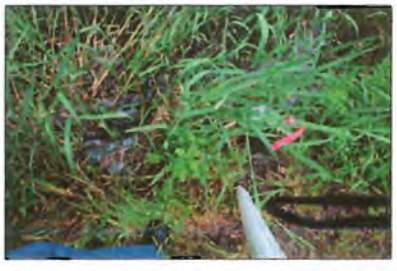
13(N)

13(S)

14

14

14(E) & 15(E)



14(W) & 15(W)

16

16

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DRAINAGE STUDY

EXISTING CULVERT
PHOTOS (2)

FIGURE 3-2B

17(E)

17(W)

18(E)

18(W)

19(E)

19(W)

20(E)

20(W)

21(E) & 22(E)

21(W)

22(W)

22(W)

23

BEAVER DAM AREA 23

BEAVER DAM AREA 23

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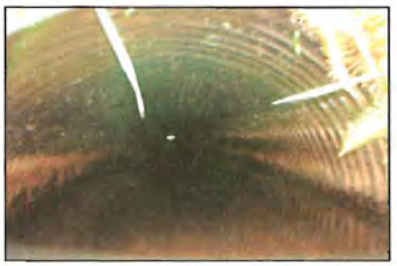
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

EXISTING CULVERT PHOTOS (3)

FIGURE 3-3A

BEAVER DAM AREA 23



24(N)

24(S)

25(E)

25(W)

26(NE)

26(SW)

26(SW)

27(E)

27(E)

28

28(E)

28(W)

29(N)

29(S)

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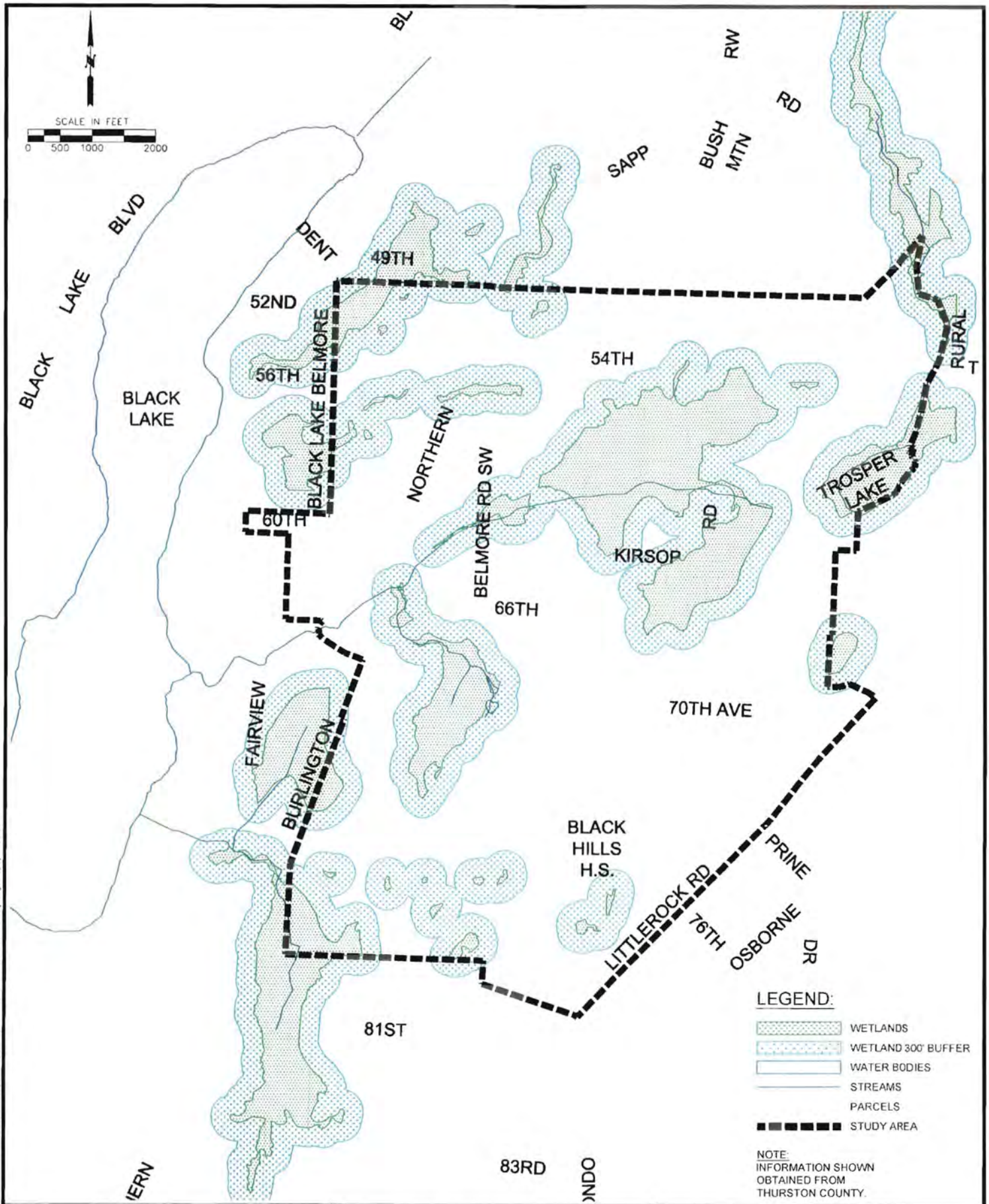
CITY OF TUMWATER
ANNEXATION AREA
DRAINAGE STUDY

EXISTING CULVERT
PHOTOS (4)

FIGURE 3-3B



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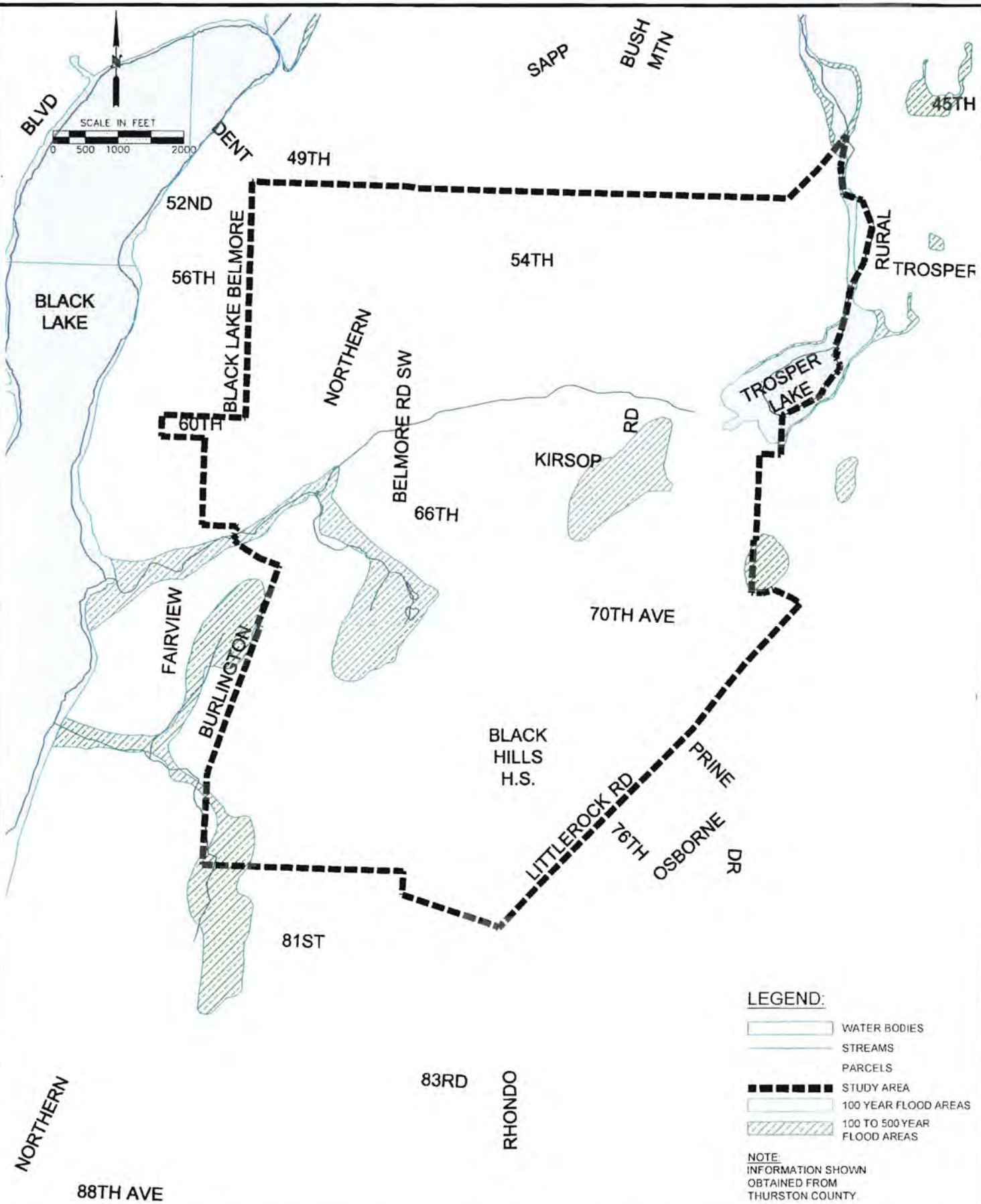
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

WETLANDS AND BUFFERS

FIGURE 3-4



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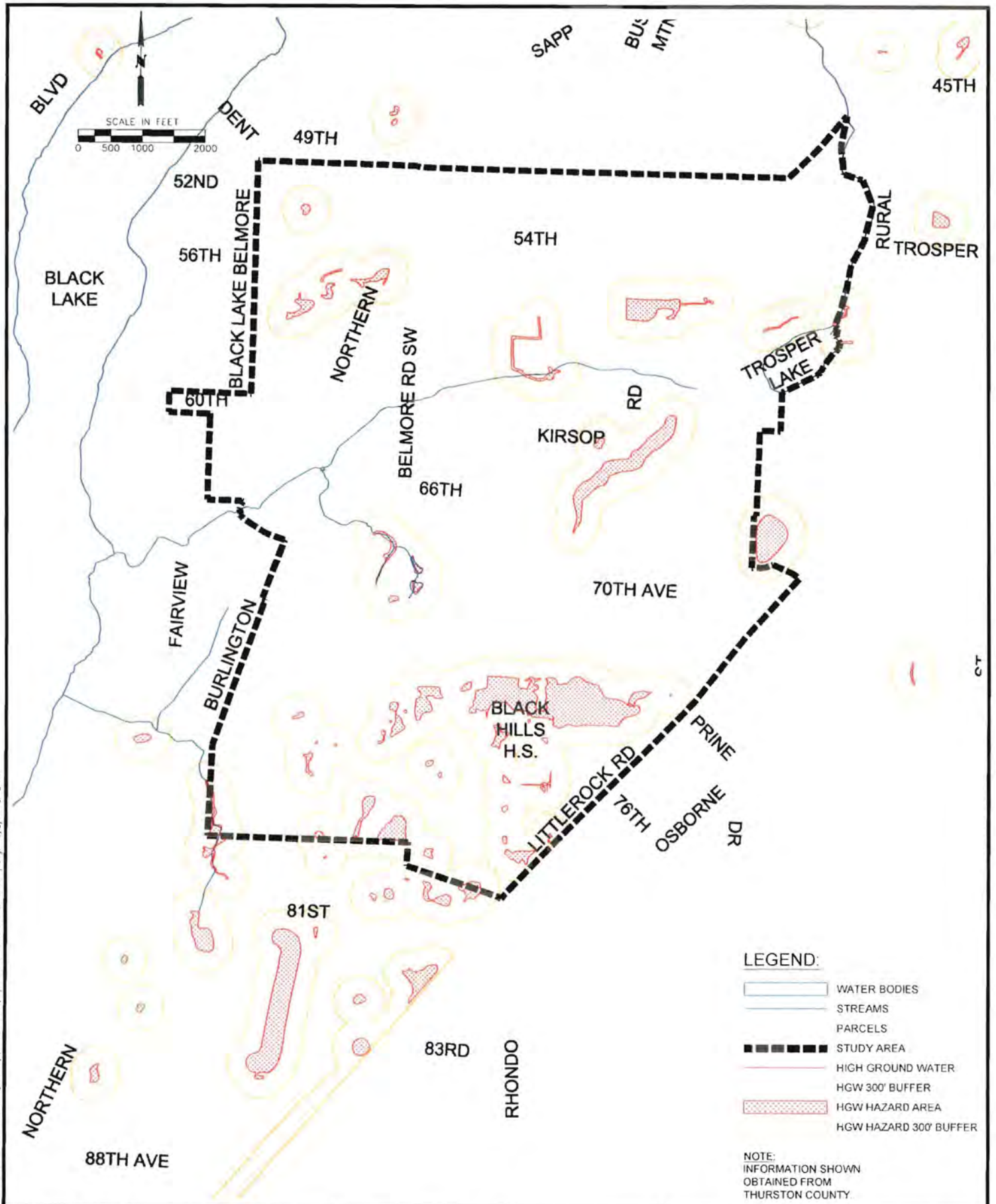
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

FLOOD ZONES

FIGURE 3-5



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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

HIGH GROUND WATER AND BUFFERS

FIGURE 3-6

Sanitary sewer is proposed to extend to the west down Trosper Road/54th, south from Trosper Road down Kirsop Road, and along 70th Avenue, branching into the housing developments along 70th Avenue.

Since water lines are typically extended to the same areas as sanitary sewer lines, the assumption was made that development of water lines would happen in the same areas as sanitary sewer. See Figure 3-7 for existing and proposed sanitary sewer mapping.

3.5 Interviews

On April 12, 2010, the City of Tumwater held an open house for annexation area residents to provide their comments about flooding in the project area. Following are key comments taken from that meeting:

Trosper Road

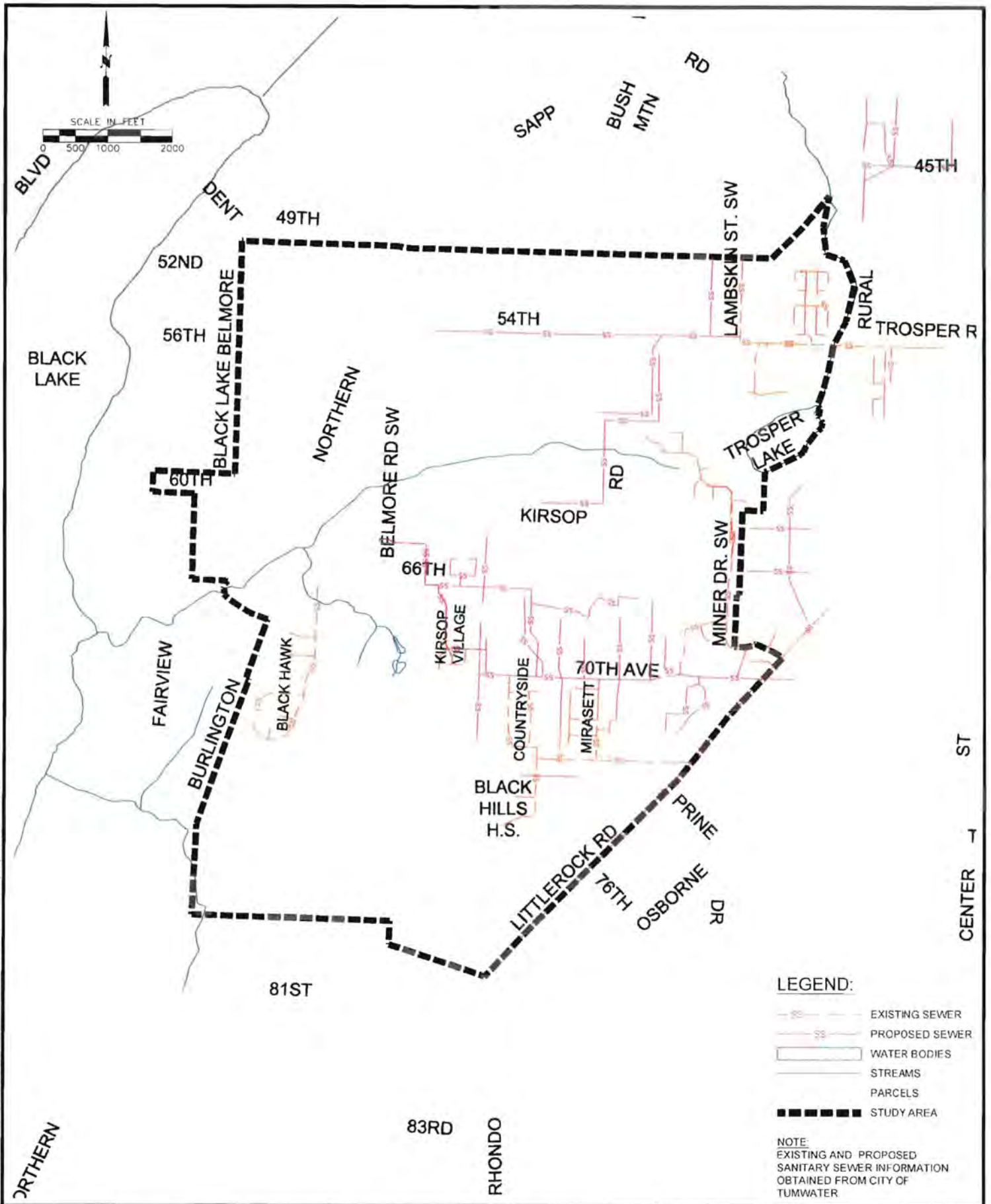
Residents were concerned about the failing road bed of Trosper Road falling into the ditch. The north and south edges of the asphalt roadway are cracking due to saturated subgrade along Trosper Road, in the vicinity of Lambskin Road SE. This due primarily because of flooding from existing culverts 4 through 7. Residents would like to see a more solid base to the roadway to avoid potholes. Some wetlands around Trosper Road had been filled in years ago.

Black Lake Blueberry Farm & Ditch

Owners of the blueberry farm spoke of a ditch along the back of the property that they believe connects Black Lake to Trosper Lake. (Mapping indicates this "ditch" to be Fish Pond Creek.) Residents stated that the ditch periodically gets plugged by beaver dams and that a local trapper used to remove the beavers, and at one point had planned to pipe through the dams rather than remove them. Historically, the ditch behind the farm would be kept flowing by using dynamite.

Kirsop Road

Water frequently flows over the roadway, to the point of only having half of each lane usable through most of the year (not just seasonally). Residents stated that this road has been raised several times over the years, but continues to sink. An owner of 10 acres off of Kirsop said that he would be willing to sell part of his property to the City for drainage improvements. See Appendix A for the owner's name and parcel number of the property in question. Using this property to build a regional facility is an alternative that the city should consider.



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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

EXISTING AND PROPOSED SEWER

FIGURE 3-7

Black Lake Park

Residents from this area said that routine maintenance is needed; the small (6-inch diameter) culverts get plugged and need to be cleaned. The perimeter perforated pipe works well, and the stormwater pond stays dry. The residents stated that some of the ditches fill with water and do not appear to flow to the stormwater pond.

66th Avenue

Property owners along 66th Avenue mentioned beavers coming up from Black Lake and making dams, and that they have had flooding problems over the years. Owners observed that after 66th Avenue was constructed, Kirsop Road began flooding, even in the summer months. The residents also stated that 66th Avenue has a culvert that has settled, and that 66th Avenue floods up to the top of the road embankment.

Black Hills High School

The property owner east of the high school has had stormwater basins surveyed, and the County has constructed a drain pipe to drain his property across the school site, to property west of the school site. Overflow from the school parking lot flows north to a small pond.

See Appendix A for a copy of the meeting notes.

3.6 Flood Areas Studied

The following is a list of known flooding areas compiled from field observation and resident interviews.

66th Avenue, West of Caviler Street (Culvert #24)

Probable Cause of Flooding

- ✓ Backed up water from beaver dam near Culvert #23.
- ✓ Field notes indicate Culvert #24 is partially crushed, was installed flat, or has settled.

Looking south at 66th Ave. Water back up at Culvert #24, at 66th Ave west of Cavalier Street

Recommendations to Alleviate Flooding

- ✓ Installation of beaver deceivers or flexible levelers
- ✓ Replace Culvert #24

Kirsop Road #1, directly South of 54th Culvert #17 Area

Water entering the roadway from ditch at Kirsop Rd, directly south of 54th

Probable Cause of Flooding

- ✓ This area has both high ground water and wetlands.
- ✓ Culvert #19/20 (downstream) is at a gravel access road for overhead power lines that is acting as a dam to the stream channel. This could be causing water to back up to Culvert #17 (where this flooding occurs).

Recommendations to Alleviate Flooding

- ✓ Possible downstream culvert upsizing/fixing driveway at Culvert #19/20 that is acting as a dam could alleviate some of the stormwater runoff from backing up to Culvert #17 (where this flooding occurs).
- ✓ Due to the flat topography, the road may need to be raised to avoid flooding over the roadway.

Kirsop Road #2 (At "Water over Roadway" Sign)

Water over the roadway at the sag in Kirsop Road

Probable Cause of Flooding

- ✓ This area is marked as wetlands.

Recommendations to Alleviate Flooding

- ✓ Upgrade Culvert 19/20 and the gravel access road that is acting as a dam could alleviate stormwater runoff from backing up to site #30 (where this flooding occurs).
- ✓ Due to the flat nature of this area, Kirsop Road could be raised and new culvert(s) could be installed to reduce flooding over the roadway.

54th Avenue, near Kirsop and Joppa Street SW

Probable Cause of Flooding

- ✓ Culvert #4 is noted to be submerged on the south end, with 6 inches of debris in the north end.
- ✓ This area is noted as having wetlands.
- ✓ Culvert #4 is noted to have a backwards slope.

Recommendations to Alleviate Flooding

- ✓ Culvert #4 should be upsized and sloped with a positive grade.

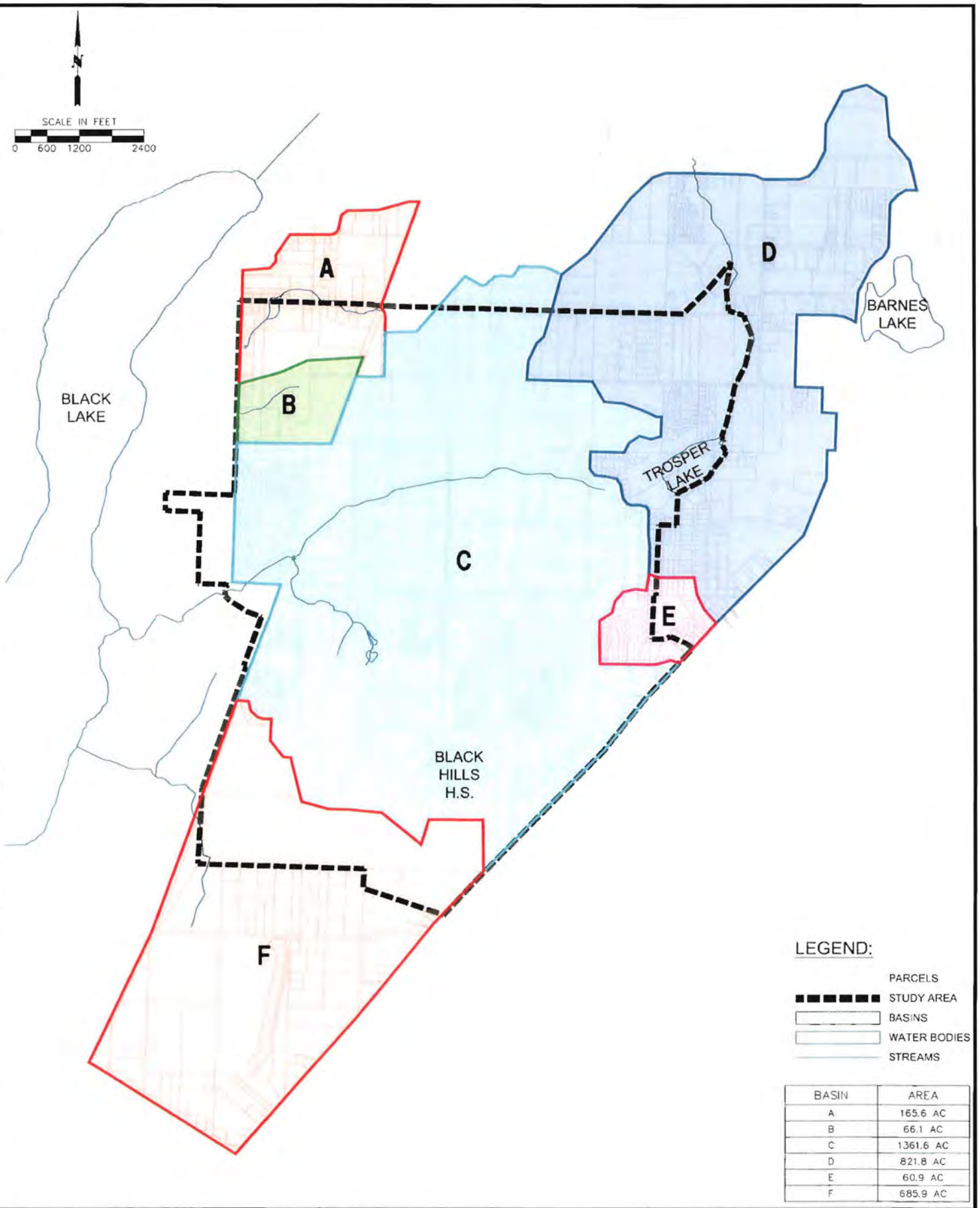
Flooded ditch along 54th, at Culvert #4

4 HYDRAULIC ANALYSIS

A hydraulic analysis was performed for each major culvert within the study area. First, overall drainage basins were delineated for each location where stormwater discharged from the study area. Next, drainage basins that contributed to each culvert were delineated based on contours and site observations. See Figure 4-1 for the overall drainage basins, and Figure 4-2 for the sub-basins contributing to each culvert.

Runoff Curve numbers used for the different land and soil types were taken from the December 2009 City of Tumwater Drainage Design and Erosion Control Manual.

Land uses for the current conditions were determined based on the most recent aerial photography provided by the City of Tumwater. Land uses were delineated into the categories described in the Tumwater Drainage Manual based on the aerial photography. Areas were calculated and catalogued for each sub-basin, defining land use and hydrologic soil types, and thus the runoff curve number for each area. The curve number represents a co-efficient of stormwater runoff based on soil types. The modeling software used to calculate the flows for each sub-basin calculated composite runoff curve number for the entire sub-basin, based on the weighted average of runoff curve numbers within that sub-basin.



BASIN	AREA
A	165.6 AC
B	66.1 AC
C	1361.6 AC
D	821.8 AC
E	60.9 AC
F	685.9 AC

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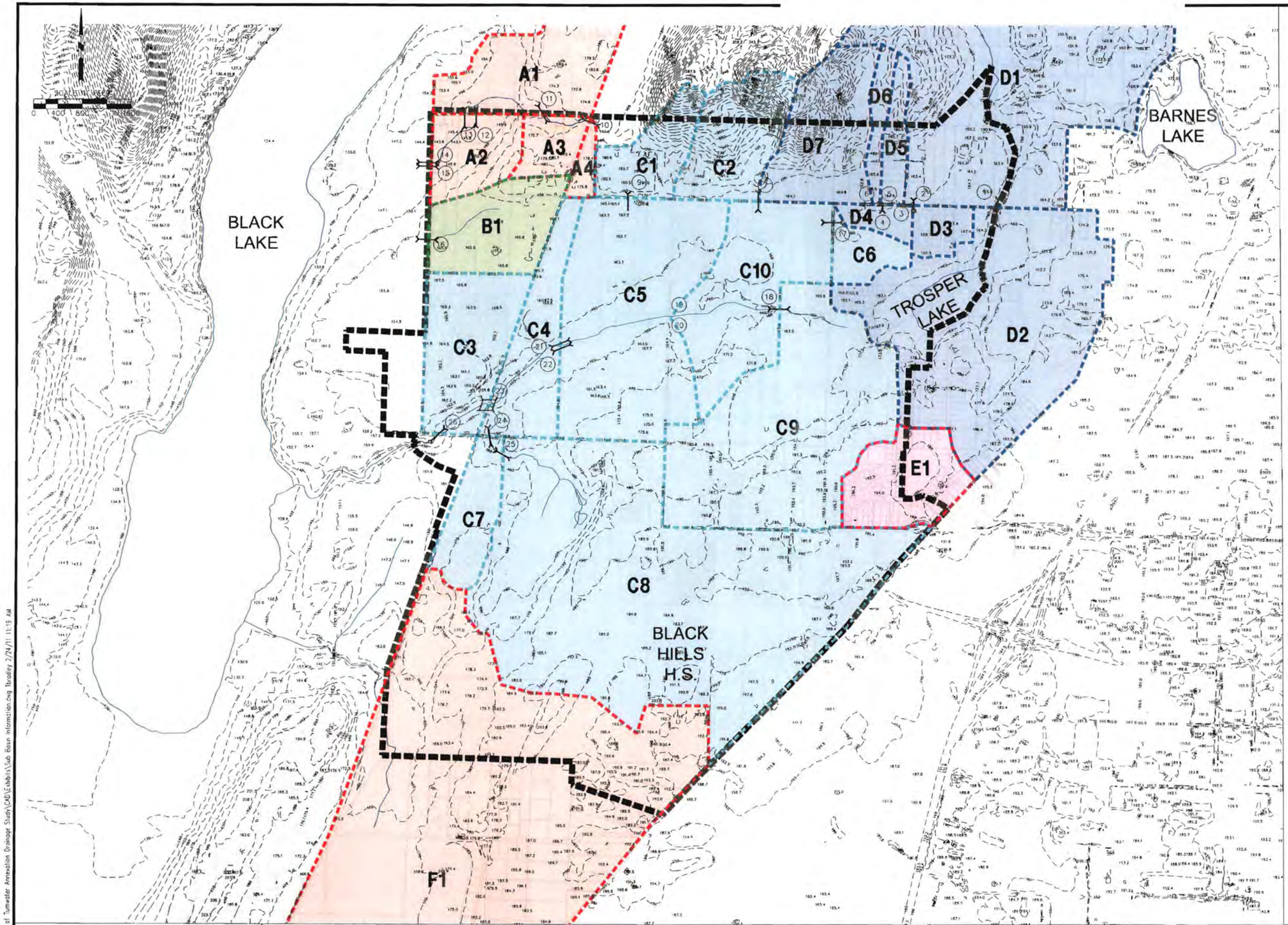
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

DRAINAGE BASINS

FIGURE 4-1



LEGEND:

- CULVERT
- PARCELS
- CONTOUR LINE
- STUDY AREA
- SUB-BASIN BOUNDARY LINE
- BASINS
- WATER BODIES
- STREAMS
- (X) CULVERT NUMBER

BASIN	AREA (ACRES)	DRAINS TO CULVERT #
A1	91.03	12&13
A2	42.66	14&15
A3	22.93	11
A4	5.04	10
B1	66.09	16
C1	42.97	9
C2	66.06	7
C3	81.23	26
C4	66.13	23
C5	200.50	21&22
C6	22.74	17
C7	40.94	24
C8	275.74	25
C9	229.33	18
C10	115.62	19&20
D1	403.72	29
D2	271.37	1
D3	17.23	2
D4	12.85	4
D5	19.24	3
D6	15.25	5
D7	82.09	6
E1	60.90	N/A
F1	685.89	-

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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

SUB-BASIN INFORMATION

FIGURE 4-2

Future land uses were projected so that runoff curve numbers could be estimated for future build-out flow calculations. First, areas where development is likely to occur were identified based on the proposed sanitary sewer and water lines, power availability, and wetlands/high ground water areas. Zoning was then researched for these areas, and land uses reclassified within these areas based on the current zoning regulations. This method projected the future land use, assuming full build out. The curve numbers were then calculated using the same method as was used for the current conditions, based on both land use and hydrologic soil type.

4.1 Current Conditions Analysis

Culverts were analyzed for existing land uses to determine if they are undersized based on current drainage design criteria. Runoff factors were determined based on soil types and land uses within each basin. Soil types were obtained from USGS soil maps, and land uses were determined from aerial photos obtained from the City of Tumwater. Soil types are directly related to infiltration rates. Figure 4-4 shows the different soil types within the study area, Type A, B, C, or D. This gives an indication of whether or not infiltration is practical in the area. Soil type A generally has high infiltration rates, soil type B generally has moderate infiltration rates, soil type C generally has slow infiltration rates, and soil type D generally has very slow infiltration rates. As always, a geotechnical analysis should be done prior to any design or development, to verify the infiltration rates specific to a site. See Figure 4-3 for the current land uses and Figure 4-4 for soil types within the study area.

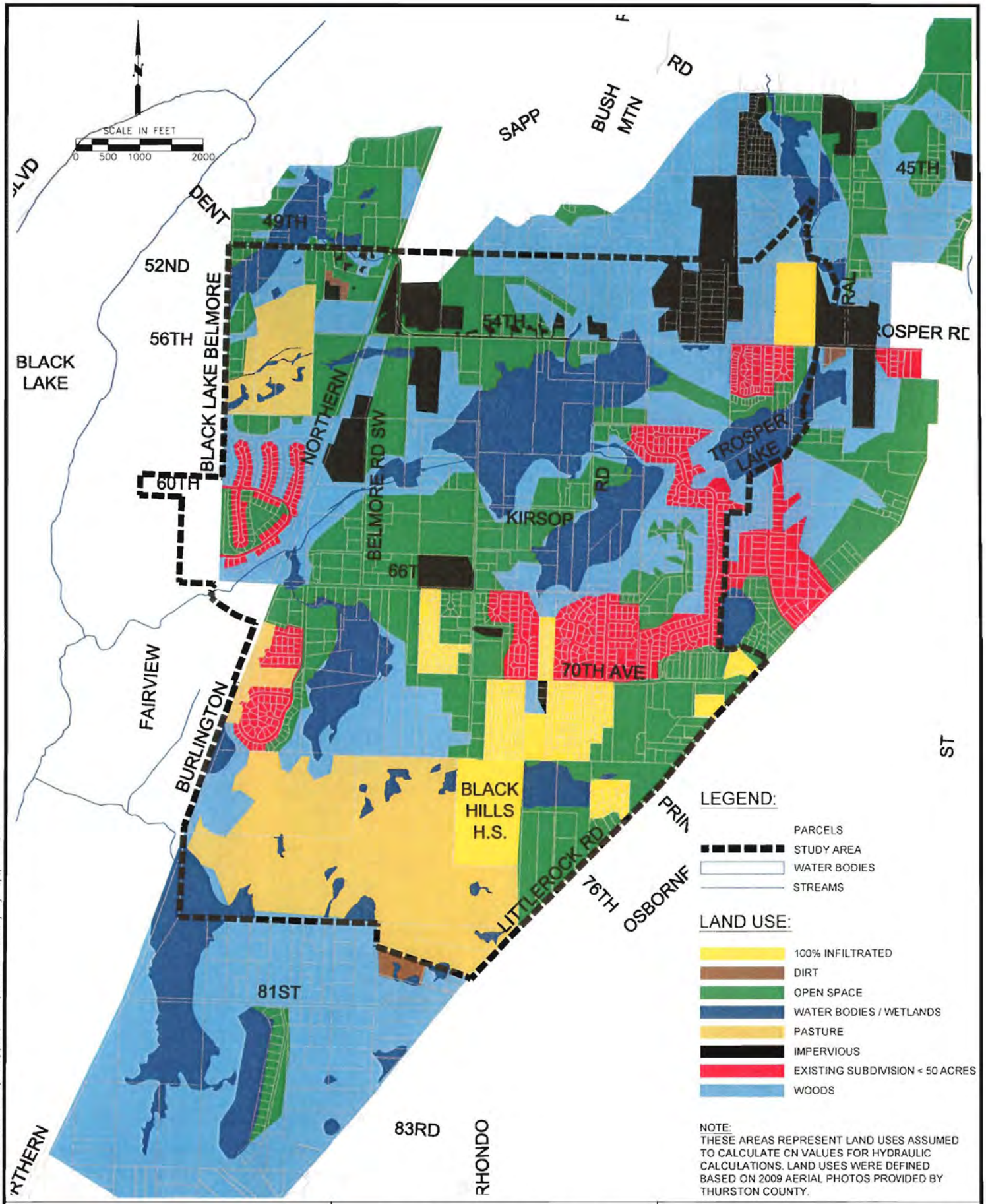
The modeling software HydroCAD was used to model the flows entering each culvert. The runoff flow for the 25 and 100 year flows are presented in Table 4-1 at the end of this section.

4.2 Future Conditions Analysis

Culverts were analyzed for the projected future build-out land uses. Areas where development was likely to occur were determined based on zoning, the location of proposed sanitary sewer, proposed water lines and power availability. Areas identified as unlikely to be developed were identified based on a combination of wetlands (with a 100 foot buffer) and high ground water hazard areas, as logged by Thurston County. Some areas were identified as likely to be developed, but would be unsuitable to provide adequate flow control requirements due to a high groundwater table, low infiltration rates or lack of sufficient hydraulic grade capacity. These areas were separated from other "development likely" areas, and modeled as if flow control requirements were not provided. The recommended improvements account for these areas not providing detention. It is our recommendation to the City that these areas are allowed to be

developed with a fee in lieu of flow control requirements, and that new culverts downstream of these sites are sized considering that these sites do not provide flow control. The fee in lieu of could be determined by designing and then estimating the cost of an onsite detention system. The City could then use these funds to make downstream improvements. See Figure 4-5 for development availabilities.

Land uses were then determined for the areas likely to be developed, based on zoning. Runoff curve numbers were determined based on soil types and the projected land uses. See Figure 4-6 for future land uses.



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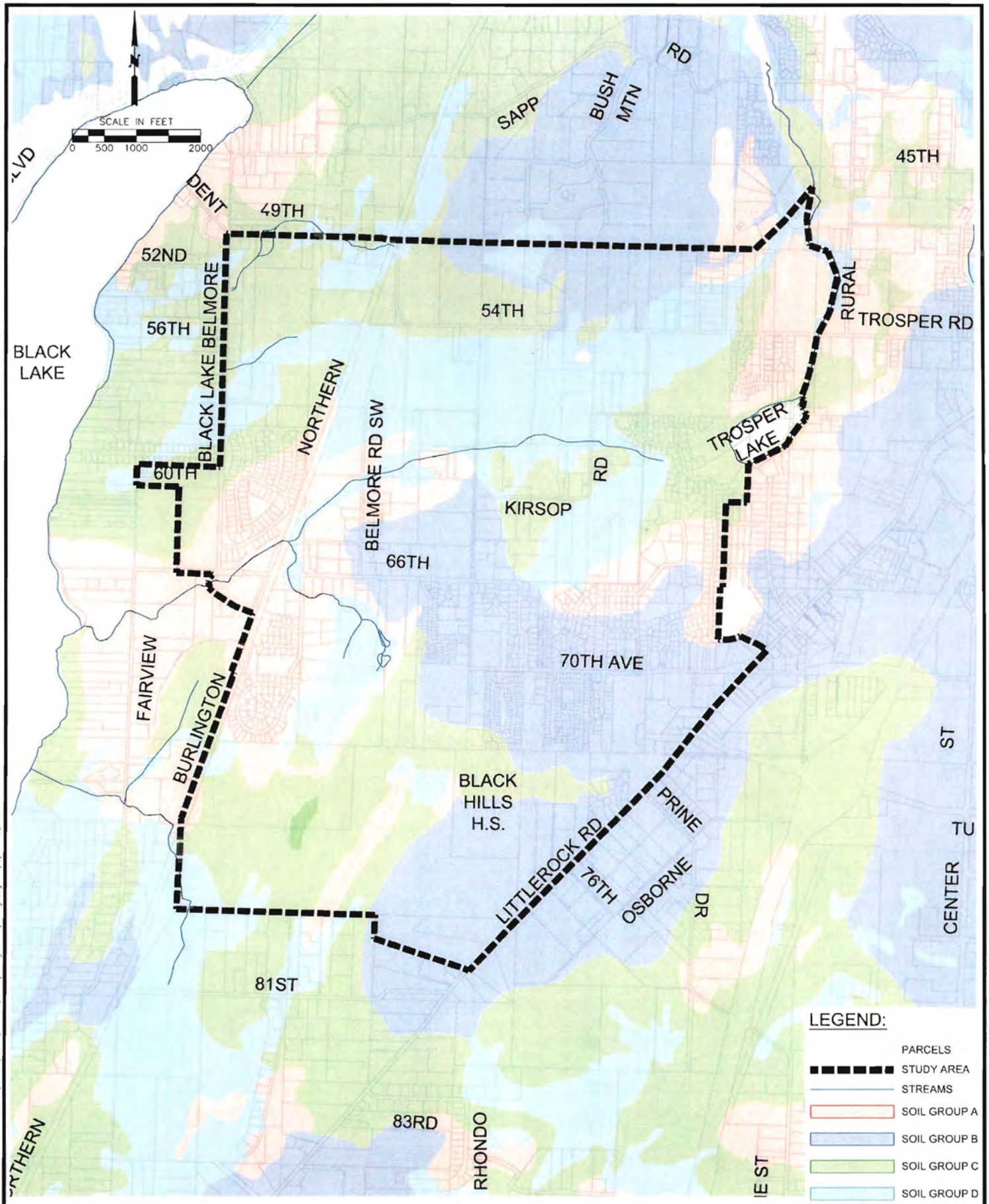
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

CURRENT LAND USE

FIGURE 4-3



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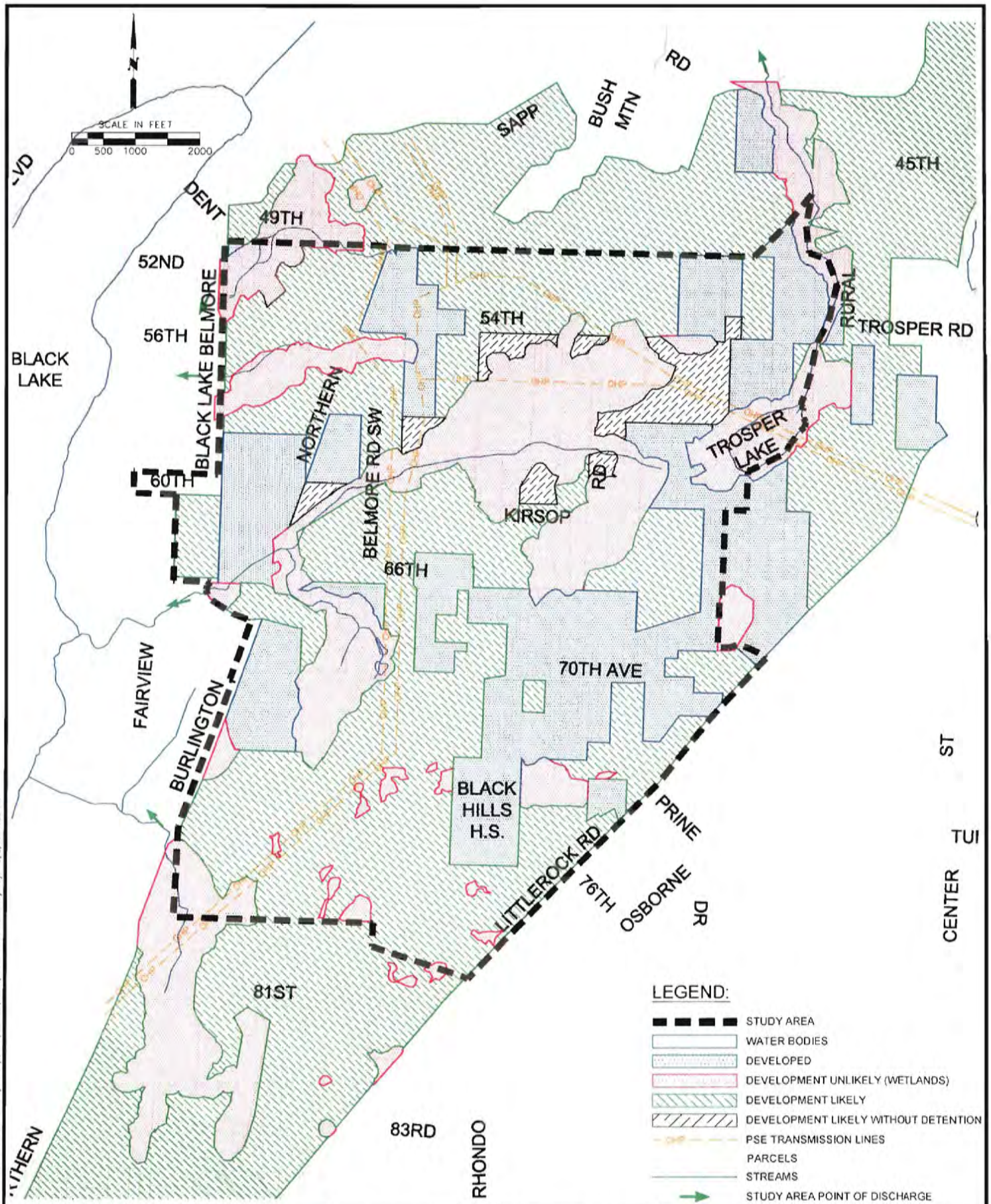
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

SOIL HYDROLOGIC GROUPS

FIGURE 4-4



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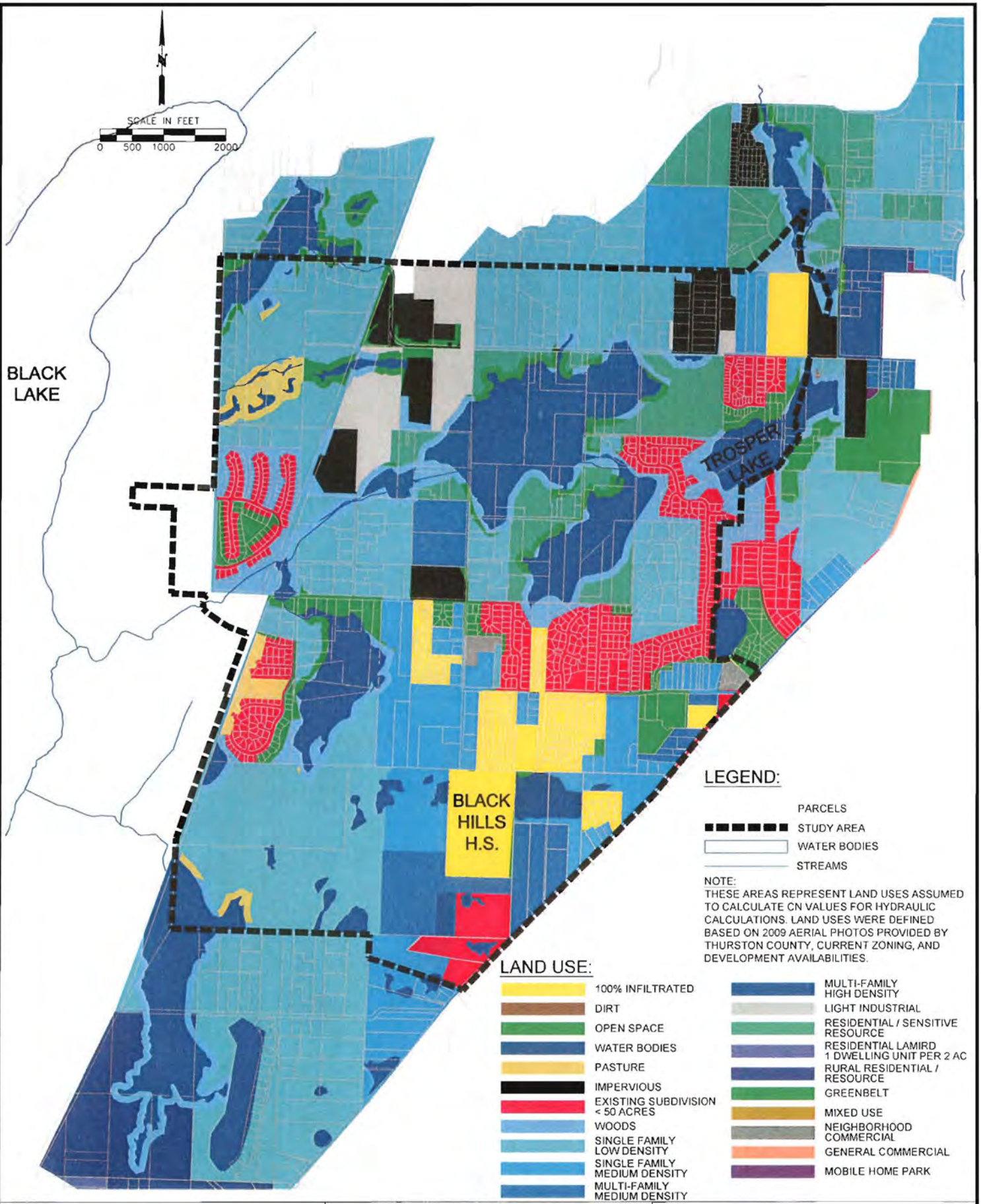
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

DEVELOPMENT AVAILABILITIES

FIGURE 4-5



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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

FUTURE LAND USE

FIGURE 4-6

Future projected flows for each culvert were calculated in two parts: 1) flows resulting from areas providing detention, and 2) flows from areas not providing detention. Flows from areas providing detention were determined using the continuous simulation software MGS Flood, adhering to the guidelines in the City of Tumwater Drainage Design and Erosion Control Manual (December 2009). Flows from areas not receiving detention were determined from the HydroCAD software modeling the individual culverts.

The modeling software HydroCAD was used to model and size each individual culvert. The time of concentration values remained the same from current conditions to future conditions.

4.3 Recommended Culvert Sizes

The existing culverts that are undersized are recommended to be replaced as soon as the City acquired funds. In the near term, all existing culverts that have accumulated sediment should be cleaned to increase flow capacity. Table 4-1 summarizes the recommended culvert sizes, based on the analysis of both the current and projected land uses.

The table also summarizes the calculated flows contributing to each culvert for both the existing and future land use conditions. For most culverts, the future flows are smaller than the existing flows, because most future developments will be required to provide flow control. A few sites may not provide flow control where it is impractical.

Table 4-1 also summarizes stormwater flows for the 25- and 100-year events.

TABLE 4-1 CULVERT CALCULATIONS

														Existing Land Conditions							Future Land Conditions								
Culvert No.	Size (in)	Material	Ex n value	Length (ft)	Inlet IE	Outlet IE	Outlet Water elev.	Roadway Crown Elev.	Slope* (SEE NOTE 1)	Inlet (HW)	Q existing capacity	Area	Base Flow (cfs)	Q 25yr (cfs)	25yr HW Elev.	Q 100yr (cfs)	100yr HW Elev.	Excess 100 yr HW	Pass 25yr	Pass 100yr	Q 25yr from Detention Areas (cfs)	Q 25yr TOTAL (cfs)	Q 100yr from Detention Areas (cfs)	Q 100yr TOTAL (cfs)	Contributing Sub-Basins	Recommendation	Max Q(100) (cfs)	100yr Headwater Available (with existing road elevation)	100yr Headwater Calculated	Available HW
1	36"	Concrete	0.012	63'	154.57	154.62	155.62	167.22	-0.08%	9.65	22.91	271.4	0.00	50.89	N/A	68.35	160.22	7.00	N	Y	6.78	45.95	12.33	62.78	D2	Double 30" @ 0.35%, Q = 52 cfs	68.35	10.15	1.22	8.93
2	12"	PVC	0.012	40'	161.87	162.64	Free Discharge	165.50	-1.92%	2.63	1.22	17.2	0.00	14.61	N/A	18.42	N/A		N	N	0.00	14.57	0.00	18.37	D3	Single 24" @ 0.40%, Q = 15.5 cfs	18.42	1.63	0.83	0.80
3	30"	Concrete	0.012	63'	160.46	160.48	161.35	164.81	-0.03%	1.85	14.09	129.4	0.00	33.78	N/A	44.39	N/A		N	N	7.29	25.71	14.04	36.87	D4, D5, D6, D7	Double 30" @ 0.35%, Q = 52 cfs	44.39	1.85	0.05	1.80
4	24"	PVC	0.012	40'	158.68	160.21	161.61	164.33	-3.83%	3.65	7.77	12.9	0.00	2.69	N/A	3.73	161.75	2.58	N	Y	0.00	4.21	0.00	5.41	D4	Single 18" @ 0.40%, Q = 6.2 cfs	5.41	4.15	1.83	2.32
5	30"	Concrete	0.012	67'	160.37	160.17	160.17	163.83	0.30%	0.96	24.34	97.3	0.00	25.18	N/A	35.25	164.23		N	N	6.77	18.24	13.06	27.59	D4, D6, D7	Passes 25yr, fill road 0.5' to pass 100 yr	35.25	0.96	1.36	-0.40
6	30"	Concrete	0.012	71'	161.36	159.99	161.46	164.29	1.93%	0.43	61.89	82.1	0.00	14.93	163.00	22.14	163.49	0.80	Y	Y	6.09	9.52	11.79	16.23	D7	Passes 25yr and 100 yr headwater	22.14	0.43	-0.37	0.80
7	18"	Concrete	0.012	28'	166.21	165.73	167.46	169.12	1.71%	1.41	14.94	66.1	0.00	23.01	N/A	34.22	N/A		N	N	6.75	7.58	11.26	12.34	C2	96"w x 24"h B.C. @ 0.30%, Q = 65 cfs	34.22	0.91	-0.39	1.30
8	**CULVERT 8 IS AN OFFSITE PRIVATE CULVERT, OUTLET NOT FOUND - ANALYSIS NOT PERFORMED**																													
9	18"	Concrete	0.012	100'	169.10	168.6	Free Discharge	171.87	0.50%	1.27	3.61	43.0	0.00	23.01	N/A	30.04	N/A		N	N	2.91	14.96	4.00	18.68	C1	Double 18" @ 1.20%, Q = 25 cfs	30.04	0.77	-0.02	0.79
10	30"	Concrete	0.012	40'	172.47	171.83	173.50	179.77	1.60%	4.80	56.36	5.0	0.00	9.00	173.98	11.04	174.09	5.68	Y	Y	0.00	8.99	0.00	11.03	A4	Passes 25yr and 100 yr headwater	11.04	4.80	-0.88	5.68
11	18"	Concrete	0.012	40'	157.98	157.81	159.51	161.62	0.42%	2.14	7.44	28.0	0.00	16.73	N/A	21.17	N/A		N	N	3.40	12.44	5.12	16.28	A3, A4	Double 18" @ 0.60%, Q = 17 cfs	21.17	2.14	1.58	0.56
12 & 13	12"	CMP	0.024	30'	147.24	146.79	148.52	150.41	1.50%	2.17	2.37	119.0	0.00	38.89	N/A	50.18	N/A		N	N	9.97	27.78	13.46	35.69	A1, A3, A4	96" w x 24" h Box Culvert, @ 0.30%	50.18	1.17	-0.12	1.29
	12"	CMP	0.024	31'	147.44	147.87			-1.39%		0.61																			
14 & 15	18"	CMP	0.024	40'	144.73	144.38	144.63	147.48	0.87%	1.25	5.34	161.7	0.00	53.04	N/A	68.86	N/A		N	N	12.70	38.56	17.11	49.56	A1, A2, A3, A4	96" w x 24" h Box Culvert, @ 0.30%	68.86	0.75	0.21	0.54
	18"	CMP	0.024	40'	144.80	144.32			1.20%		6.25																			
16	12"	Concrete	0.012	28'	163.87	163.15	Free Discharge	167.21	2.57%	2.34	6.21	66.1	0.00	30.09	N/A	40.28	N/A		N	N	5.11	18.88	6.48	24.43	B1	Triple 18" @ 2.50%, Q = 45 cfs	40.28	1.84	1.74	0.10
17	18"	CMP	0.024	31'	161.02	161.27	162.97	164.01	-0.81%	1.49	1.80	22.7	0.00	4.44	N/A	6.01	163.77	0.24	N	Y	0.00	6.46	0.00	8.26	C6	Double 18" @ 1.75%, Q = 7.6 cfs	8.26	1.49	0.69	0.80
18	24"	Concrete	0.012	37'	161.07	161.26	163.46	166.55	-0.51%	3.48	7.77	229.3	0.47	58.57	N/A	76.42	N/A		N	N	5.27	57.25	10.28	76.11	C9	96" w x 24" h Box Culvert, @ 0.30%	76.42	3.48	1.37	2.11
19 & 20	24"	CMP	0.024	18'	158.94	158.73	160.30	161.13	1.17%	0.19	13.27	367.7	1.29	86.35	N/A	113.06	N/A		N	N	13.81	82.42	24.18	110.13	C2, C6, C9, C10	96" w x 24" h Box Culvert, @ 0.30%	113.06	0.19	1.62	-1.43
	18"	CMP	0.024	18'	159.04	158.65			2.17%		8.40																			
21 & 22	30"	CMP	0.024	48'	151.54	151.73	153.54	157.73	-0.40%	3.69	7.04	568.2	2.18	143.44	N/A	187.25	N/A		N	N	26.20	128.11	40.38	167.61	C1, C2, C5, C6, C9, C10	144" w x 24" h Box Culvert, @ 0.30%, Q = 65 cfs	187.25	4.19	2.63	1.56
	30"	CMP	0.024	48'	151.66	151.51			0.31%		12.45																			
23	**CULVERT 23 IS AN OPEN BRIDGE - NO PROBLEMS NOTED, ANALYSIS NOT PERFORMED**																													
24	48"	CMP	0.024	80'	149.40	149.42	151.07	162.46	-0.02%	9.06	24.67	316.7	0.00	34.44	152.75	48.84	153.53	8.93	N	Y	26.59	49.71	35.49	64.60	C7, C8	Double 30" @ 0.35%, Q = 52 cfs	64.60	10.56	1.09	9.47
25	48"	CMP	0.024	60'	149.59	149.75	152.45	161.10	-0.27%	7.51	24.67	275.7	0.00	31.13	153.03	44.42	153.40	7.70	N	Y	26.06	40.72	34.37	52.04	C8	Double 30" @ 0.30%, Q = 48 cfs	52.04	9.01	1.57	7.44
26	72" W 46" H	CMP	0.024	123'	144.50	144.09	144.69	159.66	0.33%	11.33	81.67	1032.2	3.31	178.70	N/A	237.38	158.13	1.53	N	Y	57.82	189.16	83.82	248.42	C1, C2, C3, C4, C5, C6, C7, C8, C9,	Double 48" @ 0.40%, Q = 197 cfs	248.42	11.16	2.45	8.71
27	**14 FT WIDE BY 6 FT HIGH BOX CULVERT OUTSIDE OF STUDY AREA**																													
28	**CULVERT 28 IS AN OPEN BRIDGE - NO PROBLEMS NOTED, ANALYSIS NOT PERFORMED**																													
29	60"	Concrete	0.012	43'	139.13	138.16	139.08	152.06	2.26%	9.10	424.91	821.8	0.00	155.79	N/A	213.94	146.75	5.31	N	Y	41.25	124.31	76.12	179.70	D1, D2, D3, D4, D5, D6, D7	Passes 25yr and 100 yr headwater	213.94	7.93	2.62	5.31
30	POINT 30 IS A LOW AREA IN THE ROAD, WITH WARNING SIGN OF STANDING WATER**																													

NOTE 1: FOR ESTIMATING PURPOSES, CULVERTS WITH NEGATIVE SLOPES WERE GIVEN A SLOPE OF 0.1% IN THE MANNING'S EQUATION. ALL PIPES WITH NEGATIVE SLOPES ARE RECOMMENDED TO BE REPLACED.

5 HYDROLOGIC ANALYSIS

5.1 Geology

The Tumwater Annexation area is underlain by glacial outwash and ice-contact till deposits. These deposits consist of poorly to moderately sorted, rounded gravel in a sandy matrix. The Advance Outwash deposits in the study area underlie the till and are generally about 50 feet thick. In most areas, these Advance Outwash deposits are moderately dense.

The glacial till consists of a gray, concrete-like mixture consisting of silt, sand and gravel. It is generally very dense, and has a very low permeability.

Recessional Outwash deposits overlie the glacial till in most portions of the study area. The Recessional Outwash deposits consist of poorly sorted, laterally discontinuous deposits of sand and gravel.

5.2 Hydrogeology

The Advance Outwash deposits form a productive and highly utilized aquifer in Thurston County. The aquifer is tapped by numerous wells for both domestic and municipal supply. Generally, groundwater within the aquifer is partially or fully confined with the surface elevation and within, or above the confining bed. The hydraulic conductivity of the Advance Outwash aquifer ranges from about 50 to over 500 cubic feet per square foot per day.

The glacial till deposits serve as an aquitard and upper confining bed for the Advance Outwash aquifer. Recharge through the till is slow with a hydraulic conductivity of generally less than 10 cubic feet per square foot per day.

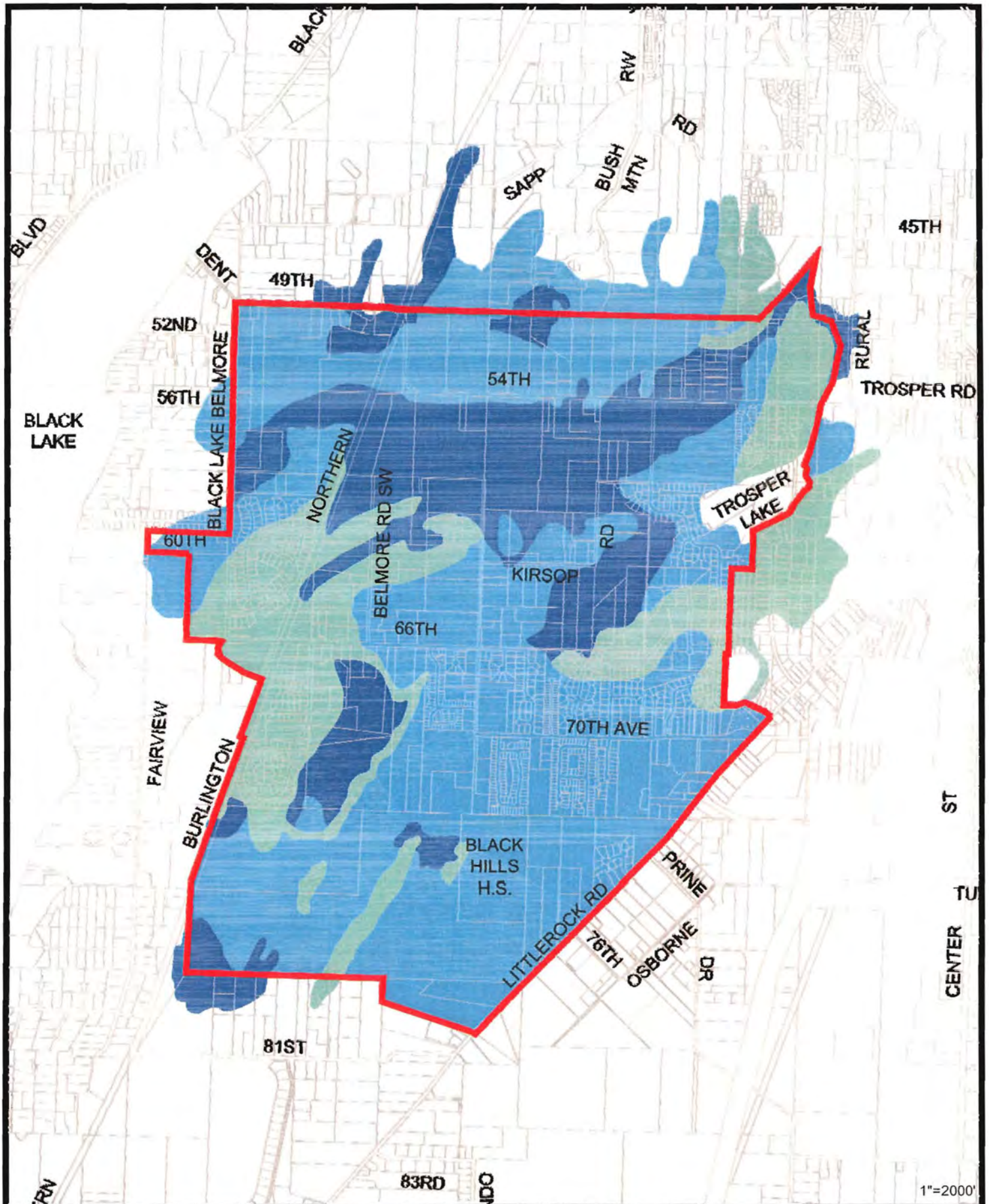
Groundwater within the Recessional Outwash deposits occurs under unconfined, water-table conditions with the glacial till unit serving as the lower confining layer. Groundwater yields are moderate but the susceptibility to contamination from surface activities is high. Recharge to the aquifer is generally rapid resulting directly from precipitation resulting in a moderately rapid response in groundwater levels following significant precipitation events.

The significance of the Recessional Outwash aquifer in the Tumwater Annexation area is the shallow nature of the water table in many locations and the contribution of groundwater discharge to the streams that drain to Black Lake. The shallow aquifer can create "groundwater flooding" conditions wherein the water level in the aquifer rises above ground surface during significant or prolonged precipitation events, similar to conditions found in the Salmon Creek

Basin area of Thurston County to the east. Historically, these conditions were dealt with by creating a system of ditches and drains to convey excess water away during winter months. Over time, these ditches and drains have either not been maintained, or have been filled as land has been subdivided and developed, resulting in slow drainage of the area and contributing to flooding events.

All private stormwater systems should be maintained per Appendix 1E of the Tumwater Drainage Design and Erosion Control Manual. It is recommended that the City follow up on reports submitted by property owners to ensure maintenance is being provided.

Figures 5-1 and 5-2 show the general groundwater runoff and infiltration rates for the study area, respectively. These figures help determine which areas will be contributing more stormwater runoff to the system (higher groundwater runoff rates), and which areas are most suitable for flow control by infiltration (higher infiltration rates).



SKILLINGS CONNOLLY	CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY	GROUNDWATER RUNOFF MAP FIGURE 5-1

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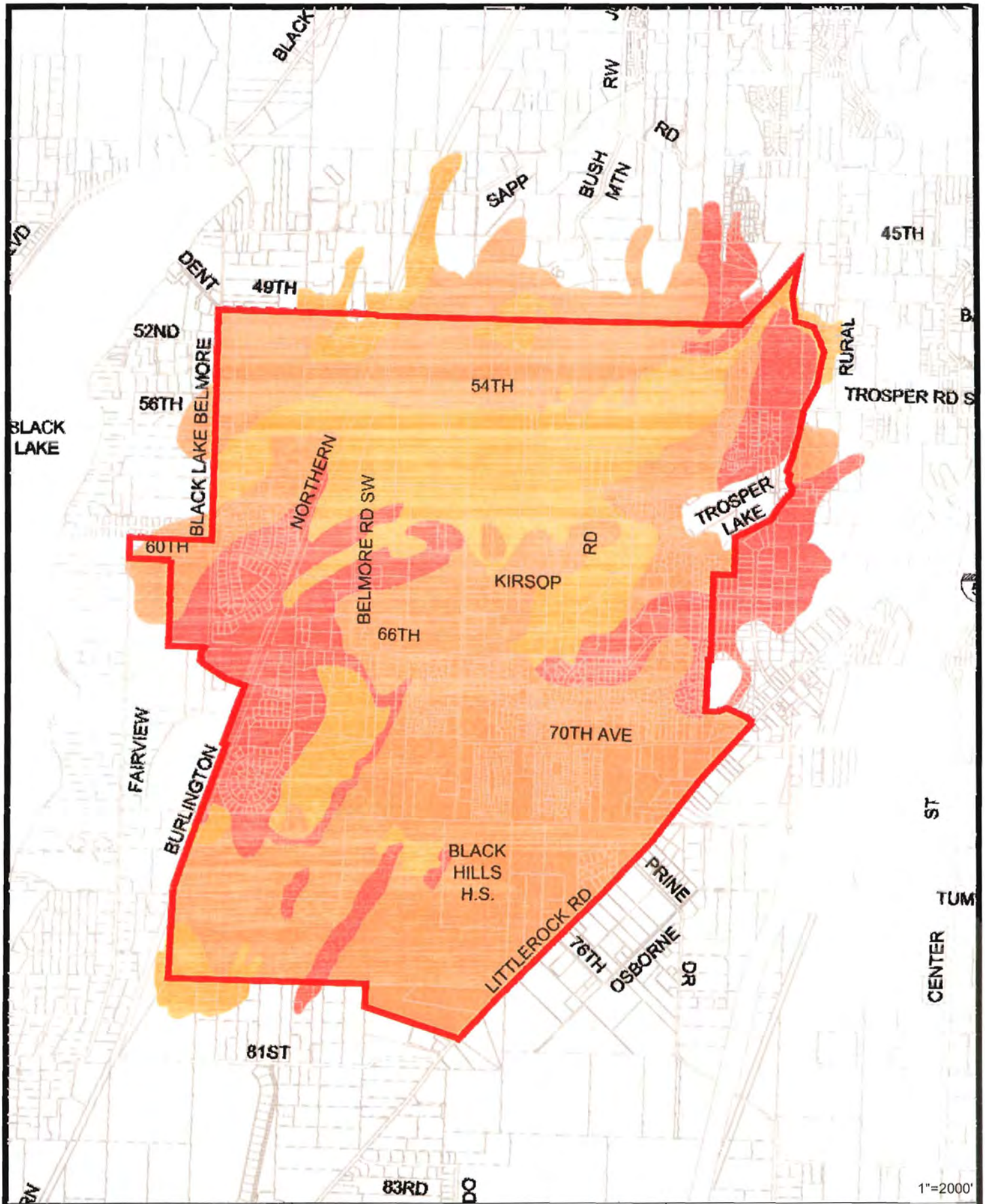

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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

INFILTRATION RATE MAP

FIGURE 5-2

Plotted By: Steven Egan on 5/3/11 1:28 PM

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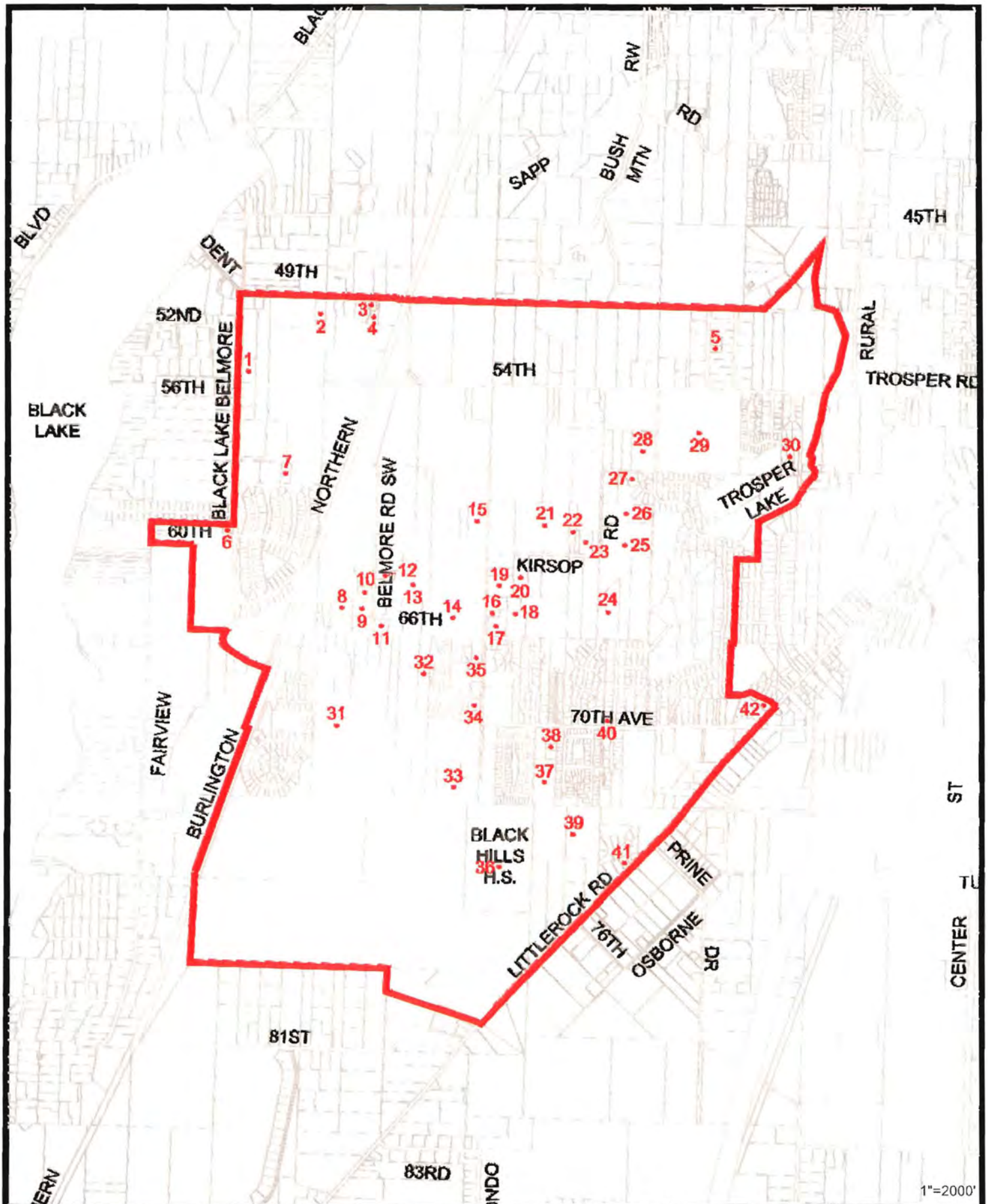

1"=2000'

SKILLINGS CONNOLLY	CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY	WELL LOCATION MAP FIGURE 5-3

Plotted By: Steven Egan on 5/3/11 1:30 PM

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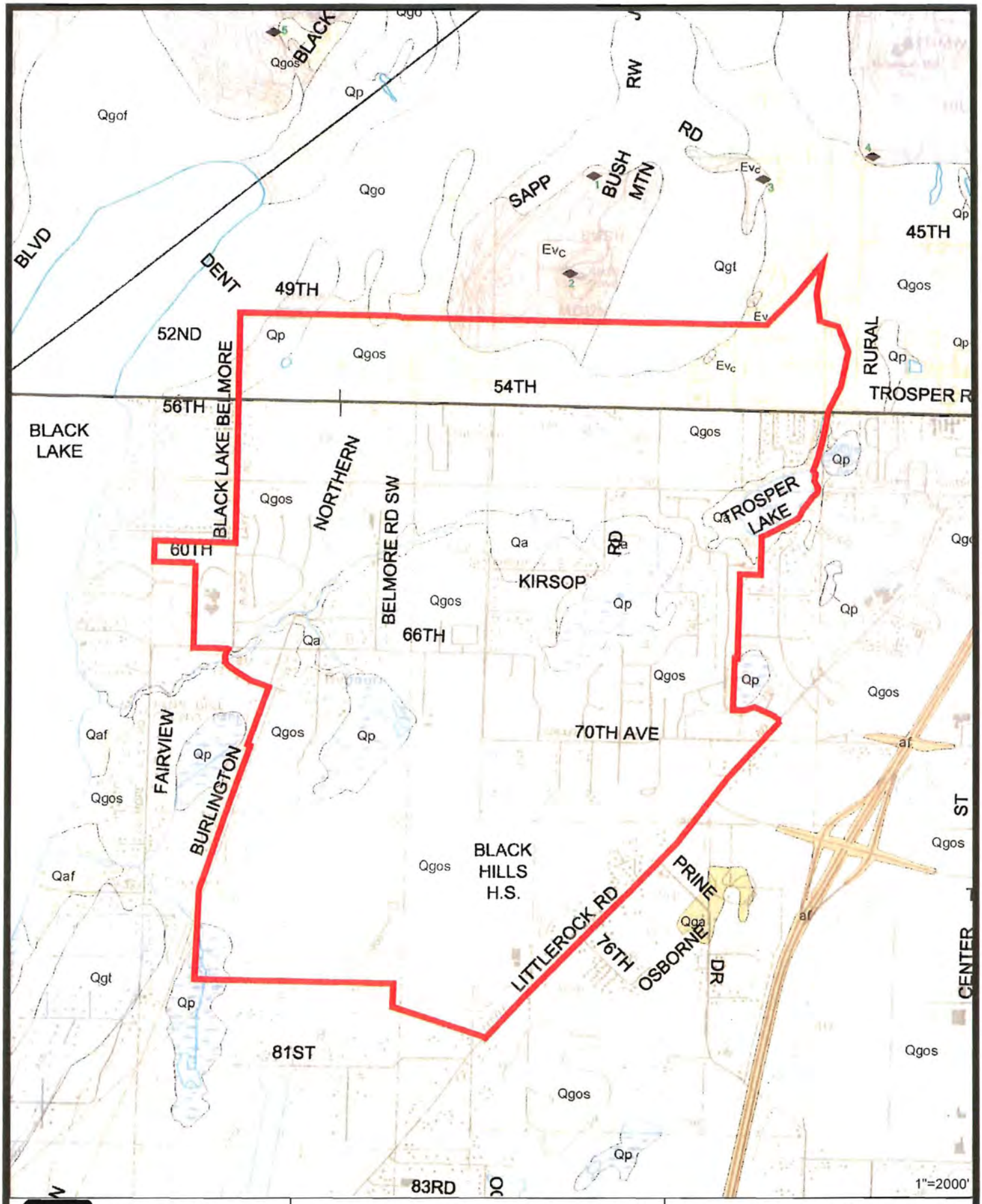
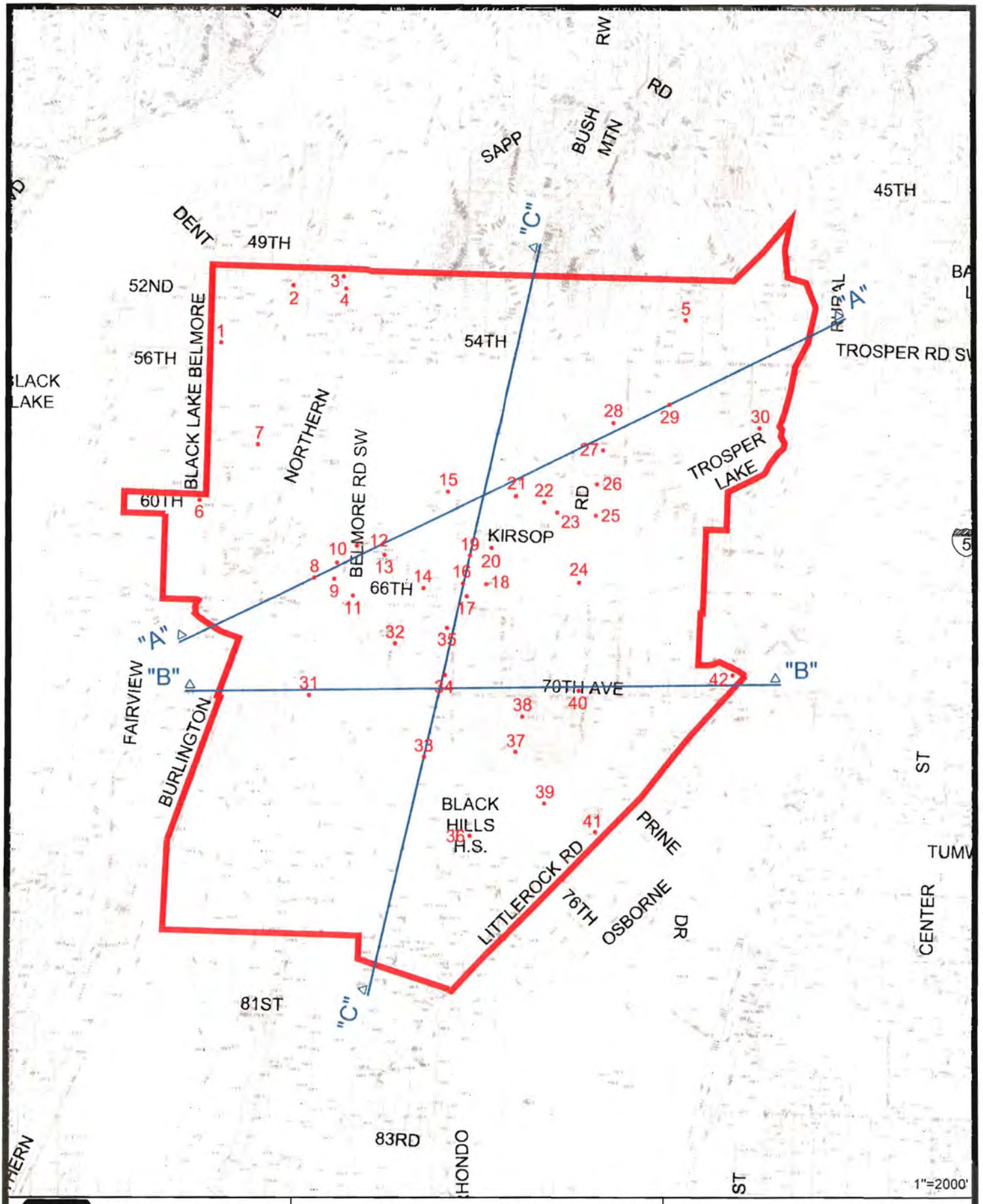


SKILLINGS CONNOLLY

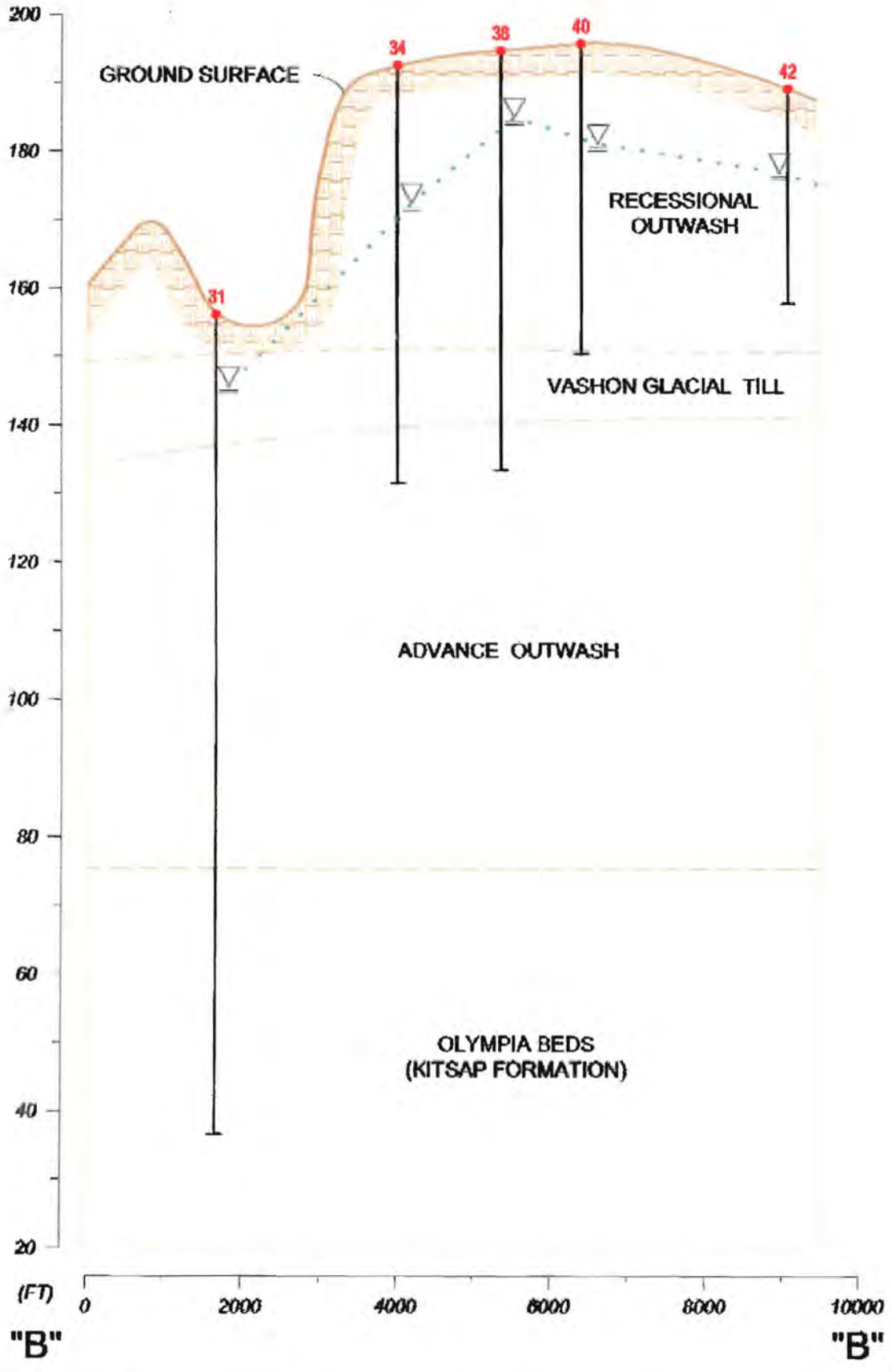
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

GEOLOGIC MAP

FIGURE 5-4



SKILLINGS CONNOLLY	CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY	GEOLOGIC CROSS SECTION REFERENCE MAP FIGURE 5-5



1"=2000'

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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

GEOLOGIC CROSS SECTION "B-B"

FIGURE 5-7

Plotted By: Steven Egan on 5/3/11 1:25 PM

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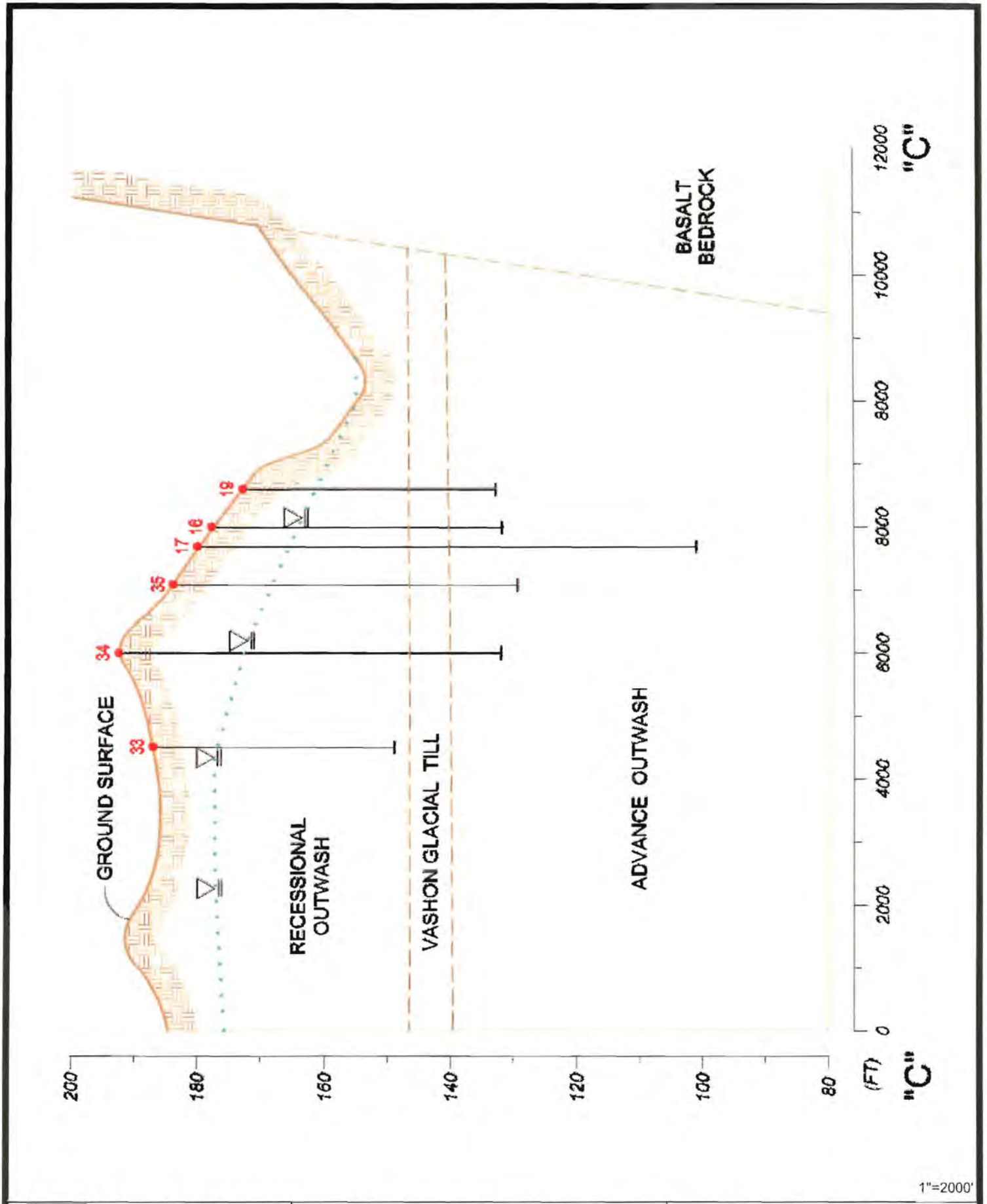

1"=2000'

SKILLINGS CONNOLLY

CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

GEOLOGIC CROSS SECTION "C-C"

FIGURE 5-8

Plotted By: Steven Egan on 5/3/11 1:27 PM

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6 ENVIRONMENTAL ANALYSIS

Known environmental concerns within the study area include beaver habitat, amphibian habitat, salmon habitat and passage, and wetlands.

6.1 Beaver Habitat

A site visit was conducted on June 3, 2010 to observe beaver dams on Fish Pond Creek in the Black Lake-Belmore/ 66th Avenue area. One beaver dam was located approximately 50 feet upstream of the railroad trestle. Three areas of deterioration were observed on the beaver dam. It appeared that a trench was excavated to bypass water around the pond as well as two areas that looked to have been dismantled. Furthermore, no fresh brush cutting was evident, indicating that the beavers may not be using either of these ponds.

There are two separate ponds that are separated by the one dam. One is fed from the south tributary under 66th Avenue and the other is being fed from Fish Pond Creek.

Although observations indicated that the beavers have left the area, residents at the open house mentioned that beavers have habitually come and gone over the years. Two measures to alleviate flooding have been recommended by the Washington State Department of Fish and Wildlife (WDFW) in other streams in the Puget Sound Area: beaver deceivers and flexible levelers. These are structural measures that reduce flooding without disturbing beaver habitat. See Figure 6-1 for sketches of a beaver deceiver and flexible leveler.

6.2 Salmon Habitat & Passage

Historically, salmon most likely spawned and reared in this stream system. Local knowledge confirms that salmon have spawned in other Black Lake tributaries. WDFW biologist Jason Kunz confirms that augmentation of Chinook salmon occurred in tributaries draining into Black Lake in the late 1970s to the early 1980s (Jason Kunz, WDFW Fish Biologist, Personal Communication June 2010).

Because salmon are known to enter and spawn in the major tributary of Fish Pond Creek, box culverts are recommended to replace existing pipe culverts.

6.3 Wetlands

The National Wetland Inventory map was accessed to determine if wetlands were present in the annexation area and to determine their Cowardin Classification. Palustrine shrub scrub wetlands were identified in the annexation site, with the majority of the identified wetlands occurring between 54th Avenue to the north and Kirsop Road to the south. Wetlands have become established behind the beaver dam, just east of the railroad trestle. These wetlands provide habitat to red-wing blackbird, various species of ducks, amphibians and great blue heron.

6.4 Threatened, Endangered and Sensitive Species

A search of existing information from National Marine Fisheries Service, U.S. Fish and Wildlife Service, and the Washington Department of Fish and Wildlife was conducted to determine if any threatened, endangered, and sensitive species and/or habitats exist in the study area. The U.S. Fish and Wildlife Service threatened and endangered species list for Thurston County include Bull trout, Marbled murrelet, Northern spotted owl, water howellia, and golden paintbrush. None of these species were observed on-site and would not be expected to be found on-site due to lack of appropriate habitat. National Marine Fisheries Service threatened and endangered species list for Thurston County include Chinook salmon and Steelhead trout. Both of these species have historically had access to Fish Pond Creek (Larry Phillips, Biologist, WDFW, Personal Communication, 2011) but their presence in Fish Pond Creek is currently unknown.

Other salmonids species of importance such as Coho salmon and cutthroat trout may also have historically occupied Fish Pond Creek. However, it is currently unknown if those species still use the creek but there is no reason to believe that they wouldn't since salmon have access to Black Lake.

Non-salmonids such as the Olympic mudminnow are listed on WDFW's species of concern. Olympic mudminnow are found in the Chehalis Basin including Black Lake and in the Deschutes watershed (Mongillo and Haddock 1999). The Fish Pond Creek site, especially the wetland ponds, provide appropriate habitat for the Olympic mudminnow; however, no recent surveys have been conducted to determine their presence in Fish Pond Creek (Pers. Comm. Larry Phillips, WDFW Biologist, 2011)

6.5 Environmental Recommendations

It appears the main culvert under 66th Avenue (Culvert #26) is of adequate size for fish passage. However, the first set of beaver dams near the railroad trestle appear to be impassable. There are no plunge pools for salmon to use to help propel them over the dams. The water level and width of the dam appear to block migration upstream.

According to WDFW biologist Jason Kunz, permitting the removal of an established beaver dam is highly unlikely because of the potential loss of wetland habitat created behind the beaver dam. With that in mind, the following recommendations should be conducted to determine the impacts of the proposed project:

Determine upstream extent of fish migration.

Locate and GPS of other fish blockages, culverts, dams etc.

Conduct a fish survey in the fall when salmonids are migrating to their natal spawning ground. Record and identify species.

Conduct an observation of the dam during same time period to verify if dam is a fish blockage.

Conduct a fish survey for Olympic Mudminnow in the wetland ponds to determine presence/absence.

Property owner outreach/involvement

Recommend plants that are not beaver forage such as Douglas fir and Nootka Rose instead of deciduous plants such as alders, willow, and maple.

If dam is a fish blockage, and beavers are no longer using pond, notching the beaver dam may be an option, also consider using a "beaver deceiver" and install small fish ladder.

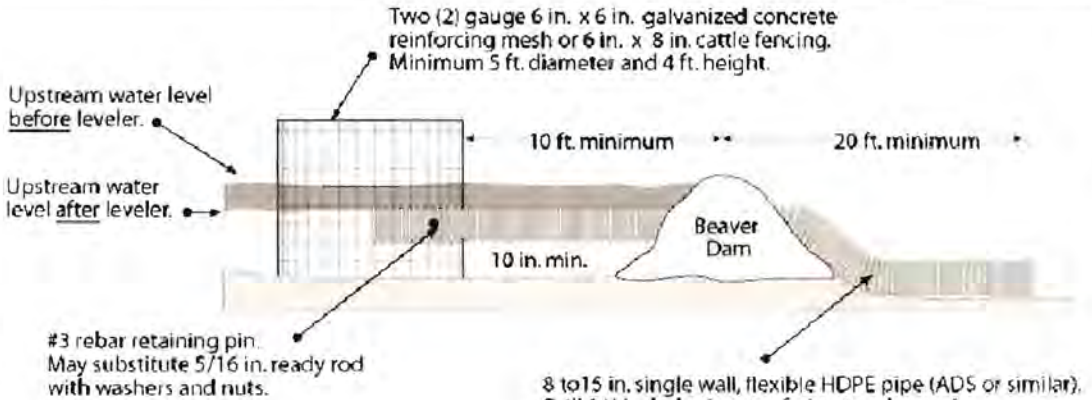
6.6 Permit Requirements

In-water work could require a US Army Corps of Engineers Permit and would trigger ESA consultation with the federal resource agencies.

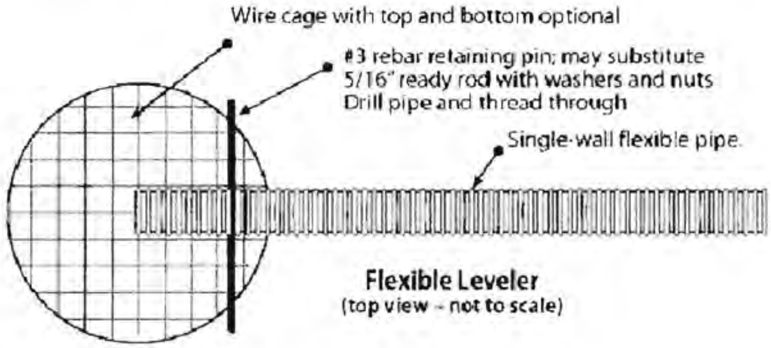
HPA-WDFW-for beaver dam work and for upgrading culverts

Critical Areas Report-City of Tumwater

NOTE:
THESE SKETCHES ARE COURTESY OF WDFW



Flexible Leveler
(side view – not to scale)



Flexible Leveler
(top view – not to scale)

Construction notes:

1. Construct wire cage using hog rings or similar devices for fasteners. Overlap one section for cage wall.
2. Cut out hole for flexible pipe in cage wall.
3. Remove dam as needed to place flexible pipe. Replace dam after leveler is installed.
4. Stake single-wall HDPE pipe every 6 ft. To prevent it from floating or beavers from moving it, use two T-posts and wire between them and over the top of the pipe to secure the pipe.
5. Drill 3/8th in. hole in culvert for rebar to allow for friction fit. If ready rod is used, place washers next to pipe and secure with double nuts.
6. One (1) 16 foot section of fencing will construct a cage wall approximately 5 feet in diameter. An additional section is needed to construct the top and bottom of each cage.
7. Pipe diameter should be sized to pass the stream base flow.
8. Final layout of the pipe should allow for a shallow gradient to facilitate fish passage.

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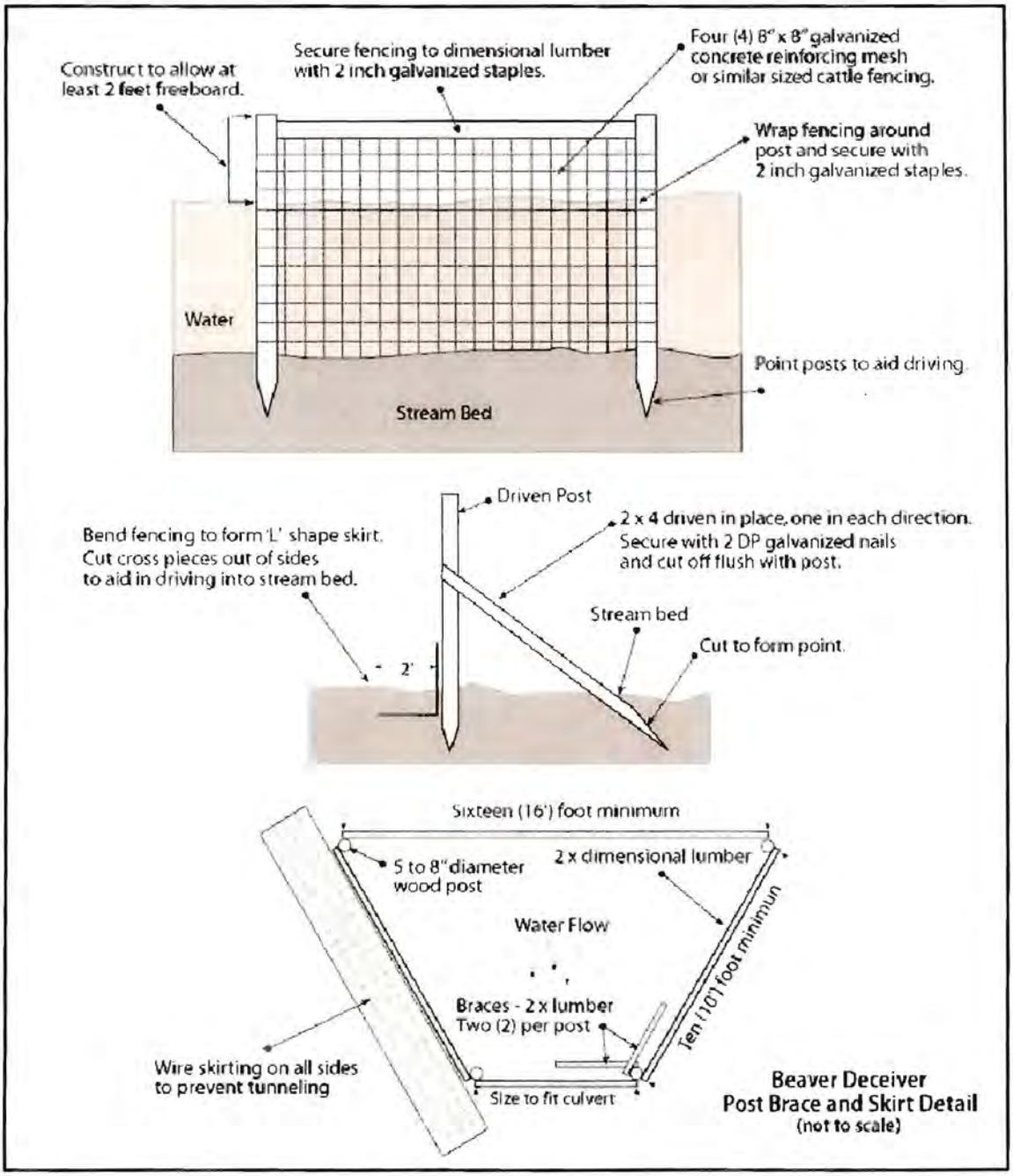
CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

FLEXIBLE LEVELER DETAIL

FIGURE 6-1A

NOTE:
THESE SKETCHES ARE COURTESY OF WDFW



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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

BEAVER DECEIVER DETAIL

FIGURE 6-1B

7 PROBLEM IDENTIFICATION & RECOMMENDATIONS

Analysis has culminated in a list of recommended projects to improve flooding issues within the study area. It is recommended that any culvert needing replacement would be replaced with the new recommended size. It is not recommended to reuse the existing culverts because of the age, slope, size, etc. of the existing culverts. These projects have been prioritized based on cost and need, and are discussed from highest to lowest priority. The projects have been prioritized by addressing flooding problems first, then replacing undersized culverts second. Culvert replacement is prioritized by replacing the culvert the farthest downstream and having the greatest amount of flow under capacity. The following costs have been evaluated to determine a capital improvement cost to be used by the City for future planning:

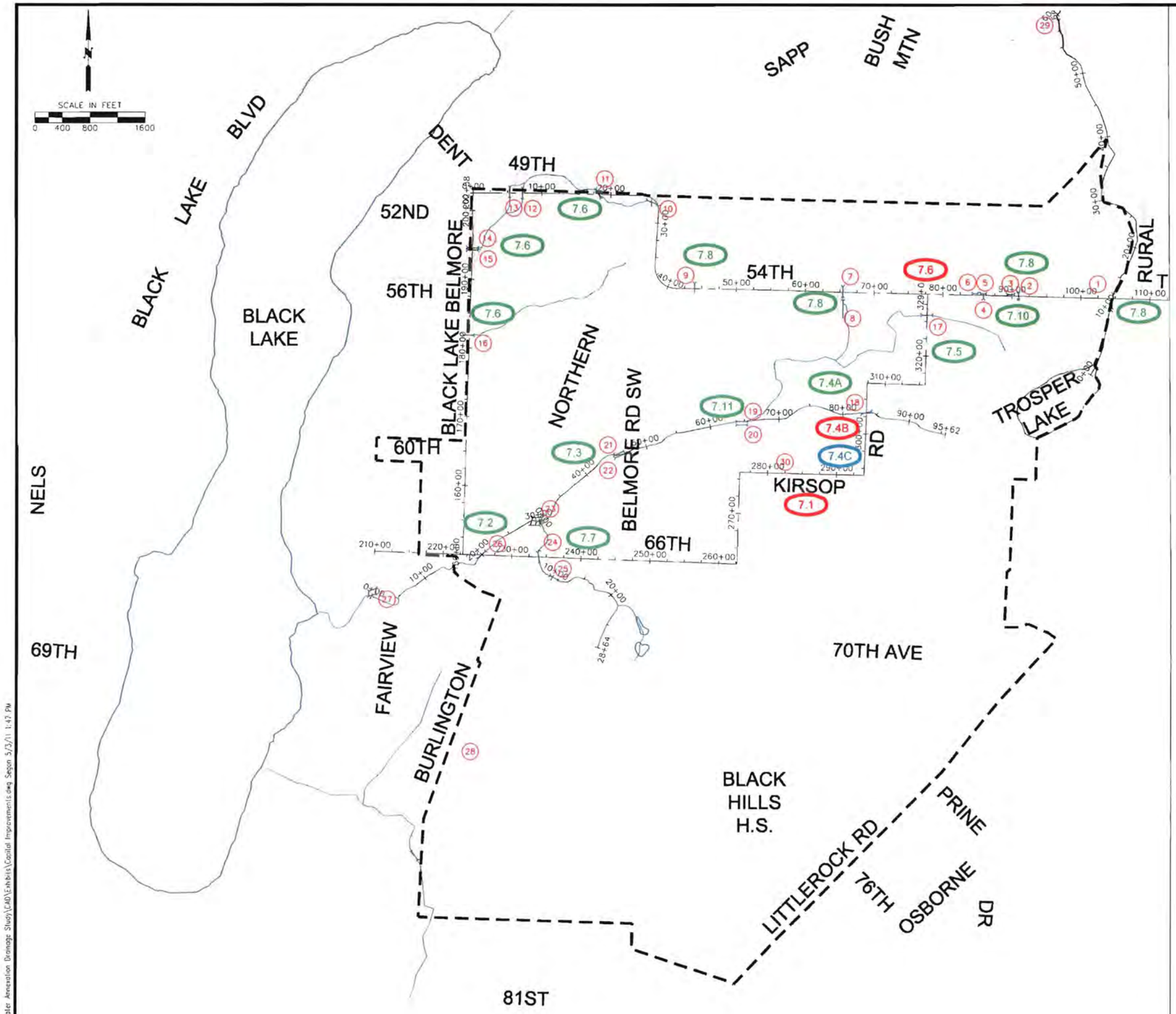
- Construction Costs
- Sales Tax (8.5%)
- Contingency (25%)
- Permitting (5%)
- Environmental Mitigation/Wetland Restoration (5 to 25%)
- Engineering Design & Construction Administration (25%)

Figure 7-1 shows the location of the proposed Capital Improvements Projects. Detailed cost estimates are included in Appendix B.

7.1 Install New Culvert(s) at Low Area along Kirsop Road

Existing Issues Addressed: Reduce flooding along Kirsop Road

There is a low area on the southerly east/west portion of Kirsop Road where stormwater flows over the road. To eliminate flooding at the low area, it will be necessary to raise the profile of the roadway with fill and install a cross culvert(s). This will be one of the major drainage improvement projects in the annexation area, in that it will require wetland mitigation and property acquisition to provide stormwater treatment and flow control. The roadway fill depth could range from four to eight feet depending on the design and may require retaining walls to minimize the impacts to adjacent wetlands.



LEGEND:

STUDY AREA | WATER BODIES | (x) CULVERT NUMBER

EXISTING CULVERTS | STREAMS

ALLEVIATE FLOODING		
Project No.	Project Description	Capital Cost
7.1	Install Culvert(s) in low spot on Kirsop Road, Raise Roadway	$1,582,900
7.4B	Install swales along the west side of Kirsop Road	$137,600
7.6	Install new Culvert 7A at the intersection of 54th Ave. & Kirsop Road	$37,400
CULVERT REPLACEMENT		
Project No.	Project Description	Capital Cost
7.2	Replace culvert 26 along 66th Ave	$329,700
7.3	Replace culverts 21 and 22 along Belmore Road SW	$147,400
7.4A	Replace Culvert 18	$115,400
7.5	Replace Culvert 17	$91,100
7.6	Replace culverts 11 through 16 along Black Lake Belmore Road and 49th Ave	$324,100
7.7	Replace culverts 24 and 25 along 66th Ave and Cavalier Road	$336,300
7.8	Replace culverts 1, 2, 7 and 9 along 54th Ave/Trosper Road	$449,200
7.10	Replace culverts 3 & 4, fill for culvert 5 along 54th Ave/Trosper Road	$446,500
7.11	Replace culverts 19 and 20	$103,900
WATER QUALITY IMPROVEMENT		
Project No.	Project Description	Capital Cost
7.4C	Install Water Quality Feature along the west side of Kirsop Road	$252,100
	TOTAL	$4,353,600

DATUM: NAD 83

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CITY OF TUMWATER ANNEXATION AREA DRAINAGE STUDY

CAPITAL IMPROVEMENT PROJECTS

FIGURE 7-1

7.2 66th Avenue from Black Lake Belmore Road to Cavalier Road

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along Fish Pond Creek and its south tributary.

This roadway has a Cross Culvert (#26)

- ✓ Culvert #26 – 46" x 72" CMP Arch Pipe, Fish Pond Creek.

This culvert is undersized to convey the flows for the 25-year design storm and is recommended to be replaced with the following culverts.

- ✓ Replace Culvert #26 with two 48" Dia. culvert pipes.

7.3 Belmore Road SW

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along Fish Pond Creek.

Fish Pond Creek crosses under Belmore Road SW, which is a no-through roadway that provides access to the ADS storage yard and at a gravel access road to the east Belmore Road SW about 2,000 feet. This gravel road provides access to overhead power lines and appears to be used very infrequently.

- ✓ Culvert #21 – 30" Dia. CMP, tributary to Fish Pond Creek.
- ✓ Culvert #22 – 30" Dia. CMP, tributary to Fish Pond Creek.

These culverts are undersized to convey the flows for the 25-year design storm and are recommended to be replaced with the following culverts. These culvert replacements have low priority as this roadway provides access to very few residences.

- ✓ Replace Culverts #21 and #22, each with a 12-foot wide by 2-foot high box culvert.

Fish Pond Creek also crosses underneath the Burlington Railroad Trestle. At the railroad crossing, the Creek has an invert elevation of 148.8. About 80 feet east of the railroad trestle, Fish Pond Creek divides into the main stem (north) and the south tributary. At this location, there are the remnants of a beaver dam which has formed a pond that has a water surface elevation of 152.7 in the main stem and a water surface elevation of 150.4 in the south tributary. This is significant, because the twin culverts (#21 and #22) under Belmore Road SW have an invert outlet elevation of 151.5 and a water surface elevation of 153.5. The south tributary of Fish Pond Creek flows under the 66th Avenue and has an invert outlet elevation of 149.4 and a

water surface elevation of 151.1. The beaver dam has created a backwater condition (ponding) along both the main stem and the south tributary of Fish Pond Creek.

7.4 Kirsop Road from 66th Avenue to 54th Avenue - Phase 1

Existing Issues Addressed: Reduce flooding along Kirsop Road

This roadway has Cross Culvert #18 located in the middle north-south segment. It also has two areas of local flooding at low points in the roadway profile. The two low areas are at the 90 degree turns in the roadway at stations 294+00 and 307+50.

- ✓ Culvert #18 – 24" Dia. Conc., Fish Pond Creek

Cross Culvert #18 is undersized to convey the flow for the 25-year design storm and is recommended to be replaced with the following culvert.

- ✓ Replace Culvert #18 with an 8-foot wide by 2-foot high box culvert.
- ✓ The two locations at 90 degree bends will need to install new swales (ditches) parallel to the roadway and direct flows to nearby Fish pond Creek.
- ✓ A water quality treatment facility is also recommended to treat stormwater runoff from the paved surface. A constructed wetland is the most viable water quality treatment facility at this location due to high groundwater.

7.5 Kirsop Road from 66th Avenue to 54th Avenue - Phase 2

Existing Issues Addressed: Reduce flooding along Kirsop Road

This roadway has Cross Culvert #17 located along the north end of Kirsop Road.

- ✓ Culvert #17 – 18" Dia. CMP, unnamed tributary to Fish Pond Creek.

Cross Culvert #17 is undersized to convey the flow for the 25-year design storm and is recommended to be replaced with the following culvert.

- ✓ Replace Culvert #17 with two 18" culvert pipes.

7.6 Intersection of 54th Avenue and Kirsop Road

Existing Issues Addressed: Reduce flooding along 54th Avenue

This drainage ditch that flows east to Percival Creek on the north side of the roadway is undersized to convey the 25-year flow. A portion of sub-basin D7 flows into this system. However, based on the topography, this sub-basin once flowed into Fish Pond Creek prior to 54th Avenue being constructed. It is recommended that this flow be diverted back to its natural basin by installing a cross culvert along the west side of Kirsop Road and direct flow into an existing ditch that flows south along the west side of Kirsop Road. This new culvert is designated as Culvert 7A.

7.7 Black Lake Belmore Road from 66th Ave to 49th Ave

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along these tributaries to Black Lake.

This roadway has seven Cross Culverts #10 through #16.

- Culvert #10 – 30" Dia. Concrete, unnamed tributary to Black Lake.
- Culvert #11 – 18" Dia. Concrete, unnamed tributary to Black Lake.
- Culvert #12 – 12" Dia. CMP, unnamed tributary to Black Lake.
- Culvert #13 – 12" Dia. CMP, unnamed tributary to Black Lake.
- Culvert #14 – 18" Dia. CMP, unnamed tributary to Black Lake.
- Culvert #15 – 18" Dia. CMP, unnamed tributary to Black Lake.
- Culvert #16 – 12" Dia. Concrete, unnamed tributary to Black Lake.

Culvert #10 is adequately sized to convey the 25-year design storm. The other six culverts are undersized to convey the flows for the 25-year design storm and are recommended to be replaced with the following culverts.

- Replace Culvert #11 with two 18" Dia. culvert pipes.
- Replace Culvert #12 and #13, each with an 8-foot wide by 2-foot high box culvert.
- Replace Culvert #14 and #15, each with an 8-foot wide by 2-foot high box culvert.
- Replace Culvert #16 with three 18" Dia. culvert pipes.

7.8 66th Avenue from Black Lake Belmore Road to Cavalier Road

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along Fish Pond Creek and its south tributary.

This roadway has two Cross Culverts (#24) and Culvert #25 that crosses underneath Cavalier Street, about 200 feet south of 66th Ave.

- ✓ Culvert #24 – 48" Dia. CMP, south tributary of Fish Pond Creek.
- ✓ Culvert #25 – 48" Dia. CMP, south tributary of Fish Pond Creek.

These culverts are undersized to convey the flows for the 25-year design storm and are recommended to be replaced with the following culverts.

- ✓ Replace Culvert #24 with two 30" Dia. culvert pipes.
- ✓ Replace Culvert #25 with two 30" Dia. culvert pipes.

7.9 54th Avenue/Trosper Road from 49th Avenue to Rural Road SW - Phase 1

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along this tributary to Percival Creek.

This roadway has four Cross Culverts #1, #2, #7, and #9.

- ✓ Culvert #1 – 36" Dia. Concrete, Percival Creek.
- ✓ Culvert #2 – 12" Dia. PVC, unnamed tributary to Percival Creek.
- ✓ Culvert #7 – 18" Dia. Concrete, unnamed tributary to Fish Pond Creek.
- ✓ Culvert #9 – 18" Dia. Concrete, unnamed tributary to Fish Pond Creek.

Cross Culverts #1, #7, and #9 are undersized to convey the flow for the 25-year design storm and are recommended to be replaced with the following culverts.

- ✓ Replace Culvert #1 with two 30" culvert pipes.
- ✓ Replace Culvert #2 with single 24" storm drain.
- ✓ Replace Culvert #7 with an 8 ft wide by 2 ft high concrete box culvert.
- ✓ Replace Culvert #9 with two 18" culvert pipes.

Cross Culvert #4 needs additional field topography to determine and verify the tributary area and flow direction. It appears to be acting as overflow drainage for the drainage course along the north side of 54th Avenue SW that flows east to Percival Creek. This overflow drainage might flow south into two small wetland areas and continue flowing south to Fish Pond Creek.

Cross Culvert #7 is two-thirds full of standing water. Further evaluation in needed to determine the downstream condition and final design sizing of this culvert. Culvert #7 flows into a culvert private culvert that is submerged and full of water.

7.10 54th Avenue/Trosper Road from 49th Avenue to Rural Road SW - Phase 2

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along this tributary to Percival Creek.

This roadway has three Parallel Culverts #3, #5, and #6 and a Cross Culvert #4 that convey flow to the east along the north side of the roadway that conveys flow to Percival Creek. These three parallel culverts cross under a grassed area, Joppa Street SW and Lambskin Street SW.

- Culvert #3 – 30" Dia. Concrete, unnamed tributary to Percival Creek.
- Culvert #4 – 24" Dia. PVC, unnamed tributary to Percival Creek.
- Culvert #5 – 30" Dia. Concrete, unnamed tributary to Percival Creek.
- Culvert #6 – 30" Dia. Concrete, unnamed tributary to Percival Creek.

Parallel Culverts #5 and #6 are adequately sized to convey the 25-year design storm. The other Parallel Culvert #3 and Cross Culvert #4 are undersized to convey the flow for the 25-year design storm and are recommended to be replaced.

- Replace Culvert #3 with two 30" culvert pipes.
- Replace Culvert #4 with two 30" culvert pipes.
- Raise the roadway 0.5' to contain the 100 year headwater.

7.11 Fish Pond Creek

Existing Issues Addressed: Reduce the backwater conditions for these culverts and alleviate flooding along Fish Pond Creek.

Fish Pond Creek crosses under a gravel access road that is located to the east of Belmore Road SW about 2,000 feet. This gravel road provides access to overhead power lines (Bonneville Power) and appears to be used infrequently.

- ✓ Culvert #19 – 18" Dia. CMP, tributary to Fish Pond Creek.
- ✓ Culvert #20 – 24" Dia. CMP, tributary to Fish Pond Creek.

These culverts are undersized to convey the flows for the 25-year design storm and are recommended to be replaced with the following culverts. These culvert replacements have low priority as this gravel road is used for maintenance of the existing overhead power lines.

- ✓ Replace Culverts #19 and #20 with an 8-foot wide by 2-foot high box culvert.

7.12 Additional Recommended Projects

Clean out existing culverts

This will alleviate some flooding by allowing the existing culverts to flow to their full capacity.

Trim and clean out roadside swales (ditches)

This will help prevent culverts from getting clogged with debris from the swales, and alleviate some flooding by providing additional capacity in the swales for stormwater.

Install beaver deceiving devices and flexible leveler

This would alleviate major flooding issues that have been caused by the beaver dams.

7.13 Recommended Project Costs

Table 7-1 summarizes the capital costs for the recommended projects.

Table 7-1 Cost Estimate Summary

Project No.	Project Description	Construction Costs	Envir., Engr. & Admin	Total Capital Cost
7.1	Install Culvert(s) in low spot on Kirsop Road, Raise Roadway	$1,021,200	$561,700	**$1,582,900**
7.2	Replace culvert 26 along 66th Ave.	$227,300	$102,400	**$329,700**
7.3	Replace culverts 21 and 22 along Belmore Road SW	$95,000	$52,400	**$147,400**
7.4A	Replace Culvert 18	$82,300	$33,100	**$115,400**
7.4B	Install swales along the west side of Kirsop Road	$98,100	$39,500	**$137,600**
7.4C	Install Water Quality Feature along the west side of Kirsop Road	$162,500	$89,600	**$252,100**
7.5	Replace Culvert 17	$65,000	$26,100	**$91,100**
7.6	Install new Culvert 7A at the intersection of 54th Ave. & Kirsop Road	$26,000	$11,400	**$37,400**
7.7	Replace culverts 11 through 16 along Black Lake Belmore Road and 49th Ave.	$223,400	$100,700	**$324,100**
7.8	Replace culverts 24 and 25 along 66th Ave. and Cavalier Road	$231,900	$104,400	**$336,300**
7.9	Replace culverts 1, 2, 7 and 9 along 54th Ave/Trosper Road	$292,100	$157,100	**$449,200**
7.10	Replace culverts 3 & 4, fill for culvert 5 along 54th Ave/Trosper Road	$297,600	$148,900	**$446,500**
7.11	Replace culverts 19 and 20	$66,900	$37,000	**$103,900**
			TOTAL	**$4,353,600**

8 REFERENCES

City's Capital Facilities Plan (2009)

December 2009 City of Tumwater Drainage Design and Erosion Control Manual (Tumwater Drainage Manual)

Aerial photography provided by City of Tumwater

USGS soil maps

Jason Kunz, WDFW Fish Biologist, Pers. Comm. June 2010

Mongillo, P.E. and Hallock, M. 1999. Washington state status report for the Olympic mudminnow. Wash. Dept. Fish and Wildlife, Olympia. 36 pp.

APPENDIX A – MEETING NOTES

City of Tumwater
Annexation Area Drainage Study Open House
Meeting Notes

When: Monday, April 12, 2010, 6-8 pm
Where: Black Lake Elementary School
Why: Learn and share information regarding an upcoming study of the issues within the annexed area of southwest Tumwater

The following is based on comments made by property owners.

Trosper Road

- As ditch is excavated the road bed creeps and falls into ditch
- Trosper should be torn up and a more solid base added to roadway to avoid sinkage and alleviate flooding
- Concerns that road will never be fixed by city
- North of Trosper, a development is planned on 19-acres (likely TCP# 12833320600, 12833320500 and 12833320400) for about 275 units; developer wants to run stormwater across property to south (likely TCP#12832440100) and to and through blueberry farm - owners not likely to concur with plans
- Charlie Hendrickson started filling wetlands years ago, recently got in trouble for doing so

Black Lake Blueberry Farm & Ditch

- Steve (his mother owns farm) will give tour of blueberry farm ditch along back of property - call him prior to site visit at 357-6970
- Cory Johnson, "The Trapper Guy", knows all the ditches in the area, used to remove beavers from ditches; also was going to pipe dams rather than remove them - good contact for historical information; Steve from blueberry farm provided phone numbers for Cory Johnson as 704-8337 (cell), and 705-0163
- Whole back area of blueberry farm floods, very wet and keeps getting wetter as time goes on
- A drainage ditch (4-5 ft wide) was dug along back of property, he believes connecting Black Lake and Trosper Lake; ditch gets overgrown and plugged by beaver dams
- Near the train tracks you can see where water comes through
- Years ago, used to dynamite ditch behind farm to keep flowing

Kirsop Road

- Frequent water over roadway to the point of only having ½ lane useable, at least two times per year
- Property south of Kirsop on hill never floods, however, a swampy wetland is located behind the property
- Owner of 10 acres off Kirsop (TCP#79900000401), Mansoor Ghorbani , stated that he'd be willing to sell his property to the City for drainage improvements
    - The ditch along southern boundary has never been maintained
    - Asked if City has an easement for the ditch?
        - City is looking into existence of ditch districts and easements
- Road has been raised up several times and continues to sink

- Water from artesian wells coming off Bush Mtn. has to go somewhere

Black Lake Park

- Ditches fill with water, don't flow to stormwater pond, pond stays dry
- Neighborhood contains City roads, not private
- Ditches need routine maintenance, 6 inch diameter culverts get plugged and need to be cleaned
- Newport Crt SW and Lido Crt SW turn into lakes during heavy rains while the stormwater pond stays dry
- South of neighborhood is swampy
- Perimeter french drain works well

66th

- Southeast of intersection of 66th and railroad tracks are several parcels owned by one family
    - Owner stated that beavers come up from Black Lake and make dams, you can't get rid of them
    - After 66th was put in Kirsop started flooding, even in the summer
    - 66th has a culvert that has sunk and flooded up to the banks
- Sewer pump station located off 66th
- Choke point near Bonneville property

70th Avenue

- Homeowner along 70th does not like proposed drainage along 70th as proposed by city roadway improvement project

Black Hills High School

- Overflow runoff from school parking lot flows north to small pond
- Property owner east of high school has had stormwater basins surveyed in, and county has put in a drain pipe to drain his property across the school site, to property west of the school site

Future Public Involvement

- Question about next step of public involvement
    - Response was to finish drainage study and report, present findings to City Council with a list of capital improvement projects
    - Public is welcome to come and testify about drainage report at Council meeting
    - Other opportunities will include involvement in individual capital improvement projects

APPENDIX B – DETAILED COST ESTIMATES

City of Tumwater - Annnexation Area Drainage Study
Project 7.1
Install Culvert(s) in low spot on Kirsop Road, Raise Roadway

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$57,000	$	57,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.		L.F.		$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.	100	L.F.	$150	$	15,000
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	Concrete Box Culvert		L.F.			
10	Ditch Excavation		C.Y.			
11	Structure Excavation Class B Incl. Haul	1,200	C.Y.	$15	$	18,000
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported Fill	6,700	C.Y.	$25	$	167,500
14	Crushed Surfacing Top Course	450	C.Y.	$40	$	18,000
15	Asphalt Conc. Pavement Cl. B PG22	470	Ton	$120	$	56,400
16	Conc. Sidewalk	670	S.Y.	$40	$	26,800
17	Retaining Wall	4,800	S.F.	$50	$	240,000
18	Project Temporary Traffic Control	1	L.S.	$20,000	$	20,000
19	Stormwater Quality	1	L.S.	$50,000	$	50,000
20	Erosion Control	1	L.S.	$20,000	$	20,000
21	Property Acquisition	15,000	S.F.	$5	$	75,000
22				SubTotal:	$	706,700
23				Construction SubTotal:	$	763,700
24						
25				Tax 8.7%	$	66,500
26				Contingency 25%	$	191,000
27						
28				CONSTRUCTION TOTAL:	$	1,021,200
29						
30				Environmental Permitting 5%	$	51,100
31				Environmental Mitigation 25%	$	255,300
32				Engineering Design & Construction Management 25%	$	255,300
33				ADMINISTRATIVE COSTS:	$	561,700
34						
35				**TOTAL:**	**$**	**1,582,900**

City of Tumwater - Annnexation Area Drainage Study
Project 7.2
Replace culvert 26 along 66th Ave.

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$13,000	$	13,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.		L.F.	$150	$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.	$350	$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.	250	L.F.	$500	$	125,000
9	Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	300	C.Y.	$15	$	4,500
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	300	C.Y.	$25	$	7,500
14	Crushed Surfacing Top Course	30	C.Y.	$40	$	1,200
15	Asphalt Conc. Pavement Cl. B PG22	40	Ton	$120	$	4,800
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$7,000	$	7,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$7,000	$	7,000
21	Property Acquisition					
22				SubTotal:	$	157,000
23			Construction SubTotal:		$	170,000
24						
25			Tax	8.7%	$	14,800
26			Contingency	25%	$	42,500
27						
28			CONSTRUCTION TOTAL:		$	227,300
29						
30			Environmental Permitting	5%	$	11,400
31			Environmental Mitigation	15%	$	34,100
32			Engineering Design & Construction Management	25%	$	56,900
33			ADMINISTRATIVE COSTS:		$	102,400
34						
35				**TOTAL:**	**$**	**329,700**

City of Tumwater - Annnexation Area Drainage Study
Project 7.3
Replace culverts 21 and 22 along Belmore Road SW

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$6,000	$	6,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 15 In. Diam.		L.F.		$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	12 ft Wide Concrete Box Culvert	40	L.F.	$750	$	30,000
10	Ditch Excavation		C.Y.		$	-
11	Structure Excavation Class B Incl. Haul	100	C.Y.	$15	$	1,500
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	100	C.Y.	$25	$	2,500
14	Crushed Surfacing Top Course	30	C.Y.	$40	$	1,200
15	Asphalt Conc. Pavement Cl. B PG22	40	Ton	$120	$	4,800
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$10,000	$	10,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$15,000	$	15,000
21	Property Acquisition					
22				SubTotal:	$	65,000
23				Construction SubTotal:	$	71,000
24						
25				Tax 8.7%	$	6,200
26				Contingency 25%	$	17,800
27						
28				CONSTRUCTION TOTAL:	$	95,000
29						
30				Environmental Permitting 5%	$	4,800
31				Environmental Mitigation 25%	$	23,800
32				Engineering Design & Construction Management 25%	$	23,800
33				ADMINISTRATIVE COSTS:	$	52,400
34						
35				**TOTAL:**	**$**	**147,400**

City of Tumwater - Annnexation Area Drainage Study
Project 7.4A
Replace Culvert 18

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$5,000	$	5,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.		L.F.	$150	$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	8 Ft Wide Concrete Box Culvert	40	L.F.	$600	$	24,000
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	50	C.Y.	$15	$	750
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported Fill	30	C.Y.	$25	$	750
14	Crushed Surfacing Top Course	30	C.Y.	$40	$	1,200
15	Asphalt Conc. Pavement Cl. B PG22	40	Ton	$120	$	4,800
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$10,000	$	10,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$15,000	$	15,000
21	Property Acquisition					
22				SubTotal:	$	56,500
23				Construction SubTotal:	$	61,500
24						
25				Tax 8.7%	$	5,400
26				Contingency 25%	$	15,400
27						
28				CONSTRUCTION TOTAL:	$	82,300
29						
30				Environmental Permitting 5%	$	4,200
31				Environmental Mitigation 10%	$	8,300
32				Engineering Design & Construction Management 25%	$	20,600
33				ADMINISTRATIVE COSTS:	$	33,100
34						
35				**TOTAL:**	**$**	**115,400**

City of Tumwater - Annnexation Area Drainage Study
Project 7.4B
Install swales along the west side of Kirsop Road

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$6,000	$	6,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.	120	L.F.	$125	$	15,000
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.		L.F.		$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	8 Ft Wide Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation	1,250	C.Y.	$30	$	37,500
11	Structure Excavation Class B Incl. Haul		C.Y.	$15	$	-
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported Fill		C.Y.	$25	$	-
14	Crushed Surfacing Top Course	30	C.Y.	$40	$	1,200
15	Asphalt Conc. Pavement Cl. B PG22	30	Ton	$120	$	3,600
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$5,000	$	5,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$5,000	$	5,000
21	Property Acquisition					
22				SubTotal:	$	67,300
23			Construction SubTotal:		$	73,300
24						
25			Tax	8.7%	$	6,400
26			Contingency	25%	$	18,400
27						
28			CONSTRUCTION TOTAL:		$	98,100
29						
30		Environmental Permitting		5%	$	5,000
31		Environmental Mitigation		10%	$	9,900
32		Engineering Design & Construction Management		25%	$	24,600
33			ADMINISTRATIVE COSTS:		$	39,500
34						
35				**TOTAL:**	**$**	**137,600**

City of Tumwater - Annnexation Area Drainage Study
Project 7.4C
Install Water Quality Feature along the west side of Kirsop Road

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$9,000	$	9,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.	100	L.F.	$125	$	12,500
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.		L.F.	$150	$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	8 Ft Wide Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	1,000	C.Y.	$15	$	15,000
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported Fill	200	C.Y.	$25	$	5,000
14	Crushed Surfacing Top Course		C.Y.	$40	$	-
15	Asphalt Conc. Pavement Cl. B PG22		Ton	$120	$	-
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control		L.S.	$10,000	$	-
19	Stormwater Quality	1	L.S.	$25,000	$	25,000
20	Erosion Control	1	L.S.	$15,000	$	15,000
21	Property Acquisition	8,000	S.F.	$5	$	40,000
22				SubTotal:	$	112,500
23			Construction SubTotal:		$	121,500
24						
25			Tax	8.7%	$	10,600
26			Contingency	25%	$	30,400
27						
28			CONSTRUCTION TOTAL:		$	162,500
29						
30		Environmental Permitting		5%	$	8,200
31		Environmental Mitigation		25%	$	40,700
32		Engineering Design & Construction Management		25%	$	40,700
33			ADMINISTRATIVE COSTS:		$	89,600
34						
35				**TOTAL:**	**$**	**252,100**

City of Tumwater - Annnexation Area Drainage Study
Project 7.5
Replace Culvert 17

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$4,000	$	4,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.	80	L.F.	$150	$	12,000
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	8 Ft Wide Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	50	C.Y.	$15	$	750
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported Fill	30	C.Y.	$25	$	750
14	Crushed Surfacing Top Course	30	C.Y.	$40	$	1,200
15	Asphalt Conc. Pavement Cl. B PG22	40	Ton	$120	$	4,800
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$10,000	$	10,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$15,000	$	15,000
21	Property Acquisition					
22				SubTotal:	$	44,500
23				Construction SubTotal:	$	48,500
24						
25				Tax 8.7%	$	4,300
26				Contingency 25%	$	12,200
27						
28				CONSTRUCTION TOTAL:	$	65,000
29						
30				Environmental Permitting 5%	$	3,300
31				Environmental Mitigation 10%	$	6,500
32				Engineering Design & Construction Management 25%	$	16,300
33				ADMINISTRATIVE COSTS:	$	26,100
34						
35				**TOTAL:**	**$**	**91,100**

City of Tumwater - Annnexation Area Drainage Study
Project 7.6
Install new Culvert 7A at the intersection of 54th Ave. & Kirsop Road

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$2,000	$	2,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.	40	L.F.	$150	$	6,000
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	8 Ft Wide Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	30	C.Y.	$15	$	450
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported Fill	30	C.Y.	$25	$	750
14	Crushed Surfacing Top Course	20	C.Y.	$40	$	800
15	Asphalt Conc. Pavement Cl. B PG22	20	Ton	$120	$	2,400
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$5,000	$	5,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$2,000	$	2,000
21	Property Acquisition					
22				SubTotal:	$	17,400
23				Construction SubTotal:	$	19,400
24						
25				Tax 8.5%	$	1,700
26				Contingency 25%	$	4,900
27						
28				CONSTRUCTION TOTAL:	$	26,000
29						
30				Environmental Permitting 8.7%	$	2,300
31				Environmental Mitigation 10%	$	2,600
32				Engineering Design & Construction Management 25%	$	6,500
33				ADMINISTRATIVE COSTS:	$	11,400
34						
35				**TOTAL:**	**$**	**37,400**

City of Tumwater - Annnexation Area Drainage Study
Project 7.7
Replace culverts 11 through 16 along Black Lake Belmore Road and 49th Ave.

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$13,000	$	13,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.	200	L.F.	$150	$	30,000
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	8 Ft Wide Concrete Box Culvert	80	L.F.	$600	$	48,000
10	Ditch Excavation	0	C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	300	C.Y.	$15	$	4,500
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	300	C.Y.	$25	$	7,500
14	Crushed Surfacing Top Course	120	C.Y.	$40	$	4,800
15	Asphalt Conc. Pavement Cl. B PG22	160	Ton	$120	$	19,200
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$20,000	$	20,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$20,000	$	20,000
21	Property Acquisition					
22				SubTotal:	$	154,000
23			Construction SubTotal:		$	167,000
24						
25			Tax	8.7%	$	14,600
26			Contingency	25%	$	41,800
27						
28			CONSTRUCTION TOTAL:		$	223,400
29						
30		Environmental Permitting		5%	$	11,200
31		Environmental Mitigation		15%	$	33,600
32		Engineering Design & Construction Management		25%	$	55,900
33			ADMINISTRATIVE COSTS:		$	100,700
34						
35				**TOTAL:**	**$**	**324,100**

City of Tumwater - Annnexation Area Drainage Study
Project 7.8
Replace culverts 24 and 25 along 66th Ave. and Cavalier Road

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$13,000	$	13,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.		L.F.	$150	$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.	280	L.F.	$350	$	98,000
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.	$500	$	-
9	Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	600	C.Y.	$15	$	9,000
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	600	C.Y.	$25	$	15,000
14	Crushed Surfacing Top Course	50	C.Y.	$40	$	2,000
15	Asphalt Conc. Pavement Cl. B PG22	70	Ton	$120	$	8,400
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$14,000	$	14,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$14,000	$	14,000
21	Property Acquisition					
22				SubTotal:	$	160,400
23				Construction SubTotal:	$	173,400
24						
25				Tax 8.7%	$	15,100
26				Contingency 25%	$	43,400
27						
28				CONSTRUCTION TOTAL:	$	231,900
29						
30				Environmental Permitting 5%	$	11,600
31				Environmental Mitigation 15%	$	34,800
32				Engineering Design & Construction Management 25%	$	58,000
33				ADMINISTRATIVE COSTS:	$	104,400
34						
35				**TOTAL:**	**$**	**336,300**

City of Tumwater - Annnexation Area Drainage Study
Project 7.9
Replace culverts 1, 2, 7 and 9 along 54th Ave/Trosper Road

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$17,000	$	17,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.	200	L.F.	$150	$	30,000
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.	40	L.F.	$200	$	8,000
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.	140	L.F.	$350	$	49,000
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	Concrete Box Culvert	40	L.F.	$600	$	24,000
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	600	C.Y.	$15	$	9,000
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	600	C.Y.	$25	$	15,000
14	Crushed Surfacing Top Course	100	C.Y.	$40	$	4,000
15	Asphalt Conc. Pavement Cl. B PG22	190	Ton	$120	$	22,800
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$20,000	$	20,000
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$20,000	$	20,000
21	Property Acquisition					
22				SubTotal:	$	201,800
23				Construction SubTotal:	$	218,800
24						
25				Tax 8.5%	$	18,600
26				Contingency 25%	$	54,700
27						
28				CONSTRUCTION TOTAL:	$	292,100
29						
30				Environmental Permitting 8.7%	$	25,500
31				Environmental Mitigation 20%	$	58,500
32				Engineering Design & Construction Management 25%	$	73,100
33				ADMINISTRATIVE COSTS:	$	157,100
34						
35				**TOTAL:**	**$**	**449,200**

City of Tumwater - Annnexation Area Drainage Study
Project 7.10
Replace culverts 3 & 4, fill for culvert 5 along 54th Ave/Trosper Road

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$18,000	$	18,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 18 In. Diam.	40	L.F.	$150	$	6,000
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.	$200	$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.	130	L.F.	$350	$	45,500
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Type 2 Catch Basin - 54 In. Diam.	1	EA	$5,000	$	5,000
8	54" Dia Manhole	0	EA	$5,000	$	-
9	Concrete Box Culvert		L.F.	$600	$	-
10	Ditch Excavation		C.Y.	$30	$	-
11	Structure Excavation Class B Incl. Haul	500	C.Y.	$15	$	7,500
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	500	C.Y.	$25	$	12,500
14	Crushed Surfacing Top Course	80	C.Y.	$40	$	3,200
15	Asphalt Conc. Pavement Cl. B PG22	190	Ton	$120	$	22,800
16	Conc. Sidewalk		S.Y.	$40	$	-
17	Retaining Wall		S.F.	$50	$	-
18	Project Temporary Traffic Control	1	L.S.	$50,000	$	50,000
19	Stormwater Quality	1	L.S.	$50,000	$	50,000
20	Erosion Control	1	L.S.	$20,000	$	20,000
21	Property Acquisition					
22				SubTotal:	$	216,500
23				Construction SubTotal:	$	222,500
24						
25				Tax 8.7%	$	19,400
26				Contingency 25%	$	55,700
27						
28				CONSTRUCTION TOTAL:	$	297,600
29						
30				Environmental Permitting 5%	$	14,900
31				Environmental Mitigation 20%	$	59,600
32				Engineering Design & Construction Management 25%	$	74,400
33				ADMINISTRATIVE COSTS:	$	148,900
34						
35				**TOTAL:**	**$**	**446,500**

City of Tumwater - Annnexation Area Drainage Study
Project 7.11
Replace culverts 19 and 20

	Bid Item	Quantity	Unit	Unit Price		Total
1	Mobilization	1	L.S.	$4,000	$	4,000
2	Cl. 4 Reinf. Conc. Culv. Pipe 12 In. Diam.		L.F.		$	-
3	Cl. 4 Reinf. Conc. Culv. Pipe 15 In. Diam.		L.F.		$	-
4	Cl. 4 Reinf. Conc. Culv. Pipe 24 In. Diam.		L.F.		$	-
5	Cl. 3 Reinf. Conc. Culv. Pipe 30 In. Diam.		L.F.		$	-
6	Cl. 3 Reinf. Conc. Culv. Pipe 36 In. Diam.		L.F.		$	-
7	Cl. 3 Reinf. Conc. Culv. Pipe 42 In. Diam.		L.F.		$	-
8	Cl. 3 Reinf. Conc. Culv. Pipe 48 In. Diam.		L.F.		$	-
9	12 Ft Wide Concrete Box Culvert	40	L.F.	$750	$	30,000
10	Ditch Excavation		C.Y.		$	-
11	Structure Excavation Class B Incl. Haul	100	C.Y.	$15	$	1,500
12	Shoring or Extra Excavation Class B		S.F.		$	-
13	Imported fill	100	C.Y.	$25	$	2,500
14	Crushed Surfacing Top Course	50	C.Y.	$40	$	2,000
15	Asphalt Conc. Pavement Cl. B PG22		Ton		$	-
16	Conc. Sidewalk		S.Y.		$	-
17	Retaining Wall		S.F.		$	-
18	Project Temporary Traffic Control		L.S.		$	-
19	Stormwater Quality		L.S.		$	-
20	Erosion Control	1	L.S.	$10,000	$	10,000
21	Property Acquisition					
22				SubTotal:	$	46,000
23				Construction SubTotal:	$	50,000
24						
25				Tax 8.7%	$	4,400
26				Contingency 25%	$	12,500
27						
28				CONSTRUCTION TOTAL:	$	66,900
29						
30				Environmental Permitting 5%	$	3,400
31				Environmental Mitigation 25%	$	16,800
32				Engineering Design & Construction Management 25%	$	16,800
33				ADMINISTRATIVE COSTS:	$	37,000
34						
35				**TOTAL:**	**$**	**103,900**

APPENDIX C – DRAINAGE BASIN AREA CALCULATIONS

Basin A1 - Current 91.03 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	161,655	3.71
Woods/Good	B	55	0	0.00
Woods/Good	C	70	315,325	7.24
Woods/Good	D	77	45,634	1.05
Open Space/Fair	A	77	198,660	4.56
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	1,335,395	30.66
Open Space/Fair	D	92	129,484	2.97
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	786,656	18.06
Open Space/Good	D	90	138,088	3.17
Open Water Bodies	N/A	100	854,214	19.61
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	3,965,111	91.03

Basin A1 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	76,180	1.75
Woods/Good	B	55	0	0.00
Woods/Good	C	70	98,834	2.27
Woods/Good	D	77	39,373	0.90
Open Space/Fair	A	77	29,506	0.68
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	161,872	3.72
Open Space/Fair	D	92	47,293	1.09
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	124,770	2.86
Open Space/Good	D	90	65,755	1.51
Open Water Bodies	N/A	100	854,214	19.61
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,497,897	34.39

Basin A1 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	112,004	2.57
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	902,834	20.73
Open Space/Good	D	90	70,748	1.62
Pavement & Driveways	N/A	98	1,381,655	31.72
		Total:	2,467,241	56.64

Total Area Accounted For: 91.03 Acres

Total Percentage Accounted For: 100.00%

Basin A2 - Current 42.66 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	454,303	10.43
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	377,609	8.67
Woods/Fair	D	79	7,081	0.16
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	68,176	1.57
Woods/Good	D	77	17,803	0.41
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	425,292	9.76
Open Space/Fair	D	92	53,623	1.23
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	454,568	10.44
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,858,455	42.66

Basin A2 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	26168	0.60
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	158,178	3.63
Woods/Fair	D	79	7,081	0.16
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	67,201	1.54
Woods/Good	D	77	17,803	0.41
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	118,997	2.73
Open Space/Fair	D	92	15,370	0.35
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	454,568	10.44
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	865,366	19.87

Basin A2 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	420,126	9.64
Open Space/Good	D	90	16,832	0.39
Pavement & Driveways	N/A	98	556,128	12.77
		Total:	993,085	22.80

Total Area Accounted For: 42.66 Acres

Total Percentage Accounted For: 100.01%

Basin A3 - Current 22.93 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	2,984	0.07
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	232,043	5.33
Woods/Fair	D	79	114,889	2.63
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	79,185	1.82
Open Space/Fair	D	92	341,364	7.84
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	530	0.01
Open Space/Good	D	90	7,085	0.16
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	144,463	3.32
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	5,122	0.12
Dirt	D	89	71,343	1.64
100% Infiltrated	N/A	1	0	0.00
		Total:	998,808	22.93

Basin A3 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	20,771	0.48
Woods/Fair	D	79	26,133	0.60
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	16,845	0.39
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	6,207	0.14
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	23,391	0.54
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	93,347	2.14

Basin A3 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	144,153	3.31
Open Space/Good	D	90	254,333	5.84
Pavement & Driveways	N/A	98	507,165	11.64
		Total:	905,651	20.79

Total Area Accounted For: 22.93 Acres

Total Percentage Accounted For: 100.00%

Basin A4 - Current 8.95 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	78,370	1.80
Open Space/Good	D	90	31,758	0.73
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	279,861	6.42
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	389,989	8.95

Basin A4 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	78,370	1.80
Open Space/Good	D	90	31,530	0.72
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	279,861	6.42
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	389,761	8.95

Basin A4 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	100	0.00
Pavement & Driveways	N/A	98	128	0.00
		Total:	228	0.01

Total Area Accounted For: 8.95 Acres

Total Percentage Accounted For: 100.00%

Basin B1 - Current 66.09 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	723,618	16.61
Pasture/Good	D	80	699,765	16.06
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	252,789	5.80
Woods/Fair	D	79	24,470	0.56
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	147,764	3.39
Open Space/Fair	D	92	9,722	0.22
Open Space/Good	A	68	49,525	1.14
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	290,188	6.66
Open Space/Good	D	90	419,720	9.64
Open Water Bodies	N/A	100	261,279	6.00
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	2,878,840	66.09

Basin B1 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	108775	2.50
Pasture/Good	D	80	570641	13.10
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	21,755	0.50
Woods/Fair	D	79	85	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	1,696	0.04
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	24,394	0.56
Open Space/Good	D	90	176,847	4.06
Open Water Bodies	N/A	100	261,279	6.00
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,165,473	26.76

Basin B1 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	21,791	0.50
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	554,151	12.72
Open Space/Good	D	90	177,939	4.08
Pavement & Driveways	N/A	98	959,485	22.03
		Total:	1,713,366	39.33

Total Area Accounted For: 66.09 Acres

Total Percentage Accounted For: 100.00%

Basin C1 - Current 42.97 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	379,116	8.70
Woods/Good	C	70	0	0.00
Woods/Good	D	77	70,208	1.61
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	190,698	4.38
Open Space/Fair	C	90	356,369	8.18
Open Space/Fair	D	92	4,078	0.09
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	16,263	0.37
Open Space/Good	C	86	241,582	5.55
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	613,237	14.08
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,871,651	42.97

Basin C1 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	129,775	2.98
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	1,360	0.03
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	535,631	12.30
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total	666,766	15.31

Basin C1 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	163,780	3.76
Open Space/Good	C	86	36,018	0.83
Open Space/Good	D	90	32,686	0.75
Pavement & Driveways	N/A	98	972,601	22.33
		Total:	1,205,086	27.66

Total Area Accounted For: 42.97 Acres

Total Percentage Accounted For: 100.00%

Basin C2 - Current 66.06 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	1,277,038	29.32
Woods/Good	C	70	209,853	4.82
Woods/Good	D	77	497,024	11.41
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	226,117	5.19
Open Space/Fair	C	90	19,845	0.46
Open Space/Fair	D	92	69,960	1.61
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	27,785	0.64
Open Space/Good	C	86	433,197	9.94
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	3,129	0.07
Pavement & Driveways	N/A	98	113,570	2.61
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	2,877,518	66.06

Basin C2 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	14,143	0.32
Woods/Good	C	70	0	0.00
Woods/Good	D	77	1,704	0.04
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	4,170	0.10
Open Space/Good	C	86	13,190	0.30
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	3,129	0.07
Pavement & Driveways	N/A	98	20,981	0.48
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	57,317	1.32

Basin C2 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	674,816	15.49
Open Space/Good	C	86	317,350	7.29
Open Space/Good	D	90	248,723	5.71
Pavement & Driveways	N/A	98	1,579,314	36.26
		Total:	2,820,203	64.74

Total Area Accounted For: 66.06 Acres

Total Percentage Accounted For: 100.00%

Basin C3 - Current 81.23 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	952,864	21.87
Woods/Good	B	55	0	0.00
Woods/Good	C	70	588,872	13.52
Woods/Good	D	77	113,814	2.61
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	89,242	2.05
Open Space/Fair	D	92	144,376	3.31
Open Space/Good	A	68	820,402	18.83
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	143,409	3.29
Open Space/Good	D	90	179	0.00
Open Water Bodies	N/A	100	5,732	0.13
Pavement & Driveways	N/A	98	679,621	15.60
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	3,538,510	81.23

Basin C3 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	758,693	17.42
Woods/Good	B	55	0	0.00
Woods/Good	C	70	338,170	7.76
Woods/Good	D	77	48,055	1.10
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	1,197	0.03
Open Space/Good	A	68	801,896	18.41
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	132,400	3.04
Open Space/Good	D	90	179	0.00
Open Water Bodies	N/A	100	5,732	0.13
Pavement & Driveways	N/A	98	700,420	16.08
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	2,786,742	63.97

Basin C3 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	83,772	1.92
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	155,072	3.56
Open Space/Good	D	90	91,933	2.11
Pavement & Driveways	N/A	98	420,990	9.66
		Total:	751,767	17.26

Total Area Accounted For: 81.23 Acres

Total Percentage Accounted For: 100.00%

Basin C4 - Current 66.13 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	15,586	0.36
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	5,978	0.14
Woods/Fair	D	79	403,879	9.27
Woods/Good	A	30	443,300	10.18
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	348,093	7.99
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	686,215	15.75
Open Space/Good	B	80	155,027	3.56
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	5,517	0.13
Open Water Bodies	N/A	100	167,440	3.84
Pavement & Driveways	N/A	98	649,762	14.92
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	2,880,777	66.13

Basin C4 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	14,354	0.33
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	486	0.01
Woods/Fair	D	79	117,876	2.71
Woods/Good	A	30	180,417	4.14
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	260,871	5.99
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	106,170	2.44
Open Space/Good	B	80	3,308	0.08
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	167,440	3.84
Pavement & Driveways	N/A	98	642,002	14.74
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,492,924	34.27

Basin C4 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	327,579	7.52
Open Space/Good	B	80	66,757	1.53
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	56,332	1.29
Pavement & Driveways	N/A	98	937,183	21.51
		Total:	1,387,851	31.86

Total Area Accounted For: 66.13 Acres

Total Percentage Accounted For: 100.00%

Basin C5 - Current 200.50 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	327,034	7.51
Woods/Good	B	55	37,230	0.85
Woods/Good	C	70	3,981	0.09
Woods/Good	D	77	1,121,175	25.74
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	5,106	0.12
Open Space/Fair	D	92	2,544	0.06
Open Space/Good	A	68	897,256	20.60
Open Space/Good	B	80	1,997,419	45.85
Open Space/Good	C	86	386,843	8.88
Open Space/Good	D	90	1,446,259	33.20
Open Water Bodies	N/A	100	1,634,487	37.52
Pavement & Driveways	N/A	98	874,286	20.07
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total	8,733,620	200.50

Basin C5 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	213,434	4.90
Woods/Good	B	55	37,230	0.85
Woods/Good	C	70	3,981	0.09
Woods/Good	D	77	518,818	11.91
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	2,223	0.05
Open Space/Good	A	68	48,434	1.13
Open Space/Good	B	80	84,680	1.94
Open Space/Good	C	86	231,524	5.32
Open Space/Good	D	90	574,344	13.19
Open Water Bodies	N/A	100	1,634,487	37.52
Pavement & Driveways	N/A	98	958,016	21.99
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	4,308,171	98.90

Basin C5 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	384,730	8.83
Open Space/Good	B	80	632,450	14.52
Open Space/Good	C	86	1,953	0.04
Open Space/Good	D	90	85,592	1.96
Pavement & Driveways	N/A	98	3,320,533	76.23
		Total:	4,425,258	101.59

Total Area Accounted For: 200.49 Acres

Total Percentage Accounted For: 100.00%

Basin C6 - Current 22.74 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	459,096	10.54
Woods/Good	D	77	137,699	3.15
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	206,561	4.74
Open Space/Good	D	90	86,223	1.98
Open Water Bodies	N/A	100	100,964	2.32
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	990,543	22.74

Basin C6 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	45,672	1.05
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	565,026	12.97
Open Space/Good	D	90	160,972	3.70
Open Water Bodies	N/A	100	100,964	2.32
Pavement & Driveways	N/A	98	116,987	2.69
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	989,621	22.72

Basin C6 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Pavement & Driveways	N/A	98	0	0.00
		Total:	0	0.00

Total Area Accounted For: 22.72 Acres

Total Percentage Accounted For: 99.91%

Basin C7 - Current 40.94 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	495,879	11.38
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	645,342	14.84
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	60,653	1.39
Open Water Bodies	N/A	100	20,445	0.47
Pavement & Driveways	N/A	98	559,833	12.85
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,783,152	40.94

Basin C7 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	433,066	9.94
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	402,060	9.23
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	52,050	1.19
Open Water Bodies	N/A	100	20,445	0.47
Pavement & Driveways	N/A	98	556,450	12.77
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	1,464,071	33.61

Basin C7 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	136,805	3.14
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	3,785	0.09
Pavement & Driveways	N/A	98	178,933	4.11
		Total:	319,523	7.34

Total Area Accounted For: 40.95 Acres

Total Percentage Accounted For: 100.02%

Basin C8 - Current 496.07 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	796,305	18.28
Pasture/Good	B	61	494,877	11.36
Pasture/Good	C	74	2,295,303	52.69
Pasture/Good	D	80	288,216	6.62
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	420,386	9.65
Woods/Good	B	55	397,401	9.12
Woods/Good	C	70	1,320,354	30.31
Woods/Good	D	77	593,147	13.62
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	1,052,518	24.16
Open Space/Good	B	80	5,845,556	134.20
Open Space/Good	C	86	313,406	7.19
Open Space/Good	D	90	64,055	1.47
Open Water Bodies	N/A	100	2,578,853	59.20
Pavement & Driveways	N/A	98	57,611	1.32
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	5,090,753	116.87
		Total:	21,508,743	496.07

Basin C8 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	2,078	0.05
Pasture/Good	B	61	5953	0.14
Pasture/Good	C	74	4226	0.10
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	101,832	2.34
Woods/Good	B	55	4,151	0.10
Woods/Good	C	70	58,465	1.34
Woods/Good	D	77	435,433	10.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	649,719	14.92
Open Space/Good	B	80	1,024,667	23.52
Open Space/Good	C	86	3,729	0.09
Open Space/Good	D	90	62,529	1.44
Open Water Bodies	N/A	100	2,577,822	59.18
Pavement & Driveways	N/A	98	2,167	0.05
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	4,999,043	114.76
		Total:	9,931,814	228.00

Basin C8 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	636,746	14.62
Open Space/Good	B	80	1,600,576	36.74
Open Space/Good	C	86	1,523,352	34.97
Open Space/Good	D	90	173,312	3.98
Pavement & Driveways	N/A	98	7,742,504	177.74
		Total:	11,676,489	268.06

Total Area Accounted For: 496.06 Acres

Total Percentage Accounted For: 100.00%

Basin C9 - Current 229.33 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	780,167	17.91
Woods/Good	B	55	178,413	4.05
Woods/Good	C	70	550,825	12.64
Woods/Good	D	77	656,309	15.30
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	775,727	17.81
Open Space/Good	B	80	1,930,750	44.32
Open Space/Good	C	86	733,551	16.84
Open Space/Good	D	90	118,357	2.72
Open Water Bodies	N/A	100	1,920,463	44.09
Pavement & Driveways	N/A	98	2,091,815	48.02
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	245,459	5.63
		Total:	9,989,637	229.33

Basin C9 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	143,066	3.28
Woods/Good	B	55	64,056	1.47
Woods/Good	C	70	167,356	3.84
Woods/Good	D	77	556,254	12.77
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	292,145	6.71
Open Space/Good	B	80	1,078,568	24.76
Open Space/Good	C	86	546,499	12.55
Open Space/Good	D	90	115,841	2.66
Open Water Bodies	N/A	100	1,920,463	44.09
Pavement & Driveways	N/A	98	2,071,933	47.57
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	245,459	5.63
		Total:	7,201,840	165.33

Basin C9 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	617,578	14.18
Open Space/Good	B	80	368,724	8.46
Open Space/Good	C	86	281,665	6.47
Open Space/Good	D	90	75,356	1.73
Pavement & Driveways	N/A	98	1,441,585	33.09
		Total:	2,784,909	63.93

Total Area Accounted For: 229.26 Acres

Total Percentage Accounted For: 99.97%

Basin C10 - Current 115.62 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	229	0.01
Woods/Good	C	70	223,006	5.12
Woods/Good	D	77	287,436	6.60
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	37,793	0.87
Open Space/Fair	C	90	78,711	1.81
Open Space/Fair	D	92	163,939	3.76
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	5,370	0.12
Open Space/Good	C	86	931,168	21.38
Open Space/Good	D	90	166,212	3.82
Open Water Bodies	N/A	100	3,142,277	72.14
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	5,035,141	115.61

Basin C10 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	229	0.01
Woods/Good	C	70	74,090	1.70
Woods/Good	D	77	241,987	5.56
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	23,208	0.53
Open Space/Fair	C	90	3,369	0.08
Open Space/Fair	D	92	124,309	2.85
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	10,900	0.25
Open Space/Good	C	86	431,815	9.91
Open Space/Good	D	90	221,765	5.09
Open Water Bodies	N/A	100	3,142,277	72.14
Pavement & Driveways	N/A	98	96,012	2.20
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	4,369,872	100.32

Basin C10 - Future Detention Areas

**Areas to which detension will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	2,363	0.05
Open Space/Good	C	86	504,845	11.59
Open Space/Good	D	90	2,491	0.06
Pavement & Driveways	N/A	98	154,447	3.55
		Total:	664,185	15.25

Total Area Accounted For: 115.57 Acres

Total Percentage Accounted For: 99.95%

Basin D1 - Current 403.72 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	2,717,076	62.38
Woods/Good	B	55	1,504,441	34.54
Woods/Good	C	70	2,444,520	56.12
Woods/Good	D	77	829,920	19.05
Open Space/Fair	A	77	2,284,850	52.45
Open Space/Fair	B	85	1,354,911	31.10
Open Space/Fair	C	90	332,689	7.64
Open Space/Fair	D	92	1,719,510	39.47
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	998,907	22.93
Pavement & Driveways	N/A	98	2,544,437	58.41
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	853,944	19.60
		Total:	17,585,203	403.70

Basin D1 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	270,555	6.21
Woods/Good	B	55	246,499	5.66
Woods/Good	C	70	300,487	6.90
Woods/Good	D	77	366,728	8.42
Open Space/Fair	A	77	68,853	1.58
Open Space/Fair	B	85	97,314	2.23
Open Space/Fair	C	90	34,237	0.79
Open Space/Fair	D	92	37,996	0.87
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	998,907	22.93
Pavement & Driveways	N/A	98	1,333,331	30.61
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	853,944	19.60
		Total:	4,606,951	105.81

Basin D1 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	2,948,510	67.69
Open Space/Good	B	80	1,637,134	37.58
Open Space/Good	C	86	1,121,308	25.74
Open Space/Good	D	90	977,295	22.44
Pavement & Driveways	N/A	98	5,285,388	144.29
		Total:	12,969,635	297.74

Total Area Accounted For: 403.55 Acres

Total Percentage Accounted For: 99.96%

Basin D2 - Current 271.37 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	1,743,887	40.03
Woods/Good	B	55	639,978	14.69
Woods/Good	C	70	1,028,867	23.62
Woods/Good	D	77	166,961	3.83
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	1,161,536	26.67
Open Space/Good	B	80	3,051,931	70.06
Open Space/Good	C	86	332,471	7.63
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	1,545,683	35.48
Pavement & Driveways	N/A	98	2,077,146	47.68
Dirt	A	72	71,132	1.63
Dirt	B	82	0	0.00
Dirt	C	87	1,386	0.03
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	11,820,978	271.37

Basin D2 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	721,632	16.57
Woods/Good	B	55	6,203	0.14
Woods/Good	C	70	817,224	18.76
Woods/Good	D	77	43,831	1.01
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	747,249	17.15
Open Space/Good	B	80	879,391	20.19
Open Space/Good	C	86	443,316	10.18
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	1,545,683	35.48
Pavement & Driveways	N/A	98	1,750,830	40.19
Dirt	A	72	8,398	0.19
Dirt	B	82	0	0.00
Dirt	C	87	1,386	0.03
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	5,965,143	159.90

Basin D2 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	914,322	20.99
Open Space/Good	B	80	1,627,872	37.37
Open Space/Good	C	86	42,798	0.98
Open Space/Good	D	90	54,075	1.24
Pavement & Driveways	N/A	98	2,212,446	50.79
		Total:	4,851,517	111.36

Total Area Accounted For: 271.27 Acres

Total Percentage Accounted For: 99.96%

Basin D3 - Current 17.23 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	211,867	4.86
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	86,457	1.98
Open Space/Good	D	90	1,956	0.04
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	450,420	10.34
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	750,700	17.23

Basin D3 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	211,867	4.86
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	89,677	2.06
Open Space/Good	D	90	2,228	0.05
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	446,911	10.26
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	750,683	17.23

Basin D3 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Pavement & Driveways	N/A	98	0	0.00
		Total:	0	0.00

Total Area Accounted For: 17.23 Acres

Total Percentage Accounted For: 100.00%

Basin D4 - Current 12.85 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	112,836	2.59
Woods/Good	D	77	415,765	9.55
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	31,269	0.72
Pavement & Driveways	N/A	98	0	0.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	559,892	12.85

Basin D4 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	121,121	2.78
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	95,912	2.20
Open Space/Good	D	90	246,711	5.66
Open Water Bodies	N/A	100	31,269	0.72
Pavement & Driveways	N/A	98	64,756	1.49
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	559,769	12.85

Basin D4 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Pavement & Driveways	N/A	98	0	0.00
		Total:	0	0.00

Total Area Accounted For: 12.85 Acres

Total Percentage Accounted For: 99.98%

Basin D5 - Current 19.24 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	838,082	19.24
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	838,082	19.24

Basin D5 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	0	0.00
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	538,208	12.36
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	538,208	12.36

Basin D5 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	58,231	1.34
Open Space/Good	B	80	49,722	1.14
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Pavement & Driveways	N/A	98	191,916	4.41
		Total:	299,869	6.88

Total Area Accounted For: 19.24 Acres

Total Percentage Accounted For: 100.00%

Basin D6 - Current 15.25 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	183,141	4.20
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	86	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	481,280	11.05
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	664,421	15.25

Basin D6 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	28,858	0.66
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	86	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	0	0.00
Pavement & Driveways	N/A	98	248,933	5.71
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	277,791	6.38

Basin D6 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	5,793	0.13
Open Space/Good	B	80	133,392	3.06
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Pavement & Driveways	N/A	98	247,439	5.68
		Total:	386,623	8.88

Total Area Accounted For: 15.25 Acres

Total Percentage Accounted For: 100.00%

Basin D7 - Current 82.09 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	2,617,477	60.09
Woods/Good	C	70	35,587	0.82
Woods/Good	D	77	244,350	5.61
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	86	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	58,883	1.35
Pavement & Driveways	N/A	98	619,484	14.22
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	3,575,781	82.09

Basin D7 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	0	0.00
Woods/Good	B	55	80,815	1.86
Woods/Good	C	70	0	0.00
Woods/Good	D	77	85,470	1.96
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	86	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	4,771	0.11
Open Space/Good	D	90	5,571	0.13
Open Water Bodies	N/A	100	58,883	1.35
Pavement & Driveways	N/A	98	103,574	2.38
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	339,084	7.78

Basin D7 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	0	0.00
Open Space/Good	B	80	1,211,595	27.82
Open Space/Good	C	86	25,080	0.58
Open Space/Good	D	90	113,704	2.61
Pavement & Driveways	N/A	98	1,885,216	43.28
		Total:	3,235,595	74.28

Total Area Accounted For: 82.07 Acres

Total Percentage Accounted For: 99.97%

Basin E1 - Current 60.90 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	22,135	0.51
Woods/Good	B	55	124,082	2.85
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	168,035	3.86
Open Space/Fair	B	85	1,018,274	23.38
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	196,319	4.51
Open Space/Good	B	80	111,949	2.57
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	384,457	8.83
Pavement & Driveways	N/A	98	462,402	10.62
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	165,133	3.79
		Total:	2,652,786	60.90

Basin E1 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	0	0.00
Pasture/Good	B	61	0	0.00
Pasture/Good	C	74	0	0.00
Pasture/Good	D	80	0	0.00
Woods/Poor	A	45	0	0.00
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	0	0.00
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	7,951	0.18
Woods/Good	B	55	2,824	0.06
Woods/Good	C	70	0	0.00
Woods/Good	D	77	0	0.00
Open Space/Fair	A	77	153,220	3.52
Open Space/Fair	B	85	637,270	14.63
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	195,295	4.48
Open Space/Good	B	80	94,135	2.16
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	384,457	8.83
Pavement & Driveways	N/A	98	434,145	9.97
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	5,958	0.16
		Total:	1,916,255	43.99

Basin E1 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	12,175	0.28
Open Space/Good	B	80	208,447	4.79
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Pavement & Driveways	N/A	98	513,108	11.78
		Total:	733,730	16.84

Total Area Accounted For: 60.84 Acres

Total Percentage Accounted For: 99.89%

Basin F1 - Current 685.89 Acre

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	647,648	14.87
Pasture/Good	B	61	2,907,602	66.75
Pasture/Good	C	74	2,976,951	68.34
Pasture/Good	D	80	90,878	2.09
Woods/Poor	A	45	935,450	21.47
Woods/Poor	B	66	2,714,536	62.32
Woods/Poor	C	77	4,302,111	98.76
Woods/Poor	D	83	2,004,310	46.01
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	438,111	10.06
Woods/Good	B	55	116,970	2.69
Woods/Good	C	70	2,621,026	60.17
Woods/Good	D	77	3,991,889	91.64
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	215,628	4.97
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	156,442	3.59
Open Space/Good	D	90	279,661	6.42
Open Water Bodies	N/A	100	5,192,456	119.20
Pavement & Driveways	N/A	98	43,767	1.00
Dirt	A	72	0	0.00
Dirt	B	82	240,887	5.53
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	29,877,323	685.89

Basin F1 - Future Non-Detention Areas

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Pasture/Good	A	39	157	0.00
Pasture/Good	B	61	17249	0.40
Pasture/Good	C	74	120455	2.77
Pasture/Good	D	80	47107	1.08
Woods/Poor	A	45	279	0.01
Woods/Poor	B	66	0	0.00
Woods/Poor	C	77	0	0.00
Woods/Poor	D	83	59,200	1.36
Woods/Fair	A	36	0	0.00
Woods/Fair	B	60	0	0.00
Woods/Fair	C	73	0	0.00
Woods/Fair	D	79	0	0.00
Woods/Good	A	30	59,045	1.36
Woods/Good	B	55	0	0.00
Woods/Good	C	70	134,172	3.08
Woods/Good	D	77	1,161,234	26.66
Open Space/Fair	A	77	0	0.00
Open Space/Fair	B	85	0	0.00
Open Space/Fair	C	90	0	0.00
Open Space/Fair	D	92	0	0.00
Open Space/Good	A	68	29,052	0.67
Open Space/Good	B	80	0	0.00
Open Space/Good	C	86	0	0.00
Open Space/Good	D	90	0	0.00
Open Water Bodies	N/A	100	5,153,547	118.31
Pavement & Driveways	N/A	98	43,579	1.00
Dirt	A	72	0	0.00
Dirt	B	82	0	0.00
Dirt	C	87	0	0.00
Dirt	D	89	0	0.00
100% Infiltrated	N/A	1	0	0.00
		Total:	6,825,076	156.68

Basin F1 - Future Detention Areas

**Areas to which detention will be applied

Land Use	Soil Group	Cn	Area (S.F.)	Area (Acres)
Open Space/Good	A	68	1,056,947	24.26
Open Space/Good	B	80	2,303,071	52.87
Open Space/Good	C	86	4,955,313	113.76
Open Space/Good	D	90	3,785,039	86.89
Pavement & Driveways	N/A	98	10,955,592	251.51
		Total:	23,055,962	529.29

Total Area Accounted For: 585.97 Acres

Total Percentage Accounted For: 100.01%