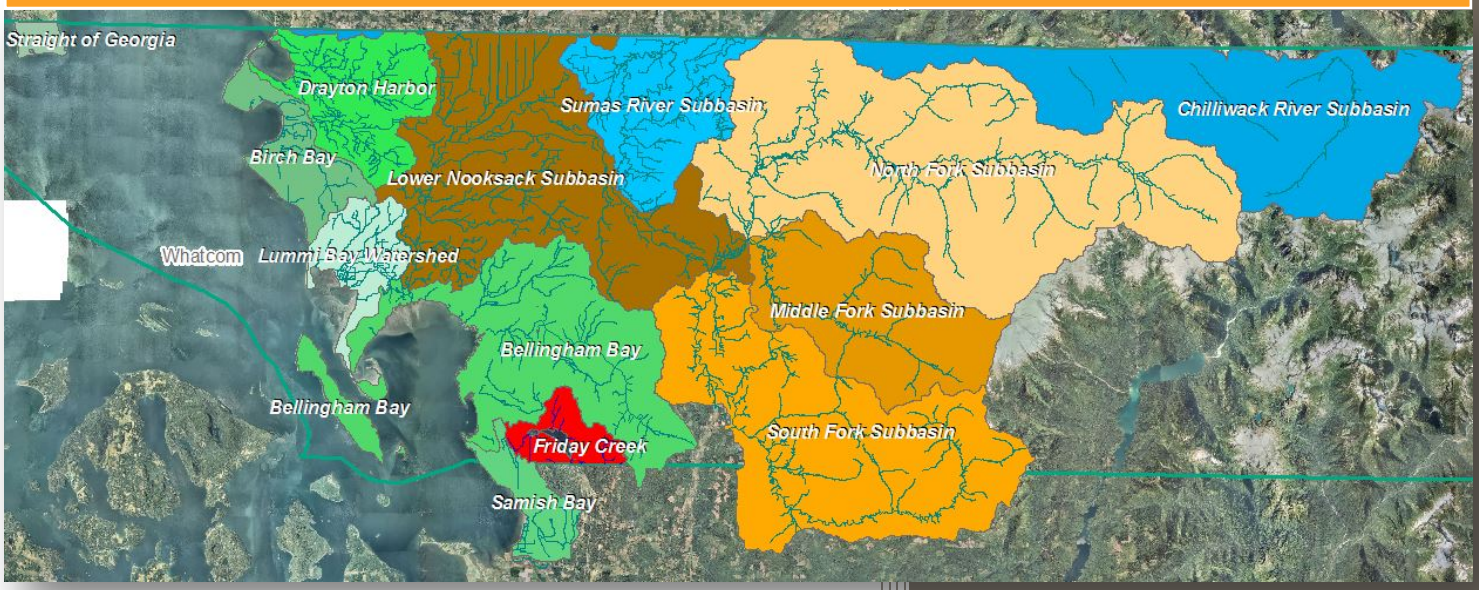
WDFW High Resolution Change Detection Project
Whatcom County: Land Cover Change by Sub-Basin



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Contents

Figures

Tables

Overview

Using 2006 to 2011 HRCD data, land cover change within WRIA 1 and part of Friday Creek watershed (HUC12 watershed that contains Lake Samish within WRIA 3) was analyzed and separated by sub-watersheds based on the watershed layer available for Whatcom County. Land cover change, including canopy loss and impervious surface increase, was quantified by first- and second-order watersheds, as described within the watershed layer's attributes, and by likely change agents. Fish bearing riverine systems, based on the Statewide Washington Integrated Fish Distribution (SWFID) data, were buffered 0 to 100' and 100 to 200' for the purpose of comparing change within valuable riparian areas (represented by the 0 to 100' buffer) with the area immediately beyond (100 to 200'). Watershed and buffer areas were calculated in ArcGIS and used to weight land cover change for direct comparison between spaces. All areas within this report are measured in acres unless otherwise stated. Land cover change event segments have a minimum mapping unit of ~0.05 acres (~2,180 sq. feet). Change agents for this report are classified as anthropogenic (i.e. development, tree removal, water mitigation structures, and re-development), commercial forestry and natural (i.e. stream course change). Also, note the HRCD data does not capture over-water change (e.g. docks) or added canopy (e.g. tree growth, restoration events).

Tables 1 and 2 show total land cover change, canopy loss, and impervious surface increase across WRIA 1 sub-watersheds, and likely change agent, respectively. Note that Samish Bay and South Fork watersheds include area outside of Whatcom County jurisdiction, while watersheds are cut-off by the Canadian border due to lack of HRCD and SWFID data; all area calculations reflect this. Tables 3-5 show riparian change, canopy loss, and impervious surface increase by sub-watershed, respectively. Tables 6 -30 flesh-out land cover change details (including likely change agents and within riparian buffers) by each second-order watershed of interest. Tables 31 – 33 show the Lake Whatcom Watershed (part of Bellingham Bay 2nd order watershed) by total change and riparian change.

TABLE 1. 2006 TO 2011 LAND COVER CHANGE BY FIRST AND SECOND ORDER WRIA 1 SUB-WATERSHEDS IN ACRES

Watershed (First order, *Second order*)	Watershed Area	Total Change	Acres of Change per 1,000 Acres of Watershed per Year	Canopy Loss	Canopy Loss per 1,000 Acres of Watershed per Year	Impervious Surface Increase	Impervious Surface Increase of 1,000 Acres of Watershed per Year
Coastal	**169,114.08**	**2,286.59**	**2.70**	**2,065.49**	**2.44**	**187.64**	**0.22**
Bellingham Bay	*7,8478.68*	*960.78*	*2.45*	*888.18*	*2.26*	*72.11*	*0.18*
Birch Bay	*20,191.95*	*134.08*	*1.33*	*79.01*	*0.78*	*45.64*	*0.45*
Drayton Harbor	*36,312.67*	*484.03*	*2.67*	*430.33*	*2.37*	*38.53*	*0.21*
Lummi Bay	*17,466.13*	*573.72*	*6.57*	*537.66*	*6.16*	*28.66*	*0.33*
Samish Bay	*13,572.59*	*118.53*	*1.75*	*117.07*	*1.73*	*0.65*	*0.01*
Strait of Georgia	*3,092.06*	*15.45*	*1.00*	*13.24*	*0.86*	*2.05*	*0.13*
Fraser	**212,971.49**	**1,200.80**	**1.13**	**1,091.87**	**1.03**	**102.32**	**0.10**
Chilliwack River	*160,345.97*	*295.53*	*0.37*	*207.35*	*0.26*	*88.36*	*0.11*
Sumas River	*52,625.51*	*905.27*	*3.44*	*884.52*	*3.36*	*13.96*	*0.05*
Nooksack	**516,290.01**	**10,152.66**	**3.93**	**9,975.27**	**3.86**	**136.27**	**0.05**
Lower Nooksack	*144,176.28*	*2,123.52*	*2.95*	*1,956.89*	*2.71*	*129.32*	*0.18*
Middle Fork	*63,685.36*	*1,008.49*	*3.17*	*1,008.27*	*3.17*	*0.17*	*0.00*
North Fork	*190,157.36*	*2,085.92*	*2.19*	*2,081.87*	*2.19*	*4.18*	*0.00*
South Fork	*118,271.02*	*4,934.74*	*8.34*	*4,928.25*	*8.33*	*2.60*	*0.00*
Friday Creek*	**10,560**	**48.83**	**0.92**	**47.18**	**0.89**	**3.03**	**0.09**
Grand Total	**908,935.57**	**13,640.05**	**3.00**	**13,132.63**	**2.89**	**429.26**	**0.09**

**Friday Creek, the HUC12 watershed that contains Lake Samish, is part of WRIA 3*

TABLE 2. TOTAL LAND COVER CHANGE BY LIKELY CHANGE AGENT FOR WRIA 1 AND FRIDAY CREEK (LAKE WHATCOM AREA) SUB-WATERSHED BETWEEN 2006 AND 2011

	Total Change (acres)	Canopy Loss (acres)	Impervious Surface Increase (acres)
Anthropogenic (non-Forestry)	**3,217.77**	**2,820.31**	**319.27**
Development	*438.83*	*153.53*	*287.53*
Tree Removal	*2,657.83*	*2,646.86*	*4.06*
Redevelopment	*25.53*	*6.52*	*5.81*
Stormwater Management	*48.54*	*13.23*	*21.87*
Other (Non-Natural)	*47.04*	*0.18*	*0.00*
Forestry	**9,779.44**	**9,762.52**	**19.18**
Natural	**691.68**	**596.99**	**90.80**
Stream	*367.57*	*360.13*	*3.55*
Other (Natural)	*324.11*	*236.86*	*87.25*
Grand Total	**13,688.89**	**13,179.82**	**429.25**

TABLE 3. TOTAL LAND COVER CHANGE WITHIN WRIA 1 FISH BEARING RIVERINE SYSTEMS (BASED ON SWFID DATA) BETWEEN 2006 AND 2011

	0 – 100'			*100 – 200'*		
Watershed (First order, *Second order*)	**Buffer area**	**Total Change**	**Acres of Change per 1,000 Acres of Buffer per Year**	**Buffer area**	**Total Change**	**Acres of Change per 1,000 Acres of Buffer per Year**
Coastal	**8,841.40**	**67.49**	**1.53**	**8,550.18**	**85.66**	**2.00**
Bellingham Bay	*2,904.73*	*16.83*	*1.16*	*2,845.59*	*19.15*	*1.35*
Birch Bay	*983.32*	*5.28*	*1.07*	*957.21*	*8.35*	*1.74*
Drayton Harbor	*2,912.83*	*10.39*	*0.71*	*2,805.54*	*19.63*	*1.40*
Lummi Bay	*1,362.27*	*33.98*	*4.99*	*1,294.19*	*36.25*	*5.60*
Samish Bay	*678.25*	*1.02*	*0.30*	*647.65*	*2.28*	*0.71*
Fraser	**4,174.78**	**33.46**	**1.60**	**4,054.38**	**43.66**	**2.15**
Chilliwack River	*834.62*	*0.30*	*0.07*	*823.95*	*0.20*	*0.05*
Sumas River	*3,340.15*	*33.16*	*1.99*	*3,230.43*	*43.47*	*2.69*
Nooksack	**20,526.87**	**212.88**	**2.07**	**19,462.45**	**212.47**	**2.18**
Lower Nooksack	*7,566.33*	*86.08*	*2.28*	*7,138.25*	*88.94*	*2.49*
Middle Fork	*1,798.04*	*26.73*	*2.97*	*1,710.14*	*24.55*	*2.87*
North Fork	*6,126.10*	*51.14*	*1.67*	*5,793.53*	*39.83*	*1.38*
South Fork	*5,036.41*	*48.92*	*1.94*	*4,820.53*	*59.14*	*2.45*
Friday Creek*	**390**	**0.86**	**0.44**	**396**	**1.20**	**0.61**
Grand Total	**33,933.04**	**314.69**	**1.85**	**32,463.01**	**342.99**	**2.11**

**Friday Creek, the HUC12 watershed that contains Lake Samish, is part of WRIA 3*

TABLE 4. CANOPY LOSS WITHIN WRIA 1 FISH BEARING RIVERINE SYSTEMS (BASED ON SWFID DATA) BETWEEN 2006 AND 2011

	0 – 100'			*100 – 200'*		
Watershed (First order, *Second order*)	**Buffer area**	**Canopy Loss**	**Canopy Loss per 1,000 Acres of Buffer per Year**	**Buffer area**	**Canopy Loss**	**Canopy Loss per 1,000 Acres of Buffer per Year**
Coastal	**8,841.40**	**62.65**	**1.42**	**8,550.18**	**76.31**	**1.78**
Bellingham Bay	*2,904.73*	*15.74*	*1.08*	*2,845.59*	*17.43*	*1.23*
Birch Bay	*983.32*	*4.00*	*0.81*	*957.21*	*5.59*	*1.17*
Drayton Harbor	*2,912.83*	*9.18*	*0.63*	*2,805.54*	*16.66*	*1.19*
Lummi Bay	*1,362.27*	*32.70*	*4.80*	*1,294.19*	*34.48*	*5.33*
Samish Bay	*678.25*	*1.02*	*0.30*	*647.65*	*2.15*	*0.66*
Fraser	**4,174.78**	**32.96**	**1.58**	**4,054.38**	**43.11**	**2.13**
Chilliwack River	*834.62*	*0.30*	*0.07*	*823.95*	*0.20*	*0.05*
Sumas River	*3,340.15*	*32.66*	*1.96*	*3,230.43*	*42.91*	*2.66*
Nooksack	**20,526.87**	**207.00**	**2.02**	**19,462.45**	**206.06**	**2.12**
Lower Nooksack	*7,566.33*	*80.61*	*2.13*	*7,138.25*	*83.21*	*2.33*
Middle Fork	*1,798.04*	*26.63*	*2.96*	*1,710.14*	*24.46*	*2.86*
North Fork	*6,126.10*	*51.01*	*1.67*	*5,793.53*	*39.61*	*1.37*
South Fork	*5,036.41*	*48.75*	*1.94*	*4,820.53*	*58.78*	*2.44*
Friday Creek*	**390**	**0.78**	**0.40**	**396**	**1.05**	**0.54**
Grand Total	**33,933.04**	**303.39**	**1.79**	**32,463.01**	**326.52**	**2.01**

**Friday Creek, the HUC12 watershed that contains Lake Samish, is part of WRIA 3*

TABLE 5. IMPERVIOUS SURFACE INCREASE WITHIN WRIA 1 FISH BEARING RIVERINE SYSTEMS (BASED ON SWFID DATA) BETWEEN 2006 AND 2011

	0 – 100'			*100 – 200'*		
Watershed (First order, *Second order*)	**Buffer area**	**Impervious Surface Increase**	**Impervious Surface Increase 1,000 Acres of Buffer per Year**	**Buffer area**	**Impervious Surface Increase**	**Impervious Surface Increase 1,000 Acres of Buffer per Year**
Coastal	**8,841.40**	**2.73**	**0.06**	**8,550.18**	**7.04**	**0.16**
Bellingham Bay	*2,904.73*	*0.72*	*0.05*	*2,845.59*	*1.97*	*0.14*
Birch Bay	*983.32*	*1.23*	*0.25*	*957.21*	*2.61*	*0.55*
Drayton Harbor	*2,912.83*	*0.62*	*0.04*	*2,805.54*	*1.97*	*0.14*
Lummi Bay	*1,362.27*	*0.17*	*0.02*	*1,294.19*	*0.41*	*0.06*
Samish Bay	*678.25*	*0.00*	*0.00*	*647.65*	*0.08*	*0.02*
Fraser	**4,174.78**	**0.16**	**0.01**	**4,054.38**	**0.41**	**0.02**
Chilliwack River	*834.62*	*0.00*	*0.00*	*823.95*	*0.00*	*0.00*
Sumas River	*3,340.15*	*0.16*	*0.01*	*3,230.43*	*0.41*	*0.03*
Nooksack	**20,526.87**	**3.65**	**0.04**	**19462.45**	**4.97**	**0.05**
Lower Nooksack	*7,566.33*	*3.31*	*0.09*	*7,138.25*	*4.41*	*0.12*
Middle Fork	*1,798.04*	*0.10*	*0.01*	*1,710.14*	*0.03*	*0.00*
North Fork	*6,126.10*	*0.13*	*0.00*	*5,793.53*	*0.18*	*0.01*
South Fork	*5,036.41*	*0.11*	*0.00*	*4,820.53*	*0.35*	*0.01*
Friday Creek*	*390*	*0.09*	*0.05*	*396*	*0.23*	*0.12*
Grand Total	**33,933.04**	**6.63**	**0.04**	**32,463.01**	**12.65**	**0.08**

**Friday Creek, the HUC12 watershed that contains Lake Samish, is part of WRIA 3*

Coastal Sub-Watershed

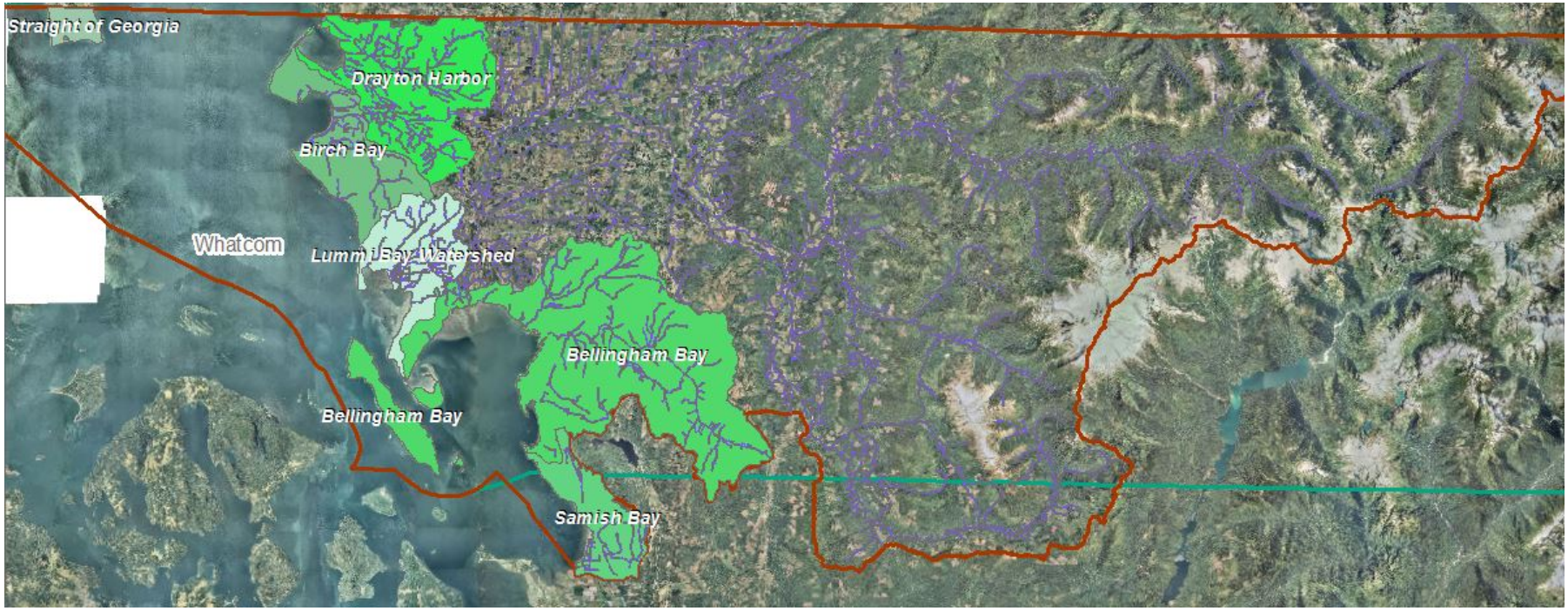

FIGURE 1. EXTENT OF FIRST ORDER "COASTAL" SUB-WATERSHED AND ITS SIX SECOND ORDER SUB-WATERSHEDS (IN GREEN)

Bellingham Bay

TABLE 6. BELLINGHAM BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Bellingham Bay *(78,478.68 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	101.57	48.92	66.27
Tree Removal	274.40	273.08	0.63
Redevelopment	3.76	0.17	0.46
Stormwater Management	1.54	0.62	0.07
Other (Non-Natural)	9.08	0.00	0.00
Forestry	**556.78**	**552.10**	**4.64**
Natural			
Stream	4.92	4.56	0.05
Other (Natural)	8.73	8.73	0.00
Grand Total	**960.78**	**888.18**	**72.11**

TABLE 7. BELLINGHAM BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Bellingham Bay

	0 – 100' (2,904.73 acres)			*100 – 200' (2,845.59 acres)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.88	0.38	0.72	2.46	1.02	1.88
Tree Removal	12.64	12.64	0.00	13.13	13.13	0.00
Redevelopment				0.03	0.00	0.01
Other (Non-Natural)	0.59	0.00	0.00	0.10	0.00	0.00
Forestry						
Forestry	0.51	0.51	0.00	2.30	2.15	0.07
Natural						
Stream	1.41	1.41	0.00	0.63	0.63	0.00
Other (Natural)	0.80	0.80	0.00	0.50	0.50	0.00
Grand Total	**16.83**	**15.74**	**0.72**	**19.15**	**17.43**	**1.97**

Birch Bay

TABLE 8. BIRCH BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Birch Bay *(20,191.95 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	31.50	5.76	21.68
Tree Removal	67.36	66.63	0.00
Redevelopment	0.44	0.00	0.12
Stormwater Management	20.66	0.00	20.66
Other (Non-Natural)	4.02	0.00	0.00
Forestry	**6.30**	**4.30**	**2.62**
Natural			
Stream	3.78	2.32	0.56
Grand Total	**134.08**	**79.01**	**45.64**

TABLE 9. BIRCH BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Birch Bay

	0 – 100' (983.32 acres)			*100 – 200' (957.21 acres)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.92	0.26	0.73	2.15	1.30	1.11
Tree Removal	3.82	3.74	0.00	4.61	4.29	0.00
Redevelopment	0.07	0.00	0.03	0.06	0.00	0.04
Stormwater Management	0.47	0.00	0.47	1.46	0.00	1.46
Other (Non-Natural)				0.06	0.00	0.00
Grand Total	**5.28**	**4.00**	**1.23**	**8.35**	**5.59**	**2.61**

Drayton Harbor

TABLE 10. DRAYTON HARBOR SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Drayton Harbor *(36,312.67 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	60.29	23.89	33.16
Tree Removal	334.56	333.97	0.00
Redevelopment	10.05	0.16	4.03
Stormwater Management	4.11	1.58	0.00
Other (Non-Natural)	4.03	0.00	0.00
Forestry	**70.98**	**70.74**	**1.34**
Grand Total	**484.03**	**430.33**	**38.53**

TABLE 11. DRAYTON HARBOR SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Drayton Harbor

	0 – 100' (2,912.83 acres)			***100 – 200' (2,805.54 acres)***		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	1.11	0.50	0.61	3.09	1.43	1.86
Tree Removal	8.70	8.66	0.00	15.09	14.94	0.00
Other (Non-Natural)	0.56	0.00	0.00	1.16	0.00	0.00
Forestry	**0.02**	**0.02**	**0.01**	**0.29**	**0.29**	**0.11**
Grand Total	**10.39**	**9.18**	**0.62**	**19.63**	**16.66**	**1.97**

Lummi Bay

TABLE 12. LUMMI BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Lummi *(17,466.13 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	22.97	3.21	17.79
Tree Removal	508.71	505.66	2.82
Redevelopment	1.97	0.26	0.45
Stormwater Management	5.82	0.06	0.43
Other (Non-Natural)	1.46	0.10	0.00
Forestry	**30.41**	**28.33**	**4.98**
Natural			
Stream	2.33	0.00	2.19
Other (Natural)	0.04	0.04	0.00
Grand Total	**573.72**	**537.66**	**28.66**

TABLE 13. LUMMI BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Lummi

	0 – 100' (1,362.27 acres)			***100 – 200' (1,294.19 acres)***		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.33	0.00	0.17	0.56	0.01	0.41
Tree Removal	32.66	32.66	0.00	34.46	34.45	0.00
Stormwater Management	0.99	0.04	0.00	1.16	0.02	0.00
Other (Non-Natural)				0.07	0.00	0.00
Grand Total	**33.98**	**32.70**	**0.17**	**36.25**	**34.48**	**0.41**

Samish Bay

TABLE 14. SAMISH BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Samish Bay *(13,572.59 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	0.88	0.09	0.48
Tree Removal	27.95	27.95	0.00
Other (Non-Natural)	0.59	0.00	0.00
Forestry	**88.38**	**88.30**	**0.16**
Natural			
Other (Natural)	0.73	0.73	0.00
Grand Total	**118.53**	**117.07**	**0.65**

TABLE 15. SAMISH BAY SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Samish Bay

	0 – 100' (678.25 acres)			*100 – 200' (647.65)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development				0.18	0.05	0.08
Tree Removal	0.81	0.81	0.00	0.82	0.82	0.00
Forestry						
Forestry	0.08	0.08	0.00	1.18	1.18	0.00
Natural						
Other (Natural)	0.14	0.14	0.00	0.10	0.10	0.00
Grand Total	**1.02**	**1.02**	**0.00**	**2.28**	**2.15**	**0.08**

Strait of Georgia (no observed riparian change)

TABLE 16. STRAIT OF GEORGIA SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Strait of Georgia (*3,092.06 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	2.85	1.22	1.97
Tree Removal	12.05	12.02	0.00
Redevelopment	0.15	0.00	0.08
Other (Non-Natural)	0.40	0.00	0.00
Grand Total	**15.45**	**13.24**	**2.05**

Nooksack Sub-Watershed

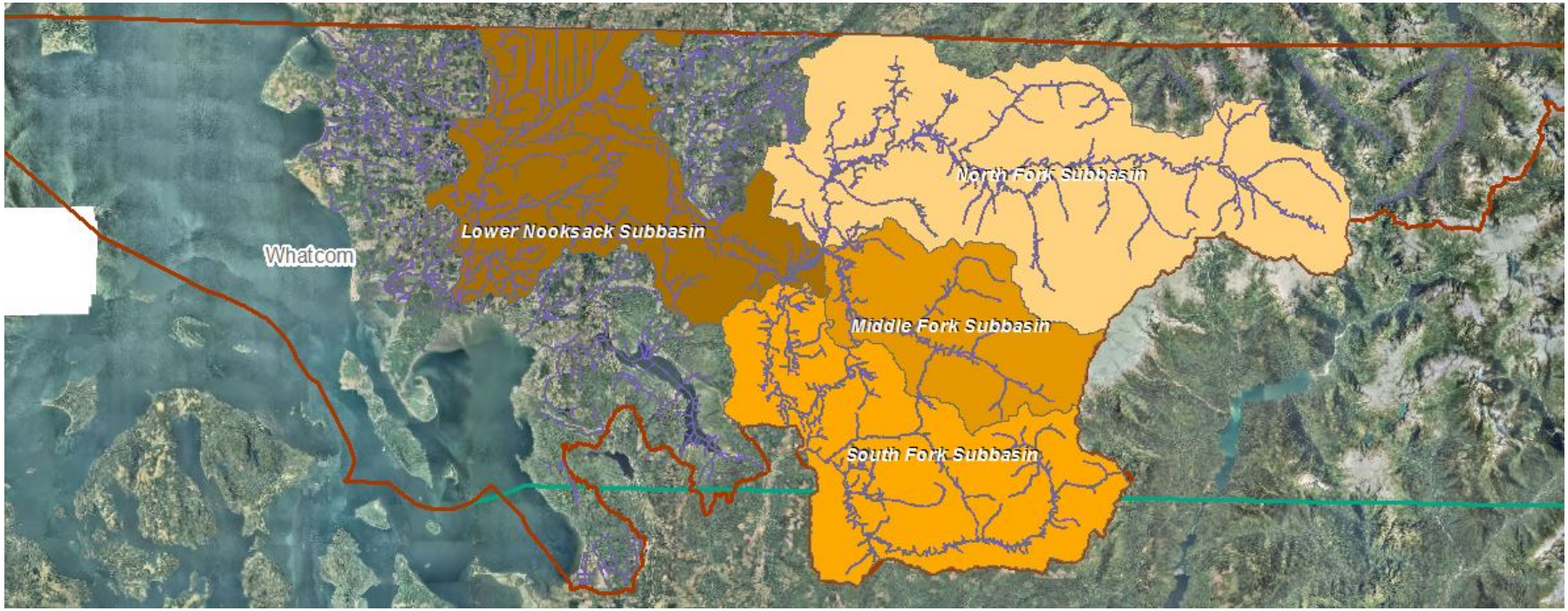

FIGURE 2. EXTENT OF FIRST ORDER "NOOKSACK" SUB-WATERSHED AND ITS SIX SECOND ORDER SUB-WATERSHEDS (IN ORANGE).

Lower Nooksack

TABLE 17. LOWER NOOKSACK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Lower Nooksack *(144,176.28 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	182.63	57.21	122.82
Tree Removal	511.28	506.98	0.61
Redevelopment	3.33	0.61	0.57
Stormwater Management	4.57	1.98	0.71
Other (Non-Natural)	23.09	0.07	0.00
Forestry	**1,188.39**	**1,182.08**	**4.35**
Natural			
Stream	200.20	197.91	0.25
Other (Natural)	10.03	10.03	0.00
Grand Total	**2,123.52**	**1,956.89**	**129.32**

TABLE 18. LOWER NOOKSACK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Lower Nooksack

	0 – 100' (7,566.33 acres)			***100 – 200' (7,138.25 acres)***		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	5.19	0.89	3.02	5.97	1.58	4.10
Tree Removal	24.13	24.12	0.00	26.49	26.47	0.00
Redevelopment	0.04	0.02	0.00	0.17	0.08	0.00
Stormwater Management	0.41	0.27	0.13	0.39	0.24	0.12
Other (Non-Natural)	0.81	0.00	0.00	0.86	0.00	0.00
Forestry	**5.99**	**5.79**	**0.16**	**8.53**	**8.30**	**0.19**
Natural						
Stream	47.69	47.69	0.00	44.55	44.55	0.00
Other (Natural)	1.83	1.83	0.00	1.99	1.99	0.00
Grand Total	**86.08**	**80.61**	**3.31**	**88.94**	**83.21**	**4.41**

Middle Fork

TABLE 19. MIDDLE FORK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Middle Fork *(63,685.36 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	0.48	0.33	0.17
Tree Removal	37.84	37.84	0.00
Other (Non-Natural)	0.07	0.00	0.00
Forestry	**923.67**	**923.67**	**0.00**
Natural			
Stream	43.60	43.60	0.00
Other (Natural)	2.83	2.83	0.00
Grand Total	**1,008.49**	**1,008.27**	**0.17**

TABLE 20. MIDDLE FORK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Middle Fork

	0 – 100' (1,798.04 acres)			***100 – 200' (1,710.14 acres)***		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.30	0.20	0.10	0.09	0.06	0.03
Tree Removal	1.72	1.72	0.00	2.99	2.99	0.00
Other (Non-Natural)				0.07	0.00	0.00
Forestry						
Forestry	3.73	3.73	0.00	8.96	8.96	0.00
Natural						
Stream	20.98	20.98	0.00	12.45	12.45	0.00
Grand Total	**26.73**	**26.63**	**0.10**	**24.55**	**24.46**	**0.03**

North Fork

TABLE 21. NORTH FORK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

North Fork *(190157.36 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	7.51	4.55	4.05
Tree Removal	149.29	149.17	0.00
Redevelopment	5.22	5.22	0.00
Stormwater Management	8.93	8.93	0.00
Other (Non-Natural)	0.90	0.00	0.00
Forestry	**1,703.09**	**1,703.02**	**0.13**
Natural			
Stream	94.21	94.21	0.00
Other (Natural)	116.76	116.76	0.00
Grand Total	**2,085.92**	**2,081.87**	**4.18**

TABLE 22. NORTH FORK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

North Fork

	0 – 100' (6,126.10 acres)			*100 – 200' (5,793.53 acres)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.26	0.13	0.13	0.31	0.09	0.18
Tree Removal	1.22	1.22	0.00	2.48	2.48	0.00
Redevelopment	1.27	1.27	0.00	1.55	1.55	0.00
Stormwater Management	0.50	0.50	0.00	0.61	0.61	0.00
Forestry	**2.96**	**2.96**	**0.00**	**6.67**	**6.67**	**0.00**
Natural						
Stream	38.17	38.17	0.00	24.29	24.29	0.00
Other (Natural)	6.75	6.75	0.00	3.93	3.93	0.00
Grand Total	**51.14**	**51.01**	**0.13**	**39.83**	**39.61**	**0.18**

South Fork

TABLE 23. SOUTH FORK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

South Fork *(118,271.02 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	2.99	0.42	2.50
Tree Removal	442.39	441.95	0.00
Redevelopment	0.21	0.00	0.10
Stormwater Management	2.71	0.00	0.00
Other (Non-Natural)	0.56	0.00	0.00
Forestry	**4,460.06**	**4,460.06**	**0.00**
Natural			
Stream	15.10	15.10	0.00
Other (Natural)	10.72	10.72	0.00
Grand Total	**4,934.74**	**4,928.25**	**2.60**

TABLE 24. SOUTH FORK SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

South Fork

	0 – 100' (5,036.41 acres)			*100 – 200' (4,820.53 acres)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.34	0.17	0.11	0.35	0.00	0.35
Tree Removal	18.99	18.99	0.00	21.89	21.89	0.00
Redevelopment				0.01	0.00	0.00
Forestry	**19.80**	**19.80**	**0.00**	**31.50**	**31.50**	**0.00**
Natural						
Stream	8.91	8.91	0.00	4.35	4.35	0.00
Other (Natural)	0.88	0.88	0.00	1.04	1.04	0.00
Grand Total	**48.92**	**48.75**	**0.11**	**59.14**	**58.78**	**0.35**

Fraser Sub-Watershed

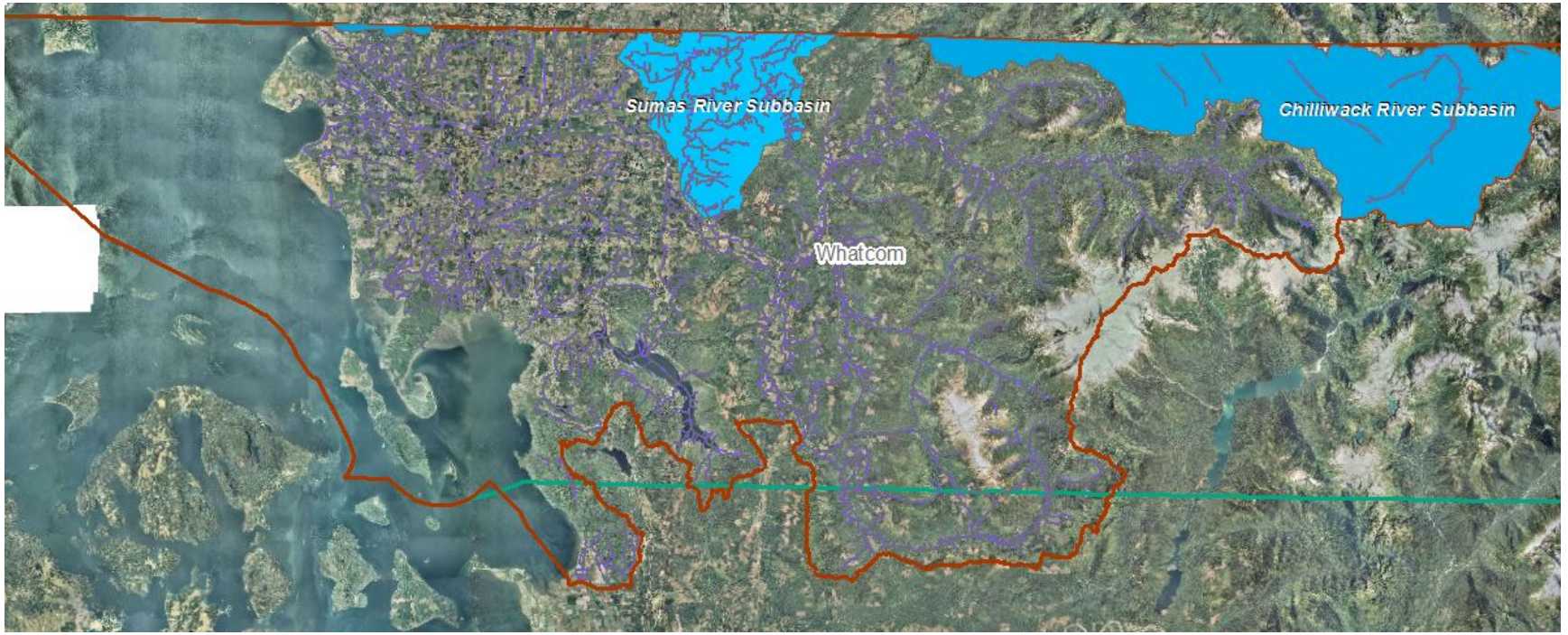

FIGURE 3. EXTENT OF FIRST ORDER "FRASER" SUB-WATERSHED AND ITS SIX SECOND ORDER SUB-WATERSHEDS (IN BLUE)

Chilliwack River

TABLE 25. CHILLIWACK RIVER SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Chilliwack *(160,345.97 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	2.08	1.15	0.76
Tree Removal	31.29	31.29	0.00
Forestry	**91.75**	**91.75**	**0.35**
Natural			
Stream	1.72	1.72	0.00
Other (Natural)	168.68	81.43	87.25
Grand Total	**295.53**	**207.35**	**88.36**

TABLE 26. CHILLIWACK RIVER SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

	0 – 100' (834.62 acres)			*100 – 200' (823.95 acres)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Natural						
Stream	0.29	0.29	0.00	0.08	0.08	0.00
Other (Natural)	0.01	0.01	0.00	0.12	0.12	0.00
Grand Total	**0.30**	**0.30**	**0.00**	**0.20**	**0.20**	**0.00**

Sumas River

TABLE 27. SUMAS RIVER SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Sumas River *(52,625.51 acres)*

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic (non-Forestry)			
Development	17.11	2.05	12.91
Tree Removal	240.55	240.44	0.00
Redevelopment	0.28	0.09	0.00
Stormwater Management	0.20	0.06	0.00
Other (Non-Natural)	2.82	0.00	0.00
Forestry	**640.31**	**638.86**	**0.55**
Natural			
Stream	1.70	0.70	0.50
Other (Natural)	2.31	2.31	0.00
Grand Total	**905.27**	**884.52**	**13.96**

TABLE 28. SUMAS RIVER SUB-WATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Sumas River

	0 – 100' (3,340.15 acres)			***100 – 200' (3,230.43 acres)***		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic (non-Forestry)						
Development	0.23	0.05	0.16	0.56	0.16	0.41
Tree Removal	8.08	8.08	0.00	10.34	10.34	0.00
Other (Non-Natural)	0.32	0.00	0.00	0.14	0.00	0.00
Forestry						
Forestry	23.69	23.69	0.00	32.22	32.22	0.00
Natural						
Stream	0.66	0.66	0.00	0.04	0.04	0.00
Other (Natural)	0.17	0.17	0.00	0.15	0.15	0.00
Grand Total	**33.16**	**32.66**	**0.16**	**43.47**	**42.91**	**0.41**

Friday Creek (Lake Whatcom area)

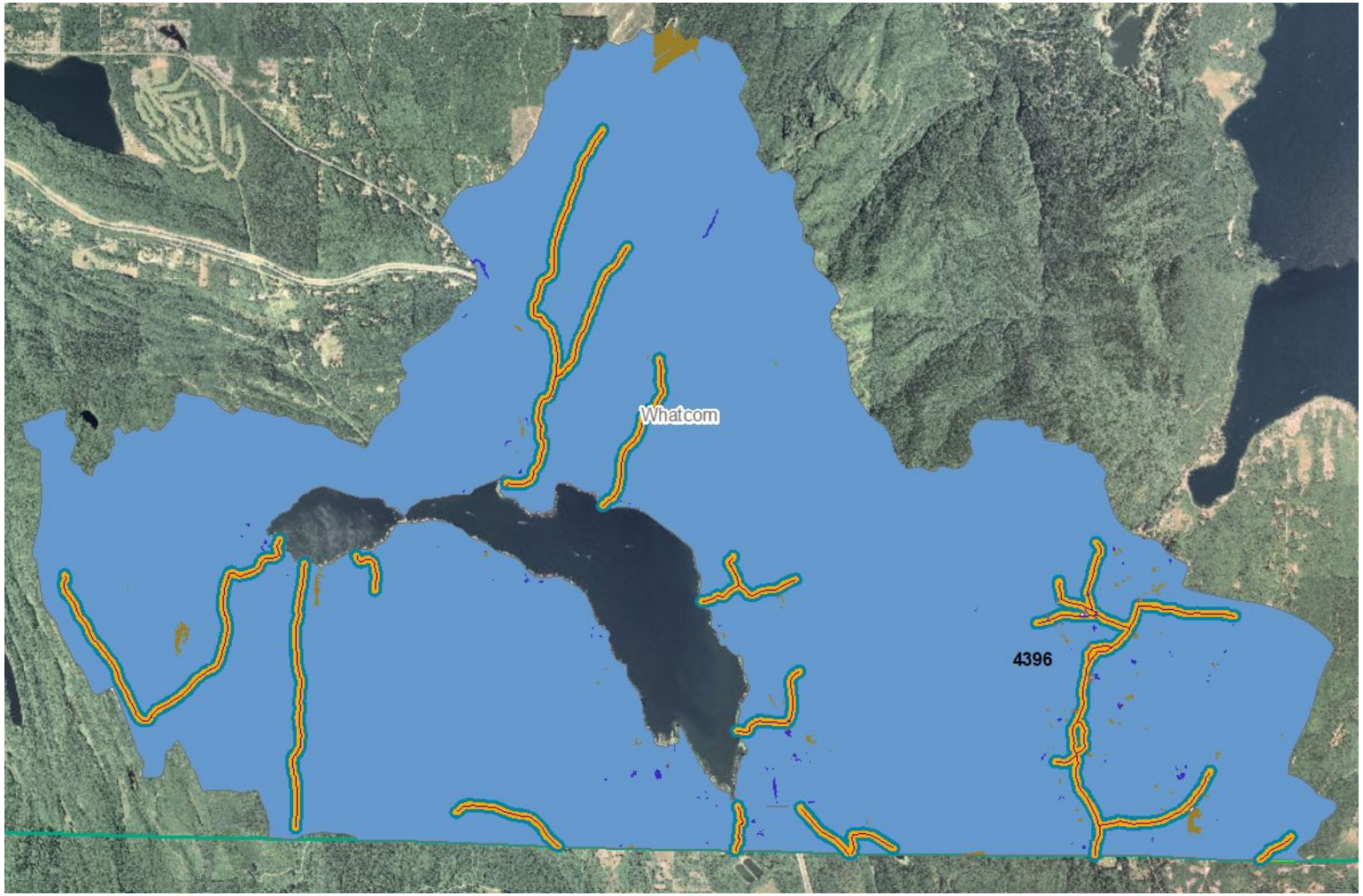

FIGURE 4. EXTENT OF "FRIDAY CREEK" HUC12 AREA WITHIN WRIA 3 EXAMINED FOR LAND COVER CHANGE

TABLE 29. FRIDAY CREEK (10,560 ACRES) 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic	**26.24**	**24.59**	**2.96**
Development	5.98	4.73	2.96
Tree Removal	20.13	19.86	0.00
Redevelopment	0.11	0.00	0.00
Other - NonNatural	0.02	0.00	0.00
Forestry	**19.32**	**19.32**	**0.07**
Other - Natural	**3.28**	**3.28**	**0.00**
Grand Total	**48.83**	**47.18**	**3.03**

TABLE 30. RIDAY CREEK 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

	0-100' (390 acres)			*100-200' (396 acres)*		
Change Agent	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**	**Total Change**	**Canopy Loss**	**Impervious Surface Increase**
Anthropogenic	**0.83**	**0.75**	**0.08**	**1.07**	**0.92**	**0.20**
Development	0.11	0.03	0.08	0.36	0.21	0.20
Tree Removal	0.72	0.72	0.00	0.72	0.72	0.00
Forestry	**0.03**	**0.03**	**0.01**	**0.13**	**0.13**	**0.03**
Grand Total	**0.86**	**0.78**	**0.09**	**1.20**	**1.05**	**0.23**

Lake Whatcom Watershed

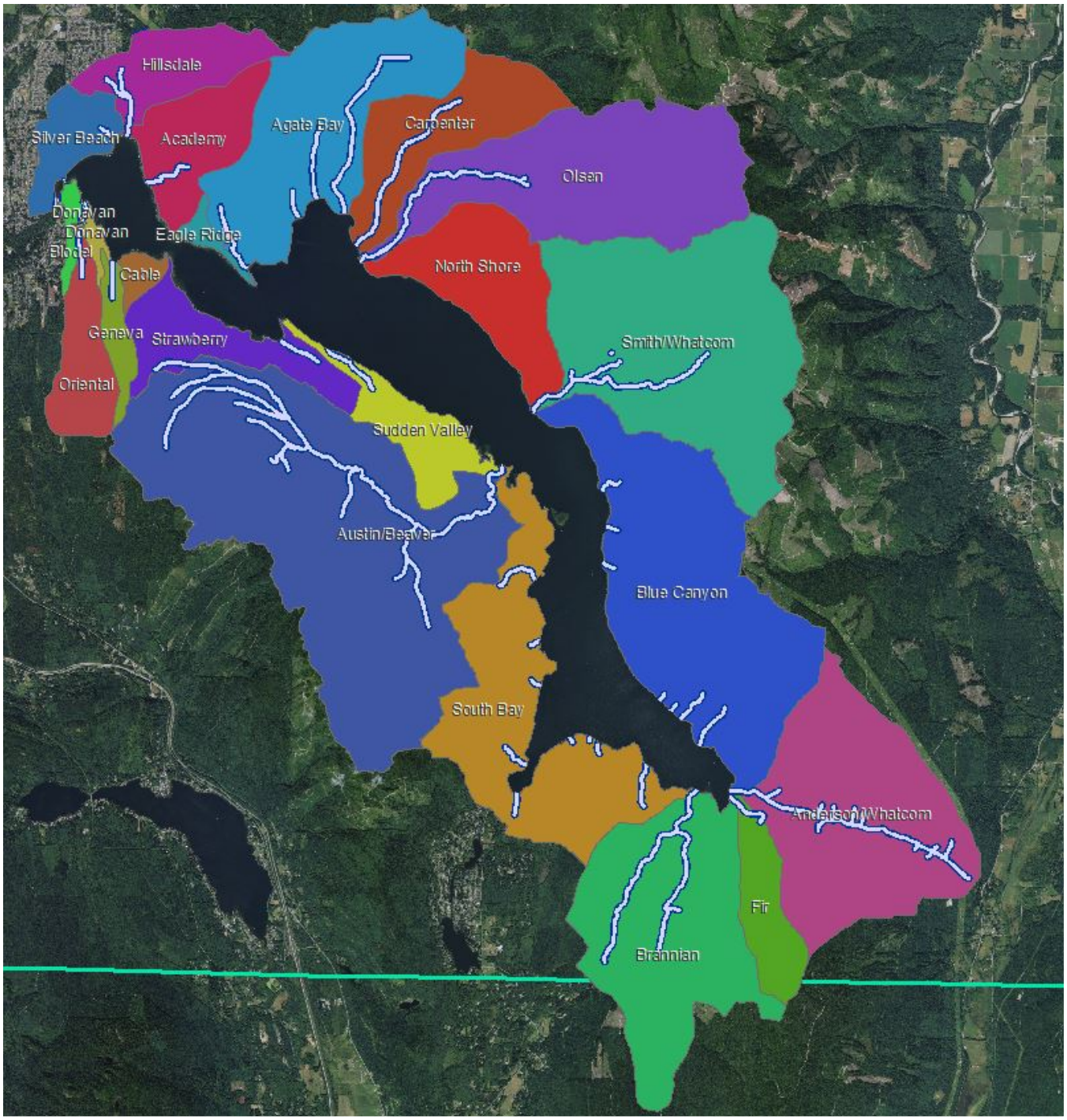

FIGURE 5. EXTENT OF AREA EXAMINED FOR LAND COVER CHANGE. 3RD ORDER "LAKE WHATCOM" WATERSHED BROKEN OUT BY 4TH ORDER SUB-WATERSHED

TABLE 31. 2006 TO 2011 LAND COVER CHANGE SUMMARY STATISTICS OF 4TH ORDER WATERSHEDS WITHIN LAKE WHATCOM WATERSHED

4th order Watershed	*Watershed Acres*	Total Change	Canopy Loss	Impervious Surface Increase	Total Change per 1000 acres of Watershed per Year
Academy	*779.74*	4.29	3.27	1.60	1.10
Agate Bay	*2136.57*	2.52	2.33	0.06	0.40
Anderson/Whatcom	*2591.11*	54.22	54.22	0.06	0.33
Austin/Beaver	*5360.05*	67.65	67.65	0.09	0.16
Bloedel	*97.48*	1.49	1.49	0.00	8.80
Blue Canyon	*3,316.74*	12.07	12.07	0.00	0.26
Brannian	*2,455.86*	61.41	61.36	0.03	0.35
Carpenter	*1,151.69*	18.13	18.06	0.05	0.75
Donavan	*62.84*	0.13	0.06	0.13	13.66
Fir	*544.26*	39.72	39.72	0.00	1.58
Geneva	*225.49*	3.81	3.63	0.12	3.81
Hillsdale	*734.59*	6.18	5.47	0.87	1.17
North Shore	*1,170.25*	70.07	69.85	0.09	0.73
Olsen	*2,433.71*	114.72	114.53	0.19	0.35
Oriental	*573.57*	17.41	17.28	0.13	1.50
Silver Beach	*435.99*	2.89	2.56	1.63	1.97
Smith/Whatcom	*3,309.03*	62.60	62.60	0.00	0.26
South Bay	*2,314.42*	2.30	1.59	0.30	0.37
Strawberry	*776.13*	0.51	0.40	0.27	1.11
Sudden Valley	*603.94*	0.92	0.75	0.43	1.42
Total	***31,276.10***	***543.04***	***538.87***	***6.05***	***3.47***

TABLE 32. LAKE WHATCOM SUBWATERSHED 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE, BY LIKELY CHANGE AGENT

Change Agent	Total Change	Canopy Loss	Impervious Surface Increase
Anthropogenic	**48.79**	**45.14**	**5.36**
Development	9.31	6.50	5.16
Tree Removal	38.49	38.49	0.00
Redevelopment	0.49	0.15	0.19
Other - NonNatural	0.50	0.00	0.00
Forestry	**485.83**	**485.31**	**0.69**
Other - Natural	**8.42**	**8.42**	**0.00**
Grand Total	**543.04**	**538.87**	**6.05**

TABLE 33. LAKE WHATCOM 2006 TO 2011 LAND COVER CHANGE, INCLUDING CANOPY LOSS AND IMPERVIOUS SURFACE INCREASE WITHIN SWFID RIPARIAN BUFFERS BY LIKELY CHANGE AGENT

Buffer Distance	Acres	Total Change	Canopy Loss	Impervious Surface Increase	Total Change per 1000 acres of Buffer per Year
0-100'	927.79	1.53	1.42	0.05	0.33
100-200'	941.56	3.53	3.35	0.16	0.75
Total	1869.35	5.06	4.77	0.22	0.54