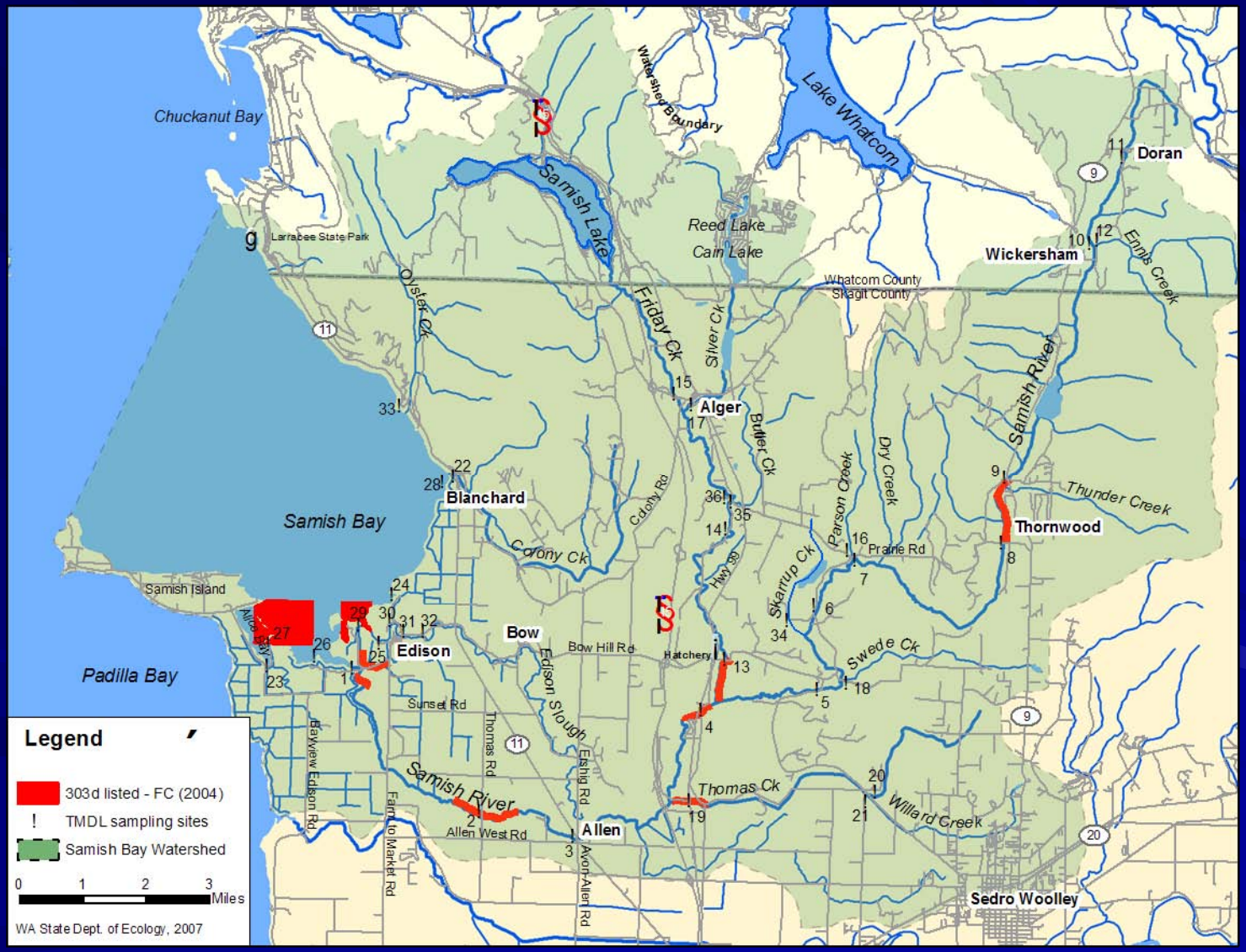
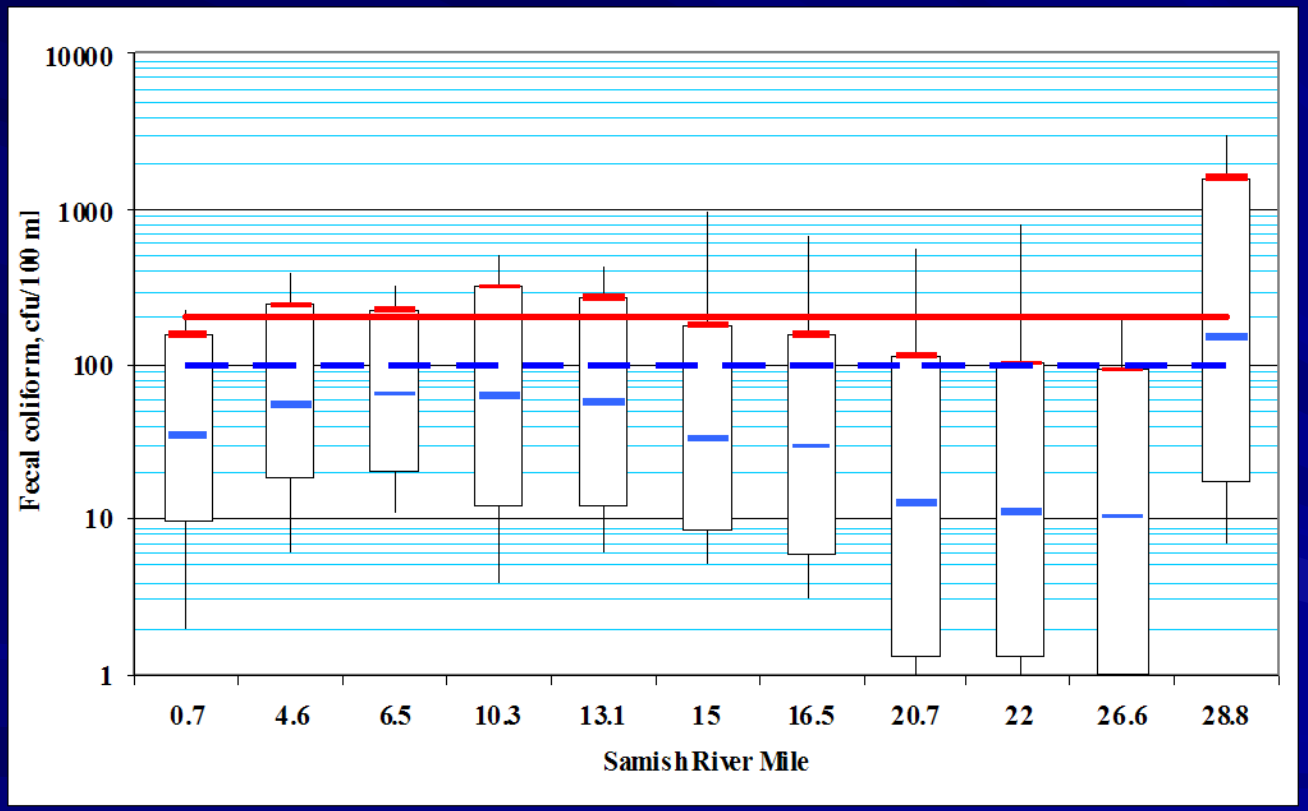
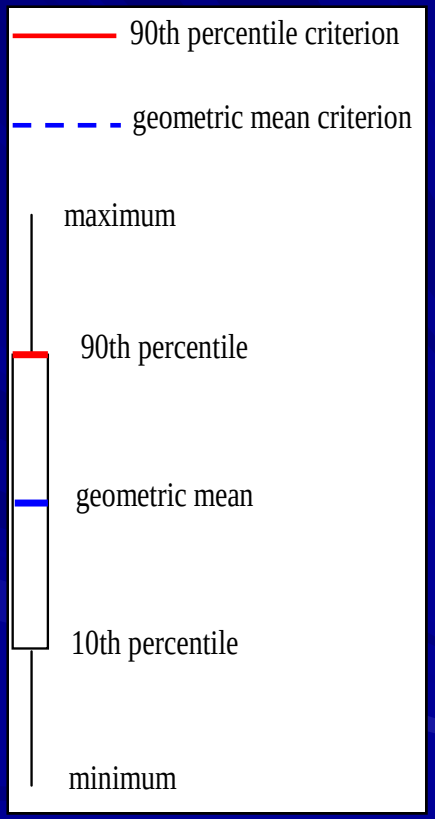
Samish Bay Fecal Coliform TMDL 2006 – 2008: Overview of Technical Report



Field ID w/ River Mile	map #	Site Location	n	Min	Max	Geo-metric mean	90th percen-tile
		Samish River					
03-SAM-00.7	1	At Bayview/ Edison Rd	25	2	220	35	156
03-SAM-04.6	2	Thomas Rd -average of both days	25	6	385	56	243
03-SAM-06.5	3	Chuckanut Dr	25	11	330	65	226
03-SAM-10.3	4	Hwy 99	24	4	510	62	322
03-SAM-13.1	5	F&S Grade Rd	24	6	410	58	277
03-SAM-15.0	6	2nd Prairie Rd Crossing from Hwy 99	24	5	950	34	177
03-SAM-16.5	7	Off Prairie Rd upstream of Parson Ck	24	3	650	30	154
03-SAM-20.7	8	3rd Praire Rd crossing from Hwy 99	24	1	560	13	114
03-SAM-22.0	9	Hwy 9	24	1	800	11	103
03-SAM-26.6	10	Wickersham Rd	24	1	210	10	92
03-SAM-28.8	11	Innis Ck Rd (in Doran)	24	7	3000	149	1604
		Samish River Tributaries					
03-ENN-00.0	12	Ennis Ck at mouth, Wickersham Rd	21	1	470	5	80
03-FRI-00.8	13	Friday Ck at Bow Hill / Prairie Rd (below Hatchery)	24	4	840	39	283
03-FRI-03.8	14	Friday Ck at Friday Ck. Rd	24	4	1400	34	257
03-FRI-06.5	15	Friday Ck at Lake Samish Rd / Alger Cain Lk Rd	24	1	130	11	82
03-PAR-00.0	16	Parson Ck at confluence w/ Samish R	24	1	3200	105	2839
03-SIL-00.4	17	Silver Creek at Friday Ck Rd	24	2	620	11	59
03-SWE-00.0	18	Swede Ck at Grip Rd	24	9	1200	75	441
03-THO-00.3	19	Thomas Ck at Old Hwy 99	24	8	1800	96	488
03-THO-03.6	20	Thomas Ck off F&S Grade Rd abv. Willard Ck confluence	24	22	5700	399	3105
03-WIL-00.0	21	Willard Ck Off F&S Grade Rd abv. Thomas Ck confluence	17	13	15000	234	2327
03-SKA-00.5	34	Skarrup Creek at first road crossing	17	22	2400	170	750
		Samish Bay Tributaries					
03-COL-00.0	22	Colony Ck near mouth, upstream of tidegates	25	6	310	52	189
03-ALI-PUMP	23	Drainage to Alice Bay	25	1	170	16	127
03-NED-PUMP	24	N Edison drainage at Key Ave., off Smith Rd	24	1	330	109	330
03-SED-PUMP	25	S Edison drainage near liquor store	21	32	2400	167	601
03-BAY-GATE	26	Drainage west of Samish River mouth, to Samish Bay	25	5	810	52	342
03-ALI-GATE	27	Drainage to Alice Bay	12	3	230	21	96
03-MCE-GATE	28	Tidegate to McElroy/Colony Slough	25	1	970	65	542
03-WED-GATE	29	W Edison drainage near Edison Slough mouth	15	1	610	41	428
03-SMI-GATE	30	Drainage to Edison Slough at Smith Rd nr. NED-PUMP	4	3	400	too few samples	
03-EDI-01.2	31	Edison Slough just upstream of tidegates in Edison	24	5	830	30	188
03-EDI-01.6	32	Edison Slough at private drive upstream of school	25	1	870	24	222
03-OYS-00.0	33	Oyster Ck near mouth	25	1	50	4	23

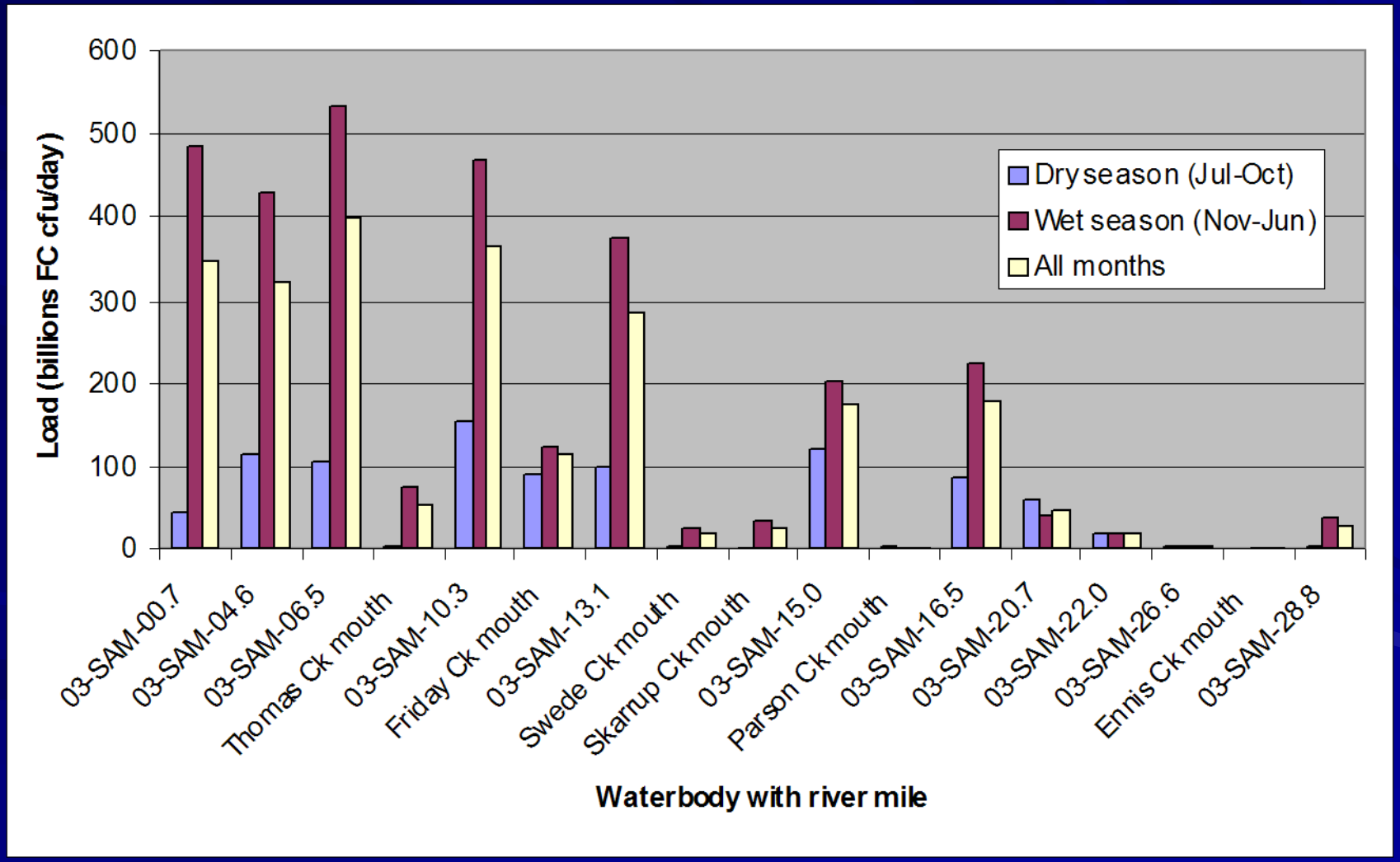
Samish R. longitudinal FC concentration profile (all 2006-2007 TMDL data)



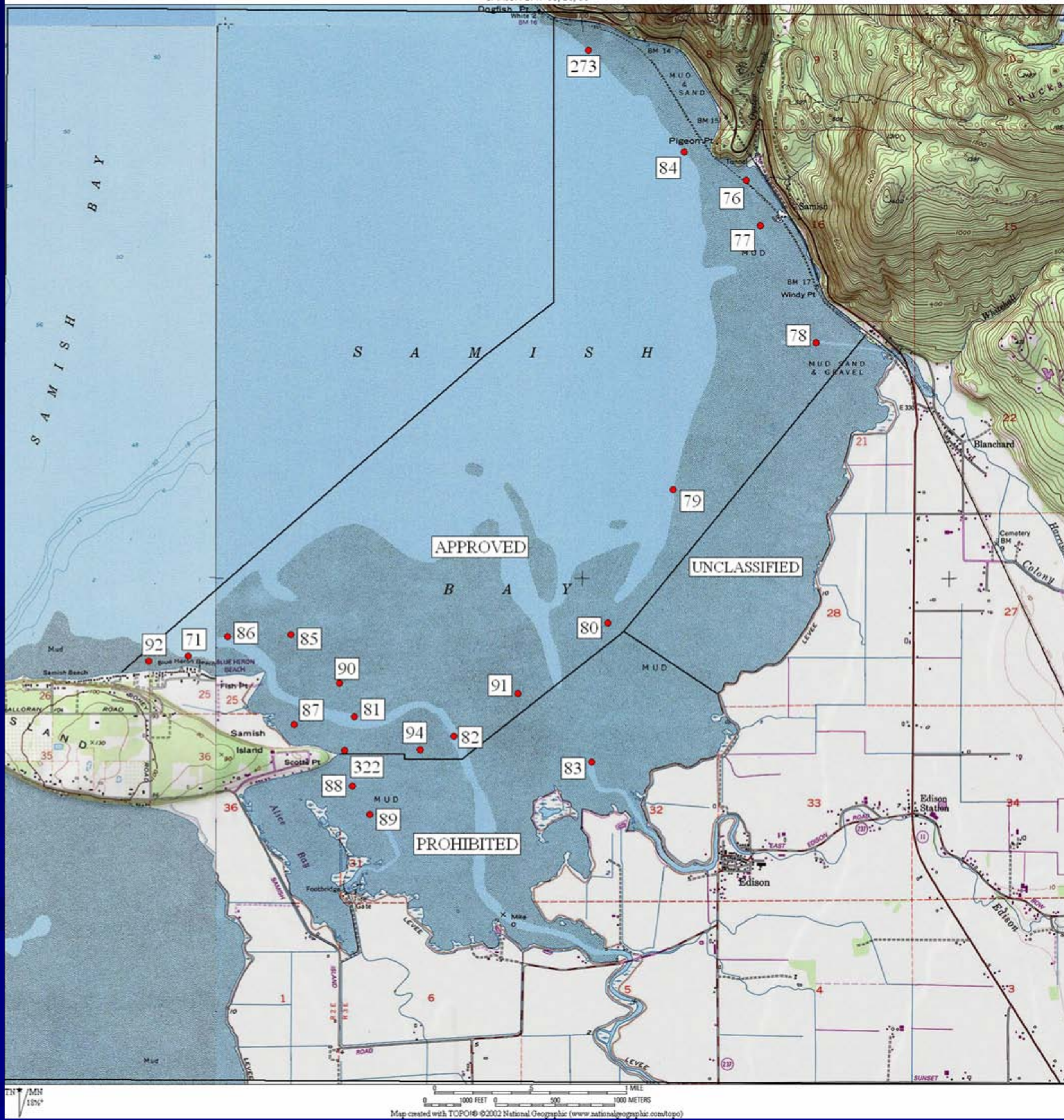


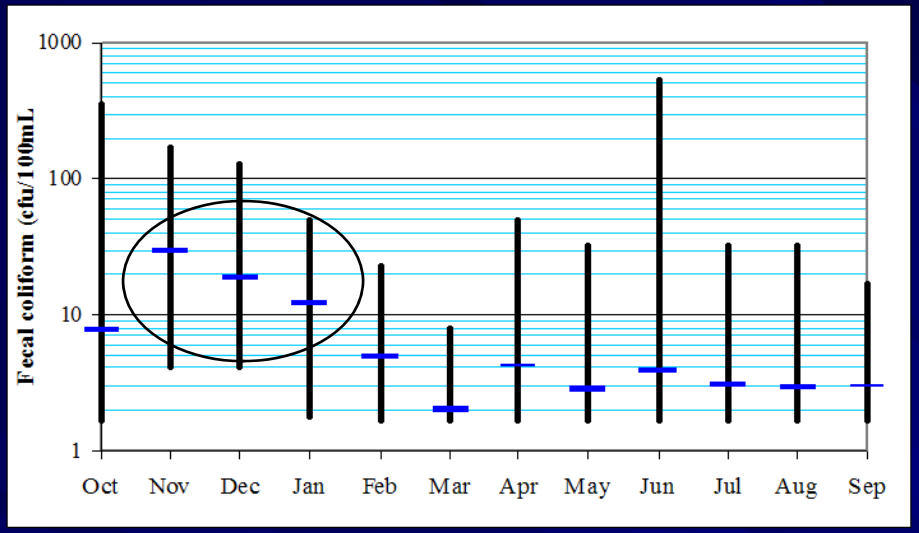
Critical season data is not shown.

Samish R. and trib. FC loading by season

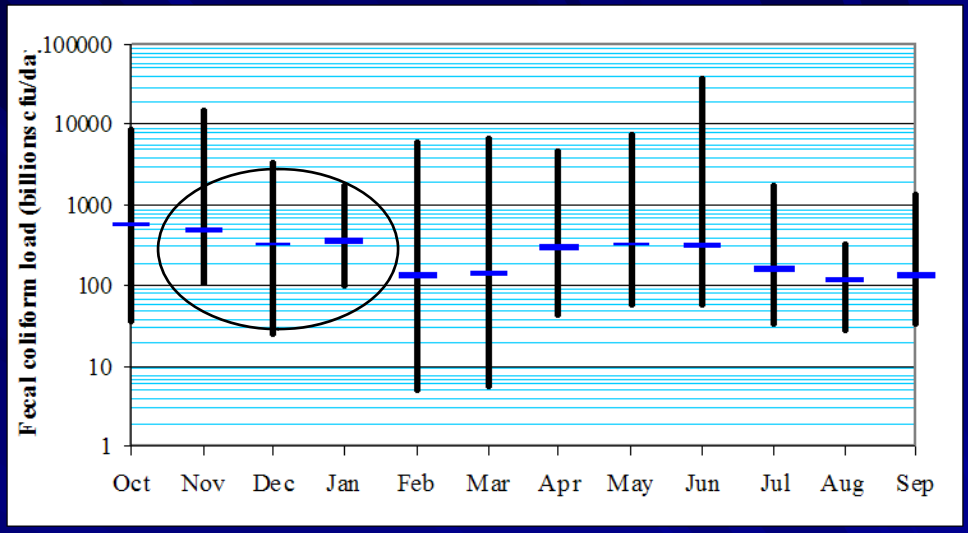


SAMISH BAY 05/16/06

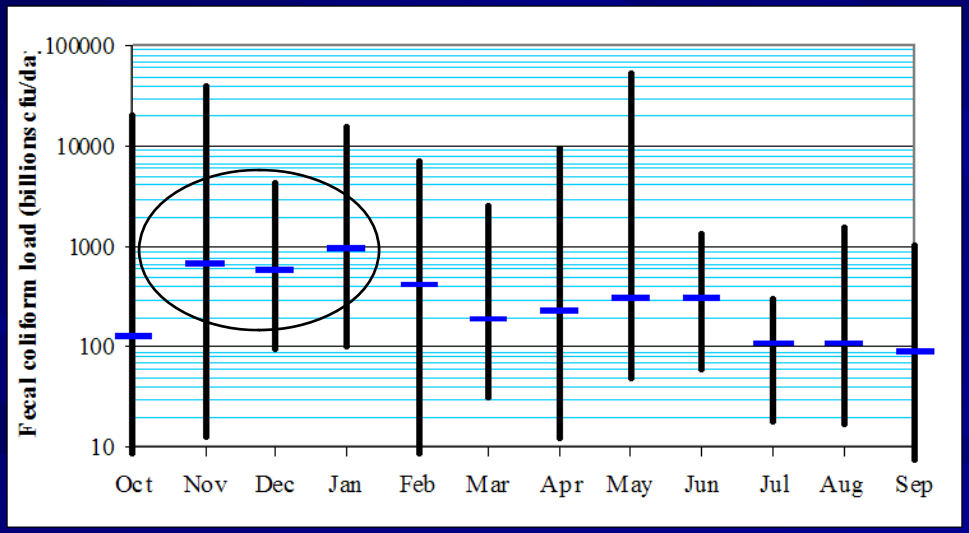




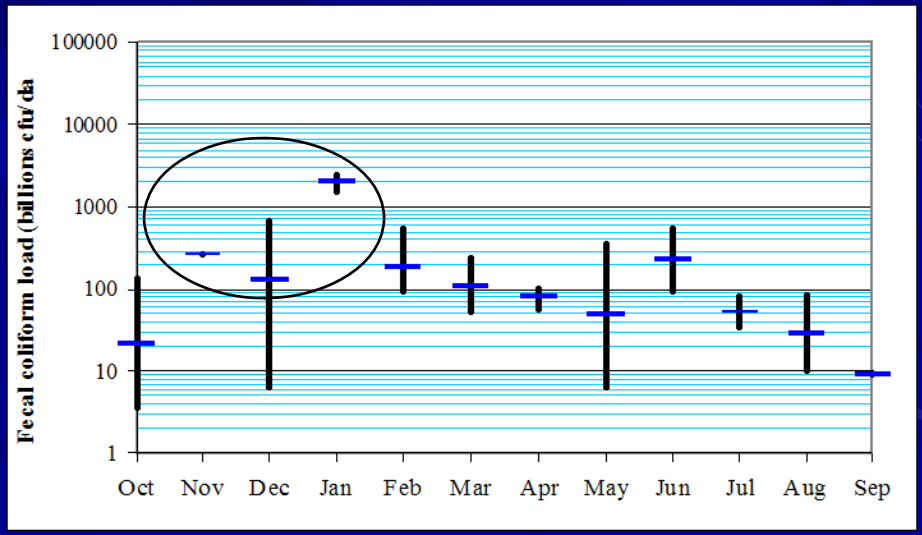
DOH station 82 monthly FC concentrations (1995-2007)



Skagit County monthly FC loading at RM 4.6 (2000-2007)

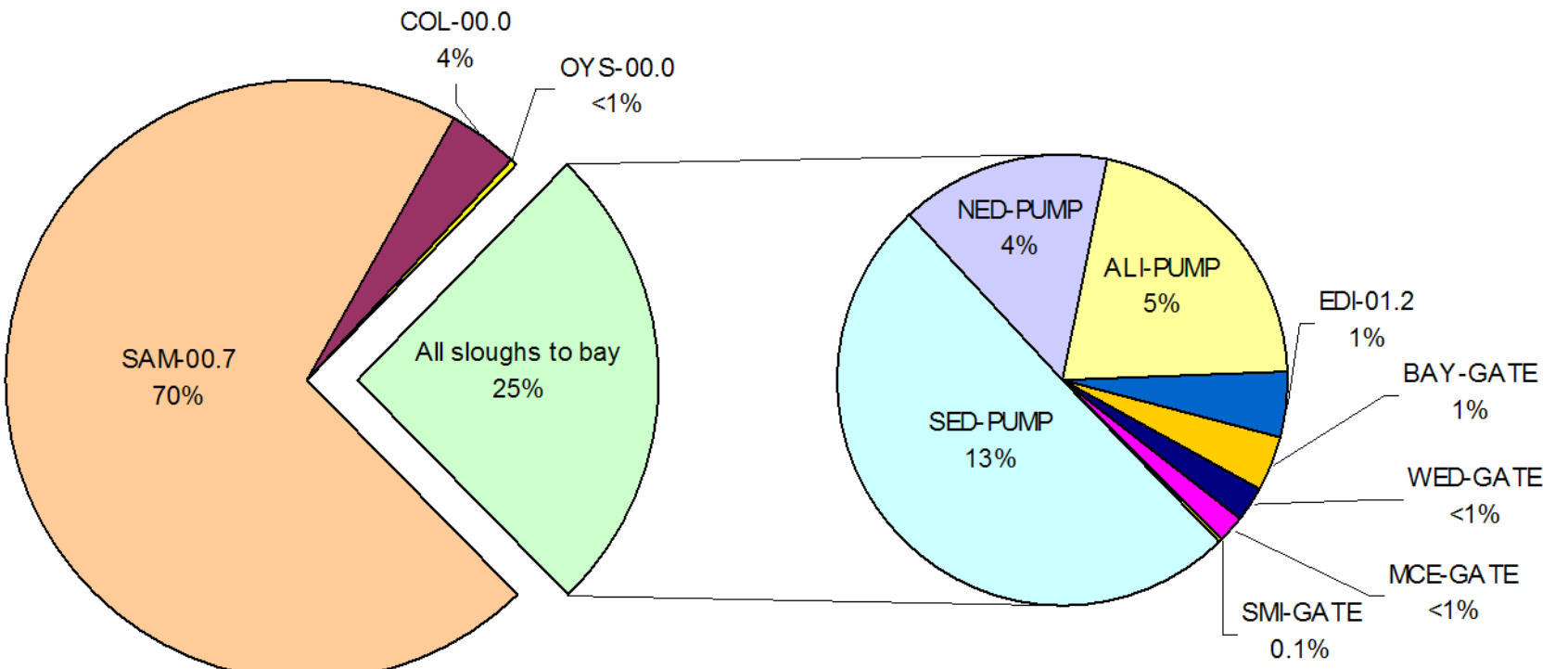


Ecology's ambient monthly FC loading (1995-2008)



Ecology's TMDL FC loading (2006-2007)

Where's the FC loading coming from?

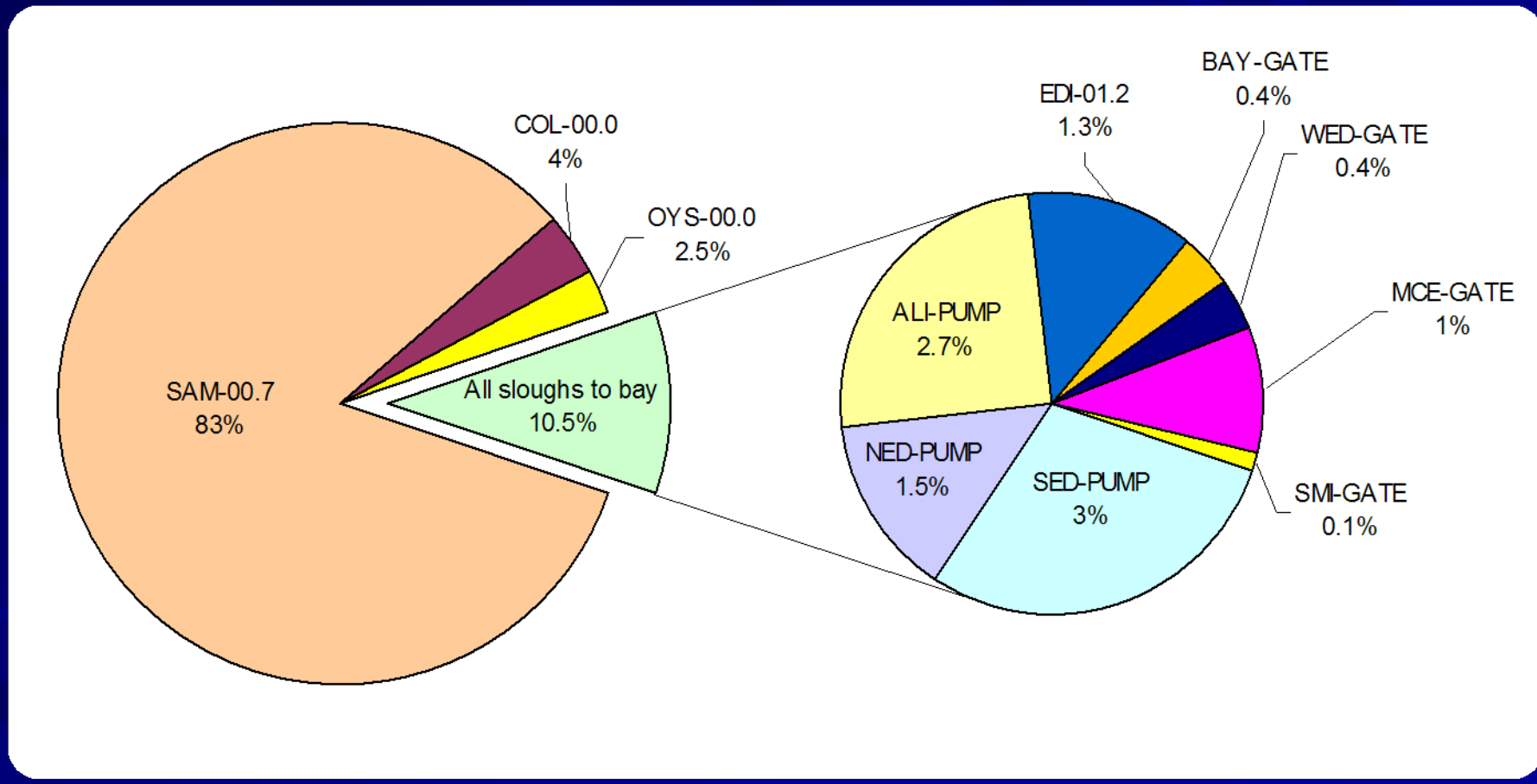


FC Loading to Bay

Site	Wet load (Nov 1 - Feb. 28) billions cfu/day	Intermediate load (Mar 1 - June 30) billions cfu/day	Dry load (Jul 1 - Oct 31) billions cfu/day	Percent of total wet load %	Percent of total intermediate load %	Percent of total dry load %
03-SAM-00.7	2044.6	181	45	70.1	54.2	86.9
03-ALI-PUMP	357.7	10.2	0.4	12.3	3.1	0.7
03-SED-PUMP	104.6	101.8	2.3	3.6	30.5	4.4
03-WED-GATE	48.1	0.3	0.0	1.7	0.1	0.0
03-EDI-01.2	41.7	6.6	0.1	1.4	2.0	0.2
03-BAY-GATE	27.3	1.9	0.8	0.9	0.6	1.6
03-MCE-GATE	6.9	1.0	0.5	0.2	0.3	1.0
03-NED-PUMP	191.7	17.0	0	6.6	5.1	0.0
03-SMI-GATE	3.3	0.1	0.1	0.1	0.0	0.1
03-COL-00.0	61.5	13.2	2.6	2.1	3.9	4.9
03-OYS-00.0	30.3	0.9	0.1	1.0	0.3	0.2
Total	2917.8	333.9	52.1	100.0	100.0	100.0
Total (minus Samish)	873.2	152.9	6.8	29.9	45.8	13.1
Total (sloughs only)	781.4	138.9	4.1	26.8	41.6	8.0

- Samish R. adds an average of 70% of total load to bay
- All other sources add an average of 30% of total load to bay
- Sloughs alone add an average of 25% of total load to bay

Where is the water coming from?



Freshwater Sources to Bay

Site	Wet ave. flow (Nov 1 - Feb. 28)	Intermediate ave. flow (Mar 1 - June 30)	Dry ave. flow (Jul 1 - Oct 31)	Wet percent of total flow	Intermediate percent of total flow	Dry percent of total flow
	cubic ft./sec.	cubic ft./sec.	cubic ft./sec.	%	%	%
03-SAM-00.7	468	149	33	78.3	80.0	91.3
03-ALI-PUMP	20	6	0.5	3.3	3.2	1.4
03-SED-PUMP	20	8	0.5	3.3	4.3	1.4
03-WED-GATE	6.8	0.2	0	1.1	0.1	0.0
03-EDI-01.2	17.4	1.0	0.2	2.9	0.5	0.6
03-BAY-GATE	2.5	0.5	0.2	0.4	0.3	0.6
03-MCE-GATE	6.9	1.0	0.5	1.2	0.5	1.4
03-NED-PUMP	10	5	0	1.7	2.7	0.0
03-SMI-GATE	0.5	0.1	0.1	0.1	0.1	0.3
03-COL-00.0	23.8	9.4	0.9	4.0	5.1	2.5
03-OYS-00.0	21.9	5.9	0.2	3.7	3.2	0.6
Total	597.8	185.6	35.7	100.0	100.0	100.0
Total (minus Samish)	129.8	37.1	3.1	21.7	20.0	8.7
Total (sloughs only)	84.1	21.8	2.0	14.1	11.7	5.6

- Samish R. adds an average of 83% of total freshwater to bay
- All other sources add and average of 17% of total water to bay
- Sloughs alone add an average of 10% of total water to bay

How did we get tidegate and pump station flows?

- Tidegates (seasonal average)
  - Took flows/notes during all conditions during regular surveys.
  - Did special surveys (dry and wet), taking flow up to 3 times during time gates were open.
  - Calculated average flow for each gate when they were open.
  - Estimated how long each gate was open during each and every tide.
  - Multiplied flow by total time the gates were open each season to get estimated total cfs to bay for each season.
  - Divided by number of days in season to get daily flow for each season.
    - Inherent estimations, but method was surprisingly accurate, time consuming, and complicated.
- Pump stations (seasonal average)
  - Measured discharge once at each pump (they always pumped at same rate, no matter what the head pressure)
  - Estimated when pumps were on from lots and lots of notes and special surveys (no electrical records or anyone to help here)
  - Multiplied flow times time the pumps were on for each season.

Samish R. FC reductions necessary to bring streams back into compliance with state standards and protect bay resources

Site ID w/River Mile	Site Location	Number of Samples	Critical Period	Critical Period FC (cfu/100mL) 90th %tile	Critical Period FC (cfu/100mL) Geo-mean	FC Reduction	FC Target Capacity (cfu/100mL) 90th %tile	FC Target Capacity (cfu/100mL) Geo-mean
03-SAM-00.7	Bayview/ Edison Rd	25	all year	156	35	72%	43	10
03-SAM-04.6	Thomas Rd	25	all year	243	56	72%	67	15
03-SAM-06.5	Chuckanut Dr	25	all year	226	65	73%	62	18
03-THO-00.3	Thomas Ck at Old Hwy 99	24	May-Sep	920	254	78%	200	55
03-SAM-10.3	Hwy 99	24	May-Oct	428	181	53%	200	85
03-FRI-00.8	Friday Ck at Bow Hill / Prairie Rd	24	Jun-Sep	936	174	79%	200	37
03-SAM-13.1	F&S Grade Rd	24	May-Oct	380	130	47%	200	69
03-SWE-00.0	Swede Ck at Grip Rd	24	Apr-Sep	828	157	76%	200	38
03-SKA-00.5	Skarrup Creek at first road crossing	21	all year	750	170	73%	200	45
03-SAM-15.0	2nd Prairie Rd Crossing from Hwy 99	24	May-Aug	572	97	65%	200	34
03-PAR-00.0	Parson Ck at confluence w/Samish R	24	July-Oct	3605	1976	95%	182	100
03-SAM-16.5	Off Prairie Rd upstream of Parson Ck	24	May-Aug	356	87	44%	200	49
03-SAM-20.7	3rd Praire Rd crossing from Hwy 99	24	May-Aug	372	74	46%	200	40
03-SAM-22.0	Hwy 9	24	none	--	--	--	200	100
03-SAM-26.6	Wickersham Rd	24	none	--	--	--	200	100
03-ENN-00.0	Ennis Ck at mouth, Wickersham Rd	21	none	--	--	--	200	100
03-SAM-28.8	Innis Ck Rd (in Doran)	24	all year	1604	149	88%	200	19

How'd we get FC targets for the lower Samish River?

- Since it appears that the Samish R. impacts the bay's FC levels so much, and not all bacteria die instantly when they hit the salt water, the Samish should meet 43 cfu/100mL at the mouth (marine 90th percentile criterion).
- In order for the mouth of the Samish (RM 0.7) to meet the marine criterion, Thomas Rd (RM 4.6) should meet 67 cfu/100mL and Chuckanut Dr. (RM 6.5) should meet 62 cfu/100mL). These targets are guides to help get the mouth to 43 cfu/100mL.
- When upstream reductions occur at HWY 99, Thomas Ck, and Friday Ck mouth, these targets should be attainable.
- More detail in report.

FC reductions for sloughs and creeks

Site ID w/River Mile	Site Location	Number of	Critical Period	Critical Period FC (cfu/100mL) 90th %tile	Critical Period FC (cfu/100mL) Geo-mean	FC Reduction	FC Target Capacity (cfu/100mL) 90th %tile	FC Target Capacity (cfu/100mL) Geo-mean
03-COL-00.0	Colony Ck nr. mouth, up of tidegates	25	May-Oct	244	103	18%	200	85
03-ALI-PUMP	Drainage to Alice Bay	25	all year	127	16	66%	43	5
03-NED-PUMP	N Edison drainage at Key Ave.	17[1]	all year	330	109	39%	200	66
03-SED-PUMP	S Edison drainage nr. liquor store	21	all year	601	167	67%	200	56
03-BAY-GATE	Drainage W of Sam. R mouth	25	all year	342	52	42%	200	30
03-MCE-GATE	Tidegate to McElroy/Col. Slough	25	Apr-Sep	836	196	76%	200	47
03-WED-GATE	W Edison drainage nr. Edison Slough	15[1]	all year	428	41	53%	200	19
03-SMI-GATE	Drain to Edison Slough at Smith Rd	4	none	--	--	NA[2]	NA[2]	NA[2]
03-EDI-01.2	Edison Slough up of gates in Edison	24	Apr-Jul	846	129	76%	200	31
03-EDI-01.6	Edison Slough just up of school	25	Apr-Jul	960	153	79%	200	32
03-OYS-00.0	Oyster Ck near mouth	25	none	--	--	--	NA	NA

[1]Some samples were taken during the dry period, but not used because there was no flow.

[2]SMI-GATE reductions will occur as NED-PUMP's reduction targets are met. They are fed through the same slough system.

Friday and Thomas reductions

Site ID w/River Mile	Site Location	Number of	Critical Period	Critical Period FC (cfu/100mL) 90th %tile	Critical Period FC (cfu/100mL) Geo-mean	FC Reduction	FC Target Capacity (cfu/100mL) 90th %tile	FC Target Capacity (cfu/100mL) Geo-mean
03-FRI-00.8	Friday Ck at Bow Hill / Prairie Rd	24	Jun-Sep	936	174	79%	200	37
03-FRI-03.8	Friday Ck at Friday Ck. Rd	24	Jun-Sep	911	159	78%	200	35
03-SIL-00.4	Silver Creek at Friday Ck Rd	24	none	--	--	--	200	100
03-FRI-06.5	Friday Ck at Lake Samish Rd	24	none	--	--	--	200	100

Site ID w/River Mile	Site Location	Number of	Critical Period	Critical Period FC (cfu/100mL) 90th %tile	Critical Period FC (cfu/100mL) Geo-mean	FC Reduction	FC Target Capacity (cfu/100mL) 90th %tile	FC Target Capacity (cfu/100mL) Geo-mean
03-THO-00.3	Old Hwy 99	24	May-Sep	920	254	78%	200	55
03-WIL-00.0	Off F&S Grade Rd abv. Thomas Ck	17[1]	all year	2327	234	91%	200	20
03-THO-03.6	Off F&S Grade Rd abv. Willard Ck	24	May-Sep	3105	399	94%	200	26

[1]Some samples were taken during the dry period, but not used because there was no flow.

How do we calculate reductions?

- Rollback method
  - Compare critical season geomean and 90th percentile to FC criteria.
  - If one or both do not meet criteria, the whole distribution of FC values is “rolled-back” to match the most restrictive of the criteria
  - The 90th percentile is usually the most restrictive

Example roll-back

- Friday Creek (May – Sept was critical season, or the time when FC concentrations were statistically highest)
  - Geomean = 254 cfu/100mL
  - 90th percentile = 920 cfu/100mL

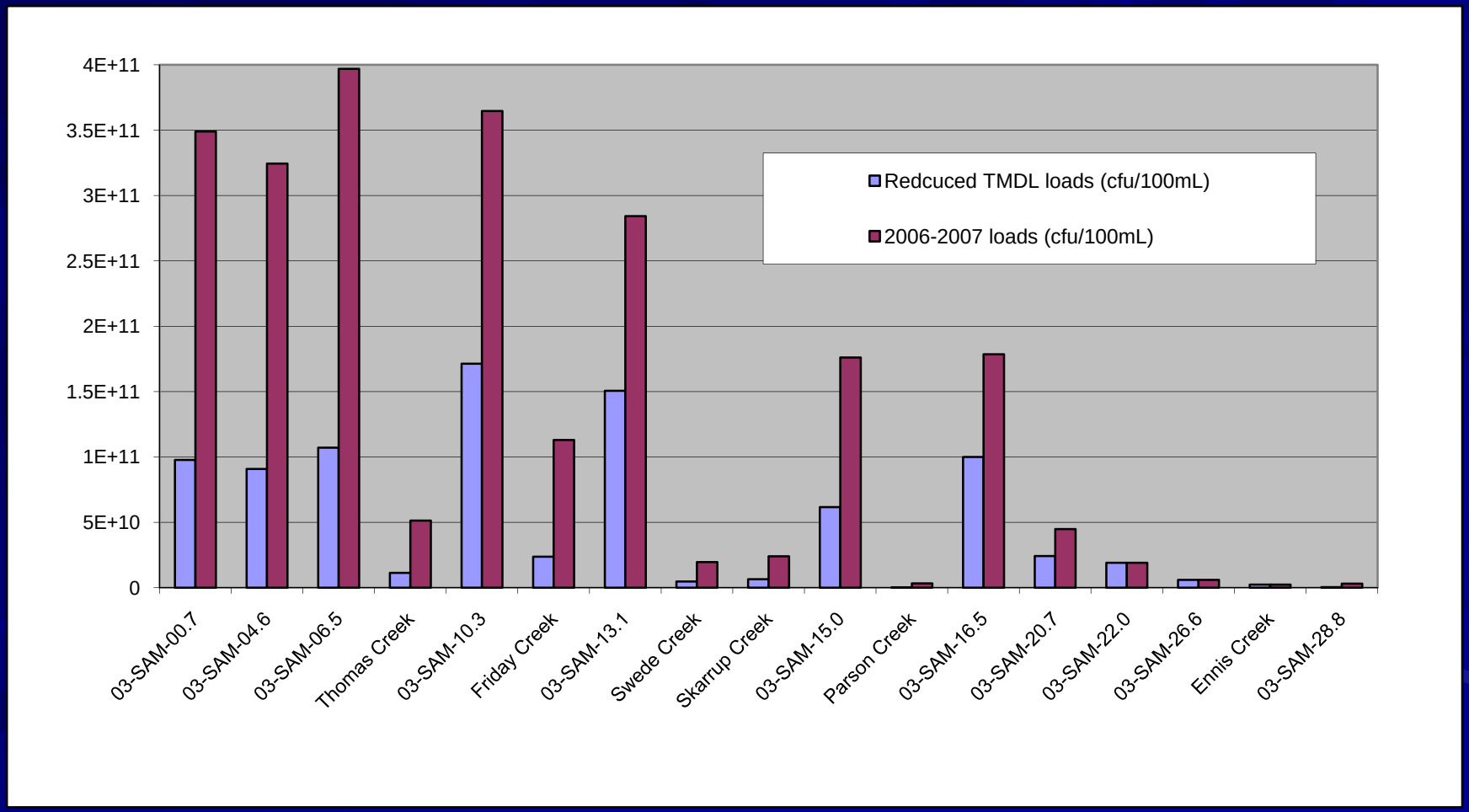
  - In this case, we rolled-back the 90th percentile to 200 from 920. This equals a 78% reduction during the critical season.

Critical Season

- The months when FC concentrations were at their highest.
- Examples…
  - Friday Creek = May to September
  - Upper Samish = May to Aug/Oct
  - Lower Samish = all year (because concentrations were high in summer, but loading was high in wet season)

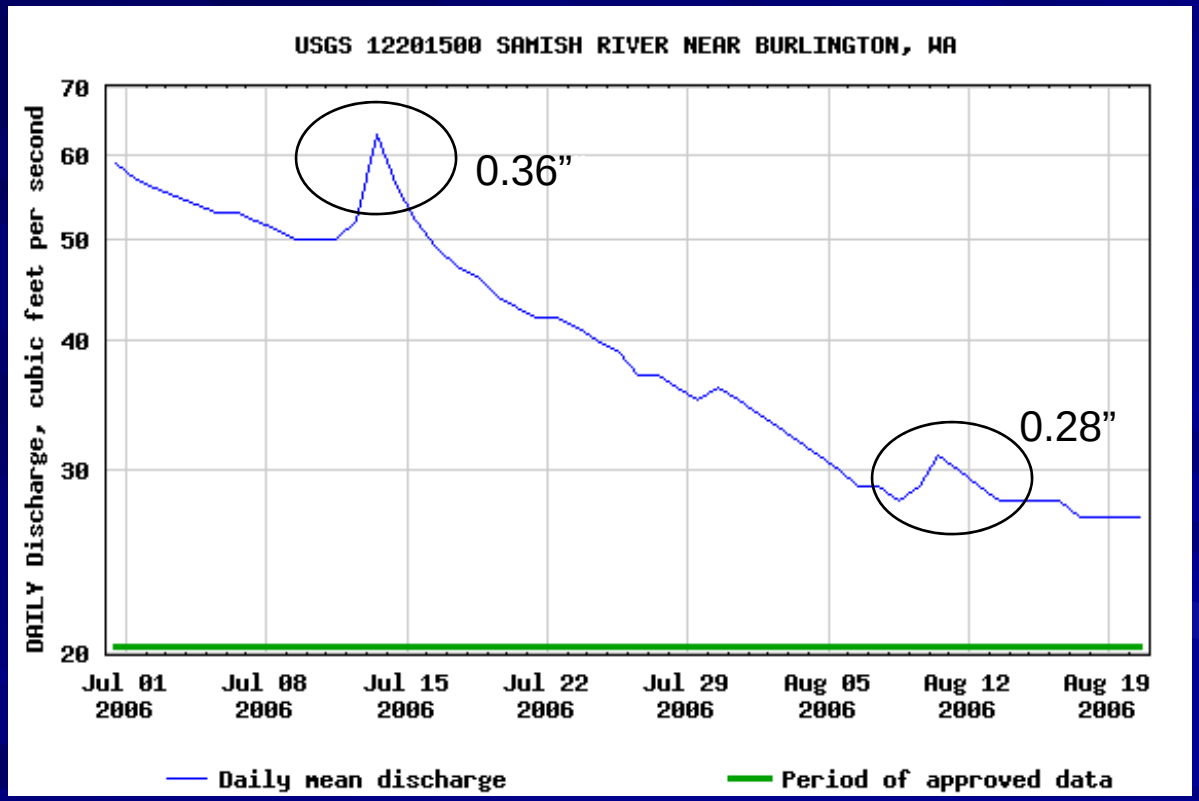

Chuckanut Bay
Larrabee State Park
Samish Bay
Samish Island
Padilla Bay
Lake Whatcom
Watershed Boundary
Samish Lake
Reed Lake
Cain Lake
Whatcom County
Skagit County
Oyster Ck
Friday Ck
Silver Ck
Butler Ck
Dry Ck
Parson Ck
Skarrup Ck
Swede Ck
Ennis Ck
Samish River
Thunder Ck
Colony Ck
Colony Rd
Hwy 99
Prairie Rd
Bow Hill Rd
Edison Slough
Ersig Rd
Avon Allen Rd
Thomas Rd
Thomas Ck
Willard Ck
Sunset Rd
Allen West Rd
Bayview Edison Rd
Farm to Market Rd
Alice Bay
Hatchery
Doran
Wickersham
Thornwood
Blanchard
Alger
Bow
Edison
Allen
Sedro Woolley
FC Target Reductions
No reduction required
1% to 29%
30% to 59%
60% to 99%
TMDL sampling sites
0 1 2 3 Miles
WA State Dept of Ecology, 2008

TMDL loads versus reduced loads



Samish R. summer rain events

FC at RM 4.6 increased from 57 cfu/100mL on July 11 (before rain) to 210 cfu/100mL on July 12 (after/during rain).



FC at RM 4.6 increased from 100 cfu/100mL (before rain) on August 9 to 310 cfu/100mL (after/during rain) on August 10.

November, 2006 rain event

USGS discharge at Samish RM 10.3 (HWY 99) increased 847% from November 5 to November 6 in response to the rain event. Ecology sampled on Nov. 6 and 7.

Samish River		
03-SAM-00.7	140	370
03-SAM-04.6	770	370
03-SAM-06.5	1600	350
03-SAM-10.3	1700	280
03-SAM-13.1	1100	270
03-SAM-15.0	900	
03-SAM-16.5	400	
03-SAM-20.7	280	
03-SAM-22.0	200	
03-SAM-26.6	92	
03-SAM-28.8	2800	

Samish River Tributaries		
03-ENN-00.0	69	
03-FRI-00.8	2100	200
03-FRI-03.8	1500	
03-FRI-06.5	430	
03-PAR-00.0	10000	
03-SIL-00.4	360	
03-SWE-00.0	1700	
03-THO-00.3	1000	1500
03-THO-03.6	3500	480
03-WIL-00.0	9400	1900

Samish Bay Tributaries		
03-COL-00.0	200	40
03-ALI-PUMP	2800	5000
03-NED-PUMP	2400	4800
03-SED-PUMP	220	470
03-BAY-GATE	930	2700
03-ALI-GATE		
03-MCE-GATE	1600	43000
03-WED-GATE	320	1500
03-SMI-GATE	110	290
03-EDI-01.2	550	360
03-EDI-01.6	140	160
03-OYS-00.0	140	27

November rain event cont'd.

- Samish R. flow increased again (95%) from November 12 to November 13.

- On November 14, the DOH sampled FC in Samish Bay. At station 82, FC results were higher than water the quality criterion (79 FC/100mL).

Priority cleanup areas

- Cleaning up direct sources of FC to the bay is the highest priority. Since Samish River is the largest FC source; clean up should begin there.
- Priority should also be given to the sloughs in south Edison (pump), north Edison (pump), Alice Bay (pump), and Colony Creek since they contribute the highest loads other than the Samish River to the bay.
- Other priority sites should include upper Samish River, upper Thomas Creek, lower Friday Creek, and Parson, Skarrup, and Swede Creeks.

Thanks!

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