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CHAPTER GREAT SALT LAKE

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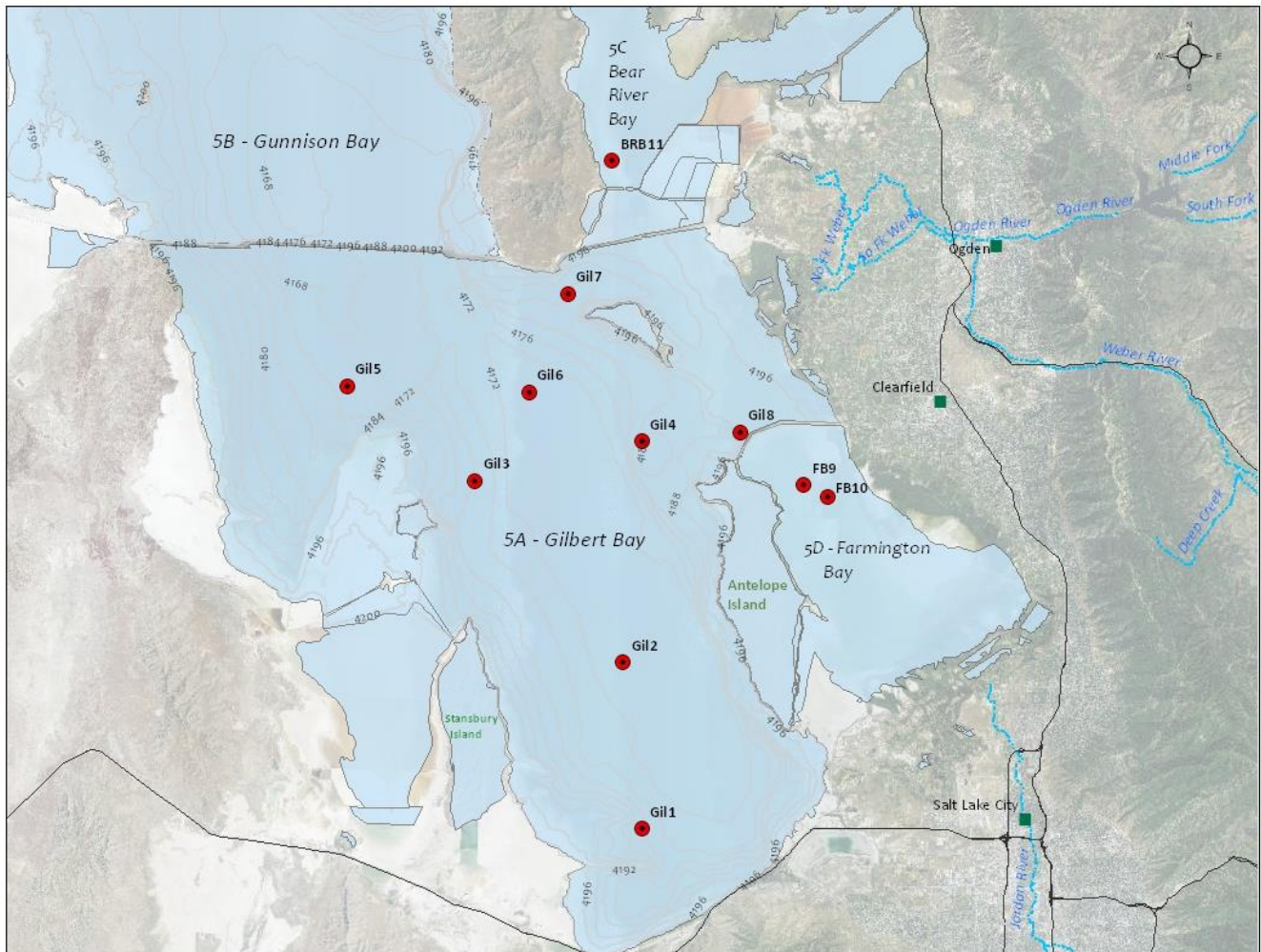


FIGURE 1 GREAT SALT LAKE BASELINE SAMPLE PLAN SAMPLING SITES. THE STUDY AREA INCLUDES THE “OPEN WATERS OF GREAT SALT LAKE” INCLUDING GILBERT BAY, GUNNISON BAY, FARMINGTON BAY, AND BEAR RIVER BAY AT CURRENT LAKE WATER LEVEL. THE UNION PACIFIC RAILROAD CAUSEWAY SEPARATES GILBERT BAY FROM GUNNISON BAY AND BEAR RIVER BAY. THE ANTELOPE ISLAND CAUSEWAY AT THE NORTHERN END OF ANTELOPE ISLAND AND THE ISLAND DIKE ROAD AT THE SOUTHERN END OF ANTELOPE ISLAND SEPARATE GILBERT BAY FROM FARMINGTON BAY.

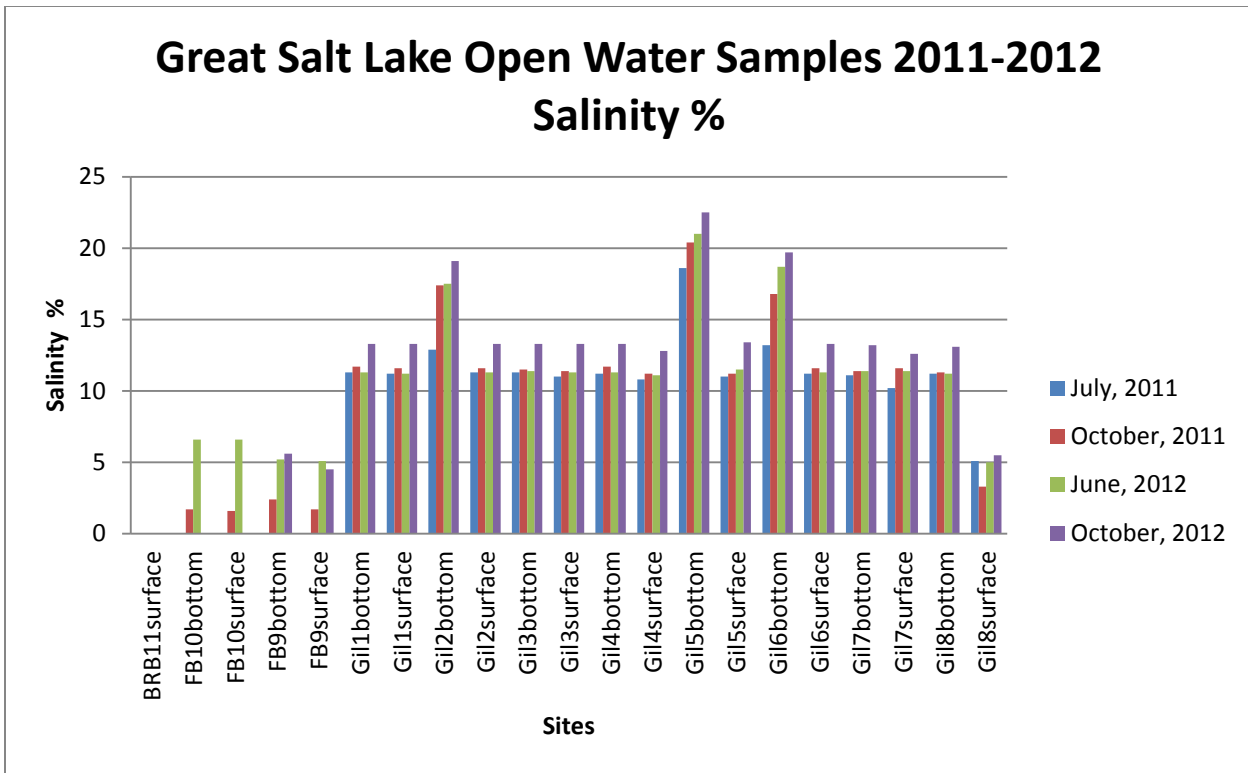


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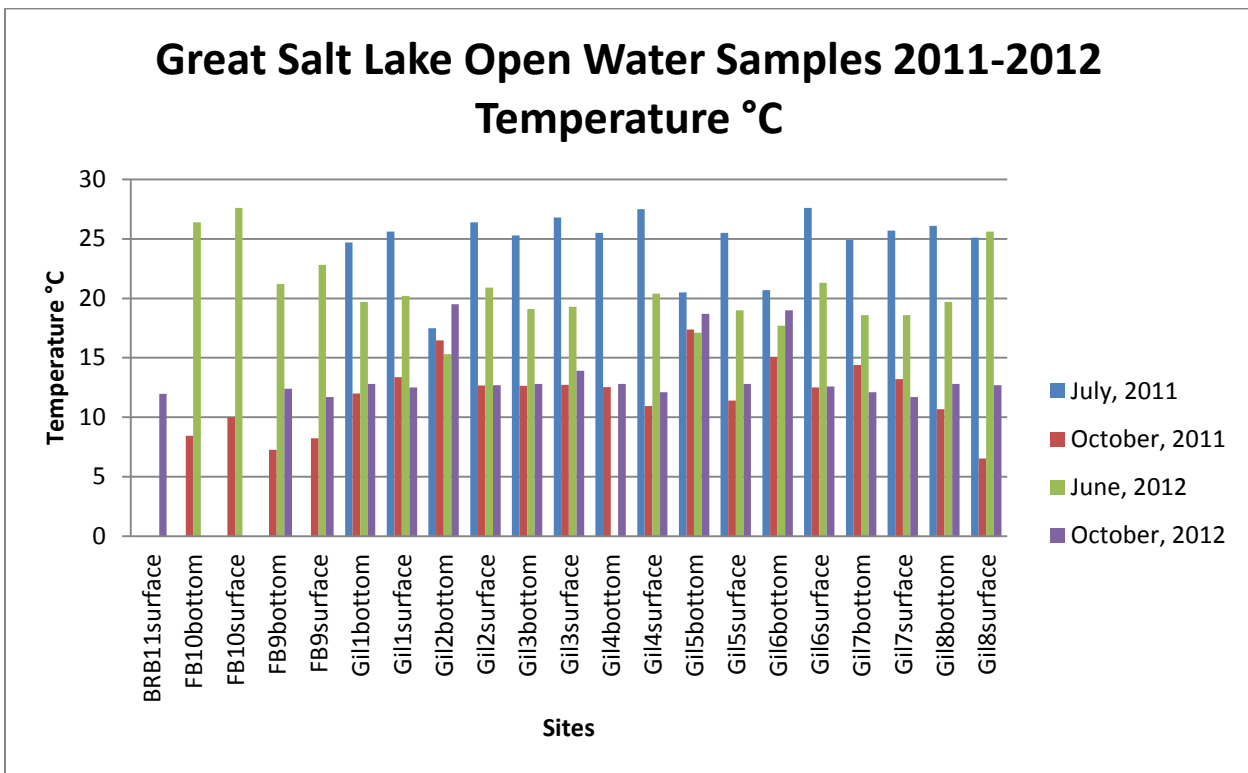


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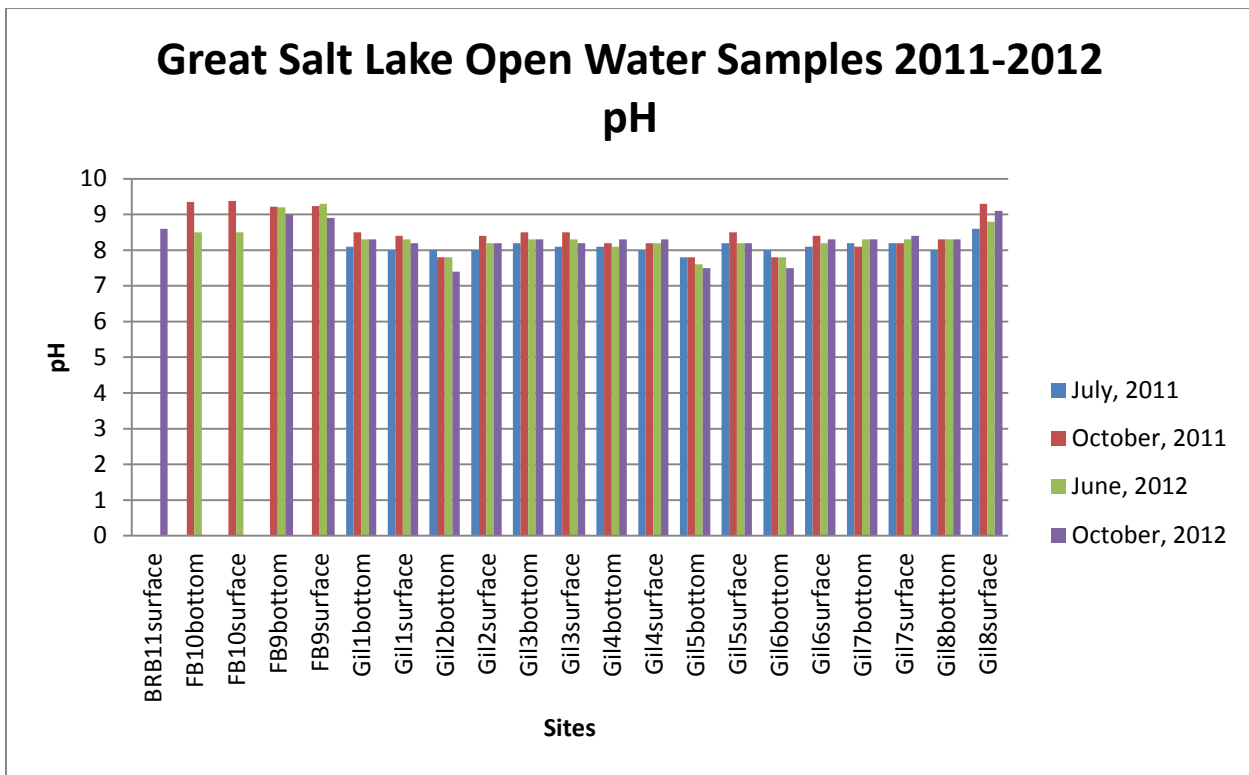


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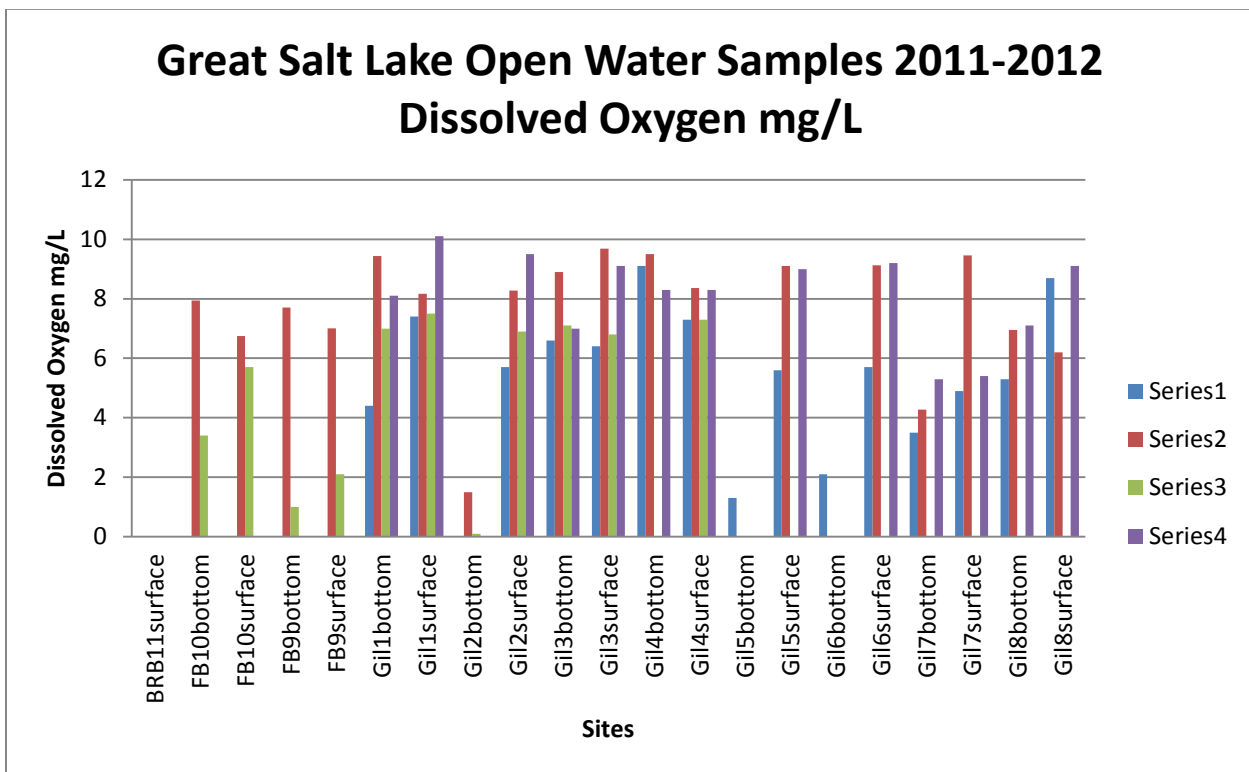


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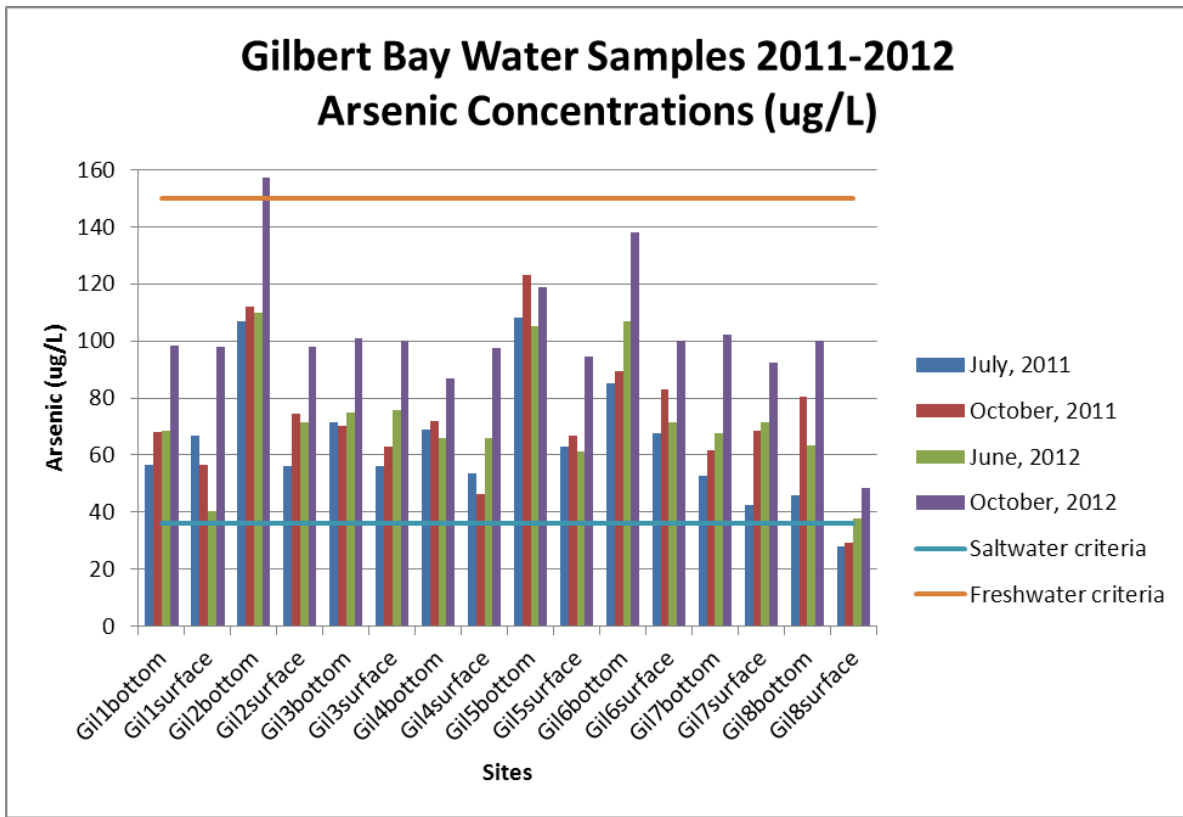


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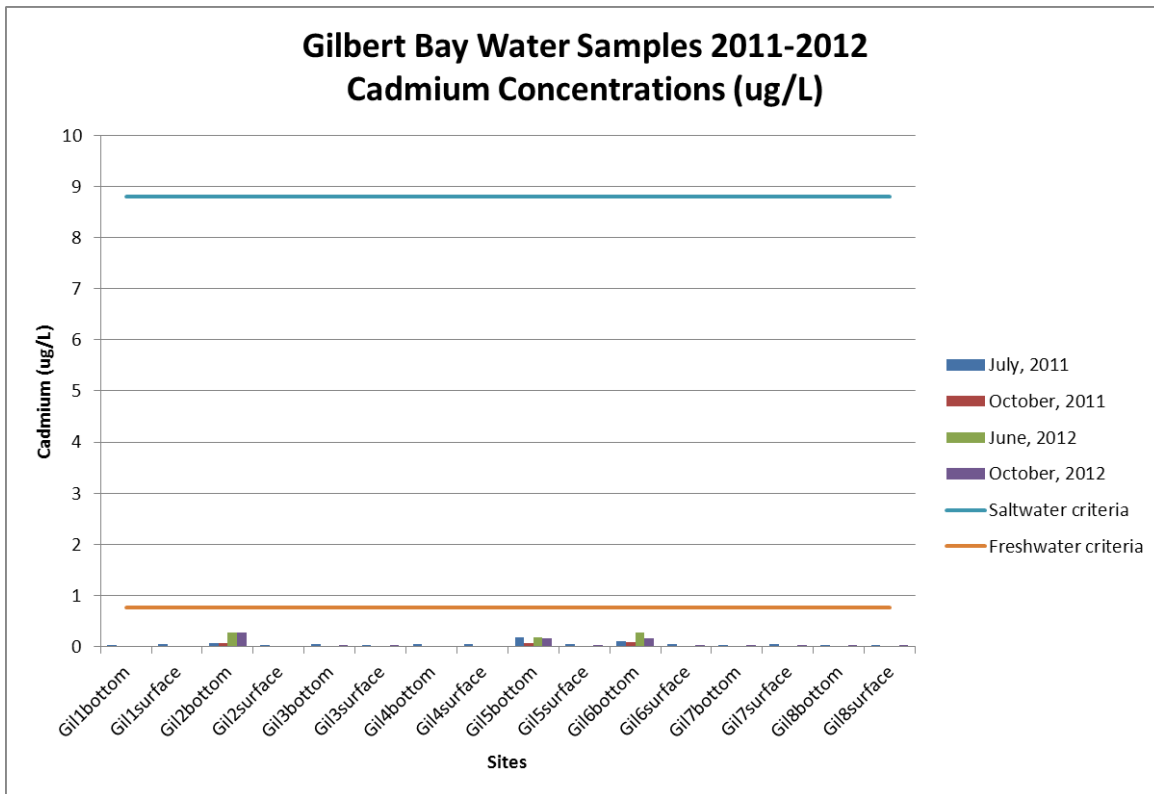


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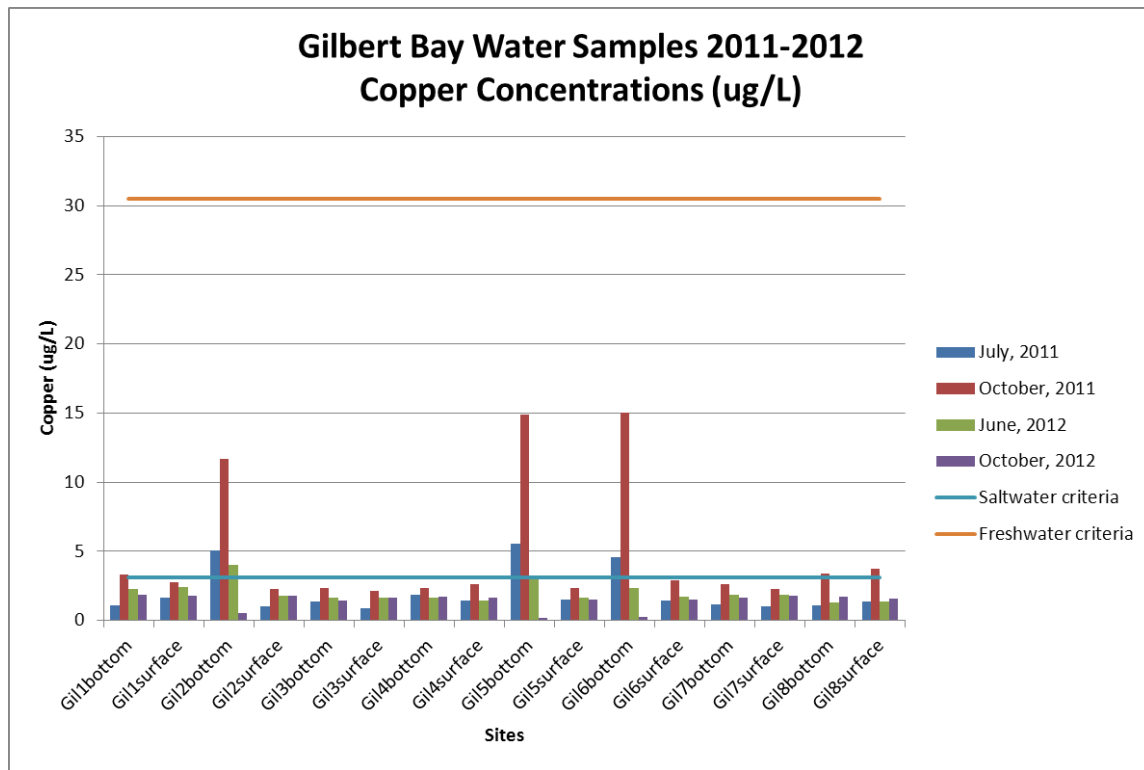


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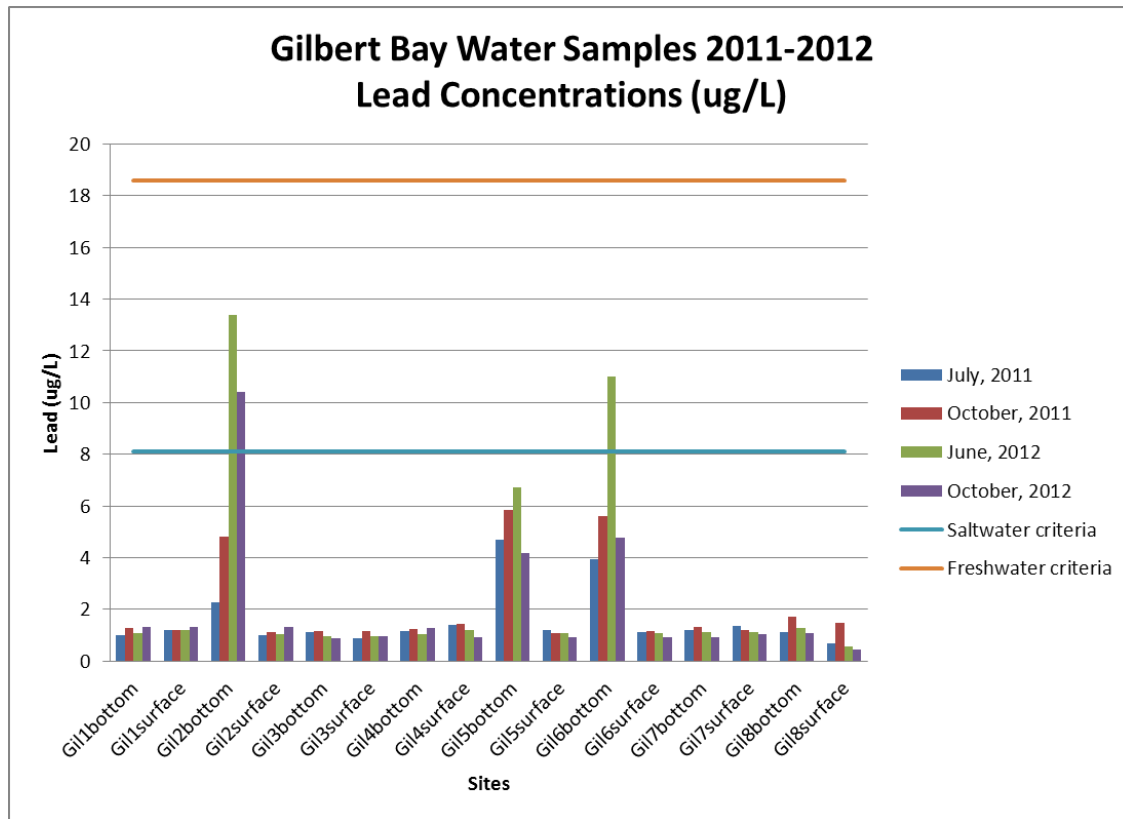


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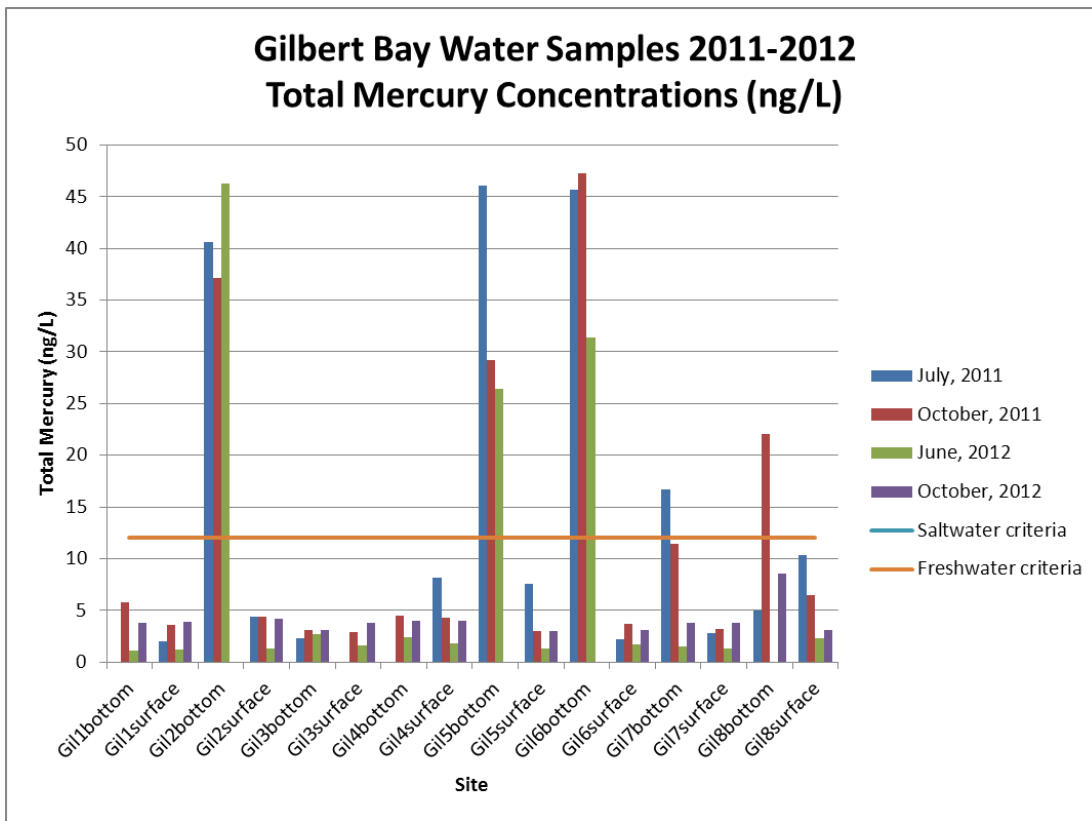


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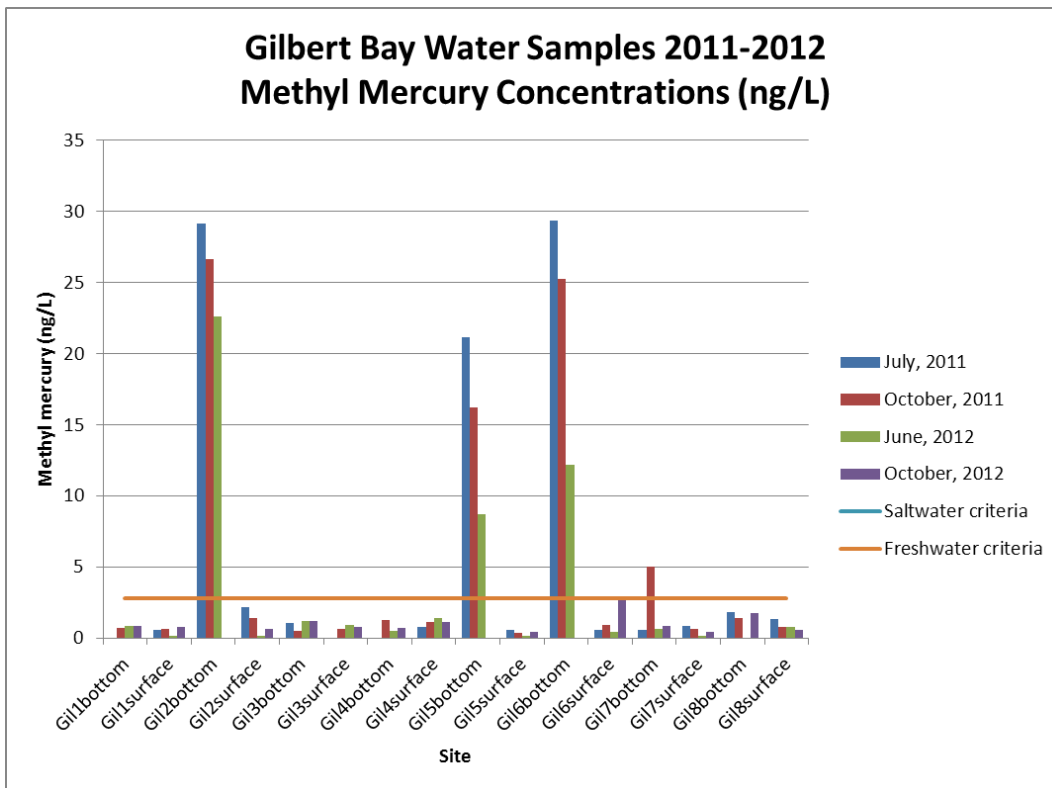


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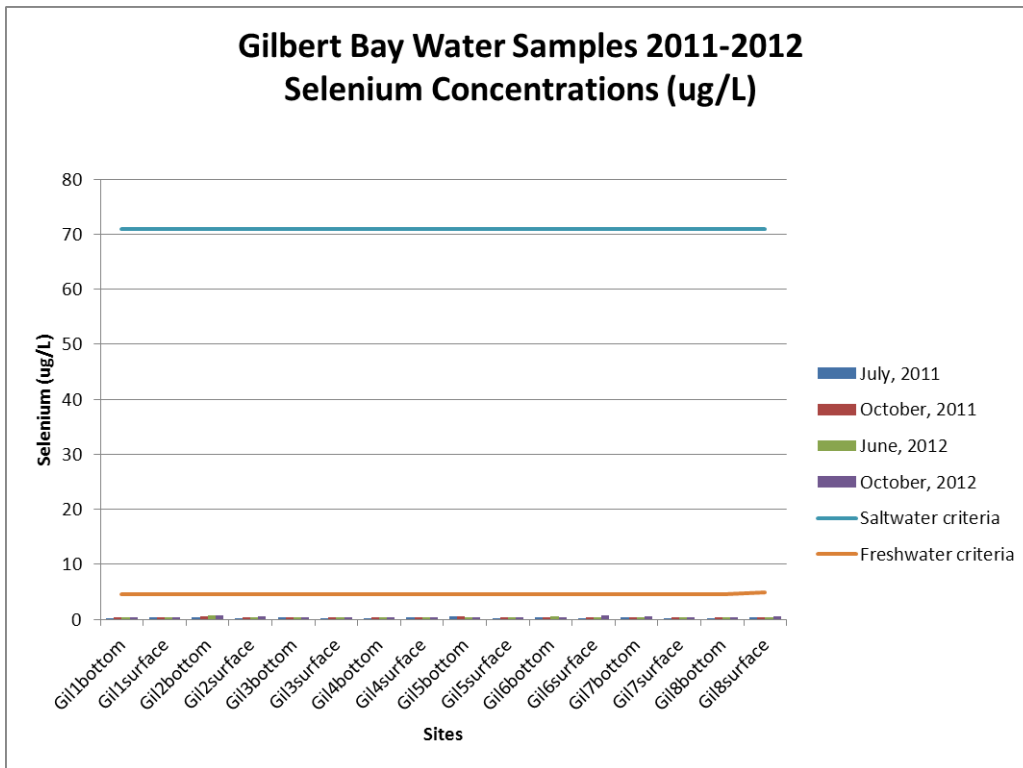


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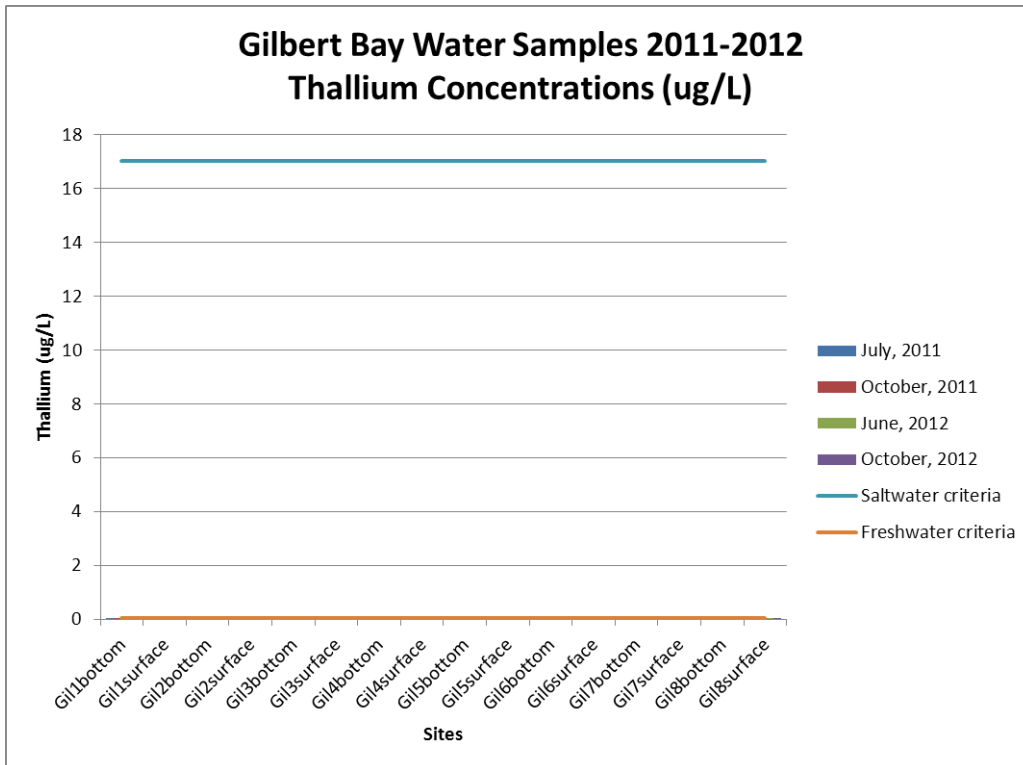


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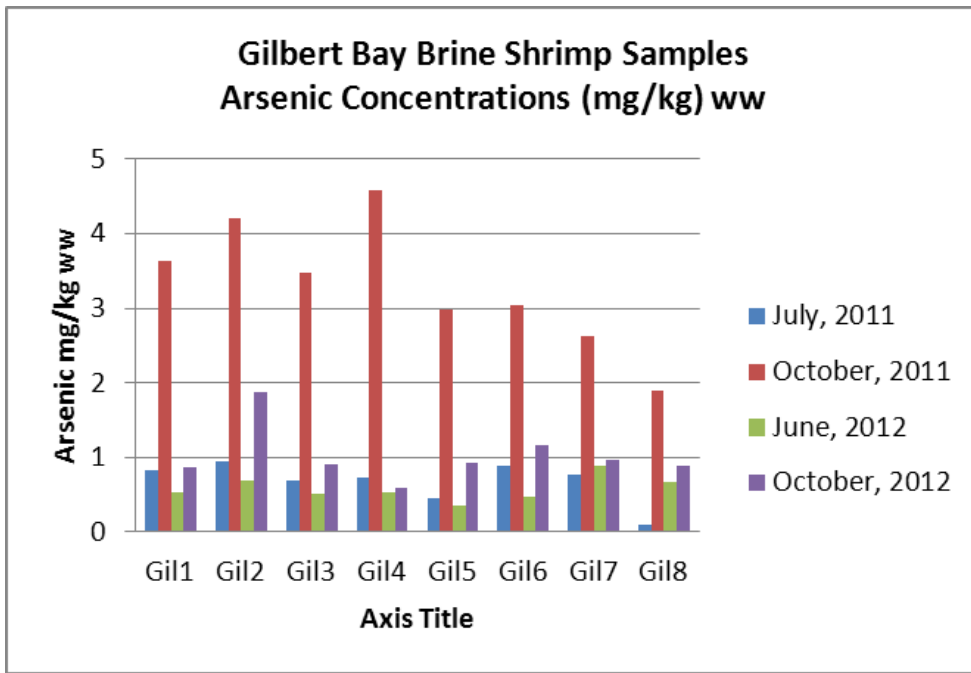


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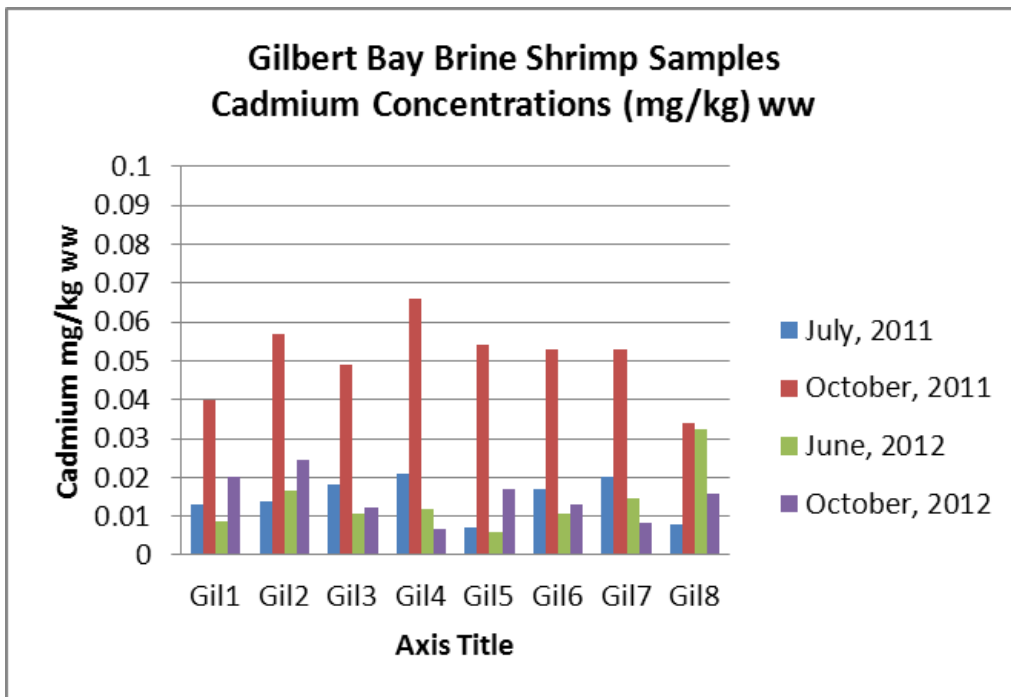


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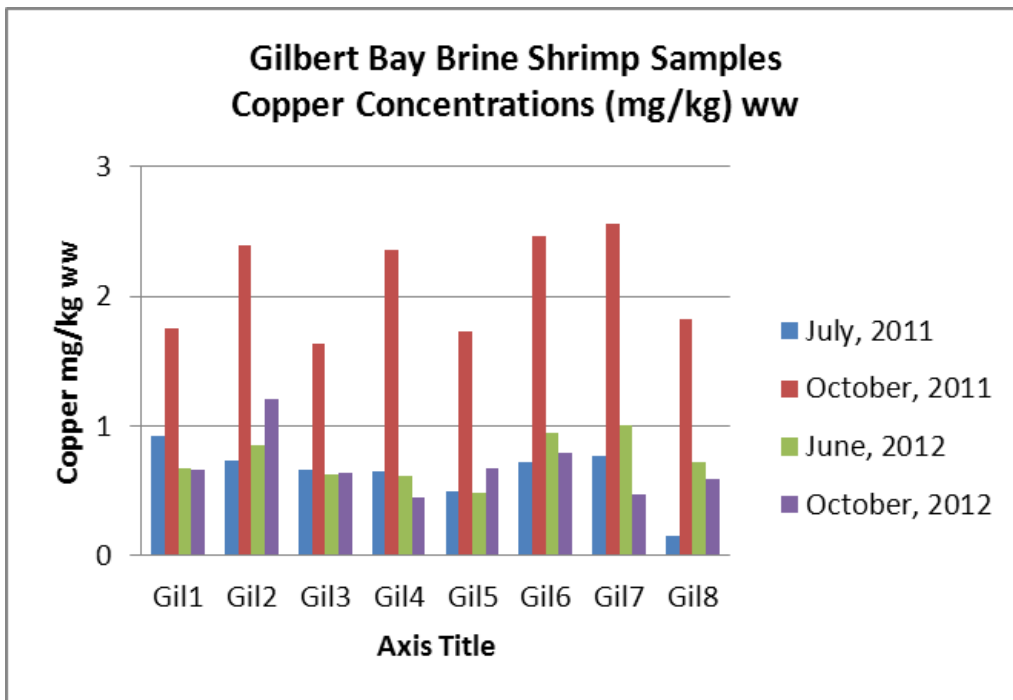


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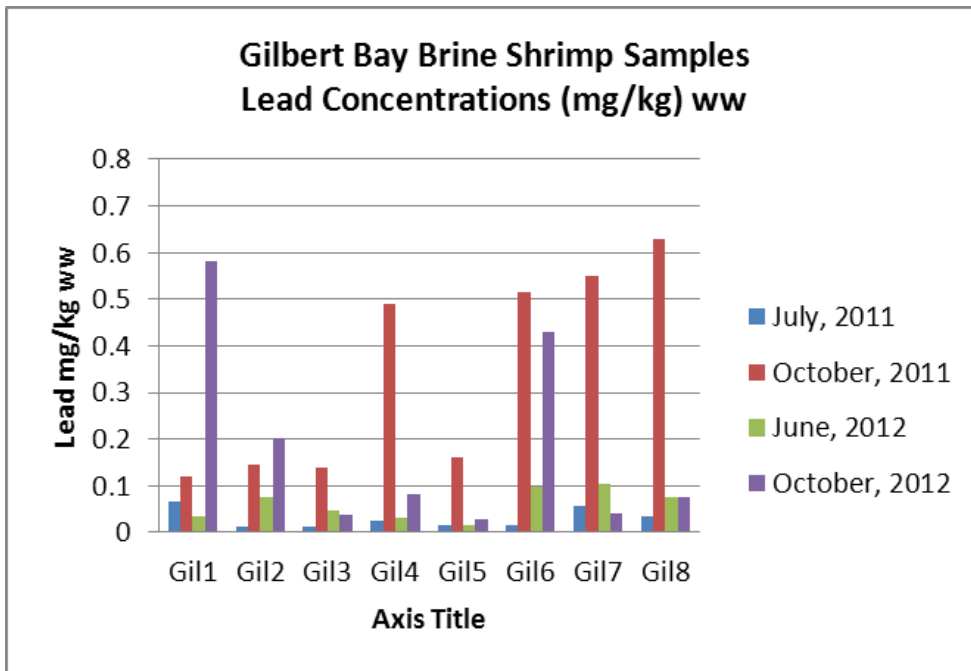


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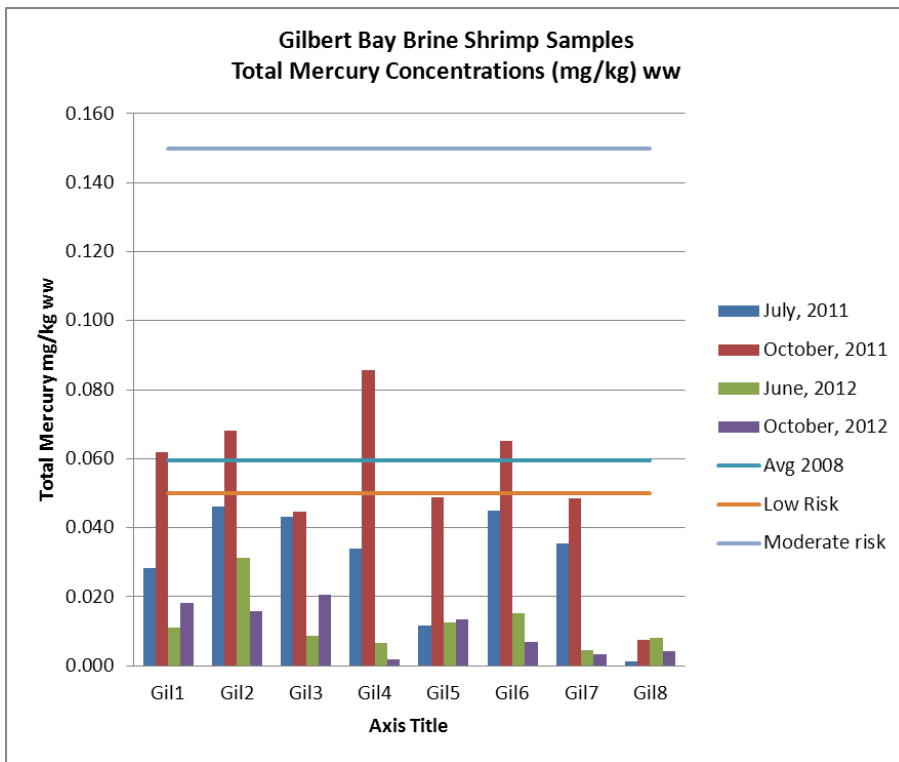


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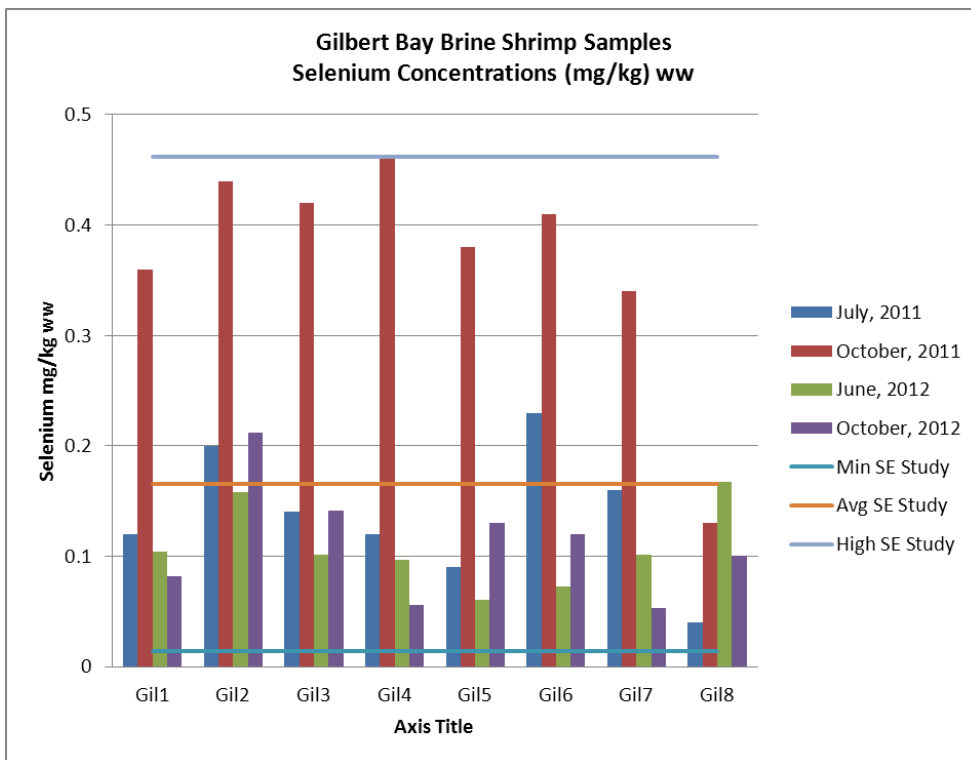


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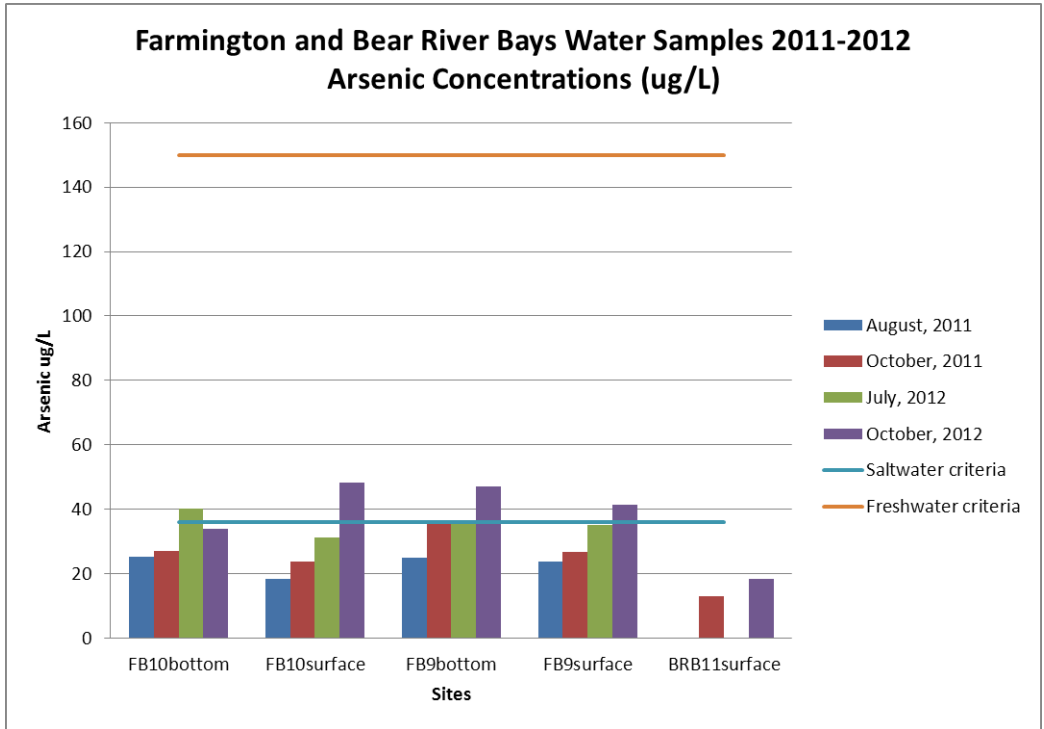


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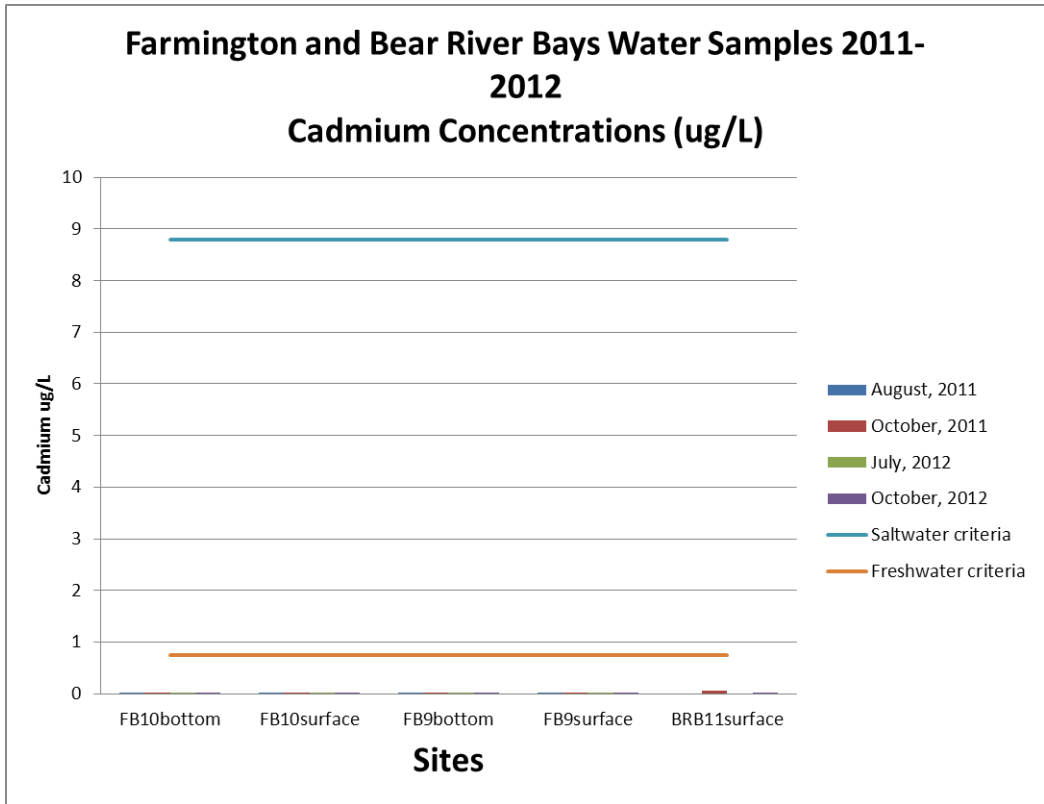


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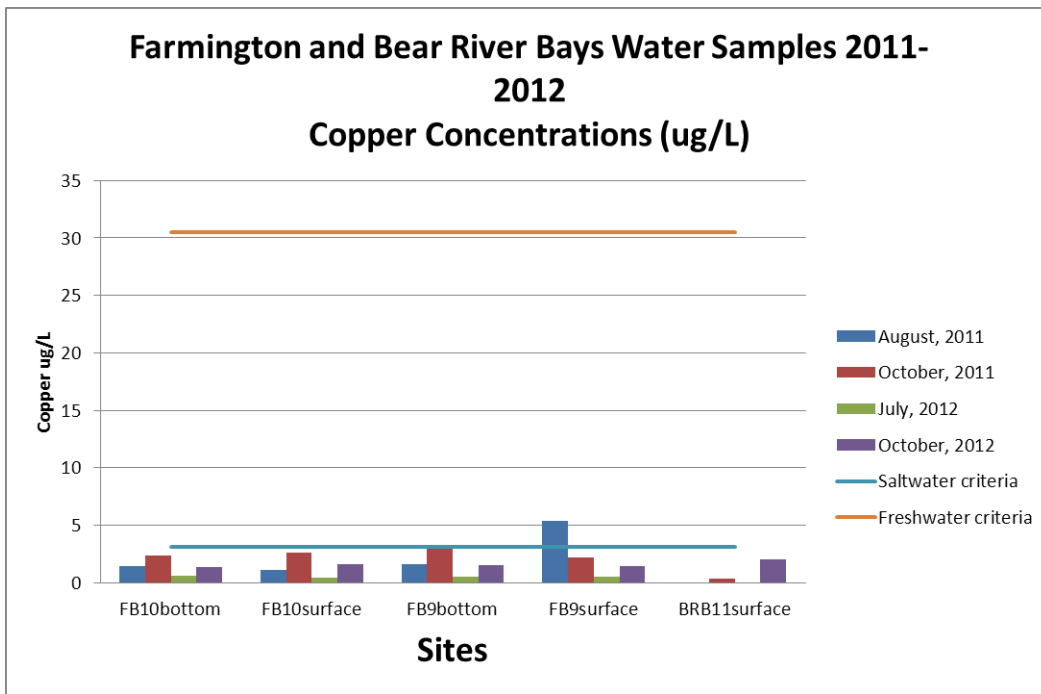


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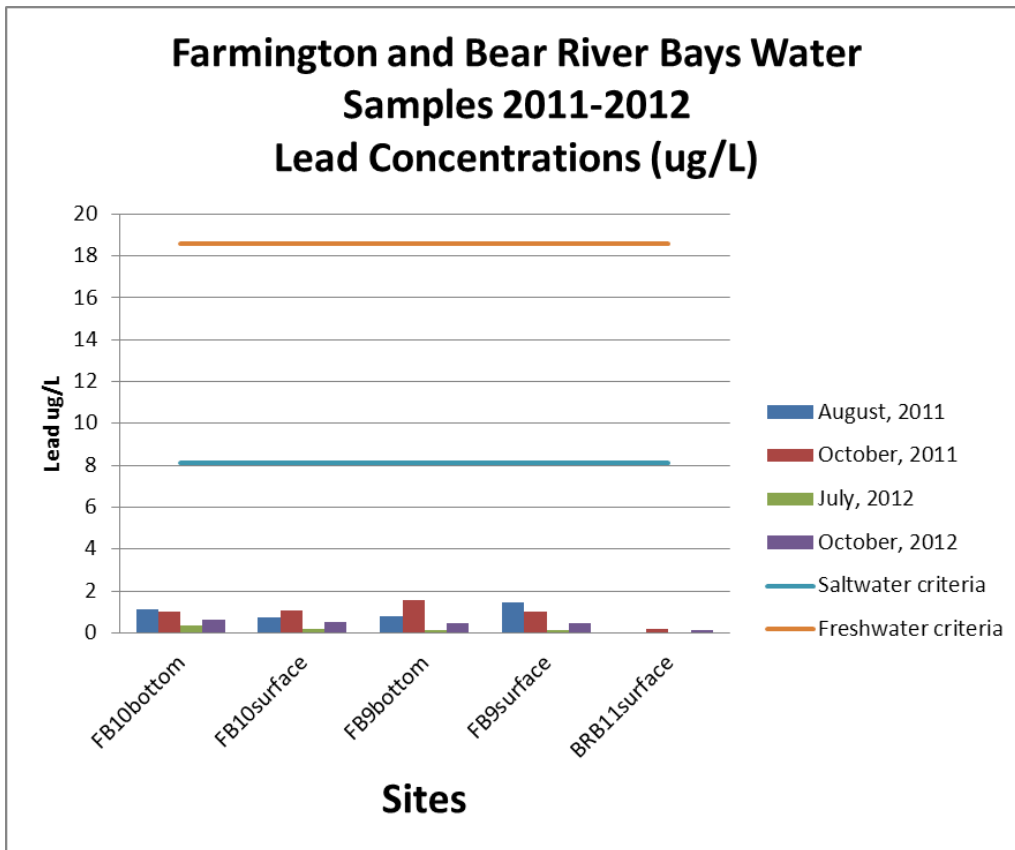


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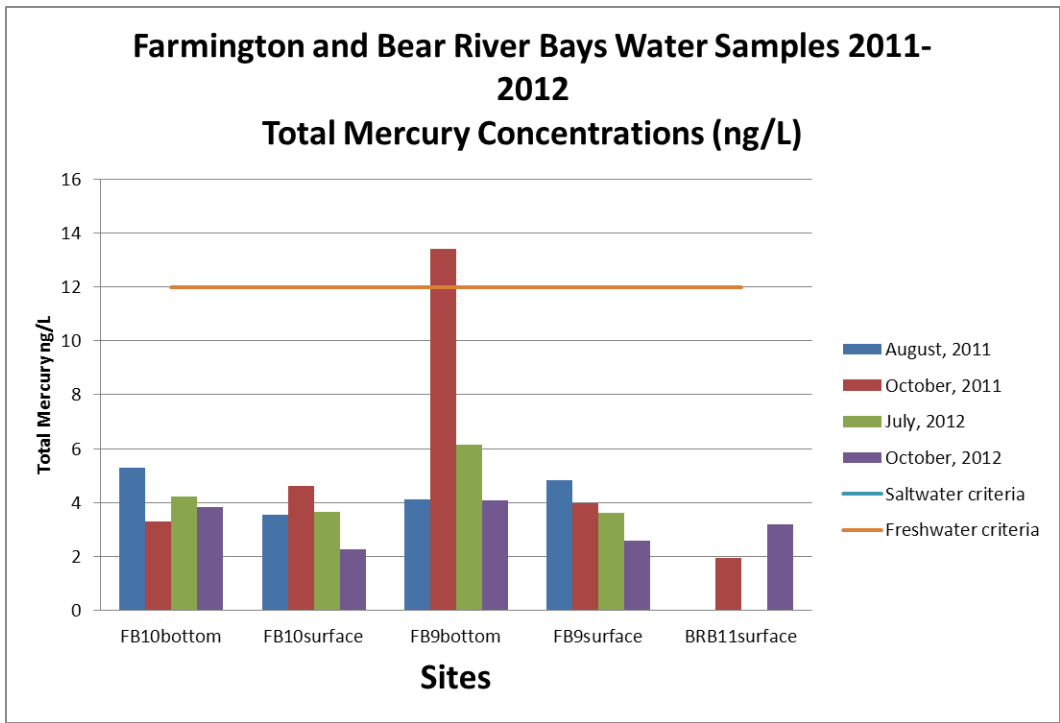


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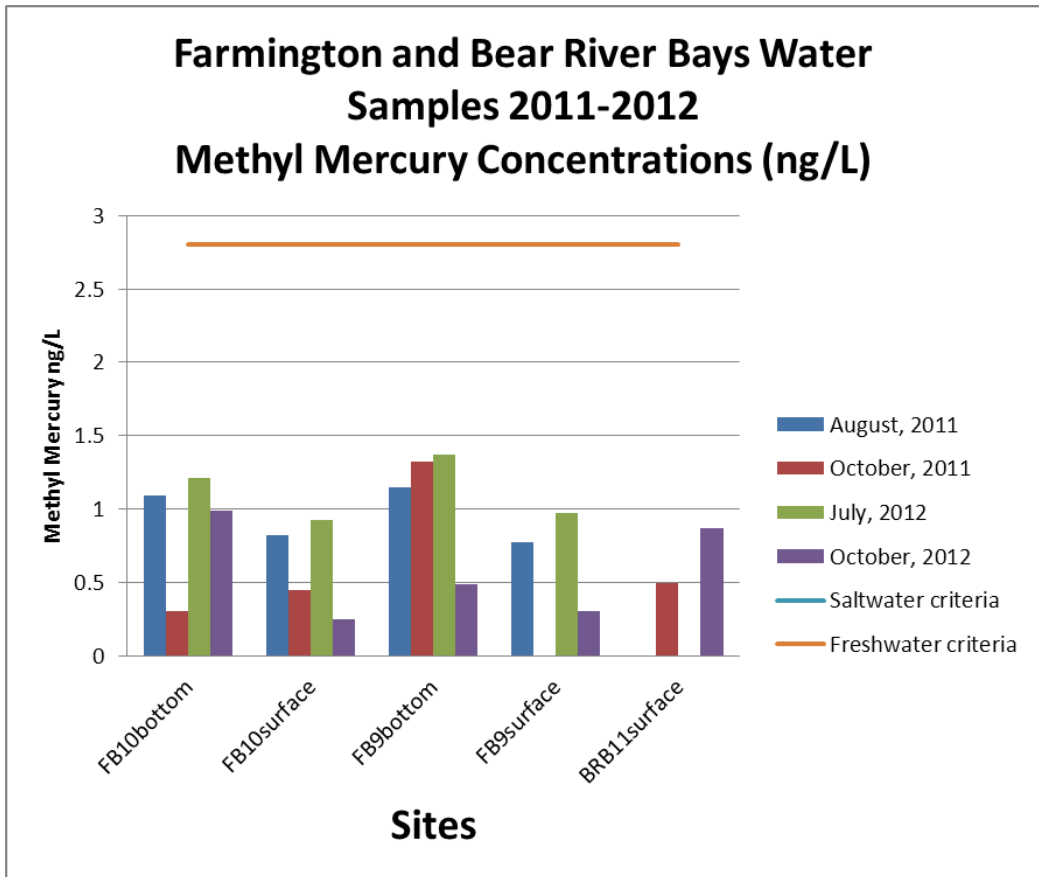


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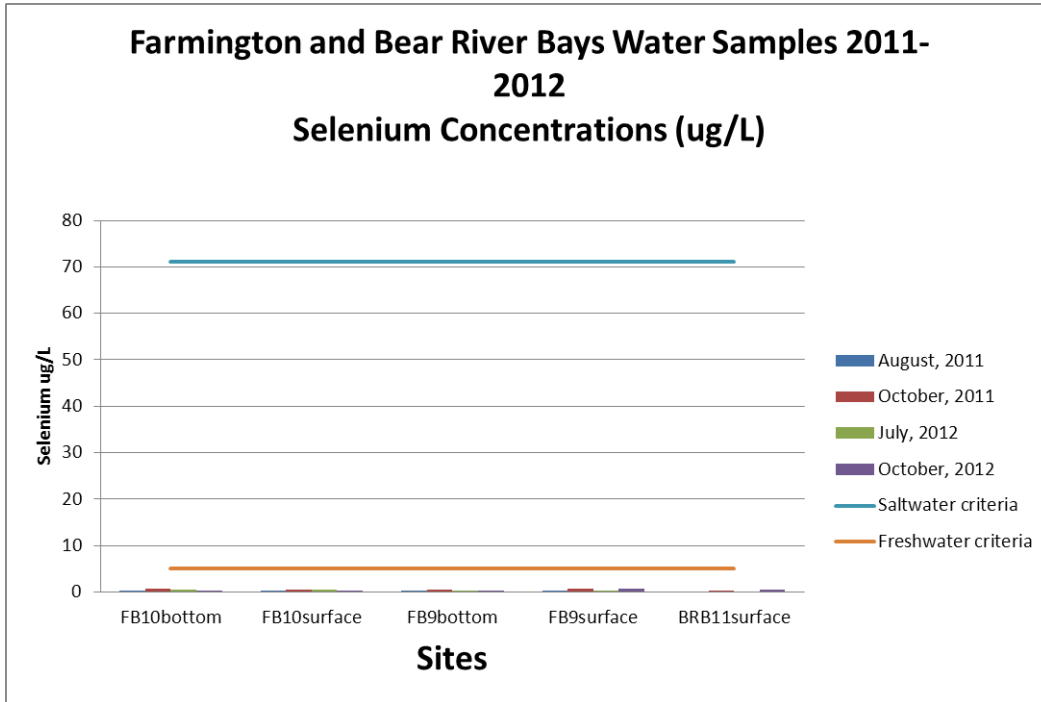


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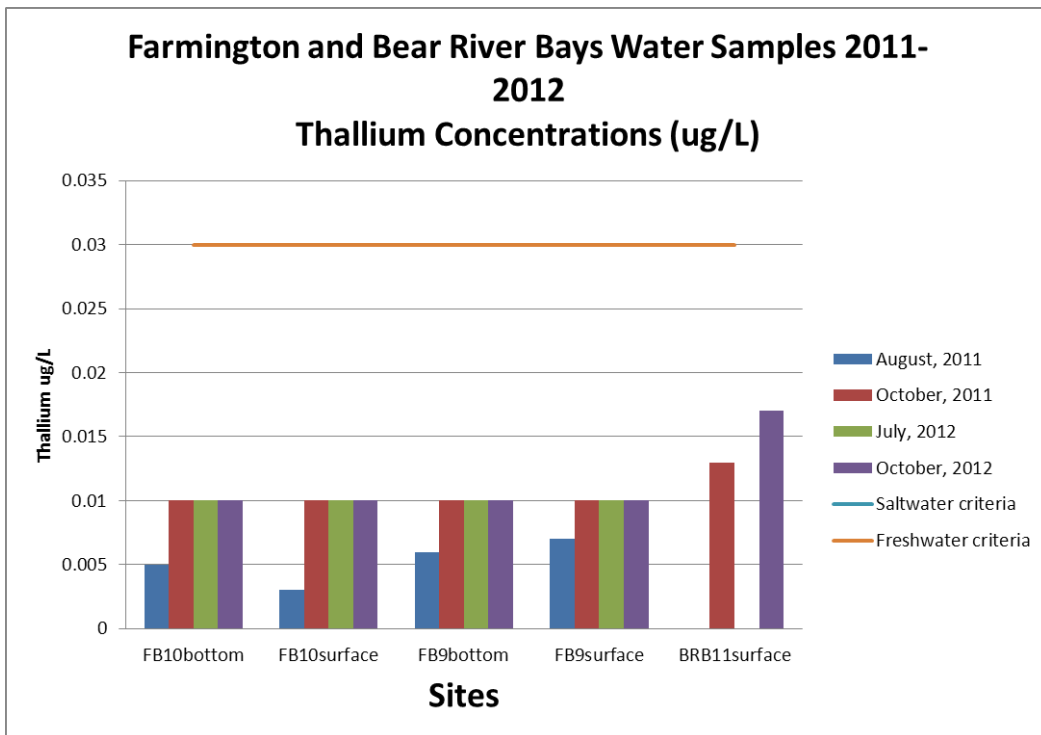


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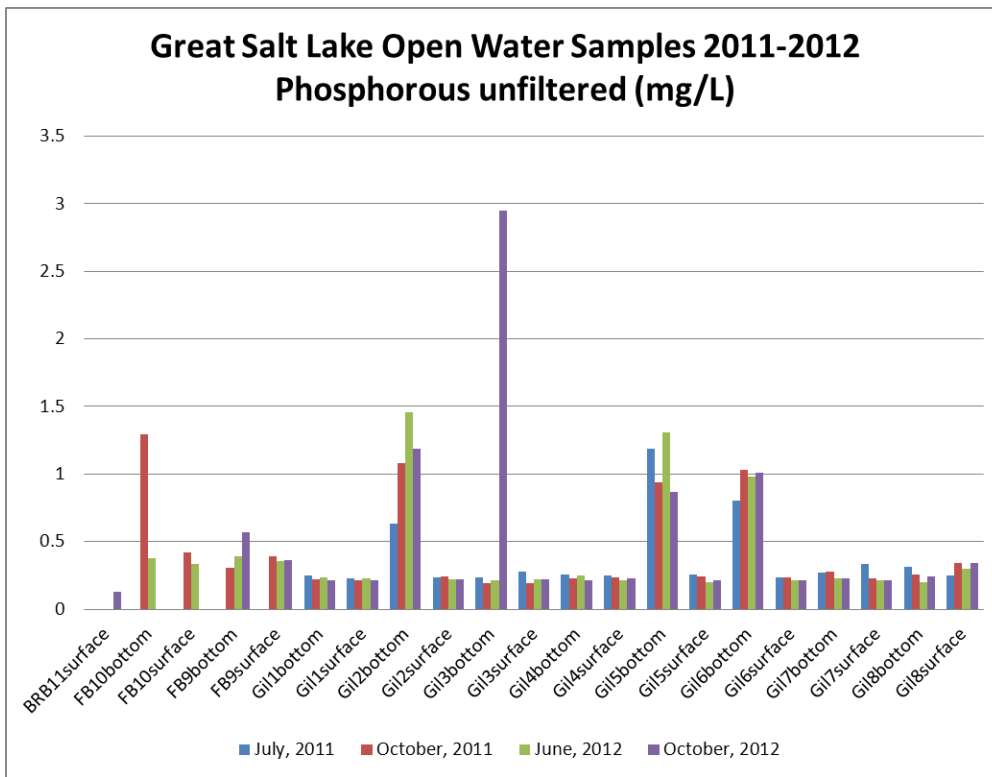


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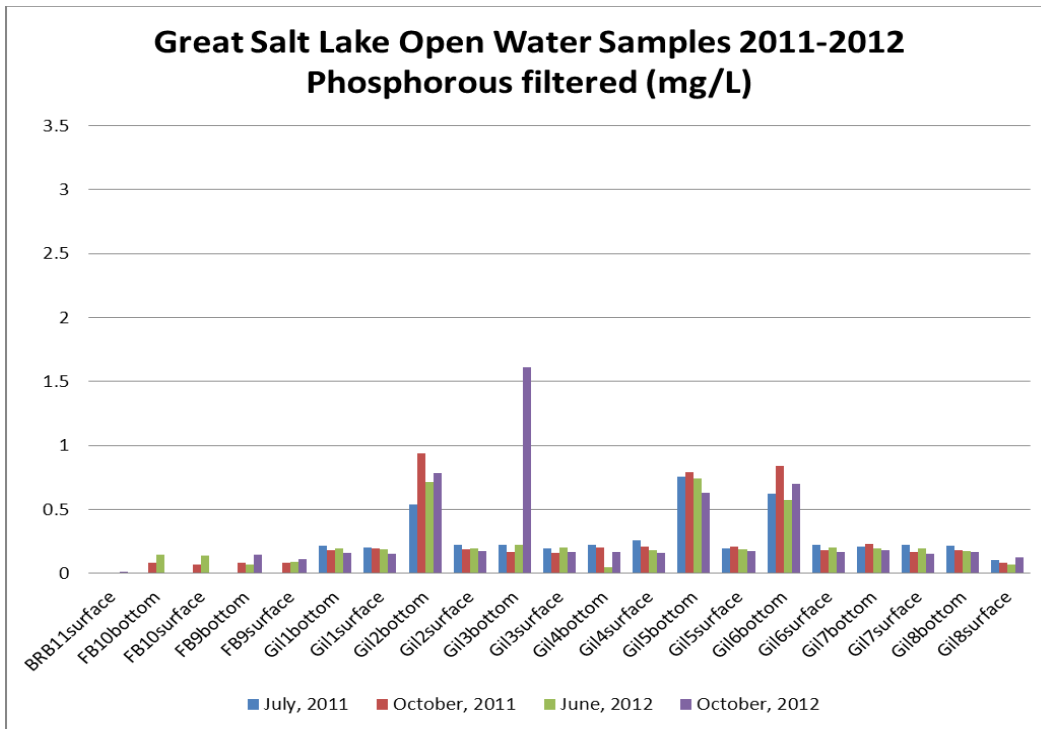


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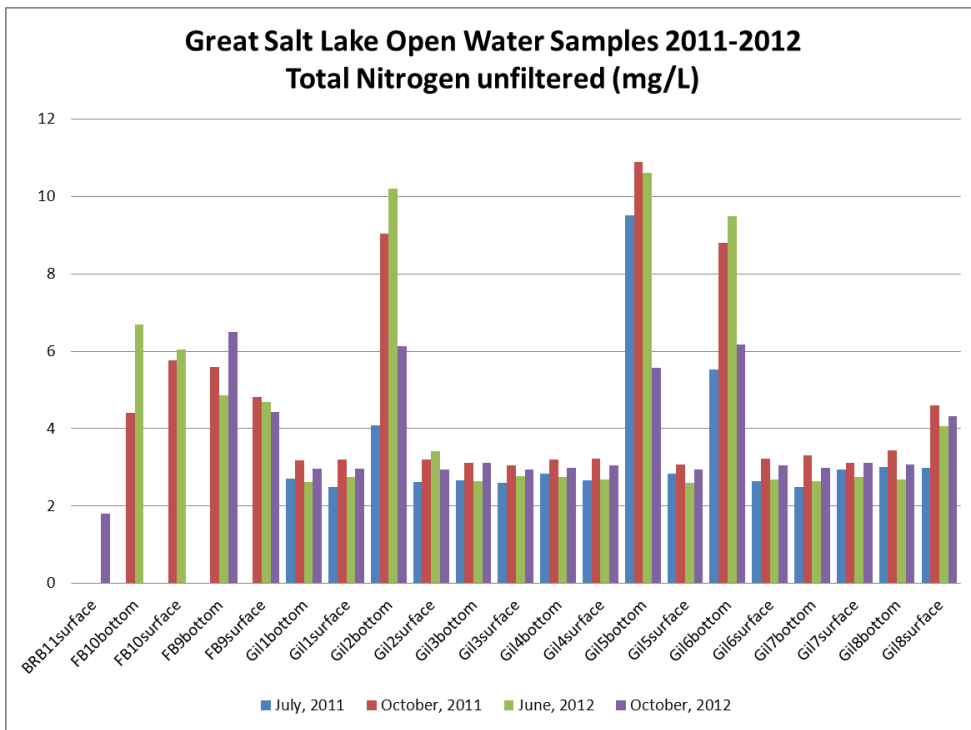


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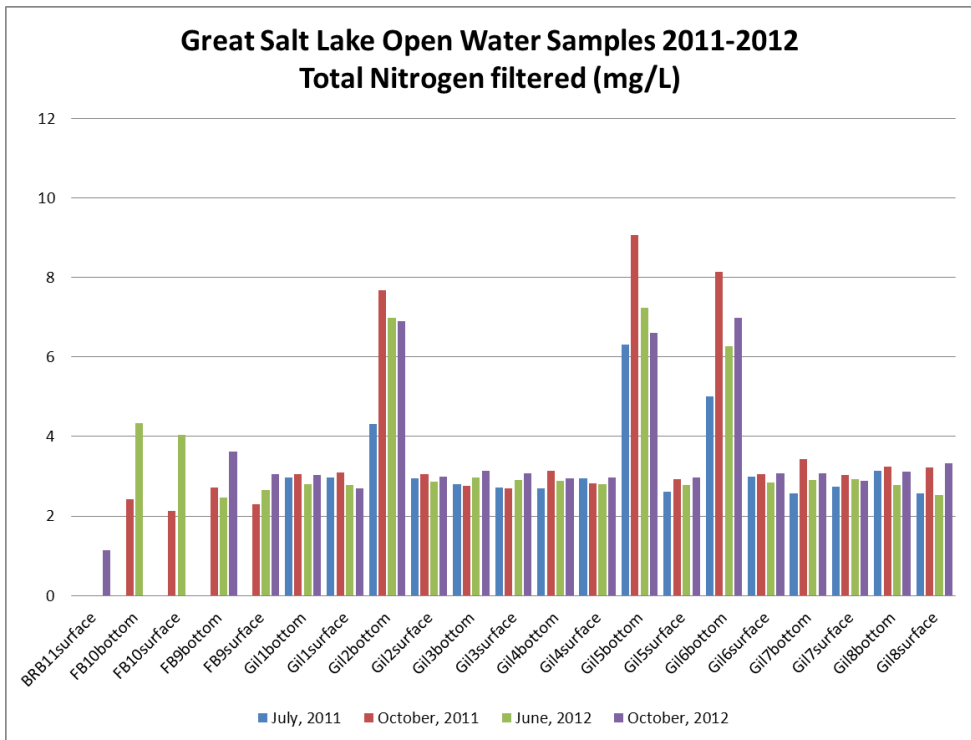


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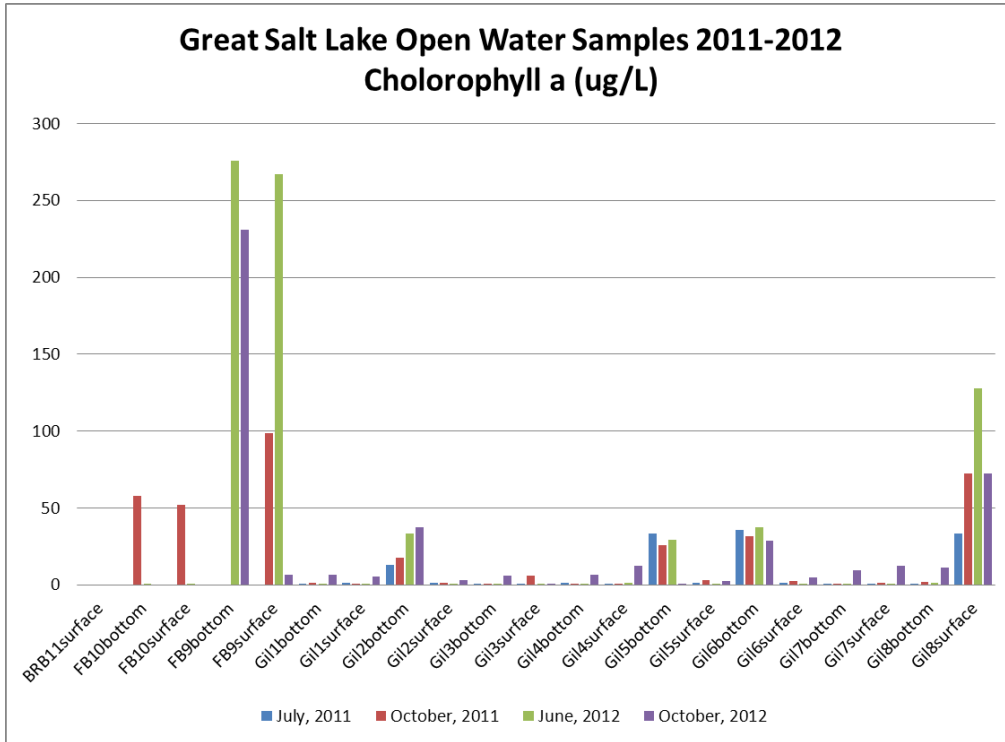


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TABLES

TABLE 1 METALS AND NUTRIENTS MEASURED IN WATER, BRINE SHRIMP AND AQUATIC DEPENDENT BIRD EGGS, RATIONALE FOR SELECTION AND COMPARISON CRITERIA

Matrix	Analytes	Rationale for selection	Comparison Criteria
Water	Metals - total selenium, total and methyl-mercury, total arsenic, total copper, cadmium, lead, thallium Nutrients - total phosphorus, total nitrogen, ammonia, and chlorophyll-a Field Measurements – temperature, pH, dissolved oxygen, specific conductivity and depth	Direct measurement of media covered by the Clean Water Act for recreational and aquatic wildlife beneficial use support	Metals - EPA recommended numeric water quality chronic criteria for the protection of salt water aquatic wildlife and Utah fresh water numeric water quality standards
Brine Shrimp	Total selenium, total and methyl-mercury, total arsenic, total copper, cadmium, lead, and thallium,	Indicator of attainment of aquatic wildlife beneficial use as the food chain of avian species	Ever's Dietary Risk Ranges for total mercury. Dietary risk ranges for the rest of the metals will be compiled in the future
Bird Eggs	Total selenium and total mercury	Indicator of attainment of aquatic wildlife beneficial use that includes shorebirds and reflects the potential for biomagnification and/or bioaccumulation due to time spent foraging at GSL	Gilbert Bay selenium numeric water quality standard Ever's Egg tissue Risk Ranges for total mercury.

TABLE 2 2011-2012 MEASUREMENTS OF WATER, BRINE SHRIMP AND SHOREBIRD EGGS

Date	Bay	Matrix	Metals	Nutrients	Field Measurements
June/2010	Gilbert Bay (Saltair)	Shorebird eggs	X (THg and Se only)	NA	NA
June/2011	Gilbert (Bridger Bay, Antelope Island)	Shorebird eggs	X (THg and Se only)	NA	NA
	Farmington Bay (Farmington Bay Waterfowl Management Area)	Shorebird eggs	X (THg and Se only)	NA	NA
July/2011	Gilbert	Water	X	X	X
	Gilbert	Brine shrimp	X	NA	NA
	Farmington	Water	X	Not sampled ²	Not sampled ²
	Bear River ¹	Water	Not sampled	Not sampled	Not sampled
October/2011	Gilbert	Brine shrimp	X	X	X
	Farmington	Water	X	X	X
	Bear River	Water	X	Not sampled	
June/2012	Gilbert Bay (Antelope Island Causeway and Ogden Bay Waterfowl Management Area)	Shorebird eggs	X (THg and Se only)	NA	NA
June/2012	Gilbert	Water	X	X	X
	Gilbert	Brine shrimp	X	NA	NA
	Farmington	Water	X	X	X
	Bear River ³	Water	Not sampled	Not sampled	Not sampled
October/2012	Gilbert	Water	X	X	X
	Gilbert	Brine shrimp	X		
	Farmington	Water	X	FB10 Not sampled ⁴	FB09 Not sampled ⁵
	Bear River	Water	X		

Appendix 1 Figures and Tables

Notes:

NA – Not applicable

1. Not sampled due to high velocities under the GSL Minerals bridge. Moved location further north.
2. Salinity and dissolved oxygen not sampled due to probe calibration issues. Only pH and temperature recorded.
3. Dry, no water
4. Nutrients not sampled at site FB10
5. Probe malfunction at site FB9

TABLE 3 GREAT SALT LAKE BASELINE SAMPLING SITES INCLUDING TARGET BAY, UDWQ SITE NAME, CORRESPONDING USGS SITE NAME AND TARGETED MEDIA

UDWQ Sample Points	Target Bay and UDWQ Site Name	Coordinates	USGS NWIS Site Name and Description	Matrix/ Depth of Sample
1	Gilbert Bay Gil1	Latitude 40°46'07", Longitude 112°19'38"	USGS 404607112193801 GSL 4069, 8 Miles West Of Saltair Marina	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
2	Gilbert Bay Gil2	Latitude 40°53'56", Longitude 112°20'56"	USGS 405356112205601 GSL 3510, 6 Miles West Of Antelope Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
3	Gilbert Bay Gil3	Latitude 41°02'23", Longitude 112°30'19"	USGS 410323112301901 GSL 2820, 2 Miles East Of Carrington Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
4	Gilbert Bay Gil4	Latitude 41°04'22", Longitude 112°20'00"	USGS 410422112200001 GSL 2767, 4 Miles West Of North Tip Of Antelope Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
5	Gilbert Bay Gil5	Latitude 41°06'44", Longitude 112°38'26"	USGS 410644112382601 GSL 2565, Northwest Of Hat Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
6	Gilbert Bay Gil6	Latitude 41°06'37", Longitude 112°27'04"	USGS 410637112270401 N1018 6 Miles Southwest Of Fremont Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
7	Gilbert Bay Gil7	Latitude 41°11'16", Longitude 112°24'44"	USGS 411116112244401 GSL 2267, 1 Mile Northwest Of Fremont Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
8	Gilbert Bay/ Farmington Bay Gil8	Latitude 41°04'52", Longitude 112°13'51"	USGS 410401112134801 GSL Farmington Bay Outflow At Causeway Bridge	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom Brine Shrimp
9	Farmington Bay FB9	Latitude 41°02'24.36", Longitude 112°09'51.12"	USGS 410224112095101 Farmington Bay, 1.4 Miles East, 3.5 Miles South of Farmington Bay marina	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom
10	Farmington Bay FB10	Latitude 41°01'53", Longitude	USGS 410153112082301 GSL 2963, Farmington Bay 4 Miles Southeast Of Antelope Island	Water Sample - 0.2m from surface Water Sample – 0.5m from bottom

		112°08'23"	Marina	
11	Bear River Bay BRB11	Latitude 41 17.340, Longitude 112 22.006	USGS 10010060 North of Great Salt Lake Minerals Bridge	Water Sample - 0.2m from surface

TABLE 4 PERCENT SALINITY OF OPEN WATER SITES PER SITE PER DATE

Great Salt Lake Open Water Sites	Percent Salinity			
	July, 2011	October, 2011	June, 2012	October, 2012
BRB11surface	NA	NA	NA	NA
FB10bottom	NA	1.7	6.6	NA
FB10surface	NA	1.6	6.6	NA
FB9bottom	NA	2.4	5.2	5.6
FB9surface	NA	1.7	5.1	4.5
Gil1bottom	11.3	11.7	11.3	13.3
Gil1surface	11.2	11.6	11.2	13.3
Gil2bottom	12.9	17.4	17.5	19.1
Gil2surface	11.3	11.6	11.3	13.3
Gil3bottom	11.3	11.5	11.4	13.3
Gil3surface	11.0	11.4	11.3	13.3
Gil4bottom	11.2	11.7	11.3	13.3
Gil4surface	10.8	11.2	11.1	12.8
Gil5bottom	18.6	20.4	21.0	22.5
Gil5surface	11.0	11.2	11.5	13.4
Gil6bottom	13.2	16.8	18.7	19.7
Gil6surface	11.2	11.6	11.3	13.3
Gil7bottom	11.1	11.4	11.4	13.2
Gil7surface	10.2	11.6	11.4	12.6
Gil8bottom	11.2	11.3	11.2	13.1
Gil8surface	5.1	3.3	5.0	5.5
Average Farmington Bay Salinity	NA	1.9	5.9	5.1
Average Gilbert Bay Salinity	11.4	12.2	12.4	14.1
Average Gilbert Bay Surface Salinity	10.2	10.4	10.5	12.2
Average Gilbert Bay Bottom Salinity	12.6	14.0	14.2	15.9
Note: NA – Not available or applicable				

TABLE 5 TEMPERATURE IN DEGREES CELSIUS OF OPEN WATER SITES PER SITE PER DATE

Great Salt Lake Open Water Sites	Temperature (Degrees Celsius)			
	July, 2011	October, 2011	June, 2012	October, 2012
BRB11surface	NA	NA	NA	11.98
FB10bottom	NA	8.44	26.40	NA
FB10surface	NA	10.02	27.60	NA
FB9bottom	NA	7.28	21.20	12.40
FB9surface	NA	8.23	22.80	11.70
Gil1bottom	24.70	12.00	19.70	12.80
Gil1surface	25.60	13.38	20.20	12.50
Gil2bottom	17.50	16.47	15.30	19.50
Gil2surface	26.40	12.68	20.90	12.70

Appendix 1 Figures and Tables

Gil3bottom	25.30	12.64	19.10	12.80
Gil3surface	26.80	12.72	19.30	13.90
Gil4bottom	25.50	12.54	NA	12.80
Gil4surface	27.50	10.96	20.40	12.10
Gil5bottom	20.50	17.37	17.10	18.70
Gil5surface	25.50	11.40	19.00	12.80
Gil6bottom	20.70	15.07	17.70	19.00
Gil6surface	27.60	12.52	21.30	12.60
Gil7bottom	24.90	14.40	18.60	12.10
Gil7surface	25.70	13.20	18.60	11.70
Gil8bottom	26.10	10.67	19.70	12.80
Gil8surface	25.10	6.55	25.60	12.70
Average Farmington Bay Temp	NA	8.49	24.50	12.05
Average Gilbert Bay Temp	24.71	12.79	19.50	13.84
Average Gilbert Bay Surface Brine Temp	26.28	11.68	20.66	12.63
Average Gilbert Bay Bottom Temp	23.15	13.90	18.17	15.06
Note: NA – Not available or applicable				

TABLE 6 PH OF OPEN WATER SITES PER SITE PER DATE

Great Salt Lake Open Water Sites	pH			
	July, 2011	October, 2011	June, 2012	October, 2012
BRB11surface	NA	NA	NA	8.6
FB10bottom	NA	9.4	8.5	NA
FB10surface	NA	9.4	8.5	NA
FB9bottom	NA	9.2	9.2	9.0
FB9surface	NA	9.2	9.3	8.9
Gil1bottom	8.1	8.5	8.3	8.3
Gil1surface	8.0	8.4	8.3	8.2
Gil2bottom	8.0	7.8	7.8	7.4
Gil2surface	8.0	8.4	8.2	8.2
Gil3bottom	8.2	8.5	8.3	8.3
Gil3surface	8.1	8.5	8.3	8.2
Gil4bottom	8.1	8.2	8.1	8.3
Gil4surface	8.0	8.2	8.2	8.3
Gil5bottom	7.8	7.8	7.6	7.5
Gil5surface	8.2	8.5	8.2	8.2
Gil6bottom	8.0	7.8	7.8	7.5
Gil6surface	8.1	8.4	8.2	8.3
Gil7bottom	8.2	8.1	8.3	8.3
Gil7surface	8.2	8.2	8.3	8.4
Gil8bottom	8.0	8.3	8.3	8.3

Gil8surface	8.6	9.3	8.8	9.1
Average Farmington Bay pH	NA	9.3	8.9	9.0
Average Gilbert Bay pH	8.1	8.3	8.2	8.2
Average Gilbert Bay Surface pH	8.2	8.5	8.3	8.4
Average Gilbert Bay Bottom pH	8.1	8.1	8.1	8.0
Note: NA – Not available or applicable				

TABLE 7 DISSOLVED OXYGEN OF OPEN WATER SITES PER SITE PER DATE

Great Salt Lake Open Water Sites	Dissolved Oxygen (milligrams/liter)			
	July, 2011	October, 2011	June, 2012	October, 2012
BRB11 surface	NA	NA	NA	NA
FB10bottom	NA	7.94	3.40	NA
FB10surface	NA	6.75	5.70	NA
FB9bottom	NA	7.71	1.00	NA
FB9surface	NA	7.01	2.10	NA
Gil1bottom	4.40	9.44	7.00	8.10
Gil1surface	7.40	8.17	7.50	10.10
Gil2bottom	0.00	1.50	0.10	0.00
Gil2surface	5.70	8.28	6.90	9.50
Gil3bottom	6.60	8.90	7.10	7.00
Gil3surface	6.40	9.68	6.80	9.10
Gil4bottom	9.10	9.50	NA	8.30
Gil4surface	7.30	8.36	7.30	8.30
Gil5bottom	1.30	0.00	NA	0.00
Gil5surface	5.60	9.10	NA	9.00
Gil6bottom	2.10	0.00	NA	0.00
Gil6surface	5.70	9.13	NA	9.20
Gil7bottom	3.50	4.27	NA	5.30
Gil7surface	4.90	9.46	NA	5.40
Gil8bottom	5.30	6.95	NA	7.10
Gil8surface	8.70	6.20	NA	9.10
Average Farmington Bay DO	NA	7.35	3.05	NA
Average Gilbert Bay DO	5.25	6.81	6.10	6.59
Average Gilbert Bay Surface DO	6.46	8.55	7.13	8.71
Average Gilbert Bay Bottom DO	4.04	5.07	4.73	4.48
Note: NA – Not available or applicable				

TABLE 8

Analyte	Freshwater			Saltwater		
	total	dissolved	Conversion ¹	total	dissolved	Conversion ¹

Appendix 1 Figures and Tables

Arsenic (ug/L)	150	150	1	36	36	1
Cadmium ² (ug/L)	0.76	0.64	$e^{0.7409(\ln(\text{hardness})-4.719)}$	8.846	8.8	0.994
Copper ² (ug/L)	30.5	29.3	$e^{0.845(\ln(\text{hardness})-1.702)}$	TBT	3.1	0.83
Total Mercury (ng/L)	0.9081	0.77	0.85	1.106	0.94	0.85
Methylmercury (ng/L)	NA	NA	NA	NA	NA	NA
Lead ² (ug/L)	18.6	10.9	$e^{1.273(\ln(\text{hardness})-4.705)}$		8.1	0.951
Selenium (ug/L)	5	4.6		TBT	71	0.998
Notes:						
1. Based on total recoverable metal						
2. Hardness dependent criteria. 400 mg/L hardness used. Used equations to convert dissolved metals standard to total recoverable metals						
3. NA – Not available or applicable						

TABLE 9 DESCRIPTIVE STATISTICS OF METALS CONCENTRATIONS AT ALL GILBERT BAY SITES OVER ALL DEPTHS IN 2011 AND 2012

All Gilbert Bay Sites (Gil 1 – Gil8), at all depths over 2011 and 2012							
Analyte	Average	Minimum	Maximum	Standard Deviation	Count	Freshwater Aquatic Criteria	Saltwater Aquatic Criteria
Arsenic (ug/L)	77.852	27.900	157.000	25.760	64	150	36
Cadmium (ug/L)	0.046	0.010	0.280	0.065	64	0.76	8.8
Copper(ug/L)	2.553	0.175	15.000	2.742	64	30.5	3.1
Total Mercury (ng/L)	9.866	1.150	47.300	13.541	57	12	940
Methyl mercury (ng/L)	4.156	0.150	29.300	7.996	57	2.8 ¹	NA
Lead (ug/L)	2.117	0.439	13.400	2.538	64	18.6	8.1
Selenium (ug/L)	0.379	0.197	0.776	0.113	64	4.6	71
Thallium (ug/L)	0.038	0.010	0.113	0.015	64	0.03 ²	17 ²
Notes:							
1: LANL, 2009 Tier II value for protection of aquatic life communities							
2: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 2. 2000. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol2.pdf							
3. NA – Not available or applicable							

TABLE 10 DESCRIPTIVE STATISTICS OF METALS CONCENTRATIONS AT ALL GILBERT BAY SITES IN THE SURFACE WATER SAMPLES IN 2011 AND 2012

All Gilbert Bay Sites (Gil 1 – Gil8), surface water samples (0.2 meters from the surface) over 2011 and 2012							
Analyte	Average	Minimum	Maximum	Standard Deviation	Count	Freshwater Aquatic Criteria	Saltwater Aquatic Criteria
Arsenic (ug/L)	67.063	27.900	100.000	20.783	32	150	36
Cadmium (ug/L)	0.020	0.010	0.046	0.013	32	0.76	8.8
Copper(ug/L)	1.825	0.880	3.750	0.602	32	30.5	3.1

Total Mercury (ng/L)	3.562	1.230	10.300	2.108	31	12	940
Methyl mercury (ng/L)	0.813	0.150	2.880	0.575	31	2.8 ¹	
Lead (ug/L)	1.084	0.439	1.490	0.232	32	18.6	8.1
Selenium (ug/L)	0.362	0.197	0.756	0.106	32	4.6	71
Thallium (ug/L)	0.032	0.010	0.042	0.008	32	0.03 ²	17 ²
Notes:							
1: LANL, 2009 Tier II value for protection of aquatic life communities							
2: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 2. 2000. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol2.pdf							
3. NA – Not available or applicable							

TABLE 11 DESCRIPTIVE STATISTICS OF METALS CONCENTRATIONS OF GILBERT BAY IN THE DEEP BRINE LAYER SITES IN 2011 AND 2012

Deep Brine Layer Samples from Gil2bottom, Gil5bottom and Gil6bottom over 2011 and 2012							
Analyte	Average	Minimum	Maximum	Standard Deviation	Count	Freshwater Aquatic Criteria	Saltwater Aquatic Criteria
Arsenic (ug/L)	113.367	85.100	157.000	19.555	12	150	36
Cadmium (ug/L)	0.155	0.060	0.280	0.084	12	0.76	8.8
Copper(ug/L)	5.621	0.175	15.000	5.353	12	30.5	3.1
Total Mercury (ng/L)	38.900	26.400	47.300	8.186	9	12	940
Methyl mercury (ng/L)	21.223	8.710	29.300	7.392	9	2.8 ¹	
Lead (ug/L)	6.474	2.280	13.400	3.344	12	18.6	8.1
Selenium (ug/L)	0.488	0.348	0.776	0.142	12	4.6	71
Thallium (ug/L)	0.056	0.023	0.113	0.026	12	0.03 ²	17 ²
Notes:							
1: LANL, 2009 Tier II value for protection of aquatic life communities							
2: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 2. 2000. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol2.pdf							
3. NA – Not available or applicable							

TABLE 12 DESCRIPTIVE STATISTICS OF METALS IN BRINE SHRIMP TISSUE IN GILBERT BAY OVER 2011 AND 2012

Analyte (expressed as wet weight)	Average	Minimum	Maximum	Standard Deviation	Count	Avian Dietary Effects Levels
Arsenic (mg/kg)	1.398	0.097	4.580	1.226	32	TBD
Cadmium (mg/kg)	0.024	0.006	0.066	0.018	32	TBD
Copper(mg/kg)	1.040	0.150	2.560	0.670	32	TBD
Total Mercury (mg/kg)	0.027	0.001	0.086	0.023	32	Low Risk in Diet: < 0.05 mg/kg ww Moderate Risk in Diet:0.05-0.15 mg/kg ww High Risk in Diet:0.15–0.3mg/kg ww Extra High Risk in Diet: >0.3 mg/kg ww
Lead (mg/kg)	0.155	0.011	0.630	0.192	32	TBD
Selenium (mg/kg)	0.181	0.040	0.460	0.128	32	TBD
Thallium (mg/kg)	0.005	0.001	0.021	0.005	32	TBD

Appendix 1 Figures and Tables

Notes:

1. Effect on Common Loons (Evers et al, 2004)
2. TBD – To be determined

TABLE 13 DESCRIPTIVE STATISTICS OF SELENIUM IN BIRD EGG TISSUE (MG/KG DRY WEIGHT) COMPARED TO THE SELENIUM NUMERIC STANDARD

Date/Location Sampled	Geomean	Minimum	Maximum	Standard Deviation	Count	Gilbert Bay Selenium Numeric Standard ¹
07/27/2010 at Saltair	1.32	3.5	6	0.77	13	12.5 mg/kg dry weight
06/02/2011 at Bridger Bay, Antelope Island	1.56	1.38	1.84	0.19	5	
06/22/2011 at Farmington Bay Waterfowl Management Area ²	2.54	2.28	2.83	0.21	5	
06/11/2012 at Ogden Bay Waterfowl Management Area	1.46	1.13	2.03	0.33	9	
06/20/2012 at Antelope Island Causeway	1.51	1.21	2.84	0.48	10	

Notes:

1. Utah Administrative Code R317-2-14
2. The selenium numeric water quality standard was established for Gilbert Bay. For Farmington Bay, the standard is used as a benchmark of avian risk

TABLE 14 DESCRIPTIVE STATISTICS OF MERCURY IN BIRD EGG TISSUE (MG/KG WET WEIGHT) COMPARED TO EVERS RISK RANGES

Date/Location Sampled	Mean	Minimum	Maximum	Standard Deviation	Count	Evers Egg Tissue Risk Ranges ¹
06/02/2011 at Bridger Bay, Antelope Island	0.23	0.15	0.33	0.07	5	Low risk in eggs: 0 – 0.5 Hg mg/kg ww Moderate risk in eggs: 0.5 – 1.3 Hg mg/kg ww High risk in eggs: 1.3 -2.0 Hg mg/kg ww Extreme High Risk in eggs: >2.0 Hg mg/kg ww
06/22/2011 at Farmington Bay Waterfowl Management Area	0.34	0.21	0.42	0.08	5	
06/11/2012 at Ogden Bay Waterfowl Management Area	0.12	0.05	0.24	0.06	8	
06/20/2012 at Antelope Island Causeway	0.15	0.04	0.38	0.11	10	

Notes:

1. Effect on Common Loons (Evers et al, 2004)

TABLE 15 DESCRIPTIVE STATISTICS OF METALS CONCENTRATIONS AT THE BEAR RIVER BAY SITE OVER 2011 AND 2012

Bear River Bay Site BRB11, at all depths over 2011 and 2012							
Analyte	Average	Minimum	Maximum	Standard Deviation	Count	Freshwater Aquatic Criteria	Saltwater Aquatic Criteria
Arsenic (ug/L)	15.700	13.100	18.300	3.677	2	150	36
Cadmium (ug/L)	0.035	0.020	0.051	0.021	2	0.76	8.8
Copper(ug/L)	1.209	0.368	2.050	1.189	2	30.5	3.1
Total Mercury (ng/L)	2.565	1.930	3.200	0.898	2	12	940
Methyl mercury (ng/L)	0.685	0.499	0.870	0.262	2	2.8 ¹	NA
Lead (ug/L)	0.170	0.148	0.192	0.031	2	18.6	8.1
Selenium (ug/L)	0.380	0.192	0.567	0.265	2	4.6	71
Thallium (ug/L)	0.015	0.013	0.017	0.003	2	0.03 ²	17 ²

Notes:
1: LANL, 2009 Tier II value for protection of aquatic life communities
2: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 2. 2000. <http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol2.pdf>
3. NA – Not available or applicable

TABLE 16 DESCRIPTIVE STATISTICS OF METALS CONCENTRATIONS AT ALL FARMINGTON BAY SITES OVER ALL DEPTHS IN 2011 AND 2012

All Farmington Bay Sites (FB9 and FB10), at all depths over 2011 and 2012							
Analyte	Average	Minimum	Maximum	Standard Deviation	Count	Freshwater Aquatic Criteria	Saltwater Aquatic Criteria
Arsenic (ug/L)	32.431	18.400	48.200	8.780	16	150	36
Cadmium (ug/L)	0.015	0.006	0.025	0.007	16	0.76	8.8
Copper(ug/L)	1.734	0.467	5.400	1.229	16	30.5	3.1
Total Mercury (ng/L)	4.590	2.250	13.400	2.532	16	12	940
Methyl-mercury (ng/L)	0.829	0.251	1.370	0.383	15	2.8 ¹	
Lead (ug/L)	0.726	0.133	1.550	0.446	16	18.6	8.1
Selenium (ug/L)	0.414	0.235	0.608	0.112	16	4.6	71
Thallium (ug/L)	0.009	0.003	0.010	0.002	16	0.03 ²	17 ²

Notes:
1: LANL, 2009 Tier II value for protection of aquatic life communities
2: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 2. 2000. <http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol2.pdf>
3. NA – Not available or applicable

TABLE 17 DESCRIPTIVE STATISTICS OF NUTRIENT CONCENTRATIONS AT ALL GILBERT BAY SITES OVER ALL DEPTHS DURING 2011 AND 2012

All Gilbert Bay Sites (Gil 1 – Gil8), at all depths over 2011 and 2012					
Nutrients	Average	Minimum	Maximum	Standard Deviation	Count
Phosphorous - unfiltered (mg/L)	0.431	0.189	2.95	0.460	64
Phosphorous - filtered (mg/L)	0.305	0.048	1.610	0.275	64

Appendix 1 Figures and Tables

Total Nitrogen - unfiltered (mg/L)	3.935	2.490	10.900	2.230	64
Total Nitrogen - filtered (mg/L)	3.652	2.53	9.07	1.621	64
Chlorophyll a (ug/L)	11.780	0.004	128	21.876	64

TABLE 18 DESCRIPTIVE STATISTICS OF NUTRIENT CONCENTRATIONS AT ALL GILBERT BAY SITES IN SURFACE WATER SAMPLES DURING 2011 AND 2012

All Gilbert Bay Sites surface water samples (Gil 1 – Gil8) over 2011 and 2012					
Nutrients	Average	Minimum	Maximum	Standard Deviation	Count
Phosphorous - unfiltered (mg/L)	0.239	0.189	0.342	0.039	32
Phosphorous - filtered (mg/L)	0.179	0.070	0.259	0.039	32
Total Nitrogen - unfiltered (mg/L)	3.045	2.500	4.600	0.479	32
Total Nitrogen - filtered (mg/L)	2.900	2.530	3.330	0.181	32
Chlorophyll a (ug/L)	11.740	0.004	128.000	27.855	32

TABLE 19 DESCRIPTIVE STATISTICS OF NUTRIENT CONCENTRATIONS AT ALL GILBERT BAY SITES IN THE DEEP BRINE DURING 2011 AND 2012

All Gilbert Bay Sites bottom water samples (Gil 1 – Gil8) over 2011 and 2012					
Nutrients	Average	Minimum	Maximum	Standard Deviation	Count
Phosphorous - unfiltered (mg/L)	1.041	0.632	1.460	0.226	12
Phosphorous - filtered (mg/L)	0.719	0.536	0.940	0.115	12
Total Nitrogen - unfiltered (mg/L)	8.002	4.090	10.900	2.343	12
Total Nitrogen - filtered (mg/L)	6.793	4.310	9.070	1.279	12
Chlorophyll a (ug/L)	43.297	0.025	134.000	36.175	15

TABLE 20 DESCRIPTIVE STATISTICS OF NUTRIENT CONCENTRATIONS AT ALL FARMINGTON BAY SITES OVER ALL DEPTHS DURING 2011 AND 2012

All Farmington Bay Sites (FB9 and FB10), at all depths over 2011 and 2012					
Nutrients	Average	Minimum	Maximum	Standard Deviation	Count
Phosphorous - unfiltered (mg/L)	0.481	0.309	1.29	0.293	10
Phosphorous - filtered (mg/L)	0.102	0.071	0.147	0.0304	10
Total Nitrogen - unfiltered (mg/L)	5.375	4.41	6.69	0.852	10
Total Nitrogen - filtered (mg/L)	2.972	2.12	4.34	0.771	10
Chlorophyll a (ug/L)	109.882	0.114	276	116.145	9