Appendix F

August 20, 2015

Mr. Mitchell Dickie
Cooke Aquaculture
669 Main Street
Blacks Harbour, NB E5H 1K1

Dear Mr. Dickie,

Re: Water Quality Environmental Baseline Study
Oak Bay Hatchery, Oak Haven, NB

Strum Consulting was retained by Cooke Aquaculture to conduct an Environmental Assessment which included an environmental baseline assessment at their Oak Bay Hatchery in Oak Haven, NB (Drawing 1, attached). The objective of the study was to determine environmental baseline conditions for benthic habitat, fish, and water quality within Oak Bay. This report outlines the results of the water quality assessment.

INTRODUCTION

The Oak Bay Hatchery includes a broodstock rearing operation for gamete production and incubation room for housing salmon eggs. All wastewater is treated through drum filtration prior to being discharged into Oak Bay. The facility is licensed through the New Brunswick Department of Agriculture, Aquaculture, and Fisheries (NB DAAF) and operates under 'Approval to Operate I-8539' (COA), issued by the New Brunswick Department of environment and Local Government (NB DELG) and effective from November 1, 2013 until October 31, 2016.

The COA requires monthly water quality sampling events at five locations around the hatchery at a 'Level 1' effort as listed in Table 2.10 of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick* (NB DELG, 2013) (the Regulations), including at the edge of an established mixing zone. The COA states that the level of total nitrogen (TN) and total phosphorus (TP) at the edge of the mixing zone is in accordance with the performance based standard (PBS) variables listed in the Regulations. However, a mixing zone has not been established for the facility and water samples from the current sampling locations are out of compliance for TN and TP. In response, Strum was retained to complete a water quality study to identify baseline water quality conditions and aid in the identification of proper sampling locations for the monthly water quality sampling required by the COA.

METHODOLOGY

Field sampling was completed July 15, 2015, during the flood and ebb tide. Using a Van Dorn bottle, water samples were collected from the top and bottom of the water column at six locations around Oak Bay for a total of 24 samples (Drawing 1). Sampling time and water depth was recorded with each sampling. A handheld YSI unit was used to record temperature, conductivity, salinity, dissolved oxygen, total dissolved solids, and pH during the ebb tide.

Samples were analyzed for TN, TP, total suspended solids (TSS), total ammonia nitrogen (TAN), and chemical oxygen demand (COD). TN and TP are both required sampling parameters in the COA. TSS is a required sampling parameter and although compliance with TSS is not stated in the COA, it is of special interest to provincial regulators and its guideline thresholds are outlined by the Canadian Council of Ministers of the Environment (CCME). TAN and COD are currently not required sampling parameters in the COA. However, they were included in the study as further non-compliances may require that monthly sampling is increased from a 'Level 1' effort to a 'Level 2' effort which would include sampling for TAN and COD.

Water quality values were compared against surface water results collected during monthly sampling by Cooke employees at the outflow pipe from the setting pond into Oak Bay.

RESULTS

Total Nitrogen (TN)

Values for TN varied from 0.215 mg/L to 0.686 mg/L (Table 1, below). Four (4) samples, collected from WQ1, WQ3, WQ4, and WQ6, exceeded the PBS threshold of 0.500 mg/L. Additional high values (greater than 0.400 mg/L), although not in exceedance, were observed at all sampling locations except for WQ2, which did not have a sample higher than 0.400 mg/L. All of the exceedances were collected on the ebb tide.

Although monthly monitoring observed TN values as high as 8.2 mg/L, the wide spread distribution of high TN values throughout the bay suggests that a number of influences are impacting water TN values, not just hatchery effluent. Additionally, the higher values in ebb tide samples suggests that the sources of nitrogen are incorporated into the water column during high tide.

Total Phosphorus (TP)

Values for TP varies from 0.021 mg/L to 0.095 mg/L (Table 1). Ten (10) samples exceeded the PBS threshold of 0.035 mg/L; seven (7) samples were collected from WQ1 and WQ2, two (2) samples from WQ4 and one (1) sample from WQ6. No exceedances were observed at WQ3 and WQ5.

The results of the samples taken in June 2015 from the effluent pond outflow into the bay observed a TP value of 0.69 mg/L and monthly monitoring values obtained from Cooke noted TP values as high as 2.62 mg/L. It is probable that TP values will vary with the type of effluent being released from the hatchery. During periods of high flow, drum filter bypass, surges, and swirl separator flushes, TP values in hatchery effluent will be higher.

The lack of exceedances observed at WQ3 suggest that the exceedance at WQ4 is irrespective of hatchery effluent. However, the high number of exceedances at WQ1 and WQ2 is of concern and TP should continue to be monitored closely in both the effluent and within Oak Bay. For TP analyses, WQ5 should be used as a control site and its values of 0.025 mg/L – 0.030 mg/L as a baseline for future monitoring activities.

Total Suspended Solids (TSS)

TSS results showed high bottom values which may be a result of the substrate being stirred up during sampling. Therefore, bottom samples were disregarded and further analysis was done only on the surface samples. Surface TSS values varied from 3.2 mg/L to 15 mg/L (Table 1). The highest value, 15 mg/L, was observed at WQ5, on the opposite side of Spoon Island to the hatchery.

If the TSS values are used as baseline values around Oak Bay, then the TSS value taken from the effluent pond discharge pipe in June, 2015 of 6.8 mg/L is within the acceptable limit of a 5 mg/L increase for long-term exposure. However values from monthly monitoring events collected by Cooke employees vary between 7 mg/L to 128 mg/L. CCME guidelines limit a maximum increase of 25 mg/L for short-term exposure, and outflow values of 128 mg/L greatly exceeds this value.

As in the case with TP, TSS values will vary with the type of effluent being released from the hatchery. It is likely that standard operations do not result in an exceedance in TSS thresholds, however, events that result in effluent bypassing drum filtration is of particular concern. TSS monitoring should continue observing both TSS in hatchery effluent and within Oak Bay.

Chemical Oxygen Demand (COD)

Values for COD varied between 640 mg/L and 1200 mg/L (Table 1). The regulations do not identify any thresholds for COD (NB DELG, 2013). Values greater than 900 mg/L were observed at all sites.

Total Ammonia Nitrogen (TAN)

Values for TAN varied between 0.065 mg/L and 0.27 mg/L (Table 1). The regulations do not identify any thresholds for TAN (NB DELG, 2013). Values varied between 0.065 mg/L (WQ5) and 0.270 mg/L (WQ6). All sites had values below the reportable detection limit of 0.050 mg/L.

Oak Bay Water Quality					Lab Parameters					Field Parameters							
					TN (mg/L)	TP (mg/L)	TSS (mg/L)	COD (mg/L)	TAN (mg/L)	Sample Depth (m)	Temperature (°C)	DO (%)	DO (mg/L)	TDS (mg/L)	Salinity (ppt)	pH	Conductivity (µS/cm)
Sample Locations	WQ1	Flood	SW2	Top	0.276	0.036	8.5	910	0.072	0	15.5	127.3	10.49	28815	29.79	7.14	37552
			SW1	Bottom	0.432	0.054	21	**640**	0.220	1.97							
		Ebb	SW 14	Top	**0.686**	0.082	8.8	910	0.096	0							
			SW 13	Bottom	0.238	0.078	67	1000	ND	3.96							
	WQ2	Flood	SW4	Top	0.285	0.025	4.0	950	ND	0	14.3	150.9	12.76	29763	29.68	7.66	36447
			SW3	Bottom	0.369	0.038	30	760	ND	3.27							
		Ebb	SW16	Top	0.365	0.041	4.3	1100	0.150	0							
			SW15	Bottom	0.399	0.052	50	1100	ND	4.45							
	WQ3	Flood	SW6	Top	0.342	0.026	4.2	1000	0.130	0	14.9	147.3	12.31	29971	29.94	7.73	37166
			SW5	Bottom	0.492	0.030	4.2	1100	0.250	3.70							
		Ebb	SW18	Top	0.597	0.024	4.2	1000	0.230	0							
			SW17	Bottom	0.287	**0.021**	5.8	1100	ND	4.45							
	WQ4	Flood	SW8	Top	0.231	0.028	**3.2**	700	ND	0	14.0	139.9	11.73	29159	29.01	7.91	35384
			SW7	Bottom	0.474	**0.095**	41	**1200**	0.097	5.05							
		Ebb	SW20	Top	0.526	0.036	8.8	960	0.100	0							
			SW19	Bottom	0.300	0.033	5.8	1000	ND	5.45							
	WQ5	Flood	SW10	Top	0.239	0.027	5.2	930	0.110	0	14.8	138.3	11.95	29997	29.96	7.92	37114
			SW9	Bottom	0.243	0.025	6.8	910	ND	5.80							
		Ebb	SW22	Top	0.227	0.027	**15.0**	970	0.090	0							
			SW21	Bottom	0.485	0.030	7.3	840	**0.065**	5.05							
	WQ6	Flood	SW12	Top	**0.215**	0.029	7.4	940	ND	0	15.6	133.6	11.11	29666	26.68	7.90	37467
			SW11	Bottom	0.455	0.044	33	**1200**	ND	5.30							
		Ebb	SW24	Top	0.523	0.023	7.4	**1200**	**0.270**	0							
			SW23	Bottom	0.418	0.028	7.8	990	ND	5.38							
Settling Pond Effluent[5]					<1 - 8.2	0.069 - 2.620	6.0 - 59.0	34	0.47								
Regulatory Guidelines					0.5	0.035	-	-	-	-	-	-	-	-	-	-	-

Table Notes:

1. Highest and lowest values are bolded
2. Values exceeding regulatory thresholds are highlighted in red
3. TSS values highlighted in grey have been disregarded
4. Regulatory guideline thresholds were taken from NB DELG, 2013
5. Setting pond effluent ranges are taken from Cooke monthly monitoring results

CONCLUSION AND RECOMMENDATIONS

Water quality sampling results indicate that the Oak Bay Hatchery is currently out of compliance for TSS during high flow events (e.g. flushing of the swirl separators and backwash of drum filters) and for TP. The results of this sampling do not indicate that wastewater effluent from the hatchery is increasing TN values above regulatory levels.

It is recommended that effluent quality and water quality in Oak Bay continue to be monitored in order to determine the complete impact of wastewater effluent on the receiving environment. Additionally, an established effluent mixing zone is required to fully assess non-compliance issues and continued water quality monitoring may aid in its determination.

If you have any questions, please contact us.

Thank you,

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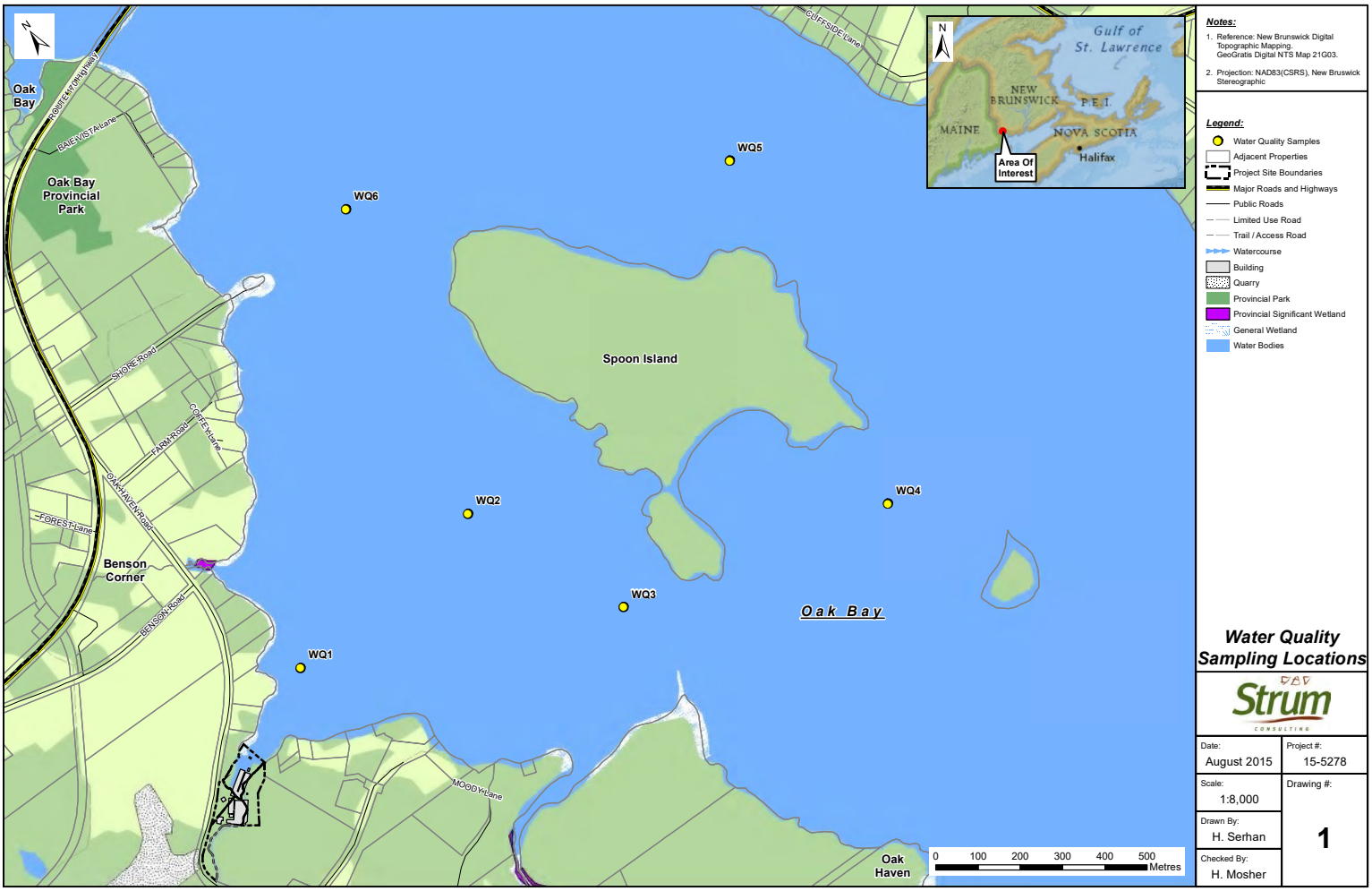
Shawn Duncan, BSc.
Vice President
sduncan@strum.com



Notes:

1. Reference: New Brunswick Digital Topographic Mapping. GeoGratis Digital NTS Map 21G03.
2. Projection: NAD83(CSRS), New Bruswick Stereographic

Legend:

- Water Quality Samples
- Adjacent Properties
- Project Site Boundaries
- Major Roads and Highways
- Public Roads
- Limited Use Road
- Trail / Access Road
- Watercourse
- Building
- Quarry
- Provincial Park
- Provincial Significant Wetland
- General Wetland
- Water Bodies

Water Quality Sampling Locations

Strum Consulting

Date: August 2015	Project #: 15-5278
Scale: 1:8,000	Drawing #: 1
Drawn By: H. Serhan	
Checked By: H. Mosher	

Maxxam Job #: B5E1711
Report Date: 2015/07/27

Strum Environmental
Client Project #: 15-5278

RESULTS OF ANALYSES OF WATER

Maxxam ID		AQP738		AQP739	AQP741	AQP741			AQP742		
Sampling Date		2015/07/15		2015/07/15	2015/07/15	2015/07/15			2015/07/15		
COC Number		N/A		N/A	N/A	N/A			N/A		
	Units	SW1-JL15	RDL	SW2-JL15	SW3-JL15	SW3-JL15 Lab-Dup	RDL	QC Batch	SW4-JL15	RDL	QC Batch
Inorganics											
Total Chemical Oxygen Demand	mg/L	640	100	910	760		100	4113838	950	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.22	0.050	0.072	ND		0.050	4115474	ND	0.050	4115479
Total Phosphorus	mg/L	0.054	0.020	0.036	0.038		0.020	4116921	0.025	0.020	4116921
Total Suspended Solids	mg/L	21	1.0	8.5	30		2.0	4114923	4.0	1.0	4114923
Total Kjeldahl Nitrogen	mg/L	0.19	0.10	0.31	0.35	0.26	0.10	4114884	0.34	0.10	4114884

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP743	AQP744	AQP744	AQP745	AQP746	AQP747	AQP748		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Units	SW5-JL15	SW6-JL15	SW6-JL15 Lab-Dup	SW7-JL15	SW8-JL15	SW9-JL15	SW10-JL15	RDL	QC Batch
Inorganics										
Total Chemical Oxygen Demand	mg/L	1100	1000		1200	700	910	930	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.25	0.13		0.097	ND	ND	0.11	0.050	4115479
Total Phosphorus	mg/L	0.030	0.026		0.095	0.028	0.025	0.027	0.020	4116921
Total Suspended Solids	mg/L	4.2	4.2		41	3.2	6.8	5.2	1.0	4114923
Total Kjeldahl Nitrogen	mg/L	0.22	0.32	0.29	0.32	0.25	0.29	0.27	0.10	4114887

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP749	AQP749	AQP750	AQP751	AQP752	AQP753		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	Units	SW11-JL15	SW11-JL15 Lab-Dup	SW12-JL15	SW13-JL15	SW14-JL15	SW15-JL15	RDL	QC Batch
Inorganics									
Total Chemical Oxygen Demand	mg/L	1200		940	1000	910	1100	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	ND	ND	ND	ND	0.096	ND	0.050	4115479
Total Phosphorus	mg/L	0.044		0.029	0.078	0.082	0.052	0.020	4116921
Total Suspended Solids	mg/L	33		7.4	67	8.8	50	1.0	4114923
Total Kjeldahl Nitrogen	mg/L	0.32		0.30	0.30	0.58	0.43	0.10	4114887

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B5E1711
Report Date: 2015/07/27

Strum Environmental
Client Project #: 15-5278

RESULTS OF ANALYSES OF WATER

Maxxam ID		AQP754		AQP755		AQP756	AQP756		AQP757		
Sampling Date		2015/07/15		2015/07/15		2015/07/15	2015/07/15		2015/07/15		
COC Number		N/A		N/A		N/A	N/A		N/A		
	Units	SW16-JL15	RDL	SW17-JL15	QC Batch	SW18-JL15	SW18-JL15 Lab-Dup	QC Batch	SW19-JL15	RDL	QC Batch
Inorganics											
Total Chemical Oxygen Demand	mg/L	1100	100	1100	4113916	1000	1100	4113916	1000	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.15	0.050	ND	4115479	0.23		4115479	ND	0.050	4115479
Total Phosphorus	mg/L	0.041	0.020	0.021	4116921	0.024		4116921	0.033	0.020	4116921
Total Suspended Solids	mg/L	4.3	2.0	5.8	4114923	4.2		4114923	5.8	1.0	4114931
Total Kjeldahl Nitrogen	mg/L	0.52	0.10	0.35	4114887	0.36		4117378	0.26	0.10	4117378

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP758	AQP758			AQP759		AQP760	AQP761		
Sampling Date		2015/07/15	2015/07/15			2015/07/15		2015/07/15	2015/07/15		
COC Number		N/A	N/A			N/A		N/A	N/A		
	Units	SW20-JL15	SW20-JL15 Lab-Dup	RDL	QC Batch	SW21-JL15	RDL	SW22-JL15	SW23-JL15	RDL	QC Batch
Inorganics											
Total Chemical Oxygen Demand	mg/L	960		100	4113916	840	100	970	990	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.10	0.081	0.050	4115474	0.065	0.050	0.090	ND	0.050	4115479
Total Phosphorus	mg/L	0.036		0.020	4116922	0.030	0.020	0.027	0.028	0.020	4116922
Total Suspended Solids	mg/L	8.8		1.0	4114931	7.3	2.0	15	7.8	1.0	4114931
Total Kjeldahl Nitrogen	mg/L	0.27		0.10	4117378	0.18	0.10	0.26	0.19	0.10	4117378

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP762		
Sampling Date		2015/07/15		
COC Number		N/A		
	Units	SW24-JL15	RDL	QC Batch
Inorganics				
Total Chemical Oxygen Demand	mg/L	1200	100	4119016
Nitrogen (Ammonia Nitrogen)	mg/L	0.27	0.050	4115479
Total Phosphorus	mg/L	0.023	0.020	4116922
Total Suspended Solids	mg/L	7.4	1.0	4114931
Total Kjeldahl Nitrogen	mg/L	0.29	0.10	4117378

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B564540
Report Date: 2015/07/30

MAXXAM ANALYTICS
Client Project #: DB5E1711

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		MT7019	MT7020		MT7021		MT7022		
Sampling Date		2015/07/15	2015/07/15		2015/07/15		2015/07/15		
COC Number		08412354	08412354		08412354		08412354		
	UNITS	**SW1-JL15 (AQP738)**	**SW2-JL15 (AQP739)**	**QC Batch**	**SW3-JL15 (AQP741)**	**QC Batch**	**SW4-JL15 (AQP742)**	**RDL**	**QC Batch**
Nutrients									
Total Nitrogen (N)	mg/L	0.432	0.276	7984903	0.369	7984901	0.285	0.020	7984903

RDL = Reportable Detection Limit

Maxxam ID		MT7023	MT7024		MT7025	MT7026		MT7027		
Sampling Date		2015/07/15	2015/07/15		2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354	08412354		08412354	08412354		08412354		
	UNITS	**SW5-JL15 (AQP743)**	**SW6-JL15 (AQP744)**	**QC Batch**	**SW7-JL15 (AQP745)**	**SW8-JL15 (AQP746)**	**QC Batch**	**SW9-JL15 (AQP747)**	**RDL**	**QC Batch**
Nutrients										
Total Nitrogen (N)	mg/L	0.492	0.342	7984901	0.474	0.231	7984903	0.243	0.020	7984901

RDL = Reportable Detection Limit

Maxxam ID		MT7028		MT7029	MT7030	MT7030		MT7031		
Sampling Date		2015/07/15		2015/07/15	2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354		08412354	08412354	08412354		08412354		
	UNITS	**SW10-JL15 (AQP748)**	**QC Batch**	**SW11-JL15 (AQP749)**	**SW12-JL15 (AQP750)**	**SW12-JL15 (AQP750) Lab-Dup**	**QC Batch**	**SW13-JL15 (AQP751)**	**RDL**	**QC Batch**
Nutrients										
Total Nitrogen (N)	mg/L	0.239	7984903	0.455	0.215	0.231	7984901	0.238	0.020	7984903

RDL = Reportable Detection Limit

Maxxam ID		MT7032	MT7033	MT7034	MT7035		MT7036		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354	08412354	08412354	08412354		08412354		
	UNITS	**SW14-JL15 (AQP752)**	**SW15-JL15 (AQP753)**	**SW16-JL15 (AQP754)**	**SW17-JL15 (AQP755)**	**QC Batch**	**SW18-JL15 (AQP756)**	**RDL**	**QC Batch**
Nutrients									
Total Nitrogen (N)	mg/L	0.686	0.399	0.365	0.287	7984903	0.597	0.020	7984901

RDL = Reportable Detection Limit

Maxxam Job #: B564540
Report Date: 2015/07/30

MAXXAM ANALYTICS
Client Project #: DB5E1711

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		MT7037	MT7038	MT7039	MT7040	MT7040		MT7041		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354	08412354	08412354	08412354	08412354		08412354		
	UNITS	**SW19-JL15 (AQP757)**	**SW20-JL15 (AQP758)**	**SW21-JL15 (AQP759)**	**SW22-JL15 (AQP760)**	**SW22-JL15 (AQP760) Lab-Dup**	**QC Batch**	**SW23-JL15 (AQP761)**	**RDL**	**QC Batch**
Nutrients										
Total Nitrogen (N)	mg/L	0.299	0.526	0.485	0.227	0.230	7984903	0.418	0.020	7984901

RDL = Reportable Detection Limit

Maxxam ID		MT7042		
Sampling Date		2015/07/15		
COC Number		08412354		
	UNITS	**SW24-JL15 (AQP762)**	**RDL**	**QC Batch**
Nutrients				
Total Nitrogen (N)	mg/L	0.523	0.020	7984903

RDL = Reportable Detection Limit