Keeyask Infrastructure Project

Terrestrial and Aquatic Monitoring Plan

Water Quality Monitoring

Annual Report 2012-2013

KEEYASK

Hydropower Limited Partnership

December 2013

KEEYASK INFRASTRUCTURE PROJECT

TERRESTRIAL AND AQUATIC MONITORING PLAN

Water Quality: Annual Report 2012 - 2013

Report for

MANITOBA CONSERVATION AND WATER STEWARDSHIP

Prepared on Behalf of the
Keeyask Hydropower Limited Partnership

By

Environmental Licensing & Protection Department
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1.0 INTRODUCTION

The Keeyask Hydropower Limited Partnership is constructing the Keeyask Infrastructure Project (the Project or KIP). The Project is located approximately 40 km southwest of Gillam, extending between Provincial Road (PR) 280 and Gull Rapids on the Nelson River. The Project includes a start-up camp and associated infrastructure, a 25 km all-weather access road and the first phase of a main camp.

This report covers the period beginning at the start of construction, January 2012, through to March 31, 2013. During this period, water quality monitoring was conducted at two stream crossings, Looking Back Creek and an unnamed tributary to the South Moswakot River (unnamed tributary), on four occasions in 2012. This work was conducted in accordance with Section 2.1.1 of the Terrestrial and Aquatic Monitoring Plan.

2.0 METHODS

2.1 SAMPLING LOCATIONS

Water quality monitoring was conducted at transects located upstream and downstream of the two crossings (Figure 1).

At Looking Back Creek, four transects were located as follows:

- One upstream of the construction area at the road crossing (SC1-T1).
- One immediately downstream of the construction area (SC1-T2);
- One approximately 50 m downstream of the road crossing (SC1-T3); and
- One approximately 100 m downstream of the road crossing (SC1-T4).

In June 2012, three sites were sampled along each transect at Looking Back Creek. Sample sites were located at mid-channel and approximately half way between mid-channel and each bank. Each transect was sampled and named starting from the left-hand bank (when facing upstream) to the right-hand bank (i.e., -1, -2, -3 corresponds left, mid, right). In August, due to accessibility issues created by the presence of equipment working at the creek, low water levels and debris that impeded access by canoe, samples were collected from the shores immediately upstream and downstream of construction.

At the unnamed tributary, four transects were located as follows:

- One at the treeline, where water entered the road right-of-way within the natural channel of the creek (SC2-T1);
- One upstream of the road crossing, located alongside the roadway within the ditch (SC2-T2);
- One immediately downstream of the road crossing (SC2-T3); and
- One approximately 30 m downstream of the road crossing (SC2-T4).

In June 2012, at transects SC2-T1,-T2 and -T4, one site was sampled. At SC2-T, two sites were sampled, one located in the side flow off the main channel as it flowed towards the ditch (SC2-

T3-1), and one located in the main flow of the creek immediately downstream of the ditch (SC2-T3-2). Due to low water levels during August and September 2012, turbidity was measured in the middle of each transect only. An additional sample transect was established at the treeline, approximately 10 m downstream of the road crossing, to measure sediment moving out of the road right-of-way.

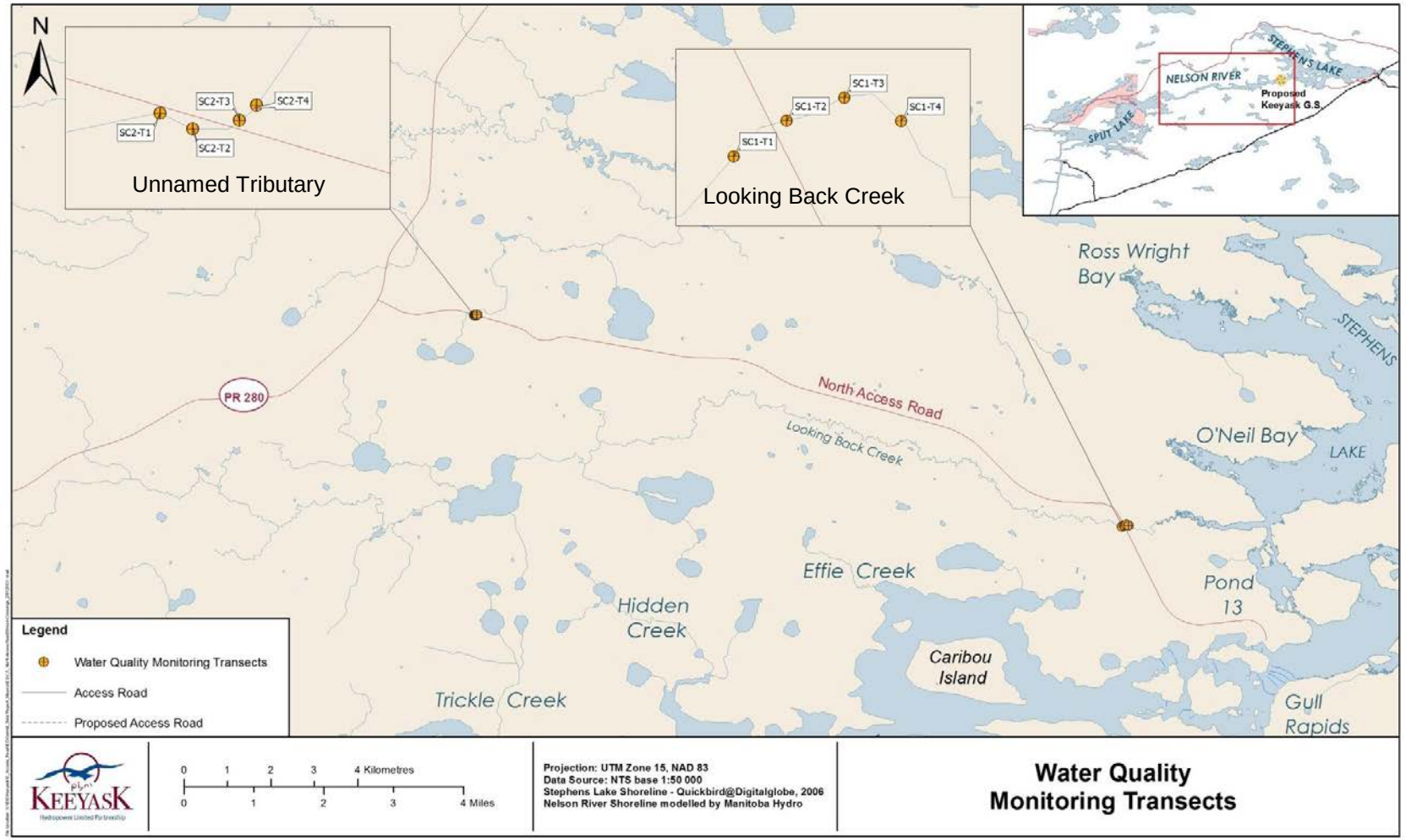

Figure 1. Location of water quality monitoring transects near stream crossings along the Keeyask Infrastructure Project road.

2.2 SAMPLING DATES

All water quality sampling for the reporting period was conducted between June and September, 2012.

2.2.1 Looking Back Creek

Samples were collected at Looking back Creek on June 28, 2012, prior to the construction of a permanent clear-span bridge over the creek, but after the installation of a temporary bridge that allowed pedestrian traffic to cross the creek. The intent of the June monitoring at this location was to gather baseline water quality information, and to determine if there were any differences in water quality upstream and downstream of the road crossing that could be a result of the existing construction activities.

Turbidity monitoring at Looking Back Creek took place on August 10, 12 and 21, 2012. These dates were selected to monitor for effects on water quality caused by construction activities taking place directly over the creek during the open water period. Work over the creek at this time consisted of a conveyor belt moving rock material across the water to construct an abutment on the opposite side (Figure 2). This was the only activity that took place over Looking Back Creek during the open water period. The remainder of the clear span bridge was installed during the winter months, when the creek was covered with ice, so no additional water quality monitoring was carried out.

Figure 2. Conveyor belt moving material from the north to south side of Looking Back Creek at the crossing location.

2.2.2 Unnamed Tributary

Construction of the access road and culvert across the unnamed tributary took place in early 2012, during the winter, when there was no detectable flow; therefore monitoring of water quality at the unnamed tributary was not conducted during these activities.

Water quality monitoring at the unnamed tributary was conducted on August 9, 12-14, 16-18, 24, 25 and September 2, 2012. During this time, the construction activities being carried out were grading of slopes (ditches) immediately adjacent to the unnamed tributary crossing (Figure 3), and installing rip rap as a measure to prevent erosion and sedimentation in the adjacent ditches (Figure 4). Monitoring in 2012 concluded once the rip rap installation was complete (Figure 5).

Figure 3. Area in vicinity of the culvert crossing during construction.

Figure 4. Unnamed tributary flowing through the culvert during construction – rip rap placed to control erosion of material.

Figure 5. Erosion control (rip rap) complete along ditches and banks of the unnamed tributary.

2.3 SAMPLING METHODS AND PARAMETERS

Both sampling areas were accessed by truck. Sites located on Looking Back Creek were sampled by canoe on June 16, 2012 and from the banks during subsequent sampling rounds. Sites located on the unnamed tributary were sampled from the banks. In June 2012, at each site, water depth was measured using either a handheld Digital Sonar system or a meter stick.

During the first sample outing, Universal Transverse Mercator (UTM) coordinates were recorded at each sample transect using a handheld Garmin eTrex. The same UTM coordinates were used to locate and sample along the same transects on subsequent sampling days, unless access to them was restricted. In August, sampling was not carried out at the transects located 50 and 100m downstream of Looking Back Creek bridge due to safety issues in accessing the sites by canoe, as water levels were low and the presence of debris in the in the creek prevented safe access (Figure 6). At the time of sampling, the placement and compaction of aggregate material for both the north and south approaches for the bridge was taking place, making it difficult and

unsafe to access the area near the creek. Sampling immediately downstream of the bridge site was taken via the pedestrian bridge; however, further areas downstream were not entirely accessible by foot, particularly the 100m downstream transect, which required the use a canoe.

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Figure 6. Debris in Looking Back Creek downstream from the crossing site.

At each sampling site, *in situ* measurements of turbidity were collected using an Analite NEP 160 turbidity meter. At Looking Back Creek, measurements were collected near the surface, at mid-depth and near the bottom; where water depths were < 1 m only a surface measurement was taken. At the unnamed tributary, measurements were taken just below the surface.

In June 2012, at most sites, water samples were collected for laboratory analysis of total suspended solids (TSS). Additionally, water samples were collected from at least one site per transect to be analysed for nutrients. Nutrients measured included: nitrate-N, nitrite-N, dissolved nitrate/nitrite-N, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and dissolved phosphorus

(DP). As described in Section 2.1.1.6 of the *Keeyask Infrastructure Project Terrestrial and Aquatic Monitoring Plan,* nutrient sampling will be undertaken on one occasion before, during and after construction. The samples collected in June represent nutrient sampling for 2012.

After collection, samples were kept cool and in the dark until submission to a Canadian Association for Laboratory Accreditations, Inc. (CALA) accredited laboratory (ALS Laboratories, Winnipeg) for analysis. All samples were analysed within laboratory specified hold-times. All samples were collected as grab samples from just below the surface (i.e., 0.3 m where water depths were sufficient).

3.0 RESULTS

3.1 LOOKING BACK CREEK

Water quality data for Looking Back Creek are presented in Table 1and Table 2 in Appendix A.

With respect to pre-construction monitoring (June 2012), TSS, turbidity and nutrient concentrations from samples collected in June were similar at all sites sampled in Looking Back Creek. There were no observed differences in either water clarity or nutrients from upstream to downstream of the stream crossing, or across transects. Turbidity was similar throughout the water column at all sites sampled.

In-situ turbidity results collected in August 2012 were similar to those collected in June, with no observed differences noted between upstream and immediately downstream of the crossing and no differences observed between the June and August sampling events.

Given the consistency of in-situ turbidity measured during the June and August sampling events, and the close relationship between turbidity and TSS, samples were not collected for TSS in August as it was inferred the TSS would be similar to those measured in June.

3.2 UNNAMED TRIBUTARY

Water quality data for the unnamed tributary are presented in Table 3 and Table 4 in Appendix A.

In June 2012, TSS and turbidity were somewhat higher than background levels (3.2 mg/L and 0.6 NTU, respectively) along the road upstream of the road crossing (3.6 mg/L and 2.7 NTU), and immediately downstream of the road crossing (9.6 mg/L and 4.2 NTU/3.1 NTU). At this time, installation of the culvert had taken place, so changes in turbidity were indicative of some small effect on water clarity. Both TSS and turbidity had returned to background levels by 30 m downstream of the road crossing.

With the possible exception of dissolved phosphorus (DP), nutrient concentrations were similar upstream and downstream of the road crossing. DP concentrations along the road upstream of the road crossing and immediately downstream of the road crossing were slightly higher than they were 30 m downstream of the road crossing. Due to laboratory error, there is no DP result available for the upstream site to indicate what background concentrations were in the stream.

Turbidity monitoring resumed in August 2012 at the unnamed tributary during construction activities in the vicinity in the ditches on either side of the road. Monitoring began on August 9, after a heavy rainfall the previous evening. The turbidity results measured at the various transects along the unnamed tributary and culvert were similar to results observed in June 2012, with no apparent changes in values upstream or downstream of the culvert. Repeated sampling on August 12 indicated an increase in turbidity through the ditch/culvert along the road that was still elevated 10 m downstream. Sampling continued daily from August 12 to 18 (with the exception of August 15 due to heavy rainfall during the day), but was eventually stopped as the water level in the unnamed tributary was so low that water stopped flowing and turbidity could not be measured. Turbidity results recorded during this time varied but remained fairly consistent and similar to those collected in June 2012.

A large rain event on August 24 generated sufficient flow to resume turbidity monitoring. After the rain, erosion around the culvert indicated a need for additional erosion control measures to be implemented at this location. The contractor placed rip rap in the ditch and on the banks between August 26 and September 1. During this time, the turbidity in the unnamed tributary was monitored and the results varied (see Table 3 and Table 4). On August 25, an intense rainfall took place in the morning, during sampling. A sediment plume was evident. The site was revisited later that day and the turbidity was much higher as a result of sediment being carried downstream (as high as 84 NTU, 10 m downstream of the culvert). By September 2, all rip rap in the vicinity of the unnamed tributary had been placed. A final round of sampling during a second rainfall event indicated the turbidity did rise through the culvert (56 NTU) but had dropped back down to the baseline turbidity levels measured upstream (1.06 NTU) 30 m downstream from the culvert. This indicated the rip rap placed along the unnamed tributary and in the ditches was effective in preventing additional erosion. No further turbidity monitoring was conducted in 2012.

Because of the low water in the unnamed tributary caused by the dry conditions in the summer of 2012, collection of TSS samples was not possible.

4.0 FOLLOW-UP

Water quality monitoring at the crossings on Looking Back Creek and the unnamed tributary will continue monthly during the open water period in 2013 (during construction) and 2014 (post-construction).

Appendix A

Water Quality Data 2012

Table 1. Turbidity data collected at Looking Back Creek in 2012.

Transect ID	Site ID	Sample Time	Total Water Depth (m)	Sample Depth (m)	Turbidity (NTU)
		28-Jun-12			
SC1-T1 Upstream	SC1-T1-1	16:22	0.9	0.3	9.6
				0.7	9.8
	SC1-T1-2	16:22	1.6	0.3	9.7
				0.8	9.9
				1.5	9.9
	SC1-T1-3	16:22	1.5	0.3	9.5
				0.7	9.6
				1.3	10.0
SC1-T2	SC1-T2-1	16:00	0.8	0.3	9.6
				0.7	10.1
	SC1-T2-2	16:00	1.4	0.3	9.6
				0.9	9.6
				1.3	9.7
	SC1-T2-3	16:00	1.3	0.3	10.0
				0.9	10.2
				0.2	10.1
SC1-T3	SC1-T3-1	15:40	0.9	0.3	10.2
				0.8	10.0
	SC1-T3-2	15:40	1.1	0.3	10.1
				0.7	9.8
				1.0	10.1
	SC1-T3-3	15:40	0.8	0.3	9.9
				0.7	10.6

Transect ID	Site ID	Sample Time	Total Water Depth (m)	Sample Depth (m)	Turbidity (NTU)
		28-Jun-12			
SC1-T4	SC1-T4-1	15:05	0.8	0.3	9.6
				0.7	10.2
	SC1-T4-2	15:05	1.1	0.3	9.9
				1.0	9.6
	SC1-T4-3	15:05	1.0	0.3	10.2
				0.9	9.5
		10-Aug-12			
SC1-T1	SC1-T1-1	Start at 14:00		0.3	8.65
Upstream	SC1-T1-3			0.3	7.65
SC1-T2	SC1-T2-1			0.3	8.6
	SC1-T2-1			0.3	8.08
	SC1-T2-3			0.3	8.6
	SC1-T2-3			0.3	7.5
		12-Aug-12			
SC1-T1	SC1-T1-1	Start at 14:15		0.3	8.31
SC1-T2	SC1-T2-1			0.3	8.38
	SC1-T2-1			0.3	7.6
		21-Aug-12			
SC1-T1	SC1-T1-1	Start at 11:05		0.3	9.7
SC1-T2	SC1-T2-1			0.3	9.6
	SC1-T2-3			0.3	9.5
	SC1-T2-3			0.3	8.49

Table 2. Total Suspended Solids and nutrient results for water samples collected at Looking Back Creek – June 2012.

Transect	Site ID	Total Suspended Solids (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Nitrate/Nitrite -N (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Nitrogen (mg/L)	Total Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)
SC1-T1	SC1-T1-1	8.2	<0.050	<0.050	<0.071	0.39	0.39	0.0041	0.015
	SC1-T1-2	7.2	-	-	-	-	-	-	-
	SC1-T1-3	2.2	<0.050	<0.050	<0.071	0.43	0.43	0.0051	0.016
SC1-T2	SC1-T2-1	8.2	<0.050	<0.050	<0.071	0.42	0.42	0.0041	0.017
	SC1-T2-2	-	-	-	-	-	-	-	-
	SC1-T2-3	9.2	<0.050	<0.050	<0.071	0.41	0.41	0.0051	0.016
SC1-T3	SC1-T3-1	8.6	<0.050	<0.050	<0.071	0.39	0.39	0.0048	0.015
	SC1-T3-2	7.4	-	-	-	-	-	-	-
	SC1-T3-3	8.4	<0.050	<0.050	<0.071	0.40	0.40	0.0052	0.016
SC1-T4	SC1-T4-1	9.2	<0.050	<0.050	<0.071	0.39	0.39	0.0044	0.017
	SC1-T4-2	7.6	-	-	-	-	-	-	-
	SC1-T4-3	9.2	<0.050	<0.050	<0.071	0.41	0.41	0.004	0.015

Table 3. Turbidity data collected at the unnamed tributary in 2012.

Transect ID	Site ID	Sample Time	Total Water Depth (m)	Sample Depth (m)	Turbidity (NTU)
		28-Jun-12			
SC2-T1	SC2-T1	17:50	0.5	0.1	0.6
SC2-T2	SC2-T2	18:10	0.3	0.1	2.7
SC2-T3	SC2-T3-1	18:20	0.4	0.1	4.2
	SC2-T3-2	18:20	0.4	0.1	3.1
SC2-T4	SC2-T4-1	18:35	0.2	0.1	0.9
		9-Aug-12			
SC2-T1	SC2-T1	15:43		0.1	1.5
SC2-T2	SC2-T2-1	16:16		0.1	2
	SC2-T2-2	16:10		0.1	1.9
SC2-T3	SC2-T3	16:31		0.1	2.1
10 m downstream		16:27		0.1	3.0
SC2-T4	SC2-T4	-		-	-
		12-Aug-12			
SC2-T1	SC2-T1	7:43		0.1	1.46
SC2-T2	SC2-T2-1	7:51		0.1	4.76
	SC2-T2-2	7:57		0.1	4.02
SC2-T3	SC2-T3	8:16		0.1	5.3
10 m downstream	1	8:09		0.1	6.3
	2	8:20		0.1	6.7
SC2-T4	SC2-T4	-		-	-
		13-Aug-12			
SC2-T1	SC2-T1	Start 13:25		0.1	1.25
SC2-T2	SC2-T2-1			0.1	1.5
	SC2-T2-2			0.1	1.9

Transect ID	Site ID	Sample Time	Total Water Depth (m)	Sample Depth (m)	Turbidity (NTU)
		13-Aug-12			
SC2-T3	SC2-T3			0.1	2.1
10 m downstream	1			0.1	2.3
	2			0.1	2.0
SC2-T4	SC2-T4			0.1	0.45
SC2-T1	SC2-T1	Start 18:51		0.1	1.07
SC2-T2	SC2-T2-1			0.1	1.75
	SC2-T2-2			0.1	1.84
SC2-T3	SC2-T3			0.1	2.0
10 m downstream	1			-	-
	2			0.1	2.0
SC2-T4	SC2-T4	-		0.1	0.7
		14-Aug-12			
SC2-T1	SC2-T1	Start 15:53		0.1	1.14
SC2-T2	SC2-T2-1			0.1	1.49
	SC2-T2-2			0.1	1.55
SC2-T3	SC2-T3			0.1	1.6
10 m downstream	1			-	-
	2			0.1	1.9
SC2-T4	SC2-T4			0.1	1.64
		16-Aug-12			
SC2-T1	SC2-T1	Start 12:14		0.1	1.09
SC2-T2	SC2-T2-1			0.1	1.3
	SC2-T2-2			0.1	1.31
SC2-T3	SC2-T3			0.1	1.9
10 m downstream	1			-	-
	2			0.1	2.3

Transect ID	Site ID	Sample Time	Total Water Depth (m)	Sample Depth (m)	Turbidity (NTU)
		16-Aug-12			
SC2-T4	SC2-T4			0.1	0.89
		17-Aug-12			
SC2-T1	SC2-T1	Start 16:47		0.1	0.69
SC2-T2	SC2-T2-1			0.1	1
	SC2-T2-2			0.1	1.04
SC2-T3	SC2-T3			0.1	1.5
10 m downstream	1			-	-
	2			0.1	1.7
SC2-T4	SC2-T4			0.1	0.68
		18-Aug-12			
SC2-T1	SC2-T1	Start 10:35		0.1	0.68
SC2-T2	SC2-T2-1			0.1	0.86
	SC2-T2-2			0.1	0.91
SC2-T3	SC2-T3			0.1	1.6
10 m downstream	1			-	-
	2			0.1	1.7
SC2-T4	SC2-T4			0.1	0.74
		24-Aug-12			
SC2-T1	SC2-T1	Start 15:35		0.1	1
SC2-T2	SC2-T2-1			0.1	10.67
	SC2-T2-2			0.1	6.04
SC2-T3	SC2-T3			0.1	28.1
10 m downstream	1			-	
	2			0.1	18.4
SC2-T4	SC2-T4			0.1	0.64

Transect ID	Site ID	Sample Time	Total Water Depth (m)	Sample Depth (m)	Turbidity (NTU)
		25-Aug-12			
SC2-T1	SC2-T1	Start 11:41		0.1	0.87
SC2-T2	SC2-T2-1			0.1	1.21
	SC2-T2-2			0.1	1.16
SC2-T3	SC2-T3			0.1	4.2
10 m downstream	1			0.1	-
	2			0.1	2.7
SC2-T4	SC2-T4			0.1	-
SC2-T1	SC2-T1	Start 16:09		0.1	1.45
SC2-T2	SC2-T2-1			0.1	38.2
	SC2-T2-2			0.1	43.1
SC2-T3	SC2-T3			0.1	84.6
10 m downstream	1			-	80.9
	2			0.1	84.6
SC2-T4	SC2-T4	-		0.1	64
		2-Sep-12			
SC2-T1	SC2-T1	Start 11:00		0.1	1.72
SC2-T2	SC2-T2-1			0.1	4.5
	SC2-T2-2			0.1	3.69
SC2-T3	SC2-T3			0.1	49.8
10 m downstream	1			0.1	56.4
	2			-	-
SC2-T4	SC2-T4			0.1	1.06

Table 4. Total Suspended Solids and nutrient results for samples collected at the unnamed tributary – June 2012.

Transect	Site ID	Total Suspended	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Nitrate/Nitrite-N (mg/L)	Total Kjeldahl Nitrogen	Total Nitrogen	Total Dissolved Phosphorus	Total Phosphorus

		Solids (mg/L)				(mg/L)	(mg/L)	(mg/L)	(mg/L)
SC2-T1	SC2-T1	3.2	<0.050	<0.050	<0.071	0.46	0.46	NR*	0.013
SC2-T2	SC2-T2	3.6	<0.050	<0.050	<0.071	0.46	0.46	0.0027	0.014
SC2-T3	SC2-T3-2	9.6	<0.050	<0.050	<0.071	0.44	0.44	0.0032	0.014
SC2-T4	SC2-T4	<2.0	<0.050	<0.050	<0.071	0.48	0.48	<0.0010	0.015

***NR = Not recorded by the laboratory.**