Harrington Dam and Conservation Area

Existing Geomorphic Conditions

December 2015, Draft

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1. Existing Conditions

1.1 Fluvial Geomorphology

The intent of the fluvial geomorphic assessment was to characterize channel form and gain insight into channel processes along Harrington Creek, in the vicinity of Harrington Pond. Harrington Creek drains into Wildwood Lake, north of Road 96; it is a tributary of Trout Creek. The geomorphic assessment included both a desktop review and field investigations; data collection completed by ERI was supplemented by UTRCA's topographic survey of the channel bed profile. Findings from the geomorphic assessment are presented by sub-section in this report.

1.3.1 Historical Assessment

A review of historical channel conditions was completed to gain insight into changes that have occurred within the study area. UTRCA provided airphotos dated from 1955, 1972, 1989, 2000, and 2010; additional aerial imagery was available from Google Maps (2013). Key observations are summarized in Table 1-1 a collection of historical airphotos of the study area is provided in **Figure 1-1**.

Table 1-1. Summary of historical study area changes.

Year	Observation
1955	• Harrington pond was clearly visible in the airphoto • Downstream of the Harrington pond outlet, Harrington Creek appeared to have been straightened and was situated along a hedgerow. • Upstream of Harrington pond, a trail/bridge exists over the creek; backwater conditions appear to extend somewhat upstream of the bridge. In general, Harrington Creek was slightly sinuous and appears to be situated in an agricultural field within a wooded creek corridor. • Low density residential housing occurs to the east of the pond, and downstream of the outlet structure
1972	• Portions of Harrington Creek are obscured from view on the photo. • Upstream of Harrington pond, the tree density within the creek corridor appears to have increased; this may also reflect a time of year difference between the 1955 and 1972 photos. • No change in creek or pond planform configuration is evident in comparison to the 1955 image.
1989	• No change in creek or pond planform configuration is evident in comparison to the 1972 image.
2000	• The upstream west end of Harrington pond appears to have been modified. Shading within the pond may reflect wind on the water or draw-down. • No change in creek planform configuration is evident in comparison to the 1989 image.
2010	• Harrington pond size has decreased in length since the 2000 image; this results in a longer backwater channel that extends into the pond. The smaller pond size may reflect time of year and/or drought conditions. • No change in planform configuration is evident in comparison to the 2000 image upstream of the bridge.
2013	• Harrington pond size has increased, similar to the 2000 configuration. • No change in creek planform configuration is evident in comparison to the 2000 image upstream of the bridge.

1955 **1972**

Figure 1-1a. Overview of historical channel change along Harrington Creek in proximity to Harrington Pond.

Figure 1-1b. Overview of historical channel change along Harrington Creek in proximity to Harrington Pond.

2010 **2013**

Figure 1-1c. Overview of historical channel change along Harrington Creek in proximity to Harrington Pond.

1.3.2 Existing Conditions

A geomorphic field investigation was undertaken on June 16, 2015 to assess existing conditions along Harrington Creek, both upstream and downstream of Harrington Pond. The field investigation included both reconnaissance level observations and detailed data collection.

During the field assessment, three reaches were identified (see **Figure 1-2**). Reaches are defined as lengths of channel along which there is relative homogeneity of controlling and modifying influences and thus channel form and processes are similar. A description of dominant channel characteristics is provided by reach below. Although intended for urban watercourses, the Rapid Geomorphic Assessment (RGA) was applied to gain insight into overall channel stability and to identify dominant channel processes.

The focus of field data collection/measurements was predominantly upstream of the dam's backwater influence and included cross-section profiles and substrate characterization. A topographic survey of the channel bed morphology was undertaken by UTRCA and provided to the ERI team for analysis and integration into the fluvial geomorphic assessment. The surveyed channel bed profile is illustrated in **Figure 1-3** which includes a profile through Harrington Pond based on 2015 water depth mapping provided by UTRCA.

Figure 1-2. Reach delineation along Harrington Creek.

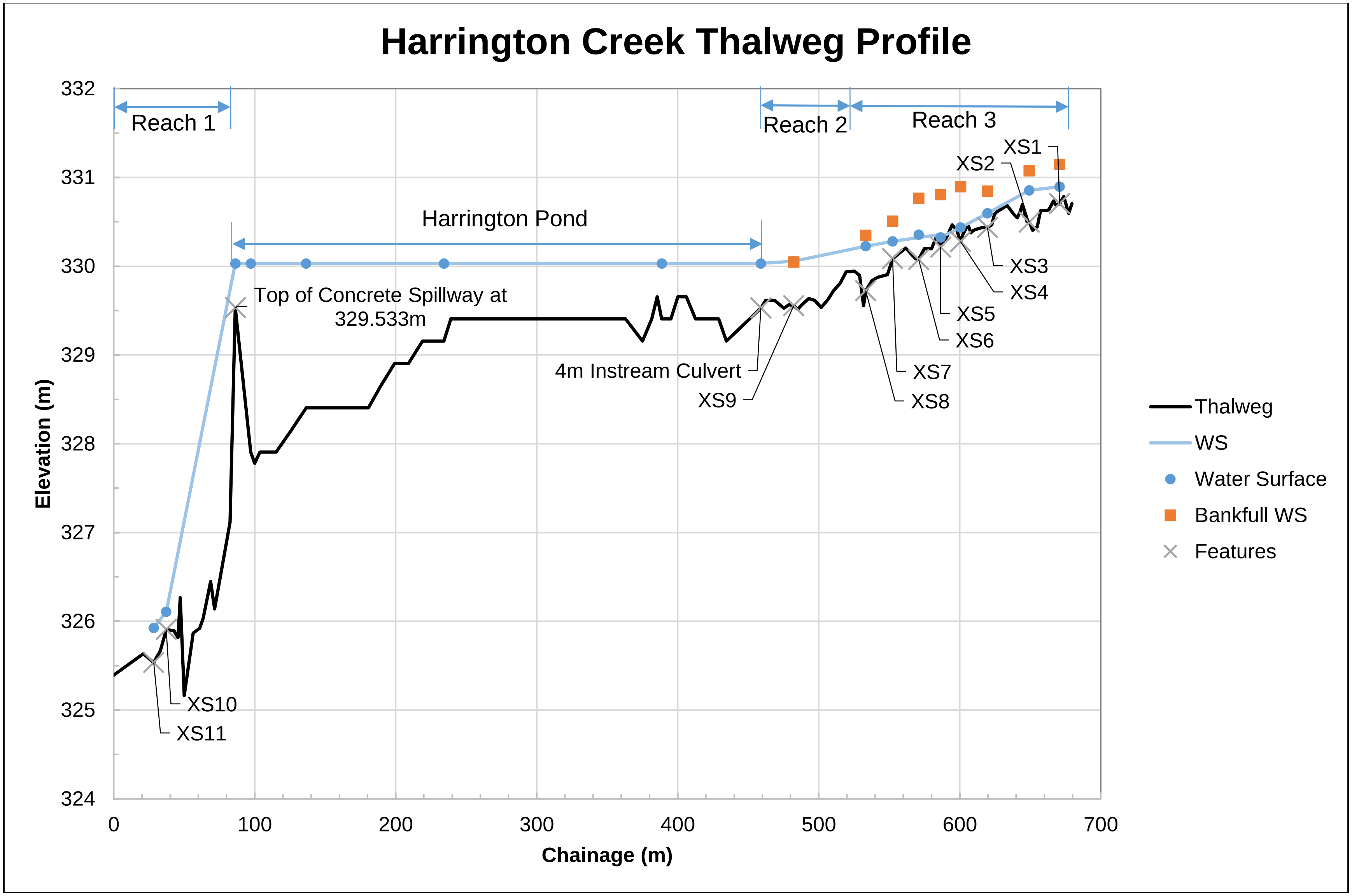

Figure 1-3. Channel bed profile along Harrington Creek.

1.3.2.1 Reach 1. Downstream of Harrington Pond

At the outlet of Harrington pond, water flows over a 2.42 m high concrete outlet structure. Boulders and cobble placed at the transition between concrete and creek bed, convey water to the downstream portion of Harrington Creek. From the dam to Road 96, the watercourse was relatively straight, likely reflecting the channel condition associated with historic mill activity.

The bed morphology consisted of pool and riffle sequences and bed materials consisted of cobble and gravel. The deepest pool (0.46 m) occurred within 25 m downstream of the dam. Several fish were observed swimming downstream from this pool.

The cross-sections were trapezoidal and banks were steeper and higher along the west side of the channel. The bankfull channel was set within a deeper channel cross-section. Banks were well vegetated with trees and shrubs. Tree roots were exposed and minor undercutting (0.14 m) was measured.

A densely vegetated (shrub) island (5.7 m wide) separated the active channel from a 2.1 m wide and 0.25 m deep dry channel situated adjacent to the east valley wall. This secondary channel is likely occupied during periods of high flow. The active channel was ~ 9.2m wide; the cross-section increased to ~ 17 m wide where the island occurred. Measurements were made at only two cross-sections (1 pool and 1 riffle), average channel dimensions are provided in **Table 1-2**

Overall, the creek was considered stable, downstream of Harrington Pond.

	
West bank along cross-section 10.	View downstream at Cross-section 11.

Table 1-2. Overview of Reach 1 cross-section parameters based on measurements at Cross-Sections 10 and 11.

Parameter	Range	Parameter	Range
BANKFULL		**LOW FLOW WATER**	
Width (m)	7.88	**Width (m)**	5.14
Depth (m) **Max.** **Avg.**	 0.79 0.52	**Depth (m)** **Max.** **Avg.**	 0.28 0.17
Width:depth ratio (m/m)	15.22	**Width:depth ratio (m/m)**	33.6
Area (m^2)	4.26	**Area (m^2)**	0.86
Perimeter (m)	8.61	**Wetted perimeter (m)**	5.57
Bank Height (m)	0.75		
Bank undercutting (m)	0.14		
Bank Vegetation and rooting influence	Trees with exposed roots, shrubs		
Floodplain connectivity	Channel is well connected to a floodplain along the upstream facing left bank, but appears entrenched along the right bank		
Substrate Gradation (mm) **D90** **D84** **D50** **D16** **D10**	 145 110 30 5 5		

1.3.2.2 Reach 2. Harrington Pond trail bridge to 79 m upstream.

Along this reach, Harrington Creek appears to be influenced by backwater conditions from the pond. The backwater condition, on the day of observation, appeared to extend approximately 79 m upstream. From the topographic survey, the UTRCA field crew noted that sediment covered the streambed for a distance of approximately 56 m upstream of the trail bridge.

Channel banks were well vegetated with grasses and herbaceous plants; the fine and dense rooting network extended to the water surface. Bank materials consisted of silty clay sediment that was considered very soft/moist. The bank configuration was generally irregular which is characteristic of banks influenced by backwater conditions in which hydration of bank materials leads to erosion; the rooting network of bankside vegetation holds the banks together in ‘clumps’. Undercutting of the banks occurred near the water surface. The relatively low banks indicated good floodplain accessibility during high flows. The floodplain sediment was moist along the west side of the channel; cedar trees flanked the bankside vegetation along the east side.

The cross-sections were uniform in configuration and increased gradually in width along this reach. A bankfull channel was not well defined since it appeared that flows higher than the channel bank spread over the vegetated west floodplain. This floodplain was very moist, suggesting frequent flooding, poor drainage and/or high groundwater content. Measurement of the active channel at one cross section (section 9) situated 23 m upstream of the trail bridge, enabled quantification of several cross-section parameters (**Table 1-3**).

Table 1-3. Overview of Reach 2 cross-section parameters based on measurements at Cross-Section 9.

Parameter	Range	Parameter	Range
BANKFULL		**LOW FLOW WATER**	
Width (m)	7.50	**Width (m)**	7.26
Depth (m) **Max.** **Avg.**	 0.49 0.37	**Depth (m)** **Max.** **Avg.**	 0.45 0.34
Width:depth ratio (m/m)	20.34	**Width:depth ratio (m/m)**	21.34
Area (m^2)	2.77	**Area (m^2)**	2.47
Perimeter (m)	6.68	**Wetted perimeter (m)**	7.47
Bank Height (m)	0.75		
Bank undercutting (m)	none		
Bank Vegetation and rooting influence	grasses along both banks		
Floodplain connectivity	well-connected		
Substrate Gradation (mm) **D90** **D84** **D50** **D16** **D10**	all substrate consisted of sand and silt		

The bed morphology through this reach was poorly defined and little variability in water depth occurred (i.e., 0.42 to 0.51 m). Bed materials consisted entirely of fine sediment (silt, sand) that had been sculpted into ripples by the flow; the thickness of this sediment ranged from 5 to 20 cm. Further upstream, occasional cobbles and branches/logs were observed on the channel bed. A vegetated (grass) bar was observed in the channel, towards the upstream limit of the backwater influence.

Overall, the reach was considered to be stable. Given the low energy grade (see **Figure 1-3**), both aggradation and channel widening processes are gradually affecting channel form and processes.

View upstream at ~33 m upstream of bridge.

Substrate materials consisted of fine (silt, sand) sediment.

1.3.2.3 Reach 3. From 79 m to 220 m upstream of pedestrian bridge.

The upstream limit of the backwater conditions appeared to extend to a shallow and low gradient riffle feature. Harrington Creek, within this reach, was situated within a predominantly wooded (cedar) forest. Subtle terracing was observed in the floodplain in a few locations, suggesting that, in the long term, Harrington Creek has likely gradually migrated over its floodplain and downcut.

Floodplain materials, especially those along the west side of the channel were often moist and surface water channels originating from within the west floodplain were observed. Fallen and leaning trees were common within the reach and occupied the entire cross-section in several locations.

Overall, Harrington Creek had a somewhat sinuous planform configuration; no well-developed meander bends were observed. In several locations, large woody debris appears to have caused the channel to bifurcate or split. Accumulations of fine sediment (silt/sand) were observed in the ‘lee’ side of logs or fallen trees in the channel.

The channel banks were generally well vegetated with herbaceous plants, mosses and cedar trees. Tree roots were often exposed through the gradual winnowing of bank materials, and minor undercutting (e.g., 0.10 m) was measured. The bank were generally low, enabling access during flood flows. Materials were moist and hydrated near the bank toe.

The cross-sections within Reach 3 were generally considered to be wide and relatively shallow. The configuration tended to be relatively uniform, with no asymmetric forms observed. The cross-section configuration was determined at eight cross-sections in the field, including 3 pools and 6 riffle/runs.

The channel bed configuration consisted of riffles and shallow pools (depth ranged from 0.12 to 0.34 m) (Figure 1-3). The water surface grade, from the upstream to downstream cross-section was 0.65 %. Overall, the bed morphology appeared to be poorly developed. This is likely due to the influence of large woody debris and the high channel width-depth ratio which reduces scour potential of pools.

Throughout the reach, accumulations of sand (very fine to medium size) and silt were observed as lateral deposits (i.e., along the banks); often, the materials appeared to be a hydrated slurry of sediment. The measured grain size gradation within Reach 3 is summarized in **Table 1-3** which shows that pools substrate was somewhat smaller than riffle substrate. Occasional larger cobble and boulders were observed on the channel bed. Insight into general channel bed roughness was obtained by measuring the height that substrate materials projected into the water column at each cross-section; measurements revealed that the average maximum, intermediate and minimum protrusion heights were 17, 9 and 1.5 cm respectively.

Analysis of the topographic channel bed profile, provided by UTRCA, was undertaken. The average water surface grade during the field survey (June 16, 2015) was 0.45 % and the average bankfull grade was 0.58 %. Quantification of riffle and pool parameters, for Reach 3 is provided in **Table 1-5**.

Application of the Rapid Geomorphic Assessment (RGA) for this reach indicated that the channel is ‘in transition’. The dominant process within the reach was aggradation. Gradual widening of the cross-sections is also prevalent due to hydration effects of the bank materials.

Table 1-4. Overview of Reach 3 cross-section parameters based on measurements taken at Cross-Sections 1 to 8.

Parameter	Riffle		Pool	
	Range	Average	Range	Average
Bankfull				
Width (m)	5.32-15.77	10.59	5.7-6.3	6.0
Depth (m)				
Max.	0.41-0.62	0.47	0.58-0.69	0.63
Avg.	0.28-0.35	0.32	0.39-0.50	0.43
Width:depth ratio (m/m)	17.26-52.95	33.5	11.47-16.24	14.34
Area (m^2)	1.64-5.47	3.38	2.43-2.84	2.57
Perimeter (m)	6.11-15.41	11.27	6.59-7.23	6.84
Low Flow				
Wetted width (m)	4.16-7.38	6.42	4.54-5.74	5.06
Water depth (m)			0.32-0.50	0.40
Max.	0.12-0.23	0.19	0.22-0.29	0.26
Avg.	0.10-0.13	0.12		
Width:depth ratio (m/m)	32.01-71.50	55.23	18.87-20.18	19.51
Area (m^2)	0.54-0.87	0.72	1.02-1.69	1.33
Wetted perimeter (m)	4.43-9.86	7.38	4.85-6.10	5.39
Substrate Gradation (mm)				
D90	90		100	
D84	60		40	
D50	15		10	
D16	1		0.25	
D10	0.25		0.25	

Table 1-5. Channel bed profile characteristics along Reach 3.

Parameter	Range	Average
Max. residual pool depth (m)	0.04-0.34	0.17
Pool area (2D along profile) (m^2)	0.03-1.11	0.38
Pool length (m)	6.30-22.00	15.33
Avg. pool depth	0.01-0.14	0.07
Riffle length (m)	3.50-32.25	12.31
Riffle grade (%)	0.26-3.51	1.58
Inter-riffle spacing	11.31 – 36.40	29.14

	
View upstream near downstream limit of Reach 3. Banks were low; the creek was well connected to its floodplain.	Seepage from the west flood plain entered the creek in several locations
	
Large woody debris were frequently in the channel.	Leaning trees were common along the reach.
	
The floodplain was typically accessible and included subtle terracing.	Upstream end of Reach 3