



**To:** Lucy Benham, CLOCA  
**From:** Tony Dang and Steve Hollingworth, TYLin  
**c.c.** Perry Sisson, CLOCA  
**Date:** September 2023  
**Re:** **Robinson and Tooley Creek Flood Mitigation Study**

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## TECHNICAL MEMORANDUM

### 1 INTRODUCTION

T.Y. Lin International Canada Inc. (TYLin) was retained by Central Lake Ontario Conservation Authority (CLOCA) to complete the Robinson and Tooley Creek Flood Mitigation Study in the Municipality of Clarington (the Municipality).

The recently completed Robinson and Tooley Creek Subwatershed Study, Phase 2 and 3 (SWS) (ABL, 2022) predicted that future development in the Tooley Creek watershed will result in increased peak flow rates in Tooley Creek during the Regulatory Storm. This Flood Mitigation Study is an additional assessment of flood mitigation measures beyond the SWS to identify approaches to provide Regulatory flood protection along Tooley Creek.

The SWS had previously recommended Regional Storm control SWM facilities as flood control measures within future development areas. Sizing SWM facilities for Regional Storm control usually results in larger footprints relative to facilities designed for standard 100-year peak flow control, which will reduce the remaining development areas and increase the Municipality's long-term maintenance costs. Potential flood mitigation alternatives to reduce Regulatory flood levels may offer greater benefits to a broader range of stakeholders relative to Regional Storm control ponds.

Prior to developing additional flood mitigation alternatives, this study included refinements to the hydraulic modelling that is currently used by CLOCA for the Regulatory floodplain mapping for Robinson and Tooley Creeks. The refinements included spill analyses to delineate a more accurate Regulatory floodplain, with CLOCA's current Regulatory peak flow rates, to be used as the basis for assessing impacts and flood mitigation alternatives. Hydrologic modelling updates for future land uses were also completed to determine new Regulatory peak flow rates due to proposed development.

This technical memorandum summarizes the hydrologic and hydraulic modelling refinements (**Sections 2 and 3**), the potential flood mitigation options (including Regional Storm control

SWM facilities recommended in the SWS) (**Section 4**), an evaluation of the mitigation options (**Section 5**), and modelling analysis of the preferred option with ultimate development within the watersheds (**Section 6**).

## 2 HYDROLOGIC MODELLING UPDATE

The hydrologic peak flow rates used in this study were based on CLOCA's Visual OTTHYMO (VO) hydrologic modelling for Robinson Creek and Tooley Creek, which is currently used to establish the Regulatory floodplains in both watersheds. The current flood modelling package for Robinson Creek was completed by CLOCA in February 2010 (revised March 31, 2010) (CLOCA, 2010), while the Tooley Creek flood modelling package was completed in October 2007 (revised March 2008 and March 2012) (CLOCA, 2012). The current floodplain mapping for these watersheds was based on the future conditions Regulatory flow rates from the above models. For this study, the VO models for each watershed were updated to reflect future conditions land use from three Secondary Plan areas (Southeast Courtice, Southwest Courtice, and Courtice Waterfront and Energy Park) and the Official Plan (OP) for the Courtice Employment Lands (**Attachment A**) to assess the impact of proposed development on the floodplain.

The hydrologic modelling update was limited to the future conditions Regulatory (uncontrolled) scenario, which does not consider quantity controls from SWM Ponds within the watersheds. This approach is consistent with provincial guidelines, documented in the Technical Guide, River and Stream Systems; Flooding Hazard Limit (MNR, 2002). Design storms were limited to the 100-year 12-hour Chicago distribution and the Regional Storm (Hurricane Hazel). Peak flow rates from both design storms were used in the hydraulic model, where the outer most floodline generated from the above design storm peak flow rates is used as the Regulatory floodline. The design storms were consistent with previous hydrologic modelling for these watersheds.

A future conditions GIS land use layer and hydrologic modelling parameters were provided by CLOCA for this analysis. The main land use categories for the hydrologic model are presented on **Figure 2a, Attachment D**, while land use subcategories found in Secondary Plans and the OP are shown on **Figure 2b, Attachment D**. The models' land use update was completed by determining the area associated with each land use for each subcatchment area using GIS tools. The land areas were incorporated into the hydrologic parameter spreadsheets provided by CLOCA as part of the modelling packages to calculate the imperviousness, initial abstraction and CN values. Subwatershed boundaries, channel routing parameters, flow nodes, and hydrologic modelling parameters unrelated to land use were unchanged from previous modelling.

Results from the hydrologic modelling update indicated that 100-year and Regional Storm peak flow rates slightly decreased in the Robinson Creek watershed for most flow nodes (relative to



the 2010 future conditions model) due to the land use update, except for minor increases in the Robinson West Tributary (**Table 2-1**). This result is because the land use update included more greenspaces and natural heritage area, which increased the total pervious area in the watershed compared to the 2010 future conditions model, thus decreasing peak flow rates.

In Tooley Creek, the updated future conditions land use generated 100-year and Regional Storm peak flows that were greater than the 2012 future conditions modelling (**Table 2-2**) due to the increase in proposed development (impervious) area. Additional modelling results are provided **Attachment B** and flow node locations are shown on **Figure 1, Attachment D**.

**Table 2-1 Robinson Creek Peak Flow Rates**

Reach	NHYD	2010 CLOCA Future Conditions Peak Flow Rate (m <sup>3</sup> /s)		2023 TYLin Future Conditions Update Peak Flow Rate (m <sup>3</sup> /s)	
		100-year	Regional	100-year	Regional
<b>Robinson Creek upstream of West Tributary</b> HEC-RAS Reach: RobinsonUpper	349 MJR	2.02	0.72	2.02 (Note 1)	0.86
	351	7.05	1.21	7.71	1.82
	305	7.48	2.07	8.02	2.66
	336	13.92	3.01	12.42	3.63
	307	19.99	8.06	18.13	8.58
<b>Robinson Creek downstream of West Tributary</b> HEC-RAS Reach: RobinsonLower	338	32.59	16.17	28.90	16.49
	309	31.80	19.14	27.25	19.31
	310	44.23	26.87	37.44	26.72
	315	49.08	31.54	40.23	31.02
	318	92.18	54.72	86.91	53.91
	319	89.88	61.05	75.43	60.08
	320	91.04	63.01	76.93	61.99
	321	91.47	63.75	78.61	62.72
	322	92.05	64.58	79.28	63.52
<b>Robinson Creek West Tributary</b> HEC-RAS Reach: RobinsonWest	340	31.30	18.07	34.14	18.18
	317	44.26	23.18	46.68	23.33

1. Major flows from future development (NHYD 349 MJR) directed to the upstream reach of Robinson Creek must not exceed 2.02 m<sup>3</sup>/s to the tributary unless it can be demonstrated that through the provision of mitigation measures, there will be no downstream flooding impacts.

**Table 2-2 Tooley Creek Peak Flow Rates**

Reach	NHYD	2012 CLOCA Future Conditions Peak Flow Rate (m <sup>3</sup> /s)		2023 TYLin Future Conditions Update Peak Flow Rate (m <sup>3</sup> /s)	
		100-year	Regional	100-year	Regional
<b>Tooley Creek Upstream of West Tributary</b> HEC-RAS Reach: Tooley_Upper	1	4.24	12.41	15.60	16.07
	1 + 69% of NHYD 2 (Note 1)	9.18	20.48	29.56	24.82
	3	9.23	22.09	26.93	27.62
	3 + 23% of NHYD 6 (Note 1, 2)	12.01	31.15	39.02	38.29
	3 + 62% of NHYD 6 (Note 1, 2)	20.23	46.51	59.53	56.37
	3 + 92% of NHYD 6 (Note 1, 2)	26.55	58.33	75.30	70.28
	7	27.48	59.94	63.79	70.66
	17	35.03	74.24	84.81	87.39
	18	35.18	74.77	93.55	87.88
	19	43.09	91.51	111.82	108.75
	20	48.87	99.84	118.46	117.34
24	48.87	99.88	114.79	118.09	
<b>Tooley Creek Downstream of West Tributary</b> HEC-RAS Reach: Tooley_Lower	29	65.08	118.12	150.64	137.84
	35	64.74	127.67	134.78	146.98
<b>Tooley Creek West Tributary</b> HEC-RAS Reach: Tooley_West	25	13.82	17.64	39.26	18.14
	27	16.67	20.80	35.85	21.46

1. Peak flow rates were calculated by dividing hydrologic subcatchment flow rates according to flow node locations within select subcatchments. This methodology was carried over from the Tooley Creek hydrologic modelling completed in 2012 (CLOCA, 2012).
2. The 2012 hydrologic modelling included a computational error that incorrectly reported flow rates for RS 3700, 3300 and 2800, which was corrected in this study and hydraulic model input.

## 3 HYDRAULIC MODELLING UPDATE

### 3.1 Hydraulic Modelling Methodology

The hydraulic modelling updates to the Robinson and Tooley Creek floodplain modelling were completed to incorporate spill analyses that were either not completed, or partially completed under the current floodplain modelling packages for each respective watershed. From previous modelling, three spill areas were identified:

- ▶ From the main branch of Robinson Creek to the West Tributary of Tooley Creek along the ditch north of and parallel to Highway 401 (referred to herein as the 'Robinson Creek Spill')
- ▶ From the main branch of Tooley Creek through the Courtice Road underpass at Highway 401 (referred to herein as the 'Courtice Road Underpass Spill')
- ▶ From the main branch of Tooley Creek to the West Tributary of Tooley Creek along the ditch north of and parallel to Highway 401 (referred to herein as the 'Tooley Creek Main Branch Spill').

Similar to the hydrologic modelling update, the hydraulic modelling updates built upon the HEC-RAS models for Robinson Creek (CLOCA, 2010) and Tooley Creek (CLOCA, 2012) provided in the floodplain modelling packages. Modifications to the model geometry are summarized as follows:

- ▶ The Digital Elevation Model (DEM) for the area around the Courtice Road and Highway 401 interchange was updated with a recent DEM compiled by CLOCA that reflect the recent works by the Ministry of Transportation (MTO). Additional information used to update the geometry include a topographic survey provided by CLOCA (dated November 2, 2022) for the ditch along the north side of the Highway 401 and select culverts, as well as drawings provided by MTO for the Highway 401 profile and culvert crossings. The height of the Highway 401 concrete median was also included at a height of 1.05 m above the road deck elevation as per the Highway 401 design drawings.
- ▶ Due to the spill from Robinson Creek to Tooley Creek, the hydraulic models from the two watersheds were combined into a single HEC-RAS model.
- ▶ The West Tributary of Tooley Creek was extended north of Highway 401 with the culvert crossing and Highway 401 road deck (including concrete median). North of Highway 401, the west tributary was divided into two reaches extending east and west along the ditch parallel to the north side of Highway 401, which receive flows from the Robinson Creek Spill and the Tooley Creek Main Branch Spill.

- ▶ The Robinson Creek Spill and Tooley Creek Main Branch Spill were modelled with lateral structures that used the cross-section geometry at the spill crests as weirs. Flows that overtop the lateral structure weirs were carried downstream into branches of the Tooley Creek West Tributary that follow the ditch along the north side of Highway 401.
- ▶ The Tooley Creek main branch cross-section geometry upstream and downstream of Highway 401 was reconfigured to model the Courtice Road underpass at Highway 401 as a hydraulic opening in the Highway 401 crossing. This required cross-sections to be reconfigured such that the road decks at Highway 401 and Darlington Park Road are perpendicular to the direction of flow.

To assess the impact of proposed development on the Regulatory floodplain, hydraulic modelling was completed using the updated geometry with peak flow rates outlined in **Section 2**, including flows from CLOCA (2010/2012) and flows updated through this study. A summary of the HEC-RAS plans used in this analysis is provided in **Table 3-1** below. Flow rates for each HEC-RAS plan and output tables are provided in **Attachment C**. The resulting preliminary floodplain was plotted on **Figure 3, Attachment D**.

For Robinson Creek, the spill analysis (described in **Section 3.2**) indicated a spill towards the West Tributary of Tooley Creek. To be conservative, the peak flow rates used in plans *ExReg* and *PropReg* had included the Robinson Creek Spill flow rate (lost to the west tributary of Tooley Creek) within the main branch of Robinson Creek downstream of the spill area.

The Robinson Creek Spill flow rate ( $15.27 \text{ m}^3/\text{s}$  or  $3.38 \text{ m}^3/\text{s}$ , **Table 3-3**) was added to the flow rate within the main branch of Robinson Creek at River Station 772 (from NHYD 322, **Table 2-1**), downstream of Darlington Park Road, which was selected because the location is far enough downstream to not impact the tailwater condition for the Robinson Creek Spill upstream of Highway 401. Note that the Tooley Creek Main Branch Spill was a small flow rate that was considered negligible compared to peak flow rates downstream of the spill and hence the spill flow was not added back into the main branch of Tooley Creek downstream of the spill.

Additionally, the Robinson Creek hydraulic model completed by CLOCA in 2010 included a storage analysis upstream of the CPR to determine the upstream water elevations. This storage analysis is sensitive to tailwater condition downstream of the CPR, which in turn was influenced by the Robinson Creek Spill.

Therefore, the updated Robinson Creek Spill also required an update to the storage analysis upstream of CPR to account for the change in peak flow rates. The methodology outlined by in the Robinson Creek Floodplain modelling package (CLOCA, 2010) was generally replicated with the HEC-RAS hydraulic model and VO hydrologic model for storage volume analysis.

**Table 3-1 Summary of HEC-RAS Model Plans**

Plan Title / File	Geometry Title / File	Flow Title / File
<p><b>ExReg_spill</b>  <i>TooleyRobinson.p06</i>            To determine spill flow rates under current Regulatory flow rates.</p>	<p><b>Tooley_Robinson_2023</b>  <i>TooleyRobinson.g04</i>            CLOCA's 2010/2012 model geometry updated by TYLin for spill analysis and Courtice Road / Highway 401 interchange improvements.</p>	<p><b>ExReg_flows_spill</b>  <i>TooleyRobinson.f04</i>            CLOCA 2010/2012 flow rates.</p>
<p><b>PropReg_spill</b>  <i>TooleyRobinson.p08</i>            To determine spill flow rates under proposed Regulatory flow rates.</p>	<p><b>Tooley_Robinson_2023</b>  <i>TooleyRobinson.g04</i>            See above</p>	<p><b>PropReg_flows_spill</b>  <i>TooleyRobinson.f03</i>            Flow rates updated by TYLin with new future land use data.</p>
<p><b>ExReg</b>  <i>TooleyRobinson.p07</i>            To plot Regulatory floodline under the current Regulatory flow rates.</p>	<p><b>Tooley_Robinson_2023</b>  <i>TooleyRobinson.g04</i>            See above</p>	<p><b>ExReg_flows</b>  <i>TooleyRobinson.f08</i>            CLOCA 2010/2012 flow rates, with spill flows lost from system added back to downstream reaches.</p>
<p><b>PropReg</b>  <i>TooleyRobinson.p10</i>            To plot Regulatory floodline under TYLin updated future conditions flow rates. This plan to be carried into future floodplain mapping and modelling package.</p>	<p><b>Tooley_Robinson_2023</b>  <i>TooleyRobinson.g04</i>            See above</p>	<p><b>PropReg_flows</b>  <i>TooleyRobinson.f09</i>            Flow rates updated by TYLin with new future land use data, and spill flows lost from system added back to downstream reaches.</p>
<p><b>CPR_wse</b>  <i>TooleyRobinson.p11</i>            Robinson without a set WSE upstream of CPR to determine stage-discharge rating curve at CPR.</p>	<p><b>Tooley_Robinson_2023</b>  <i>TooleyRobinson.g04</i>            See above</p>	<p><b>PropReg_flows_CPR</b>  <i>TooleyRobinson.f10</i>            Same as <i>PropReg_flows</i> without a set WSE upstream of CPR at Robinson Creek and additional profiles to develop stage-discharge rating curve.</p>
<p><b>Tooley_mitigation</b>  <i>TooleyRobinson.p09</i>            To evaluate structural mitigation options.</p>	<p><b>Tooley_mitigation</b>  <i>TooleyRobinson.g08</i>            Same as <i>Tooley-Robinson_2023</i> with structural improvements</p>	<p><b>PropReg_flows</b>  <i>TooleyRobinson.f09</i>            See above</p>

In TYLin’s update, the stage-storage relationship upstream of the CPR established in the analysis completed by CLOCA in 2010 was used because the topography for the reach was expected to have remained the same as the previous analysis. A stage-discharge rating curve for the CPR was obtained from the HEC-RAS model (plan: *CPR\_wse*) to form a stage-discharge-storage relationship.

The tailwater elevation downstream of the CPR (with spill analysis) was also modelled with HEC-RAS plan: *CPR\_wse*. The discharge-storage rating curve was inputted into VO to model the storage volumes upstream of the CPR for the 100-year and Regional Storm events, which in turn, were used to determine the water surface elevation upstream of the CPR using the stage-storage curve. The storage used, as reported from the VO model, was applied to the stage-storage curve above the tailwater elevation, consistent with the method by described in the floodplain modelling package (CLOCA 2010), recognizing that this is a conservative approach. The resulting water surface elevation was inserted into the HEC-RAS model for Robinson Creek immediately upstream of the CPR (**Table 3-2**).

**Table 3-2 Summary of Robinson Creek Storage Upstream of CPR**

Study	Scenario	Water Surface Elevation (m)
CLOCA 2010	Regional – Without Storage Analysis	99.55
	Regional – With Storage Analysis	96.28
	100-year – Without Storage Analysis	99.58
	100-year – With Storage Analysis	96.19
TYLin Robinson-Tooley Flood Mitigation	Regional – Without Storage Analysis	99.69
	Regional – With Storage Analysis	94.78
	100-year – Without Storage Analysis	99.78
	100-year – With Storage Analysis	95.88

## 3.2 Hydraulic Modelling Results

The hydraulic modelling at the spills predicted that flows from both the Robinson and Tooley Creek main branches spill towards the Tooley Creek West Tributary located between the main branches of each creek (**Table 3-3**). The low point in Highway 401 within these watersheds is also located near the Tooley Creek West Tributary culvert crossing of Highway 401, and thus the



model also predicted flows overtopping Highway 401 at that location.

Flows also spill through the Courtice Road underpass, as noted in current floodplain mapping, but was not previously modelled. Also note that the TYLin updated flow rates had a decrease in Robinson Creek flows and an increase in Tooley Creek flows compared to CLOCA’s 2012 future conditions flows, which had a corresponding impact on the flow rates at each spill area.

Floodplain mapping downstream of the spill areas was based on full flows in both the Robinson and Tooley Creek main branches (i.e., conservatively includes the flows that are removed from the reaches due to the spills).

**Table 3-3 Summary of Spill Analyses Results**

Spill Area	Peak Flow Rate through Spill		Notes
	CLOCA Flows	TYLin Updated Flows	
Robinson Creek Spill to Highway 401 Ditch (ultimately to Tooley West Tributary)	100-year: 15.27 m <sup>3</sup> /s Regional: no spill	100-year: 3.38 m <sup>3</sup> /s Regional: no spill	Previous spill analysis completed by CLOCA in 2010 indicated a spill flow rate of 19.10 m <sup>3</sup> /s. TYLin updated 100-year flows were about 14 m <sup>3</sup> /s less than CLOCA 2010 flows, hence the difference between flow rate scenarios.
Courtice Road Underpass Spill under Highway 401 (to main branch of Tooley Creek)	100-year: none Regional: 24.17 m <sup>3</sup> /s	100-year: 39.85 m <sup>3</sup> /s Regional: 37.62 m <sup>3</sup> /s	Not modelled in 2012 CLOCA hydraulic model. TYLin updated total flows in Tooley Creek were greater than CLOCA 2012 flows by about 60 m <sup>3</sup> /s for the 100-year storm and about 13 m <sup>3</sup> /s for the Regional storm, hence the difference between flow rate scenarios.
Tooley Creek Main Branch Spill Highway 401 Ditch (ultimately to Tooley West Tributary)	No spill for 100-year or Regional	100-year: 0.32 m <sup>3</sup> /s Regional: 0.13 m <sup>3</sup> /s	

Select water surface elevations for Robinson Creek are presented in **Table 3-4** with the updated hydraulic modelling. In general, no change or minor decreases in flood levels were noted.

The predicted water surface elevations for select areas in the Tooley Creek watershed are summarized in **Table 3-5**. Tooley Creek was divided into reaches based on the hydraulic modelling results, for the purposes of developing flood mitigation options (described in

**Section 4).** The water surface elevations were generated from model scenarios using the CLOCA flows and TYLin flows and rounded to the nearest 0.1 m according to CLOCA’s standard practice. HEC-RAS output tables for both Robinson and Tooley Creek are included in **Attachment C**.

In general, increases in water surface elevations due to the increase in flow were predicted for all reaches of Tooley Creek, where reaches upstream of the CPR and downstream of the CNR had increases in flood elevations of up to 0.2 m. The most impacted area is located between Highway 401 and the CPR, which had flood elevation increases of up to 0.9 m (Reaches 3 and 4). The corresponding impacts to floodplain area are shown on **Figure 3, Attachment D**.

**Table 3-4 Summary of Regulatory Water Surface Elevations in Robinson Creek**

HEC-RAS Reach	River Station	Regulatory Water Surface Elevation (m)		WSE Change with TYLin Flows (m)
		CLOCA	TYLin	
RobinsonUpper	3494	133.2	133.2	0.0
	3100	131.3	131.3	0.0
	2800	130.1	130.1	0.0
	2400	126.9	126.8	-0.1
	1900	119.8	119.7	-0.1
	1200	105.8	105.8	0.0
	600	99.3	99.1	-0.2
	200	96.3	96.1	-0.2
RobinsonLower	1900	96.3	96.1	-0.2
	1408	96.3	96.1	-0.2
	1300	95.7	95.4	-0.3
	1076	95.6	95.4	-0.2
	834	86.6	86.5	-0.1
	728	82.9	82.8	-0.1
	400	82.4	81.5	-0.9
	254	77.2	77.2	0.0
RobinsonWest	300	96.3	96.1	-0.2
	122	96.3	96.1	-0.2

1. The water surface elevation from the Robinson Creek CPR storage analysis was applied at River Station 1389.

**Table 3-5 Summary of Regulatory Water Surface Elevations in Tooley Creek**

Flood Mitigation Reach	HEC-RAS Reach	River Station	Regulatory Water Surface Elevation (m)		WSE Change with TYLin Flows (m)
			CLOCA	TYLin	
Reach 1 (upstream of Bloor Street)	Tooley_Upper	4600	128.4	128.5	+0.1
		4000	120.3	120.5	+0.2
Reach 2 (Bloor Street to CPR)	Tooley_Upper	3600	116.4	116.5	+0.1
		2700	107.9	108.0	+0.1
		1800	105.5	105.5	0.0
Reach 3 (CPR to Baseline Road)	Tooley_Upper	1600	98.4	99.1	+0.7
		1400	98.2	99.1	+0.9
Reach 4 (Baseline Road to Hwy 401)	Tooley_Upper	1270	95.4	96.0	+0.6
		863	95.4	96.0	+0.6
		784	95.4	96.0	+0.6
Reach 5 (Hwy 401 to Darlington Park Road)	Tooley_Upper	500	91.7	91.7	0.0
		451	91.7	91.7	0.0
Reach 6 (Darlington Park Road to Lake Ontario)	Tooley_Upper	300	91.7	91.7	0.0
		100	83.2	83.2	0.0
	Tooley_Lower	800	81.0	81.1	+0.1
		200	77.3	77.4	+0.1
West Tributary Reach 1 (Upstream of Hwy 401)	Tooley_West/Downstream	1046	94.5	94.6	+0.1
West Tributary Reach 2 (Confluence to Hwy 401)	Tooley_West/Downstream	794	91.5	91.5	0.0
		600	89.4	89.6	+0.2
		200	86.3	86.3	0.0

## 4 MITIGATION OPTIONS

### 4.1 Overview

A discussion of the floodplain areas impacted by future development and potential flood mitigations options are described below. These options build upon the flood control considerations from the SWS. Note that flood mitigation options are not proposed for Robinson Creek because the updated hydraulic modelling for Robinson Creek predicted no change or minor decreases in flood levels across the floodplain model.

For each mitigation option, a brief discussion is provided of the feasibility, effectiveness, implementation, approvals and cost considerations.

### 4.2 Tooley Creek Flood Mitigation Options

#### 4.2.1 Main Branch Reach 1 (Upstream of Bloor Street)

The increase in Regulatory water surface elevation (up to 0.2m) and floodplain extent upstream of Bloor Street is relatively minor and do not appear to be impacted by the Bloor Street crossing. The specific flood mitigation options for this reach are as follows:

► **Option 1a – Regional control SWM facilities for all new development**

All new development areas contributing to Tooley Creek are to have Regional Storm control to match peak flows in existing conditions. The SWS outlined twelve (12) municipal dry ponds located within the Tooley Creek watershed under the Southeast Courtice Secondary Plan and within the Courtice Employment Lands. A unit storage of 450 m<sup>3</sup>/ha was selected by the SWS based on hydrologic modelling to reduce post-development flows below pre-development flows. A list of SWM facilities within the Tooley Creek watershed proposed by the SWS is found in **Table 4-1**.

**Table 4-1 Proposed Municipal SWM Facilities within Tooley Creek Watershed**

Secondary Plan	SWM Facility Name (from SWS)	Drainage Area (ha)	Storage Volume (m <sup>3</sup> )
<b>Courtice Employment Lands</b>	CEL-P1	54.9	24,706
	CEL-P2	30.3	13,626
	CEL-P3	48.0	21,587
	CEL-P4	32.2	14,491
<b>Southeast Courtice</b>	SEC-P1	31.9	14,355
	SEC-P2	9.2	4,144
	SEC-P3	26.6	11,951
	SEC-P4	31.7	14,250
	SEC-P5	10.9	4,927
	SEC-P6	10.9	7,931
	SEC-P7	21.7	9,770
	SEC-P10	19.3	8,668

1. Data from Table 7.1 of the Robinson Creek & Tooley Creek SWS, Phase 2 and 3 report (ABL, 2022).

The Regional Storm control SWM facilities would be implemented as development occurs and will be sized according to criteria outlined in the SWS. To be considered for Regulatory storm control, the SWM facilities must be designed according to the Lakes and Rivers Improvement Act (LIRA) standards for small dams (ABL, 2022).

This option has large cost considerations when considering the additional land requirements taking away from development potential, and additional costs for the Municipality to maintain and reconstruct the facilities at the end-of-life cycle.

► **Option 1b – Landowner consent for minor increase in flood levels**

This area is future urban development under the Southeast Courtice Secondary Plan. The minor increase in flood levels and floodplain area will remain contained within the limits of natural features associated with the Tooley Creek Valley. The impact to development from the local increase in floodplain area would be less than the impact to development if Regional Storm control SWM facilities were implemented and is therefore likely to achieve a net increase in developable area. Given that increase in flood extent will not impact any structures, this option will have a negligible impact on the short-term utility of the land for agriculture and will not reduce developable area, the solution would likely be considered acceptable to the affected landowners.

## 4.2.2 Main Branch Reach 2 (Bloor Street to CPR)

The increase in Regulatory water surface elevation (up to 0.1m) and floodplain extent is relatively minor between Bloor Street and the CPR. The specific flood mitigation options for this reach are as follows:

- ▶ **Option 2a – Regional control SWM facilities for all new development**

Refer to description under Option 1a.

- ▶ **Option 2b – Regional control SWM facilities in select areas of new development**

This option considers only providing Regional Storm control for the upstream residential/mixed use developments within the Southeast Courtice Secondary Plan, and not providing Regional Storm control for the Courtice Employment Lands located further downstream in the Tooley Creek watershed.

Quantity controls in the upstream areas of the watershed will sufficiently delay peak flow rates in Tooley Creek such that overall runoff peaks further downstream in the watershed will be equal to (or marginally greater than) existing Regulatory flows. Since the Courtice Employment Lands are located further downstream in the watershed than the Southeast Courtice Secondary Plan area, the four Regional control SWM facilities proposed for those areas would be excluded in this option.

A cursory review of this option was completed using the SWS hydrologic model as a proxy for assessing the effectiveness of this option (**Table 4-2**). Note that the peak flow rates within Main Branch Reaches 3 and 4 are less than the existing Regulatory flow rates (Regional Storm) in this option. More detailed hydrologic modelling would need to be completed to confirm the effectiveness of this option.

The results indicate that peak flow rates in Tooley Creek will be sufficiently mitigated for the Main Branch Reaches 1 to 4, which includes the area upstream of Highway 401 with the greatest flood elevation and extent increase in future conditions. This option will not provide mitigation for the West Tributary of Tooley Creek and the downstream-most reach of the main branch of Tooley Creek. Mitigation measures for these areas are discussed in **Sections 4.2.6 to 4.2.8**.

**Table 4-2 Review of Subwatershed Study SWM Facilities for Flood Mitigation in Tooley Creek**

Flood Mitigation Reach	NHYD (Note 1)	Existing 2018 (m <sup>3</sup> /s) (Note 1)	Future Uncontrolled (m <sup>3</sup> /s) (Note 1)	Future (Traditional) at 450 m <sup>3</sup> /ha (m <sup>3</sup> /s) (Note 1)	Future (Traditional) at 450 m <sup>3</sup> /ha Without SWM Facilities CEL-P1 to CEL-P4 (m <sup>3</sup> /s)
<b>100-year</b>					
Reach 1 (upstream of Bloor Street)	3	22.33	<b>26.08</b>	11.14	10.87
Reach 2 (Bloor Street to CPR)	7	39.53	50.69	27.20	25.98
Reach 3 (CPR to Baseline Road)	17	46.59	66.93	32.48	44.06
Reach 4 (Baseline Road to Hwy 401)	18	46.95	76.19	32.97	49.25
	19	62.19	96.78	52.04	77.71
Reach 5 (Hwy 401 to Darlington Park Road)	20	69.30	<b>109.62</b>	67.58	<b>95.38</b>
West Tributary Reach 2 (Confluence to Hwy 401)	27	<b>26.35</b>	<b>40.91</b>	<b>22.58</b>	<b>44.51</b>
Reach 6 (Darlington Park Road to Lake Ontario)	29	95.85	<b>132.78</b>	85.82	<b>123.29</b>
	35	92.30	122.24	81.98	112.24
<b>Regional</b>					
Reach 1 (upstream of Bloor Street)	3	<b>25.85</b>	25.75	<b>19.68</b>	<b>19.68</b>
Reach 2 (Bloor Street to CPR)	7	<b>62.37</b>	<b>62.03</b>	<b>51.10</b>	<b>52.11</b>
Reach 3 (CPR to Baseline Road)	17	<b>76.72</b>	<b>77.24</b>	<b>62.28</b>	<b>64.86</b>
Reach 4 (Baseline Road to Hwy 401)	18	<b>77.35</b>	<b>78.38</b>	<b>62.84</b>	<b>65.43</b>
	19	<b>94.01</b>	<b>97.15</b>	<b>77.62</b>	<b>82.22</b>
Reach 5 (Hwy 401 to Darlington Park Road)	20	<b>102.07</b>	106.93	<b>85.72</b>	91.99
West Tributary Reach 2 (Confluence to Hwy 401)	27	19.72	19.80	15.26	19.85
Reach 6 (Darlington Park Road to Lake Ontario)	29	<b>119.60</b>	124.48	<b>98.68</b>	109.43
	35	<b>128.68</b>	<b>133.29</b>	<b>107.74</b>	<b>118.80</b>

1. Based on Tables 6.1 and 6.2 of the Robinson Creek & Tooley Creek SWS, Phase 2 and 3 report (ABL, 2022).
2. **Bolded** peak flow rate denotes Regulatory peak flow rate for each scenario.



► **Option 2c – Landowner consent for minor increase in flood levels**

Structural solutions to mitigate flooding through this reach were initially explored. However, the backwater from the CPR embankment only extends a short distance upstream, and modifications to the CPR crossing would not fully mitigate the predicted increases in flood levels through the majority of this reach.

There are five (5) impacted landowners within this reach. Increases in Regulatory water surface elevations are relatively minor (0.1m or less) throughout the reach, and in most areas the associated increase in flood extent is imperceptible. Where there is a visible increase in flood extent, the increase is comparable to the thickness of the flood line as plotted on **Figure 3**, and the increases are generally contained within the apparent natural heritage system (i.e., outside of active agricultural areas). Given that this part of the watershed is within the next future urban expansion area in the Municipality and the floodplain is contained within the Tooley Creek valley corridor that will ultimately form the future Environmental Protection Area (i.e., not developable), it can be argued that the predicted slight increase in the depth and extent of flooding through this reach would have no impact on current land uses and no impact on the future development potential of the lands.

It may be possible to obtain consent from the affected landowners for the small increase in the extent of flooding on their lands. It is difficult to predict if any compensation or formal commitments would be needed to secure permission from the landowners for the small increase in flooding.

It is recommended that legal representatives from CLOCA and the Municipality review this memo and associated mapping to determine if formal consent is needed, or if the impacts are so minor that consent can be implied.

### **4.2.3 Main Branch Reach 3 (CPR to Baseline Road)**

There is a relatively large increase in Regulatory water surface elevation (up to 0.9 m) and moderate increase floodplain extent between CPR and Baseline Road. The Baseline Road crossing is largely unaffected by the backwater from Highway 401 and appears to have an impact on flood elevation and extents with the increased flow rate in Tooley Creek. The specific flood mitigation options for this reach are as follows:

► **Option 3a – Regional control SWM facilities for all new development**

Refer to description under Option 1a.

► **Option 3b – Regional control SWM facilities in select areas of new development**

Refer to description under Option 2b.

► **Option 3c – Enlarge Culvert at Baseline Road**

The water surface elevations within this reach area are impacted by the Baseline Road crossing, where water levels are approximately 3 m higher than the downstream reach between Highway 401 and Baseline Road (Reach 4). Improvements at the Highway 401 crossing (discussed below) will have negligible impact on water surface elevation upstream of Baseline Road. HEC-RAS profile results are provided in **Attachment C**.

The existing culvert is a 6.34m by 2.81m concrete box culvert. Adding or enlarging the culvert by an approximate equivalent of a 1950mm diameter circular culvert would be sufficient to mitigate the flood impacts upstream of Baseline Road. **Table 4-3** summarizes the water surface elevations with and without crossing improvements. The crossing improvements may potentially be timed with future Baseline Road improvements.

**Table 4-3 Summary of Water Surface Elevation with Crossing Improvement at Baseline Road**

Culvert	HEC-RAS River Station	Regulatory Water Surface Elevation, (2012 flows) (m)	Water Surface Elevation without Mitigation (updated flows) (m)	Water Surface Elevation with Mitigation (updated flows) (m)
<b>Baseline Road Culvert</b>	1600	98.39	99.10	98.41
	1500	98.28	99.07	98.25
	1412	98.23	99.07	98.16
	1400	98.23	99.05	98.16

► **Option 3d – Landowner consent for increase in flood levels**

While increases in flood elevations of up to 0.9 m are predicted for this reach, the extent of flooding remains generally contained within the deep, steep walled valley corridor, resulting in a relatively minor increase in the extent of flooding.

This area is designated for future urban development within the Courtice Employment Lands, and the predicted increase in the extent of flooding will be contained within the Environmental Protection Area, with no loss of developable area and a potential increase in future developable area if the requirement for Regional Storm control SWM facilities was eliminated.

Given that increase in flood extent will not impact any structures, will have a negligible impact on the short-term utility of the land for agriculture and will not reduce

developable area, the solution would likely be considered acceptable to the single affected landowner. It is difficult to predict if any compensation or formal commitments would be needed to secure permission from the landowner for the small increase in flooding.

#### **4.2.4 Main Branch Reach 4 (Baseline Road to Highway 401)**

There is a relatively large increase in Regulatory water surface elevation (up to 0.6 m) and floodplain extent between Baseline Road and Highway 401. A large backwater is caused by Highway 401 and has an impact on flood elevation and extents with the increased flow rates in Tooley Creek. The Courtice Road crossing is lower in elevation than Highway 401 and does not impact the Regulatory water surface elevation. The specific flood mitigation options for this reach are as follows:

- ▶ **Option 4a – Regional control SWM facilities for all new development**

Refer to description under Option 1a.

- ▶ **Option 4b – Regional control SWM facilities in select areas of new development**

Refer to description under Option 2b.

- ▶ **Option 4c – Relief Culvert across Highway 401**

The floodplain area north of Highway 401 is influenced by the capacity of the current culvert under Highway 401 and the Courtice Road Underpass Spill. A second culvert, sized as a 2250mm diameter circular opening culvert can reduce water surface elevations upstream of Highway 401 to be below the current Regulatory water surface elevation. **Table 4-4** summarizes the water surface elevations with and without the relief culvert. Similarly, a larger Courtice Road underpass opening will also provide additional conveyance capacity, if an opportunity to widen Courtice Road is contemplated in the future.

This option will have a difficult and lengthy approvals process to implement, including approvals from the Ministry of Transportation (MTO) and a Schedule B Class Environmental Assessment (EA) for modifying the existing water crossing for the purposes of flood control. There also large cost considerations to tunnel a new culvert under Highway 401.

**Table 4-4 Summary of Water Surface Elevation with Crossing Improvements at Highway 401**

Culvert	HEC-RAS River Station	Regulatory Water Surface Elevation, with CLOCA flows (m)	Water Surface Elevation without Mitigation (m)	Water Surface Elevation with Additional 2250mm Diameter Culvert (m)
<b>Highway 401 Relief Culvert</b>	1270	95.44	96.01	95.40
	1100	95.42	95.99	95.36
	863	95.42	95.98	95.37
	784	95.42	95.98	95.37

► **Option 4d – Landowner consent for increase in flood levels**

Similar to the reach upstream of Baseline Road, despite the predicted 0.6 m in flood elevation, the extent of flooding remains generally contained within the valley corridor, resulting in a relatively minor increase in the extent of flooding.

This area is future urban development under within the Courtice Employment Lands, and the majority of the predicted increase in the extent of flooding will be contained within the Environmental Protection Area, with a potential loss of developable area that may be partially offset if the requirement for Regional Storm control SWM facilities was eliminated.

The predicted increase in flood extent will not impact any structures, but appears very close to a trailer storage area at the south-east corner of Baseline Road and Courtice Road.

It may be possible to secure permissions from affected property owners for the relatively small increases in flood extents. However, there are seven (7) different private properties affected by the increase in flooding, including three (3) small residential properties.

**4.2.5 Main Branch Reach 5 (Highway 401 to Darlington Park Road)**

No increases in water surface elevation are anticipated and no specific mitigation is warranted.

## 4.2.6 Main Branch Reach 6 (Darlington Park Road to Lake Ontario)

The increases in Regulatory water surface elevation (up to 0.1 m) and floodplain extent from Darlington Park Road to Lake Ontario are relatively minor. The specific flood mitigation options for this reach are as follows:

- ▶ **Option 6a – Regional control SWM facilities for all new development**

Refer to description under Option 1a.

- ▶ **Option 6b – Regional control SWM facilities in select areas of new development**

Refer to description under Option 2b.

- ▶ **Option 6c – Landowner consent for increase in flood levels**

Structural solutions to mitigate flooding through this reach were initially explored. However, there are no specific ‘bottlenecks’ in the system contributing to the very slight predicted increase in flood extents south of the CNR line.

There is one impacted private landowner within this reach, while all the other remaining properties within this reach are owned by CLOCA or MTO. Increases in Regulatory water surface elevation are relatively minor (0.1m or less) throughout the reach, and in most areas the associated increase in flood extent is imperceptible. Where there is a visible increase in flood extent, the increase is comparable to the thickness of the flood line as plotted on **Figure 3**, and the increases are fully contained within the Environmental Protection Area under the Waterfront & Energy Park Secondary Plan. It can therefore be argued that the predicted slight increase in the depth and extent of flooding through this reach would have no impact on current land uses and no impact on the future development potential of the lands.

It may be possible to obtain consent from the affected landowner for the small increase in the extent of flooding on their lands.

## 4.2.7 West Tributary Reach 1 (Upstream of Highway 401)

The increase in Regulatory water surface elevation (up to 0.1 m) and floodplain extent in the West Tributary upstream of Highway 401 is relatively minor. The specific flood mitigation options for this reach are as follows:

- ▶ **Option 7a – Regional control SWM facilities for all new development**

The West Tributary has two future SWM ponds north of Highway 401, according to SWS: CEL-P1 and CEL-P4. The considerations are the same as Option 1a for these proposed SWM facilities.

► **Option 7b – Open Centre Median in Highway 401 (for West Tributary Overflow)**

Flooding south of Baseline Road in the vicinity of Trulls Road is largely governed by the backwater behind the Highway 401 embankment and concrete median barrier. The predicted minor increases in flood depth upstream of Highway 401 (0.1 m or less) could be offset by removing a portion of the concrete median barrier and replacing it with an open barrier such as a steel beam guiderail. The open median barrier would allow floodwater to spill over Highway 401 at a lower elevation, effectively lowering the flood levels upstream of Highway 401. The works could also improve public safety through lower flood depths on the westbound lanes of Highway 401 during a severe storm event.

**Table 4-5** below demonstrates that by removing a length of approximately 25 m of concrete median barrier and replacing it with an open barrier, upstream flood levels would be reduced below current levels, more than offsetting the small predicted increase in flow rates. Note that replacing the concrete median barrier with an open barrier over the full approximately 200 m wide overtopping flow width could significantly reduce flood levels relative to existing conditions.

**Table 4-5 Summary of Water Surface Elevation with Median Barrier Improvements at Highway 401**

HEC-RAS River Station	Regulatory Water Surface Elevation, with CLOCA flows (m)	Water Surface Elevation without Mitigation (m)	Water Surface Elevation with Open Median Barrier (m)
1046	94.5	94.6	94.3

► **Option 7c – Flood Proofing**

The only area where the predicted 0.1 m increase in flooding results in a visible increase in the extent of flooding in this reach is south of Baseline Road and east of Trulls Road. It is our understanding that plans for development of the affected parcel were approved based on the previous floodplain mapping and construction is underway.

Given the status of the affected parcel, it can be argued that no works are warranted to mitigate the small increase in flood depths. However, it is recommended that the Municipality and CLOCA work with the developer to ensure that the new development is raised above the predicted Regional Storm floodplain and protected from flooding during both current and future watershed conditions.

## 4.2.8 West Tributary Reach 2 (Highway 401 to Confluence)

The increase in Regulatory water surface elevation (up to 0.1 m) is relatively minor, while there is a moderate increase in floodplain extent, particularly at the two properties on Down Road. The specific flood mitigation options for this reach are as follows:

► **Option 8a – Regional control SWM facilities for all new development**

The West Tributary has two future SWM ponds north of Highway 401, according to SWS: CEL-P1 and CEL-P4. The considerations are the same as Option 1a for these proposed SWM facilities.

► **Option 8b – Landowner consent for increase in flood levels**

Structural solutions to mitigate flooding through this reach were initially explored. However, there are no specific 'bottlenecks' in the system contributing to the very slight (up to 0.2 m) predicted increase in flood extents south of Highway 401.

There are two (2) impacted properties within this reach, both of which fall under the Waterfront & Energy Park Secondary Plan. The predicted extent of flooding under both current and future land use conditions appears to extend beyond the Environmental Protection Area as shown in the Secondary Plan. Active agricultural activities appear to take place to the edge of the narrow channel corridor.

It may be possible to obtain consent from the affected landowners for the small increase in the extent of flooding on their lands.



## 5 EVALUATION OF MITIGATION OPTIONS

### 5.1 Evaluation Criteria

The flood mitigation options described in Section 4 were comparatively and qualitatively evaluated based on criteria developed within the following categories:

- ▶ **Technical feasibility**, which relates to the effectiveness, constructability, operation and maintenance, and other engineering aspects of the options.
- ▶ **Impacts/benefits to environmental resources**, which relates to potential impacts and benefits to the natural and physical components of the environment, including environmental sensitive areas, recognizing that broad generalizations were made, given that environmental resources were not characterized through this study.
- ▶ **Cost effectiveness**, which relates to the capital and maintenance costs of the options. Considerations for the potential impact to future developable area were also included.
- ▶ **Timing**, which relates to implementation timing, which considers the timing of future development and approval processes.

### 5.2 Evaluation

The comparative and qualitative evaluation are outlined in the matrix below (**Table 5-1**), including a recommendation for each flood mitigation option. For many reaches of Tooley Creek, the small increases in flood extents (less than 0.2 m) will be fully contained within the extent of the natural features associated with the valley that form the Environmental Protection Areas depicted on current and future Secondary Plans, and permission from these affected landowners for the floodplain increases would be practical.

The exception is the area between Baseline Road to Highway 401 (Main Branch Reach 4). There are seven (7) private properties within this reach impacted by the flood level increase, including three (3) residential properties. The flood extents appear to be beyond the limit of natural features associated with the Tooley Creek Valley, and thus would become the governing constraint for future development on these properties. The relatively large magnitude of increase in the water surface elevation and flood extents would also severely limit the likelihood of obtaining landowner permissions for the increase.

The options for Main Branch Reach 4 become limited to either providing quantity control in upstream developments to reduce peak flow rates in Tooley Creek (Options 4a or 4b) or increasing the conveyance capacity at Highway 401 (Option 4c). To elaborate on the evaluation

of these options, Option 4c provides a relief culvert at Highway 401 to mitigate flood floods and potentially reduce the Regulatory floodplain from its current extent, provided that there is a suitable alignment to tunnel an opening of the required size. However, the capital costs will be very high and the approvals process with MTO and the required Class EA would be onerous.

The option to provide Regional Storm controls for new development (Option 4a) will also effectively mitigate flooding for all reaches downstream of these controlled discharges. The SWS recommended twelve (12) Regional Storm control SWM facilities within the Tooley Creek watershed, which would need to be operated and maintained by the Municipality in the long-term. There is also a reduction in developable area due to the larger SWM facility footprints for larger storage volumes.

With that, Option 4b was considered to reduce the number of Regional Storm control SWM facilities in the new development areas. Typically, runoff timing effects within a watershed will allow downstream catchment areas to discharge without quantity controls, while upstream areas are controlled, to stagger peak flows within the main branch of a watercourse.

From the land use plans, the downstream development areas consist of the Courtice Employment Lands, thus Option 4b considers uncontrolled flows for these lands, while the upstream Southeast Courtice Secondary Plan area will have Regional Storm controls. Furthermore, employment lands (industrial development) are generally less conducive to publicly owned SWM facilities (required for Regional storm control) because of fewer public roads, large properties, and more disintegrated development phasing.

Therefore, the overall recommendation for Tooley Creek flood mitigation is as follows:

- ▶ **Option 2b – Regional control SWM facilities in select areas of new development (namely, the Southeast Courtice Secondary Plan Area)**

- ▶ **Option 6c and 8b - Landowner consent for minor increase in flood levels**

This option is required because Option 2b is not expected to provide adequate flood mitigation for the West Tributary of Tooley Creek and areas downstream of Highway 401.

- ▶ **Option 7c – Flood Proofing**

This option is required because Option 2b is not expected to provide adequate flood mitigation the West Tributary of Tooley Creek upstream of Highway 401.

**Table 5-1 Evaluation Matrix**

Option	Technical Feasibility	Impact / Benefits to Environmental Resources	Cost Effectiveness	Timing	Recommendation
<b>1a, 2a, 3a, 4a, 5a, 7a, and 8a – Regional control SWM facilities for all new development</b>	<b>Will effectively mitigate the increase in peak flow rates across all Tooley Creek reaches, and negates the need for other mitigation options.</b> Long-term maintenance required at twelve (12) SWM facilities.	Neither negative impact nor benefit to environmental resources.	Developers to fund initial capital costs. <b>For the MOC, relatively high long-term operating and replacement costs for twelve (12) SWM facilities. Loss of developable area relative to no Regional controls.</b>	To be implemented as each development area is constructed.	Not Recommended
<b>1b, 2c, 3d, 4d, 6c, 8b – Landowner consent for minor increase in flood levels</b>	No mitigation provided to downstream reaches. For Option 8b, Channel reconstruction within the Waterfront & Energy Park Secondary Plan will provide full flood mitigation.	Neither negative impact nor benefit to environmental resources. For Option 8b, channel reconstruction within the Waterfront & Energy Park Secondary Plan will require removal of vegetation within the existing watercourse valley that will be restored post-construction.	No capital costs associated with this option. No impact or minor impact to developable area.	Landowner permissions would need to be obtained in the short term to confirm that this option is viable, prior to upstream development occurring.	<b>Recommended for Main Branch Reach 6 and West Tributary Reach 2 (Option 6c and 8b), in combination with 2b, 3b, 4b, 6b – Regional control SWM facilities in select areas of new development.</b>
<b>2b, 3b, 4b, 6b – Regional control SWM facilities in select areas of new development</b>	<b>Will effectively mitigate the increase in peak flow rates for Main Branch Reach 4 (the reach with greatest increase in flood elevation and extents).</b> Long-term maintenance required at eight (8) SWM facilities.	Neither negative impact nor benefit to environmental resources.	Developers to fund initial capital costs. <b>For the MOC, relatively high long-term operating and replacement costs for eight (8) SWM facilities. Loss of developable area relative to no Regional controls for Southeast Courtice Secondary Plan area.</b>	To be implemented as each development area is constructed.	<b>Recommended</b>
<b>3c – Enlarge Culvert at Baseline Road</b>	Will effectively mitigate the increase in peak flow rates within Main Branch Reach 3.	Neither negative impact nor benefit to environmental resources.	Moderately high initial capital costs, which can be lessened if constructed in conjunction with road improvements. No impact or minor impact to developable area.	To be implemented prior to proposed upstream development occurring and/or in conjunction with road improvements.	Not Recommended
<b>4c – Relief Culvert across Highway 401</b>	Will effectively mitigate the increase in peak flow rates within Main Branch Reach 4. <b>Difficult approvals process involving MTO and a Class EA.</b>	Neither negative impact nor benefit to environmental resources.	<b>Relatively high capital costs.</b> Potentially improves developable area for affected properties.	To be implemented prior to proposed upstream development occurring.	Not Recommended due to the high cost and difficulty of obtaining approvals.
<b>7b – Open Centre Median in Highway 401 (for West Tributary Overflow)</b>	Approvals from MTO are required.	Neither negative impact nor benefit to environmental resources.	Moderately higher capital costs. Potentially improves developable area for affected properties.	To be implemented prior to proposed upstream development occurring.	Not Recommended
<b>7c – Flood Proofing</b>	Will be effective flood mitigation for individual properties implementing flood proofing measures.	Neither negative impact nor benefit to environmental resources.	Developer to fund capital costs and maintain any floodproofing measures. No impact or minor impact to developable area.	To be implemented as sites are developed.	<b>Recommended</b>

## 6 ADDITIONAL MODELLING ANALYSIS OF THE RECOMMENDED FLOOD MITIGATION OPTION

### 6.1 Overview

The recommendations for Tooley Creek flood mitigation summarized in **Section 5.2** included Regional control SWM facilities in select areas of new development. The initial analysis for this option was a cursory review of the SWS hydrologic model which indicated that peak flow rates in Tooley Creek for the Main Branch Reaches 1 to 4 would be sufficiently mitigated, including the area upstream of Highway 401 with the greatest flood elevation increase in future conditions (**Section 4.2.2**).

To provide guidance on Regional control criteria for future development within the Tooley Creek watershed, additional modelling was completed to determine target release rates. In addition, based on discussions with CLOCA, future development within the watershed will also include large portions of the watershed that are outside of the current MOC Official Plan, but were recently added to the Region of Durham's new Official Plan adopted by Regional Council in May 2023. Map 1 of the Regional Official Plan designates the additional lands as part of the '2051 urban expansion area', which was not previously considered during the SWS.

Thus, the hydrologic model updated for this study (**Section 2**) was further refined to include the future land uses within the 2051 urban expansion area and proposed Regional control to confirm that the recommended flood mitigation strategy will be effective for mitigating peak flow rates increases in Tooley Creek.

In general, the additional modelling analysis demonstrated that the 2051 urban expansion area impacts downstream peak flow rates such that all future development in the 2051 urban expansion area will also be required to provide Regional flood control. For future development areas within the current MOC Official Plan, the previous recommendation (**Section 5.2**) was also confirmed to be required: future residential areas (i.e., the Southeast Courtice Secondary Plan area) shall have Regional flood control, while future employment lands within the MOC Official will not have Regional flood control. Results of the modelling analysis and recommendations for the implementation of the mitigation strategy are provided in the following sections.

### 6.2 Additional Modelling Analysis

The additional modelling analysis builds upon the Tooley Creek hydrologic model update described in **Section 2**, which was based on CLOCA's 2012 VO model. Future conditions land

use was further updated according to Durham's new Regional Official Plan Map 1 for the 2051 urban expansion area, which consisted of employment lands and residential lands beyond the current MOC Official Plan that was used for the SWS (**Figure 5 and 6**). GIS data from Durham Region was used to confirm the extents of the urban expansion area within the Tooley Creek watershed.

With the objective of introducing quantity controls into the VO model, the Tooley Creek catchment areas upstream of Highway 401 were divided based on the future development land use from the MOC Secondary Plans and Official Plan, and the Regional Official Plan's 2051 urban expansion area, such that residential, industrial/commercial, and utility (highway) corridors were divided to model the flood mitigation strategy.

Six (6) route reservoirs were added to the model for all future residential areas and for the 2051 urban expansion area to determine allowable release rates for Regional control. A single unit release rate for the Regional storm was applied at each of route reservoirs. The unit release rate was iterated in the model until the peak flow rates within the Tooley Creek, upstream of Highway 401, matched the peak flow rates from the CLOCA's 2012 future conditions hydrologic model that produced CLOCA's current Regulatory peak flow rates. A minor exception is noted at Flow Node 1 for the upstream-most catchment area of Tooley Creek due to the difficulty with matching CLOCA's 2012 future conditions peak flow rates with Regional control applied to only the future residential development upstream of Flow Node 1. However, the minor (or potentially negligible impact) to the floodplain in the area of Flow Node 1 is expected to be acceptable for landowners in lieu of a larger Regional control SWM facility for future development in that area.

While the Regulatory floodline is determined from the greater of the 100-year storm or Regional Storm floodlines, this only applies to uncontrolled catchment areas. For areas with flood control facilities, the Regional Storm produces higher peak flow rates due to larger runoff volumes routed through the storage facilities. Therefore, only the Regional Storm was modelled to verify the effectiveness of the flood mitigation strategy.

Furthermore, based on the SWS's quantity control criteria, each development area is also required to match pre-development peak flow rates up to the 100-year storm event, which would be more restrictive than the 100-year peak flow rates under CLOCA's 2012 Regulatory hydrologic model (which considered uncontrolled future development areas). Within the VO model, the route reservoir rating curves did not consider 2-year to 100-year control release rates and storage volumes. Instead, the rating curves consisted of one discharge-storage point representing the Regional Storm allowable release rate. Thus, the Regional storage volume determined through this model is not representative of the total required storage for SWM facilities at these development areas. The unit release rate is the flood control criteria that would need to be considered during the design of these SWM facilities (see **Section 6.3** for more

discussion on implementation).

A model scenario for the updated land use was also created without any quantity controls. The results indicated that downstream peak flow rates in the 100-year and Regional Storm events were well above CLOCA’s current Regulatory peak flow rates (2012 future conditions modelling) (**Table 6-1**). For the flood control SWM facilities, a Regional Storm unit release rate of 0.098 m<sup>3</sup>/s/ha was required to mitigate peak flow rates in Tooley Creek Main Branch upstream of Highway 401 (**Table 6-2**). The preliminary Regulatory floodline is presented on **Figure 7** for the 2051 urban expansion with flood control.

**Table 6-1 Tooley Creek Uncontrolled Peak Flow Rates with 2051 Urban Expansion**

Tooley Creek Reach	Flow Node	2012 CLOCA Future Conditions Peak Flow Rate (m <sup>3</sup> /s)		2023 TYLin Future Conditions Update Uncontrolled Peak Flow Rate with 2051 Urban Expansion (m <sup>3</sup> /s)	
		100-year	Regional	100-year	Regional
Upstream of West Tributary HEC-RAS Reach: Tooley_Upper	1	4.24	12.41	23.24	16.82
	1 + 69% of Flow Node 2	9.18	20.48	n.a. (Note 1)	n.a. (Note 1)
	3	9.23	22.09	33.48	28.71
	3 + 23% of Flow Node 6	12.01	31.15	n.a. (Note 1)	n.a. (Note 1)
	3 + 62% of Flow Node 6	20.23	46.51	n.a. (Note 1)	n.a. (Note 1)
	3 + 92% of Flow Node 6	26.55	58.33	n.a. (Note 1)	n.a. (Note 1)
	7	27.48	59.94	91.53	74.46
	17	35.03	74.24	99.07	91.74
	18	35.18	74.77	106.61	92.39
	19	43.09	91.51	123.00	113.45
	20	48.87	99.84	127.56	122.38
Downstream of West Tributary HEC-RAS Reach: Tooley_Lower	24	48.87	99.88	129.57	122.44
	29	65.08	118.12	158.69	142.81
West Tributary HEC-RAS Reach: Tooley_West	35	64.74	127.67	146.12	151.55
	25	13.82	17.64	39.26	18.14
	27	16.67	20.80	35.85	21.46

1. Catchment areas in the 2051 urban expansion area model scenario were re-delineated for the flood mitigation strategy and did not match the 2012 CLOCA modelled catchment areas at this flow node, therefore, results were not calculated.

**Table 6-2 Tooley Creek Peak Flow Rates with 2051 Urban Expansion and Flood Control**

Tooley Creek Reach	Flow Node	2012 CLOCA Future Conditions Peak Flow Rate (m <sup>3</sup> /s)		2023 TYLin Future Conditions Update Peak Flow Rate with 2051 Urban Expansion and Flood Control (m <sup>3</sup> /s)		Regulatory Peak Flow Rate (m <sup>3</sup> /s)
		100-year	Regional	100-year (Note 1)	Regional	
Upstream of West Tributary HEC-RAS Reach: Tooley_Upper	1	4.24	12.41	n.a.	14.09	14.09 (Note 3)
	1 + 69% of Flow Node 2	9.18	20.48	n.a.	n.a. (Note 2)	20.48
	3	9.23	22.09	n.a.	21.96	22.09
	3 + 23% of Flow Node 6	12.01	31.15	n.a.	n.a. (Note 2)	31.15
	3 + 62% of Flow Node 6	20.23	46.51	n.a.	n.a. (Note 2)	46.51
	3 + 92% of Flow Node 6	26.55	58.33	n.a.	n.a. (Note 2)	58.33
	7	27.48	59.94	n.a.	54.62	59.94
	17	35.03	74.24	n.a.	67.61	74.24
	18	35.18	74.77	n.a.	68.14	74.77
	19	43.09	91.51	n.a.	84.19	91.51
	20	48.87	99.84	n.a.	93.09	99.84
24	48.87	99.88	n.a.	93.48	99.88	
Downstream of West Tributary HEC-RAS Reach: Tooley_Lower	29	65.08	118.12	n.a.	113.23	118.12
	35	64.74	127.67	n.a.	122.20	127.67
West Tributary HEC-RAS Reach: Tooley_West	25	13.82	17.64	40.79	18.14	40.79 (Note 4)
	27	16.67	20.80	35.71	21.46	35.71 (Note 4)

1. The 2051 urban expansion model scenario for flood mitigation does not provide accurate 100-year peak flow rates due to the rating curves used at the route reservoir storages (as described in the above text).
2. Catchment areas in the 2051 urban expansion area model scenario were re-delineated for the flood mitigation strategy and did not match the 2012 CLOCA modelled catchment areas at this flow node. However, the unit discharge (m<sup>3</sup>/s/ha) in the 2023 flood control model scenario was confirmed to be below the 2012 CLOCA future conditions unit discharge.
3. Refer to Section 6.2 for discussion on the slight increase in Regulatory flow rate at Node 1 above the 2012 CLOCA Regulatory flow rate.
4. Regulatory flow rate increases in the West Tributary shall be mitigated according to Options 6c and 8b (refer to Section 5.2 for discussion).



## 6.3 Implementation of Regional Control SWM Facility Mitigation Option

The Regional Storm target release rate would apply to new development areas within the watershed specified through the recommended flood mitigation strategy (**Table 6-3**). Stormwater management facilities in these areas will provide quantity control for the 2-year to 100-year storm events as well as control for the Regional Storm.

The storage volume requirements for Regional Storm control would be determined for each individual SWM facility based on the design specifications to meet all quantity control criteria (match pre-development peak flow rates up to the 100-year storm and Regional storm control).

**Table 6-3 Summary of Regional Storm Control Release Rates**

Subwatershed	Development Area	Regional Storm Control Unit Release Rate
Tooley Creek	Southeast Courtice Secondary Plan	0.098 m <sup>3</sup> /s/ha
	2051 Urban Expansion Area	0.098 m <sup>3</sup> /s/ha
	All areas outside of the above development areas	No Regional Storm Control
Robinson Creek	All areas	No Regional Storm Control

A future SWS update(s) to consider the 2051 urban expansion area in upcoming secondary plans shall also include analysis for Regional release rate targets to verify the flood mitigation strategy. In addition, Regulatory floodplain mapping with the recommended flood mitigation strategy will be updated after this study is finalized.

## 7 CLOSING

We trust that the analysis and findings summarized herein meets the needs of CLOCA and the Municipality at this time.

Please contact the undersigned should you have any questions.

Sincerely,

**T.Y. LIN INTERNATIONAL CANADA INC.**



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Director of Water Resources  
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## ATTACHMENTS

**Attachment A – Background and Correspondence**

**Attachment B – Hydrologic Modelling**

**Attachment C – Hydraulic Modelling**

**Attachment D – Figures**

*Figure 1: Catchment Areas and Flow Nodes*

*Figure 2a: Hydrologic Model Future Land Use*

*Figure 2b: Secondary Plan and Official Plan Land Use*

*Figure 3: Regulatory Floodline with Spill Analysis*

*Figure 4: Preliminary Regulatory Floodline with Clarington Official Plan (Uncontrolled Discharge)*

*Figure 5: Catchment Areas and Flow Nodes for 2051 Urban Expansion Area*

*Figure 6: Hydrologic Model Future Land Use for 2051 Urban Expansion Area*

*Figure 7: Preliminary Regulatory Floodline with 2051 Urban Expansion and Flood Mitigation Strategy*

## REFERENCES

Aquafor Beech Limited (ABL) (2022). *'Robinson Creek & Tooley Creek Subwatershed Study, Phase 2 and 3 Report.'* Prepared for the Municipality of Clarington, August 2022.

Central Lake Ontario Conservation (CLOCA) (2012). *'Hydrologic and Hydraulic Modeling for Tooley Creek – Documentation.'* October 2007, revised March 2008 and March 2012.

Central Lake Ontario Conservation (CLOCA) (2010). *'Hydrologic and Hydraulic Modeling for Robinson Creek – Documentation.'* February 2010, revised March 31, 2010.

Ontario Ministry of Natural Resources (MNR) (2002). *'Technical Guide – River & Stream Systems: Flooding Hazard Limit.'*



## ATTACHMENT A

### Background and Correspondence

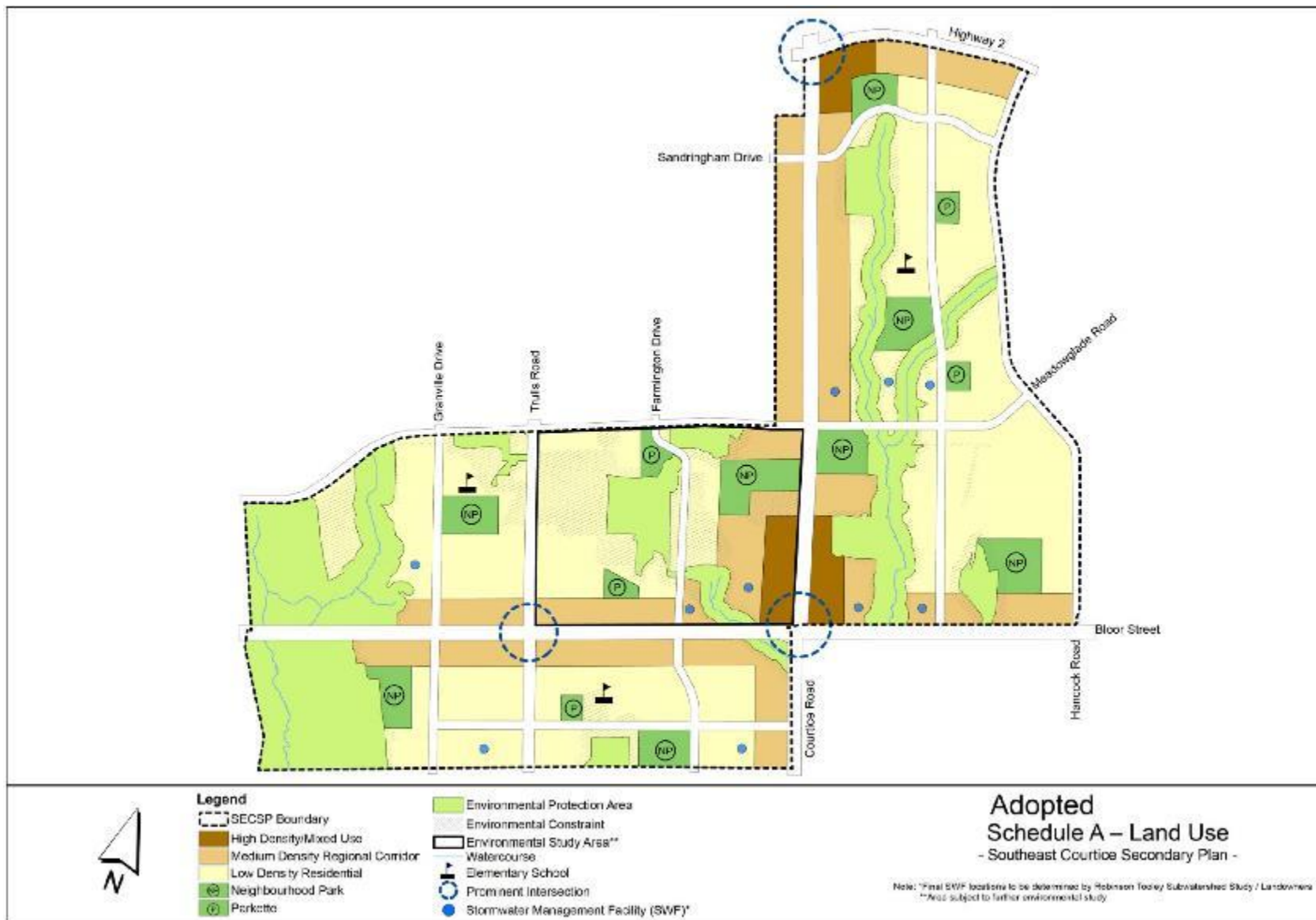


Figure 3.1: Southeast Courtyce Secondary Plan – Adopted Land Use Plan

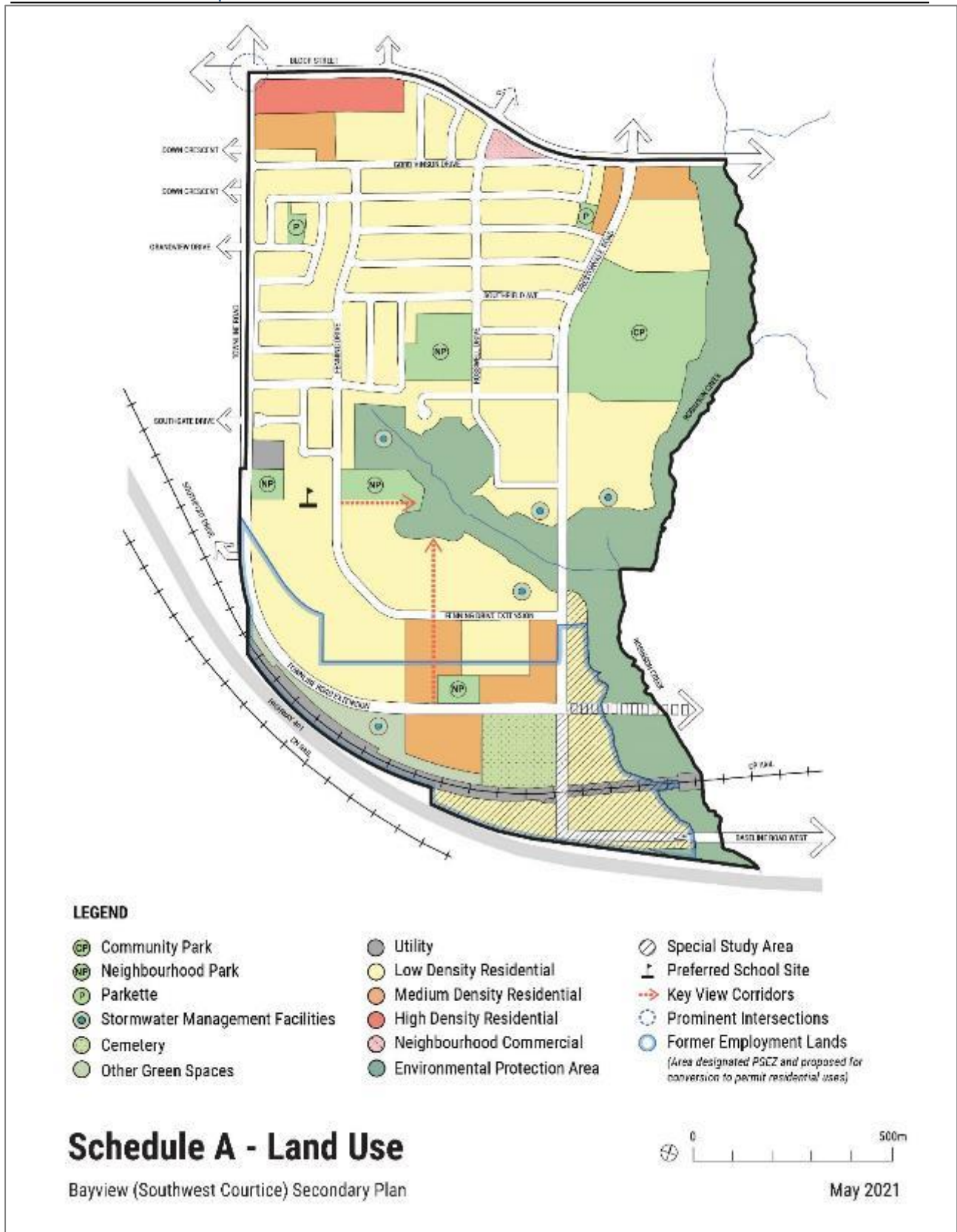
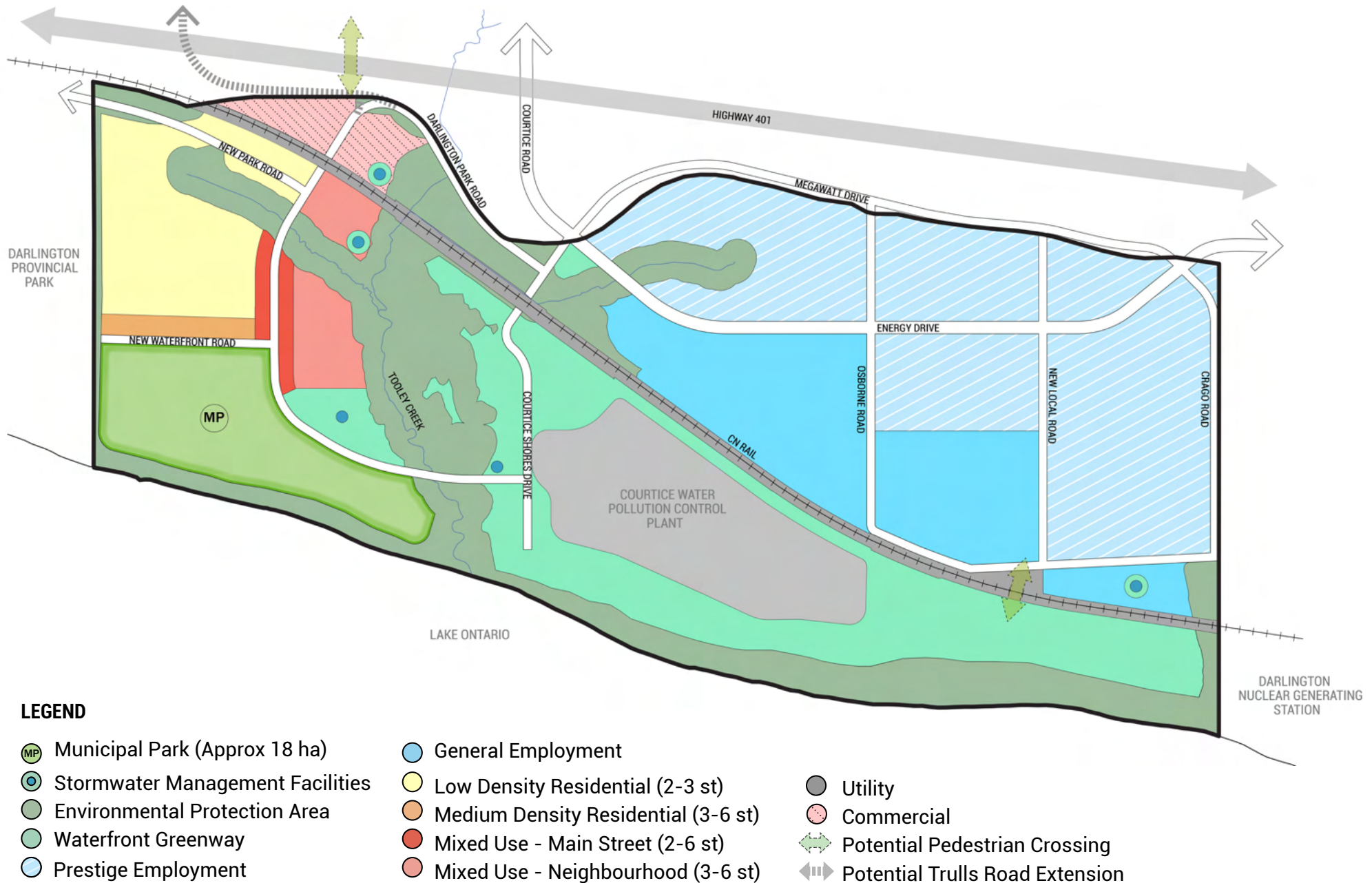


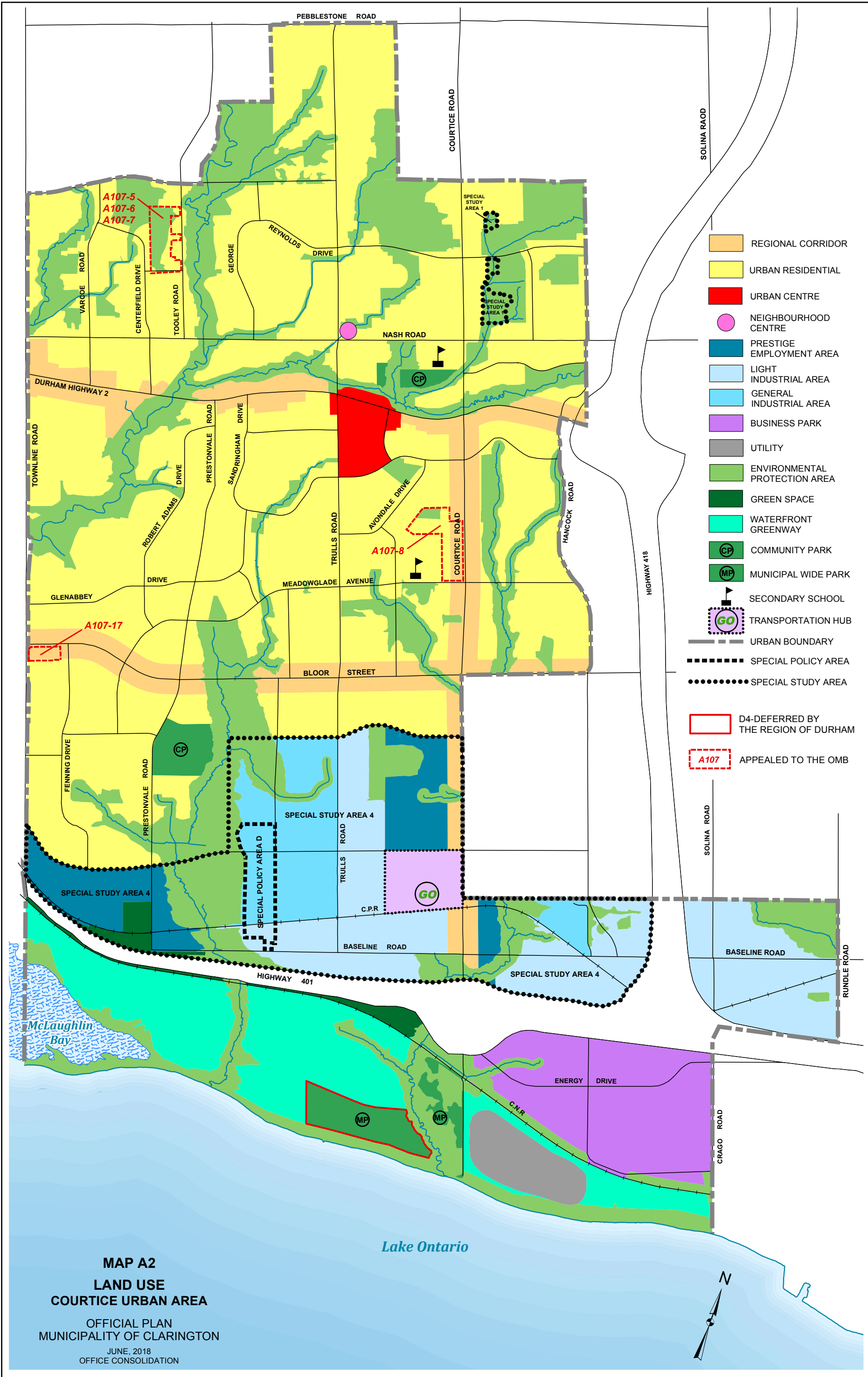
Figure 3.2: Southwest Courtice Secondary Plan – Adopted Land Use Plan



# Draft Land Use Plan



\*EP boundaries are preliminary and are subject to further field work by SWS.

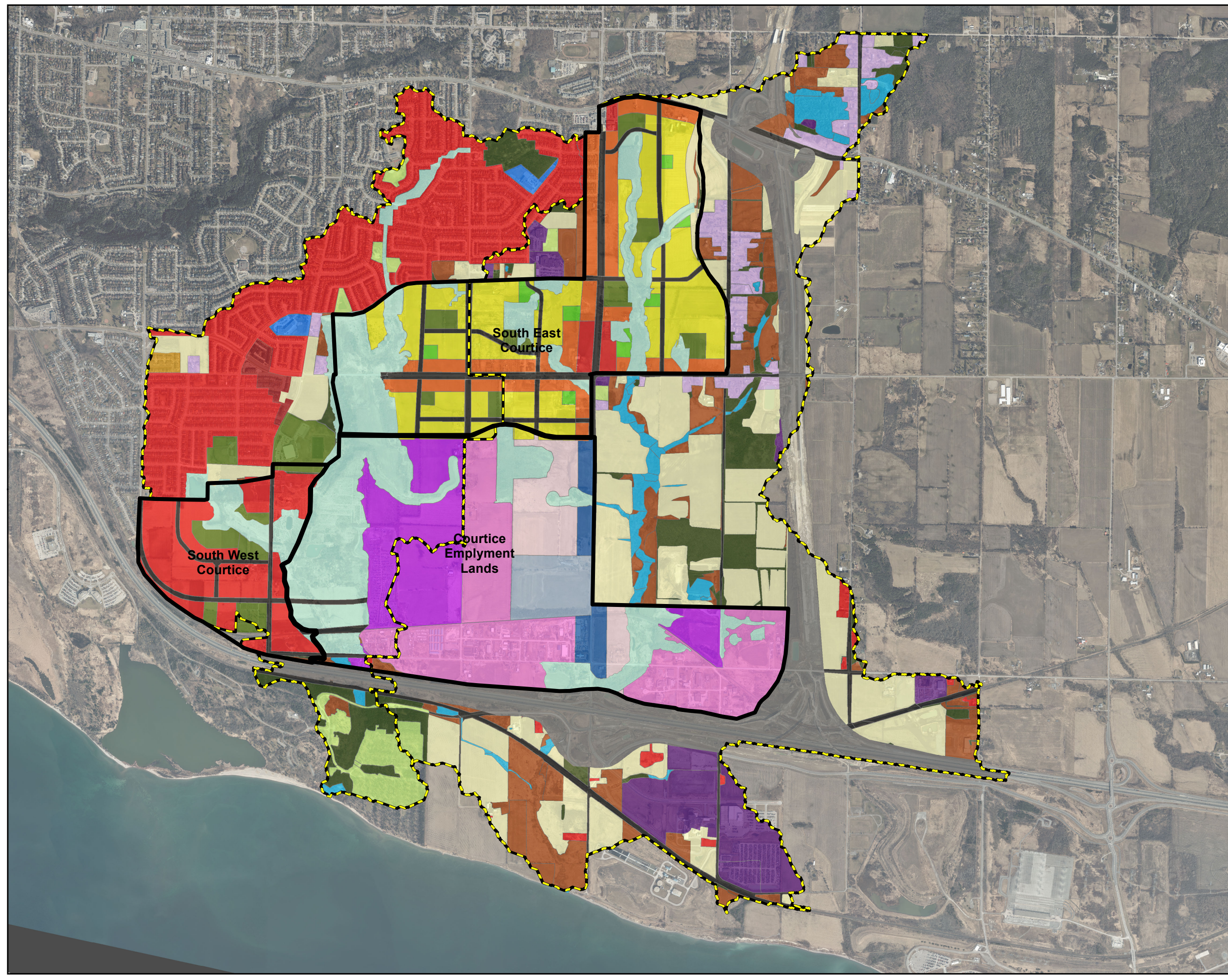


- REGIONAL CORRIDOR
- URBAN RESIDENTIAL
- URBAN CENTRE
- NEIGHBOURHOOD CENTRE
- PRESTIGE EMPLOYMENT AREA
- LIGHT INDUSTRIAL AREA
- GENERAL INDUSTRIAL AREA
- BUSINESS PARK
- UTILITY
- ENVIRONMENTAL PROTECTION AREA
- GREEN SPACE
- WATERFRONT GREENWAY
- CP COMMUNITY PARK
- MP MUNICIPAL WIDE PARK
- GO SECONDARY SCHOOL
- TRANSPORTATION HUB
- URBAN BOUNDARY
- SPECIAL POLICY AREA
- SPECIAL STUDY AREA
- D4-DEFERRED BY THE REGION OF DURHAM
- A107 APPEALED TO THE OMB

**MAP A2**  
**LAND USE**  
**COURTICE URBAN AREA**  
 OFFICIAL PLAN  
 MUNICIPALITY OF CLARINGTON  
 JUNE, 2018  
 OFFICE CONSOLIDATION







- Legend**
- Future Landuse**
- Crop & Improved
  - Environmental Constraint
  - General Industrial
  - High Density /Mixed Use (R.C.)
  - Highway
  - Industrial & Commercial
  - Lakes and Wetlands
  - Light Industrial
  - Low Density Residential
  - Manicured Greenspace
  - Mid Density Residential (R.C.)
  - Parkette
  - Parks
  - Pasture & UnImproved
  - Prestige Employment
  - Regional Corridor
  - Rural Residential
  - Schools
  - Semi Detached
  - Townhouses
  - Transportation & Utility
  - Transportation Hub
  - Urban Residential
  - Woodlots & Forest

Figure 4.3  
 Robinson & Tooley  
 Subdivided Subcatchments

Date: August 2022  
 Projection: NAD83 UTM\_Zone\_17N  
 Data Source: Municipality of Clarington, CLOCA







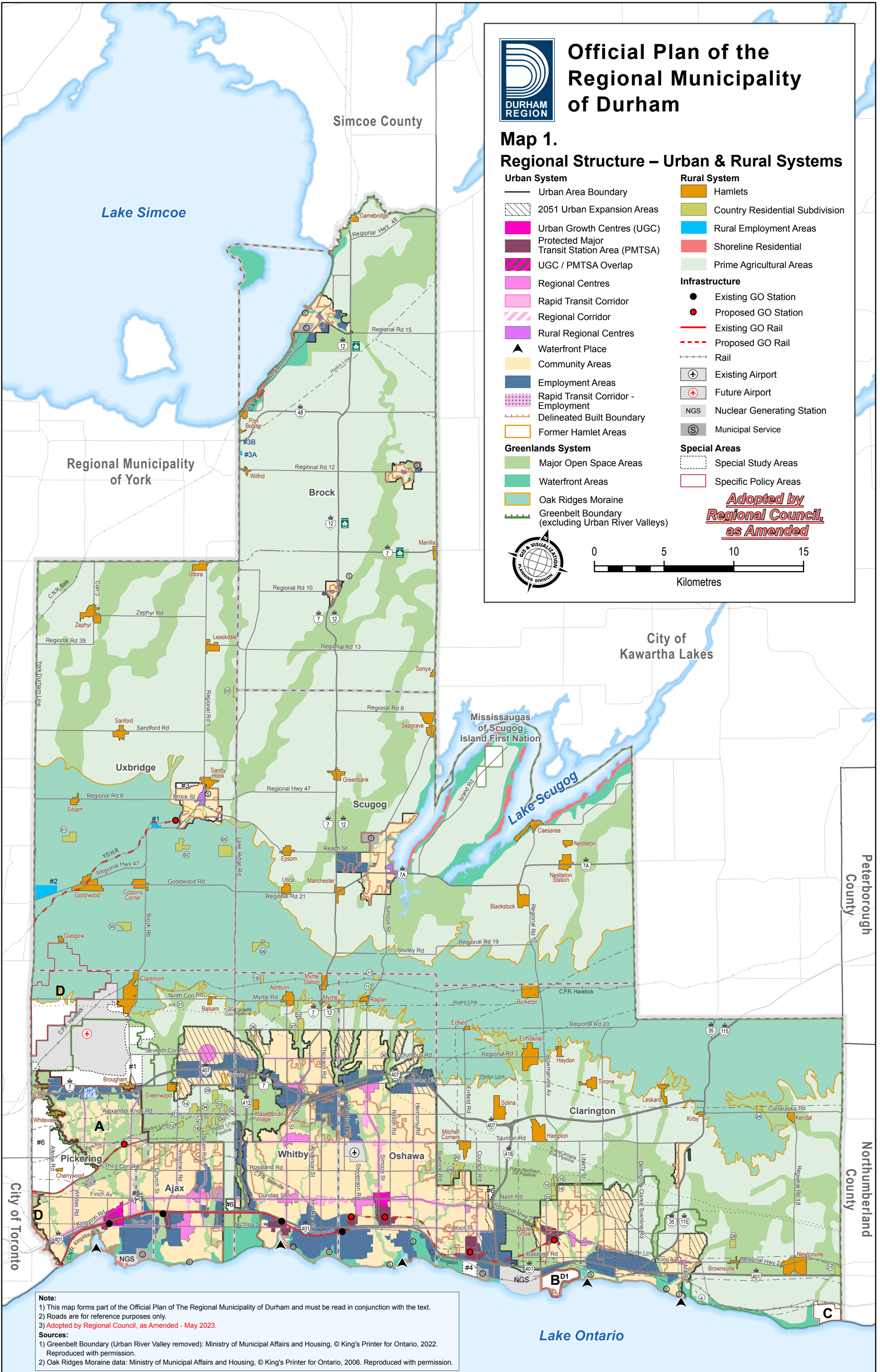
# Official Plan of the Regional Municipality of Durham

## Map 1.

### Regional Structure – Urban & Rural Systems

- |  |                                   |
|--|-----------------------------------|
| <b>Urban System</b>                                  | <b>Rural System</b>               |
| — Urban Area Boundary                                | ■ Hamlets                         |
| ▨ 2051 Urban Expansion Areas                         | ■ Country Residential Subdivision |
| ■ Urban Growth Centres (UGC)                         | ■ Rural Employment Areas          |
| ■ Protected Major Transit Station Area (PMTSA)       | ■ Shoreline Residential           |
| ▨ UGC / PMTSA Overlap                                | ■ Prime Agricultural Areas        |
| ■ Regional Centres                                   | <b>Infrastructure</b>             |
| ■ Rapid Transit Corridor                             | ● Existing GO Station             |
| ■ Regional Corridor                                  | ● Proposed GO Station             |
| ■ Rural Regional Centres                             | — Existing GO Rail                |
| ▲ Waterfront Place                                   | - - - Proposed GO Rail            |
| ■ Community Areas                                    | — Rail                            |
| ■ Employment Areas                                   | ✈ Existing Airport                |
| ▨ Rapid Transit Corridor - Employment                | ✈ Future Airport                  |
| ▨ Delineated Built Boundary                          | ■ NGS Nuclear Generating Station  |
| ■ Former Hamlet Areas                                | ■ Municipal Service               |
| <b>Greenlands System</b>                             | <b>Special Areas</b>              |
| ■ Major Open Space Areas                             | ▨ Special Study Areas             |
| ■ Waterfront Areas                                   | ▨ Specific Policy Areas           |
| ■ Oak Ridges Moraine                                 |                                   |
| ▨ Greenbelt Boundary (excluding Urban River Valleys) |                                   |

*Adopted by  
Regional Council,  
as Amended*



**Note:**  
 1) This map forms part of the Official Plan of The Regional Municipality of Durham and must be read in conjunction with the text.  
 2) Roads are for reference purposes only.  
 3) *Adopted by Regional Council, as Amended - May 2023.*

**Sources:**  
 1) Greenbelt Boundary (Urban River Valley removed): Ministry of Municipal Affairs and Housing, © King's Printer for Ontario, 2022. Reproduced with permission.  
 2) Oak Ridges Moraine data: Ministry of Municipal Affairs and Housing, © King's Printer for Ontario, 2006. Reproduced with permission.



## ATTACHMENT B

### Hydrologic Modelling

## Tooley Creek Watershed Hydrology

Hydrologic Soils Groups

February 13, 2008

Soils	Hydrologic Soil Group
Bondhead Fine Sandy Loam	AB
Bondhead Loam	B
Bondhead Sandy Loam	AB
Bottom Land	C
Bridgeman Sands	A
Brighton Gravelly Sand	A
Brighton Sand	A
Brighton Sandy Loam	AB
Darlington Loam	C
Darlington Sandy Loam	B
Dundonald Sandy Loam	AB
Granby Sandy Loam	B
Guerin Loam	B
Lyons Loam	B
Muck	B
Newcastle Clay Loam	C
Newcastle Loam	BC
Otonabee Loam Steep	B
Ponty Pool Sand	A
Pontypool Sandy Loam	AB
Smithfield Clay Loam	CD
Tecumseth Sandy Loam	AB
Whitby	BC

Source: MTO Drainage Manual (Included in References Section)

**Tooley Creek Watershed Hydrology**

Subcatchment Parameters

February 13, 2008

Updated: March 21, 2023

Updates Include: Updated future landuse categories and associated percent impervious

Land Use Curve Numbers (CN) for NasHyd

Land Use	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	66	70	74	78	82	84	86
Pasture & Unimproved	58	62	65	71	76	79	81
Urban Residential	77	81	85	88	90	91	92
Rural Residential	51	60	68	74	79	82	84
Industrial & Commercial	85	88	90	92	93	94	94
Wetland	50	50	50	50	50	50	50
Woodlot & Forest	36	48	60	67	73	76	79
Manicured Greenspace	39	50	61	68	74	77	80
Landfill and Aggregate	50	50	50	50	50	50	50
Transportation & Utility	98	98	98	98	98	98	98

Land Use Curve Numbers (CN) for StandHyd

(previous parts only)

Land Use	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	66	70	74	78	82	84	86
Pasture & Unimproved	58	62	65	71	76	79	81
Urban Residential	39	50	61	68	74	77	80
Rural Residential	39	50	61	68	74	77	80
Industrial & Commercial	58	62	65	71	76	78	80
Wetland	50	50	50	50	50	50	50
Woodlot & Forest	50	54	58	65	71	74	79
Manicured Greenspace	39	50	61	68	74	77	80
Landfill and Aggregate	50	50	50	50	50	50	50
Transportation & Utility	58	62	65	71	76	79	81

Note: Values for Landfill and Aggregate were chosen to be similar to a wetland as runoff is stored on site

Source: US Soil Conservation Services, US Department of Agriculture, MTO Drainage Manual (Included in Reference Section)

### Rational Method Constants (Runoff Coefficients)

Land Use	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	0.30	0.39	0.48	0.57	0.65	0.71	0.76
Pasture & Unimproved	0.09	0.15	0.20	0.25	0.29	0.32	0.34
Urban Residential	0.50	0.55	0.60	0.65	0.70	0.75	0.80
Rural Residential	0.19	0.20	0.21	0.23	0.25	0.27	0.29
Industrial & Commercial	0.70	0.70	0.70	0.71	0.71	0.71	0.71
Lakes and Wetlands	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Woodlot & Forest	0.07	0.09	0.11	0.12	0.13	0.14	0.15
Manicured Greenspace	0.12	0.14	0.16	0.18	0.19	0.22	0.24
Landfill and Aggregate	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Transportation & Utility	0.90	0.90	0.90	0.90	0.90	0.90	0.90

Note: Values for Landfill and Aggregate were chosen to be similar to a wetland as runoff is stored on site  
 Source: Based on MTO Drainage Manual, Maryland State Highway Administration (Included in Reference Section)

### Initial Abstractions

Soil Type	Initial Abstractions
Crop & Improved	7
Pasture & Unimproved	8
Urban Residential	1.5
Rural Residential	1.5
Industrial & Commercial	1.5
Lakes and Wetlands	0
Woodlot & Forest	10
Manicured Greenspace	5
Landfill and Aggregate	10
Transportation & Utility	1.5

### Existing Percent Impervious

(GIS based PCSWMM Spatial Weighting Tool Used to Calculate TIMP and XIMP)

Land Use	Total (%)	Connected (%)
Crop & Improved	0	0
Pasture & Unimproved	0	0
Urban Residential	45	35
Rural Residential	20	10
Industrial & Commercial	85	85
Lakes and Wetlands	0	0
Woodlot & Forest	0	0
Manicured Greenspace	0	0
Landfill and Aggregate	50	0
Transportation & Utility	50	25

Future Percent Impervious

(GIS Based PCSWMM Spatial Weighting Tool Used to Calculate Landuse for Tab "Fu-Land Use")

CLOCA Existing Landuse Categories	Existing Landuse Code	Future Landuse Code	Flood Study Landuse Categories	Total (%)	Connected (%)
Crop & Improved	CI	CI	Crop / Improved	0	0
Pasture/Unimproved	PU	PU	Pasture / Unimproved	0	0
Woodlot/Forest	WF	WF	Woodlot / Forest	0	0
Lake/Wetland	LW	LW1	Lake / Wetland	0	0
		LW2	Stormwater Management	0	0
Manicured Greenspace	MG	MG1	Manicured Greenspace	0	0
		MG2	Parks	15	0
		MG3	Cemetery	0	0
		MG4	Green Space	0	0
		MG5	Waterfront Greenway	0	0
Rural Residential	RR	RR	Rural Residential	20	10
Urban Residential	UR	UR1	Urban Residential-Outside SPs	45	35
		UR2	Urban Residential-Inside SPs	60	60
		UR3	Low Density Residential	60	55
		UR4	Medium Density Residential	70	70
		UR5	Mid-Density Residential (Regional Corridor)	80	80
		UR6	Mixed Use – Main Street	90	90
		UR7	Mixed Use – Neighbourhood	80	80
		UR8	Residential – High Density	90	90
		UR9	High Density/Mixed Use (Regional Corridor)	90	90
Industrial/Commercial	IC	IC1	Industrial/Commercial	85	85
		IC2	Commercial	90	90
		IC3	Prestige Employment	90	90
		IC4	General Employment	90	90
		IC5	General Industrial	90	90
		IC6	Light Industrial	90	90
		IC7	Neighbourhood Commercial	90	90
		IC8	Regional Corridor	90	90
		IC9	Transportation Hub	90	90
		IC10	Urban Centre	80	80
Transportation/Utility	TU	TU1	Transportation / Utility	50	50
		TU2	Future Transportation/Utility	95	95
Environmental Constraints	EC	CI-EC	Environmental Constraint	0	0
		IC-EC	Environmental Constraint	0	0
		LW-EC	Environmental Constraint	0	0
		MG-EC	Environmental Constraint	0	0
		PU-EC	Environmental Constraint	0	0
		RR-EC	Environmental Constraint	0	0
		UR-EC	Environmental Constraint	0	0
WF-EC	Environmental Constraint	0	0		

Landuse Classification

Dissolved Landuse	GIS Classification	
	Cloca Landuse	ELC
Crop & Improved	Agricultural Facility Crop Field Nursery	
Pasture & Unimproved	Pature Transportation Greenspace Treed Field (Orchard)	Cultural Meadow Cultural Savanah Cultural Thicket
Urban Residential	Urban Residential	
Rural Residential	Rural Residential	
Industrial & Commercial	Commercial Industrial Institutional Building	
Lakes and Wetlands	Stormwater Pond Water Feature	Open Fen Meadow Marsh Shallow Marsh Open Aquatic Submerged shallow aquatic Floating leaves shallow aquatic Deciduous Swamp Coniferous Swamp Mixed Swamp Thicket Swamp
Woodlot & Forest		Cultural Plantation Cultural Woodland Coniferous Forest Deciduous Forest Mixed Forest
Manicured Greenspace	Athletic field Golf facility Institutional greenspace Park Skihill	
Landfill and Aggregate	Aggregate Landfill	
Transportation & Utility	Transportation Corridor Utility Corridor Utility Transfer Station	

Note: Landuse was taken from the 2007 ELC layer



# Tooley Creek Watershed Hydrology

## Subcatchment Soil Group Coverage

Sub Catchment No.	Area (ha)	Mean Hydrologic Soil Group
L1	62.85	C
L2	24.66	C
W1	23.96	C
W2	126.64	C
U1	2.04	D
U2	76.56	C
U3	152.46	C
U4	5.55	D
U5	126.36	C
U6	336.94	C
U7	92.91	C
U8	126.11	BC

Query From CLOCA soils layer

## Tooley Creek Watershed Hydrology

Future Land Use Condition

Updated: Jun-23

Updates include: % Landuse Coverage updated using new landuse categories and updated landuse shapefile provided by CLOCA

Sub Area No.	Area (ha)	% Landuse Coverage - CLOCA Categories (Environmental Constraints added in respective areas)									
		CI	PU	UR	RR	IC	LW	WF	MG	LA	TU
L1	62.85	0.00%	23.99%	8.59%	0.00%	19.58%	0.03%	1.09%	31.74%	0.00%	14.98%
L2	24.66	0.00%	0.00%	0.00%	0.00%	89.78%	0.00%	0.00%	0.00%	0.00%	10.22%
W1	23.96	0.00%	18.47%	54.32%	0.00%	11.30%	4.01%	0.27%	0.02%	0.00%	11.61%
W2	126.64	0.00%	1.86%	7.57%	0.00%	61.28%	0.85%	5.63%	4.15%	0.00%	18.68%
U1	2.04	0.00%	61.87%	21.52%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	16.60%
U2	76.56	0.00%	10.20%	0.00%	0.00%	31.97%	1.08%	2.01%	0.65%	0.00%	54.09%
U3	152.46	0.00%	3.15%	0.00%	0.00%	68.31%	0.03%	0.07%	0.00%	0.00%	28.44%
U4	5.55	0.00%	5.37%	0.00%	0.00%	35.62%	31.34%	17.61%	0.00%	0.00%	10.06%
U5	126.36	17.79%	7.32%	0.93%	0.02%	39.89%	0.40%	8.98%	0.00%	0.00%	24.66%
U6	336.94	26.24%	8.95%	19.53%	2.34%	9.19%	6.32%	9.53%	4.02%	0.00%	13.89%
U7	92.91	2.46%	12.13%	53.51%	0.64%	0.00%	5.85%	2.80%	5.59%	0.00%	17.03%
U8	126.11	10.14%	15.75%	7.46%	18.79%	0.36%	8.94%	3.17%	1.27%	0.00%	34.13%

CI	Crop/Improved	IC1	Industrial/Commercial
PU	Pasture/Unimproved	IC2	Commercial
WF	Woodlot/Forest	IC3	Prestige Employment
LW1	Lake/Wetland	IC4	General Employment
LW2	Stormwater Management	IC5	General Industrial
MG1	Manicured Greenspace	IC6	Light Industrial
MG2	Parks	IC7	Neighbourhood Commercial
MG3	Cemetery	IC8	Regional Corridor
MG4	Green Space	IC9	Transportation Hub
MG5	Waterfront Greenway	IC10	Urban Centre
RR	Rural Residential	TU1	Transportation/Utility
UR1	Urban Residential-Outside SPs	TU2	Future Transportation/Utility
UR2	Urban Residential-Inside SPs	CI-EC	Environmental Constraint
UR3	Low Density Residential	IC-EC	Environmental Constraint
UR4	Medium Density Residential	LW-EC	Environmental Constraint
UR5	Mid-Density Residential (Regional Corridor)	MG-EC	Environmental Constraint
UR6	Mixed Use – Main Street	PU-EC	Environmental Constraint
UR7	Mixed Use – Neighbourhood	RR-EC	Environmental Constraint
UR8	Residential – High Density	UR-EC	Environmental Constraint
UR9	High Density/Mixed Use (Regional Corridor)	WF-EC	Environmental Constraint

Sub Area No.	Area (ha)	% Landuse Coverage - Flood Study Landuse Categories																				
		CI	PU	WF	LW		MG					RR	UR									
					LW1	LW2	MG1	MG2	MG3	MG4	MG5		UR1	UR2	UR3	UR4	UR5	UR6	UR7	UR8	UR9	
L1	62.85	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.31%	0.00%	0.00%	26.43%	0.00%	0.00%	0.00%	0.20%	0.35%	0.00%	2.08%	5.95%	0.00%	0.00%	
L2	24.66	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
W1	23.96	0.00%	0.00%	0.27%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	42.14%	0.30%	0.00%	11.15%	0.73%	0.00%	0.00%
W2	126.64	0.00%	1.12%	2.89%	0.00%	0.00%	3.36%	0.40%	0.00%	0.39%	0.00%	0.00%	0.00%	0.00%	6.11%	0.00%	1.46%	0.00%	0.00%	0.00%	0.00%	
U1	2.04	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	21.52%	0.00%	0.00%	0.00%	
U2	76.56	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
U3	152.46	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
U4	5.55	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
U5	126.36	17.79%	2.08%	6.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.93%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
U6	336.94	26.24%	5.52%	7.53%	4.82%	0.00%	1.51%	2.51%	0.00%	0.00%	0.00%	2.34%	3.14%	0.00%	7.96%	0.00%	6.95%	0.00%	0.00%	0.00%	1.47%	
U7	92.91	2.46%	0.89%	0.00%	0.00%	0.00%	0.00%	5.59%	0.00%	0.00%	0.00%	0.64%	0.96%	0.00%	30.54%	0.00%	20.45%	0.00%	0.00%	0.00%	1.56%	
U8	126.11	10.14%	11.94%	2.95%	8.94%	0.00%	0.00%	1.27%	0.00%	0.00%	0.00%	18.79%	0.00%	0.00%	7.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	

Sub Area No.	Area (ha)	% Landuse Coverage - Flood Study Landuse Categories																					
		IC										TU		CI-EC	IC-EC	LW-EC	MG-EC	PU-EC	RR-EC	UR-EC	WF-EC	Check	
		IC1	IC2	IC3	IC4	IC5	IC6	IC7	IC8	IC9	IC10	TU1	TU2									Check1	Check2
L1	62.85	0.00%	0.87%	1.68%	17.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	13.93%	1.05%	7.34%	0.00%	0.03%	0.00%	16.05%	0.00%	0.61%	1.09%	100.00%	100.00%
L2	24.66	0.00%	0.00%	42.80%	46.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
W1	23.96	0.00%	11.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.06%	6.55%	12.72%	0.00%	4.01%	0.00%	5.75%	0.00%	0.00%	0.00%	100.00%	100.00%
W2	126.64	0.16%	0.24%	0.00%	0.00%	17.66%	43.12%	0.00%	0.00%	0.10%	0.00%	17.72%	0.96%	0.07%	0.00%	0.85%	0.00%	0.66%	0.00%	0.00%	2.75%	100.00%	100.00%
U1	2.04	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.60%	0.00%	0.00%	0.00%	0.00%	0.00%	61.87%	0.00%	0.00%	0.00%	100.00%	100.00%
U2	76.56	0.00%	2.23%	19.39%	10.36%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	53.95%	0.13%	2.28%	0.00%	1.08%	0.00%	7.92%	0.00%	0.00%	2.01%	100.00%	100.00%
U3	152.46	0.00%	0.00%	5.93%	0.00%	0.00%	46.02%	0.00%	3.75%	12.61%	0.00%	28.44%	0.00%	1.59%	0.17%	0.03%	0.00%	1.03%	0.00%	0.36%	0.07%	100.00%	100.00%
U4	5.55	0.00%	0.00%	13.49%	0.00%	0.00%	19.30%	0.00%	2.84%	0.00%	0.00%	10.06%	0.00%	0.01%	3.51%	31.34%	0.00%	1.85%	0.00%	0.00%	17.61%	100.00%	100.00%
U5	126.36	9.08%	0.00%	2.60%	0.00%	6.17%	21.51%	0.00%	0.52%	0.00%	0.00%	24.66%	0.00%	0.20%	0.75%	0.40%	0.00%	4.29%	0.00%	0.00%	2.81%	100.00%	100.00%
U6	336.94	2.78%	0.00%	5.00%	0.00%	0.00%	0.01%	0.00%	1.40%	0.00%	0.00%	12.64%	1.25%	0.34%	0.09%	1.50%	0.00%	1.68%	1.10%	0.24%	2.00%	100.00%	100.00%
U7	92.91	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.51%	6.52%	2.58%	0.00%	5.85%	0.05%	7.25%	1.37%	0.00%	2.80%	100.00%	100.00%
U8	126.11	0.36%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.13%	1.01%	1.00%	0.00%	0.00%	0.00%	0.40%	2.41%	0.00%	0.22%	100.00%	100.00%

## Tooley Creek Watershed Hydrology

Future Parameters

Updated: March 21, 2023

Updates Include: Updated VO input parameters based on updated landuse categories and landuse shape file provided by CLOCA

Sub Watershed No.	NHYD	Command	DT	Sub-Watershed Information													
				Area (ha)	HSG	CN (II)	CN (III)	C	IA (mm)	N	Length (m)	Width (m)	Slope (%)	TC (min)	TP (hr)	TIMP (%)	XIMP (%)
L1	32	StandHYD	10	62.85	C	75	87	0.47	4.26	3	1000	700	1.50	34.74	0.39	33	33
L2	36	StandHYD	10	24.66	C	76	88	0.73	1.50	3	600	800	1.30	23.55	0.26	86	86
W1	28	StandHYD	10	23.96	C	74	87	0.62	2.66	3	600	800	1.30	23.62	0.26	55	53
W2	25	StandHYD	10	126.64	C	75	87	0.68	2.23	3	1000	400	2.30	29.74	0.33	70	69
U1	12	StandHYD	10	2.04	D	81	91	0.53	5.52	3	100	100	3.10	4.23	0.05	28	28
U2	22	StandHYD	10	76.56	C	76	88	0.75	2.34	3	1100	700	2.90	32.84	0.37	56	56
U3	21	StandHYD	10	152.46	C	76	88	0.75	1.71	3	2600	500	2.60	74.05	0.83	76	76
U4	9	StandHYD	10	5.55	D	71	85	0.40	2.88	3	300	200	2.00	12.54	0.14	37	37
U5	8	StandHYD	10	126.36	C	76	88	0.66	3.71	3	1300	600	3.10	36.42	0.41	48	48
U6	6	StandHYD	10	336.94	C	75	87	0.55	4.38	3	2400	1300	3.60	59.17	0.66	30	28
U7	2	StandHYD	10	92.91	C	73	86	0.60	2.77	3	1300	600	1.20	45.41	0.51	49	46
U8	1	StandHYD	10	126.11	BC	68	83	0.51	3.26	3	1800	700	1.00	63.25	0.71	26	24

**Tooley Creek Watershed Hydrology**  
Channel Routing

RC	Length	Channel S	Floodplain S	XS used	Channel n	Floodplain n
L1	1009.52	0.60%	1.50	800	0.03	0.05
L2	N/A	-	-	-	-	-
W1	635.41	1.20%	1.30	300	0.03	0.05
W2	N/A	-	-	-	-	-
U1	232.12	1.87%	3.10	100	0.03	0.05
U2	453.78	0.23%	2.90	400	0.03	0.05
U3	286.75	1.58%	2.60	800	0.03	0.05
U4	394.44	1.50%	20.00	1200	0.03	0.05
U5	411.43	0.22%	3.10	1500	0.03	0.05
U6	2099.27	0.96%	3.60	2200	0.03	0.05
U7	949.00	1.01%	1.20	4200	0.03	0.05
U8	N/A	-	-	-	-	-

**Tooley Creek Watershed Hydrology**

12 Hour Chicago Storm - Peak Flows

26-Mar-12

Updated March 21, 2023

Updates Include: Future Chicago Peak Flows, obtained using the updated version of the CLOCA VO model (updated by TYLin March 2023)

NHYD	Sub-watershed	Peak Flow (m <sup>3</sup> /s)																	
		2 Year			5 Year			10 Year			25 Year			50 Year			100 Year		
		Existing	Future	Change	Existing	Future	Change	Existing	Future	Change	Existing	Future	Change	Existing	Future	Change	Existing	Future	Change
1	U8	0.93	4.76	411.71%	1.69	7.19	325.37%	2.13	8.43	296.24%	2.13	10.818	408.60%	3.69	12.65	242.43%	4.24	15.60	268.38%
2	U7	1.50	7.12	374.62%	2.77	10.24	269.30%	3.49	11.86	239.79%	3.49	15.748	351.10%	6.02	18.28	203.94%	6.87	20.23	194.34%
3		1.87	8.86	374.14%	3.45	13.01	276.88%	4.39	15.20	246.63%	4.39	20.219	360.99%	7.81	23.61	202.45%	8.97	26.93	200.14%
4		0.90	3.35	273.88%	1.66	5.50	231.28%	2.12	6.53	208.31%	2.12	8.587	305.24%	3.65	10.11	177.24%	4.19	12.91	208.19%
5		1.49	5.12	244.65%	2.86	8.16	185.24%	3.69	9.73	163.36%	3.69	13.44	263.93%	6.62	16.20	144.70%	7.69	19.60	154.90%
6	U6	4.19	16.04	282.75%	7.75	25.77	232.70%	9.78	30.53	212.26%	9.78	39.818	307.30%	16.97	46.99	176.87%	19.44	52.58	170.46%
7		5.29	17.94	239.44%	9.94	28.74	189.08%	12.62	34.16	170.66%	12.62	46.427	267.91%	22.37	55.75	149.21%	25.72	63.79	147.99%
8	U5	2.25	10.94	385.18%	4.26	16.25	282.00%	5.40	18.88	249.90%	5.40	23.89	342.65%	9.43	27.66	193.24%	10.81	30.55	182.63%
9	U4	0.14	0.47	234.04%	0.25	0.66	161.02%	0.32	0.76	140.25%	0.32	0.963	202.83%	0.55	1.11	103.11%	0.63	1.22	95.20%
12	U1	0.02	0.15	504.17%	0.05	0.21	365.22%	0.06	0.25	332.76%	0.06	0.433	646.55%	0.10	0.52	421.21%	0.11	0.58	414.16%
13		5.27	18.98	260.50%	9.89	29.19	195.22%	12.55	35.16	180.15%	12.55	47.553	278.85%	22.22	57.07	156.86%	25.57	65.04	154.40%
14		6.91	28.55	313.02%	12.99	43.41	234.18%	16.47	51.82	214.73%	16.47	68.952	318.75%	28.89	82.09	184.15%	33.18	92.83	179.81%
15		6.93	27.45	296.05%	13.02	40.06	207.58%	16.54	47.99	190.24%	16.54	62.924	280.55%	29.03	74.91	158.04%	33.35	84.80	154.26%
16		9.30	36.50	292.64%	16.65	53.98	224.23%	20.98	63.02	200.40%	20.98	81.172	286.92%	36.21	94.69	161.51%	41.30	106.31	157.40%
17		6.92	25.42	267.15%	12.98	39.44	203.82%	16.44	47.12	186.55%	16.44	62.818	282.03%	28.87	74.87	159.35%	33.18	84.81	155.62%
18		6.95	28.76	313.87%	13.06	43.73	234.84%	16.55	52.21	215.43%	16.55	69.481	319.77%	29.03	82.72	184.97%	33.33	93.55	180.64%
19		9.34	38.84	315.99%	16.80	56.02	233.52%	21.14	66.07	212.52%	21.14	84.912	301.63%	36.54	99.76	173.01%	41.78	111.82	167.65%
20		10.58	40.81	285.66%	18.86	60.56	221.07%	23.85	70.62	196.13%	23.85	90.716	280.39%	41.48	105.71	154.86%	47.58	118.46	149.00%
21	U3	5.09	19.51	283.64%	9.40	28.00	197.80%	11.66	32.28	176.93%	11.66	40.312	245.85%	19.81	46.28	133.63%	22.65	50.81	124.36%
22	U2	2.82	8.06	185.54%	5.15	11.74	128.20%	6.42	13.56	111.21%	6.42	16.994	164.66%	11.00	19.56	77.72%	12.59	21.51	70.85%
23		10.56	39.67	275.52%	18.86	58.96	212.61%	23.85	68.59	187.61%	23.85	87.971	268.87%	41.36	102.36	147.48%	47.57	114.52	140.73%
24		10.57	39.75	276.14%	18.87	59.10	213.24%	23.86	68.77	188.25%	23.86	88.173	269.59%	41.38	102.59	147.96%	47.59	114.79	141.19%
25	W2	3.32	14.90	349.41%	5.89	21.51	265.19%	7.31	24.83	239.60%	7.31	31.071	325.05%	12.19	35.72	193.00%	13.82	39.26	184.02%
26		3.21	12.30	283.06%	5.86	17.86	204.52%	7.34	20.56	180.20%	7.34	25.647	249.51%	12.46	29.44	136.25%	14.18	32.30	127.79%
27		3.79	13.54	257.30%	6.91	19.73	185.66%	8.64	22.72	163.04%	8.64	28.418	229.03%	14.65	32.65	122.91%	16.67	35.85	115.14%
28	W1	0.63	2.47	293.46%	1.17	3.56	204.01%	1.48	4.11	177.76%	1.48	5.162	249.02%	2.56	5.94	132.20%	2.92	6.52	123.35%
29		14.07	53.29	278.63%	25.22	78.82	212.60%	31.85	91.49	187.21%	31.85	116.591	266.02%	55.46	135.24	143.88%	63.90	150.64	135.73%
31		0.56	2.16	286.20%	1.05	2.99	185.03%	1.32	3.41	158.35%	1.32	4.18	217.15%	2.20	4.74	115.34%	2.50	5.17	107.01%
32	L1	1.23	3.80	208.77%	2.31	5.49	138.14%	2.92	6.79	133.00%	2.92	8.796	201.75%	5.05	10.28	103.68%	5.77	11.43	98.09%
33		1.76	5.21	196.70%	3.28	7.47	127.61%	4.18	9.05	116.67%	4.18	11.577	177.23%	7.23	13.45	85.98%	8.26	14.89	80.19%
34		13.55	41.53	206.44%	25.45	63.94	151.19%	31.36	75.56	140.92%	31.36	98.176	213.03%	50.84	115.47	127.11%	56.76	124.91	120.09%
35		15.15	45.07	197.45%	28.47	69.14	142.87%	33.56	81.56	143.02%	33.56	105.87	215.46%	57.15	124.39	117.65%	63.49	134.78	112.29%
36	L2	0.83	4.02	383.15%	1.49	5.63	278.53%	1.85	6.44	248.65%	1.85	7.95	330.66%	3.08	9.06	194.57%	3.48	9.89	183.98%

## Tooley Creek Watershed Hydrology

Regional Storm (Hurricane Hazel) - Peak Flows

26-Mar-12

Updated March 21, 2023

Updates Include: Future Regional Peak Flows, obtained using the updated version of the CLOCA VO model

NHVD	Sub-watershed	Peak Flow (m <sup>3</sup> /s)		
		Existing	Future	Change
1	U8	12.41	16.07	29.52%
2	U7	11.64	12.69	9.00%
3	0	22.04	27.62	25.31%
4	0	12.30	15.48	25.87%
5	0	21.72	26.41	21.57%
6	U6	39.17	46.37	18.39%
7	0	59.66	70.66	18.44%
8	U5	16.62	17.90	7.68%
9	U4	0.76	0.78	3.04%
12	U1	0.06	0.29	425.00%
13	0	59.62	70.01	17.42%
14	0	73.92	87.10	17.84%
15	0	74.47	87.80	17.90%
16	0	91.13	107.78	18.27%
17	0	73.95	87.39	18.19%
18	0	74.47	87.88	18.01%
19	0	91.20	108.75	19.24%
20	0	99.53	117.34	17.89%
21	U3	21.16	21.99	3.92%
22	U2	10.79	10.94	1.40%
23	0	99.52	117.83	18.40%
24	0	99.56	118.09	18.61%
25	W2	17.64	18.14	2.83%
26	0	17.41	18.06	3.72%
27	0	20.80	21.46	3.20%
28	W1	3.38	3.40	0.53%
29	0	117.78	137.84	17.04%
31	0	3.31	3.46	4.38%
32	L1	8.42	8.69	3.18%
33	0	11.67	12.14	4.04%
34	0	116.91	135.67	16.05%
35	0	127.32	146.98	15.44%
36	L2	3.51	3.59	2.22%

**Tooley Creek Watershed Hydrology**

HEC-RAS Flow Input

26-Mar-12

Updated: Jun-23

Updates include: Future Chicago Peak Flows, obtained using the updated version of the CLOCA VO model (updated by TYLin March 2023)

	River	Reach	RS		NHYD	%	NHYD	Future Regional	100	Regulatory
1	Tooley_Lower	Lower	1000		29			137.84	150.64	150.64
2	Tooley_Lower	Lower	500		35			146.98	134.78	146.98
3	Tooley_Upper	Upper	4800		1			16.07	15.60	16.07
4	Tooley_Upper	Upper	4600	1+69%2	1	69	2	24.82	29.56	29.56
5	Tooley_Upper	Upper	4200		3			27.62	26.93	27.62
6	Tooley_Upper	Upper	3700	3+23%6	3	23	6	38.29	39.02	39.02
7	Tooley_Upper	Upper	3300	3+62%6	3	62	6	56.37	59.53	59.53
8	Tooley_Upper	Upper	2800	3+92%6	3	92	6	70.28	75.30	75.30
9	Tooley_Upper	Upper	2100		7			70.66	63.79	70.66
10	Tooley_Upper	Upper	1500		17			87.39	84.81	87.39
11	Tooley_Upper	Upper	1100		18			87.88	93.55	93.55
12	Tooley_Upper	Upper	800		19			108.75	111.82	111.82
13	Tooley_Upper	Upper	400		20			117.34	118.46	118.46
14	Tooley_Upper	Upper	200		24			118.09	114.79	118.09
15	Tooley_West	West	600		25			18.14	39.26	39.26
16	Tooley_West	West	300		27			21.46	35.85	35.85



**Tooley Creek Watershed Hydrology**

Future Land Use Condition

Updated: September, 2023

Updates include: % Landuse Coverage updated using 2051 Urban Expansion landuse shapefile provided by CLOCA

Sub Area No.	Area (ha)	% Landuse Coverage - CLOCA Categories (Environmental Contraints added in respective areas)									
		CI	PU	UR	RR	IC	LW	WF	MG	LA	TU
L1	62.85	0.00%	23.99%	8.59%	0.00%	19.57%	0.03%	1.09%	31.73%	0.00%	14.97%
L2	24.66	0.00%	0.00%	0.00%	0.00%	89.79%	0.00%	0.00%	0.00%	0.00%	10.23%
W1	23.96	0.00%	18.47%	54.32%	0.00%	11.30%	4.01%	0.27%	0.02%	0.00%	11.61%
W2	126.64	0.00%	1.85%	7.57%	0.00%	61.27%	0.85%	5.63%	4.14%	0.00%	18.67%
U1	2.04	0.00%	61.80%	21.49%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	16.57%
U2	76.56	0.00%	10.20%	0.00%	0.00%	31.97%	1.08%	2.01%	0.65%	0.00%	54.09%
U3	152.46	0.00%	3.15%	0.00%	0.00%	68.31%	0.03%	0.07%	0.00%	0.00%	28.44%
U4	5.55	0.00%	5.36%	0.00%	0.00%	35.59%	31.31%	17.59%	0.00%	0.00%	10.05%
U5a	81.39	0.00%	6.91%	1.67%	0.00%	49.11%	0.63%	4.36%	0.00%	0.00%	37.32%
U5b	44.97	0.00%	0.19%	0.00%	0.07%	80.65%	0.00%	17.34%	0.00%	0.00%	1.74%
U6a	63.66	0.00%	0.32%	73.11%	0.00%	1.16%	10.61%	0.87%	3.56%	0.00%	10.36%
U6b	88.35	0.00%	0.50%	0.00%	0.00%	67.31%	8.44%	22.45%	0.00%	0.00%	1.30%
U6c	30.23	0.00%	9.70%	0.00%	0.00%	70.98%	8.29%	11.00%	0.00%	0.00%	0.02%
U6d	58.77	0.00%	0.42%	66.21%	0.00%	1.79%	4.33%	6.78%	7.46%	0.00%	13.01%
U6e	53.72	0.00%	0.01%	58.02%	0.00%	19.73%	1.93%	8.18%	4.87%	0.00%	7.26%
U6f	18.71	0.00%	0.00%	0.25%	0.00%	7.18%	0.00%	0.03%	0.00%	0.00%	92.55%
U6g	12.17	0.00%	0.62%	20.00%	0.00%	44.20%	0.00%	0.00%	35.16%	0.00%	0.00%
U6h	11.33	0.06%	1.20%	0.00%	0.00%	0.00%	8.77%	0.00%	0.00%	0.00%	89.98%
U7	92.91	0.00%	0.07%	68.59%	0.00%	0.08%	5.85%	2.80%	5.59%	0.00%	17.03%
U8a	44.05	0.00%	0.03%	88.31%	0.00%	0.00%	0.00%	0.63%	3.63%	0.00%	7.38%
U8b	82.05	1.33%	7.64%	0.00%	22.43%	1.83%	13.74%	4.53%	0.00%	0.00%	48.49%

UR9	High Density/Mixed Use (Regional Corridor)	CI	Crop/Improved
IC1	Industrial/Commercial	PU	Pasture/Unimproved
IC2	Commercial	WF	Woodlot/Forest
IC3	Prestige Employment	LW1	Lake/Wetland
IC4	General Employment	LW2	Stormwater Management
IC5	General Industrial	MG1	Manicured Greenspace
IC6	Light Industrial	MG2	Parks
IC7	Neighbourhood Commercial	MG3	Cemetery
IC8	Regional Corridor	MG4	Green Space
IC9	Transportation Hub	MG5	Waterfront Greenway
IC10	Urban Centre	RR	Rural Residential
TU1	Transportation/Utility	UR1	Urban Residential-Outside SPs
TU2	Future Transportation/Utility	UR2	Urban Residential-Inside SPs
CI-EC	Environmental Constraint	UR3	Low Density Residential
IC-EC	Environmental Constraint	UR4	Medium Density Residential
LW-EC	Environmental Constraint	UR5	Mid-Density Residential (Regional Corridor)
MG-EC	Environmental Constraint	UR6	Mixed Use – Main Street
PU-EC	Environmental Constraint	UR7	Mixed Use – Neighbourhood
RR-EC	Environmental Constraint	UR8	Residential – High Density
UR-EC	Environmental Constraint		
WF-EC	Environmental Constraint		

Sub Area No.	Area (ha)	% Landuse Coverage - Flood Study Landuse Categories																				
		CI	PU	WF	LW		MG					RR	UR									
					LW1	LW2	MG1	MG2	MG3	MG4	MG5		UR1	UR2	UR3	UR4	UR5	UR6	UR7	UR8	UR9	
L1	62.85	0.00%	10.19%	0.00%	0.00%	0.03%	0.00%	0.00%	5.31%	0.00%	0.00%	26.43%	0.00%	0.00%	0.00%	0.20%	0.35%	0.00%	2.08%	5.95%	0.00%	0.00%
L2	24.66	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
W1	23.96	0.00%	2.51%	0.27%	0.00%	4.01%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	42.14%	0.30%	0.00%	11.15%	0.73%	0.00%	0.00%
W2	126.64	0.00%	1.27%	2.88%	0.00%	1.27%	0.85%	3.36%	0.40%	0.00%	0.39%	0.00%	0.00%	0.00%	0.00%	6.11%	0.00%	1.46%	0.00%	0.00%	0.00%	0.00%
U1	2.04	0.00%	39.49%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	21.49%	0.00%	0.00%	0.00%	0.00%
U2	76.56	0.00%	0.89%	0.00%	0.00%	1.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U3	152.46	0.00%	1.03%	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U4	5.55	0.00%	1.85%	0.00%	0.00%	31.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U5a	81.39	0.00%	5.48%	0.00%	0.00%	0.63%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.67%	0.00%	0.00%	0.00%	0.00%
U5b	44.97	0.00%	0.19%	17.34%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U6a	63.66	0.00%	0.23%	0.75%	10.61%	0.00%	1.23%	2.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	13.37%	0.00%	57.90%	0.00%	0.00%	0.00%	1.84%
U6b	88.35	0.00%	0.50%	22.45%	8.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U6c	30.23	0.00%	5.40%	0.00%	0.00%	8.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U6d	58.77	0.00%	0.00%	1.14%	0.00%	4.33%	0.03%	7.43%	0.00%	0.00%	0.00%	0.00%	13.88%	0.00%	17.90%	0.00%	25.99%	0.00%	0.00%	0.00%	0.00%	8.44%
U6e	53.72	0.00%	0.01%	8.18%	1.93%	0.00%	0.00%	4.87%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	44.59%	0.00%	13.43%	0.00%	0.00%	0.00%	0.00%	0.00%
U6f	18.71	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U6g	12.17	0.00%	0.00%	0.00%	0.00%	0.00%	35.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.99%	0.00%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
U6h	11.33	0.06%	1.20%	0.00%	8.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U7	92.91	0.00%	0.01%	0.00%	0.00%	5.85%	0.00%	5.59%	0.00%	0.00%	0.00%	0.00%	0.96%	0.00%	43.65%	0.00%	22.42%	0.00%	0.00%	0.00%	0.00%	1.56%
U8a	44.05	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	3.63%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	88.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U8b	82.05	1.33%	7.64%	4.53%	13.74%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	22.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Sub Area No.	Area (ha)	% Landuse Coverage - Flood Study Landuse Categories																			Check		
		IC										TU		CI-EC	IC-EC	LW-EC	MG-EC	PU-EC	RR-EC	UR-EC	WF-EC	Check1	Check2
		IC1	IC2	IC3	IC4	IC5	IC6	IC7	IC8	IC9	IC10	TU1	TU2										
L1	62.85	0.00%	0.87%	1.68%	17.02%	0.00%	0.00%	0.00%	0.00%	0.00%	13.93%	1.05%	7.34%	0.00%	0.00%	0.00%	0.00%	5.85%	0.61%	1.09%	99.99%	99.99%	
L2	24.66	0.00%	0.00%	42.80%	46.98%	0.00%	0.00%	0.00%	0.00%	0.00%	10.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.01%	100.01%	
W1	23.96	0.00%	11.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.06%	6.55%	12.72%	0.00%	0.00%	0.00%	3.24%	0.00%	0.00%	0.00%	100.00%	100.00%	
W2	126.64	0.16%	0.24%	0.00%	0.00%	17.65%	43.12%	0.00%	0.00%	0.10%	0.00%	17.72%	0.96%	0.07%	0.00%	0.00%	0.51%	0.00%	0.00%	2.75%	100.00%	100.00%	
U1	2.04	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.57%	0.00%	0.00%	0.00%	0.00%	22.31%	0.00%	0.00%	0.00%	99.88%	99.88%		
U2	76.56	0.00%	2.23%	19.39%	10.36%	0.00%	0.00%	0.00%	0.00%	0.00%	53.95%	0.13%	2.28%	0.00%	0.00%	0.00%	7.03%	0.00%	0.00%	2.01%	100.00%	100.00%	
U3	152.46	0.00%	0.00%	5.93%	0.00%	0.00%	46.02%	0.00%	3.75%	12.61%	0.00%	28.44%	0.00%	1.59%	0.17%	0.00%	0.00%	0.00%	0.36%	0.07%	100.00%	100.00%	
U4	5.55	0.00%	0.00%	13.47%	0.00%	0.00%	19.28%	0.00%	2.84%	0.00%	0.00%	10.05%	0.00%	0.01%	3.51%	0.00%	0.00%	0.00%	0.00%	17.59%	99.91%	99.91%	
U5a	81.39	0.00%	0.00%	4.04%	0.00%	9.58%	34.68%	0.00%	0.81%	0.00%	0.00%	37.32%	0.00%	0.26%	1.16%	0.00%	0.00%	0.00%	4.36%	100.00%	100.00%		
U5b	44.97	25.50%	0.00%	0.00%	0.00%	0.00%	55.15%	0.00%	0.00%	0.00%	0.00%	1.74%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	99.99%		
U6a	63.66	0.81%	0.00%	0.22%	0.00%	0.00%	0.14%	0.00%	0.00%	0.00%	6.94%	3.42%	0.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12%	100.00%	100.00%		
U6b	88.35	2.73%	0.00%	0.00%	0.00%	0.00%	64.58%	0.00%	0.00%	0.00%	1.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%		
U6c	30.23	0.00%	0.00%	55.30%	0.00%	0.00%	0.07%	0.00%	15.61%	0.00%	0.00%	0.02%	0.00%	1.71%	0.00%	0.00%	0.00%	0.00%	2.59%	11.00%	100.01%	100.01%	
U6d	58.77	1.79%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.89%	3.12%	0.01%	0.37%	0.00%	0.00%	0.00%	0.03%	5.64%	100.00%	100.00%		
U6e	53.72	0.00%	0.00%	0.00%	0.00%	0.00%	19.73%	0.00%	0.00%	0.00%	6.86%	0.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	99.99%		
U6f	18.71	0.00%	0.00%	0.00%	0.00%	0.00%	7.18%	0.00%	0.00%	0.00%	92.55%	0.00%	0.00%	0.00%	0.00%	0.62%	0.00%	0.00%	0.00%	100.01%	100.01%		
U6g	12.17	44.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.98%	99.98%		
U6h	11.33	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	89.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.02%	100.02%		
U7	92.91	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.00%	0.00%	0.00%	10.51%	6.52%	0.01%	0.00%	0.00%	0.05%	0.00%	0.00%	2.80%	100.00%	100.00%		
U8a	44.05	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.50%	2.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.63%	99.98%	99.98%		
U8b	82.05	0.56%	0.00%	0.00%	0.00%	0.00%	1.28%	0.00%	0.00%	0.00%	48.49%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%		

# Tooley Creek Watershed Hydrology

Future Parameters

Updated: September, 2023

Updates Include: Updated VO input parameters based on 2051 Urban Expansion landuse shapefile provided by CLOCA

Sub Watershed No.	NHYD	Command	DT	Sub-Watershed Information													
				Area (ha)	HSG	CN (II)	CN (III)	C	IA (mm)	N	Length (m)	Width (m)	Slope (%)	TC (min)	TP (hr)	TIMP (%)	XIMP (%)
L1	32	StandHYD	10	62.85	C	75	87	0.47	4.26	3	700	600	1.50	24.32	0.27	33.4	32.6
L2	36	StandHYD	10	24.66	C	76	88	0.73	1.50	3	600	800	1.30	23.55	0.26	85.9	85.9
W1	28	StandHYD	10	23.96	C	74	87	0.62	2.66	3	600	600	1.30	23.62	0.26	55.0	52.9
W2	25	StandHYD	10	126.64	C	75	87	0.68	2.23	3	1000	700	2.30	29.74	0.33	69.8	69.4
U1	12	StandHYD	10	2.04	D	75	88	0.48	5.52	3	100	100	3.10	4.23	0.05	27.6	27.6
U2	22	StandHYD	10	76.56	C	76	88	0.75	2.34	3	1100	700	2.90	32.84	0.37	55.9	55.9
U3	21	StandHYD	10	152.46	C	76	88	0.75	1.71	3	2600	500	2.60	74.05	0.83	75.7	75.7
U4	9	StandHYD	10	5.55	D	67	82	0.40	2.87	3	300	200	2.00	31.57	0.35	37.1	37.1
U5a	48	StandHYD	10	96.14	C	76	88	0.72	2.31	3	1400	1000	2.30	42.79	0.48	64.2	64.2
U5b	49	StandHYD	10	30.21	C	75	87	0.61	2.99	3	1000	500	2.40	34.03	0.38	72.2	72.2
U6a	43	StandHYD	10	63.66	C	72	85	0.63	1.56	3	1100	500	1.50	38.16	0.43	64.1	63.1
U6b	6	StandHYD	10	88.35	C	73	86	0.52	3.31	3	1700	1000	1.50	57.08	0.64	61.1	61.1
U6c	44	StandHYD	10	30.23	C	73	86	0.55	2.94	3	800	600	1.40	30.32	0.34	63.9	63.9
U6d	39	StandHYD	10	58.77	C	73	86	0.62	2.30	3	1200	700	1.50	41.97	0.47	55.9	52.5
U6e	38	StandHYD	10	53.72	C	74	87	0.63	2.34	3	1800	600	1.00	68.89	0.77	59.8	56.8
U6f	45	StandHYD	10	18.71	C	76	88	0.89	1.50	3	300	200	1.30	12.11	0.14	52.9	52.9
U6g	41	StandHYD	10	12.17	C	75	87	0.52	2.77	3	400	400	1.00	17.76	0.20	46.6	44.6
U6h	50	StandHYD	10	11.33	C	74	87	0.82	1.45	3	400	400	1.00	17.89	0.20	45.0	45.0
U7	2	StandHYD	10	92.91	0	73	86	0.65	1.85	3	1300	600	1.20	45.41	0.51	58.3	55.2
U8a	1	StandHYD	10	44.05	0	74	87	0.69	1.68	3	1500	700	1.00	58.56	0.65	58.5	53.6
U8b	10	StandHYD	10	82.05	0	72	85	0.55	2.25	3	700	700	0.70	27.58	0.31	30.4	28.1

## Tooley Creek Watershed Hydrology

### Channel Routing

Updated: September, 2023

Updates Include: Splitting up of RC U6 based on new subcatchments formed

RC	Length	Channel S	Floodplain S	XS used	Channel n	Floodplain n
RRL1	1009.52	0.60%	1.50	800	0.03	0.05
L2	N/A	-	-	-	-	-
RRW1	635.41	1.20%	1.30	300	0.03	0.05
W2	N/A	-	-	-	-	-
RRU1	232.12	1.87%	3.10	100	0.03	0.05
RRU2	453.78	0.23%	2.90	400	0.03	0.05
RRU3	286.75	1.58%	2.60	800	0.03	0.05
RRU4	394.44	1.50%	20.00	1200	0.03	0.05
RRU5	411.43	0.22%	3.10	1500	0.03	0.05
RRU6a	708.00	0.71%	3.60	2200	0.03	0.05
RRU6b	1017.00	0.98%	3.60	2200	0.03	0.05
RRU6c	393.00	1.08%	3.60	2200	0.03	0.05
RRU7	949.00	1.01%	1.20	4200	0.03	0.05
U8	N/A	-	-	-	-	-

# Tooley Creek Watershed Hydrology

Route Reservoir

Date: August, 2023

Flood Control (Route Reservoir)	Drainage area [ha]	Unit Release Rate [m <sup>3</sup> /s]	Target Release Rate [m <sup>3</sup> /s]
1	44.05	0.098	4.317
2	92.91	0.098	9.105
3	112.49	0.098	11.024
4	88.35	0.098	8.658
5	63.66	0.098	6.239
6	30.21	0.098	2.961

Flood Control 1	
Release rate [m <sup>3</sup> /s]	Total storage [ha.m]
0.000	0.000
4.317	2.203

Flood Control 4	
Release rate [m <sup>3</sup> /s]	Total storage [ha.m]
0.000	0.000
8.658	4.418

Flood Control 2	
Release rate [m <sup>3</sup> /s]	Total storage [ha.m]
0.000	0.000
9.105	4.646

Flood Control 5	
Release rate [m <sup>3</sup> /s]	Total storage [ha.m]
0.000	0.000
6.239	3.183

Flood Control 3	
Release rate [m <sup>3</sup> /s]	Total storage [ha.m]
0.000	0.000
11.024	5.625

Flood Control 6	
Release rate [m <sup>3</sup> /s]	Total storage [ha.m]
0.000	0.000
2.961	1.511

## Tooley Creek Watershed Hydrology

HEC-RAS Flow Input

26-Mar-12

Updated: September, 2023

Updates include: Uncontrolled future 100-year Chicago and Regional Storm (Hurricane Hazel) for 2051 Urban Expansion scenario (updated by TYLin September 2023)

	River	Reach	RS		Flow node	%	Flow node	100	Future Regional	Regulatory Storm	Regulatory
1	Tooley_Lower	Lower	1000		29			158.69	142.81	100 Year	158.69
2	Tooley_Lower	Lower	500		35			146.12	151.15	Regional	151.15
3	Tooley_Upper	Upper	4800		1			23.24	16.82	100 Year	23.24
4	Tooley_Upper	Upper	4600	1+69%2	1	69	2			100 Year	
5	Tooley_Upper	Upper	4200		3			33.48	28.71	100 Year	33.48
6	Tooley_Upper	Upper	3700	3+23%6	3	23	6	59.94	48.66	100 Year	59.94
7	Tooley_Upper	Upper	3300	3+62%6	3	62	6			100 Year	
8	Tooley_Upper	Upper	2800	3+92%6	3	92	6	84.05	69.23	100 Year	84.05
9	Tooley_Upper	Upper	2100		7			91.53	74.46	100 Year	91.53
10	Tooley_Upper	Upper	1500		17			99.07	91.74	100 Year	99.07
11	Tooley_Upper	Upper	1100		18			106.61	92.39	100 Year	106.61
12	Tooley_Upper	Upper	800		19			123.00	113.45	100 Year	123.00
13	Tooley_Upper	Upper	400		20			127.56	122.38	100 Year	127.56
14	Tooley_Upper	Upper	200		24			129.57	122.44	100 Year	129.57
15	Tooley_West	West	600		25			39.26	18.14	100 Year	39.26
16	Tooley_West	West	300		27			35.85	21.46	100 Year	35.85

**Robinson Creek**

Subcatchment Parameters

February 13, 2008

Updated: March 21, 2023

Updates Include: Updated future landuse categories and associated percent impervious

Land Use Curve Numbers (CN) for NasHyd

Land Use	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	66	70	74	78	82	84	86
Pasture & Unimproved	58	62	65	71	76	79	81
Urban Residential	77	81	85	88	90	91	92
Rural Residential	51	60	68	74	79	82	84
Industrial & Commercial	85	88	90	92	93	94	94
Wetland	50	50	50	50	50	50	50
Woodlot & Forest	36	48	50	67	73	76	79
Manicured Greenspace	39	50	61	68	74	77	80
Landfill and Aggregate	50	50	50	50	50	50	50
Transportation & Utility	98	98	98	98	98	98	98

Land Use Curve Numbers (CN) for StandHyd

(pervious parts only)

Land Use	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	66	70	74	78	82	84	86
Pasture & Unimproved	58	62	65	71	76	79	81
Urban Residential	39	50	61	68	74	77	80
Rural Residential	39	50	61	68	74	77	80
Industrial & Commercial	58	62	65	71	76	78	80
Wetland	50	50	50	50	50	50	50
Woodlot & Forest	50	54	58	65	71	74	79
Manicured Greenspace	39	50	61	68	74	77	80
Landfill and Aggregate	50	50	50	50	50	50	50
Transportation & Utility	58	62	65	71	76	79	81

Note: Values for Landfill and Aggregate were chosen to be similar to a wetland as runoff is stored on site

Source: US Soil Conservation Services, US Department of Agriculture, MTO Drainage Manual (Included in Reference Section)

Runoff Coefficients

Land Use	Hydrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	0.30	0.39	0.48	0.57	0.65	0.71	0.76
Pasture & Unimproved	0.09	0.15	0.20	0.25	0.29	0.32	0.34
Urban Residential	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Rural Residential	0.19	0.20	0.21	0.23	0.25	0.27	0.29
Industrial & Commercial	0.70	0.70	0.70	0.71	0.71	0.71	0.71
Lakes and Wetlands	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Woodlot & Forest	0.07	0.09	0.11	0.12	0.13	0.14	0.15
Manicured Greenspace	0.12	0.14	0.16	0.18	0.19	0.22	0.24
Landfill and Aggregate	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Transportation & Utility	0.90	0.90	0.90	0.90	0.90	0.90	0.90

Note: Values for Landfill and Aggregate were chosen to be similar to a wetland as runoff is stored on site

Source: MTO Drainage Manual, Maryland State Highway Administration (Included in Reference Section)

Initial Abstractions

Soil Type	Initial Abstractions
Crop & Improved	7
Pasture & Unimproved	8
Urban Residential	1.5
Rural Residential	1.5
Industrial & Commercial	1.5
Lakes and Wetlands	0
Woodlot & Forest	10
Manicured Greenspace	5
Landfill and Aggregate	10
Transportation & Utility	1.5

Percent Impervious

Land Use	Total (%)	Connected (%)
Crop & Improved	0	0
Pasture & Unimproved	0	0
Urban Residential	45	35
Rural Residential	20	10
Industrial & Commercial	85	85
Lakes and Wetlands	0	0
Woodlot & Forest	0	0
Manicured Greenspace	0	0
Landfill and Aggregate	50	0
Transportation & Utility	50	25

Future Percent Impervious

(GIS Based PCSWMM Spatial Weighting Tool Used to Calculate Landuse for Tab "FutureLU")

CLOCA Existing Landuse Categories	Existing Landuse Code	Future Landuse Code	Flood Study Landuse Categories	Total (%)	Connected (%)
Crop & Improved	CI	CI	Crop / Improved	0	0
Pasture/Unimproved	PU	PU	Pasture / Unimproved	0	0
Woodlot/Forest	WF	WF	Woodlot / Forest	0	0
Lake/Wetland	LW	LW1	Lake / Wetland	0	0
		LW2	Stormwater Management	0	0
Manicured Greenspace	MG	MG1	Manicured Greenspace	0	0
		MG2	Parks	15	0
		MG3	Cemetery	0	0
		MG4	Green Space	0	0
		MG5	Waterfront Greenway	0	0
Rural Residential	RR	RR	Rural Residential	20	10
Urban Residential	UR	UR1	Urban Residential-Outside SPs	45	35
		UR2	Urban Residential-Inside SPs	60	60
		UR3	Low Density Residential	60	55
		UR4	Medium Density Residential	70	70
		UR5	Mid-Density Residential (Regional Corridor)	80	80
		UR6	Mixed Use – Main Street	90	90
		UR7	Mixed Use – Neighbourhood	80	80
		UR8	Residential – High Density	90	90
		UR9	High Density / Mixed Use (Regional Corridor)	90	90
Industrial/Commercial	IC	IC1	Industrial/Commercial	85	85
		IC2	Commercial	90	90
		IC3	Prestige Employment	90	90
		IC4	General Employment	90	90
		IC5	General Industrial	90	90
		IC6	Light Industrial	90	90
		IC7	Neighbourhood Commercial	90	90
		IC8	Regional Corridor	90	90
		IC9	Transportation Hub	90	90
		IC10	Urban Centre	80	80
Transportation/Utility	TU	TU1	Transportation/Utility	50	50
		TU2	Future Transportation/Utility	95	95
Environmental Constraint	EC	CI-EC	Environmental Constraint	0	0
		IC-EC	Environmental Constraint	0	0
		LW-EC	Environmental Constraint	0	0
		MG-EC	Environmental Constraint	0	0
		PU-EC	Environmental Constraint	0	0
		RR-EC	Environmental Constraint	0	0
		UR-EC	Environmental Constraint	0	0
WF-EC	Environmental Constraint	0	0		



Landuse Classification

Dissolved Lanuse	GIS Classification	
	Cloca Landuse	ELC
Crop & Improved	Agricultural Facility Crop Field Nursery	
Pasture & Unimproved	Pature Transportation Greenspace Treed Field (Orchard)	Cultural Meadow Cultural Savanah Cultural Thicket
Urban Residential	Urban Residential	
Rural Residential	Rural Residential	
Industrial & Commercial	Commercial Industrial Institutional Building	
Lakes and Wetlands	Stormwater Pond Water Feature	Open Fen Meadow Marsh Shallow Marsh Open Aquatic Submerged shallow aquatic Floating leaves shallow aquatic Deciduous Swamp Coniferous Swamp Mixed Swamp Thicket Swamp
Woodlot & Forest		Cultural Plantation Cultural Woodland Coniferous Forest Deciduous Forest Mixed Forest
Manicured Greenspace	Athletic field Golf facility Institutional greenspace Park Skihill	
Landfill and Aggregate	Aggregate Landfill	
Transportation & Utility	Transportation Corridor Utility Corridor Utility Transfer Station	

Note: Landuse was taken from the September 2002 ELC layer

Landuse Classification

Dissolved Lanuse	GIS Classification	
	Cloca Landuse	ELC
Crop & Improved	Agricultural Facility Crop Field Nursery	
Pasture & Unimproved	Pature Transportation Greenspace Treed Field (Orchard)	Cultural Meadow Cultural Savanah Cultural Thicket
Urban Residential	Urban Residential	
Rural Residential	Rural Residential	
Industrial & Commercial	Commercial Industrial Institutional Building	
Lakes and Wetlands	Stormwater Pond Water Feature	Open Fen Meadow Marsh Shallow Marsh Open Aquatic Submerged shallow aquatic Floating leaves shallow aquatic Deciduous Swamp Coniferous Swamp Mixed Swamp Thicket Swamp
Woodlot & Forest		Cultural Plantation Cultural Woodland Coniferous Forest Deciduous Forest Mixed Forest
Manicured Greenspace	Athletic field Golf facility Institutional greenspace Park Skihill	
Landfill and Aggregate	Aggregate Landfill	
Transportation & Utility	Transportation Corridor Utility Corridor Utility Transfer Station	

Note: Landuse was taken from the September 2002 ELC layer

## Robinson Creek

### Subcatchment Soil Group Coverage

June 13, 2008

Sub Catchment No.	Area (ha)	Mean Hydrologic Soil Group
L1	40.35	C
L2	5.83	C
L3	5.61	C
L4	14.5	C
L5	50.67	C
U1	35.74	C
U2	54.13	C
U3	24.97	C
U4	18.95	C
U5	36.93	C
U6	7.38	C
U7	13.04	C
U8	57.16	B
U9	23.24	C
U10	7.07	C
U11	7.69	C
U12	2.32	C
U13	21.55	AB
W1	2.96	C
W2	33.61	C
W3	20.48	C
W4	107.78	C

**Robinson Creek**

Future Land Use

June 13, 2008

Updated: Jun-23

Updates include: % Landuse Coverage updated using new landuse categories and updated landuse shapefile provided by CLOCA

Sub Area No.	Area (ha)	% Landuse Coverage - CLOCA Categories (Environmental Constraints added in respective areas)									
		CI	PU	UR	RR	IC	LW	WF	MG	LA	TU
L1	40.35	0.02%	3.60%	0.00%	0.00%	0.00%	3.33%	37.35%	49.71%	0.00%	6.00%
L2	5.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
L3	5.61	0.00%	12.89%	12.51%	0.00%	15.80%	11.56%	2.04%	0.00%	0.00%	45.21%
L4	14.50	0.00%	23.37%	24.53%	0.00%	30.39%	4.10%	0.19%	0.00%	0.00%	17.42%
L5	50.67	0.00%	45.81%	12.34%	0.00%	18.57%	4.72%	1.74%	6.36%	0.00%	10.46%
U1	35.74	0.00%	47.16%	16.16%	0.00%	7.62%	5.18%	7.51%	16.37%	0.00%	0.00%
U2	54.13	0.00%	18.71%	20.88%	0.00%	49.14%	0.00%	4.11%	0.81%	0.00%	6.36%
U3	24.97	0.00%	38.29%	18.90%	0.00%	0.14%	0.00%	30.01%	9.32%	0.00%	3.35%
U4	18.95	0.00%	30.16%	30.72%	0.00%	0.00%	24.18%	8.23%	0.00%	0.00%	6.70%
U5	36.93	0.00%	11.77%	67.02%	0.00%	1.59%	0.44%	1.51%	5.50%	0.00%	12.17%
U6	7.38	0.00%	8.92%	78.48%	0.00%	0.00%	0.00%	2.07%	10.54%	0.00%	0.00%
U7	13.04	0.00%	2.74%	90.95%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.31%
U8	57.16	0.00%	0.93%	82.10%	0.00%	4.40%	0.00%	6.13%	3.89%	0.00%	2.55%
U9	23.24	0.00%	0.00%	91.66%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%	8.27%
U10	7.07	0.00%	27.06%	64.72%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.23%
U11	7.69	0.00%	0.00%	94.61%	0.00%	1.87%	0.00%	0.00%	0.00%	0.00%	3.52%
U12	2.32	0.00%	0.00%	98.94%	0.00%	0.00%	0.00%	1.06%	0.00%	0.00%	0.00%
U13	21.55	0.00%	0.00%	66.63%	0.00%	23.87%	0.00%	8.95%	0.00%	0.00%	0.54%
W1	2.96	0.00%	49.56%	21.42%	0.00%	0.00%	9.47%	0.00%	0.00%	0.00%	19.56%
W2	33.61	0.00%	13.40%	62.01%	0.00%	8.29%	0.77%	0.73%	4.31%	0.00%	10.50%
W3	20.48	0.00%	11.30%	70.63%	0.00%	0.00%	4.40%	0.38%	7.09%	0.00%	6.21%
W4	107.78	0.00%	1.64%	81.89%	0.00%	3.06%	0.88%	0.00%	4.05%	0.00%	8.47%

CI	Crop/Improved	IC1	Industrial/Commercial
PU	Pasture/Unimproved	IC2	Commercial
WF	Woodlot/Forest	IC3	Prestige Employment
LW1	Lake/Wetland	IC4	General Employment
LW2	Stormwater Management	IC5	General Industrial
MG1	Manicured Greenspace	IC6	Light Industrial
MG2	Parks	IC7	Neighbourhood Commercial
MG3	Cemetery	IC8	Regional Corridor
MG4	Green Space	IC9	Transportation Hub
MG5	Waterfront Greenway	IC10	Urban Centre
RR	Rural Residential	TU1	Transportation/Utility
UR1	Urban Residential-Outside SPs	TU2	Future Transportation/Utility
UR2	Urban Residential-Inside SPs	CI-EC	Environmental Constraint
UR3	Low Density Residential	IC-EC	Environmental Constraint
UR4	Medium Density Residential	LW-EC	Environmental Constraint
UR5	Mid-Density Residential (Regional Corridor)	MG-EC	Environmental Constraint
UR6	Mixed Use – Main Street	PU-EC	Environmental Constraint
UR7	Mixed Use – Neighbourhood	RR-EC	Environmental Constraint
UR8	Residential – High Density	UR-EC	Environmental Constraint
UR9	High Density/Mixed Use (Regional Corridor)	WF-EC	Environmental Constraint

Sub Area No.	Area (ha)	% Landuse Coverage - Flood Study Landuse Categories																					
		CI	PU	WF	LW		MG					RR	UR										
					LW1	LW2	MG1	MG2	MG3	MG4	MG5		UR1	UR2	UR3	UR4	UR5	UR6	UR7	UR8	UR9		
L1	40.35	0.02%	3.60%	37.35%	3.33%	0.00%	49.71%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
L2	5.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
L3	5.61	0.00%	12.89%	2.04%	11.56%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	12.51%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
L4	14.50	0.00%	0.20%	0.19%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	24.53%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
L5	50.67	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%	1.02%	5.34%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.09%	3.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U1	35.74	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.37%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U2	54.13	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.81%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	15.46%	0.00%	5.42%	0.00%	0.00%	0.00%	0.00%	0.00%
U3	24.97	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.32%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.95%	0.00%	10.03%	3.10%	3.81%	0.00%	0.00%	0.00%	0.00%
U4	18.95	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.15%	0.00%	11.56%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
U5	36.93	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38%	0.00%	54.52%	0.00%	12.12%	0.00%	0.00%	0.00%	0.00%	0.00%
U6	7.38	0.00%	0.00%	0.00%	0.00%	0.00%	10.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	78.48%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U7	13.04	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	88.99%	0.00%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U8	57.16	0.00%	0.00%	0.48%	0.00%	0.00%	3.89%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	82.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U9	23.24	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	91.66%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U10	7.07	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	22.15%	0.00%	42.57%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U11	7.69	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	94.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U12	2.32	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.94%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
U13	21.55	0.00%	0.00%	8.95%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	64.34%	0.00%	0.00%	0.00%	2.30%	0.00%	0.00%	0.00%	0.00%	0.00%
W1	2.96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	21.42%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
W2	33.61	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.31%	0.00%	0.00%	0.00%	0.00%	0.00%	13.49%	0.00%	42.63%	5.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
W3	20.48	0.00%	0.05%	0.00%	0.00%	0.00%	0.02%	7.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%	0.00%	62.85%	7.58%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
W4	107.78	0.00%	0.05%	0.00%	0.00%	0.00%	0.05%	4.01%	0.00%	0.00%	0.00%	0.00%	0.00%	71.91%	0.00%	3.67%	3.33%	0.00%	0.00%	0.00%	0.00%	2.99%	0.00%

Sub Area No.	Area (ha)	% Landuse Coverage - Flood Study Landuse Categories																				Check		
		IC										TU		CI-EC	IC-EC	LW-EC	MG-EC	PU-EC	RR-EC	UR-EC	WF-EC	Check1	Check2	
		IC1	IC2	IC3	IC4	IC5	IC6	IC7	IC8	IC9	IC10	TU1	TU2											
L1	40.35	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
L2	5.83	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
L3	5.61	15.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	45.21%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
L4	14.50	0.06%	0.00%	0.00%	0.00%	5.93%	24.40%	0.00%	0.00%	0.00%	0.00%	17.42%	0.00%	4.08%	0.01%	4.10%	0.00%	16.13%	0.00%	2.95%	0.00%	100.00%	100.00%	
L5	50.67	0.00%	0.00%	0.00%	0.00%	18.57%	0.00%	0.00%	0.00%	0.00%	0.00%	5.15%	5.32%	7.36%	4.46%	4.72%	0.00%	33.85%	0.00%	0.10%	1.74%	100.00%	100.00%	
U1	35.74	1.38%	0.00%	0.00%	0.00%	6.24%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.00%	5.18%	0.00%	46.39%	0.00%	0.00%	7.51%	100.00%	100.00%	
U2	54.13	0.00%	0.00%	0.00%	0.00%	49.14%	0.00%	0.00%	0.00%	0.00%	0.00%	3.37%	2.99%	12.86%	0.00%	0.00%	0.00%	5.84%	0.00%	0.00%	4.11%	100.00%	100.00%	
U3	24.97	0.00%	0.00%	0.00%	0.00%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%	3.35%	0.00%	21.03%	0.00%	0.00%	0.00%	17.25%	0.00%	0.00%	30.01%	100.00%	100.00%	
U4	18.95	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.70%	0.00%	0.01%	0.00%	24.18%	0.00%	25.20%	0.00%	4.95%	8.23%	100.00%	100.00%	
U5	36.93	1.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.08%	3.10%	0.38%	0.00%	0.44%	0.00%	10.36%	0.00%	1.03%	1.51%	100.00%	100.00%	
U6	7.38	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.68%	0.00%	0.00%	0.00%	2.24%	2.07%	100.00%	100.00%	
U7	13.04	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.10%	0.21%	0.00%	0.00%	0.00%	0.00%	2.37%	0.00%	0.38%	0.00%	100.00%	100.00%	
U8	57.16	2.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.93%	2.55%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.92%	5.66%	100.00%	100.00%	
U9	23.24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.27%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
U10	7.07	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.72%	3.51%	0.00%	0.00%	0.00%	0.00%	2.59%	0.00%	24.47%	0.00%	100.00%	100.00%	
U11	7.69	1.87%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
U12	2.32	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.06%	100.00%	100.00%	
U13	21.55	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	21.91%	0.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
W1	2.96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.56%	0.00%	0.00%	16.23%	9.47%	0.00%	33.31%	0.00%	0.03%	0.00%	100.00%	100.00%	
W2	33.61	8.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.65%	5.85%	2.83%	0.00%	0.77%	0.00%	10.57%	0.00%	0.00%	0.73%	100.00%	100.00%	
W3	20.48	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.21%	4.37%	0.00%	4.40%	1.14%	5.74%	0.00%	0.00%	0.38%	100.00%	100.00%	
W4	107.78	2.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.63%	0.00%	0.00%	0.00%	8.10%	0.38%	0.00%	0.00%	0.88%	1.38%	0.17%	0.00%	0.04%	0.00%	100.00%	100.00%	

**Robinson Creek**

Future Parameters

June 13, 2008

Updated: March 21, 2023

Updates Include: Updated Future parameters, updated using new landuse categories and updated landuse shapefile provided by CLOCA

Sub Watershed No.	NHVD	Command	Sub-Watershed Information												
			Area (ha)	HSG	CN AMC II	CN AMC III	C	IA (mm)	Length (m)	Width (m)	Slope (%)	TC (min)	TP (hr)	TIMP (%)	XIMP (%)
L1	101	NasHYD	40.35	C	74	87	0.21	6.60	918	500	2.90	61.92	0.69	3	3
L2	102	StandHYD	5.83	C	76	88	0.90	1.50	105	500	1.30	4.76	0.05	50	50
L3	103	StandHYD	5.61	C	73	86	0.62	2.34	176	500	2.60	6.97	0.08	44	43
L4	104	StandHYD	14.50	C	74	87	0.55	2.97	178	500	2.60	6.41	0.07	51	50
L5	105	StandHYD	50.67	C	74	87	0.43	4.78	703	900	3.60	20.95	0.23	32	32
U1	201	NasHYD	35.74	C	78	89	0.31	5.70	850	600	6.70	40.23	0.45	19	16
U2	202	StandHYD	54.13	C	75	88	0.56	3.09	900	600	1.00	34.42	0.38	63	62
U3	203	NasHYD	24.97	C	78	89	0.28	6.87	544	600	6.40	33.63	0.38	15	13
U4	204	NasHYD	18.95	C	75	87	0.31	3.80	900	400	10.00	36.19	0.40	19	16
U5	205	StandHYD	36.93	C	74	87	0.47	2.58	500	900	1.50	18.32	0.20	52	49
U6	206	StandHYD	7.38	C	74	87	0.40	2.62	300	400	2.10	12.07	0.13	35	28
U7	207	StandHYD	13.04	C	74	87	0.47	1.68	400	100	2.00	15.35	0.17	45	36
U8	208	StandHYD	57.16	B	61	78	0.44	2.22	1000	500	2.00	33.11	0.37	42	34
U9	209	StandHYD	23.24	C	74	87	0.49	1.50	600	400	2.60	20.63	0.23	45	36
U10	210	StandHYD	7.07	C	75	87	0.44	3.26	224	200	2.00	9.14	0.10	41	37
U11	211	StandHYD	7.69	C	74	87	0.47	1.50	350	100	1.30	15.44	0.17	46	37
U12	212	StandHYD	2.32	C	74	87	0.45	1.59	200	100	1.00	10.48	0.12	45	35
U13	213	StandHYD	21.55	AB	53	72	0.48	2.26	800	200	2.00	29.20	0.33	50	44
W1	301	StandHYD	2.96	C	73	86	0.42	4.58	149	200	3.10	6.08	0.07	23	22
W2	302	StandHYD	33.61	C	74	87	0.48	2.57	326	900	5.10	9.44	0.11	51	47
W3	303	StandHYD	20.48	C	73	86	0.42	2.45	200	500	3.20	6.68	0.07	50	46
W4	304	StandHYD	107.78	C	74	87	0.48	1.74	900	1500	3.00	25.79	0.29	47	39

**Robinson Creek**  
Route Channel Parameters  
June 13, 2008

RC	Length	Channel S	Floodplain S	Channel n	Floodplain n
L1	918	2	3	0.03	0.05
L2	105	4	1	0.03	0.05
L3	176	-1	3	0.03	0.05
L4	178	2	3	0.03	0.05
L5	703	0	4	0.03	0.05
U1	850	1	7	0.03	0.05
U2	n/a				
U3	544	1	6	0.03	0.05
U4	360	2	10	0.03	0.05
U5	500	4	2	0.03	0.05
U6	300	2	2	0.03	0.05
U7	n/a				
U8	1000	1	2	0.03	0.05
U9	n/a				
U10	224	1	2	0.03	0.05
U11	n/a				
U12	n/a				
U13	n/a				
W1	149	1	3	0.03	0.05
W2	326	1	5	0.03	0.05
W3	200	2	3	0.03	0.05
W4	n/a				

L1	
Sta	Elev
94.77	84
108.83	83
119.34	80
121.93	79
141.49	78
145.24	77
147.87	78
162.81	79
167.5	80
181.04	83
182.65	84

L2	
Sta	Elev
29.69	92
44.83	91
50.05	89
56.68	87
58.65	86
62.83	87
77.49	88
117.33	89
142.02	90
153.99	91

L3	
Sta	Elev
14.38	91
18.58	90
26.98	88
31.41	87
49.24	86
52.04	85
58.82	86
64.4	87
66.56	88
74.52	90
80.03	91

L4	
Sta	Elev
2.31	93
20.2	92
29.15	91
34.53	90
56.99	89
66.88	88
73.89	89
82.83	90
94.16	91
97.04	92
100.23	93

L5	
Sta	Elev
33.59	92
78.31	91
95.7	91
98.18	90
110.11	90.5
118.43	91
123.52	92
132.53	93

U1	
Sta	Elev
0	106
32.22	105
38.65	104
52.88	101
61.43	100
65.26	99
71.09	99
84.2	100
91.97	102
103.36	106



U3	
Sta	Elev
31.56	121
69.23	114
132.77	109
201.56	106
228.41	105.5
269.05	106
282.86	108
323.42	112
348.44	117
380.79	120
423.36	121

U5	
Sta	Elev
25.29	127
37.67	126
55.91	124
60.49	125
69.49	126
80.06	127

W2	
Sta	Elev
20.14	97
75.4	96
104.37	95
106.22	94.5
110.99	95
140.86	96
167.05	97

U4	
Sta	Elev
29.14	123
34.71	121
42.28	119
54.45	116
63.51	114
70.59	116
72.63	117
82.31	121
91.49	125

U6	
Sta	Elev
19.75	132
43.6	131
57.54	130
60.16	128
71.54	127.5
78.77	128
82.62	129
107.45	130

W1	
Sta	Elev
18.47	95
84.19	94.5
100.34	94
108.83	94
113.56	93.5
121.74	95

U8	
Sta	Elev
82	131.6
91.1	131.4
102.7	131
121.2	130.9
123.9	130.7
124.3	130.6
125.3	130.8
136.3	131
153.3	131.8

**Robinson Creek**

100 Year Chicago, Uncontrolled Peak Flows

July 23, 2009

Updated: March 21, 2023

Updates include: Future 100-yr Chicago Uncontrolled Peak Flows, obtained using the updated version of the CLOCA VO model (updated by TYLin March 2023)

NHYD	Sub-watershed	Peak Flow (m3/s)
5	mnr to Blk	6.51
5	mjr to Blk	7.22
101	L1	2.41
102	L2	2.49
103	L3	2.26
104	L4	6.16
105	L5	17.03
112		78.92
113		78.29
114		75.82
115		72.01
201	U1	3.44
202	U2	20.29
203	U3	2.67
204	U4	1.90
205	U5	12.34
206	U6	2.59
207	U7	4.98
208	U8	13.73
209	U9	8.87
210	U10	2.71
211	U11	2.93
212	U12	0.88
213		6.41
214		9.06
215		11.57
231		37.38
250		24.81
301	W1	0.94
302	W2	14.29
303	W3	8.45
304	W4	30.73
305		8.01
306		8.13
307		18.19
309		27.30
310		37.48
311		46.30
312		36.49
315		40.27
316		41.32
317		46.68
318		86.94
319		75.46
320		76.95
321		78.65
322		79.32
323		80.45
324		82.42
326	mnr to Qua	0.34
326	mjr to Qual	0.54
327		8.24
328		6.97
329	mnr to Qua	1.81
329	mjr to Qual	3.17
330		2.15
331		11.02
333		10.77
334		11.47
336		12.48
338		28.96
340		34.14
341		8.97
342		27.10
344	mnr	1.11
344	mjr	1.81
349	mnr to Blk	2.01
349	mjr to Blk	4.40
350		1.53
351		7.71
352		7.62

**Robinson Creek**

**Regional Peak Flows**

March 31, 2010

Updated: March 21, 2023

Updates include: Future Regional Peak Flows, obtained using the updated version of the CLOCA VO model (TYLin March 2023)

NHYD	Sub-watershed	Peak Flow (m3/s)		
		Existing	Future	Change
5	mjr to Blk	1.16	1.204	3.79%
5	mnr to Blk	6.51	6.51	-0.02%
101	L1	4.57	4.57	-0.01%
102	L2	0.82	0.83	1.01%
103	L3	0.48	0.80	66.88%
104	L4	1.00	2.07	107.56%
105	L5	7.11	7.14	0.36%
112		60.12	62.81	4.48%
113		59.72	62.04	3.88%
114		58.87	60.04	1.99%
115		52.11	53.46	2.60%
201	U1	4.46	4.60	3.14%
202	U2	7.30	7.58	3.93%
203	U3	3.39	3.33	-1.95%
204	U4	2.54	2.46	-3.13%
205	U5	5.14	5.23	1.59%
206	U6	0.94	1.05	10.80%
207	U7	1.78	1.86	4.30%
208	U8	7.67	7.71	0.58%
209	U9	3.26	3.31	1.57%
210	U10	0.97	1.01	3.42%
211	U11	1.06	1.09	3.51%
212	U12	0.29	0.33	15.05%
213		2.33	2.87	23.45%
214		3.26	5.45	67.26%
215		7.78	3.59	-53.90%
231		28.23	26.41	-6.45%
250		18.05	16.02	-11.22%
301	W1	0.20	0.42	106.52%
302	W2	3.96	4.82	21.84%
303	W3	1.41	2.92	107.18%
304	W4	15.21	15.25	0.21%
305		4.16	2.66	-36.06%
306		5.82	2.71	-53.43%
307		12.65	8.58	-32.15%
309		21.18	19.31	-8.80%
310		28.43	26.73	-6.00%
311		20.51	22.92	11.73%
312		16.55	18.09	9.28%
315		32.70	31.02	-5.14%
316		20.51	22.91	11.70%
317		20.71	23.33	12.65%
318		52.67	53.91	2.35%
319		58.86	60.09	2.09%
320		59.73	61.99	3.78%
321		60.13	62.72	4.30%
322		60.91	63.52	4.28%
323		60.56	63.54	4.91%
324		64.86	67.83	4.59%
326	mjr to Blk		0.00	
326	mnr to Blk		0.33	
327		3.47	1.82	-47.57%
328		3.38	1.61	-52.31%
329	mjr to Blk		0.05	
329	mnr to Blk		1.81	
330			2.14	
331			5.45	
333		5.80	7.91	36.42%
334		6.87	2.63	-61.73%
336		7.82	3.64	-53.53%
338		18.45	16.49	-10.61%
340		16.61	18.18	9.42%
341		6.87	2.71	-60.58%
342		15.20	15.25	0.35%
344	mjr to Blk		0.00	
344	mnr to Blk		1.09	
346		3.24		
349	mjr to Blk		0.86	
349	mnr to Blk		2.01	
350			0.64	
351			1.82	
352			7.60	

## Robinson Creek

HEC-RAS Flow Inputs

10-Sep-09

Updated: March 21, 2023

Updates include: Future Chicago Peak Flows, obtained using the updated version of the CLOCA VO model (updated by TYLin March 2023)

	River	Reach	RS	NHYD	100 Year Uncontrolled	Regional	Regulatory	Regulatory
1	RobinsonLower	Lower	2075.481	318	86.94	53.91	100 Year	86.94
2	RobinsonLower	Lower	1600	319	75.46	60.09	100 Year	75.46
3	RobinsonLower	Lower	1300	320	76.95	61.99	100 Year	76.95
4	RobinsonLower	Lower	1076.022	321	78.65	62.72	100 Year	78.65
5	RobinsonLower	Lower	928	322	79.32	63.52	100 Year	79.32
6	RobinsonLower	Lower	500	324	82.42	67.83	100 Year	82.42
7	RobinsonUpper	Upper	3542.466	349 MJR	4.40	0.86	100 Year	4.40
8	RobinsonUpper	Upper	3200	351	7.71	1.82	100 Year	7.71
9	RobinsonUpper	Upper	2600	305	8.01	2.66	100 Year	8.01
10	RobinsonUpper	Upper	2300	336	12.48	3.64	100 Year	12.48
11	RobinsonUpper	Upper	2000	307	18.19	8.58	100 Year	18.19
12	RobinsonUpper	Upper	1700	338	28.96	16.49	100 Year	28.96
13	RobinsonUpper	Upper	1200	309	27.30	19.31	100 Year	27.30
14	RobinsonUpper	Upper	900	310	37.48	26.73	100 Year	37.48
15	RobinsonUpper	Upper	500	315	40.27	31.02	100 Year	40.27
16	RobinsonWest	West	486.4874	340	34.14	18.18	100 Year	34.14
17	RobinsonWest	West	300	317	46.68	23.33	100 Year	46.68

**\*\*NOTE: AMC II used for 100 Year Uncontrolled**



## ATTACHMENT C

### Hydraulic Modelling

Project: Robinson and Tooley Flood Mitigation Study  
 Project No.: 10568  
 Date: Jun-23

**Table C1.a: Regulatory Flows for flow files ExReg\_flows\_spill.f04 and ExReg\_flows.f08**

	River	Reach	RS	100 yr Flow	Spill Through Robinson Lateral (100yr)	100 yr Flow Adjusted to account for spill	Regional Flow*
1	RobinsonLower	Lower	2075.481	92.18		92.18	54.72
2	RobinsonLower	Lower	1600	89.88		89.88	61.05
3	RobinsonLower	Lower	1300	91.04		91.04	63.01
4	RobinsonLower	Lower	1076.022	91.47		91.47	63.75
5	RobinsonLower	Lower	1050.327	91.47		91.47	63.75
6	RobinsonLower	Lower	876.9869	92.05		92.05	64.58
7	RobinsonLower	Lower	772.9675	92.05	15.27	107.32	64.58
8	RobinsonLower	Lower	500	91.20	15.27	106.47	68.31
9	RobinsonUpper	Upper	3542.466	2.02		2.02	0.72
10	RobinsonUpper	Upper	3200	7.05		7.05	1.21
11	RobinsonUpper	Upper	2600	7.48		7.48	2.07
12	RobinsonUpper	Upper	2300	13.92		13.92	3.01
13	RobinsonUpper	Upper	2000	19.99		19.99	8.06
14	RobinsonUpper	Upper	1700	32.59		32.59	16.17
15	RobinsonUpper	Upper	1200	31.80		31.8	19.14
16	RobinsonUpper	Upper	900	44.23		44.23	26.87
17	RobinsonUpper	Upper	500	49.08		49.08	31.54
18	RobinsonWest	West	486.4874	31.30		31.3	18.07
19	RobinsonWest	West	300	44.26		44.26	23.18
20	Tooley_Lower	Lower	1000	65.08		65.08	118.12
21	Tooley_Lower	Lower	500	64.74		64.74	127.67
22	Tooley_Upper	Upper	4800	4.24		4.24	12.41
23	Tooley_Upper	Upper	4600	9.18		9.18	20.48
24	Tooley_Upper	Upper	4200	9.23		9.23	22.09
25	Tooley_Upper	Upper	3700	14.07		14.07	31.15
26	Tooley_Upper	Upper	3300	22.29		22.29	46.51
27	Tooley_Upper	Upper	2800	28.62		28.62	58.33
28	Tooley_Upper	Upper	2100	27.48		27.48	59.94
29	Tooley_Upper	Upper	1500	35.03		35.03	74.24
30	Tooley_Upper	Upper	1100	35.18		35.18	74.77
31	Tooley_Upper	Upper	800	43.09		43.09	91.51
32	Tooley_Upper	Upper	400	48.87		48.87	99.84
33	Tooley_Upper	Upper	200	48.87		48.87	99.88
34	Tooley_West	TribW1	300	0.001		0.00	0.001
35	Tooley_West	TribW2	3000	0.001		0.001	0.001
36	Tooley_West	Downstream	1046	11.35		11.35	14.49
37	Tooley_West	Downstream	668	13.82		13.82	17.64
38	Tooley_West	Downstream	600	13.82		13.82	17.64
39	Tooley_West	Downstream	300	16.67		16.67	20.8

\*No spill occurs during the regional event

**Table C1.b: SET WSE**

Robinson Lower  
 Set WSE at xs 1389.432 (just upstream of CPR Culvert)  
 (based on Tooley Brief last revised March 2012)

	Profile	100 yr	Regional	2 Year	5 Year	10 Year	25 Year	50 Year
xs	1389.432	96.08	96.23	91.28	91.79	92.08	92.38	93.35

**Table C1.c: Calculated flows for node 1046 (Tooley West Downstream)**

Area W2 contributes 100 % to XS 668 (a bit US of node 600). Therefore the flow contributing to XS 1046 is proportioned as follow:

Area (ha)	Flow %	Flow m3/s	xs
126.64	100.0%	17.64	668
104	82.1%	14.49	1046
126.64	100.0%	13.82	668
104	82.1%	11.35	1046

Regional  
100 year

**Table C1.d: Spill Flow Reported**

River	Reach	River Sta	Profile	Q US (m <sup>3</sup> /s)	Q Leaving Total (m <sup>3</sup> /s)
Tooley_Upper	Upper	780	Future 100 yr	43.09	0
Tooley_Upper	Upper	780	Future Regional	91.51	0
RobinsonLower	Lower	1170	Future 100 yr	91.04	15.27
RobinsonLower	Lower	1170	Future Regional	63.01	0

Courtice Road Underpass

Profile	Underpass Flow (m <sup>3</sup> /s)
Future 100 yr	0
Future Regional	24.17

Project: Robinson and Tooley Flood Mitigation Study  
 Project No.: 10568  
 Date: Jun-23

**Table C2.a: Regulatory flows for flow files PropReg\_flows\_spill.f03 and PropReg\_flows.f09**

	River	Reach	RS	100 yr Flow	Spill Through Robinson Lateral (100yr)	100 yr Flow Adjusted to account for spill	Regional Flow	Spill Through Robinson Lateral (Regional)	Regional Flow Adjusted to account for spill
1	RobinsonLower	Lower	2075.481	86.94		86.94	53.91		53.91
2	RobinsonLower	Lower	1600	75.46		75.46	60.09		60.09
3	RobinsonLower	Lower	1300	76.95		76.95	61.99		61.99
4	RobinsonLower	Lower	1076.022	78.65		78.65	62.72		62.72
5	RobinsonLower	Lower	1050.327	78.65		78.65	62.72		62.72
6	RobinsonLower	Lower	876.9869	79.32		79.32	63.52		63.52
7	RobinsonLower	Lower	772.9675	79.32	3.38	82.70	63.52		63.52
8	RobinsonLower	Lower	500	82.42	3.38	85.80	67.83		67.83
9	RobinsonUpper	Upper	3542.466	2.02		2.02	0.86		0.86
10	RobinsonUpper	Upper	3200	7.71		7.71	1.82		1.82
11	RobinsonUpper	Upper	2600	8.01		8.01	2.66		2.66
12	RobinsonUpper	Upper	2300	12.48		12.48	3.64		3.64
13	RobinsonUpper	Upper	2000	18.19		18.19	8.58		8.58
14	RobinsonUpper	Upper	1700	28.96		28.96	16.49		16.49
15	RobinsonUpper	Upper	1200	27.30		27.30	19.31		19.31
16	RobinsonUpper	Upper	900	37.48		37.48	26.73		26.73
17	RobinsonUpper	Upper	500	40.27		40.27	31.02		31.02
18	RobinsonWest	West	486.4874	34.14		34.14	18.18		18.18
19	RobinsonWest	West	300	46.68		46.68	23.33		23.33
20	Tooley_Lower	Lower	1000	150.64		150.64	137.84		137.84
21	Tooley_Lower	Lower	500	134.78		134.78	146.98		146.98
22	Tooley_Upper	Upper	4800	15.60		15.60	16.07		16.07
23	Tooley_Upper	Upper	4600	29.56		29.56	24.82		24.82
24	Tooley_Upper	Upper	4200	26.93		26.93	27.62		27.62
25	Tooley_Upper	Upper	3700	39.02		39.02	38.29		38.29
26	Tooley_Upper	Upper	3300	59.53		59.53	56.37		56.37
27	Tooley_Upper	Upper	2800	75.30		75.30	70.28		70.28
28	Tooley_Upper	Upper	2100	63.79		63.79	70.66		70.66
29	Tooley_Upper	Upper	1500	84.81		84.81	87.39		87.39
30	Tooley_Upper	Upper	1100	93.55		93.55	87.88		87.88
31	Tooley_Upper	Upper	800	111.82		111.82	108.75		108.75
32	Tooley_Upper	Upper	500	111.82	0.32	112.14	108.75	0.13	108.88
33	Tooley_Upper	Upper	400	118.46	0.32	118.78	117.34	0.13	117.47
34	Tooley_Upper	Upper	200	114.79	0.32	115.11	118.09	0.13	118.22
35	Tooley_West	TribW1	300	0.001		0.001	0.001		0.001
36	Tooley_West	TribW2	3000	0.001		0.001	0.001		0.001
37	Tooley_West	Downstream	1046	32.24		32.24	14.90		14.90
38	Tooley_West	Downstream	668	39.26		39.26	18.14		18.14
39	Tooley_West	Downstream	600	39.26		39.26	18.14		18.14
40	Tooley_West	Downstream	300	35.85		35.85	21.46		21.46

**Table C2.b: SET WSE**

Robinson Lower  
 Set WSE at xs 1389.432 (just upstream of CPR Culvert)

	Profile	100 yr	Regional
xs	1389.432	96.02	94.88

**Table C2.c: Calculated flows for node 1046 (Tooley West Downstream)**

Area W2 contributes 100 % to XS 668 (a bit US of node 600). Therefore the flow contributing to XS 1046 is proportioned as follow:

Area (ha)	Flow %	Flow m3/s	xs
126.64	100.0%	39.26	668
104	82.1%	32.24	1046
126.64	100.0%	18.14	668
104	82.1%	14.90	1046

Regional  
100 year

**Table C2.d: Spill Flow Reported**

River	Reach	River Sta	Profile	Q US (m <sup>3</sup> /s)	Q Leaving Total (m <sup>3</sup> /s)
Tooley_Upper	Upper	780	100yr	111.82	0.32
Tooley_Upper	Upper	780	Regional	108.75	0.13
RobinsonLower	Lower	1170	100yr	76.95	3.38
RobinsonLower	Lower	1170	Regional	61.99	0

Courtice Road Underpass

Profile	Underpass Flow (m <sup>3</sup> /s)
100yr	39.85
Regional	37.62

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	TribW1	300	100yr(Cloca)	0	94.5	94.79		94.79	0	0	2.21	14.6	0
Tooley_West	TribW1	300	Regional(Cloca)	0	94.5	94.51	94.51	94.51	0.00233	0.07	0.01	1.5	0.24
Tooley_West	TribW1	200	100yr(Cloca)	15.27	93.93	94.67		94.69	0.001105	0.88	29.31	78	0.33
Tooley_West	TribW1	200	Regional(Cloca)	0	93.93	94.44		94.44	0	0	15.23	49.58	0
Tooley_West	TribW1	100	100yr(Cloca)	15.27	93.63	94.66		94.67	0.000276	0.52	44.28	79.02	0.17
Tooley_West	TribW1	100	Regional(Cloca)	0	93.63	94.44		94.44	0	0	27.82	72.22	0
Tooley_West	TribW1	50	100yr(Cloca)	15.27	93.47	94.48		94.57	0.002241	1.5	13.69	24.28	0.5
Tooley_West	TribW1	50	Regional(Cloca)	0	93.47	94.44		94.44	0	0	12.81	23.26	0
Tooley_West	TribW2	3000	100yr(Cloca)	0	93.92	94.54		94.54	0	0	3.22	8.72	0
Tooley_West	TribW2	3000	Regional(Cloca)	0	93.92	94.44		94.44	0	0	2.39	7.73	0
Tooley_West	TribW2	2000	100yr(Cloca)	0	92.82	94.54	92.83	94.54	0	0	22.45	26.72	0
Tooley_West	TribW2	2000	Regional(Cloca)	0	92.82	94.44	92.83	94.44	0	0	19.91	23.91	0
Tooley_West	TribW2	1000	100yr(Cloca)	0	91.65	94.54		94.54	0	0	57.72	43.51	0
Tooley_West	TribW2	1000	Regional(Cloca)	0	91.65	94.44		94.44	0	0	53.59	37.13	0
Tooley_West	Downstream	1046	100yr(Cloca)	26.62	91.07	94.54	93.02	94.54	0.000002	0.09	617.17	330.79	0.02
Tooley_West	Downstream	1046	Regional(Cloca)	14.49	91.07	94.44	92.38	94.44	0.000001	0.05	584.37	322.14	0.01
Tooley_West	Downstream	1021.5		Culvert									
Tooley_West	Downstream	997	100yr(Cloca)	26.62	90.96	92.85	92.85	92.86	0.000192	0.52	143.71	347.87	0.15
Tooley_West	Downstream	997	Regional(Cloca)	14.49	90.96	92.36	92.36	92.99	0.008663	3.54	4.1	134.74	1
Tooley_West	Downstream	962	100yr(Cloca)	26.62	91.6	92.03	92.03	92.04	0.000522	0.37	92.17	226.66	0.2
Tooley_West	Downstream	962	Regional(Cloca)	14.49	91.6	92.03	92.03	92.03	0.000155	0.2	92.17	226.66	0.11
Tooley_West	Downstream	869	100yr(Cloca)	26.62	90.9	91.68		91.69	0.000956	0.74	65.53	174.73	0.3
Tooley_West	Downstream	869	Regional(Cloca)	14.49	90.9	91.53		91.54	0.000713	0.53	43.27	133.7	0.25
Tooley_West	Downstream	794	100yr(Cloca)	26.62	91.13	91.46	91.46	91.57	0.024734	2.11	19.58	85.91	1.33
Tooley_West	Downstream	794	Regional(Cloca)	14.49	91.13	91.37	91.37	91.45	0.027877	1.72	12.79	78.28	1.33



**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	Downstream	736	100yr(Cloca)	26.62	90.95	91.51		91.51	0.000094	0.17	191.96	345.14	0.09
Tooley_West	Downstream	736	Regional(Cloca)	14.49	90.95	91.39		91.39	0.000005	0.1	154.25	309.37	0.06
Tooley_West	Downstream	720	100yr(Cloca)	26.62	88.89	91.5	90.96	91.51	0.000063	0.36	201.19	369.9	0.09
Tooley_West	Downstream	720	Regional(Cloca)	14.49	88.89	91.39	90.31	91.39	0.000031	0.24	160.97	320.79	0.06
Tooley_West	Downstream	704		Culvert									
Tooley_West	Downstream	700	100yr(Cloca)	26.62	88.44	90.66	90.66	90.68	0.000817	0.97	71.46	177.4	0.28
Tooley_West	Downstream	700	Regional(Cloca)	14.49	88.44	90.1	90.1	90.73	0.011611	3.53	4.11	39.66	1
Tooley_West	Downstream	688	100yr(Cloca)	26.62	88.97	89.85	89.63	89.92	0.002298	1.18	27.78	75.05	0.47
Tooley_West	Downstream	688	Regional(Cloca)	14.49	88.97	89.69		89.73	0.001955	0.9	17.6	53.58	0.42
Tooley_West	Downstream	668	100yr(Cloca)	29.09	88.92	89.55	89.55	89.75	0.009532	2.05	16.86	51.81	0.93
Tooley_West	Downstream	668	Regional(Cloca)	17.64	88.92	89.42	89.42	89.58	0.010664	1.77	10.85	39.1	0.93
Tooley_West	Downstream	600	100yr(Cloca)	29.09	88.87	89.44		89.46	0.000905	0.65	66.06	170	0.29
Tooley_West	Downstream	600	Regional(Cloca)	17.64	88.87	89.29		89.31	0.001186	0.59	41.95	151.9	0.31
Tooley_West	Downstream	500	100yr(Cloca)	29.09	88.49	89.17	89.08	89.3	0.005713	1.81	26.77	102.07	0.74
Tooley_West	Downstream	500	Regional(Cloca)	17.64	88.49	89.07		89.14	0.003978	1.34	19.42	61.48	0.6
Tooley_West	Downstream	400	100yr(Cloca)	29.09	87.99	88.71	88.63	88.81	0.004753	1.6	28.07	82.17	0.67
Tooley_West	Downstream	400	Regional(Cloca)	17.64	87.99	88.53	88.51	88.64	0.007638	1.59	15.38	62.9	0.8
Tooley_West	Downstream	300	100yr(Cloca)	31.94	86.82	87.92	87.92	88.32	0.008334	3	13.78	22.31	0.97
Tooley_West	Downstream	300	Regional(Cloca)	20.8	86.82	87.71	87.71	88.02	0.008658	2.6	9.6	17.8	0.95
Tooley_West	Downstream	200	100yr(Cloca)	31.94	84.99	86.25	86.25	86.53	0.006933	2.57	17.41	34.45	0.86
Tooley_West	Downstream	200	Regional(Cloca)	20.8	84.99	86.08	86.08	86.31	0.006951	2.24	11.96	30.66	0.84
Tooley_West	Downstream	100	100yr(Cloca)	31.94	82.81	83.7	83.7	83.97	0.008594	2.32	16.01	38.49	0.92
Tooley_West	Downstream	100	Regional(Cloca)	20.8	82.81	83.54	83.54	83.76	0.01062	2.12	10.38	28.64	0.97
Tooley_Upper	Upper	4800	100yr(Cloca)	4.24	128.54	128.83	128.83	128.91	0.041464	1.19	3.68	24.53	0.7
Tooley_Upper	Upper	4800	Regional(Cloca)	12.41	128.54	129	129	129.11	0.029075	1.35	8.98	38.96	0.64

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	4700	100yr(Cloca)	4.24	127.91	128.52	128.21	128.53	0.000782	0.38	15.47	45.69	0.16
Tooley_Upper	Upper	4700	Regional(Cloca)	12.41	127.91	128.78	128.36	128.79	0.001021	0.55	29.04	59.71	0.19
Tooley_Upper	Upper	4600	100yr(Cloca)	9.18	127.55	128.21	128.05	128.25	0.00837	1.36	10.69	33	0.54
Tooley_Upper	Upper	4600	Regional(Cloca)	20.48	127.55	128.41	128.24	128.47	0.010534	1.83	18.59	47.73	0.64
Tooley_Upper	Upper	4500.017	100yr(Cloca)	9.18	126.74	127	127	127.07	0.017481	1.49	7.88	55.42	0.96
Tooley_Upper	Upper	4500.017	Regional(Cloca)	20.48	126.74	127.11	127.11	127.21	0.015343	1.78	14.68	76.63	0.95
Tooley_Upper	Upper	4400	100yr(Cloca)	9.18	125.07	125.79		125.87	0.005437	1.66	8.05	21.86	0.63
Tooley_Upper	Upper	4400	Regional(Cloca)	20.48	125.07	126.04	125.9	126.15	0.005835	2.11	14.54	30.98	0.69
Tooley_Upper	Upper	4300	100yr(Cloca)	9.18	124.45	124.91	124.83	124.99	0.016381	1.52	7.42	22.17	0.72
Tooley_Upper	Upper	4300	Regional(Cloca)	20.48	124.45	125.16		125.28	0.013863	1.86	13.3	25.39	0.71
Tooley_Upper	Upper	4200	100yr(Cloca)	9.23	122.69	123.46	123.34	123.56	0.012405	1.22	7.96	18.8	0.45
Tooley_Upper	Upper	4200	Regional(Cloca)	22.09	122.69	123.79	123.65	123.96	0.012661	1.58	15.58	27.23	0.48
Tooley_Upper	Upper	4100	100yr(Cloca)	9.23	120.54	121.08	121.06	121.19	0.062244	2.16	6.53	24.29	0.95
Tooley_Upper	Upper	4100	Regional(Cloca)	22.09	120.54	121.26	121.26	121.46	0.069725	2.8	11.45	28.66	1.06
Tooley_Upper	Upper	4000	100yr(Cloca)	9.23	118.77	119.37		119.42	0.008142	1.77	11.22	25.71	0.75
Tooley_Upper	Upper	4000	Regional(Cloca)	22.09	118.77	120.28		120.3	0.000912	1.12	41.52	40.98	0.29
Tooley_Upper	Upper	3900	100yr(Cloca)	9.23	117.88	118.27	118.26	118.4	0.012876	1.58	5.85	21.88	0.97
Tooley_Upper	Upper	3900	Regional(Cloca)	22.09	117.88	120.28		120.28	0.000036	0.34	89.21	59.54	0.07
Tooley_Upper	Upper	3896.167	100yr(Cloca)	9.23	117.81	118.21	118.21	118.34	0.013639	1.61	5.73	21.55	1
Tooley_Upper	Upper	3896.167	Regional(Cloca)	22.09	117.81	120.28		120.28	0.000027	0.3	95.85	64.02	0.06
Tooley_Upper	Upper	3884	100yr(Cloca)	9.23	116.59	118.2	117.4	118.28	0.001137	1.2	7.72	7.97	0.33
Tooley_Upper	Upper	3884	Regional(Cloca)	22.09	116.59	120.28	117.96	120.28	0.000036	0.32	99.53	78.72	0.07
Tooley_Upper	Upper	3875.491		Culvert									
Tooley_Upper	Upper	3866	100yr(Cloca)	9.23	116.8	117.86	117.62	118.08	0.005877	2.07	4.46	4.73	0.68
Tooley_Upper	Upper	3866	Regional(Cloca)	22.09	116.8	118.23	118.23	118.86	0.012329	3.52	6.27	5.09	1

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	3840.997	100yr(Cloca)	9.23	117.15	117.86		117.91	0.002023	1.06	10.92	26.5	0.44
Tooley_Upper	Upper	3840.997	Regional(Cloca)	22.09	117.15	118.27		118.34	0.001547	1.31	23.39	34.06	0.42
Tooley_Upper	Upper	3800	100yr(Cloca)	9.23	116.94	117.6	117.55	117.76	0.006359	1.87	6.32	16	0.78
Tooley_Upper	Upper	3800	Regional(Cloca)	22.09	116.94	117.93	117.88	118.2	0.006715	2.58	12.78	24.74	0.86
Tooley_Upper	Upper	3700	100yr(Cloca)	14.07	115.99	117.02	116.82	117.14	0.005898	2.1	9.76	20.33	0.69
Tooley_Upper	Upper	3700	Regional(Cloca)	31.15	115.99	117.36		117.53	0.006251	2.65	18.06	29.1	0.75
Tooley_Upper	Upper	3600	100yr(Cloca)	14.07	115.2	116.08	116.08	116.28	0.013393	2.95	7.51	18.4	1.02
Tooley_Upper	Upper	3600	Regional(Cloca)	31.15	115.2	116.38	116.38	116.65	0.012802	3.54	14.12	25.83	1.05
Tooley_Upper	Upper	3500	100yr(Cloca)	14.07	114.05	114.6	114.6	114.76	0.016236	2.4	7.97	24.05	1.05
Tooley_Upper	Upper	3500	Regional(Cloca)	31.15	114.05	114.84	114.84	115.08	0.014655	2.92	14.52	29.98	1.06
Tooley_Upper	Upper	3400	100yr(Cloca)	14.07	112.84	113.77		113.84	0.003885	1.68	12.59	26.11	0.56
Tooley_Upper	Upper	3400	Regional(Cloca)	31.15	112.84	114.05		114.17	0.005042	2.29	20.87	33.61	0.67
Tooley_Upper	Upper	3300	100yr(Cloca)	22.29	112.42	113.1		113.22	0.008807	2.02	15.24	39.42	0.8
Tooley_Upper	Upper	3300	Regional(Cloca)	46.51	112.42	113.37		113.53	0.007596	2.35	26.54	45.87	0.78
Tooley_Upper	Upper	3200	100yr(Cloca)	22.29	111.71	112.28		112.4	0.007679	1.7	14.9	33.63	0.73
Tooley_Upper	Upper	3200	Regional(Cloca)	46.51	111.71	112.53		112.73	0.008398	2.28	24.19	39.99	0.81
Tooley_Upper	Upper	3100	100yr(Cloca)	22.29	110.6	111.2	111.19	111.37	0.014609	2.44	12.54	34.45	1.01
Tooley_Upper	Upper	3100	Regional(Cloca)	46.51	110.6	111.44	111.42	111.69	0.013367	2.92	21.24	39.77	1.02
Tooley_Upper	Upper	3000	100yr(Cloca)	22.29	109.61	110.12		110.23	0.008905	1.7	15	36.69	0.77
Tooley_Upper	Upper	3000	Regional(Cloca)	46.51	109.61	110.34		110.54	0.009655	2.27	23.75	40.73	0.85
Tooley_Upper	Upper	2900	100yr(Cloca)	22.29	108.83	109.55		109.6	0.004437	1.49	21.71	55.2	0.57
Tooley_Upper	Upper	2900	Regional(Cloca)	46.51	108.83	109.78		109.87	0.004396	1.8	35.92	63.83	0.6
Tooley_Upper	Upper	2800	100yr(Cloca)	28.62	107.97	108.58	108.58	108.76	0.016384	2.58	15.41	42.98	1.07
Tooley_Upper	Upper	2800	Regional(Cloca)	58.33	107.97	108.8	108.8	109.07	0.014833	3.03	25.43	47.7	1.07
Tooley_Upper	Upper	2700	100yr(Cloca)	28.62	106.94	107.6	107.45	107.69	0.005844	1.65	21.24	43.99	0.65
Tooley_Upper	Upper	2700	Regional(Cloca)	58.33	106.94	107.85	107.69	108.01	0.006729	2.2	33.04	50.64	0.74

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	2593.81	100yr(Cloca)	28.62	106.15	106.53	106.53	106.68	0.017952	1.98	16.81	56.07	1.04
Tooley_Upper	Upper	2593.81	Regional(Cloca)	58.33	106.15	106.71	106.71	106.94	0.01632	2.48	28.04	63.51	1.06
Tooley_Upper	Upper	2500	100yr(Cloca)	28.62	105.13	106.06		106.09	0.002483	0.93	39.08	81.68	0.31
Tooley_Upper	Upper	2500	Regional(Cloca)	58.33	105.13	106.33		106.38	0.002389	1.09	62.41	88	0.32
Tooley_Upper	Upper	2400	100yr(Cloca)	28.62	104.67	105.39	105.39	105.58	0.015173	2.78	15.22	40.8	1.06
Tooley_Upper	Upper	2400	Regional(Cloca)	58.33	104.67	105.63	105.63	105.89	0.013253	3.15	25.97	48.99	1.04
Tooley_Upper	Upper	2300	100yr(Cloca)	28.62	103.65	104.54		104.62	0.004573	1.76	23.14	46	0.6
Tooley_Upper	Upper	2300	Regional(Cloca)	58.33	103.65	105.47		105.5	0.000493	0.94	82.05	78.45	0.22
Tooley_Upper	Upper	2200	100yr(Cloca)	28.62	102.99	103.65	103.65	103.84	0.016145	2.71	15.11	40.53	1.07
Tooley_Upper	Upper	2200	Regional(Cloca)	58.33	102.99	105.46		105.47	0.00013	0.59	123	76.93	0.12
Tooley_Upper	Upper	2100	100yr(Cloca)	27.48	101.75	102.6	102.48	102.72	0.007019	2.14	18.68	39.18	0.74
Tooley_Upper	Upper	2100	Regional(Cloca)	59.94	101.75	105.46		105.46	0.000025	0.34	228.36	91.31	0.06
Tooley_Upper	Upper	2000	100yr(Cloca)	27.48	101.08	101.59	101.59	101.74	0.014392	1.91	17.91	59.7	1.06
Tooley_Upper	Upper	2000	Regional(Cloca)	59.94	101.08	105.46	101.79	105.46	0.000005	0.2	455.59	159.27	0.03
Tooley_Upper	Upper	1900	100yr(Cloca)	27.48	100.1	101.03		101.04	0.000329	0.52	63.95	95.44	0.19
Tooley_Upper	Upper	1900	Regional(Cloca)	59.94	100.1	105.46		105.46	0.000002	0.14	669.88	296.95	0.02
Tooley_Upper	Upper	1818.172	100yr(Cloca)	27.48	98.87	101.02		101.03	0.000048	0.36	101.61	71.68	0.08
Tooley_Upper	Upper	1818.172	Regional(Cloca)	59.94	98.87	105.46		105.46	0.000002	0.17	879.25	447.67	0.02
Tooley_Upper	Upper	1800	100yr(Cloca)	27.48	98.53	101.02		101.03	0.000022	0.27	127.11	71.45	0.06
Tooley_Upper	Upper	1800	Regional(Cloca)	59.94	98.53	105.46		105.46	0.000001	0.14	938.75	388.73	0.02
Tooley_Upper	Upper	1779	100yr(Cloca)	27.48	97.53	100.87	99.06	101.01	0.000552	1.68	16.41	54.11	0.3
Tooley_Upper	Upper	1779	Regional(Cloca)	59.94	97.53	105.33	100.05	105.45	0.000147	1.54	38.94	423.2	0.18
Tooley_Upper	Upper	1764.263		Culvert									
Tooley_Upper	Upper	1748	100yr(Cloca)	27.48	97.53	99.48	99.48	100.37	0.017203	4.18	6.58	3.69	1
Tooley_Upper	Upper	1748	Regional(Cloca)	59.94	97.53	100.66	100.66	101.88	0.013547	4.88	12.27	41.76	1

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	1700	100yr(Cloca)	27.48	97.62	98.36	98.36	98.59	0.008954	2.42	16.53	38.48	0.94
Tooley_Upper	Upper	1700	Regional(Cloca)	59.94	97.62	98.75	98.75	99.01	0.006341	2.77	38.81	75.87	0.86
Tooley_Upper	Upper	1670.175	100yr(Cloca)	27.48	97.27	98.07	97.96	98.16	0.009219	2.75	23.89	56.27	0.98
Tooley_Upper	Upper	1670.175	Regional(Cloca)	59.94	97.27	98.51		98.59	0.00475	2.64	52.61	74.07	0.76
Tooley_Upper	Upper	1600	100yr(Cloca)	27.48	97.02	97.89		97.91	0.001725	0.74	45.47	73.34	0.26
Tooley_Upper	Upper	1600	Regional(Cloca)	59.94	97.02	98.39		98.42	0.001278	0.87	88.75	97.03	0.24
Tooley_Upper	Upper	1500	100yr(Cloca)	35.03	95.92	97.46		97.54	0.009036	2.43	31.86	77.17	0.64
Tooley_Upper	Upper	1500	Regional(Cloca)	74.24	95.92	98.28		98.31	0.000986	1.08	116	115.08	0.23
Tooley_Upper	Upper	1412.393	100yr(Cloca)	35.03	94.78	96.54	96.52	96.78	0.007912	4.08	23.43	38.04	1.01
Tooley_Upper	Upper	1412.393	Regional(Cloca)	74.24	94.78	98.23		98.25	0.000445	1.54	131.93	96.37	0.27
Tooley_Upper	Upper	1400	100yr(Cloca)	35.03	94.56	96.51		96.64	0.008628	2.71	25.11	41.71	0.64
Tooley_Upper	Upper	1400	Regional(Cloca)	74.24	94.56	98.23		98.24	0.000388	0.89	138.47	89.26	0.15
Tooley_Upper	Upper	1376	100yr(Cloca)	35.03	94.05	96.36	95.41	96.56	0.001672	1.97	17.75	10.07	0.43
Tooley_Upper	Upper	1376	Regional(Cloca)	74.24	94.05	97.9	96.23	98.2	0.001224	2.43	30.59	75.58	0.4
Tooley_Upper	Upper	1360.285		Culvert									
Tooley_Upper	Upper	1343.5	100yr(Cloca)	35.03	94.04	95.37	95.37	95.99	0.009425	3.48	10.07	9.81	1
Tooley_Upper	Upper	1343.5	Regional(Cloca)	74.24	94.04	96.17	96.17	97.18	0.008147	4.44	16.73	14.85	1
Tooley_Upper	Upper	1300	100yr(Cloca)	35.03	93.99	95.09	95.09	95.31	0.0059	2.24	21.68	58.82	0.79
Tooley_Upper	Upper	1300	Regional(Cloca)	74.24	93.99	95.51		95.73	0.004035	2.44	47.92	65.51	0.7
Tooley_Upper	Upper	1270.062	100yr(Cloca)	35.03	93.91	94.77	94.73	94.98	0.008944	2.72	21.92	40.03	0.97
Tooley_Upper	Upper	1270.062	Regional(Cloca)	74.24	93.91	95.44		95.6	0.003317	2.48	52.02	49.62	0.65
Tooley_Upper	Upper	1200	100yr(Cloca)	35.03	93.15	94.1	94.1	94.37	0.008254	2.43	17.86	35.81	0.91
Tooley_Upper	Upper	1200	Regional(Cloca)	74.24	93.15	95.4		95.48	0.000715	1.42	73.8	48.9	0.32
Tooley_Upper	Upper	1100	100yr(Cloca)	35.18	92.43	93.63		93.71	0.001515	1.31	31.52	41.17	0.41
Tooley_Upper	Upper	1100	Regional(Cloca)	74.77	92.43	95.42		95.45	0.00015	0.81	126.97	61.23	0.15

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	1054	100yr(Cloca)	35.18	91.89	93.64		93.67	0.000357	0.87	55.18	47.27	0.22
Tooley_Upper	Upper	1054	Regional(Cloca)	74.77	91.89	95.42		95.44	0.000095	0.74	147.67	56.37	0.13
Tooley_Upper	Upper	1013	100yr(Cloca)	35.18	91.56	93.64		93.66	0.000153	0.63	73.94	50.39	0.15
Tooley_Upper	Upper	1013	Regional(Cloca)	74.77	91.56	95.42		95.43	0.00006	0.62	172.91	60.88	0.1
Tooley_Upper	Upper	1000	100yr(Cloca)	35.18	90.71	93.64		93.65	0.000064	0.51	95.98	55.13	0.1
Tooley_Upper	Upper	1000	Regional(Cloca)	74.77	90.71	95.42		95.43	0.000036	0.54	211.12	73.57	0.08
Tooley_Upper	Upper	970.5	100yr(Cloca)	35.18	89.9	93.64	91.48	93.65	0.000022	0.37	160.26	77.95	0.06
Tooley_Upper	Upper	970.5	Regional(Cloca)	74.77	89.9	95.42	92.51	95.43	0.000017	0.43	324.57	107.58	0.06
Tooley_Upper	Upper	957.6232		Culvert									
Tooley_Upper	Upper	943.5	100yr(Cloca)	35.18	90.11	93.2	91.84	93.21	0.00004	0.41	160.63	106.78	0.08
Tooley_Upper	Upper	943.5	Regional(Cloca)	74.77	90.11	95.42	92.86	95.42	0.000013	0.35	439.06	145.86	0.05
Tooley_Upper	Upper	900	100yr(Cloca)	35.18	89.09	93.2		93.2	0.00001	0.24	263.52	136.35	0.04
Tooley_Upper	Upper	900	Regional(Cloca)	74.77	89.09	95.42		95.42	0.000005	0.24	653.53	235.61	0.03
Tooley_Upper	Upper	863	100yr(Cloca)	35.18	88.99	93.2		93.2	0.000007	0.2	330.34	221.33	0.03
Tooley_Upper	Upper	863	Regional(Cloca)	74.77	88.99	95.42		95.42	0.000003	0.17	1021.52	401.46	0.02
Tooley_Upper	Upper	800	100yr(Cloca)	43.09	88.78	93.2		93.2	0.000004	0.16	389.11	217.47	0.03
Tooley_Upper	Upper	800	Regional(Cloca)	91.51	88.78	95.42		95.42	0.000002	0.16	1091.65	374.89	0.02
Tooley_Upper	Upper	784	100yr(Cloca)	43.09	87.66	93.2		93.2	0.000002	0.13	586.92	304.73	0.02
Tooley_Upper	Upper	784	Regional(Cloca)	91.51	87.66	95.42		95.42	0.000001	0.13	1378.5	384.19	0.02
Tooley_Upper	Upper	780		Lat Struct									
Tooley_Upper	Upper	735	100yr(Cloca)	43.09	86.76	93.2	88.13	93.2	0.000005	0.21	348.52	374.96	0.03
Tooley_Upper	Upper	735	Regional(Cloca)	91.51	86.76	95.42	88.76	95.42	0.000001	0.14	1516.04	481.48	0.02
Tooley_Upper	Upper	724		Bridge									
Tooley_Upper	Upper	713	100yr(Cloca)	43.09	86.15	93.2	87.92	93.2	0.000004	0.2	377.75	294.85	0.03

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**Table C3: Hec Ras Output**

Plan: ExReg\_spill (TooleyRobinson.p06) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: ExReg\_flows\_spill (TooleyRobinson.f04)

Description: To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	713	Regional(Cloca)	91.51	86.15	95.42	88.61	95.42	0.000002	0.16	1289.94	427.88	0.02
Tooley_Upper	Upper	709	100yr(Cloca)	43.09	86.02	93.2		93.2	0.000005	0.21	364.55	215.84	0.03
Tooley_Upper	Upper	709	Regional(Cloca)	91.51	86.02	95.42		95.42	0.000002	0.19	1120.3	432.28	0.02
Tooley_Upper	Upper	705	100yr(Cloca)	43.09	86.66	93.15	88.56	93.19	0.000073	0.93	46.41	141.67	0.12
Tooley_Upper	Upper	705	Regional(Cloca)	91.51	86.66	95.32	89.53	95.41	0.000101	1.34	85.91	385.53	0.15
Tooley_Upper	Upper	641.6027		Mult Open									
Tooley_Upper	Upper	577	100yr(Cloca)	43.09	86.08	91.68	87.8	91.73	0.000108	1.05	41	208.64	0.14
Tooley_Upper	Upper	577	Regional(Cloca)	91.51	86.08	91.58	88.76	91.84	0.000518	2.27	40.25	205.32	0.32
Tooley_Upper	Upper	500	100yr(Cloca)	43.09	85.97	91.7		91.7	0.000002	0.16	548.07	176.39	0.02
Tooley_Upper	Upper	500	Regional(Cloca)	91.51	85.97	91.71		91.71	0.000001	0.33	548.69	176.46	0.05
Tooley_Upper	Upper	497	100yr(Cloca)	43.09	85.75	91.7		91.7	0.000001	0.09	910.79	243.25	0.01
Tooley_Upper	Upper	497	Regional(Cloca)	91.51	85.75	91.71		91.71	0.000003	0.19	911.87	243.31	0.02
Tooley_Upper	Upper	483	100yr(Cloca)	43.09	85.19	91.7		91.7	0	0.06	1109.09	236.57	0.01
Tooley_Upper	Upper	483	Regional(Cloca)	91.51	85.19	91.71		91.71	0.000001	0.12	1110.18	236.64	0.02
Tooley_Upper	Upper	451	100yr(Cloca)	43.09	84.5	91.7		91.7	0	0.05	1647.94	502.31	0.01
Tooley_Upper	Upper	451	Regional(Cloca)	91.51	84.5	91.71		91.71	0.000001	0.12	1650.27	503.1	0.01
Tooley_Upper	Upper	438	100yr(Cloca)	43.09	83.91	91.7	85.42	91.7	0	0.05	2302.98	597.41	0.01
Tooley_Upper	Upper	438	Regional(Cloca)	91.51	83.91	91.71	86.36	91.71	0.000001	0.1	2305.8	597.89	0.01
Tooley_Upper	Upper	424		Culvert									
Tooley_Upper	Upper	410	100yr(Cloca)	43.09	83.75	91.7	85.26	91.7	0	0.04	2410.68	575.23	0
Tooley_Upper	Upper	410	Regional(Cloca)	91.51	83.75	91.71	86.19	91.71	0	0.08	2413.56	575.39	0.01
Tooley_Upper	Upper	400	100yr(Cloca)	48.87	83.54	91.7		91.7	0	0.04	2468.78	603.78	0.01
Tooley_Upper	Upper	400	Regional(Cloca)	99.84	83.54	91.71		91.71	0	0.09	2471.8	604.09	0.01
Tooley_Upper	Upper	300	100yr(Cloca)	48.87	82.97	91.7		91.7	0	0.04	2827.9	623.4	0
Tooley_Upper	Upper	300	Regional(Cloca)	99.84	82.97	91.71		91.71	0	0.08	2831.02	623.61	0.01

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	255	100yr(Cloca)	48.87	82.91	91.7		91.7	0	0.03	3103.7	657.68	0
Tooley_Upper	Upper	255	Regional(Cloca)	99.84	82.91	91.71		91.71	0	0.07	3106.99	658	0.01
Tooley_Upper	Upper	243	100yr(Cloca)	48.87	82.32	91.7	84.73	91.7	0	0.03	3744.27	824	0
Tooley_Upper	Upper	243	Regional(Cloca)	99.84	82.32	91.71	86.14	91.71	0	0.06	3748.41	824.3	0.01
Tooley_Upper	Upper	227.3807		Mult Open									
Tooley_Upper	Upper	211	100yr(Cloca)	48.87	82.28	84.8	84.8	85.96	0.008171	4.77	10.26	24.01	1
Tooley_Upper	Upper	211	Regional(Cloca)	99.84	82.28	86.21	86.21	88.07	0.006948	6.04	16.53	90.38	1
Tooley_Upper	Upper	200	100yr(Cloca)	48.87	82.22	83.77		83.85	0.004413	1.77	44.16	69.96	0.46
Tooley_Upper	Upper	200	Regional(Cloca)	99.88	82.22	84.06		84.2	0.006191	2.35	67.09	88.19	0.56
Tooley_Upper	Upper	100	100yr(Cloca)	48.87	81.47	82.91	82.91	83.08	0.016716	3.2	29.58	89.99	0.86
Tooley_Upper	Upper	100	Regional(Cloca)	99.88	81.47	83.18	83.18	83.32	0.013375	3.22	68.29	302.62	0.8
Tooley_Lower	Lower	1000	100yr(Cloca)	80.35	80.59	82.23		82.28	0.003712	1.6	87.3	135.16	0.41
Tooley_Lower	Lower	1000	Regional(Cloca)	118.12	80.59	82.43		82.48	0.003415	1.66	119.66	259.53	0.4
Tooley_Lower	Lower	900	100yr(Cloca)	80.35	79.76	81.48		81.64	0.012802	3.11	49.35	87.87	0.77
Tooley_Lower	Lower	900	Regional(Cloca)	118.12	79.76	81.59		81.82	0.016297	3.67	59.33	95.71	0.88
Tooley_Lower	Lower	800	100yr(Cloca)	80.35	78.95	80.86	80.72	80.92	0.004276	1.96	85.81	219.01	0.46
Tooley_Lower	Lower	800	Regional(Cloca)	118.12	78.95	80.99	80.81	81.05	0.004041	1.99	113.56	231.89	0.45
Tooley_Lower	Lower	700	100yr(Cloca)	80.35	78.33	79.93	79.93	80.15	0.017049	3.33	41.05	99.59	0.87
Tooley_Lower	Lower	700	Regional(Cloca)	118.12	78.33	80.08	80.08	80.3	0.016425	3.47	58.51	129.65	0.87
Tooley_Lower	Lower	600	100yr(Cloca)	80.35	77.54	79.44		79.49	0.002699	1.49	83.76	129.15	0.36
Tooley_Lower	Lower	600	Regional(Cloca)	118.12	77.54	79.66		79.72	0.002405	1.52	114.27	145.99	0.34
Tooley_Lower	Lower	500	100yr(Cloca)	80.01	77.19	79		79.1	0.006209	2.08	58.57	99.03	0.52
Tooley_Lower	Lower	500	Regional(Cloca)	127.67	77.19	79.21		79.34	0.006223	2.26	80.92	112.22	0.53
Tooley_Lower	Lower	400	100yr(Cloca)	80.01	76.08	77.99	77.96	78.21	0.013184	3.48	43.08	81.11	0.81
Tooley_Lower	Lower	400	Regional(Cloca)	127.67	76.08	78.21	78.21	78.45	0.01323	3.75	63.52	125.77	0.83



**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Lower	Lower	300	100yr(Cloca)	80.01	75.58	77.45		77.5	0.003938	1.86	83.95	128.82	0.44
Tooley_Lower	Lower	300	Regional(Cloca)	127.67	75.58	77.7		77.77	0.003675	1.96	117.93	141.18	0.43
Tooley_Lower	Lower	200	100yr(Cloca)	80.01	75.1	77.05		77.11	0.003946	1.96	78.67	111.21	0.45
Tooley_Lower	Lower	200	Regional(Cloca)	127.67	75.1	77.31		77.39	0.00378	2.09	109.87	123.79	0.45
Tooley_Lower	Lower	100	100yr(Cloca)	80.01	75.1	76.78		76.82	0.002155	1.31	93.28	105.91	0.32
Tooley_Lower	Lower	100	Regional(Cloca)	127.67	75.1	77.01	76.31	77.07	0.002665	1.59	119.04	117.08	0.37
Tooley_Lower	Lower	8.907429	100yr(Cloca)	80.01	75.1	76.12	76.12	76.31	0.020218	4.79	48.5	134.59	1.52
Tooley_Lower	Lower	8.907429	Regional(Cloca)	127.67	75.1	76.27	76.27	76.48	0.020001	5.24	74.69	178.7	1.55
RobinsonWest	West	486.4874	100yr(Cloca)	31.3	96.16	97.64	97.64	97.85	0.007449	2.88	22.49	55.75	0.8
RobinsonWest	West	486.4874	Regional(Cloca)	18.07	96.16	97.45	97.45	97.64	0.007132	2.53	13.67	35.17	0.76
RobinsonWest	West	400	100yr(Cloca)	31.3	95.2	96.82	96.82	96.98	0.005494	2.3	30.17	91.16	0.67
RobinsonWest	West	400	Regional(Cloca)	18.07	95.2	96.68	96.68	96.83	0.004876	1.99	18.34	76.12	0.62
RobinsonWest	West	300	100yr(Cloca)	44.26	94.02	96.21		96.24	0.000779	1.21	78.27	104.64	0.28
RobinsonWest	West	300	Regional(Cloca)	23.18	94.02	96.29		96.3	0.000167	0.57	86.77	116.6	0.13
RobinsonWest	West	193.175	100yr(Cloca)	44.26	93.64	96.2		96.2	0.00015	0.61	153.36	164.67	0.13
RobinsonWest	West	193.175	Regional(Cloca)	23.18	93.64	96.29		96.29	0.000032	0.29	168.49	171.18	0.06
RobinsonWest	West	176.2835	100yr(Cloca)	44.26	92.92	96.19	94.45	96.2	0.000252	0.91	151.3	178.89	0.16
RobinsonWest	West	176.2835	Regional(Cloca)	23.18	92.92	96.28	94.15	96.29	0.000052	0.42	168.72	184.61	0.08
RobinsonWest	West	165.6963		Mult Open									
RobinsonWest	West	154.4447	100yr(Cloca)	44.26	92.88	96.19		96.19	0.000011	0.19	165.66	180.73	0.04
RobinsonWest	West	154.4447	Regional(Cloca)	23.18	92.88	96.28		96.28	0.000002	0.09	181.88	188.62	0.02
RobinsonWest	West	122.0857	100yr(Cloca)	44.26	93.03	96.19		96.19	0.000106	0.56	223.41	204.57	0.11
RobinsonWest	West	122.0857	Regional(Cloca)	23.18	93.03	96.28		96.28	0.000024	0.27	242.01	211.31	0.05
RobinsonWest	West	7.527757	100yr(Cloca)	44.26	91.63	96.19		96.19	0.000003	0.12	610.22	318.6	0.02

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 Project No.: 10568  
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**Table C3: Hec Ras Output**

Plan: ExReg\_spill (TooleyRobinson.p06) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: ExReg\_flows\_spill (TooleyRobinson.f04)

Description: To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonWest	West	7.527757	Regional(Cloca)	23.18	91.63	96.28		96.28	0.000001	0.06	638.5	325.8	0.01
RobinsonUpper	Upper	3542.466	100yr(Cloca)	2.02	132.1	133.2	132.61	133.2	0.00016	0.37	18.98	71.95	0.11
RobinsonUpper	Upper	3542.466	Regional(Cloca)	0.72	132.1	132.79	132.42	132.8	0.000358	0.4	4.28	14.48	0.16
RobinsonUpper	Upper	3494.811	100yr(Cloca)	2.02	131.88	133.19	132.39	133.2	0.000096	0.32	18.22	36.57	0.09
RobinsonUpper	Upper	3494.811	Regional(Cloca)	0.72	131.88	132.79	132.2	132.79	0.00009	0.24	7.61	18.27	0.08
RobinsonUpper	Upper	3484.383	100yr(Cloca)	2.02	132.03	133.18	132.42	133.19	0.000239	0.46	7.97	30.26	0.14
RobinsonUpper	Upper	3484.383	Regional(Cloca)	0.72	132.03	132.78	132.25	132.79	0.00013	0.25	3.74	18	0.1
RobinsonUpper	Upper	3469.744		Mult Open									
RobinsonUpper	Upper	3454.014	100yr(Cloca)	2.02	132.13	132.81		132.84	0.001601	0.81	3.02	12.91	0.33
RobinsonUpper	Upper	3454.014	Regional(Cloca)	0.72	132.13	132.4		132.45	0.012656	1.02	0.72	6.02	0.77
RobinsonUpper	Upper	3430.442	100yr(Cloca)	2.02	131.86	132.81	132.32	132.82	0.000331	0.48	13.92	47.17	0.16
RobinsonUpper	Upper	3430.442	Regional(Cloca)	0.72	131.86	132.32	132.17	132.34	0.002131	0.73	2.1	9.88	0.36
RobinsonUpper	Upper	3400	100yr(Cloca)	2.02	131.78	132.8		132.81	0.000321	0.49	11.88	35.64	0.16
RobinsonUpper	Upper	3400	Regional(Cloca)	0.72	131.78	132.25		132.27	0.002305	0.74	1.79	8.7	0.37
RobinsonUpper	Upper	3344.928	100yr(Cloca)	2.02	131.6	132.78	132.12	132.79	0.000305	0.51	10.03	38.04	0.16
RobinsonUpper	Upper	3344.928	Regional(Cloca)	0.72	131.6	132.16	131.91	132.18	0.001359	0.61	1.59	5.8	0.29
RobinsonUpper	Upper	3334.47	100yr(Cloca)	2.02	131.49	132.75	132.19	132.78	0.000994	0.92	3.17	8.24	0.28
RobinsonUpper	Upper	3334.47	Regional(Cloca)	0.72	131.49	132.12	131.94	132.15	0.002994	0.9	1.06	3.68	0.42
RobinsonUpper	Upper	3316.727		Culvert									
RobinsonUpper	Upper	3298.848	100yr(Cloca)	2.02	131.61	132.01	132.01	132.19	0.016454	1.91	1.06	17.19	0.99
RobinsonUpper	Upper	3298.848	Regional(Cloca)	0.72	131.61	131.85	131.82	131.92	0.012169	1.16	0.62	14.58	0.78
RobinsonUpper	Upper	3274.914	100yr(Cloca)	2.02	131.26	131.82	131.77	131.86	0.004771	1.16	4.47	29.98	0.54
RobinsonUpper	Upper	3274.914	Regional(Cloca)	0.72	131.26	131.63	131.57	131.68	0.008562	1.09	0.93	6.25	0.66
RobinsonUpper	Upper	3200	100yr(Cloca)	7.05	130.86	131.59		131.61	0.003012	1.16	17.44	56.75	0.46
RobinsonUpper	Upper	3200	Regional(Cloca)	1.21	130.86	131.27		131.28	0.003991	0.85	3.26	19.14	0.47

Project: Robinson and Tooley Flood Mitigation Study  
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**Table C3: Hec Ras Output**

Plan: ExReg\_spill (TooleyRobinson.p06) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: ExReg\_flows\_spill (TooleyRobinson.f04)

Description: To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	3100	100yr(Cloca)	7.05	130.61	131.32		131.34	0.002432	1.07	17.25	44.14	0.41
RobinsonUpper	Upper	3100	Regional(Cloca)	1.21	130.61	131.01		131.02	0.00186	0.63	5.42	32.19	0.33
RobinsonUpper	Upper	3000	100yr(Cloca)	7.05	130.32	131.19	130.96	131.19	0.000927	0.74	28.16	79.78	0.26
RobinsonUpper	Upper	3000	Regional(Cloca)	1.21	130.32	130.95	130.74	130.96	0.000303	0.34	11.81	62.88	0.14
RobinsonUpper	Upper	2917.452	100yr(Cloca)	7.05	129.96	131.18	130.57	131.18	0.000037	0.19	133.95	304.26	0.06
RobinsonUpper	Upper	2917.452	Regional(Cloca)	1.21	129.96	130.95	130.32	130.95	0.000005	0.06	71.03	236.39	0.02
RobinsonUpper	Upper	2906.009	100yr(Cloca)	7.05	129.59	131.09	131.09	131.17	0.004153	1.57	14.34	96.35	0.56
RobinsonUpper	Upper	2906.009	Regional(Cloca)	1.21	129.59	130.94	130.02	130.95	0.000223	0.49	2.46	57.98	0.14
RobinsonUpper	Upper	2894.43		Culvert									
RobinsonUpper	Upper	2882.851	100yr(Cloca)	7.05	129.58	130.6	130.6	130.74	0.012797	1.92	6.64	24.07	0.91
RobinsonUpper	Upper	2882.851	Regional(Cloca)	1.21	129.58	130.3	129.95	130.35	0.00173	0.96	1.26	22.33	0.36
RobinsonUpper	Upper	2855.66	100yr(Cloca)	7.05	129.88	130.5	130.38	130.52	0.003427	1.14	18.21	76.4	0.48
RobinsonUpper	Upper	2855.66	Regional(Cloca)	1.21	129.88	130.28	130.21	130.29	0.002949	0.76	4.62	35.52	0.41
RobinsonUpper	Upper	2800	100yr(Cloca)	7.05	129.48	130.11	130.11	130.17	0.012803	1.87	11.35	68.39	0.88
RobinsonUpper	Upper	2800	Regional(Cloca)	1.21	129.48	129.9	129.9	129.98	0.012616	1.39	1.53	19.15	0.82
RobinsonUpper	Upper	2700	100yr(Cloca)	7.05	128.15	128.72	128.72	128.84	0.011289	1.97	4.83	18.44	0.86
RobinsonUpper	Upper	2700	Regional(Cloca)	1.21	128.15	128.5	128.5	128.56	0.01176	1.39	1.22	9.61	0.8
RobinsonUpper	Upper	2600	100yr(Cloca)	7.48	126.86	127.69		127.77	0.005061	1.64	6.23	18.64	0.6
RobinsonUpper	Upper	2600	Regional(Cloca)	2.07	126.86	127.41	127.35	127.5	0.007518	1.47	1.95	11.85	0.68
RobinsonUpper	Upper	2539.354	100yr(Cloca)	7.48	126.65	127.47		127.53	0.002955	1.28	7.07	16.58	0.47
RobinsonUpper	Upper	2539.354	Regional(Cloca)	2.07	126.65	127.18		127.21	0.002963	0.94	2.91	12.46	0.43
RobinsonUpper	Upper	2529.293	100yr(Cloca)	7.48	126.55	127.47		127.51	0.001336	0.94	9.54	18.77	0.32
RobinsonUpper	Upper	2529.293	Regional(Cloca)	2.07	126.55	127.18		127.19	0.001024	0.62	4.41	15.75	0.26
RobinsonUpper	Upper	2519.291	100yr(Cloca)	7.48	126.75	127.44		127.49	0.002607	1.1	7.56	17.68	0.43
RobinsonUpper	Upper	2519.291	Regional(Cloca)	2.07	126.75	127.14		127.17	0.003903	0.92	2.89	14.29	0.48

**Project:** Robinson and Tooley Flood Mitigation Study  
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**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	2499.168	100yr(Cloca)	7.48	126.44	127.27		127.39	0.008117	2.13	6.13	14.46	0.77
RobinsonUpper	Upper	2499.168	Regional(Cloca)	2.07	126.44	126.98	126.96	127.06	0.007532	1.5	2.38	11.34	0.69
RobinsonUpper	Upper	2400	100yr(Cloca)	7.48	126.24	126.87		126.9	0.003102	1.13	10.32	19.25	0.46
RobinsonUpper	Upper	2400	Regional(Cloca)	2.07	126.24	126.53		126.55	0.003567	0.71	4.32	16.66	0.43
RobinsonUpper	Upper	2300	100yr(Cloca)	13.92	125.59	126.2	126.14	126.26	0.01074	2.01	14.64	52.38	0.85
RobinsonUpper	Upper	2300	Regional(Cloca)	3.01	125.59	126.03	126	126.05	0.006315	1.21	6.23	45.4	0.61
RobinsonUpper	Upper	2200	100yr(Cloca)	13.92	124.91	125.62	125.55	125.65	0.003928	1.34	19.35	80.15	0.52
RobinsonUpper	Upper	2200	Regional(Cloca)	3.01	124.91	125.44	125.44	125.47	0.005422	1.27	5.96	66.91	0.58
RobinsonUpper	Upper	2154.378	100yr(Cloca)	13.92	124.68	125.57		125.58	0.000688	0.66	33.42	82.34	0.23
RobinsonUpper	Upper	2154.378	Regional(Cloca)	3.01	124.68	125.22	125.09	125.25	0.004515	1.19	6.03	62.44	0.54
RobinsonUpper	Upper	2100	100yr(Cloca)	13.92	124.1	125.22	125.22	125.46	0.010291	2.82	8.42	17.32	0.9
RobinsonUpper	Upper	2100	Regional(Cloca)	3.01	124.1	124.71	124.71	124.86	0.012439	1.91	2.13	7.54	0.88
RobinsonUpper	Upper	2000	100yr(Cloca)	19.99	121.93	123.03	123.03	123.37	0.016295	3.45	9.15	15.01	1.13
RobinsonUpper	Upper	2000	Regional(Cloca)	8.06	121.93	122.67	122.67	122.89	0.017359	2.6	4.52	11.08	1.08
RobinsonUpper	Upper	1900	100yr(Cloca)	19.99	118.54	119.76	119.76	120.04	0.010994	3.17	10.84	21.67	0.95
RobinsonUpper	Upper	1900	Regional(Cloca)	8.06	118.54	119.37	119.37	119.59	0.013387	2.62	4.67	11.05	0.98
RobinsonUpper	Upper	1800	100yr(Cloca)	19.99	115.2	116.49	116.49	116.84	0.012117	3.3	9.41	14.86	1
RobinsonUpper	Upper	1800	Regional(Cloca)	8.06	115.2	116.07	116.07	116.32	0.013932	2.57	4.21	9.57	0.99
RobinsonUpper	Upper	1700	100yr(Cloca)	32.59	112.31	112.88	112.88	113.12	0.028137	3.13	15.7	34	1.36
RobinsonUpper	Upper	1700	Regional(Cloca)	16.17	112.31	112.7	112.7	112.85	0.031832	2.52	9.63	31.75	1.35
RobinsonUpper	Upper	1478.247	100yr(Cloca)	32.59	107.45	111.88	109.88	111.92	0.000515	1.66	58.08	181.81	0.25
RobinsonUpper	Upper	1478.247	Regional(Cloca)	16.17	107.45	111.64	109.15	111.71	0.000444	1.48	14.84	177.38	0.23
RobinsonUpper	Upper	1466.204		Culvert									
RobinsonUpper	Upper	1454.188	100yr(Cloca)	32.59	106.9	109.55	109.55	110.87	0.00412	3.44	7.62	126.98	0.68
RobinsonUpper	Upper	1454.188	Regional(Cloca)	16.17	106.9	108.58	108.58	109.41	0.005581	2.92	4.63	81.16	0.73

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	1421.456	100yr(Cloca)	32.59	106.75	107.88		107.95	0.005489	1.97	32.87	65.2	0.65
RobinsonUpper	Upper	1421.456	Regional(Cloca)	16.17	106.75	107.63		107.68	0.005948	1.67	18.59	50.02	0.64
RobinsonUpper	Upper	1400	100yr(Cloca)	32.59	106.42	107.53	107.53	107.75	0.014951	3.37	20.06	45.69	1.08
RobinsonUpper	Upper	1400	Regional(Cloca)	16.17	106.42	107.34	107.34	107.5	0.012395	2.67	12.38	36.34	0.95
RobinsonUpper	Upper	1300	100yr(Cloca)	32.59	105.59	106.58		106.62	0.002965	1.47	40.87	66.14	0.48
RobinsonUpper	Upper	1300	Regional(Cloca)	16.17	105.59	106.37		106.39	0.002416	1.12	27.52	59.46	0.42
RobinsonUpper	Upper	1200	100yr(Cloca)	31.8	104.78	105.81	105.81	106.02	0.017667	3.71	19.94	40.97	1.19
RobinsonUpper	Upper	1200	Regional(Cloca)	19.14	104.78	105.67	105.67	105.84	0.016296	3.22	14.45	37.47	1.11
RobinsonUpper	Upper	1100	100yr(Cloca)	31.8	103.75	105.13		105.19	0.003421	1.97	36.95	44.6	0.55
RobinsonUpper	Upper	1100	Regional(Cloca)	19.14	103.75	104.89		104.93	0.0032	1.66	26.73	39.18	0.51
RobinsonUpper	Upper	1000	100yr(Cloca)	31.8	103.04	104.36	104.29	104.59	0.012368	3.63	20.93	31.14	1.03
RobinsonUpper	Upper	1000	Regional(Cloca)	19.14	103.04	104.1	104.09	104.32	0.01433	3.36	13.58	25.81	1.07
RobinsonUpper	Upper	900	100yr(Cloca)	44.23	102.03	103.5		103.63	0.007801	2.23	31.3	32.85	0.76
RobinsonUpper	Upper	900	Regional(Cloca)	26.87	102.03	103.22		103.31	0.007771	1.97	22.43	30.29	0.74
RobinsonUpper	Upper	800	100yr(Cloca)	44.23	100.84	102.26	102.19	102.54	0.015404	4.37	25.16	32.35	1.18
RobinsonUpper	Upper	800	Regional(Cloca)	26.87	100.84	102.02	101.97	102.25	0.015185	3.81	17.5	29.95	1.13
RobinsonUpper	Upper	700	100yr(Cloca)	44.23	99.37	100.63	100.63	100.95	0.016556	4.11	21.55	31.52	1.19
RobinsonUpper	Upper	700	Regional(Cloca)	26.87	99.37	100.43	100.43	100.68	0.016188	3.6	15.38	29	1.14
RobinsonUpper	Upper	600	100yr(Cloca)	44.23	97.64	99.26		99.42	0.006113	2.97	28.18	30.55	0.75
RobinsonUpper	Upper	600	Regional(Cloca)	26.87	97.64	99		99.12	0.005662	2.54	20.45	28.95	0.71
RobinsonUpper	Upper	500	100yr(Cloca)	49.08	96.51	98.32	98.32	98.66	0.009013	3.4	29.68	46.05	0.9
RobinsonUpper	Upper	500	Regional(Cloca)	31.54	96.51	98.08	98.08	98.38	0.008991	3.02	19.96	35.43	0.87
RobinsonUpper	Upper	400	100yr(Cloca)	49.08	94.75	96.32		96.53	0.009561	3.55	31.72	52.21	0.93
RobinsonUpper	Upper	400	Regional(Cloca)	31.54	94.75	96.31		96.4	0.004074	2.31	31.29	51.7	0.61
RobinsonUpper	Upper	300	100yr(Cloca)	49.08	93.81	96.16		96.21	0.001211	1.65	60.73	71.27	0.35

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**Table C3: Hec Ras Output**

Plan: ExReg\_spill (TooleyRobinson.p06) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: ExReg\_flows\_spill (TooleyRobinson.f04)

Description: To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	300	Regional(Cloca)	31.54	93.81	96.27		96.29	0.000372	0.94	68.71	76.07	0.2
RobinsonUpper	Upper	200	100yr(Cloca)	49.08	92.7	96.19		96.19	0.00002	0.26	400.14	235.19	0.05
RobinsonUpper	Upper	200	Regional(Cloca)	31.54	92.7	96.28		96.28	0.000007	0.16	420.95	238.6	0.03
RobinsonUpper	Upper	11.06822	100yr(Cloca)	49.08	91.81	96.19		96.19	0.000001	0.05	1370.59	516.17	0.01
RobinsonUpper	Upper	11.06822	Regional(Cloca)	31.54	91.81	96.28		96.28	0	0.03	1416.11	522.72	0.01
RobinsonLower	Lower	2075.481	100yr(Cloca)	92.18	91.47	96.19		96.19	0.000002	0.11	1268.15	462.73	0.02
RobinsonLower	Lower	2075.481	Regional(Cloca)	54.72	91.47	96.28		96.28	0.000001	0.06	1308.92	466.23	0.01
RobinsonLower	Lower	2000	100yr(Cloca)	92.18	91.13	96.19		96.19	0.000003	0.13	1213.62	433.61	0.02
RobinsonLower	Lower	2000	Regional(Cloca)	54.72	91.13	96.28		96.28	0.000001	0.07	1251.95	437.91	0.01
RobinsonLower	Lower	1900	100yr(Cloca)	92.18	90.68	96.19		96.19	0.000002	0.12	1337.24	415.32	0.02
RobinsonLower	Lower	1900	Regional(Cloca)	54.72	90.68	96.28		96.28	0.000001	0.07	1373.96	418.23	0.01
RobinsonLower	Lower	1800	100yr(Cloca)	92.18	90.11	96.19		96.19	0.000002	0.13	1350.6	406.91	0.02
RobinsonLower	Lower	1800	Regional(Cloca)	54.72	90.11	96.28		96.28	0.000001	0.07	1386.63	409.79	0.01
RobinsonLower	Lower	1700	100yr(Cloca)	92.18	89.93	96.19		96.19	0.000002	0.12	1444.01	419.03	0.02
RobinsonLower	Lower	1700	Regional(Cloca)	54.72	89.93	96.28		96.28	0.000001	0.07	1481.17	422.51	0.01
RobinsonLower	Lower	1600	100yr(Cloca)	89.88	89.14	96.19		96.19	0.000001	0.11	1460.31	444.19	0.01
RobinsonLower	Lower	1600	Regional(Cloca)	61.05	89.14	96.28		96.28	0.000001	0.08	1499.75	448.08	0.01
RobinsonLower	Lower	1500	100yr(Cloca)	89.88	89.05	96.19		96.19	0.000001	0.11	1487.79	437.91	0.01
RobinsonLower	Lower	1500	Regional(Cloca)	61.05	89.05	96.28		96.28	0.000001	0.07	1526.65	440.67	0.01
RobinsonLower	Lower	1408.42	100yr(Cloca)	89.88	89.04	96.19		96.19	0.000003	0.18	1047.52	396.63	0.02
RobinsonLower	Lower	1408.42	Regional(Cloca)	61.05	89.04	96.28		96.28	0.000001	0.12	1083.12	405.54	0.01
RobinsonLower	Lower	1389.432	100yr(Cloca)	89.88	89.23	96.08		96.18	0.000299	1.75	66.8	362.11	0.21
RobinsonLower	Lower	1389.432	Regional(Cloca)	61.05	89.23	96.23		96.27	0.000128	1.16	68.29	370.29	0.14
RobinsonLower	Lower	1370.068		Culvert									
RobinsonLower	Lower	1349.056	100yr(Cloca)	89.88	88.42	95.51	91.54	95.88	0.001555	4.03	127	344.03	0.49

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**Table C3: Hec Ras Output**

Plan: ExReg\_spill (TooleyRobinson.p06) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: ExReg\_flows\_spill (TooleyRobinson.f04)

Description: To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	1349.056	Regional(Cloca)	61.05	88.42	93.94		94.1	0.000704	2.29	37.38	108.32	0.31
RobinsonLower	Lower	1318.902	100yr(Cloca)	89.88	87.8	95.66		95.66	0.000002	0.17	861.09	336.4	0.02
RobinsonLower	Lower	1318.902	Regional(Cloca)	61.05	87.8	94.05		94.05	0.000004	0.2	451.82	173.06	0.03
RobinsonLower	Lower	1300	100yr(Cloca)	91.04	87.85	95.66		95.66	0.000003	0.19	794.46	310.7	0.02
RobinsonLower	Lower	1300	Regional(Cloca)	63.01	87.85	94.05		94.05	0.000006	0.23	418.52	153.12	0.03
RobinsonLower	Lower	1225.673	100yr(Cloca)	91.04	86.9	95.66		95.66	0.000006	0.29	604.91	296.11	0.03
RobinsonLower	Lower	1225.673	Regional(Cloca)	63.01	86.9	94.05		94.05	0.000009	0.32	279.52	83.83	0.04
RobinsonLower	Lower	1208.394	100yr(Cloca)	91.04	86.55	95.65	90.33	95.66	0.000044	0.81	368.89	288.01	0.09
RobinsonLower	Lower	1208.394	Regional(Cloca)	63.01	86.55	93.85	89.62	94.03	0.000368	2	34.12	75.03	0.24
RobinsonLower	Lower	1186.848		Culvert									
RobinsonLower	Lower	1174.573	100yr(Cloca)	91.04	86.36	95.63		95.63	0.000012	0.44	645.2	305.02	0.05
RobinsonLower	Lower	1174.573	Regional(Cloca)	63.01	86.36	92.26		92.45	0.000811	2.66	75.08	76.24	0.35
RobinsonLower	Lower	1170		Lat Struct									
RobinsonLower	Lower	1146.689	100yr(Cloca)	81.52	85.94	95.63		95.63	0.000001	0.12	1207.71	373.71	0.01
RobinsonLower	Lower	1146.689	Regional(Cloca)	63.01	85.94	92.39		92.39	0.000003	0.17	452.4	124.06	0.02
RobinsonLower	Lower	1076.022	100yr(Cloca)	77.61	85.39	95.63		95.63	0.000001	0.14	1140.77	432.26	0.02
RobinsonLower	Lower	1076.022	Regional(Cloca)	63.75	85.39	92.39		92.39	0.000004	0.23	371.96	115.84	0.03
RobinsonLower	Lower	1050.327	100yr(Cloca)	76.2	84.97	95.58	87.24	95.63	0.000035	0.94	80.78	407.99	0.09
RobinsonLower	Lower	1050.327	Regional(Cloca)	63.75	84.97	92.32	86.99	92.39	0.000085	1.15	55.67	109.75	0.14
RobinsonLower	Lower	994.6486		Culvert									
RobinsonLower	Lower	928.2293	100yr(Cloca)	76.2	82.86	92.66		92.68	0.000055	0.94	292.92	237.38	0.1
RobinsonLower	Lower	928.2293	Regional(Cloca)	63.75	82.86	90.31		90.44	0.000294	1.81	44.27	92.1	0.21
RobinsonLower	Lower	918.8482	100yr(Cloca)	76.2	82.75	92.65	85.36	92.68	0.000068	0.92	96.82	124.91	0.09
RobinsonLower	Lower	918.8482	Regional(Cloca)	63.75	82.75	90.37	85.16	90.41	0.000123	1.04	72.76	100.96	0.12

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**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	899.0165		Culvert									
RobinsonLower	Lower	876.9869	100yr(Cloca)	76.78	82.53	86.33		86.73	0.001966	3.04	27.64	34.03	0.5
RobinsonLower	Lower	876.9869	Regional(Cloca)	64.58	82.53	85.13		85.83	0.006024	4.11	17.72	32.97	0.82
RobinsonLower	Lower	834.4676	100yr(Cloca)	76.78	82.37	86.6		86.61	0.000047	0.5	177.84	55.8	0.08
RobinsonLower	Lower	834.4676	Regional(Cloca)	64.58	82.37	85.59		85.61	0.000094	0.59	124.84	50.04	0.11
RobinsonLower	Lower	823.6441	100yr(Cloca)	76.78	82.29	86.6		86.6	0.000035	0.44	200.75	59.8	0.07
RobinsonLower	Lower	823.6441	Regional(Cloca)	64.58	82.29	85.6		85.61	0.000066	0.5	143.88	54.02	0.09
RobinsonLower	Lower	800.6076	100yr(Cloca)	76.78	80.77	86.44	83.42	86.59	0.000438	1.89	45.24	48.52	0.25
RobinsonLower	Lower	800.6076	Regional(Cloca)	64.58	80.77	85.42	83.21	85.59	0.000658	2.03	36.06	43.4	0.3
RobinsonLower	Lower	787.4796		Mult Open									
RobinsonLower	Lower	772.9675	100yr(Cloca)	92.05	80.04	82.96	82.96	83.65	0.010907	6.03	36.81	58.83	1.13
RobinsonLower	Lower	772.9675	Regional(Cloca)	64.58	80.04	82.68	82.68	83.22	0.009245	5.19	30.76	58.3	1.03
RobinsonLower	Lower	728.9347	100yr(Cloca)	92.05	80.86	82.89		83	0.003073	2.47	83.68	65.04	0.56
RobinsonLower	Lower	728.9347	Regional(Cloca)	64.58	80.86	82.63		82.72	0.002964	2.2	66.73	63.63	0.54
RobinsonLower	Lower	700	100yr(Cloca)	92.05	80.76	82.38	82.38	82.81	0.013136	4.34	45.31	47.07	1.11
RobinsonLower	Lower	700	Regional(Cloca)	64.58	80.76	82.18	82.18	82.54	0.012369	3.85	36.12	45.89	1.05
RobinsonLower	Lower	600	100yr(Cloca)	92.05	79.1	82.36		82.43	0.001062	1.47	90.66	42.33	0.33
RobinsonLower	Lower	600	Regional(Cloca)	64.58	79.1	80.76	80.76	81.16	0.013001	3.54	29.82	33.34	1.04
RobinsonLower	Lower	500	100yr(Cloca)	91.2	77.13	82.37		82.39	0.000126	0.87	187.86	61.01	0.13
RobinsonLower	Lower	500	Regional(Cloca)	68.31	77.13	80.32		80.4	0.000759	1.45	77.82	46.63	0.29
RobinsonLower	Lower	400	100yr(Cloca)	91.2	76.53	82.38		82.38	0.000027	0.45	400.33	143.17	0.06
RobinsonLower	Lower	400	Regional(Cloca)	68.31	76.53	80.34		80.35	0.000153	0.77	173.22	84.05	0.13
RobinsonLower	Lower	349.8643	100yr(Cloca)	91.2	76.3	82.38		82.38	0.000004	0.19	878.9	288.41	0.03
RobinsonLower	Lower	349.8643	Regional(Cloca)	68.31	76.3	80.34		80.34	0.000028	0.36	372	195.77	0.06
RobinsonLower	Lower	310.5079	100yr(Cloca)	91.2	75.81	77.56	77.56	81.94	0.069867	10.76	10	69.09	2.62



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**Date:** Jun-23

**Table C3: Hec Ras Output**

**Plan:** ExReg\_spill (TooleyRobinson.p06) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** ExReg\_flows\_spill (TooleyRobinson.f04)

**Description:** To determine spill flow rates under current Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	310.5079	Regional(Cloca)	68.31	75.81	77.54	77.54	80.09	0.041444	8.22	9.83	68.63	2.02
RobinsonLower	Lower	302.0028		Culvert									
RobinsonLower	Lower	289.6513	100yr(Cloca)	91.2	75.83	77.9	77.9	78.13	0.007696	4.03	49.75	95.13	0.9
RobinsonLower	Lower	289.6513	Regional(Cloca)	68.31	75.83	77.81	77.81	78.01	0.007711	3.91	40.84	92.13	0.89
RobinsonLower	Lower	254.9745	100yr(Cloca)	91.2	75.46	77.22		77.31	0.003277	2.29	101.11	119.94	0.56
RobinsonLower	Lower	254.9745	Regional(Cloca)	68.31	75.46	77.08		77.15	0.002995	2.07	84.8	113.76	0.53
RobinsonLower	Lower	200	100yr(Cloca)	91.2	75.28	76.78	76.78	77	0.009967	3.34	73.27	143.63	0.93
RobinsonLower	Lower	200	Regional(Cloca)	68.31	75.28	76.71	76.71	76.89	0.008099	2.9	63.63	139.41	0.83

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	TribW1	300	100yr	0	94.5	94.61		94.61	0	0	0.34	4.76	0
Tooley_West	TribW1	300	Regional	0	94.5	94.51	94.51	94.51	0.00233	0.07	0.01	1.5	0.24
Tooley_West	TribW1	200	100yr	3.38	93.93	94.61		94.61	0.00008	0.22	24.51	65.9	0.09
Tooley_West	TribW1	200	Regional	0	93.93	94.45		94.45	0	0	15.52	50.08	0
Tooley_West	TribW1	100	100yr	3.38	93.63	94.6		94.61	0.000018	0.13	39.95	77.51	0.04
Tooley_West	TribW1	100	Regional	0	93.63	94.45		94.45	0	0	28.24	72.48	0
Tooley_West	TribW1	50	100yr	3.38	93.47	94.6		94.6	0.000068	0.28	16.79	29.87	0.09
Tooley_West	TribW1	50	Regional	0	93.47	94.45		94.45	0	0	12.95	23.41	0
Tooley_West	TribW2	3000	100yr	0	93.92	94.6		94.6	0	0	3.72	9.26	0
Tooley_West	TribW2	3000	Regional	0	93.92	94.45		94.45	0	0	2.44	7.79	0
Tooley_West	TribW2	2000	100yr	0.32	92.82	94.6	92.94	94.6	0	0.02	24	28.24	0
Tooley_West	TribW2	2000	Regional	0.13	92.82	94.45	92.9	94.45	0	0.01	20.05	24.07	0
Tooley_West	TribW2	1000	100yr	0.32	91.65	94.6		94.6	0	0.01	60.39	50.34	0
Tooley_West	TribW2	1000	Regional	0.13	91.65	94.45		94.45	0	0	53.81	37.77	0
Tooley_West	Downstream	1046	100yr	35.94	91.07	94.6	93.44	94.6	0.000003	0.11	635.67	331.84	0.02
Tooley_West	Downstream	1046	Regional	15.03	91.07	94.45	92.42	94.45	0.000001	0.05	586.25	322.69	0.01
Tooley_West	Downstream	1021.5		Culvert									
Tooley_West	Downstream	997	100yr	35.94	90.96	92.85	92.85	92.86	0.000349	0.71	143.71	347.87	0.2
Tooley_West	Downstream	997	Regional	15.03	90.96	92.39	92.39	93.04	0.008527	3.57	4.21	161.06	1
Tooley_West	Downstream	962	100yr	35.94	91.6	92.03	92.03	92.04	0.000951	0.51	92.17	226.66	0.27
Tooley_West	Downstream	962	Regional	15.03	91.6	92.03	92.03	92.03	0.000166	0.21	92.17	226.66	0.11
Tooley_West	Downstream	869	100yr	35.94	90.9	91.75		91.77	0.001061	0.84	80.55	210.89	0.33
Tooley_West	Downstream	869	Regional	15.03	90.9	91.54		91.55	0.000739	0.55	44.93	138.52	0.26
Tooley_West	Downstream	794	100yr	35.94	91.13	91.51	91.51	91.65	0.023694	2.34	24.29	91.02	1.35
Tooley_West	Downstream	794	Regional	15.03	91.13	91.38	91.38	91.46	0.027946	1.75	13.08	78.64	1.33
Tooley_West	Downstream	736	100yr	35.94	90.95	91.56		91.56	0.000132	0.22	210.53	359.6	0.11
Tooley_West	Downstream	736	Regional	15.03	90.95	91.4		91.4	0.000051	0.11	156.74	311.03	0.06

Project: Robinson and Tooley Flood Mitigation Study  
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 Date: Jun-23

**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	Downstream	720	100yr	35.94	88.89	91.55	90.96	91.56	0.000091	0.44	220.53	376.64	0.11
Tooley_West	Downstream	720	Regional	15.03	88.89	91.4	90.34	91.4	0.000032	0.24	163.55	323.77	0.06
Tooley_West	Downstream	704		Culvert									
Tooley_West	Downstream	700	100yr	35.94	88.44	90.66	90.66	90.69	0.001489	1.31	71.46	177.4	0.37
Tooley_West	Downstream	700	Regional	15.03	88.44	90.13	90.13	90.78	0.011529	3.57	4.21	41.34	1
Tooley_West	Downstream	688	100yr	35.94	88.97	90.01	89.73	90.07	0.001708	1.18	46.69	158.61	0.42
Tooley_West	Downstream	688	Regional	15.03	88.97	89.7		89.75	0.001966	0.92	18.14	55.89	0.42
Tooley_West	Downstream	668	100yr	42.96	88.92	89.66	89.66	89.92	0.010049	2.4	23.09	65.73	0.98
Tooley_West	Downstream	668	Regional	18.27	88.92	89.42	89.42	89.59	0.011124	1.82	10.96	39.35	0.95
Tooley_West	Downstream	600	100yr	42.96	88.87	89.56		89.58	0.000899	0.74	87.15	181.8	0.3
Tooley_West	Downstream	600	Regional	18.27	88.87	89.3		89.32	0.001169	0.6	43.25	153.22	0.31
Tooley_West	Downstream	500	100yr	42.96	88.49	89.28	89.25	89.42	0.005692	2.01	38.38	115.71	0.76
Tooley_West	Downstream	500	Regional	18.27	88.49	89.08		89.15	0.004055	1.36	19.82	62.02	0.61
Tooley_West	Downstream	400	100yr	42.96	87.99	88.84		88.95	0.004459	1.77	39.7	97.46	0.67
Tooley_West	Downstream	400	Regional	18.27	87.99	88.54	88.51	88.65	0.007383	1.59	16.04	63.93	0.79
Tooley_West	Downstream	300	100yr	39.55	86.82	88.05	88.05	88.5	0.007903	3.18	17.17	28.24	0.96
Tooley_West	Downstream	300	Regional	21.59	86.82	87.72	87.72	88.05	0.008525	2.62	9.94	18.14	0.94
Tooley_West	Downstream	200	100yr	39.55	84.99	86.34	86.34	86.66	0.006994	2.76	20.74	36.55	0.88
Tooley_West	Downstream	200	Regional	21.59	84.99	86.09	86.09	86.33	0.00707	2.28	12.28	30.92	0.84
Tooley_West	Downstream	100	100yr	39.55	82.81	83.8	83.8	84.08	0.007861	2.43	19.96	43.89	0.9
Tooley_West	Downstream	100	Regional	21.59	82.81	83.55	83.55	83.78	0.010114	2.11	10.88	29.66	0.95
Tooley_Upper	Upper	4800	100yr	15.6	128.54	129.07		129.17	0.021022	1.26	11.89	45.87	0.55
Tooley_Upper	Upper	4800	Regional	16.07	128.54	129.09		129.18	0.018032	1.19	12.84	47.99	0.52
Tooley_Upper	Upper	4700	100yr	15.6	127.91	128.89	128.4	128.9	0.000863	0.55	36.09	66.59	0.18
Tooley_Upper	Upper	4700	Regional	16.07	127.91	128.85	128.41	128.86	0.00114	0.61	33.44	64.09	0.2
Tooley_Upper	Upper	4600	100yr	29.56	127.55	128.5	128.34	128.58	0.011545	2.05	23.42	57.78	0.68

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	4600	Regional	24.82	127.55	128.45	128.29	128.53	0.01138	1.97	20.72	52.17	0.67
Tooley_Upper	Upper	4500.017	100yr	29.56	126.74	127.17	127.17	127.29	0.014454	1.92	20.03	90.43	0.95
Tooley_Upper	Upper	4500.017	Regional	24.82	126.74	127.14	127.14	127.25	0.014608	1.84	17.41	87.45	0.94
Tooley_Upper	Upper	4400	100yr	29.56	125.07	126.18	126.04	126.31	0.005409	2.23	19.2	33.48	0.68
Tooley_Upper	Upper	4400	Regional	24.82	125.07	126.1	125.97	126.22	0.00584	2.2	16.59	32.12	0.7
Tooley_Upper	Upper	4300	100yr	29.56	124.45	125.28		125.45	0.015143	2.17	16.53	26.99	0.76
Tooley_Upper	Upper	4300	Regional	24.82	124.45	125.24		125.37	0.013272	1.96	15.36	26.42	0.71
Tooley_Upper	Upper	4200	100yr	26.93	122.69	123.88	123.74	124.06	0.012796	1.67	17.92	29.34	0.49
Tooley_Upper	Upper	4200	Regional	27.62	122.69	123.88	123.75	124.07	0.012859	1.68	18.21	29.52	0.5
Tooley_Upper	Upper	4100	100yr	26.93	120.54	121.32	121.32	121.54	0.069349	2.94	13.15	29.9	1.07
Tooley_Upper	Upper	4100	Regional	27.62	120.54	121.33	121.33	121.55	0.069171	2.96	13.39	30.08	1.07
Tooley_Upper	Upper	4000	100yr	26.93	118.77	120.43		120.45	0.000885	1.17	48.01	43.6	0.29
Tooley_Upper	Upper	4000	Regional	27.62	118.77	120.46		120.48	0.000876	1.18	49.03	44	0.29
Tooley_Upper	Upper	3900	100yr	26.93	117.88	120.43		120.44	0.000041	0.39	98.54	62.41	0.08
Tooley_Upper	Upper	3900	Regional	27.62	117.88	120.46		120.46	0.000042	0.39	99.99	62.85	0.08
Tooley_Upper	Upper	3896.167	100yr	26.93	117.81	120.43		120.44	0.000032	0.33	105.93	67.69	0.07
Tooley_Upper	Upper	3896.167	Regional	27.62	117.81	120.46		120.46	0.000032	0.34	107.51	68.25	0.07
Tooley_Upper	Upper	3884	100yr	26.93	116.59	120.43	118.13	120.44	0.00004	0.35	111.83	81.64	0.07
Tooley_Upper	Upper	3884	Regional	27.62	116.59	120.46	118.19	120.46	0.000041	0.36	113.73	82.04	0.07
Tooley_Upper	Upper	3875.491		Culvert									
Tooley_Upper	Upper	3866	100yr	26.93	116.8	118.41	118.41	119.13	0.012195	3.76	7.16	5.26	1
Tooley_Upper	Upper	3866	Regional	27.62	116.8	118.45	118.45	119.17	0.012121	3.76	7.35	5.5	1
Tooley_Upper	Upper	3840.997	100yr	26.93	117.15	118.38		118.46	0.001517	1.39	27.34	35.86	0.42
Tooley_Upper	Upper	3840.997	Regional	27.62	117.15	118.4		118.48	0.001506	1.4	27.93	36.12	0.42
Tooley_Upper	Upper	3800	100yr	26.93	116.94	118.04	118.02	118.32	0.006403	2.71	15.6	28.61	0.85
Tooley_Upper	Upper	3800	Regional	27.62	116.94	118.04	118.04	118.34	0.006709	2.77	15.63	28.63	0.87
Tooley_Upper	Upper	3700	100yr	39.02	115.99	117.46		117.66	0.006391	2.83	21.34	31.73	0.76

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	3700	Regional	38.29	115.99	117.45		117.65	0.006393	2.81	21.03	31.48	0.76
Tooley_Upper	Upper	3600	100yr	39.02	115.2	116.48	116.48	116.78	0.01265	3.72	16.89	28.51	1.06
Tooley_Upper	Upper	3600	Regional	38.29	115.2	116.47	116.47	116.77	0.012673	3.7	16.63	28.27	1.06
Tooley_Upper	Upper	3500	100yr	39.02	114.05	114.92	114.92	115.19	0.014499	3.11	17.11	31.95	1.07
Tooley_Upper	Upper	3500	Regional	38.29	114.05	114.92	114.92	115.18	0.014562	3.1	16.85	31.76	1.07
Tooley_Upper	Upper	3400	100yr	39.02	112.84	114.15		114.29	0.005129	2.44	24.49	36.14	0.68
Tooley_Upper	Upper	3400	Regional	38.29	112.84	114.13		114.27	0.005344	2.47	23.79	35.68	0.7
Tooley_Upper	Upper	3300	100yr	59.53	112.42	113.49		113.67	0.007101	2.46	32.19	48.57	0.77
Tooley_Upper	Upper	3300	Regional	56.37	112.42	113.46		113.63	0.007243	2.44	30.79	47.91	0.78
Tooley_Upper	Upper	3200	100yr	59.53	111.71	112.63		112.87	0.008922	2.53	28.13	42.05	0.85
Tooley_Upper	Upper	3200	Regional	56.37	111.71	112.61		112.84	0.008729	2.47	27.28	41.62	0.84
Tooley_Upper	Upper	3100	100yr	59.53	110.6	111.54	111.53	111.82	0.012438	3.05	25.62	41.54	1.01
Tooley_Upper	Upper	3100	Regional	56.37	110.6	111.52	111.5	111.79	0.012759	3.03	24.53	41.26	1.01
Tooley_Upper	Upper	3000	100yr	59.53	109.61	110.43		110.67	0.010468	2.54	27.28	42.23	0.9
Tooley_Upper	Upper	3000	Regional	56.37	109.61	110.41		110.64	0.010196	2.47	26.53	41.92	0.89
Tooley_Upper	Upper	2900	100yr	59.53	108.83	109.89		109.99	0.004239	1.9	42.99	67.2	0.6
Tooley_Upper	Upper	2900	Regional	56.37	108.83	109.86		109.96	0.004338	1.89	41.1	66.32	0.6
Tooley_Upper	Upper	2800	100yr	75.3	107.97	108.91	108.91	109.22	0.014002	3.21	30.75	50.02	1.07
Tooley_Upper	Upper	2800	Regional	70.28	107.97	108.88	108.88	109.18	0.01426	3.16	29.18	49.35	1.07
Tooley_Upper	Upper	2700	100yr	75.3	106.94	107.96	107.8	108.15	0.007133	2.44	38.68	53.49	0.77
Tooley_Upper	Upper	2700	Regional	70.28	106.94	107.93	107.77	108.11	0.00703	2.37	37.05	52.68	0.76
Tooley_Upper	Upper	2593.81	100yr	75.3	106.15	106.81	106.81	107.06	0.015471	2.67	34.02	67.1	1.06
Tooley_Upper	Upper	2593.81	Regional	70.28	106.15	106.78	106.78	107.02	0.015896	2.63	32.14	65.96	1.06
Tooley_Upper	Upper	2500	100yr	75.3	105.13	106.47		106.52	0.002327	1.16	74.33	91.17	0.32
Tooley_Upper	Upper	2500	Regional	70.28	105.13	106.43		106.48	0.002338	1.14	70.95	90.28	0.32
Tooley_Upper	Upper	2400	100yr	75.3	104.67	105.72	105.72	106.03	0.01344	3.38	30.78	50.83	1.06
Tooley_Upper	Upper	2400	Regional	70.28	104.67	105.69	105.69	105.99	0.013513	3.33	29.31	50.28	1.06

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 Date: Jun-23

**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	2300	100yr	75.3	103.65	105.48		105.52	0.000805	1.2	82.65	78.7	0.29
Tooley_Upper	Upper	2300	Regional	70.28	103.65	105.51		105.55	0.000639	1.08	85.32	79.79	0.26
Tooley_Upper	Upper	2200	100yr	75.3	102.99	105.46		105.48	0.000216	0.76	122.94	76.92	0.16
Tooley_Upper	Upper	2200	Regional	70.28	102.99	105.5		105.51	0.000176	0.7	125.84	77.52	0.14
Tooley_Upper	Upper	2100	100yr	63.79	101.75	105.46		105.47	0.000028	0.36	228.58	91.35	0.06
Tooley_Upper	Upper	2100	Regional	70.66	101.75	105.5		105.5	0.000033	0.39	231.78	92	0.07
Tooley_Upper	Upper	2000	100yr	63.79	101.08	105.46	101.82	105.46	0.000006	0.22	455.94	159.57	0.03
Tooley_Upper	Upper	2000	Regional	70.66	101.08	105.5	101.85	105.5	0.000007	0.24	460.75	162.7	0.04
Tooley_Upper	Upper	1900	100yr	63.79	100.1	105.46		105.46	0.000002	0.15	670.64	297.21	0.02
Tooley_Upper	Upper	1900	Regional	70.66	100.1	105.5		105.5	0.000003	0.16	681.13	300.83	0.02
Tooley_Upper	Upper	1818.172	100yr	63.79	98.87	105.46		105.46	0.000002	0.18	880.38	447.75	0.02
Tooley_Upper	Upper	1818.172	Regional	70.66	98.87	105.5		105.5	0.000003	0.19	896.1	448.86	0.02
Tooley_Upper	Upper	1800	100yr	63.79	98.53	105.46		105.46	0.000002	0.15	939.74	388.93	0.02
Tooley_Upper	Upper	1800	Regional	70.66	98.53	105.5		105.5	0.000002	0.16	953.44	393.12	0.02
Tooley_Upper	Upper	1779	100yr	63.79	97.53	105.31	100.15	105.45	0.000168	1.64	38.86	409.9	0.19
Tooley_Upper	Upper	1779	Regional	70.66	97.53	105.5	100.34	105.5	0.000003	0.19	894.53	552.97	0.02
Tooley_Upper	Upper	1764.263		Culvert									
Tooley_Upper	Upper	1748	100yr	63.79	97.53	100.77	100.77	102.03	0.013337	4.98	12.8	48.33	1
Tooley_Upper	Upper	1748	Regional	70.66	97.53	100.94	100.94	102.3	0.013074	5.16	13.69	70.22	1
Tooley_Upper	Upper	1700	100yr	63.79	97.62	98.93		99.09	0.00344	2.26	53.58	95	0.65
Tooley_Upper	Upper	1700	Regional	70.66	97.62	99.1		99.22	0.002332	2.03	71.81	117.47	0.54
Tooley_Upper	Upper	1670.175	100yr	63.79	97.27	98.96		98.99	0.001344	1.73	92.09	106.96	0.43
Tooley_Upper	Upper	1670.175	Regional	70.66	97.27	99.12		99.14	0.001042	1.62	109.85	117.26	0.38
Tooley_Upper	Upper	1600	100yr	63.79	97.02	98.93		98.94	0.000339	0.56	145.64	113.22	0.13
Tooley_Upper	Upper	1600	Regional	70.66	97.02	99.1		99.1	0.000293	0.55	164.38	117.77	0.12
Tooley_Upper	Upper	1500	100yr	84.81	95.92	98.9		98.91	0.000277	0.67	190.93	127.33	0.12
Tooley_Upper	Upper	1500	Regional	87.39	95.92	99.07		99.08	0.000212	0.61	212.72	130.4	0.11

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C4: HEC-RAS Output**

**Plan:** PropReg\_spill (TooleyRobinson.p08) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** PropReg\_flows\_spill (TooleyRobinson.f03)

**Description:** To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	1412.393	100yr	84.81	94.78	98.88		98.89	0.00018	1.1	197.24	102.89	0.18
Tooley_Upper	Upper	1412.393	Regional	87.39	94.78	99.05		99.06	0.000148	1.03	215.19	104.61	0.16
Tooley_Upper	Upper	1400	100yr	84.81	94.56	98.88		98.89	0.00017	0.66	198.99	95.7	0.1
Tooley_Upper	Upper	1400	Regional	87.39	94.56	99.05		99.06	0.000142	0.62	215.69	97.43	0.1
Tooley_Upper	Upper	1376	100yr	84.81	94.05	98.58	96.42	98.86	0.000908	2.34	36.25	83.43	0.36
Tooley_Upper	Upper	1376	Regional	87.39	94.05	98.76	96.47	99.03	0.000842	2.32	37.74	85.41	0.35
Tooley_Upper	Upper	1360.285		Culvert									
Tooley_Upper	Upper	1343.5	100yr	84.81	94.04	96.36	96.36	97.46	0.007881	4.63	18.3	22.6	1
Tooley_Upper	Upper	1343.5	Regional	87.39	94.04	96.4	96.4	97.52	0.007881	4.69	18.64	23.55	1
Tooley_Upper	Upper	1300	100yr	84.81	93.99	96.04		96.12	0.001115	1.63	84.52	72.29	0.39
Tooley_Upper	Upper	1300	Regional	87.39	93.99	95.96		96.07	0.001434	1.79	78.96	71.55	0.44
Tooley_Upper	Upper	1270.062	100yr	84.81	93.91	96.01		96.09	0.001164	1.83	82.04	56.09	0.41
Tooley_Upper	Upper	1270.062	Regional	87.39	93.91	95.92		96.02	0.001465	1.99	77.36	55.29	0.46
Tooley_Upper	Upper	1200	100yr	84.81	93.15	95.99		96.04	0.000357	1.19	103.68	53.64	0.24
Tooley_Upper	Upper	1200	Regional	87.39	93.15	95.9		95.96	0.000432	1.28	98.98	52.91	0.26
Tooley_Upper	Upper	1100	100yr	93.55	92.43	95.99		96.02	0.000116	0.81	162.98	64.47	0.14
Tooley_Upper	Upper	1100	Regional	87.88	92.43	95.91		95.93	0.000112	0.78	157.7	64.01	0.14
Tooley_Upper	Upper	1054	100yr	93.55	91.89	95.99		96.01	0.000083	0.76	180.72	59.16	0.12
Tooley_Upper	Upper	1054	Regional	87.88	91.89	95.91		95.93	0.000079	0.74	175.89	58.76	0.12
Tooley_Upper	Upper	1013	100yr	93.55	91.56	95.99		96.01	0.000055	0.65	208.76	64.43	0.1
Tooley_Upper	Upper	1013	Regional	87.88	91.56	95.91		95.92	0.000052	0.62	203.5	63.92	0.1
Tooley_Upper	Upper	1000	100yr	93.55	90.71	95.99		96	0.000034	0.57	254.85	78.85	0.08
Tooley_Upper	Upper	1000	Regional	87.88	90.71	95.91		95.92	0.000033	0.55	248.39	78.24	0.08
Tooley_Upper	Upper	970.5	100yr	93.55	89.9	96	92.92	96	0.000018	0.47	393.08	131.93	0.06
Tooley_Upper	Upper	970.5	Regional	87.88	89.9	95.91	92.8	95.92	0.000017	0.45	382.31	127.64	0.06
Tooley_Upper	Upper	957.6232		Culvert									
Tooley_Upper	Upper	943.5	100yr	93.55	90.11	95.98	92.93	95.99	0.000014	0.39	528.19	172.36	0.05

Project: **Robinson and Tooley Flood Mitigation Study**  
 Project No.: **10568**  
 Date: **Jun-23**

**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	943.5	Regional	87.88	90.11	95.91	92.93	95.91	0.000013	0.37	514.76	166.86	0.05
Tooley_Upper	Upper	900	100yr	93.55	89.09	95.98		95.99	0.000005	0.26	796.63	275.67	0.03
Tooley_Upper	Upper	900	Regional	87.88	89.09	95.91		95.91	0.000005	0.25	775.06	269.01	0.03
Tooley_Upper	Upper	863	100yr	93.55	88.99	95.98		95.99	0.000002	0.17	1254.1	424.74	0.02
Tooley_Upper	Upper	863	Regional	87.88	88.99	95.91		95.91	0.000002	0.16	1220.79	415.8	0.02
Tooley_Upper	Upper	800	100yr	111.82	88.78	95.98		95.99	0.000002	0.16	1308.41	391.5	0.02
Tooley_Upper	Upper	800	Regional	108.75	88.78	95.91		95.91	0.000002	0.16	1277.55	387.42	0.02
Tooley_Upper	Upper	784	100yr	111.82	87.66	95.98		95.99	0.000001	0.14	1600.61	399.53	0.02
Tooley_Upper	Upper	784	Regional	108.75	87.66	95.91		95.91	0.000001	0.14	1569.04	397.27	0.02
Tooley_Upper	Upper	780		Lat Struct									
Tooley_Upper	Upper	735	100yr	111.82	86.76	95.98	88.98	95.99	0.000001	0.15	1795.78	496.73	0.02
Tooley_Upper	Upper	735	Regional	108.75	86.76	95.91	88.94	95.91	0.000001	0.14	1758.5	494.33	0.02
Tooley_Upper	Upper	724		Bridge									
Tooley_Upper	Upper	713	100yr	111.82	86.15	95.98	88.82	95.98	0.000002	0.16	1538.06	449.26	0.02
Tooley_Upper	Upper	713	Regional	108.75	86.15	95.9	88.79	95.91	0.000002	0.16	1503.01	446.17	0.02
Tooley_Upper	Upper	709	100yr	111.82	86.02	95.98		95.98	0.000002	0.19	1376.39	519.11	0.02
Tooley_Upper	Upper	709	Regional	108.75	86.02	95.9		95.91	0.000002	0.19	1337.44	463.52	0.02
Tooley_Upper	Upper	705	100yr	111.51	86.66	95.87	89.87	95.98	0.000114	1.48	96.3	581.76	0.16
Tooley_Upper	Upper	705	Regional	108.62	86.66	95.8	89.82	95.9	0.000113	1.46	94.85	516.08	0.16
Tooley_Upper	Upper	641.6027		Mult Open									
Tooley_Upper	Upper	577	100yr	111.51	86.08	91.53	89.11	91.93	0.000791	2.79	39.91	203.87	0.39
Tooley_Upper	Upper	577	Regional	108.62	86.08	91.54	89.06	91.92	0.000746	2.72	39.98	204.18	0.38
Tooley_Upper	Upper	500	100yr	111.83	85.97	91.73		91.73	0.000015	0.4	552.52	176.91	0.06
Tooley_Upper	Upper	500	Regional	108.75	85.97	91.73		91.73	0.000014	0.39	552.32	176.89	0.05
Tooley_Upper	Upper	497	100yr	111.83	85.75	91.73		91.73	0.000005	0.22	917.27	243.59	0.03
Tooley_Upper	Upper	497	Regional	108.75	85.75	91.73		91.73	0.000004	0.22	916.97	243.57	0.03



Project: Robinson and Tooley Flood Mitigation Study  
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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	483	100yr	111.83	85.19	91.73		91.73	0.000002	0.15	1115.46	236.97	0.02
Tooley_Upper	Upper	483	Regional	108.75	85.19	91.73		91.73	0.000002	0.14	1115.17	236.96	0.02
Tooley_Upper	Upper	451	100yr	111.83	84.5	91.73		91.73	0.000001	0.14	1661.55	506.71	0.02
Tooley_Upper	Upper	451	Regional	108.75	84.5	91.73		91.73	0.000001	0.14	1660.93	506.52	0.02
Tooley_Upper	Upper	438	100yr	111.83	83.91	91.73	86.7	91.73	0.000001	0.12	2319.22	601.07	0.01
Tooley_Upper	Upper	438	Regional	108.75	83.91	91.73	86.65	91.73	0.000001	0.11	2318.48	600.89	0.01
Tooley_Upper	Upper	424		Culvert									
Tooley_Upper	Upper	410	100yr	111.83	83.75	91.73	86.53	91.73	0.000001	0.1	2424.25	575.96	0.01
Tooley_Upper	Upper	410	Regional	108.75	83.75	91.73	86.48	91.73	0	0.09	2424.23	575.96	0.01
Tooley_Upper	Upper	400	100yr	118.47	83.54	91.73		91.73	0.000001	0.11	2483.04	605.28	0.01
Tooley_Upper	Upper	400	Regional	117.34	83.54	91.73		91.73	0.000001	0.11	2483	605.27	0.01
Tooley_Upper	Upper	300	100yr	118.47	82.97	91.73		91.73	0.000001	0.1	2842.62	624.41	0.01
Tooley_Upper	Upper	300	Regional	117.34	82.97	91.73		91.73	0	0.09	2842.59	624.41	0.01
Tooley_Upper	Upper	255	100yr	118.47	82.91	91.73		91.73	0	0.08	3119.24	659.18	0.01
Tooley_Upper	Upper	255	Regional	117.34	82.91	91.73		91.73	0	0.08	3119.2	659.17	0.01
Tooley_Upper	Upper	243	100yr	118.47	82.32	91.73	86.59	91.73	0	0.07	3763.75	825.39	0.01
Tooley_Upper	Upper	243	Regional	117.34	82.32	91.73	86.57	91.73	0	0.07	3763.72	825.38	0.01
Tooley_Upper	Upper	227.3807		Mult Open									
Tooley_Upper	Upper	211	100yr	118.47	82.28	86.66	86.66	88.74	0.006676	6.39	18.54	121.55	1
Tooley_Upper	Upper	211	Regional	117.34	82.28	86.64	86.64	88.7	0.006673	6.37	18.43	120.06	1
Tooley_Upper	Upper	200	100yr	114.8	82.22	84.12		84.27	0.006629	2.48	72.46	91.73	0.58
Tooley_Upper	Upper	200	Regional	118.09	82.22	84.13		84.29	0.006746	2.52	73.52	92.41	0.58
Tooley_Upper	Upper	100	100yr	114.8	81.47	83.22	83.22	83.35	0.013559	3.28	79.56	338.16	0.8
Tooley_Upper	Upper	100	Regional	118.09	81.47	83.22	83.22	83.35	0.013483	3.28	82.24	342.19	0.8
Tooley_Lower	Lower	1000	100yr	154.02	80.59	82.56		82.61	0.003129	1.67	164.95	375.78	0.39
Tooley_Lower	Lower	1000	Regional	137.84	80.59	82.51		82.56	0.003218	1.66	145.82	359.48	0.39

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Lower	Lower	900	100yr	154.02	79.76	81.69	81.66	81.98	0.017666	3.96	69.46	103.91	0.93
Tooley_Lower	Lower	900	Regional	137.84	79.76	81.64	81.59	81.91	0.017803	3.9	64.15	99.6	0.92
Tooley_Lower	Lower	800	100yr	154.02	78.95	81.07	80.88	81.14	0.004287	2.11	132.74	236.04	0.47
Tooley_Lower	Lower	800	Regional	137.84	78.95	81.04	80.85	81.1	0.004032	2.02	125.91	234.62	0.45
Tooley_Lower	Lower	700	100yr	154.02	78.33	80.21	80.17	80.42	0.013239	3.29	78.85	174.58	0.79
Tooley_Lower	Lower	700	Regional	137.84	78.33	80.14	80.14	80.37	0.016097	3.52	66.43	145.86	0.87
Tooley_Lower	Lower	600	100yr	154.02	77.54	79.73		79.81	0.003153	1.79	124.88	150.25	0.4
Tooley_Lower	Lower	600	Regional	137.84	77.54	79.74		79.8	0.002452	1.58	126.15	150.74	0.35
Tooley_Lower	Lower	500	100yr	138.16	77.19	79.24		79.38	0.006428	2.32	84.41	113.64	0.54
Tooley_Lower	Lower	500	Regional	146.98	77.19	79.27		79.41	0.006592	2.37	87.16	114.4	0.55
Tooley_Lower	Lower	400	100yr	138.16	76.08	78.25	78.24	78.49	0.012783	3.73	68.73	127.6	0.82
Tooley_Lower	Lower	400	Regional	146.98	76.08	78.28	78.26	78.52	0.012447	3.72	72.95	129.17	0.81
Tooley_Lower	Lower	300	100yr	138.16	75.58	77.75		77.82	0.00365	1.98	124.86	143.87	0.43
Tooley_Lower	Lower	300	Regional	146.98	75.58	77.79		77.86	0.00362	2	130.53	145.56	0.43
Tooley_Lower	Lower	200	100yr	138.16	75.1	77.36		77.44	0.003784	2.12	115.9	125.95	0.45
Tooley_Lower	Lower	200	Regional	146.98	75.1	77.4		77.48	0.00379	2.15	120.93	127.9	0.45
Tooley_Lower	Lower	100	100yr	138.16	75.1	77.05	76.35	77.11	0.002786	1.65	123.73	118.87	0.38
Tooley_Lower	Lower	100	Regional	146.98	75.1	77.08	76.38	77.15	0.002886	1.69	127.55	120.31	0.38
Tooley_Lower	Lower	8.907429	100yr	138.16	75.1	76.32	76.32	76.51	0.018452	5.18	83.78	186.26	1.5
Tooley_Lower	Lower	8.907429	Regional	146.98	75.1	76.33	76.33	76.54	0.019219	5.32	86.02	186.63	1.53
RobinsonWest	West	486.4874	100yr	34.14	96.16	97.68	97.68	97.88	0.00743	2.93	24.49	60.75	0.8
RobinsonWest	West	486.4874	Regional	18.18	96.16	97.45	97.45	97.64	0.00715	2.54	13.74	35.29	0.77
RobinsonWest	West	400	100yr	34.14	95.2	96.85	96.85	97	0.005676	2.36	32.19	92.79	0.69
RobinsonWest	West	400	Regional	18.18	95.2	96.68	96.68	96.83	0.004935	2	18.34	76.12	0.63
RobinsonWest	West	300	100yr	46.68	94.02	96.14		96.18	0.0011	1.4	71.42	88.74	0.33
RobinsonWest	West	300	Regional	23.33	94.02	95.78		95.81	0.001125	1.23	41.79	73.91	0.32
RobinsonWest	West	193.175	100yr	46.68	93.64	96.12		96.13	0.000211	0.71	140.76	159.24	0.15

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C4: HEC-RAS Output**

**Plan:** PropReg\_spill (TooleyRobinson.p08) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** PropReg\_flows\_spill (TooleyRobinson.f03)

**Description:** To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonWest	West	193.175	Regional	23.33	93.64	95.75		95.76	0.000193	0.61	87.96	129.7	0.14
RobinsonWest	West	176.2835	100yr	46.68	92.92	96.11	94.49	96.12	0.00036	1.07	136.96	173.73	0.2
RobinsonWest	West	176.2835	Regional	23.33	92.92	95.74	94.15	95.75	0.000346	0.96	80.69	135.01	0.19
RobinsonWest	West	165.6963		Mult Open									
RobinsonWest	West	154.4447	100yr	46.68	92.88	96.1		96.1	0.000017	0.23	149.49	173.49	0.04
RobinsonWest	West	154.4447	Regional	23.33	92.88	94.93		95.02	0.001043	1.3	17.54	45.34	0.31
RobinsonWest	West	122.0857	100yr	46.68	93.03	96.1		96.1	0.000144	0.63	205.21	190.25	0.12
RobinsonWest	West	122.0857	Regional	23.33	93.03	94.93		94.97	0.001034	1.15	46.03	91.7	0.3
RobinsonWest	West	7.527757	100yr	46.68	91.63	96.1		96.1	0.000003	0.13	581.45	311.77	0.02
RobinsonWest	West	7.527757	Regional	23.33	91.63	94.95		94.96	0.000004	0.12	301.07	177.98	0.02
RobinsonUpper	Upper	3542.466	100yr	2.02	132.1	133.2	132.61	133.2	0.00016	0.37	18.98	71.95	0.11
RobinsonUpper	Upper	3542.466	Regional	0.86	132.1	132.9	132.45	132.9	0.000278	0.39	6.4	25.68	0.14
RobinsonUpper	Upper	3494.811	100yr	2.02	131.88	133.19	132.39	133.2	0.000096	0.32	18.22	36.57	0.09
RobinsonUpper	Upper	3494.811	Regional	0.86	131.88	132.89	132.22	132.9	0.000075	0.24	9.71	21.87	0.08
RobinsonUpper	Upper	3484.383	100yr	2.02	132.03	133.18	132.42	133.19	0.000239	0.46	7.97	30.26	0.14
RobinsonUpper	Upper	3484.383	Regional	0.86	132.03	132.89	132.27	132.89	0.000112	0.26	4.39	19.25	0.09
RobinsonUpper	Upper	3469.744		Mult Open									
RobinsonUpper	Upper	3454.014	100yr	2.02	132.13	132.81		132.84	0.001601	0.81	3.02	12.91	0.33
RobinsonUpper	Upper	3454.014	Regional	0.86	132.13	132.43		132.49	0.009962	1.02	0.88	6.52	0.7
RobinsonUpper	Upper	3430.442	100yr	2.02	131.86	132.81	132.32	132.82	0.000331	0.48	13.92	47.17	0.16
RobinsonUpper	Upper	3430.442	Regional	0.86	131.86	132.36	132.19	132.38	0.002089	0.76	2.55	11.95	0.36
RobinsonUpper	Upper	3400	100yr	2.02	131.78	132.8		132.81	0.000321	0.49	11.88	35.64	0.16
RobinsonUpper	Upper	3400	Regional	0.86	131.78	132.3		132.32	0.002056	0.75	2.24	9.88	0.36
RobinsonUpper	Upper	3344.928	100yr	2.02	131.6	132.78	132.12	132.79	0.000305	0.51	10.03	38.04	0.16
RobinsonUpper	Upper	3344.928	Regional	0.86	131.6	132.22	131.94	132.23	0.001252	0.64	1.94	6.39	0.28
RobinsonUpper	Upper	3334.47	100yr	2.02	131.49	132.75	132.19	132.78	0.000994	0.92	3.17	8.24	0.28
RobinsonUpper	Upper	3334.47	Regional	0.86	131.49	132.17	131.97	132.21	0.002778	0.93	1.24	4.07	0.41

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C4: HEC-RAS Output**

**Plan:** PropReg\_spill (TooleyRobinson.p08) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** PropReg\_flows\_spill (TooleyRobinson.f03)

**Description:** To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	3316.727		Culvert									
RobinsonUpper	Upper	3298.848	100yr	2.02	131.61	132.01	132.01	132.19	0.016454	1.91	1.06	17.19	0.99
RobinsonUpper	Upper	3298.848	Regional	0.86	131.61	131.87	131.84	131.95	0.014138	1.3	0.66	14.81	0.85
RobinsonUpper	Upper	3274.914	100yr	2.02	131.26	131.83	131.77	131.87	0.003952	1.07	4.86	30.44	0.5
RobinsonUpper	Upper	3274.914	Regional	0.86	131.26	131.67	131.6	131.72	0.006715	1.06	1.39	12.77	0.6
RobinsonUpper	Upper	3200	100yr	7.71	130.86	131.61		131.63	0.002936	1.17	18.74	57.76	0.45
RobinsonUpper	Upper	3200	Regional	1.82	130.86	131.33		131.35	0.004162	0.98	4.69	25.65	0.49
RobinsonUpper	Upper	3100	100yr	7.71	130.61	131.34		131.36	0.002498	1.11	18.22	44.97	0.42
RobinsonUpper	Upper	3100	Regional	1.82	130.61	131.06		131.07	0.001962	0.7	7.13	34.28	0.34
RobinsonUpper	Upper	3000	100yr	7.71	130.32	131.2	130.96	131.21	0.000988	0.77	29.36	81.05	0.27
RobinsonUpper	Upper	3000	Regional	1.82	130.32	130.98	130.78	130.99	0.000464	0.43	13.66	65.08	0.18
RobinsonUpper	Upper	2917.452	100yr	7.71	129.96	131.2	130.58	131.2	0.000041	0.2	138.35	305.13	0.06
RobinsonUpper	Upper	2917.452	Regional	1.82	129.96	130.98	130.38	130.98	0.00001	0.09	77.97	254.1	0.03
RobinsonUpper	Upper	2906.009	100yr	7.71	129.59	131.1	131.1	131.19	0.004301	1.62	15.61	98.17	0.57
RobinsonUpper	Upper	2906.009	Regional	1.82	129.59	130.95	130.13	130.98	0.001105	0.72	3.23	60.14	0.28
RobinsonUpper	Upper	2894.43		Culvert									
RobinsonUpper	Upper	2882.851	100yr	7.71	129.58	130.62	130.62	130.76	0.012673	1.97	7.15	24.19	0.91
RobinsonUpper	Upper	2882.851	Regional	1.82	129.58	130.4	130.06	130.46	0.009297	1.13	2.07	22.9	0.7
RobinsonUpper	Upper	2855.66	100yr	7.71	129.88	130.51	130.39	130.53	0.003468	1.16	19.34	78.23	0.48
RobinsonUpper	Upper	2855.66	Regional	1.82	129.88	130.32	130.24	130.33	0.003391	0.87	6.29	52.03	0.45
RobinsonUpper	Upper	2800	100yr	7.71	129.48	130.12	130.12	130.19	0.01278	1.89	12.14	68.93	0.89
RobinsonUpper	Upper	2800	Regional	1.82	129.48	129.98	129.98	130.03	0.009341	1.32	3.46	35.88	0.72
RobinsonUpper	Upper	2700	100yr	7.71	128.15	128.73	128.73	128.86	0.012235	2.07	4.98	18.48	0.89
RobinsonUpper	Upper	2700	Regional	1.82	128.15	128.55	128.55	128.62	0.011135	1.5	1.8	13.2	0.8
RobinsonUpper	Upper	2600	100yr	8.01	126.86	127.71		127.79	0.005032	1.66	6.57	19.01	0.61
RobinsonUpper	Upper	2600	Regional	2.66	126.86	127.46	127.46	127.54	0.00704	1.51	2.5	13.18	0.67

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	2539.354	100yr	8.01	126.65	127.5		127.56	0.002884	1.3	7.49	17.05	0.46
RobinsonUpper	Upper	2539.354	Regional	2.66	126.65	127.22		127.26	0.00297	0.99	3.45	12.96	0.44
RobinsonUpper	Upper	2529.293	100yr	8.01	126.55	127.5		127.53	0.001323	0.95	10.02	19.02	0.32
RobinsonUpper	Upper	2529.293	Regional	2.66	126.55	127.22		127.23	0.001105	0.68	5.09	16.27	0.27
RobinsonUpper	Upper	2519.291	100yr	8.01	126.75	127.46		127.51	0.002487	1.1	8.04	18.02	0.42
RobinsonUpper	Upper	2519.291	Regional	2.66	126.75	127.18		127.21	0.003595	0.94	3.5	14.77	0.47
RobinsonUpper	Upper	2499.168	100yr	8.01	126.44	127.32		127.43	0.006937	2.05	6.82	14.97	0.72
RobinsonUpper	Upper	2499.168	Regional	2.66	126.44	127.04		127.11	0.007043	1.56	3	11.9	0.68
RobinsonUpper	Upper	2400	100yr	8.01	126.24	126.84		126.87	0.004254	1.27	9.73	19.01	0.54
RobinsonUpper	Upper	2400	Regional	2.66	126.24	126.57		126.58	0.003948	0.81	4.9	16.93	0.46
RobinsonUpper	Upper	2300	100yr	12.48	125.59	126.21	126.13	126.25	0.008187	1.76	14.91	52.59	0.74
RobinsonUpper	Upper	2300	Regional	3.64	125.59	126.05		126.07	0.006097	1.23	7.19	46.25	0.61
RobinsonUpper	Upper	2200	100yr	12.48	124.91	125.58	125.54	125.62	0.004993	1.46	16.62	78.05	0.59
RobinsonUpper	Upper	2200	Regional	3.64	124.91	125.45	125.45	125.48	0.005775	1.34	6.75	68.92	0.6
RobinsonUpper	Upper	2154.378	100yr	12.48	124.68	125.53		125.54	0.000792	0.69	29.88	81.95	0.24
RobinsonUpper	Upper	2154.378	Regional	3.64	124.68	125.24	125.09	125.27	0.003685	1.11	7.64	67.39	0.49
RobinsonUpper	Upper	2100	100yr	12.48	124.1	125.18	125.18	125.41	0.010057	2.72	7.76	16.53	0.89
RobinsonUpper	Upper	2100	Regional	3.64	124.1	124.75	124.75	124.92	0.012521	2.04	2.49	8.17	0.89
RobinsonUpper	Upper	2000	100yr	18.19	121.93	123	123	123.31	0.015494	3.28	8.68	14.63	1.09
RobinsonUpper	Upper	2000	Regional	8.58	121.93	122.69	122.69	122.91	0.017214	2.65	4.75	11.3	1.08
RobinsonUpper	Upper	1900	100yr	18.19	118.54	119.72	119.72	119.99	0.010944	3.09	9.98	20.81	0.94
RobinsonUpper	Upper	1900	Regional	8.58	118.54	119.39	119.39	119.62	0.013069	2.65	4.95	11.36	0.97
RobinsonUpper	Upper	1800	100yr	18.19	115.2	116.44	116.44	116.78	0.012186	3.21	8.68	14.24	0.99
RobinsonUpper	Upper	1800	Regional	8.58	115.2	116.09	116.09	116.35	0.013754	2.62	4.45	9.88	0.99
RobinsonUpper	Upper	1700	100yr	28.96	112.31	112.85	112.85	113.07	0.028619	3.01	14.47	33.7	1.35
RobinsonUpper	Upper	1700	Regional	16.49	112.31	112.7	112.7	112.86	0.033294	2.58	9.61	31.75	1.38
RobinsonUpper	Upper	1478.247	100yr	28.96	107.45	111.85	109.74	111.89	0.000556	1.72	52.6	181.41	0.26
RobinsonUpper	Upper	1478.247	Regional	16.49	107.45	111.64	109.17	111.71	0.000462	1.51	14.84	177.38	0.24

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	1466.204		Culvert									
RobinsonUpper	Upper	1454.188	100yr	28.96	106.9	109.36	109.36	110.58	0.00431	3.33	7.02	112.86	0.69
RobinsonUpper	Upper	1454.188	Regional	16.49	106.9	108.6	108.6	109.44	0.005525	2.93	4.7	82.93	0.73
RobinsonUpper	Upper	1421.456	100yr	28.96	106.75	107.83		107.9	0.005547	1.91	29.92	62.42	0.65
RobinsonUpper	Upper	1421.456	Regional	16.49	106.75	107.63		107.69	0.005957	1.68	18.86	50.37	0.64
RobinsonUpper	Upper	1400	100yr	28.96	106.42	107.49	107.49	107.7	0.014416	3.23	18.51	43.77	1.06
RobinsonUpper	Upper	1400	Regional	16.49	106.42	107.35	107.35	107.5	0.012353	2.67	12.6	36.66	0.95
RobinsonUpper	Upper	1300	100yr	28.96	105.59	106.53		106.56	0.003039	1.43	37.49	64.51	0.48
RobinsonUpper	Upper	1300	Regional	16.49	105.59	106.37		106.39	0.002447	1.13	27.76	59.59	0.42
RobinsonUpper	Upper	1200	100yr	27.3	104.78	105.76	105.76	105.96	0.017684	3.59	17.96	39.82	1.18
RobinsonUpper	Upper	1200	Regional	19.31	104.78	105.67	105.67	105.84	0.016338	3.23	14.53	37.52	1.12
RobinsonUpper	Upper	1100	100yr	27.3	103.75	105.06		105.11	0.003278	1.86	33.76	42.96	0.53
RobinsonUpper	Upper	1100	Regional	19.31	103.75	104.89		104.93	0.003204	1.67	26.88	39.27	0.51
RobinsonUpper	Upper	1000	100yr	27.3	103.04	104.27	104.22	104.5	0.013048	3.56	18.3	29.5	1.05
RobinsonUpper	Upper	1000	Regional	19.31	103.04	104.11	104.1	104.33	0.014295	3.36	13.68	25.9	1.07
RobinsonUpper	Upper	900	100yr	37.48	102.03	103.4		103.51	0.007802	2.14	27.99	31.88	0.76
RobinsonUpper	Upper	900	Regional	26.73	102.03	103.22		103.31	0.007762	1.97	22.36	30.27	0.74
RobinsonUpper	Upper	800	100yr	37.48	100.84	102.18	102.12	102.43	0.015345	4.17	22.32	31.38	1.16
RobinsonUpper	Upper	800	Regional	26.73	100.84	102.02	101.96	102.24	0.015215	3.81	17.41	29.93	1.13
RobinsonUpper	Upper	700	100yr	37.48	99.37	100.56	100.56	100.85	0.016281	3.92	19.36	30.96	1.17
RobinsonUpper	Upper	700	Regional	26.73	99.37	100.43	100.43	100.67	0.016153	3.59	15.33	28.97	1.14
RobinsonUpper	Upper	600	100yr	37.48	97.64	99.14		99.3	0.006411	2.89	24.71	29.85	0.76
RobinsonUpper	Upper	600	Regional	26.73	97.64	98.99		99.11	0.005756	2.55	20.25	28.91	0.71
RobinsonUpper	Upper	500	100yr	40.27	96.51	98.21	98.21	98.53	0.008829	3.2	25.03	41.77	0.88
RobinsonUpper	Upper	500	Regional	31.02	96.51	98.07	98.07	98.37	0.008972	3	19.69	35.29	0.87
RobinsonUpper	Upper	400	100yr	40.27	94.75	96.2		96.41	0.009949	3.44	26.22	41.79	0.94
RobinsonUpper	Upper	400	Regional	31.02	94.75	96.18		96.31	0.006444	2.73	25.28	39.54	0.75

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**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	300	100yr	40.27	93.81	96.07		96.12	0.001047	1.49	54.74	67.45	0.33
RobinsonUpper	Upper	300	Regional	31.02	93.81	95.35	95.35	95.59	0.007802	3.09	18.15	34.3	0.83
RobinsonUpper	Upper	200	100yr	40.27	92.7	96.1		96.1	0.000016	0.23	378.88	231.58	0.04
RobinsonUpper	Upper	200	Regional	31.02	92.7	94.95		94.96	0.000121	0.46	146.33	170.85	0.11
RobinsonUpper	Upper	11.06822	100yr	40.27	91.81	96.1		96.1	0	0.04	1323.84	509.08	0.01
RobinsonUpper	Upper	11.06822	Regional	31.02	91.81	94.96		94.96	0.000001	0.06	791.21	429.53	0.01
RobinsonLower	Lower	2075.481	100yr	86.94	91.47	96.1		96.1	0.000002	0.11	1226.16	457.71	0.02
RobinsonLower	Lower	2075.481	Regional	53.91	91.47	94.95		94.96	0.000004	0.11	741.32	389.97	0.02
RobinsonLower	Lower	2000	100yr	86.94	91.13	96.1		96.1	0.000003	0.13	1174.28	428.9	0.02
RobinsonLower	Lower	2000	Regional	53.91	91.13	94.95		94.95	0.000006	0.13	713.59	376.3	0.02
RobinsonLower	Lower	1900	100yr	86.94	90.68	96.1		96.1	0.000002	0.12	1299.52	411.84	0.02
RobinsonLower	Lower	1900	Regional	53.91	90.68	94.95		94.95	0.000003	0.12	853.84	366.2	0.02
RobinsonLower	Lower	1800	100yr	86.94	90.11	96.1		96.1	0.000002	0.13	1313.62	403.92	0.02
RobinsonLower	Lower	1800	Regional	53.91	90.11	94.95		94.95	0.000002	0.12	874.35	361.47	0.02
RobinsonLower	Lower	1700	100yr	86.94	89.93	96.1		96.1	0.000002	0.11	1405.95	415.43	0.01
RobinsonLower	Lower	1700	Regional	53.91	89.93	94.95		94.95	0.000002	0.11	952.38	377.88	0.02
RobinsonLower	Lower	1600	100yr	75.46	89.14	96.1		96.1	0.000001	0.1	1420.01	440.18	0.01
RobinsonLower	Lower	1600	Regional	60.09	89.14	94.95		94.95	0.000002	0.13	944.01	392.51	0.02
RobinsonLower	Lower	1500	100yr	75.46	89.05	96.1		96.1	0.000001	0.09	1448.04	434.64	0.01
RobinsonLower	Lower	1500	Regional	60.09	89.05	94.95		94.95	0.000002	0.11	985.97	356.13	0.02
RobinsonLower	Lower	1408.42	100yr	75.46	89.04	96.1		96.1	0.000002	0.15	1011.82	387.96	0.02
RobinsonLower	Lower	1408.42	Regional	60.09	89.04	94.95		94.95	0.000005	0.21	625.07	288.81	0.03
RobinsonLower	Lower	1389.432	100yr	75.46	89.23	96.02		96.09	0.000217	1.48	66.2	358.66	0.18
RobinsonLower	Lower	1389.432	Regional	60.09	89.23	94.88		94.95	0.000257	1.42	54.88	255.4	0.19
RobinsonLower	Lower	1370.068		Culvert									
RobinsonLower	Lower	1349.056	100yr	75.46	88.42	95.34	91.26	96.08	0.002295	4.82	70.2	331.75	0.59
RobinsonLower	Lower	1349.056	Regional	60.09	88.42	93.34		93.53	0.001044	2.58	32.86	82.38	0.37

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 Date: **Jun-23**

**Table C4: HEC-RAS Output**

Plan: PropReg\_spill (TooleyRobinson.p08) Geometry: Tooley\_Robinson\_2023 (TooleyRobinson.g04) Flow: PropReg\_flows\_spill (TooleyRobinson.f03)

Description: To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	1318.902	100yr	75.46	87.8	95.44		95.44	0.000002	0.15	789.46	308.82	0.02
RobinsonLower	Lower	1318.902	Regional	60.09	87.8	93.47		93.47	0.000008	0.25	359.9	145.5	0.03
RobinsonLower	Lower	1300	100yr	76.95	87.85	95.44		95.44	0.000003	0.18	727.64	291.43	0.02
RobinsonLower	Lower	1300	Regional	61.99	87.85	93.47		93.47	0.000009	0.27	338.13	125.43	0.04
RobinsonLower	Lower	1225.673	100yr	76.95	86.9	95.44		95.44	0.000005	0.26	542.01	273.21	0.03
RobinsonLower	Lower	1225.673	Regional	61.99	86.9	93.47		93.47	0.000014	0.36	235.45	68.28	0.05
RobinsonLower	Lower	1208.394	100yr	76.95	86.55	95.43	89.99	95.44	0.00005	0.84	306.1	273.09	0.09
RobinsonLower	Lower	1208.394	Regional	61.99	86.55	93.24	89.6	93.45	0.000486	2.17	31.05	63.86	0.27
RobinsonLower	Lower	1186.848		Culvert									
RobinsonLower	Lower	1174.573	100yr	76.95	86.36	95.37		95.37	0.000012	0.43	566.48	290.99	0.05
RobinsonLower	Lower	1174.573	Regional	61.99	86.36	91.73	89.39	92.44	0.002356	4.25	37.23	66.39	0.59
RobinsonLower	Lower	1170		Lat Struct									
RobinsonLower	Lower	1146.689	100yr	73.73	85.94	95.37		95.37	0.000001	0.11	1111.95	347.9	0.01
RobinsonLower	Lower	1146.689	Regional	61.99	85.94	92.15		92.16	0.000003	0.18	423.89	116.22	0.03
RobinsonLower	Lower	1076.022	100yr	75.3	85.39	95.37		95.37	0.000001	0.15	1030.01	392.3	0.02
RobinsonLower	Lower	1076.022	Regional	62.72	85.39	92.15		92.16	0.000005	0.24	345.08	110.73	0.03
RobinsonLower	Lower	1050.327	100yr	75.27	84.97	95.32	87.22	95.36	0.000037	0.96	78.74	371.89	0.1
RobinsonLower	Lower	1050.327	Regional	62.72	84.97	92.08	86.97	92.15	0.000092	1.17	53.82	102.65	0.14
RobinsonLower	Lower	994.6486		Culvert									
RobinsonLower	Lower	928.2293	100yr	75.27	82.86	92.47		92.5	0.000071	1.06	251.88	197.34	0.11
RobinsonLower	Lower	928.2293	Regional	62.72	82.86	90.14		90.27	0.000309	1.83	43.18	91.25	0.22
RobinsonLower	Lower	918.8482	100yr	75.27	82.75	92.46	85.34	92.49	0.000071	0.93	94.86	120.02	0.1
RobinsonLower	Lower	918.8482	Regional	62.72	82.75	90.2	85.15	90.24	0.000129	1.05	70.96	97.86	0.12
RobinsonLower	Lower	899.0165		Culvert									
RobinsonLower	Lower	876.9869	100yr	75.94	82.53	86.25		86.66	0.002089	3.08	26.96	33.95	0.52
RobinsonLower	Lower	876.9869	Regional	63.52	82.53	84.99	84.84	85.77	0.007211	4.33	16.61	32.85	0.89



**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C4: HEC-RAS Output**

**Plan:** PropReg\_spill (TooleyRobinson.p08) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** PropReg\_flows\_spill (TooleyRobinson.f03)

**Description:** To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	834.4676	100yr	75.94	82.37	86.52		86.53	0.000049	0.5	173.66	55.38	0.08
RobinsonLower	Lower	834.4676	Regional	63.52	82.37	85.51		85.53	0.0001	0.6	120.77	49.57	0.11
RobinsonLower	Lower	823.6441	100yr	75.94	82.29	86.52		86.53	0.000036	0.44	196.26	59.34	0.07
RobinsonLower	Lower	823.6441	Regional	63.52	82.29	85.51		85.53	0.00007	0.51	139.48	53.58	0.09
RobinsonLower	Lower	800.6076	100yr	75.94	80.77	86.36	83.4	86.52	0.000451	1.9	44.55	48.13	0.26
RobinsonLower	Lower	800.6076	Regional	63.52	80.77	85.34	83.19	85.51	0.000682	2.04	35.31	43.04	0.31
RobinsonLower	Lower	787.4796		Mult Open									
RobinsonLower	Lower	772.9675	100yr	79.32	80.04	82.84	82.84	83.46	0.010142	5.65	34.19	58.6	1.09
RobinsonLower	Lower	772.9675	Regional	63.52	80.04	82.67	82.67	83.2	0.009155	5.15	30.52	58.28	1.02
RobinsonLower	Lower	728.9347	100yr	79.32	80.86	82.78		82.88	0.003023	2.35	76.15	64.42	0.55
RobinsonLower	Lower	728.9347	Regional	63.52	80.86	82.62		82.71	0.00296	2.19	66.01	63.57	0.54
RobinsonLower	Lower	700	100yr	79.32	80.76	82.29	82.29	82.69	0.012972	4.14	41.04	46.53	1.09
RobinsonLower	Lower	700	Regional	63.52	80.76	82.18	82.18	82.53	0.012305	3.82	35.76	45.85	1.05
RobinsonLower	Lower	600	100yr	79.32	79.1	81.5		81.64	0.003236	2.16	56.04	37.49	0.55
RobinsonLower	Lower	600	Regional	63.52	79.1	80.75	80.75	81.15	0.012957	3.52	29.5	33.28	1.04
RobinsonLower	Lower	500	100yr	82.42	77.13	81.52		81.55	0.000236	1.04	138.5	54.9	0.17
RobinsonLower	Lower	500	Regional	67.83	77.13	80.29		80.36	0.000794	1.47	76.1	46.37	0.29
RobinsonLower	Lower	400	100yr	82.42	76.53	81.53		81.53	0.000055	0.56	290.55	113.64	0.08
RobinsonLower	Lower	400	Regional	67.83	76.53	80.3		80.32	0.000158	0.78	170.15	83.14	0.14
RobinsonLower	Lower	349.8643	100yr	82.42	76.3	81.53		81.53	0.000008	0.24	647.1	256.75	0.03
RobinsonLower	Lower	349.8643	Regional	67.83	76.3	80.31		80.31	0.000029	0.36	364.84	194.92	0.06
RobinsonLower	Lower	310.5079	100yr	82.42	75.81	77.56	77.56	81.17	0.057958	9.78	9.95	68.96	2.39
RobinsonLower	Lower	310.5079	Regional	67.83	75.81	77.54	77.54	80.05	0.040935	8.17	9.82	68.62	2
RobinsonLower	Lower	302.0028		Culvert									
RobinsonLower	Lower	289.6513	100yr	82.42	75.83	77.87	77.87	78.08	0.007604	3.96	46.64	94.09	0.89
RobinsonLower	Lower	289.6513	Regional	67.83	75.83	77.8	77.8	78.01	0.00773	3.91	40.61	92.05	0.89

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**Table C4: HEC-RAS Output**

**Plan:** PropReg\_spill (TooleyRobinson.p08) **Geometry:** Tooley\_Robinson\_2023 (TooleyRobinson.g04) **Flow:** PropReg\_flows\_spill (TooleyRobinson.f03)

**Description:** To determine spill flow rates uner proposed Regulatory flow rates.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	254.9745	100yr	82.42	75.46	77.18		77.25	0.003157	2.21	95.35	117.74	0.55
RobinsonLower	Lower	254.9745	Regional	67.83	75.46	77.08		77.15	0.002986	2.06	84.46	113.63	0.53
RobinsonLower	Lower	200	100yr	82.42	75.28	76.75	76.75	76.96	0.009472	3.2	69.19	141.42	0.91
RobinsonLower	Lower	200	Regional	67.83	75.28	76.71	76.71	76.89	0.008069	2.89	63.37	139.31	0.83

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**Table C5: Water Surface Elevation Comparison**

**Description:** Comparison of water surface elevations between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_West	TribW1	300	100yr	0	0	94.79	94.61	-0.18
Tooley_West	TribW1	300	Regional	0	0	94.51	94.51	0
Tooley_West	TribW1	200	100yr	15.27	3.38	94.67	94.61	-0.06
Tooley_West	TribW1	200	Regional	0	0	94.44	94.45	0.01
Tooley_West	TribW1	100	100yr	15.27	3.38	94.66	94.6	-0.06
Tooley_West	TribW1	100	Regional	0	0	94.44	94.45	0.01
Tooley_West	TribW1	50	100yr	15.27	3.38	94.48	94.6	0.12
Tooley_West	TribW1	50	Regional	0	0	94.44	94.45	0.01
Tooley_West	TribW2	3000	100yr	0	0	94.54	94.6	0.06
Tooley_West	TribW2	3000	Regional	0	0	94.44	94.45	0.01
Tooley_West	TribW2	2000	100yr	0	0.32	94.54	94.6	0.06
Tooley_West	TribW2	2000	Regional	0	0.13	94.44	94.45	0.01
Tooley_West	TribW2	1000	100yr	0	0.32	94.54	94.6	0.06
Tooley_West	TribW2	1000	Regional	0	0.13	94.44	94.45	0.01
Tooley_West	Downstream	1046	100yr	26.62	35.94	94.54	94.6	0.06
Tooley_West	Downstream	1046	Regional	14.49	15.03	94.44	94.45	0.01
Tooley_West	Downstream	1021.5		Culvert	Culvert			
Tooley_West	Downstream	997	100yr	26.62	35.94	92.85	92.85	0
Tooley_West	Downstream	997	Regional	14.49	15.03	92.36	92.39	0.03
Tooley_West	Downstream	962	100yr	26.62	35.94	92.03	92.03	0
Tooley_West	Downstream	962	Regional	14.49	15.03	92.03	92.03	0
Tooley_West	Downstream	869	100yr	26.62	35.94	91.68	91.75	0.07

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_West	Downstream	869	Regional	14.49	15.03	91.53	91.54	0.01
Tooley_West	Downstream	794	100yr	26.62	35.94	91.46	91.51	0.05
Tooley_West	Downstream	794	Regional	14.49	15.03	91.37	91.38	0.01
Tooley_West	Downstream	736	100yr	26.62	35.94	91.51	91.56	0.05
Tooley_West	Downstream	736	Regional	14.49	15.03	91.39	91.4	0.01
Tooley_West	Downstream	720	100yr	26.62	35.94	91.5	91.55	0.05
Tooley_West	Downstream	720	Regional	14.49	15.03	91.39	91.4	0.01
Tooley_West	Downstream	704		Culvert	Culvert			
Tooley_West	Downstream	700	100yr	26.62	35.94	90.66	90.66	0
Tooley_West	Downstream	700	Regional	14.49	15.03	90.1	90.13	0.03
Tooley_West	Downstream	688	100yr	26.62	35.94	89.85	90.01	0.16
Tooley_West	Downstream	688	Regional	14.49	15.03	89.69	89.7	0.01
Tooley_West	Downstream	668	100yr	29.09	42.96	89.55	89.66	0.11
Tooley_West	Downstream	668	Regional	17.64	18.27	89.42	89.42	0
Tooley_West	Downstream	600	100yr	29.09	42.96	89.44	89.56	0.12
Tooley_West	Downstream	600	Regional	17.64	18.27	89.29	89.3	0.01
Tooley_West	Downstream	500	100yr	29.09	42.96	89.17	89.28	0.11
Tooley_West	Downstream	500	Regional	17.64	18.27	89.07	89.08	0.01
Tooley_West	Downstream	400	100yr	29.09	42.96	88.71	88.84	0.13
Tooley_West	Downstream	400	Regional	17.64	18.27	88.53	88.54	0.01
Tooley_West	Downstream	300	100yr	31.94	39.55	87.92	88.05	0.13
Tooley_West	Downstream	300	Regional	20.8	21.59	87.71	87.72	0.01

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_West	Downstream	200	100yr	31.94	39.55	86.25	86.34	0.09
Tooley_West	Downstream	200	Regional	20.8	21.59	86.08	86.09	0.01
Tooley_West	Downstream	100	100yr	31.94	39.55	83.7	83.8	0.1
Tooley_West	Downstream	100	Regional	20.8	21.59	83.54	83.55	0.01
Tooley_Upper	Upper	4800	100yr	4.24	15.6	128.83	129.07	0.24
Tooley_Upper	Upper	4800	Regional	12.41	16.07	129	129.09	0.09
Tooley_Upper	Upper	4700	100yr	4.24	15.6	128.52	128.89	0.37
Tooley_Upper	Upper	4700	Regional	12.41	16.07	128.78	128.85	0.07
Tooley_Upper	Upper	4600	100yr	9.18	29.56	128.21	128.5	0.29
Tooley_Upper	Upper	4600	Regional	20.48	24.82	128.41	128.45	0.04
Tooley_Upper	Upper	4500.017	100yr	9.18	29.56	127	127.17	0.17
Tooley_Upper	Upper	4500.017	Regional	20.48	24.82	127.11	127.14	0.03
Tooley_Upper	Upper	4400	100yr	9.18	29.56	125.79	126.18	0.39
Tooley_Upper	Upper	4400	Regional	20.48	24.82	126.04	126.1	0.06
Tooley_Upper	Upper	4300	100yr	9.18	29.56	124.91	125.28	0.37
Tooley_Upper	Upper	4300	Regional	20.48	24.82	125.16	125.24	0.08
Tooley_Upper	Upper	4200	100yr	9.23	26.93	123.46	123.88	0.42
Tooley_Upper	Upper	4200	Regional	22.09	27.62	123.79	123.88	0.09
Tooley_Upper	Upper	4100	100yr	9.23	26.93	121.08	121.32	0.24
Tooley_Upper	Upper	4100	Regional	22.09	27.62	121.26	121.33	0.07
Tooley_Upper	Upper	4000	100yr	9.23	26.93	119.37	120.43	1.06
Tooley_Upper	Upper	4000	Regional	22.09	27.62	120.28	120.46	0.18

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	3900	100yr	9.23	26.93	118.27	120.43	2.16
Tooley_Upper	Upper	3900	Regional	22.09	27.62	120.28	120.46	0.18
Tooley_Upper	Upper	3896.167	100yr	9.23	26.93	118.21	120.43	2.22
Tooley_Upper	Upper	3896.167	Regional	22.09	27.62	120.28	120.46	0.18
Tooley_Upper	Upper	3884	100yr	9.23	26.93	118.2	120.43	2.23
Tooley_Upper	Upper	3884	Regional	22.09	27.62	120.28	120.46	0.18
Tooley_Upper	Upper	3875.491		Culvert	Culvert			
Tooley_Upper	Upper	3866	100yr	9.23	26.93	117.86	118.41	0.55
Tooley_Upper	Upper	3866	Regional	22.09	27.62	118.23	118.45	0.22
Tooley_Upper	Upper	3840.997	100yr	9.23	26.93	117.86	118.38	0.52
Tooley_Upper	Upper	3840.997	Regional	22.09	27.62	118.27	118.4	0.13
Tooley_Upper	Upper	3800	100yr	9.23	26.93	117.6	118.04	0.44
Tooley_Upper	Upper	3800	Regional	22.09	27.62	117.93	118.04	0.11
Tooley_Upper	Upper	3700	100yr	14.07	39.02	117.02	117.46	0.44
Tooley_Upper	Upper	3700	Regional	31.15	38.29	117.36	117.45	0.09
Tooley_Upper	Upper	3600	100yr	14.07	39.02	116.08	116.48	0.4
Tooley_Upper	Upper	3600	Regional	31.15	38.29	116.38	116.47	0.09
Tooley_Upper	Upper	3500	100yr	14.07	39.02	114.6	114.92	0.32
Tooley_Upper	Upper	3500	Regional	31.15	38.29	114.84	114.92	0.08
Tooley_Upper	Upper	3400	100yr	14.07	39.02	113.77	114.15	0.38
Tooley_Upper	Upper	3400	Regional	31.15	38.29	114.05	114.13	0.08

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	3300	100yr	22.29	59.53	113.1	113.49	0.39
Tooley_Upper	Upper	3300	Regional	46.51	56.37	113.37	113.46	0.09
Tooley_Upper	Upper	3200	100yr	22.29	59.53	112.28	112.63	0.35
Tooley_Upper	Upper	3200	Regional	46.51	56.37	112.53	112.61	0.08
Tooley_Upper	Upper	3100	100yr	22.29	59.53	111.2	111.54	0.34
Tooley_Upper	Upper	3100	Regional	46.51	56.37	111.44	111.52	0.08
Tooley_Upper	Upper	3000	100yr	22.29	59.53	110.12	110.43	0.31
Tooley_Upper	Upper	3000	Regional	46.51	56.37	110.34	110.41	0.07
Tooley_Upper	Upper	2900	100yr	22.29	59.53	109.55	109.89	0.34
Tooley_Upper	Upper	2900	Regional	46.51	56.37	109.78	109.86	0.08
Tooley_Upper	Upper	2800	100yr	28.62	75.3	108.58	108.91	0.33
Tooley_Upper	Upper	2800	Regional	58.33	70.28	108.8	108.88	0.08
Tooley_Upper	Upper	2700	100yr	28.62	75.3	107.6	107.96	0.36
Tooley_Upper	Upper	2700	Regional	58.33	70.28	107.85	107.93	0.08
Tooley_Upper	Upper	2593.81	100yr	28.62	75.3	106.53	106.81	0.28
Tooley_Upper	Upper	2593.81	Regional	58.33	70.28	106.71	106.78	0.07
Tooley_Upper	Upper	2500	100yr	28.62	75.3	106.06	106.47	0.41
Tooley_Upper	Upper	2500	Regional	58.33	70.28	106.33	106.43	0.1
Tooley_Upper	Upper	2400	100yr	28.62	75.3	105.39	105.72	0.33
Tooley_Upper	Upper	2400	Regional	58.33	70.28	105.63	105.69	0.06
Tooley_Upper	Upper	2300	100yr	28.62	75.3	104.54	105.48	0.94
Tooley_Upper	Upper	2300	Regional	58.33	70.28	105.47	105.51	0.04

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	2200	100yr	28.62	75.3	103.65	105.46	1.81
Tooley_Upper	Upper	2200	Regional	58.33	70.28	105.46	105.5	0.04
Tooley_Upper	Upper	2100	100yr	27.48	63.79	102.6	105.46	2.86
Tooley_Upper	Upper	2100	Regional	59.94	70.66	105.46	105.5	0.04
Tooley_Upper	Upper	2000	100yr	27.48	63.79	101.59	105.46	3.87
Tooley_Upper	Upper	2000	Regional	59.94	70.66	105.46	105.5	0.04
Tooley_Upper	Upper	1900	100yr	27.48	63.79	101.03	105.46	4.43
Tooley_Upper	Upper	1900	Regional	59.94	70.66	105.46	105.5	0.04
Tooley_Upper	Upper	1818.172	100yr	27.48	63.79	101.02	105.46	4.44
Tooley_Upper	Upper	1818.172	Regional	59.94	70.66	105.46	105.5	0.04
Tooley_Upper	Upper	1800	100yr	27.48	63.79	101.02	105.46	4.44
Tooley_Upper	Upper	1800	Regional	59.94	70.66	105.46	105.5	0.04
Tooley_Upper	Upper	1779	100yr	27.48	63.79	100.87	105.31	4.44
Tooley_Upper	Upper	1779	Regional	59.94	70.66	105.33	105.5	0.17
Tooley_Upper	Upper	1764.263		Culvert	Culvert			
Tooley_Upper	Upper	1748	100yr	27.48	63.79	99.48	100.77	1.29
Tooley_Upper	Upper	1748	Regional	59.94	70.66	100.66	100.94	0.28
Tooley_Upper	Upper	1700	100yr	27.48	63.79	98.36	98.93	0.57
Tooley_Upper	Upper	1700	Regional	59.94	70.66	98.75	99.1	0.35
Tooley_Upper	Upper	1670.175	100yr	27.48	63.79	98.07	98.96	0.89
Tooley_Upper	Upper	1670.175	Regional	59.94	70.66	98.51	99.12	0.61
Tooley_Upper	Upper	1600	100yr	27.48	63.79	97.89	98.93	1.04



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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	1600	Regional	59.94	70.66	98.39	99.1	0.71
Tooley_Upper	Upper	1500	100yr	35.03	84.81	97.46	98.9	1.44
Tooley_Upper	Upper	1500	Regional	74.24	87.39	98.28	99.07	0.79
Tooley_Upper	Upper	1412.393	100yr	35.03	84.81	96.54	98.88	2.34
Tooley_Upper	Upper	1412.393	Regional	74.24	87.39	98.23	99.05	0.82
Tooley_Upper	Upper	1400	100yr	35.03	84.81	96.51	98.88	2.37
Tooley_Upper	Upper	1400	Regional	74.24	87.39	98.23	99.05	0.82
Tooley_Upper	Upper	1376	100yr	35.03	84.81	96.36	98.58	2.22
Tooley_Upper	Upper	1376	Regional	74.24	87.39	97.9	98.76	0.86
Tooley_Upper	Upper	1360.285		Culvert	Culvert			
Tooley_Upper	Upper	1343.5	100yr	35.03	84.81	95.37	96.36	0.99
Tooley_Upper	Upper	1343.5	Regional	74.24	87.39	96.17	96.4	0.23
Tooley_Upper	Upper	1300	100yr	35.03	84.81	95.09	96.04	0.95
Tooley_Upper	Upper	1300	Regional	74.24	87.39	95.51	95.96	0.45
Tooley_Upper	Upper	1270.062	100yr	35.03	84.81	94.77	96.01	1.24
Tooley_Upper	Upper	1270.062	Regional	74.24	87.39	95.44	95.92	0.48
Tooley_Upper	Upper	1200	100yr	35.03	84.81	94.1	95.99	1.89
Tooley_Upper	Upper	1200	Regional	74.24	87.39	95.4	95.9	0.5
Tooley_Upper	Upper	1100	100yr	35.18	93.55	93.63	95.99	2.36
Tooley_Upper	Upper	1100	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	1054	100yr	35.18	93.55	93.64	95.99	2.35
Tooley_Upper	Upper	1054	Regional	74.77	87.88	95.42	95.91	0.49

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	1013	100yr	35.18	93.55	93.64	95.99	2.35
Tooley_Upper	Upper	1013	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	1000	100yr	35.18	93.55	93.64	95.99	2.35
Tooley_Upper	Upper	1000	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	970.5	100yr	35.18	93.55	93.64	96	2.36
Tooley_Upper	Upper	970.5	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	957.6232		Culvert	Culvert			
Tooley_Upper	Upper	943.5	100yr	35.18	93.55	93.2	95.98	2.78
Tooley_Upper	Upper	943.5	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	900	100yr	35.18	93.55	93.2	95.98	2.78
Tooley_Upper	Upper	900	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	863	100yr	35.18	93.55	93.2	95.98	2.78
Tooley_Upper	Upper	863	Regional	74.77	87.88	95.42	95.91	0.49
Tooley_Upper	Upper	800	100yr	43.09	111.82	93.2	95.98	2.78
Tooley_Upper	Upper	800	Regional	91.51	108.75	95.42	95.91	0.49
Tooley_Upper	Upper	784	100yr	43.09	111.82	93.2	95.98	2.78
Tooley_Upper	Upper	784	Regional	91.51	108.75	95.42	95.91	0.49
Tooley_Upper	Upper	780		Lat Struct	Lat Struct			
Tooley_Upper	Upper	735	100yr	43.09	111.82	93.2	95.98	2.78
Tooley_Upper	Upper	735	Regional	91.51	108.75	95.42	95.91	0.49
Tooley_Upper	Upper	724		Bridge	Bridge			

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	713	100yr	43.09	111.82	93.2	95.98	2.78
Tooley_Upper	Upper	713	Regional	91.51	108.75	95.42	95.9	0.48
Tooley_Upper	Upper	709	100yr	43.09	111.82	93.2	95.98	2.78
Tooley_Upper	Upper	709	Regional	91.51	108.75	95.42	95.9	0.48
Tooley_Upper	Upper	705	100yr	43.09	111.51	93.15	95.87	2.72
Tooley_Upper	Upper	705	Regional	91.51	108.62	95.32	95.8	0.48
Tooley_Upper	Upper	641.6027		Mult Open	Mult Open			
Tooley_Upper	Upper	577	100yr	43.09	111.51	91.68	91.53	-0.15
Tooley_Upper	Upper	577	Regional	91.51	108.62	91.58	91.54	-0.04
Tooley_Upper	Upper	500	100yr	43.09	111.83	91.7	91.73	0.03
Tooley_Upper	Upper	500	Regional	91.51	108.75	91.71	91.73	0.02
Tooley_Upper	Upper	497	100yr	43.09	111.83	91.7	91.73	0.03
Tooley_Upper	Upper	497	Regional	91.51	108.75	91.71	91.73	0.02
Tooley_Upper	Upper	483	100yr	43.09	111.83	91.7	91.73	0.03
Tooley_Upper	Upper	483	Regional	91.51	108.75	91.71	91.73	0.02
Tooley_Upper	Upper	451	100yr	43.09	111.83	91.7	91.73	0.03
Tooley_Upper	Upper	451	Regional	91.51	108.75	91.71	91.73	0.02
Tooley_Upper	Upper	438	100yr	43.09	111.83	91.7	91.73	0.03
Tooley_Upper	Upper	438	Regional	91.51	108.75	91.71	91.73	0.02
Tooley_Upper	Upper	424		Culvert	Culvert			
Tooley_Upper	Upper	410	100yr	43.09	111.83	91.7	91.73	0.03

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Upper	Upper	410	Regional	91.51	108.75	91.71	91.73	0.02
Tooley_Upper	Upper	400	100yr	48.87	118.47	91.7	91.73	0.03
Tooley_Upper	Upper	400	Regional	99.84	117.34	91.71	91.73	0.02
Tooley_Upper	Upper	300	100yr	48.87	118.47	91.7	91.73	0.03
Tooley_Upper	Upper	300	Regional	99.84	117.34	91.71	91.73	0.02
Tooley_Upper	Upper	255	100yr	48.87	118.47	91.7	91.73	0.03
Tooley_Upper	Upper	255	Regional	99.84	117.34	91.71	91.73	0.02
Tooley_Upper	Upper	243	100yr	48.87	118.47	91.7	91.73	0.03
Tooley_Upper	Upper	243	Regional	99.84	117.34	91.71	91.73	0.02
Tooley_Upper	Upper	227.3807		Mult Open	Mult Open			
Tooley_Upper	Upper	211	100yr	48.87	118.47	84.8	86.66	1.86
Tooley_Upper	Upper	211	Regional	99.84	117.34	86.21	86.64	0.43
Tooley_Upper	Upper	200	100yr	48.87	114.8	83.77	84.12	0.35
Tooley_Upper	Upper	200	Regional	99.88	118.09	84.06	84.13	0.07
Tooley_Upper	Upper	100	100yr	48.87	114.8	82.91	83.22	0.31
Tooley_Upper	Upper	100	Regional	99.88	118.09	83.18	83.22	0.04
Tooley_Lower	Lower	1000	100yr	80.35	154.02	82.23	82.56	0.33
Tooley_Lower	Lower	1000	Regional	118.12	137.84	82.43	82.51	0.08
Tooley_Lower	Lower	900	100yr	80.35	154.02	81.48	81.69	0.21
Tooley_Lower	Lower	900	Regional	118.12	137.84	81.59	81.64	0.05
Tooley_Lower	Lower	800	100yr	80.35	154.02	80.86	81.07	0.21
Tooley_Lower	Lower	800	Regional	118.12	137.84	80.99	81.04	0.05

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
Tooley_Lower	Lower	700	100yr	80.35	154.02	79.93	80.21	0.28
Tooley_Lower	Lower	700	Regional	118.12	137.84	80.08	80.14	0.06
Tooley_Lower	Lower	600	100yr	80.35	154.02	79.44	79.73	0.29
Tooley_Lower	Lower	600	Regional	118.12	137.84	79.66	79.74	0.08
Tooley_Lower	Lower	500	100yr	80.01	138.16	79	79.24	0.24
Tooley_Lower	Lower	500	Regional	127.67	146.98	79.21	79.27	0.06
Tooley_Lower	Lower	400	100yr	80.01	138.16	77.99	78.25	0.26
Tooley_Lower	Lower	400	Regional	127.67	146.98	78.21	78.28	0.07
Tooley_Lower	Lower	300	100yr	80.01	138.16	77.45	77.75	0.3
Tooley_Lower	Lower	300	Regional	127.67	146.98	77.7	77.79	0.09
Tooley_Lower	Lower	200	100yr	80.01	138.16	77.05	77.36	0.31
Tooley_Lower	Lower	200	Regional	127.67	146.98	77.31	77.4	0.09
Tooley_Lower	Lower	100	100yr	80.01	138.16	76.78	77.05	0.27
Tooley_Lower	Lower	100	Regional	127.67	146.98	77.01	77.08	0.07
Tooley_Lower	Lower	8.907429	100yr	80.01	138.16	76.12	76.32	0.2
Tooley_Lower	Lower	8.907429	Regional	127.67	146.98	76.27	76.33	0.06
RobinsonWest	West	486.4874	100yr	31.3	34.14	97.64	97.68	0.04
RobinsonWest	West	486.4874	Regional	18.07	18.18	97.45	97.45	0
RobinsonWest	West	400	100yr	31.3	34.14	96.82	96.85	0.03
RobinsonWest	West	400	Regional	18.07	18.18	96.68	96.68	0
RobinsonWest	West	300	100yr	44.26	46.68	96.21	96.14	-0.07
RobinsonWest	West	300	Regional	23.18	23.33	96.29	95.78	-0.51

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonWest	West	193.175	100yr	44.26	46.68	96.2	96.12	-0.08
RobinsonWest	West	193.175	Regional	23.18	23.33	96.29	95.75	-0.54
RobinsonWest	West	176.2835	100yr	44.26	46.68	96.19	96.11	-0.08
RobinsonWest	West	176.2835	Regional	23.18	23.33	96.28	95.74	-0.54
RobinsonWest	West	165.6963		Mult Open	Mult Open			
RobinsonWest	West	154.4447	100yr	44.26	46.68	96.19	96.1	-0.09
RobinsonWest	West	154.4447	Regional	23.18	23.33	96.28	94.93	-1.35
RobinsonWest	West	122.0857	100yr	44.26	46.68	96.19	96.1	-0.09
RobinsonWest	West	122.0857	Regional	23.18	23.33	96.28	94.93	-1.35
RobinsonWest	West	7.527757	100yr	44.26	46.68	96.19	96.1	-0.09
RobinsonWest	West	7.527757	Regional	23.18	23.33	96.28	94.95	-1.33
RobinsonUpper	Upper	3542.466	100yr	2.02	2.02	133.2	133.2	0
RobinsonUpper	Upper	3542.466	Regional	0.72	0.86	132.79	132.9	0.11
RobinsonUpper	Upper	3494.811	100yr	2.02	2.02	133.19	133.19	0
RobinsonUpper	Upper	3494.811	Regional	0.72	0.86	132.79	132.89	0.1
RobinsonUpper	Upper	3484.383	100yr	2.02	2.02	133.18	133.18	0
RobinsonUpper	Upper	3484.383	Regional	0.72	0.86	132.78	132.89	0.11
RobinsonUpper	Upper	3469.744		Mult Open	Mult Open			
RobinsonUpper	Upper	3454.014	100yr	2.02	2.02	132.81	132.81	0
RobinsonUpper	Upper	3454.014	Regional	0.72	0.86	132.4	132.43	0.03
RobinsonUpper	Upper	3430.442	100yr	2.02	2.02	132.81	132.81	0

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonUpper	Upper	3430.442	Regional	0.72	0.86	132.32	132.36	0.04
RobinsonUpper	Upper	3400	100yr	2.02	2.02	132.8	132.8	0
RobinsonUpper	Upper	3400	Regional	0.72	0.86	132.25	132.3	0.05
RobinsonUpper	Upper	3344.928	100yr	2.02	2.02	132.78	132.78	0
RobinsonUpper	Upper	3344.928	Regional	0.72	0.86	132.16	132.22	0.06
RobinsonUpper	Upper	3334.47	100yr	2.02	2.02	132.75	132.75	0
RobinsonUpper	Upper	3334.47	Regional	0.72	0.86	132.12	132.17	0.05
RobinsonUpper	Upper	3316.727		Culvert	Culvert			
RobinsonUpper	Upper	3298.848	100yr	2.02	2.02	132.01	132.01	0
RobinsonUpper	Upper	3298.848	Regional	0.72	0.86	131.85	131.87	0.02
RobinsonUpper	Upper	3274.914	100yr	2.02	2.02	131.82	131.83	0.01
RobinsonUpper	Upper	3274.914	Regional	0.72	0.86	131.63	131.67	0.04
RobinsonUpper	Upper	3200	100yr	7.05	7.71	131.59	131.61	0.02
RobinsonUpper	Upper	3200	Regional	1.21	1.82	131.27	131.33	0.06
RobinsonUpper	Upper	3100	100yr	7.05	7.71	131.32	131.34	0.02
RobinsonUpper	Upper	3100	Regional	1.21	1.82	131.01	131.06	0.05
RobinsonUpper	Upper	3000	100yr	7.05	7.71	131.19	131.2	0.01
RobinsonUpper	Upper	3000	Regional	1.21	1.82	130.95	130.98	0.03
RobinsonUpper	Upper	2917.452	100yr	7.05	7.71	131.18	131.2	0.02
RobinsonUpper	Upper	2917.452	Regional	1.21	1.82	130.95	130.98	0.03
RobinsonUpper	Upper	2906.009	100yr	7.05	7.71	131.09	131.1	0.01
RobinsonUpper	Upper	2906.009	Regional	1.21	1.82	130.94	130.95	0.01

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonUpper	Upper	2894.43		Culvert	Culvert			
RobinsonUpper	Upper	2882.851	100yr	7.05	7.71	130.6	130.62	0.02
RobinsonUpper	Upper	2882.851	Regional	1.21	1.82	130.3	130.4	0.1
RobinsonUpper	Upper	2855.66	100yr	7.05	7.71	130.5	130.51	0.01
RobinsonUpper	Upper	2855.66	Regional	1.21	1.82	130.28	130.32	0.04
RobinsonUpper	Upper	2800	100yr	7.05	7.71	130.11	130.12	0.01
RobinsonUpper	Upper	2800	Regional	1.21	1.82	129.9	129.98	0.08
RobinsonUpper	Upper	2700	100yr	7.05	7.71	128.72	128.73	0.01
RobinsonUpper	Upper	2700	Regional	1.21	1.82	128.5	128.55	0.05
RobinsonUpper	Upper	2600	100yr	7.48	8.01	127.69	127.71	0.02
RobinsonUpper	Upper	2600	Regional	2.07	2.66	127.41	127.46	0.05
RobinsonUpper	Upper	2539.354	100yr	7.48	8.01	127.47	127.5	0.03
RobinsonUpper	Upper	2539.354	Regional	2.07	2.66	127.18	127.22	0.04
RobinsonUpper	Upper	2529.293	100yr	7.48	8.01	127.47	127.5	0.03
RobinsonUpper	Upper	2529.293	Regional	2.07	2.66	127.18	127.22	0.04
RobinsonUpper	Upper	2519.291	100yr	7.48	8.01	127.44	127.46	0.02
RobinsonUpper	Upper	2519.291	Regional	2.07	2.66	127.14	127.18	0.04
RobinsonUpper	Upper	2499.168	100yr	7.48	8.01	127.27	127.32	0.05
RobinsonUpper	Upper	2499.168	Regional	2.07	2.66	126.98	127.04	0.06
RobinsonUpper	Upper	2400	100yr	7.48	8.01	126.87	126.84	-0.03
RobinsonUpper	Upper	2400	Regional	2.07	2.66	126.53	126.57	0.04



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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonUpper	Upper	2300	100yr	13.92	12.48	126.2	126.21	0.01
RobinsonUpper	Upper	2300	Regional	3.01	3.64	126.03	126.05	0.02
RobinsonUpper	Upper	2200	100yr	13.92	12.48	125.62	125.58	-0.04
RobinsonUpper	Upper	2200	Regional	3.01	3.64	125.44	125.45	0.01
RobinsonUpper	Upper	2154.378	100yr	13.92	12.48	125.57	125.53	-0.04
RobinsonUpper	Upper	2154.378	Regional	3.01	3.64	125.22	125.24	0.02
RobinsonUpper	Upper	2100	100yr	13.92	12.48	125.22	125.18	-0.04
RobinsonUpper	Upper	2100	Regional	3.01	3.64	124.71	124.75	0.04
RobinsonUpper	Upper	2000	100yr	19.99	18.19	123.03	123	-0.03
RobinsonUpper	Upper	2000	Regional	8.06	8.58	122.67	122.69	0.02
RobinsonUpper	Upper	1900	100yr	19.99	18.19	119.76	119.72	-0.04
RobinsonUpper	Upper	1900	Regional	8.06	8.58	119.37	119.39	0.02
RobinsonUpper	Upper	1800	100yr	19.99	18.19	116.49	116.44	-0.05
RobinsonUpper	Upper	1800	Regional	8.06	8.58	116.07	116.09	0.02
RobinsonUpper	Upper	1700	100yr	32.59	28.96	112.88	112.85	-0.03
RobinsonUpper	Upper	1700	Regional	16.17	16.49	112.7	112.7	0
RobinsonUpper	Upper	1478.247	100yr	32.59	28.96	111.88	111.85	-0.03
RobinsonUpper	Upper	1478.247	Regional	16.17	16.49	111.64	111.64	0
RobinsonUpper	Upper	1466.204		Culvert	Culvert			
RobinsonUpper	Upper	1454.188	100yr	32.59	28.96	109.55	109.36	-0.19
RobinsonUpper	Upper	1454.188	Regional	16.17	16.49	108.58	108.6	0.02
RobinsonUpper	Upper	1421.456	100yr	32.59	28.96	107.88	107.83	-0.05

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonUpper	Upper	1421.456	Regional	16.17	16.49	107.63	107.63	0
RobinsonUpper	Upper	1400	100yr	32.59	28.96	107.53	107.49	-0.04
RobinsonUpper	Upper	1400	Regional	16.17	16.49	107.34	107.35	0.01
RobinsonUpper	Upper	1300	100yr	32.59	28.96	106.58	106.53	-0.05
RobinsonUpper	Upper	1300	Regional	16.17	16.49	106.37	106.37	0
RobinsonUpper	Upper	1200	100yr	31.8	27.3	105.81	105.76	-0.05
RobinsonUpper	Upper	1200	Regional	19.14	19.31	105.67	105.67	0
RobinsonUpper	Upper	1100	100yr	31.8	27.3	105.13	105.06	-0.07
RobinsonUpper	Upper	1100	Regional	19.14	19.31	104.89	104.89	0
RobinsonUpper	Upper	1000	100yr	31.8	27.3	104.36	104.27	-0.09
RobinsonUpper	Upper	1000	Regional	19.14	19.31	104.1	104.11	0.01
RobinsonUpper	Upper	900	100yr	44.23	37.48	103.5	103.4	-0.1
RobinsonUpper	Upper	900	Regional	26.87	26.73	103.22	103.22	0
RobinsonUpper	Upper	800	100yr	44.23	37.48	102.26	102.18	-0.08
RobinsonUpper	Upper	800	Regional	26.87	26.73	102.02	102.02	0
RobinsonUpper	Upper	700	100yr	44.23	37.48	100.63	100.56	-0.07
RobinsonUpper	Upper	700	Regional	26.87	26.73	100.43	100.43	0
RobinsonUpper	Upper	600	100yr	44.23	37.48	99.26	99.14	-0.12
RobinsonUpper	Upper	600	Regional	26.87	26.73	99	98.99	-0.01
RobinsonUpper	Upper	500	100yr	49.08	40.27	98.32	98.21	-0.11
RobinsonUpper	Upper	500	Regional	31.54	31.02	98.08	98.07	-0.01
RobinsonUpper	Upper	400	100yr	49.08	40.27	96.32	96.2	-0.12

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonUpper	Upper	400	Regional	31.54	31.02	96.31	96.18	-0.13
RobinsonUpper	Upper	300	100yr	49.08	40.27	96.16	96.07	-0.09
RobinsonUpper	Upper	300	Regional	31.54	31.02	96.27	95.35	-0.92
RobinsonUpper	Upper	200	100yr	49.08	40.27	96.19	96.1	-0.09
RobinsonUpper	Upper	200	Regional	31.54	31.02	96.28	94.95	-1.33
RobinsonUpper	Upper	11.06822	100yr	49.08	40.27	96.19	96.1	-0.09
RobinsonUpper	Upper	11.06822	Regional	31.54	31.02	96.28	94.96	-1.32
RobinsonLower	Lower	2075.481	100yr	92.18	86.94	96.19	96.1	-0.09
RobinsonLower	Lower	2075.481	Regional	54.72	53.91	96.28	94.95	-1.33
RobinsonLower	Lower	2000	100yr	92.18	86.94	96.19	96.1	-0.09
RobinsonLower	Lower	2000	Regional	54.72	53.91	96.28	94.95	-1.33
RobinsonLower	Lower	1900	100yr	92.18	86.94	96.19	96.1	-0.09
RobinsonLower	Lower	1900	Regional	54.72	53.91	96.28	94.95	-1.33
RobinsonLower	Lower	1800	100yr	92.18	86.94	96.19	96.1	-0.09
RobinsonLower	Lower	1800	Regional	54.72	53.91	96.28	94.95	-1.33
RobinsonLower	Lower	1700	100yr	92.18	86.94	96.19	96.1	-0.09
RobinsonLower	Lower	1700	Regional	54.72	53.91	96.28	94.95	-1.33
RobinsonLower	Lower	1600	100yr	89.88	75.46	96.19	96.1	-0.09
RobinsonLower	Lower	1600	Regional	61.05	60.09	96.28	94.95	-1.33
RobinsonLower	Lower	1500	100yr	89.88	75.46	96.19	96.1	-0.09
RobinsonLower	Lower	1500	Regional	61.05	60.09	96.28	94.95	-1.33
RobinsonLower	Lower	1408.42	100yr	89.88	75.46	96.19	96.1	-0.09

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River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonLower	Lower	1408.42	Regional	61.05	60.09	96.28	94.95	-1.33
RobinsonLower	Lower	1389.432	100yr	89.88	75.46	96.08	96.02	-0.06
RobinsonLower	Lower	1389.432	Regional	61.05	60.09	96.23	94.88	-1.35
RobinsonLower	Lower	1370.068		Culvert	Culvert			
RobinsonLower	Lower	1349.056	100yr	89.88	75.46	95.51	95.34	-0.17
RobinsonLower	Lower	1349.056	Regional	61.05	60.09	93.94	93.34	-0.6
RobinsonLower	Lower	1318.902	100yr	89.88	75.46	95.66	95.44	-0.22
RobinsonLower	Lower	1318.902	Regional	61.05	60.09	94.05	93.47	-0.58
RobinsonLower	Lower	1300	100yr	91.04	76.95	95.66	95.44	-0.22
RobinsonLower	Lower	1300	Regional	63.01	61.99	94.05	93.47	-0.58
RobinsonLower	Lower	1225.673	100yr	91.04	76.95	95.66	95.44	-0.22
RobinsonLower	Lower	1225.673	Regional	63.01	61.99	94.05	93.47	-0.58
RobinsonLower	Lower	1208.394	100yr	91.04	76.95	95.65	95.43	-0.22
RobinsonLower	Lower	1208.394	Regional	63.01	61.99	93.85	93.24	-0.61
RobinsonLower	Lower	1186.848		Culvert	Culvert			
RobinsonLower	Lower	1174.573	100yr	91.04	76.95	95.63	95.37	-0.26
RobinsonLower	Lower	1174.573	Regional	63.01	61.99	92.26	91.73	-0.53
RobinsonLower	Lower	1170		Lat Struct	Lat Struct			
RobinsonLower	Lower	1146.689	100yr	81.52	73.73	95.63	95.37	-0.26
RobinsonLower	Lower	1146.689	Regional	63.01	61.99	92.39	92.15	-0.24
RobinsonLower	Lower	1076.022	100yr	77.61	75.3	95.63	95.37	-0.26

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C5: Water Surface Elevation Comparison**

**Description:** Comparison of water surface elevations between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonLower	Lower	1076.022	Regional	63.75	62.72	92.39	92.15	-0.24
RobinsonLower	Lower	1050.327	100yr	76.2	75.27	95.58	95.32	-0.26
RobinsonLower	Lower	1050.327	Regional	63.75	62.72	92.32	92.08	-0.24
RobinsonLower	Lower	994.6486		Culvert	Culvert			
RobinsonLower	Lower	928.2293	100yr	76.2	75.27	92.66	92.47	-0.19
RobinsonLower	Lower	928.2293	Regional	63.75	62.72	90.31	90.14	-0.17
RobinsonLower	Lower	918.8482	100yr	76.2	75.27	92.65	92.46	-0.19
RobinsonLower	Lower	918.8482	Regional	63.75	62.72	90.37	90.2	-0.17
RobinsonLower	Lower	899.0165		Culvert	Culvert			
RobinsonLower	Lower	876.9869	100yr	76.78	75.94	86.33	86.25	-0.08
RobinsonLower	Lower	876.9869	Regional	64.58	63.52	85.13	84.99	-0.14
RobinsonLower	Lower	834.4676	100yr	76.78	75.94	86.6	86.52	-0.08
RobinsonLower	Lower	834.4676	Regional	64.58	63.52	85.59	85.51	-0.08
RobinsonLower	Lower	823.6441	100yr	76.78	75.94	86.6	86.52	-0.08
RobinsonLower	Lower	823.6441	Regional	64.58	63.52	85.6	85.51	-0.09
RobinsonLower	Lower	800.6076	100yr	76.78	75.94	86.44	86.36	-0.08
RobinsonLower	Lower	800.6076	Regional	64.58	63.52	85.42	85.34	-0.08
RobinsonLower	Lower	787.4796		Mult Open	Mult Open			
RobinsonLower	Lower	772.9675	100yr	92.05	79.32	82.96	82.84	-0.12
RobinsonLower	Lower	772.9675	Regional	64.58	63.52	82.68	82.67	-0.01
RobinsonLower	Lower	728.9347	100yr	92.05	79.32	82.89	82.78	-0.11

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C5: Water Surface Elevation Comparison**

**Description:** Comparison of water surface elevations between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	Q Total (CLOCA) (m3/s)	Q Total (TYLin Update) (m3/s)	W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	WSE Change (m)
RobinsonLower	Lower	728.9347	Regional	64.58	63.52	82.63	82.62	-0.01
RobinsonLower	Lower	700	100yr	92.05	79.32	82.38	82.29	-0.09
RobinsonLower	Lower	700	Regional	64.58	63.52	82.18	82.18	0
RobinsonLower	Lower	600	100yr	92.05	79.32	82.36	81.5	-0.86
RobinsonLower	Lower	600	Regional	64.58	63.52	80.76	80.75	-0.01
RobinsonLower	Lower	500	100yr	91.2	82.42	82.37	81.52	-0.85
RobinsonLower	Lower	500	Regional	68.31	67.83	80.32	80.29	-0.03
RobinsonLower	Lower	400	100yr	91.2	82.42	82.38	81.53	-0.85
RobinsonLower	Lower	400	Regional	68.31	67.83	80.34	80.3	-0.04
RobinsonLower	Lower	349.8643	100yr	91.2	82.42	82.38	81.53	-0.85
RobinsonLower	Lower	349.8643	Regional	68.31	67.83	80.34	80.31	-0.03
RobinsonLower	Lower	310.5079	100yr	91.2	82.42	77.56	77.56	0
RobinsonLower	Lower	310.5079	Regional	68.31	67.83	77.54	77.54	0
RobinsonLower	Lower	302.0028		Culvert	Culvert			
RobinsonLower	Lower	289.6513	100yr	91.2	82.42	77.9	77.87	-0.03
RobinsonLower	Lower	289.6513	Regional	68.31	67.83	77.81	77.8	-0.01
RobinsonLower	Lower	254.9745	100yr	91.2	82.42	77.22	77.18	-0.04
RobinsonLower	Lower	254.9745	Regional	68.31	67.83	77.08	77.08	0
RobinsonLower	Lower	200	100yr	91.2	82.42	76.78	76.75	-0.03
RobinsonLower	Lower	200	Regional	68.31	67.83	76.71	76.71	0

**Project:** Robinson and Tooley Flood Mitigation Study  
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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	TribW1	300	100yr	0	94.5	94.51	94.51	94.51	0.00233	0.07	0.01	1.5	0.24
Tooley_West	TribW1	300	Regional	0	94.5	94.51	94.51	94.51	0.00233	0.07	0.01	1.5	0.24
Tooley_West	TribW1	200	100yr	3.38	93.93	94.33		94.34	0.000749	0.47	10.16	40.86	0.25
Tooley_West	TribW1	200	Regional	0	93.93	93.9	93.9	93.9	0.002403		0.02	1.68	0
Tooley_West	TribW1	100	100yr	3.38	93.63	94.32		94.33	0.000123	0.26	19.5	67.02	0.11
Tooley_West	TribW1	100	Regional	0	93.63	93.83		93.83	0	0	1.58	12.59	0
Tooley_West	TribW1	50	100yr	3.38	93.47	94.29		94.3	0.00027	0.45	9.57	19.74	0.17
Tooley_West	TribW1	50	Regional	0	93.47	93.83		93.83	0	0	2.51	10.98	0
Tooley_West	TribW2	3000	100yr	0	93.92	94.3		94.3	0	0	1.38	6.19	0
Tooley_West	TribW2	3000	Regional	0	93.92	93.94	93.94	93.94	0.017433	0.19	0.01	0.58	0.64
Tooley_West	TribW2	2000	100yr	0	92.82	94.3	92.83	94.3	0	0	16.72	20.19	0
Tooley_West	TribW2	2000	Regional	0	92.82	93.83	92.83	93.83	0	0	8.94	13.82	0
Tooley_West	TribW2	1000	100yr	0	91.65	94.3		94.3	0	0	48.48	34.32	0
Tooley_West	TribW2	1000	Regional	0	91.65	93.83		93.83	0	0	33.52	28.41	0
Tooley_West	Downstream	1046	100yr	35.62	91.07	94.3	93.34	94.3	0.000004	0.13	538.44	305.51	0.02
Tooley_West	Downstream	1046	Regional	14.9	91.07	93.83	92.41	93.83	0.000001	0.07	411.39	245.35	0.01
Tooley_West	Downstream	1021.5											
Tooley_West	Downstream	997	100yr	35.62	90.96	92.85	92.85	92.86	0.000343	0.7	143.71	347.87	0.2
Tooley_West	Downstream	997	Regional	14.9	90.96	92.39	92.39	93.03	0.008505	3.56	4.19	157.31	1
Tooley_West	Downstream	962	100yr	35.62	91.6	92.03	92.03	92.04	0.000934	0.5	92.17	226.66	0.27
Tooley_West	Downstream	962	Regional	14.9	91.6	92.03	92.03	92.03	0.000163	0.21	92.17	226.66	0.11
Tooley_West	Downstream	869	100yr	35.62	90.9	91.75		91.77	0.00106	0.84	80.08	210.71	0.32
Tooley_West	Downstream	869	Regional	14.9	90.9	91.54		91.55	0.000768	0.56	44	137.22	0.26

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	Downstream	794	100yr	35.62	91.13	91.51	91.51	91.65	0.023754	2.33	24.13	90.85	1.35
Tooley_West	Downstream	794	Regional	14.9	91.13	91.38	91.38	91.46	0.02794	1.74	13.01	78.56	1.33
Tooley_West	Downstream	736	100yr	35.62	90.95	91.56		91.56	0.000126	0.21	212.38	361.17	0.1
Tooley_West	Downstream	736	Regional	14.9	90.95	91.4		91.4	0.00005	0.1	156.39	310.8	0.06
Tooley_West	Downstream	720	100yr	35.62	88.89	91.56	90.96	91.56	0.000087	0.43	222.51	377.32	0.1
Tooley_West	Downstream	720	Regional	14.9	88.89	91.4	90.33	91.4	0.000032	0.24	163.19	323.36	0.06
Tooley_West	Downstream	704		Culvert									
Tooley_West	Downstream	700	100yr	35.62	88.44	90.66	90.66	90.69	0.001463	1.3	71.46	177.4	0.37
Tooley_West	Downstream	700	Regional	14.9	88.44	90.13	90.13	90.77	0.011496	3.56	4.19	41.04	1
Tooley_West	Downstream	688	100yr	35.62	88.97	90.01	89.73	90.07	0.001717	1.18	46.11	157.92	0.42
Tooley_West	Downstream	688	Regional	14.9	88.97	89.7		89.74	0.001971	0.92	18	55.73	0.42
Tooley_West	Downstream	668	100yr	42.64	88.92	89.66	89.66	89.92	0.009999	2.39	22.99	65.47	0.98
Tooley_West	Downstream	668	Regional	18.14	88.92	89.42	89.42	89.58	0.01103	1.81	10.94	39.3	0.95
Tooley_West	Downstream	600	100yr	42.64	88.87	89.56		89.58	0.000898	0.74	86.73	181.43	0.3
Tooley_West	Downstream	600	Regional	18.14	88.87	89.3		89.31	0.001172	0.6	42.99	152.96	0.31
Tooley_West	Downstream	500	100yr	42.64	88.49	89.28	89.25	89.42	0.005673	2	38.19	115.53	0.76
Tooley_West	Downstream	500	Regional	18.14	88.49	89.08		89.15	0.004044	1.36	19.73	61.9	0.61
Tooley_West	Downstream	400	100yr	42.64	87.99	88.84		88.95	0.004479	1.77	39.39	97.1	0.67
Tooley_West	Downstream	400	Regional	18.14	87.99	88.54	88.51	88.65	0.007413	1.59	15.92	63.75	0.79
Tooley_West	Downstream	300	100yr	39.23	86.82	88.04	88.04	88.49	0.008018	3.19	16.91	27.68	0.97
Tooley_West	Downstream	300	Regional	21.46	86.82	87.72	87.72	88.04	0.008546	2.62	9.89	18.08	0.94
Tooley_West	Downstream	200	100yr	39.23	84.99	86.34	86.34	86.65	0.007003	2.75	20.59	36.46	0.88
Tooley_West	Downstream	200	Regional	21.46	84.99	86.09	86.09	86.33	0.007076	2.28	12.21	30.86	0.84



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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_West	Downstream	100	100yr	39.23	82.81	83.8	83.8	84.08	0.007877	2.43	19.8	43.72	0.9
Tooley_West	Downstream	100	Regional	21.46	82.81	83.55	83.55	83.78	0.010184	2.11	10.8	29.5	0.96
Tooley_Upper	Upper	4800	100yr	15.6	128.54	129.07		129.17	0.021022	1.26	11.89	45.87	0.55
Tooley_Upper	Upper	4800	Regional	16.07	128.54	129.09		129.18	0.018032	1.19	12.84	47.99	0.52
Tooley_Upper	Upper	4700	100yr	15.6	127.91	128.89	128.4	128.9	0.000863	0.55	36.09	66.59	0.18
Tooley_Upper	Upper	4700	Regional	16.07	127.91	128.85	128.41	128.86	0.00114	0.61	33.44	64.09	0.2
Tooley_Upper	Upper	4600	100yr	29.56	127.55	128.5	128.34	128.58	0.011545	2.05	23.42	57.78	0.68
Tooley_Upper	Upper	4600	Regional	24.82	127.55	128.45	128.29	128.53	0.01138	1.97	20.72	52.17	0.67
Tooley_Upper	Upper	4500.017	100yr	29.56	126.74	127.17	127.17	127.29	0.014454	1.92	20.03	90.43	0.95
Tooley_Upper	Upper	4500.017	Regional	24.82	126.74	127.14	127.14	127.25	0.014608	1.84	17.41	87.45	0.94
Tooley_Upper	Upper	4400	100yr	29.56	125.07	126.18	126.04	126.31	0.005409	2.23	19.2	33.48	0.68
Tooley_Upper	Upper	4400	Regional	24.82	125.07	126.1	125.97	126.22	0.00584	2.2	16.59	32.12	0.7
Tooley_Upper	Upper	4300	100yr	29.56	124.45	125.28		125.45	0.015143	2.17	16.53	26.99	0.76
Tooley_Upper	Upper	4300	Regional	24.82	124.45	125.24		125.37	0.013272	1.96	15.36	26.42	0.71
Tooley_Upper	Upper	4200	100yr	26.93	122.69	123.88	123.74	124.06	0.012796	1.67	17.92	29.34	0.49
Tooley_Upper	Upper	4200	Regional	27.62	122.69	123.88	123.75	124.07	0.012859	1.68	18.21	29.52	0.5
Tooley_Upper	Upper	4100	100yr	26.93	120.54	121.32	121.32	121.54	0.069349	2.94	13.15	29.9	1.07
Tooley_Upper	Upper	4100	Regional	27.62	120.54	121.33	121.33	121.55	0.069171	2.96	13.39	30.08	1.07
Tooley_Upper	Upper	4000	100yr	26.93	118.77	120.43		120.45	0.000885	1.17	48.01	43.6	0.29
Tooley_Upper	Upper	4000	Regional	27.62	118.77	120.46		120.48	0.000876	1.18	49.03	44	0.29
Tooley_Upper	Upper	3900	100yr	26.93	117.88	120.43		120.44	0.000041	0.39	98.54	62.41	0.08
Tooley_Upper	Upper	3900	Regional	27.62	117.88	120.46		120.46	0.000042	0.39	99.99	62.85	0.08
Tooley_Upper	Upper	3896.167	100yr	26.93	117.81	120.43		120.44	0.000032	0.33	105.93	67.69	0.07
Tooley_Upper	Upper	3896.167	Regional	27.62	117.81	120.46		120.46	0.000032	0.34	107.51	68.25	0.07

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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	3884	100yr	26.93	116.59	120.43	118.13	120.44	0.00004	0.35	111.83	81.64	0.07
Tooley_Upper	Upper	3884	Regional	27.62	116.59	120.46	118.19	120.46	0.000041	0.36	113.73	82.04	0.07
Tooley_Upper	Upper	3875.491											
			Culvert										
Tooley_Upper	Upper	3866	100yr	26.93	116.8	118.41	118.41	119.13	0.012195	3.76	7.16	5.26	1
Tooley_Upper	Upper	3866	Regional	27.62	116.8	118.45	118.45	119.17	0.012121	3.76	7.35	5.5	1
Tooley_Upper	Upper	3840.997	100yr	26.93	117.15	118.38		118.46	0.001517	1.39	27.34	35.86	0.42
Tooley_Upper	Upper	3840.997	Regional	27.62	117.15	118.4		118.48	0.001506	1.4	27.93	36.12	0.42
Tooley_Upper	Upper	3800	100yr	26.93	116.94	118.04	118.02	118.32	0.006403	2.71	15.6	28.61	0.85
Tooley_Upper	Upper	3800	Regional	27.62	116.94	118.04	118.04	118.34	0.006709	2.77	15.63	28.63	0.87
Tooley_Upper	Upper	3700	100yr	39.02	115.99	117.46		117.66	0.006391	2.83	21.34	31.73	0.76
Tooley_Upper	Upper	3700	Regional	38.29	115.99	117.45		117.65	0.006393	2.81	21.03	31.48	0.76
Tooley_Upper	Upper	3600	100yr	39.02	115.2	116.48	116.48	116.78	0.01265	3.72	16.89	28.51	1.06
Tooley_Upper	Upper	3600	Regional	38.29	115.2	116.47	116.47	116.77	0.012673	3.7	16.63	28.27	1.06
Tooley_Upper	Upper	3500	100yr	39.02	114.05	114.92	114.92	115.19	0.014499	3.11	17.11	31.95	1.07
Tooley_Upper	Upper	3500	Regional	38.29	114.05	114.92	114.92	115.18	0.014562	3.1	16.85	31.76	1.07
Tooley_Upper	Upper	3400	100yr	39.02	112.84	114.15		114.29	0.005129	2.44	24.49	36.14	0.68
Tooley_Upper	Upper	3400	Regional	38.29	112.84	114.13		114.27	0.005344	2.47	23.79	35.68	0.7
Tooley_Upper	Upper	3300	100yr	59.53	112.42	113.49		113.67	0.007101	2.46	32.19	48.57	0.77
Tooley_Upper	Upper	3300	Regional	56.37	112.42	113.46		113.63	0.007243	2.44	30.79	47.91	0.78
Tooley_Upper	Upper	3200	100yr	59.53	111.71	112.63		112.87	0.008922	2.53	28.13	42.05	0.85
Tooley_Upper	Upper	3200	Regional	56.37	111.71	112.61		112.84	0.008729	2.47	27.28	41.62	0.84
Tooley_Upper	Upper	3100	100yr	59.53	110.6	111.54	111.53	111.82	0.012438	3.05	25.62	41.54	1.01
Tooley_Upper	Upper	3100	Regional	56.37	110.6	111.52	111.5	111.79	0.012759	3.03	24.53	41.26	1.01

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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09)   
**Geometry:** Tooley\_mitigation (TooleyRobinson.g08)   
**Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	3000	100yr	59.53	109.61	110.43		110.67	0.010468	2.54	27.28	42.23	0.9
Tooley_Upper	Upper	3000	Regional	56.37	109.61	110.41		110.64	0.010196	2.47	26.53	41.92	0.89
Tooley_Upper	Upper	2900	100yr	59.53	108.83	109.89		109.99	0.004239	1.9	42.99	67.2	0.6
Tooley_Upper	Upper	2900	Regional	56.37	108.83	109.86		109.96	0.004338	1.89	41.1	66.32	0.6
Tooley_Upper	Upper	2800	100yr	75.3	107.97	108.91	108.91	109.22	0.014002	3.21	30.75	50.02	1.07
Tooley_Upper	Upper	2800	Regional	70.28	107.97	108.88	108.88	109.18	0.01426	3.16	29.18	49.35	1.07
Tooley_Upper	Upper	2700	100yr	75.3	106.94	107.96	107.8	108.15	0.007133	2.44	38.68	53.49	0.77
Tooley_Upper	Upper	2700	Regional	70.28	106.94	107.93	107.77	108.11	0.00703	2.37	37.05	52.68	0.76
Tooley_Upper	Upper	2593.81	100yr	75.3	106.15	106.81	106.81	107.06	0.015471	2.67	34.02	67.1	1.06
Tooley_Upper	Upper	2593.81	Regional	70.28	106.15	106.78	106.78	107.02	0.015896	2.63	32.14	65.96	1.06
Tooley_Upper	Upper	2500	100yr	75.3	105.13	106.47		106.52	0.002327	1.16	74.33	91.17	0.32
Tooley_Upper	Upper	2500	Regional	70.28	105.13	106.43		106.48	0.002338	1.14	70.95	90.28	0.32
Tooley_Upper	Upper	2400	100yr	75.3	104.67	105.72	105.72	106.03	0.01344	3.38	30.78	50.83	1.06
Tooley_Upper	Upper	2400	Regional	70.28	104.67	105.69	105.69	105.99	0.013513	3.33	29.31	50.28	1.06
Tooley_Upper	Upper	2300	100yr	75.3	103.65	105.48		105.52	0.000805	1.2	82.65	78.7	0.29
Tooley_Upper	Upper	2300	Regional	70.28	103.65	105.51		105.55	0.000639	1.08	85.32	79.79	0.26
Tooley_Upper	Upper	2200	100yr	75.3	102.99	105.46		105.48	0.000216	0.76	122.94	76.92	0.16
Tooley_Upper	Upper	2200	Regional	70.28	102.99	105.5		105.51	0.000176	0.7	125.84	77.52	0.14
Tooley_Upper	Upper	2100	100yr	63.79	101.75	105.46		105.47	0.000028	0.36	228.58	91.35	0.06
Tooley_Upper	Upper	2100	Regional	70.66	101.75	105.5		105.5	0.000033	0.39	231.78	92	0.07
Tooley_Upper	Upper	2000	100yr	63.79	101.08	105.46	101.82	105.46	0.000006	0.22	455.94	159.57	0.03
Tooley_Upper	Upper	2000	Regional	70.66	101.08	105.5	101.85	105.5	0.000007	0.24	460.75	162.7	0.04
Tooley_Upper	Upper	1900	100yr	63.79	100.1	105.46		105.46	0.000002	0.15	670.64	297.21	0.02

**Project:** Robinson and Tooley Flood Mitigation Study  
**Project No.:** 10568  
**Date:** Jun-23

**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	1900	Regional	70.66	100.1	105.5		105.5	0.000003	0.16	681.13	300.83	0.02
Tooley_Upper	Upper	1818.172	100yr	63.79	98.87	105.46		105.46	0.000002	0.18	880.38	447.75	0.02
Tooley_Upper	Upper	1818.172	Regional	70.66	98.87	105.5		105.5	0.000003	0.19	896.1	448.86	0.02
Tooley_Upper	Upper	1800	100yr	63.79	98.53	105.46		105.46	0.000002	0.15	939.74	388.93	0.02
Tooley_Upper	Upper	1800	Regional	70.66	98.53	105.5		105.5	0.000002	0.16	953.44	393.12	0.02
Tooley_Upper	Upper	1779	100yr	63.79	97.53	105.31	100.15	105.45	0.000168	1.64	38.86	409.9	0.19
Tooley_Upper	Upper	1779	Regional	70.66	97.53	105.5	100.34	105.5	0.000003	0.19	894.53	552.97	0.02
Tooley_Upper	Upper	1764.263		Culvert									
Tooley_Upper	Upper	1748	100yr	63.79	97.53	100.77	100.77	102.03	0.013337	4.98	12.8	48.33	1
Tooley_Upper	Upper	1748	Regional	70.66	97.53	100.94	100.94	102.3	0.013074	5.16	13.69	70.22	1
Tooley_Upper	Upper	1700	100yr	63.79	97.62	98.78	98.78	99.05	0.006345	2.82	40.93	77.49	0.86
Tooley_Upper	Upper	1700	Regional	70.66	97.62	98.81	98.81	99.1	0.006709	2.96	43.6	79.5	0.89
Tooley_Upper	Upper	1670.175	100yr	63.79	97.27	98.5		98.59	0.005515	2.84	52.14	73.79	0.82
Tooley_Upper	Upper	1670.175	Regional	70.66	97.27	98.56		98.66	0.005445	2.91	56.42	76.27	0.82
Tooley_Upper	Upper	1600	100yr	63.79	97.02	98.35		98.38	0.001632	0.96	85.09	95.56	0.27
Tooley_Upper	Upper	1600	Regional	70.66	97.02	98.41		98.44	0.001685	1.01	90.41	97.71	0.28
Tooley_Upper	Upper	1500	100yr	84.81	95.92	98.17		98.21	0.001854	1.43	103.21	112.97	0.31
Tooley_Upper	Upper	1500	Regional	87.39	95.92	98.25		98.28	0.00152	1.32	112.1	114.44	0.28
Tooley_Upper	Upper	1412.393	100yr	84.81	94.78	98.06		98.11	0.000797	2	116.62	91.1	0.36
Tooley_Upper	Upper	1412.393	Regional	87.39	94.78	98.16		98.19	0.000715	1.93	125.18	95.67	0.34
Tooley_Upper	Upper	1400	100yr	84.81	94.56	98.07		98.09	0.000701	1.17	124.26	87.7	0.2
Tooley_Upper	Upper	1400	Regional	87.39	94.56	98.16		98.18	0.000616	1.11	132.3	88.57	0.19
Tooley_Upper	Upper	1376	100yr	84.81	94.05	97.81	96.04	98.05	0.000963	2.17	39.76	74.49	0.36

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**Plan:** Tooley\_mitigation (TooleyRobinson.p09)   
**Geometry:** Tooley\_mitigation (TooleyRobinson.g08)   
**Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	1376	Regional	87.39	94.05	97.9	96.08	98.14	0.000942	2.18	40.78	75.61	0.36
Tooley_Upper	Upper	1360.285		Culvert									
Tooley_Upper	Upper	1343.5	100yr	84.81	94.04	96.01	96.01	96.9	0.00894	4.18	20.31	13.58	1
Tooley_Upper	Upper	1343.5	Regional	87.39	94.04	96.05	96.05	96.96	0.008872	4.21	20.75	13.88	1
Tooley_Upper	Upper	1300	100yr	84.81	93.99	95.51	95.45	95.8	0.005297	2.79	47.81	65.49	0.8
Tooley_Upper	Upper	1300	Regional	87.39	93.99	95.47	95.47	95.81	0.006353	3.01	45.63	64.97	0.87
Tooley_Upper	Upper	1270.062	100yr	84.81	93.91	95.4		95.63	0.004857	2.95	49.97	49.05	0.79
Tooley_Upper	Upper	1270.062	Regional	87.39	93.91	95.33		95.61	0.00633	3.25	46.53	48.05	0.89
Tooley_Upper	Upper	1200	100yr	84.81	93.15	95.34		95.45	0.001046	1.69	70.86	48.38	0.38
Tooley_Upper	Upper	1200	Regional	87.39	93.15	95.25		95.38	0.001323	1.84	66.6	47.63	0.43
Tooley_Upper	Upper	1100	100yr	93.55	92.43	95.36		95.4	0.000256	1.04	123.22	60.85	0.2
Tooley_Upper	Upper	1100	Regional	87.88	92.43	95.28		95.32	0.000251	1.01	118.73	60.39	0.2
Tooley_Upper	Upper	1054	100yr	93.55	91.89	95.36		95.39	0.00016	0.94	144.19	56.06	0.16
Tooley_Upper	Upper	1054	Regional	87.88	91.89	95.28		95.31	0.000153	0.91	140.07	55.7	0.16
Tooley_Upper	Upper	1013	100yr	93.55	91.56	95.36		95.38	0.0001	0.79	169.19	60.51	0.13
Tooley_Upper	Upper	1013	Regional	87.88	91.56	95.28		95.31	0.000095	0.76	164.73	60.06	0.13
Tooley_Upper	Upper	1000	100yr	93.55	90.71	95.36		95.38	0.00006	0.68	206.67	73	0.1
Tooley_Upper	Upper	1000	Regional	87.88	90.71	95.29		95.3	0.000057	0.66	201.29	72.31	0.1
Tooley_Upper	Upper	970.5	100yr	93.55	89.9	95.36	92.92	95.37	0.000028	0.54	318.29	106.19	0.07
Tooley_Upper	Upper	970.5	Regional	87.88	89.9	95.29	92.8	95.3	0.000027	0.52	310.43	104.8	0.07
Tooley_Upper	Upper	957.6232		Culvert									
Tooley_Upper	Upper	943.5	100yr	93.55	90.11	95.37	92.93	95.37	0.000021	0.44	431.54	143.76	0.06
Tooley_Upper	Upper	943.5	Regional	87.88	90.11	95.28	92.93	95.28	0.00002	0.42	418.98	141.33	0.06

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**Geometry:** Tooley\_mitigation (TooleyRobinson.g08)   
**Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	900	100yr	93.55	89.09	95.37		95.37	0.000009	0.31	641.38	233.19	0.04
Tooley_Upper	Upper	900	Regional	87.88	89.09	95.28		95.28	0.000008	0.3	620.98	228.8	0.04
Tooley_Upper	Upper	863	100yr	93.55	88.99	95.37		95.37	0.000004	0.21	1000.81	399.92	0.03
Tooley_Upper	Upper	863	Regional	87.88	88.99	95.28		95.28	0.000004	0.21	965.62	397.08	0.03
Tooley_Upper	Upper	800	100yr	111.82	88.78	95.37		95.37	0.000003	0.2	1072.29	373.43	0.03
Tooley_Upper	Upper	800	Regional	108.75	88.78	95.28		95.28	0.000003	0.2	1039.43	370.25	0.03
Tooley_Upper	Upper	784	100yr	111.82	87.66	95.37		95.37	0.000002	0.16	1358.67	383.03	0.02
Tooley_Upper	Upper	784	Regional	108.75	87.66	95.28		95.28	0.000002	0.16	1324.92	381.07	0.02
Tooley_Upper	Upper	780		Lat Struct									
Tooley_Upper	Upper	735	100yr	111.82	86.76	95.37	88.98	95.37	0.000002	0.17	1493.49	480.14	0.02
Tooley_Upper	Upper	735	Regional	108.75	86.76	95.28	88.94	95.28	0.000002	0.17	1454.91	477.91	0.02
Tooley_Upper	Upper	724		Bridge									
Tooley_Upper	Upper	713	100yr	111.82	86.15	95.36	88.82	95.36	0.000003	0.2	1267.56	426.07	0.02
Tooley_Upper	Upper	713	Regional	108.75	86.15	95.28	88.79	95.28	0.000003	0.2	1230.01	422.09	0.02
Tooley_Upper	Upper	709	100yr	111.82	86.02	95.36		95.36	0.000004	0.24	1097.59	429.79	0.03
Tooley_Upper	Upper	709	Regional	108.75	86.02	95.27		95.28	0.000004	0.24	1060.1	419.55	0.03
Tooley_Upper	Upper	705	100yr	111.82	86.66	95.31	89.37	95.36	0.000063	1.03	125.68	384.5	0.12
Tooley_Upper	Upper	705	Regional	108.75	86.66	95.22	89.33	95.27	0.000063	1.02	123.56	379.54	0.12
Tooley_Upper	Upper	641.6027		Mult Open									
Tooley_Upper	Upper	577	100yr	111.82	86.08	91.65	88.58	91.82	0.000355	1.87	59.92	207.62	0.26
Tooley_Upper	Upper	577	Regional	108.75	86.08	91.64	88.54	91.81	0.000336	1.82	59.87	207.48	0.25
Tooley_Upper	Upper	500	100yr	112.14	85.97	91.73		91.74	0.000015	0.4	553.07	176.98	0.06

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**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	500	Regional	108.88	85.97	91.72		91.73	0.000015	0.39	551.53	176.8	0.05
Tooley_Upper	Upper	497	100yr	112.14	85.75	91.73		91.74	0.000005	0.23	918.03	243.63	0.03
Tooley_Upper	Upper	497	Regional	108.88	85.75	91.73		91.73	0.000004	0.22	915.88	243.52	0.03
Tooley_Upper	Upper	483	100yr	112.14	85.19	91.73		91.73	0.000002	0.15	1116.19	237.02	0.02
Tooley_Upper	Upper	483	Regional	108.88	85.19	91.73		91.73	0.000002	0.14	1114.1	236.89	0.02
Tooley_Upper	Upper	451	100yr	112.14	84.5	91.73		91.73	0.000001	0.14	1663.13	507.19	0.02
Tooley_Upper	Upper	451	Regional	108.88	84.5	91.73		91.73	0.000001	0.14	1658.65	505.84	0.02
Tooley_Upper	Upper	438	100yr	112.14	83.91	91.73	86.7	91.73	0.000001	0.12	2321.09	601.52	0.01
Tooley_Upper	Upper	438	Regional	108.88	83.91	91.73	86.65	91.73	0.000001	0.11	2315.78	600.24	0.01
Tooley_Upper	Upper	424		Culvert									
Tooley_Upper	Upper	410	100yr	112.14	83.75	91.73	86.53	91.73	0.000001	0.1	2425.74	576.04	0.01
Tooley_Upper	Upper	410	Regional	108.88	83.75	91.72	86.48	91.72	0	0.09	2422.9	575.89	0.01
Tooley_Upper	Upper	400	100yr	118.78	83.54	91.73		91.73	0.000001	0.11	2484.59	605.44	0.01
Tooley_Upper	Upper	400	Regional	117.47	83.54	91.72		91.72	0.000001	0.11	2481.61	605.13	0.01
Tooley_Upper	Upper	300	100yr	118.78	82.97	91.73		91.73	0.000001	0.1	2844.23	624.52	0.01
Tooley_Upper	Upper	300	Regional	117.47	82.97	91.72		91.72	0	0.1	2841.16	624.31	0.01
Tooley_Upper	Upper	255	100yr	118.78	82.91	91.73		91.73	0	0.08	3120.93	659.32	0.01
Tooley_Upper	Upper	255	Regional	117.47	82.91	91.72		91.72	0	0.08	3117.69	659.04	0.01
Tooley_Upper	Upper	243	100yr	118.78	82.32	91.73	86.6	91.73	0	0.07	3765.88	825.54	0.01
Tooley_Upper	Upper	243	Regional	117.47	82.32	91.72	86.57	91.72	0	0.07	3761.82	825.25	0.01
Tooley_Upper	Upper	227.3807		Mult Open									
Tooley_Upper	Upper	211	100yr	118.78	82.28	86.66	86.66	88.75	0.006696	6.4	18.55	121.74	1
Tooley_Upper	Upper	211	Regional	117.47	82.28	86.64	86.64	88.71	0.006667	6.37	18.45	120.33	1

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**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Upper	Upper	200	100yr	115.11	82.22	84.12		84.27	0.00669	2.49	72.37	91.67	0.58
Tooley_Upper	Upper	200	Regional	118.22	82.22	84.13		84.29	0.006749	2.52	73.57	92.44	0.58
Tooley_Upper	Upper	100	100yr	115.11	81.47	83.22	83.22	83.35	0.013333	3.26	80.6	341.33	0.8
Tooley_Upper	Upper	100	Regional	118.22	81.47	83.22	83.22	83.35	0.01349	3.28	82.3	342.22	0.8
Tooley_Lower	Lower	1000	100yr	154.02	80.59	82.56		82.61	0.003129	1.67	164.95	375.78	0.39
Tooley_Lower	Lower	1000	Regional	137.84	80.59	82.51		82.56	0.003218	1.66	145.82	359.48	0.39
Tooley_Lower	Lower	900	100yr	154.02	79.76	81.69	81.66	81.98	0.017666	3.96	69.46	103.91	0.93
Tooley_Lower	Lower	900	Regional	137.84	79.76	81.64	81.59	81.91	0.017803	3.9	64.15	99.6	0.92
Tooley_Lower	Lower	800	100yr	154.02	78.95	81.07	80.88	81.14	0.004287	2.11	132.74	236.04	0.47
Tooley_Lower	Lower	800	Regional	137.84	78.95	81.04	80.85	81.1	0.004032	2.02	125.91	234.62	0.45
Tooley_Lower	Lower	700	100yr	154.02	78.33	80.21	80.17	80.42	0.013239	3.29	78.85	174.58	0.79
Tooley_Lower	Lower	700	Regional	137.84	78.33	80.14	80.14	80.37	0.016097	3.52	66.43	145.86	0.87
Tooley_Lower	Lower	600	100yr	154.02	77.54	79.73		79.81	0.003153	1.79	124.88	150.25	0.4
Tooley_Lower	Lower	600	Regional	137.84	77.54	79.74		79.8	0.002452	1.58	126.15	150.74	0.35
Tooley_Lower	Lower	500	100yr	138.16	77.19	79.24		79.38	0.006428	2.32	84.41	113.64	0.54
Tooley_Lower	Lower	500	Regional	146.98	77.19	79.27		79.41	0.006592	2.37	87.16	114.4	0.55
Tooley_Lower	Lower	400	100yr	138.16	76.08	78.25	78.24	78.49	0.012783	3.73	68.73	127.6	0.82
Tooley_Lower	Lower	400	Regional	146.98	76.08	78.28	78.26	78.52	0.012447	3.72	72.95	129.17	0.81
Tooley_Lower	Lower	300	100yr	138.16	75.58	77.75		77.82	0.00365	1.98	124.86	143.87	0.43
Tooley_Lower	Lower	300	Regional	146.98	75.58	77.79		77.86	0.00362	2	130.53	145.56	0.43
Tooley_Lower	Lower	200	100yr	138.16	75.1	77.36		77.44	0.003784	2.12	115.9	125.95	0.45
Tooley_Lower	Lower	200	Regional	146.98	75.1	77.4		77.48	0.00379	2.15	120.93	127.9	0.45
Tooley_Lower	Lower	100	100yr	138.16	75.1	77.05	76.35	77.11	0.002786	1.65	123.73	118.87	0.38



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**Geometry:** Tooley\_mitigation (TooleyRobinson.g08)   
**Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Tooley_Lower	Lower	100	Regional	146.98	75.1	77.08	76.38	77.15	0.002886	1.69	127.54	120.31	0.38
Tooley_Lower	Lower	8.907429	100yr	138.16	75.1	76.32	76.32	76.51	0.018452	5.18	83.78	186.26	1.5
Tooley_Lower	Lower	8.907429	Regional	146.98	75.1	76.33	76.33	76.54	0.019214	5.32	86.03	186.64	1.53
RobinsonWest	West	486.4874	100yr	34.14	96.16	97.68	97.68	97.88	0.00743	2.93	24.49	60.75	0.8
RobinsonWest	West	486.4874	Regional	18.18	96.16	97.45	97.45	97.64	0.00715	2.54	13.74	35.29	0.77
RobinsonWest	West	400	100yr	34.14	95.2	96.85	96.85	97	0.005676	2.36	32.19	92.79	0.69
RobinsonWest	West	400	Regional	18.18	95.2	96.7	96.7	96.83	0.004473	1.92	19.41	78.09	0.6
RobinsonWest	West	300	100yr	46.68	94.02	96.14		96.18	0.0011	1.4	71.42	88.74	0.33
RobinsonWest	West	300	Regional	23.33	94.02	95.78		95.81	0.001125	1.23	41.78	73.91	0.32
RobinsonWest	West	193.175	100yr	46.68	93.64	96.12		96.13	0.000211	0.71	140.76	159.24	0.15
RobinsonWest	West	193.175	Regional	23.33	93.64	95.75		95.76	0.000194	0.61	87.95	129.69	0.14
RobinsonWest	West	176.2835	100yr	46.68	92.92	96.11	94.49	96.12	0.00036	1.07	136.96	173.73	0.2
RobinsonWest	West	176.2835	Regional	23.33	92.92	95.74	94.15	95.75	0.000346	0.96	80.68	135.01	0.19
RobinsonWest	West	165.6963		Mult Open									
RobinsonWest	West	154.4447	100yr	46.68	92.88	96.1		96.1	0.000017	0.23	149.49	173.49	0.04
RobinsonWest	West	154.4447	Regional	23.33	92.88	94.93		95.02	0.001043	1.3	17.54	45.34	0.31
RobinsonWest	West	122.0857	100yr	46.68	93.03	96.1		96.1	0.000144	0.63	205.21	190.25	0.12
RobinsonWest	West	122.0857	Regional	23.33	93.03	94.93		94.97	0.001034	1.15	46.03	91.7	0.3
RobinsonWest	West	7.527757	100yr	46.68	91.63	96.1		96.1	0.000003	0.13	581.45	311.77	0.02
RobinsonWest	West	7.527757	Regional	23.33	91.63	94.95		94.96	0.000004	0.12	301.07	177.98	0.02
RobinsonUpper	Upper	3542.466	100yr	2.02	132.1	133.2	132.61	133.2	0.00016	0.37	18.98	71.95	0.11
RobinsonUpper	Upper	3542.466	Regional	0.86	132.1	132.9	132.45	132.9	0.000278	0.39	6.4	25.68	0.14
RobinsonUpper	Upper	3494.811	100yr	2.02	131.88	133.19	132.39	133.2	0.000096	0.32	18.22	36.57	0.09

**Project:** Robinson and Tooley Flood Mitigation Study  
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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	3494.811	Regional	0.86	131.88	132.89	132.22	132.9	0.000075	0.24	9.71	21.87	0.08
RobinsonUpper	Upper	3484.383	100yr	2.02	132.03	133.18	132.42	133.19	0.000239	0.46	7.97	30.26	0.14
RobinsonUpper	Upper	3484.383	Regional	0.86	132.03	132.89	132.27	132.89	0.000112	0.26	4.39	19.25	0.09
RobinsonUpper	Upper	3469.744		Mult Open									
RobinsonUpper	Upper	3454.014	100yr	2.02	132.13	132.81		132.84	0.001601	0.81	3.02	12.91	0.33
RobinsonUpper	Upper	3454.014	Regional	0.86	132.13	132.43		132.49	0.009962	1.02	0.88	6.52	0.7
RobinsonUpper	Upper	3430.442	100yr	2.02	131.86	132.81	132.32	132.82	0.000331	0.48	13.92	47.17	0.16
RobinsonUpper	Upper	3430.442	Regional	0.86	131.86	132.36	132.19	132.38	0.002089	0.76	2.55	11.95	0.36
RobinsonUpper	Upper	3400	100yr	2.02	131.78	132.8		132.81	0.000321	0.49	11.88	35.64	0.16
RobinsonUpper	Upper	3400	Regional	0.86	131.78	132.3		132.32	0.002056	0.75	2.24	9.88	0.36
RobinsonUpper	Upper	3344.928	100yr	2.02	131.6	132.78	132.12	132.79	0.000305	0.51	10.03	38.04	0.16
RobinsonUpper	Upper	3344.928	Regional	0.86	131.6	132.22	131.94	132.23	0.001252	0.64	1.94	6.39	0.28
RobinsonUpper	Upper	3334.47	100yr	2.02	131.49	132.75	132.19	132.78	0.000994	0.92	3.17	8.24	0.28
RobinsonUpper	Upper	3334.47	Regional	0.86	131.49	132.17	131.97	132.21	0.002778	0.93	1.24	4.07	0.41
RobinsonUpper	Upper	3316.727		Culvert									
RobinsonUpper	Upper	3298.848	100yr	2.02	131.61	132.01	132.01	132.19	0.016454	1.91	1.06	17.19	0.99
RobinsonUpper	Upper	3298.848	Regional	0.86	131.61	131.87	131.84	131.95	0.014138	1.3	0.66	14.81	0.85
RobinsonUpper	Upper	3274.914	100yr	2.02	131.26	131.83	131.77	131.87	0.003952	1.07	4.86	30.44	0.5
RobinsonUpper	Upper	3274.914	Regional	0.86	131.26	131.67	131.6	131.72	0.006715	1.06	1.39	12.77	0.6
RobinsonUpper	Upper	3200	100yr	7.71	130.86	131.61		131.63	0.002936	1.17	18.74	57.76	0.45
RobinsonUpper	Upper	3200	Regional	1.82	130.86	131.33		131.35	0.004162	0.98	4.69	25.65	0.49
RobinsonUpper	Upper	3100	100yr	7.71	130.61	131.34		131.36	0.002498	1.11	18.22	44.97	0.42
RobinsonUpper	Upper	3100	Regional	1.82	130.61	131.06		131.07	0.001962	0.7	7.13	34.28	0.34

**Project:** Robinson and Tooley Flood Mitigation Study  
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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09)    **Geometry:** Tooley\_mitigation (TooleyRobinson.g08)    **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	3000	100yr	7.71	130.32	131.2	130.96	131.21	0.000988	0.77	29.36	81.05	0.27
RobinsonUpper	Upper	3000	Regional	1.82	130.32	130.98	130.78	130.99	0.000464	0.43	13.66	65.08	0.18
RobinsonUpper	Upper	2917.452	100yr	7.71	129.96	131.2	130.58	131.2	0.000041	0.2	138.35	305.13	0.06
RobinsonUpper	Upper	2917.452	Regional	1.82	129.96	130.98	130.38	130.98	0.00001	0.09	77.97	254.1	0.03
RobinsonUpper	Upper	2906.009	100yr	7.71	129.59	131.1	131.1	131.19	0.004301	1.62	15.61	98.17	0.57
RobinsonUpper	Upper	2906.009	Regional	1.82	129.59	130.95	130.13	130.98	0.001105	0.72	3.23	60.14	0.28
RobinsonUpper	Upper	2894.43											
RobinsonUpper	Upper	2882.851	100yr	7.71	129.58	130.62	130.62	130.76	0.012673	1.97	7.15	24.19	0.91
RobinsonUpper	Upper	2882.851	Regional	1.82	129.58	130.4	130.06	130.46	0.009297	1.13	2.07	22.9	0.7
RobinsonUpper	Upper	2855.66	100yr	7.71	129.88	130.51	130.39	130.53	0.003468	1.16	19.34	78.23	0.48
RobinsonUpper	Upper	2855.66	Regional	1.82	129.88	130.32	130.24	130.33	0.003391	0.87	6.29	52.03	0.45
RobinsonUpper	Upper	2800	100yr	7.71	129.48	130.12	130.12	130.19	0.01278	1.89	12.14	68.93	0.89
RobinsonUpper	Upper	2800	Regional	1.82	129.48	129.98	129.98	130.03	0.009341	1.32	3.46	35.88	0.72
RobinsonUpper	Upper	2700	100yr	7.71	128.15	128.73	128.73	128.86	0.012235	2.07	4.98	18.48	0.89
RobinsonUpper	Upper	2700	Regional	1.82	128.15	128.55	128.55	128.62	0.011135	1.5	1.8	13.2	0.8
RobinsonUpper	Upper	2600	100yr	8.01	126.86	127.71		127.79	0.005032	1.66	6.57	19.01	0.61
RobinsonUpper	Upper	2600	Regional	2.66	126.86	127.46	127.46	127.54	0.00704	1.51	2.5	13.18	0.67
RobinsonUpper	Upper	2539.354	100yr	8.01	126.65	127.5		127.56	0.002884	1.3	7.49	17.05	0.46
RobinsonUpper	Upper	2539.354	Regional	2.66	126.65	127.22		127.26	0.00297	0.99	3.45	12.96	0.44
RobinsonUpper	Upper	2529.293	100yr	8.01	126.55	127.5		127.53	0.001323	0.95	10.02	19.02	0.32
RobinsonUpper	Upper	2529.293	Regional	2.66	126.55	127.22		127.23	0.001105	0.68	5.09	16.27	0.27
RobinsonUpper	Upper	2519.291	100yr	8.01	126.75	127.46		127.51	0.002487	1.1	8.04	18.02	0.42
RobinsonUpper	Upper	2519.291	Regional	2.66	126.75	127.18		127.21	0.003595	0.94	3.5	14.77	0.47

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**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	2499.168	100yr	8.01	126.44	127.32		127.43	0.006937	2.05	6.82	14.97	0.72
RobinsonUpper	Upper	2499.168	Regional	2.66	126.44	127.04		127.11	0.007043	1.56	3	11.9	0.68
RobinsonUpper	Upper	2400	100yr	8.01	126.24	126.84		126.87	0.004254	1.27	9.73	19.01	0.54
RobinsonUpper	Upper	2400	Regional	2.66	126.24	126.57		126.58	0.003948	0.81	4.9	16.93	0.46
RobinsonUpper	Upper	2300	100yr	12.48	125.59	126.21	126.13	126.25	0.008187	1.76	14.91	52.59	0.74
RobinsonUpper	Upper	2300	Regional	3.64	125.59	126.05		126.07	0.006097	1.23	7.19	46.25	0.61
RobinsonUpper	Upper	2200	100yr	12.48	124.91	125.58	125.54	125.62	0.004993	1.46	16.62	78.05	0.59
RobinsonUpper	Upper	2200	Regional	3.64	124.91	125.45	125.45	125.48	0.005775	1.34	6.75	68.92	0.6
RobinsonUpper	Upper	2154.378	100yr	12.48	124.68	125.53		125.54	0.000792	0.69	29.88	81.95	0.24
RobinsonUpper	Upper	2154.378	Regional	3.64	124.68	125.24	125.09	125.27	0.003685	1.11	7.64	67.39	0.49
RobinsonUpper	Upper	2100	100yr	12.48	124.1	125.18	125.18	125.41	0.010057	2.72	7.76	16.53	0.89
RobinsonUpper	Upper	2100	Regional	3.64	124.1	124.75	124.75	124.92	0.012521	2.04	2.49	8.17	0.89
RobinsonUpper	Upper	2000	100yr	18.19	121.93	123	123	123.31	0.015494	3.28	8.68	14.63	1.09
RobinsonUpper	Upper	2000	Regional	8.58	121.93	122.69	122.69	122.91	0.017214	2.65	4.75	11.3	1.08
RobinsonUpper	Upper	1900	100yr	18.19	118.54	119.72	119.72	119.99	0.010944	3.09	9.98	20.81	0.94
RobinsonUpper	Upper	1900	Regional	8.58	118.54	119.39	119.39	119.62	0.013069	2.65	4.95	11.36	0.97
RobinsonUpper	Upper	1800	100yr	18.19	115.2	116.44	116.44	116.78	0.012186	3.21	8.68	14.24	0.99
RobinsonUpper	Upper	1800	Regional	8.58	115.2	116.09	116.09	116.35	0.013754	2.62	4.45	9.88	0.99
RobinsonUpper	Upper	1700	100yr	28.96	112.31	112.85	112.85	113.07	0.028619	3.01	14.47	33.7	1.35
RobinsonUpper	Upper	1700	Regional	16.49	112.31	112.7	112.7	112.86	0.033294	2.58	9.61	31.75	1.38
RobinsonUpper	Upper	1478.247	100yr	28.96	107.45	111.85	109.74	111.89	0.000556	1.72	52.6	181.41	0.26
RobinsonUpper	Upper	1478.247	Regional	16.49	107.45	111.64	109.17	111.71	0.000462	1.51	14.84	177.38	0.24
RobinsonUpper	Upper	1466.204		Culvert									

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**Geometry:** Tooley\_mitigation (TooleyRobinson.g08)   
**Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	1454.188	100yr	28.96	106.9	109.36	109.36	110.58	0.00431	3.33	7.02	112.86	0.69
RobinsonUpper	Upper	1454.188	Regional	16.49	106.9	108.6	108.6	109.44	0.005525	2.93	4.7	82.93	0.73
RobinsonUpper	Upper	1421.456	100yr	28.96	106.75	107.83		107.9	0.005547	1.91	29.92	62.42	0.65
RobinsonUpper	Upper	1421.456	Regional	16.49	106.75	107.63		107.69	0.005957	1.68	18.86	50.37	0.64
RobinsonUpper	Upper	1400	100yr	28.96	106.42	107.49	107.49	107.7	0.014416	3.23	18.51	43.77	1.06
RobinsonUpper	Upper	1400	Regional	16.49	106.42	107.35	107.35	107.5	0.012353	2.67	12.6	36.66	0.95
RobinsonUpper	Upper	1300	100yr	28.96	105.59	106.53		106.56	0.003039	1.43	37.49	64.51	0.48
RobinsonUpper	Upper	1300	Regional	16.49	105.59	106.37		106.39	0.002447	1.13	27.76	59.59	0.42
RobinsonUpper	Upper	1200	100yr	27.3	104.78	105.76	105.76	105.96	0.017684	3.59	17.96	39.82	1.18
RobinsonUpper	Upper	1200	Regional	19.31	104.78	105.67	105.67	105.84	0.016338	3.23	14.53	37.52	1.12
RobinsonUpper	Upper	1100	100yr	27.3	103.75	105.06		105.11	0.003278	1.86	33.76	42.96	0.53
RobinsonUpper	Upper	1100	Regional	19.31	103.75	104.89		104.93	0.003204	1.67	26.88	39.27	0.51
RobinsonUpper	Upper	1000	100yr	27.3	103.04	104.27	104.22	104.5	0.013048	3.56	18.3	29.5	1.05
RobinsonUpper	Upper	1000	Regional	19.31	103.04	104.11	104.1	104.33	0.014295	3.36	13.68	25.9	1.07
RobinsonUpper	Upper	900	100yr	37.48	102.03	103.4		103.51	0.007802	2.14	27.99	31.88	0.76
RobinsonUpper	Upper	900	Regional	26.73	102.03	103.22		103.31	0.007762	1.97	22.36	30.27	0.74
RobinsonUpper	Upper	800	100yr	37.48	100.84	102.18	102.12	102.43	0.015345	4.17	22.32	31.38	1.16
RobinsonUpper	Upper	800	Regional	26.73	100.84	102.02	101.96	102.24	0.015215	3.81	17.41	29.93	1.13
RobinsonUpper	Upper	700	100yr	37.48	99.37	100.56	100.56	100.85	0.016281	3.92	19.36	30.96	1.17
RobinsonUpper	Upper	700	Regional	26.73	99.37	100.43	100.43	100.67	0.016153	3.59	15.33	28.97	1.14
RobinsonUpper	Upper	600	100yr	37.48	97.64	99.14		99.3	0.006411	2.89	24.71	29.85	0.76
RobinsonUpper	Upper	600	Regional	26.73	97.64	98.99		99.11	0.005756	2.55	20.25	28.91	0.71
RobinsonUpper	Upper	500	100yr	40.27	96.51	98.21	98.21	98.53	0.008829	3.2	25.03	41.77	0.88

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**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonUpper	Upper	500	Regional	31.02	96.51	98.07	98.07	98.37	0.008972	3	19.69	35.29	0.87
RobinsonUpper	Upper	400	100yr	40.27	94.75	96.2		96.41	0.009949	3.44	26.22	41.79	0.94
RobinsonUpper	Upper	400	Regional	31.02	94.75	96.18		96.31	0.006444	2.73	25.28	39.54	0.75
RobinsonUpper	Upper	300	100yr	40.27	93.81	96.07		96.12	0.001047	1.49	54.74	67.45	0.33
RobinsonUpper	Upper	300	Regional	31.02	93.81	95.35	95.35	95.59	0.007802	3.09	18.15	34.3	0.83
RobinsonUpper	Upper	200	100yr	40.27	92.7	96.1		96.1	0.000016	0.23	378.88	231.58	0.04
RobinsonUpper	Upper	200	Regional	31.02	92.7	94.95		94.96	0.000121	0.46	146.33	170.85	0.11
RobinsonUpper	Upper	11.06822	100yr	40.27	91.81	96.1		96.1	0	0.04	1323.84	509.08	0.01
RobinsonUpper	Upper	11.06822	Regional	31.02	91.81	94.96		94.96	0.000001	0.06	791.21	429.53	0.01
RobinsonLower	Lower	2075.481	100yr	86.94	91.47	96.1		96.1	0.000002	0.11	1226.16	457.71	0.02
RobinsonLower	Lower	2075.481	Regional	53.91	91.47	94.95		94.96	0.000004	0.11	741.32	389.97	0.02
RobinsonLower	Lower	2000	100yr	86.94	91.13	96.1		96.1	0.000003	0.13	1174.28	428.9	0.02
RobinsonLower	Lower	2000	Regional	53.91	91.13	94.95		94.95	0.000006	0.13	713.59	376.3	0.02
RobinsonLower	Lower	1900	100yr	86.94	90.68	96.1		96.1	0.000002	0.12	1299.52	411.84	0.02
RobinsonLower	Lower	1900	Regional	53.91	90.68	94.95		94.95	0.000003	0.12	853.84	366.2	0.02
RobinsonLower	Lower	1800	100yr	86.94	90.11	96.1		96.1	0.000002	0.13	1313.62	403.92	0.02
RobinsonLower	Lower	1800	Regional	53.91	90.11	94.95		94.95	0.000002	0.12	874.35	361.47	0.02
RobinsonLower	Lower	1700	100yr	86.94	89.93	96.1		96.1	0.000002	0.11	1405.95	415.43	0.01
RobinsonLower	Lower	1700	Regional	53.91	89.93	94.95		94.95	0.000002	0.11	952.38	377.88	0.02
RobinsonLower	Lower	1600	100yr	75.46	89.14	96.1		96.1	0.000001	0.1	1420.01	440.18	0.01
RobinsonLower	Lower	1600	Regional	60.09	89.14	94.95		94.95	0.000002	0.13	944.01	392.51	0.02
RobinsonLower	Lower	1500	100yr	75.46	89.05	96.1		96.1	0.000001	0.09	1448.04	434.64	0.01
RobinsonLower	Lower	1500	Regional	60.09	89.05	94.95		94.95	0.000002	0.11	985.97	356.13	0.02

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**Date:** Jun-23

**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	1408.42	100yr	75.46	89.04	96.1		96.1	0.000002	0.15	1011.82	387.96	0.02
RobinsonLower	Lower	1408.42	Regional	60.09	89.04	94.95		94.95	0.000005	0.21	625.07	288.81	0.03
RobinsonLower	Lower	1389.432	100yr	75.46	89.23	96.02		96.09	0.000217	1.48	66.2	358.66	0.18
RobinsonLower	Lower	1389.432	Regional	60.09	89.23	94.88		94.95	0.000257	1.42	54.88	255.4	0.19
RobinsonLower	Lower	1370.068		Culvert									
RobinsonLower	Lower	1349.056	100yr	75.46	88.42	95.34	91.26	96.08	0.002295	4.82	70.2	331.75	0.59
RobinsonLower	Lower	1349.056	Regional	60.09	88.42	93.34		93.53	0.001044	2.58	32.86	82.38	0.37
RobinsonLower	Lower	1318.902	100yr	75.46	87.8	95.44		95.44	0.000002	0.15	789.46	308.82	0.02
RobinsonLower	Lower	1318.902	Regional	60.09	87.8	93.47		93.47	0.000008	0.25	359.9	145.5	0.03
RobinsonLower	Lower	1300	100yr	76.95	87.85	95.44		95.44	0.000003	0.18	727.64	291.43	0.02
RobinsonLower	Lower	1300	Regional	61.99	87.85	93.47		93.47	0.000009	0.27	338.13	125.43	0.04
RobinsonLower	Lower	1225.673	100yr	76.95	86.9	95.44		95.44	0.000005	0.26	542.01	273.21	0.03
RobinsonLower	Lower	1225.673	Regional	61.99	86.9	93.47		93.47	0.000014	0.36	235.45	68.28	0.05
RobinsonLower	Lower	1208.394	100yr	76.95	86.55	95.43	89.99	95.44	0.000005	0.84	306.1	273.09	0.09
RobinsonLower	Lower	1208.394	Regional	61.99	86.55	93.24	89.6	93.45	0.000486	2.17	31.05	63.86	0.27
RobinsonLower	Lower	1186.848		Culvert									
RobinsonLower	Lower	1174.573	100yr	76.95	86.36	95.37		95.37	0.000012	0.43	566.48	290.99	0.05
RobinsonLower	Lower	1174.573	Regional	61.99	86.36	91.73	89.39	92.44	0.002356	4.25	37.23	66.39	0.59
RobinsonLower	Lower	1170		Lat Struct									
RobinsonLower	Lower	1146.689	100yr	73.73	85.94	95.37		95.37	0.000001	0.11	1111.95	347.9	0.01
RobinsonLower	Lower	1146.689	Regional	61.99	85.94	92.15		92.16	0.000003	0.18	423.89	116.22	0.03
RobinsonLower	Lower	1076.022	100yr	75.3	85.39	95.37		95.37	0.000001	0.15	1030.01	392.3	0.02
RobinsonLower	Lower	1076.022	Regional	62.72	85.39	92.15		92.16	0.000005	0.24	345.08	110.73	0.03

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**Project No.:** 10568  
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**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09) **Geometry:** Tooley\_mitigation (TooleyRobinson.g08) **Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	1050.327	100yr	75.27	84.97	95.32	87.22	95.36	0.000037	0.96	78.74	371.89	0.1
RobinsonLower	Lower	1050.327	Regional	62.72	84.97	92.08	86.97	92.15	0.000092	1.17	53.82	102.65	0.14
RobinsonLower	Lower	994.6486		Culvert									
RobinsonLower	Lower	928.2293	100yr	75.27	82.86	92.47		92.5	0.000071	1.06	251.88	197.34	0.11
RobinsonLower	Lower	928.2293	Regional	62.72	82.86	90.14		90.27	0.000309	1.83	43.18	91.25	0.22
RobinsonLower	Lower	918.8482	100yr	75.27	82.75	92.46	85.34	92.49	0.000071	0.93	94.86	120.02	0.1
RobinsonLower	Lower	918.8482	Regional	62.72	82.75	90.2	85.15	90.24	0.000129	1.05	70.96	97.86	0.12
RobinsonLower	Lower	899.0165		Culvert									
RobinsonLower	Lower	876.9869	100yr	75.94	82.53	86.25		86.66	0.002089	3.08	26.96	33.95	0.52
RobinsonLower	Lower	876.9869	Regional	63.52	82.53	84.99	84.84	85.77	0.007211	4.33	16.61	32.85	0.89
RobinsonLower	Lower	834.4676	100yr	75.94	82.37	86.52		86.53	0.000049	0.5	173.66	55.38	0.08
RobinsonLower	Lower	834.4676	Regional	63.52	82.37	85.51		85.53	0.0001	0.6	120.77	49.57	0.11
RobinsonLower	Lower	823.6441	100yr	75.94	82.29	86.52		86.53	0.000036	0.44	196.26	59.34	0.07
RobinsonLower	Lower	823.6441	Regional	63.52	82.29	85.51		85.53	0.00007	0.51	139.48	53.58	0.09
RobinsonLower	Lower	800.6076	100yr	75.94	80.77	86.36	83.4	86.52	0.000451	1.9	44.55	48.13	0.26
RobinsonLower	Lower	800.6076	Regional	63.52	80.77	85.34	83.19	85.51	0.000682	2.04	35.31	43.04	0.31
RobinsonLower	Lower	787.4796		Mult Open									
RobinsonLower	Lower	772.9675	100yr	79.32	80.04	82.84	82.84	83.46	0.010142	5.65	34.19	58.6	1.09
RobinsonLower	Lower	772.9675	Regional	63.52	80.04	82.67	82.67	83.2	0.009155	5.15	30.52	58.28	1.02
RobinsonLower	Lower	728.9347	100yr	79.32	80.86	82.78		82.88	0.003023	2.35	76.15	64.42	0.55
RobinsonLower	Lower	728.9347	Regional	63.52	80.86	82.62		82.71	0.00296	2.19	66.01	63.57	0.54
RobinsonLower	Lower	700	100yr	79.32	80.76	82.29	82.29	82.69	0.012972	4.14	41.04	46.53	1.09



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**Project No.:** 10568  
**Date:** Jun-23

**Table C6: Hec Ras Output**

**Plan:** Tooley\_mitigation (TooleyRobinson.p09)   
**Geometry:** Tooley\_mitigation (TooleyRobinson.g08)   
**Flow:** PropReg\_flows (TooleyRobinson.f09)

**Description:** To evaluate structural mitigation options.

River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
RobinsonLower	Lower	700	Regional	63.52	80.76	82.18	82.18	82.53	0.012305	3.82	35.76	45.85	1.05
RobinsonLower	Lower	600	100yr	79.32	79.1	81.5		81.64	0.003236	2.16	56.04	37.49	0.55
RobinsonLower	Lower	600	Regional	63.52	79.1	80.75	80.75	81.15	0.012957	3.52	29.5	33.28	1.04
RobinsonLower	Lower	500	100yr	82.42	77.13	81.52		81.55	0.000236	1.04	138.5	54.9	0.17
RobinsonLower	Lower	500	Regional	67.83	77.13	80.29		80.36	0.000794	1.47	76.1	46.37	0.29
RobinsonLower	Lower	400	100yr	82.42	76.53	81.53		81.53	0.000055	0.56	290.55	113.64	0.08
RobinsonLower	Lower	400	Regional	67.83	76.53	80.3		80.32	0.000158	0.78	170.15	83.14	0.14
RobinsonLower	Lower	349.8643	100yr	82.42	76.3	81.53		81.53	0.000008	0.24	647.1	256.75	0.03
RobinsonLower	Lower	349.8643	Regional	67.83	76.3	80.31		80.31	0.000029	0.36	364.84	194.92	0.06
RobinsonLower	Lower	310.5079	100yr	82.42	75.81	77.56	77.56	81.17	0.057958	9.78	9.95	68.96	2.39
RobinsonLower	Lower	310.5079	Regional	67.83	75.81	77.54	77.54	80.05	0.040935	8.17	9.82	68.62	2
RobinsonLower	Lower	302.0028		Culvert									
RobinsonLower	Lower	289.6513	100yr	82.42	75.83	77.87	77.87	78.08	0.007604	3.96	46.64	94.09	0.89
RobinsonLower	Lower	289.6513	Regional	67.83	75.83	77.8	77.8	78.01	0.00773	3.91	40.61	92.05	0.89
RobinsonLower	Lower	254.9745	100yr	82.42	75.46	77.18		77.25	0.003157	2.21	95.35	117.74	0.55
RobinsonLower	Lower	254.9745	Regional	67.83	75.46	77.08		77.15	0.002986	2.06	84.46	113.63	0.53
RobinsonLower	Lower	200	100yr	82.42	75.28	76.75	76.75	76.96	0.009472	3.2	69.19	141.42	0.91
RobinsonLower	Lower	200	Regional	67.83	75.28	76.71	76.71	76.89	0.008069	2.89	63.37	139.31	0.83

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**Table C7: Water Surface Elevation Comparison**

Description: Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_mitigation	ExReg	PropReg	Tooley_mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_West	TribW1	300	100yr	94.79	94.61	94.51	94.79	94.61	94.51	-0.18	-0.28
Tooley_West	TribW1	300	Regional	94.51	94.51	94.51					
Tooley_West	TribW1	200	100yr	94.67	94.61	94.33	94.67	94.61	94.33	-0.06	-0.34
Tooley_West	TribW1	200	Regional	94.44	94.45	93.9					
Tooley_West	TribW1	100	100yr	94.66	94.6	94.32	94.66	94.6	94.32	-0.06	-0.34
Tooley_West	TribW1	100	Regional	94.44	94.45	93.83					
Tooley_West	TribW1	50	100yr	94.48	94.6	94.29	94.48	94.6	94.29	0.12	-0.19
Tooley_West	TribW1	50	Regional	94.44	94.45	93.83					
Tooley_West	TribW2	3000	100yr	94.54	94.6	94.3	94.54	94.6	94.3	0.06	-0.24
Tooley_West	TribW2	3000	Regional	94.44	94.45	93.94					
Tooley_West	TribW2	2000	100yr	94.54	94.6	94.3	94.54	94.6	94.3	0.06	-0.24
Tooley_West	TribW2	2000	Regional	94.44	94.45	93.83					
Tooley_West	TribW2	1000	100yr	94.54	94.6	94.3	94.54	94.6	94.3	0.06	-0.24
Tooley_West	TribW2	1000	Regional	94.44	94.45	93.83					
Tooley_West	Downstream	1046	100yr	94.54	94.6	94.3	94.54	94.6	94.3	0.06	-0.24
Tooley_West	Downstream	1046	Regional	94.44	94.45	93.83					
Tooley_West	Downstream	1021.5									
Tooley_West	Downstream	997	100yr	92.85	92.85	92.85	92.85	92.85	92.85	0	0
Tooley_West	Downstream	997	Regional	92.36	92.39	92.39					
Tooley_West	Downstream	962	100yr	92.03	92.03	92.03	92.03	92.03	92.03	0	0
Tooley_West	Downstream	962	Regional	92.03	92.03	92.03					
Tooley_West	Downstream	869	100yr	91.68	91.75	91.75	91.68	91.75	91.75	0.07	0.07

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**Table C7: Water Surface Elevation Comparison**

Description: Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_mitigation	ExReg	PropReg	Tooley_mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_West	Downstream	869	Regional	91.53	91.54	91.54					
Tooley_West	Downstream	794	100yr	91.46	91.51	91.51	91.46	91.51	91.51	0.05	0.05
Tooley_West	Downstream	794	Regional	91.37	91.38	91.38					
Tooley_West	Downstream	736	100yr	91.51	91.56	91.56	91.51	91.56	91.56	0.05	0.05
Tooley_West	Downstream	736	Regional	91.39	91.4	91.4					
Tooley_West	Downstream	720	100yr	91.5	91.55	91.56	91.5	91.55	91.56	0.05	0.06
Tooley_West	Downstream	720	Regional	91.39	91.4	91.4					
Tooley_West	Downstream	704									
Tooley_West	Downstream	700	100yr	90.66	90.66	90.66	90.66	90.66	90.66	0	0
Tooley_West	Downstream	700	Regional	90.1	90.13	90.13					
Tooley_West	Downstream	688	100yr	89.85	90.01	90.01	89.85	90.01	90.01	0.16	0.16
Tooley_West	Downstream	688	Regional	89.69	89.7	89.7					
Tooley_West	Downstream	668	100yr	89.55	89.66	89.66	89.55	89.66	89.66	0.11	0.11
Tooley_West	Downstream	668	Regional	89.42	89.42	89.42					
Tooley_West	Downstream	600	100yr	89.44	89.56	89.56	89.44	89.56	89.56	0.12	0.12
Tooley_West	Downstream	600	Regional	89.29	89.3	89.3					
Tooley_West	Downstream	500	100yr	89.17	89.28	89.28	89.17	89.28	89.28	0.11	0.11
Tooley_West	Downstream	500	Regional	89.07	89.08	89.08					
Tooley_West	Downstream	400	100yr	88.71	88.84	88.84	88.71	88.84	88.84	0.13	0.13
Tooley_West	Downstream	400	Regional	88.53	88.54	88.54					
Tooley_West	Downstream	300	100yr	87.92	88.05	88.04	87.92	88.05	88.04	0.13	0.12
Tooley_West	Downstream	300	Regional	87.71	87.72	87.72					

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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_West	Downstream	200	100yr	86.25	86.34	86.34	86.25	86.34	86.34	0.09	0.09
Tooley_West	Downstream	200	Regional	86.08	86.09	86.09					
Tooley_West	Downstream	100	100yr	83.7	83.8	83.8	83.7	83.8	83.8	0.1	0.1
Tooley_West	Downstream	100	Regional	83.54	83.55	83.55					
Tooley_Upper	Upper	4800	100yr	128.83	129.07	129.07	129	129.09	129.09	0.09	0.09
Tooley_Upper	Upper	4800	Regional	129	129.09	129.09					
Tooley_Upper	Upper	4700	100yr	128.52	128.89	128.89	128.78	128.89	128.89	0.11	0.11
Tooley_Upper	Upper	4700	Regional	128.78	128.85	128.85					
Tooley_Upper	Upper	4600	100yr	128.21	128.5	128.5	128.41	128.5	128.5	0.09	0.09
Tooley_Upper	Upper	4600	Regional	128.41	128.45	128.45					
Tooley_Upper	Upper	4500.017	100yr	127	127.17	127.17	127.11	127.17	127.17	0.06	0.06
Tooley_Upper	Upper	4500.017	Regional	127.11	127.14	127.14					
Tooley_Upper	Upper	4400	100yr	125.79	126.18	126.18	126.04	126.18	126.18	0.14	0.14
Tooley_Upper	Upper	4400	Regional	126.04	126.1	126.1					
Tooley_Upper	Upper	4300	100yr	124.91	125.28	125.28	125.16	125.28	125.28	0.12	0.12
Tooley_Upper	Upper	4300	Regional	125.16	125.24	125.24					
Tooley_Upper	Upper	4200	100yr	123.46	123.88	123.88	123.79	123.88	123.88	0.09	0.09
Tooley_Upper	Upper	4200	Regional	123.79	123.88	123.88					
Tooley_Upper	Upper	4100	100yr	121.08	121.32	121.32	121.26	121.33	121.33	0.07	0.07
Tooley_Upper	Upper	4100	Regional	121.26	121.33	121.33					
Tooley_Upper	Upper	4000	100yr	119.37	120.43	120.43	120.28	120.46	120.46	0.18	0.18
Tooley_Upper	Upper	4000	Regional	120.28	120.46	120.46					

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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	3900	100yr	118.27	120.43	120.43	120.28	120.46	120.46	0.18	0.18
Tooley_Upper	Upper	3900	Regional	120.28	120.46	120.46					
Tooley_Upper	Upper	3896.167	100yr	118.21	120.43	120.43	120.28	120.46	120.46	0.18	0.18
Tooley_Upper	Upper	3896.167	Regional	120.28	120.46	120.46					
Tooley_Upper	Upper	3884	100yr	118.2	120.43	120.43	120.28	120.46	120.46	0.18	0.18
Tooley_Upper	Upper	3884	Regional	120.28	120.46	120.46					
Tooley_Upper	Upper	3875.491	BLOOR								
Tooley_Upper	Upper	3866	100yr	117.86	118.41	118.41	118.23	118.45	118.45	0.22	0.22
Tooley_Upper	Upper	3866	Regional	118.23	118.45	118.45					
Tooley_Upper	Upper	3840.997	100yr	117.86	118.38	118.38	118.27	118.4	118.4	0.13	0.13
Tooley_Upper	Upper	3840.997	Regional	118.27	118.4	118.4					
Tooley_Upper	Upper	3800	100yr	117.6	118.04	118.04	117.93	118.04	118.04	0.11	0.11
Tooley_Upper	Upper	3800	Regional	117.93	118.04	118.04					
Tooley_Upper	Upper	3700	100yr	117.02	117.46	117.46	117.36	117.46	117.46	0.1	0.1
Tooley_Upper	Upper	3700	Regional	117.36	117.45	117.45					
Tooley_Upper	Upper	3600	100yr	116.08	116.48	116.48	116.38	116.48	116.48	0.1	0.1
Tooley_Upper	Upper	3600	Regional	116.38	116.47	116.47					
Tooley_Upper	Upper	3500	100yr	114.6	114.92	114.92	114.84	114.92	114.92	0.08	0.08
Tooley_Upper	Upper	3500	Regional	114.84	114.92	114.92					
Tooley_Upper	Upper	3400	100yr	113.77	114.15	114.15	114.05	114.15	114.15	0.1	0.1
Tooley_Upper	Upper	3400	Regional	114.05	114.13	114.13					

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**Table C7: Water Surface Elevation Comparison**

Description: Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	3300	100yr	113.1	113.49	113.49	113.37	113.49	113.49	0.12	0.12
Tooley_Upper	Upper	3300	Regional	113.37	113.46	113.46					
Tooley_Upper	Upper	3200	100yr	112.28	112.63	112.63	112.53	112.63	112.63	0.1	0.1
Tooley_Upper	Upper	3200	Regional	112.53	112.61	112.61					
Tooley_Upper	Upper	3100	100yr	111.2	111.54	111.54	111.44	111.54	111.54	0.1	0.1
Tooley_Upper	Upper	3100	Regional	111.44	111.52	111.52					
Tooley_Upper	Upper	3000	100yr	110.12	110.43	110.43	110.34	110.43	110.43	0.09	0.09
Tooley_Upper	Upper	3000	Regional	110.34	110.41	110.41					
Tooley_Upper	Upper	2900	100yr	109.55	109.89	109.89	109.78	109.89	109.89	0.11	0.11
Tooley_Upper	Upper	2900	Regional	109.78	109.86	109.86					
Tooley_Upper	Upper	2800	100yr	108.58	108.91	108.91	108.8	108.91	108.91	0.11	0.11
Tooley_Upper	Upper	2800	Regional	108.8	108.88	108.88					
Tooley_Upper	Upper	2700	100yr	107.6	107.96	107.96	107.85	107.96	107.96	0.11	0.11
Tooley_Upper	Upper	2700	Regional	107.85	107.93	107.93					
Tooley_Upper	Upper	2593.81	100yr	106.53	106.81	106.81	106.71	106.81	106.81	0.1	0.1
Tooley_Upper	Upper	2593.81	Regional	106.71	106.78	106.78					
Tooley_Upper	Upper	2500	100yr	106.06	106.47	106.47	106.33	106.47	106.47	0.14	0.14
Tooley_Upper	Upper	2500	Regional	106.33	106.43	106.43					
Tooley_Upper	Upper	2400	100yr	105.39	105.72	105.72	105.63	105.72	105.72	0.09	0.09
Tooley_Upper	Upper	2400	Regional	105.63	105.69	105.69					
Tooley_Upper	Upper	2300	100yr	104.54	105.48	105.48	105.47	105.51	105.51	0.04	0.04
Tooley_Upper	Upper	2300	Regional	105.47	105.51	105.51					

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**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	2200	100yr	103.65	105.46	105.46	105.46	105.5	105.5	0.04	0.04
Tooley_Upper	Upper	2200	Regional	105.46	105.5	105.5					
Tooley_Upper	Upper	2100	100yr	102.6	105.46	105.46	105.46	105.5	105.5	0.04	0.04
Tooley_Upper	Upper	2100	Regional	105.46	105.5	105.5					
Tooley_Upper	Upper	2000	100yr	101.59	105.46	105.46	105.46	105.5	105.5	0.04	0.04
Tooley_Upper	Upper	2000	Regional	105.46	105.5	105.5					
Tooley_Upper	Upper	1900	100yr	101.03	105.46	105.46	105.46	105.5	105.5	0.04	0.04
Tooley_Upper	Upper	1900	Regional	105.46	105.5	105.5					
Tooley_Upper	Upper	1818.172	100yr	101.02	105.46	105.46	105.46	105.5	105.5	0.04	0.04
Tooley_Upper	Upper	1818.172	Regional	105.46	105.5	105.5					
Tooley_Upper	Upper	1800	100yr	101.02	105.46	105.46	105.46	105.5	105.5	0.04	0.04
Tooley_Upper	Upper	1800	Regional	105.46	105.5	105.5					
Tooley_Upper	Upper	1779	100yr	100.87	105.31	105.31	105.33	105.5	105.5	0.17	0.17
Tooley_Upper	Upper	1779	Regional	105.33	105.5	105.5					
Tooley_Upper	Upper	1764.263	CPR								
Tooley_Upper	Upper	1748	100yr	99.48	100.77	100.77	100.66	100.94	100.94	0.28	0.28
Tooley_Upper	Upper	1748	Regional	100.66	100.94	100.94					
Tooley_Upper	Upper	1700	100yr	98.36	98.93	98.78	98.75	99.1	98.81	0.35	0.06
Tooley_Upper	Upper	1700	Regional	98.75	99.1	98.81					
Tooley_Upper	Upper	1670.175	100yr	98.07	98.96	98.5	98.51	99.12	98.56	0.61	0.05
Tooley_Upper	Upper	1670.175	Regional	98.51	99.12	98.56					
Tooley_Upper	Upper	1600	100yr	97.89	98.93	98.35	98.39	99.1	98.41	0.71	0.02

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River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	1600	Regional	98.39	99.1	98.41					
Tooley_Upper	Upper	1500	100yr	97.46	98.9	98.17	98.28	99.07	98.25	0.79	-0.03
Tooley_Upper	Upper	1500	Regional	98.28	99.07	98.25					
Tooley_Upper	Upper	1412.393	100yr	96.54	98.88	98.06	98.23	99.05	98.16	0.82	-0.07
Tooley_Upper	Upper	1412.393	Regional	98.23	99.05	98.16					
Tooley_Upper	Upper	1400	100yr	96.51	98.88	98.07	98.23	99.05	98.16	0.82	-0.07
Tooley_Upper	Upper	1400	Regional	98.23	99.05	98.16					
Tooley_Upper	Upper	1376	100yr	96.36	98.58	97.81	97.9	98.76	97.9	0.86	0
Tooley_Upper	Upper	1376	Regional	97.9	98.76	97.9					
Tooley_Upper	Upper	1360.285	Baseline								
Tooley_Upper	Upper	1343.5	100yr	95.37	96.36	96.01	96.17	96.4	96.05	0.23	-0.12
Tooley_Upper	Upper	1343.5	Regional	96.17	96.4	96.05					
Tooley_Upper	Upper	1300	100yr	95.09	96.04	95.51	95.51	96.04	95.51	0.53	0
Tooley_Upper	Upper	1300	Regional	95.51	95.96	95.47					
Tooley_Upper	Upper	1270.062	100yr	94.77	96.01	95.4	95.44	96.01	95.4	0.57	-0.04
Tooley_Upper	Upper	1270.062	Regional	95.44	95.92	95.33					
Tooley_Upper	Upper	1200	100yr	94.1	95.99	95.34	95.4	95.99	95.34	0.59	-0.06
Tooley_Upper	Upper	1200	Regional	95.4	95.9	95.25					
Tooley_Upper	Upper	1100	100yr	93.63	95.99	95.36	95.42	95.99	95.36	0.57	-0.06
Tooley_Upper	Upper	1100	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	1054	100yr	93.64	95.99	95.36	95.42	95.99	95.36	0.57	-0.06
Tooley_Upper	Upper	1054	Regional	95.42	95.91	95.28					



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Description: Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_mitigation	ExReg	PropReg	Tooley_mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	1013	100yr	93.64	95.99	95.36	95.42	95.99	95.36	0.57	-0.06
Tooley_Upper	Upper	1013	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	1000	100yr	93.64	95.99	95.36	95.42	95.99	95.36	0.57	-0.06
Tooley_Upper	Upper	1000	Regional	95.42	95.91	95.29					
Tooley_Upper	Upper	970.5	100yr	93.64	96	95.36	95.42	96	95.36	0.58	-0.06
Tooley_Upper	Upper	970.5	Regional	95.42	95.91	95.29					
Tooley_Upper	Upper	957.6232									
Tooley_Upper	Upper	943.5	100yr	93.2	95.98	95.37	95.42	95.98	95.37	0.56	-0.05
Tooley_Upper	Upper	943.5	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	900	100yr	93.2	95.98	95.37	95.42	95.98	95.37	0.56	-0.05
Tooley_Upper	Upper	900	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	863	100yr	93.2	95.98	95.37	95.42	95.98	95.37	0.56	-0.05
Tooley_Upper	Upper	863	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	800	100yr	93.2	95.98	95.37	95.42	95.98	95.37	0.56	-0.05
Tooley_Upper	Upper	800	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	784	100yr	93.2	95.98	95.37	95.42	95.98	95.37	0.56	-0.05
Tooley_Upper	Upper	784	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	780	401								
Tooley_Upper	Upper	735	100yr	93.2	95.98	95.37	95.42	95.98	95.37	0.56	-0.05
Tooley_Upper	Upper	735	Regional	95.42	95.91	95.28					
Tooley_Upper	Upper	724									

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River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_mitigation	ExReg	PropReg	Tooley_mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	713	100yr	93.2	95.98	95.36	95.42	95.98	95.36	0.56	-0.06
Tooley_Upper	Upper	713	Regional	95.42	95.9	95.28					
Tooley_Upper	Upper	709	100yr	93.2	95.98	95.36	95.42	95.98	95.36	0.56	-0.06
Tooley_Upper	Upper	709	Regional	95.42	95.9	95.27					
Tooley_Upper	Upper	705	100yr	93.15	95.87	95.31	95.32	95.87	95.31	0.55	-0.01
Tooley_Upper	Upper	705	Regional	95.32	95.8	95.22					
Tooley_Upper	Upper	641.6027									
Tooley_Upper	Upper	577	100yr	91.68	91.53	91.65	91.68	91.54	91.65	-0.14	-0.03
Tooley_Upper	Upper	577	Regional	91.58	91.54	91.64					
Tooley_Upper	Upper	500	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	500	Regional	91.71	91.73	91.72					
Tooley_Upper	Upper	497	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	497	Regional	91.71	91.73	91.73					
Tooley_Upper	Upper	483	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	483	Regional	91.71	91.73	91.73					
Tooley_Upper	Upper	451	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	451	Regional	91.71	91.73	91.73					
Tooley_Upper	Upper	438	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	438	Regional	91.71	91.73	91.73					
Tooley_Upper	Upper	424									
Tooley_Upper	Upper	410	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02

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River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_mitigation	ExReg	PropReg	Tooley_mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Upper	Upper	410	Regional	91.71	91.73	91.72					
Tooley_Upper	Upper	400	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	400	Regional	91.71	91.73	91.72					
Tooley_Upper	Upper	300	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	300	Regional	91.71	91.73	91.72					
Tooley_Upper	Upper	255	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	255	Regional	91.71	91.73	91.72					
Tooley_Upper	Upper	243	100yr	91.7	91.73	91.73	91.71	91.73	91.73	0.02	0.02
Tooley_Upper	Upper	243	Regional	91.71	91.73	91.72					
Tooley_Upper	Upper	227.3807									
Tooley_Upper	Upper	211	100yr	84.8	86.66	86.66	86.21	86.66	86.66	0.45	0.45
Tooley_Upper	Upper	211	Regional	86.21	86.64	86.64					
Tooley_Upper	Upper	200	100yr	83.77	84.12	84.12	84.06	84.13	84.13	0.07	0.07
Tooley_Upper	Upper	200	Regional	84.06	84.13	84.13					
Tooley_Upper	Upper	100	100yr	82.91	83.22	83.22	83.18	83.22	83.22	0.04	0.04
Tooley_Upper	Upper	100	Regional	83.18	83.22	83.22					
Tooley_Lower	Lower	1000	100yr	82.23	82.56	82.56	82.43	82.56	82.56	0.13	0.13
Tooley_Lower	Lower	1000	Regional	82.43	82.51	82.51					
Tooley_Lower	Lower	900	100yr	81.48	81.69	81.69	81.59	81.69	81.69	0.1	0.1
Tooley_Lower	Lower	900	Regional	81.59	81.64	81.64					
Tooley_Lower	Lower	800	100yr	80.86	81.07	81.07	80.99	81.07	81.07	0.08	0.08
Tooley_Lower	Lower	800	Regional	80.99	81.04	81.04					

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River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Tooley_Lower	Lower	700	100yr	79.93	80.21	80.21	80.08	80.21	80.21	0.13	0.13
Tooley_Lower	Lower	700	Regional	80.08	80.14	80.14					
Tooley_Lower	Lower	600	100yr	79.44	79.73	79.73	79.66	79.74	79.74	0.08	0.08
Tooley_Lower	Lower	600	Regional	79.66	79.74	79.74					
Tooley_Lower	Lower	500	100yr	79	79.24	79.24	79.21	79.27	79.27	0.06	0.06
Tooley_Lower	Lower	500	Regional	79.21	79.27	79.27					
Tooley_Lower	Lower	400	100yr	77.99	78.25	78.25	78.21	78.28	78.28	0.07	0.07
Tooley_Lower	Lower	400	Regional	78.21	78.28	78.28					
Tooley_Lower	Lower	300	100yr	77.45	77.75	77.75	77.7	77.79	77.79	0.09	0.09
Tooley_Lower	Lower	300	Regional	77.7	77.79	77.79					
Tooley_Lower	Lower	200	100yr	77.05	77.36	77.36	77.31	77.4	77.4	0.09	0.09
Tooley_Lower	Lower	200	Regional	77.31	77.4	77.4					
Tooley_Lower	Lower	100	100yr	76.78	77.05	77.05	77.01	77.08	77.08	0.07	0.07
Tooley_Lower	Lower	100	Regional	77.01	77.08	77.08					
Tooley_Lower	Lower	8.907429	100yr	76.12	76.32	76.32	76.27	76.33	76.33	0.06	0.06
Tooley_Lower	Lower	8.907429	Regional	76.27	76.33	76.33					
RobinsonWest	West	486.4874	100yr	97.64	97.68	97.68	97.64	97.68	97.68	0.04	0.04
RobinsonWest	West	486.4874	Regional	97.45	97.45	97.45					
RobinsonWest	West	400	100yr	96.82	96.85	96.85	96.82	96.85	96.85	0.03	0.03
RobinsonWest	West	400	Regional	96.68	96.68	96.7					
RobinsonWest	West	300	100yr	96.21	96.14	96.14	96.29	96.14	96.14	-0.15	-0.15
RobinsonWest	West	300	Regional	96.29	95.78	95.78					

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River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonWest	West	193.175	100yr	96.2	96.12	96.12	96.29	96.12	96.12	-0.17	-0.17
RobinsonWest	West	193.175	Regional	96.29	95.75	95.75					
RobinsonWest	West	176.2835	100yr	96.19	96.11	96.11	96.28	96.11	96.11	-0.17	-0.17
RobinsonWest	West	176.2835	Regional	96.28	95.74	95.74					
RobinsonWest	West	165.6963									
RobinsonWest	West	154.4447	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonWest	West	154.4447	Regional	96.28	94.93	94.93					
RobinsonWest	West	122.0857	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonWest	West	122.0857	Regional	96.28	94.93	94.93					
RobinsonWest	West	7.527757	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonWest	West	7.527757	Regional	96.28	94.95	94.95					
RobinsonUpper	Upper	3542.466	100yr	133.2	133.2	133.2	133.2	133.2	133.2	0	0
RobinsonUpper	Upper	3542.466	Regional	132.79	132.9	132.9					
RobinsonUpper	Upper	3494.811	100yr	133.19	133.19	133.19	133.19	133.19	133.19	0	0
RobinsonUpper	Upper	3494.811	Regional	132.79	132.89	132.89					
RobinsonUpper	Upper	3484.383	100yr	133.18	133.18	133.18	133.18	133.18	133.18	0	0
RobinsonUpper	Upper	3484.383	Regional	132.78	132.89	132.89					
RobinsonUpper	Upper	3469.744									
RobinsonUpper	Upper	3454.014	100yr	132.81	132.81	132.81	132.81	132.81	132.81	0	0
RobinsonUpper	Upper	3454.014	Regional	132.4	132.43	132.43					
RobinsonUpper	Upper	3430.442	100yr	132.81	132.81	132.81	132.81	132.81	132.81	0	0

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River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonUpper	Upper	3430.442	Regional	132.32	132.36	132.36					
RobinsonUpper	Upper	3400	100yr	132.8	132.8	132.8	132.8	132.8	132.8	0	0
RobinsonUpper	Upper	3400	Regional	132.25	132.3	132.3					
RobinsonUpper	Upper	3344.928	100yr	132.78	132.78	132.78	132.78	132.78	132.78	0	0
RobinsonUpper	Upper	3344.928	Regional	132.16	132.22	132.22					
RobinsonUpper	Upper	3334.47	100yr	132.75	132.75	132.75	132.75	132.75	132.75	0	0
RobinsonUpper	Upper	3334.47	Regional	132.12	132.17	132.17					
RobinsonUpper	Upper	3316.727									
RobinsonUpper	Upper	3298.848	100yr	132.01	132.01	132.01	132.01	132.01	132.01	0	0
RobinsonUpper	Upper	3298.848	Regional	131.85	131.87	131.87					
RobinsonUpper	Upper	3274.914	100yr	131.82	131.83	131.83	131.82	131.83	131.83	0.01	0.01
RobinsonUpper	Upper	3274.914	Regional	131.63	131.67	131.67					
RobinsonUpper	Upper	3200	100yr	131.59	131.61	131.61	131.59	131.61	131.61	0.02	0.02
RobinsonUpper	Upper	3200	Regional	131.27	131.33	131.33					
RobinsonUpper	Upper	3100	100yr	131.32	131.34	131.34	131.32	131.34	131.34	0.02	0.02
RobinsonUpper	Upper	3100	Regional	131.01	131.06	131.06					
RobinsonUpper	Upper	3000	100yr	131.19	131.2	131.2	131.19	131.2	131.2	0.01	0.01
RobinsonUpper	Upper	3000	Regional	130.95	130.98	130.98					
RobinsonUpper	Upper	2917.452	100yr	131.18	131.2	131.2	131.18	131.2	131.2	0.02	0.02
RobinsonUpper	Upper	2917.452	Regional	130.95	130.98	130.98					
RobinsonUpper	Upper	2906.009	100yr	131.09	131.1	131.1	131.09	131.1	131.1	0.01	0.01
RobinsonUpper	Upper	2906.009	Regional	130.94	130.95	130.95					

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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	W.S. Elev (TYLin flows) (m)	Regulatory WSE (m)	Regulatory WSE (m)	Regulatory WSE (m)	WSE Change (m)	WSE Change (m)
RobinsonUpper	Upper	2894.43									
RobinsonUpper	Upper	2882.851	100yr	130.6	130.62	130.62	130.6	130.62	130.62	0.02	0.02
RobinsonUpper	Upper	2882.851	Regional	130.3	130.4	130.4					
RobinsonUpper	Upper	2855.66	100yr	130.5	130.51	130.51	130.5	130.51	130.51	0.01	0.01
RobinsonUpper	Upper	2855.66	Regional	130.28	130.32	130.32					
RobinsonUpper	Upper	2800	100yr	130.11	130.12	130.12	130.11	130.12	130.12	0.01	0.01
RobinsonUpper	Upper	2800	Regional	129.9	129.98	129.98					
RobinsonUpper	Upper	2700	100yr	128.72	128.73	128.73	128.72	128.73	128.73	0.01	0.01
RobinsonUpper	Upper	2700	Regional	128.5	128.55	128.55					
RobinsonUpper	Upper	2600	100yr	127.69	127.71	127.71	127.69	127.71	127.71	0.02	0.02
RobinsonUpper	Upper	2600	Regional	127.41	127.46	127.46					
RobinsonUpper	Upper	2539.354	100yr	127.47	127.5	127.5	127.47	127.5	127.5	0.03	0.03
RobinsonUpper	Upper	2539.354	Regional	127.18	127.22	127.22					
RobinsonUpper	Upper	2529.293	100yr	127.47	127.5	127.5	127.47	127.5	127.5	0.03	0.03
RobinsonUpper	Upper	2529.293	Regional	127.18	127.22	127.22					
RobinsonUpper	Upper	2519.291	100yr	127.44	127.46	127.46	127.44	127.46	127.46	0.02	0.02
RobinsonUpper	Upper	2519.291	Regional	127.14	127.18	127.18					
RobinsonUpper	Upper	2499.168	100yr	127.27	127.32	127.32	127.27	127.32	127.32	0.05	0.05
RobinsonUpper	Upper	2499.168	Regional	126.98	127.04	127.04					
RobinsonUpper	Upper	2400	100yr	126.87	126.84	126.84	126.87	126.84	126.84	-0.03	-0.03
RobinsonUpper	Upper	2400	Regional	126.53	126.57	126.57					

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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonUpper	Upper	2300	100yr	126.2	126.21	126.21	126.2	126.21	126.21	0.01	0.01
RobinsonUpper	Upper	2300	Regional	126.03	126.05	126.05					
RobinsonUpper	Upper	2200	100yr	125.62	125.58	125.58	125.62	125.58	125.58	-0.04	-0.04
RobinsonUpper	Upper	2200	Regional	125.44	125.45	125.45					
RobinsonUpper	Upper	2154.378	100yr	125.57	125.53	125.53	125.57	125.53	125.53	-0.04	-0.04
RobinsonUpper	Upper	2154.378	Regional	125.22	125.24	125.24					
RobinsonUpper	Upper	2100	100yr	125.22	125.18	125.18	125.22	125.18	125.18	-0.04	-0.04
RobinsonUpper	Upper	2100	Regional	124.71	124.75	124.75					
RobinsonUpper	Upper	2000	100yr	123.03	123	123	123.03	123	123	-0.03	-0.03
RobinsonUpper	Upper	2000	Regional	122.67	122.69	122.69					
RobinsonUpper	Upper	1900	100yr	119.76	119.72	119.72	119.76	119.72	119.72	-0.04	-0.04
RobinsonUpper	Upper	1900	Regional	119.37	119.39	119.39					
RobinsonUpper	Upper	1800	100yr	116.49	116.44	116.44	116.49	116.44	116.44	-0.05	-0.05
RobinsonUpper	Upper	1800	Regional	116.07	116.09	116.09					
RobinsonUpper	Upper	1700	100yr	112.88	112.85	112.85	112.88	112.85	112.85	-0.03	-0.03
RobinsonUpper	Upper	1700	Regional	112.7	112.7	112.7					
RobinsonUpper	Upper	1478.247	100yr	111.88	111.85	111.85	111.88	111.85	111.85	-0.03	-0.03
RobinsonUpper	Upper	1478.247	Regional	111.64	111.64	111.64					
RobinsonUpper	Upper	1466.204									
RobinsonUpper	Upper	1454.188	100yr	109.55	109.36	109.36	109.55	109.36	109.36	-0.19	-0.19
RobinsonUpper	Upper	1454.188	Regional	108.58	108.6	108.6					
RobinsonUpper	Upper	1421.456	100yr	107.88	107.83	107.83	107.88	107.83	107.83	-0.05	-0.05



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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonUpper	Upper	1421.456	Regional	107.63	107.63	107.63					
RobinsonUpper	Upper	1400	100yr	107.53	107.49	107.49	107.53	107.49	107.49	-0.04	-0.04
RobinsonUpper	Upper	1400	Regional	107.34	107.35	107.35					
RobinsonUpper	Upper	1300	100yr	106.58	106.53	106.53	106.58	106.53	106.53	-0.05	-0.05
RobinsonUpper	Upper	1300	Regional	106.37	106.37	106.37					
RobinsonUpper	Upper	1200	100yr	105.81	105.76	105.76	105.81	105.76	105.76	-0.05	-0.05
RobinsonUpper	Upper	1200	Regional	105.67	105.67	105.67					
RobinsonUpper	Upper	1100	100yr	105.13	105.06	105.06	105.13	105.06	105.06	-0.07	-0.07
RobinsonUpper	Upper	1100	Regional	104.89	104.89	104.89					
RobinsonUpper	Upper	1000	100yr	104.36	104.27	104.27	104.36	104.27	104.27	-0.09	-0.09
RobinsonUpper	Upper	1000	Regional	104.1	104.11	104.11					
RobinsonUpper	Upper	900	100yr	103.5	103.4	103.4	103.5	103.4	103.4	-0.1	-0.1
RobinsonUpper	Upper	900	Regional	103.22	103.22	103.22					
RobinsonUpper	Upper	800	100yr	102.26	102.18	102.18	102.26	102.18	102.18	-0.08	-0.08
RobinsonUpper	Upper	800	Regional	102.02	102.02	102.02					
RobinsonUpper	Upper	700	100yr	100.63	100.56	100.56	100.63	100.56	100.56	-0.07	-0.07
RobinsonUpper	Upper	700	Regional	100.43	100.43	100.43					
RobinsonUpper	Upper	600	100yr	99.26	99.14	99.14	99.26	99.14	99.14	-0.12	-0.12
RobinsonUpper	Upper	600	Regional	99	98.99	98.99					
RobinsonUpper	Upper	500	100yr	98.32	98.21	98.21	98.32	98.21	98.21	-0.11	-0.11
RobinsonUpper	Upper	500	Regional	98.08	98.07	98.07					
RobinsonUpper	Upper	400	100yr	96.32	96.2	96.2	96.32	96.2	96.2	-0.12	-0.12

**Project:** Robinson and Tooley Flood Mitigation Study  
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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonUpper	Upper	400	Regional	96.31	96.18	96.18					
RobinsonUpper	Upper	300	100yr	96.16	96.07	96.07	96.27	96.07	96.07	-0.2	-0.2
RobinsonUpper	Upper	300	Regional	96.27	95.35	95.35					
RobinsonUpper	Upper	200	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonUpper	Upper	200	Regional	96.28	94.95	94.95					
RobinsonUpper	Upper	11.06822	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonUpper	Upper	11.06822	Regional	96.28	94.96	94.96					
RobinsonLower	Lower	2075.481	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	2075.481	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	2000	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	2000	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1900	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	1900	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1800	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	1800	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1700	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	1700	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1600	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	1600	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1500	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18
RobinsonLower	Lower	1500	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1408.42	100yr	96.19	96.1	96.1	96.28	96.1	96.1	-0.18	-0.18

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**Table C7: Water Surface Elevation Comparison**

**Description:** Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonLower	Lower	1408.42	Regional	96.28	94.95	94.95					
RobinsonLower	Lower	1389.432	100yr	96.08	96.02	96.02	96.23	96.02	96.02	-0.21	-0.21
RobinsonLower	Lower	1389.432	Regional	96.23	94.88	94.88					
RobinsonLower	Lower	1370.068									
RobinsonLower	Lower	1349.056	100yr	95.51	95.34	95.34	95.51	95.34	95.34	-0.17	-0.17
RobinsonLower	Lower	1349.056	Regional	93.94	93.34	93.34					
RobinsonLower	Lower	1318.902	100yr	95.66	95.44	95.44	95.66	95.44	95.44	-0.22	-0.22
RobinsonLower	Lower	1318.902	Regional	94.05	93.47	93.47					
RobinsonLower	Lower	1300	100yr	95.66	95.44	95.44	95.66	95.44	95.44	-0.22	-0.22
RobinsonLower	Lower	1300	Regional	94.05	93.47	93.47					
RobinsonLower	Lower	1225.673	100yr	95.66	95.44	95.44	95.66	95.44	95.44	-0.22	-0.22
RobinsonLower	Lower	1225.673	Regional	94.05	93.47	93.47					
RobinsonLower	Lower	1208.394	100yr	95.65	95.43	95.43	95.65	95.43	95.43	-0.22	-0.22
RobinsonLower	Lower	1208.394	Regional	93.85	93.24	93.24					
RobinsonLower	Lower	1186.848									
RobinsonLower	Lower	1174.573	100yr	95.63	95.37	95.37	95.63	95.37	95.37	-0.26	-0.26
RobinsonLower	Lower	1174.573	Regional	92.26	91.73	91.73					
RobinsonLower	Lower	1170						0	0	0	0
RobinsonLower	Lower	1146.689	100yr	95.63	95.37	95.37	95.63	95.37	95.37	-0.26	-0.26
RobinsonLower	Lower	1146.689	Regional	92.39	92.15	92.15					
RobinsonLower	Lower	1076.022	100yr	95.63	95.37	95.37	95.63	95.37	95.37	-0.26	-0.26

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**Table C7: Water Surface Elevation Comparison**

Description: Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_ mitigation Vs ExReg
				W.S. Elev (CLOCA flows)	W.S. Elev (TYLin flows)	W.S. Elev (TYLin flows)	Regulatory WSE	Regulatory WSE	Regulatory WSE	WSE Change	WSE Change
				(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
RobinsonLower	Lower	1076.022	Regional	92.39	92.15	92.15					
RobinsonLower	Lower	1050.327	100yr	95.58	95.32	95.32	95.58	95.32	95.32	-0.26	-0.26
RobinsonLower	Lower	1050.327	Regional	92.32	92.08	92.08					
RobinsonLower	Lower	994.6486									
RobinsonLower	Lower	928.2293	100yr	92.66	92.47	92.47	92.66	92.47	92.47	-0.19	-0.19
RobinsonLower	Lower	928.2293	Regional	90.31	90.14	90.14					
RobinsonLower	Lower	918.8482	100yr	92.65	92.46	92.46	92.65	92.46	92.46	-0.19	-0.19
RobinsonLower	Lower	918.8482	Regional	90.37	90.2	90.2					
RobinsonLower	Lower	899.0165									
RobinsonLower	Lower	876.9869	100yr	86.33	86.25	86.25	86.33	86.25	86.25	-0.08	-0.08
RobinsonLower	Lower	876.9869	Regional	85.13	84.99	84.99					
RobinsonLower	Lower	834.4676	100yr	86.6	86.52	86.52	86.6	86.52	86.52	-0.08	-0.08
RobinsonLower	Lower	834.4676	Regional	85.59	85.51	85.51					
RobinsonLower	Lower	823.6441	100yr	86.6	86.52	86.52	86.6	86.52	86.52	-0.08	-0.08
RobinsonLower	Lower	823.6441	Regional	85.6	85.51	85.51					
RobinsonLower	Lower	800.6076	100yr	86.44	86.36	86.36	86.44	86.36	86.36	-0.08	-0.08
RobinsonLower	Lower	800.6076	Regional	85.42	85.34	85.34					
RobinsonLower	Lower	787.4796									
RobinsonLower	Lower	772.9675	100yr	82.96	82.84	82.84	82.96	82.84	82.84	-0.12	-0.12
RobinsonLower	Lower	772.9675	Regional	82.68	82.67	82.67					
RobinsonLower	Lower	728.9347	100yr	82.89	82.78	82.78	82.89	82.78	82.78	-0.11	-0.11

Project: **Robinson and Tooley Flood Mitigation Study**  
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**Table C7: Water Surface Elevation Comparison**

Description: Comparison in water surface elevation between CLOCA's 2010 and 2012 Regulatory flow rates and 2023 updated flow rates

River	Reach	River Sta	Profile	ExReg	PropReg	Tooley_ mitigation	ExReg	PropReg	Tooley_ mitigation	PropReg Vs ExReg	Tooley_mitigation Vs ExReg
				W.S. Elev (CLOCA flows) (m)	W.S. Elev (TYLin flows) (m)	W.S. Elev (TYLin flows) (m)	Regulatory WSE (m)	Regulatory WSE (m)	Regulatory WSE (m)	WSE Change (m)	WSE Change (m)
RobinsonLower	Lower	728.9347	Regional	82.63	82.62	82.62					
RobinsonLower	Lower	700	100yr	82.38	82.29	82.29	82.38	82.29	82.29	-0.09	-0.09
RobinsonLower	Lower	700	Regional	82.18	82.18	82.18					
RobinsonLower	Lower	600	100yr	82.36	81.5	81.5	82.36	81.5	81.5	-0.86	-0.86
RobinsonLower	Lower	600	Regional	80.76	80.75	80.75					
RobinsonLower	Lower	500	100yr	82.37	81.52	81.52	82.37	81.52	81.52	-0.85	-0.85
RobinsonLower	Lower	500	Regional	80.32	80.29	80.29					
RobinsonLower	Lower	400	100yr	82.38	81.53	81.53	82.38	81.53	81.53	-0.85	-0.85
RobinsonLower	Lower	400	Regional	80.34	80.3	80.3					
RobinsonLower	Lower	349.8643	100yr	82.38	81.53	81.53	82.38	81.53	81.53	-0.85	-0.85
RobinsonLower	Lower	349.8643	Regional	80.34	80.31	80.31					
RobinsonLower	Lower	310.5079	100yr	77.56	77.56	77.56	77.56	77.56	77.56	0	0
RobinsonLower	Lower	310.5079	Regional	77.54	77.54	77.54					
RobinsonLower	Lower	302.0028									
RobinsonLower	Lower	289.6513	100yr	77.9	77.87	77.87	77.9	77.87	77.87	-0.03	-0.03
RobinsonLower	Lower	289.6513	Regional	77.81	77.8	77.8					
RobinsonLower	Lower	254.9745	100yr	77.22	77.18	77.18	77.22	77.18	77.18	-0.04	-0.04
RobinsonLower	Lower	254.9745	Regional	77.08	77.08	77.08					
RobinsonLower	Lower	200	100yr	76.78	76.75	76.75	76.78	76.75	76.75	-0.03	-0.03
RobinsonLower	Lower	200	Regional	76.71	76.71	76.71	76.71	76.71	76.71	0	0

**PROJECT:** Tooley and Robinson Creek Floodplain Analysis  
**PROJECT NO.:** 10568  
**Task:** Storage Analysis North of CPR  
**DATE:** Sep-23

**Table C8.a: RATING CURVE at CPR Crossing**

Discharge (m3/s) *	WS ELEV (m)*
0.01	89.29
3.15	90.00
5.00	90.42
8.41	91.00
10.00	91.27
14.45	92.00
15.00	92.09
19.10	93.00
23.60	94.00
20.00	93.20
25.00	94.63
26.06	95.00
28.91	96.00
30.00	96.38
31.50	97.00
32.75	98.00
35.00	98.44
37.57	99.00
40.00	99.53
45.00	99.54
50.00	99.54
55.00	99.55
60.09	99.69
70.00	99.75
75.46	99.78

\* xs 1408 Hec Ras model, scenario without WSE

**Table C8.b: Storage Discharge Curve for input to VO model (100 yr)**

Discharge (m3/s)	Storage (ham)	Elevation (m)
0.00	0.000	95.44
28.91	16.757	96.00
31.50	52.060	97.00
32.75	94.014	98.00
37.57	142.113	99.00

**Table C8.c: Storage Discharge Curve for input to VO model (Regional)**

Discharge (m3/s)	Storage (ham)	Elevation (m)
0.00	0.000	93.47
23.60	9.246	94.00
26.06	31.348	95.00
28.91	59.718	96.00
31.50	95.021	97.00
32.75	136.976	98.00
37.57	185.074	99.00

Storm Event	Storage Used (ham)	WS Elevations (m)
100 year	13.22	95.88
Regional	26.398	94.78

Storm Event	WS Elevations without Storage Analysis (m)
100 year	99.78
Regional	99.69

Project: Robinson and Tooley Flood Mitigation Study  
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**Table C9: Storage North of CPR Robinson Creek\_Lower (North of cross section 1389.432)  
 Provided Storage Calculations**

POND CHARACTERISTICS		
Base of Pond:	83.00	
TW	95.44	masl
Increment for Volume:	0.1	m
Volume up to TW:	631,444	m <sup>3</sup>
Permanent Pool Volume Provided:	631,444	m <sup>3</sup>
VOLUME		
Known Water Level:	96.03	
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	96	
Lower Known Volume:	799,010.92	
Upper Known Elevation:	97	
Upper Known Volume:	1,152,044.65	
Volume of Known W.L. Elevation:	809,602	178,158
Water Level of Known Volume		
Known Volume:	165620	132,190
	INCL. P.P.	214.6
Lower Known Elevation:	93.00	95.44
Lower Known Volume:	136,850.62	0.00
Upper Known Elevation:	94.00	96.00
Upper Known Volume:	294,292.02	167,566.50
W.L. Elevation of Known Volume:	93.18	95.88
100yr	132,190	m3
	13.2190	ham

**STAGE / STORAGE INFORMATION**

	Elevation	Stage	Area	Total Area	Avg. Area	Incremental Storage	Cumulative Storage	Cumulative Storage
	(m)	(m)	(m <sup>2</sup> )	(m <sup>2</sup> )	(m <sup>2</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )
Base:	89.09	0.00	0.0	0.0		0.0		
	90.00	0.91	2,241.9	2,241.9	1,120.9	1,020.0	1,020	0
	91.00	1.91	20,761.3	20,761.3	11,501.6	11,501.6	12,522	0
	92.00	2.91	53,323.0	53,323.0	37,042.1	37,042.1	49,564	0
	93.00	3.91	121,250.7	121,250.7	87,286.9	87,286.9	136,851	0
	94.00	4.91	193,632.1	193,632.1	157,441.4	157,441.4	294,292	0
	95.00	5.91	248,408.8	248,408.8	221,020.4	221,020.4	515,312	0
	95.44	6.35	279,463.7	279,463.7	263,936.3	116,132.0	631,444	0
	96.00	6.91	318,988.1	318,988.1	299,225.9	167,566.5	799,011	167,567
	97.00	7.91	387,079.4	387,079.4	353,033.7	353,033.7	1,152,045	520,600
	98.00	8.91	452,009.5	452,009.5	419,544.5	419,544.5	1,571,589	940,145
	99.00	9.91	509,960.3	509,960.3	480,984.9	480,984.9	2,052,574	1,421,130

TWL 100YR (XS 1318.9020)

Project: Robinson and Tooley Flood Mitigation Study  
 Project No.: 10568  
 Date: Sep-23

**Table C10: Storage North of CPR Robinson Creek\_Lower (North of cross section 1389.432)  
 Provided Storage Calculations**

POND CHARACTERISTICS	
Base of Pond:	83.00
TW	93.47 masl
Increment for Volume:	0.1 m
Volume up to TW:	201,833 m <sup>3</sup>
Permanent Pool Volume Provided:	201,833 m <sup>3</sup>
VOLUME	
Known Water Level:	93.00
	INCL. P.P. ACTIVE ONLY
Lower Known Elevation:	93
Lower Known Volume:	136,850.62
Upper Known Elevation:	93.47
Upper Known Volume:	201,832.98
Volume of Known W.L. Elevation:	136,851 -64,982
Water Level of Known Volume	
Known Volume:	114200 263,980
	INCL. P.P. 214.6
Lower Known Elevation:	92.00 94.00
Lower Known Volume:	49,563.74 92,459.04
Upper Known Elevation:	93.00 95.00
Upper Known Volume:	136,850.62 313,479.48
W.L. Elevation of Known Volume:	92.74 94.78
reg	263,980
	26.3980 ham

**STAGE / STORAGE INFORMATION**

Elevation	Stage	Area	Total Area	Avg. Area	Incremental Storage	Cumulative Storage	Cumulative Storage
(m)	(m)	(m <sup>2</sup> )	(m <sup>2</sup> )	(m <sup>2</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )
Base: 89.09	0.00	0.0	0.0		0.0		
90.00	0.91	2,241.9	2,241.9	1,120.9	1,020.0	1,020	0
91.00	1.91	20,761.3	20,761.3	11,501.6	11,501.6	12,522	0
92.00	2.91	53,323.0	53,323.0	37,042.1	37,042.1	49,564	0
93.00	3.91	121,250.7	121,250.7	87,286.9	87,286.9	136,851	0
93.47	4.38	155,270.0	155,270.0	138,260.4	64,982.4	201,833	0
94.00	4.91	193,632.1	193,632.1	174,451.0	92,459.0	294,292	92,459
95.00	5.91	248,408.8	248,408.8	221,020.4	221,020.4	515,312	313,479
96.00	6.91	318,988.1	318,988.1	283,698.5	283,698.5	799,011	597,178
97.00	7.91	387,079.4	387,079.4	353,033.7	353,033.7	1,152,045	950,212
98.00	8.91	452,009.5	452,009.5	419,544.5	419,544.5	1,571,589	1,369,756
99.00	9.91	509,960.3	509,960.3	480,984.9	480,984.9	2,052,574	1,850,741

TWL REG (XS 1318.9020)



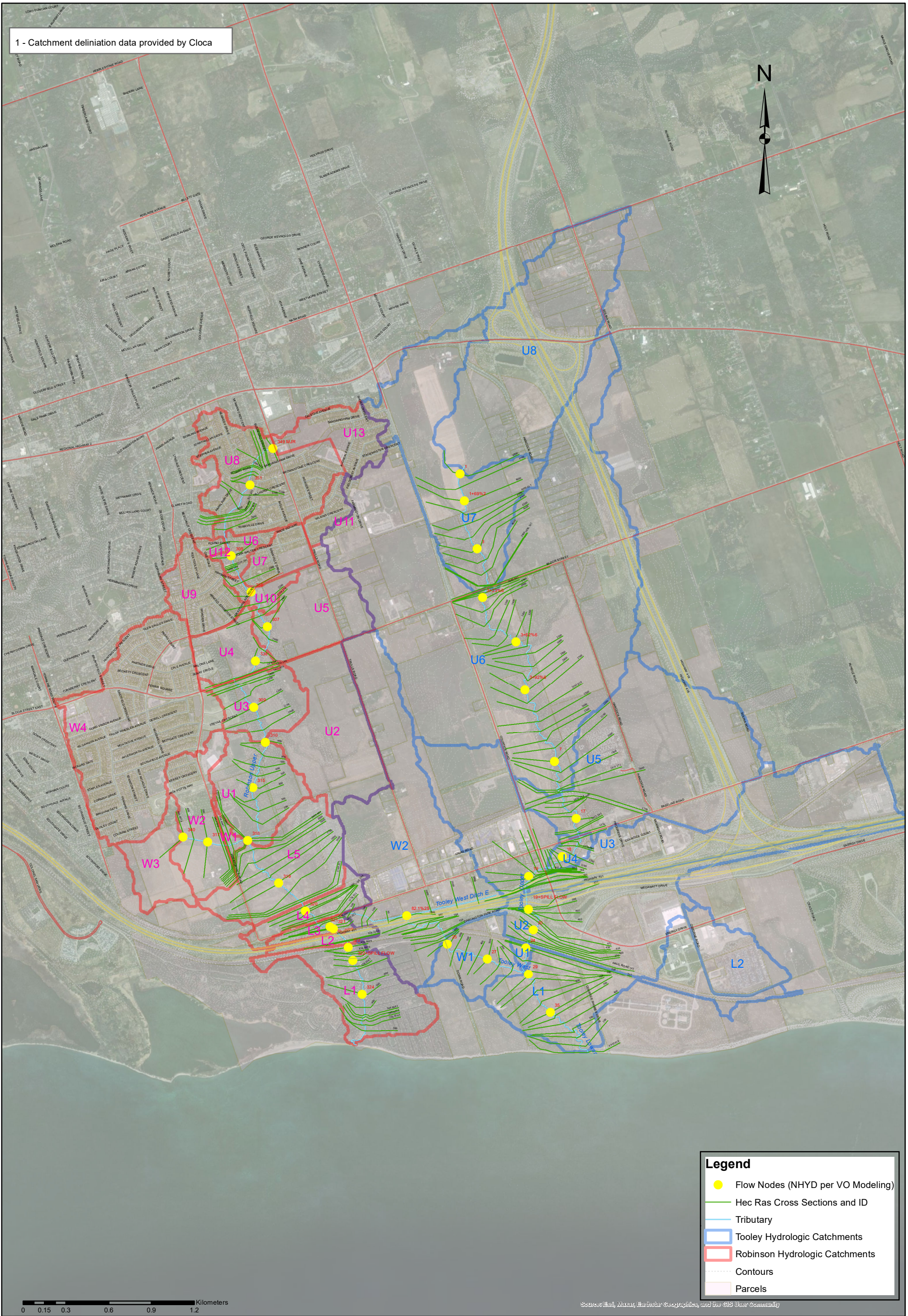


## ATTACHMENT D

### Figures



1 - Catchment delineation data provided by Cloca



**Legend**

- Flow Nodes (NHYD per VO Modeling)
- Hec Ras Cross Sections and ID
- Tributary
- Tooley Hydrologic Catchments
- Robinson Hydrologic Catchments
- Contours
- Parcels

Document Path: G:\Projects\2022\10568 - CLOCA - Robinson-Tooley Flood Mitigation\GIS work\2023-09\10568 - FIG 1 - catchments 11X17.mxd

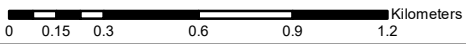
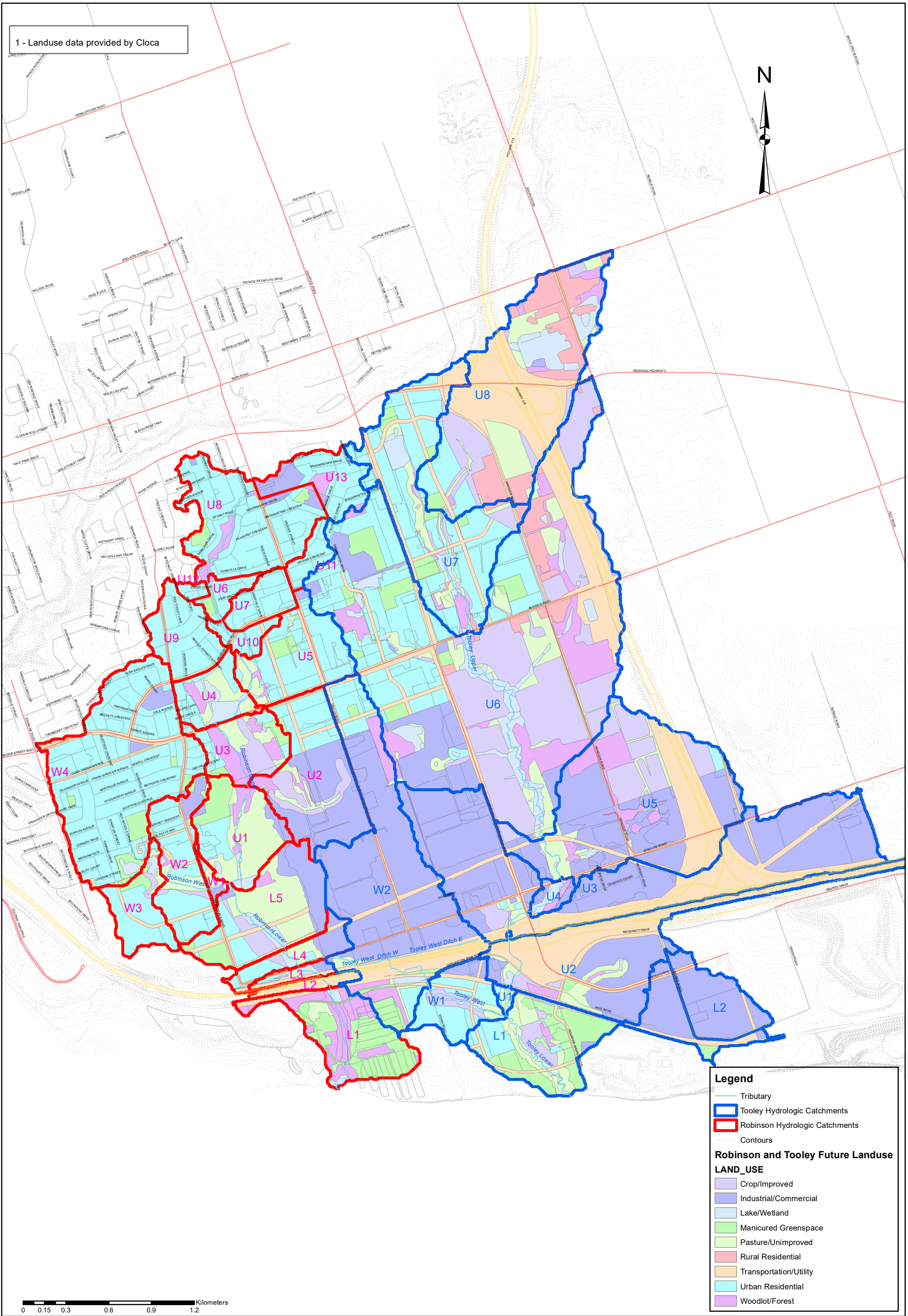


**TOOLEY AND ROBINSON CREEK  
MUNICIPALITY OF CLARINGTON  
CATCHMENT AREAS AND FLOW NODES**

SCALE 1 :24,000	PROJECT NO. 10568
DATE SEPTEMBER 2023	FIGURE NO. 1



1 - Landuse data provided by Cloca



Document Path: G:\Projects\2022\10568 - CLOCA - Robinson-Tooley Flood Mitigation\GIS work\2023-09\10568 - FIG 2a - Overall Future Landuse 11X17.mxd



TOOLEY AND ROBINSON CREEK  
MUNICIPALITY OF CLARINGTON  
OVERALL FUTURE LANDUSE

SCALE 1 :24,000	PROJECT NO. 10568
DATE SEPTEMBER 2023	FIGURE NO. 2a



1 - Landuse Data provided by Cloca

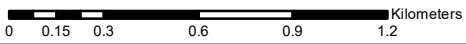
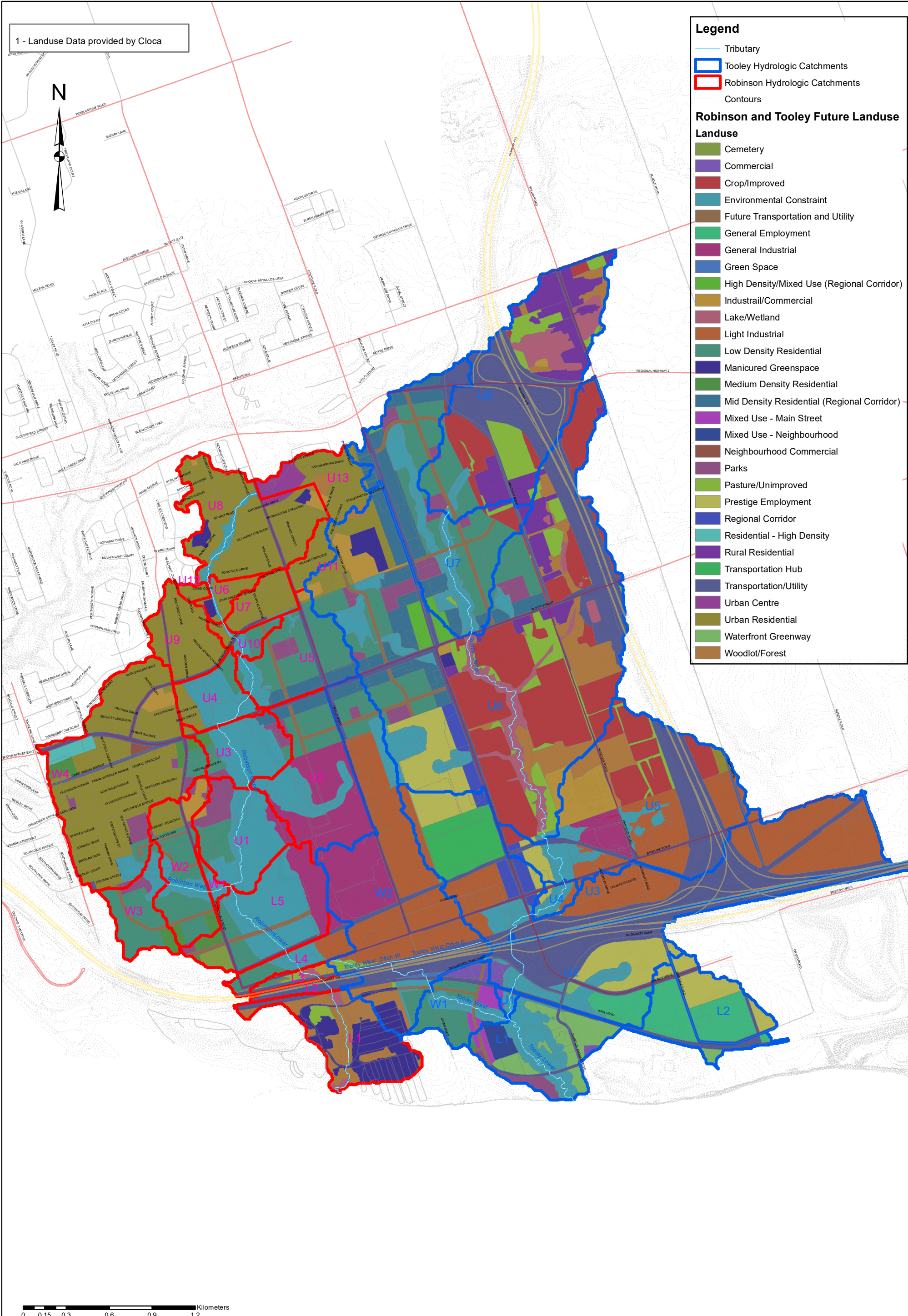


**Legend**

- Tributary
- Tooley Hydrologic Catchments
- Robinson Hydrologic Catchments
- Contours

**Robinson and Tooley Future Landuse**

- Cemetery
- Commercial
- Crop/Improved
- Environmental Constraint
- Future Transportation and Utility
- General Employment
- General Industrial
- Green Space
- High Density/Mixed Use (Regional Corridor)
- Industriail/Commercial
- Lake/Wetland
- Light Industrial
- Low Density Residential
- Manicured Greenspace
- Medium Density Residential
- Mid Density Residential (Regional Corridor)
- Mixed Use - Main Street
- Mixed Use - Neighbourhood
- Neighbourhood Commercial
- Parks
- Pasture/Unimproved
- Prestige Employment
- Regional Corridor
- Residential - High Density
- Rural Residential
- Transportation Hub
- Transportation/Utility
- Urban Centre
- Urban Residential
- Waterfront Greenway
- Woodlot/Forest



Document Path: G:\Projects\2022\10568 - CLOCA - Robinson-Tooley Flood Mitigation\600\_DSGN\Figures\GIS\work\2023-09\10568 - FIG 2b - Detailed Future Landuse 11x17.mxd



TOOLEY AND ROBINSON CREEK  
MUNICIPALITY OF CLARINGTON  
SECONDARY PLAN AND OFICIAL PLAN FUTURE LANDUSE

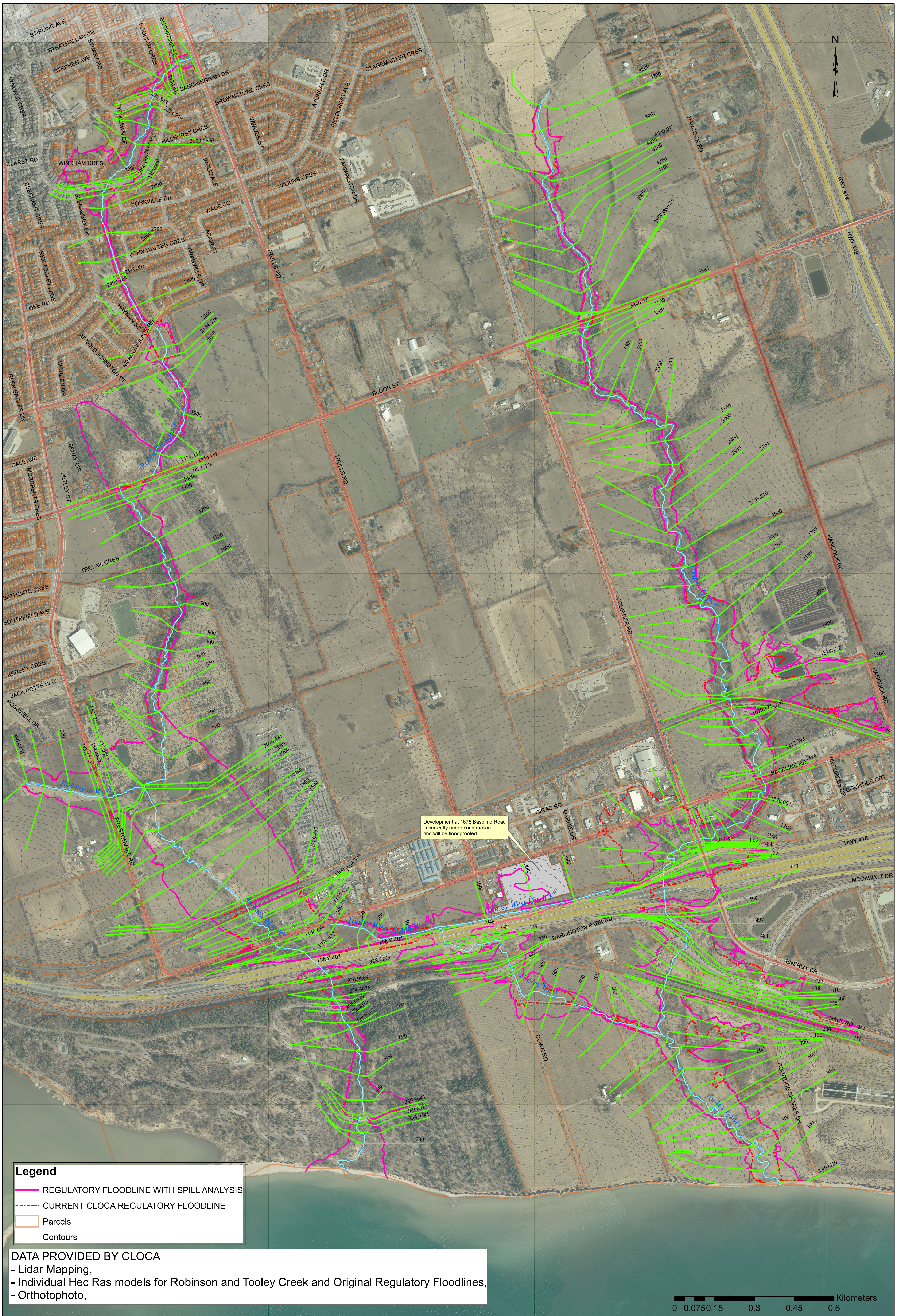
SCALE  
1 :24,000

DATE  
SEPTEMBER 2023

PROJECT NO.  
10568

FIGURE NO.  
2b





**Legend**

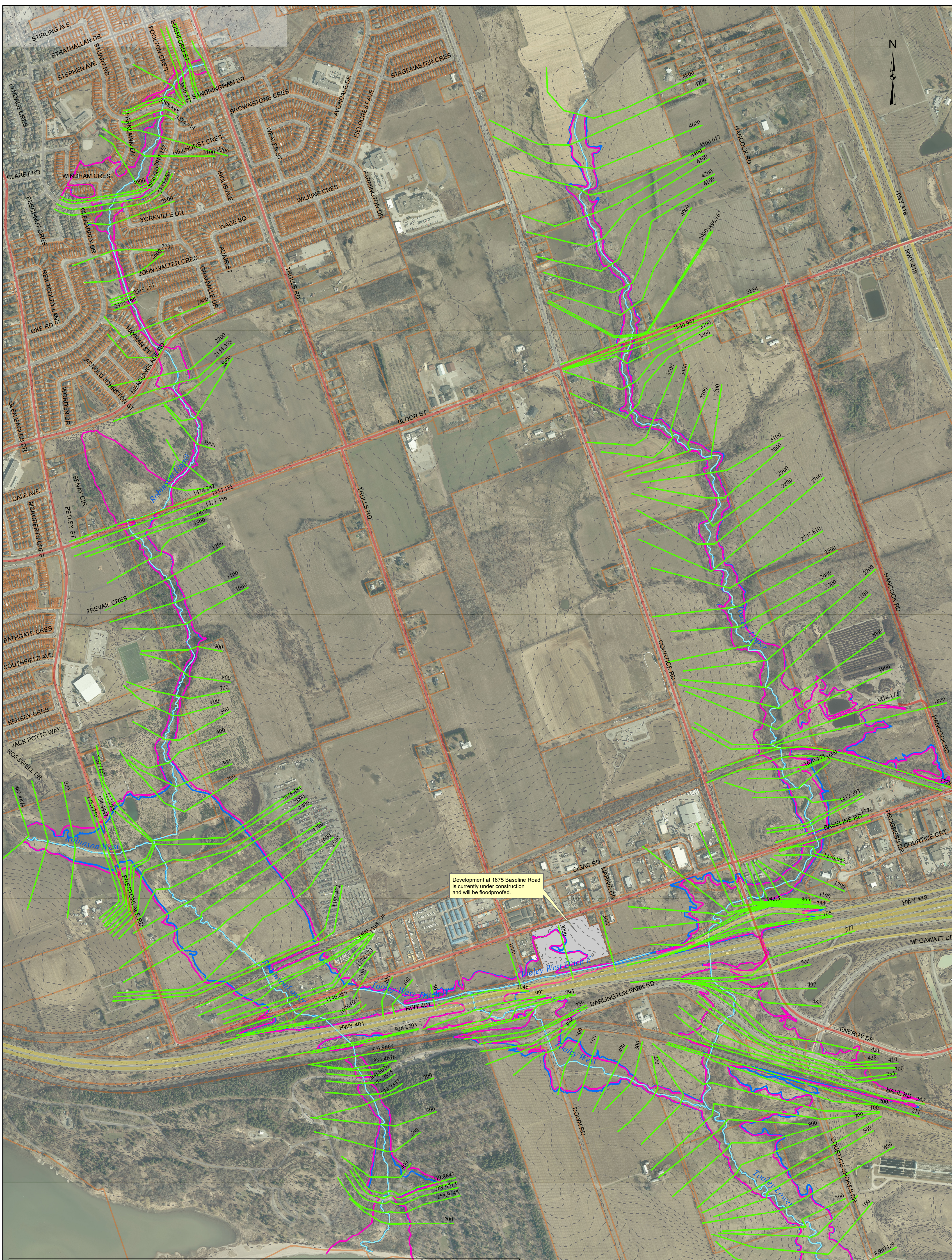
- REGULATORY FLOODLINE WITH SPILL ANALYSIS
- - - CURRENT CLOCA REGULATORY FLOODLINE
- Parcels
- Contours

DATA PROVIDED BY CLOCA

- Lidar Mapping,
- Individual Hec Ras models for Robinson and Tooley Creek and Original Regulatory Floodlines,
- Orthophoto,



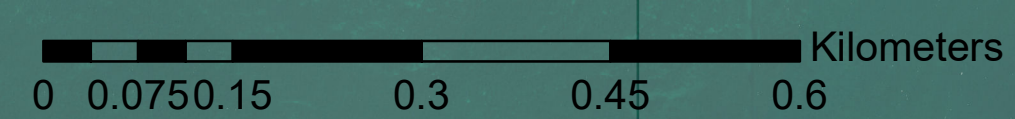




Development at 1675 Baseline Road is currently under construction and will be floodproofed.

Legend	
	REGULATORY FLOODLINE WITH SPILL ANALYSIS
	PRELIMINARY REGULATORY FLOODLINE WITH CLARINGTON OFFICIAL PLAN (UNCONTROLLED DISCHARGE)
	Parcels
	Contours

**DATA PROVIDED BY CLOCA**  
 - Lidar Mapping,  
 - Individual Hec Ras models for Robinson and Tooley Creek and Original Regulatory Floodlines,  
 - Orthophoto,



TOOLEY AND ROBINSON CREEK  
 MUNICIPALITY OF CLARINGTON  
 PRELIMINARY REGULATORY FLOODLINE WITH  
 CLARINGTON OFFICIAL PLAN (UNCONTROLLED DISCHARGE)

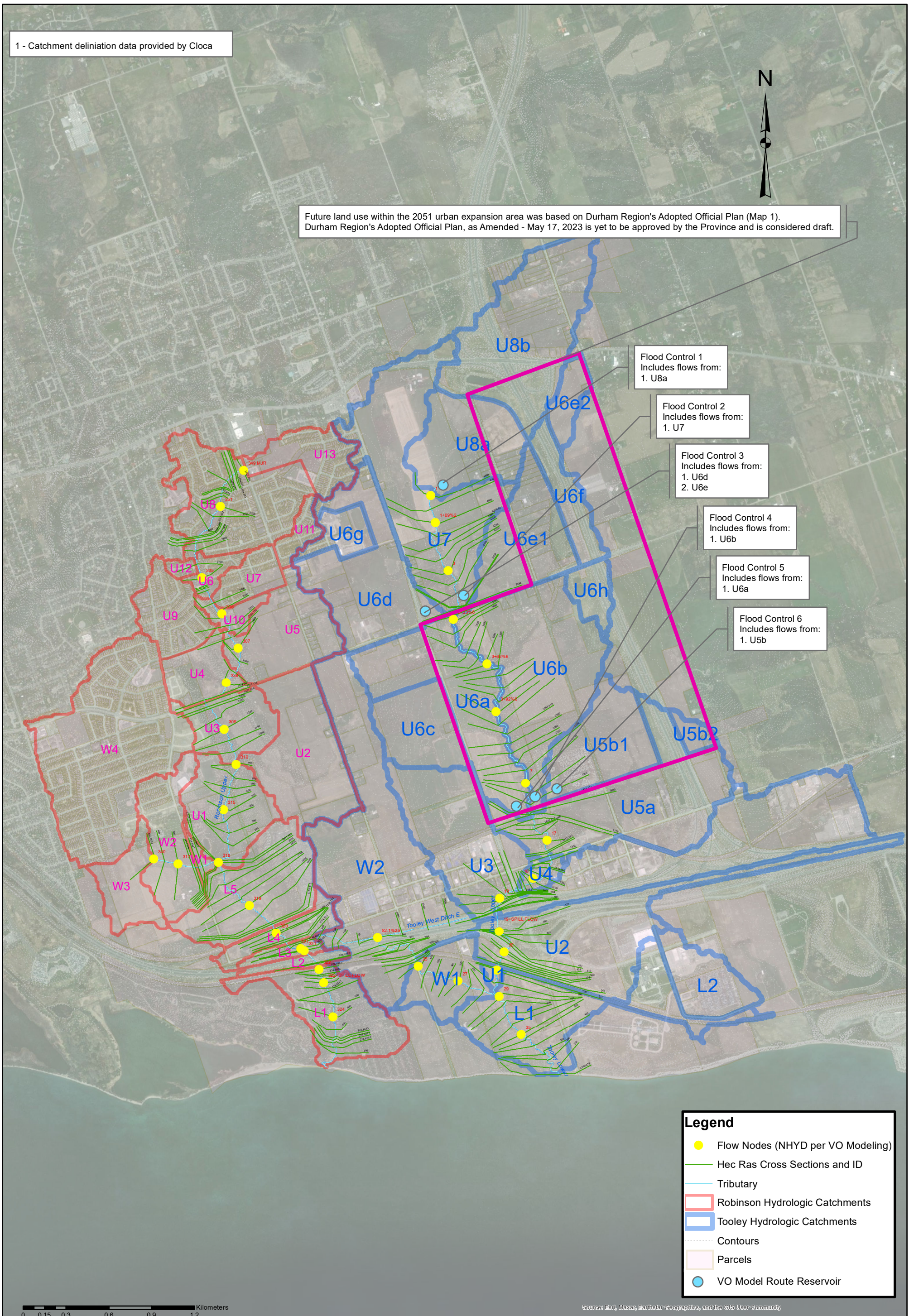
SCALE 1:6,000	PROJECT NO. 10568
DATE SEPTEMBER 2023	FIGURE NO. 4



1 - Catchment delineation data provided by Cloca



Future land use within the 2051 urban expansion area was based on Durham Region's Adopted Official Plan (Map 1). Durham Region's Adopted Official Plan, as Amended - May 17, 2023 is yet to be approved by the Province and is considered draft.



Flood Control 1  
Includes flows from:  
1. U8a

Flood Control 2  
Includes flows from:  
1. U7

Flood Control 3  
Includes flows from:  
1. U6d  
2. U6e

Flood Control 4  
Includes flows from:  
1. U6b

Flood Control 5  
Includes flows from:  
1. U6a

Flood Control 6  
Includes flows from:  
1. U5b

**Legend**

- Flow Nodes (NHYP per VO Modeling)
- Hec Ras Cross Sections and ID
- Tributary
- Robinson Hydrologic Catchments
- Tooley Hydrologic Catchments
- Contours
- Parcels
- VO Model Route Reservoir



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



TOOLEY AND ROBINSON CREEK  
MUNICIPALITY OF CLARINGTON  
CATCHMENT AREAS AND FLOW NODES FOR 2051 URBAN EXPANSION AREA

SCALE  
1 :24,000  
DATE  
SEPTEMBER 2023

PROJECT NO.  
10568  
FIGURE NO.  
5

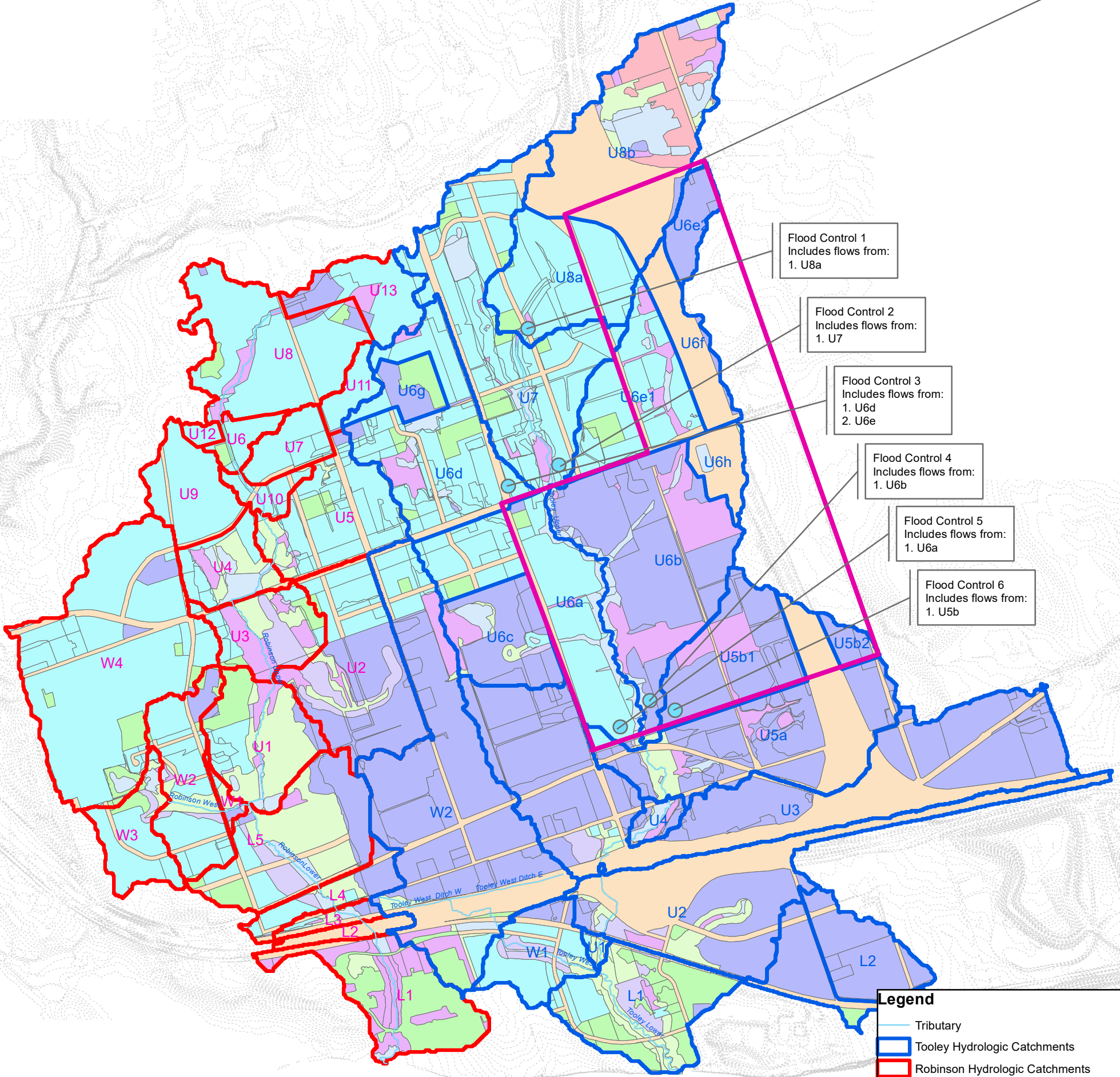
Document Path: C:\Users\kruvaavani.podhala\OneDrive - Global Infrastructure\00 Projects - KW10568 - Tooley\FIG 5 - updated catchments 11X17\_G\_230914.mxd



1 - Landuse data provided by Cloca



Future land use within the 2051 urban expansion area was based on Durham Region's Adopted Official Plan (Map 1). Durham Region's Adopted Official Plan, as Amended - May 17, 2023 is yet to be approved by the Province and is considered draft.



Flood Control 1  
Includes flows from:  
1. U8a

Flood Control 2  
Includes flows from:  
1. U7

Flood Control 3  
Includes flows from:  
1. U6d  
2. U6e

Flood Control 4  
Includes flows from:  
1. U6b

Flood Control 5  
Includes flows from:  
1. U6a

Flood Control 6  
Includes flows from:  
1. U5b

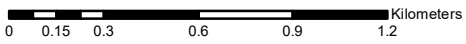
**Legend**

- Tributary
- Tooley Hydrologic Catchments
- Robinson Hydrologic Catchments
- Contours
- VO Model Route Reservoir

**Robinson and Tooley Future Landuse**

**LAND\_USE**

- Crop/Improved
- Industrial/Commercial
- Lake/Wetland
- Manicured Greenspace
- Pasture/Unimproved
- Rural Residential
- Transportation/Utility
- Urban Residential
- Woodlot/Forest

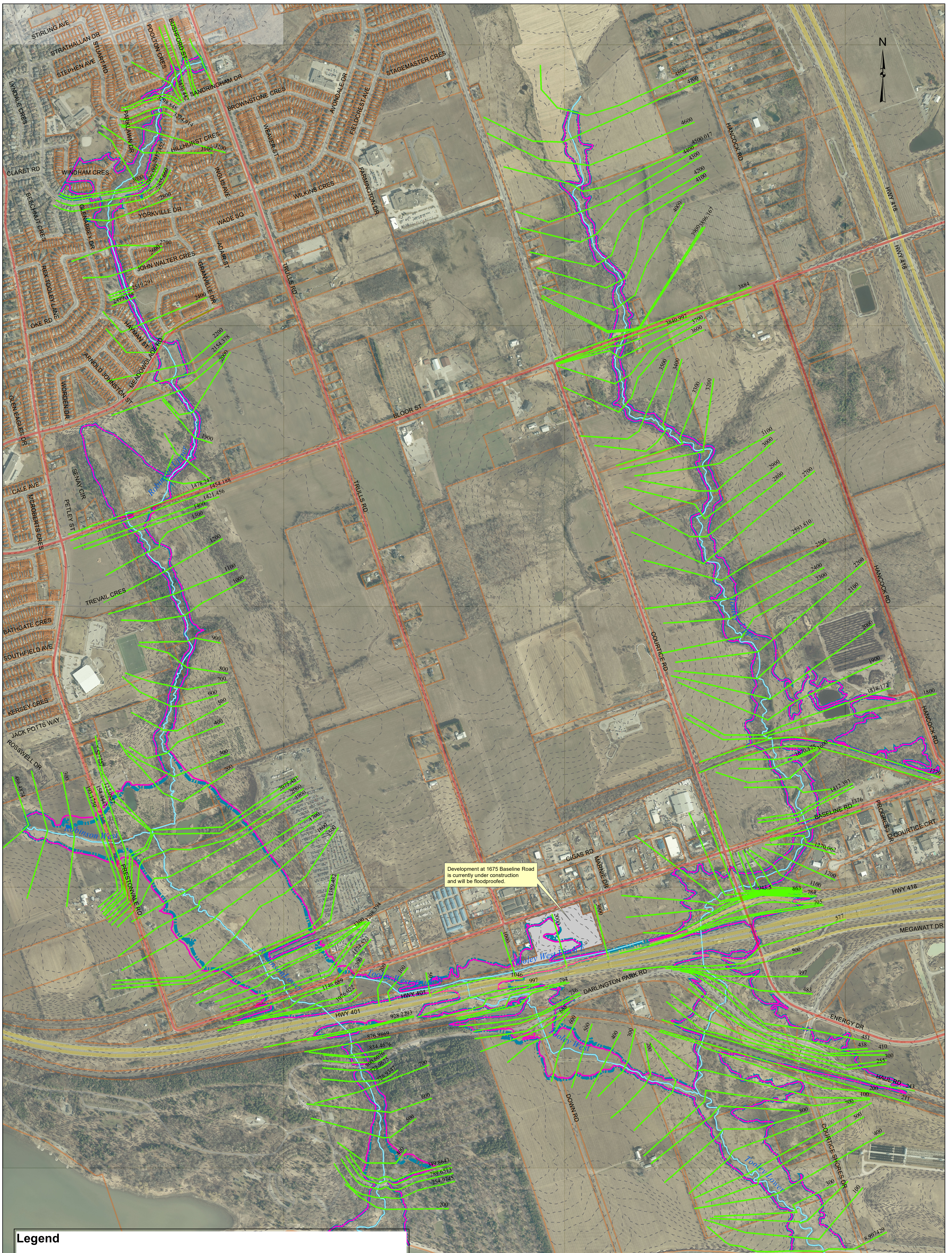


TOOLEY AND ROBINSON CREEK  
MUNICIPALITY OF CLARINGTON  
HYDROLOGIC MODEL FUTURE LAND USE FOR 2051 URBAN EXPANSION AREA

SCALE 1 :24,000	PROJECT NO. 10568
DATE SEPTEMBER 2023	FIGURE NO. 6

Document Path: C:\Users\kruvaavani.podhala\OneDrive - Global Infrastructure\00 Projects - KVI10568 - tooley\FIG 4\_1656\_Updated Future Landuse.mxd





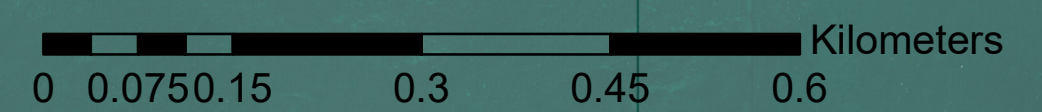
Development at 1675 Baseline Road is currently under construction and will be floodproofed.

- Legend**
- REGULATORY FLOODLINE WITH SPILL ANALYSIS
  - - - Preliminary Regulatory Floodline with 2051 Urban Expansion and Flood Mitigation Strategy
  - Parcels
  - - - Contours

DATA PROVIDED BY CLOCA

- Lidar Mapping,
- Individual Hec Ras models for Robinson and Tooley Creek and Original Regulatory Floodlines,
- Orthophoto,

**PRELIMINARY**



TOOLEY AND ROBINSON CREEK  
MUNICIPALITY OF CLARINGTON  
PRELIMINARY REGULATORY FLOODLINE  
WITH 2051 URBAN EXPANSION AND FLOOD MITIGATION STRATEGY

SCALE	PROJECT NO.
1:6,000	10568
DATE	FIGURE NO.
SEPTEMBER 2023	7