

APPENDIX ‘E’

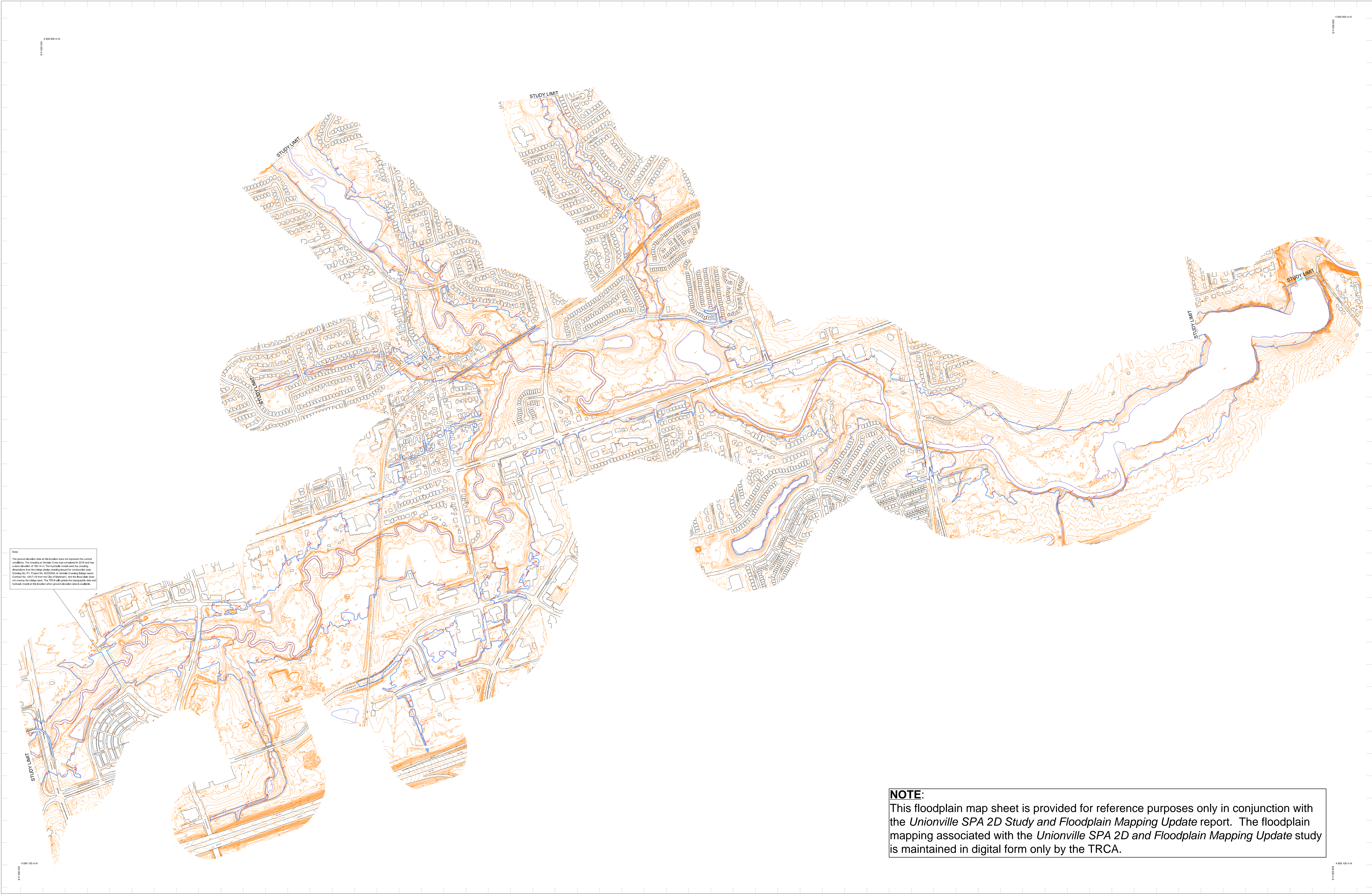
Updated Floodplain Map Sheets

Unionville SPA 2D Modelling Study and Floodplain Mapping Update

Toronto and Region Conservation Authority

Appendix ‘E’ Contents:

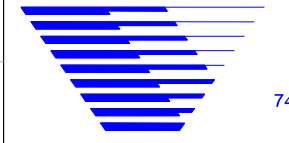
- **Sheet 01** Unionville SPA 2D Study and Floodplain Map Update (Regional)
(17x11)
- **Sheet 02** Unionville SPA 2D Study and Floodplain Map Update (350-yr) (17x11)




Unionville SPA 2D Study and
Flood Plain Map Update

Regional Storm Flood Event


Hydraulic Engineering Consultant:



VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
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The Professional Engineer's Seal verifies the location of the floodline and associated water surface elevations. Please see CFN 59726 for the final report and other details.



**AIRBORNE
IMAGING**
A Clean Harbors Company

Mapping Note:
The elevation data on this map was produced by TRCA from a DEM with 0.5 m grid resolution. The DEM was created using aerial photography and a vertical accuracy tolerance of +/- 0.5m RMSE on wet flat surfaces. The map points were collected using GNSS from 2015 to 2016. The hydraulic model used the existing elevations from the bridge design drawing issued for construction. Changes to the Project for the 2015/16 Annual Construction Report. Contour No. 100.0m is shown in the drawing and the flood data does not consider the bridge area. The TRCA will update the hydraulic data and hydraulic model at the location where ground elevation data is available.

The planimetric data on this map was acquired from a number of sources with different collection dates and may not match with the elevation data set and is for reference only. The building footprints were acquired from the Region of York in 2017.
The vertical datum is mean sea level as established by the Geomatics Survey of Canada CGVD 1985/1979 Ontario Adjusted Version.
The horizontal datum is North American Datum of 1983, UTM 81° projection Zone 17, Central Meridian 81° W.
Grid Interval: 100 m.

LEGEND

Contour - 5m

Contour - 1m

Contour - 0.5m

Spot Elevation

Building

Road

Bridge

Dam

Railway

Water features and Drainage

Regulatory Flood Line

Regulatory Flood Water Surface Elevation

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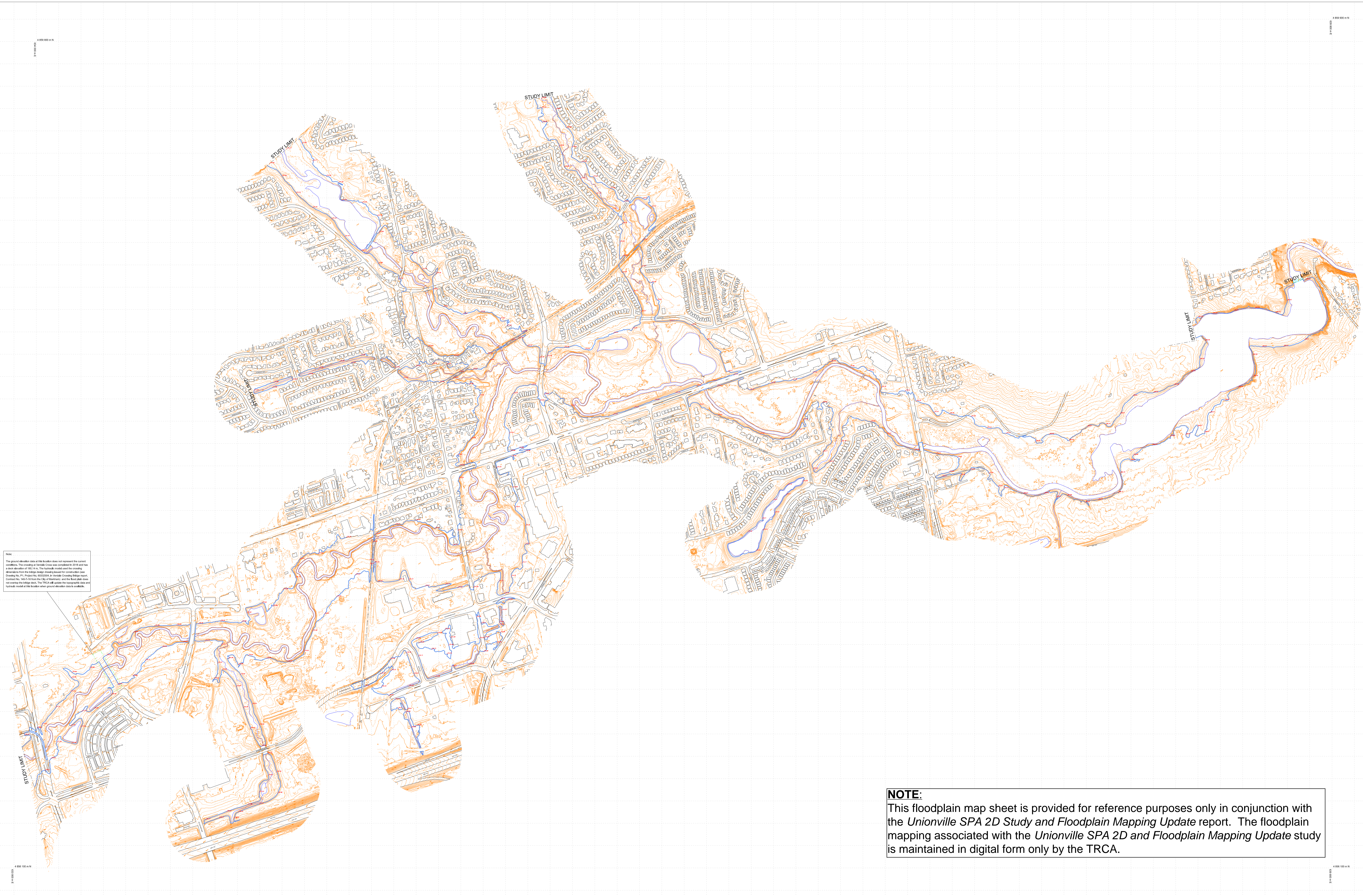
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Unionville SPA 2D Study and Flood Plain Map Update

350 Year Storm Event

Hydraulic Engineering Consultant:



The Professional Engineer's Seal verifies the location of the floodline and associated water surface elevations. Please see CFN 59726 for the final report and other details.



Mapping Note:

The elevation data on this map was produced by TRCA from a DEM with 5 m grid resolution. The DEM was created by interpolating points with a vertical accuracy tolerance of ± 0.10 m RMSE on hand flat terrain. The main data points were collected using LIDAR from 2015 by Airborne Imaging.

The spot elevations shown on this map were produced by TRCA using the DEM mentioned above. The contour lines were generated by TRCA from a smoothed surface map. The data set is provided as is.

The planimetric data on this map was acquired from a number of sources with different collection dates and may not match with the elevation data and is for reference only. The building footprints were acquired from the Region of York in 2017.

The vertical datum is mean sea level as *established* by the Geodetic Survey of Canada CGD 1928/1979 Ontario Adjusted Vertical.

The horizontal datum is North American Datum of 1983. UTM 6° projection Zone 17, Central Meridian 81° W.

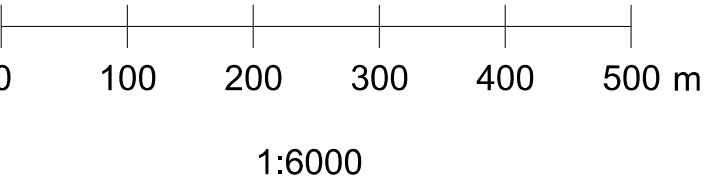
Grid Interval: 100 m.

LEGEND

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|----------------|--|----------------------------------------|--|
| Contour - 5m | | Bridge | |
| Contour - 1m | | / Culvert | |
| Contour - 0.5m | | Dam | |
| Spot Elevation | | Railway | |
| Building | | Water feature and Drainage | |
| Road | | 350 Year Event Flood Line | |
| | | 250 Year Event Water Surface Elevation | |



SCALE



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(416)-661-6600, info@trca.on.ca

Drawn by : MDT	Checked by : QIN
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SHEET :

02 of 02

APPENDIX 'F'

TRCA Correspondence, Meeting Minutes

Unionville SPA 2D Modelling Study and Floodplain Mapping Update

Toronto and Region Conservation Authority



VALDOR ENGINEERING INC.

Consulting Engineers – Project Managers

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04 July 2018
File: **18123**

Steering Committee Meeting #1 Unionville SPA 2D Study and Floodplain Mapping Update TRCA

NOTES OF MEETING

Location:	TRCA – Don Room	
Date of Meeting:	03 July 2018 (13h00 – 14h00)	
Attendees:	Nick Lorrain Qiao Ying Christina Bright Abdul Baten Bill Coffey	Toronto and Region Conservation Authority (TRCA) Toronto and Region Conservation Authority (TRCA) Toronto and Region Conservation Authority (TRCA) Valdor Engineering (Valdor) Valdor Engineering (Valdor)

Introductions

1. Introductions were made.
2. The purpose of the meeting was to “kick-off” the project with the TRCA and to review the work plan, schedule and available background information.

Project Discussions – Summary of Key Items

The following is a brief summary of the key items discussed at the meeting, including any required action items:

3. Administrative Items: The engineering agreement and data sharing agreements were signed previously. Valdor provided previously the TRCA with the required WSIB Clearance Certificate and insurance certificates for professional liability, commercial general liability and automobile liability. Valdor will record and distribute minutes from the project meetings. Qiao Y. will be the main contact for this project at the TRCA and Nick L. will be the contact for invoicing.
4. The Project Team: The project lead consultant will be Valdor Engineering. Also included on the project team is Calder Engineering for provisional survey work.
5. The TRCA will setup a project using Basecamp which is a web based project management tool to enable organized communications, file sharing, etc. between members of the project team.
6. The project work plan and schedule were reviewed.
7. Transfer of Information: The TRCA provided Valdor with a hard drive with various files, reports and information (see attached list). Valdor will review the information provided and identify any data gaps.



Professional Engineers
Ontario

Authorized by the Association of Professional Engineers
of Ontario to offer professional engineering services.

8. The TRCA indicated the importance to have the project completed within the allocated schedule as the funding is time sensitive.
9. The Study Area is identified by the red line included in Figure 1 in the RFP. The MIKE Flood model extents are generally described as from 16th Avenue to the north to Warden Avenue to the west to HWY 407 to the south and to just downstream of the Milne Dam to the east. The specific model extents will be confirmed with the TRCA prior to model development.
10. The TRCA noted a new crossing at Verdale Cross for inclusion in the MIKE Flood model.
11. The 2015 and 2017 orthophotos were provided by the TRCA and the LiDAR was flown in 2015. The TRCA would like to use the 2017 orthophoto when completing the report. The 2015 orthophoto was/will be used to delineate the edge of water.
12. The MIKE Flood model bathymetry will be prepared using mesh. Valdor will prepare the mesh resolution polygons and send to the TRCA for review.
13. The TRCA indicated that hard copies of floodplain map sheets are being phased out and that a new approach will be employed for this project whereby a digital floodline will be overlaid on a digital base. Further discussions will be had prior to delineation of the floodline to confirm the specific details regarding this new approach.
14. The TRCA noted that the building footprints have been digitized and that buildings were merged where there was a gap of approx. 1 m or less.
15. It was noted that the surface provided by the TRCA does not need to be modified for the South Unionville SWMP. The depth of water in the SWM pond was minimal or dry during the LiDAR capture. The rating curve provided in the SWM Pond Design Brief can be used, if required.
16. The stage-discharge curve was provided by the TRCA for the Milne Dam and will be used to establish the downstream boundary conditions for the MIKE Flood model.
17. The LiDAR surface was modified by the TRCA for the Toogood SWM Pond to reflect the SWM pond bathymetry. Valdor to look in the report provided for the rating curve. If no rating curve is located, the concrete spillway associated with the SWM pond will be included directly in the MIKE Flood model.
18. The TRCA indicated that the topographic survey is currently being completed for the watercourse and should be available soon.
19. It was noted that the hydrology update report is not yet finalized but that updated flow information should be available soon.
20. Valdor to prepare a map with the proposed extents of floodlines, etc. for review by the TRCA before proceeding.
21. QUESTION FOR THE TRCA – Do any of the as-constructed drawings require an adjustment (10 cm?) to account for the historical vertical datum adjustment (similar to the Ajax/Pickering project)?
22. Steady and unsteady inflow hydrographs (incremental and point source) will be provided by the TRCA for the identified flow nodes.
23. Valdor to sign the TRCA's data sharing agreement.

24. The meeting was adjourned.

Notes Prepared By*:

VALDOR ENGINEERING INC.

A handwritten signature in black ink, appearing to read "Bill Coffey", is written over a light gray rectangular background.

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources

c: All Attendees and project team

* Any errors or omissions should be reported to the author in writing as soon as possible.

**Unionville SPA 2D Model Project
Data Transfer List**

Last Edited: July 4, 2018 by Qiao

Data	Notes	Status	Folder
1 Study area GIS shapefile		In hard drive	\Background\GIS Data
2 Flow Nodes GIS shapefile		In hard drive	\Background\Hydrology\
3 Catchments GIS shapefile		In hard drive	\Background\Hydrology
4 Watercourse GIS shapefile		In hard drive	\Background\Hydrology\
5 Landuse GIS shapefile	Category and Manning's n values	In hard drive	\Background\GIS Data
6 Existing HEC-RAS models		In hard drive	\Background\Existing HEC-RAS
7 LiDAR data (ASCII, dfs2 format)	0.5-m	In hard drive	\Background\GIS Data
8 Contour		In hard drive	\Background\GIS Data
9 Aerial Imagery	2015/2017 10cm	In hard drive	\Background\GIS Data
10 Building footprint GIS shapefile	2017	In hard drive	\Background\GIS Data
11 Roads GIS shapefile		In hard drive	\Background\GIS Data
12 TRCA Standard Manning's n (pdf)	Manning's Roughness	In hard drive	\Background
13 Existing Map Sheets index GIS shapefile		In hard drive	\Background\Mapsheets
14 Existing Map Sheets (dwg format)	8 map sheets	In hard drive	\Background\GIS Data
15 Existing Floodline		In hard drive	\Background\GIS Data
16 Hydraulic Structure Inventory Sheet	template	In hard drive	\Background
17 Flow data (in excel)		Pending	\Background\Hydrology\Flow data
18 Crossing as-built		In hard drive	\Background\Structure_AsBuilt
19 Survey Data		In progress	\Background\GIS Data
20 Water Edge		In hard drive	\Background\GIS Data
21 SWM Ponds	Q-H Relationship	In hard drive	\Background\SWM Ponds
22 Previous Study	Toogood Pond Dam Safety Investigation (structure info and Q-H relationship)	In hard drive	\Background\Previous Study

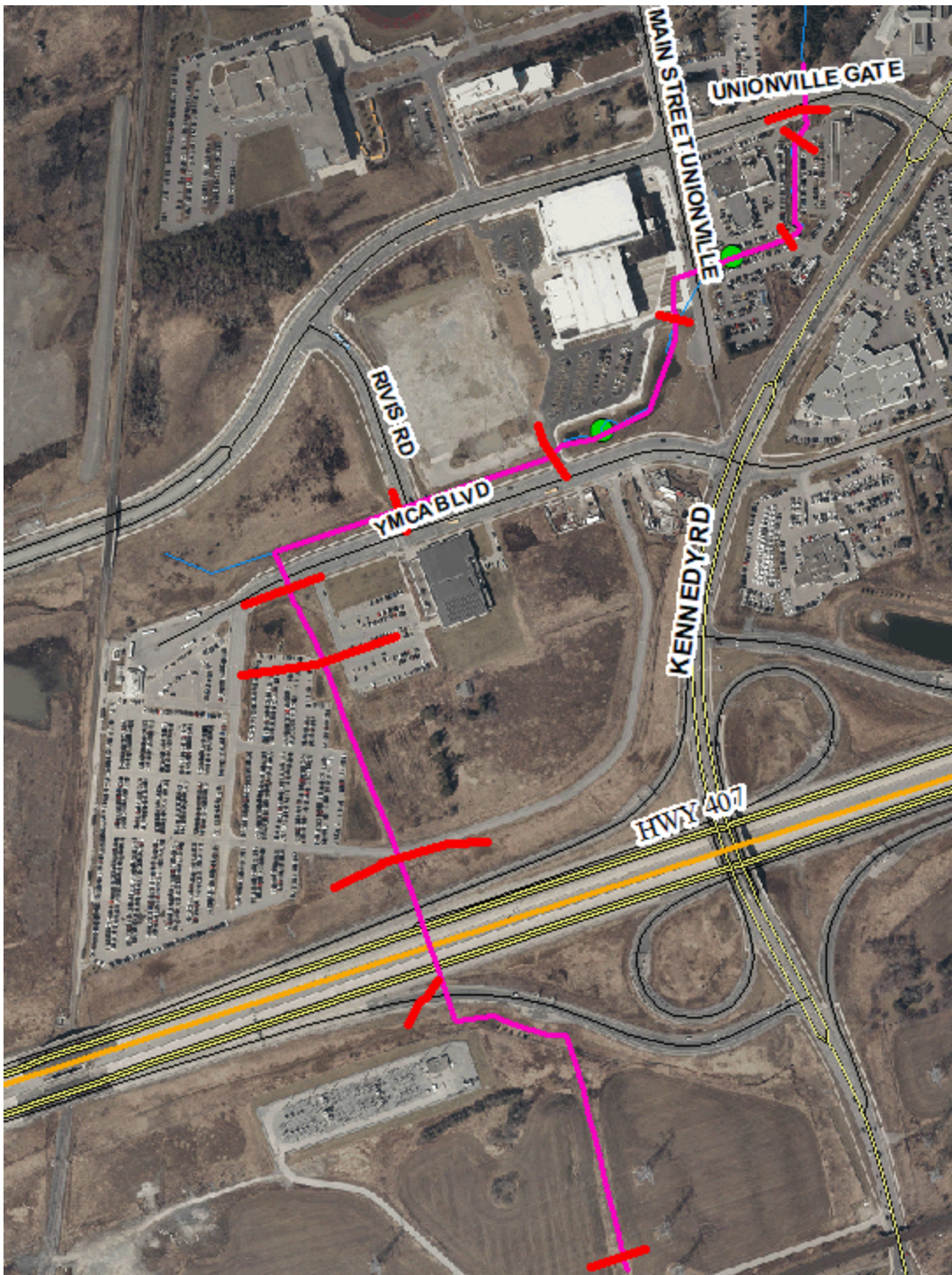
Abdul Baten

From: Qiao Ying <qiao.ying@trca.on.ca>
Sent: Thursday, September 13, 2018 4:35 PM
To: Abdul Baten
Cc: Bill Coffey
Subject: Tributary runs near Pan Am Cener in Unionville
Attachments: HECRAS-Trib 5.zip; Trib5_Centerline.zip

Hi Abdul,

Yesterday I had a talk with Eric from our Water Resources team, and he provided some new information on one of tributary. In the following picture, the blue line indicates the watercourse lines I provided to you and it shows the small tributary (in the exiting hec-ras model it was called Tributary 5) running parallel to YMCA Blvd. Eric indicated Tributary 5 starts from south of HWY 407, and runs through a couple of culverts towards north and then join the reach parallel to YMCA Blvd. (pink line in the picture below).

We have a latest HEC-RAS model for this tributary developed as part of Markham Center Master Environmental Servicing Plan Study (August, 2018). This model has all crossing information from HWY 407 to Unionville Gate. Below I have attached this latest HEC-RAS model as well as the new central line for the section shown in pink line in the image below. What I want you to do is to the supersede the centerline using the pink line upto Unionville Gate, and for the reach section from HWY 407 to YMCA Blvd please use the crossing information from the latest model, for the reach section from YMCA Blvd to Unionville Gate, crossing information from the latest model can be also used to supplement crossing data.



Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure

T: 416 661 6600 ext. 5219

E: qiao.ying@trca.on.ca

A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6

Toronto and Region Conservation Authority (TRCA) | trca.ca/

From: [Bill Coffey](#)
To: [Qiao Ying](#)
Cc: [Abdul Baten](#)
Subject: RE: Drainage line confirmation - Tributary running through Pan Am Center
Date: Monday, September 17, 2018 10:54:00 AM

Hi Qiao,

Yes, we did look around this area when out in the field on Friday. There does appear to be a channel that runs as noted in blue on the map from Kennedy Road west towards the culvert under HWY 407. There is no evidence, however, of any outlets at the terminus of the noted channel at Kennedy Road. The drainage area indicated on the figure that you provided does look reasonable based on our approx. field observations. The high point to the south of HWY 407 appears to be around 14th Avenue. The railroad acts as a dam and it appears that major flow to the south of the railroad would be collected and conveyed to the Kennedy Road underpass and then be conveyed north on Kennedy Road towards the low point (near the noted channel) on Kennedy Road south of HWY 407. I don't know for sure, but I'm guessing that the storm sewer under Kennedy Road may run north under the recently constructed HWY 407 and 407 overpass and outlet minor flows to the watercourse somewhere on the north side of HWY 407. Major flow that would collect at the low point on Kennedy Road south of HWY 407 may end up spilling to the channel that runs from Kennedy Road west to the culvert under HWY 407. Lands to the east of Kennedy Road and north of the railroad appear to drain north and east to another culvert under HWY 407 to the east. Hope this helps!

Regards,

Bill Coffey, M.Sc., P.Eng.

Head of Water Resources

Valdor Engineering Inc.

From: Qiao Ying [mailto:qiao.ying@trca.on.ca]

Sent: Monday, September 17, 2018 9:44 AM

To: Bill Coffey <BCoffey@Valdor-Engineering.com>

Subject: Re: Drainage line confirmation - Tributary running through Pan Am Center

Hi Bill,

I like to follow up on the site visit you did last Friday. What are your findings?

Qiao

Regards,

Qiao Ying M.Sc. P.Eng.

Senior Project Engineer, Capital Projects

Engineering Services | Restoration and Infrastructure

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A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6

Toronto and Region Conservation Authority (TRCA) | trca.ca/

From: Bill Coffey <BCoffey@Valdor-Engineering.com>

To: Qiao Ying <qiao.ying@trca.on.ca>

Hi Qiao - Not a problem. We will try to confirm for you.

Regards,
Bill Coffey, M.Sc., P.Eng.
Valdor Engineering Inc.

On Sep 14, 2018, at 11:40 AM, Qiao Ying <qiao.ying@trca.on.ca> wrote:

Hi Bill,

I have one thing that I like to have your big favour. As we talked today over the phone, the tributary running through Pan Am Center is actually starting from south of HWY 407. I know we are not going to model reach south of HWY 407 which is out of scope of work, but we still need account for the flow draining into that reach from south of HWY 407. In the attached image below, you will see a drainage area upto YMCA Blvd. delineated based on the 2015 Lidar data, and this drainage area is much bigger than what the 2018 Rouge Hydrology model used. I know your team is out in the field to verify crossings. Would it possible for your team to go to south of HWY 407? The purpose is to confirm if there is a ditch running through the highlighted area (black line) and if there is an outlet draining into this ditch.

<mime-attachment.gif>

Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure

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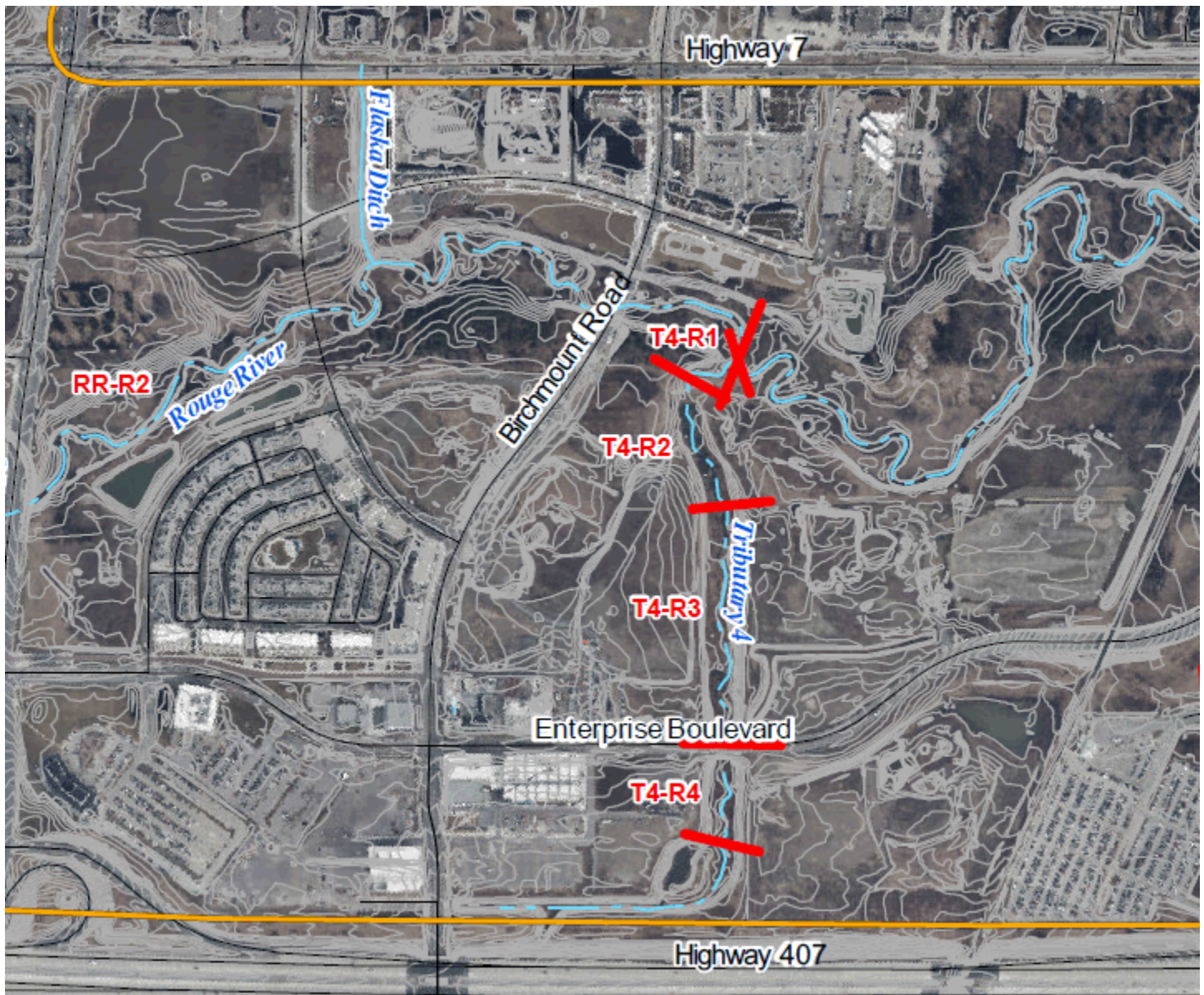
[\[attachment "ATT00001.gif" deleted by Qiao Ying/TRCA\]](#)

Abdul Baten

From: Qiao Ying <qiao.ying@trca.on.ca>
Sent: Monday, September 17, 2018 9:43 AM
To: Abdul Baten
Subject: Naming of two tributaries

Hi Abdul,

I know we have talked about how to name river branches in the study area. Please look at the following image, I remember you named them as West Branch and South Branch respectively, for consistency of name convention with other studies can you name the reach just west of Birchmount Road as Tributary 4, and name the reach running from HWY 407 through Pan Am Center as Tributary 5?



Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure

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E: qiao.ying@trca.on.ca

A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6

Toronto and Region Conservation Authority (TRCA) | trca.ca/

From: [Bill Coffey](#)
To: [Qiao Ying](#)
Subject: RE: Fonthill Creek Culverts/Markham Village
Date: Friday, September 21, 2018 7:31:00 PM

Hi Qiao,

Yes, we noted based on our field inspections that the as-built drawings were not reflective of the current structure at this location but that it appears to match the information provided in the HEC-RAS model. Where information does not match any of the available information, or there is no available information, we have collected detailed measurements and tied this in with the LiDAR at a known location. We should be able to provide this for you sometime next week. Have a nice weekend!

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valdor Engineering Inc.

From: Qiao Ying [mailto:qiao.ying@trca.on.ca]
Sent: Friday, September 21, 2018 10:19 AM
To: Bill Coffey <BCoffey@Valdor-Engineering.com>
Subject: Fw: Fonthill Creek Culverts/Markham Village
Hi Bill,

Please read attached e-mail below from Rob Grech from Markham. As he indicated the culvert as-built for Fonthill Creek is not correct but the existing hec-ras has the correct info. I believe your team has visited culverts along this creek. Is information from site visit consistent with that coded in the existing hec-ras model I provided?

Has your team done any crossing surveys? If yes, can you send survey info to me.

Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure

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A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6

Toronto and Region Conservation Authority (TRCA) | trca.ca/

----- Forwarded by Qiao Ying/TRCA on 09/21/2018 10:13 AM -----

From: "Grech, Rob" <RGrech@markham.ca>
To: "Nick Lorrain (nlorrain@trca.on.ca)" <nlorrain@trca.on.ca>
Cc: Qiao Ying <qiao.ying@trca.on.ca>
Date: 09/21/2018 09:48 AM
Subject: Fonthill Creek Culverts/Markham Village

Hi Nick/Qiao,

We've been reviewing some of our data/reports for the study and have noticed that the drawings that were provided for the Fonthill Creek culverts are not correct. They are for the original culverts and not the upgrades.

I noticed that the TRCA modelling does have the most up to date information, and so I'm wondering if you have surveys. I know that it's a long shot, but let me know.

If you don't have the survey, let me know how crucial this is to your study, and if you have funding for surveying other crossings. If you are, we can probably work something out where we both do some of these and share all of the info.

Also, if you can let me know what is going on with the Rouge Hydrology Study, and if I can have an updated draft, that would be great.

Thanks.

Rob

Rob Grech, P.Eng.

Environmental Engineer

Environmental Services Department, City of Markham

T: 905-477-7000 x 2357 • F: 905-479-7766 • E: RGrech@markham.ca
8100 Warden Ave • Markham • Ontario • L6G 1B4 • www.markham.ca

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From: [Bill Coffey](#)
To: [Qiao Ying](#)
Cc: [Abdul Baten](#); [Wilfred Ho](#); [Nick Lorrain](#)
Subject: Re: Regional flow data - Unionville SPA 2D study
Date: Monday, October 29, 2018 7:09:44 AM

Hi Qiao,

Thank you for sending over this information. Yes, the model is coupled and Abdul has been working over the weekend to continue finalizing the model setup. We plan to start a preliminary run later on Monday. Thank you.

Regards,
Bill Coffey, M.Sc., P.Eng.
Valdor Engineering Inc.

On Oct 26, 2018, at 9:29 AM, Qiao Ying <qiao.ying@trca.on.ca> wrote:

Hi Bill/Abdul,

We have finished flow data preparation for regional event under Future condition without SWM ponds, and I placed 4 files in OneDrive shared folder:

1. Regional_Unsteady_future_noSWM.xlsx: this file contains the hydrograph at each flow nodes. We have aggregated a number of flow nodes, and they are highlighted in yellow and their Node ID contains IDs that are aggregated. In total, there are 43 flow nodes. In the summary tab, you will find the peak flows for each node (Note: for intermediate flow nodes, incremental flows were pulled and for head flow nodes total flows were pulled). We also put the type of flow (i.e. total vs. lateral inflows) and application in the model (upstream inflow vs. point sources). In terms of point source application in the model, please look at the collectivity of catchment to individual flow node in Flow Location Overview.xlsx, some of flow nodes should be applied at single chainage and some should be distributed along chainages.

2. Flow Location Overview.xlsx: this file contains the connectivity of catchment to individual flow nodes, which was organized by reach name. (Thanks to Wilfred, he did great job to pull these information from the model)

3. Junctions_regional.shp: this GIS files shows the location of flow nodes. Note: I did not removed aggregated flow nodes.

4. Subcatchments.shp: this GIS files shows the catchment delineation used in the hydrology model.

Here is the link to download files https://torontoregion-my.sharepoint.com/:f:/g/personal/qiao_ying_trca_on_ca/Es6Zpf_G2QZLhXyFVR7yFYMBYIsXBFrDp6QRfgNSeRR8-g?e=aikqtX.

If you have any questions related to flow data, please contact Wilfred and cc'd me.

In terms of progress of project, please give me update on where things are. is 1D model configuration donw? have you started coupling of 1D and 2D components? To this point if these tasks are finished, then you should have enough time today to plug in all flow data and run the model over the weekend. Please let me know.

Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure

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A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6

Toronto and Region Conservation Authority (TRCA) | trca.ca/

From: [Bill Coffey](#)
To: [Qiao Ying](#)
Cc: [Abdul Baten](#)
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping
Date: Wednesday, November 21, 2018 1:33:00 PM

Hi Qiao,

My apologies for not getting back to you earlier. I've been out of the office at meetings and just returned. As per your latest e-mail, I think I have a better understanding of the issue. As you have noted, the subtraction of upstream hydrographs from the downstream hydrograph results in a negative flow. As you have noted, this is due to time shifting of the individual hydrographs among other things. Perhaps if the incremental hydrographs were based on the cumulative increase in flow from the additional catchments themselves to the downstream node (as opposed to the total calculated hydrograph), this would avoid the problem? I'm in the office now for the afternoon if you would like to discuss further. Thank you.

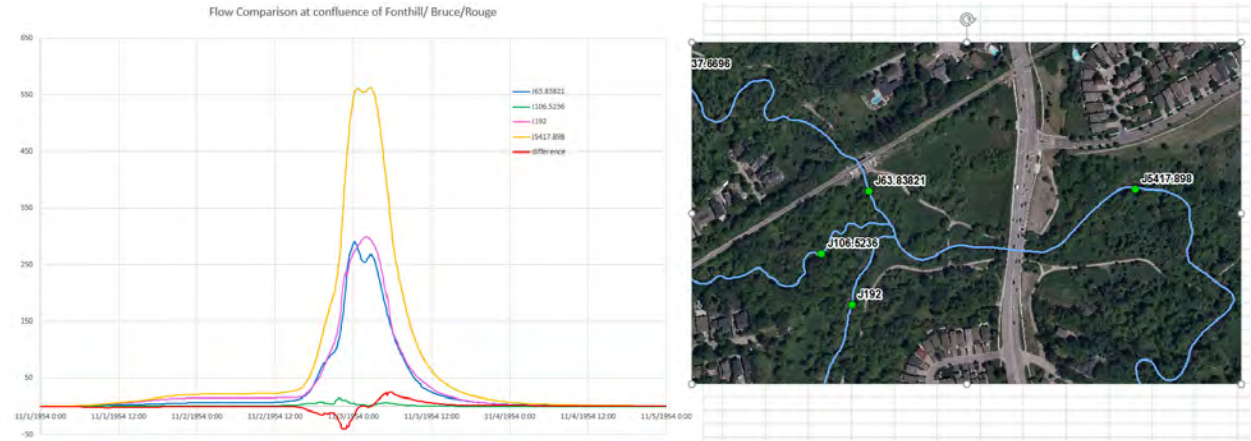
Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valdor Engineering Inc.
From: Qiao Ying [<mailto:qiao.ying@trca.on.ca>]
Sent: Wednesday, November 21, 2018 9:54 AM
To: Bill Coffey <BCoffey@Valdor-Engineering.com>
Cc: Abdul Baten <ABaten@Valdor-Engineering.com>
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping

Hi Bill,

Of course, we have thought about incremental hydrograph approach and calculated all the incremental hydrograph at each flow node. Even with the incremental hydrograph, we are still facing negative flow. As you know in the hydrology model, when water moves downstream the reach and collects lateral flows along the way, the hydrograph becomes wider and shift a bit due to timing, and peak may go down due to channel routing. If we simply subtract hydrograph from previous node, we may still see negative flows in the incremental hydrograph.

For example, the following plot shows the comparison of flows near confluence of Fonthill/Bruce/Rouge. In order to calculate the incremental flow from confluence to Node J5417.898, we sum hydrographs at Nodes J63.83821, J106.5236, J192, and then subtract hydrograph at Node J5417.898 from the total hydrograph at confluence. The red line in the plot shows the incremental hydrograph, you can see there are negative flows, and now the question is for steady state run which peak flow we should use, the biggest negative flow or positive flow? This situation occurs at other nodes as well. My thought is simply subtracting hydrographs between nodes to get incremental hydrograph still does not fully make sense in this case.



Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure
T: 416 661 6600 ext. 5219
E:qiao.ying@trca.on.ca
A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6
Toronto and Region Conservation Authority (TRCA) trca.ca/

From: [Bill Coffey](#) <BCoffey@Valdor-Engineering.com>
To: [Qiao Ying](#) <qiao.ying@trca.on.ca>
Cc: [Abdul Baten](#) <ABaten@Valdor-Engineering.com>
Date: 11/20/2018 8:44 PM
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping

Hi Qiao,

The way that we would typically approach this (and I believe was the original plan in this case) is to prepare the incremental hydrographs for the identified flow node locations based on the approved hydrology model using a similar approach as would be used for a HEC-RAS model (i.e. same approach regarding hydrograph timing and areal reduction would apply to the flows used). Not sure why you would be experiencing these discrepancies if the incremental hydrographs are prepared on this basis. The areal reduction factor would normally be accounted for in the hydrology model and so would not typically be an issue or cause for discrepancy. Having said that, however, I'm not aware of how exactly the areal reduction factor was applied to the hydrology model in this particular case. Without looking at this in depth, it's difficult for us to confirm all the details that have gone into the incremental flow preparations and why they are not matching with the hydrology model. If the TRCA has determined that a reduction in the flow is justified, we would recommend this be applied to the incremental hydrographs prior to including in the MIKE Flood model as opposed to applying a negative flow in the MIKE Flood model. Our concern is that this could lead to other potential issues (e.g. how will this be applied for unsteady model runs?) and it becomes awkward to explain this manipulation of the flow data within the MIKE Flood model. Hope this helps. Thank you.

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valdor Engineering Inc.
From: Qiao Ying [<mailto:qiao.ying@trca.on.ca>]
Sent: Tuesday, November 20, 2018 11:29 AM
To: Bill Coffey <BCoffey@Valdor-Engineering.com>
Cc: Abdul Baten <ABaten@Valdor-Engineering.com>
Subject: Fw: Unionville SPA 2D Study and Floodplain Mapping

Hi Bill,

In terms of flow data, we did detail analysis on the peak flows applied in the current MFlood model, and we found out the peak flow applied would be much higher than peak flows generated from the hydrology model at some key locations. This issue has not been our concern in the past since the drainage systems studied is much less complicated than Unionville, and most of the systems only contains one tributary. Here are reasons for the difference.

Yes, we pulled flows from the hydrology model. Only the total flows at the beginning of each branch include area reduction factor and flow routing, and all lateral flows from sub-catchments don't include area reduction factor and flow routing, so peak flows from these lateral flows would stack on top each other and produce much higher peak flows than what hydrology model produced at the same location. For example, at Kennedy RD immediately downstream of confluence (Node: J5417.898), the peak discharge from MFlood model is about 700 cms comparing to 572 cms from hydrology model, and at the Millie Dam (Node: J273) the peak discharge from MFlood model 857 cms comparing to 576 cms from Hydrology model.

As we all know steady-state HEC-RAS model has been used as industrial standard for flood plain mapping. In tradition steady-state HEC-RAS model, we would not pull lateral flows from sub-catchments, but we would only pull peak discharges at flow change locations along the river reach directly from hydrology model, and peak flows can be even lower at next flow change location due to flow routing/areal reduction factor applied. But in MFlood, we don't normally apply negative flows, the only time to apply negative flow is when there is diversion or intakes for water supply (pumping out) etc. I am thinking over about how to mimic the way traditional HEC-RAS model uses hydrology peak flows in MFlood, and the only way to mimic is to apply negative flows along the reach sections. I have done the test run with the negative flows to match the hydrology peak discharges at each flow change locations, and compared the flood extent with that generated from MFlood model using original peak flows.

I have placed two images at OneDrive at <https://torontoregion-my.sharepoint.com/:f?personal/qiao.ying@trca.on.ca&eom=0x7J6Q2C4Nk1m2B6v84vaBzK2bDl0xG4fyw==P&id=>, the steadyFlow comparison image shows the comparison of MFlood peak flows and Hydrology peak flows at key locations, and it shows the significant differences between two types of peak flows. The FloodExtent comparison image shows the comparison of flood extents between two models (MFlood Peak Q represents results from model using original peak flows we provided, and Hydrology Peak Q represents results from model using negative flow to match hydrology peak flows), as you can see using negative flows to match hydrology peak flows would produce smaller flood extent and this flood extent would be similar to that produced from HEC-RAS model using hydrology peak flows at each flow change location.

We like to hear your thoughts on applying negative flows to mimic the way tradition HEC-RAS uses hydrology peak flows for flood plain mapping purpose.

Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure
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A: 101 Exchange Avenue | Vaughan, Ontario L4K 5R6
Toronto and Region Conservation Authority (TRCA) trca.ca/

From: [Bill Coffey](#) <BCoffey@Valdor-Engineering.com>
To: [Qiao Ying](#) <qiao.ying@trca.on.ca>, [Abdul Baten](#) <ABaten@Valdor-Engineering.com>
Cc: [Nick Larkin](#) <NLarkin@trca.on.ca>
Date: 11/20/2018 12:02 PM
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping

Hi Qiao,

Thanks for your efforts in reviewing the MIRC Flood model. Based on recent discussions between you and Abdul and your review and comments to date, I understand that we are very close to having a finalized model that we can use for the various runs, floodplain mapping and flood characterization. Given the tight timeline remaining, we are hoping to start the finalized model runs very shortly.

To date, we have been using the "draft" flow hydrographs provided by the TRCA. I believe that the TRCA is working to provide updated hydrographs for us to use in the finalized model runs. Given that we anticipate completing the final runs soon, could you please confirm when we may expect to receive the "final" flow hydrographs. Thank you.

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Vastor Engineering Inc.

From: Bill Coffey
To: Qiao Ying
Cc: Abdul Baten, Nick Lorrain
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping
Date: Thursday, November 22, 2018 2:14:00 PM

Hi Qiao,

As requested, please see our comments below in **RED**. Hopefully these discussion will lead to a reasonable solution! Thank you.

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valcor Engineering Inc.
From: Qiao Ying [mailto:qiao.ying@trca.on.ca]
Sent: Thursday, November 22, 2018 10:52 AM
To: Bill Coffey <BCoffey@Valcor-Engineering.com>
Cc: Abdul Baten <ABaten@Valcor-Engineering.com>; Nick Lorrain <nlorrain@trca.on.ca>
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping

Hi Bill,

We have thought about timing effect, especially at confluence near Kennedy RD. At that location, there are three hydrographs come in, i.e. Fonthill, Bruce and Main Rouge, see plot below. Among three hydrographs, Fonthill peaks earlier and may not have any effect, and Bruce and Main Rouge hydrographs donot peak at the same time, so due to time effect the peak at the Kennedy RD does not equal to the sum of peaks of hydrographs from Bruce and Main Rouge. When running steady state model, we normally pull the peaks from the hydrographs, and then hold them steady, and this approach would stack all peaks from hydrographs which of course results much higher peak at confluence, for example, at Kenney RD sum of steady peak flows (peaks from total inflows plus peaks from lateral flows) would be over 680 cms, but peak of hydrograph from hydrology model at Kennedy Rd is about 572 cms. Yes, when running MIKE Flood using steady flow hydrographs in situations where there are multiple contributing tributaries, the timing effects that are accounted for in the VO flows are lost in the MIKE Flood model. Using unsteady flow hydrographs may be a better approach to consider when dealing with this type of a river network, although we know that MNR does not agree with using unsteady hydrographs for floodplain mapping.....another issue!

On the phone call yesterday, you suggested we apply area reduction factor (ARF) to the lateral inflows. I have looked into this option, since the difference between ARFs is very small, less than 2%, this won't help. In the followin image, ARF used at both J63.83821 and J192 is 97.1%, and ARF used at J5417.898 is 95.4%. **Agreed, this issue is relatively minor compared with the timing issue noted above when running MIKE Flood using steady flow hydrographs.**

Last night, I was thinking of another approach, and I like to discuss with you.

Since SPA is our main focus, and it is basically lying on area of the confluence of Fonthill/Bruce/Main Rouge, I think it would be appropriate to pull all flows (including total flows and lateral flows) upto Kennedy Rd at Node J5417.898 from the storm with 95.4% ARF applied at this node in hydrology model, and then pull rest of flows between Kennedy RD and Millie Dam from the storm with 94.8% ARF applied at the Dam in hydrology model. This is related to the application of the ARF and making equivalent adjustments for which we do not have all the detailed information to really comment. In principle, if the justification is there, it may be reasonable. We should also be thinking of the other storms we need to run such as 350-yr, 100-yr, 50-yr, etc. as we may also have similar issues to address. If adjusting the ARF is part of the process, it would of course only apply to the Regional storm. If so, we may want to think of an approach that could be applied for all storms. Please also see comments to next item.

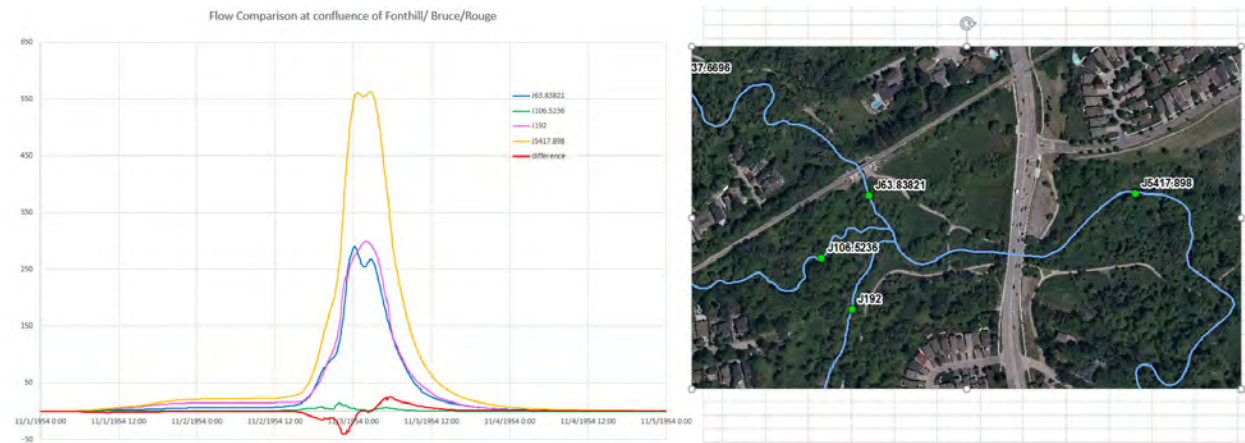
For steady peaks, we pull total flow hydrograph at the flow nodes along the reaches, and find the peaks and subtract peaks from previous node to get increment peak, if the increment peak is negative then we donot apply any increment flow. The main issue contributing to the discrepancy in peak flows at similar flow node locations in MIKE Flood and in VO for this project appears to be attributed to the difference in timing and is most notable downstream of a confluence points. If the difference between peak flows downstream of a confluence point is greater than the additional contributing incremental flows to the downstream node, then the additional incremental flow alone based on the suggested approach may be too small to make up the difference. Perhaps another way to address this is to subtract the difference in peak flow from the upstream incremental hydrographs. For example, if the peak flow downstream of a confluence is 700 cms in VO and 800 cms based on the addition of peak flows upstream of the subject flow node in MF then 100 cms could be subtracted from the input flow hydrographs used in MF for the contributing branches/catchments upstream. The subtraction of flow from the upstream hydrographs could be distributed based on an area-weighted approach. If this were completed moving in a downstream direction at the flow nodes adjusting for differences in peak flow between the upstream sum total in MF and the peak flow from the VO model, then the flows should match pretty well between the MF model and the VO model. You may want to look into this approach in more detail to confirm it is acceptable.

For unsteady, we pull total flow hydrographs at the beginning of the reach, and pull lateral hydrographs. Since we are pulling flows from the same storm using ARF of 95.4% upto Kennedy RD, theoretically the unsteady simulation from MFlood should produce very similar hydrograph at Kennedy RD as that from hydrology model. We should still expect to see difference. **We would suggest that there should not be any issue in using the incremental unsteady flow hydrographs from the VO model in this case. The MIKE Flood model will handle the incremental unsteady flow hydrographs appropriately accounting for any differences in timing.**

This difference would be due to:

1. Engine: MFlood uses fully dynamic calculation but Rouge PCSWMM used for hydrology model uses damped dynamic calculation
2. Scale: MFlood is focusing on the local scale with much more detailed back ground information, but PCSWMM is a regional hydrology model
3. channel geometry: MFlood has contains much detailed channel geometry with about 10-m spacing, but PCSWMM only contains average channel geometry and maybe only has one or two cross-sections along a reach section
4. reach length: MFlood represents detailed channel central-line, but PCSWMM may not fully represent the actual central-line
5. crossings: MFlood contains all hydraulically significant crossings, but PCSWMM only contains selected crossings that may affect flows

Let me know your thought. On Monday we will also have a internal meeting to discuss flow data issue.



Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
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Toronto and Region Conservation Authority (TRCA) [trca.ca]
From: Bill Coffey <BCoffey@Valcor-Engineering.com>
To: Qiao Ying <qiao.ying@trca.on.ca>
Cc: Abdul Baten <ABaten@Valcor-Engineering.com>
Date: 11/21/2018 03:31 PM
Subject: RE: Unionville SPA 2D Study and Floodplain Mapping

Hi Qiao,

Abdul and I were just looking at some other possible factors that may be contributing to the discrepancy between the flows at similar flow nodes in the MIKE Flood model and the VO model. Given that we are using steady flow inputs for the MIKE Flood model, and given that we have significant boundary flows that are being added in the MIKE Flood model, the flows in the MIKE Flood model would "effectively" no longer be accounting for any timing when two tributaries are added together (i.e two steady flat line hydrographs added up equals more or less the addition of the two peaks). The flows in the VO model at the same location, however, would be adding unsteady hydrographs and the sum could be much lower due to timing effects. Depending on the difference in hydrograph timing, this could make a significant difference when comparing flows at similar nodes between MIKE Flood and VO. This might be something else worth investigating and may be more significant than any discrepancies due to differences in how the ARF was applied regarding the incremental flow hydrographs. If this is the case, then running unsteady flows in MIKE Flood may match much better the VO flows.

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valcor Engineering Inc.

From: [Bill Coffey](#)
To: [Qiao Ying](#)
Cc: [Abdul Baten](#)
Subject: RE: Flow issue in Unionville
Date: Monday, November 26, 2018 7:19:00 PM

Hi Qiao,

Given the numerous tributaries for the Unionville study and the additional challenges this introduces when using steady hydrographs, we don't object to your decision to proceed with using the unsteady flow hydrographs for the Regional storm. Thank you.

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valdor Engineering Inc.

From: Qiao Ying [mailto:qiao.ying@trca.on.ca]

Sent: Monday, November 26, 2018 2:51 PM

To: Bill Coffey <BCoffey@Valdor-Engineering.com>

Cc: Abdul Baten <ABaten@Valdor-Engineering.com>

Subject: Flow issue in Unionville

Hi Bill/Abdul,

We just had internal meeting discussing flow issue for Unionville, and we decided to go with Unsteady state simulation for Unionville. As I proposed in my previous e-mail:

For unsteady, we pull all flows (including total flows and lateral flows) upto Kennedy Rd at Node J5417.898 from the storm with 95.4% ARF applied at this node in hydrology model, and then pull rest of flows between Kennedy RD and Miline Dam from the stom with 94.8% ARF applied at the Dam in hydrology model.

I have placed regional unsteady flow at the following OneDrive link. I corrected one flow node connection. Flow node J92.23235 was connected to South Unionville, but this node is actually downstream of Miline Dam and should not be included in the model. I am running the model using the final model files on my end since last Friday, but it crashed due to instability near Fonthill. I am still working on getting model stable, but at the same time I want you two to know our decision and you also can run the unsteady simulation on your end. I also want to know Valdor is Okay with the decision of using unsteady flow approach for this project. I also put a ppt file there I presented to the meeting, and why I suggested the proposed solution at the last slide. Please let me know if you have any comments or questions.

https://torontoregion-my.sharepoint.com/:f/g/personal/qiao_ying_trca_on_ca/Egv1j2AEnqlKqXGOVmH4WqUBErSVZaZUtmxshiC0dDsWgw?e=67vF9n.

Qiao

Regards,

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Toronto and Region Conservation Authority (TRCA) | trca.ca/

From: [Bill Coffey](#)
To: [Qiao Ying](#)
Subject: RE: Unionville Flows Memo Final
Date: Thursday, January 10, 2019 1:38:00 PM

Hi Qiao,

Thank you for sending over the Flow Memo. We will include this in our report.

Regards,

Bill Coffey, M.Sc., P.Eng.
Head of Water Resources
Valdor Engineering Inc.

From: Qiao Ying [mailto:qiao.ying@trca.on.ca]
Sent: Thursday, January 10, 2019 1:12 PM
To: Bill Coffey <BCoffey@Valdor-Engineering.com>
Subject: Fw: Unionville Flows Memo Final
Hi Bill,

We prepared a memo describing how flows were pulled from the 2018 Rouge River Hydrology model and the rationale to use unsteady hydrographs instead of steady peak flows as per MNRF standard floodplain mapping procedure. Please attach this memo as one of appendixes in the final report.

Qiao

Regards,

Qiao Ying M.Sc. P.Eng.
Senior Project Engineer, Capital Projects
Engineering Services | Restoration and Infrastructure

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----- Forwarded by Qiao Ying/TRCA on 01/10/2019 01:08 PM -----

From: Wilfred Ho/TRCA
To: Qiao Ying/TRCA@MTRCA
Date: 01/10/2019 01:03 PM
Subject: Unionville Flows Memo Final

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