



Rideau Valley Conservation Authority

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Technical Memorandum

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Subject: Nichols Creek Flood Risk Mapping
from Montague Boundary Road to Jock River

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Executive Summary

This report provides a summary of the analytical methods used and underlying assumptions applied in the preparation of flood plain mapping for the Nichols Creek from Montague Boundary Road to the Jock River. The project has been completed in accordance with the technical guidelines set out under the Canada-Ontario Flood Damage Reduction Program (FDRP) (MNR, 1986), and the technical guide for the flood hazard delineation in Ontario (MNR, 2002) as laid out by the Ontario Ministry of Natural Resources. The 1:100 year flood lines delineated here are suitable for use in the RVCA's regulation limits mapping (as per Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.

Contents

Executive Summary	1
Contents	2
1. Introduction	3
2. Study Area.....	4
3. Data Used	5
4. Hydrological Computations	8
4.1 Overall Methodology	8
4.2 SWMHYMO Model.....	9
4.3 Selection of Design Storm.....	12
4.4 Estimated Flood Quantiles	14
4.5 Comparison with Other Methods	15
5. Hydraulic Computations.....	16
5.1 HEC-RAS Model	16
5.2 Computed Water Surface Profiles.....	18
5.3 Sensitivity Analysis.....	19
6. Selection of Regulatory Flood Levels	21
7. Flood Line Delineation.....	23
7.1 General Description.....	23
7.2 Buildings in the floodplain	24
7.3 Islands in the floodplain	24
7.4 Flood Mapping Data in GIS	24
8. Project Deliverables	25
9. Closure.....	26
10. References:	27

Tables

Figures

Appendix A: Buildings and Islands in Floodplain – RVCA Policy

Appendix B: HEC-RAS Profiles and Cross-Sections

Appendix C: Field Verification of LIDAR Data

Appendix D: SWMHYMO Files

Appendix E: Road Crossings – Photographs

Appendix F: Full-Size Drawings

1. Introduction

In 2012, The City of Ottawa and three conservation authorities (Mississippi, Rideau and South Nation) initiated a program for flood risk mapping within the boundary of the City. A multi-year plan for mapping a number of high priority rivers and streams was made. As part of this program, the RVCA has identified 12 stream reaches, where the existing mapping would be updated or mapping will be created for the first time.

Mapping along several large rivers has largely been completed, and smaller streams are now being mapped within the RVCA. Nichols Creek is one of them.

There is no previous flood mapping of Nichols Creek. However, engineered flood risk mappings are available for the Jock River (PSR/JFSA 2004a, 2004b, 2005), van Gaal Drain (JFSA 2009), and Kings Creek (RVCA 2017c). Information from these studies, when found useful, is used in the present study. Summary of available information has recently been compiled by RVCA in a watershed report card of the Jock Subwatershed and associated catchment sheets (RVCA, 2016b).

This report provides a summary of the analytical methods used and underlying assumptions applied in the preparation of flood plain mapping for the Nichols Creek from Montague Boundary Road to its confluence with the Jock River (Figures 1 and 2). The project has been done in accordance with the technical guidelines set out under the Canada-Ontario Flood Damage Reduction Program (FDRP) (MNR, 1986), and the technical guide for the flood hazard delineation in Ontario (MNR, 2002) as laid out by the Ontario Ministry of Natural Resources. It also conforms to the ‘generic regulation’ guidelines of Conservation Ontario (2005). The 1:100 year flood lines delineated here are suitable for use in the RVCA’s regulation limits mapping (as per Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.

2. Study Area

Only the 17 km long main stem of the Nichols Creek from Montague Boundary Road to the Jock River has been mapped during this study (Figures 2 and 17).

The study area is in the rural part of the City of Ottawa (Figure 2). The watershed is largely undeveloped, with 41% forest, 4% meadow land, 38% wetland and 11% agricultural fields. Only about 3% is developed (mainly rural residents).

3. Data Used

LIDAR: High quality topography is the key to high quality flood risk mapping. Digital Elevation Models (DEM) were derived from LIDAR data procured by the City of Ottawa. The LIDAR was flown in 2012 and in 2015. This data set has a density of about 4 to 10 points per square meter, and an estimated consolidated vertical accuracy (CVA) of 20-25 cm (Airborne Imagery, 2013, 2015). As shown in Figure C.3 in Appendix C, the Nichols Creek watershed is covered with data collected in 2012 only. These two data sets were however merged together in a seamless DEM and used in this and other studies. The City also provided 0.25 m contour lines that were derived from LIDAR data. However, we only used the LIDAR points directly for this study, and the contour lines were never used.

The accuracy of the LIDAR data was checked in the field by RVCA staff in August-September 2014. The true elevations of features on the ground that are identifiable on the mapping were determined using RVCA's survey grade GPS equipment (Trimble R8) and compared with the elevations indicated by the LIDAR spot heights, to determine that any differences between mapped and true elevations were within the accuracy prescribed by the FDRP standards.

In total, 458 spot heights were verified (see Table C.1 and Figure C.1 in Appendix C). As described in the FDRP guidelines (MNR 1986), the spot height checks are considered satisfactory when 90% of the data points are within 0.33 m of the field measurement. As shown in Table C.1, this criterion has been adequately met¹. On average, the spot heights are within 4.5 cm (Table C.1).

At the few locations where these criteria are not met, changes to the landscape since the date of air photo have been identified as the probable cause of the discrepancy. Data at these locations were disregarded in the DTM verification.

Drape Imagery: The Drape imagery was collected in April-June 2014 with a horizontal accuracy of ± 0.5 metre. This high quality colored photo clearly shows the rivers, creeks, land use, houses, buildings, roads, infrastructure, vegetation and other details.

¹ FDRP (1986) Manual also specifies criteria for checking contour crossings. However, in this study we used only LIDAR spot heights, not contour lines. Therefore, we did not check the accuracy of contour lines supplied by the City of Ottawa.

2011 Aerial photo: The 2011 aerial photo was also available from the City of Ottawa. It is accurate, sharp and in colour, and shows various natural and man-made features clearly.

Building footprint: The ‘building footprint’ layer was provided by the City of Ottawa for the area inside the urban boundary. It enables us to accurately draw flood lines around buildings. This data layer contained information collected over a number of years.

Land use: A GIS-based land use data set, based on information up to 2010, was obtained from the City of Ottawa. It has 33 categories of land use (see Table 1 and Figure 4). This data set was used in the hydrologic parameter estimation.

RVCA’s GIS Department has created this land cover dataset for the Jock River subwatershed (RVCA, 2016b). Vector data originally obtained during approximately the early to late 1990s by the Ministry of Natural Resources and Forests (MNRF) were used to produce a pre-classification of the area. This pre-classification provided a historical overview of the spatial distribution of transportation, settled areas, aggregate sites, evaluated and unevaluated wetlands, wooded areas and water. Updates to this land cover vector data were based on 20cm ortho-imagery acquired through the Digital Raster Acquisition Project for the East (DRAPE), a program lead by the MNRF in 2008 and 2014. DRAPE imagery was also used to incorporate crop and pasture and meadow/thicket as additional land cover classes. Currently RVCA houses two spatially continuous land cover datasets representing the Jock River subwatershed in 2008 and 2014 using 10 land cover classes, which are further divided in to 24 subclasses. This vector data was produced through heads up digitizing to represent the landscape at a 1:4000 scale. Industry standard techniques were used to ensure topological integrity.

Imperviousness: A GIS-based data layer showing the impervious surfaces was obtained from the City. It identified various impervious surfaces such as roads, parking lots, buildings, etc. (Figure 5). This data was based on information collected over a number of years up to 2011. The imperviousness varied in the range from 0.73% to 1.48% for the sub-catchments, with an average of 1.21% for the entire Nichols catchment (Table 3). This data set was used in the hydrologic analysis.

Soil classification: A soils classification layer was obtained from MNRF’s LIO (Land Information Ontario) database, details of which are documented in a report by

MNR (2012). Soil is classified in four categories (A, B, C and D) based on the infiltration capacity.

Group A soils have a high infiltration rate (low runoff potential) when thoroughly wet; these consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B soils have a moderate infiltration rate and consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture; these soils have a moderate rate of water transmission.

Group C soils have a slow infiltration rate and consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture; these soils have a slow rate of water transmission.

Group D soils have a very slow infiltration rate (high runoff potential) and consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material; these soils have a very slow rate of water transmission.

This report (MNR, 2012) describes the infiltration rate in qualitative terms without giving numerical values. However, it appears to be based on the SCS's original classification. USDA-SCS (1986) gives specific range of infiltration or transmission rate (Group A: greater than 0.30 inch/hour; Group B: 0.15-0.30 inch/hour; Group C: 0.05-0.15 inch/hour; Group D: 0-0.05 inch/hour). This soil information was used in hydrological parameter estimation.

As shown in Table 2 and Figure 3, Soil Group B is predominant (56%) in the Nichols catchment, followed by Group D (30%) and Group C (9%). Thus, the soil in this area has a moderate infiltration rate. It consists chiefly of moderately deep to deep, moderately to well drained soils. The texture is moderately fine to course sand. It also has a moderate rate of water transmission.

4. Hydrological Computations

4.1 Overall Methodology

In the absence of any streamflow measurement – a common situation in many small catchments – we have used a single-event hydrological model to estimate flood flows at key locations along Nichols Creek. This approach is sometimes referred to as the ‘return period design storm’ method and is one of the acceptable flow estimation procedures discussed in the provincial guidelines (MNR, 1986, 2002). In this method, a synthetic design storm (hyetograph) of specified return period is fed into a rainfall-runoff model to generate the corresponding peak flow, which is generally assumed to have the same return period. This procedure is quite popular and is regularly used in studies related to drainage, stormwater, flooding, and so on.

For small catchments of this size, floods generated by summer storms are expected to be larger compared to spring freshet and should therefore be used in flood risk mapping. Past studies in this area support this notion².

Suitable data for calibrating the SWMHYMO model was not available. Therefore, we have estimated the flood quantiles based on theoretical (or synthetic) storms and uncalibrated hydrologic modeling as the best available methodology at the present time. As described later in the report, lack of data also prevented calibration of the hydraulic model.

Synthetic storms of various types and durations were first used to estimate the 1:100 year flood flows. Based largely on engineering judgement, one of the storms was selected as suitable for the flood mapping purposes within the Nichols Creek basin. The selected storm was then used to estimate the flood quantiles for various return periods (2, 5, 10, 20, 50, 50, 100, 200, 350 and 500 years).

² For example, the 1:100 year summer and spring floods of an adjacent catchment (Flowing Creek with an area of 49.5 km²) were estimated at 51 and 46 cms respectively by PRS/JFSA (2005) during a larger mapping study on the Jock watershed; it was recommended that the summer flows be used for flood mapping. MVCA (2015) analyzed snowmelt events using the Ottawa Airport data and concluded that ‘if a location on a river has a response time somewhat longer than 12 hours, it would be expected that snow melt would govern’ (as opposed to summer rainfall). Nichols Creek catchment is smaller than the Flowing Creek (45.1 km² vs. 49.5 km²) and its response time is much lower (1.2-4.7 hours) than 12 hours; therefore, summer rainfall is expected to produce larger runoff than spring snowmelt.

4.2 SWMHYMO Model

We have used version 4.02 of SWMHYMO model (JFSA 2000) for estimating the summer floods. This model is used widely in Ontario for both urban and rural catchments.

As shown in Figures 2 and 7, the Nichols Creek basin has been divided into four catchments, and flood quantiles have been estimated at five locations along the drain (Figure 13). A schematic of the SWMHYMO model is shown in Figure 8, where both the catchments and channel segments used for flow routing are included.

Among the available runoff-generating modules in SWMHYMO model, two commands (CALIB NASHYD and CALIB STANDHYD) were considered for calculating runoff from rural and urban catchments respectively. In case of Nichols Creek, all catchments are essentially rural with imperviousness less than 1.5%. Therefore, only the CALIB NASHYD command was used.

The CALIB NASHYD command, used for rural areas with imperviousness less than 20%, requires the following input:

AREA = area of the catchment (hectares),

DWF = dry weather flow component (m^3/s),

CN or *CN ** = original or conjugate (modified) curve number,

IA = initial abstraction (mm),

DT = computational time step (minutes),

N = number of lineal reservoirs, and

T_p = time to peak (hour).

Table 3 lists the parameters for all five catchments within Hobbs basin. The dry weather flow or base flow was assumed to be zero (*DWF* = 0.0). A one minute time step was used (*DT* = 1.0 minute). The number of linear reservoirs was set at three (*N* = 3). These are typical values that hydrologists use in the absence of more site-specific information. Two parameters (curve number and time to peak) are very important in SWMHYMO modeling and therefore require elaborate discussion.

Curve Number Method: The curve number (*CN*) method of estimating runoff was first introduced by US Department of Agriculture's Soil Conservation Service (USDA-

SCS 1986) and is widely used in North America and elsewhere. This method is used in the SWMHYMO model too. The curve number (*CN*) was calculated based on land use and soil type (Tables 1 and 2). Equivalent land use and associated *CN* from TR-55 were first selected for each of the 33 land use and 4 soils types found in this region (Table 4). For each elemental area with a particular land use-soil combination, the appropriate *CN* value was chosen; these *CN* values were then area-averaged over the whole catchment to find the aggregate *CN* for the catchment. *CN* values varied from 73 to 86 for different sub-catchments, with an average value of 79 for the entire Nichols Creek catchment (Table 3).

Both the original SCS curve number method and its ‘conjugate’ or modified version can be used in SWMHYMO. For this study, we have used the modified method – commonly known as the *CN ** method. For parameter estimation and calculation procedures, we have closely followed the original SCS manual (USDA-SCS, 1986) and a recent, comprehensive state-of-the-art review done by a task committee (Hawkins et al., 2009).

The first step is estimating the *CN* value based on land use and soil type as given in the SCS manual (USDA-SCS, 1986). We have used the following information:

- 2014 land cover data compiled by RVCA (RVCA, 2016b)
- 2009 soil classification by OMAFRA (MNR, 2012)

Both data sets were available in digital format. Tables 1, 2 and 4 summarizes parameters related to the estimation of *CN* and *CN **. This process was automated in the GIS system.

Once *CN* was estimated, then the ‘conjugate’ or modified curve number *CN ** was calculated using the following equation:

$$CN * = \frac{100}{1.879(\frac{100}{CN} - 1)^{1.15} + 1}$$

Soil storage capacity (*S*) in mm was related to *CN ** by the relation:

$$CN * = \frac{25400}{254 + S}$$

And the initial abstraction (*IA*) in mm was calculated as:

$$IA = 0.05S$$

The above equations were taken from Hawkins et al. (2009; pages 35, 9 and 34 respectively).

While the original *CN* was estimated based on the assumption of an initial abstraction equal to 20% of the soil moisture capacity, later research revealed that the initial abstraction equal to 5% of the soil moisture capacity is more appropriate, the new curve number was called *CN **, and the relationship between *CN* and *CN ** was established. At present, both the original and the modified methods are widely used, with more and more practitioners preferring the later. However, given that they can be readily converted to each other, one has the option to use any of them.

Time to Peak: The time of concentration (T_c) of a watershed is defined as the time required for water to move from the most remote part of the watershed to its outlet. Many methods are available, mostly empirical and developed for specific conditions, to estimate T_c . Here, we have used the ‘velocity method’ originally introduced by Soil Conservation Service (USDA-SCS, 1986) and later elaborated by Natural Resources Conservation Service (USDA-NRCS, 2010). This method has a sound physical basis³, i.e., the movement of water over the land and along the channel, although estimating parameters – as the case frequently is in hydrology – is at best an approximation.

³ The SCS velocity method is generally considered to have the soundest physical basis and is often used as a yardstick to evaluate other methods (see, for instance, Grimaldi et al. 2012 and Sharifi and Hosseini 2011). Grimaldi et al. found that as much as 500% variation is quite common when using different methods to estimate time of concentration. They also made an interesting remark: “Indeed, it a paradox that advanced hydraulic models, such as 2-D flood propagation models for hydraulic risk mapping based on very expensive topographic and remote sensing data, are actually limited by design hydrographs based on anachronistic parameters, such as T_c .” This is consistent with the commonly observed fact that hydraulic calculations are much more accurate than hydrologic calculations.

The time to peak (T_p) is defined as the time between rainfall event and the corresponding peak flow. It is related to the time of concentration as (USDA-CSC 1986, page 15-3):

$$T_p = 0.6T_c$$

Both T_c and T_p were calculated using the method detailed in the USDA-NRCS (2010) manual. The time to peak (T_p) was an input to SWMHYMO model (Table 3). It varied from 1.17 to 4.66 hours for different sub-catchments.

All estimated parameters necessary for the SWMHYMO modeling of the Hobbs Drain catchment are listed in Table 3.

Channel Routing: The ROUTE CHANNEL command of the SWMHYMO model was used for routing the flow along rivers and streams. The model requires channel length, slope, roughness and a typical channel cross-section. Channel length and slope are given in Table 3a. Figure 8 shows how the channels fit within the overall model structure. Typical cross-section for each channel was based on the characteristic main channel and adjacent floodplains where applicable. Manning's roughness coefficients for the main channel and floodplain were also assigned based on land use and expected flow conditions. Care was taken to ensure that parameter values used in SWMHYMO were consistent with those used in HEC-RAS model.

4.3 Selection of Design Storm

A wide variety of design (or synthetic) storms are available. However, a particular storm is generally selected for flood mapping purposes after appropriate scrutiny. For this study, synthetic storms of two types (Chicago and SCS Type II) and four durations (3, 6, 12 and 24 hours) were considered for hydrologic modeling (Table 5). These storms are routinely used in Canada for both stormwater management and flood risk studies. Recent studies in neighboring conservation authorities (SNCA 2014; MVCA 2015; RVCA 2017a, 2017b, 2017c) confirm the suitability of these storms for the purposes of floodplain mapping in small basins.

The following synthetic storms were considered:

- 3 hour SCS Type II storm
- 6 hour SCS Type II storm
- 12 hour SCS Type II storm
- 24 hour SCS Type II storm
- 3 hour Chicago storm
- 6 hour Chicago storm
- 12 hour Chicago storm
- 24 hour Chicago storm

Hyetographs for these storms were generated from the most recent IDF curve at Ottawa Airport (Station ID 6106000), obtained from Environment Canada⁴. This IDF curve was based on the most recent analysis using 39 years of data from 1967 to 2007 (with 2001 and 2005 data missing)⁵. Generally, the curve for a certain return period follows an equation like:

$$I = \frac{a}{(b + t)^c}$$

where,

I = rainfall intensity (mm/hour), and

a, b, c = constants.

From the EC IDF curve (Figure 9), equations were fitted via the STORM software and constants determined for all return periods (Figure 10). These equations were then used to generate rainfall hyetographs, for which we used the STORMS 2010 utility software (version 3.0.1) from JFSA (2011). Figure 11 shows the storm hyetographs. Hyetographs were input to SWMHYMO model, where they drive the rainfall-runoff computation. This procedure was followed for all Chicago storms and the SCS 24 hour storm. For all other SCS storms (3, 6, 12 hour durations), the distribution was taken from the City Sewer Guidelines (2012; page 5.18).

⁴ Information on IDF curve was obtained from Environment Canada's website [http://climate.weather.gc.ca/prods_servs/engineering_e.html].

⁵ City of Ottawa's Sewer Design Guidelines (2012) contain an old IDF curve based on 1961-1990 data, which yields somewhat smaller storm depths than the more recent IDF curve (based on 1967-2007 data). We have opted to use the most recent IDF curve because it reflects recent climatic conditions, is based on more data (39 years as opposed to 31 years), and is slightly conservative (produces bigger storms). The FDRP Manual (MNR 1986) also recommends the use of most recent IDF information.

Using the eight synthetic storms, the 1:100 year flows were computed for all sub-catchments and at key locations along the stream (Table 6), which were then scrutinized to select an appropriate storm for the purposes of flood mapping. This step is somewhat subjective and requires engineering judgement. As expected, the longer duration storms produced higher flows; usually the flow corresponding to a 3 hour storm was about 55-60% of that produced by a 24 hour storm. The SCS storms produced slightly higher flows (by about 10-12%) compared to Chicago storms. The estimated flows from various storms were thus within the typical variation associated with hydrologic computation; no storm produced extremely high or low flows. This appears to endorse the notion that all storms considered here and associated flows were within the realm of hydrological plausibility. No storm stood out as an outlier or as unrealistic. In the selection of a storm for flood mapping purposes, we wanted to be as close as possible to reality with a slight degree of conservatism. Considering all, we selected the 24 hour SCS Type II storm as the most suitable for Hobbs Drain flood mapping⁶. As can be seen in Table 6 and Figure 12, it produced the higher flows, but only marginally so (10-12% higher than those produced by the Chicago storm). This selection was consistent with our philosophy of being as close as possible to reality, with only a slight degree of conservatism to account for the uncertainty.

4.4 Estimated Flood Quantiles

After the 24 hour SCS Type II storm was selected for the flood mapping purposes, the SYMHYMO model was run with all events from 2 to 500 year return periods (Table 7), and the flood quantiles at key location were tabulated (Table 8 and Figures 13 and 14). Flood flows from this table were then used in the hydraulic modeling; thus, this table is the link between hydrologic and hydraulic computations.

⁶ The hydrological analyses done here and the results obtained therefrom are considered suitable for the purposes of floodplain mapping of Nichols Creek only, and for no other purpose. It should be emphasized that the methodology, storms considered and selected, modeling, and the estimated flood quantiles may not be suitable for any other purpose, including land drainage, stormwater management and infrastructure design. Any subsequent use of the data, model and other information contained in this report should be made only after independent verification and scrutiny by qualified engineers/hydrologists.

4.5 Comparison with Other Methods

In order to assess the reasonableness of the flood quantiles computed here (with SCS Type II 24 hour storm), a comparison was made to those computed at other small catchments elsewhere (Figures 15 and 16). Besides comparing the data points to each other, three lines were drawn to provide the context. They are:

- Area pro-rating: based on Jock River at Moodie Drive; 1:100 year spring flood of 196 cms based on measured data (PSR/JFSA 2004a)
- 1:100 year floods computed by the Index Flood Method (MNR, 1986)
- Creager envelope curve with a coefficient of 30 (Watt et al. 1989)

Figures 15 and 16 show that, in general, the Nichols flows are within the usual variation of computed floods from other catchments, both within and outside of the Jock watershed. In particular, the good matching of Nichols data with other small catchments within the Jock watershed (taken from PSR/JFSA 2005b; JFSA 2010; RVCA 2017a, 2017b, 2017c) and elsewhere (RVCA 2018a, 2018b) gave credence to the hydrologic modeling presented here. Some of the data from highly urban catchments (mainly from Bilberry Creek area) exhibit high flows, which is expected. In rural areas dominated by lakes and long streams such as the Otter-Hutton system, the flows were lower than even the index floods (RVCA, 2016a). We note that all of the estimated floods within the Nichols basin are higher than those given by the Index Flood Method, which was based on measured streamflow data and was prescribed for estimating floods in the absence of better information. The estimated floods are also in line with the prorated values based on Jock River. All data points are below the Creager envelope curve⁷, although flows from the highly urban areas can get very close. On the balance, we found that the Nichols data compares well with other data and are within the confines of pertinent estimation methods.

⁷ Catchment M4 produced high runoff, comparable to that from urban areas. It was dominated by wetlands (44%) and falls partly within the much larger Richmond Fen. The soil has very little transmittivity and infiltration rate (Group C and D). Review of last 40 years of aerial photo indicated frequent standing water within this catchment. A field visit by RVCA staff on 28 June 2017 confirmed the presence of standing water as well. All these contributed to the very high runoff rate from this catchment.

5. Hydraulic Computations

5.1 HEC-RAS Model

Following standard procedures (MNR, 1986; USACE, 1990, 2010), a steady-state hydraulic model of Nichols Creek was built. The HEC-RAS software (version 4.1.0) developed by the US Army Corps of Engineers (USACE, 2010) was used. It uses the same back water calculation procedure as HEC-2 (USACE, 1990), which has been the industry standard since the 1970s, but with improved data processing and graphical capabilities. Only 17 km the Nichols Creek main stem, from Montague Boundary Road to the Jock River, was included in the HEC-RAS model.

Cross-Sections: The cross-sections used in the modeling were generated from the latest topography (2012 LIDAR) using GIS tools. While, the above-water part of the cross-sections generated from LIDAR is accurate, the under-water portion of the channel is sometimes not adequate. In such cases, the under-water portion of the cross-section was adjusted from field observation. Since the LIDAR were flown during low flow conditions, the adjustment required for under-water channel was usually minor (less than 30-50 cm). The probable impact of such minor adjustments on 1:100 year flood level is expected to be insignificant as well. Therefore, the cross-sectional data was considered adequate for the purpose of flood mapping.

In total, 68 cross-sections were used in our HEC-RAS model. Figure 17 shows a schematic of the HEC-RAS model. Drawings NL-1 and NL-2 show the cross-sections in greater detail, along with the computed Regulatory Flood Levels (RFLs) and flood risk limits. The location and alignment of river cross-sections within the model were based on engineering judgment as related to the expected flow during high flood events.

Channel Roughness: The Manning's roughness coefficient was estimated to be 0.035 in the main channel. In the overbank areas, a coefficient of 0.05 or 0.08 was used for wetland and treed areas respectively (Table A.1 in Appendix A). These values were consistent with standard values, such as those recommended by Chow (1959).

Bridges/Culverts: Within the study area there are eight road and rail crossings (Table 10). As-built drawings for one bridge were obtained from the City of Ottawa; information on the rest was obtained from VIA Rail and by field survey. The bridges and associated cross-sections were updated to match the as-built information. Out of the eight

crossings, we could not obtain data for two; so, we could not include them in the HEC-RAS model.

Flood Quantiles: The design flows from the hydrologic analysis (discussed above), with return periods ranging from 2 to 500 years (Table 8), were used in the HEC-RAS model. Table 9 shows the flows that were input to the HEC-RAS model.

For each channel reach, flows at both upstream and downstream ends were estimated from the SWMHYMO model, as listed in Table 8. As is the usual practice, the higher of these two flows – almost always the downstream one – was used for the hydraulic calculation in the HEC-RAS model. However, an exception was noticed for the most downstream reach of Nichols Creek (Kettles Road to Jock River), which was bounded by Nodes N3 and N4 at the upstream and downstream ends respectively. The SWMHYMO-generated flows at Node N4 were higher only for 2 and 5 year events, and were lower for all other events (see Table 8 and Figure 14). For the HEC-RAS model we have taken the greater of the two for all individual events⁸ (Table 9).

Downstream Boundary Condition: Known or estimated water levels are usually used as downstream boundary conditions in HEC-RAS models. In this case, Nichols Creek drains into the Jock River and Richmond Fen. So, the water level of the Jock River (or Richmond Fen) during summer months, if known, could be used as the downstream boundary condition of the Nichols Creek model. During the Jock River flood mapping study (PSR/JFSA, 2004b, 2005), this reach of the Jock River through the Richmond Fen was excluded from the hydraulic analysis. Spring flood levels at an upstream and a downstream point were computed (98.31 m and 97.51 m respectively); summer levels were not computed by PSR/JFSA. Due to the difference in size of the Nichols and Jock basins, it is very likely that the peak runoffs from them during summer storms would not coincide. Running the Jock River model with summer flows, computed as part of this study, yielded 98.21 m at the confluence of Nichols Creek, which is only 10 cm lower than the Richmond Fen spring level. Therefore, we conservatively assumed a water level

⁸ This can be explained by the presence of wide floodplains along this reach, which roughly coincides with the identified wetlands in this area. During small events (2 and 5 year), the flow is mainly contained within the main channel, the floodplain does not come into play, and the downstream (peak) flow is greater than the upstream flow. However, during high flow events (10 year and up), the flow goes overbank, the floodplain attenuates the flow to a large degree, and the downstream (peak) flow becomes smaller than the upstream flow. In other words, in this case, the attenuating effect of wide floodplains and wetlands is more profound than the locally generated runoff.

of 98.31 as the downstream boundary condition for Nichols Creek model (Figure 18). We tested the sensitivity of the computed water surface to the assumed boundary condition (from 97.0 to 98.31 m range) and found its effects to be confined to about 1.5 km of Nichols Creek (Figure 18), which is already a part of the wetland and thus within RVCA's regulation limits.

Once the model was set up, the computed profiles and other parameters were scrutinized to assess the reasonableness of model outputs. Special attention was given to the computed water level and energy profiles near bridges. Adjustments of model parameters – mainly the channel resistance and contraction and expansion coefficients – were made as necessary.

Suitable data to calibrate or validate the HEC-RAS model was not available. Therefore, no calibration was done⁹. However, we exercised professional judgement and tried to be slightly on the conservative side. Our approach of slight conservatism (a combination of hydrologic and hydraulic computations) is also congruent with the current notion of the Precautionary Principle, which applies when there exist considerable scientific uncertainties about causality, magnitude, probability, and consequences of different course of action (UNESCO 2005). The Precautionary Principle is also a key policy of Environment Canada¹⁰.

5.2 Computed Water Surface Profiles

The HEC-RAS model was run with the design floods. The 1:100 year computed water surface elevations and other parameters are shown in Table 12. A few typical water surface profiles and all cross-sections are included in Appendix A.

⁹ Given the constraints, this HEC-RAS model is the best we could build for the limited purpose of floodplain mapping at this time. We recognize that this model may not be suitable for other purposes. Further model improvement/adjustment/modification may be necessary for other purposes; it all depends on the purpose of the modeling and the features and phenomena a model is meant to capture. We therefore caution against using this model for other purposes without first confirming its suitability.

¹⁰ Canada's environmental policy is also guided by the precautionary principle and is reflected in the Federal Sustainable Development Act which states that the Minister of Environment must "develop a Federal Sustainable Development Strategy based on the precautionary principle". The precautionary principle states that: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". In other words, the absence of complete scientific evidence to take precautions does not mean that precautions should not be taken – especially when there is a possibility of irreversible damage (Environment Canada, 2010).

Computed water surface elevations for various flood events with return periods ranging from 2 to 500 years are presented in Tables 13 and 14. It should be pointed out that the model has been built for the expected conditions prevailing during intense rainfall-generated flood events in the summer. Caution should be used when applying this model to simulate water surface profiles for events of other magnitude and during other seasons of the year.

Computed head losses across road crossings are listed in Table 11.

In cold climate areas like Ontario, spring floods may also be accompanied by ice jams. Here we have only analyzed the summer floods, not the spring floods. We are unaware of any ice-related flooding that caused significant concern in this area.

5.3 Sensitivity Analysis

Flood quantiles have the highest degree of uncertainty in our computation and is most likely to affect the water surface profile. Therefore, we decided to test the sensitivity of water surface profile to a wide variation in flow.

The sensitivity analysis was conducted to determine how much the computed water surface elevations will vary with changes in the value used for the 1:100 year discharge. Six flow conditions were tested:

- 1:100 year flow increased by 10%
- 1:100 year flow increased by 25%
- 1:100 year flow increased by 50%
- 1:100 year flows decreased by 10%
- 1:100 year flow decreased by 25%
- 1:100 year flow decreased by 50%

Figures 19 and 20 show the computed water surface profiles and the differences in computed water levels for each condition. Figure 19 indicates that the computed water surface elevations are less sensitive to the discharge value in the steeper portions of the reach. The sensitivity analysis indicates that the computed water level can vary by about 0.05 m for a 10% variation in flow along most of the river reach, which is typical in the

hydrologic estimation of design flow. For a 25% increase in flow, the water level can go up by 0.1 to 0.5 m.

The sensitivity analysis provides an indication of the potential implications of inaccuracies in flow estimation, and changes in the expected flood flows that might result from urbanization and climate change.

6. Selection of Regulatory Flood Levels

As per Section 3 of the Provincial Policy Statement under the Planning Act (MMAH, 2005, 2014), the regulatory flood in Zone 2, which includes the RVCA, is the 1:100 year flood. Depending on the local hydraulic conditions, the computed water surface elevation, the energy grade or a value in between is generally taken as the Regulatory Flood Level (RFL). Engineering judgment is applied to recommend an appropriate value for the regulatory flood level at each cross-section, using the model outputs and considering hydraulic characteristics of the river reach, and the inherent limitations of numerical modeling.

When the stream velocity is relatively low and varies only gradually over relatively long river reaches, the water surface can generally be taken as the RFL.

However, near bridges, culverts and other water control structures and on steeper reaches where streamflow velocities are higher, and may change more abruptly, the computed water surface elevation may be substantially lower than the energy grade level, with the possibility that the water level may rise to the energy grade near obstacles and irregularities in the channel profile or cross-section which may not be represented in the hydraulic model. In such cases, the regulatory flood level is generally based on the computed energy grade as a conservative approach, given that the numerical model is less likely to be a true representation of reality in such situations.

Another possible situation arises when the computed water surface profile is undulating, with downstream water levels occasionally higher than upstream levels. When this occurs, it is more often an artifact from the simplifying assumptions of the modeling scheme than a reliable prediction of the actual differences in streamflow velocity and depth (and hence energy grade) from one cross-section to the next. Accordingly, the regulatory flood level at the upstream cross-section is taken to be equivalent to the downstream water surface elevation in these situations.

In all cases, the RFL is always between the computed water level and energy grade line. Hence, for the sake of simplicity and consistency, the energy grade elevation is often used as the RFL as a standard practice in delineating flood hazard areas.

For the present study, the regulatory flood levels were set equal to the computed energy grade and are tabulated in Table 12, along with the computed water surface elevations and energy grades at each cross-section in the model.

7. Flood Line Delineation

7.1 General Description

Once the RFLs are established, the plotting of 1:100 year flood lines or flood risk limits is a relatively straightforward matter. Given the topographical information in the form of LIDAR spot heights, the inundated area below the RFLs can be easily delineated manually or by using automated computer programs. In the present case, it was done manually with a focus on areas with complex topography, infrastructure, and overbank flow paths. The raw LIDAR spot heights were extensively used in the plotting the flood risk limit.

Field surveys were conducted by RVCA staff on May 10, 2017 to verify hydraulic connectivity through culvert openings and flood prone areas.

The record of site-specific information associated with RVCA's regulatory approval process since 2006 was checked. It was found that no site-specific work affects the flood risk lines.

The floodplain of Nichols merges with and becomes indistinguishable from the Richmond Fen wetland (Drawings NL-1 and NL-2). Therefore, the eastern edge of the Nichols Creek floodplain cannot be delineated precisely, and we have drawn it along the rail line in a somewhat arbitrary fashion. Fortunately, this is rather inconsequential in terms of land use planning since both the floodplain and the wetland are under regulation. It may be mentioned that, in this study, we deal with the flood hazard from only Nichols Creek, not the Jock River or Richmond Fen; however, any development in the area should take in to account all hazards from all sources.

Four spill sections were identified on the northeast side of Nichols Creek (Drawings NL-1 and NL-2). During high flood events, water is expected to spill across watershed divide in to Richmond Fen. Flows through these spills are expected to be small and will occur only if the water level in Richmond Fen is low. When the fen water level is high, these flows will diminish or may even reverse the direction.

Another spill at the southeastern side of Nichols Creek has been identified (near the intersection of McKenna Road and Montague Boundary Road). Again, the spill is expected to be small.

7.2 Buildings in the floodplain

Presence of existing buildings within the floodplain and associated variation in the way a building could be exposed to flood risk required special attention. Recently, RVCA has consolidated a few rules for drawing flood lines in the vicinity of buildings (Appendix A), which have been followed in this study. Due to the limitations of the data and methodology used in the current mapping done at a large scale, and the small degree of (inevitable) subjectivity in drawing flood lines around buildings at a smaller scale, RVCA recommends that, should the need arise for accurate flood line delineation near buildings, site-specific information be taken into account when dealing with flood risk at these locations. It is the practice of RVCA to refine flood lines when more accurate information becomes available.

7.3 Islands in the floodplain

Presence of small islands, especially those associated with septic beds, within the floodplain also requires special attention. Recently, RVCA has decided to show small islands with an area less than 1000 m² as flood risk area (Appendix A). This guidance was followed during this study.

7.4 Flood Mapping Data in GIS

The regulatory flood lines and cross-sections have been incorporated as separate layers in RVCA's Geographical Information System (GIS). In this system, one can view the flood lines, cross-sections, design flow, water level, energy grade, RFL, and other computed parameters. The flood lines can be overlain on the aerial photography or any other base mapping layers that are in the system and at any scale that suits the user's need.

The regulatory flood line layer is maintained and updated as required according to the established procedures of the RVCA (RVCA 2005).

Drawings NL-1 and NL-2 show the flood risk limits as delineated in this study. At all cross-section locations, the RFL is indicated. The general surroundings and land marks are also included for easy referencing.

8. Project Deliverables

The key information or knowledge products generated from this project are:

- 1) The Flood Mapping Report (this Technical Memorandum) – which summarizes the analytical methods that were used and the underlying assumptions
- 2) SWMHYMO model files
- 3) HEC-RAS model files
- 4) The flood risk limit lines in GIS format (shape files) – identifying the extent of lands which are considered to be vulnerable to flooding during a regulatory flood event (1:100 year flood)
- 5) The position and orientation of cross-sections used in the HEC-RAS model, in GIS format (shape files) – which, when used in conjunction with the HEC-RAS model output files, informs the user as to the estimated 1:100 year water surface elevation and the regulatory flood level for any location in the study area

A “documentation folder” containing working notes and relevant background information accumulated during the study process is maintained by the water resources engineering unit within RVCA’s Watershed Science and Engineering Services department.

9. Closure

The hydrotechnical and cartographic procedures used in this study generally conform to present day standards for flood hazard delineation, as set out in the MNR's Natural Hazards Technical Guide (MNR, 2002). The resulting 1:100 year flood lines are suitable for use in the RVCA's regulation limits mapping (as per Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.



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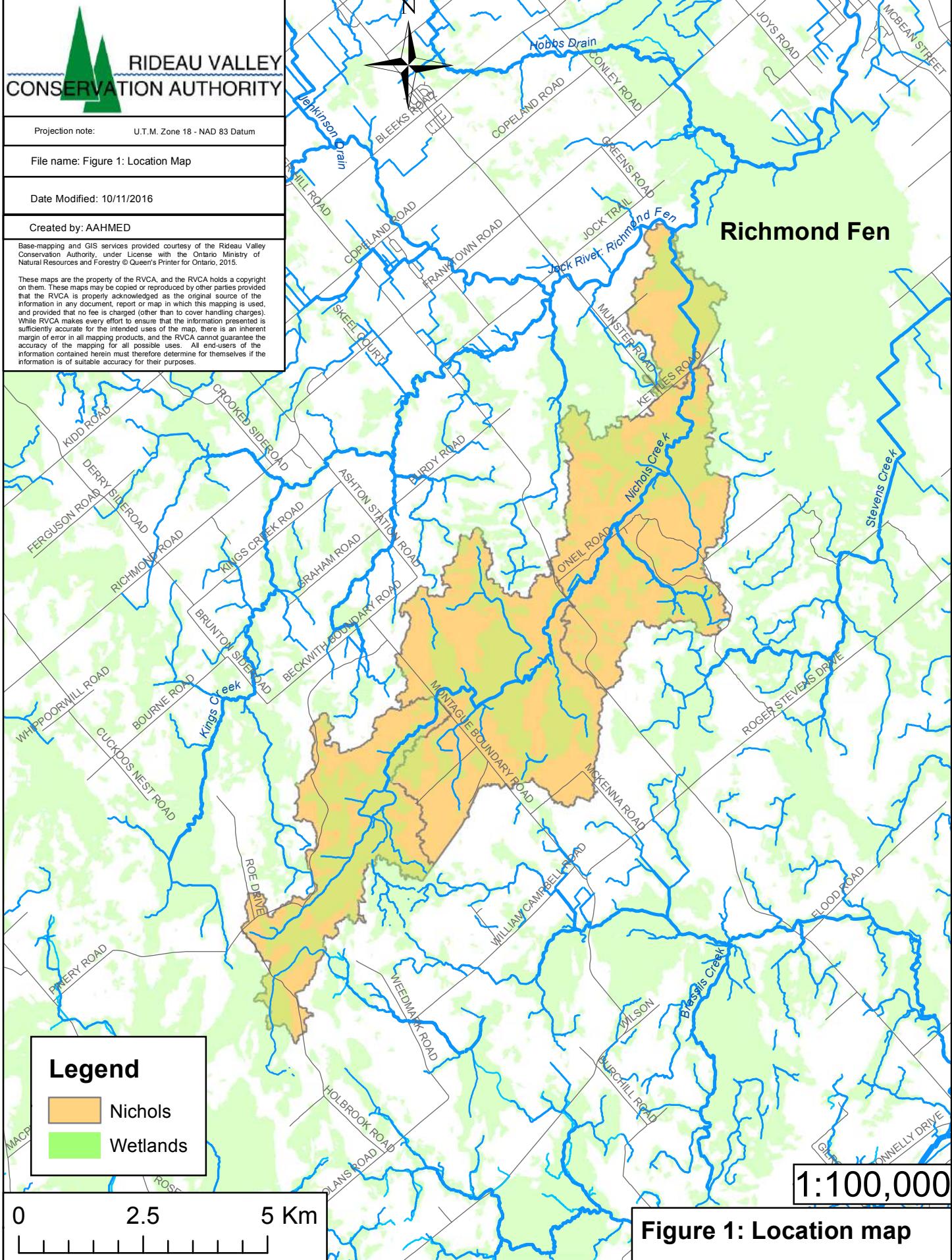
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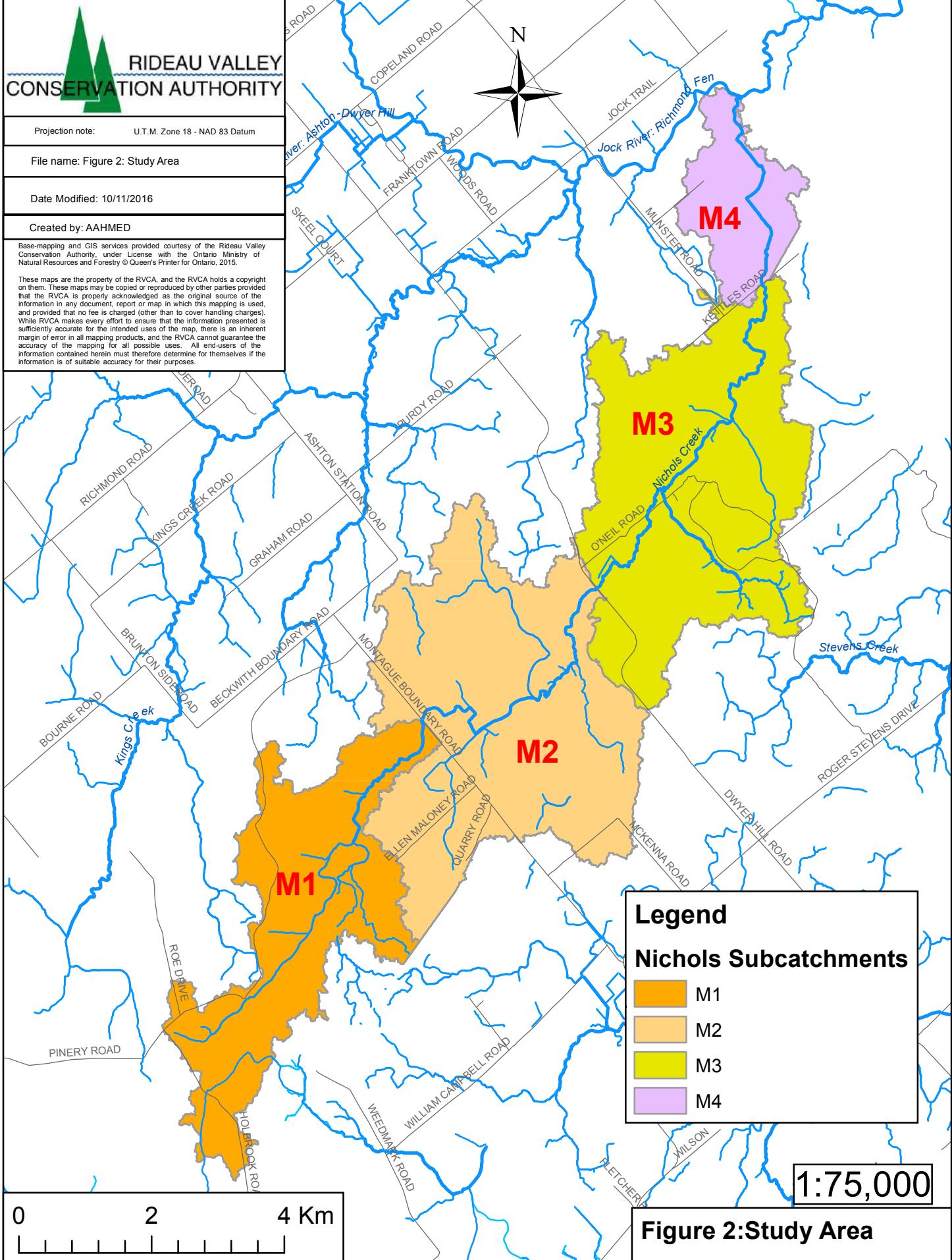
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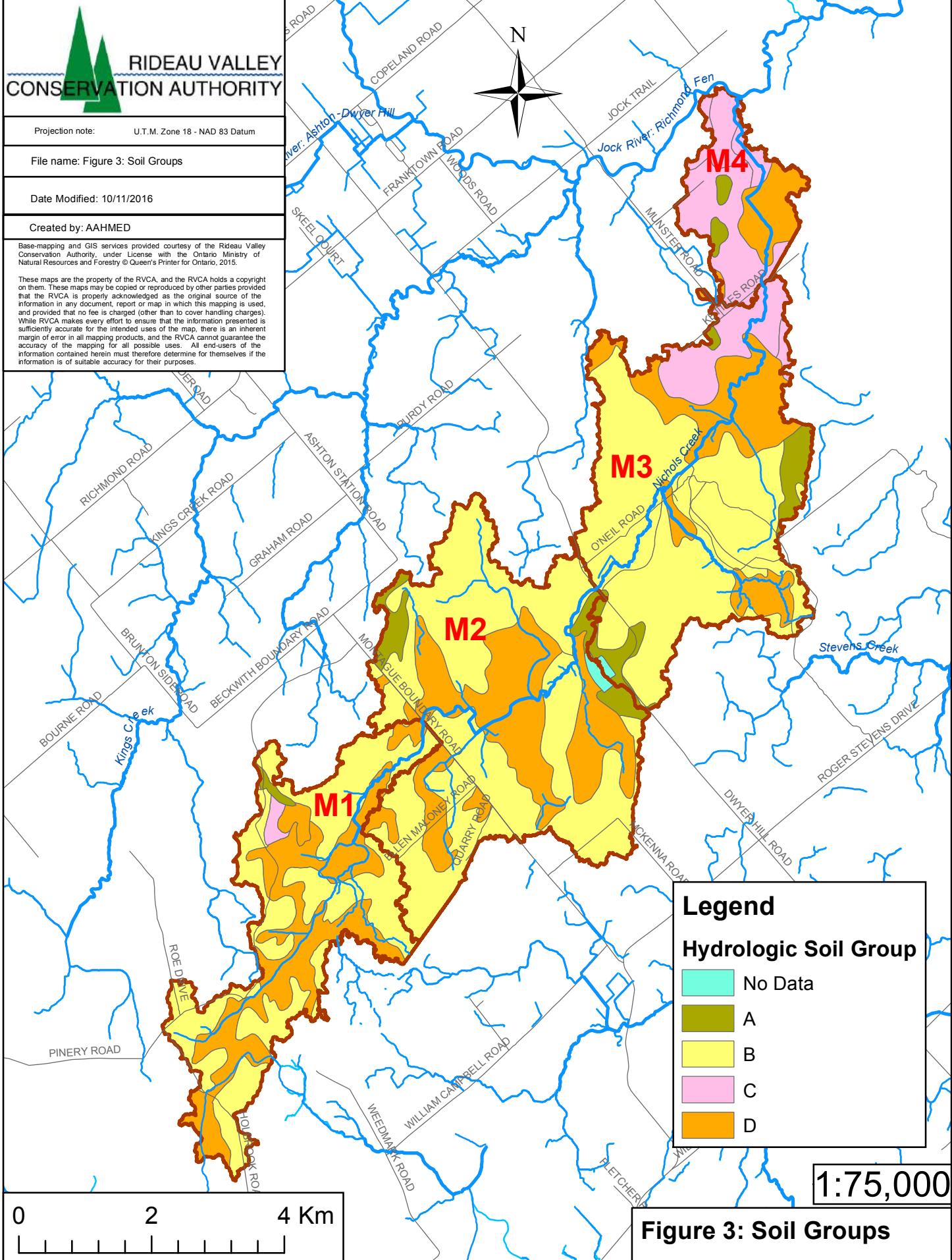
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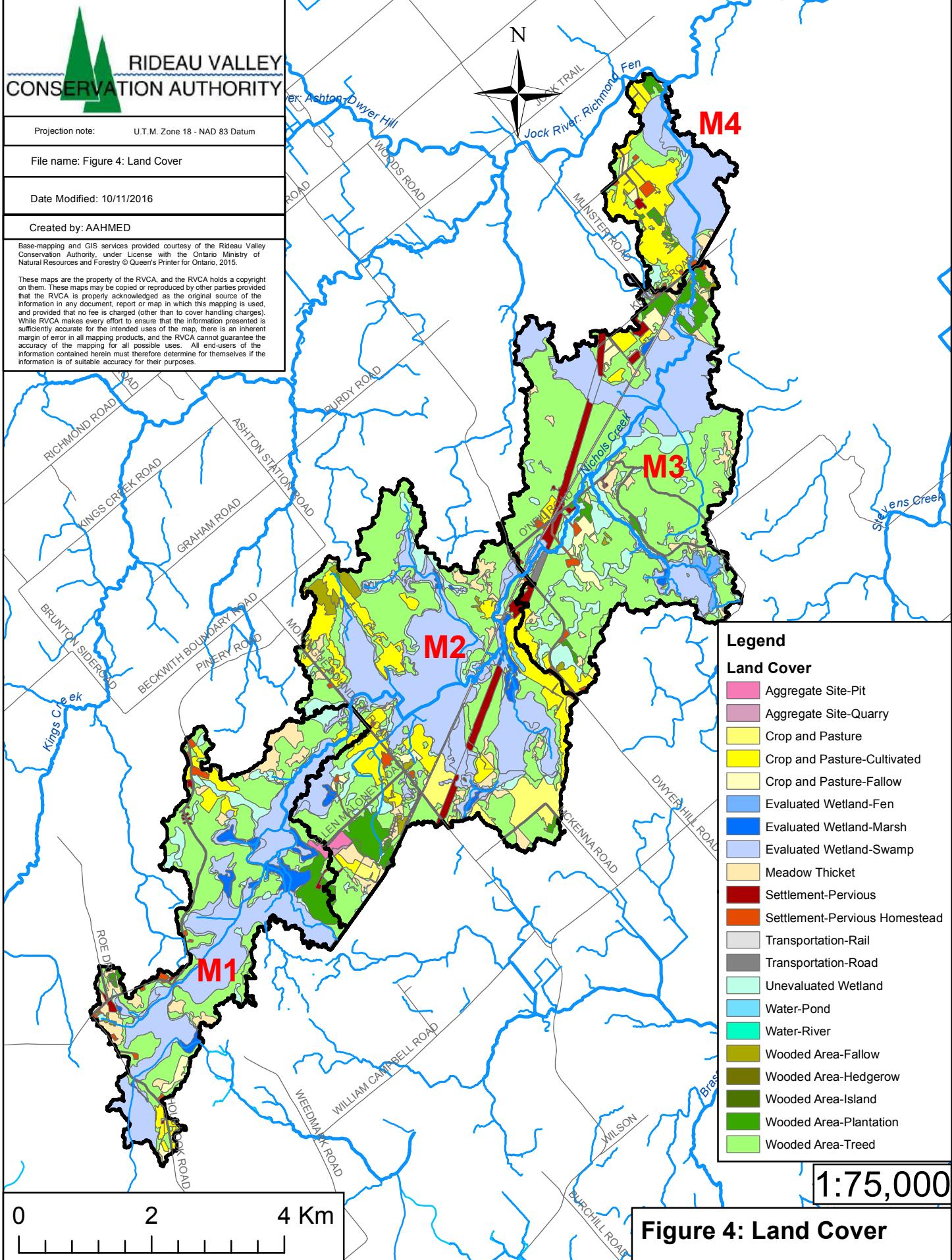
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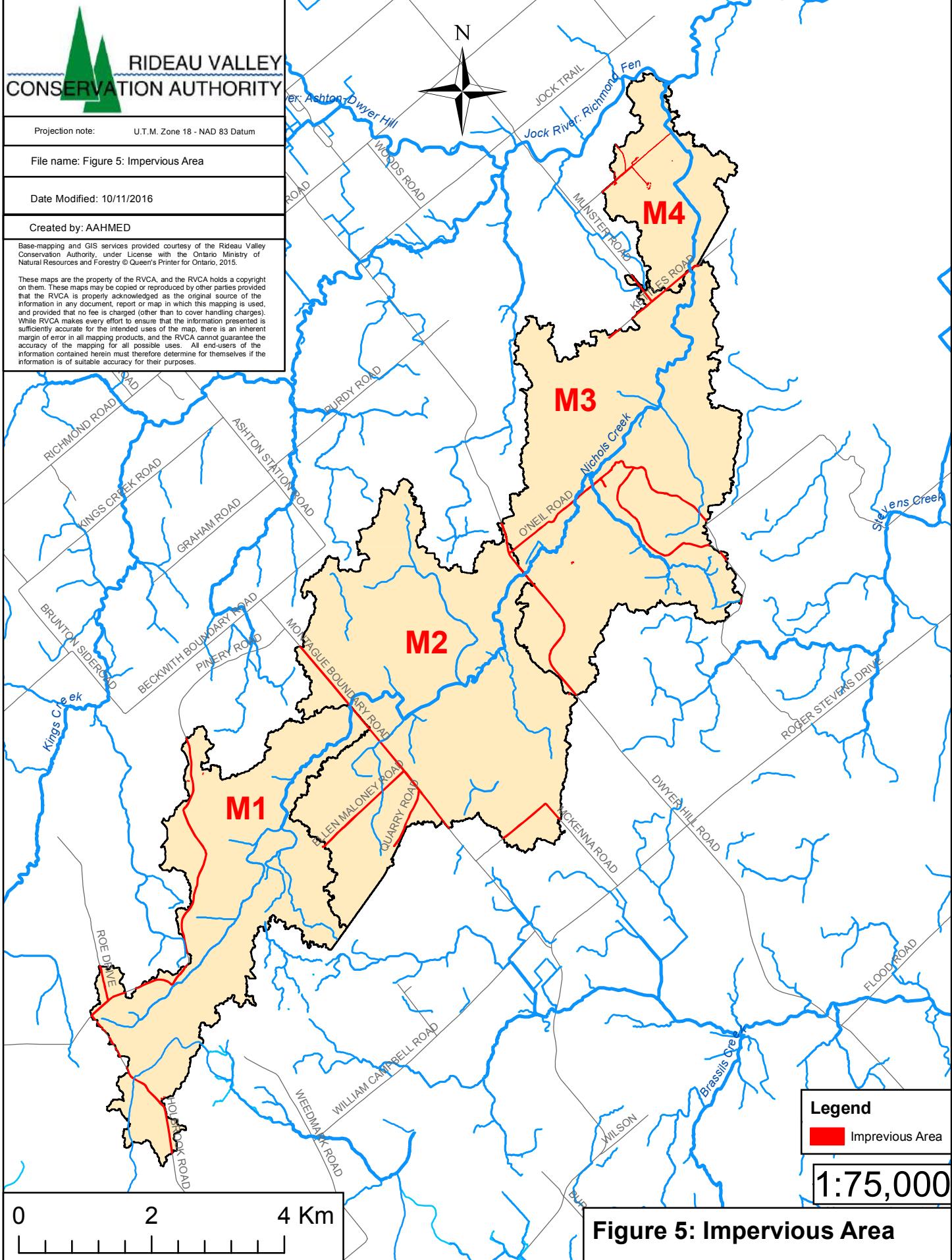
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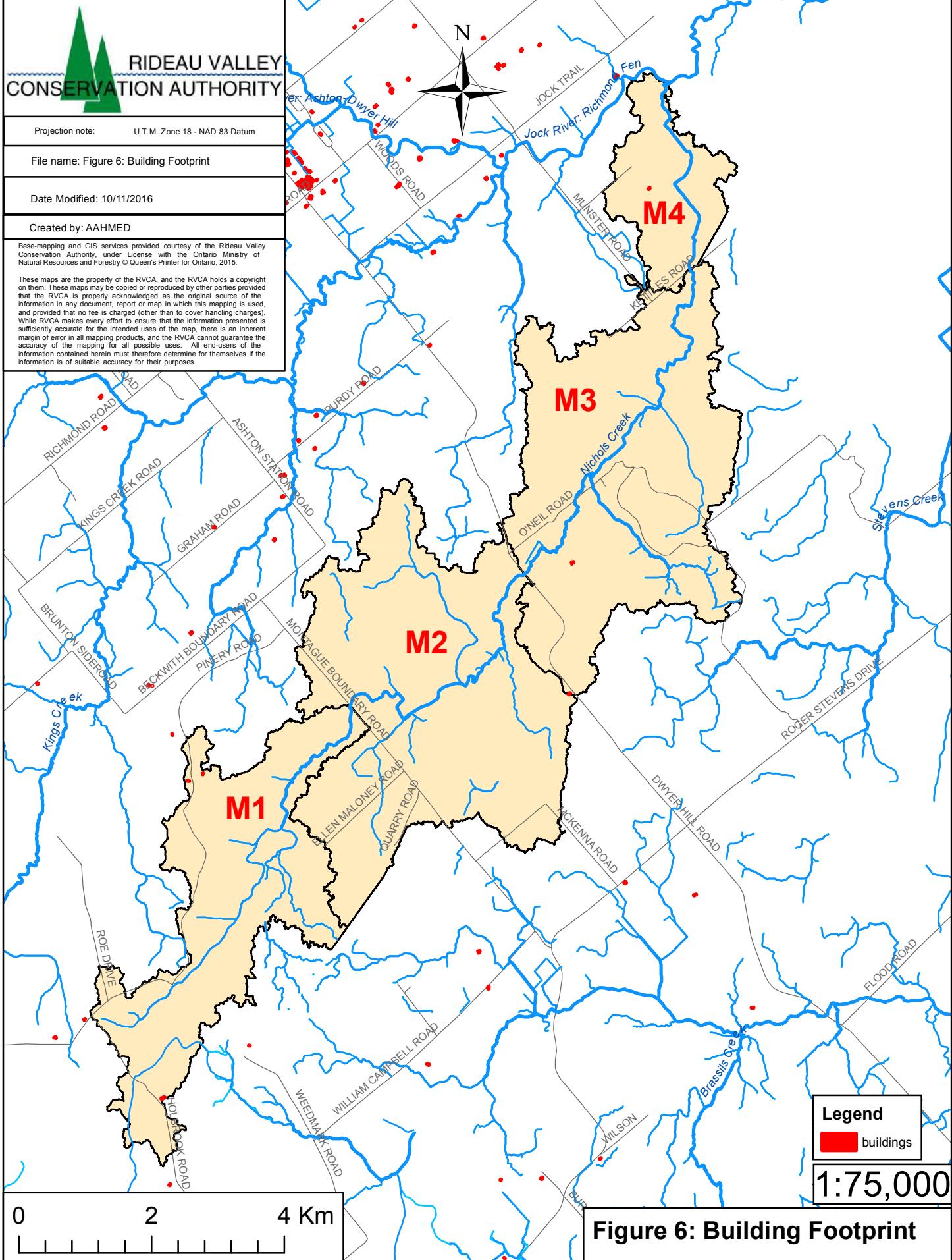


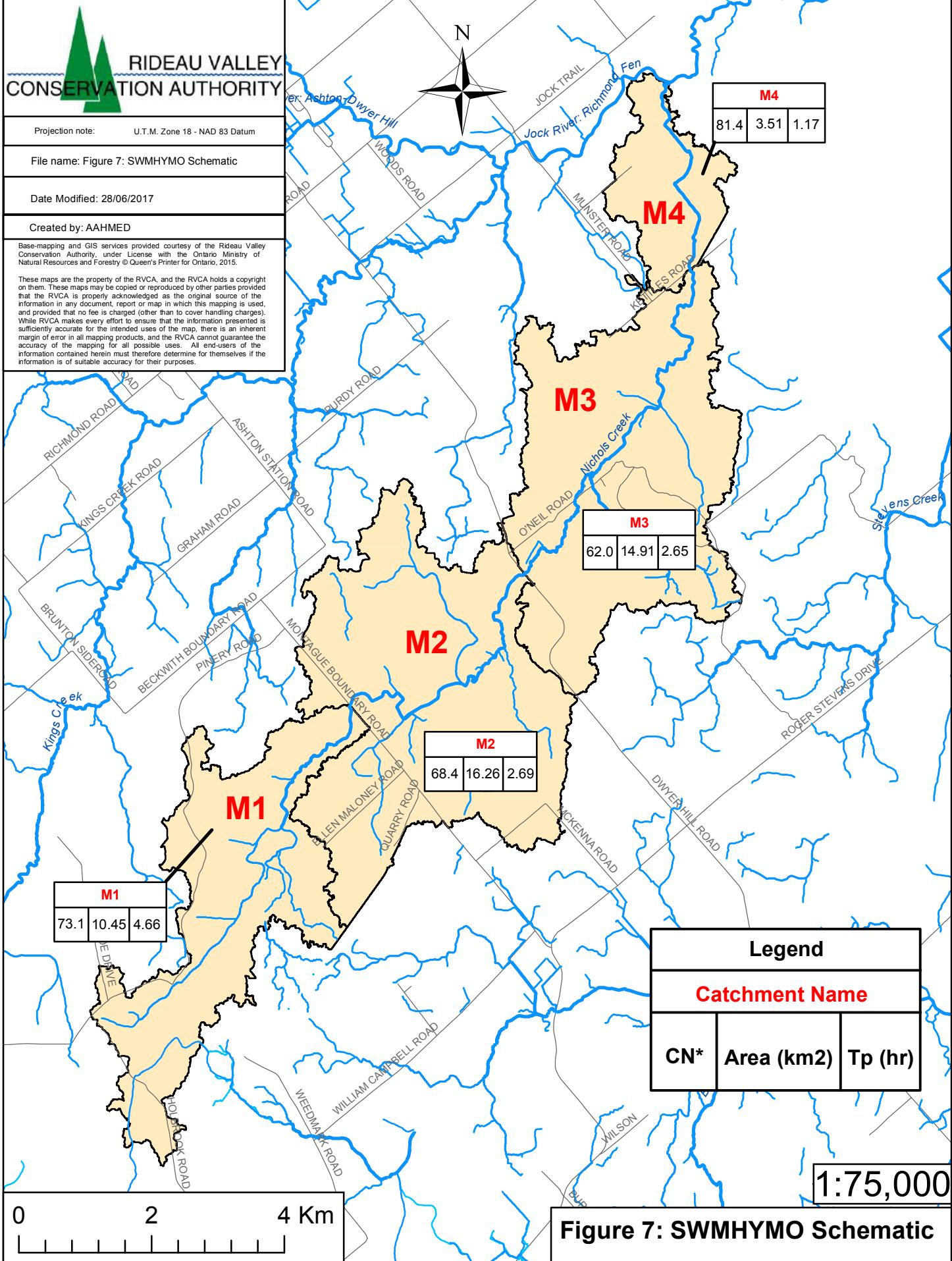












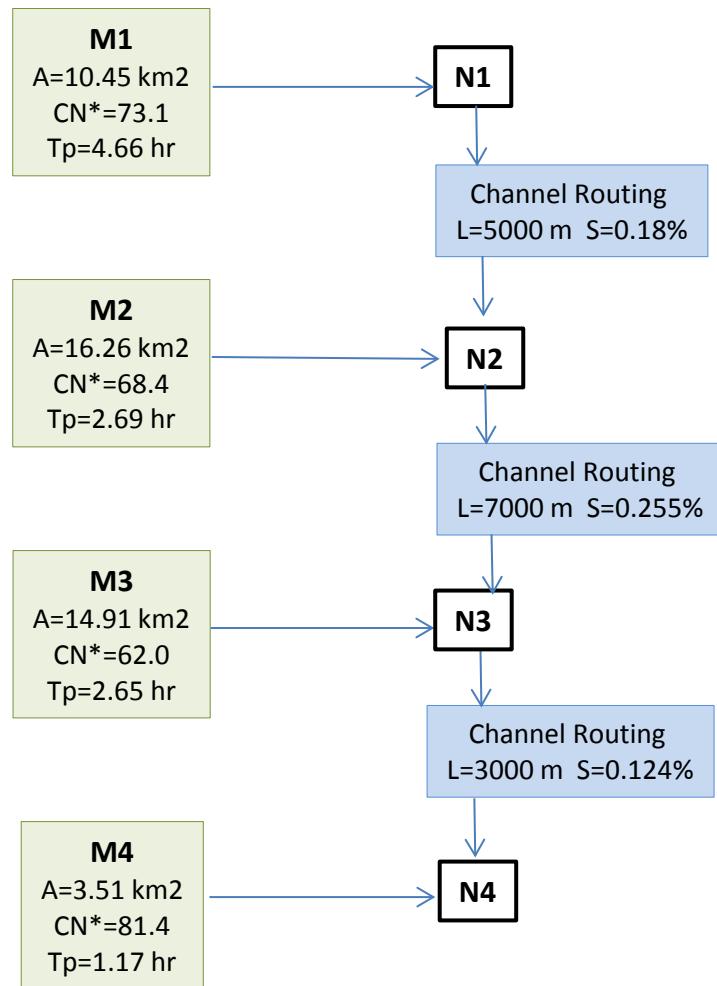


Figure 8 SWMHYMO Flow Chart

Figure 9 IDF curve for Ottawa Airport based on 1967-2007 data

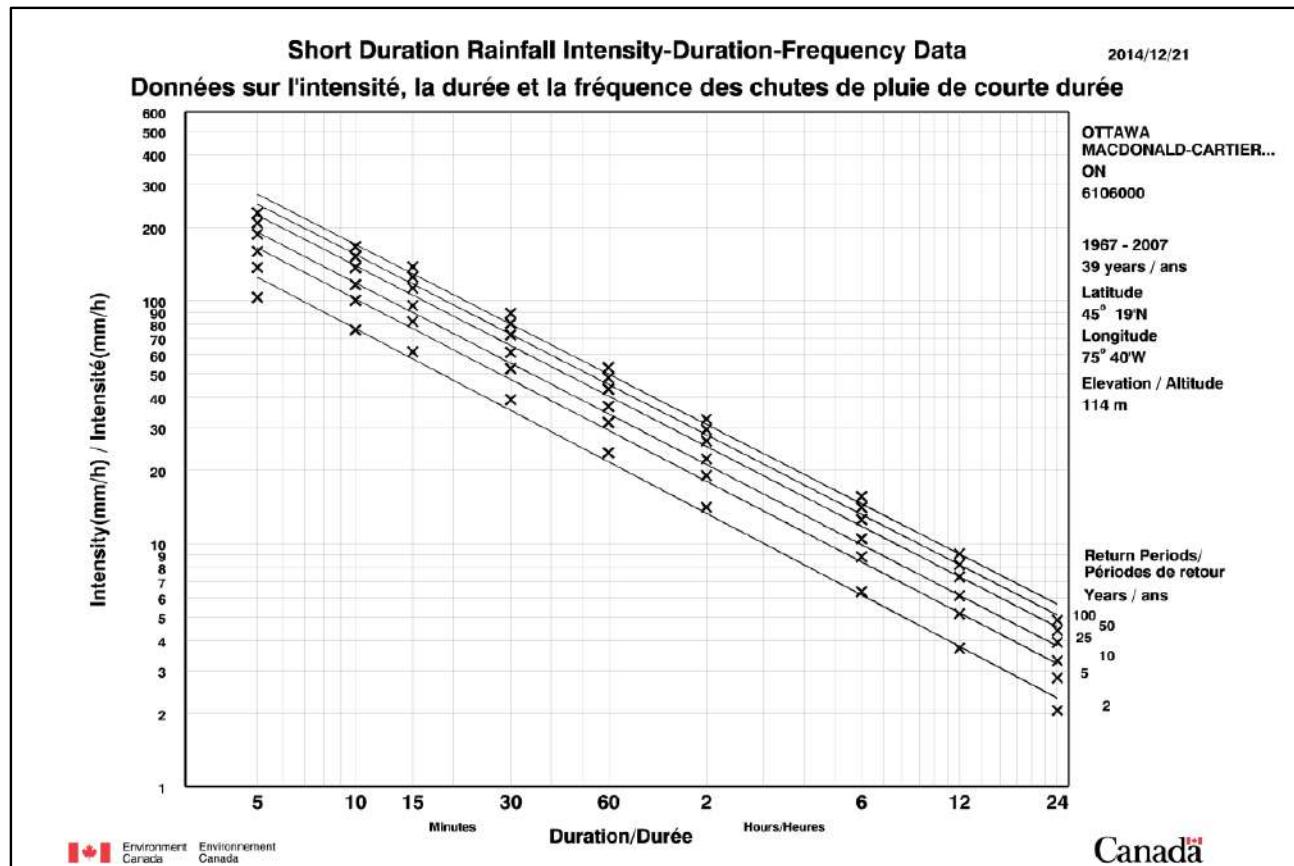


Figure 10 Fitted IDF curves for Ottawa Airport generated by STORMS software

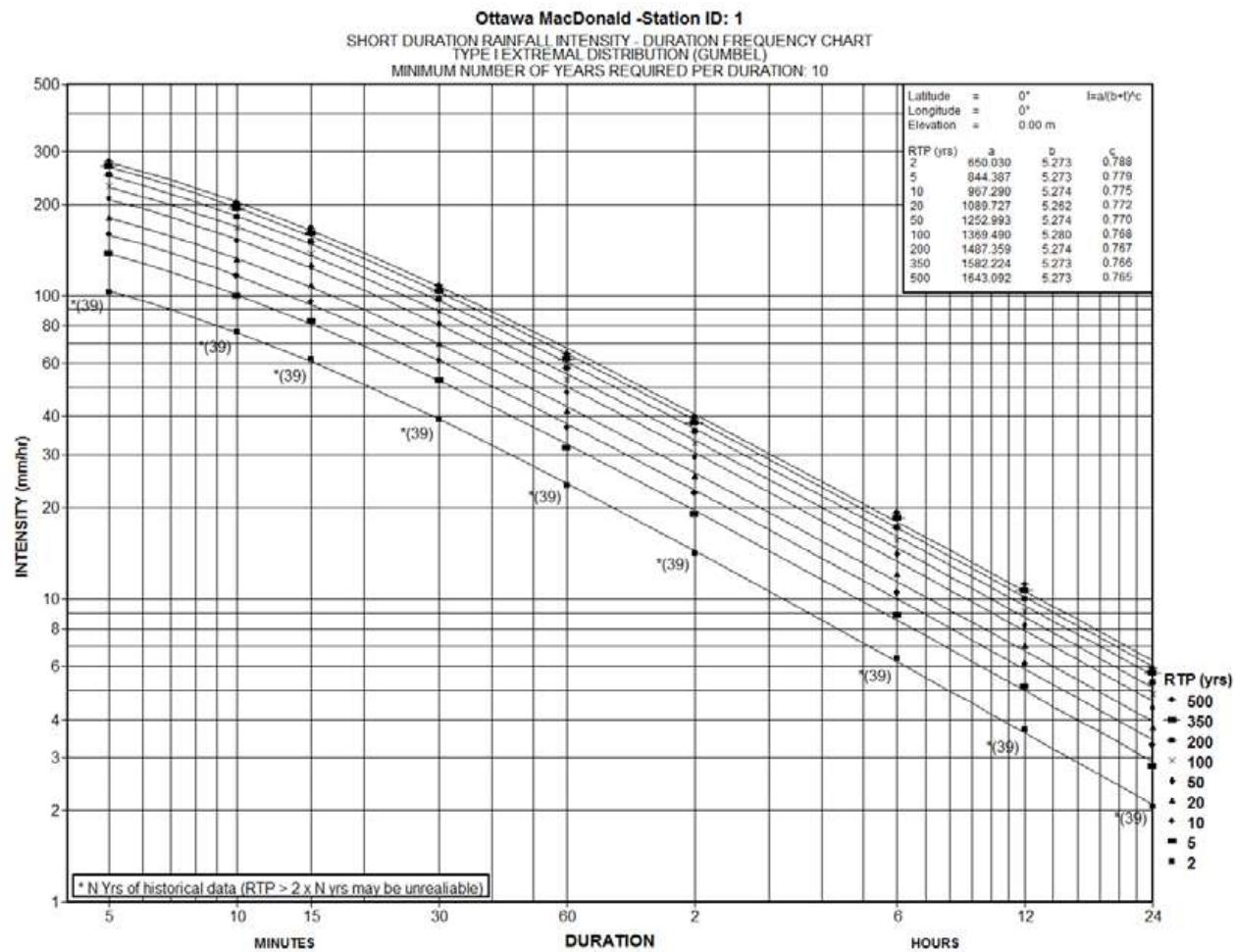


Figure 11 Hyetographs of various design storms

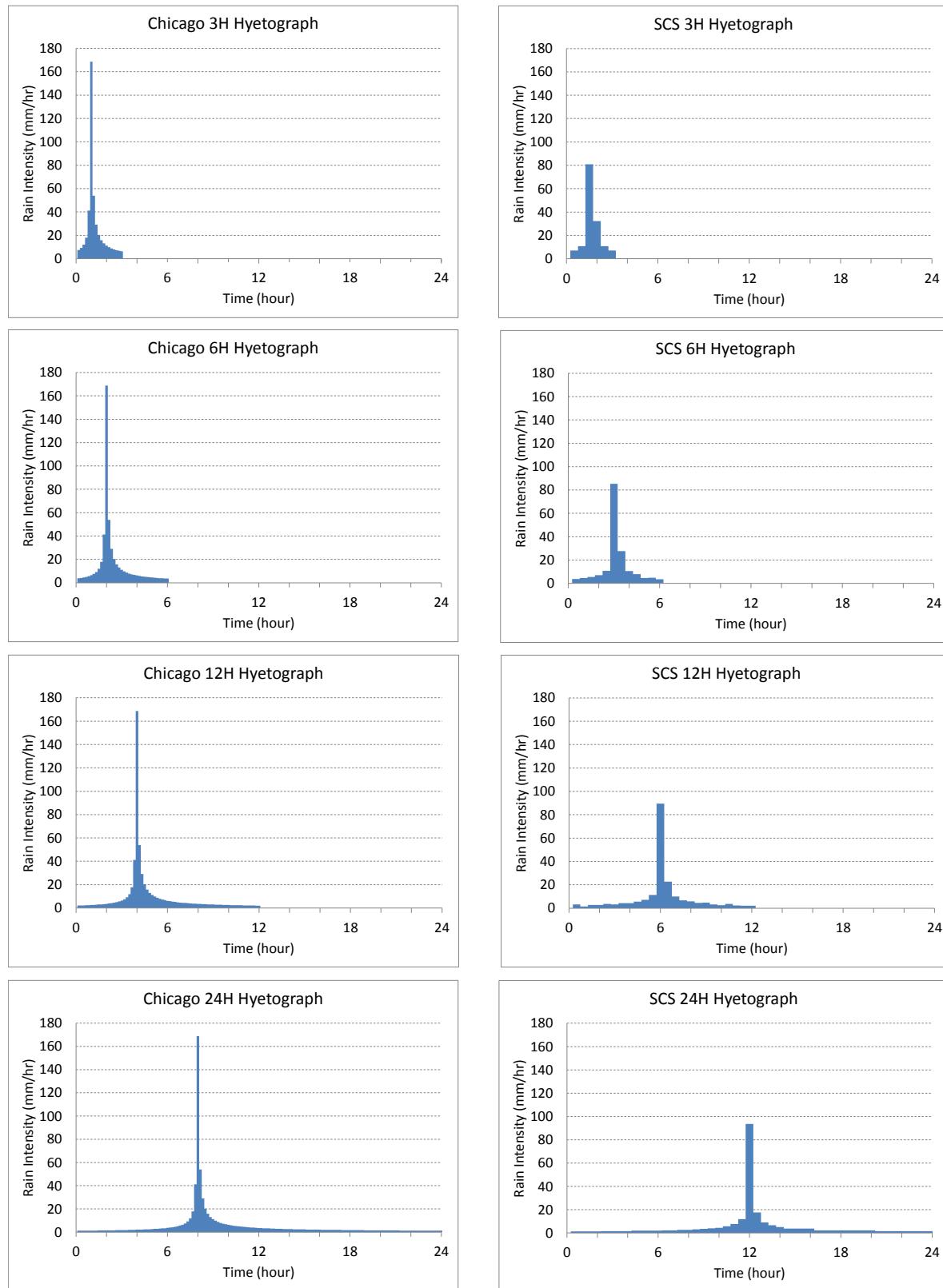
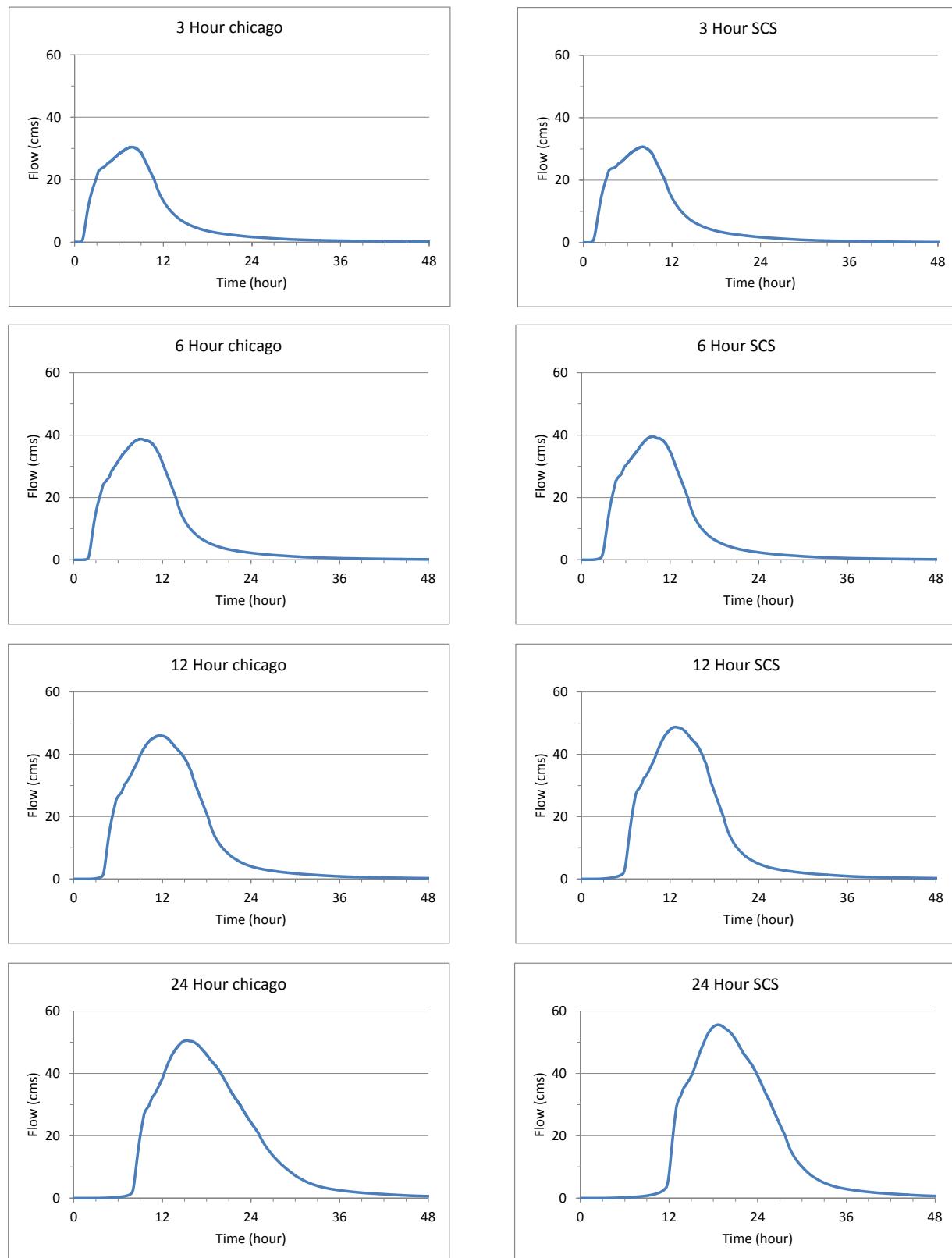


Figure 12 SWMHYMO generated flow at node N4 for different design storms



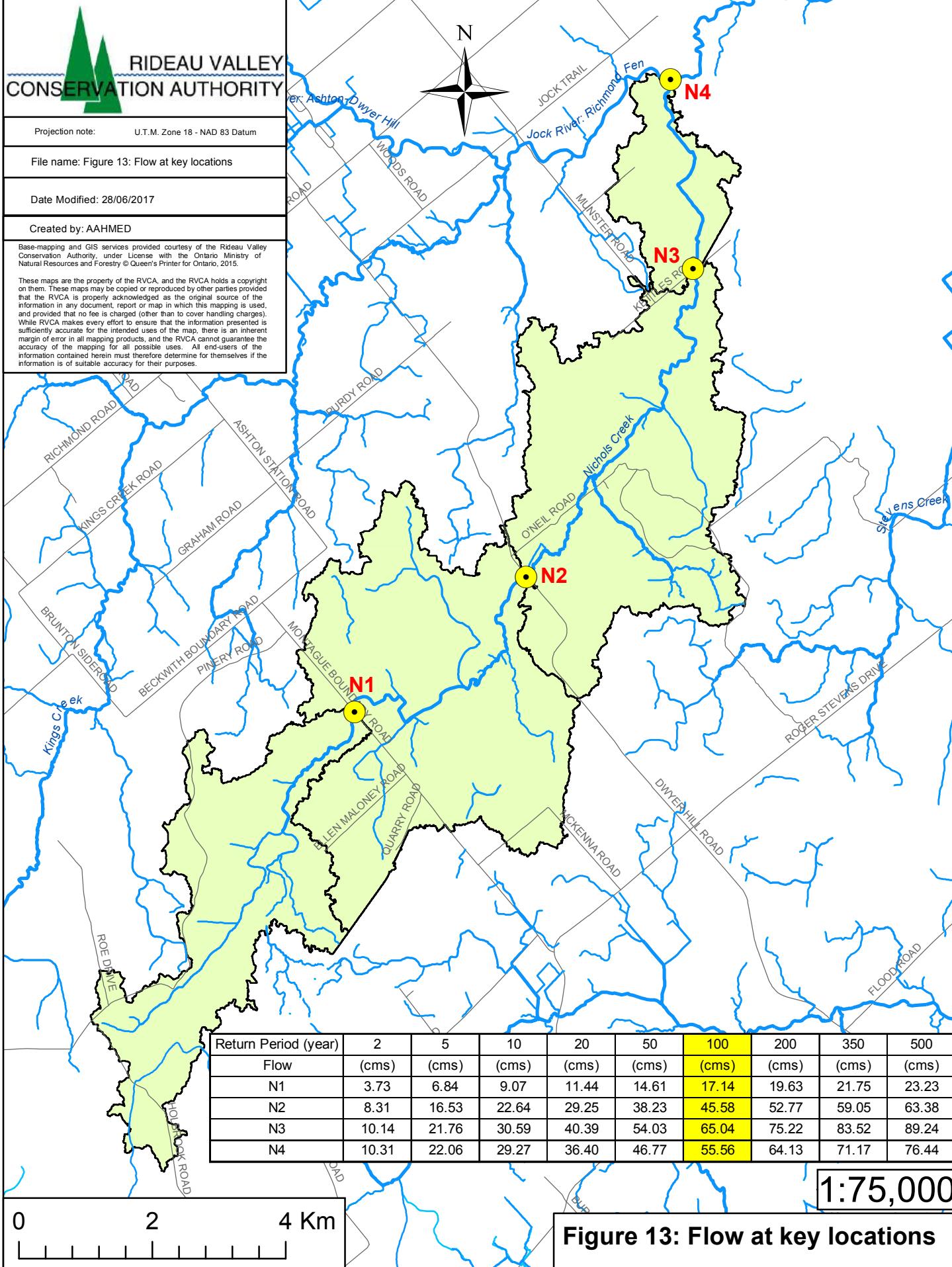


Figure 14 Estimated 1:100 year flows along Nichols Creek

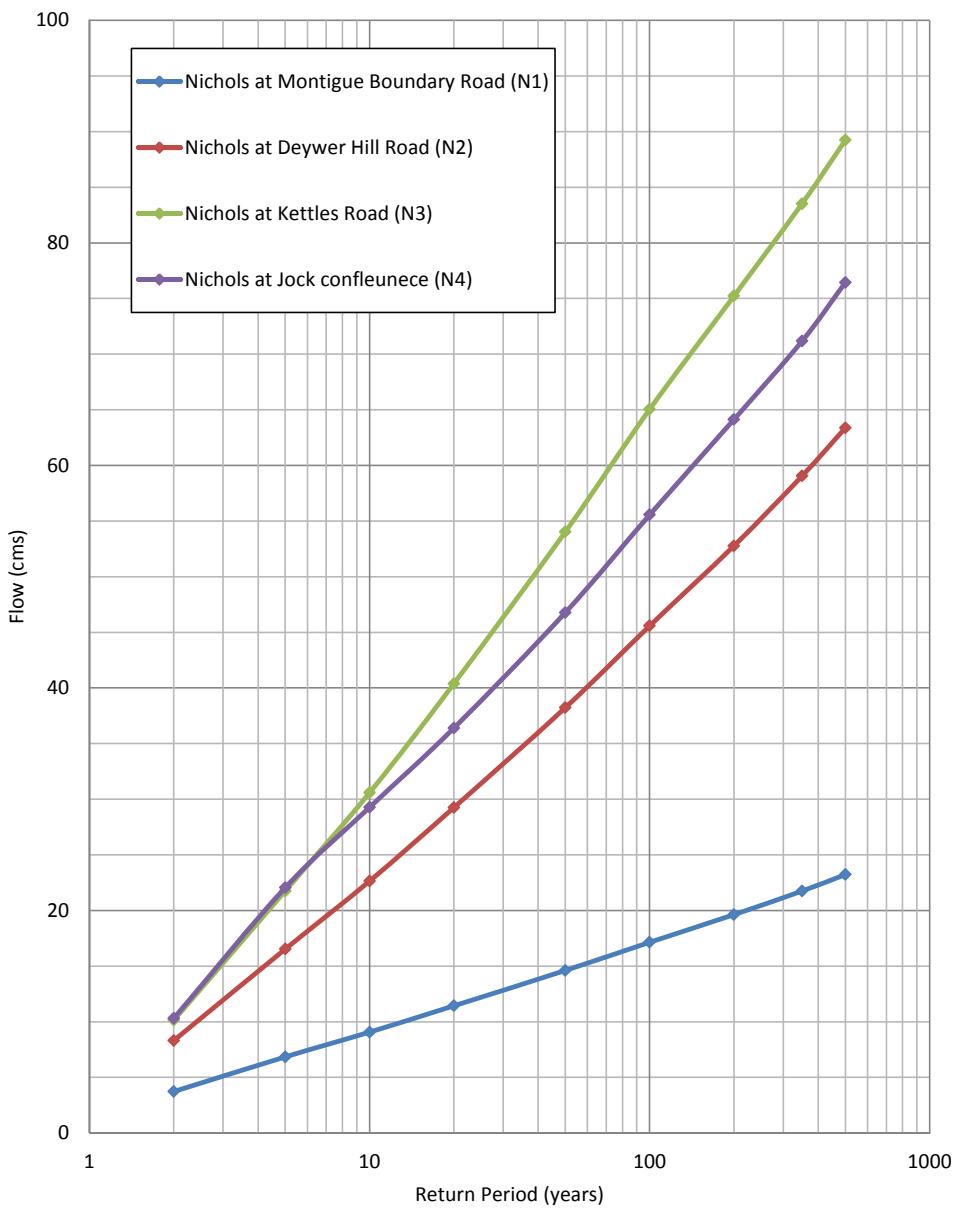


Figure 15 Comparison of estimated 1:100 year flows

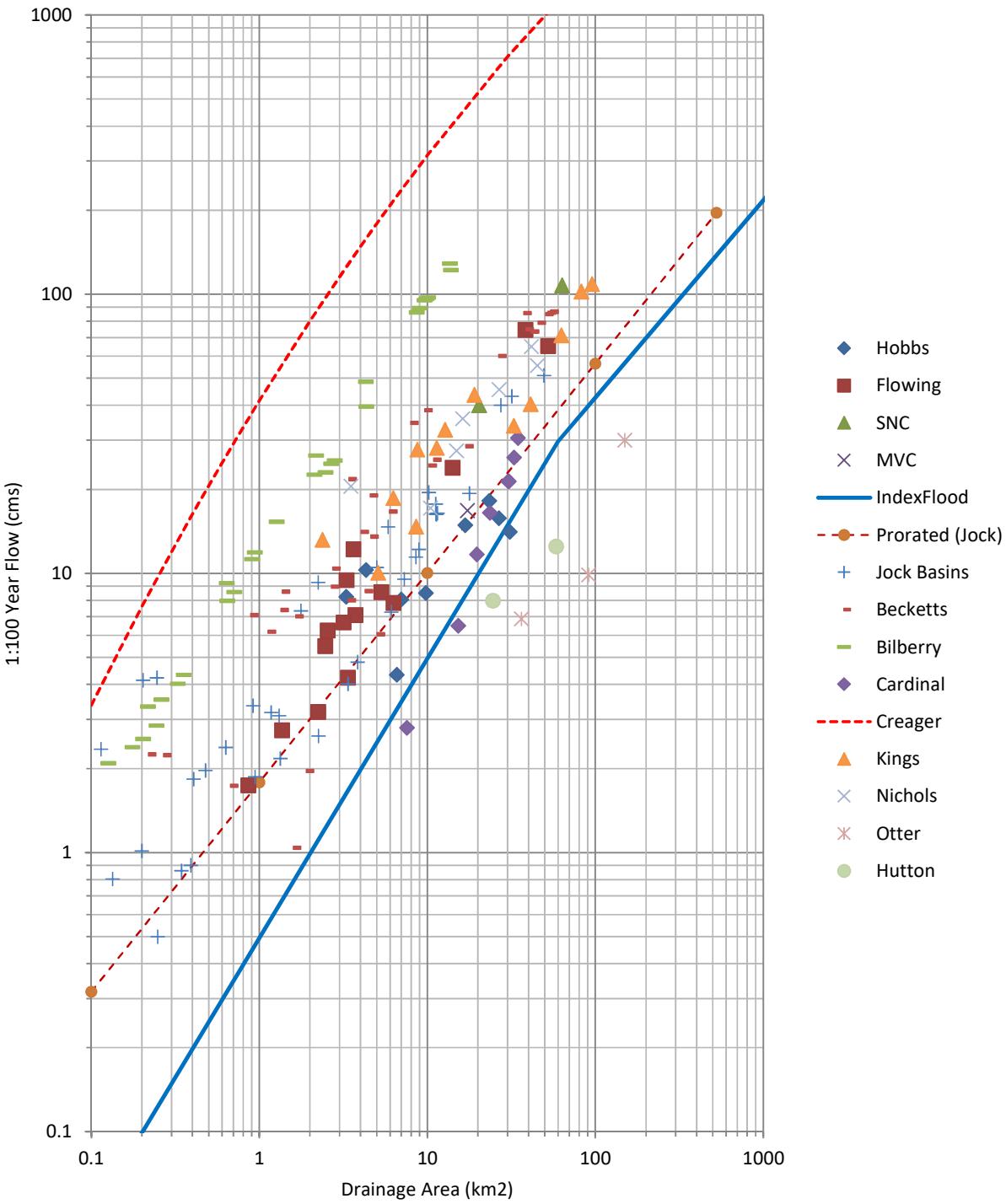
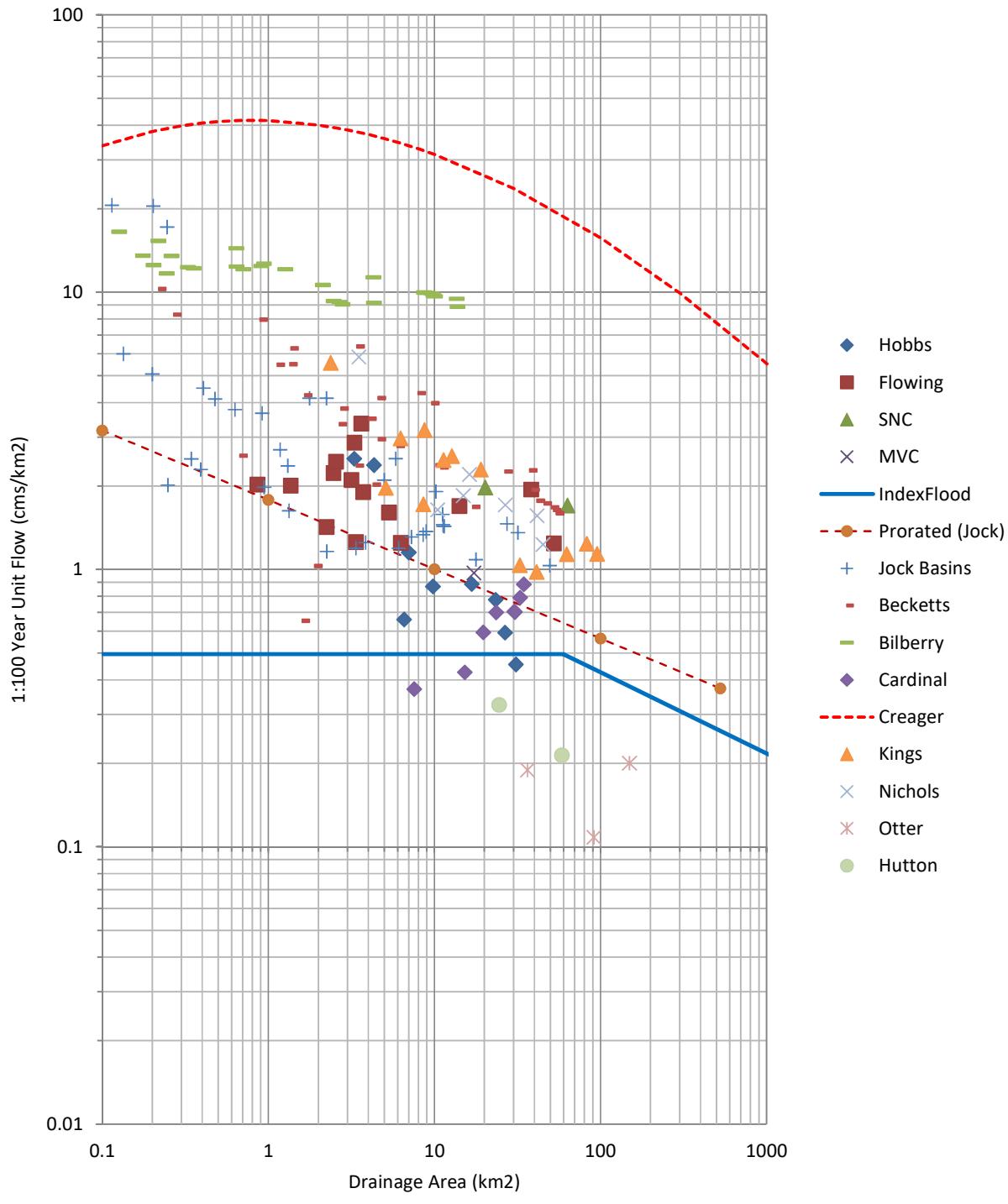


Figure 16 Comparison of 1:100 year flows per unit area



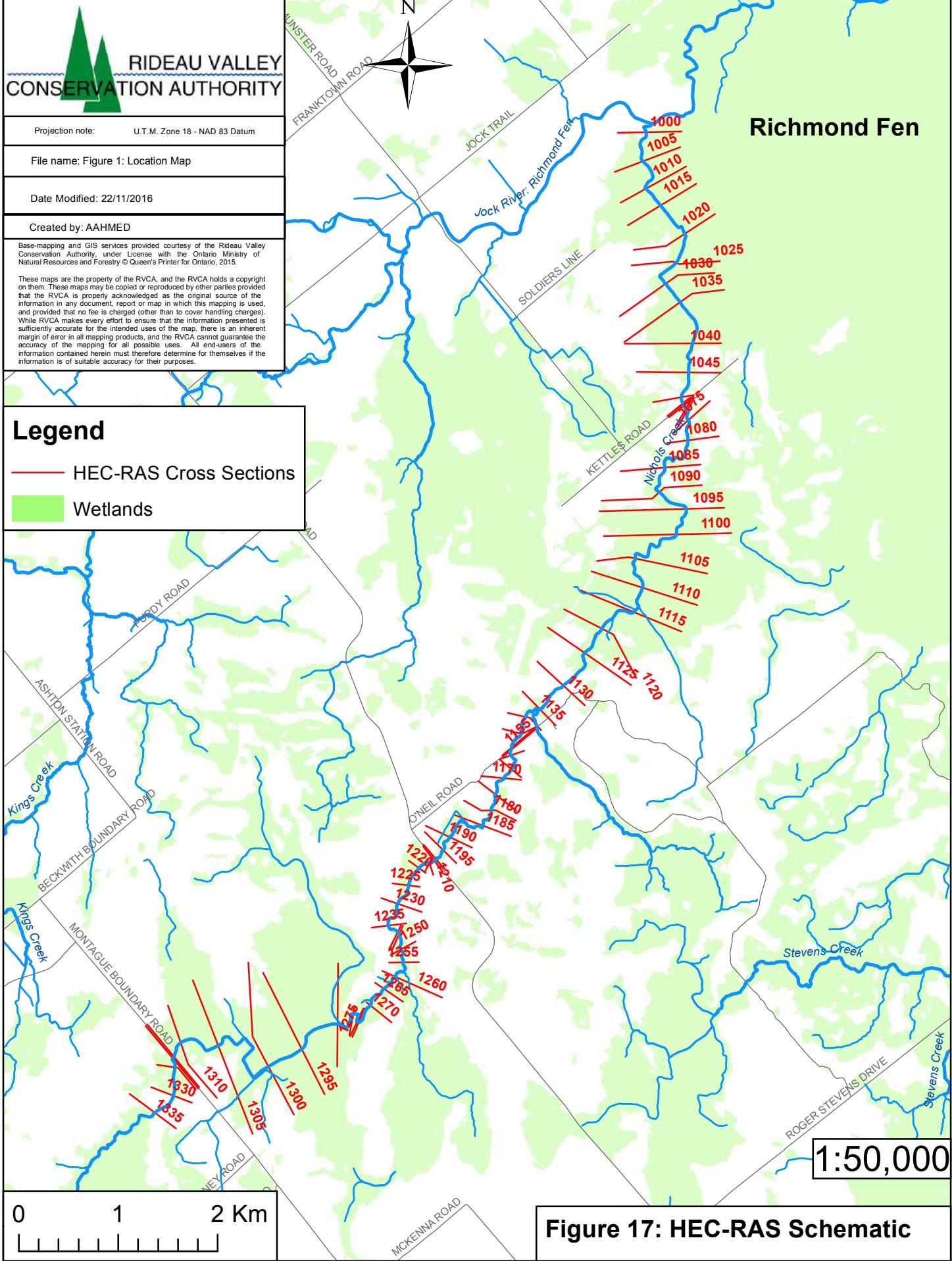


Figure 18 Selection of Boundary Condition

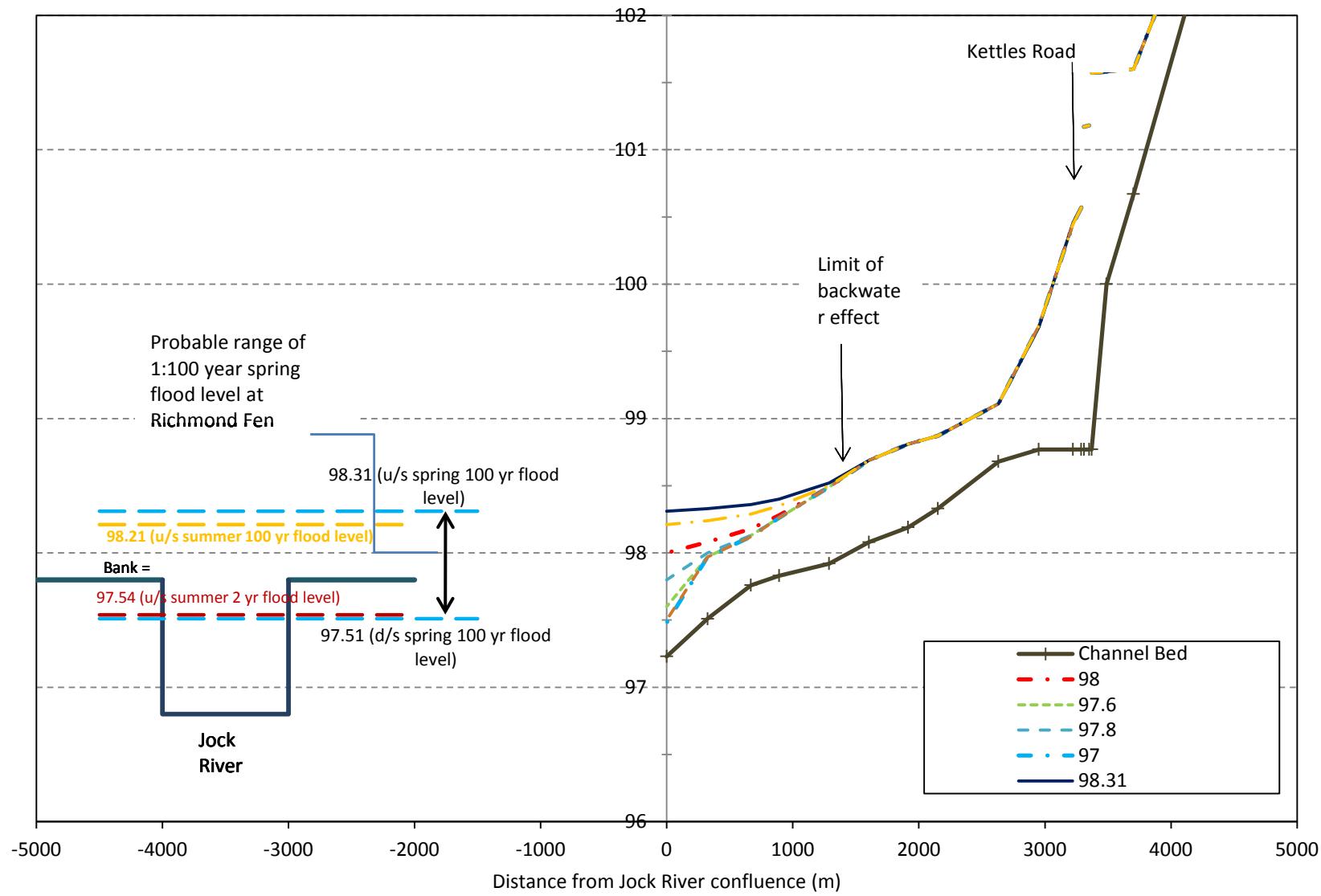


Figure 19 Sensitivity analysis of the computed water level for the design flow

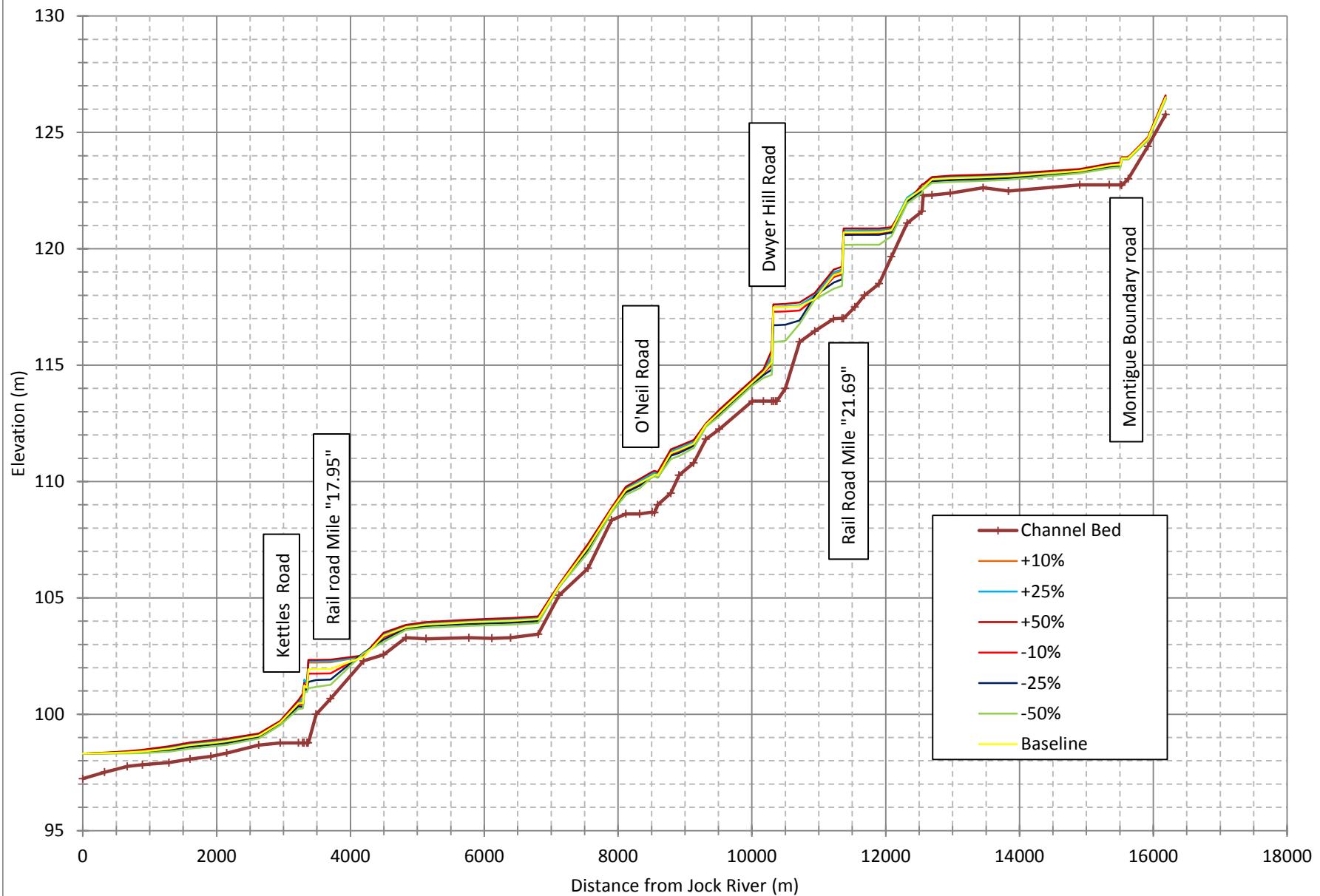


Figure 20 Sensitivity analysis - water level difference

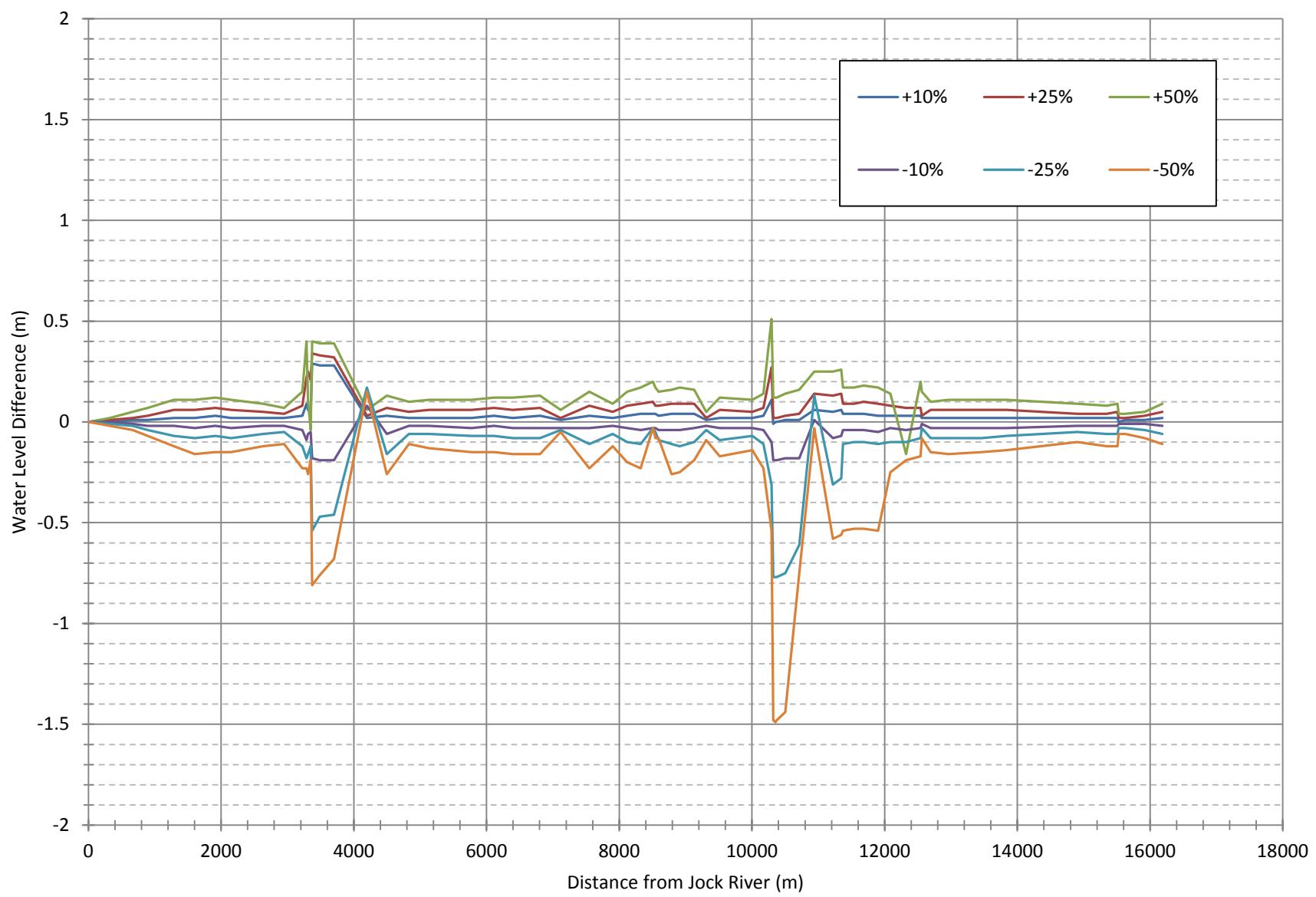


Table 1: Land cover breakdown in the Nichols basin*

	Catchment	M1		M2		M3		M4		Total Nichols	
	Description	Area (km ²)	%								
1	Aggregate Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Aggregate Site-Pit	0.04	0.35	0.06	0.36	0.00	0.00	0.00	0.00	0.10	0.21
3	Aggregate Site-Quarry	0.00	0.00	0.02	0.10	0.00	0.00	0.00	0.00	0.02	0.04
4	Crop and Pasture	0.00	0.00	0.76	4.67	0.02	0.14	0.00	0.00	0.78	1.73
5	Crop and Pasture-Cultivated	0.40	3.81	1.88	11.58	0.44	2.92	1.14	32.39	3.85	8.54
6	Crop and Pasture-Fallow	0.10	0.97	0.08	0.52	0.30	1.99	0.05	1.33	0.53	1.17
7	Evaluated Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Evaluated Wetland-Bog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Evaluated Wetland-Fen	0.00	0.04	0.00	0.00	0.16	1.06	0.00	0.00	0.16	0.36
10	Evaluated Wetland-Marsh	0.42	4.05	0.26	1.57	0.06	0.40	0.00	0.00	0.74	1.64
11	Evaluated Wetland-Open Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	Evaluated Wetland-Swamp	3.72	35.60	4.76	29.27	2.97	19.90	1.48	42.02	12.92	28.63
13	Meadow Thicket	0.68	6.51	0.63	3.87	0.46	3.06	0.07	1.99	1.83	4.06
14	Settlement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Settlement-Impervious	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Settlement-Pervious	0.07	0.70	0.27	1.64	0.44	2.97	0.03	0.96	0.82	1.81
17	Settlement-Pervious Homestead	0.11	1.09	0.09	0.58	0.13	0.90	0.07	1.93	0.41	0.91
18	Settlement-Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Transportation-Rail	0.00	0.04	0.09	0.53	0.11	0.71	0.01	0.31	0.21	0.46
21	Transportation-Road	0.18	1.76	0.19	1.20	0.30	2.00	0.02	0.61	0.70	1.55
22	Unevaluated Wetland	0.71	6.84	0.99	6.06	1.64	10.99	0.06	1.81	3.40	7.54
23	Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Water-Buffer around wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Water-Lake	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Water-Pond	0.00	0.00	0.03	0.16	0.00	0.00	0.00	0.00	0.03	0.06
27	Water-River	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
28	Wooded Area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	Wooded Area-Fallow	0.02	0.17	0.29	1.79	0.04	0.27	0.00	0.09	0.35	0.78
30	Wooded Area-Hedgerow	0.00	0.00	0.01	0.05	0.00	0.02	0.01	0.22	0.02	0.04
31	Wooded Area-Island	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
32	Wooded Area-Plantation	0.35	3.34	0.41	2.55	0.40	2.68	0.12	3.45	1.28	2.85
33	Wooded Area-Treed	3.63	34.73	5.45	33.50	7.45	49.99	0.45	12.86	16.98	37.63
	Total	10.45	100	16.26	100	14.91	100	3.51	100	45.13	100

* Land cover based on RVCA in-house work which represents conditions of spring 2014

Table 2 Hydrological Soil Groups in Nichols Basin

Catchment	Area (km ²)	Soil Group area (km ²)					as percent (%) of catchment area				
		A	B	C	D	Unclassified	A	B	C	D	Unclassified
M1	10.45	0.10	5.99	0.14	4.21	0.00	0.94	57.36	1.38	40.32	0.00
M2	16.26	0.79	10.22	0.00	5.16	0.10	4.84	62.83	0.00	31.71	0.63
M3	14.91	0.93	9.15	1.63	3.15	0.05	6.21	61.39	10.94	21.10	0.35
M4	3.51	0.18	0.00	2.35	0.97	0.00	5.26	0.00	67.01	27.73	0.00
Entire Nichols	45.13	2.00	25.36	4.13	13.49	0.16	4.42	56.20	9.15	29.89	0.34

Note: Based on MNRF's LIO (Land Information System) database and documentation by MNR (2012)

Table 3 Estimated watershed parameters

Catchment	Area (km ²)	imperviousness (%)	CN ¹	CN* ²	IA (mm)	Channel Slope (%)	Channel Length (m)	Tc ³ (hr)	Tp ⁴ (hr)
M1	10.45	1.48	80	73.0	4.69	0.07	5000	7.77	4.66
M2	16.26	0.96	77	68.4	5.88	0.18	5214	4.48	2.69
M3	14.91	1.40	73	62.0	7.79	0.26	7044	4.42	2.65
M4	3.51	0.73	86	81.4	2.90	0.12	3444	1.95	1.17
Entire Nichols	45.13	1.21	79.11	71.1	5.16	0.12	14000	11.01	6.06

1) Calculated from land use and TR-55 Curve Number tables (Urban Hydrology for Small Watersheds by USDA-SCS, 1986)

2) Calculated based on equation $CN^*=100/(1.879((100/CN)-1)^{1.15}+1)$ (Curve Number Hydrology by Hawkins et al. Page 35, 2009)

3) Calculated based on the velocity method (National engineering handbook Chapter 15 by USDA-NRCS, 2010)

4) Calculated based on $t_p = 0.6 \times t_c$ (National engineering handbook Chapter 15 by USDA-NRCS, 2010)

Table 4 Curve number for different land cover and soil groups

RVCA Land Cover ¹	Corresponding TR-55 land cover category ²			Assigned Curve Number (CN)			
	Cover description			Soil group			
	Land cover Class	Cover type	Hydrologic condition	A	B	C	D
1	Aggregate Site - Quarry	Industrial	N/A	81	88	91	93
2	Aggregate Site - Pit	Industrial	N/A	81	88	91	93
3	Aggregate Site - unclassified	Industrial	N/A	81	88	91	93
4	Settlement - Pervious	Open space (lawns, parks, golf courses, cemeteries, etc)	Good condition (grass cover >75%)	39	61	74	80
5	Settlement - Impervious	Commercial and business	N/A	89	92	94	95
6	Settlement - Pervious Homestead	Residential district (average lot size 2 acres)	N/A	46	65	77	82
7	Settlement - Residential	Residential district (average lot size 1/8 acre or less (townhouse))	N/A	77	85	90	92
8	Settlement - unclassified			77	85	90	92
9	Transportation - Rail	Streets and roads	N/A	98	98	98	98
10	Transportation - Road	Streets and roads	N/A	98	98	98	98
11	Transportation - unclassified	Streets and roads	N/A	98	98	98	98
12	Water - Lake	N/A	N/A	98	98	98	98
13	Water - River	N/A	N/A	98	98	98	98
14	Water - Buffer around wetland	N/A	N/A	98	98	98	98
15	Water - Pond	N/A	N/A	98	98	98	98
16	Water - unclassified	N/A	N/A	98	98	98	98
17	Unevaluated Wetland	N/A	N/A	98	98	98	98
18	Evaluated Wetland - Swamp	N/A	N/A	98	98	98	98
19	Evaluated Wetland - Open Water	N/A	N/A	98	98	98	98
20	Evaluated Wetland - Bog	N/A	N/A	98	98	98	98
21	Evaluated Wetland - Marsh	N/A	N/A	98	98	98	98
22	Evaluated Wetland - Fen	N/A	N/A	98	98	98	98
23	Evaluated Wetland - unclassified	N/A	N/A	98	98	98	98
24	Wooded Area - Treed	Wood	Good	30	55	70	77
25	Wooded Area - Plantation	Wood	Poor	45	66	77	83
26	Wooded Area - Hedgerow	Wood	Poor	45	66	77	83
27	Wooded Area - Island	Wood	Good	30	55	70	77
28	Wooded Area - Fallow	Pasture	Fair	49	69	79	84
29	Wooded Area - unclassified	Wood	Good	30	55	70	77
30	Crop and Pasture - Cultivated	Row Crops	Good	64	75	82	85
31	Crop and Pasture - Fallow	Fallow	Poor	76	85	90	93
32	Crop and Pasture - unclassified			64	75	82	85
33	Meadow Thicket	Herbaceous - mixture of grass, weeds, and low-growing brush, with brush the minor element.	Fair	60	71	81	89

1) Land cover classifications based on in-house RVCA work which represent conditions in the spring of 2014

2) Values and descriptors extracted from TR-55 "Urban Hydrology for Small Watersheds", USDA, Natural Resources Conservation Service, June 1986

Table 5 Characteristics of design storms

	Duration	Total volume	Peak intensity	Time step	Source of hyetograph shape
	(hour)	(mm)	(mm/hr)	(minutes)	
Chicago 3 hour	3	74.43	168.71	10	generated by STORMS osftware
Chicago 6 hour	6	88.42	168.71	10	generated by STORMS osftware
Chicago 12 hour	12	104.44	168.71	10	generated by STORMS osftware
Chicago 24 hour	24	123.02	168.71	10	generated by STORMS osftware
SCS 3 hour	3	74.47	80.87	30	City of Ottawa Sewer Design Guidelines 2012
SCS 6 hour	6	88.43	85.25	30	City of Ottawa Sewer Design Guidelines 2012
SCS 12 hour	12	104.44	89.40	30	City of Ottawa Sewer Design Guidelines 2012
SCS 24 hour	24	123.01	93.49	30	generated by STORMS osftware

Table 6 Estimated peak flows generated by various storms

Storm	3H Chicago	6H Chicago	12H Chicago	24H Chicago	3H SCS	6H SCS	12H SCS	24H SCS
Return Period	100 year	100 year	100 year	100 year	100 year	100 year	100 year	100 year
Flow	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)

Catchment	M1	12.70	14.27	15.67	10.11	13.06	15.42	17.14
	M2	25.86	28.72	31.94	22.44	27.89	31.76	35.83
	M3	19.25	21.54	24.19	16.50	20.86	24.04	27.52
	M4	15.73	17.24	18.70	15.11	17.01	18.81	20.53

Nodes	N1	12.70	14.27	15.67	10.11	13.06	15.42	17.14
	N2	32.91	36.54	40.73	26.73	34.71	40.27	45.58
	N3	45.69	51.54	57.83	35.37	47.83	57.01	65.04
	N4	38.72	46.07	50.52	30.65	39.53	48.71	55.56

Table 7 SCS Type II 24 hour design storms for different return periods

Return Period (year)	Total volume (mm)	Peak intensity (mm/hr)	Time step (minutes)	hyetograph generated by
2	50.48	38.08	30	STORMS software
5	70.01	53.21	30	STORMS software
10	82.57	62.75	30	STORMS software
20	95.07	72.25	30	STORMS software
50	110.92	84.3	30	STORMS software
100	123.01	93.49	30	STORMS software
200	134.57	102.27	30	STORMS software
350	144.20	109.59	30	STORMS software
500	150.84	114.64	30	STORMS software

Table 8 Estimated peak flows for SCS Type II 24 hour design storm

Storm	24 hour SCS Type II								
Return Period (year)	2	5	10	20	50	100	200	350	500
Flow	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
Catchments									
M1	3.73	6.84	9.07	11.44	14.61	17.14	19.63	21.75	23.23
M2	7.06	13.51	18.24	23.33	30.25	35.83	41.34	46.09	49.42
M3	4.78	9.66	13.34	17.38	22.96	27.52	32.08	36.02	38.81
M4	5.21	8.99	11.58	14.26	17.78	20.53	23.19	25.43	26.99
Nodes									
N1	3.73	6.84	9.07	11.44	14.61	17.14	19.63	21.75	23.23
N2	8.31	16.53	22.64	29.25	38.23	45.58	52.77	59.05	63.38
N3	10.14	21.76	30.59	40.39	54.03	65.04	75.22	83.52	89.24
N4	10.31	22.06	29.27	36.40	46.77	55.56	64.13	71.17	76.44

Table 9 Estimated flows for hydraulic modeling (HEC-RAS)

			Return Period (year)	2	5	10	20	50	100	200	350	500
Stream	Reach	Nearest Cross Section	Distance from Jock Confluence (m)	Flow (cms)								
Nichols	Reach 1	1335	16184.71	3.73	6.84	9.07	11.44	14.61	17.14	19.63	21.75	23.23
Nichols	Reach 1	1310	15344.26	8.31	16.53	22.64	29.25	38.23	45.58	52.77	59.05	63.38
Nichols	Reach 1	1195	10173.26	10.14	21.76	30.59	40.39	54.03	65.04	75.22	83.52	89.24
Nichols	Reach 1	1050	3223.1	10.31	22.06	30.59	40.39	54.03	65.04	75.22	83.52	89.24

Table 10 Structures on Nichols Creek

Stream	Location	Bridge or Culvert	Chainage (m)	Bounding Cross Sections	Width (m)	Height (m)	Length (m)	Source(s)
Nichols	Montague Boundary Road	C	15517	1320 & 1315	Diameter	0.90	12.00	RVCA Survey September 9th 2016
Nichols	Rail Road at Mile "22.16"	-	-	-	-	-	-	No data. Not accessible. Not used in the HEC-RAS Model
Nichols	Rail Road at Mile "21.69"	C	11359	1245 & 1240	3.02	2.13	16.60	VIA Rail Canada Inc. M.21.69 Bridge over Nichols Creek Near Dwyer Hill, ONT. Bridge Replacment. Drawing SMF -21.69-1.1. Hatch Mott MacDonald. September 19th 2013
Nichols	Rail Road at Mile "21.21"	-	-	-	-	-	-	No data. Not accessible. Not used in the HEC-RAS Model
Nichols	Dwyer Hill Road	C	10309	1205 & 1200	4.27	2.74	20.50	RVCA Survey August 27th 2010
Nichols	O'Neil Road	C	8527	1155 & 1150	2.22	1.53	9.00	RVCA Survey August 27th 2010
Nichols	Rail road Mile "17.95"	B	3361	1070 & 1065	12.52	1.90	6.84	VIA Rail Canada Inc. M.17.95 Smith Falls Nichols Creek - Concrete Repairs Drawing # 09-ST4001. AECOM. December 18th 2009
Nichols	Kettles Road	C	3299	1060 & 1055	5.00	1.50	7.00	RVCA Survey 2010, and City of Ottawa drawing: Nichols Creek Bridge Rehabilitation, Drawing # B-675201-001 TSH Engineering, Architects, Planners. October 2004.

Table 11 Calculated head loss at road crossings (during 1:100 Year flood)

Stream	Location	Chainage (m)	Bounding Cross Sections	Upstream Invert ¹ (m)	Downstream Invert ¹ (m)	Upstream Obvert ¹ (m)	Downstream Obvert ¹ (m)	Upstream Energy Grade (m)	Downstream Energy Grade (m)	Head Loss (cm)	Road Overtopped
Nichols	Montague Boundary Road	15517	1320 & 1315	122.73	122.75	123.63	123.65	123.89	123.62	27	Yes
Nichols	Rail Road at Mile "21.69"	11359	1245 & 1240	117.01	117.01	119.14	119.14	120.70	119.02	168	Yes
Nichols	Dwyer Hill Road	10309	1205 & 1200	113.45	113.53	116.19	116.27	117.49	115.94	155	Yes
Nichols	O'Neil Road	8527	1155 & 1150	108.66	108.69	110.19	110.22	110.30	110.23	7	Yes
Nichols	Rail road at Mile "17.95"	3361	1070 & 1065	98.77	98.77	100.67	100.67	101.94	101.38	56	Yes
Nichols	Kettles Road	3299	1060 & 1055	98.77	98.86	100.27	100.36	101.25	101.16	9	Yes

1) RVCA Surveys (August 2010, May 2015, and September 2016) as well as design drawings

Table 12 Regulatory Flood Levels for 100 Year Flood Event

River	Reach	Xsec ID	Q (total)	Computed WSEL (m)	EGL (m)	RFL (m)
Nichols Creek	Reach1	1335	17.14	126.51	126.53	126.53
	Reach1	1330	17.14	124.74	124.83	124.83
	Reach1	1325	17.14	123.89	123.89	123.89
	Reach1	1320	17.14	123.89	123.89	123.89
	Reach1	1318		Montague Boundary Road		
	Reach1	1315	17.14	123.62	123.62	123.62
	Reach1	1310	45.58	123.58	123.58	123.58
	Reach1	1305	45.58	123.34	123.35	123.35
	Reach1	1300	45.58	123.11	123.11	123.11
	Reach1	1295	45.58	123.07	123.07	123.07
	Reach1	1290	45.58	123.03	123.03	123.03
	Reach1	1285	45.58	122.98	122.99	122.99
	Reach1	1280	45.58	122.63	122.73	122.73
	Reach1	1275	45.58	122.57	122.59	122.59
	Reach1	1270	45.58	122.13	122.17	122.17
	Reach1	1265	45.58	120.79	120.98	120.98
	Reach1	1260	45.58	120.71	120.71	120.71
	Reach1	1255	45.58	120.70	120.71	120.71
	Reach1	1250	45.58	120.70	120.70	120.70
	Reach1	1245	45.58	120.70	120.70	120.70
	Reach1	1243		Rail Raod Mile "21.69"		
	Reach1	1240	45.58	118.97	119.02	119.02
	Reach1	1235	45.58	118.86	118.92	118.92
	Reach1	1230	45.58	117.85	118.03	118.03
	Reach1	1225	45.58	117.53	117.56	117.56
	Reach1	1220	45.58	117.49	117.50	117.50
	Reach1	1215	45.58	117.49	117.49	117.49
	Reach1	1210	45.58	117.49	117.49	117.49
	Reach1	1205	45.58	117.49	117.49	117.49
	Reach1	1203		Dwyer Hill Road		
	Reach1	1200	45.58	115.12	115.94	115.94
	Reach1	1195	65.04	114.68	114.71	114.71
	Reach1	1190	65.04	114.26	114.30	114.30
	Reach1	1185	65.04	112.97	112.99	112.99
	Reach1	1180	65.04	112.44	112.46	112.46
	Reach1	1175	65.04	111.63	111.68	111.68
	Reach1	1170	65.04	111.35	111.37	111.37
	Reach1	1165	65.04	111.22	111.24	111.24
	Reach1	1160	65.04	110.26	110.46	110.46
	Reach1	1155	65.04	110.29	110.30	110.30
	Reach1	1153		O'Neil Road		
	Reach1	1150	65.04	110.22	110.23	110.23
	Reach1	1145	65.04	109.94	109.98	109.98
	Reach1	1140	65.04	109.63	109.65	109.65
	Reach1	1135	65.04	108.79	108.93	108.93
	Reach1	1130	65.04	107.17	107.19	107.19

River	Reach	Xsec ID	Q (total)	Computed WSEL (m)	EGL (m)	RFL (m)
	Reach1	1125	65.04	105.52	105.61	105.61
	Reach1	1120	65.04	104.08	104.10	104.10
	Reach1	1115	65.04	104.01	104.01	104.01
	Reach1	1110	65.04	103.98	103.98	103.98
	Reach1	1105	65.04	103.95	103.95	103.95
	Reach1	1100	65.04	103.85	103.85	103.85
	Reach1	1095	65.04	103.74	103.74	103.74
	Reach1	1090	65.04	103.37	103.39	103.39
	Reach1	1085	65.04	102.47	102.57	102.57
	Reach1	1080	65.04	101.95	101.96	101.96
	Reach1	1075	65.04	101.94	101.94	101.94
	Reach1	1070	65.04	101.93	101.94	101.94
	Reach1	1068		Rail Road Mile "17.95"		
	Reach1	1065	65.04	101.14	101.38	101.38
	Reach1	1060	65.04	101.24	101.25	101.25
	Reach1	1058		Kettles Road		
	Reach1	1055	65.04	100.48	101.16	101.16
	Reach1	1050	65.04	100.46	100.50	100.50
	Reach1	1045	65.04	99.64	99.71	99.71
	Reach1	1040	65.04	99.08	99.08	99.08
	Reach1	1035	65.04	98.84	98.84	98.84
	Reach1	1030	65.04	98.76	98.77	98.77
	Reach1	1025	65.04	98.68	98.68	98.68
	Reach1	1020	65.04	98.51	98.51	98.51
	Reach1	1015	65.04	98.40	98.40	98.40
	Reach1	1010	65.04	98.36	98.36	98.36
	Reach1	1005	65.04	98.33	98.33	98.33
	Reach1	1000	65.04	98.31	98.31	98.31

Table 13 Flows and Computed Water Levels for the 100, 200, 350 and 500 Year Flood Events

River	Reach	Xsec ID	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q350	WL350	Q200	WL200	Q100	WL100
Nichols Creek	Reach1	1335	23.23	126.58	21.75	126.56	19.63	126.54	17.14	126.51
	Reach1	1330	23.23	124.78	21.75	124.77	19.63	124.76	17.14	124.74
	Reach1	1325	23.23	123.92	21.75	123.91	19.63	123.90	17.14	123.89
	Reach1	1320	23.23	123.92	21.75	123.91	19.63	123.90	17.14	123.89
	Reach1	1318	Montague Boundary Road							
	Reach1	1315	23.23	123.70	21.75	123.68	19.63	123.65	17.14	123.62
	Reach1	1310	63.38	123.65	59.05	123.63	52.77	123.61	45.58	123.58
	Reach1	1305	63.38	123.41	59.05	123.39	52.77	123.37	45.58	123.34
	Reach1	1300	63.38	123.20	59.05	123.18	52.77	123.15	45.58	123.11
	Reach1	1295	63.38	123.16	59.05	123.14	52.77	123.10	45.58	123.07
	Reach1	1290	63.38	123.12	59.05	123.10	52.77	123.07	45.58	123.03
	Reach1	1285	63.38	123.07	59.05	123.05	52.77	123.02	45.58	122.98
	Reach1	1280	63.38	122.68	59.05	122.67	52.77	122.65	45.58	122.63
	Reach1	1275	63.38	122.57	59.05	122.65	52.77	122.62	45.58	122.57
	Reach1	1270	63.38	122.29	59.05	122.22	52.77	122.18	45.58	122.13
	Reach1	1265	63.38	120.90	59.05	120.88	52.77	120.84	45.58	120.79
	Reach1	1260	63.38	120.84	59.05	120.81	52.77	120.77	45.58	120.71
	Reach1	1255	63.38	120.84	59.05	120.81	52.77	120.77	45.58	120.70
	Reach1	1250	63.38	120.83	59.05	120.80	52.77	120.76	45.58	120.70
	Reach1	1245	63.38	120.83	59.05	120.80	52.77	120.76	45.58	120.70
	Reach1	1243	Rail Raod Mile "21.69"							
	Reach1	1240	63.38	119.18	59.05	119.13	52.77	119.06	45.58	118.97
	Reach1	1235	63.38	119.06	59.05	119.01	52.77	118.94	45.58	118.86
	Reach1	1230	63.38	118.05	59.05	118.01	52.77	117.94	45.58	117.85
	Reach1	1225	63.38	117.64	59.05	117.60	52.77	117.54	45.58	117.53
	Reach1	1220	63.38	117.59	59.05	117.55	52.77	117.50	45.58	117.49
	Reach1	1215	63.38	117.58	59.05	117.54	52.77	117.49	45.58	117.49
	Reach1	1210	63.38	117.57	59.05	117.53	52.77	117.48	45.58	117.49
	Reach1	1205	63.38	117.58	59.05	117.54	52.77	117.48	45.58	117.49
	Reach1	1203	Dwyer Hill Road							
	Reach1	1200	63.38	115.53	59.05	115.43	52.77	115.29	45.58	115.12
	Reach1	1195	89.24	114.79	83.52	114.76	75.22	114.73	65.04	114.68
	Reach1	1190	89.24	114.34	83.52	114.32	75.22	114.29	65.04	114.26
	Reach1	1185	89.24	113.06	83.52	113.04	75.22	113.01	65.04	112.97
	Reach1	1180	89.24	112.48	83.52	112.47	75.22	112.45	65.04	112.44
	Reach1	1175	89.24	111.75	83.52	111.73	75.22	111.69	65.04	111.63
	Reach1	1170	89.24	111.48	83.52	111.45	75.22	111.41	65.04	111.35
	Reach1	1165	89.24	111.34	83.52	111.32	75.22	111.28	65.04	111.22
	Reach1	1160	89.24	110.37	83.52	110.35	75.22	110.30	65.04	110.26
	Reach1	1155	89.24	110.40	83.52	110.37	75.22	110.35	65.04	110.29
	Reach1	1153	O'Neil Road							
	Reach1	1150	89.24	110.37	83.52	110.33	75.22	110.28	65.04	110.22
	Reach1	1145	89.24	110.07	83.52	110.04	75.22	110.00	65.04	109.94
	Reach1	1140	89.24	109.75	83.52	109.72	75.22	109.68	65.04	109.63
	Reach1	1135	89.24	108.86	83.52	108.85	75.22	108.82	65.04	108.79
	Reach1	1130	89.24	107.29	83.52	107.26	75.22	107.22	65.04	107.17
	Reach1	1125	89.24	105.56	83.52	105.55	75.22	105.54	65.04	105.52
	Reach1	1120	89.24	104.18	83.52	104.16	75.22	104.12	65.04	104.08

River	Reach	Xsec ID	Flow (m³/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q350	WL350	Q200	WL200	Q100	WL100
Reach1	1115	89.24	104.10	83.52	104.08	75.22	104.05	65.04	104.01	
	1110	89.24	104.08	83.52	104.06	75.22	104.02	65.04	103.98	
	1105	89.24	104.04	83.52	104.02	75.22	103.99	65.04	103.95	
	1100	89.24	103.93	83.52	103.91	75.22	103.89	65.04	103.85	
	1095	89.24	103.82	83.52	103.80	75.22	103.77	65.04	103.74	
	1090	89.24	103.47	83.52	103.45	75.22	103.42	65.04	103.37	
	1085	89.24	102.52	83.52	102.51	75.22	102.49	65.04	102.47	
	1080	89.24	102.31	83.52	102.28	75.22	102.25	65.04	101.95	
	1075	89.24	102.30	83.52	102.28	75.22	102.24	65.04	101.94	
	1070	89.24	102.30	83.52	102.27	75.22	102.24	65.04	101.93	
	1068	Rail Road Mile "17.95"								
	1065	89.24	101.49	83.52	101.4	75.22	101.24	65.04	101.14	
	1060	89.24	101.64	83.52	101.53	75.22	101.36	65.04	101.24	
	1058	Kettles Road								
	1055	89.24	100.80	83.52	100.73	75.22	100.62	65.04	100.48	
	1050	89.24	100.58	83.52	100.55	75.22	100.51	65.04	100.46	
	1045	89.24	99.69	83.52	99.68	75.22	99.66	65.04	99.64	
	1040	89.24	99.15	83.52	99.13	75.22	99.11	65.04	99.08	
	1035	89.24	98.93	83.52	98.91	75.22	98.88	65.04	98.84	
	1030	89.24	98.85	83.52	98.83	75.22	98.80	65.04	98.76	
	1025	89.24	98.77	83.52	98.75	75.22	98.72	65.04	98.68	
	1020	89.24	98.59	83.52	98.57	75.22	98.55	65.04	98.51	
	1015	89.24	98.45	83.52	98.44	75.22	98.42	65.04	98.40	
	1010	89.24	98.40	83.52	98.39	75.22	98.37	65.04	98.36	
	1005	89.24	98.34	83.52	98.34	75.22	98.33	65.04	98.33	
	1000	89.24	98.31	83.52	98.31	75.22	98.31	65.04	98.31	

Table 14 Flows and Computed Water Levels for the 2, 5, 10, 20 and 50 Year Flood Events

River	Reach	Xsec ID	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events									
			Q50	WL50	Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Nichols Creek	Reach1	1335	14.61	126.48	11.44	126.44	9.07	126.41	6.84	126.38	3.73	126.32
	Reach1	1330	14.61	124.72	11.44	124.69	9.07	124.66	6.84	124.64	3.73	124.59
	Reach1	1325	14.61	123.87	11.44	123.85	9.07	123.83	6.84	123.80	3.73	123.77
	Reach1	1320	14.61	123.87	11.44	123.85	9.07	123.83	6.84	123.80	3.73	123.77
	Reach1	1318	Montague Boundary Road									
	Reach1	1315	14.61	123.59	11.44	123.54	9.07	123.50	6.84	123.42	3.73	123.35
	Reach1	1310	38.23	123.55	29.25	123.50	22.64	123.46	16.53	123.41	8.31	123.33
	Reach1	1305	38.23	123.31	29.25	123.27	22.64	123.24	16.53	123.20	8.31	123.13
	Reach1	1300	38.23	123.07	29.25	123.01	22.64	122.97	16.53	122.92	8.31	122.85
	Reach1	1295	38.23	123.02	29.25	122.97	22.64	122.91	16.53	122.86	8.31	122.77
	Reach1	1290	38.23	122.98	29.25	122.93	22.64	122.87	16.53	122.82	8.31	122.73
	Reach1	1285	38.23	122.94	29.25	122.88	22.64	122.83	16.53	122.78	8.31	122.69
	Reach1	1280	38.23	122.61	29.25	122.56	22.64	122.55	16.53	122.52	8.31	122.47
	Reach1	1275	38.23	122.52	29.25	122.46	22.64	122.40	16.53	122.35	8.31	122.24
	Reach1	1270	38.23	122.07	29.25	122.00	22.64	121.94	16.53	121.87	8.31	121.76
	Reach1	1265	38.23	120.74	29.25	120.63	22.64	120.53	16.53	120.43	8.31	120.27
	Reach1	1260	38.23	120.63	29.25	120.60	22.64	120.15	16.53	119.47	8.31	118.93
	Reach1	1255	38.23	120.63	29.25	120.60	22.64	120.15	16.53	119.46	8.31	118.73
	Reach1	1250	38.23	120.63	29.25	120.60	22.64	120.15	16.53	119.45	8.31	118.66
	Reach1	1245	38.23	120.63	29.25	120.59	22.64	120.14	16.53	119.45	8.31	118.66
	Reach1	1243	Rail Raod Mile "21.69"									
	Reach1	1240	38.23	118.84	29.25	118.60	22.64	118.40	16.53	118.16	8.31	117.81
	Reach1	1235	38.23	118.72	29.25	118.48	22.64	118.28	16.53	118.04	8.31	117.72
	Reach1	1230	38.23	117.93	29.25	117.95	22.64	117.82	16.53	117.64	8.31	117.39
	Reach1	1225	38.23	117.14	29.25	116.81	22.64	116.78	16.53	116.68	8.31	116.56
	Reach1	1220	38.23	117.06	29.25	116.49	22.64	116.04	16.53	115.66	8.31	115.37
	Reach1	1215	38.23	117.06	29.25	116.47	22.64	116.00	16.53	115.54	8.31	115.04
	Reach1	1210	38.23	117.05	29.25	116.46	22.64	115.99	16.53	115.51	8.31	114.51
	Reach1	1205	38.23	117.05	29.25	116.47	22.64	116.00	16.53	115.52	8.31	114.78
	Reach1	1203	Dwyer Hill Road									
	Reach1	1200	38.23	114.94	29.25	114.71	22.64	114.56	16.53	114.51	8.31	114.31
	Reach1	1195	54.03	114.62	40.39	114.52	30.59	114.43	21.76	114.34	10.14	114.14
	Reach1	1190	54.03	114.22	40.39	114.16	30.59	114.10	21.76	114.04	10.14	113.90
	Reach1	1185	54.03	112.92	40.39	112.84	30.59	112.79	21.76	112.74	10.14	112.64
	Reach1	1180	54.03	112.42	40.39	112.38	30.59	112.34	21.76	112.28	10.14	112.18
	Reach1	1175	54.03	111.57	40.39	111.48	30.59	111.44	21.76	111.41	10.14	111.36
	Reach1	1170	54.03	111.28	40.39	111.18	30.59	111.08	21.76	110.98	10.14	110.84
	Reach1	1165	54.03	111.16	40.39	111.05	30.59	110.94	21.76	110.81	10.14	110.58
	Reach1	1160	54.03	110.19	40.39	110.15	30.59	110.18	21.76	110.19	10.14	110.19
	Reach1	1155	54.03	110.23	40.39	110.21	30.59	110.20	21.76	110.20	10.14	110.19
	Reach1	1153	O'Neil Road									
	Reach1	1150	54.03	110.19	40.39	110.19	30.59	110.19	21.76	110.19	10.14	109.82
	Reach1	1145	54.03	109.87	40.39	109.78	30.59	109.69	21.76	109.60	10.14	109.44
	Reach1	1140	54.03	109.57	40.39	109.49	30.59	109.41	21.76	109.33	10.14	109.20
	Reach1	1135	54.03	108.75	40.39	108.70	30.59	108.66	21.76	108.62	10.14	108.55
	Reach1	1130	54.03	107.11	40.39	107.01	30.59	106.93	21.76	106.85	10.14	106.71
	Reach1	1125	54.03	105.49	40.39	105.48	30.59	105.47	21.76	105.45	10.14	105.39
	Reach1	1120	54.03	104.03	40.39	103.97	30.59	103.91	21.76	103.85	10.14	103.74
	Reach1	1115	54.03	103.96	40.39	103.89	30.59	103.84	21.76	103.77	10.14	103.66
	Reach1	1110	54.03	103.94	40.39	103.87	30.59	103.82	21.76	103.76	10.14	103.65
	Reach1	1105	54.03	103.90	40.39	103.84	30.59	103.79	21.76	103.73	10.14	103.63
	Reach1	1100	54.03	103.81	40.39	103.76	30.59	103.71	21.76	103.66	10.14	103.57
	Reach1	1095	54.03	103.70	40.39	103.66	30.59	103.62	21.76	103.58	10.14	103.48
	Reach1	1090	54.03	103.27	40.39	103.16	30.59	103.10	21.76	103.04	10.14	102.98
	Reach1	1085	54.03	102.60	40.39	102.66	30.59	102.61	21.76	102.54	10.14	102.32

River	Reach	Xsec ID	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events									
			Q50	WL50	Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Reach1	1080	54.03	101.65	40.39	101.33	30.59	101.25	21.76	101.20	10.14	101.26	
	1075	54.03	101.64	40.39	101.33	30.59	101.14	21.76	100.99	10.14	100.53	
	1070	54.03	101.55	40.39	101.25	30.59	101.07	21.76	100.94	10.14	100.15	
	1068	Rail Road Mile "17.95"										
	1065	54.03	101.06	40.39	100.99	30.59	100.93	21.76	100.86	10.14	100.12	
	1060	54.03	101.14	40.39	101.03	30.59	100.95	21.76	100.86	10.14	100.11	
	1058	Kettles Road										
	1055	54.03	100.32	40.39	100.29	30.59	100.24	21.76	100.15	10.14	99.77	
	1050	54.03	100.39	40.39	100.29	30.59	100.21	22.06	100.10	10.31	99.74	
	1045	54.03	99.61	40.39	99.57	30.59	99.53	22.06	99.48	10.31	99.36	
	1040	54.03	99.04	40.39	98.99	30.59	98.95	22.06	98.91	10.31	98.83	
	1035	54.03	98.79	40.39	98.73	30.59	98.68	22.06	98.63	10.31	98.55	
	1030	54.03	98.72	40.39	98.66	30.59	98.60	22.06	98.55	10.31	98.47	
	1025	54.03	98.63	40.39	98.56	30.59	98.51	22.06	98.45	10.31	98.36	
	1020	54.03	98.47	40.39	98.42	30.59	98.38	22.06	98.35	10.31	98.32	
	1015	54.03	98.37	40.39	98.35	30.59	98.33	22.06	98.32	10.31	98.31	
	1010	54.03	98.34	40.39	98.33	30.59	98.32	22.06	98.32	10.31	98.31	
	1005	54.03	98.32	40.39	98.32	30.59	98.31	22.06	98.31	10.31	98.31	
	1000	54.03	98.31	40.39	98.31	30.59	98.31	22.06	98.31	10.31	98.31	

Appendix A

Buildings and Islands in Floodplain – RVCA Policy

Ferdous Ahmed

From: Ewan Hardie
Sent: Wednesday, June 29, 2016 10:35 AM
To: Ferdous Ahmed
Subject: Buildings in the Floodplain Guidelines

Hi Ferdous,

As discussed at recent meetings please consider the following guidelines when undertaking floodplain mapping projects

Effective June 13th 2016, when plotting floodlines RVCA staff will use the following guidelines in order to apply a conservative approach to the delineation of the regulatory floodplain, specifically in areas that have buildings that are in the floodplain or affected by the floodplain:

1. Include any buildings in the floodplain that have any part of the footprint touching the floodplain. This is done to be conservative based on the lack of knowledge on the conditions around the buildings: soil conditions, window wells, walk out doors, building egress are all not known at the time of a floodplain mapping study so it is wise to adopt a conservative approach and include building footprints in the floodplain.
2. With regards to dry islands in and around buildings, islands will be removed if they did not meet the minimum mapping unit acceptable for the data. An envelope of 2 metres around building footprints is to be considered. If the floodplain comes close to or is in this 2m building envelope the entire envelope should be included in the floodplain. This approach is also consistent with the above approach (building footprints) in that the lack of knowledge of the conditions around the building forces the uses of a conservative approach, which is to remove the islands
3. In cases where a building has been included in the floodplain (because of the above criteria), the adjacent building will need to be included in the floodplain as well because of a lack of data in between the buildings and/or the 2m building envelope rule.
4. In the case of townhome or connected type buildings and the floodplain touching the foundations, the building footprint should be included up to the next visible unit partition where the elevation changes

Thanks

Ewan Hardie

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Watershed Science and Engineering Services
Rideau Valley Conservation Authority
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www.rvca.ca



Ferdous Ahmed

From: Ewan Hardie
Sent: Thursday, July 6, 2017 5:12 PM
To: Ferdous Ahmed
Cc: Brian Stratton
Subject: Floodplain delineation guidance

Good Afternoon Ferdous,

As discussed here is the documentation of the guidance that was given to RVCA staff when it comes to plotting floodlines using LiDAR data for this most recent project.

Guidance:

When delineating the regulatory flood water levels, RVCA staff will follow a precautionary principle to include island areas in the floodplain that are up to 1000 square metres.

Ewan Hardie

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Watershed Science and Engineering Services
Rideau Valley Conservation Authority
ewan.hardie@rvca.ca
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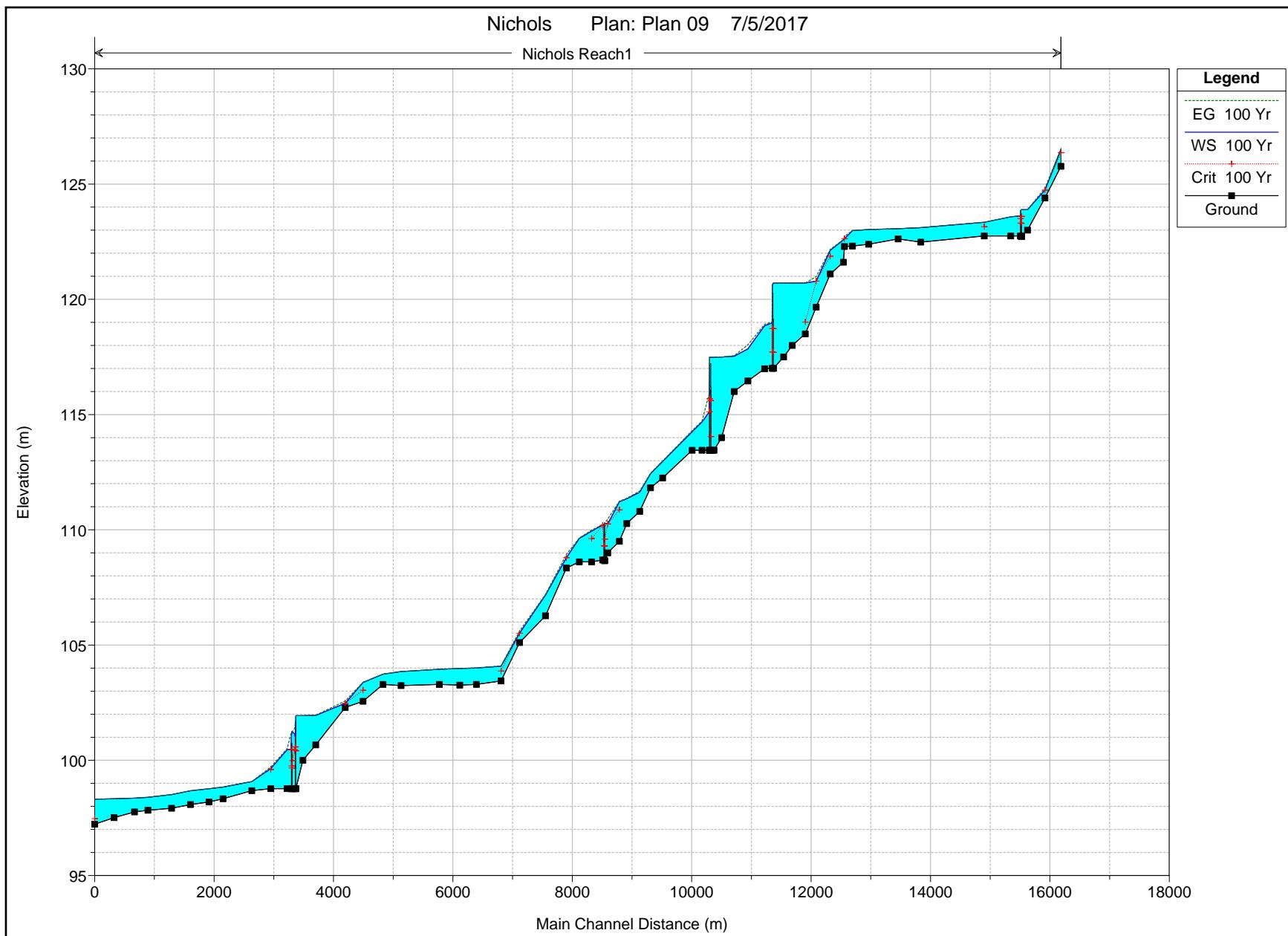


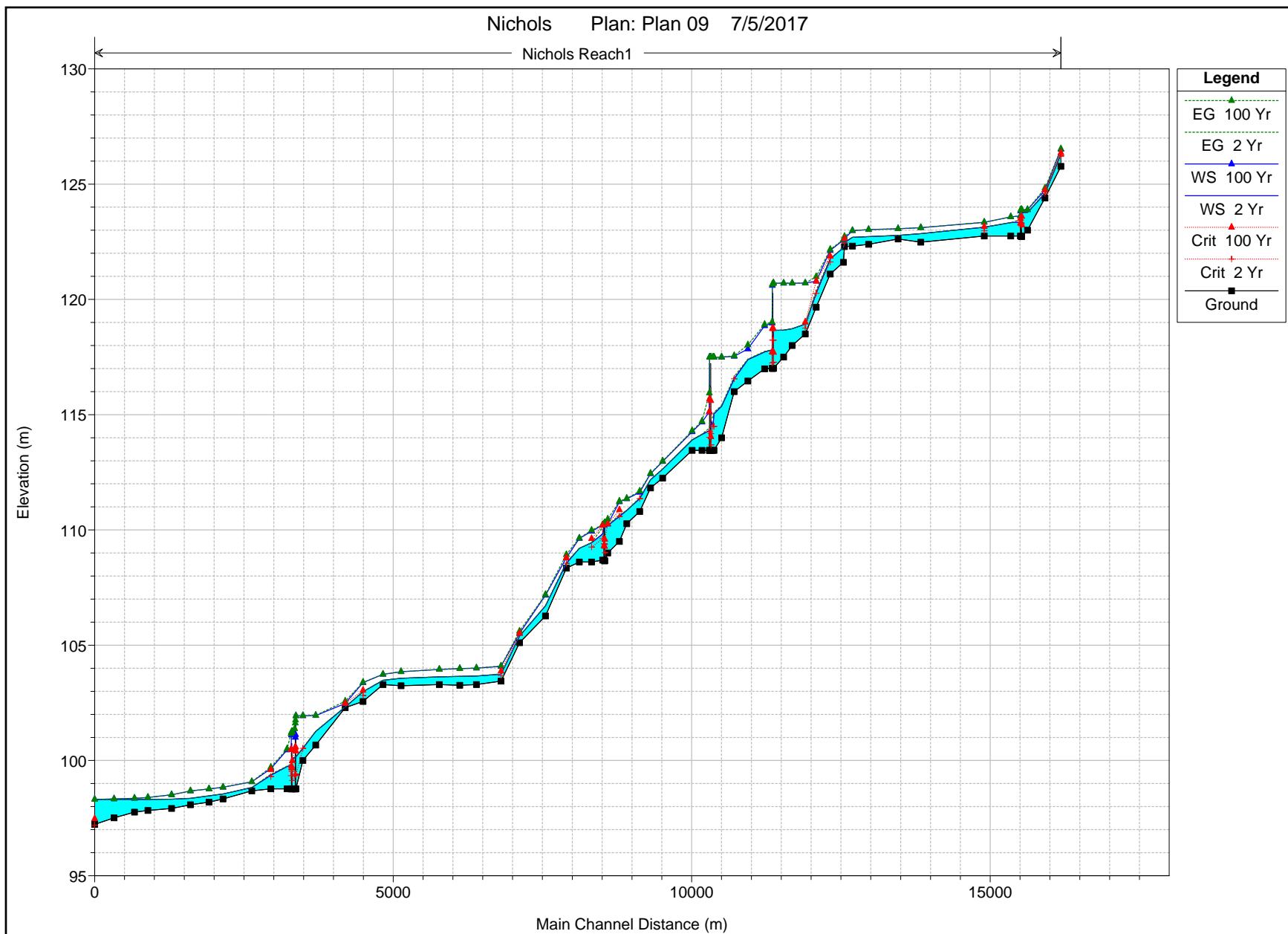
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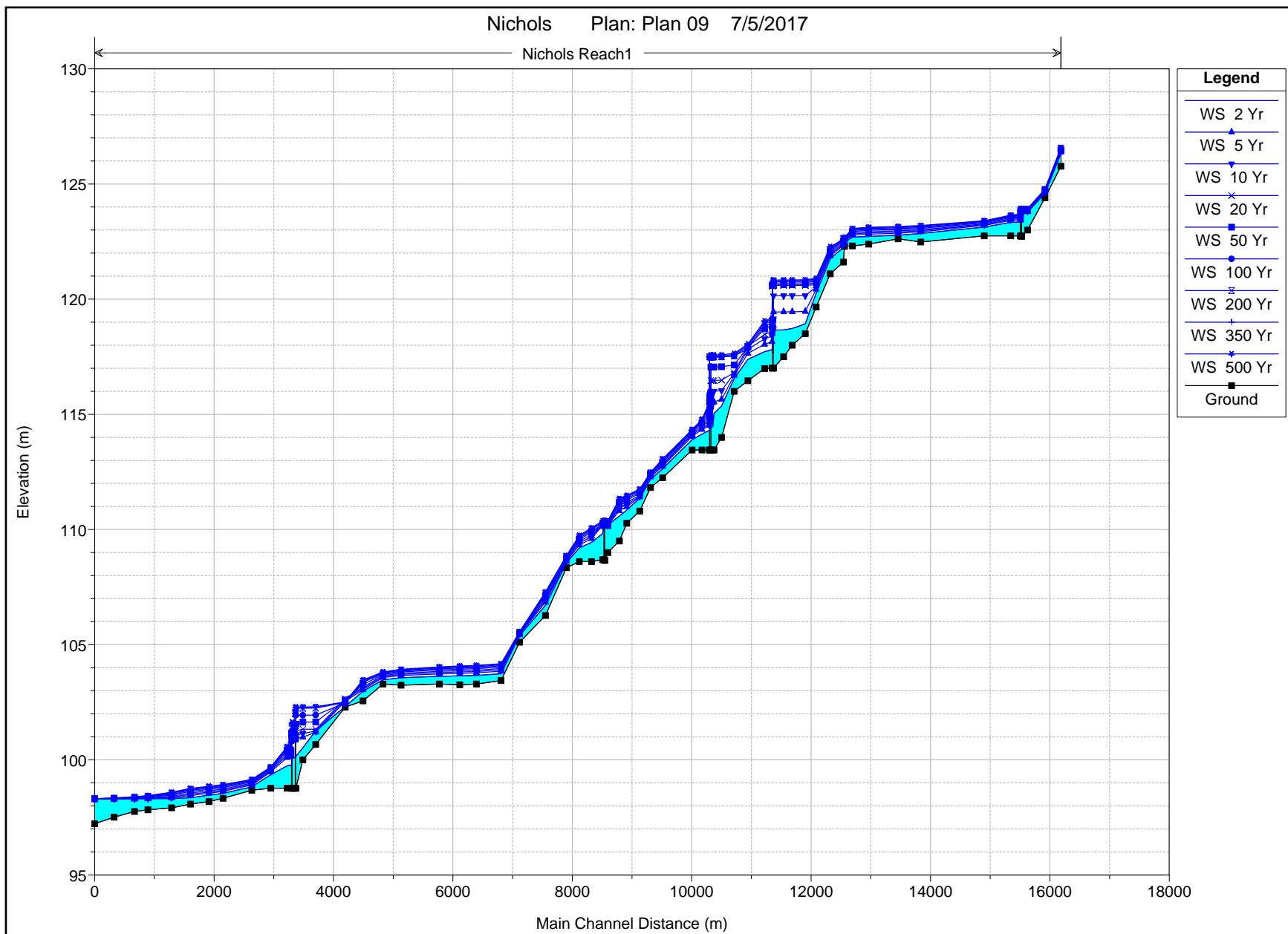
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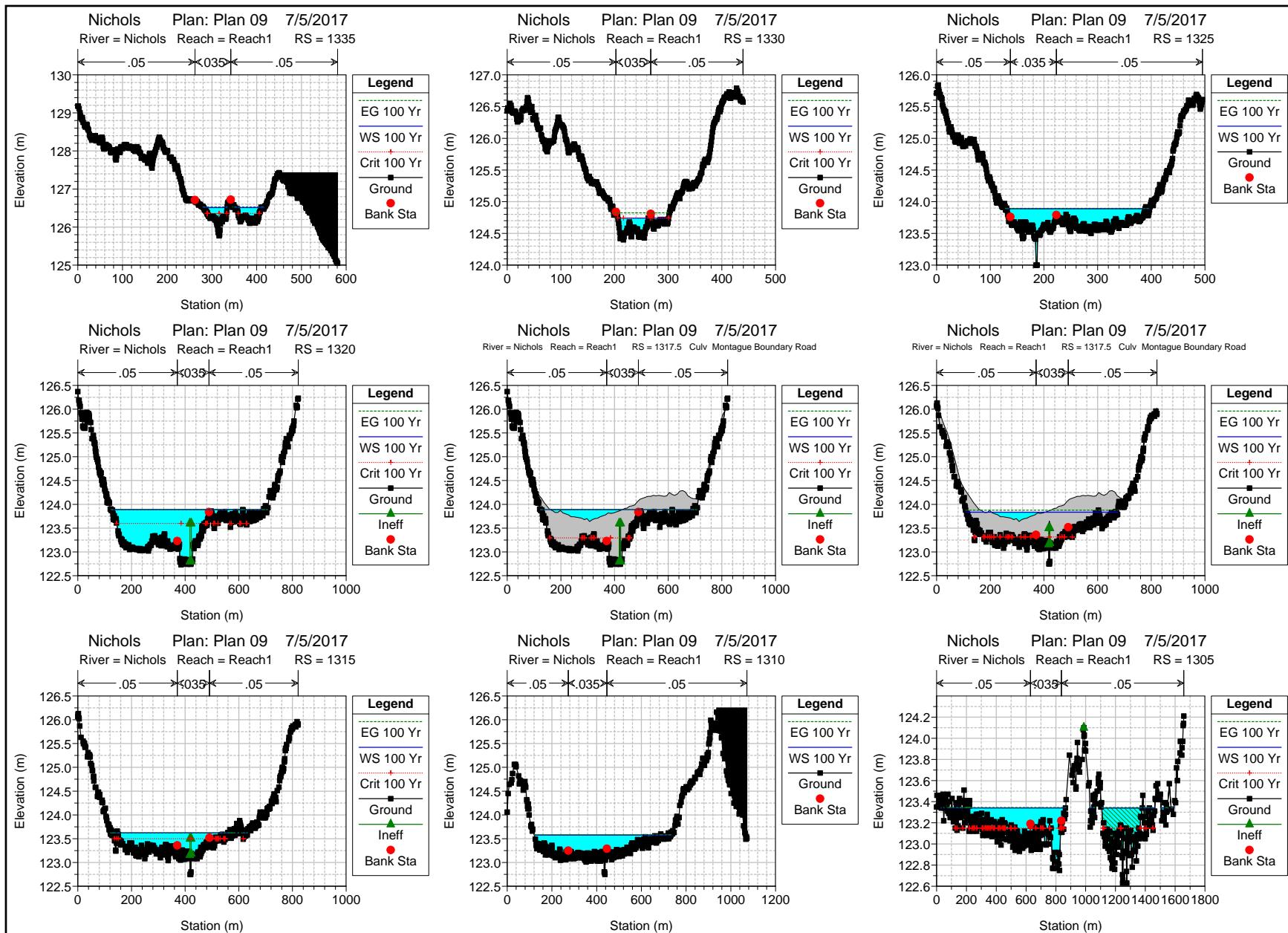
Appendix B

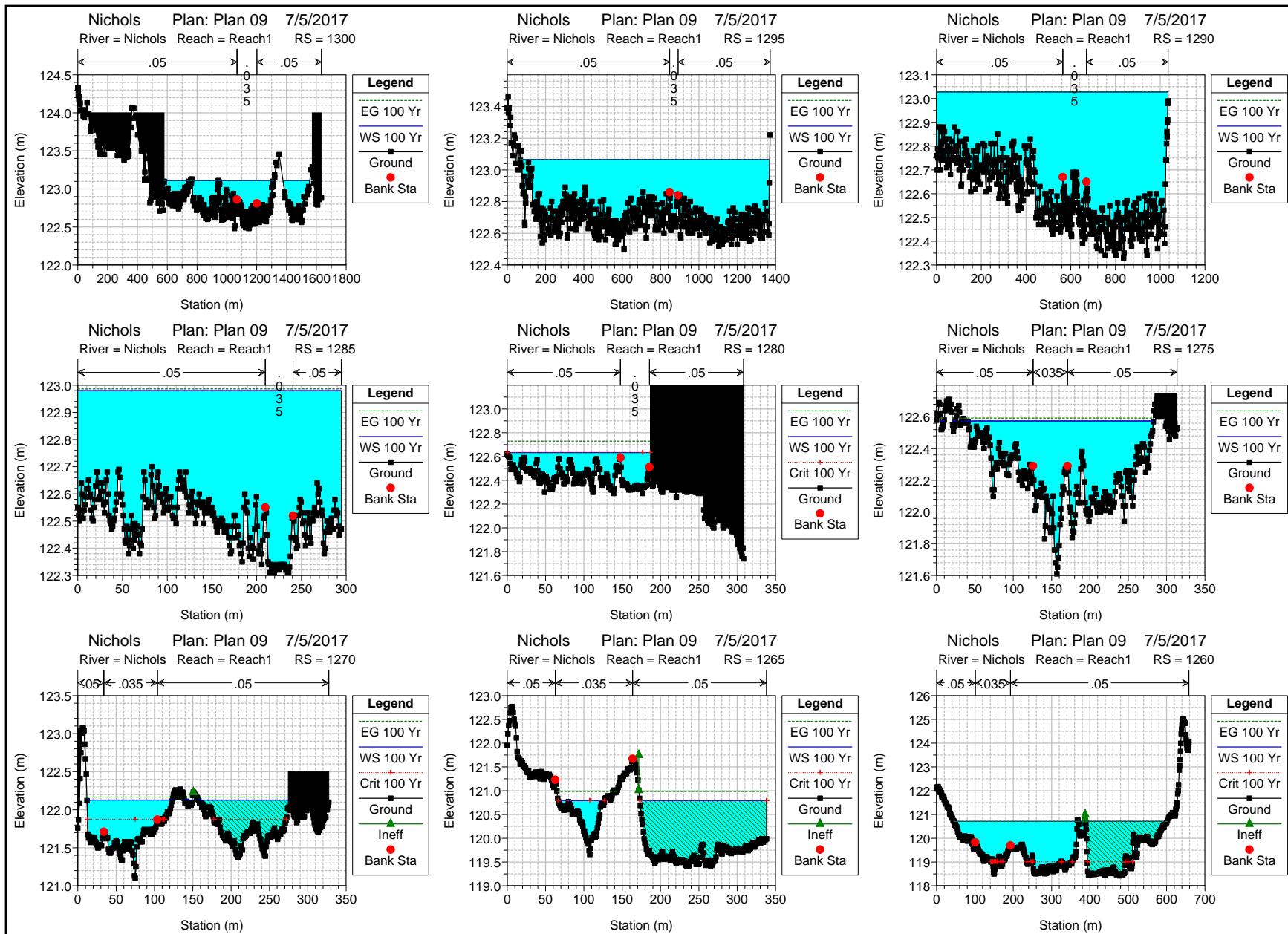
HEC-RAS Profiles and Cross-Sections

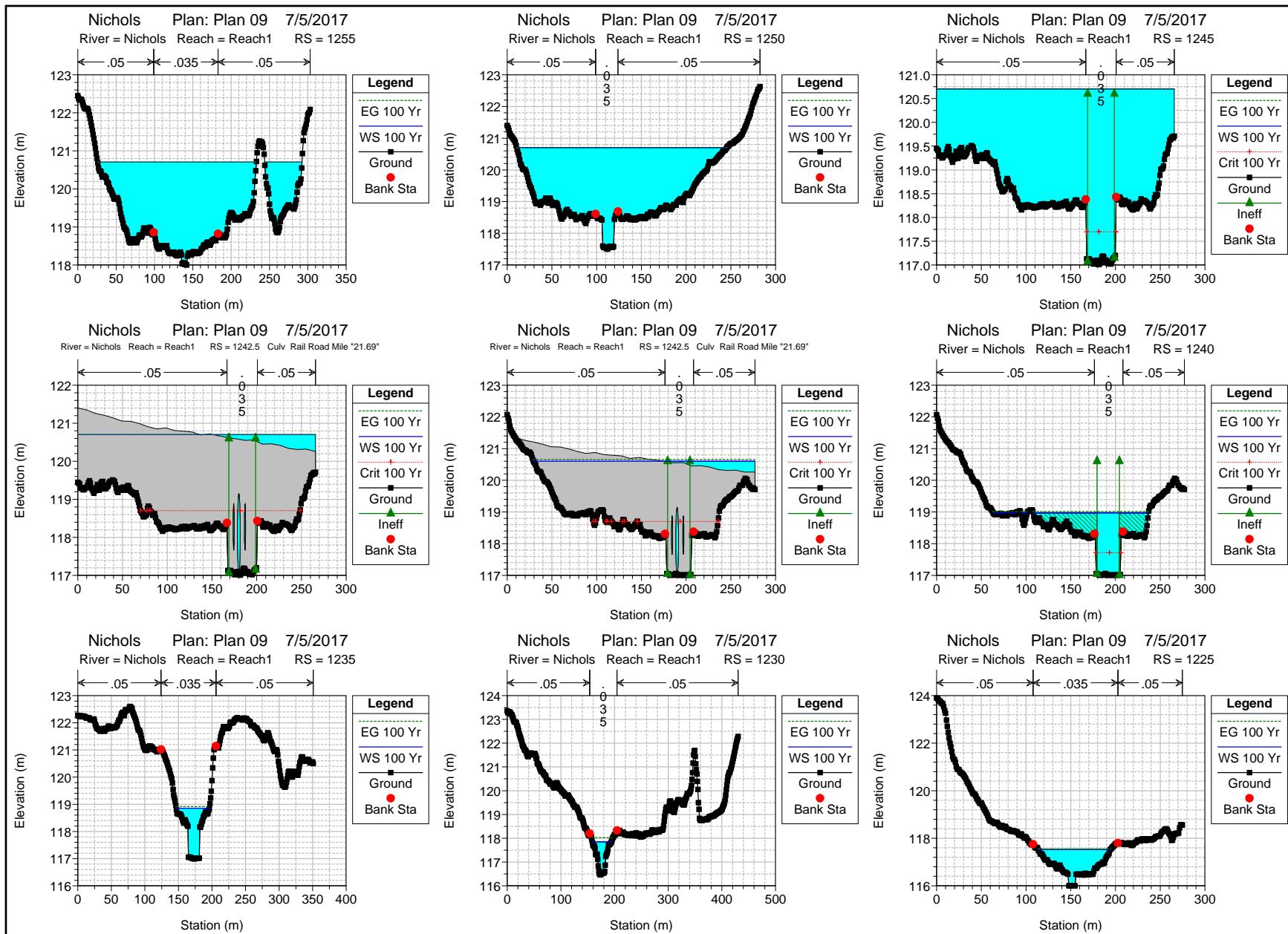


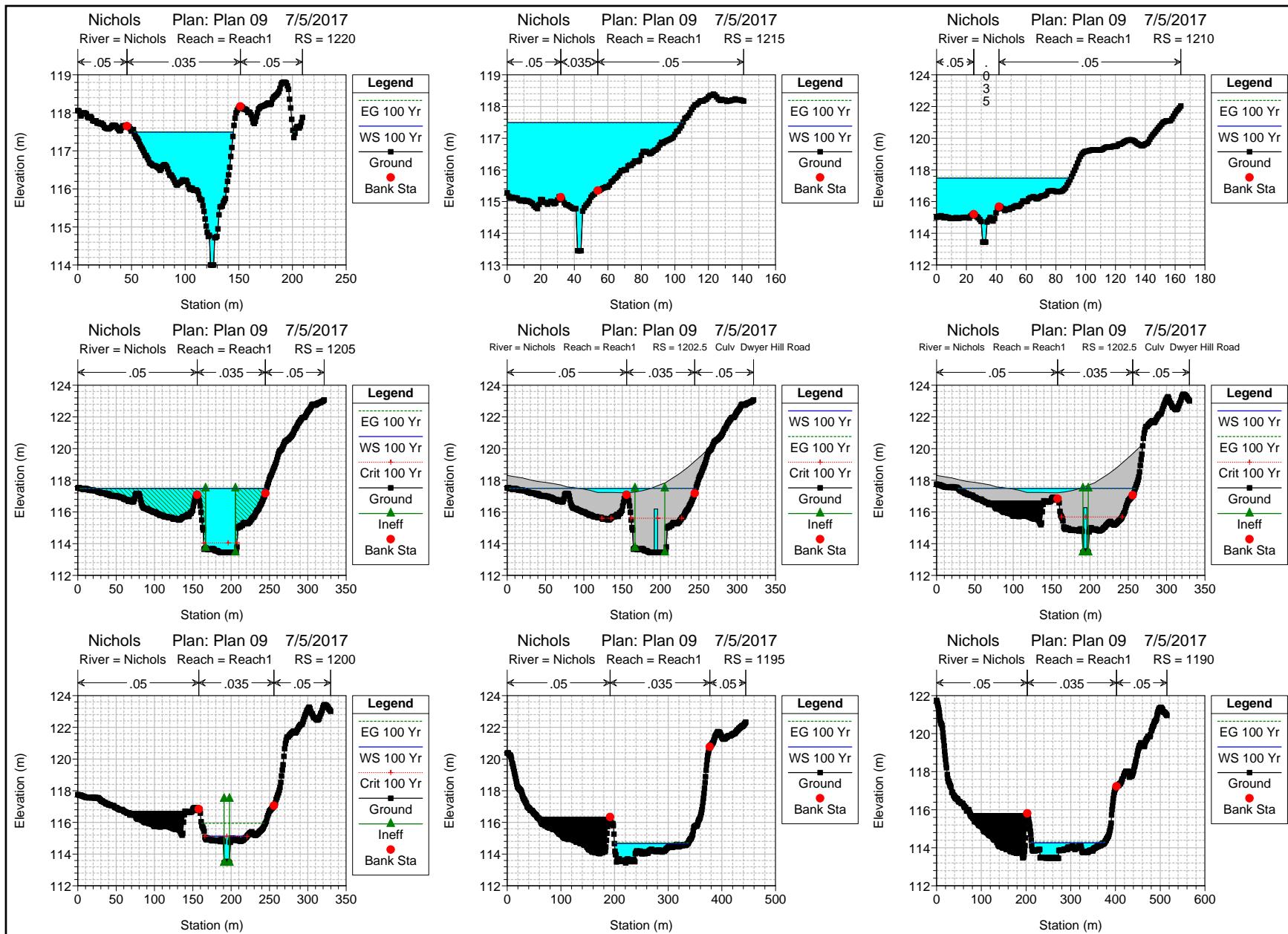


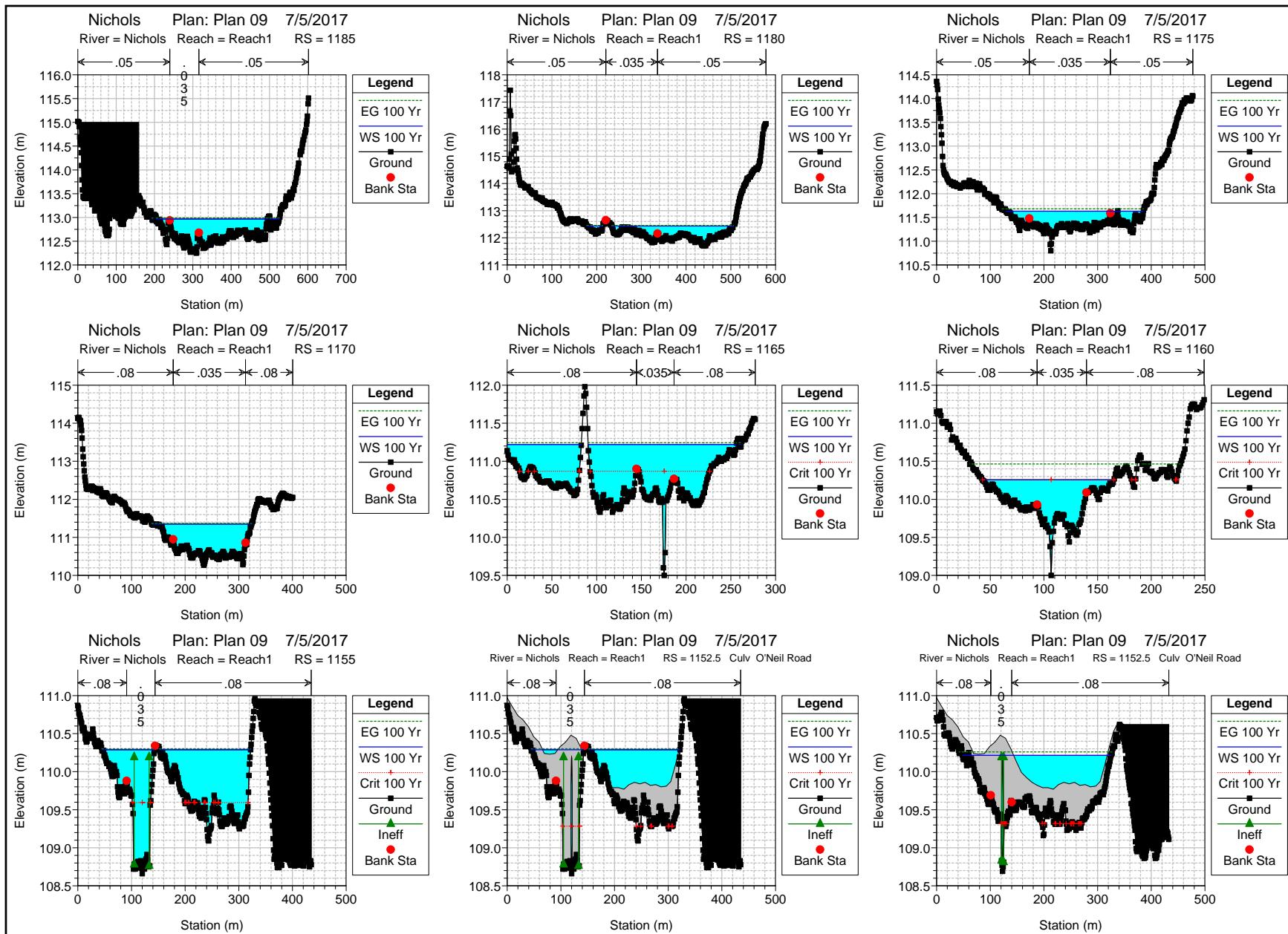


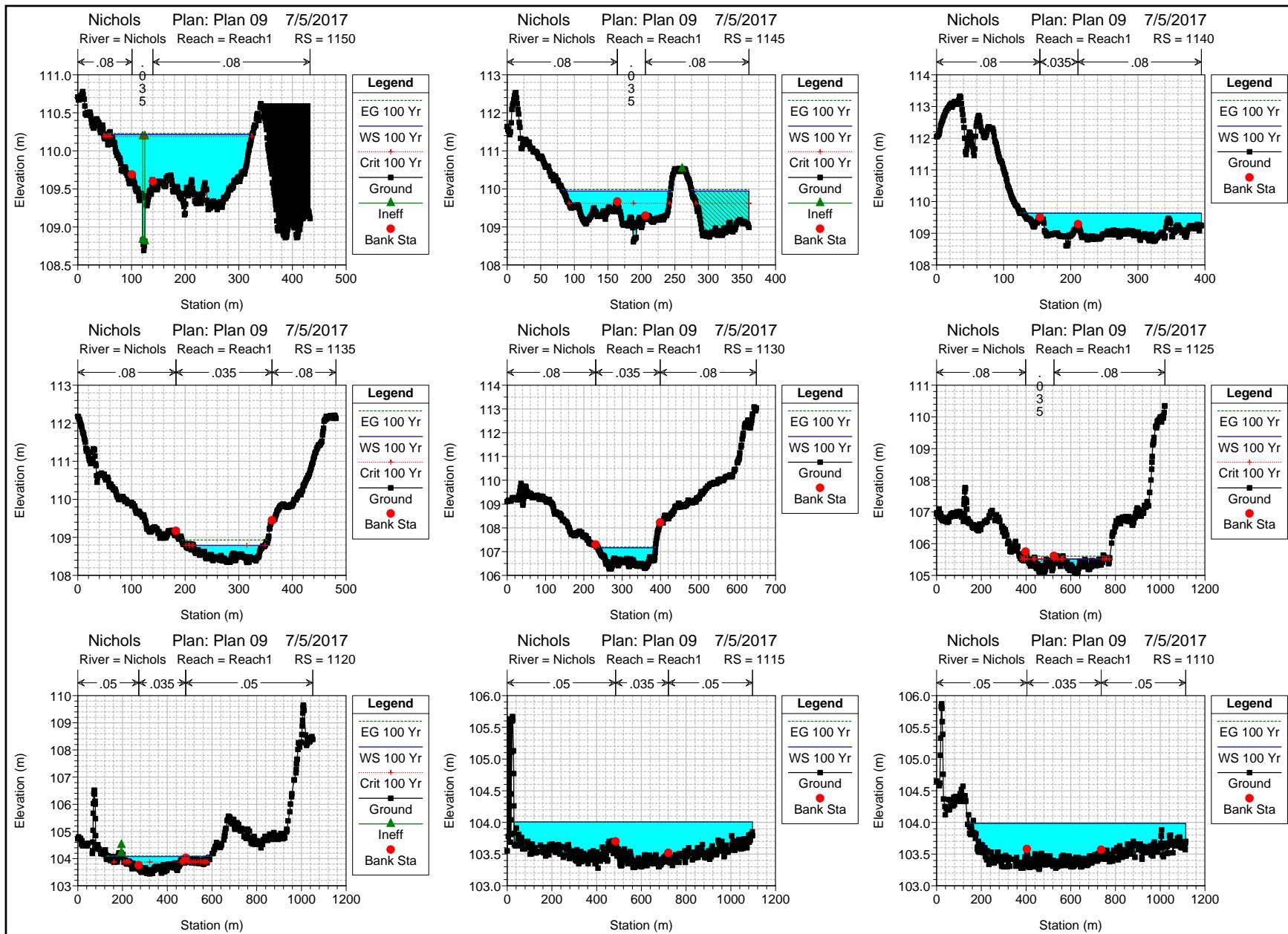


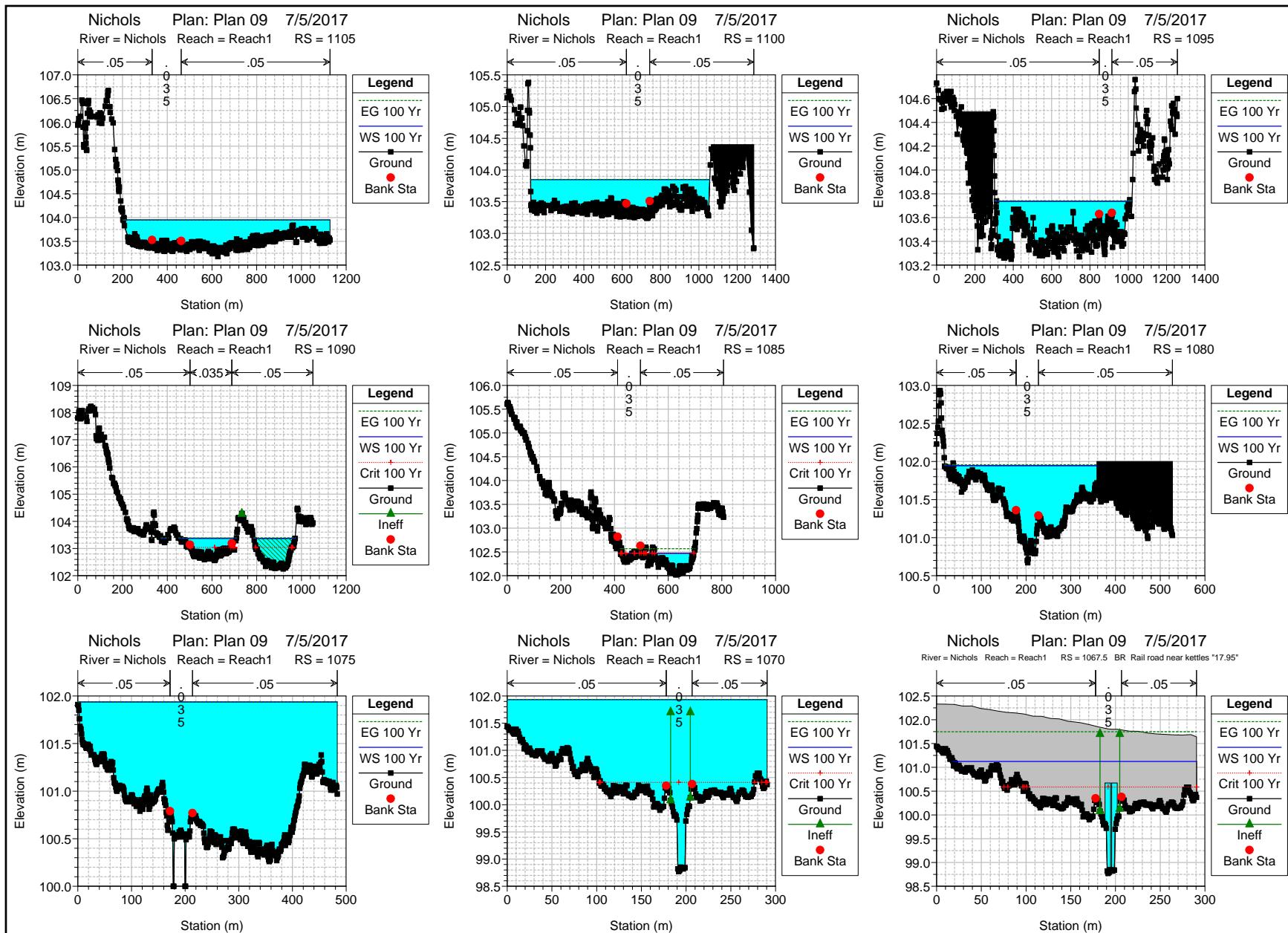


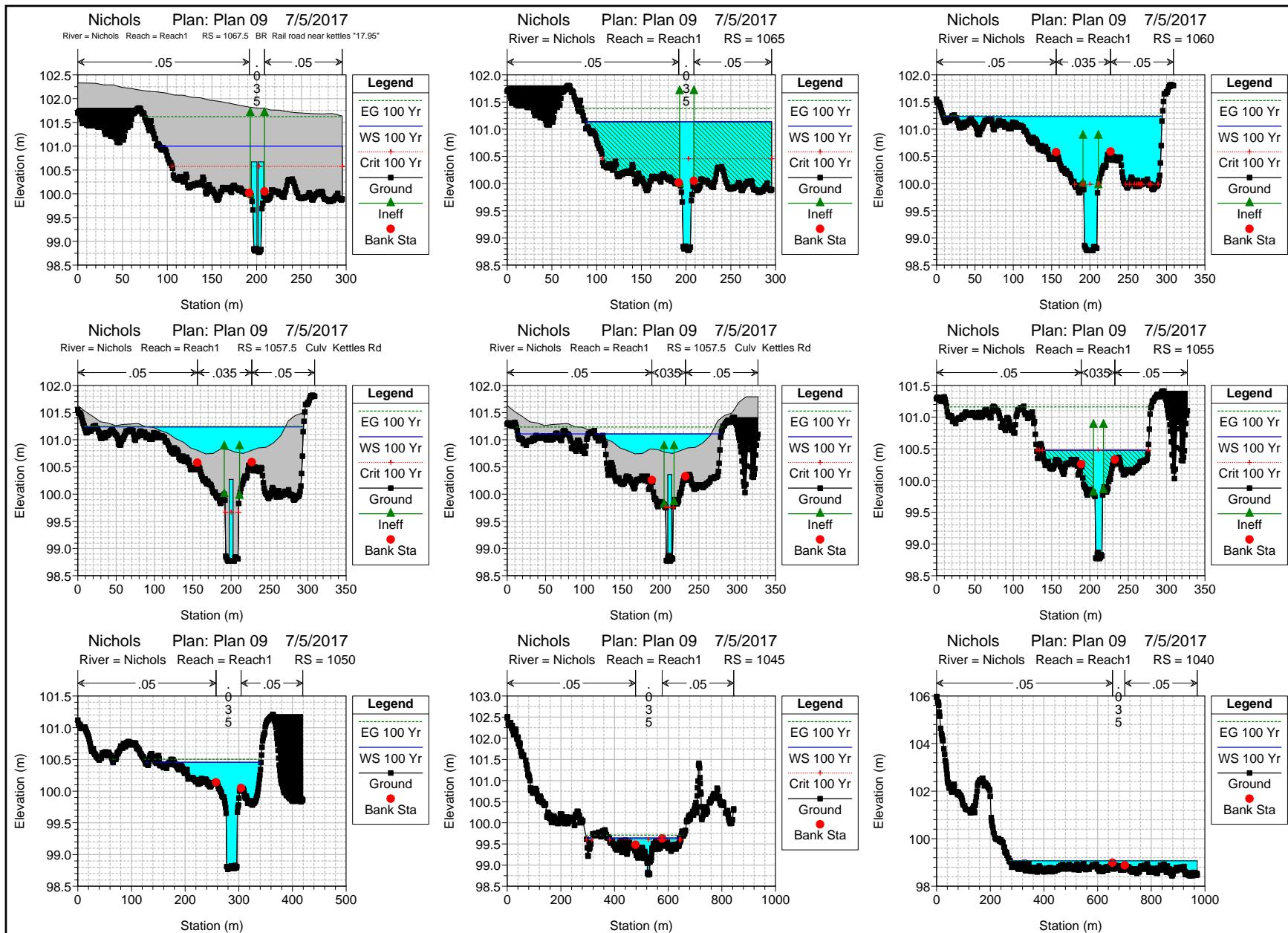












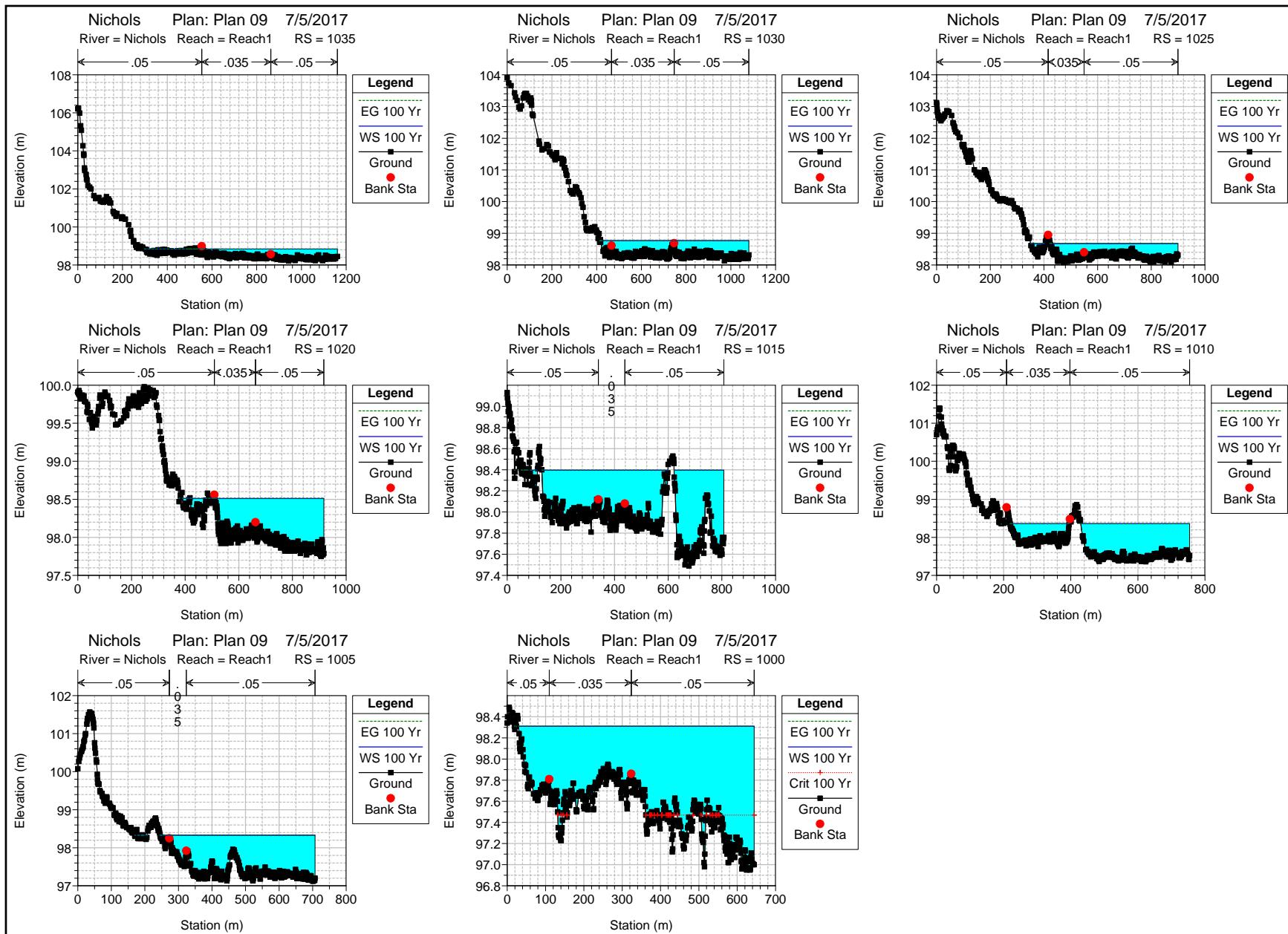


Table B1 Manning n values

River	Reach	Xsec ID	Left Overbank n	Channel n	Right Overbank n
Nichols Creek	Reach1	1335	0.05	0.035	0.05
	Reach1	1330	0.05	0.035	0.05
	Reach1	1325	0.05	0.035	0.05
	Reach1	1320	0.05	0.035	0.05
	Reach1	1318	Montague Boundary Road		
	Reach1	1315	0.05	0.035	0.05
	Reach1	1310	0.05	0.035	0.05
	Reach1	1305	0.05	0.035	0.05
	Reach1	1300	0.05	0.035	0.05
	Reach1	1295	0.05	0.035	0.05
	Reach1	1290	0.05	0.035	0.05
	Reach1	1285	0.05	0.035	0.05
	Reach1	1280	0.05	0.035	0.05
	Reach1	1275	0.05	0.035	0.05
	Reach1	1270	0.05	0.035	0.05
	Reach1	1265	0.05	0.035	0.05
	Reach1	1260	0.05	0.035	0.05
	Reach1	1255	0.05	0.035	0.05
	Reach1	1250	0.05	0.035	0.05
	Reach1	1245	0.05	0.035	0.05
	Reach1	1243	Rail Raod Mile "21.69"		
	Reach1	1240	0.05	0.035	0.05
	Reach1	1235	0.05	0.035	0.05
	Reach1	1230	0.05	0.035	0.05
	Reach1	1225	0.05	0.035	0.05
	Reach1	1220	0.05	0.035	0.05
	Reach1	1215	0.05	0.035	0.05
	Reach1	1210	0.05	0.035	0.05
	Reach1	1205	0.05	0.035	0.05
	Reach1	1203	Dwyer Hill Road		
	Reach1	1200	0.05	0.035	0.05
	Reach1	1195	0.05	0.035	0.05
	Reach1	1190	0.05	0.035	0.05
	Reach1	1185	0.05	0.035	0.05
	Reach1	1180	0.05	0.035	0.05
	Reach1	1175	0.05	0.035	0.05
	Reach1	1170	0.08	0.035	0.08
	Reach1	1165	0.08	0.035	0.08
	Reach1	1160	0.08	0.035	0.08
	Reach1	1155	0.08	0.035	0.08
	Reach1	1153	O'Neil Road		
	Reach1	1150	0.08	0.035	0.08
	Reach1	1145	0.08	0.035	0.08
	Reach1	1140	0.08	0.035	0.08
	Reach1	1135	0.08	0.035	0.08
	Reach1	1130	0.08	0.035	0.08

River	Reach	Xsec ID	Left Overbank n	Channel n	Right Overbank n
	Reach1	1125	0.08	0.035	0.08
	Reach1	1120	0.05	0.035	0.05
	Reach1	1115	0.05	0.035	0.05
	Reach1	1110	0.05	0.035	0.05
	Reach1	1105	0.05	0.035	0.05
	Reach1	1100	0.05	0.035	0.05
	Reach1	1095	0.05	0.035	0.05
	Reach1	1090	0.05	0.035	0.05
	Reach1	1085	0.05	0.035	0.05
	Reach1	1080	0.05	0.035	0.05
	Reach1	1075	0.05	0.035	0.05
	Reach1	1070	0.05	0.035	0.05
	Reach1	1068	Rail Road Mile "17.95"		
	Reach1	1065	0.05	0.035	0.05
	Reach1	1060	0.05	0.035	0.05
	Reach1	1058	Kettles Road		
	Reach1	1055	0.05	0.035	0.05
	Reach1	1050	0.05	0.035	0.05
	Reach1	1045	0.05	0.035	0.05
	Reach1	1040	0.05	0.035	0.05
	Reach1	1035	0.05	0.035	0.05
	Reach1	1030	0.05	0.035	0.05
	Reach1	1025	0.05	0.035	0.05
	Reach1	1020	0.05	0.035	0.05
	Reach1	1015	0.05	0.035	0.05
	Reach1	1010	0.05	0.035	0.05
	Reach1	1005	0.05	0.035	0.05
	Reach1	1000	0.05	0.035	0.05

Appendix C

Field Verification of LIDAR Data

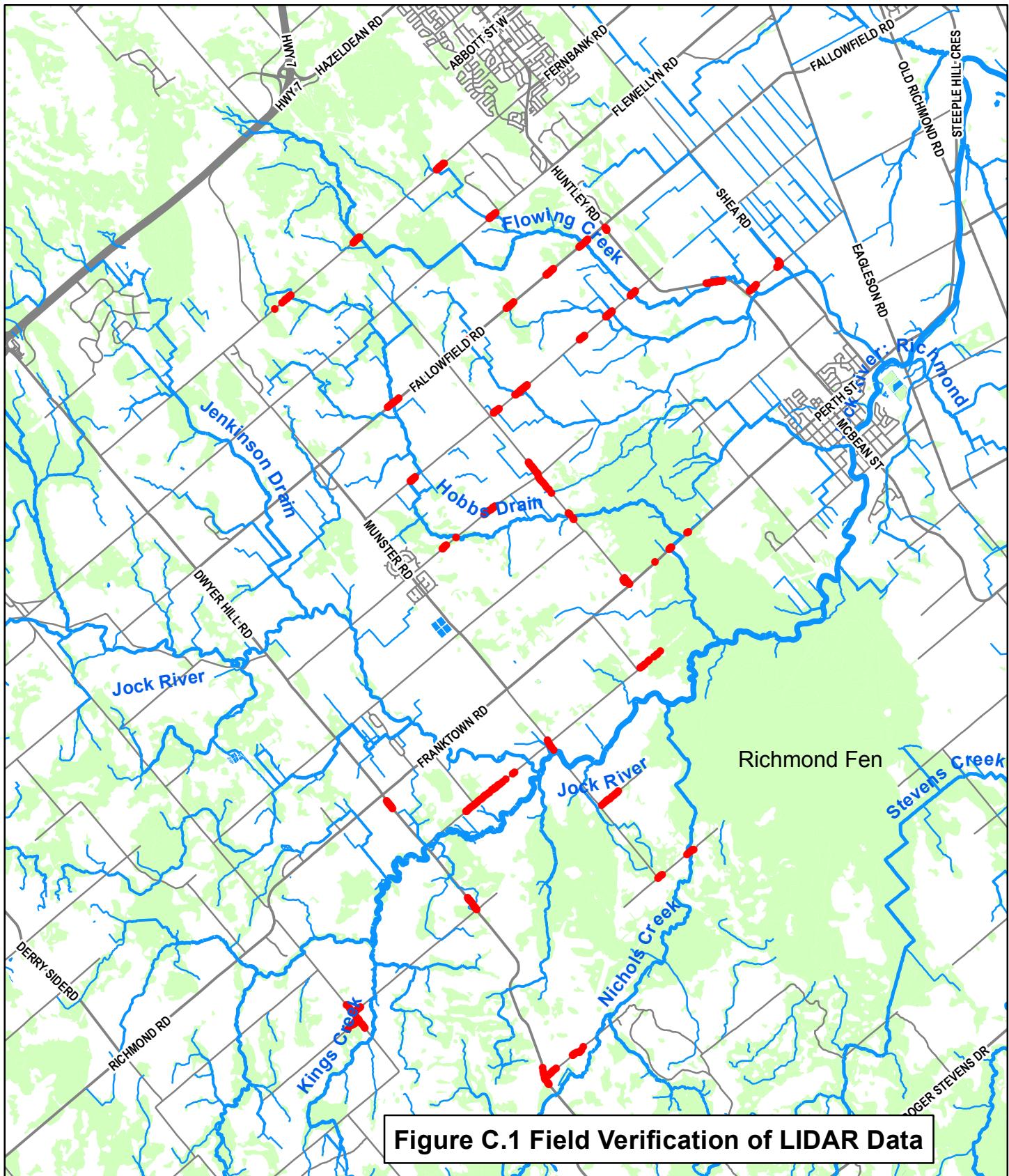


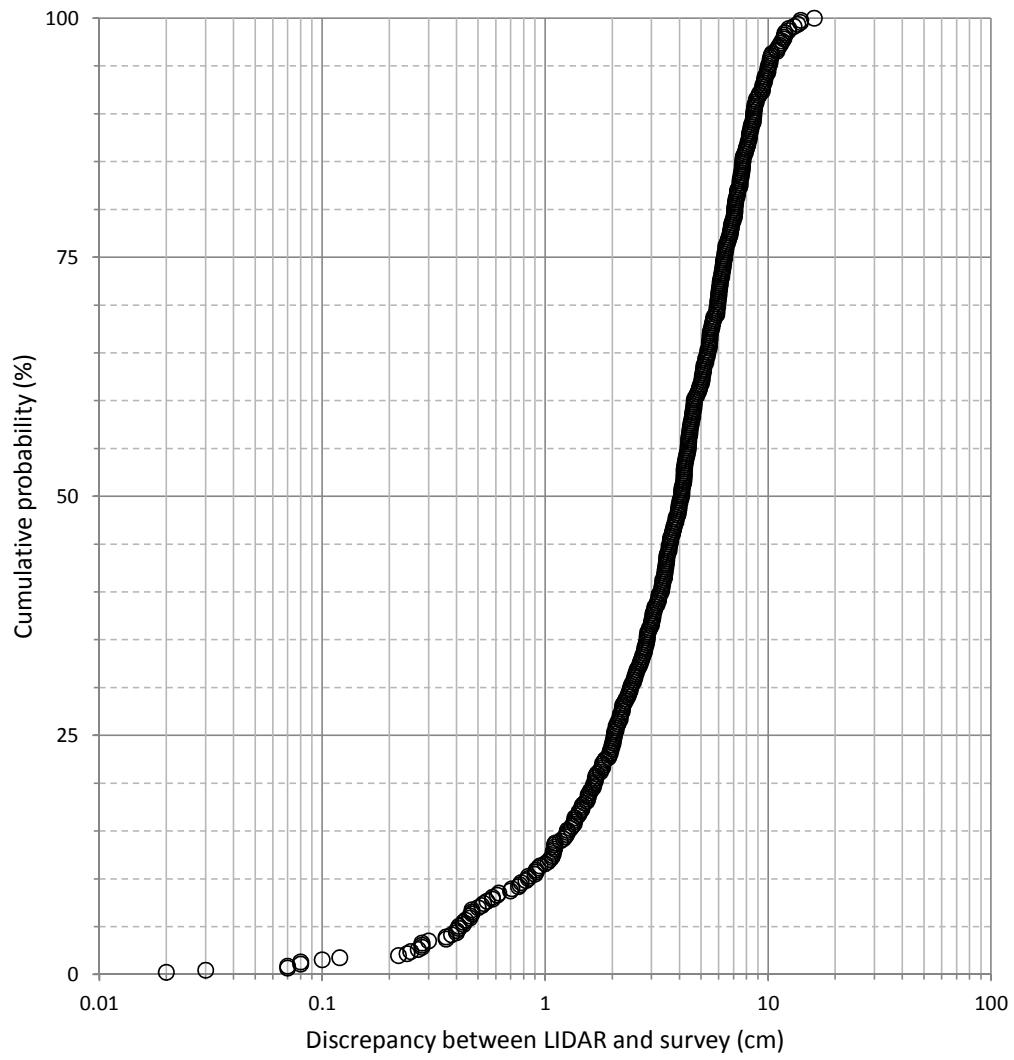
Figure C.1 Field Verification of LIDAR Data



Map Scale: 1:100,000 Date Modified: 4/20/2016

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Figure C.2 Field Verification of LIDAR Data
(Flowing, Hobbs, Kings and Nichols Basins)



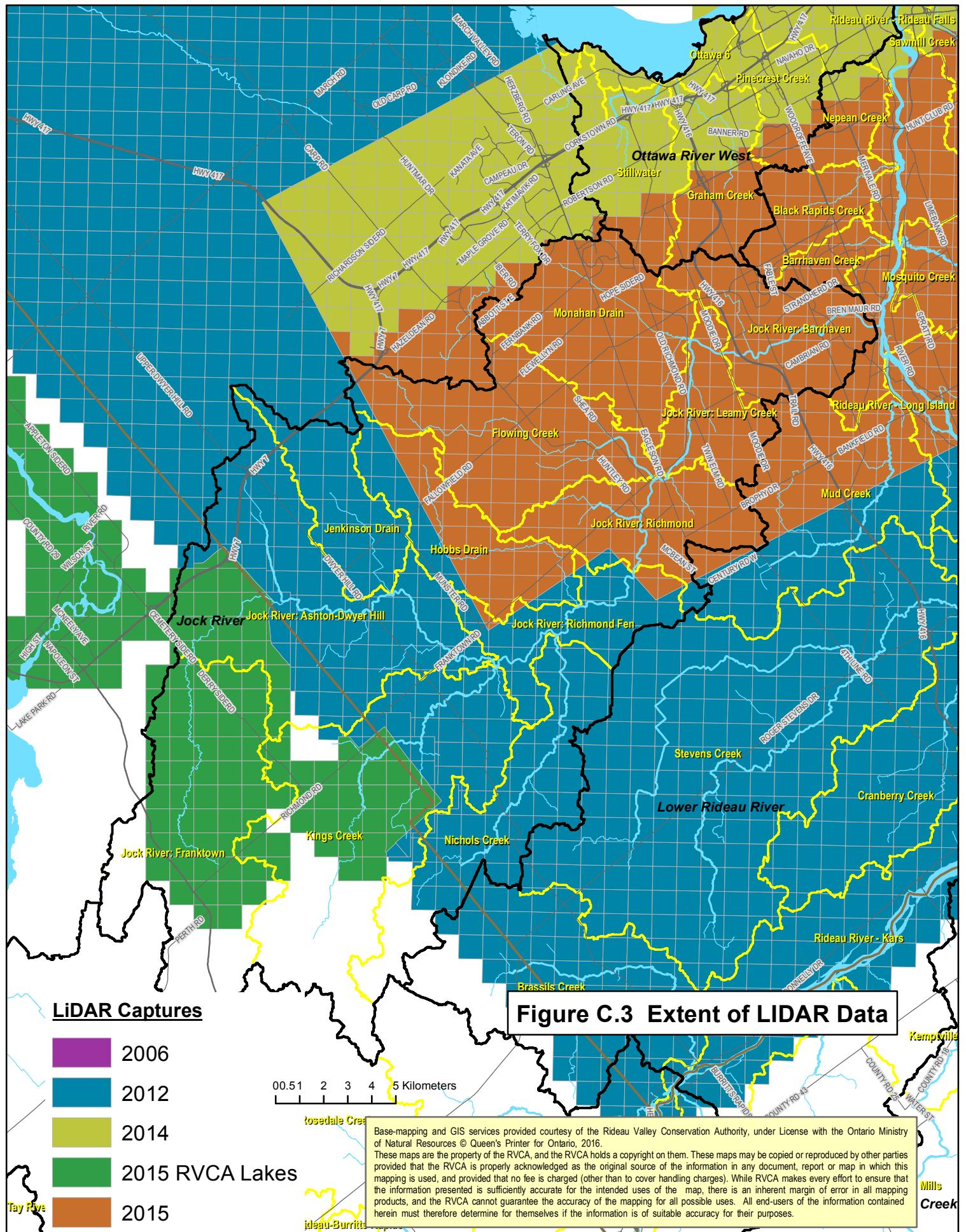


Table C.1 Field verification of LIDAR data (spot heights)

Location ID	RVCA Field Survey (August 28, 29 and Seprember 3, 2014)							Nearest Lidar Point			
	X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Veritcal Accuracy (m)	Date/Time	Field Observations		Δz (m)	Δz (cm)	Δz > 0.33m
gra rd 1	4993233.286	425168.503	121.51	0.008	0.012	8/28/2014 9:28	road centre line	121.625	0.118	11.8	
gra rd 2	4993224.945	425159.245	121.42	0.009	0.013	8/28/2014 9:29	road centre line	121.576	0.161	16.1	
gra rd 3	4993216.678	425149.373	121.50	0.009	0.013	8/28/2014 9:30	road centre line	121.578	0.080	8.0	
gra rd 4	4993208.592	425139.579	121.62	0.008	0.014	8/28/2014 9:30	road centre line	121.573	-0.044	4.4	
gra rd 5	4993197.902	425126.930	121.77	0.011	0.018	8/28/2014 9:31	road centre line	121.729	-0.044	4.4	
gra rd 6	4993186.914	425114.147	121.92	0.012	0.019	8/28/2014 9:31	road centre line	121.823	-0.096	9.6	
gra rd 7	4993176.040	425101.479	122.07	0.010	0.014	8/28/2014 9:33	road centre line	122.078	0.008	0.8	
gra rd 8	4993161.773	425084.432	122.24	0.015	0.020	8/28/2014 9:41	road centre line	122.209	-0.030	3.0	
gra rd 9	4993148.084	425068.611	122.31	0.014	0.019	8/28/2014 9:42	road centre line	122.304	-0.005	0.5	
gra rd 10	4993132.058	425049.631	122.46	0.013	0.019	8/28/2014 9:44	road centre line	122.369	-0.092	9.2	
gra rd 11	4993062.350	424967.057	123.05	0.014	0.020	8/28/2014 9:46	road centre line	123.126	0.075	7.5	
ash rd 1	4993087.249	425291.836	122.53	0.015	0.020	8/28/2014 9:54	road centre line	122.507	-0.023	2.3	
ash rd 2	4993106.936	425276.573	122.37	0.015	0.020	8/28/2014 9:56	road centre line	122.319	-0.052	5.2	
ash rd 3	4993142.712	425248.156	121.79	0.015	0.020	8/28/2014 9:57	road centre line	121.817	0.025	2.5	
ash rd 4	4993179.081	425219.078	121.63	0.014	0.020	8/28/2014 9:58	road centre line	121.559	-0.068	6.8	
ash rd 5	4993223.491	425184.663	121.53	0.014	0.020	8/28/2014 10:06	road centre line	121.517	-0.013	1.3	
ash rd 6	4993236.194	425174.230	121.62	0.014	0.020	8/28/2014 10:07	road centre line	121.573	-0.042	4.2	
ash rd 7	4993252.583	425161.255	121.67	0.015	0.020	8/28/2014 10:09	road centre line	121.704	0.031	3.1	
ash rd 8	4993296.485	425126.189	121.91	0.015	0.018	8/28/2014 10:15	road centre line	121.835	-0.071	7.1	
ash rd 9	4993366.419	425072.296	123.86	0.014	0.019	8/28/2014 10:18	road centre line	123.787	-0.077	7.7	
ash rd 10	4993402.791	425042.782	124.80	0.014	0.020	8/28/2014 10:20	road centre line	124.700	-0.100	10.0	
ash rd 11	4993449.808	425004.282	124.91	0.014	0.020	8/28/2014 10:21	road centre line	124.776	-0.136	13.6	
ash rd 12	4993520.806	424945.344	125.44	0.014	0.020	8/28/2014 10:24	road centre line	125.295	-0.140	14.0	
purdy 1	4993383.778	425091.227	123.60	0.013	0.018	8/28/2014 10:27	road centre line	123.562	-0.040	4.0	
purdy 2	4993413.515	425126.887	123.52	0.013	0.018	8/28/2014 10:28	road centre line	123.494	-0.028	2.8	
purdy 3	4993438.550	425156.183	123.53	0.013	0.018	8/28/2014 10:29	road centre line	123.461	-0.069	6.9	
purdy 4	4993478.904	425202.929	122.99	0.014	0.018	8/28/2014 10:30	road centre line	122.976	-0.014	1.4	
purdy 5	4993461.696	425183.142	123.35	0.013	0.018	8/28/2014 10:31	road centre line	123.321	-0.029	2.9	
purdy 6	4993449.633	425169.144	123.51	0.013	0.017	8/28/2014 10:31	road centre line	123.467	-0.044	4.4	
mont 1	4989479.637	426616.853	126.54	0.009	0.011	8/28/2014 10:51	road centre line	126.460	-0.082	8.2	
mont 2	4989466.703	426627.746	126.05	0.013	0.017	8/28/2014 10:51	road centre line	126.000	-0.053	5.3	
mont 3	4989453.525	426638.637	125.62	0.011	0.016	8/28/2014 10:52	road centre line	125.579	-0.038	3.8	
mont 4	4989405.199	426678.298	124.97	0.014	0.020	8/28/2014 10:53	road centre line	124.952	-0.019	1.9	
mont 5	4989391.520	426689.372	124.76	0.014	0.020	8/28/2014 10:54	road centre line	124.739	-0.017	1.7	

mont 6	4989378.270	426700.348	124.55	0.014	0.020	8/28/2014 10:54	road centre line	124.494	-0.060	6.0	
mont 7	4989312.327	426754.214	124.63	0.014	0.020	8/28/2014 10:56	road centre line	124.609	-0.024	2.4	
mont 8	4989298.679	426765.264	124.73	0.014	0.020	8/28/2014 10:57	road centre line	124.699	-0.034	3.4	
mont 9	4989284.414	426776.893	124.74	0.014	0.020	8/28/2014 10:58	road centre line	124.693	-0.045	4.5	
mont 10	4989194.677	426851.413	125.03	0.015	0.020	8/28/2014 11:04	road centre line	124.968	-0.064	6.4	
dwy hill1	4992008.016	428791.032	118.77	0.012	0.020	8/28/2014 11:31	edge of road	118.796	0.022	2.2	
dwy hill2	4992021.944	428781.391	119.02	0.012	0.020	8/28/2014 11:33	edge of road	118.985	-0.036	3.6	
dwy hill3	4992034.617	428771.069	119.27	0.012	0.020	8/28/2014 11:34	edge of road	119.314	0.042	4.2	
dwy hill4	4992048.312	428760.110	119.61	0.011	0.019	8/28/2014 11:35	edge of road	119.655	0.046	4.6	
dwy hill5	4992102.280	428721.502	122.05	0.010	0.017	8/28/2014 11:36	edge of road	122.040	-0.011	1.1	
dwy hill6	4992121.878	428711.226	122.92	0.014	0.020	8/28/2014 11:37	edge of road	122.939	0.017	1.7	
dwy hill7	4992138.083	428704.057	123.48	0.014	0.020	8/28/2014 11:38	edge of road	123.552	0.073	7.3	
dwy hill8	4992211.438	428685.464	124.40	0.014	0.020	8/28/2014 11:40	edge of road	124.406	0.008	0.8	
dwy hill9	4992260.980	428678.327	124.52	0.015	0.019	8/28/2014 11:41	edge of road	124.567	0.050	5.0	
dwy hill10	4992322.272	428670.229	124.80	0.013	0.020	8/28/2014 11:42	edge of road	124.792	-0.003	0.3	
oneil1	4992142.736	428720.506	123.03	0.010	0.014	8/28/2014 11:45	road centre line	123.042	0.012	1.2	
oneil2	4992153.720	428734.939	123.16	0.010	0.014	8/28/2014 11:46	road centre line	123.168	0.011	1.1	
oneil3	4992164.663	428748.833	123.30	0.012	0.018	8/28/2014 11:46	road centre line	123.312	0.015	1.5	
oneil4	4992175.512	428761.868	123.49	0.014	0.018	8/28/2014 11:47	road centre line	123.504	0.011	1.1	
oneil5	4992191.946	428781.488	123.48	0.012	0.018	8/28/2014 11:47	road centre line	123.477	-0.005	0.5	
oneil6	4992211.220	428805.017	123.04	0.015	0.020	8/28/2014 11:48	road centre line	123.057	0.021	2.1	
oneil7	4992238.746	428839.076	122.80	0.014	0.019	8/28/2014 11:49	road centre line	122.797	-0.001	0.1	
oneil8	4992254.969	428858.852	122.52	0.015	0.020	8/28/2014 11:50	road centre line	122.483	-0.036	3.6	
oneil9	4992280.898	428890.892	120.93	0.012	0.016	8/28/2014 11:51	road centre line	120.857	-0.071	7.1	
oneil10	4992304.843	428920.760	118.96	0.012	0.017	8/28/2014 11:51	road centre line	118.896	-0.063	6.3	
oneil11	4992560.709	429237.257	115.33	0.008	0.014	8/28/2014 11:59	road centre line	115.322	-0.004	0.4	
oneil12	4992571.049	429248.010	115.17	0.007	0.011	8/28/2014 12:00	road centre line	115.238	0.067	6.7	
oneil13	4992581.106	429260.438	114.90	0.007	0.011	8/28/2014 12:00	road centre line	114.929	0.032	3.2	
oneil14	4992592.304	429273.656	114.62	0.008	0.013	8/28/2014 12:01	road centre line	114.682	0.060	6.0	
oneil15	4992607.151	429294.360	114.31	0.008	0.013	8/28/2014 12:02	road centre line	114.340	0.030	3.0	
oneil16	4992612.098	429325.023	114.39	0.009	0.015	8/28/2014 12:02	road centre line	114.419	0.032	3.2	
oneil17	4992610.288	429348.359	114.32	0.010	0.017	8/28/2014 12:03	road centre line	114.411	0.091	9.1	
oneil18	4992620.816	429375.882	114.32	0.011	0.020	8/28/2014 12:04	road centre line	114.403	0.086	8.6	
oneil19	4992642.766	429392.612	114.32	0.010	0.016	8/28/2014 12:04	road centre line	114.352	0.029	2.9	
oneil20	4992666.385	429405.770	114.18	0.009	0.016	8/28/2014 12:05	road centre line	114.191	0.015	1.5	
oneil21	4992723.454	429437.409	113.29	0.011	0.018	8/28/2014 12:06	road centre line	113.373	0.082	8.2	
dwy hill2 1	4995330.728	427416.869	118.54	0.009	0.012	8/28/2014 12:46	edge of road	118.606	0.071	7.1	
dwy hill2 2	4995347.869	427403.657	118.34	0.012	0.017	8/28/2014 12:47	edge of road	118.459	0.118	11.8	
dwy hill2 3	4995360.540	427394.171	118.20	0.012	0.017	8/28/2014 12:47	edge of road	118.294	0.090	9.0	
dwy hill2 4	4995371.379	427386.141	118.08	0.010	0.014	8/28/2014 12:48	edge of road	118.144	0.069	6.9	
dwy hill2 5	4995382.626	427377.761	117.98	0.009	0.013	8/28/2014 12:49	edge of road	118.044	0.065	6.5	
dwy hill2 6	4995406.878	427359.683	117.89	0.010	0.014	8/28/2014 12:50	edge of road	118.010	0.119	11.9	
dwy hill2 7	4995426.099	427345.365	117.79	0.010	0.014	8/28/2014 12:50	edge of road	117.847	0.061	6.1	
dwy hill2 8	4995460.464	427319.447	117.61	0.013	0.018	8/28/2014 12:52	edge of road	117.683	0.071	7.1	

dwy hill2 9	4995482.816	427302.304	117.36	0.015	0.020	8/28/2014 12:52	edge of road	117.427	0.066	6.6	
dwy hill2 10	4995502.394	427286.994	116.82	0.014	0.020	8/28/2014 12:53	edge of road	116.933	0.111	11.1	
dwy hill2 11	4995518.188	427274.543	116.30	0.015	0.020	8/28/2014 12:54	edge of road	116.379	0.077	7.7	
dwy hill2 12	4995533.234	427262.501	115.70	0.007	0.010	8/28/2014 12:54	edge of road	115.766	0.070	7.0	
dwy hill2 13	4995556.265	427244.217	114.81	0.009	0.013	8/28/2014 12:55	edge of road	114.893	0.087	8.7	
dwy hill3 1	4997386.748	425706.107	114.88	0.007	0.011	8/28/2014 13:04	edge of road	114.862	-0.016	1.6	
dwy hill3 2	4997368.649	425721.165	114.55	0.011	0.016	8/28/2014 13:05	edge of road	114.527	-0.020	2.0	
dwy hill3 3	4997357.704	425730.518	114.40	0.008	0.012	8/28/2014 13:06	edge of road	114.435	0.033	3.3	
dwy hill3 4	4997349.492	425737.281	114.31	0.010	0.014	8/28/2014 13:06	edge of road	114.408	0.103	10.3	
dwy hill3 5	4997334.569	425749.724	114.09	0.009	0.012	8/28/2014 13:07	edge of road	114.188	0.097	9.7	
dwy hill3 6	4997312.192	425768.753	113.79	0.009	0.012	8/28/2014 13:08	edge of road	113.806	0.016	1.6	
dwy hill3 7	4997300.114	425778.733	113.65	0.011	0.015	8/28/2014 13:09	edge of road	113.712	0.061	6.1	
dwy hill3 8	4997286.127	425790.575	113.45	0.011	0.014	8/28/2014 13:09	edge of road	113.507	0.060	6.0	
dwy hill3 9	4997270.780	425803.333	113.22	0.010	0.014	8/28/2014 13:10	edge of road	113.305	0.087	8.7	
dwy hill3 10	4997255.432	425816.193	112.92	0.012	0.016	8/28/2014 13:10	edge of road	112.974	0.055	5.5	
jock tr 1	4997189.214	427210.597	109.94	0.007	0.010	8/28/2014 13:19	road centre line	109.951	0.014	1.4	
jock tr 2	4997201.098	427224.768	110.30	0.011	0.013	8/28/2014 13:20	road centre line	110.341	0.040	4.0	
jock tr 3	4997211.579	427241.529	110.32	0.013	0.017	8/28/2014 13:20	road centre line	110.350	0.027	2.7	
jock tr 4	4997231.380	427261.568	110.15	0.013	0.016	8/28/2014 13:21	road centre line	110.118	-0.028	2.8	
jock tr 5	4997257.756	427293.195	109.65	0.014	0.020	8/28/2014 13:22	road centre line	109.676	0.031	3.1	
jock tr 6	4997284.655	427325.141	109.33	0.015	0.019	8/28/2014 13:23	road centre line	109.323	-0.009	0.9	
jock tr 7	4997315.827	427362.352	109.00	0.015	0.019	8/28/2014 13:24	road centre line	108.999	0.001	0.1	
jock tr 8	4997342.902	427394.925	108.97	0.015	0.017	8/28/2014 13:26	road centre line	108.979	0.011	1.1	
jock tr 9	4997369.192	427426.725	109.09	0.015	0.019	8/28/2014 13:27	road centre line	109.113	0.020	2.0	
jock tr 10	4997390.982	427453.399	108.94	0.015	0.019	8/28/2014 13:28	road centre line	108.947	0.011	1.1	
jock tr 11	4997418.262	427486.435	108.63	0.015	0.019	8/28/2014 13:29	road centre line	108.638	0.009	0.9	
jock tr 12	4997440.306	427513.303	108.66	0.012	0.017	8/28/2014 13:30	road centre line	108.664	0.002	0.2	
jock tr 13	4997454.913	427531.148	108.65	0.015	0.017	8/28/2014 13:31	road centre line	108.666	0.012	1.2	
jock tr 14	4997478.344	427559.480	108.47	0.015	0.019	8/28/2014 13:32	road centre line	108.466	-0.001	0.1	
jock tr 15	4997495.160	427580.199	108.36	0.014	0.019	8/28/2014 13:33	road centre line	108.371	0.010	1.0	
jock tr 16	4997516.618	427606.476	108.29	0.015	0.019	8/28/2014 13:34	road centre line	108.297	0.004	0.4	
jock tr 17	4997538.821	427633.859	108.20	0.015	0.020	8/28/2014 13:35	road centre line	108.226	0.026	2.6	
jock tr 18	4997558.086	427658.109	108.09	0.013	0.018	8/28/2014 13:35	road centre line	108.068	-0.022	2.2	
jock tr 19	4997597.192	427707.525	108.07	0.015	0.020	8/28/2014 13:37	road centre line	108.093	0.022	2.2	
jock tr 20	4997620.045	427736.499	108.21	0.014	0.020	8/28/2014 13:38	road centre line	108.251	0.043	4.3	
jock tr 21	4997637.958	427758.949	108.66	0.013	0.018	8/28/2014 13:39	road centre line	108.706	0.047	4.7	
jock tr 22	4997654.149	427779.377	109.08	0.014	0.020	8/28/2014 13:39	road centre line	109.095	0.011	1.1	
jock tr 23	4997671.858	427802.041	109.16	0.014	0.019	8/28/2014 13:40	road centre line	109.199	0.043	4.3	
jock tr 24	4997690.969	427826.471	108.98	0.014	0.019	8/28/2014 13:41	road centre line	109.010	0.035	3.5	
jock tr 25	4997716.023	427858.003	108.70	0.014	0.019	8/28/2014 13:41	road centre line	108.783	0.084	8.4	
jock tr 26	4997754.827	427906.639	108.28	0.014	0.020	8/28/2014 13:42	road centre line	108.313	0.037	3.7	
jock tr 27	4997802.594	427966.280	107.83	0.014	0.020	8/28/2014 13:44	road centre line	107.888	0.055	5.5	
jock tr 28	4997916.364	428106.392	106.88	0.010	0.015	8/28/2014 13:50	road centre line	106.943	0.060	6.0	
jock tr 29	4997941.369	428137.050	106.30	0.012	0.017	8/28/2014 13:50	road centre line	106.303	0.006	0.6	

ket rd 1	4996467.561	431537.597	101.74	0.009	0.015	8/28/2014 14:02	road centre line	101.787	0.050	5.0	
ket rd 2	4996466.128	431512.851	101.51	0.010	0.015	8/28/2014 14:03	road centre line	101.571	0.059	5.9	
ket rd 3	4996451.792	431493.685	100.98	0.010	0.016	8/28/2014 14:03	road centre line	101.037	0.059	5.9	
ket rd 4	4996434.447	431472.484	100.80	0.010	0.016	8/28/2014 14:04	road centre line	100.840	0.043	4.3	
ket rd 5	4996409.239	431441.468	100.77	0.011	0.017	8/28/2014 14:05	road centre line	100.786	0.013	1.3	
ket rd 6	4996384.032	431409.623	100.75	0.013	0.020	8/28/2014 14:06	road centre line	100.820	0.067	6.7	
ket rd 7	4995930.548	430865.040	104.29	0.012	0.019	8/28/2014 14:12	road centre line	104.320	0.032	3.2	
ket rd 8	4995950.305	430891.107	104.11	0.011	0.018	8/28/2014 14:12	road centre line	104.094	-0.018	1.8	
ket rd 9	4995971.233	430913.615	103.85	0.013	0.020	8/28/2014 14:15	road centre line	103.886	0.035	3.5	
ket rd 10	4995990.470	430936.463	103.88	0.010	0.019	8/28/2014 14:17	road centre line	103.920	0.045	4.5	
sold ln 1	4997580.216	430107.182	104.38	0.012	0.020	8/28/2014 14:29	road centre line	104.455	0.075	7.5	
sold ln 2	4997558.391	430082.750	104.10	0.012	0.020	8/28/2014 14:31	road centre line	104.126	0.027	2.7	
sold ln 3	4997531.417	430051.719	103.87	0.006	0.011	8/28/2014 14:33	road centre line	103.882	0.009	0.9	
sold ln 4	4997508.558	430024.652	103.65	0.009	0.016	8/28/2014 14:34	road centre line	103.627	-0.018	1.8	
sold ln 5	4997474.804	429984.571	103.59	0.011	0.020	8/28/2014 14:34	road centre line	103.607	0.020	2.0	
sold ln 6	4997441.723	429945.130	103.53	0.011	0.019	8/28/2014 14:35	road centre line	103.592	0.062	6.2	
sold ln 7	4997419.141	429918.234	103.42	0.011	0.017	8/28/2014 14:36	road centre line	103.437	0.019	1.9	
sold ln 8	4997386.575	429879.416	103.21	0.011	0.017	8/28/2014 14:37	road centre line	103.310	0.100	10.0	
sold ln 9	4997386.575	429879.415	103.21	0.011	0.017	8/28/2014 14:37	road centre line	103.310	0.102	10.2	
sold ln 10	4997355.434	429841.549	103.20	0.013	0.020	8/28/2014 14:38	road centre line	103.194	-0.008	0.8	
sold ln 11	4997316.349	429795.552	103.06	0.011	0.018	8/28/2014 14:39	road centre line	103.102	0.045	4.5	
mun side1	4998545.423	428766.949	104.85	0.013	0.020	8/28/2014 14:49	road centre line	104.871	0.024	2.4	
mun side2	4998522.133	428775.258	104.61	0.010	0.017	8/28/2014 14:50	road centre line	104.572	-0.037	3.7	
mun side3	4998486.982	428786.885	104.00	0.007	0.010	8/28/2014 14:51	road centre line	103.967	-0.029	2.9	
mun side4	4998450.094	428809.579	103.56	0.010	0.020	8/28/2014 14:54	road centre line	103.544	-0.020	2.0	
mun side5	4998430.641	428824.183	103.62	0.011	0.018	8/28/2014 14:55	road centre line	103.646	0.022	2.2	
mun side6	4998410.563	428839.719	103.67	0.012	0.019	8/28/2014 14:55	road centre line	103.675	0.001	0.1	
mun side7	4998361.316	428878.607	103.52	0.012	0.020	8/28/2014 14:56	road centre line	103.548	0.030	3.0	
jock tr2 1	4999917.507	430524.909	102.85	0.011	0.018	8/28/2014 15:04	road centre line	102.854	0.005	0.5	
jock tr2 2	4999934.182	430545.053	102.77	0.009	0.015	8/28/2014 15:05	road centre line	102.847	0.077	7.7	
jock tr2 3	4999953.472	430568.106	102.82	0.009	0.015	8/28/2014 15:05	road centre line	102.862	0.044	4.4	
jock tr2 4	4999970.330	430588.741	102.59	0.009	0.015	8/28/2014 15:06	road centre line	102.717	0.123	12.3	
jock tr2 5	4999990.237	430613.083	102.28	0.009	0.015	8/28/2014 15:07	road centre line	102.327	0.047	4.7	
jock tr2 6	5000035.628	430667.542	100.88	0.010	0.017	8/28/2014 15:08	road centre line	100.955	0.073	7.3	
jock tr2 7	5000060.684	430697.087	100.34	0.011	0.020	8/28/2014 15:09	road centre line	100.467	0.131	13.1	
jock tr2 8	5000133.837	430783.475	99.89	0.011	0.020	8/28/2014 15:13	road centre line	99.975	0.083	8.3	
jock tr2 9	5000177.382	430835.699	99.83	0.010	0.020	8/28/2014 15:17	road centre line	99.882	0.051	5.1	
jock tr2 10	5000194.312	430855.520	99.73	0.010	0.020	8/28/2014 15:19	road centre line	99.802	0.071	7.1	
jock tr2 11	5000230.572	430901.209	99.71	0.010	0.019	8/28/2014 15:22	road centre line	99.764	0.051	5.1	
bleeks 1	5002182.304	426761.424	113.56	0.010	0.017	8/29/2014 9:34	road centre line	113.513	-0.042	4.2	
bleeks 2	5002193.050	426774.949	113.52	0.014	0.020	8/29/2014 9:35	road centre line	113.555	0.035	3.5	
bleeks 3	5002204.823	426788.271	113.44	0.011	0.020	8/29/2014 9:37	road centre line	113.457	0.017	1.7	
bleeks 4	5002215.963	426801.809	113.37	0.011	0.020	8/29/2014 9:38	road centre line	113.422	0.055	5.5	
bleeks 5	5002227.772	426815.901	113.31	0.014	0.020	8/29/2014 9:38	road centre line	113.340	0.031	3.1	

bleeks 6	5002247.569	426839.460	113.13	0.011	0.020	8/29/2014 9:40	road centre line	113.143	0.016	1.6	
bleeks 7	5002404.593	427024.384	110.23	0.011	0.020	8/29/2014 9:45	road centre line	110.221	-0.004	0.4	
bleeks 9	5002832.782	427556.886	108.90	0.011	0.014	8/29/2014 9:52	road centre line	109.022	0.124	12.4	
bleeks 10	5002847.671	427576.865	108.82	0.012	0.017	8/29/2014 9:52	road centre line	108.901	0.077	7.7	
bleeks 11	5002863.569	427596.015	108.68	0.014	0.020	8/29/2014 9:53	road centre line	108.791	0.116	11.6	
bleeks 12	5002880.230	427621.577	108.75	0.013	0.019	8/29/2014 9:54	road centre line	108.750	0.004	0.4	
bleeks 13	5002892.171	427637.369	108.67	0.012	0.018	8/29/2014 9:55	road centre line	108.660	-0.006	0.6	
bleeks 14	5002908.020	427658.212	108.49	0.013	0.018	8/29/2014 9:55	road centre line	108.510	0.022	2.2	
bleeks 15	5002927.684	427683.750	108.38	0.013	0.018	8/29/2014 9:56	road centre line	108.387	0.005	0.5	
bleeks 16	5002945.616	427703.704	108.20	0.012	0.017	8/29/2014 9:57	road centre line	108.220	0.020	2.0	
bleeks 17	5002958.879	427724.393	108.23	0.014	0.020	8/29/2014 9:57	road centre line	108.186	-0.041	4.1	
bleeks 18	5002971.106	427740.043	108.18	0.014	0.019	8/29/2014 9:58	road centre line	108.184	0.005	0.5	
bleeks 19	5002991.038	427766.712	108.04	0.013	0.020	8/29/2014 9:59	road centre line	108.067	0.025	2.5	
conley 1	5003820.181	428400.572	108.36	0.015	0.020	8/29/2014 10:13	road centre line	108.374	0.017	1.7	
conley 2	5003807.419	428411.895	108.22	0.014	0.019	8/29/2014 10:14	road centre line	108.213	-0.006	0.6	
conley 3	5003788.607	428427.212	107.97	0.015	0.020	8/29/2014 10:15	road centre line	108.004	0.039	3.9	
conley 4	5003764.546	428446.985	107.52	0.015	0.020	8/29/2014 10:16	road centre line	107.574	0.054	5.4	
conley 5	5003743.869	428464.297	107.27	0.014	0.020	8/29/2014 10:17	road centre line	107.365	0.100	10.0	
conley 6	5003724.961	428479.596	107.19	0.014	0.019	8/29/2014 10:17	road centre line	107.266	0.072	7.2	
conley 7	5003706.092	428495.465	107.00	0.014	0.019	8/29/2014 10:18	road centre line	107.107	0.104	10.4	
conley 8	5003687.144	428510.944	106.88	0.014	0.019	8/29/2014 10:19	road centre line	106.962	0.087	8.7	
conley 9	5003667.497	428527.147	106.70	0.014	0.019	8/29/2014 10:19	road centre line	106.778	0.077	7.7	
conley 10	5003647.522	428543.795	106.62	0.014	0.019	8/29/2014 10:20	road centre line	106.649	0.034	3.4	
conley 11	5003629.604	428558.713	106.39	0.014	0.019	8/29/2014 10:21	road centre line	106.466	0.072	7.2	
conley 12	5003610.414	428574.001	106.27	0.014	0.019	8/29/2014 10:21	road centre line	106.337	0.064	6.4	
conley 13	5003558.576	428587.763	106.85	0.014	0.020	8/29/2014 10:23	road centre line	106.930	0.084	8.4	
conley 14	5003534.080	428596.063	106.82	0.014	0.020	8/29/2014 10:24	road centre line	106.890	0.072	7.2	
conley 15	5003512.145	428614.088	107.05	0.014	0.020	8/29/2014 10:25	road centre line	107.038	-0.015	1.5	
conley 16	5003486.154	428636.204	106.92	0.015	0.020	8/29/2014 10:26	road centre line	106.925	0.007	0.7	
conley 17	5003456.891	428660.523	106.80	0.015	0.020	8/29/2014 10:27	road centre line	106.841	0.046	4.6	
conley 18	5003425.588	428686.549	106.67	0.015	0.020	8/29/2014 10:29	road centre line	106.664	-0.005	0.5	
conley 19	5003386.083	428719.737	106.80	0.014	0.020	8/29/2014 10:30	road centre line	106.854	0.059	5.9	
conley 20	5003349.753	428750.088	106.23	0.013	0.020	8/29/2014 10:31	road centre line	106.235	0.010	1.0	
conley 21	5003308.462	428785.115	105.22	0.014	0.019	8/29/2014 10:32	road centre line	105.230	0.006	0.6	
conley 22	5003248.860	428835.169	104.80	0.014	0.019	8/29/2014 10:34	road centre line	104.790	-0.011	1.1	
conley 23	5002860.775	429164.129	103.49	0.014	0.020	8/29/2014 10:39	road centre line	103.438	-0.049	4.9	
conley 24	5002847.077	429175.335	103.32	0.014	0.020	8/29/2014 10:40	road centre line	103.264	-0.054	5.4	
conley 25	5002831.789	429187.998	103.23	0.014	0.020	8/29/2014 10:41	road centre line	103.265	0.038	3.8	
conley 29	5002767.534	429242.201	103.23	0.013	0.019	8/29/2014 10:43	road centre line	103.271	0.046	4.6	
conley 30	5002755.376	429252.350	103.19	0.013	0.019	8/29/2014 10:43	road centre line	103.239	0.045	4.5	
conley 31	5002740.367	429265.470	103.24	0.012	0.017	8/29/2014 10:44	road centre line	103.242	0.003	0.3	
conley 32	5001507.037	430321.551	103.78	0.013	0.020	8/29/2014 10:54	road centre line	103.838	0.063	6.3	
conley 33	5001520.417	430309.762	103.81	0.013	0.020	8/29/2014 10:54	road centre line	103.820	0.015	1.5	
conley 34	5001533.645	430299.068	103.91	0.013	0.020	8/29/2014 10:55	road centre line	103.901	-0.007	0.7	

conley 35	5001546.634	430288.435	103.95	0.012	0.019	8/29/2014 10:56	road centre line	103.977	0.024	2.4	
conley 36	5001558.930	430278.039	103.94	0.013	0.020	8/29/2014 10:58	road centre line	104.021	0.078	7.8	
conley 37	5001577.365	430262.505	103.82	0.012	0.018	8/29/2014 10:58	road centre line	103.844	0.028	2.8	
conley 38	5001598.022	430244.924	103.56	0.012	0.019	8/29/2014 10:59	road centre line	103.546	-0.018	1.8	
conley 39	5001620.321	430226.259	103.31	0.012	0.019	8/29/2014 10:59	road centre line	103.299	-0.010	1.0	
conley 40	5001558.070	430253.156	103.33	0.013	0.020	8/29/2014 11:01	parking lot	103.385	0.060	6.0	
conley 41	5001564.810	430247.483	103.28	0.013	0.019	8/29/2014 11:02	parking lot	103.345	0.061	6.1	
conley 42	5001571.881	430241.719	103.22	0.013	0.020	8/29/2014 11:02	parking lot	103.258	0.040	4.0	
conley 43	5001578.314	430236.169	103.10	0.013	0.020	8/29/2014 11:03	parking lot	103.139	0.042	4.2	
conley 44	5001584.551	430230.956	102.98	0.013	0.020	8/29/2014 11:03	parking lot	103.031	0.052	5.2	
conley 45	5001590.962	430225.439	102.90	0.013	0.020	8/29/2014 11:03	parking lot	102.978	0.079	7.9	
conley 46	5001586.482	430219.298	102.88	0.013	0.020	8/29/2014 11:04	parking lot	102.920	0.040	4.0	
conley 47	5001591.813	430215.595	102.81	0.013	0.020	8/29/2014 11:04	parking lot	102.850	0.044	4.4	
conley 48	5001598.668	430210.166	102.66	0.013	0.020	8/29/2014 11:05	parking lot	102.760	0.097	9.7	
conley 49	5001580.696	430225.196	102.98	0.013	0.020	8/29/2014 11:05	parking lot	103.032	0.051	5.1	
conley 50	5001574.378	430230.938	103.08	0.013	0.020	8/29/2014 11:06	parking lot	103.145	0.065	6.5	
conley 51	5001568.144	430236.635	103.22	0.013	0.020	8/29/2014 11:06	parking lot	103.280	0.062	6.2	
conley 52	5001561.866	430242.048	103.30	0.013	0.020	8/29/2014 11:07	parking lot	103.360	0.061	6.1	
conley 53	5001555.516	430247.579	103.39	0.015	0.020	8/29/2014 11:07	parking lot	103.462	0.075	7.5	
conley 54	5001550.921	430240.658	103.44	0.015	0.019	8/29/2014 11:07	parking lot	103.489	0.047	4.7	
conley 55	5001557.177	430235.519	103.36	0.013	0.017	8/29/2014 11:08	parking lot	103.418	0.055	5.5	
conley 56	5001563.753	430230.488	103.21	0.013	0.017	8/29/2014 11:08	parking lot	103.269	0.060	6.0	
conley 57	5001570.250	430225.293	103.10	0.013	0.017	8/29/2014 11:08	parking lot	103.153	0.050	5.0	
conley 58	5001576.820	430220.183	102.98	0.013	0.018	8/29/2014 11:09	parking lot	103.011	0.029	2.9	
conley 59	5001583.398	430214.813	102.88	0.013	0.017	8/29/2014 11:09	parking lot	102.920	0.036	3.6	
conley 60	5001589.701	430209.660	102.77	0.013	0.018	8/29/2014 11:10	parking lot	102.796	0.024	2.4	
conley 61	5001596.049	430204.833	102.66	0.013	0.017	8/29/2014 11:10	parking lot	102.722	0.064	6.4	
hobbs 1	5002500.449	431436.124	100.68	0.014	0.019	8/29/2014 11:18	edge of road	100.706	0.026	2.6	
hobbs 2	5002483.582	431417.588	100.50	0.015	0.020	8/29/2014 11:19	edge of road	100.522	0.027	2.7	
hobbs 3	5002208.019	431113.498	100.11	0.014	0.020	8/29/2014 11:36	edge of road	100.133	0.021	2.1	
hobbs 4	5002202.650	431106.899	100.11	0.014	0.02	8/29/2014 11:38	edge of road	100.115	0.005	0.5	
hobbs 5	5002196.240	431099.921	100.158	0.013	0.02	8/29/2014 11:39	edge of road	100.193	0.035	3.5	
hobbs 6	5002189.462	431092.320	100.218	0.012	0.018	8/29/2014 11:43	edge of road	100.259	0.041	4.1	
hobbs 7	5002183.680	431086.219	100.23	0.012	0.019	8/29/2014 11:44	edge of road	100.254	0.024	2.4	
hobbs 8	5002178.099	431080.164	100.2	0.014	0.02	8/29/2014 11:44	edge of road	100.248	0.048	4.8	
hobbs 9	5002171.552	431073.091	100.171	0.013	0.02	8/29/2014 11:45	edge of road	100.201	0.030	3.0	
hobbs 10	5001922.637	430803.438	100.215	0.013	0.02	8/29/2014 11:52	edge of road	100.250	0.035	3.5	
fern 1	5006997.698	423887.927	134.328	0.008	0.011	8/29/2014 12:24	edge of road	134.360	0.032	3.2	
fern 2	5006988.074	423876.293	134.346	0.009	0.013	8/29/2014 12:24	edge of road	134.387	0.041	4.1	
fern 3	5006971.539	423856.501	134.41	0.012	0.018	8/29/2014 12:25	edge of road	134.442	0.034	3.4	
fern 4	5006955.506	423837.188	134.67	0.013	0.020	8/29/2014 12:26	edge of road	134.749	0.084	8.4	
fern 5	5006939.100	423817.612	135.295	0.015	0.019	8/29/2014 12:26	edge of road	135.317	0.022	2.2	
fern 6	5006912.782	423785.594	136.26	0.014	0.02	8/29/2014 12:28	edge of road	136.301	0.041	4.1	
fern 7	5006896.230	423766.141	136.486	0.014	0.018	8/29/2014 12:29	edge of road	136.569	0.083	8.3	

fern 8	5006855.826	423718.438	136.948	0.013	0.02	8/29/2014 12:30	edge of road	137.007	0.059	5.9	
fern 9	5006735.481	423577.285	136.069	0.013	0.018	8/29/2014 12:33	edge of road	136.110	0.041	4.1	
ffield1 1	5004868.574	425726.972	119.706	0.015	0.02	8/29/2014 12:58	edge of road	119.786	0.080	8.0	
ffield1 2	5004879.771	425740.360	119.59	0.015	0.019	8/29/2014 12:59	edge of road	119.688	0.098	9.8	
ffield1 3	5004905.498	425771.112	119.44	0.014	0.02	8/29/2014 13:00	edge of road	119.501	0.061	6.1	
ffield1 4	5004931.372	425802.087	119.174	0.013	0.018	8/29/2014 13:01	edge of road	119.255	0.081	8.1	
ffield1 5	5004948.424	425822.515	118.995	0.013	0.019	8/29/2014 13:02	edge of road	119.066	0.071	7.1	
ffield1 6	5004956.927	425832.643	118.847	0.014	0.019	8/29/2014 13:03	edge of road	118.950	0.103	10.3	
ffield1 7	5004966.929	425844.500	118.871	0.013	0.019	8/29/2014 13:03	edge of road	118.948	0.077	7.7	
ffield1 8	5004992.157	425874.954	118.845	0.013	0.019	8/29/2014 13:04	edge of road	118.896	0.051	5.1	
ffield1 9	5005018.966	425906.741	118.913	0.014	0.019	8/29/2014 13:05	edge of road	118.966	0.053	5.3	
ffield1 10	5005042.966	425935.411	119.055	0.014	0.019	8/29/2014 13:06	edge of road	119.128	0.073	7.3	
ffield2 1	5006748.095	427984.247	117.912	0.007	0.009	8/29/2014 13:16	edge of road	117.952	0.040	4.0	
ffield2 2	5006759.004	427997.196	117.896	0.01	0.012	8/29/2014 13:17	edge of road	117.917	0.021	2.1	
ffield2 3	5006769.973	428010.226	117.886	0.011	0.014	8/29/2014 13:18	edge of road	117.887	0.001	0.1	
ffield2 4	5006780.734	428022.977	117.871	0.012	0.015	8/29/2014 13:18	edge of road	117.913	0.042	4.2	
ffield2 5	5006792.014	428036.275	117.864	0.011	0.015	8/29/2014 13:19	edge of road	117.919	0.055	5.5	
ffield2 6	5006804.527	428051.141	117.78	0.012	0.015	8/29/2014 13:20	edge of road	117.815	0.035	3.5	
ffield2 7	5006815.409	428064.171	117.801	0.012	0.015	8/29/2014 13:20	edge of road	117.787	-0.014	1.4	
ffield2 8	5006826.623	428077.280	117.866	0.012	0.016	8/29/2014 13:21	edge of road	117.868	0.002	0.2	
ffield2 9	5006842.315	428095.801	117.934	0.013	0.017	8/29/2014 13:21	edge of road	117.945	0.011	1.1	
ffield2 10	5006865.601	428123.612	118.054	0.014	0.018	8/29/2014 13:22	edge of road	118.058	0.004	0.4	
ffield2a 1	5006093.064	427189.422	118.682	0.011	0.015	8/29/2014 13:29	edge of road	118.721	0.039	3.9	
ffield2a 2	5006103.231	427201.876	118.722	0.011	0.015	8/29/2014 13:30	edge of road	118.765	0.043	4.3	
ffield2a 3	5006114.065	427215.042	118.793	0.012	0.015	8/29/2014 13:30	edge of road	118.835	0.042	4.2	
ffield2a 4	5006121.827	427224.330	118.829	0.012	0.015	8/29/2014 13:31	edge of road	118.853	0.024	2.4	
ffield2a 5	5006129.035	427232.978	118.806	0.012	0.016	8/29/2014 13:32	edge of road	118.835	0.029	2.9	
ffield2a 6	5006139.540	427245.508	118.847	0.012	0.016	8/29/2014 13:32	edge of road	118.883	0.036	3.6	
ffield2a 7	5006150.195	427258.275	118.91	0.012	0.016	8/29/2014 13:33	edge of road	118.935	0.025	2.5	
ffield2a 8	5006160.936	427271.611	118.977	0.013	0.018	8/29/2014 13:33	edge of road	119.005	0.028	2.8	
ffield2a 9	5006171.745	427284.731	119.048	0.012	0.017	8/29/2014 13:34	edge of road	119.110	0.062	6.2	
ffield2a 10	5006182.431	427297.606	119.086	0.013	0.018	8/29/2014 13:34	edge of road	119.106	0.020	2.0	
ffield2a 11	5006182.409	427297.583	119.083	0.012	0.017	8/29/2014 13:35	edge of road	119.104	0.021	2.1	
ffield3 1	5007499.106	428876.096	109.477	0.008	0.011	8/29/2014 13:45	edge of road	109.491	0.014	1.4	
ffield3 2	5007488.044	428863.158	109.625	0.011	0.014	8/29/2014 13:45	edge of road	109.637	0.012	1.2	
ffield3 3	5007476.740	428850.014	109.754	0.012	0.016	8/29/2014 13:46	edge of road	109.769	0.015	1.5	
ffield3 4	5007460.155	428830.552	109.955	0.013	0.018	8/29/2014 13:46	edge of road	109.959	0.004	0.4	
ffield3 5	5007435.917	428802.436	110.177	0.013	0.018	8/29/2014 13:47	edge of road	110.202	0.025	2.5	
ffield3 6	5007425.266	428789.931	110.37	0.012	0.016	8/29/2014 13:48	edge of road	110.395	0.025	2.5	
ffield3 7	5007413.914	428776.877	110.589	0.007	0.009	8/29/2014 13:52	edge of road	110.636	0.047	4.7	
ffield3 8	5007402.937	428764.267	110.816	0.01	0.013	8/29/2014 13:52	edge of road	110.821	0.005	0.5	
ffield3 9	5007390.937	428750.007	111.112	0.01	0.014	8/29/2014 13:53	edge of road	111.145	0.033	3.3	
ffield3 10	5007379.882	428737.046	111.387	0.01	0.014	8/29/2014 13:53	edge of road	111.473	0.086	8.6	
ffield4 1	5007916.614	429366.844	107.174	0.015	0.02	8/29/2014 14:03	edge of road	107.079	-0.095	9.5	

ffield4 2	5007927.714	429379.964	107.165	0.012	0.016	8/29/2014 14:04	edge of road	107.165	0.000	0.0	
ffield4 3	5007939.516	429393.839	107.145	0.01	0.012	8/29/2014 14:05	edge of road	107.101	-0.044	4.4	
ffield4 4	5007955.840	429413.176	107.128	0.012	0.016	8/29/2014 14:07	edge of road	107.091	-0.037	3.7	
ffield4 5	5007998.007	429462.891	107.124	0.013	0.018	8/29/2014 14:08	edge of road	107.107	-0.017	1.7	
ffield4 6	5008009.000	429475.828	107.209	0.012	0.017	8/29/2014 14:08	edge of road	107.186	-0.023	2.3	
ffield4 7	5008020.463	429489.329	107.217	0.011	0.018	8/29/2014 14:09	edge of road	107.160	-0.057	5.7	
ffield4 8	5008031.476	429502.314	107.208	0.013	0.02	8/29/2014 14:09	edge of road	107.151	-0.057	5.7	
ffield4 9	5008042.692	429515.344	107.237	0.013	0.018	8/29/2014 14:10	edge of road	107.208	-0.029	2.9	
ffield4 10	5008054.078	429528.545	107.315	0.015	0.02	8/29/2014 14:10	edge of road	107.279	-0.036	3.6	
mfield1 1	5007071.527	430431.661	102.243	0.01	0.017	8/29/2014 14:21	edge of road	102.352	0.109	10.9	
mfield1 2	5007063.280	430422.201	102.223	0.01	0.017	8/29/2014 14:21	edge of road	102.305	0.082	8.2	
mfield1 3	5007054.728	430412.231	102.269	0.01	0.016	8/29/2014 14:22	edge of road	102.382	0.113	11.3	
mfield1 4	5007043.783	430399.563	102.365	0.011	0.018	8/29/2014 14:22	edge of road	102.433	0.068	6.8	
mfield1 5	5007030.831	430384.899	102.454	0.01	0.017	8/29/2014 14:23	steep road edge	102.492	0.038	3.8	
mfield1 6	5007022.285	430375.207	102.48	0.01	0.017	8/29/2014 14:23	edge of road	102.495	0.015	1.5	
mfield1 7	5007013.975	430365.314	102.465	0.01	0.017	8/29/2014 14:24	edge of road	102.501	0.036	3.6	
mfield1 8	5007004.940	430354.617	102.45	0.01	0.017	8/29/2014 14:24	edge of road	102.492	0.042	4.2	
mfield1 9	5006995.802	430344.096	102.491	0.01	0.017	8/29/2014 14:25	edge of road	102.478	-0.013	1.3	
mfield1 10	5006987.337	430334.310	102.53	0.01	0.017	8/29/2014 14:25	edge of road	102.574	0.044	4.4	
mfield2 1	5006691.232	429991.626	101.761	0.007	0.011	8/29/2014 14:35	edge of road	101.782	0.021	2.1	
mfield2 2	5006682.929	429982.209	101.886	0.008	0.013	8/29/2014 14:35	edge of road	101.914	0.028	2.8	
mfield2 3	5006674.559	429972.579	101.838	0.009	0.013	8/29/2014 14:36	edge of road	101.884	0.046	4.6	
mfield2 4	5006666.236	429963.143	101.746	0.009	0.015	8/29/2014 14:36	edge of road	101.801	0.055	5.5	
mfield2 5	5006657.778	429953.309	101.666	0.01	0.016	8/29/2014 14:37	edge of road	101.701	0.035	3.5	
mfield2 6	5006649.663	429943.862	101.633	0.01	0.016	8/29/2014 14:37	edge of road	101.689	0.056	5.6	
mfield2 7	5006641.051	429934.042	101.611	0.01	0.015	8/29/2014 14:38	edge of road	101.634	0.023	2.3	
mfield2 8	5006633.410	429925.107	101.627	0.01	0.016	8/29/2014 14:39	edge of road	101.708	0.081	8.1	
mfield2 9	5006624.766	429915.871	101.646	0.01	0.016	8/29/2014 14:39	edge of road	101.707	0.061	6.1	
mfield2 10	5006617.379	429907.228	101.693	0.01	0.016	8/29/2014 14:40	edge of road	101.758	0.065	6.5	
mfield2 11	5006609.490	429988.104	101.744	0.01	0.016	8/29/2014 14:40	edge of road	101.773	0.029	2.9	
mfield2 12	5006601.527	429888.367	101.774	0.01	0.015	8/29/2014 14:41	edge of road	101.818	0.044	4.4	
mfield2 13	5006593.480	429879.126	101.788	0.01	0.016	8/29/2014 14:41	edge of road	101.830	0.042	4.2	
mfield2 14	5006584.047	429868.195	101.808	0.01	0.016	8/29/2014 14:42	edge of road	101.836	0.028	2.8	
mfield2 15	5006580.238	429872.716	101.78	0.01	0.016	8/29/2014 14:42	edge of road	101.777	-0.003	0.3	
mfield2 16	5006597.746	429893.123	101.675	0.01	0.016	8/29/2014 14:43	edge of road	101.655	-0.020	2.0	
mfield2 17	5006617.926	429916.709	101.556	0.01	0.016	8/29/2014 14:44	edge of road	101.515	-0.041	4.1	
mfield4 1	5006154.173	429374.244	104.166	0.01	0.017	8/29/2014 14:50	edge of road	104.252	0.086	8.6	
mfield4 2	5006161.697	429382.923	104.153	0.009	0.015	8/29/2014 14:50	edge of road	104.199	0.046	4.6	
mfield4 3	5006169.445	429391.696	104.151	0.009	0.014	8/29/2014 14:51	edge of road	104.193	0.042	4.2	
mfield4 4	5006177.391	429400.790	104.2	0.008	0.014	8/29/2014 14:51	edge of road	104.263	0.063	6.3	
mfield4 5	5006189.927	429415.059	104.188	0.009	0.015	8/29/2014 14:52	edge of road	104.218	0.030	3.0	
mfield4 6	5006198.177	429424.749	104.197	0.009	0.014	8/29/2014 14:52	edge of road	104.253	0.056	5.6	
mfield4 7	5006206.503	429434.429	104.166	0.008	0.014	8/29/2014 14:53	edge of road	104.203	0.037	3.7	
mfield4 8	5006214.864	429443.767	104.147	0.008	0.013	8/29/2014 14:54	edge of road	104.167	0.020	2.0	

mfield4 9	5006221.142	429455.374	104.262	0.008	0.013	8/29/2014 14:54	road centre line	104.282	0.020	2.0	
mfield4 10	5006229.259	429464.715	104.295	0.008	0.013	8/29/2014 14:55	road centre line	104.330	0.035	3.5	
mfield5 1	5005251.889	428333.370	109.211	0.007	0.012	8/29/2014 15:03	road centre line	109.263	0.052	5.2	
mfield5 2	5005260.161	428342.850	109.288	0.007	0.012	8/29/2014 15:04	road centre line	109.351	0.063	6.3	
mfield5 3	5005268.229	428352.625	109.294	0.007	0.012	8/29/2014 15:04	road centre line	109.364	0.070	7.0	
mfield5 4	5005276.456	428362.196	109.315	0.007	0.012	8/29/2014 15:05	road centre line	109.370	0.055	5.5	
mfield5 5	5005284.826	428371.784	109.316	0.007	0.012	8/29/2014 15:05	road centre line	109.405	0.089	8.9	
mfield5 6	5005243.461	428323.418	109.236	0.008	0.014	8/29/2014 15:06	road centre line	109.312	0.076	7.6	
mfield5 7	5005235.036	428313.531	109.271	0.007	0.013	8/29/2014 15:07	road centre line	109.324	0.053	5.3	
mfield5 8	5005227.103	428304.125	109.356	0.007	0.013	8/29/2014 15:07	road centre line	109.359	0.003	0.3	
mfield5 9	5005219.127	428294.613	109.444	0.007	0.013	8/29/2014 15:07	road centre line	109.495	0.051	5.1	
mfield5 10	5005210.600	428284.834	109.535	0.007	0.013	8/29/2014 15:08	road centre line	109.553	0.018	1.8	
mfield6 1	5005100.342	428148.510	110.813	0.007	0.013	8/29/2014 15:13	road centre line	110.899	0.086	8.6	
mfield6 2	5005110.448	428160.604	110.706	0.006	0.012	8/29/2014 15:14	edge of road	110.720	0.014	1.4	
mfield6 3	5005121.205	428173.515	110.484	0.007	0.013	8/29/2014 15:15	edge of road	110.530	0.046	4.6	
mfield6 4	5005132.341	428186.847	110.322	0.006	0.012	8/29/2014 15:15	edge of road	110.367	0.045	4.5	
mfield6 5	5005150.473	428208.634	110.198	0.009	0.017	8/29/2014 15:16	edge of road	110.258	0.060	6.0	
mfield6 6	5005156.644	428225.542	109.965	0.007	0.013	8/29/2014 15:16	edge of road	109.870	-0.095	9.5	
mfield6 7	5005171.572	428233.527	109.964	0.009	0.018	8/29/2014 15:17	edge of road	110.028	0.064	6.4	
mfield6 8	5005182.012	428245.942	109.866	0.008	0.015	8/29/2014 15:17	edge of road	109.910	0.044	4.4	
mfield6 9	5005192.876	428258.770	109.748	0.008	0.016	8/29/2014 15:18	edge of road	109.834	0.086	8.6	
mfield6 10	5005203.894	428271.885	109.61	0.007	0.014	8/29/2014 15:18	edge of road	109.699	0.089	8.9	
mfield7 1	5004759.504	427734.397	113.888	0.005	0.011	8/29/2014 15:23	edge of road	113.875	-0.013	1.3	
mfield7 2	5004767.417	427744.145	113.764	0.006	0.013	8/29/2014 15:24	edge of road	113.760	-0.004	0.4	
mfield7 3	5004777.694	427756.774	113.662	0.006	0.013	8/29/2014 15:24	edge of road	113.661	-0.001	0.1	
mfield7 4	5004786.595	427767.735	113.646	0.006	0.013	8/29/2014 15:25	edge of road	113.701	0.055	5.5	
mfield7 5	5004800.665	427785.062	113.713	0.007	0.014	8/29/2014 15:25	edge of road	113.750	0.037	3.7	
mfield7 6	5004809.008	427795.480	113.769	0.006	0.013	8/29/2014 15:26	edge of road	113.796	0.027	2.7	
mfield7 7	5004816.966	427805.181	113.848	0.007	0.014	8/29/2014 15:26	edge of road	113.831	-0.017	1.7	
mfield7 8	5004824.524	427814.875	113.958	0.009	0.018	8/29/2014 15:27	edge of road	113.988	0.030	3.0	
mfield7 9	5004835.213	427827.646	114.162	0.007	0.015	8/29/2014 15:27	edge of road	114.178	0.016	1.6	
mfield7 10	5004843.606	427837.912	114.358	0.008	0.017	8/29/2014 15:28	edge of road	114.350	-0.008	0.8	
mfield8 1	5003466.724	426155.816	113.281	0.01	0.02	8/29/2014 15:36	edge of road	113.281	0.000	0.0	
mfield8 2	5003470.108	426169.875	113.235	0.009	0.018	8/29/2014 15:37	edge of road	113.212	-0.023	2.3	
mfield8 3	5003483.188	426175.638	113.253	0.008	0.016	8/29/2014 15:37	edge of road	113.285	0.032	3.2	
mfield8 4	5003488.222	426191.075	113.183	0.006	0.012	8/29/2014 15:38	edge of road	113.209	0.026	2.6	
mfield8 5	5003502.332	426198.369	113.335	0.007	0.013	8/29/2014 15:38	edge of road	113.369	0.034	3.4	
mfield8 6	5003507.436	426213.500	113.266	0.007	0.013	8/29/2014 15:39	edge of road	113.300	0.034	3.4	
mfield8 7	5003521.841	426220.793	113.363	0.008	0.015	8/29/2014 15:39	edge of road	113.414	0.051	5.1	
mfield8 8	5003526.654	426235.924	113.34	0.007	0.014	8/29/2014 15:39	edge of road	113.346	0.006	0.6	
mfield8 9	5003541.503	426244.130	113.427	0.008	0.015	8/29/2014 15:40	edge of road	113.394	-0.033	3.3	
brown1 1	5007579.217	433182.519	96.837	0.008	0.011	9/2/2014 10:17	road centre line	96.880	0.043	4.3	
brown1 2	5007602.128	433185.275	96.938	0.01	0.014	9/2/2014 10:17	road centre line	97.026	0.088	8.8	
brown1 3	5007614.122	433173.629	96.952	0.01	0.014	9/2/2014 10:18	road centre line	97.008	0.056	5.6	

brown1 4	5007627.039	433162.399	97.084	0.01	0.014	9/2/2014 10:18	road centre line	97.160	0.076	7.6	
brown1 5	5007639.748	433151.707	97.185	0.01	0.014	9/2/2014 10:19	road centre line	97.256	0.071	7.1	
brown1 6	5007569.078	433172.221	96.955	0.01	0.015	9/2/2014 10:20	road centre line	97.023	0.068	6.8	
brown1 7	5007558.357	433159.065	97.117	0.01	0.015	9/2/2014 10:21	road centre line	97.133	0.016	1.6	
brown1 8	5007547.894	433146.716	97.267	0.01	0.014	9/2/2014 10:22	road centre line	97.284	0.017	1.7	
brown1 9	5007537.528	433134.749	97.351	0.01	0.015	9/2/2014 10:22	road centre line	97.391	0.040	4.0	
brown1 10	5007526.733	433123.024	97.408	0.01	0.015	9/2/2014 10:23	road centre line	97.476	0.068	6.8	
brown2 2	5007112.218	432640.641	97.638	0.013	0.019	9/2/2014 10:29	road centre line	97.604	-0.034	3.4	
brown2 3	5007100.794	432626.610	97.734	0.013	0.02	9/2/2014 10:30	road centre line	97.720	-0.014	1.4	
brown2 4	5007090.222	432613.809	97.735	0.014	0.02	9/2/2014 10:31	road centre line	97.721	-0.014	1.4	
brown2 5	5007078.857	432601.263	97.718	0.013	0.02	9/2/2014 10:33	road centre line	97.686	-0.032	3.2	
brown2 6	5007132.456	432665.487	97.523	0.013	0.019	9/2/2014 10:34	road centre line	97.501	-0.022	2.2	
brown2 7	5007143.973	432678.037	97.637	0.012	0.018	9/2/2014 10:35	road centre line	97.618	-0.019	1.9	
brown2 8	5007155.155	432690.515	97.801	0.012	0.018	9/2/2014 10:35	road centre line	97.791	-0.010	1.0	
brown2 9	5007166.177	432702.968	98.02	0.014	0.02	9/2/2014 10:37	road centre line	97.975	-0.045	4.5	
brown2 10	5007189.776	432730.150	98.339	0.012	0.02	9/2/2014 10:37	road centre line	98.294	-0.045	4.5	
hunt 1	5007275.430	432094.628	98.338	0.01	0.015	9/2/2014 10:45	edge of road	98.440	0.102	10.2	
hunt 2	5007272.912	432078.886	98.306	0.01	0.015	9/2/2014 10:45	edge of road	98.420	0.114	11.4	
hunt 3	5007270.180	432062.445	98.348	0.01	0.015	9/2/2014 10:46	edge of road	98.410	0.062	6.2	
hunt 4	5007267.356	432045.260	98.362	0.011	0.016	9/2/2014 10:46	edge of road	98.437	0.075	7.5	
hunt 5	5007264.443	432028.139	98.442	0.01	0.015	9/2/2014 10:47	edge of road	98.524	0.082	8.2	
hunt 6	5007261.551	432011.218	98.462	0.01	0.015	9/2/2014 10:48	edge of road	98.521	0.059	5.9	
hunt 7	5007258.909	431995.006	98.456	0.01	0.014	9/2/2014 10:48	edge of road	98.522	0.066	6.6	
hunt 8	5007255.657	431975.205	98.498	0.01	0.015	9/2/2014 10:49	edge of road	98.595	0.097	9.7	
hunt 9	5007253.118	431958.830	98.516	0.01	0.015	9/2/2014 10:49	edge of road	98.610	0.094	9.4	
hunt 10	5007250.389	431942.963	98.569	0.011	0.016	9/2/2014 10:50	edge of road	98.642	0.073	7.3	
hunt 11	5007247.470	431925.559	98.549	0.011	0.016	9/2/2014 10:51	edge of road	98.624	0.075	7.5	
hunt 12	5007244.751	431909.582	98.523	0.011	0.014	9/2/2014 10:51	edge of road	98.602	0.079	7.9	
hunt 13	5007241.900	431893.534	98.53	0.011	0.014	9/2/2014 10:51	edge of road	98.630	0.100	10.0	
hunt 14	5007238.894	431876.535	98.501	0.011	0.015	9/2/2014 10:52	edge of road	98.603	0.102	10.2	
hunt 15	5007236.042	431860.520	98.525	0.01	0.014	9/2/2014 10:53	edge of road	98.619	0.094	9.4	
hunt 16	5007233.041	431844.178	98.566	0.01	0.013	9/2/2014 10:54	edge of road	98.675	0.109	10.9	
hunt 17	5007229.936	431827.730	98.613	0.01	0.013	9/2/2014 10:54	edge of road	98.699	0.086	8.6	
hunt 18	5007226.844	431810.763	98.685	0.01	0.014	9/2/2014 10:55	edge of road	98.804	0.119	11.9	
hunt 19	5007220.568	431794.699	98.869	0.01	0.013	9/2/2014 10:56	road centre line	98.946	0.077	7.7	
hunt 20	5007220.493	431777.278	98.852	0.01	0.013	9/2/2014 10:58	edge of road	98.992	0.140	14.0	
hunt2 1	5008235.799	429886.313	109.652	0.01	0.013	9/2/2014 11:03	edge of road	109.690	0.038	3.8	
hunt2 2	5008250.444	429877.234	109.473	0.012	0.016	9/2/2014 11:04	edge of road	109.482	0.009	0.9	
hunt2 3	5008264.716	429868.453	109.261	0.013	0.016	9/2/2014 11:04	edge of road	109.257	-0.004	0.4	
hunt2 4	5008279.472	429859.555	109.002	0.012	0.016	9/2/2014 11:05	edge of road	109.029	0.027	2.7	
flew1 1	5008452.781	427652.607	121.726	0.013	0.017	9/2/2014 11:13	edge of road	121.775	0.049	4.9	
flew1 2	5008463.825	427665.199	121.61	0.014	0.017	9/2/2014 11:14	edge of road	121.663	0.053	5.3	
flew1 3	5008475.828	427676.615	121.574	0.013	0.018	9/2/2014 11:14	edge of road	121.615	0.041	4.1	
flew1 4	5008485.757	427690.051	121.751	0.014	0.018	9/2/2014 11:15	edge of road	121.782	0.031	3.1	

flew1 5	5008496.896	427702.632	121.811	0.014	0.019	9/2/2014 11:15	edge of road	121.887	0.076	7.6	
flew1 6	5008508.602	427716.284	121.717	0.015	0.019	9/2/2014 11:16	edge of road	121.774	0.057	5.7	
flew1 7	5008520.350	427729.874	121.646	0.013	0.02	9/2/2014 11:17	edge of road	121.700	0.054	5.4	
flew1 8	5008533.761	427745.899	121.461	0.013	0.02	9/2/2014 11:18	edge of road	121.490	0.029	2.9	
flew1 9	5008545.678	427759.089	121.23	0.013	0.02	9/2/2014 11:19	edge of road	121.286	0.056	5.6	
flew1 10	5008563.737	427779.822	121.081	0.013	0.02	9/2/2014 11:20	edge of road	121.123	0.042	4.2	
fern3 1	5008100.216	425193.622	128.206	0.009	0.014	9/2/2014 11:37	edge of road	128.198	-0.008	0.8	
fern3 2	5008088.324	425179.390	128.103	0.009	0.015	9/2/2014 11:37	edge of road	128.083	-0.020	2.0	
fern3 3	5008076.573	425165.384	128.009	0.01	0.016	9/2/2014 11:38	edge of road	127.964	-0.045	4.5	
fern3 4	5008064.678	425151.148	127.923	0.01	0.015	9/2/2014 11:39	edge of road	127.905	-0.018	1.8	
fern3 5	5008054.097	425138.552	127.871	0.01	0.015	9/2/2014 11:40	edge of road	127.851	-0.020	2.0	
fern3 6	5008042.992	425125.375	127.895	0.009	0.015	9/2/2014 11:41	edge of road	127.832	-0.063	6.3	
fern3 7	5008032.369	425112.938	127.891	0.009	0.015	9/2/2014 11:42	edge of road	127.843	-0.048	4.8	
fern3 8	5008021.442	425099.913	127.825	0.008	0.013	9/2/2014 11:42	edge of road	127.760	-0.065	6.5	
fern3 9	5008008.102	425084.226	127.757	0.01	0.016	9/2/2014 11:43	edge of road	127.735	-0.022	2.2	
fern3 10	5007997.008	425071.039	127.719	0.011	0.017	9/2/2014 11:44	edge of road	127.722	0.003	0.3	
fern4 1	5009377.717	426651.800	126.679	0.012	0.019	9/2/2014 11:54	edge of road	126.644	-0.035	3.5	
fern4 2	5009389.255	426664.730	126.885	0.008	0.012	9/2/2014 11:55	edge of road	126.881	-0.004	0.4	
fern4 3	5009402.854	426679.990	127.123	0.007	0.011	9/2/2014 11:55	edge of road	127.141	0.018	1.8	
fern4 4	5009414.626	426693.229	127.265	0.007	0.013	9/2/2014 11:56	edge of road	127.231	-0.034	3.4	
fern4 5	5009426.259	426706.189	127.205	0.009	0.014	9/2/2014 11:57	edge of road	127.217	0.012	1.2	
fern4 6	5009439.035	426720.463	126.984	0.011	0.017	9/2/2014 11:57	edge of road	126.945	-0.039	3.9	
fern4 7	5009452.829	426736.244	126.664	0.013	0.019	9/2/2014 11:58	edge of road	126.666	0.002	0.2	
fern4 8	5009464.436	426749.568	126.373	0.013	0.02	9/2/2014 11:59	edge of road	126.334	-0.039	3.9	
fern4 9	5009474.359	426761.008	126.115	0.012	0.017	9/2/2014 12:00	edge of road	126.111	-0.004	0.4	
fern4 10	5009484.650	426772.791	125.901	0.013	0.02	9/2/2014 12:01	edge of road	125.893	-0.008	0.8	
fern4 11	5009495.096	426784.835	125.768	0.013	0.019	9/2/2014 12:01	edge of road	125.719	-0.049	4.9	
fern4 12	5009507.253	426798.884	125.758	0.013	0.02	9/2/2014 12:05	edge of road	125.718	-0.040	4.0	

Mean ΔZ :

MedianΔZ :

Max ΔZ :

Min ΔZ :

4.5

4.1

16.1

0.0

0 Yes out of 458

Discarded Points											
bleeks 8	5002414.959	427040.093	110.18	0.014	0.020	8/29/2014 9:46	newly renovated bridge	108.620	-1.560	156.0	
conley 26	5002809.183	429206.861	103.44	0.014	0.020	8/29/2014 10:41	newly renovated bridge	103.067	-0.373	37.3	
conley 27	5002796.862	429217.127	103.50	0.014	0.020	8/29/2014 10:42	newly renovated bridge	103.108	-0.390	39.0	
mfield8 10	5003556.394	426266.441	113.619	0.006	0.012	8/29/2014 15:41	newly resurfaced road	113.062	-0.557	55.7	
brown2 1	5007123.022	432653.744	97.565	0.013	0.02	9/2/2014 10:28	newly renovated bridge	93.869	-3.696	369.6	
conley 28	5002784.438	429227.998	103.42	0.013	0.019	8/29/2014 10:42	newly renovated bridge	102.625	-0.791	79.1	

Appendix D

SWMHYMO Model Files

```

2      Metric units
*#***** Project Name: [Nichols]      Project Number: [M800-200-050-211]
*# Date       : 06-19-2017
*# Modeller   : [ AA ]
*# Company    : Rideau Valley Conservation Authority
*# License #  : 5329846
*#***** START           TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*%          ["100YC3H.stm"] <--storm filename, one per line for NSTORM time
*%-----|-----|
READ STORM        STORM_FILENAME=["storm.001"]
*%-----|-----|
DEFAULT VALUES    ICASEdef=[1], read and print values
                  DEFVAL_FILENAME=[ "NVal.val" ]
*%-----|-----|
*# Main Channel

CALIB NASHYD      ID=[1], NHYD=[ "M1" ], DT=[1]min, AREA=[1044.59](ha),
                  DWF=[0](cms), CN/C=[73.05], IA=[4.69](mm),
                  N=[3], TP=[4.66]hrs,
                  RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----|-----|
SAVE HYD          ID=[1], # OF PCYCLES=[1], ICASEsh=[1]
                  HYD_COMMENT=[ "Runoff Hydrograph for M1" ]
*%-----|-----|
ROUTE CHANNEL     IDout=[2], NHYD=[ "R1" ], IDin=[1],
                  RDT=[1](min),
                  CHLGTH=[5214](m), CHSLOPE=[0.18](%),
                  FPSLOPE=[0.18](%),
                  SECNUM=[1], NSEG=[ 3 ]
                  ( SEGROUGH, SEGDIST (m))=[0.05, 400] NSEG times
                  -0.035, 422
                  0.05, 823
                  ( DISTANCE (m), ELEVATION (m))=[0.00 ,121]
                  0.00 ,120.5
                  400.00 ,119.5
                  401.00 ,118.5
                  421.00 ,118.5
                  422.00 ,119.5
                  822.00 ,120.5
                  823.00 ,121
*%-----|-----|
SAVE HYD          ID=[2], # OF PCYCLES=[1], ICASEsh=[1]
                  HYD_COMMENT=[ "Routing Hydrograph for R1" ]
*%-----|-----|
CALIB NASHYD      ID=[3], NHYD=[ "M2" ], DT=[1]min, AREA=[1626.14](ha),
                  DWF=[0](cms), CN/C=[68.36], IA=[5.88](mm),
                  N=[3], TP=[2.69]hrs,
                  RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----|-----|
SAVE HYD          ID=[3], # OF PCYCLES=[1], ICASEsh=[1]
                  HYD_COMMENT=[ "Routing Hydrograph for M2" ]
*%-----|-----|
ADD HYD           IDsum=[4], NHYD=[ "N2" ], IDs to add=[2 + 3]
*%-----|-----|
SAVE HYD          ID=[4], # OF PCYCLES=[1], ICASEsh=[1]
                  HYD_COMMENT=[ "Hydrograph for N2" ]
*%-----|-----|
ROUTE CHANNEL     IDout=[5], NHYD=[ "R2" ], IDin=[4],

```

```

RDT=[1](min),
CHLNGTH=[7044](m), CHSLOPE=[0.255](%), FPSLOPE=[0.255](%),
SECNUM=[1], NSEG=[3]
( SEGROUGH, SEGDIST (m) )=[0.05, 200] NSEG times
-0.035, 232
0.05, 433
( DISTANCE (m), ELEVATION (m) )=[0.00 ,107.50]
0.00 ,107.11
200.00 ,106.11
201.00 ,105.11
231.00 ,105.11
232.00 ,106.11
432.00 ,107.11
433.00 ,107.50
*%-----|
SAVE HYD           | ID=[5], # OF PCYCLES=[1], ICASEsh=[1]
                   | HYD_COMMENT=[ "Routing Hydrograph for R2" ]
*%-----|
CALIB NASHYD      | ID=[6], NHYD=[ "M3" ], DT=[1]min, AREA=[1490.82](ha),
                   | DWF=[0](cms), CN/C=[61.98], IA=[7.79](mm),
                   | N=[3], TP=[2.65]hrs,
                   | RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|
SAVE HYD           | ID=[6], # OF PCYCLES=[1], ICASEsh=[1]
                   | HYD_COMMENT=[ "Runoff Hydrograph for M3" ]
*%-----|
ADD HYD            | IDsum=[7], NHYD=[ "N3" ], IDs to add=[6 + 5]
*%-----|
SAVE HYD           | ID=[7], # OF PCYCLES=[1], ICASEsh=[1]
                   | HYD_COMMENT=[ "Hydrograph for N3" ]
*%-----|
ROUTE CHANNEL      | IDout=[8], NHYD=[ "R3" ], IDin=[7],
                   | RDT=[1](min),
                   | CHLNGTH=[3444](m), CHSLOPE=[0.124](%), FPSLOPE=[0.124](%),
                   | SECNUM=[1], NSEG=[3]
( SEGROUGH, SEGDIST (m) )=[0.05, 400] NSEG times
-0.035, 422
0.05, 823
( DISTANCE (m), ELEVATION (m) )=[0.00 ,99.7]
0.00 ,99.5
400.00 ,99
401.00 ,98
421.00 ,98
422.00 ,99
822.00 ,99.5
823.00 ,99.7
*%-----|
SAVE HYD           | ID=[8], # OF PCYCLES=[1], ICASEsh=[1]
                   | HYD_COMMENT=[ "Routing Hydrograph for R3" ]
*%-----|
CALIB NASHYD      | ID=[9], NHYD=[ "M4" ], DT=[1]min, AREA=[351.30](ha),
                   | DWF=[0](cms), CN/C=[81.40], IA=[2.90](mm),
                   | N=[3], TP=[1.17]hrs,
                   | RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|
SAVE HYD           | ID=[9], # OF PCYCLES=[1], ICASEsh=[1]
                   | HYD_COMMENT=[ "Routing Hydrograph for M4" ]
*%-----|
ADD HYD            | IDsum=[1], NHYD=[ "N4" ], IDs to add=[9 + 8]
*%-----|
SAVE HYD           | ID=[1], # OF PCYCLES=[1], ICASEsh=[1]

```

```

HYD_COMMENT= [ "Hydrograph for N4" ]
*%-----|-----|
*% 100 Year 6 Hour Chicago Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[6]
*          [ "100YC6H.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 100 Year 12 Hour Chicago Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[7]
*          [ "100YC12H.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 100 Year 24 Hour Chicago Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[8]
*          [ "100YC24H.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*%100 Year 3 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[9]
*          [ "100YS3.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*%100 Year 6 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[10]
*          [ "100YS6.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*%100 Year 12 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[11]
*          [ "100YS12.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*%100 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[12]
*          [ "100YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 2 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[102]
*          [ "2YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 5 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[105]
*          [ "5YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 10 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[110]
*          [ "10YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 20 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[120]
*          [ "20YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 50 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[150]
*          [ "50YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 200 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[200]
*          [ "200YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 350 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[350]
*          [ "350YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
*% 500 Year 24 Hour SCS Design Storm
START      TZERO=[0.0]hrs or date, METOUT=[2], NSTORM=[1], NRUN=[500]
*          [ "500YS24.stm" ] <--storm filename, one per line for NSTORM time
*%-----|-----|
FINISH

```

```

=====
SSSSS W W M M H H Y Y M M 000      999 999 =====
S W W W MM MM H Y Y MM MM O O    9 9 9 9
SSSSS W W W M M M HHHHH Y M M M O O ## 9 9 9 9 Ver 4.05
S W W M M H H Y M M M O O     9999 9999 Sept 2011
SSSSS W W M M H H Y M M M 000      9 9 9 9 =====
                                                9 9 9 9 # 5329846
StormWater Management Hydrologic Model      999 999 =====
=====
***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.com *****
=====
***** Licensed user: Rideau Valley Conservation Authority *****
***** Manotick          SERIAL#:5329846 *****
=====
***** PROGRAM ARRAY DIMENSIONS *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points : 105408 *****
***** Max. number of flow points : 105408 *****
=====
***** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) *****
***** ID: Hydrograph IDentification numbers, (1-10). *****
***** NYHD: Hydrograph reference numbers, (6 digits or characters). *****
***** AREA: Drainage area associated with hydrograph, (ac.) or (ha.). *****
***** QPEAK: Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s). *****
***** Tpeakdate_hh:mm is the date and time of the peak flow. *****
***** R.V.: Runoff Volume of simulated hydrograph, (in) or (mm). *****
***** R.C.: Runoff Coefficient of simulated hydrograph, (ratio). *****
***** *: see WARNING or NOTE message printed at end of run. *****
***** **: see ERROR message printed at end of run. *****
=====
***** S U M M A R Y   O U T P U T *****
* DATE: 2017-07-06   TIME: 11:30:34   RUN COUNTER: 000341 *
* Input filename: C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\Nichols.da*
* Output filename: C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\Nichols.out*
* Summary filename: C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\Nichols.sum*
* User comments: *
* 1: *
* 2: *
* 3: *
=====
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
** END OF RUN : 2
=====

003:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:M1 1044.59 10.042 No_date 6:06 29.76 n/a
[RTD= 1.00] out-> 02:R1 1044.59 8.900 No_date 7:35 29.76 n/a
[L/S/n= 5214. / .180/.035]
{Vmax= .819:Dmax= .589}
003:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 8.900 No_date 7:35 29.76 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-R1.003
remark:Routing Hydrograph for R1
003:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 21.996 No_date 4:12 25.25 .339
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
003:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 21.996 No_date 4:12 25.25 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-M2.003
remark:Routing Hydrograph for M2
003:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 8.900 No_date 7:35 29.76 n/a
+ 03:M2 1626.14 21.996 No_date 4:12 25.25 n/a
[DT= 1.00] SUM= 04:N2 2670.73 26.404 No_date 4:44 27.01 n/a
003:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 26.404 No_date 4:44 27.01 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-N2.003
remark:Hydrograph for N2
003:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 26.404 No_date 4:44 27.01 n/a
[RTD= 1.00] out-> 05:R2 2670.73 22.155 No_date 6:14 27.01 n/a
[L/S/n= 7044. / .255/.035]
{Vmax= 1.151:Dmax= .745}
003:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 22.155 No_date 6:14 27.01 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-R2.003
remark:Routing Hydrograph for R2
003:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 16.147 No_date 4:12 19.96 .268
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
003:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 16.147 No_date 4:12 19.96 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-M3.003
remark:Runoff Hydrograph for M3
003:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 16.147 No_date 4:12 19.96 n/a
+ 05:R2 2670.73 22.155 No_date 6:14 27.01 n/a
[DT= 1.00] SUM= 07:N3 4161.55 35.029 No_date 5:18 24.49 n/a
003:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 35.029 No_date 5:18 24.49 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-N3.003
remark:Hydrograph for N3
003:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 35.029 No_date 5:18 24.49 n/a
[RTD= 1.00] out-> 08:R3 4161.55 30.376 No_date 7:46 24.49 n/a
[L/S/n= 3444. / .124/.035]
{Vmax= .538:Dmax= 1.220}
003:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 30.376 No_date 7:46 24.49 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-R3.003
remark:Routing Hydrograph for R3
003:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 14.252 No_date 2:29 39.49 n/a
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
003:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 14.252 No_date 2:29 39.49 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-M4.003
remark:Routing Hydrograph for M4
** END OF RUN : 5
=====


```

```

RUN:COMMAND#
003:0001-----
START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[INSTORM= 1]
[NRUN = 3]
*****
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
*****#
003:0002-----READ STORM
  Filename = storm.001
  Comment =
  [SDT=10.00:SDUR= 3.00:PTOT= 74.43]
003:0003-----DEFAULT VALUES
  Filename = C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\NVal.val
  ICASEdv = 1 (read and print data)
  FileTitle= File comment: [RVCA Nichols Creek FPM]
  THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
  Horton's infiltration equation parameters:
  [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
  Parameters for PERVIOUS surfaces in STANDHYD:
  [Iaper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
  Parameters for IMPERVIOUS surfaces in STANDHYD:
  [IAimp= 1.57 mm] [CLI= 1.50] [MNI= .013]
  Parameters used in NASHYD:
  [Ia= 1.50 mm] [N= 3.00]
# Main Channel
003:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  CALIB NASHYD 01:M1 1044.59 10.042 No_date 6:06 29.76 .400
  [CN= 73.1: N= 3.00]
  [Tp= 4.66:DT= 1.00]
003:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 01:M1 1044.59 10.042 No_date 6:06 29.76 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\H-M1.003
  remark:Runoff Hydrograph for M1
=====


```

```

RUN:COMMAND#
006:0001-----
START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[INSTORM= 1]
[NRUN = 6]
*****
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
*****#
006:0002-----READ STORM
  Filename = storm.001
  Comment =
  [SDT=10.00:SDUR= 6.00:PTOT= 88.42]
006:0003-----DEFAULT VALUES
  Filename = C:\Users\AAHMED-1.000\Desktop\NI1CHO-1\N61-NO-1\NVal.val
  ICASEdv = 1 (read and print data)
  FileTitle= File comment: [RVCA Nichols Creek FPM]
  THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
  Horton's infiltration equation parameters:
  [Fo= 76.20 mm/hr] [Fc=13.20 mm hr] [DCAY= 4.14 /hr] [F= .00 mm]
  Parameters for PERVIOUS surfaces in STANDHYD:
  [Iaper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
  Parameters for IMPERVIOUS surfaces in STANDHYD:
  [IAimp= 1.57 mm] [CLI= 1.50] [MNI= .013]
  Parameters used in NASHYD:
  [Ia= 1.50 mm] [N= 3.00]
# Main Channel
006:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  CALIB NASHYD 01:M1 1044.59 12.697 No_date 7:39 39.51 .447
  [CN= 73.1: N= 3.00]
  [Tp= 4.66:DT= 1.00]
006:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 01:M1 1044.59 12.697 No_date 7:39 39.51 n/a
=====


```

fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.006
 remark:Runoff Hydrograph for M1
 006:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 01:M1 1044.59 12.697 No_date 7:39 39.51 n/a
 [RDT= 1.00] out<- 02:R1 1044.59 11.648 No_date 8:56 39.51 n/a
 [L/S=n= 5214. / .180/.035]
 {Vmax= .897} Dmax= .679
 006:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 02:R1 1044.59 11.648 No_date 8:56 39.51 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.006
 remark:Routing Hydrograph for R1
 006:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 03:M2 1626.14 25.861 No_date 5:34 34.05 .385
 [CN= 68.4: N= 3.00]
 [Tp= 2.69:DT= 1.00]
 006:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 03:M2 1626.14 25.861 No_date 5:34 34.05 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.006
 remark:Routing Hydrograph for M2
 006:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 02:R1 1044.59 11.648 No_date 8:56 39.51 n/a
 + 03:M2 1626.14 25.861 No_date 5:34 34.05 n/a
 [DT= 1.00] SUM= 04:N2 2670.73 32.905 No_date 6:25 36.19 n/a
 006:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 04:N2 2670.73 32.905 No_date 6:25 36.19 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.006
 remark:Hydrograph for N2
 006:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 04:N2 2670.73 32.905 No_date 6:25 36.19 n/a
 [RDT= 1.00] out<- 05:R2 2670.73 29.362 No_date 7:39 36.19 n/a
 [L/S=n= 7044. / .255/.035]
 {Vmax= 1.250} Dmax= .850
 006:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 05:R2 2670.73 29.362 No_date 7:39 36.19 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.006
 remark:Routing Hydrograph for R2
 006:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 06:M3 1490.82 19.245 No_date 5:36 27.50 .311
 [CN= 62.0: N= 3.00]
 [Tp= 2.65:DT= 1.00]
 006:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 06:M3 1490.82 19.245 No_date 5:36 27.50 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.006
 remark:Runoff Hydrograph for M3
 006:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 06:M3 1490.82 19.245 No_date 5:36 27.50 n/a
 + 05:R2 2670.73 29.362 No_date 7:39 36.19 n/a
 [DT= 1.00] SUM= 07:N3 4161.55 45.694 No_date 6:51 33.07 n/a
 006:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 07:N3 4161.55 45.694 No_date 6:51 33.07 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.006
 remark:Hydrograph for N3
 006:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 07:N3 4161.55 45.694 No_date 6:51 33.07 n/a
 [RDT= 1.00] out<- 08:R3 4161.55 38.416 No_date 9:14 33.07 n/a
 [L/S=n= 3444. / .124/.035]
 {Vmax= .461} Dmax= 1.299
 006:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 08:R3 4161.55 38.416 No_date 9:14 33.07 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.006
 remark:Routing Hydrograph for R3
 006:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 09:M4 351.30 15.730 No_date 3:26 50.95 .576
 [CN= 81.4: N= 3.00]
 [Tp= 1.17:DT= 1.00]
 006:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 09:M4 351.30 15.730 No_date 3:26 50.95 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.006
 remark:Routing Hydrograph for M4
 006:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 09:M4 351.30 15.730 No_date 3:26 50.95 n/a
 + 08:R3 4161.55 38.416 No_date 9:14 33.07 n/a
 [DT= 1.00] SUM= 01:N4 4512.85 38.719 No_date 9:03 34.47 n/a
 006:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:N4 4512.85 38.719 No_date 9:03 34.47 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N4.006
 remark:Hydrograph for N4
 ** END OF RUN : 6

 RUN:COMMAND#
 007:0001-----
 START
 [TZERO = .00 hrs on 0]
 [METOUT= 2 (1=imperial, 2=metric output)]
 [INSTORM= 1]
 [NRUN= 7]

 # Project Name: [Nichols] Project Number: [M800-200-050-211]
 # Date : 06-19-2017
 # Modeler : [AA]
 # Company : Rideau Valley Conservation Authority
 # License # : 5329846

 007:0002-----
 READ STORM
 Filename = storm.001
 Comment =
 [SDT=10.00:SDUR= 12.00:PTOT= 104.44]
 007:0003-----
 DEFAULT VALUES
 Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\Nval.val
 ICASEdv = 1 (read and print data)
 FileTitle= File comment: [RVCA Nichols Creek FPM]
 THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
 Horton's infiltration equation parameters:
 [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
 Parameters for PERVIOUS surfaces in STANDHYD:
 [IAper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
 Parameters for IMPERVIOUS surfaces in STANDHYD:
 [IAimp= 1.57 mm] [CLI= 1.50] [MNI=.013]
 Parameters used in NASHYD:
 [Ia= 1.50 mm] [N= 3.00]
 # Main Channel
 007:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 01:M1 1044.59 14.268 No_date 9:59 51.43 .492
 [CN= 73.1: N= 3.00]
 [Tp= 4.66:DT= 1.00]

007:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:M1 1044.59 14.268 No_date 9:59 51.43 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.007
 remark:Runoff Hydrograph for M1
 007:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 01:M1 1044.59 14.268 No_date 9:59 51.43 n/a
 [RDT= 1.00] out<- 02:R1 1044.59 13.454 No_date 11:19 51.43 n/a
 [L/S=n= 5214. / .180/.035]
 {Vmax= .940} Dmax= .729
 007:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 02:R1 1044.59 13.454 No_date 11:19 51.43 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.007
 remark:Routing Hydrograph for R1
 007:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 03:M2 1626.14 28.719 No_date 7:28 44.95 .430
 [CN= 68.4: N= 3.00]
 [Tp= 2.69:DT= 1.00]

007:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 03:M2 1626.14 28.719 No_date 7:28 44.95 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.007
 remark:Routing Hydrograph for M2
 007:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 02:R1 1044.59 13.454 No_date 11:19 51.43 n/a
 + 03:M2 1626.14 28.719 No_date 7:28 44.95 n/a
 [DT= 1.00] SUM= 04:N2 2670.73 36.540 No_date 8:26 47.48 n/a
 007:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 04:N2 2670.73 36.540 No_date 8:26 47.48 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.007
 remark:Hydrograph for N2
 007:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 04:N2 2670.73 36.540 No_date 8:26 47.48 n/a
 [RDT= 1.00] out<- 05:R2 2670.73 33.628 No_date 9:49 47.48 n/a
 [L/S=n= 7044. / .255/.035]
 {Vmax= 1.302} Dmax= .905

007:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 05:R2 2670.73 33.628 No_date 9:49 47.48 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.007
 remark:Routing Hydrograph for R2
 007:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 06:M3 1490.82 21.540 No_date 7:29 37.00 .354
 [CN= 62.0: N= 3.00]
 [Tp= 2.65:DT= 1.00]

007:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 06:M3 1490.82 21.540 No_date 7:29 37.00 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.007
 remark:Runoff Hydrograph for M3
 007:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 06:M3 1490.82 21.540 No_date 7:29 37.00 n/a
 + 05:R2 2670.73 33.628 No_date 9:49 47.48 n/a
 [DT= 1.00] SUM= 07:N3 4161.55 51.542 No_date 9:01 43.73 n/a
 007:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 07:N3 4161.55 51.542 No_date 9:01 43.73 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.007
 remark:Hydrograph for N3
 007:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 07:N3 4161.55 51.542 No_date 9:01 43.73 n/a
 [RDT= 1.00] out<- 08:R3 4161.55 43.879 No_date 11:47 43.73 n/a
 [L/S=n= 3444. / .124/.035]
 {Vmax= .449} Dmax= 1.327

007:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 08:R3 4161.55 43.879 No_date 11:47 43.73 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.007
 remark:Routing Hydrograph for R3
 007:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 09:M4 351.30 17.238 No_date 5:23 64.61 .619
 [CN= 81.4: N= 3.00]
 [Tp= 1.17:DT= 1.00]

007:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 09:M4 351.30 17.238 No_date 5:23 64.61 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.007
 remark:Routing Hydrograph for M4
 007:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 09:M4 351.30 17.238 No_date 5:23 64.61 n/a
 + 08:R3 4161.55 43.879 No_date 11:47 43.73 n/a
 [DT= 1.00] SUM= 01:N4 4512.85 46.065 No_date 11:47 45.35 n/a
 007:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:N4 4512.85 46.065 No_date 11:47 45.35 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N4.007
 remark:Hydrograph for N4
 ** END OF RUN : 7

RUN:COMMAND#
 008:0001-----
 START
 [TZERO = .00 hrs on 0]
 [METOUT= 2 (1=imperial, 2=metric output)]
 [INSTORM= 1]
 [NRUN= 8]

 # Project Name: [Nichols] Project Number: [M800-200-050-211]
 # Date : 06-19-2017
 # Modeler : [AA]
 # Company : Rideau Valley Conservation Authority
 # License # : 5329846

 008:0002-----
 READ STORM
 Filename = storm.001
 Comment =
 [SDT=10.00:SDUR= 24.00:PTOT= 123.02]

008:0003-----
 DEFAULT VALUES
 Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\Nval.val
 ICASEdv = 1 (read and print data)
 FileTitle= File comment: [RVCA Nichols Creek FPM]
 THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
 Horton's infiltration equation parameters:
 [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
 Parameters for PERVIOUS surfaces in STANDHYD:
 [IAper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
 Parameters for IMPERVIOUS surfaces in STANDHYD:
 [IAimp= 1.57 mm] [CLI= 1.50] [MNI=.013]
 Parameters used in NASHYD:
 [Ia= 1.50 mm] [N= 3.00]
 # Main Channel
 008:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 01:M1 1044.59 15.673 No_date 13:50 66.03 .537
 [CN= 73.1: N= 3.00]
 [Tp= 4.66:DT= 1.00]

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[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
008:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:M1 1044.59 15.673 No_date 13:50 66.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.008
remark:Runoff Hydrograph for M1
008:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:M1 1044.59 15.673 No_date 13:50 66.03 n/a
[RDT= 1.00] out<- 02:R1 1044.59 14.869 No_date 15:08 66.03 n/a
[L/S#= 5214./ .180/.035]
[Vmax= .974:Dmax= .772]
008:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 14.869 No_date 15:08 66.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.008
remark:Routing Hydrograph for R1
008:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 31.938 No_date 11:22 58.46 .475
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
008:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 31.938 No_date 11:22 58.46 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.008
remark:Routing Hydrograph for M2
008:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 14.869 No_date 15:08 66.03 n/a
+ 03:M2 1626.14 31.938 No_date 11:22 58.46 n/a
[DT= 1.00] SUM= 04:N2 2670.73 40.728 No_date 12:20 61.42 n/a
008:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 40.728 No_date 12:20 61.42 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.008
remark:Hydrograph for N2
008:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 40.728 No_date 12:20 61.42 n/a
[RDT= 1.00] out<- 05:R2 2670.73 37.422 No_date 13:36 61.42 n/a
[L/S#= 7044./ .255/.035]
[Vmax= 1.356:Dmax= .966]
008:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 37.422 No_date 13:36 61.42 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.008
remark:Routing Hydrograph for R2
008:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 24.189 No_date 11:23 48.99 .398
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
008:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 24.189 No_date 11:23 48.99 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.008
remark:Runoff Hydrograph for M3
008:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 24.189 No_date 11:23 48.99 n/a
+ 05:R2 2670.73 37.422 No_date 13:36 61.42 n/a
[DT= 1.00] SUM= 07:N3 4161.55 57.827 No_date 12:46 56.97 n/a
008:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 57.827 No_date 12:46 56.97 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.008
remark:Hydrograph for N3
008:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 57.827 No_date 12:46 56.97 n/a
[RDT= 1.00] out<- 08:R3 4161.55 48.179 No_date 15:27 56.97 n/a
[L/S#= 3444./ .124/.035]
[Vmax= .438:Dmax= 1.358]
008:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 48.179 No_date 15:27 56.97 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.008
remark:Routing Hydrograph for R3
008:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 18.700 No_date 9:21 80.98 .658
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
008:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 18.700 No_date 9:21 80.98 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.008
remark:Routing Hydrograph for M4
** END OF RUN : 8
*****
```

```

RUN:COMMAND#
009:0001-----START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[NSTORM= 1]
[NRUN= 9]
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
*****009:0002-----READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 3.00:PTOT= 74.46]
009:0003-----DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\Nval.val
ICASEdv = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
[Fo= 76.20 mm/hr] [Fc=13.20 mm hr] [DCAY= 4.14 /hr] [F= .00 mm]
Parameters for PERVIOUS surfaces in STANDHYD:
[IAper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
[IAimp= 1.57 mm] [CLI= 1.50] [MNI=.013]
Parameters used in NASHYD:
[fa= 1.50 mm] [N= 3.00]
# Main Channel
```

```

009:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 01:M1 1044.59 10.109 No_date 6:22 29.78 .400
[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
009:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:M1 1044.59 10.109 No_date 6:22 29.78 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.009
remark:Runoff Hydrograph for M1
009:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:M1 1044.59 10.109 No_date 6:22 29.78 n/a
[RDT= 1.00] out<- 02:R1 1044.59 8.946 No_date 7:51 29.78 n/a
[L/S#= 5214./ .180/.035]
[Vmax= .821:Dmax= .592]
009:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 8.946 No_date 7:51 29.78 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.009
remark:Routing Hydrograph for R1
009:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 22.442 No_date 4:27 25.27 .339
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
009:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 22.442 No_date 4:27 25.27 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.009
remark:Routing Hydrograph for M2
009:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 8.946 No_date 7:51 29.78 n/a
+ 03:M2 1626.14 22.442 No_date 4:27 25.27 n/a
[DT= 1.00] SUM= 04:N2 2670.73 26.727 No_date 4:58 27.03 n/a
009:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 26.727 No_date 4:58 27.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.009
remark:Hydrograph for N2
009:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 26.727 No_date 4:58 27.03 n/a
[RDT= 1.00] out<- 05:R2 2670.73 22.288 No_date 6:28 27.03 n/a
[L/S#= 7044./ .255/.035]
[Vmax= 1.158:Dmax= .751]
009:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 22.288 No_date 6:28 27.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.009
remark:Routing Hydrograph for R2
009:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 16.498 No_date 4:26 19.98 .268
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
009:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 16.498 No_date 4:26 19.98 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.009
remark:Runoff Hydrograph for M3
009:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 16.498 No_date 4:26 19.98 n/a
+ 05:R2 2670.73 22.288 No_date 6:28 27.03 n/a
[DT= 1.00] SUM= 07:N3 4161.55 35.366 No_date 5:32 24.51 n/a
009:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 35.366 No_date 5:32 24.51 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.009
remark:Hydrograph for N3
009:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 35.366 No_date 5:32 24.51 n/a
[RDT= 1.00] out<- 08:R3 4161.55 35.366 No_date 7:59 24.51 n/a
[L/S#= 3444./ .124/.035]
[Vmax= .536:Dmax= 1.223]
009:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 30.626 No_date 7:59 24.51 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.009
remark:Routing Hydrograph for R3
009:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 15.113 No_date 2:52 39.52 .531
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
009:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 15.113 No_date 2:52 39.52 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.009
remark:Routing Hydrograph for M4
** END OF RUN : 9
*****
```

```

RUN:COMMAND#
010:0001-----START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[NSTORM= 1]
[NRUN= 10]
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
*****010:0002-----READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 6.00:PTOT= 88.43]
010:0003-----DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\Nval.val
ICASEdv = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
[Fo= 76.20 mm/hr] [Fc=13.20 mm hr] [DCAY= 4.14 /hr] [F= .00 mm]
Parameters for PERVIOUS surfaces in STANDHYD:
[IAper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
[IAimp= 1.57 mm] [CLI= 1.50] [MNI=.013]
Parameters used in NASHYD:
[fa= 1.50 mm] [N= 3.00]
# Main Channel
```

```

[ia= 1.50 mm] [N= 3.00]
# Main Channel
010:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 01:M1 1044.59 13.064 No_date 8:09 39.52 .447
[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
010:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:M1 1044.59 13.064 No_date 8:09 39.52 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.010
remark:Runoff Hydrograph for M1
010:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:M1 1044.59 13.064 No_date 8:09 39.52 n/a
[RDT= 1.00] out< 02:R1 1044.59 11.899 No_date 9:27 39.52 n/a
[L/S/n= 5214./ .180/.035]
{Vmax= .906:Dmax=.690}
010:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 11.899 No_date 9:27 39.52 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.010
remark:Routing Hydrograph for R1
010:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 27.885 No_date 6:14 34.06 .385
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
010:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 27.885 No_date 6:14 34.06 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.010
remark:Routing Hydrograph for M2
010:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 11.899 No_date 9:27 39.52 n/a
+ 03:M2 1626.14 27.885 No_date 6:14 34.06 n/a
[DRT= 1.00] SUM= 04:N2 2670.73 34.706 No_date 6:51 36.19 n/a
010:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 34.706 No_date 6:51 36.19 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.010
remark:Hydrograph for N2
010:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 34.706 No_date 6:51 36.19 n/a
[RDT= 1.00] out< 05:R2 2670.73 30.353 No_date 8:07 36.19 n/a
[L/S/n= 7044./ .255/.035]
{Vmax= 1.279:Dmax=.878}
010:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 30.353 No_date 8:07 36.19 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.010
remark:Routing Hydrograph for R2
010:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 20.859 No_date 6:15 27.50 .311
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
010:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 20.859 No_date 6:15 27.50 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.010
remark:Runoff Hydrograph for M3
010:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 20.859 No_date 6:15 27.50 n/a
+ 05:R2 2670.73 30.353 No_date 8:07 36.19 n/a
[DRT= 1.00] SUM= 07:N3 4161.55 47.830 No_date 7:17 33.08 n/a
010:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 47.830 No_date 7:17 33.08 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.010
remark:Hydrograph for N3
010:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 47.830 No_date 7:17 33.08 n/a
[RDT= 1.00] out< 08:R3 4161.55 39.362 No_date 9:43 33.08 n/a
[L/S/n= 3444./ .124/.035]
{Vmax= .456:Dmax= 1.310}
010:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 39.362 No_date 9:43 33.08 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.010
remark:Routing Hydrograph for R3
010:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 17.010 No_date 4:17 50.96 .576
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
010:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 17.010 No_date 4:17 50.96 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.010
remark:Routing Hydrograph for M4
010:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 09:M4 351.30 17.010 No_date 4:17 50.96 n/a
+ 08:R3 4161.55 39.362 No_date 9:43 33.08 n/a
[DRT= 1.00] SUM= 01:N4 4512.85 39.526 No_date 9:39 34.47 n/a
010:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:N4 4512.85 39.526 No_date 9:39 34.47 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N4.010
remark:Hydrograph for N4
** END OF RUN : 10
*****
```

```

RUN:COMMAND#
011:0001-----START
[TZERO = .00 hrs on 0]
[METOUT= 2 (1=imperial, 2=metric output)]
[INSTORM= 1]
[NRUN= 11]
***** Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
***** READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 12.00:PTOT= 104.44]
011:0003-----DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\NVal.val
ICASEdv = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
[Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
Parameters for PERVIOUS surfaces in STANDHYD:
[IAper= 4.67 mm] [LGP=40.00 mm] [MNP=.250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
```

```

[IAimp= 1.57 mm] [CLI= 1.50] [MNI= .013]
Parameters used in NASHYD:
[ia= 1.50 mm] [N= 3.00]
# Main Channel
011:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 01:M1 1044.59 15.418 No_date 11:31 51.44 .492
[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
011:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:M1 1044.59 15.418 No_date 11:31 51.44 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.011
remark:Runoff Hydrograph for M1
011:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:M1 1044.59 15.418 No_date 11:31 51.44 n/a
[RDT= 1.00] out< 02:R1 1044.59 14.521 No_date 12:41 51.44 n/a
[L/S/n= 5214./ .180/.035]
{Vmax= .969:Dmax=.764}
011:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 14.521 No_date 12:41 51.44 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.011
remark:Routing Hydrograph for R1
011:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 31.760 No_date 9:09 44.95 .430
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
011:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 31.760 No_date 9:09 44.95 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.010
remark:Routing Hydrograph for M2
011:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 14.521 No_date 12:41 51.44 n/a
+ 03:M2 1626.14 31.760 No_date 9:09 44.95 n/a
[DRT= 1.00] SUM= 04:N2 2670.73 40.274 No_date 10:01 47.49 n/a
011:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 40.274 No_date 10:01 47.49 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.011
remark:Hydrograph for N2
011:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 40.274 No_date 10:01 47.49 n/a
[RDT= 1.00] out< 05:R2 2670.73 36.752 No_date 11:20 47.49 n/a
[L/S/n= 7044./ .255/.035]
{Vmax= 1.350:Dmax=.959}
011:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 36.752 No_date 11:20 47.49 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.011
remark:Routing Hydrograph for R2
011:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 24.043 No_date 9:09 37.00 .354
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
011:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 24.043 No_date 9:09 37.00 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.011
remark:Runoff Hydrograph for M3
011:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 24.043 No_date 9:09 37.00 n/a
+ 05:R2 2670.73 36.752 No_date 11:20 47.49 n/a
[DRT= 1.00] SUM= 07:N3 4161.55 57.012 No_date 10:26 43.73 n/a
011:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 57.012 No_date 10:26 43.73 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.011
remark:Hydrograph for N3
011:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 57.012 No_date 10:26 43.73 n/a
[RDT= 1.00] out< 08:R3 4161.55 47.205 No_date 13:27 43.73 n/a
[L/S/n= 3444./ .124/.035]
{Vmax= .439:Dmax= 1.354}
011:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 47.205 No_date 13:27 43.73 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.011
remark:Routing Hydrograph for R3
011:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 18.812 No_date 7:11 64.61 .619
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
011:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 18.812 No_date 7:11 64.61 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.011
remark:Routing Hydrograph for M4
011:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 09:M4 351.30 18.812 No_date 7:11 64.61 n/a
+ 08:R3 4161.55 47.205 No_date 13:27 43.73 n/a
[DRT= 1.00] SUM= 01:N4 4512.85 48.712 No_date 12:44 45.36 n/a
011:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:N4 4512.85 48.712 No_date 12:44 45.36 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N4.011
remark:Hydrograph for N4
** END OF RUN : 11
*****
```

```

RUN:COMMAND#
012:0001-----START
[TZERO = .00 hrs on 0]
[METOUT= 2 (1=imperial, 2=metric output)]
[INSTORM= 1]
[NRUN= 12]
***** Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
***** READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 12.00:PTOT= 123.01]
012:0003-----DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\NVal.val
ICASEdv = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
[Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
Parameters for PERVIOUS surfaces in STANDHYD:
[IAper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
```

```

[IAPER= 4.67 mm] [LGP=40.00 m] [MNP=.250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
[IAIMP= 1.57 mm] [CLI= 1.50] [MNI= 0.013]
Parameters used in NASHYD:
[IA= 1.50 mm] [N= 3.00]
# Main Channel
012:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 01:MI 1044.59 17.141 No_date 17:15 66.03 .537
[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
012:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:MI 1044.59 17.141 No_date 17:15 66.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M1.012
remark:Runoff Hydrograph for MI
012:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:MI 1044.59 17.141 No_date 17:15 66.03 n/a
[RDT= 1.00] out-< 02:R1 1044.59 16.194 No_date 18:28 66.03 n/a
[L/S=n 5214./.180/.035]
[Vmax= 1.006:Dmax=.814]
012:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 16.194 No_date 18:28 66.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R1.012
remark:Routing Hydrograph for R1
012:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:MI 1626.14 35.830 No_date 14:55 58.46 .475
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
012:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:MI 1626.14 35.830 No_date 14:55 58.46 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M2.012
remark:Routing Hydrograph for M2
012:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 16.194 No_date 18:28 66.03 n/a
+ 03:M2 1626.14 35.830 No_date 14:55 58.46 n/a
[L/S=n 5214./.180/.035]
[Dt= 1.00] SUM= 04:N2 2670.73 45.579 No_date 15:39 61.42 n/a
012:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 45.579 No_date 15:39 61.42 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N2.012
remark:Hydrograph for N2
012:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 45.579 No_date 15:39 61.42 n/a
[RDT= 1.00] out-< 05:R2 2670.73 42.107 No_date 16:56 61.42 n/a
[L/S=n 7044./.255/.035]
[Vmax= 1.390:Dmax= 1.031]
012:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 42.107 No_date 16:56 61.42 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R2.012
remark:Routing Hydrograph for R2
012:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 27.516 No_date 14:55 48.98 .398
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
012:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 27.516 No_date 14:55 48.98 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M3.012
remark:Runoff Hydrograph for M3
012:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 27.516 No_date 14:55 48.98 n/a
+ 05:R2 2670.73 42.107 No_date 16:56 61.42 n/a
[L/S=n 7044./.255/.035]
[Dt= 1.00] SUM= 07:N3 4161.55 65.043 No_date 16:12 56.96 n/a
012:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 65.043 No_date 16:12 56.96 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N3.012
remark:Hydrograph for N3
012:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 65.043 No_date 16:12 56.96 n/a
[RDT= 1.00] out-< 08:R3 4161.55 53.455 No_date 18:45 56.96 n/a
[L/S=n 3444./.124/.035]
[Vmax= .425:Dmax= 1.392]
012:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 53.455 No_date 18:45 56.96 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-R3.012
remark:Routing Hydrograph for R3
012:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 20.528 No_date 13:06 80.98 .658
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
012:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 20.528 No_date 13:06 80.98 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-M4.012
remark:Routing Hydrograph for M4
012:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 09:M4 351.30 20.528 No_date 13:06 80.98 n/a
+ 08:R3 4161.55 53.455 No_date 18:45 56.96 n/a
[L/S=n 1021./.124/.035]
[Dt= 1.00] SUM= 01:N4 4512.85 55.562 No_date 18:39 58.83 n/a
012:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:N4 4512.85 55.562 No_date 18:39 58.83 n/a
fname :C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\H-N4.012
remark:Hydrograph for N4
** END OF RUN : 101
*****
```

```

RUN:COMMAND#
102:0001-----START
[TZERO = .00 hrs on 0]
[METOUT= 2 (1=imperial, 2=metric output)]
[INSTORM= 1]
[NRUN= 102]
*****#
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
*****#
102:0002-----READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 24.00:PTOT= 50.07]
102:0003-----DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\NVal.val
ICASEdV = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
```

```

RUN:COMMAND#
105:0001-----START
[TZERO = .00 hrs on 0]
[METOUT= 2 (1=imperial, 2=metric output)]
[INSTORM= 1]
[NRUN= 105]
*****#
# Project Name: [Nichols] Project Number: [M800-200-050-211]
# Date : 06-19-2017
# Modeler : [ AA ]
# Company : Rideau Valley Conservation Authority
# License # : 5329846
*****#
105:0002-----READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 24.00:PTOT= 70.01]
105:0003-----DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\NLICHO-1\N61-NO-1\NVal.val
ICASEdV = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
```

THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
[Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
Parameters for PERVIOUS surfaces in STANDHYD:
[TAPER= 4.67 mm] [LGP=40.00 mm] [MNP= .250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
[IAIMP= 1.57 mm] [CLI= 1.50] [MNI= .013]
Parameters used in NASHYD:
[IA= 1.50 mm] [N= 3.00]

Main Channel

105:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 01:MI 1044.59 6.843 No_date 17:26 26.83 .383
[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
105:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:MI 1044.59 6.843 No_date 17:26 26.83 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M1.105
remark:Runoff Hydrograph for M1
105:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:MI 1044.59 6.843 No_date 17:26 26.83 n/a
[RDT= 1.00] out< 02:RL 1044.59 6.127 No_date 19:14 26.83 n/a
[L/S/n= 5214./.180/.035]
{Vmax= .704:Dmax=.467}
105:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 6.127 No_date 19:14 26.83 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R1.105
remark:Routing Hydrograph for R1
105:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 13.512 No_date 15:02 22.63 .323
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
105:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 13.512 No_date 15:02 22.63 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M2.105
remark:Routing Hydrograph for M2
105:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 6.127 No_date 19:14 26.83 n/a
+ 03:M2 1626.14 13.512 No_date 15:02 22.63 n/a
[Dt= 1.00] SUM= 04:N2 2670.73 16.530 No_date 16:00 24.27 n/a
105:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 16.530 No_date 16:00 24.27 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N2.105
remark:Hydrograph for N2
105:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 16.530 No_date 16:00 24.27 n/a
[RDT= 1.00] out< 05:R2 2670.73 14.291 No_date 17:52 24.27 n/a
[L/S/n= 7044./.255/.035]
{Vmax= .953:Dmax=.560}
105:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 14.291 No_date 17:52 24.27 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R2.105
remark:Routing Hydrograph for R2
105:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 9.657 No_date 15:03 17.75 .254
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
105:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 9.657 No_date 15:03 17.75 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M3.105
remark:Runoff Hydrograph for M3
105:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 9.657 No_date 15:03 17.75 n/a
+ 05:R2 2670.73 14.291 No_date 17:52 24.27 n/a
[Dt= 1.00] SUM= 07:N3 4161.55 21.758 No_date 16:48 21.94 n/a
105:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 21.758 No_date 16:48 21.94 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N3.105
remark:Hydrograph for N3
105:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 21.758 No_date 16:48 21.94 n/a
[RDT= 1.00] out< 08:R3 4161.55 20.885 No_date 17:57 21.94 n/a
[L/S/n= 3444./.124/.035]
{Vmax= .874:Dmax=1.041}
105:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 20.885 No_date 17:57 21.94 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R3.105
remark:Routing Hydrograph for R3
105:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 8.987 No_date 13:08 35.98 .514
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
105:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 8.987 No_date 13:08 35.98 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M4.105
remark:Routing Hydrograph for M4
105:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 09:M4 351.30 8.987 No_date 13:08 35.98 n/a
+ 08:R3 4161.55 20.885 No_date 17:57 21.94 n/a
[Dt= 1.00] SUM= 01:N4 4512.85 22.057 No_date 17:57 23.03 n/a
105:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:N4 4512.85 22.057 No_date 17:57 23.03 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N4.105
remark:Hydrograph for N4
** END OF RUN : 109

RUN:COMMAND#
110:0001-----
START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[NSTORM= 1]
[NRUN= 110]

Project Name: [Nichols] Project Number: [M800-200-050-211]
Date : 06-19-2017
Modeler : [AA]
Company : Rideau Valley Conservation Authority
License # : 5329846

110:0002-----
READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 24.00:PTOT= 82.59]
110:0003-----
DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\Nval.val

RUN:COMMAND#
120:0001-----
START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[NSTORM= 1]
[NRUN= 120]

Project Name: [Nichols] Project Number: [M800-200-050-211]
Date : 06-19-2017
Modeler : [AA]
Company : Rideau Valley Conservation Authority
License # : 5329846

120:0002-----
READ STORM
Filename = storm.001
Comment =
[SDT=30.00:SDUR= 24.00:PTOT= 95.06]
120:0003-----

DEFAULT VALUES
 Filename = C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\Nval.val
 ICASEdvy = 1 (read and print data)
 FileTitle= File comment : [RVCA Nichols Creek FPM]
 THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
 Horton's infiltration equation parameters:
 [Foc= 76.20 mm/hr] [Fc=13.20 mm hr] [DCAY= 4.14 /hr] [F= .00 mm]
 Parameters for PERVIOUS surfaces in STANDHYD:
 [IAPER= 4.67 mm] [LGP=40.00 m] [MNPD=.250]
 Parameters for IMPERVIOUS surfaces in STANDHYD:
 [IAIMP= 1.57 mm] [CLI= 1.50] [MNI= .013]
 Parameters used in NASHYD:
 [IA= 1.50 mm] [N= 3.00]
Main Channel
120:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 01:M1 1044.59 11.435 No_date 17:19 44.37 467
 [CN= 73.1: N= 3.00]
 [Tp= 4.66:DT= 1.00]
120:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:M1 1044.59 11.435 No_date 17:19 44.37 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M1.120
 remark:Runoff Hydrograph for M1
120:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 01:M1 1044.59 11.435 No_date 17:19 44.37 n/a
 [RDT= 1.00] out<- 02:R1 1044.59 10.621 No_date 18:40 44.36 n/a
 [/S/n= 5214/.180/.035]
 {Vmax= .865:Dmax= .638}
120:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 02:R1 1044.59 10.621 No_date 18:40 44.36 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-R1.120
 remark:Routing Hydrograph for R1
120:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 03:M2 1626.14 23.329 No_date 14:58 38.47 405
 [CN= 68.4: N= 3.00]
 [Tp= 2.69:DT= 1.00]
120:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 03:M2 1626.14 23.329 No_date 14:58 38.47 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M2.120
 remark:Routing Hydrograph for M2
120:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 02:R1 1044.59 10.621 No_date 18:40 44.36 n/a
 + 03:M2 1626.14 23.329 No_date 14:58 38.47 n/a
 [DT= 1.00] SUM= 04:N2 2670.73 29.252 No_date 15:54 40.77 n/a
120:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 04:N2 2670.73 29.252 No_date 15:54 40.77 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-N2.120
 remark:Hydrograph for N2
120:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 04:N2 2670.73 29.252 No_date 15:54 40.77 n/a
 [RDT= 1.00] out<- 05:R2 2670.73 26.271 No_date 17:19 40.77 n/a
 [/S/n= 7044/.255/.035]
 {Vmax= 1.194:Dmax= .791}
120:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 05:R2 2670.73 26.271 No_date 17:19 40.77 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-R2.120
 remark:Routing Hydrograph for R2
120:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 06:M3 1490.82 17.376 No_date 14:58 31.33 330
 [CN= 62.0: N= 3.00]
 [Tp= 2.65:DT= 1.00]
120:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 06:M3 1490.82 17.376 No_date 14:58 31.33 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M3.120
 remark:Runoff Hydrograph for M3
120:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 06:M3 1490.82 17.376 No_date 14:58 31.33 n/a
 + 05:R2 2670.73 26.271 No_date 17:19 40.77 n/a
 [DT= 1.00] SUM= 07:N3 4161.55 40.390 No_date 16:26 37.39 n/a
120:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 07:N3 4161.55 40.390 No_date 16:26 37.39 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-N3.120
 remark:Hydrograph for N3
120:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 07:N3 4161.55 40.390 No_date 16:26 37.39 n/a
 [RDT= 1.00] out<- 08:R3 4161.55 34.881 No_date 19:24 37.39 n/a
 [/S/n= 3444/.124/.035]
 {Vmax= .497:Dmax= 1.260}
120:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 08:R3 4161.55 34.881 No_date 19:24 37.39 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-R3.120
 remark:Routing Hydrograph for R3
120:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 09:M4 351.30 14.263 No_date 13:07 56.55 595
 [CN= 81.4: N= 3.00]
 [Tp= 1.17:DT= 1.00]
120:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 09:M4 351.30 14.263 No_date 13:07 56.55 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M4.120
 remark:Routing Hydrograph for M4
120:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 09:M4 351.30 14.263 No_date 13:07 56.55 n/a
 + 08:R3 4161.55 34.881 No_date 19:24 37.39 n/a
 [DT= 1.00] SUM= 01:N4 4512.85 36.398 No_date 18:43 38.88 n/a
120:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:N4 4512.85 36.398 No_date 18:43 38.88 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-N4.120
 remark:Hydrograph for N4
** END OF RUN : 149

RUN:COMMAND#
150:0001-----
 START
 [TZERO = .00 hrs on 0]
 [METOUT= 2 (l=imperial, 2=metric output)]
 [INSTORM= 1]
 [NRUN = 150]

Project Name: [Nichols] Project Number: [M800-200-050-211]
Date : 06-19-2017
Modeler : [AA]
Company : Rideau Valley Conservation Authority
License # : 5329846

150:0002-----
 READ STORM
 Filename = storm.001
 Comment =

[SDT=30.00:SDUR= 24.00:PTOT= 110.93]
150:0003-----
 DEFAULT VALUES
 Filename = C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\Nval.val
 ICASEdvy = 1 (read and print data)
 FileTitle= File comment : [RVCA Nichols Creek FPM]
 THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
 Horton's infiltration equation parameters:
 [Foc= 76.20 mm/hr] [Fc=13.20 mm hr] [DCAY= 4.14 /hr] [F= .00 mm]
 Parameters for PERVIOUS surfaces in STANDHYD:
 [IAPER= 4.67 mm] [LGP=40.00 m] [MNPD=.250]
 Parameters for IMPERVIOUS surfaces in STANDHYD:
 [IAIMP= 1.57 mm] [CLI= 1.50] [MNI= .013]
 Parameters used in NASHYD:
 [IA= 1.50 mm] [N= 3.00]
Main Channel
150:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 01:M1 1044.59 14.611 No_date 17:17 56.44 509
 [CN= 73.1: N= 3.00]
 [Tp= 4.66:DT= 1.00]
150:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:M1 1044.59 14.611 No_date 17:17 56.44 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M1.150
 remark:Runoff Hydrograph for M1
150:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 01:M1 1044.59 14.611 No_date 17:17 56.44 n/a
 [RDT= 1.00] out<- 02:R1 1044.59 13.698 No_date 18:33 56.44 n/a
 [/S/n= 5214/.180/.035]
 {Vmax= .950:Dmax= .740}
150:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 02:R1 1044.59 13.698 No_date 18:33 56.44 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-R1.150
 remark:Routing Hydrograph for R1
150:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 03:M2 1626.14 30.251 No_date 14:56 49.57 447
 [CN= 68.4: N= 3.00]
 [Tp= 2.69:DT= 1.00]
150:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 03:M2 1626.14 30.251 No_date 14:56 49.57 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M2.150
 remark:Routing Hydrograph for M2
150:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 02:R1 1044.59 13.698 No_date 18:33 56.44 n/a
 + 03:M2 1626.14 30.251 No_date 14:56 49.57 n/a
 [DT= 1.00] SUM= 04:N2 2670.73 38.228 No_date 15:45 52.26 n/a
150:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 04:N2 2670.73 38.228 No_date 15:45 52.26 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-N2.150
 remark:Hydrograph for N2
150:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 04:N2 2670.73 38.228 No_date 15:45 52.26 n/a
 [RDT= 1.00] out<- 05:R2 2670.73 34.863 No_date 17:07 52.26 n/a
 [/S/n= 7044/.255/.035]
 {Vmax= 1.323:Dmax= .930}
150:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 05:R2 2670.73 34.863 No_date 17:07 52.26 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-R2.150
 remark:Routing Hydrograph for R2
150:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 06:M3 1490.82 22.955 No_date 14:56 41.08 370
 [CN= 62.0: N= 3.00]
 [Tp= 2.65:DT= 1.00]
150:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 06:M3 1490.82 22.955 No_date 14:56 41.08 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M3.150
 remark:Runoff Hydrograph for M3
150:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 06:M3 1490.82 22.955 No_date 14:56 41.08 n/a
 + 05:R2 2670.73 34.863 No_date 17:07 52.26 n/a
 [DT= 1.00] SUM= 07:N3 4161.55 54.029 No_date 16:19 48.25 n/a
150:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 07:N3 4161.55 54.029 No_date 16:19 48.25 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-N3.150
 remark:Hydrograph for N3
150:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ROUTE CHANNEL -> 07:N3 4161.55 54.029 No_date 16:19 48.25 n/a
 [RDT= 1.00] out<- 08:R3 4161.55 44.984 No_date 19:06 48.25 n/a
 [/S/n= 3444/.124/.035]
 {Vmax= .444:Dmax= 1.339}
150:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 08:R3 4161.55 44.984 No_date 19:06 48.25 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-R3.150
 remark:Routing Hydrograph for R3
150:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 CALIB NASHYD 09:M4 351.30 17.780 No_date 13:06 70.27 633
 [CN= 81.4: N= 3.00]
 [Tp= 1.17:DT= 1.00]
150:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 09:M4 351.30 17.780 No_date 13:06 70.27 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-M4.150
 remark:Routing Hydrograph for M4
150:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 ADD HYD 09:M4 351.30 17.780 No_date 13:06 70.27 n/a
 + 08:R3 4161.55 44.984 No_date 19:06 48.25 n/a
 [DT= 1.00] SUM= 01:N4 4512.85 46.774 No_date 19:05 49.97 n/a
150:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
 SAVE HYD 01:N4 4512.85 46.774 No_date 19:05 49.97 n/a
 fname :C:\Users\AAHMED-1.000\Desktop\NIICHO-1\N61-NO-1\H-N4.150
 remark:Hydrograph for N4
** END OF RUN : 199

RUN:COMMAND#
200:0001-----
 START
 [TZERO = .00 hrs on 0]
 [METOUT= 2 (l=imperial, 2=metric output)]
 [INSTORM= 1]
 [NRUN = 200]

Project Name: [Nichols] Project Number: [M800-200-050-211]
Date : 06-19-2017
Modeler : [AA]
Company : Rideau Valley Conservation Authority
License # : 5329846

200:0002-----
 READ STORM
 READ STORM
 Comment =

```

Filename = storm.001
Comment =
[SDT=30.00:SDUR= 24.00:PTOT= 134.54]
200:0003-----
DEFAULT VALUES
Filename = C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\Nval.val
ICASEdv = 1 (read and print data)
FileTitle= File comment: [RVCA Nichols Creek FPM]
THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
Horton's infiltration equation parameters:
[Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F= .00 mm]
Parameters for PERVIOUS surfaces in STANDHYD:
[IAper= 4.67 mm] [LGP=40.00 m] [MNP= .250]
Parameters for IMPERVIOUS surfaces in STANDHYD:
[IAimp= 1.57 mm] [CLI= 1.50] [MNI= .013]
Parameters used in NASHYD:
[Ia= 1.50 mm] [N= 3.00]
# Main Channel
200:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 01:M1 1044.59 19.628 No_date 17:13 75.42 .561
[CN= 73.1: N= 3.00]
[Tp= 4.66:DT= 1.00]
200:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:M1 1044.59 19.628 No_date 17:13 75.42 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M1.200
remark:Runoff Hydrograph for M1
200:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 01:M1 1044.59 19.628 No_date 17:13 75.42 n/a
[RDT= 1.00] out<- 02:R1 1044.59 18.656 No_date 18:18 75.42 n/a
[L/S=n 5214./ .180/.035]
{Vmax= 1.062:Dmax= .884}
200:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 02:R1 1044.59 18.656 No_date 18:18 75.42 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R1.200
remark:Routing Hydrograph for R1
200:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 03:M2 1626.14 41.355 No_date 14:54 67.23 .500
[CN= 68.4: N= 3.00]
[Tp= 2.69:DT= 1.00]
200:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 03:M2 1626.14 41.355 No_date 14:54 67.23 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M2.200
remark:Routing Hydrograph for M2
200:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 02:R1 1044.59 18.656 No_date 18:18 75.42 n/a
+ 03:M2 1626.14 41.355 No_date 14:54 67.23 n/a
[DRT= 1.00] SUM= 04:N2 2670.73 52.770 No_date 15:40 70.43 n/a
200:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 04:N2 2670.73 52.770 No_date 15:40 70.43 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N2.200
remark:Hydrograph for N2
200:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 04:N2 2670.73 52.770 No_date 15:40 70.43 n/a
[RDT= 1.00] out<- 05:R2 2670.73 48.379 No_date 17:09 70.43 n/a
[L/S=n 7044./ .255/.035]
{Vmax= 1.394:Dmax= 1.120}
200:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 05:R2 2670.73 48.379 No_date 17:09 70.43 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R2.200
remark:Routing Hydrograph for R2
200:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 06:M3 1490.82 32.078 No_date 14:54 56.86 .423
[CN= 62.0: N= 3.00]
[Tp= 2.65:DT= 1.00]
200:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 06:M3 1490.82 32.078 No_date 14:54 56.86 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M3.200
remark:Runoff Hydrograph for M3
200:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 06:M3 1490.82 32.078 No_date 14:54 56.86 n/a
+ 05:R2 2670.73 48.379 No_date 17:09 70.43 n/a
[DRT= 1.00] SUM= 07:N3 4161.55 75.223 No_date 16:07 65.57 n/a
200:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 07:N3 4161.55 75.223 No_date 16:07 65.57 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N3.200
remark:Hydrograph for N3
200:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ROUTE CHANNEL -> 07:N3 4161.55 75.223 No_date 16:07 65.57 n/a
[RDT= 1.00] out<- 08:R3 4161.55 61.817 No_date 18:49 65.57 n/a
[L/S=n 3444./ .124/.035]
{Vmax= .420:Dmax= 1.429}
200:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 08:R3 4161.55 61.817 No_date 18:49 65.57 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R3.200
remark:Routing Hydrograph for R3
200:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
CALIB NASHYD 09:M4 351.30 23.190 No_date 13:05 91.36 .679
[CN= 81.4: N= 3.00]
[Tp= 1.17:DT= 1.00]
200:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 09:M4 351.30 23.190 No_date 13:05 91.36 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M4.200
remark:Routing Hydrograph for M4
200:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
ADD HYD 09:M4 351.30 23.190 No_date 13:05 91.36 n/a
+ 08:R3 4161.55 61.817 No_date 18:49 65.57 n/a
[DRT= 1.00] SUM= 01:N4 4512.85 64.130 No_date 18:46 67.58 n/a
200:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
SAVE HYD 01:N4 4512.85 64.130 No_date 18:46 67.58 n/a
fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N4.200
remark:Hydrograph for N4
** END OF RUN : 349
*****
```

```

RUN:COMMAND#
350:0001-----
START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[NSTORM= 1 ]
[NRUN = 350 ]
*****
```

Project Name: [Nichols] Project Number: [M800-200-050-211]

Date : 06-19-2017

Modeler : [AA]

Company : Rideau Valley Conservation Authority

License # : 5329846

```

RUN:COMMAND#
500:0001-----
START
[TZERO = .00 hrs on 0]
[METOUT= 2 (l=imperial, 2=metric output)]
[NSTORM= 1 ]
[NRUN = 500 ]
*****
```

Project Name: [Nichols] Project Number: [M800-200-050-211]

Date : 06-19-2017

Modeler : [AA]

Company : Rideau Valley Conservation Authority

```

# License # : 5329846
***** READ STORM *****
500:0002-----READ STORM
  Filename = storm.001
  Comment =
  [SDT=30.00:SDUR= 24.00:PTOT= 150.87]
500:0003-----DEFAULT VALUES
  FileTitle= File comment: [RVCA Nichols Creek FPM]
  THE FOLLOWING PARAMETERS ARE USED IN THE DESIGN STANDHYD COM
  Horton's infiltration equation parameters:
  [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=.00 mm]
  Parameters for PERVIOUS surfaces in STANDHYD:
  [TAper= 4.67 mm] [LGP=40.00 m] [MNP=.250]
  Parameters for IMPERVIOUS surfaces in STANDHYD:
  [TAimp= 1.57 mm] [CLL= 1.50] [MNI=.013]
  Parameters used in NASHYD:
  [Ia= 1.50 mm] [N= 3.00]
# Main Channel
500:0004-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  CALIB NASHYD 01:M1 1044.59 23.232 No_date 17:11 89.08 .590
  [CN= 73.1: N= 3.00]
  [Tp= 4.66:DT= 1.00]
500:0005-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 01:M1 1044.59 23.232 No_date 17:11 89.08 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M1.500
  remark:Runoff Hydrograph for M1
500:0006-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  ROUTE CHANNEL -> 01:M1 1044.59 23.232 No_date 17:11 89.08 n/a
  [RDT= 1.00] out<- 02:R1 1044.59 22.186 No_date 18:14 89.08 n/a
  [L/S=n= 5214./.180/.035]
  {Vmax= 1.129:Dmax= .978}
500:0007-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 02:R1 1044.59 22.186 No_date 18:14 89.08 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R1.500
  remark:Routing Hydrograph for R1
500:0008-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  CALIB NASHYD 03:M2 1626.14 49.419 No_date 14:53 80.07 .531
  [CN= 68.4: N= 3.00]
  [Tp= 2.69:DT= 1.00]
500:0009-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 03:M2 1626.14 49.419 No_date 14:53 80.07 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M2.500
  remark:Routing Hydrograph for M2
500:0010-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  ADD HYD 02:R1 1044.59 22.186 No_date 18:14 89.08 n/a
  + 03:M2 1626.14 49.419 No_date 14:53 80.07 n/a
  [DT= 1.00] SUM= 04:N2 2670.73 63.377 No_date 15:36 83.59 n/a
500:0011-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 04:N2 2670.73 63.377 No_date 15:36 83.59 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N2.500
  remark:Hydrograph for N2
500:0012-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  ROUTE CHANNEL -> 04:N2 2670.73 63.377 No_date 15:36 83.59 n/a
  [RDT= 1.00] out<- 05:R2 2670.73 57.723 No_date 17:25 83.59 n/a
  [L/S=n= 7044./.255/.035]
  {Vmax= 1.309:Dmax= 1.222}
500:0013-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 05:R2 2670.73 57.723 No_date 17:25 83.59 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R2.500
  remark:Routing Hydrograph for R2
500:0014-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  CALIB NASHYD 06:M3 1490.82 38.807 No_date 14:53 68.49 .454
  [CN= 62.0: N= 3.00]
  [Tp= 2.65:DT= 1.00]
500:0015-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 06:M3 1490.82 38.807 No_date 14:53 68.49 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M3.500
  remark:Runoff Hydrograph for M3
500:0016-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  ADD HYD 06:M3 1490.82 38.807 No_date 14:53 68.49 n/a
  + 05:R2 2670.73 57.723 No_date 17:25 83.59 n/a
  [DT= 1.00] SUM= 07:N3 4161.55 89.235 No_date 16:05 78.18 n/a
500:0017-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 07:N3 4161.55 89.235 No_date 16:05 78.18 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N3.500
  remark:Hydrograph for N3
500:0018-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  ROUTE CHANNEL -> 07:N3 4161.55 89.235 No_date 16:05 78.18 n/a
  [RDT= 1.00] out<- 08:R3 4161.55 73.770 No_date 18:44 78.18 n/a
  [L/S=n= 3444./.124/.035]
  {Vmax= .417:Dmax= 1.476}
500:0019-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 08:R3 4161.55 73.770 No_date 18:44 78.18 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-R3.500
  remark:Routing Hydrograph for R3
500:0020-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  CALIB NASHYD 09:M4 351.30 26.988 No_date 13:05 106.28 .704
  [CN= 81.4: N= 3.00]
  [Tp= 1.17:DT= 1.00]
500:0021-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 09:M4 351.30 26.988 No_date 13:05 106.28 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-M4.500
  remark:Runoff Hydrograph for M4
500:0022-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  ADD HYD 09:M4 351.30 26.988 No_date 13:05 106.28 n/a
  + 08:R3 4161.55 73.770 No_date 18:44 78.18 n/a
  [DT= 1.00] SUM= 01:N4 4512.85 76.443 No_date 18:39 80.37 n/a
500:0023-----ID:NHYD-----AREA---QPEAK-TpeakDate_hh:mm---R.V.-R.C.-
  SAVE HYD 01:N4 4512.85 76.443 No_date 18:39 80.37 n/a
  fname :C:\Users\AAHMED-1.000\Desktop\N1ICHO-1\N61-NO-1\H-N4.500
  remark:Hydrograph for N4
500:0002-----FINISH
***** WARNINGS / ERRORS / NOTES *****
----- Simulation ended on 2017-07-06 at 11:31:01
=====
```

Appendix E

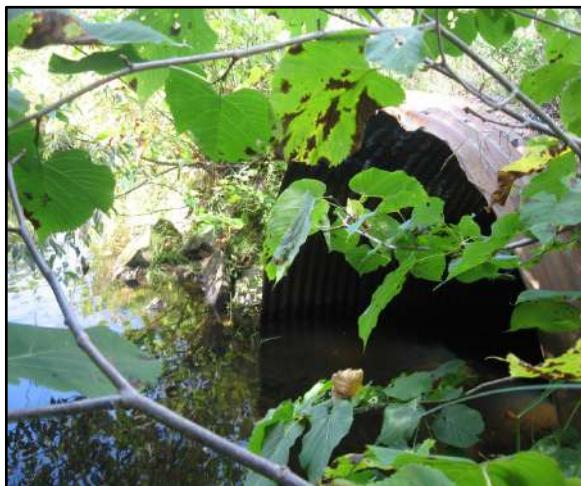
Road Crossings - Photographs



Kettles Road (Upstream)



Kettles Road (Downstream)



O'Neil Road (Upstream)



O'Neil Road (Downstream)



Dwyer Hill Road (Upstream)



Dwyer Hill Road (Downstream)



Montigue Boundary Road (Upstream)



Montigue Boundary Road (Downstream)



Kettles Road view (Upstream)



Kettles Road view (Downstream)



Dwyer Hill Road View (Upstream)



Dwyer Hill Road View (Downstream)

Appendix F

Full-Size Drawings

