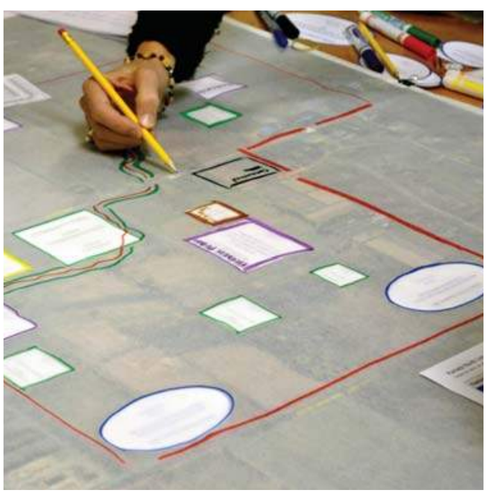
KANATA NORTH
COMMUNITY DESIGN PLAN

ENVIRONMENTAL MANAGEMENT PLAN

APPENDICES



FINAL DRAFT
JUNE 28, 2016

Engineers, Planners & Landscape Architects

KANATA NORTH COMMUNITY DESIGN PLAN

ENVIRONMENTAL MANAGEMENT PLAN

PREPARED BY:

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WITH THE ASSISTANCE OF:

GEOTECHNICAL
PATERSON GROUP INC

HYDROGEOLOGY
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NATURAL HERITAGE AND SPECIES AT RISK (ENVIRONMENT)
MUNCASTER ENVIRONMENTAL PLANNING INC.
DST
BOWFIN ENVIRONMENTAL
MCKINLEY ENVIRONMENTAL SOLUTIONS

FLUVIAL GEOMORPHOLOGY
MATRIX SOLUTIONS AND PARISH GEOMORPHIC

ARCHAEOLOGY
PATERSON GROUP INC.

INTEGRATED ENVIRONMENTAL ASSESSMENT
MORRISON HERSHFIELD GROUP INC.

JUNE/28/2016

NOVATECH FILE NO. 112117
REPORT NO. R-2016-017

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Appendix A

Scope of Work & Detailed Work Program

1.0 BACKGROUND

The Kanata North Urban Expansion (KNUEA - Area 1) is proposed to encompass approximately 181 hectares of land between the established communities of Morgan's Grant, Briarbrook, and Brookside to the south, the CN railway corridor to the east, and the Hillsview Estates Subdivision to the north, all within the West Urban Area of the City of Ottawa – Refer to Figure 1.

1.1 Study Area

The proposed limits of the study area are shown on Figures 1 and 2. The KNUEA is located within the Shirley's Brook subwatershed and is under the jurisdiction of the Mississippi Valley Conservation Authority (MVCA). Two tributaries of the Shirley's Brook Northwest Branch are located within the study area: These two tributaries merge on the east side of March Road, then flow south, entering the main branch of Shirley's Brook just downstream of Maxwell Bridge Road in the Brookside Subdivision. Downstream of the Brookside Subdivision, Shirley's Brook crosses March Valley Road and flows north through lands owned by the National Capital Commission (NCC) before ultimately flowing into the Ottawa River at Shirley's Bay.

The EMP study area includes lands to the east of the CN railway corridor that are outside of the Kanata North Urban Expansion Area (KNUEA). The lands between the CN corridor and the Main Branch of Shirley's Brook east of March Valley Road are included in the EMP study area in order to evaluate development impacts downstream of the proposed development limits. Figure 2 shows the location of the KNUEA and the EMP study area in the Shirley's Brook subwatershed.

2.0 OBJECTIVES

The Kanata North Urban Expansion Area EMP represents an important opportunity to assess the natural features in the study area and mitigate the impacts of future development. The overall objective of the EMP is to determine options for development within the KNUEA consistent with the goals, objectives and policies of the City of Ottawa, MVCA and NCC, along with other government agencies including MNR and MOE.

The EMP will determine how recommendations from the existing subwatershed plans and environmental management studies will be applied to the study area, taking into account change in Official Plan Policy and other relevant policies / legislation / guidelines since those documents were produced.

2.1 Official Plan Policy

The EMP is to be prepared following the requirements of Policy 2.4.3 of the Official Plan, which will address such matters as:

- Delineation of setbacks from surface water features;
- Specific mitigation measures to protect significant features, identified for preservation at the subwatershed level;
- Conceptual and functional design of stormwater management facilities and creek corridor restoration and enhancement.

Recommendations from environmental management plans will be implemented largely through development approval conditions and stormwater site management plans.

2.2 Integrated Environmental Assessment and Planning Act

The EMP will be completed in conformance with the requirements of the *Environmental Assessment Act* and will be part of the integrated Planning Act and Class EA documentation required for the study area.

The EMP will fulfill Phases 1 and 2 of the Municipal Class Environmental Assessment Process, including:

- Inventory of existing conditions, opportunities and constraints;
- Evaluation of alternatives; and
- Selection of recommended alternatives.

The EMP will be completed in parallel with the development of the Land Use Plan, Transportation Plan, and Master Servicing Plan through the integrated planning and EA process. Through this process, an overall environmental management strategy will be identified which includes such factors as:

- Cost;
- Public and Agency acceptance;
- Ease and effectiveness of implementation;
- Potential impact on future land use;
- Potential for preservation and enhancement of natural features.

Development of preferred alternatives will include identification of the specific projects or project modification which will be required, including approval process, costs, and phasing/timing. Interim solutions will also be identified.

This process, the interrelationship of the various components, and the schedule for completion of the studies are included as Figures 3 and 4.

Co-ordination and Integration

The Study Team will consist of municipal staff from various City departments, landowners, consultants, and approval agencies. The project proceeded under the direction of the City of Ottawa and will benefit from the direct involvement and guidance of:

- A Core Project Team (CPT) consisting of City staff and Councillors, Sponsoring Landowners and the consultants in a variety of disciplines;
- A Technical Advisory Committee (TAC) consisting of representatives from select government agencies and approval bodies;
- A Public Advisory Committee (PAC) consisting of representatives from directly affected Community Associations and interested community groups; and

Meetings will be held and information reviewed and shared amongst each of the study participants. Decisions will be made in an integrated and iterative process throughout the course of the studies. Through this iterative discussion and consultation many additional tasks and investigations may be required to ensure compatibility between the various infrastructure requirements.

The reports and planning decisions can be undertaken in an integrated fashion in a similar time frame which results in an iterative planning and decision making process. Collaboration between the different studies are key to ensuring the requirements of all the land use and infrastructure components are accommodated in an acceptable manner.

Public and Agency Consultation

Consultation will form an integral part of both the Planning and Class EA process. Consultation and the exchange of information will be undertaken throughout the assessments using a variety of methods including meetings with community associations and the general public, electronic information distribution and regular meetings with the Study Team, approval agencies, and the Ward Councillors.

Many government agencies, municipal departments and approval authorities will be involved in the process. Input will be sought regarding direction and guidance for future approval and permitting requirements and specific technical issues. Input from agencies will be solicited through various means including:

- Individual and group agency meetings to provide clarification;
- Inter-agency sharing of comments, rationalizations, and decisions;
- Completion of additional technical works;
- Design clarifications; and,
- Corrections and additions to the reports as appropriate.

Meeting details, Public Notices, and Presentation Materials will be documented in a Public Consultation Report along with the comments and inputs received.

3.0 ISSUES

3.1 Previous Studies and Guidance Documents

A number of previous studies have been produced that identify relevant issues within the current EMP study area. The EMP will evaluate the recommendations from these studies to determine how they apply to the current study area, taking into account any policy and legislation changes that have occurred since they were produced. The following provides a list of the primary documents:

- Kanata North Environmental/Stormwater Management Plan (CH2MHill, 2001)
- Shirley's Brook and Watt's Creek Subwatershed Study (Dillon, 1999)
- Shirley's Brook Floodplain Analysis & Stormwater Management Report (Novatech, 2007)
- Greater Constance Creek / Shirley's Brook EMP (Aquafor Beech, 2006) *(Unpublished report not approved by the City of Ottawa)*
- Shirley's Brook and Watt's Creek Subwatershed Study (AECOM, 2013)
- Characterization of Ottawa's Watersheds (City of Ottawa, 2011)
- South March Highlands Blanding's Turtle Conservation Needs Assessment (Dillon Consulting, 2013)
- Environmental Impact Statement Guidelines (City of Ottawa, 2012 (rev)).
- Evaluation, Classification and Management of Headwater Drainage Features Guidelines (CVC / TRCA, 2014).

4.0 WORKPLAN

The workplan for the Environmental Management Plan has been developed to satisfy the requirements of the planning and engineering process as well as City and agency requirements.

4.1 Subconsultants

The Kanata North Urban Expansion EMP will represent the synthesis of findings and recommendations from a number of separate disciplines. The scope of work includes input from subconsultants who will be retained to complete detailed studies for various aspects of the project including:

- Geotechnical
- Aquatic and Terrestrial Environment
- Fluvial Geomorphology
- Hydrogeological
- Compiled Legal Surveys (Participating Landowners)

4.2 Review Existing Background Information

Recommendations from previous studies (refer to Section 3.1) will be reviewed to determine how they apply to the current study area, taking into account any policy and legislation changes that have occurred since they were produced.

4.3 Environmental Inventory

An inventory of existing natural features will be prepared for the study area to identify environmental features and their functions independent of the potential developable area, including:

- Aquatic features and fish habitat.
- Terrestrial features and habitat. Significant woodlots will be evaluated consistent with the Urban Natural Areas Environmental Evaluation Study.
- Breeding Bird Surveys.
- Geotechnical Inventory (test pits/boreholes).
- Hydrogeology (Bedrock and surficial).
- Fluvial Geomorphology.

Based on a desktop review of the existing conditions from previous studies (including work conducted by the City regarding their Landscape Corridor Analysis), a gap analysis will be undertaken to identify additional field investigation requirements. Field investigations will be conducted to identify natural features, as well as relationships and dependencies between these features. It is anticipated that the following investigations of natural features will be completed:

- Fish sampling (spring/summer/fall) to determine extent of aquatic habitat, nursery habitat, drainage to be retained and watercourse setbacks/buffers based upon aquatic, including barriers to fish passage, riparian buffers, erosion concerns, overland flow routes, flood plain and terrestrial habitat. Minor versus significant tributaries will be identified based on fish communities and habitat features.

- Identification and analysis of the natural heritage system on the site independent of the potential developable area as per Section 3.11, Policy 6B of the Official Plan. Woodlots, hedgerows, riparian cover, meadows, linkages and other features to be surveyed in late spring and summer, including breeding bird and vegetation surveys. Observations of reptiles, amphibians and other wildlife compiled as part of bird, fish and vegetation surveys. Hedgerows for potential consideration into the land use plans will be identified based on species, connectivity and condition.
- Potential species at risk in the study area will be identified through consultation with the Ministry of Natural Resources, a review of the Natural Heritage Information Database and the Federal Species at Risk Schedules. Emphasis during the field surveys will be placed on searching for these potential species.

4.4 Hydrogeology

Hydrogeologic conditions within the study area will be identified to assist in the protection of groundwater quality and the recharge/discharge functions of the site's hydrogeology. The subsurface exploration (test pits, boreholes, monitoring wells), will be planned to identify potential issues that may come up at the time of construction of services (upward gradients, rock excavation, groundwater inflow into trenches, etc.) In addition, and particularly for the protection of the groundwater quality, the evaluation will use existing records to identify the following:

- Location of unused and unmaintained water wells that require proper well abandonment;
- Existing septic systems that will be unused and will require proper decommissioning;
- Tile drainage systems;
- Sites identified by environmental site assessments as potential sources of groundwater contamination;
- Location of areas of hydrogeological sensitivity (karst, thin soils, highly permeable soils, discharge and recharge areas, etc.);
- Any separation requirements from surrounding wells.

Field work consisting of a minimum of one full year of stream flow monitoring will be completed to determine the baseflow and other hydrologic characteristics in the major tributaries comprising the Northwest Branch of Shirley's Brook.

4.5 Fluvial Geomorphology

Note: The following provides a general overview of the approach to the geomorphology analysis. Terms of Reference for the Fluvial Geomorphology component are attached.

As part of the geomorphologic investigation, a background review of secondary source information will be completed. From this, identification of data gaps and identification of subsequent short-term and long-term monitoring needs will be completed. The stream morphology review will build upon the work completed in previous studies and reports for the Shirley's Brook subwatershed.

The geomorphology analysis will include field reconnaissance of the study area consisting of:

- Evaluation of the overall stability of the watercourses and identification of areas prone to erosion or where structures may be at risk;
- Establishment of erosion control stormwater management criteria for the proposed development;

The geomorphology analysis will work on defining cumulative headwater functions through assessing sediment budgets, linkage with local hydrology and connection to larger scale, including input from supporting disciplines. While stream rehabilitation may be required in addition to SWM controls, every effort will be made in the SWM design to avoid significant increases in erosion potential. Recommendations from this study will include:

- Mitigation measures for watercourses which may experience an increase in erosion potential as a result of development, as well as any stream reaches with existing erosion problems;
- An implementation strategy which will consider long term goals for rehabilitation and retrofit.
- Recommended stream corridors for watercourses within the study area.

The geomorphology component will also integrate the findings and results with the aquatic habitat and hydrology/hydraulic components in order to provide a more comprehensive understanding of channel processes and functions. This work will also be applied in identifying opportunities with respect to stream restoration and ultimately in the development of restoration concepts.

4.6 Geotechnical

A geotechnical investigation will be performed to assess the geologic conditions to determine design constraints and criteria for the proposed community design plan.

The geotechnical analysis will consist of:

- Test pits throughout the study area;
- Identification of soils type and depths to bedrock;
- Slope stability analysis;
- Identification of grade raise restrictions.

4.7 Stormwater Management

The impact of the development areas on the receiving waters will be a critical aspect in the development of the stormwater management strategy for the Kanata North Urban Expansion Area. The recommended SWM strategy will need to minimize any adverse impacts on watercourses, and demonstrate that the impacts of development can be mitigated through the design of the SWM infrastructure recommended within the study area.

The stormwater management analysis will:

- Prepare drainage plans showing pre and post development conditions.
- Develop SWM criteria for the study area, including:

    - Water balance / Infiltration;
    - Baseflow augmentation;
    - Water quality (including temperature);
    - Erosion control;
    - Peak flow control;
    - Low Impact Development Techniques.

  The SWM criteria are to be developed through discussions with the City, MVCA and the NCC, and approved prior to proceeding with detailed work.

- Review current conditions and examine the effectiveness of existing SWM measures that are currently in place to identify opportunities for improvement.
- Identify the preferred type, size, location, and function of proposed SWM facilities and other SWM measures required to mitigate the impacts of proposed development on the receiving watercourses (functional-level designs for the SWM facilities will be provided as part of the Master Servicing Study) all within the study area;
- Identify constraints within the existing drainage system that could impact the design of future SWM measures within the study area;
- Provide conceptual design of any recommended rehabilitation works within the study area;

Previous studies completed for the Shirley's Brook Subwatershed studies will be critically reviewed and information from these studies will be evaluated with respect to their application to the Kanata North Urban Expansion Area.

Detailed hydrologic and hydraulic assumptions will be presented, including a summary of all the key parameters. To facilitate the review of the EMP, results from the modeling will be summarized in tables.

4.8 Environmental Constraints & Opportunities

An Environmental Constraints / Opportunities Map will be prepared for the study area based on the findings and recommendations from the various sub-disciplines. Identification of opportunities and constraints will include:

- Delineation of the floodplain for the reaches of the Shirley's Brook Northwest Branch (Tributaries 2 and 3) within the limits of the UEA. Floodplain mapping will be completed using HEC-RAS using input from the hydrologic modeling, detailed topographic survey (completed by Novatech), and 1:1000 / 1:2000 scale mapping (obtained from the City of Ottawa);
- Identification of hazard areas (slope stability, contamination, geotechnical);
- Identification of hydrological resources, groundwater conditions, and recharge and discharge areas (water budget);
- Identification and evaluation of the natural heritage system within the EMP study area as defined in Section 2.4.2 and Section 3.11, Policy 6b of the Official Plan;
- Identification of aquatic habitat, barriers to fish passage, significant watercourses and tributaries using information from previous studies (Section 3.1) and field data;
- Identification of species and habitat at risk (terrestrial and aquatic);
- Identification of existing infrastructure, transportation networks and utilities;

- Delineation of stream corridor/meander belt widths based on Ministry of Natural Resources natural hazards technical guidelines, in addition to development setback requirements identified by the City of Ottawa, MVCA, and the recommendations of previous studies;

Confirmation/selection of specific locations for any required rehabilitation or recommended enhancements of stream corridors, map areas for enhancement including linkages, buffers, and riparian habitat to be improved.

The natural environment and geological work and analysis will be completed in conjunction with fluvial geomorphology and geotechnical/slope stability evaluations. The environmental constraints and opportunities analysis will be prioritized to allow natural environment features to be identified early in the assessment and planning process. For example, the extent and quality of on-site fish habitat will be evaluated, and areas to be protected and enhanced will be incorporated in the land use plan. Suitable (as per the Provincial Policy Statement) buffers and setbacks will be recommended adjacent to watercourses and other natural environment features to be retained. Detailed descriptions and figures illustrating the recommended stream rehabilitation works, as applicable, will be produced for the watercourses in conjunction with stormwater management solutions.

Timing restrictions will be identified for any in water works, as well as appropriate measures to minimize and mitigate the impact on water quality and fish habitat, including:

- The installation of sediment and erosion control measures;
- Avoiding removal, alteration, or covering of substrates used for fish spawning, feeding, over-wintering, or nursery areas; and
- Debris control measures to manage falling debris.

Locations will be identified for potential rehabilitation or enhancement measures within the study area, including greenspace connections among passive and active parkland. Tree clusters and hedgerows of desireable tree species in good condition will be influential in determining the greenspace connections. Healthy native tress will be identified for retention wherever possible, especially in public greenspaces and in hedgerows at the edges of the development area, or (if suitable for planting) for relocation elsewhere within the study area. Based on the sensitivity of the fish habitat determined as part of the field investigations, it is possible that the aquatic habitat incorporated in the land use plans can either be the existing alignments of tributaries and drains, realigned and rehabilitated to meet the overall greenspace connections and land use plans, or a combination of the two. Any proposals with respect to fish habitat relocation / compensation will be thoroughly evaluated and discussed with the approval agencies and would also be subject to DFO authorization.

4.9 Water Budget

A site specific water budget will be completed as part of the EMP to document existing conditions, including geology, hydrogeology, stream flow, and aquatic ecology. The water budget will identify any significant groundwater recharge/discharge areas, evaluate the impact of the proposed development on ground and surface water resources, and identify any recommended mitigation measures for maintaining or enhancing infiltration to ensure that development does not adversely impact existing water users in the vicinity of the study area.

The water budget will include a review of previous reports addressing ground and surface water resources, and will be supplemented by ground and surface water monitoring programs within the study area.

- Boreholes equipped with piezometers will be used to measure groundwater levels and flow patterns. Borehole locations will be determined by the hydrogeological consultant.
- Dataloggers will be installed in the Northwest Branch tributaries of Shirley's Brook to evaluate streamflow patterns. The surface water monitoring program will be used to determine baseflows and calibrate the hydrologic model of the study area.

The water budget will be calculated on a monthly soil-moisture balance approach as described in Thornwaithe and Mather (1957) to determine the average annual evapotranspiration and water surplus.

4.10 Recommendations & Implementation

Recommendations will be developed to protect natural environment features by ensuring compatibility of future development. Management and rehabilitation measures pertaining to aquatic habitat sustainability, passive recreational use including trails and interpretative signs, removal of invasive species and retention and protection of tree cover will be identified for the significant natural environment features.

The relative merits of the management solutions will be weighted against the study objectives. Solution(s) that best achieve the study objectives will be accepted as recommended solution(s). In addition to environmental guidelines and recommendations, the EMP will also identify:

- The natural heritage system, which will be transferred to the City for $1 as non-developable lands
- EA Projects (Integrated EA & Planning Act);
- Other Approval Requirements (Ontario Water Resources Act, Drainage Act, Fisheries Act, Conservation Authorities Act,);
- Cost Estimates (based on preliminary design of solutions for use in budgetary considerations).
- Implementation and Phasing (including processes and triggers for EA project amendments and changes);
- Recommendations for technical studies required to support development applications (e.g., environmental impact statements / tree conservation reports, slope stability investigations, servicing and grading plans, etc.)

5.0 DELIVERABLES

The deliverables for the project include:

1. Existing conditions reports summarizing the findings of the various sub-disciplines.
2. A detailed Environmental Management Plan prepared following the requirements of the Official Plan and will also meet the needs of the Class EA process. The resulting documentation will identify timing, costs and staging of major infrastructure works, including any interim solutions. The approval requirements and process for implementation will also be outlined.

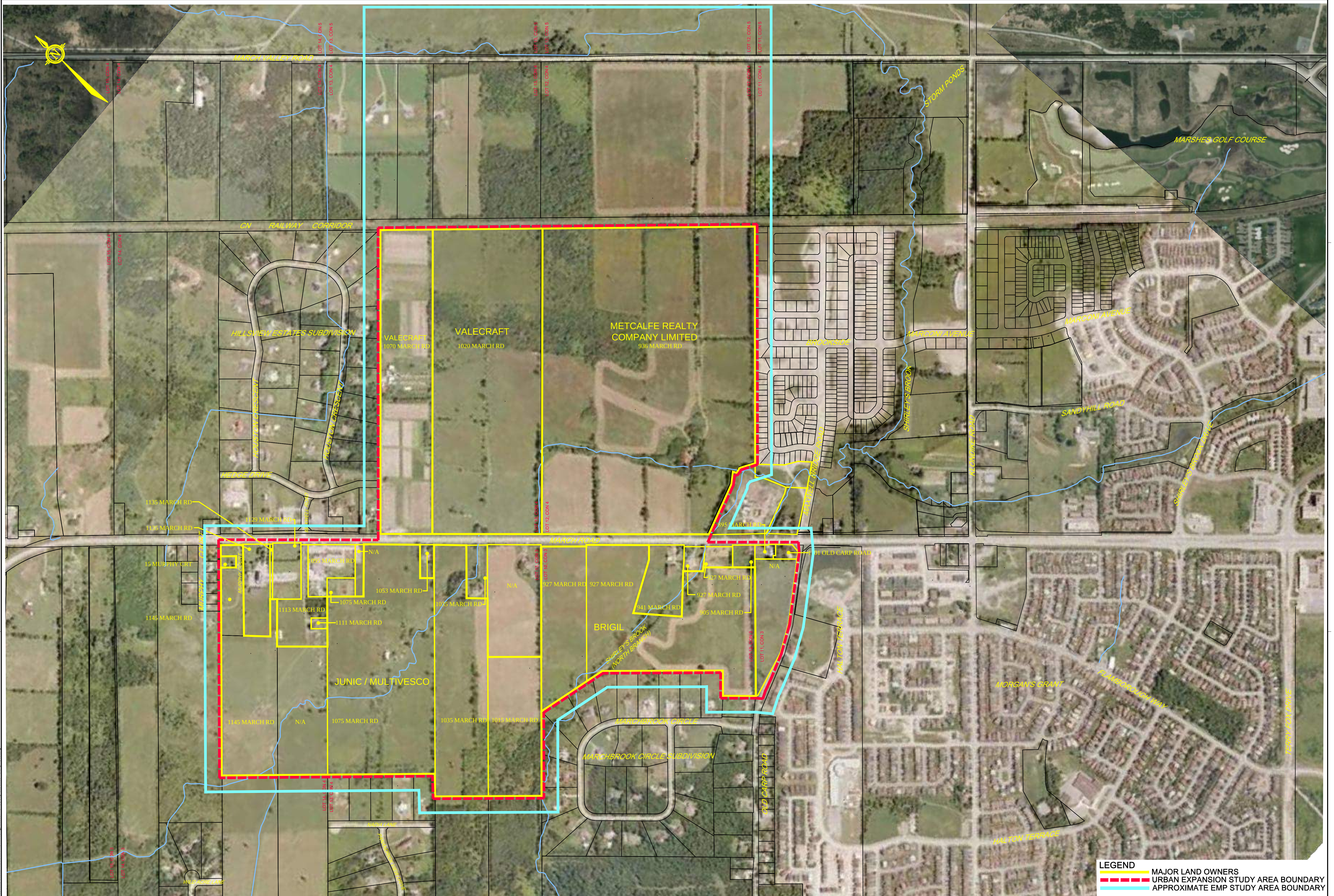
Reports must be submitted to the TAC as drafts for review:

- Draft reports should be submitted in Word format.
- Final reports should be submitted as PDF.
- All mapping should be submitted in GIS format.

Prepared by:

NOVATECH

December 16, 2014



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NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOTE::
THIS PLAN HAS BEEN COMPILED USING LEGAL INFORMATION OBTAINED FROM VARIOUS SITE PLAN DEVELOPMENTS. REFER TO LEGAL DIRECTORIES IN NECL JOB £'s 103106, 105068, 98111 AND 102095. ALL LEGAL LIMITS DEPICTED HERE ARE APPROXIMATE. CONFIRM ALL LEGAL BOUNDARIES PRIOR TO UNDERTAKING DESIGN WORK IN ANY OF THESE AREAS.

No.	REVISION	DATE	BY
REV.2	INCLUDED EMP BOUNDARY	2013/09/19	CS
REV.1	UPDATED OWNER INFORMATION	2012/06/11	EB

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DESIGN	X
CHECKED	X
DRAWN	WLS
CHECKED	X
APPROVED	X

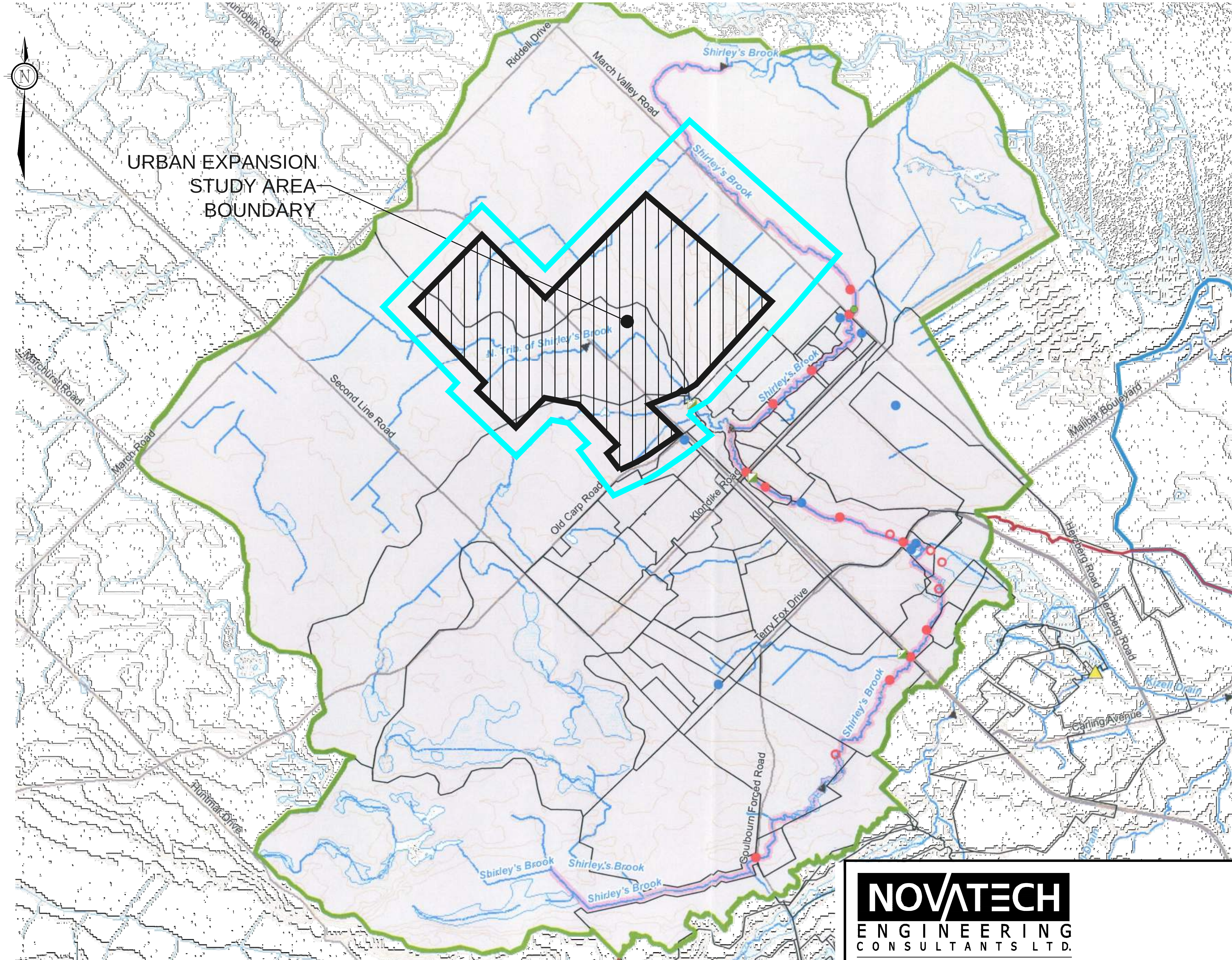
SCALE
1 : 4000
(B1 PLOT)

KANATA NORTH URBAN
EXPANSION AREA CDP

STUDY AREA

PROJECT No. 112117
DATE SEPTEMBER, 2013
DRAWING No. FIGURE 1

PLANB1.DWG - 1000mmX707mm



LEGEND

SHIRLEY'S BROOK WATERSHED BOUNDARY

STUDY AREA BOUNDARY

APPROXIMATE EMP STUDY AREA BOUNDARY

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KANATA NORTH URBAN EXPANSION AREA CDP

SHIRLEY'S BROOK WATERSHED BOUNDARY

SEPT 2013 112117 FIGURE 2

KANATA NORTH URBAN EXPANSION STUDY AREA CDP

Class EA and Planning Act Processes

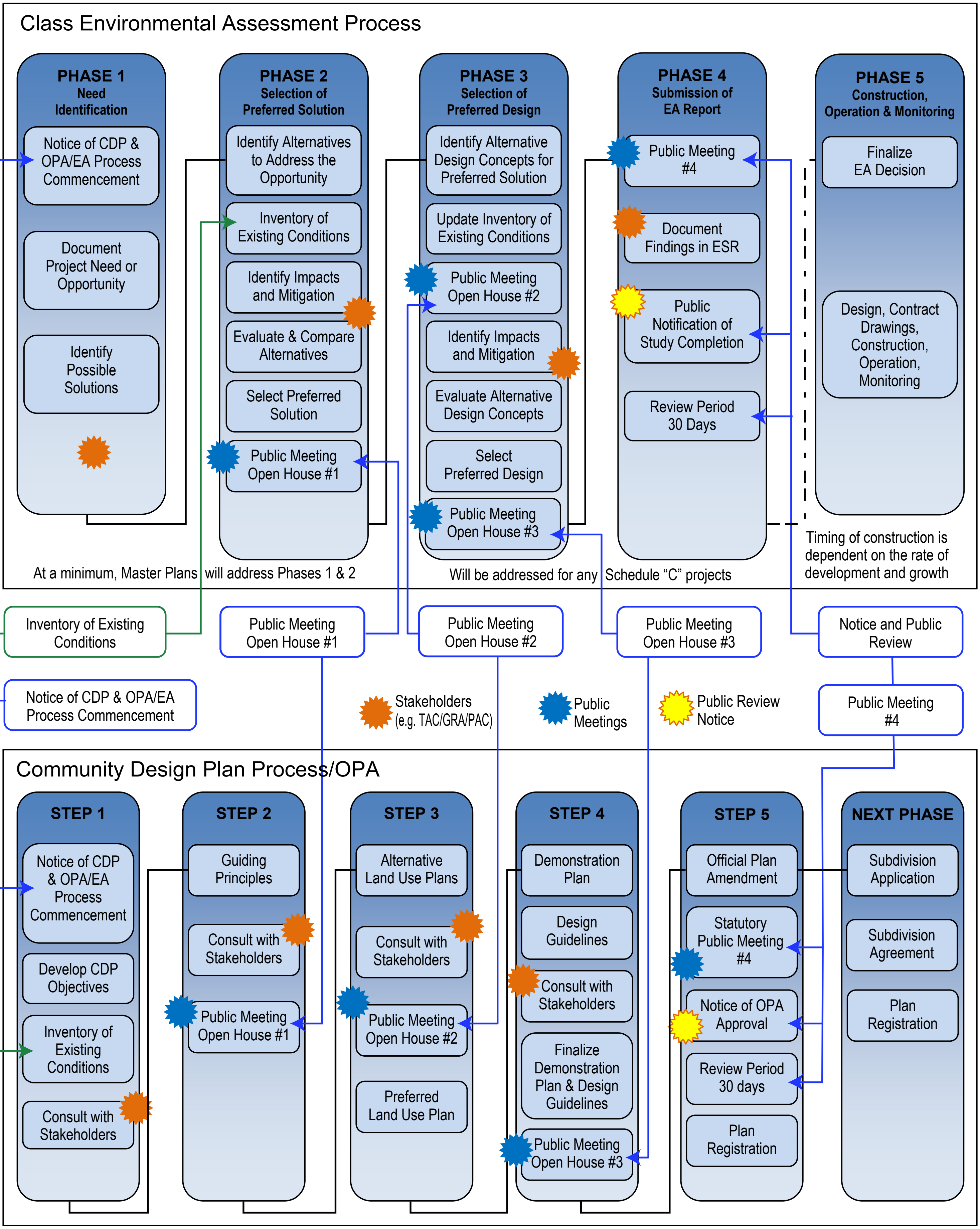

Figure 3

Appendix B

Correspondence

NOVATECH ENGINEERING CONSULTANTS LTD.

M E M O R A N D U M

DATE: NOVEMBER 12, 2013

TO: DARLENE CONWAY (CITY OF OTTAWA)
DAMIEN WHITTAKER (CITY OF OTTAWA)
MATT CRAIG (MVCA)
DOUG NUTTALL (MVCA)
JOHN RIDDELL (NOVATECH)

FROM: M.PETEPIECE

RE: SHIRLEY'S BROOK NORTHWEST – HYDROLOGIC MODELING & CALIBRATION

PROJECT #: 112117

CC: FILE

HYDROLOGIC MODEL OVERVIEW

Novatech has reviewed the available hydrologic modeling information for the Northwest Branch of Shirley's Brook provided in the *Shirley's Brook and Watt's Creek Phase 2 Stormwater Management Study* (Draft - AECOM, March 2013), and re-created the model of the Northwest Branch using the hydrologic parameters provided in Appendix C of the AECOM report (Table C-6). The intent is to use a consistent model to evaluate the impact of development of the Kanata North Urban Expansion Area (KNUEA) on peak flows in Shirley's Brook.

The results of the initial hydrologic analysis indicate that the modeled peak flows from the Northwest Branch of Shirley's Brook are quite low (100-year peak flow of approximately 2.5 m^3/s from a tributary drainage area of 730 ha). This translates to an average per-hectare flow rate of approximately 3.4 L/s/ha for the 100-year event.

The KNUEA drainage area tributary to the Northwest Branch of Shirley's Brook is approximately 100 hectares. If post-development flows are controlled to pre-development levels based on this model, this would translate to an allowable 100-year release rate of approximately 290 L/s from the development and would require over 510 m^3/ha of active storage. For contrast, the adjacent Morgan's Grant community is also approximately 100 hectares. The maximum release rate from the Morgan's Grant SWM facility is 5.5 m^3/s with a total active storage volume (forebay + main cell) of 15,700 m^3 or approximately 160 m^3/ha (Table C-7).

There is some question as to whether the current SWMHYMO model underestimates the peak flows based on the observed fluvial geomorphology characteristics of the watercourses. As a general rule, bankfull flow is typically associated with a 2-year event. The geomorphic consultant has indicated bankfull flow conditions appear to correspond to approximately 2 m^3/s (based on preliminary evaluation). While this is not a clear indication that the hydrologic model is underestimating flows, it does indicate that a closer evaluation of the model may be in order.

If the modeled peak flows have been underestimated and are subsequently used for design purposes, this could result in increased flood risk if the culverts crossing March Road are undersized, as well as potentially underestimating the extent of the 100-year floodplain.

The AECOM report indicates "no existing storage elements were identified on Northwest branch of Shirley's Brook Subwatershed" (pg. 20). This is not correct. There are several inline control structures that provide storage (see attached figure):

- Tributary 3 has two inline concrete weirs currently in place (the remnants of a third concrete weir are also present, but it has been demolished).
- Tributary 2 has a gabion basket structure installed inline approximately 100m upstream of March Road.

These structures could have a significant impact on flow characteristics, particularly during periods of low flow.

The AECOM SWMHYMO model uses a "number of linear reservoirs" value of n=1.1 for all rural catchment areas to replicate the attenuated flow patterns observed during the flow monitoring program. For the Northwest Branch of Shirley's Brook, this flow attenuation can be at least partially attributed to the presence of the inline structures and not necessarily as an intrinsic characteristic of the watershed.

PROPOSED MODEL REVISIONS

Based on a review of the current hydrologic model, it may be beneficial to make some additional refinements to the model parameters for the Northwest Tributaries. The revised model could then be re-calibrated using AECOM's flow monitoring data.

Catchment Discretization

The AECOM model discretizes the Northwest Branch into 3 large subcatchment areas. It is noted that other areas in the model have been further discretized to facilitate model calibration and comparison (Northeast Branch Catchment 5) or to reflect differences in land use (Northeast Branch Catchment 6).

For the Northwest Branch of Shirley's Brook, the headwater areas consist primarily of wetlands and heavily wooded areas, while the lower portions of the catchment (KNUEA lands) are primarily agricultural. The catchments should be discretized to reflect the differences in land use, using appropriate SCS curve numbers for each. This approach is anticipated to generate higher peak flows from the agricultural lands and lower flows from the headwater areas.

Storage Elements

The storage provided by the inline structures can be added to the SWMHYMO model. Novatech has completed a detailed survey of the Northwest Branch tributaries and can provide storage-discharge curves for these structures for model calibration purposes.

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The existing inline structures likely provide a considerable amount of flow attenuation during low flows, but minimal attenuation of runoff from larger storms. As the calibrated SWMHMO model does not include these structures, it is possible that the model underestimates the peak flows generated by larger storms.

SWM CRITERIA (KNUEA DEVELOPMENT)

Notwithstanding the proposed revisions to the AECOM model, it may be preferable to assign target release rates for the proposed KNUEA development as opposed to matching “post-to-pre”. The downstream structures and current regulatory floodplain have been designed and established based on significantly higher flows. As such, there may be some merit in adopting a stormwater management strategy to ensure no adverse impacts on the function of the watercourse (base flows, flood risk, erosion, etc.).

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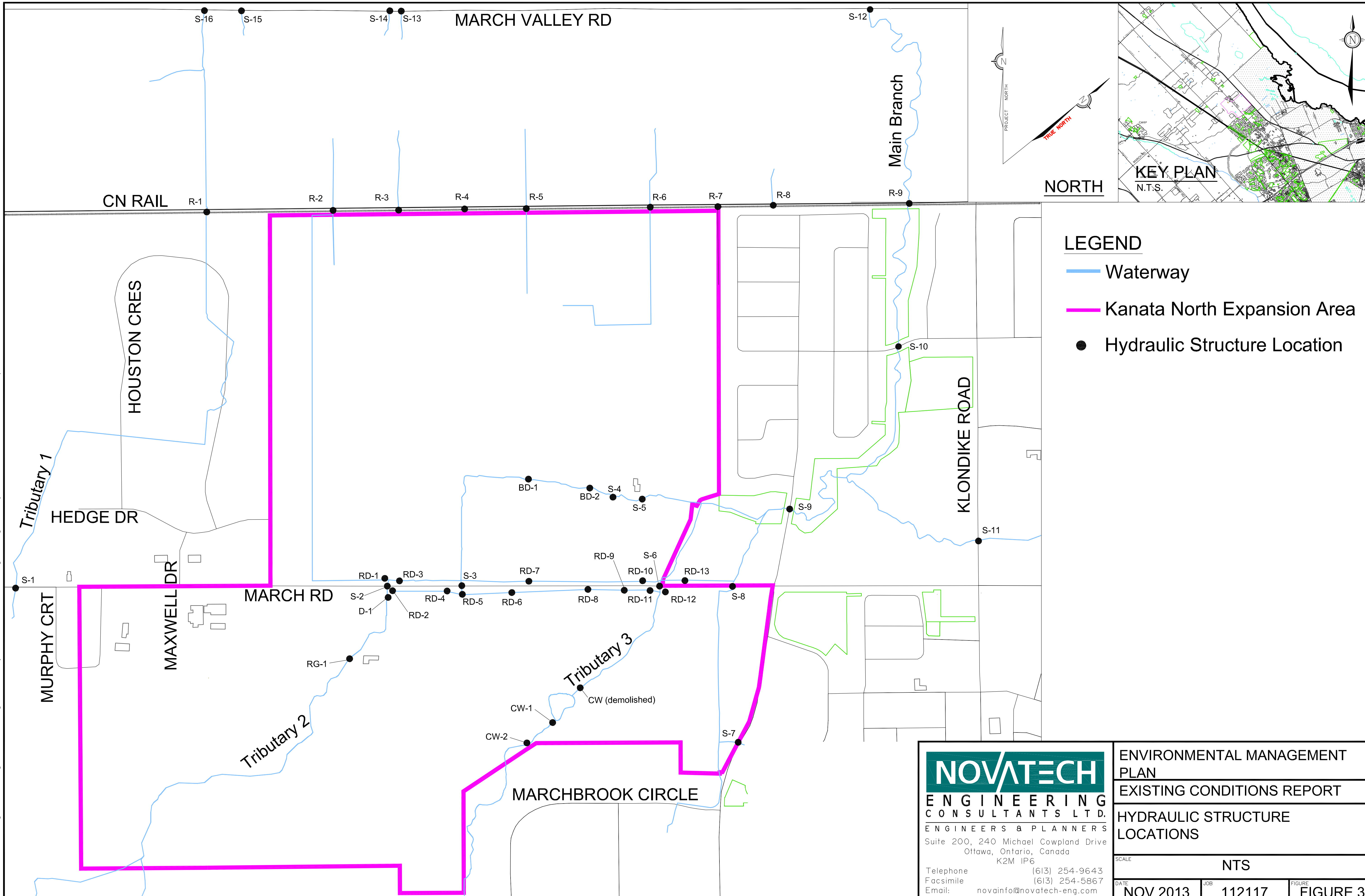

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ENVIRONMENTAL MANAGEMENT PLAN

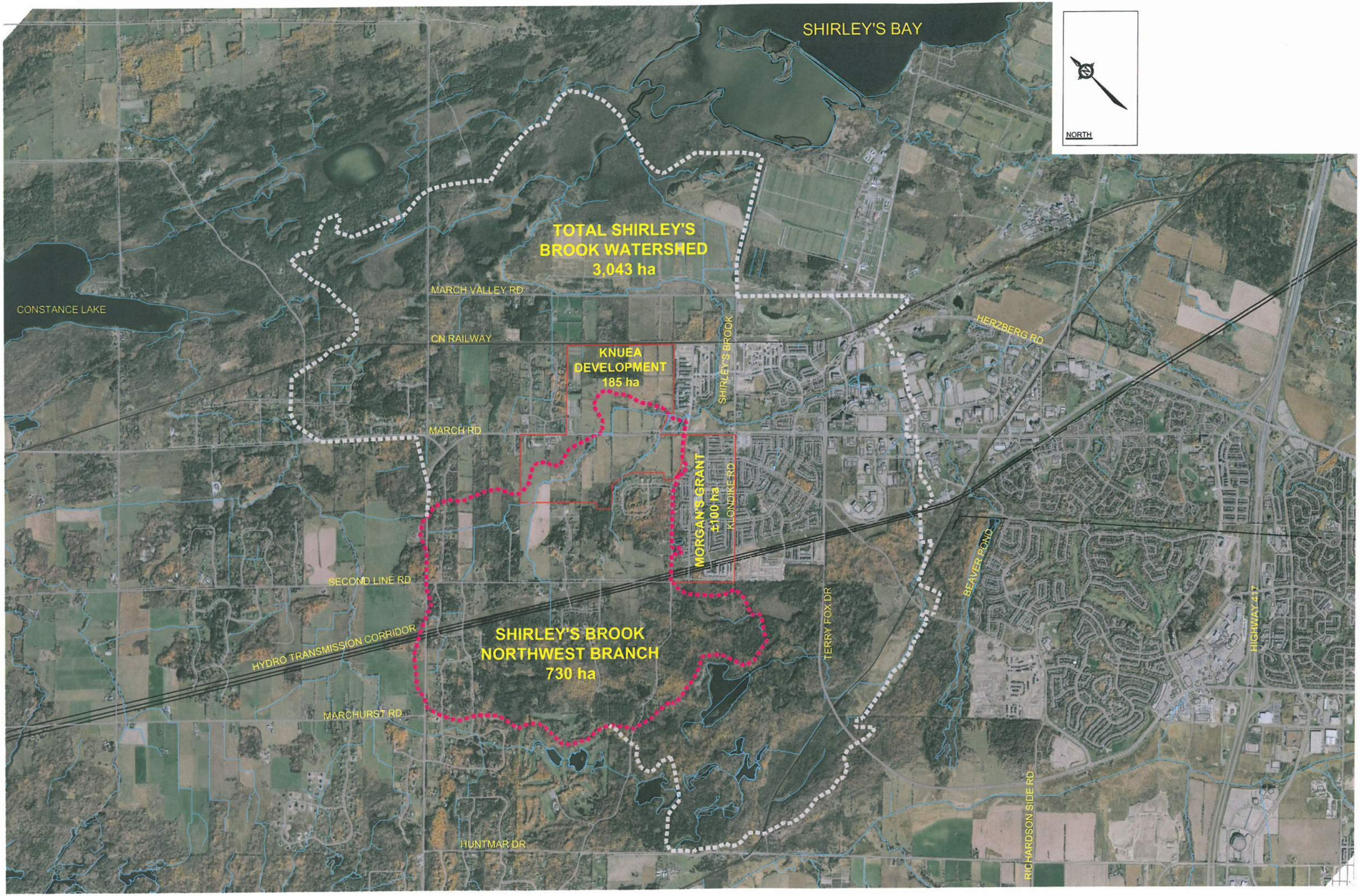
EXISTING CONDITIONS REPORT

HYDRAULIC STRUCTURE LOCATIONS

SCALE		
NTS		
DATE	JOB	FIGURE
NOV 2013	112117	FIGURE 3

SHT11X17.DWG - 279mmX432mm

M:\2012\112117\CAD\Design\SWM\Existing Condition Drawings\20131011-Hydraulic Structure Locations-Figure 3.dwg, 11x17 Hydraulic Structures, Nov 12, 2013 - 3:10pm, kbanks


SHIRLEY'S BAY
NORTH
TOTAL SHIRLEY'S BROOK WATERSHED
3,043 ha
CONSTANCE LAKE
MARCH VALLEY RD
CN RAILWAY
KNUEA DEVELOPMENT
185 ha
SHIRLEY'S BROOK
HERZBERG RD
MARCH RD
MORGAN'S GRANT
±100 ha
KLONDIKE RD
SECOND LINE RD
TERRY FOX DR
BEAVER POND
HIGHWAY 417
HYDRO TRANSMISSION CORRIDOR
SHIRLEY'S BROOK
NORTHWEST BRANCH
730 ha
MARCHURST RD
HUNTMAR DR
RICHARDSON SIDE RD

M E M O R A N D U M

DATE: JANUARY 8, 2014

TO: FILE

FROM: MICHAEL PETEPIECE

RE: KANATA NORTH URBAN EXPANSION AREA – OUR FILE NO. 112117
PRELIMINARY SWM OPTIONS

CC: JOHN RIDDELL (NECL)
MURRAY CHOWN (NECL)

INTRODUCTION

Storm servicing options for the Kanata North Urban Expansion Area will be developed and evaluated as part of the Environmental Management Plan as part of the integrated EA process.

To meet both the development objectives and stormwater management targets for this area, end-of-pipe SWM facilities will be used to provide water quality and quantity control for the proposed development. The options presented in this memo have been developed based on the following constraints:

- Existing Wooded Areas
- Depth to Bedrock
- Existing Watercourses (Shirley's Brook Northwest Branch Tributaries)
- March Road (Arterial Road)

March Road represents a logical drainage divide for the site. As such, separate and independent stormwater management options have been developed for the areas east and west of March Road.

West of March Road

Under existing conditions, the KNUEA lands west of March Road are divided into three areas by the two main tributaries comprising the Northwest Branch of Shirley's Brook (Tributaries 2 and 3). These watercourses will be retained under post-development conditions and represent the primary constraint for determining the size and location of the proposed SWM facilities.

It is not feasible to service the lands west of March Road using a single SWM facility, as this would require a very deep pond and significant excavation into bedrock to allow the storm sewers to cross underneath the Shirley's Brook Tributaries.

The lands west of March Road can be serviced using two or three SWM facilities located adjacent to March Road. There is enough topographic relief in the upper (western) portion of the development area to redirect some of runoff under the Shirley's Brook tributaries, but closer to

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March Road the tributaries will represent the drainage divide between the SWM ponds. It may also be possible to realign a portion of Tributary 2 to provide more flexibility in the development of land use concepts and road networks.

The approximate size and location of the SWM facilities west of March Road are shown on **Figures 1 and 2**. The accompanying profiles show the proposed operating levels in the ponds in relation to the existing ground and bedrock elevations.

East of March Road

The primary topographic feature on the KNUEA lands east of March Road is a slope running north/south approximately midway between March Road and the existing railway. Under existing conditions, the lands on the top of the slope are tributary to the Northwest Branch of Shirley's Brook. The remaining portions of the site are drained by a series of agricultural ditches, crossing under the existing rail line through a series of culverts towards March Valley Road.

The lands east of March Road can be serviced using either a single large pond, or two smaller ponds. The ponds should be located at the eastern limit of the site near or adjacent to the existing rail line. There is enough topographic relief to direct storm runoff from the area bounded by the Shirley's Brook Northwest Tributary and March Road underneath the watercourse to the proposed pond(s).

The proposed ponds could be located either inside the urban area (west of the rail line), or outside the urban area (east of the rail line). The locations for the SWM facilities will be influenced by the existing wooded areas, the locations of existing culverts under the railway, and the depth to bedrock, which is relatively shallow near the northern limit of the site and deeper further south.

The approximate size and location of the SWM facilities east of March Road are shown on **Figures 3 to 6**. The accompanying profiles show the proposed operating levels in the ponds in relation to the existing ground and bedrock elevations.

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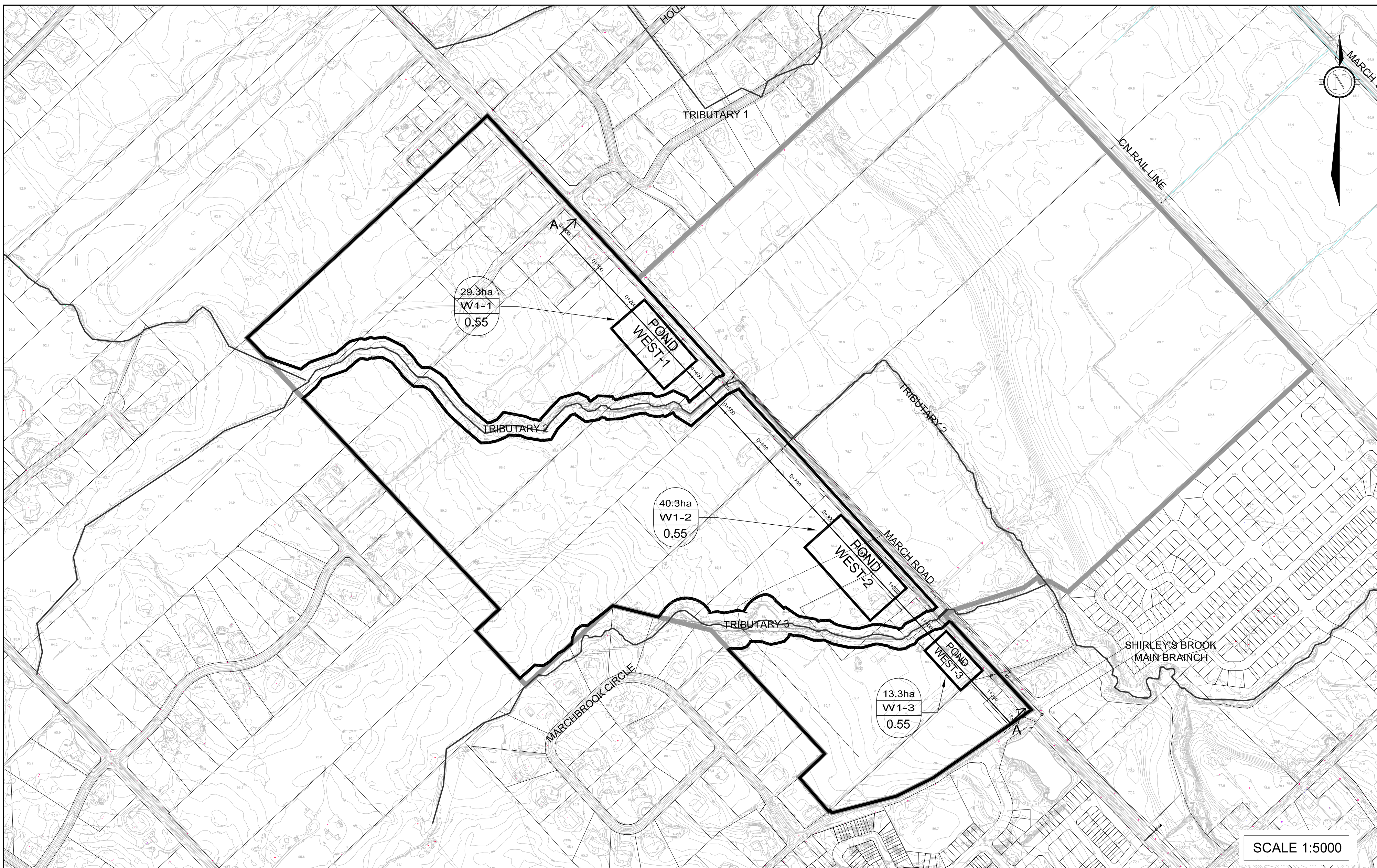

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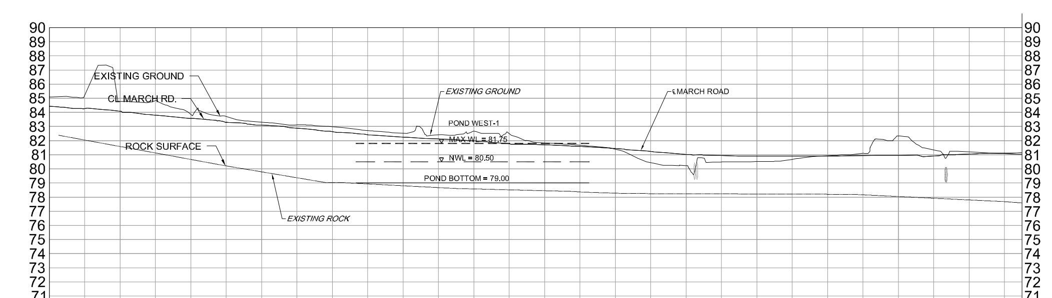
V:1:250



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000			85.09
0+025		82.04	85.20
0+050		81.59	84.78
0+075		81.13	84.84
0+100		80.67	83.86
0+125		80.21	83.71
0+150		79.79	83.31
0+175		79.37	83.11
0+200		79.03	82.98
0+225		78.94	82.71
0+250		78.81	82.53
0+275		78.67	82.42
0+300		78.58	82.67
0+325		78.52	82.50
0+350		78.45	81.84
0+375		78.37	81.68
0+400		78.28	81.39
0+425		78.25	80.44
0+450		78.24	80.23
0+475		78.23	80.49
0+500		78.22	80.51
0+525		78.21	80.67
0+550		78.20	80.93
0+575		78.16	81.10
0+600		78.04	82.34
0+625		77.92	81.35
0+650		77.80	81.20
0+675		77.68	81.08

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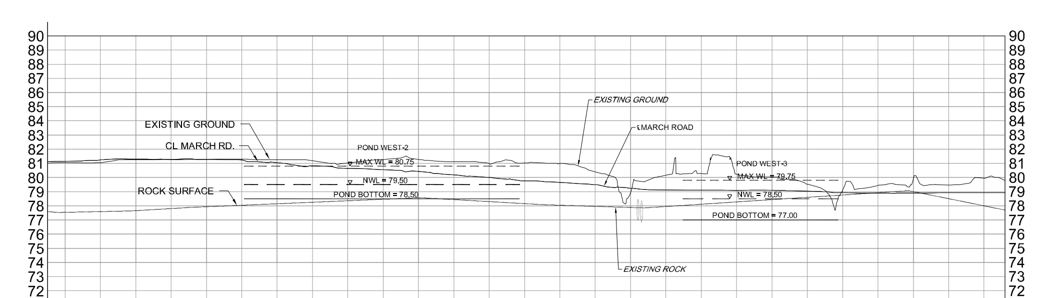
V:1:250



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+700		77.54	81.05
0+725		77.59	81.06
0+750		77.66	81.25
0+775		77.81	81.27
0+800		77.93	81.28
0+825		78.04	81.30
0+850		78.15	81.25
0+875		78.25	81.19
0+900		78.36	81.02
0+925		78.46	81.26
0+950		78.57	81.27
0+975		78.44	81.11
1+000		78.30	80.99
1+025		78.15	81.02
1+050		78.04	80.99
1+075		77.96	80.39
1+100		77.88	78.90
1+125		77.95	80.16
1+150		78.11	80.28
1+175		78.27	80.22
1+200		78.44	80.04
1+225		78.60	79.53
1+250		78.76	79.10
1+275		78.92	79.44
1+300		79.01	79.89
1+325		78.50	79.47
1+350		78.00	79.96
1+364.80		77.70	79.78

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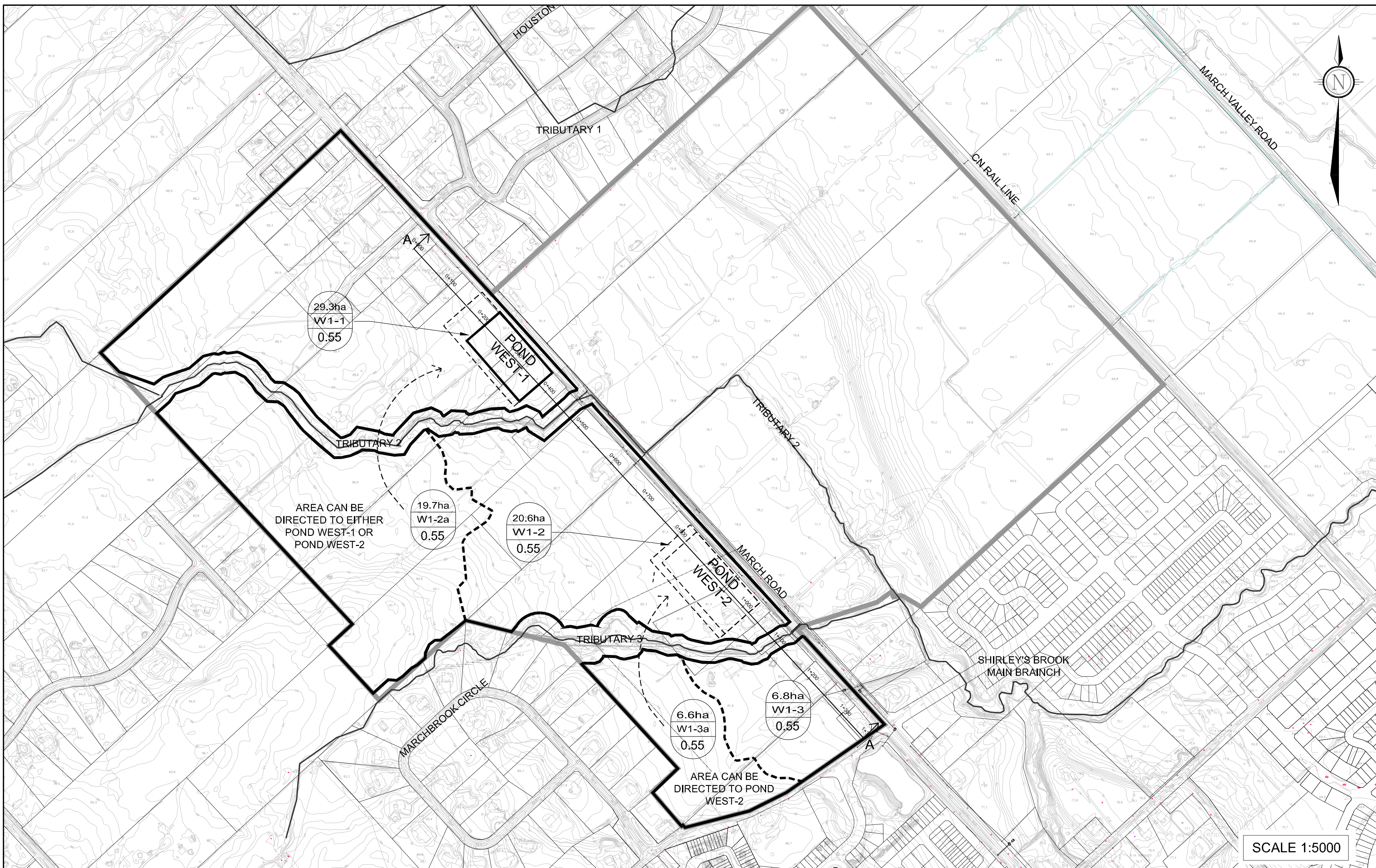
KANATA NORTH
EXPANSION AREA CDP

WEST MARCH ROAD
SWM POND OPTIONS

SCALE	DATE	JOB	FIGURE
VARIES	JAN 2014	112117	1



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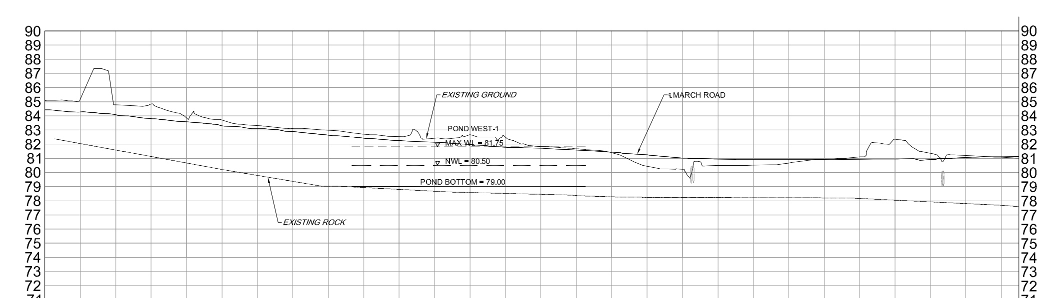
V:1:250



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000			85.09
0+025		82.04	85.20
0+050		81.59	84.78
0+075		81.13	84.84
0+100		80.67	83.86
0+125		80.21	83.71
0+150		79.79	83.31
0+175		79.37	83.11
0+200		79.03	82.98
0+225		78.94	82.71
0+250		78.81	82.53
0+275		78.67	82.42
0+300		78.58	82.67
0+325		78.52	82.50
0+350		78.45	81.84
0+375		78.37	81.68
0+400		78.28	81.39
0+425		78.25	80.44
0+450		78.24	80.23
0+475		78.23	80.49
0+500		78.22	80.51
0+525		78.21	80.67
0+550		78.20	80.93
0+575		78.16	81.10
0+600		78.04	82.34
0+625		77.92	81.35
0+650		77.80	81.20
0+675		77.68	81.08

A-A
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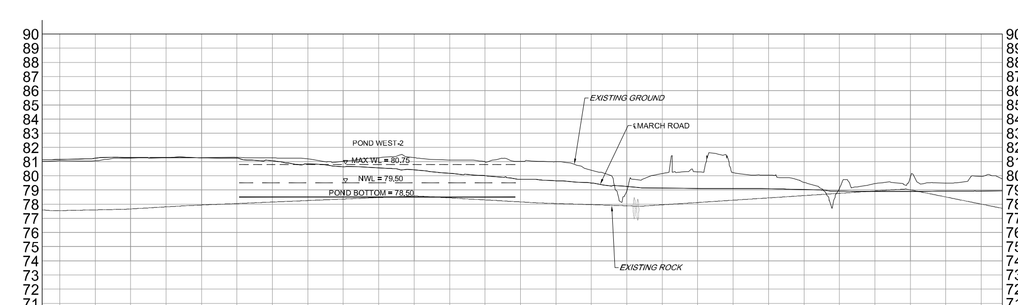
V:1:250



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+700		77.54	81.05
0+725		77.59	81.06
0+750		77.66	81.25
0+775		77.81	81.27
0+800		77.93	81.28
0+825		78.04	81.30
0+850		78.15	81.25
0+875		78.25	81.19
0+900		78.36	81.02
0+925		78.46	81.26
0+950		78.57	81.27
0+975		78.44	81.11
1+000		78.30	80.99
1+025		78.15	81.02
1+050		78.04	80.99
1+075		77.96	80.39
1+100		77.88	78.90
1+125		77.95	80.16
1+150		78.11	80.28
1+175		78.27	80.22
1+200		78.44	80.04
1+225		78.60	79.53
1+250		78.76	79.10
1+275		78.92	79.44
1+300		79.01	79.89
1+325		78.50	79.47
1+350		78.00	79.96
1+364.80		77.70	79.78

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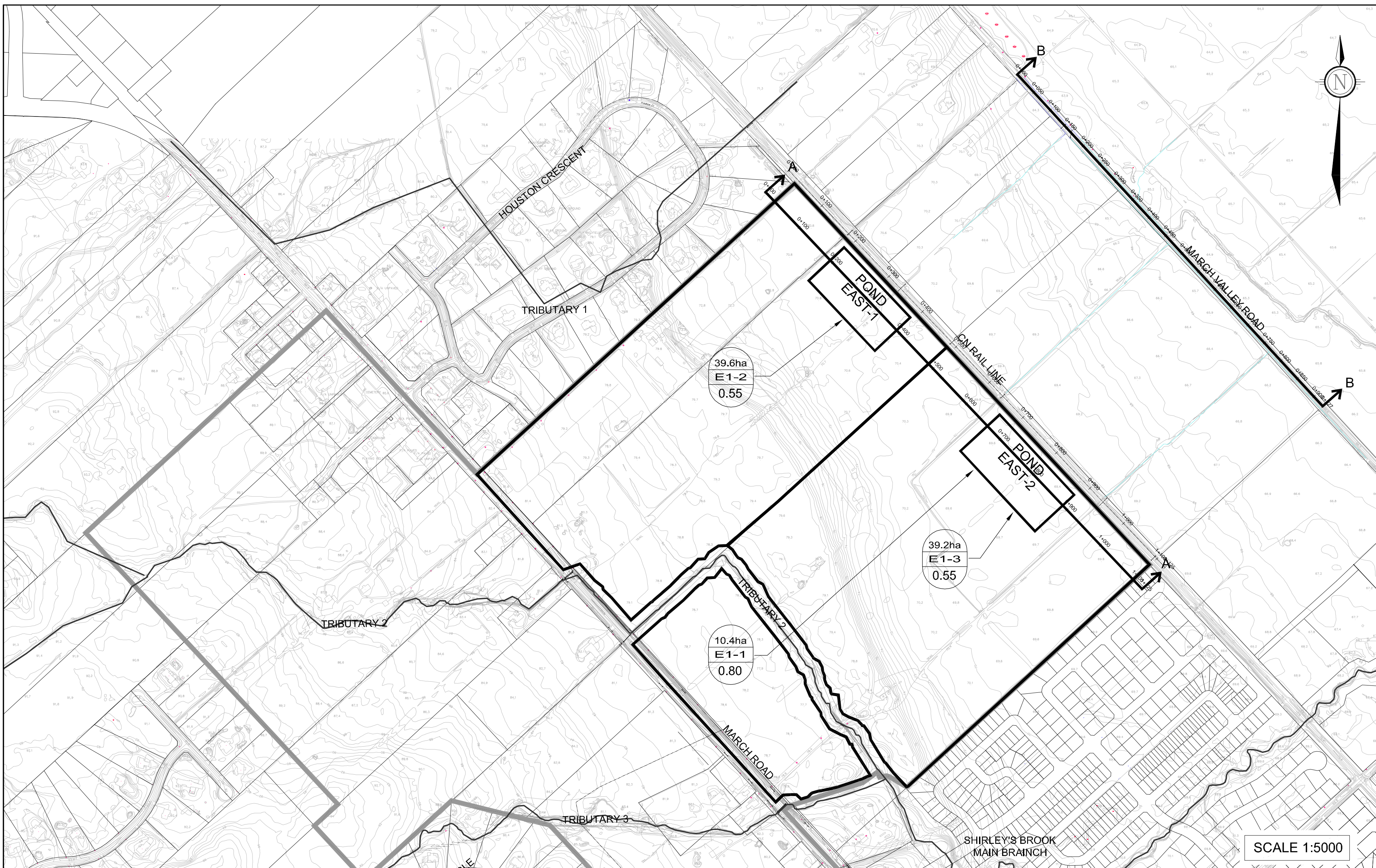
KANATA NORTH
EXPANSION AREA CDP

WEST MARCH ROAD
SWM POND OPTIONS

SCALE	DATE	JOB	FIGURE
VARIES	JAN 2014	112117	2



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A-A

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EAST Property @ CN Rail
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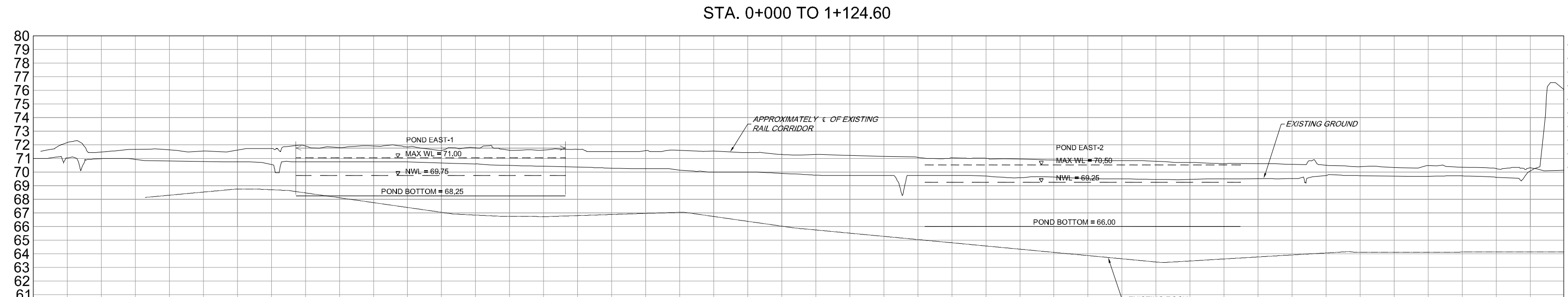
250 VERT.
STA. 0+000 TO 1+124.60

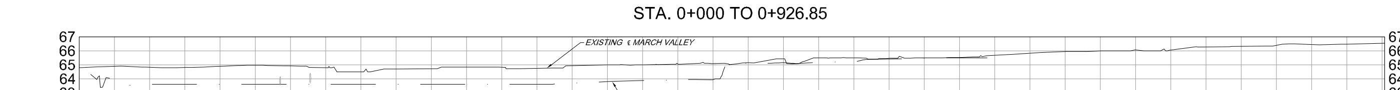


CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000			71.00
0+025			71.02
0+050			70.99
0+075			70.92
0+100		68.30	70.81
0+125		68.53	70.77
0+150		68.75	70.75
0+175		68.70	70.54
0+200		68.47	70.75
0+225		68.11	70.75
0+250		67.75	70.75
0+275		67.40	70.75
0+300		67.04	70.66
0+325		66.84	70.60
0+350		66.75	70.48
0+375		66.73	70.43
0+400		66.80	70.36
0+425		66.88	70.28
0+450		66.96	70.25
0+475		67.04	70.14
0+500		66.74	70.00
0+525		66.38	70.00
0+550		66.03	69.90
0+575		65.75	69.77
0+600		65.51	69.75
0+625		65.28	69.75
0+650		65.04	69.75
0+675		64.81	69.75
0+700		64.57	69.70
0+725		64.34	69.59
0+750		64.10	69.63
0+775		63.87	69.54
0+800		63.63	69.50
0+825		63.40	69.46
0+850		63.47	69.46
0+875		63.62	69.50
0+900		63.77	69.51
0+925		63.91	69.52
0+950		64.06	69.75
0+975		64.11	69.73
1+000		64.11	69.69
1+025		64.12	69.69
1+050		64.12	69.72
1+075		64.13	69.62
1+100		64.14	70.08
1+124.60		64.14	76.07

B-B

(STA 0+000 TO 0+926.85)
SCALE
H:1:2500
V:1:250

MARCH VALLEY
SCALE : 2500 HORIZ.
250 VERT.
STA. 0+000 TO 0+926.85



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000		64.80	64.80
0+025		64.89	64.89
0+050		64.82	64.82
0+075		64.80	64.80
0+100		64.89	64.89
0+125		64.97	64.97
0+150		64.91	64.91
0+175		64.79	64.79
0+200		64.50	64.50
0+225		64.70	64.70
0+250		64.72	64.72
0+275		64.84	64.84
0+300		64.82	64.82
0+325		64.74	64.74
0+350		64.94	64.94
0+375		65.00	65.00
0+400		65.00	65.00
0+425		65.06	65.06
0+450		65.08	65.08
0+475		65.14	65.14
0+500		65.42	65.42
0+525		65.49	65.49
0+550		65.48	65.48
0+575		65.46	65.46
0+600		65.49	65.49
0+625		65.51	65.51
0+650		65.68	65.68
0+675		65.82	65.82
0+700		65.94	65.94
0+725		65.99	65.99
0+750		66.06	66.06
0+775		66.04	66.04
0+800		66.28	66.28
0+825		66.31	66.31
0+850		66.39	66.39
0+875		66.45	66.45
0+900		66.46	66.46
0+925 / 0+926.85		66.53	66.53

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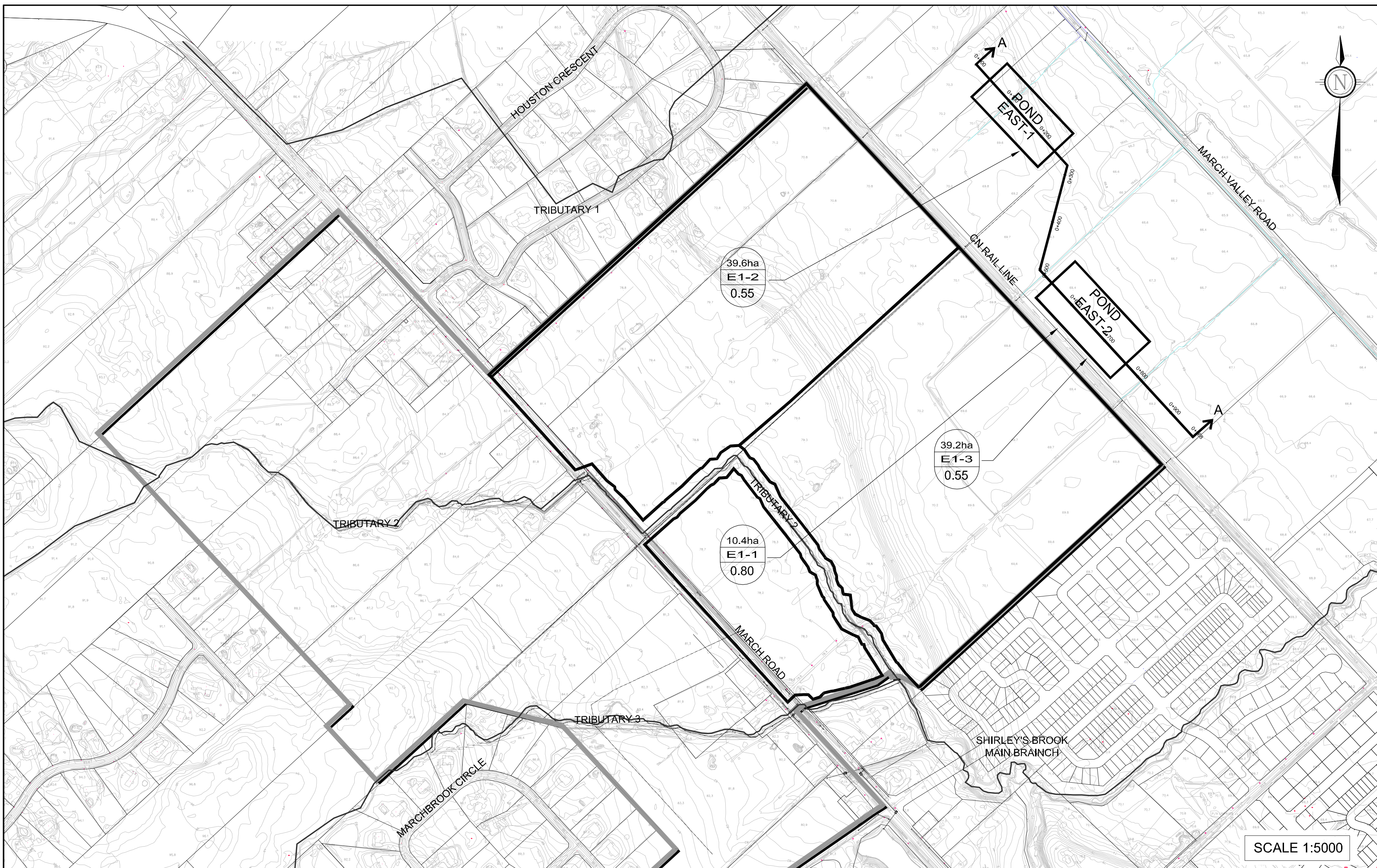
KANATA NORTH
EXPANSION AREA CDP

EAST MARCH ROAD
SWM POND OPTIONS

SCALE	DATE	JOB	FIGURE
VARIES	JAN 2014	112117	3



A-A
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V:1:250

East of Rail
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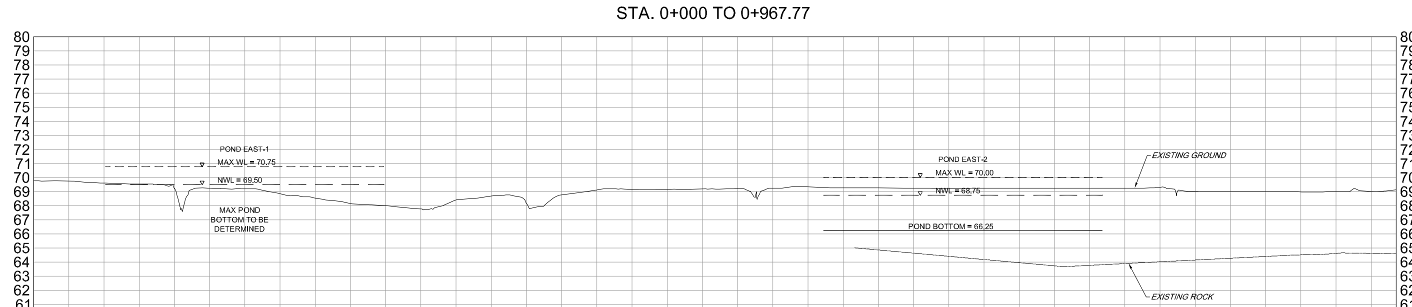
250 VERT.
STA. 0+000 TO 0+967.77



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000		69.77	69.77
0+025		69.76	69.76
0+050		69.62	69.62
0+075		69.55	69.55
0+100		69.25	69.25
0+125		69.25	69.25
0+150		69.21	69.21
0+175		68.86	68.86
0+200		68.54	68.54
0+225		68.16	68.16
0+250		68.01	68.01
0+275		67.77	67.77
0+300		68.42	68.42
0+325		68.70	68.70
0+350		68.18	68.18
0+375		68.78	68.78
0+400		69.12	69.12
0+425		69.17	69.17
0+450		69.17	69.17
0+475		69.19	69.19
0+500		69.21	69.21
0+525		69.25	69.25
0+550		69.35	69.35
0+575		69.28	69.28
0+600		69.27	69.27
0+625		69.26	69.26
0+650		69.24	69.24
0+675		69.25	69.25
0+700		69.25	69.25
0+725		69.25	69.25
0+750		69.25	69.25
0+775		69.25	69.25
0+800		69.31	69.31
0+825		69.02	69.02
0+850		69.00	69.00
0+875		69.00	69.00
0+900		68.99	68.99
0+925		69.00	69.00
0+950		69.02	69.02
0+967.77		69.14	69.14

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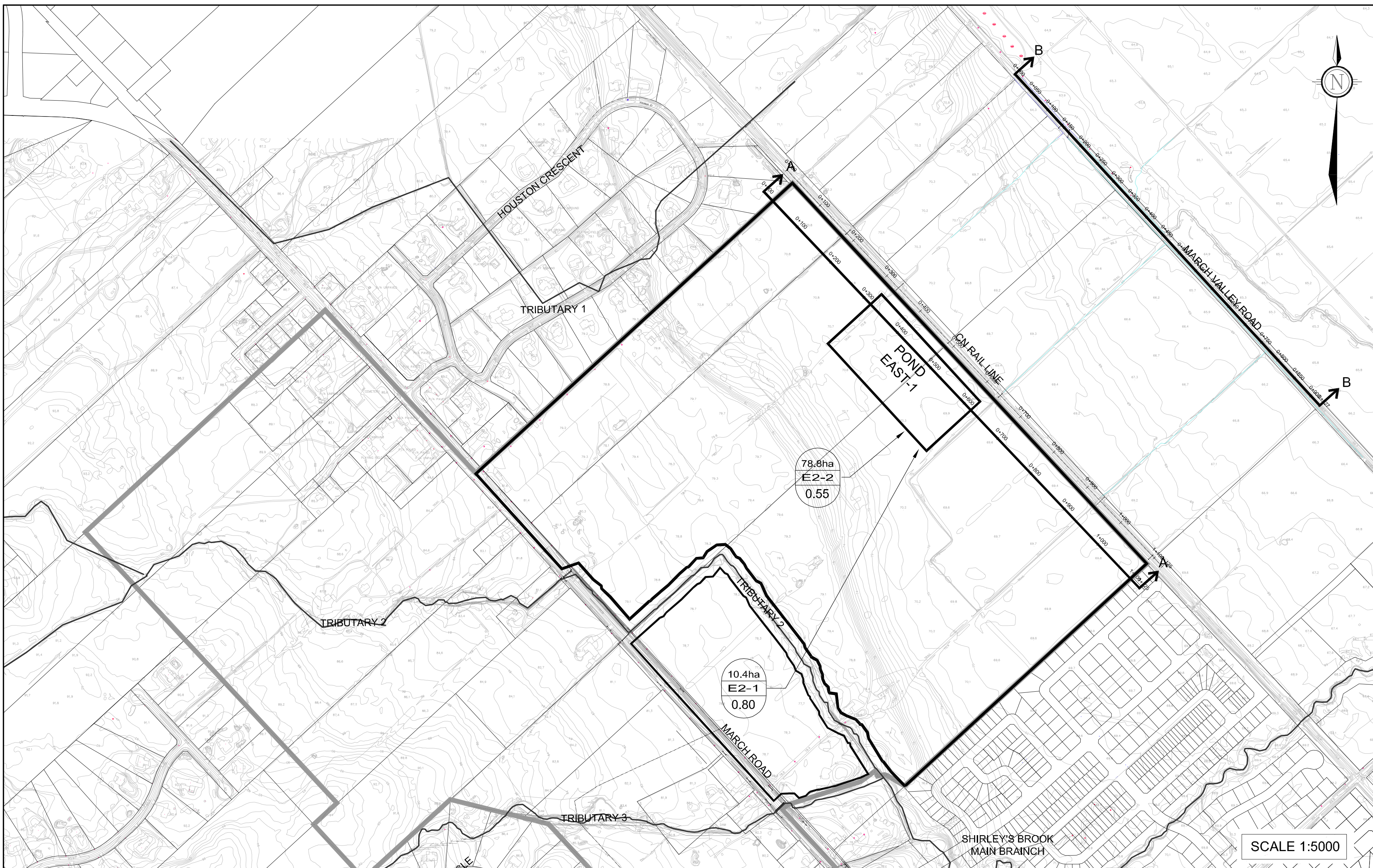
KANATA NORTH
EXPANSION AREA CDP

EAST OF CN RAIL
SWM POND LOCATIONS

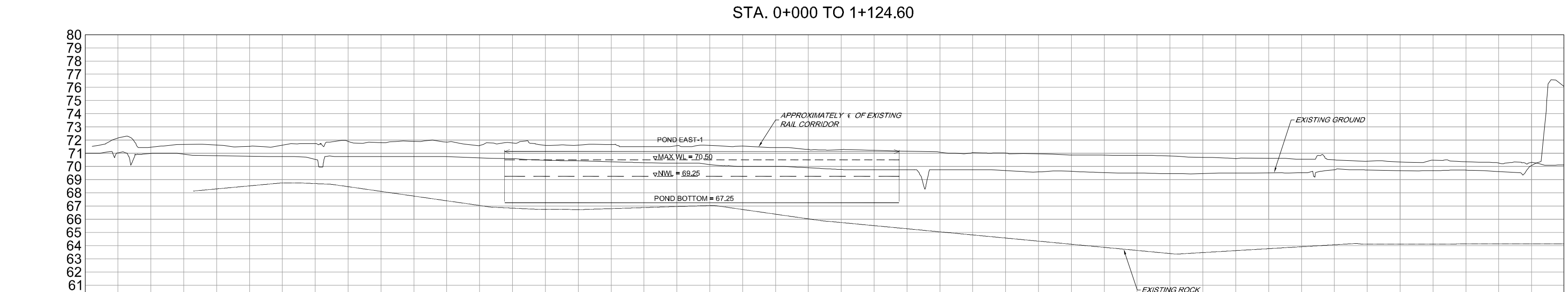
SCALE: VARIES

DATE: JAN 2014 | JOB: 112117 | FIGURE: 4



A-A
(STA 1+000 TO 1+124.60)
SCALE
H:1:2500
V:1:250

EAST Property @ CN Rail
SCALE : 2500 HORIZ.
250 VERT.
STA. 0+000 TO 1+124.60



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000			71.00
0+025			71.02
0+050			70.99
0+075			70.92
0+100		68.30	70.81
0+125		68.53	70.77
0+150		68.75	70.75
0+175		68.70	70.54
0+200		68.47	70.75
0+225		68.11	70.75
0+250		67.75	70.75
0+275		67.40	70.75
0+300		67.04	70.66
0+325		66.84	70.60
0+350		66.75	70.48
0+375		66.73	70.43
0+400		66.80	70.36
0+425		66.88	70.28
0+450		66.96	70.25
0+475		67.04	70.14
0+500		66.74	70.00
0+525		66.38	70.00
0+550		66.03	69.90
0+575		65.75	69.77
0+600		65.51	69.75
0+625		65.28	69.75
0+650		65.04	69.75
0+675		64.81	69.75
0+700		64.57	69.70
0+725		64.34	69.59
0+750		64.10	69.63
0+775		63.87	69.54
0+800		63.63	69.50
0+825		63.40	69.46
0+850		63.47	69.46
0+875		63.62	69.50
0+900		63.77	69.51
0+925		63.91	69.52
0+950		64.06	69.75
0+975		64.11	69.73
1+000		64.11	69.69
1+025		64.12	69.69
1+050		64.12	69.72
1+075		64.13	69.62
1+100		64.14	70.08
1+124.60		64.14	76.07

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KANATA NORTH
EXPANSION AREA CDP

EAST MARCH ROAD
SWM POND OPTIONS

SCALE		
VARIES		
DATE: JAN 2014	JOB: 112117	FIGURE: 5

A-A
(STA 0+000 TO 0+967.77)
SCALE
H:1:2500
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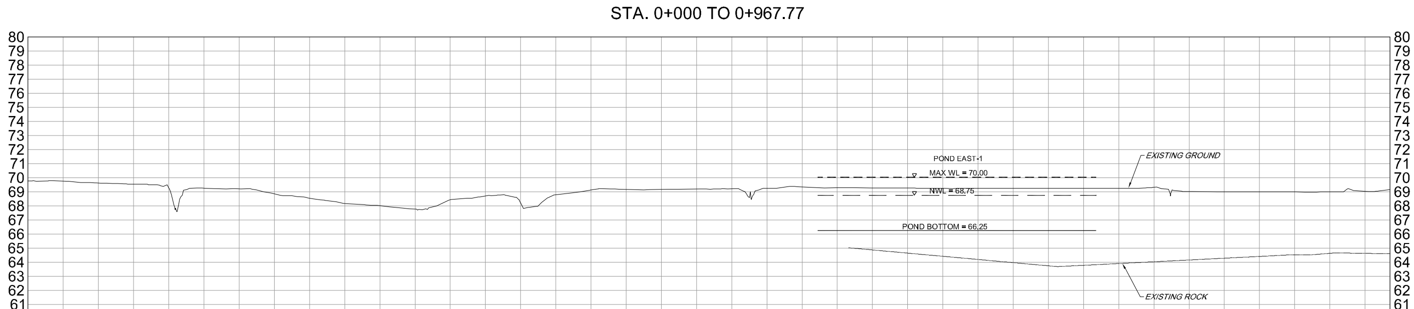
East of Rail
SCALE : 2500 HORIZ.
250 VERT.
STA. 0+000 TO 0+967.77



CHAINAGE	STORM SEWER INVERTS	EXISTING ROCK	EXISTING ELEVATION
0+000		69.77	69.77
0+025		69.76	69.76
0+050		69.62	69.62
0+075		69.55	69.55
0+100		69.25	69.25
0+125		69.25	69.25
0+150		69.21	69.21
0+175		68.86	68.86
0+200		68.54	68.54
0+225		68.16	68.16
0+250		68.01	68.01
0+275		67.77	67.77
0+300		68.42	68.42
0+325		68.70	68.70
0+350		68.18	68.18
0+375		68.78	68.78
0+400		69.12	69.12
0+425		69.17	69.17
0+450		69.17	69.17
0+475		69.19	69.19
0+500		69.21	69.21
0+525		69.25	69.25
0+550		69.35	69.35
0+575		69.28	69.28
0+600		69.27	69.27
0+625		69.26	69.26
0+650		69.24	69.24
0+675		69.25	69.25
0+700		69.25	69.25
0+725		69.25	69.25
0+750		69.25	69.25
0+775		69.25	69.25
0+800		69.31	69.31
0+825		69.02	69.02
0+850		69.00	69.00
0+875		69.00	69.00
0+900		68.99	68.99
0+925		69.00	69.00
0+950		69.02	69.02
0+967.77		69.14	69.14

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KANATA NORTH
EXPANSION AREA CDP

EAST OF CN RAIL
SWM POND LOCATIONS

SCALE		
VARIES		
DATE: JAN 2014	JOB: 112117	FIGURE: 6

NOVATECH ENGINEERING CONSULTANTS LTD.

M E M O R A N D U M

DATE: FEBRUARY 14, 2014

TO: FILE

FROM: MICHAEL PETEPIECE

RE: KANATA NORTH URBAN EXPANSION AREA – OUR FILE NO. 112117
SWM SERVICING OPTIONS

CC: JOHN RIDDELL (NECL)
MURRAY CHOWN (NECL)

1.0 INTRODUCTION

Storm servicing options for the Kanata North Urban Expansion Area have been developed and will be evaluated as part of the Environmental Management Plan in accordance with the integrated EA process.

2.0 SWM CRITERIA

All of the SWM options must adhere to the following criteria:

- Provide an Enhanced level of water quality protection (80% long-term TSS removal)
- Control post-development peak flows in Shirley's Brook to pre-development levels for all storms up to and including the 100-year event.
- Maintain baseflows in the Northwest Tributary channels.
- Provide appropriate development setbacks (corridor widths) for the Northwest Tributaries of Shirley's Brook.
- Mitigate against increase in channel erosion in Shirley's Brook resulting from the proposed development.
- Ensure the proposed design adheres to all applicable policies and guidelines of the MVCA, City, MOE, and other approval agencies.

3.0 STORMWATER MANAGEMENT OPTIONS

Wet pond SWM facilities represent the most viable approach to meeting the both the development objectives and stormwater management targets for this area. In addition to end-of-pipe SWM facilities, lot level and conveyance best management practices will be considered in areas where they are compatible with the proposed land use.

March Road represents a logical drainage divide for the site. As such, separate and independent stormwater management options have been developed for the areas east and west of March Road.

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Consulting Engineers & Planners

The location of the wet ponds shown in each of the stormwater management options have been determined by taking the following features into consideration:

- Wooded Areas
- Depth to Bedrock
- Existing Watercourses (Shirley's Brook Northwest Branch Tributaries)
- Size, elevation and condition of existing culverts and watercourse crossings.
- March Road (Arterial Road)

3.1 West of March Road

Under existing conditions, the KNUEA lands west of March Road are divided into three areas by the two main tributaries comprising the Northwest Branch of Shirley's Brook (Tributaries 2 and 3). These watercourses will be retained under post-development conditions and represent the primary constraint for determining the size and location of the proposed SWM facilities.

It is not feasible to service the lands west of March Road using a single SWM facility, as this would require a very deep pond and significant excavation into bedrock to allow the storm sewers to cross underneath the Shirley's Brook Tributaries.

Two options have been developed for the lands west of March Road. Each option includes two SWM facilities for water quality and quantity control. The primary difference between the two options is the tributary drainage area to each pond, which changes the required storage volume and size of the SWM facilities. For both options, it is assumed that a third SWM facility will not be required for the lands between the Shirley's Brook Northwest Branch and Old Carp Road.

Drainage Diversion - Area North of Old Carp Road

The KNUEA lands on the north side of Old Carp Road are currently drained by a small ditch, which also serves as the outlet for a portion of Marchbrook Circle. This ditch crosses under March Road and the parking lot for the Kanata Plastic and Cosmetic Surgery office via a 1200mm culvert. Under existing conditions, the drainage area upstream of this culvert is approximately 23.5 ha.

There is sufficient topographic relief to direct approximately 16.7 ha of this area to a storm sewer crossing underneath the tributary to the proposed SWM facility on the north side of the Shirley's Brook Northwest Branch Tributary. Quality control for the remaining area (approximately 6.8 ha) would be provided using a Vortechnics or similar treatment unit. The required quantity control storage will be minimal due to the significant reduction in drainage area and should not require a separate SWM facility.

The drainage areas and locations of the SWM facilities for Options 1 and 2 (West) are shown on Drawings **112117-SWMF1** and **SWMF2**. Cross-sections of the proposed SWM facilities are provided on Drawings **112117-P1** to **P4**, which show the operating levels in the ponds in relation to the existing ground and bedrock elevations.

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3.1.1 Option 1 (West)

Two SWM facilities adjacent to March Road. Drainage boundary follows alignment of Shirley's Brook Northwest Branch Tributary.

Two SWM facilities would be located on the west side of March Road. The drainage boundary between the proposed SWM facilities is delineated by the Northwest Branch Tributary of Shirley's Brook. While the locations of the SWM facilities are somewhat flexible, they should be located adjacent to March Road and as close as possible to their respective tributary outlets.

3.1.2 Option 2 (West)

Two SWM facilities adjacent to March Road. Maximize drainage area to North Pond (Junic / Multivesco Property)

The Junic / Multivesco property is bisected by the Northwest Tributary of Shirley's Brook. There is sufficient topographic relief in the northwest portion of the study area to provide a storm sewer crossing underneath the tributary. This would allow the majority of the Junic / Multivesco lands to be serviced by a single SWM facility. It is also possible to construct a major system crossing to allow overland flows to be conveyed underneath the tributary to the SWM facility.

The remaining areas would be directed to a second SWM facility adjacent to the Northwest Branch of Shirley's Brook. The drainage divide between the two ponds is approximate and intended to give a general idea of the area that can be directed to either of the two ponds and provide flexibility in the development of land use concepts and road networks.

3.2 East of March Road

Three options have been developed for the lands west of March Road. The first two options are based on using a single pond to service both the Valecraft and Metcalfe properties. The third option provides a separate pond for each property. For all options, the ponds should be located at the eastern limit of the development lands near or adjacent to the existing rail line.

The primary topographic feature on the KNUEA lands east of March Road is a slope running north/south approximately midway between March Road and the existing railway. The lands on the top of the slope are tributary to the Northwest Branch of Shirley's Brook. The lands below the slope are drained by a series of parallel agricultural ditches that cross the existing rail line through a series of culverts and outlet to the roadside ditch on March Valley Road.

<u>Drainage Diversion – Area Bounded by Northwest Tributary & March Road</u>

There is sufficient topographic relief to provide a storm sewer crossing underneath the Shirley's Brook Northwest Tributary, thereby eliminating the need for a separate SWM facility to service the lands bounded by the Northwest Tributary and March Road. This will result in a small reduction in the tributary drainage area upstream of the confluence of the Northwest Branch and the Main Branch of Shirley's Brook. There will be minimal impact on baseflow in Shirley's Brook as this diversion represents only a small fraction of the total upstream drainage area, and the reduction in drainage area will be offset by increased runoff from development on the west side of March Road, The SWM facilities adjacent to March Road can be designed to incorporate baseflow enhancement outlets.

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Storm Outlet Options

The most logical outlets for the proposed SWM facilities are the existing drainage ditches that outlet to Shirley's Brook via at March Valley Road (Ditches 'A' to 'C'). However, there are existing erosion and slope stability issues in this reach of Shirley's Brook where the watercourse is immediately adjacent to March Valley Road. It is anticipated that mitigation measures will be required to address any increase in erosion associated with the proposed development.

1. The first option would be to improve this reach of Shirley's Brook using natural channel design techniques. The preferred approach would be to relocate the watercourse away from the edge of the road, but it may be possible to provide improvements by re-grading and stabilizing the banks of the existing channel.
2. The second option would be to provide an outlet along the CN Rail line. The outlet would need to be a storm sewer, as an open channel would flow against the grade would be prohibitively deep (5+ metres). The storm sewer would turn east, following the alignment of the outlet channel for Houston Crescent (Tributary 1) and outlet to Shirley's Brook where the watercourse moves away from March Valley Road.
3. The third option would be to construct a new storm sewer in the March Valley Road right-of-way to collect runoff from the development area and convey it north to where Shirley's Brook moves away from March Valley Road. This option would require raising the grade of March Valley Road by several metres to accommodate the storm sewer and provide adequate pipe cover.

3.1.1 Option 1 (East)

Two SWM facilities east of the CN Rail line (outside urban boundary).

This option provides a separate SWM facility for the Metcalfe and Valecraft properties. The SWM facilities are located on the east side of the CN rail line outside the limits of the KNUEA. The southeast SWM facility (Metcalfe) is located adjacent to the CN rail line to provide connectivity to the urban development. The northeast SWM facility (Valecraft) is located in a clearing approximately 200m east of the urban area (refer to Drawing **112117-SWMF3**).

3.1.1 Option 2 (East)

One SWM facility west of the CN Rail line (inside urban boundary).

This option provides a single SWM facility to service both the Metcalfe and Valecraft properties. The SWM facility is split evenly between the two properties and located adjacent to the CN Rail line inside the urban boundary. Two separate inlets to the pond would allow servicing of each development to proceed independently (refer to Drawing **112117-SWMF4**).

3.1.1 Option 3 (East)

One SWM facility east of the CN Rail line (outside urban boundary).

This option provides a single SWM facility to service both the Metcalfe and Valecraft properties. The SWM facility is located on the east side of the CN rail line outside the limits of the KNUEA. The facility would be adjacent to the urban area to allow for connectivity. This location is at a lower elevation than Option 2, which provides more flexibility in the grading design for the KNUEA lands (refer to Drawing **112117-SWMF5**).

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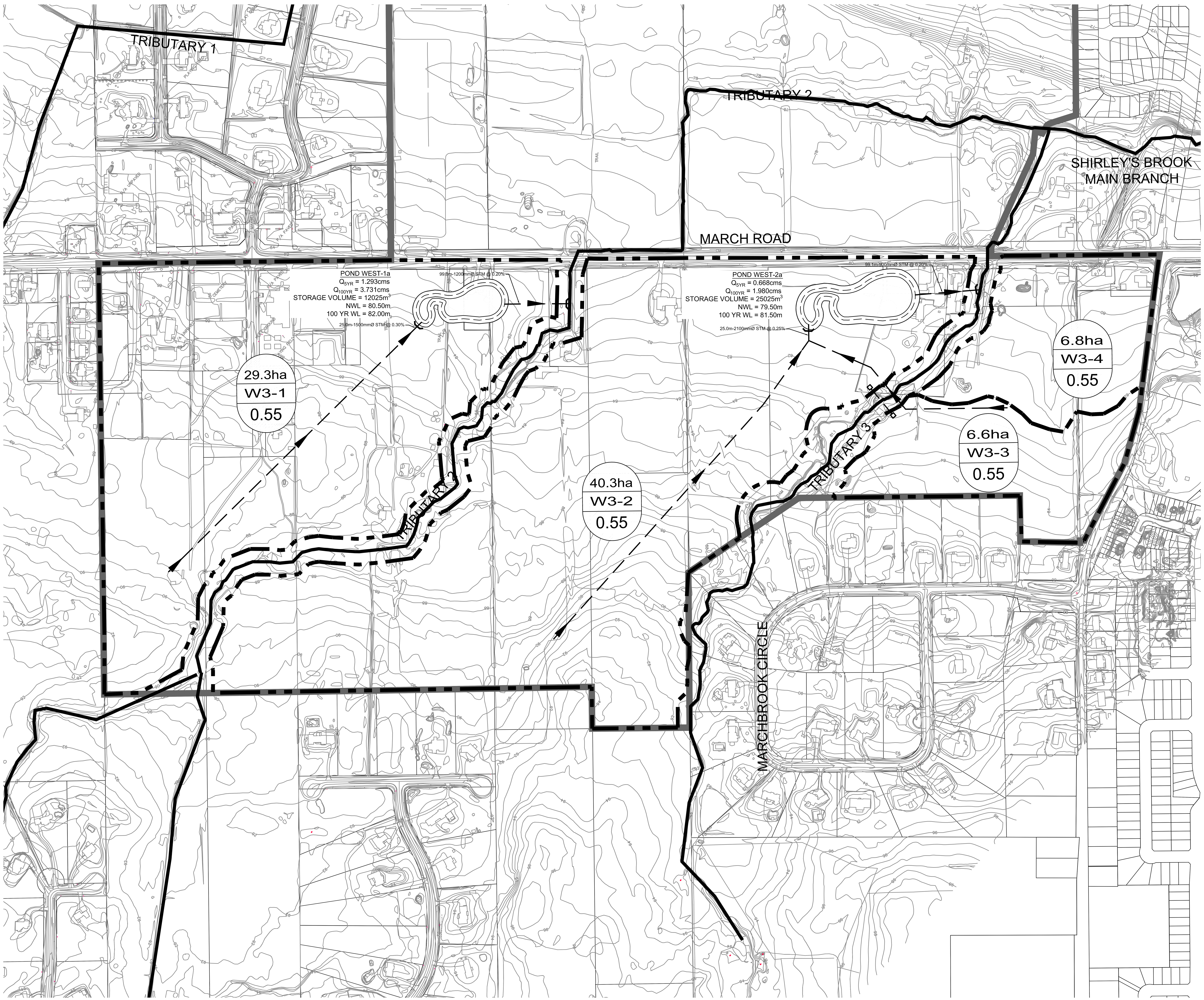

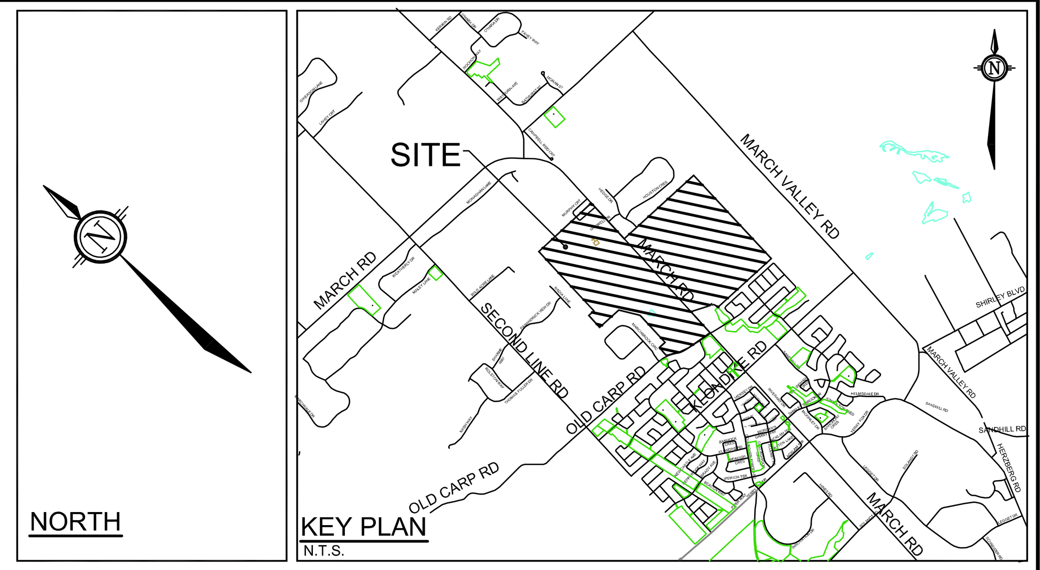

LEGEND

- 39.2ha / E1-3 / 0.55 — DRAINAGE AREA (HECTARES); DRAINAGE AREA ID; RUNOFF COEFFICIENT
- DRAINAGE AREA BOUNDARY
- PROPOSED STORM WATER MANAGEMENT FACILITY
- PROPOSED STORM PIPE WITH FLOW DIRECTION
- PROPOSED STORM INLET / OUTLET
- PROPOSED DITCH INLET CATCH BASIN C/W STORM PIPE
- *EXISTING WATER BODIES*

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

M:\2012\112117\CAD\Design\SWM\KJB-working\112117-SWMF.dwg, WEST OPT 1, Feb 14, 2014 - 3:56pm, blhuber

No.	REVISION	DATE	BY
1.	ISSUED FOR REVIEW	02/10/14	MJP

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DESIGN	KJB
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DRAWN	BET
CHECKED	MJP
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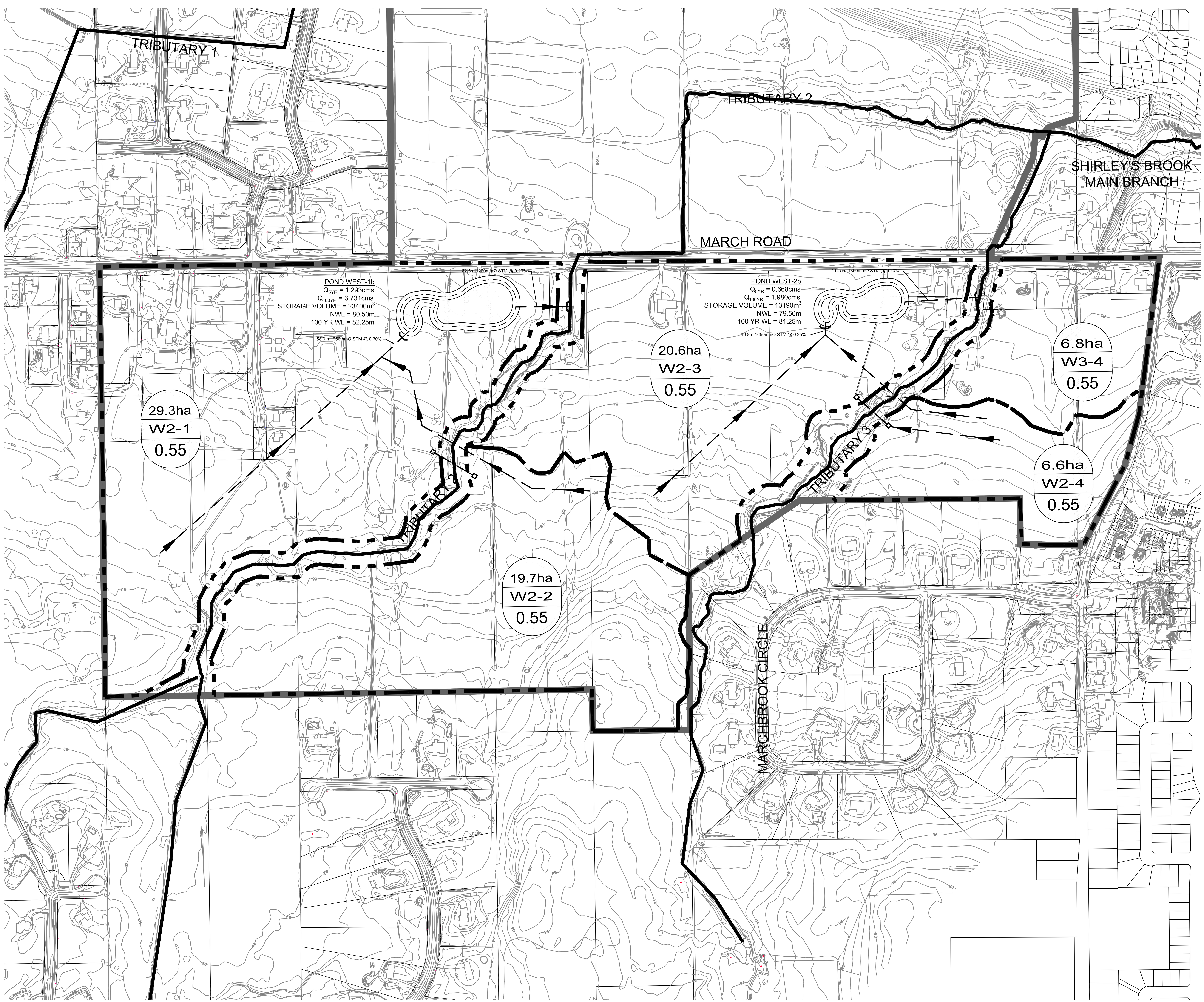
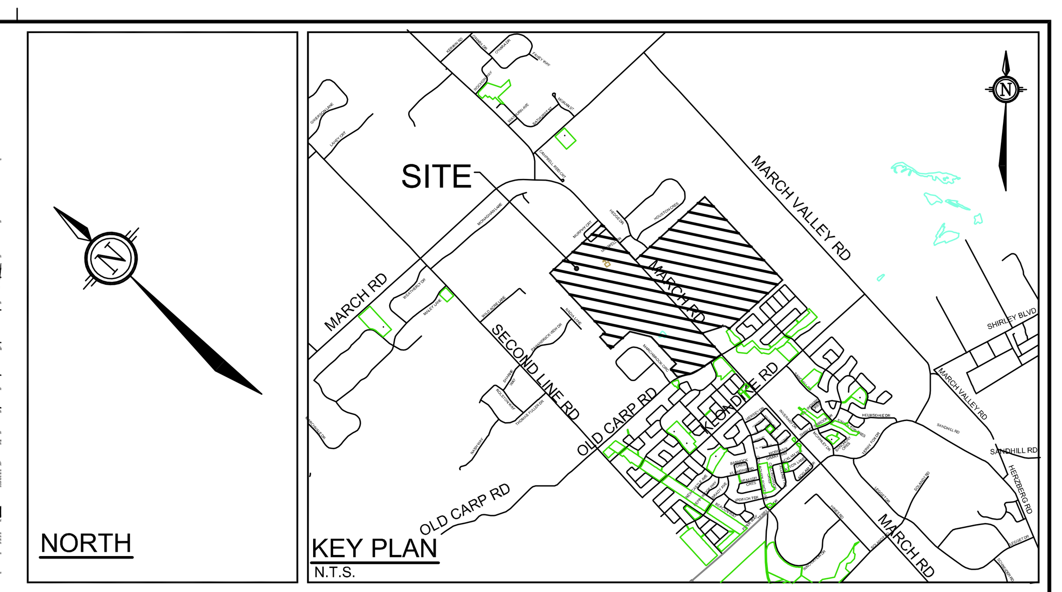
LOCATION
CITY OF OTTAWA
KANATA NORTH EXPANSION STUDY

DRAWING NAME
STORM WATER MANAGEMENT FACILITY POND OPTIONS WEST OF MARCH ROAD 1 OF 2

PROJECT No. 112117
REV 1
DRAWING No. 112117-SWMF1

PLANB1.DWG - 1000mmx707mm





LEGEND

39.2ha	DRAINAGE AREA (HECTARES)
E1-3	DRAINAGE AREA ID
0.55	RUNOFF COEFFICIENT
	DRAINAGE AREA BOUNDARY
	PROPOSED STORM WATER MANAGEMENT FACILITY
	PROPOSED STORM PIPE WITH FLOW DIRECTION
	PROPOSED STORM INLET / OUTLET
	PROPOSED DITCH INLET CATCH BASIN C/W STORM PIPE
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LOCATION
CITY OF OTTAWA
KANATA NORTH EXPANSION STUDY

DRAWING NAME
STORM WATER MANAGEMENT FACILITY POND OPTIONS WEST OF MARCH ROAD 2 OF 2

PROJECT No. 112117
REV 1
DRAWING No. 112117-SWMF2

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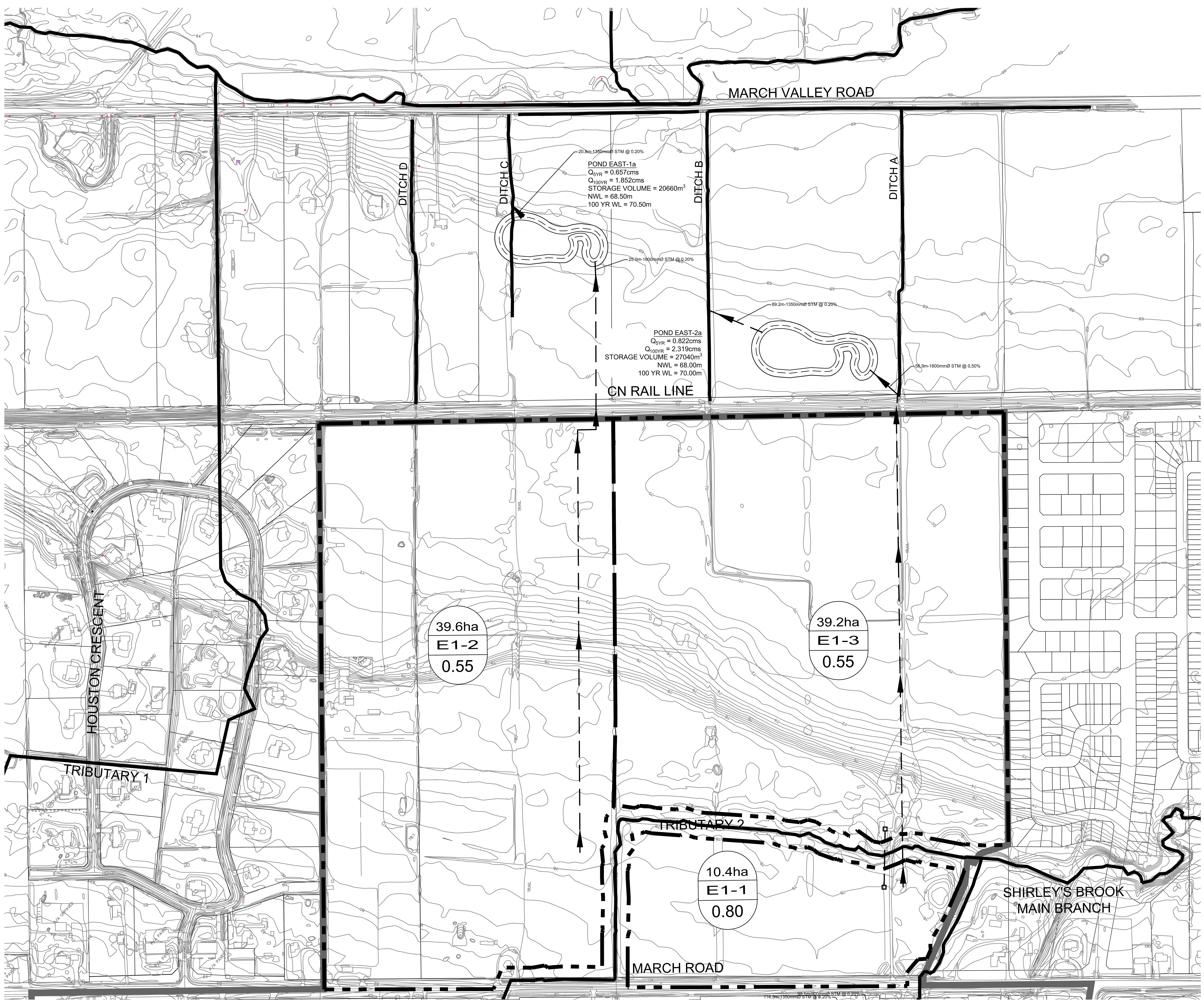

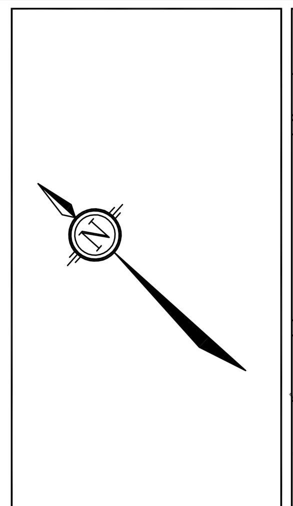

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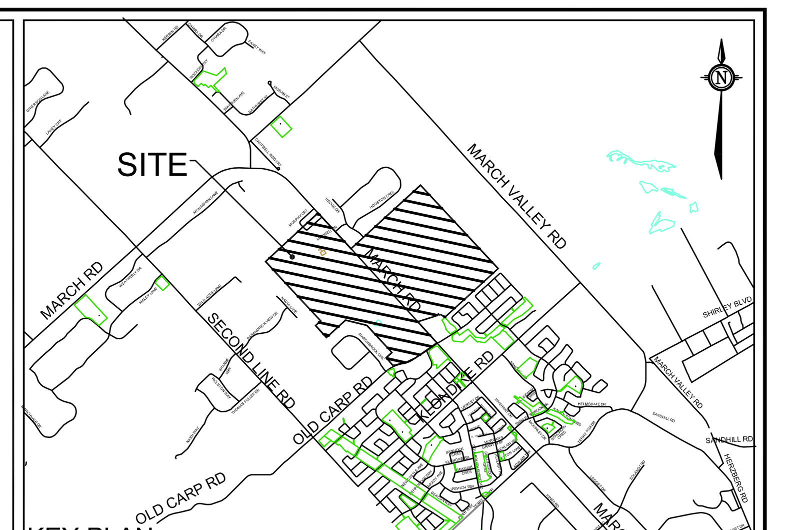

KEY PLAN
N.T.S.

LEGEND

- 39.2ha — DRAINAGE AREA (HECTARES)
- E1-3 — DRAINAGE AREA ID
- 0.55 — RUNOFF COEFFICIENT
- DRAINAGE AREA BOUNDARY
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- PROPOSED DITCH INLET CATCH BASIN C/W STORM PIPE
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LOCATION
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KANATA NORTH EXPANSION STUDY

DRAWING NAME
STORM WATER MANAGEMENT FACILITY POND OPTIONS EAST OF MARCH ROAD 1 OF 3

PROJECT No. 112117
REV REV 1
DRAWING No. 112117-SWMF3

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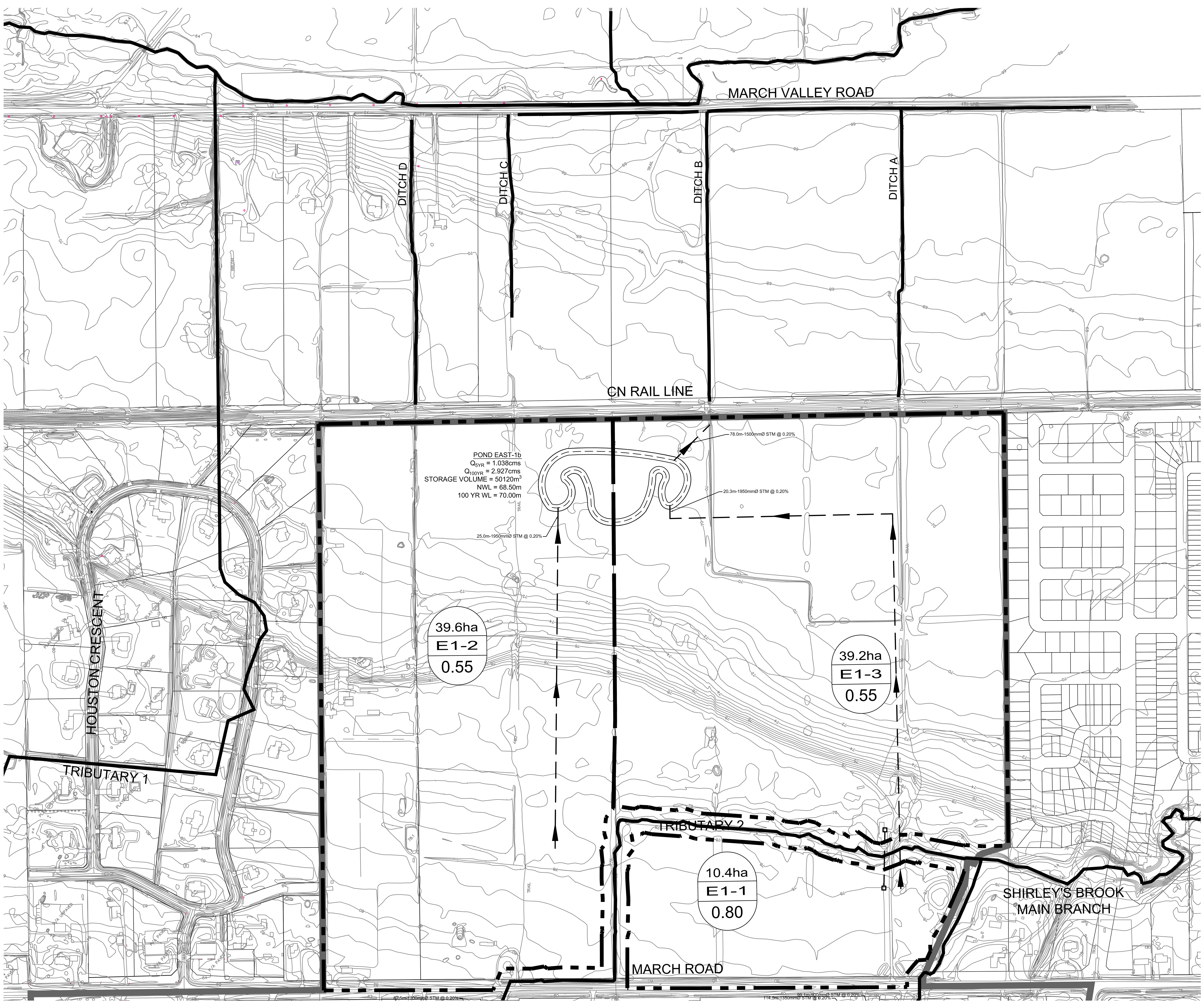

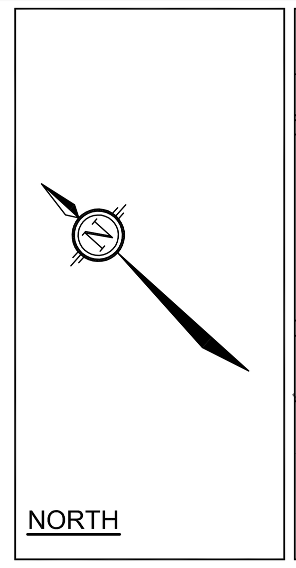

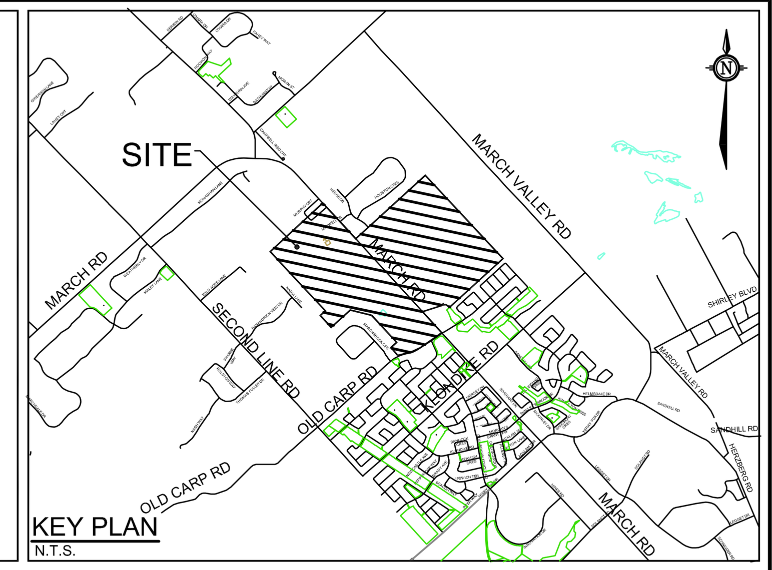

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DRAWING NAME
STORM WATER MANAGEMENT FACILITY POND OPTIONS EAST OF MARCH ROAD 2 OF 3

PROJECT No. 112117
REV: REV 1
DRAWING No. 112117-SWMF4

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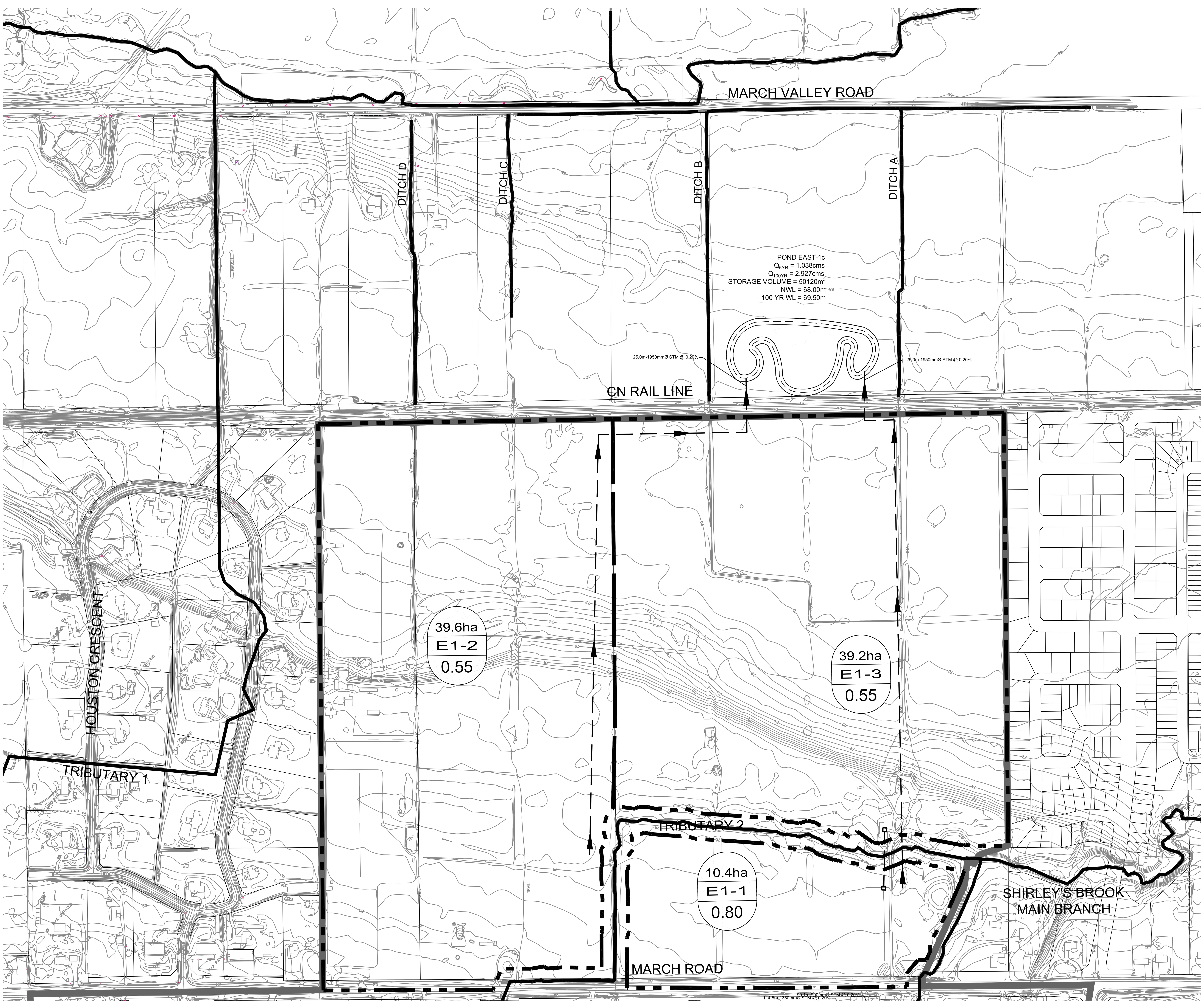

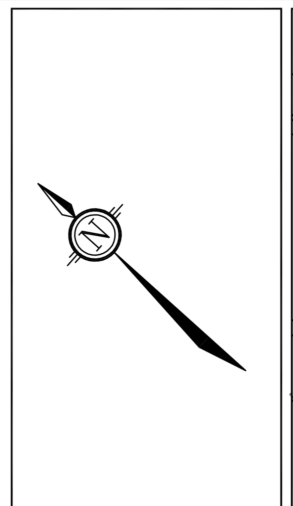

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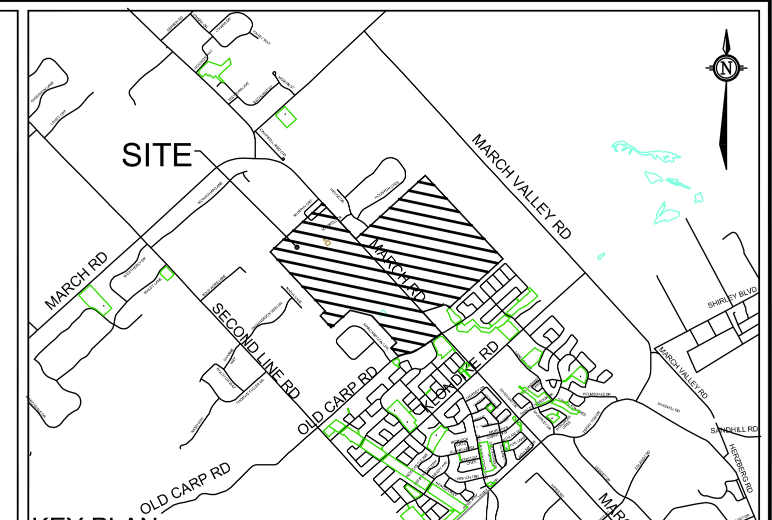

KEY PLAN
N.T.S.

LEGEND

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DRAWING NAME
STORM WATER MANAGEMENT FACILITY POND OPTIONS EAST OF MARCH ROAD 3 OF 3

PROJECT No. 112117
REV 1
DRAWING No. 112117-SWMF5

PLANB1.DWG - 1000mmx707mm