The IOS trunk sewer has three shafts located along its length within and adjacent to the site. Besides the Peach Tree Road Shaft to the west and the NRC Shaft to the east, a relatively new shaft, located near the middle of the site and referred to as the Codd's Road Shaft, was constructed in the 1990s. Future redevelopment of the site could make use of all three connection points to the IOS.

There are several developed external areas to the site which contribute flows to the existing site sewer system. The Montfort Hospital has a recently separated sewage drainage system consisting of dedicated sanitary and storm sewers. The sanitary outlet from the Montfort Hospital connects to the combined sewers on the Rockcliffe site at Via Venus Private. That sewer is located in an easement which is shown on **Figure 2.13**.

The Foxview residential development is currently serviced with sanitary sewers which outlet to the south.

The existing Fairhaven Community adjacent to the south boundary of former CFB Rockcliffe immediately adjacent to the Montfort Hospital remains a rural estate community with individual septic systems. Although not currently discharging wastewater to the former CFB Rockcliffe site, the natural topography suggests that the majority of this community would drain to the Rockcliffe sanitary system if sanitary sewers were required in the future.

The Thorncliffe Village residential development has a separated sewer system including a dedicated 300 mm diameter sanitary sewer which enters and meanders through the Rockcliffe site but connects directly to the IOS trunk sewer at the Codd's Road shaft. The connection detail is presented on **Figure 2.14**.

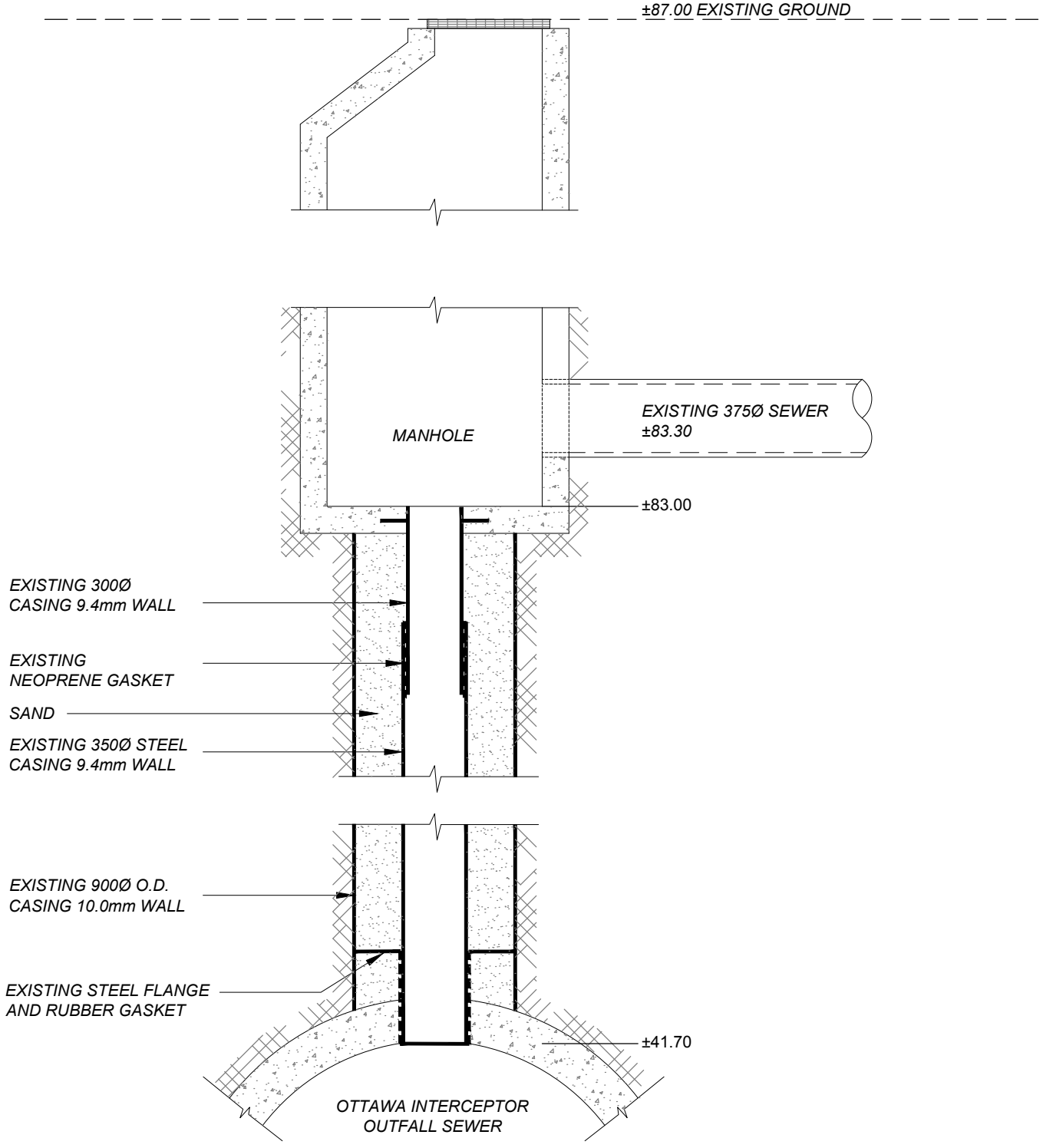
The NRC Campus is serviced with combined sewers. Discussions with NRC staff suggest that most of the combined sewage from the NRC lands north of Montreal Road is directed to the IOS trunk sewer in a combined sewer which is located within the Rockcliffe site. The NRC outlet sewer is connected directly to the large IOS trunk sewer complete with an overflow mechanism, as illustrated on **Figures 2.15** and **2.16**.

2.4.3 Stormwater

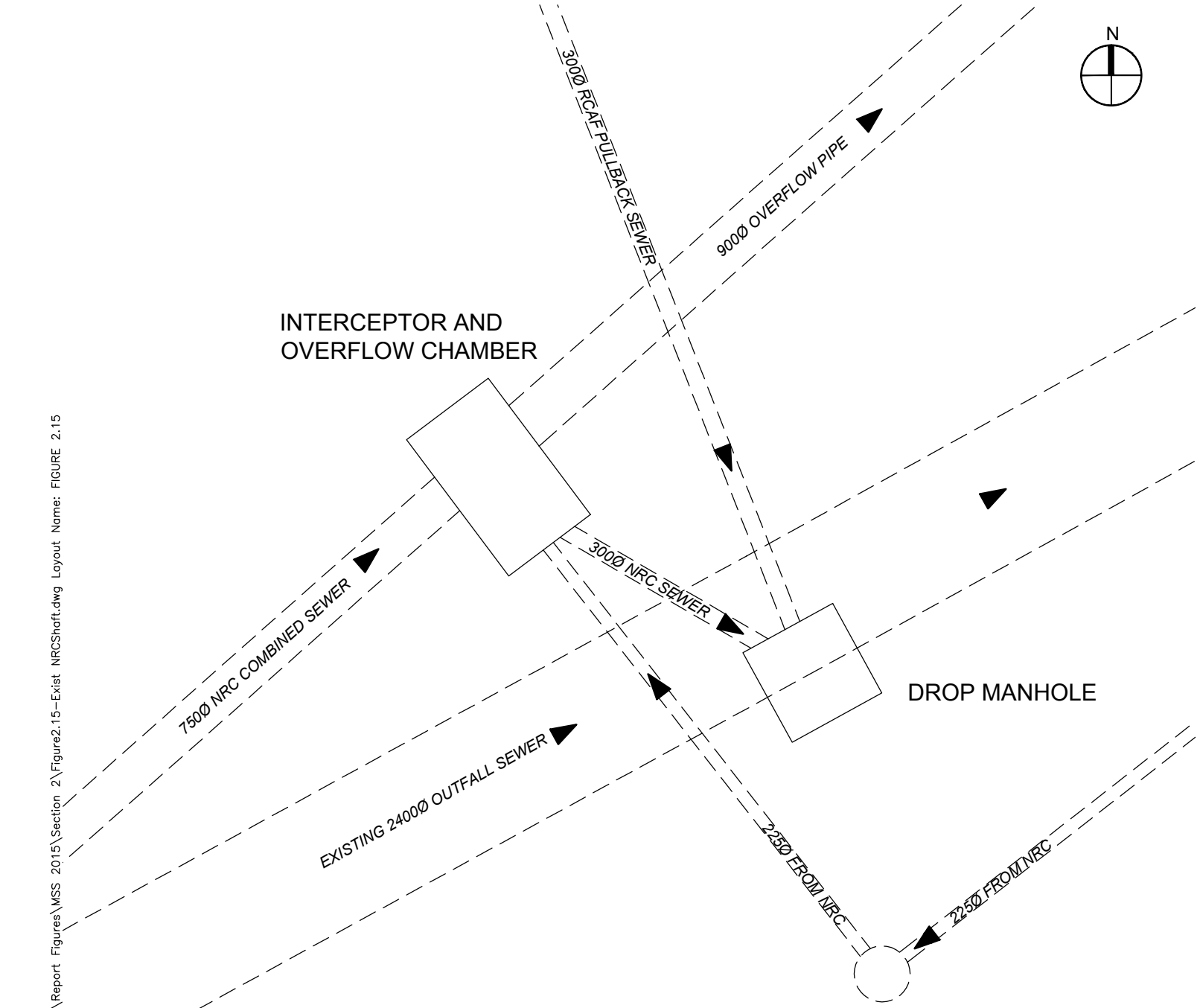
The existing surface drainage patterns for the study area and adjacent external lands are presented on **Figure 2.1**, and the existing storm drainage area plan is indicated on **Figure 2.17**. As noted in **Section 1.2**, most of the study area is relatively flat, generally sloping from the southeast to the northwest. Surface runoff discharges at the northwest limit, crossing the Aviation Parkway via a culvert and outletting to the Ottawa River along the north limit of the RCMP Lands. Surface runoff from the northeast quadrant of the site discharges northward over the north escarpment and crosses the Aviation Parkway via a culvert ultimately discharging to the Ottawa River.

In addition to the combined sewer system on the Rockcliffe site, there are two dedicated storm sewer systems. These are identified on **Figure 2.17**. The two existing storm sewers are both 1050 mm in diameter and convey discharge from the existing Burma Road Stormwater Management (SWM) Facility. These two sewers both head north from the facility, one east of Via Vega Private and the other west of that road and are discussed below. The balance of the existing site storm drainage system consists of road side ditches that direct runoff to either the combined sewers or the dedicated storm sewers.

The western 1050 mm diameter storm sewer also collects surface runoff from the central portion of the site near Via Venus Private and Codd's Road and routes those flows westward and outlets to an open ditch system located behind Dubhe Private. The ditch has a fairly steep gradient and naturalized cobble bottom in its headwaters east of Aviation Parkway. The channel crosses Aviation Parkway via a 900 mm (36") diameter corrugated steel pipe (CSP) outletting to a trapezoidal ditch, referred to as the Western Creek, adjacent to Crispin Private. The

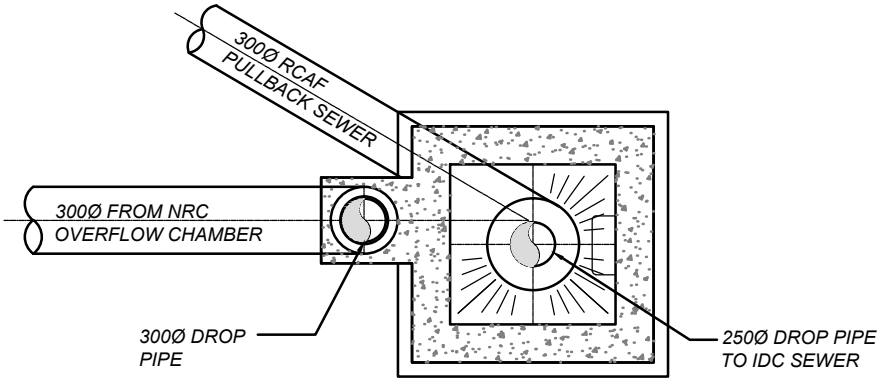


Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	CROSS-SECTION EXISTING CODD'S ROAD DROP SHAFT	FIGURE 2.14



J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 2\Figure2.15-Exist NRCShaft.dwg Layout Name: FIGURE 2.15

Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	EXISTING NRC SHAFT CONNECTION PLAN	FIGURE 2.15



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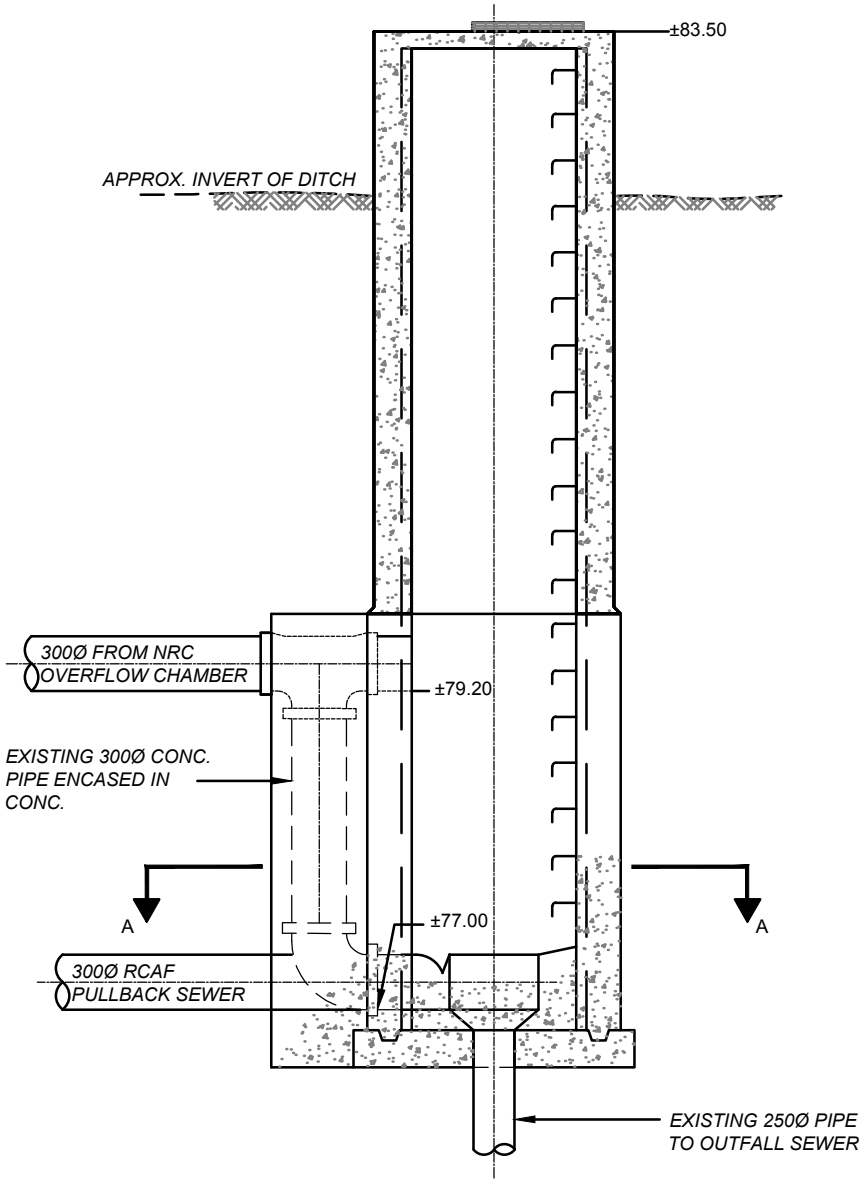
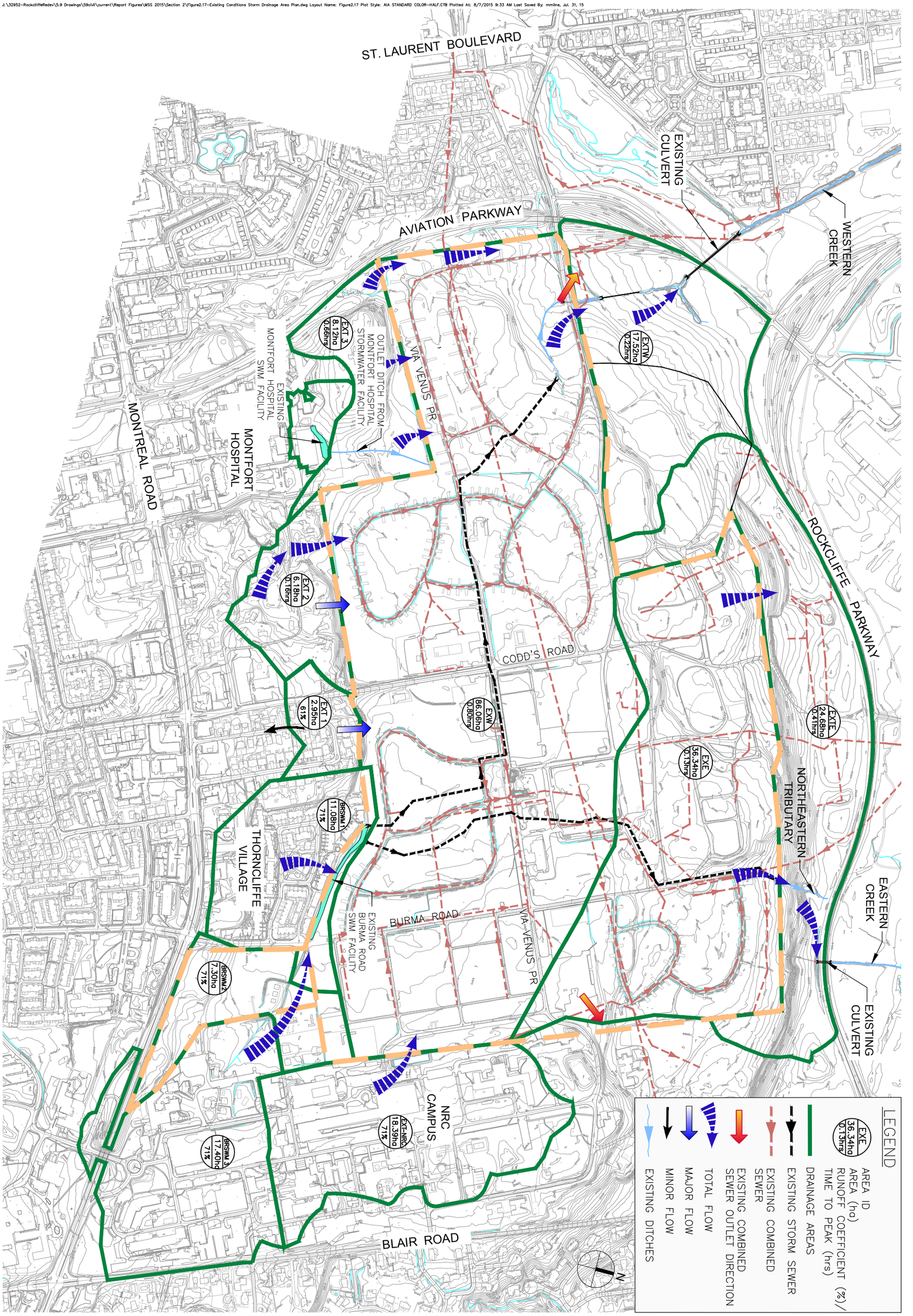


J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 2\Figure2.16-X-Sect Exist NRC Drop Shaft.dwg Layout Name: FIGURE2.16

Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	CROSS-SECTION EXISTING NRC DROP SHAFT CONNECTION	FIGURE 2.16



Sheet No.	Drawing Title	Project Title	Scale
FIGURE 2.17	EXISTING CONDITIONS STORM DRAINAGE AREA PLAN	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	0 100 200

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downstream end of the culvert is heavily silted to above the obvert, severely restricting flow through the culvert. Due to the limited available data for the culvert, the following information has been compiled from field survey work. The culvert measures approximately 137 m in length. The upstream and downstream inverts were surveyed at elevations 60.25 m, and 60.16 m, respectively, resulting in a slope of 0.07%.

Downstream of the Aviation Parkway culvert, the sediment in the channel continues for approximately 30 m westerly to the point of confluence with another channel from the Alvin Heights neighbourhood to the south. The combined channel flows westerly at a relatively flat slope through several short 900 mm diameter culverts supporting pedestrian crossings and an access road within the RCMP training grounds. The inlet to one crossing within the RCMP site is completely blocked and restricts flow to only that which can filter through the crossing embankment. At the west end of the RCMP site, the channel enters a 900 mm diameter CSP culvert that crosses under the Rockcliffe Parkway and eventually outlets to the Ottawa River. The channel between the Aviation Parkway and the Rockcliffe Parkway crossing is a relatively straight trapezoidal channel and is heavily treed along the section outside the RCMP site. There is also an existing concrete-encased sewer that partially blocks the invert of the channel immediately west of the pedestrian bridge at the end of Crispin Private. **Figure 2.18** identifies some of the creek features discussed above.

The northern 1050 mm diameter storm sewer extends northward through the site, intercepting surface runoff from the lands east and north of Via Vega Private, prior to discharging directly over the escarpment at the north limit of the study area, referred to as the Northeastern Tributary. Flow at the base of the escarpment is directed southeasterly in the southern road side ditch towards an existing roadway culvert under the Parkway. The culvert crossing under the Rockcliffe Parkway is a 1200 mm diameter (48”) CSP. Based on the limited available data for the culvert, the following information has been compiled from field survey work. The culvert measures approximately 28 m in length. The upstream and downstream inverts were surveyed at elevations 52.52 m and 52.15 m, respectively, resulting in a slope of 1.3%. The culvert discharges to a channel, referred to as the Eastern Creek, which is initially relatively straight and destabilized in the vicinity of the Rockcliffe Parkway, but graduates into a wider meandering creek with several sub-reaches as it approaches the Ottawa River. The channel is completely blocked by a pedestrian trail crossing located near the edge of the Ottawa River with no culvert, thereby restricting the discharge rate of the creek to the flow that can infiltrate through the pathway fill. The Eastern Creek is identified in **Figure 2.18**.

There are several sources of external runoff to the site. As noted above, the Burma Road SWM Facility provides treatment of runoff from the Thorncliffe Village development. In addition, an overland ditch at the south end of the NRC Campus at Montreal Road is intercepted by the Burma Road SWM Facility. The outlets from the facility are described above. Runoff from the central portion of the NRC Campus that is in excess of that intercepted by the NRC combined sewer system drains onto the site along the common east boundary. This flow is intercepted by the combined sewer system and/or the road side ditch and dedicated storm system.

The Fairhaven community uses roadside ditches to convey storm flow to the south boundary of the former CFB Rockcliffe site where the flow is intercepted and eventually directed to the western channel via road side ditches. The Foxview development contributes major system flow to the Rockcliffe site. The northeastern portion of the Montfort Hospital site is provided with a SWM Facility that outlets to an existing swale through the adjacent Montfort Hospital Woods. Outflow from the SWM facility, as well as major system flow from the northeastern portion of the hospital site is conveyed to the Rockcliffe site and into road side ditches near Via Venus Private. The runoff is eventually conveyed to the western outlet at the Aviation Parkway.

J:\32952--RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 2\Figure2.18--Location of Existing Watercourses Outlets.dwg Layout Name: Figure2.18 Plot Style: AIA STANDARD COLOR--HALF.CTB Plot Scale: 1:1 Plotted At: 8/7/2015 9:34 AM Last Saved By: mmilne Last Saved At: Jul. 31, 15

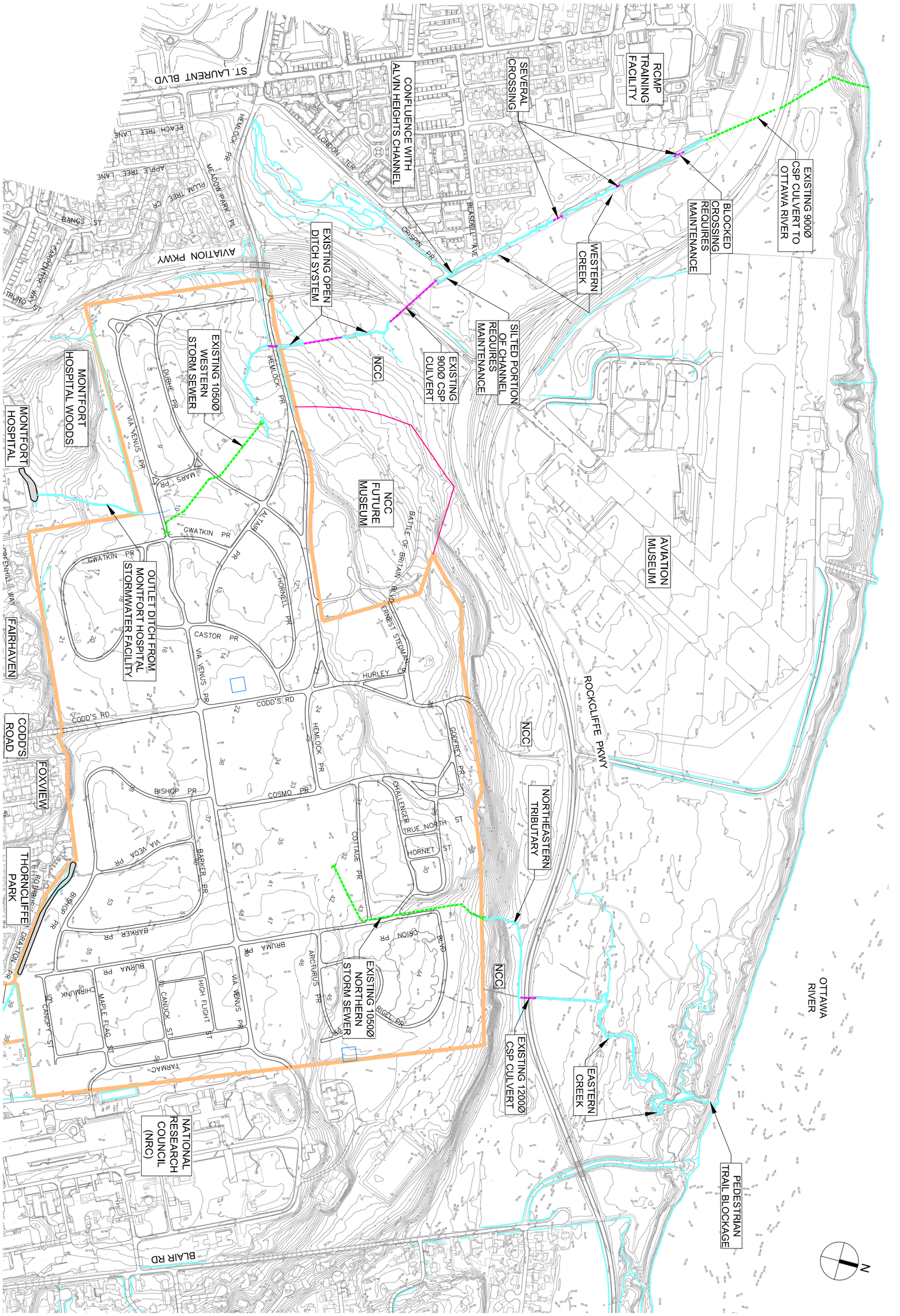

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FIGURE 2.18

LOCATION OF EXISITNG WATERCOURSES OUTLET

Project Title

FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY

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There is an undeveloped area located between the site and the Rockcliffe Parkway. The western portion contributes runoff to the existing west outlet, while the eastern portion contributes runoff to the existing east outlet.

The external drainage areas are also indicated on **Figure 2.17**.

2.5 Shallow Utilities

Utilities extending to the site, including gas, hydro, and communication lines have been decommissioned over the years as people have moved off the site and the need for services has decreased.

Hydro Ottawa confirms it services this territory. It confirmed that the only existing hydro utility on the site is an existing overhead 4Kv circuit which services the RCAF sanitary pump station located north of the site near the Rockcliffe Parkway. The service extends from Lang's Road between Fairhaven and the Montfort Hospital.

The existing utility infrastructure is presented on **Figure 2.19**. Existing utilities will not be practical for re-use in the development plan, and the redevelopment of the site will require installation of new utility services which will be located mostly underground.

2.6 Opportunities and Constraints

The natural environment and existing municipal infrastructure present several opportunities and possible constraints to the redevelopment of the former CFB Rockcliffe site.

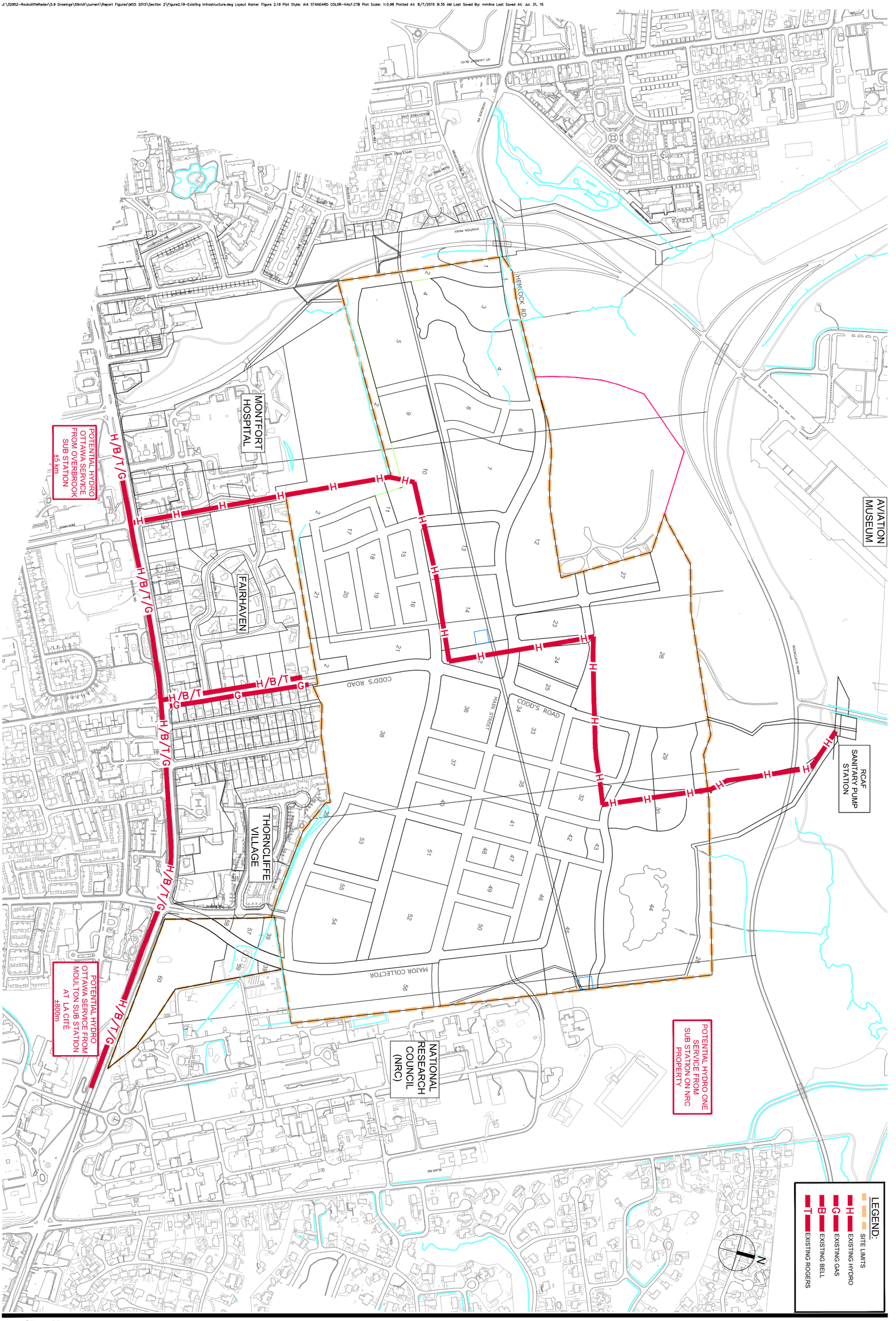
There are significant grade changes along the north perimeter, allowing shallow ponds at the base of the escarpment. The significant slope across the site limits site servicing routing to a general southeast to northwest direction. The rock escarpment provides an opportunity for a natural feature in the form of a waterfall. The escarpment also presents a constraint to development since safe setback distances must be respected.

The shallow rock at northern portion of the site accommodates significant grade raise, while clay soils at the southern portion of the site restrict grade raise.

Under existing conditions, the Eastern and Western Creeks serve as outlets from the study area with respect to surface drainage and existing storm sewers. They provide potential outlets from the stormwater management system proposed as part of the redevelopment. There are constraints associated with each creek; for example there is no outlet to the Ottawa River for the Eastern Creek, and there is debris and sediment build up at the Aviation Parkway culvert and in the Western Creek. In both cases, the restricted outlets limit discharge from the site. In order for the creeks to serve as outlets, enhancement will be considered. Specifically, at the Western Creek, debris and silt is to be removed from the Aviation Parkway culvert and the culvert through the RCMP campus. For the Eastern Creek, the constraint is the capacity of the watercourse.

During fish surveys of the respective creeks, no fish were encountered. It was concluded that the Eastern Creek could potentially provide habitat for species that are tolerant of low water levels, while sites in the Western Creek appear to provide marginal fish habitat that could be suitable for some common fish species. There is the opportunity to improve the existing and/or create fish habitat should creek enhancement works be completed.

Terrestrial surveys identified tree species on site, retention of which is recommended. In the vicinity of the Eastern SWM Facility and Eastern Creek, butternut trees classified as Category 2 (considered retainable) were identified. The Eastern SWM Facility can either be located such that the trees are retained (including a buffer); or should the trees require removal, the process must follow the 2007 Endangered Species Act regulations. The Rockcliffe Airbase Woods, located adjacent to the Eastern Creek, will be impacted by any works in the creek.



Sheet No.

FIGURE 2.19

Drawing Title

EXISTING UTILTIES INFRASTRUCTURE

Project Title

FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY

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With respect to infrastructure, its age and level of service within the limits of the former base suggest that this infrastructure (water, wastewater, stormwater and shallow utilities) has reached its useful life expectancy and will not be suitable for use in servicing redevelopment of the former CFB Rockcliffe site.

In recognition of this fact, the majority of the existing infrastructure has been taken out of service. The exceptions being the sanitary outlets for the Montfort Hospital, Thorncliffe Village, and the NRC Campus; storm drainage; and, the hydro service to the RCAF pumping station. These services will need to be maintained during redevelopment and be incorporated into any phasing of servicing as the new community is constructed over several years and phases.

The review of the existing external water distribution system and planned upgrades to this system identified in the City of Ottawa's 2013 IMP suggests that sufficient capacity will be available in this system along Montreal Road to facilitate redevelopment of the former CFB Rockcliffe site.

The existing trunk wastewater infrastructure identified within and immediately adjacent to former CFB Rockcliffe identifies three potential direct connection points available to a major trunk sanitary collector sewer, the Ottawa Interceptor Outfall Sewer (IOS). The 2013 IMP also identifies the IOS as the designated outlet for redevelopment of the former CFB Rockcliffe site.

With regard to storm drainage, the natural topography and the two existing channels which historically provided overland drainage for the former CFB Rockcliffe site, directly to the Ottawa River, are still functioning as storm drainage outlets. The combined sewer system which is used to direct less intense rain events to the sanitary sewer system is also still functioning, but contravenes municipal and provincial policy regarding the use of combined sewers for new developments. The existing storm drainage system is also deficient in that no water quality or quantity treatment is provided for stormwater discharged directly to the natural environment. The redevelopment plan for former CFB Rockcliffe will have to address these deficiencies in the existing storm drainage system, and provide the necessary new infrastructure to meet City of Ottawa and MOE design guidelines recognizing the limitations of the two historical outlets.

The existing combined sewer system currently diverts baseflow away from the creeks. Installation of separate sanitary and storm systems will facilitate baseflow being returned to the natural environment.

The review of available shallow utilities (hydro, gas and communications) reveals that the major infrastructure put in place by these utilities in communities adjacent to the former CFB Rockcliffe over the years recognizes potential redevelopment of the former CFB Rockcliffe site. Although not all this infrastructure is currently located adjacent to the site, discussion with all utilities suggests that service is readily available to meet the demands proposed by the redevelopment plan within a reasonable distance of the site. The exact location of these corridors will need to be determined as design details advance and phasing requirements are identified.

3 Integrated Environmental Assessment and Planning Process

The Municipal Class Environmental Assessment (EA) process recognizes the benefits of integrating approvals under the Environmental Assessment Act and the Planning Act. Any project which would otherwise be subject to the Municipal Class EA, that meets the intent of the Class EA (Section A.2.9) and receives approval under the Planning Act is considered to be a Schedule A project and may proceed to construction. **Figure 3.1** illustrates the integrated Environmental Assessment Act and Planning Act process followed for the former CFB Rockcliffe project.

Specific municipal servicing projects within the former CFB Rockcliffe development subject to the requirements of the Environmental Assessment Act include:

- watermains beneath roadways connecting to existing services (Schedule B);
- sanitary sewers beneath roadways connecting to existing services (Schedule B)
- western stormwater detention pond and associated sewers (Schedule B)
- eastern stormwater detention pond and associated sewers (Schedule B)

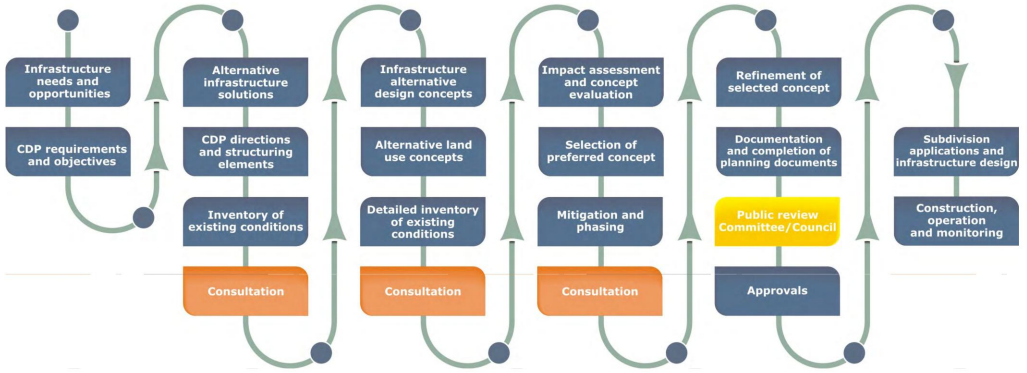
The municipal infrastructure projects for the former CFB Rockcliffe site are being identified, planned and approved through the development application process under Section 51 of the Planning Act in a manner that fulfills the requirements of Phases 1 and 2 of the Municipal Class Environmental Assessment (Section A.2.9) process. As such, these projects will require no additional EA approvals after completion of this process. Section A.2.9 of the Class EA requires the following steps be incorporated into the planning process to fulfill the Phase 1 and 2 EA requirements:

- Identify the problem or opportunity;
- Identify preliminary alternative solutions to the problem/opportunity;
- Inventory social, economic, environmental conditions;
- Select preliminary preferred solution;
- Consult with the review agencies and the public;
- Select preferred solution;
- Identify alternative concept plans and infrastructure design alternatives;
- Select preliminary preferred concept plan and infrastructure design alternatives;
- Consult with the review agencies and the public;
- Select preferred concept plan and infrastructure design alternatives;
- Review and confirm choice of schedule; and,
- Should projects remain Schedule B, a notice of completion listing projects is to be issued, identifying review period and available appeal process.

Following the review and MSS approval by City Council, the study Notice of Completion will be issued for the 30 day public review period and if no Part II Order request is received, these projects are deemed complete and can proceed to detailed design and construction phase.

Class Environmental Assessment / CDP Process

- The Rockliffe CDP process will be coordinated to integrate the *Planning Act* requirements for an implementing Official Plan Amendment, and the requirements of the Municipal Class Environmental Assessment for related environmental and infrastructure projects.
- The planning and coordination of the infrastructure and environmental management requirements for the CDP in consultation with the community will help to ensure that the objectives of the City, the community and approval authorities are fulfilled.
- Key benefits of this approach include:
  - Streamlining efforts and more effectively meet the requirements of both the Planning Act and the Environmental Assessment Act
  - Reduced duplication leading to faster implementation
  - Opportunities to co-ordinate infrastructure with land use planning
  - Improved certainty for land use decision-making
  - Co-ordinated public input
- Key points for integration include:
  - Identification and consolidation of priorities and objectives (public/municipal/owners)
  - Documentation of existing conditions
  - Public consultation
  - Development of infrastructure and land use alternatives



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Scale	Project Title	Drawing Title	Sheet No.
NTS	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	INTERGRATED PLANNING AND EA PROCESS	FIGURE 3.1

3.1 Consultation

The study team involved in the development and the evaluation of the CDP and its supporting reports, including the MSS, involved a large group of people representing numerous disciplines and interests. These included representatives of the Algonquins of Ontario (discussed in more detail below); City of Ottawa staff from several departments; representatives from select government agencies and approval bodies; the public through meetings with directly-affected Community Associations as well as general public meetings; and the land owner with his multi-disciplined consultant team. To assist in coordinating and directing the project, a Technical Advisory Committee (TAC) was established consisting of City of Ottawa staff; representatives from select government agencies; and, the land owner and his consultants. A Public Advisory Group (PAG) was also established, including representatives from directly-affected Community Associations; City of Ottawa staff; and, the land owner. Under the guidance of these committees, meetings were held; information was circulated, reviewed and discussed; and, decisions were made in an iterative process.

CLC maintains on-going consultation with the Algonquins of Ontario (AOO). Prior to acquiring the lands, CLC and the AOO entered into an exciting and innovative Participation Agreement, executed in 2010. This Agreement established a direct financial interest for the AOO in the development of one of the most desirable and valuable parcels of land in Canada. Opportunities exist between CLC and AOO which include a host of initiatives pertaining to the commemoration of the history and connection of the Algonquins people with this site. CLC has asked the AOO for ideas for the overall name of the new community, including names for neighborhoods, streets, and parks. This naming process may also provide valuable insights into Algonquin commemoration to be developed in the future. To date, several Consultation Working Groups, as well as meetings were held between CLC and the Algonquin Negotiation Representatives.

Through this extensive consultation process, input was received and factored into the evolution of the preferred concept plan throughout the evaluation process. The consultation process is captured in detail in a separate report entitled ‘Final Public Consultation Report, June 2014, Former CFB Rockcliffe Airbase Community Design Plan,’ prepared by Momentum Planning and Communications (June 2014). The consultation and review process also resulted in the preparation of numerous supporting reports required to adequately address concerns identified during the evaluation process, and the recognition of several existing background reports which were useful in evaluating proposed mitigation measures. The main reports used during this process to support the development of the preferred servicing solution are outlined in **Sections 1.7 and** 2.

3.2 Identification of Problem/Opportunity

The preferred concept plan (**Figure 1.3**) demonstrates that the redevelopment of the site will result in a significant increase in development density from that which existed previously. From the perspective of the Master Servicing Study, the problem presented by this proposed increase in density is the provision of municipal services to adequately service the preferred concept plan, and to incorporate these services into the existing surrounding municipal infrastructure while meeting the design criteria and level of service requirements of the City of Ottawa and other regulatory agencies.

3.3 Identification and Evaluation of a Preferred Servicing Solution for Water, Wastewater and Stormwater

To assist in developing a preferred servicing solution for the redevelopment of former CFB Rockcliffe, a two stage evaluation process has been followed. The first stage is the development and evaluation of basic servicing alternatives to identify a preferred servicing technique to satisfy

the Municipal Class Environmental Assessment Act requirement to assess “alternative solutions.” Alternative solutions are defined in the Environmental Assessment Act as “feasible ways of solving an identified problem (deficiency) or addressing an opportunity from which a preferred solution is selected.” NOTE: Alternative solutions include the “do nothing alternative.” A coarse screening process has been applied to the alternatives to select a preferred servicing approach.

For the second stage of the evaluation process, evaluation criteria and servicing alternatives have been developed based on the previously-selected Stage I preferred municipal servicing technique.

The two stage evaluation process is summarized in the following sections. It should be noted that this evaluation has been carried out in conjunction with the CDP process, out of which a preferred development concept plan and preferred municipal servicing plan are identified. The evaluation has been completed in sufficient detail to satisfy Phases 1 and 2 of the MEA Municipal Class EA process and, as part of the CDP process, included consultation with review agencies, stakeholders, and the public (refer to **Section 3.1**).

Finally, with the identification of a preferred concept plan and preferred municipal servicing plan, design parameters are developed for water, wastewater and stormwater to facilitate more detailed design work for each municipal service. This identifies major trunk sewer sizes, the exact location of major municipal infrastructure within the preferred plan, and elevations. This refinement of the design is required to finalize the project list from an EA perspective, to assist in the determination of environmental effects and required mitigation measures, to facilitate the preparation of preliminary cost estimates and to allow detailed design to progress in a phased approach, with the confidence that the site can be built out to meet the various approval agency design requirements.

3.4 Stage I: Identification and Evaluation of Infrastructure Solutions

The following alternative servicing solutions were identified:

1. The "do nothing" alternative, which, in the case of former CFB Rockcliffe, means redevelopment within the existing land use patterns and using the existing infrastructure.
2. Using the existing infrastructure involves the upgrading of existing services to increase capacity / meet new standards.
3. New infrastructure involves the construction of new services in conjunction with the planned redevelopment.

Evaluation of alternatives:

1. The “do nothing” alternative is not considered a viable solution because the existing infrastructure does not meet current City of Ottawa design guidelines. The existing distribution network is also too inefficient to service the increased density and design objectives. The existing infrastructure systems have reached the end of their useful life cycle. For these reasons it is recommended that this technique not be carried forward.
2. Upgrading existing infrastructure is a viable infrastructure option, if the redevelopment is limited to a similar land use layout. This solution would result in minimal social and environmental impacts while offering the potential added benefit of being a cost effective option. This option however does not permit an overall innovative redevelopment of the area.
3. New infrastructure would be constructed in concert with the proposed land use and redevelopment patterns for CFB Rockcliffe. This alternative would allow the capacity

requirements and current standards to be met. Social and environmental impacts could be mitigated in conjunction with the overall redevelopment. This is considered the most expensive alternative and does not make use of existing infrastructure / residual system capacity.

As a result of the above evaluation, a combination of new and upgraded infrastructure will be carried forward to the development of the CDP (refer to **Table 3.1**) and alternative designs for the infrastructure have been developed.

Table 3.1 Infrastructure Alternatives

Criteria	Infrastructure (Road/Transit/Water/Sewer/Storm) Alternatives		
	Do Nothing	Use Existing	New
Social	Limits innovative redevelopment potential	Limits innovative redevelopment potential	Permits innovative redevelopment potential
Biological	No impacts on biological features	Low impacts on biological features	Moderate impacts on biological features
Physical	No impacts on physical features	Low impacts on physical features	Moderate impacts on physical features
Technical	Does not permit new development Does not meet current city standards (i.e., fire flows, sewage overflow, cycling and pedestrian accommodation) No opportunities for innovation	Requires upgrading for capacity requirements and new standards Some opportunities to separate sewers and integrate pedestrians/cyclists/transit and for innovation	Meets capacity requirements and new standards Opportunities to separate sewers and integrate pedestrians/cyclists/transit and for innovation
Economic	Low capital costs High operational and maintenance costs	High capital costs Moderate operational and maintenance costs	High capital costs Low operational and maintenance costs
Preferred	✗	✓	✓

✓ a combination of new and upgraded infrastructure will be carried forward to the development of CDP options

3.4.1 Preferred Servicing Technique

Based on the above evaluation, the expansion of the existing municipal infrastructure system was determined to be the best servicing technique to advance. The technique will service the former CFB Rockcliffe site while minimizing negative impacts to the social and natural environment. It is summarized as follows:

- Water: A new water distribution system will be constructed. It will connect to the existing system and be designed to current City of Ottawa design guidelines.
- Wastewater: A new separate sanitary sewer system will be constructed. The system will be designed to current City of Ottawa and MOE design guidelines and will connect to the existing trunk sanitary sewer, which conveys flow to the R.O. Pickard Environmental Centre for treatment.
- Stormwater: A separate storm sewer system, complete with end-of-pipe SWM facility(ies) will be constructed. The system will be designed to current City of Ottawa and MOE design guidelines. The system will be designed in parallel with the LID pilot project.

The three development concept plans prepared to assist in determining a preferred concept plan were developed with regard for the corridor requirements for municipal water, wastewater and stormwater.

The comparative evaluation of these concept plans demonstrates that the development of a preferred concept plan is relatively independent of the municipal servicing requirements for all three municipal services, and that municipal servicing is not a determining factor in selecting the preferred concept plan for the redevelopment of former CFB Rockcliffe. Other factors such as natural features, planning rationale, transportation corridors and public and stakeholder input have a much more significant impact in determining the selection of the final preferred concept plan.

3.5 Stage II: Identification and Evaluation of Servicing Alternatives

3.5.1 Identification of Alternatives

In support of the preferred servicing technique established in the Stage I evaluation, three municipal servicing alternatives have been developed for each municipal service (water, wastewater and stormwater). They are summarized below and presented in conceptual form on **Figures 3.2**-**3.4**.

3.5.2 Evaluation Criteria and Indicators

To complete the evaluation of the three municipal servicing alternatives, a list of criteria and indicators has been developed to assist in evaluating each of their relative benefits. The criteria and indicators are presented in **Table 3.2** – **Table 3.4**.

Table 3.2 Stage II Evaluation Criteria and Indicators – Water

MUNICIPAL SERVICE	CRITERIA	INDICATORS
Water	Serviceability	• Is design compatible with existing infrastructure? • Is design efficient in providing trunk infrastructure corridors? • Is design conducive to long term phasing of construction?
	Social	• Does design impact existing communities or adjacent residential areas?
	Natural Environment	• Does design disrupt natural habitat (aquatic, terrestrial)?
		• Does design impact existing surface water or groundwater?
	Economic	• Is design cost effective? • Are long term operation and maintenance costs reasonable?

Table 3.3 Stage II Evaluation Criteria and Indicators – Wastewater

MUNICIPAL SERVICE	CRITERIA	INDICATORS
Wastewater	Serviceability	• Is design compatible with existing infrastructure? • Does design make efficient use of residual capacity? • Is design conducive to long term phasing construction?
	Social	• Does design impact existing communities or adjacent residential areas?
	Natural Environment	• Does design disrupt natural habitat (aquatic, terrestrial)? • Does design impact existing surface water or groundwater?
	Economic	• Is design cost effective? • Is design efficient in providing trunk infrastructure corridors? • Are long term operation and maintenance costs reasonable?

EXISTING STORM SEWER

WESTERN CREEK

AVIATION MUSEUM

RCAF SANITARY PUMP STATION

OTTAWA RIVER

EASTERN CREEK

1200Ø STORM

300Ø CO

RCAF PULL-BACK SEWER

300Ø CO

STORM SCEPTER

NRC SHAFT

EXISTING SANITARY

ALTA VISTA TRUNK SEWER (300Ø CO.)

3600Ø STORM

3000Ø STORM
525Ø SANITARY

EXISTING SANITARY

HEMLOCK RD

3600Ø STORM
525Ø SANITARY

CODD'S ROAD SHAFT

2700Ø STORM
375Ø SANITARY
406Ø WATERMAIN

PEACH TREE ROAD SHAFT

NATIONAL RESEARCH COUNCIL (NRC)

MONTFORT HOSPITAL

FAIRHAVEN

THORNCLIFFE VILLAGE

EXISTING 406Ø WATERMAIN

CODD'S ROAD

MAJOR COLLECTOR

LEGEND

- TRUNK WATERMAIN
- EXISTING WATERMAIN
- TRUNK STORM SEWER
- TRUNK SANITARY SEWER
- EXISTING SANITARY SEWER
- STORMWATER POND AND POND OUTLET
- EXISTING OUTLET CHANNEL

N

Scale

Project Title

FORMER CFB ROCKCLIFFE
MASTER SERVICING STUDY

Drawing Title

TRUNK SERVICING
ALTERNATIVE I

Sheet No.

FIGURE 3.2

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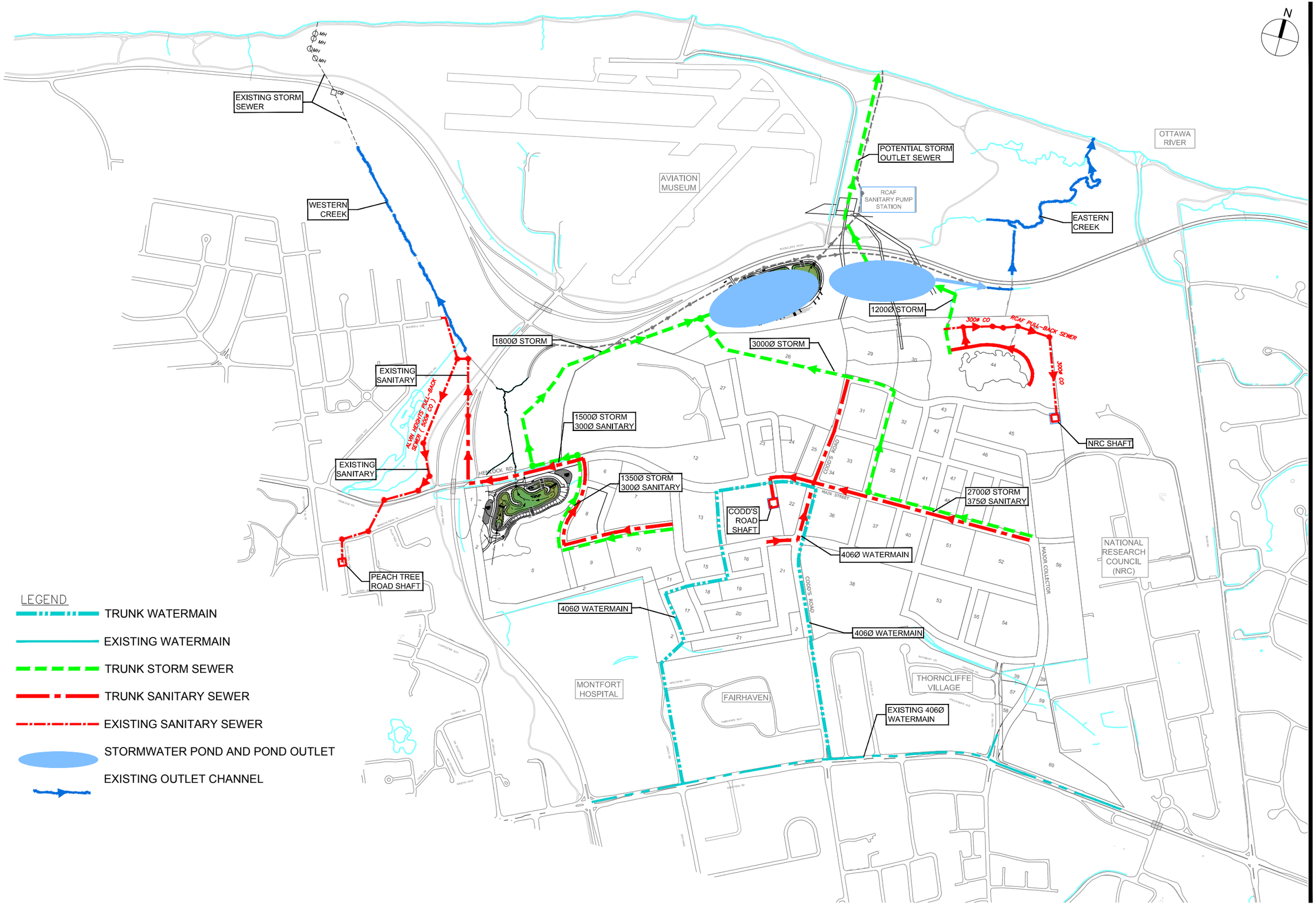

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Project Title

FORMER CFB ROCKCLIFFE
MASTER SERVICING STUDY

Drawing Title

TRUNK SERVICING
ALTERNATIVE II

Sheet No.

FIGURE 3.3

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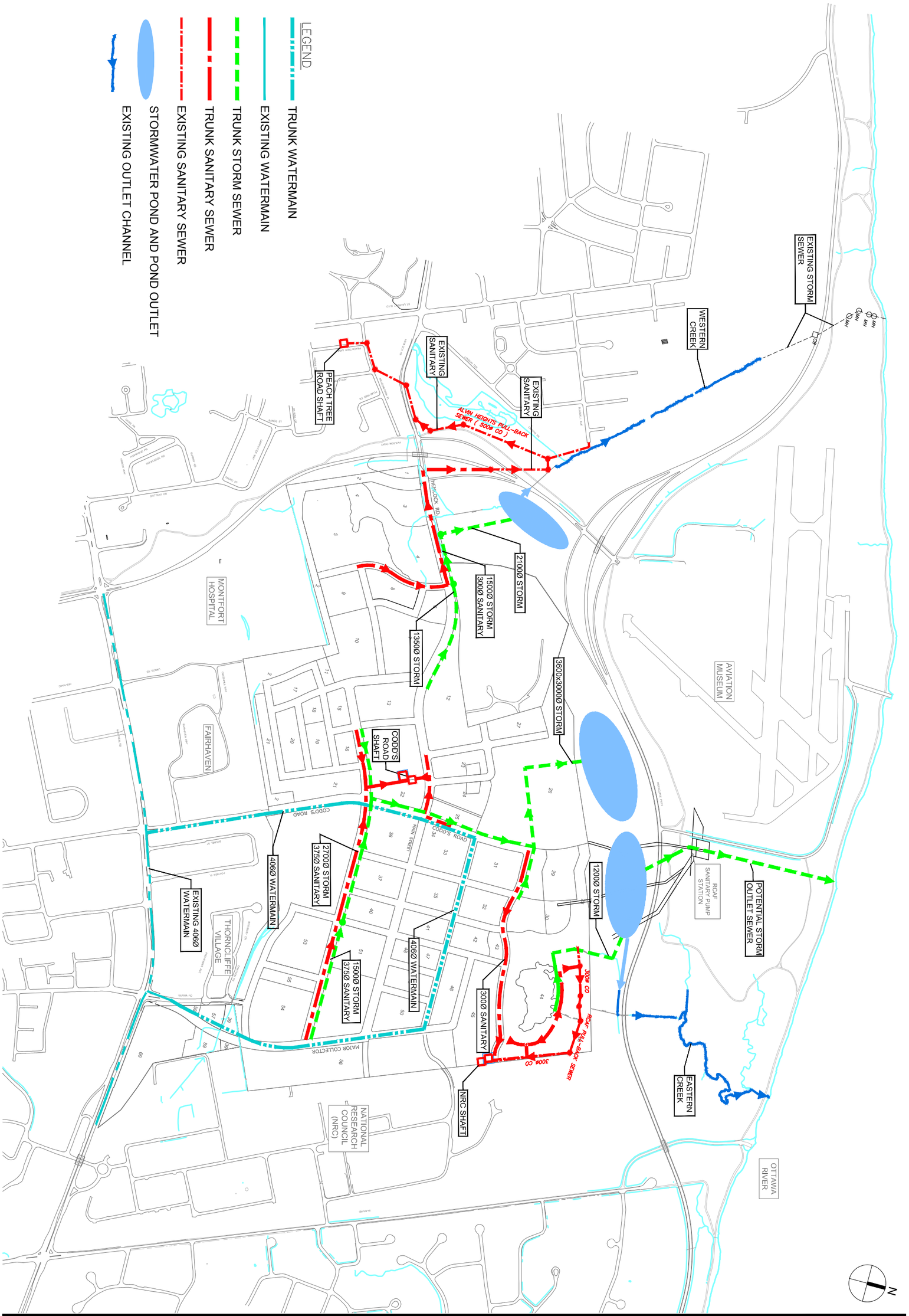


Sheet No.	Drawing Title	Project Title	Scale
FIGURE 3.4	TRUNK SERVICING ALTERNATIVE III	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	0 100 200

IBI

Table 3.4 Stage II Evaluation Criteria and Indicators – Stormwater

MUNICIPAL SERVICE	CRITERIA	INDICATORS
Stormwater	Serviceability	• Is design compatible with existing infrastructure? • Is design efficient in providing trunk infrastructure corridors? • Is design conducive to long term phasing? • Is storm system design compatible with proposed land use (aesthetically and functionally)? • Does design minimize conveyance to 100 year surface flow across arterial and collector roads?
	Social	• Does design impact existing communities or adjacent residential areas?
	Natural Environment	• Does design disrupt natural habitat (aquatic, terrestrial)? • Does design impact existing surface water or groundwater? • Does design impact existing outlets creeks?
	Economic	• Is design cost effective? • Are long term operation and maintenance costs reasonable?

A relative ranking of best, good, and poor was used to assess the relative benefits of each based on the indicators provided.

3.5.3 Evaluation of Municipal Servicing Solutions

The comparative evaluation of the three potential servicing solutions is presented in **Table 3.5-Table 3.7**. This evaluation was used to assist in determining a preferred servicing solution for the redevelopment of former CFB Rockcliffe. As noted in **Section 3.3**, the evaluation was completed in conjunction with the CDP process, taking into consideration input from review agencies and the public.

Table 3.5 Stage II Evaluation of Municipal Servicing Alternatives – Water

	CRITERIA	INDICATORS	ALTERNATIVE I	ALTERNATIVE II	ALTERNATIVE III
WATER	Serviceability	• Is design compatible with existing infrastructure? • Is design efficient in providing trunk infrastructure corridors? • Is design conducive to long term phasing of construction?	Provides direct looped access to primary source but uses remote connection through Fairhaven requiring pressure reducing valves (PRVs). A fairly direct and balanced looping of trunk watermain is provided and trunk watermain network provides looping opportunities internally, but external connection spacing increases initial looping requirement.	Provides direct looped access to primary source but uses remote connection through Fairhaven requiring PRVs. A fairly direct looping of trunk watermain is provided and trunk watermain network provides multiple looping opportunities and phasing options, but trunk loop is concentrated on the site.	Provides direct looped access to primary source using existing roads with useable frontage. A fairly direct and balanced looping of trunk watermain is provided and external connection location provides good looping and phasing potential requiring PRVs.
	Social	• Does design impact existing communities or adjacent residential areas?	Installation results in disruption to existing Fairhaven residential area during the construction of the external watermain but the main works are within new proposed rights-of-way so impact on existing communities and residential areas will be minimal.	Installation results in disruption to existing Fairhaven and Codd's Road residential areas during the construction of the external watermain but the main works are within new proposed rights-of-way so impact on existing communities and residential areas will be minimal.	Installation results in disruption to existing Codd's Road residential area during the construction of the external watermain but the main works are within new proposed rights-of-way so impact on existing communities and residential areas will be minimal.
	Natural Environment	• Does design disrupt natural habitat (aquatic, terrestrial)? • Does design impact existing surface water or groundwater?	All proposed watermains are in existing or proposed rights-of-way except for a relatively short length of watermain proposed through Fairhaven, requiring removal of a few trees. Since the watermains will be constructed within 2 m of the ground surface, standard open cut trenching techniques will be used, minimizing impact on surface water and groundwater.	All proposed watermains are in existing or proposed rights-of-way except for a relatively short length of watermain proposed through Fairhaven, requiring removal of a few trees. Since the watermains will be constructed within 2 m of the ground surface, standard open cut trenching techniques will be used, minimizing impact on surface water or groundwater.	All proposed watermains are in existing or proposed rights-of-way, minimizing impact on natural habitat. Since the watermains will be constructed within 2 m of the ground surface, standard open cut trenching techniques will be used, minimizing impact on surface water or groundwater.
	Economic	• Is design cost effective? • Are long term operation and maintenance costs reasonable?	Significant length of trunk watermain with no useable frontage through Fairhaven. This off-road trunk watermain potentially slightly increases total operation and maintenance costs but the minimum number of connections to the source limits the number of PRVs required, assisting in keeping operation and maintenance costs reasonable.	Significant length of trunk watermain with no useable frontage through Fairhaven. This off-road trunk watermain potentially slightly increases total operation and maintenance costs but the minimum number of connections to the source limits the number of PRVs required, assisting in keeping operation and maintenance costs reasonable.	All trunk watermains are in roads with useable frontage, resulting in a cost effective design. The minimum number of connections to the source also limits the number of PRVs required, assisting in keeping operation and maintenance reasonable.
Rating			***Good***	***Poor***	***Best***

Table 3.6 Stage II Evaluation of Municipal Servicing Alternatives – Wastewater

	CRITERIA	INDICATORS	ALTERNATIVE I	ALTERNATIVE II	ALTERNATIVE III
WASTE WATER	Serviceability	• Is design compatible with existing infrastructure? • Does design make efficient use of residual capacity? • Is design conducive to long term phasing construction?	Eliminates combined sewers but does not use all available outlets to minimize onsite sewer sizes and depth. Ignoring the central outlet also limits phasing options.	Eliminates combined sewers and uses all available outlets to minimize sewer size and depth and uses all available outlets and associated capacity. The use of the three outlets across the site also provides good opportunity for phasing.	Eliminates combined sewers and uses all available outlets to minimize sewer size and depth and uses all available outlets and associated capacity. The use of the three outlets across the site also provides good opportunity for phasing.
	Social	• Does design impact existing communities or adjacent residential areas?	Construction of a sanitary sewer in Codd's Road would disrupt access to Codd's Road residents during construction. Otherwise, works are confined to the development area so impact on existing communities and residential areas is minimal.	Construction of a sanitary sewer in Codd's Road would disrupt access to Codd's Road residents during construction. Otherwise, works are confined to the development area so impact on existing communities and residential areas is minimal.	Construction of a sanitary sewer in Codd's Road would disrupt access to Codd's Road residents during construction. Otherwise, works are confined to the development area so impact on existing communities and residential areas is minimal.
	Natural Environment	• Does design disrupt natural habitat (aquatic, terrestrial)? • Does design impact existing surface water or groundwater?	New sewer construction is mostly within proposed rights-of-way so there is minimal disruption to the natural environment due to the installation of the sanitary sewer system. The potentially deeper sewer excavation associated with the single main trunk sewer could increase impact on groundwater but clay dyke installation as part of the trench backfill minimizes this potential.	New sewer construction is mostly within proposed rights-of-way so there is minimal disruption to the natural environment due to the installation of the sanitary sewer system. Use of multiple outlets across the site minimizes the depth of the sanitary trunk sewers, thereby minimizing the potential impact on groundwater.	New sewer construction is mostly within proposed rights-of-way so there is minimal disruption to the natural environment due to the installation of the sanitary sewer system. Use of multiple outlets across the site minimizes the depth of the sanitary trunk sewers thereby minimizing the potential impact on groundwater.
	Economic	• Is design cost effective? • Is design efficient in providing trunk infrastructure corridors? • Are long term operation and maintenance costs reasonable?	One main trunk sewer increases capital cost due to larger and deeper pipe, which may also require a high level sewer to service local frontage along the deeper sections of the trunk sewer. This increases the capital cost and long term operation and maintenance costs.	Use of multiple outlets across the site minimizes depth and size of trunk sewers, as well as minimizes potential for a parallel high level sewer. This alternative is cost effective from both the capital cost and long term operation and maintenance perspective.	Use of multiple outlets minimizes depth and size of trunk sewers as well as minimizes potential for a parallel high level sewer. This alternative is cost effective from both the capital cost and long term operation and maintenance perspective.
Rating			***Poor***	***Good***	***Good***

Table 3.7 Stage II Evaluation of Municipal Servicing Alternatives – Stormwater

	CRITERIA	INDICATORS	ALTERNATIVE I	ALTERNATIVE II	ALTERNATIVE III
STORM WATER	Serviceability	• Is design compatible with existing infrastructure? • Is design efficient in providing trunk infrastructure corridors? • Is design conducive to long term phasing? • Is storm sewer design compatible with proposed land use (aesthetically and functionally)? • Does design minimize conveyance of 100 year surface flow across arterial and collector roads?	Uses one SWM facility, directing runoff from the majority of the site to the Western Creek via a pipe under Aviation Parkway. Majority of the trunk storm sewers are in proposed rights-of-way servicing associated frontage, resulting in an efficient design from an overall sewer length perspective; however, use of a single major trunk will result in relatively large and deep sewers. Use of a single SWM facility and single trunk sewer alignment restricts phasing potential from west to east only. Location of the main collector road on the preferred concept plan is such that there are numerous locations where the green space abuts the collector road, offering good opportunity to control major flow along the corridor, if necessary. The proximity of the collector road to the proposed trunk storm servicing corridor also provides the opportunity to increase discharge to the storm trunk system with minimal impact to the local storm system, if necessary. Due to sewers being primarily in proposed rights-of-way, and an off-site SWM facility that is significantly downgradient of the development, the design is expected to have minimal impact on the aesthetics or functionality of the development. A parallel study evaluating the potential to add LID techniques to the storm system may result in further enhancement of the development's aesthetics and functionality of the storm system.	Uses one SWM facility, directing runoff from the majority of the site to an Eastern outlet (via the Eastern Creek or a pipe directly to the Ottawa River). Majority of the trunk storm sewers are in proposed rights-of-way servicing associated frontage, resulting in an efficient design. However, a relatively long and large storm sewer will be required to convey runoff from the lower western portion of the site to the SWM facility, resulting in a relatively inefficient design from an overall sewer length perspective. Use of a single SWM facility restricts phasing potential from east to west, without the expense of constructing large off-site storm sewer to outlet the western portion of the development. Location of the main collector road on the preferred concept plan is such that there are numerous locations where the green space abuts the collector road, offering good opportunity to control major flow along the corridor, if necessary. The proximity of the collector road to the proposed trunk storm servicing corridor also provides the opportunity to increase discharge to the storm trunk system with minimal impact to the local storm system, if necessary. Due to the sewers being primarily in proposed rights-of-way, and a SWM facility that is significantly downgradient of the development, the design is expected to have minimal impact on the aesthetics or functionality of the development. A parallel study evaluating the potential to add LID techniques to the storm system may result in the further enhancement of the development's aesthetics and the functionality of the storm system.	Uses two major SWM facilities, directing runoff from the site to both Western and Eastern Creeks. This two facility system, and the existing topography, offers the opportunity to balance the post-development flow between the two creeks, mitigating the constraints associated with each creek. Majority of the trunk storm sewers are in proposed rights-of-way, servicing associated frontage, resulting in an efficient design from an overall sewer length perspective. Size and depth of the trunk storm sewers is also minimized, relative to the single SWM facility options, and also maximizes phasing potential. Location of the main collector road on the preferred concept plan is such that there are numerous locations where the green space abuts the collector road, offering good opportunity to control major flow along the corridor, if necessary. The proximity of the collector road to the proposed trunk storm servicing corridor also provides the opportunity to increase discharge to the storm trunk system with minimal impact to the local storm system, if necessary. Due to the sewers primarily in proposed rights-of-way, and off-site SWM facilities that are significantly downgradient of the development, the design is expected to have minimal impact on the aesthetics or functionality of the development. A parallel study evaluating the potential to add LID techniques to the storm system may result in further enhancement of the development's aesthetics and the functionality of the storm system.
	Social	• Does design impact existing communities or adjacent residential areas?	Use of a single SWM facility outletting to the Western Creek requires significant upgrades to the creek, from Aviation Parkway to the Ottawa River, to accommodate the post-development flow. Due to topography and proximity of the Aviation Parkway, limited space is available to provide an over-controlled SWM facility, suggesting an increase in release rate above existing culvert capacity will be required. This in turn requires significant upgrading of the creek adjacent to the Alvin Heights Community and through the RCMP Equestrian training facility. The impact of such works is the potential reduction of existing vegetative screening from the Rockcliffe Parkway abutting the residential community, and expansion of the storm outlet within the RCMP facility to the Ottawa River.	The single SWM facility outletting to an Eastern outlet (via the Eastern Creek or a pipe directly to the Ottawa River) is located along the south side of the Rockcliffe Parkway and may require upgrades to the Eastern Creek and/or the construction of a storm sewer from the SWM facility directly to the Ottawa River. Such creek or pipe work is removed from residential areas, so impact to communities is minimal and limited to the construction of an outlet to the Ottawa River.	Construction of two SWM facilities, together with the site topography, offers the opportunity to balance post-development flow. This would assist in minimizing the required upgrades to the Western Creek, thereby lessening impact to the adjacent community. The construction of the Eastern SWM Facility may require upgrades to the existing outlet channel and/or the construction of a new storm sewer outlet from the SWM facility to the Ottawa River due to the restricted space available at this location and potential design constraints imposed by the NCC.
	Natural Environment	• Does design disrupt natural habitat (aquatic, terrestrial)? • Does design impact existing water surface or groundwater? • Does design impact existing outlet creeks?	Existing combined sewer system to be eliminated and replaced by separate sanitary and storm sewers. Baseflow that had previously been diverted to the combined system is now conveyed to the natural environment. Due to the construction of one SWM facility outletting to the Western Creek, the potential baseflow gain is limited to the Western Creek, since baseflow is diverted away from the Eastern Creek. Due to the constraints associated with the Western Creek, anticipated creek upgrades will require tree removal along the creek. Potential use of natural channel design techniques and a reforestation program will minimize long term impact to natural environment. Due to the installation of one large, deep, trunk sewer, there is an increased potential impact on groundwater. Installation of clay dykes limits this potential impact to construction only.	Existing combined sewer system to be eliminated and replaced by separate sanitary and storm sewers. Baseflow that had previously been diverted to the combined system is now conveyed to the natural environment. Due to the construction of a single SWM facility outletting to the Eastern Creek or to the Ottawa River via a pipe, the potential baseflow gain is limited to the Eastern Creek, since baseflow is diverted away from the Western Creek. Due to the construction associated with the SWM facility outlet, anticipated creek upgrades will require tree removal along the creek and/or the construction of a storm sewer directly to the Ottawa River. Potential use of natural channel design techniques and a reforestation program will minimize long term environmental impact to the natural environment. Creek upgrades have the added benefit of creating a positive outlet to the Ottawa River at the recreational pathway along the river bank, which provides an opportunity to enhance the creek's aquatic habitat. Upgrades to the creek will also provide the opportunity to stabilize the slopes and terminate the active erosion currently occurring.	Existing combined sewer system to be eliminated and replaced by separate sanitary and storm sewers. Baseflow that had previously been diverted to the combined system is now conveyed to the natural environment. Since a SWM facility is proposed at the headwaters of both creeks, baseflow to both creeks will be enhanced, and there is the potential to improve aquatic habitat of both creeks. Existing topography of the site also provides opportunity to balance the post-development flow between the two outlets, minimizing impact on both creeks. However, physical constraints associated with the western outlet suggest a limited ability to convey post-development flow, compared to the eastern outlet. Any upgrades required to mitigate constraints in the Eastern Creek will require tree removal and/or the construction of a storm sewer directly to the Ottawa River. Potential use of natural channel design techniques and a reforestation program can be implemented to minimize long term impact to natural environment. Any work in the Eastern Creek has the added benefit of creating an outlet to the Ottawa River at the

	CRITERIA	INDICATORS	ALTERNATIVE I	ALTERNATIVE II	ALTERNATIVE III
					recreational pathway, which provides an opportunity to enhance the creek's aquatic habitat. It will also provide opportunity to stabilize the creek slopes and terminate the active erosion which is currently occurring.
	Cost	• Is design cost effective? • Are long term operation and maintenance costs reasonable?	Requires one SWM facility and significant upgrades to Western Creek. Also requires a large and potentially deep storm sewer, necessitating a second high level storm sewer to service adjacent frontage. Capital cost savings associated with the construction of a single SWM facility would be significantly offset by the increased trunk sewer costs. Since most of the storm sewers are located in roads with useable frontage, the system is considered relatively cost effective from a capital and long term operation and maintenance cost perspective.	Requires one SWM facility and significant upgrades to Eastern Creek. Also requires a relatively large and long off-site trunk sewer to drain the lower west portion of the site. Capital cost savings associated with the construction of a single SWM facility would be significantly offset by the cost of the large off-site trunk storm sewer. Since most of the storm sewers are located in proposed roads with useable frontage, the system is considered to be only minimally less cost effective than Alternative I from a capital and long term operation and maintenance cost perspective.	Requires construction of two SWM facilities; however, the overall sewer system is relatively cost effective due to the reduced sewer sizes and sewer depths as a result of multiple outlets. Additional costs associated with constructing two SWM facilities would be significantly offset by the savings in sewer costs throughout the development. Since most of the storm sewers are located in proposed roads with useable frontage, the system is considered to be relatively cost effective from a capital and long term operating and maintenance cost perspective.
Rating			***Poor***	***Poor***	***Best***

3.6 Preferred Municipal Servicing Solution

The comparative evaluation of the water, wastewater and stormwater alternatives identified some preferences to be carried forward in the preferred servicing solution. These preferences are summarized as follows:

- Water: Two primary feeds to Montreal Road be provided via Burma Road and Codd's Road to maximize phasing flexibility and trunk system accessibility.
- Wastewater: The three available connections to the existing IOS collector be used to maximize the use of residual capacity in these outlets, minimize sewer sizes and depth, and facilitate phasing.
- Stormwater: Two end-of-pipe SWM facilities be incorporated to balance stormwater discharge between the existing outlets recognizing the constraints and opportunities associated with these outlets, minimize storm pipe sizes and depth, and to facilitate construction phasing.

Based on these considerations, Alternative III has been identified as the preferred servicing solution for water, Alternative III has been identified as the preferred alternative for wastewater and Alternative III has been identified as the preferred alternative for stormwater.

The identification of a preferred municipal servicing plan allows for design parameters to be developed for water, wastewater and stormwater to facilitate more detailed design work for each municipal service. This more detailed design is presented in **Sections 4-6**, in which trunk sewer sizes, location, and elevation are identified. As noted in **Section 3.3**, this refinement of the design is required to finalize the project list from an EA perspective (refer to **Section 8** for a detailed project listing), to assist in the determination of environmental effects and required mitigation measures, to facilitate the preparation of preliminary cost estimates and to allow detailed design to progress in a phased approach, with the confidence that the site can be built out to meet the various approval agency design requirements.

This preferred servicing solution also recognizes the preliminary phasing plan developed in the CDP (refer to **Figure 1.6**), and has regard for the direction in the CDP to provide flexibility in the servicing solution to incorporate the LID pilot project.

4 Water Distribution System

4.1 Introduction

4.1.1 Overview

The Former CFB Rockcliffe site is located north of Montreal Road between the Aviation Parkway and the NRC lands, and generally south of the Rockcliffe Air Base.

The entire area included in the proposed development lands is currently serviced with potable water from the City of Ottawa's Montreal Road Pressure Zone (Zone MONT). The Montreal Road Pump Station (MRPS) and the Brittany Drive Pump Station (BDPS) boost the water pressure to these lands from the Pressure Zone 1E, which encompasses the majority of lands east of the Rideau River. Pressure Zone 1E is fed via the Hurdman Bridge Pump Station located near the Rideau River and Highway 417. There are two main watermains feeding the development area from Montreal Road, one on Burma Road and the second on Codd's Road. **Figure 4.1** presents a plan of the major components of the City of Ottawa Water Distribution System in this area.

The following potable water supply analysis consists primarily of the external servicing needs to the development, and focuses on the supply requirements, including linear infrastructure, pumping, and pressure controls as necessary. Internal watermain recommendations are limited to major loops or major feedermains that may be needed within the boundaries of the development. The analysis provides the appropriate boundary conditions for further, more detailed analysis of individual street watermains within the development. It should be noted that the proposed piping in any special study areas (such as the northeast quadrant of the study area) is conceptual as no defined road layout or rights of way have been identified.

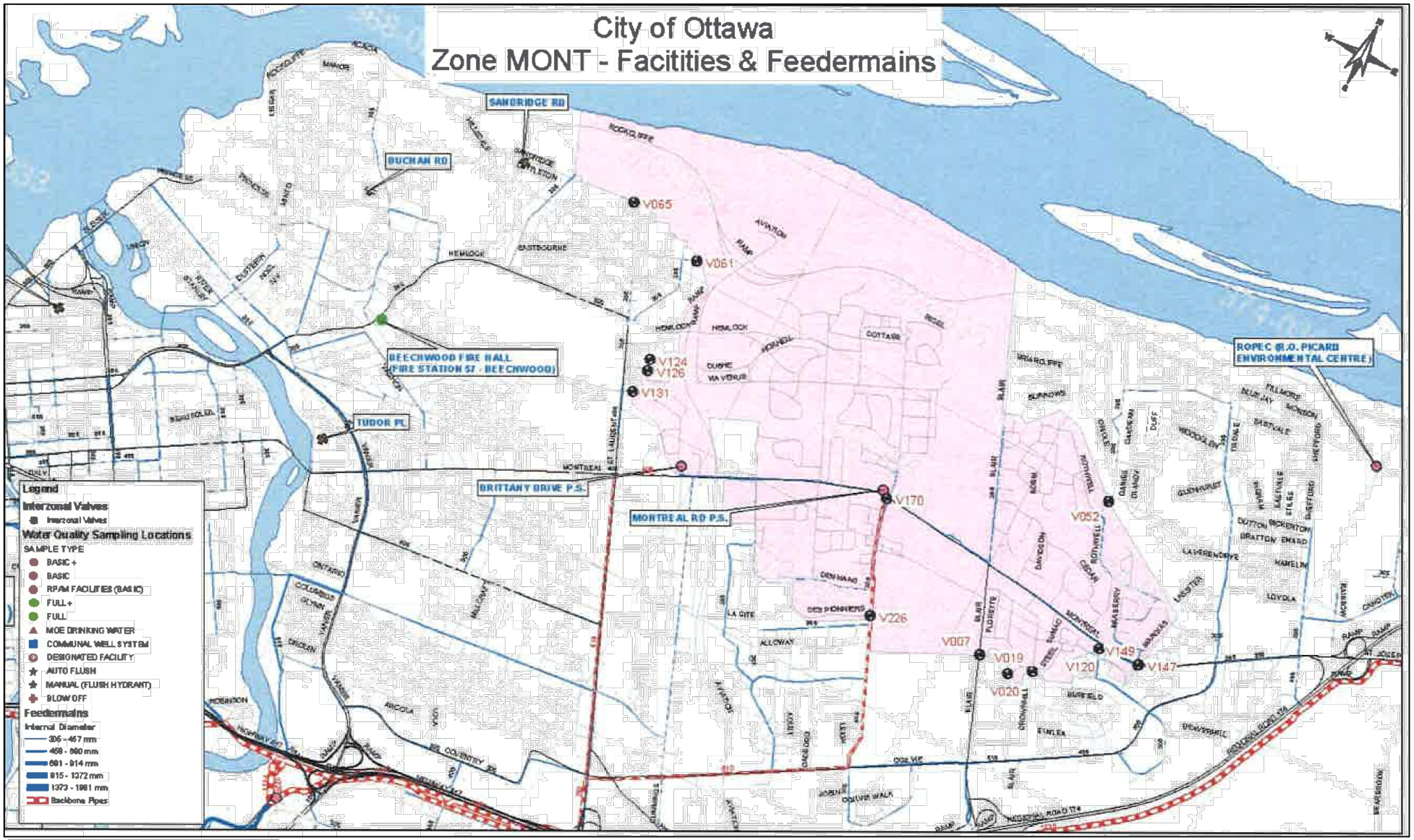
Although this report reviews the future internal subdivision watermains at a macro level, it is understood that the detail design of the internal infrastructure will be in accordance with the appropriate City separation guidelines. For instance, all watermains must maintain a horizontal clearance of a minimum of 2.5 m from sewers and a vertical clearance of a minimum of 0.50 m where watermains cross a sewer.

4.1.2 Previous Studies

In 2001, Stantec Consulting Ltd. prepared an engineering brief entitled "Montreal Road Pressure Zone Water Supply Study". This study identified the major piping and pumping infrastructure needs for the Montreal Road Pressure Zone based on anticipated growth projections within the current serviced area boundaries including the NRC lands and the Former CFB Rockcliffe site. The 2001 report included an estimated 10,000 additional persons within the development.

In 2004, Stantec completed an addendum to the 2001 report to address an increase in development growth within the subject site. The report considered a growth potential of 14,625 persons in the Former CFB Rockcliffe site (compared to the originally proposed 10,000 persons). Infrastructure recommendations from both the 2001 and 2004 reports were similar.

In 2007, Stantec Consulting Ltd. completed a potable water supply analysis for the subject lands. The analysis was developed using the previous community design plan (CDP) and proposed the most suitable watermain network and sizing based on that CDP. **Figure 4.2** presents a summary overview of the primary recommendations from this earlier study. Upgrades to the Brittany Drive and Montreal Road Pump Stations were recommended based on the anticipated population growth in the proposed development. These upgrades were previously outlined in two relevant studies on this area – "Montreal Road Pressure Zone – Water



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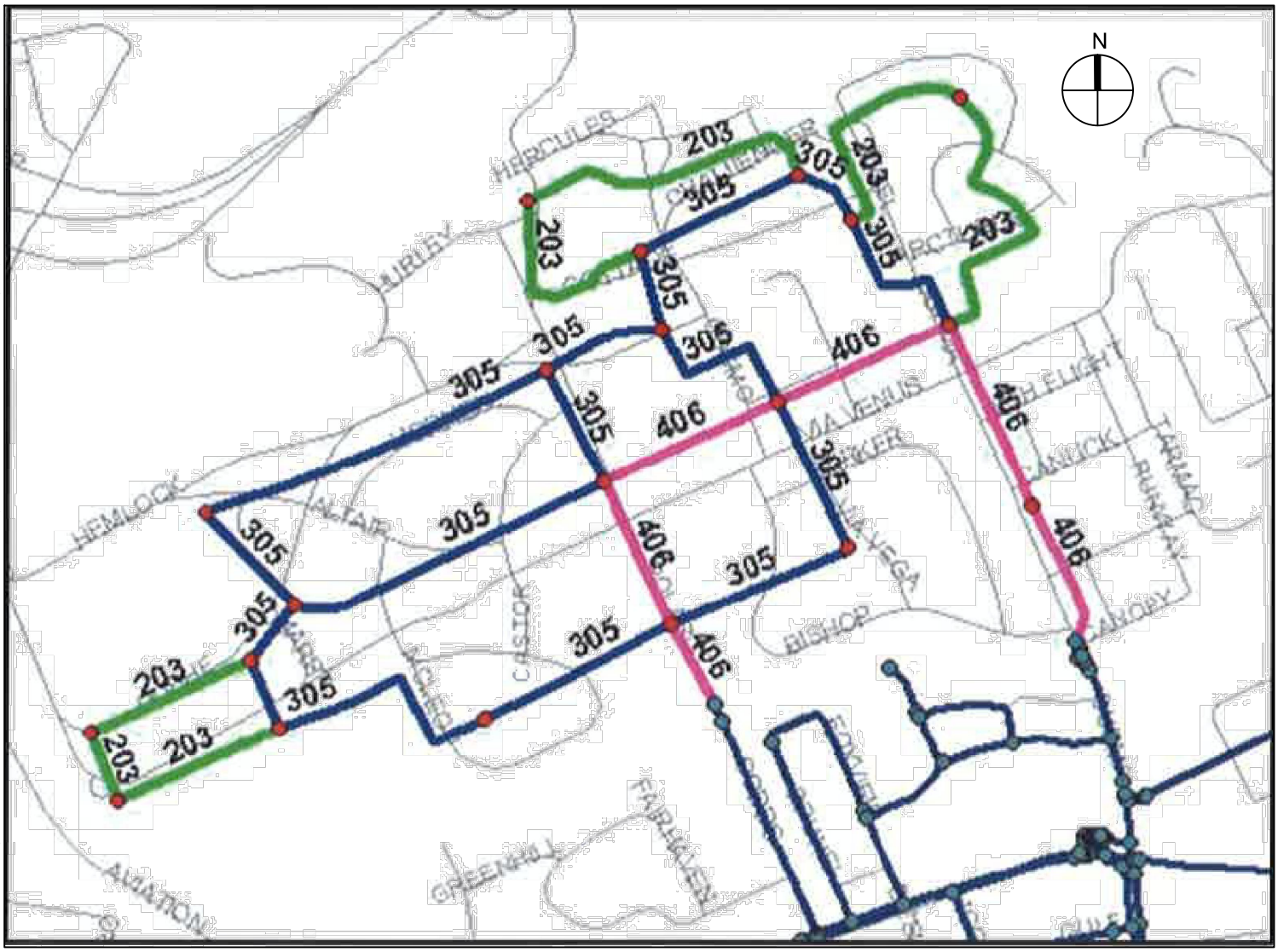
Scale	Project Title	Drawing Title	Sheet No.
NTS	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	EXISTING CITY WATER DISTRIBUTION SYSTEM	FIGURE 4.1

J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.1 Existing City Water Distribution System.dwg Layout Name: FIGURE4.1



J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.2 Previously Preferred Solution (2007).dwg Layout Name: FIGURE4.2

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Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	PREVIOUSLY PREFERRED SOLUTION (2007)	FIGURE 4.2

Supply Addendum" (Stantec 2004) and "Brittany Drive Pumping Station Functional Design" (Stantec 2006).

The following upgrades were recommended in these two previous reports to sufficiently service the build-out growth in Zone MONT. It is important to note that both of these reports indicated that the majority of the increases in water demand were due to the proposed development of the former CFB/Rockcliffe site north of Montreal Road.

1. Montreal Road PS – maintain existing 4 pumps (13.1, 8.1, 6.5, and 13.1 ML/d rated capacities) and add a 350 KW diesel generator.
2. Brittany Drive PS – replace with new PS with 2 pumps (at 13.3 ML/d).
3. New 406mm/305mm watermain through subject site to connect to the existing 406mm diameter watermain on Montreal Road at Den Haag and Burma/Bathgate.
4. Two connections to 406mm diameter watermain on Montreal Road to watermains north of Montreal within study area.

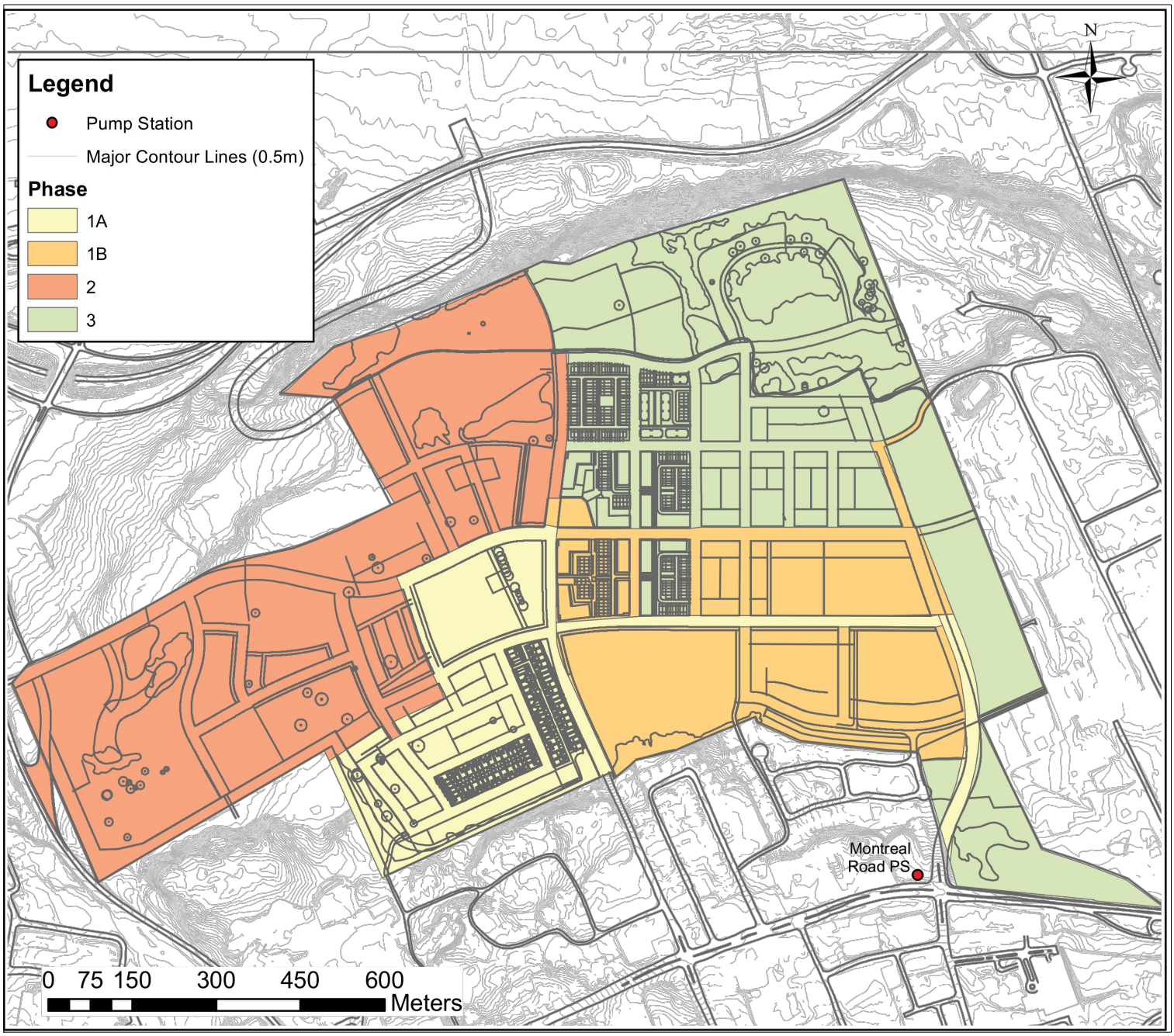
The City had implemented some of the recommended infrastructure upgrades, which were included in the analysis.

In 2013, the City of Ottawa Water Master Plan (WMP) Update (Stantec Consulting Ltd.) was completed. It determined the immediate and future infrastructure upgrades required to satisfy current and projected water demands throughout the entire city, including Zone MONT. Furthermore, it developed revisions to unit water demands and to system performance parameters that will be carried forward to all subsequent zone level water servicing analyses. For engineering work at the subdivision/site plan level, unit demands provided in the City's Water Distribution Guidelines are to be used. The 2013 WMP identified a need to upgrade the Brittany Drive Pumping Station to meet the 2012 and beyond firm capacity pumping objectives for Zone MONT. Upgrades to the Brittany Drive Pumping Station would satisfy both a growth and reliability requirement.

This report will consider the 2015 modified Community Design Plan (CDP) that was provided to Stantec by IBI Group and re-evaluate the water servicing requirements of Zone MONT infrastructure based on the 2013 WMP demand rates. The analysis will consider the recommendations provided in the 2013 WMP and determine what changes should be made (if any) to service the new Rockcliffe development.

4.1.3 Construction Phasing

Adequate pumping capacity needs to be available to meet the anticipated demands as the proposed development proceeds. The phasing of construction has been defined as well as the approximate timing of each phase (and **Table 4.1** and **Figure 4.3**) **Table 4.1** shows a more aggressive construction schedule for development than what was previously expected to the point that the WMP 2060 demands might now be achieved prior to 2031. As a result, larger capacity pump station upgrades are anticipated initially to meet the increased 2031 demand projections. Pumping requirements are further assessed in **Section 4.3**.



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Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	CONSTRUCTION PHASING OF PROPOSED DEVELOPMENT	FIGURE4.3

Table 4.1: Timing of Construction Phasing

PHASE	CONSTRUCTION PERIOD	COMMENTS
Phase 1A	2015 - 2016	Servicing in 2015; sales in 2016
Phase 1B	2017 - 2018	Servicing in 2016; sales in 2017 - 2018
Phase 2	2019 - 2024	Servicing in 2018; sales in 2019 - 2024
Phase 3	Starting 2024	Sales starting in 2024

4.2 Hydraulic Assessment

The computer modeling software package used to carry out the analysis for the Former CFB Rockcliffe development was H2OMAP Water by Innovyze.

The City of Ottawa provided Stantec with a complete pipe model of the entire City of Ottawa distribution system. As per correspondence dated March 13th 2014 with the City of Ottawa, permission was given to use the hydraulic model file(s) for the purpose of this current undertaking.

The computer model obtained from the City is a complete pipe model of the entire City of Ottawa water distribution network. The model file was considered to be the most recent model available. Multiple scenarios were included in the City model; present conditions (2012), projected 2031, and projected 2060 conditions each under summer (maximum day) and winter (basic day) demand conditions respectively for a total of six scenarios.

4.2.1 Serviceability

Hydraulic modelling was performed to assess the anticipated pressures in this development to meet minimum servicing requirements. Additionally, a fire flow analysis was used to ensure the system can provide sufficient fire protection.

4.2.1.1 System Pressure

The 2010 City of Ottawa Water Distribution Design Guidelines state that the desired range of system pressures under normal demand conditions (i.e. average day, maximum day and peak hour) is 345 to 483kPa (50 to 70 psi) and not less than 276kPa (40 psi) at the ground elevation in the streets (i.e. at hydrant level). The maximum pressure at any point in the distribution system is 689kPa (100 psi); however, as per the Ontario Building/Plumbing Code, pressure relief measures are required for services when pressures greater than 552kPa (80 psi) are anticipated. Under emergency fire flow conditions, the minimum pressure in the distribution system is allowed to drop to 138kPa (20 psi).

The highest serviced land elevation in the existing Montreal Road Pressure Zone is approximately 113m. To ensure the minimum pressures at this location remains above 275kPa (40 psi), the hydraulic gradeline must remain above 141m at this location. Since this elevated location is located in the eastern section of Zone MONT, an allowance for headloss across the network (from the pumping stations) is required. Modeling suggest, approximately 2m of headloss is observed. Therefore, a minimum discharge HGL of 143m at the pumping stations allows pressures to remain above the minimum target under normal operating/network conditions.

4.2.1.2 Fire Flows

A fire flow of 13,000 L/min is recommendations as per the 2013 Water Master Plan Update for system level analysis in the core area. The City also requires a fire flow assessment to be

carried out at the subdivision approval phase in which local watermains are checked for their ability to provide the objective Fire Underwriter Survey (FUS) fire flows. FUS fire flows will need to be confirmed when final site plans and building construction details are available. Should the FUS fire flow required be greater than 13,000 L/min, building fire protection (construction type, space between buildings, sprinkler systems, etc.) will need to be considered. Additionally, upsizing pipes where appropriate and to the City's Water Design Guideline to meet FUS fire flows may also be considered.

4.2.2 Model Development

4.2.2.1 Proposed Piping

Although the model is well developed with respect to demand allocation and the inclusion of most major infrastructure components such as pumping curves and storage dimensions, some modification was necessary to have a model that would reflect current and future hydraulic conditions in Zone MONT and the proposed development lands. The following section identifies the modifications that were carried out to the hydraulic model and the reasoning for the modifications.

Additional piping was added to the model to simulate the proposed network within the proposed development lands. **Figure 4.4** shows the preliminary alignments and sizing of the proposed watermains. In accordance with the 2010 City of Ottawa Water Design Guidelines, the Hazen Williams "C" factors for each pipe diameter were set as shown in **Table 4.2**.

Any proposed piping in the special study areas of this development are, at this point, conceptual and the exact locations of these watermains (and any looping) will be determined at the detailed design stage. For the purposes of hydraulic analysis, these conceptual pipes are intended to illustrate the need for water/looping through the area.

Table 4.2: Hazen Williams C Factors for Different Pipe Sizes

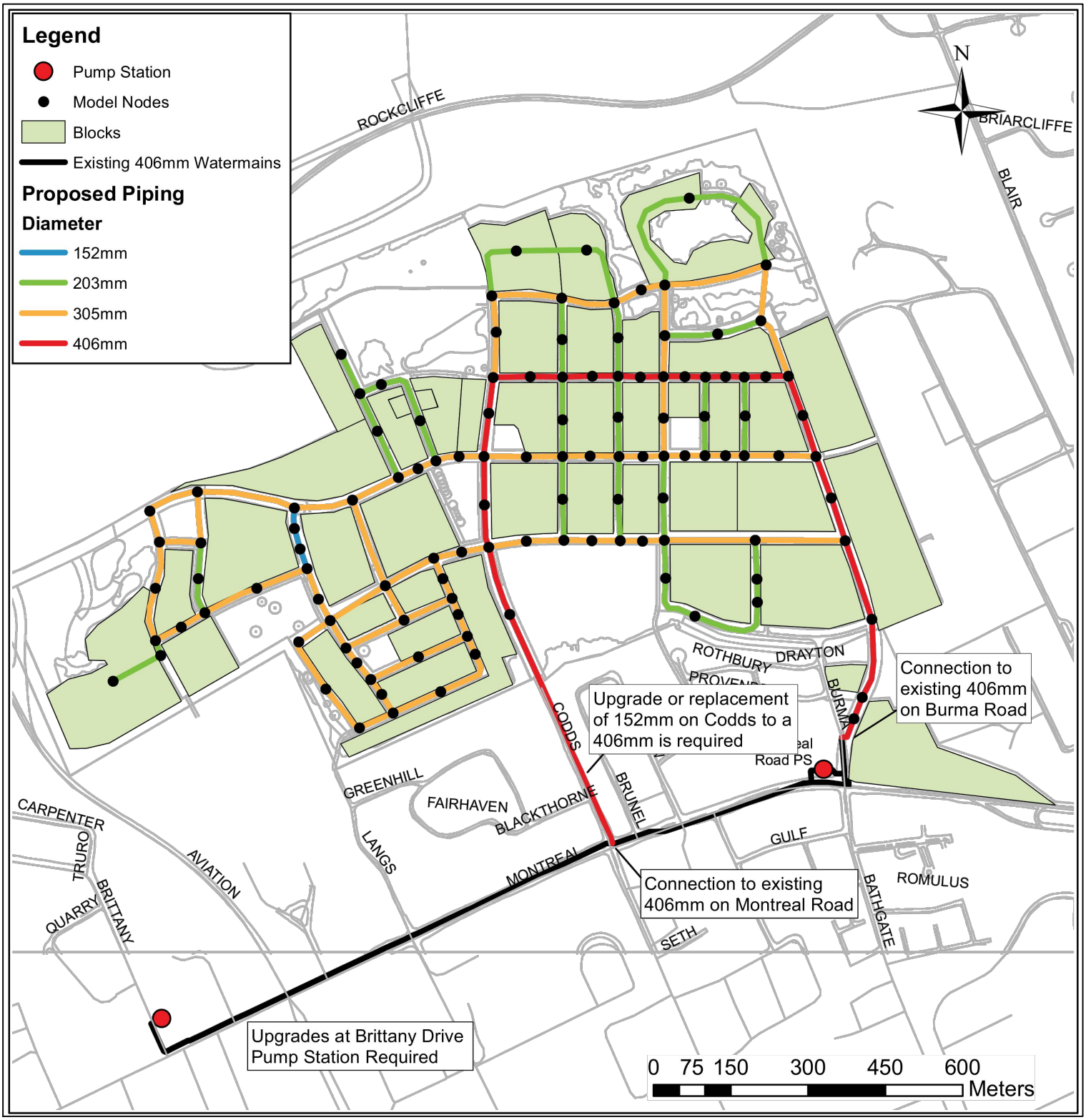
C VALUE	ACTUAL (MODELLED) PIPE DIAMETER	NOMINAL PIPE DIAMETER
100	155mm	152mm
110	204mm	203mm
110	297mm	305mm
120	406mm	406mm

The existing 152mm watermain on Codd's Road will require replacement with a larger 406mm diameter watermain, which is part of the proposed major loop that will service the development. This replacement was included in the model.

Figure 4.5 provides the approximate ground elevations at the computer model junctions within the proposed development. Ground elevations within the development range from 79.4m to 96.1m. If the Montreal Road Pressure Zone is regulated to a maximum of 147m, the highest pressure that would be observed in the proposed development is 662kPa (96 psi) at an elevation of 79.4m.

Since ground elevations in Zone MONT are as high as 112.9m, there is no concern for the HGL dropping below this minimum requirement. According to operational data, the typical maximum HGL observed at the MRPS is 147m and therefore the minimum anticipated pressure in the site is approximately 65 psi (assuming minimal head losses).

If the MRPS discharge pressure is regulated to 143m then the minimum and maximum pressures are anticipated to be approximately 296kPa (43psi) and 621kPa (90 psi), respectively.



J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.4 Proposed Pipe alignment and Diameters-REV.dwg Layout Name: FIGURE4.4

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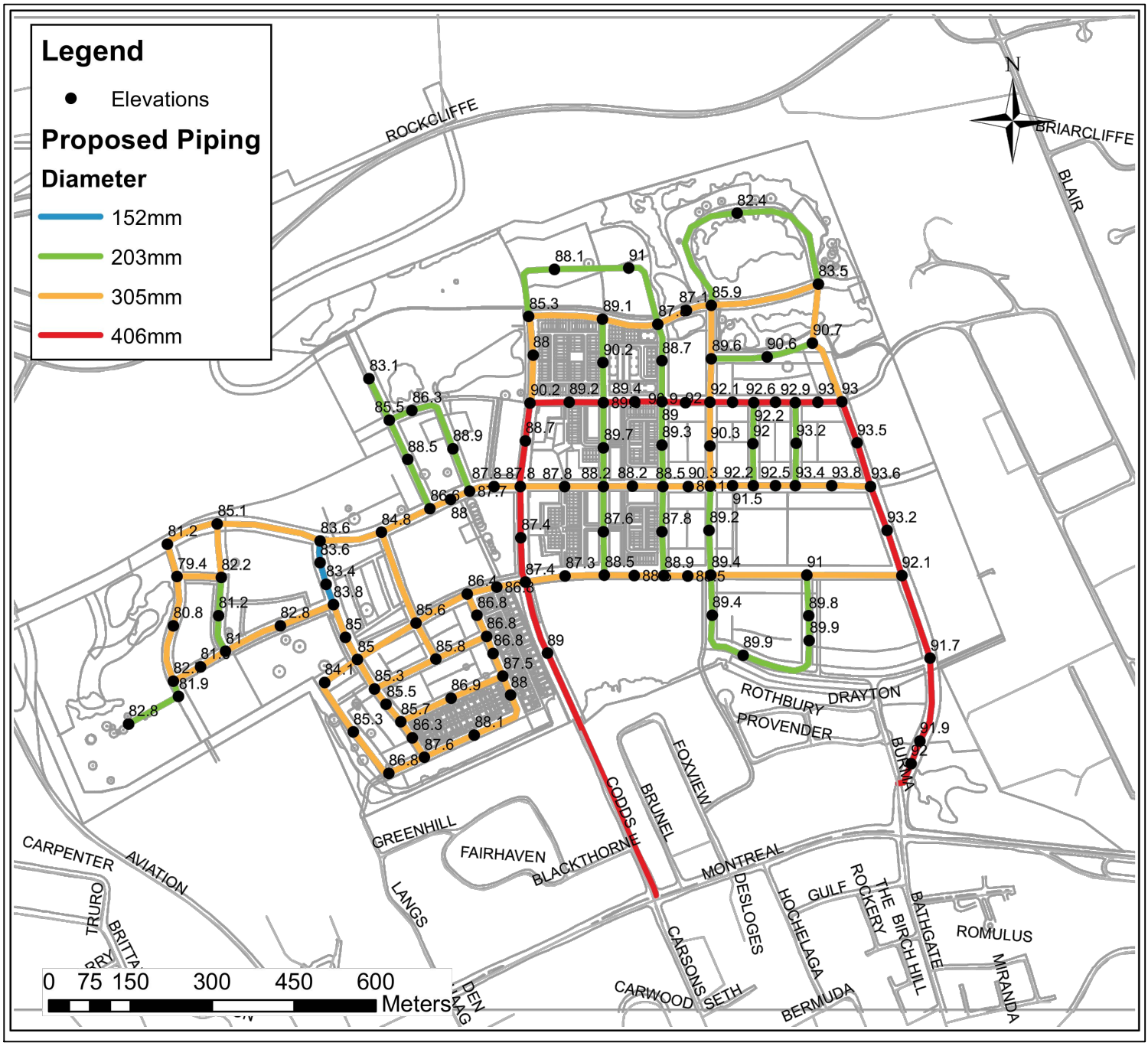
Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	PROPOSED PIPE ALIGNMENT AND DIAMETERS	FIGURE 4.4



J:\32952–RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.5 Ground Elevations.dwg Layout Name: FIGURE4.5

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Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	GROUND ELEVATIONS	FIGURE 4.5

4.2.2.2 Zone Reconfiguration Potential

The previous servicing study for this area (Potable Water Supply Analysis CFB/Rockcliffe Development; Stantec, April 27, 2007) discounted the option of servicing part of the study area directly from Zone 1E from the west as the ground elevations are too high to allow minimum pressure requirements to be achieved. The currently proposed service area extends a small amount further to the north and west near Hemlock and the Aviation Parkway ramp, with a ground elevation as low as 71.1m, although only a very small area is situated below 80m elevation (see **Figure 4.5**). Servicing this land from Zone MONT could result in pressures exceeding the City's Water Design Guidelines as well as the Ontario Building/Plumbing Code.

The normal operating HGL in Zone 1E ranges from approximately 112m to 117m, and the Orleans Reservoir has an overflow elevation of 114.7m. With a hydraulic grade line (HGL) of 112m in Zone 1E (lower operating end and considering some pipe losses to this point in the system), lands up an elevation of approximately 77m could be serviced at the minimum desired pressure of 50 psi.

It is thus clear that a connection to Zone 1E across the Aviation Parkway to service this area would only be capable of servicing a very small service area.

Conversely, servicing of this area from Zone MONT could result in pressures exceeding the desired maximum of 100 psi. With an operating HGL of 143m in Zone MONT, pressures exceeding 100 psi would occur for pipes at or below an elevation of 72.6m. This pressure would require a minor relocation of the watermain (to avoid ground elevations below 72.6m) or an increased pipe pressure rating. Additionally, pressure control valves would likely be required on any services in this area.

Given the very small area that could feasibly be serviced from Zone 1E and the high cost associated with installing a watermain from the west under the Aviation Parkway and the low cost of resolving issues associated with servicing this land from Zone MONT, it is recommended that these lands be serviced from Zone MONT as previously proposed. The decision to service the future Aviation Museum will be deferred until a site servicing plan is prepared for the facility.

4.2.3 Growth and Demand Projections

4.2.3.1 Growth Projections

According to email correspondence from IBI Group dated July 24th, 2014, the planned development for the Former CFB Rockcliffe site has been updated as follows.

1. Watermain alignments have been modified to reflect the new CDP
2. Development will be constructed in three phases
3. Unit counts and population densities have been modified
4. Water demands have been modified to reflect revisions as outlined in 2013 WMP

The latest plans call for 5,300 residential units comprised of 2.5% single family, 6.1 % semi-detached and free hold town homes, 24.2% stacked town-homes, 67.2% apartments. The previously proposed residential growth for the subject site in 2007 was 6,250 residential units, 40% (2,500 units) were comprised of singles, semis, and towns; the remaining 60% (3,750 units) were apartments.

The estimated residential population is determined based on projected household sizes as provided by IBI Group in an email correspondence dated July 24th, 2014 and slightly revised on July 21st, 2015. The following **Table 4.3** summarizes the projected population for the development based on the distribution of residential types described above.

Table 4.3: Estimated Residential Population Based on Unit Types

UNIT TYPE	PERSONS/UNIT	UNITS	POPULATION
Single Family	3.4	133	452
Semi-Detached/Freehold Towns	2.7	324	875
Stacked Towns	2.3	1,284	2,953
All Apartments	1.8	3,559	6,406
TOTAL		**5,300**	**10,686**

Therefore the latest residential population projection based is 10,686 persons. In addition to the residential component, Stantec was provided with a break-down of the anticipated Institutional, Commercial and Industrial (ICI) component of the future growth. A significant portion of ICI growth is allocated within Mixed-Use development, with some low-rise retail, employment and schools allocated to the remaining growth. The total number of jobs allocated to each of these land-uses was provided by IBI Group and is summarized in **Table 4.4**.

Table 4.4: Estimated Institutional, Commercial, Industrial (ICI) Job Population

LAND USE	JOBS
Mid-Rise Mixed Use	182
High-Rise Mixed Use	2,200
Low-Rise Retail	52
School	75
Employment	97
TOTAL	**2,606**

Therefore, a total population of 12,650 is expected after full development of the lands, including residential and commercial populations.

Note: a future Aviation Museum located northwest of the development was not included in the hydraulic analysis but was reviewed. The museum is to be developed on an 11.3 ha area with ground elevations varying from approximately 68m to 87m. Using a conservative consumption rate of 28,000 L/ha/d for commercial lands, as per the City of Ottawa's Water Design Guidelines, the total water demand for this museum is calculated to be approximately 0.32 MLD (3.66 L/s) or approximately an additional 12% of projected basic day flows.

4.2.3.2 Demand Projections

For the updated analysis, the criteria outlined in the 2013 Water Master Plan (WMP) were followed to determine water demands of the proposed development. Zone Level demands for populations greater than 3,000 persons were used. The consumption rates from the WMP were applied to the revised population projections based on land use and location with respect to the Greenbelt (inside or outside, denoted as "inside greenbelt" or IGB). It is noted that the Zone Level demands are generally used to assess larger service areas and are not generally used to size smaller internal piping. However, fire flows generally govern the minimum sizing for smaller internal watermain infrastructure, and therefore using these Zone Level demands for this analysis is considered appropriate.

Although the 2013 WMP criteria was used to estimate the water demands at a Zone level for this analysis, the City of Ottawa Water Design Guidelines are to be used upon the subdivision/site plan approval phase.

For residential land-uses, single family and semi-detached homes were considered to have similar demands, with both types of residential home categorized under “single family home” or SFH. Similarly, all free-hold townhomes and stacked townhomes were categorized under “multi-level townhomes” or MLT. All apartments were categorized under APT.

For any land-use that had a designated number of jobs (mixed-use, retail, and employment land-uses), an employment (EMP) water demand was applied. The table below summarizes the consumption rates for each unit type and provides the basic day demands for each unit type with the total basic day demand (BSDY) for the entire development determined to be 2.60 ML/d. A summary of all consumption rates and corresponding basic day demands is shown in **Table 4.5**

Table 4.5: Estimated Basic Day Demands Based on Unit Type

UNIT TYPE	CONSUMPTION RATE (L/cap/d)	TOTAL UNITS	POPULATION	BSDY (L/s)	BSDY (ML/d)
SFH	180	133	452	0.94	0.08
MLT	198	1,608	3,828	8.77	0.76
APT	219	3,559	6,406	16.24	1.40
EMP	137	n/a	2,606	4.13	0.36
TOTAL		**5,300**	**13,292**	**30.09**	**2.60**

To determine the maximum day demand of the development, the 2013 WMP allocates an outdoor water demand to all SFH units located within the development. This outdoor water demand is added to the basic day demand of 2.60 ML/d to obtain the maximum day demand for the development. An outdoor water demand (OWD) of 1,049 L/SFH/d was applied to all SFH units in the development as shown below:

Total Number of SFH Units = 133 units

Outdoor Water Demand = 1049 L/SFH/d * 133 SFH / 1,000,000 L/d = 0.14 ML/d

Maximum Day Demand = 2.60 ML/d + 0.14 ML/d = 2.74 ML/d

The projected BSDY and MXDY demands for the site were distributed to the nodes within the piping network for the corresponding scenarios (i.e. winter/BSDY and summer/MXDY). Demand patterns developed by the City of the entire Zone MONT were applied to the demands within the lands. Peak Hour demands were determined by applying the city developed diurnal patterns to the maximum day demands. The diurnal patterns are different for each unit type and all vary with time. The overall maximum observed demand when patterns are applied is the peak hour demand.

Table 4.6 shows the demands based on the three phases of development. As previously mentioned in **Section 4.2.1**, a fire flow of 13,000 L/min (217 L/s) is used as per the 2013 WMP recommendations. Refer to **Table 4.6** for the estimated time of construction of each phase.

Table 4.6: Demands Projections Based on Phasing

DEMAND (L/s)	PHASE 1A	PHASE 1B	PHASE 2	PHASE 3
BSDY	1.19	5.05	14.92	30.08
MXDY	2.64	6.49	16.54	31.69
PKHR	6.07	11.18	25.56	49.96
BSDY+FF	218	222	232	247
MXDY+FF	220	223	234	249

Table 4.7 shows what was previously anticipated in the 2007 study, what was projected from the 2013 WMP, and what is currently anticipated for the subject site (2014 study). The change in demand from the 2007 study to the 2014 study is shown as well as the percent change in demand.

Table 4.7: Comparison of Estimated Demands (Previous and Revised)

DEMAND TYPE	2007 STUDY (ML/d)	2013 WMP (ML/d)	2014 STUDY (ML/d)	CHANGE IN DEMAND FROM 2007 TO 2014 STUDY (ML/d)	CHANGE (%)
Basic Day (BSDY)	6.10	2.28	2.60	-3.50	-57%
Maximum Day (MXDY)	11.20	3.06	2.74	-8.46	-76%
Peak Hour (PKHR)	20.50	5.13	4.32	-16.18	-79%

Significant reduction in demand has occurred from the 2007 study for several reasons:

1. Reduction in total number of units, unit densities, and total population has decreased the overall number of people that are to be serviced.
2. Reduction in consumption rates (per 2013 WMP) and design based on Zone level has decreased the expected demand per person.
3. Employment demands have changed from area-based to a fixed consumption rate per job (per 2013 WMP).
4. The method in obtaining maximum day and peak hour demands has changed from applying multiplication factors to incorporating an outdoor water demand per SFH and observing peak hour demand patterns (per 2013 WMP).

Additionally, these factors have little impact on internal watermain sizing as they are controlled mostly by fire flow. It should be noted that at the subdivision/site plan approval level, the City of Ottawa's Water Design Guidelines are to be used.

4.2.3.3 External Lands

As per the City's 2013 WMP hydraulic model, 2031 demands for Polygon 55 and 56 of Zone MONT were assumed to be all demands anticipated for the Former CFB Rockcliffe development. As such these demands were adjusted based on the development information and incorporated into the proposed layout in the model. Other 2031 demands that are external to the Former CFB lands are shown in **Table 4.8** and were carried forward in the analysis herein.

Polygon 241 was located at Blair Road and Montreal Road and Polygon 251 was located at St. Laurent Boulevard and Montreal Road in the City's 2013 WMP hydraulic model. Both polygons are anticipated to contain commercial employment and polygon 241 is anticipated to contain some residential apartment units. The model shows these polygons representing a total demand of 3.54 L/s that includes 0.2 L/s of unaccounted for water. Based on the 2013 WMP consumption rate of 219 L/cap/d for apartments (APT) and 137 L/cap/d for employment (EMP), this equates to a population of 1,987 persons.

Table 4.8: 2031 Growth Polygons External to the Study Area

POLYGON	APT DEMAND (L/S)	EMP DEMAND (L/S)	POPULATION
241	0.50	2.38	1,698
251	0	0.46	289
Total			1,987

4.3 Zone Mont Pumping Capacity

Zone MONT is a closed zone and is serviced by two pump stations: Montreal Road PS and Brittany PS. **Table 4.9** shows the existing operational pump capacity at each pump station and the capacity of Zone MONT. The 2013 WMP identified the need for immediate pump capacity upgrades to meet firm capacity and reliability needs; further discussion is in the following sections.

Table 4.9: Existing Pumping Capacity

	EXISTING OPERATIONAL CAPACITY(ML/D)		
	TOTAL	FIRM	STANDBY
Montreal Rd. PS	39.4	21.9	16.5
Brittany Dr. PS	8.1	2.6	-
Zone MONT	47.5	24.5	16.5

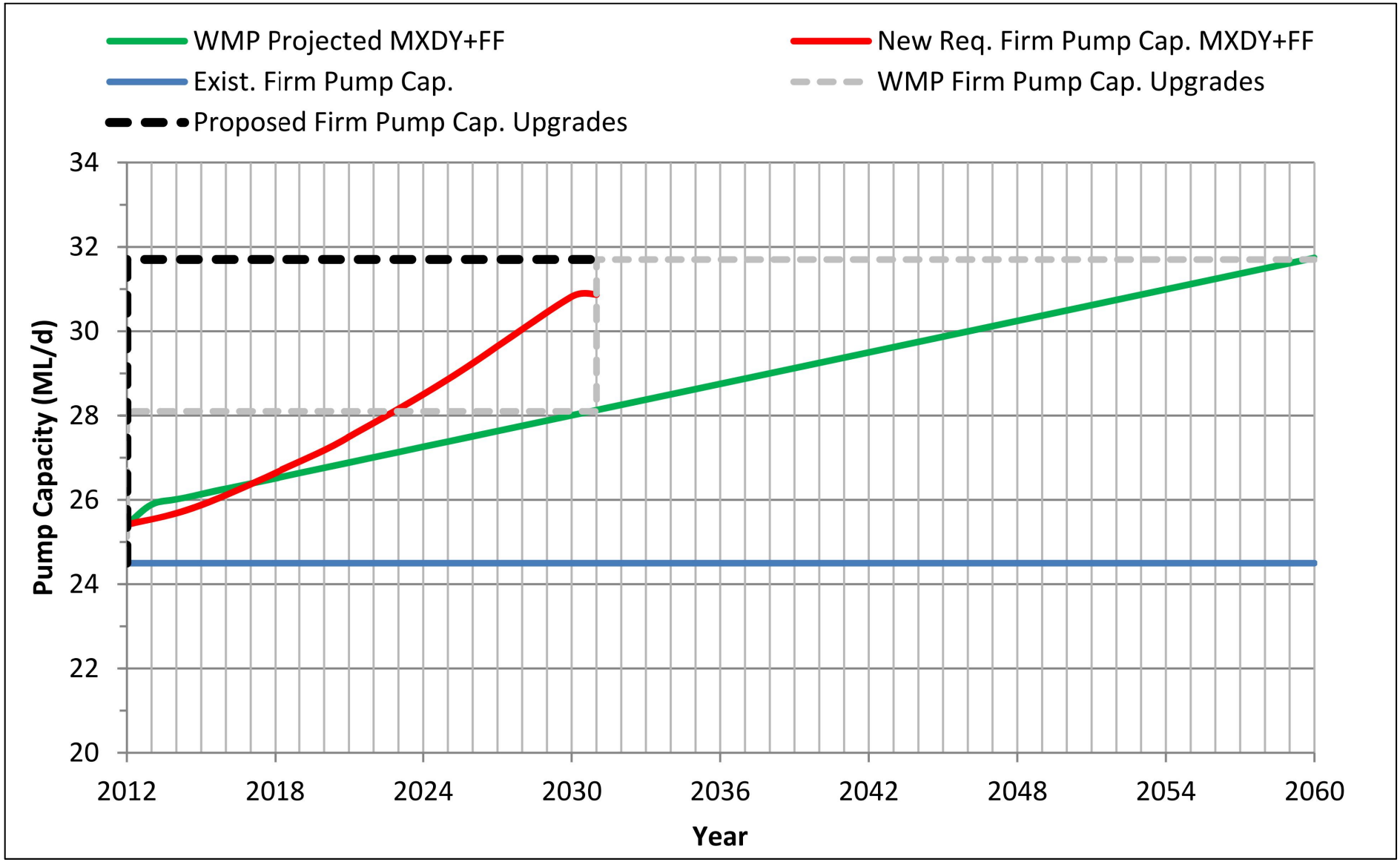
4.3.1 Firm Capacity: Maximum Day and Fire Flow

As per the 2013 WMP Level of Service Criteria, firm capacity in a closed zone is considered to be the largest pump out of service at each source of supply and must be able to supply MXDY+FF. The 2013 WMP Update indicated that an additional 3.6 ML/d of firm pumping capacity was required immediately for either the Brittany Drive PS or Montreal Road PS to meet existing demand requirements up to 2031 growth projections. A second upgrade in 2031 of 3.6 ML/d is also required to meet 2060 projections for a total of 7.2 ML/d. this increases the firm capacity from 24.5 ML/d to 30.1 ML/d.

Following a review of demand projections of the Former CFB Rockcliffe development and the zonal water demands of MONT pressure zone, recommendations for firm capacity upgrades are similar to the 2013 WMP. **Figure 4.6** shows the upgrade requirement timeline for firm capacity. It can be seen that the 2031 projections from the Former CFB Rockcliffe development is slight higher than the 2013 WMP projections for Zone MONT. It is recommended that an immediate upgrade of 4.2 ML/d take place to meet 2031 needs and accommodate build-out of the Former CFB Rockcliffe lands. A total of 7.1 ML/d of pumping upgrades is required to meet 2060 demands.

4.3.2 Reliability: Basic Day and Fire Flow

With respect to the Montreal Road Pressure Zone, the worst case scenario is the shut-down (whether intentional or not) of the MRPS. Under this scenario all flows into Zone MONT would



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Scale	Project Title	Drawing Title	Sheet No.
NTS	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	MONT PRESSURE ZONE FIRM CAPACITY REQUIREMENTS	FIGURE 4.6

J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.6 MONT Pressure Zone Firm Capacity.dwg Layout Name: FIGURE4.6

flow from the BDPS. As per the 2013 WMP Level of Service Criteria, if one pump station is out of service, it is assumed the second pump station will have all pumps available to supply BSDY+FF. The 2013 WMP indicated that BDPS requires an immediate upgrade to meet reliability needs for existing conditions.

It was confirmed during this study herein that capacity upgrade recommendations for reliability will be similar to that of the 2013 WMP. The 2013 WMP indicated that 19.2ML/d and 22 ML/d of total pumping capacity are required at BDPS for reliability purposes by 2031 and 2060, respectively. This increases the pumping capacity at BDPS to 27.3 ML/d to meet 2031 needs and 30.1 ML/d to meet 2060 needs.

As shown in **Figure 4.7** by incorporating the Former CFB Rockcliffe development projections to Zone MONT, a total of 19.5 ML/d is required immediately at the Brittany Drive Pump Station to meet 2031 demands. This increases the total pumping capacity from 8.1 ML/d to 27.6 ML/d. An additional upgrade of 1.9 ML/d will be required following 2031to meet 2060 demands and increase the total pumping capacity at BDPS to 27.6 ML/d.

As a result, in regards to reliability and redundancy where Montreal Road Pump Station is out of service, an additional 27.6ML/d of total temporary pumping at BDPS or an additional 9ML/d of back-up pumping at MRPS is required to meet the level of service during interim conditions of the MRPS and BDPS upgrades.

4.4 Hydraulic Modeling Results

The hydraulic model was tested under 2031 basic day demand conditions, to verify how the proposed network would respond with the complete build-out of the revised configuration. The following presents the results with the subject site serviced by the existing 406mm diameter watermain along Burma Road and a new 406mm diameter feed along Codd's Road.

4.4.1 Basic Day Demands

The discharge HGL at Brittany Drive PS and Montreal Road PS are shown in **Table 4.10**. Maximum pressures in the study area are expected be approximately 662kPa (96 psi).

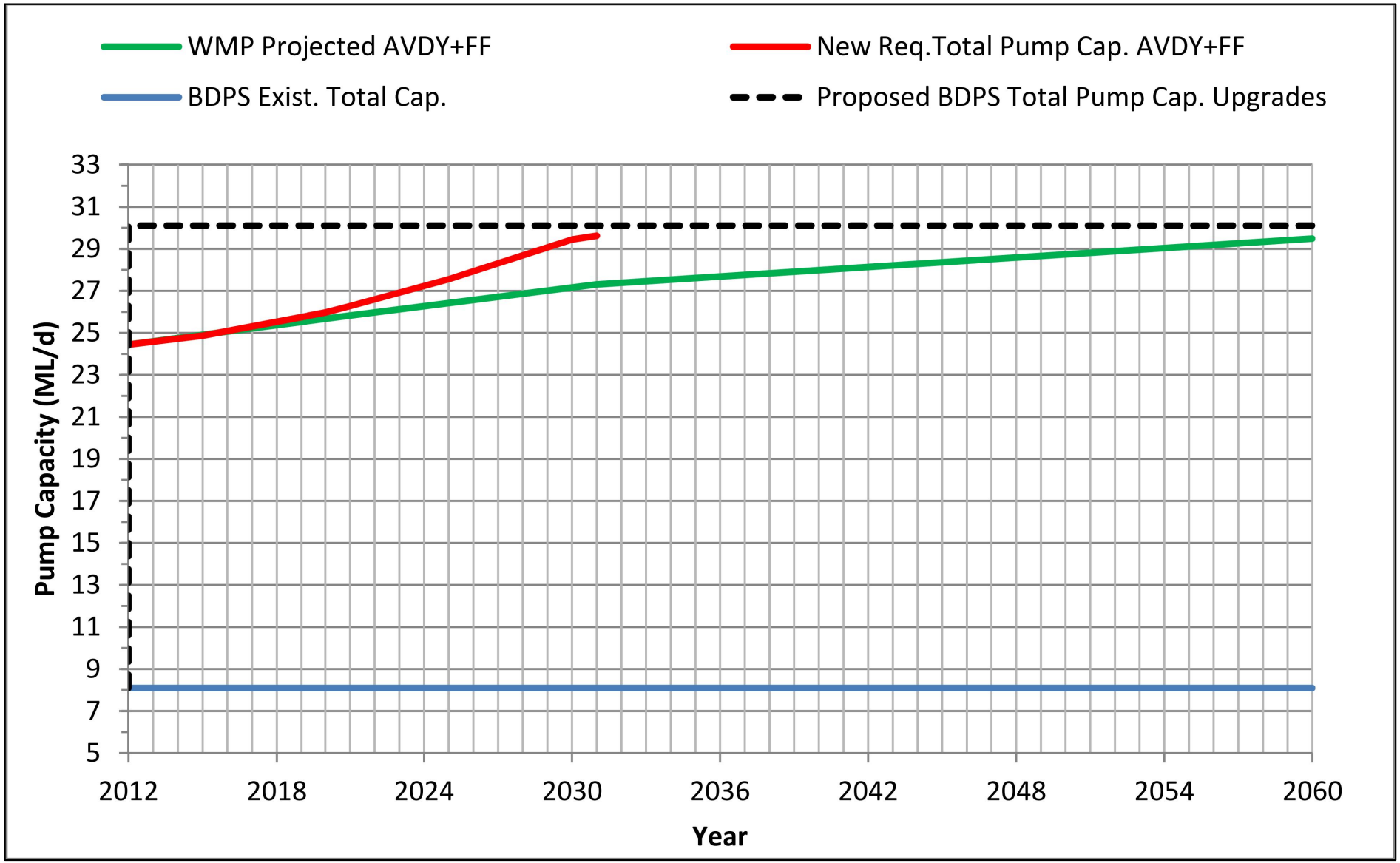
Table 4.10: Discharge Head at BDPS and MRPS Under BSDY Demands

PUMP STATION	MIN. DISCHARGE HEAD (M)	MAX. DISCHARGE HEAD (M)
Brittany Drive (BDPS)	142.0	147.7
Montreal Road (MRPS)	142.1	147.1

It is noted that a number of the service areas in the development lands are expected to exceed 550kPa (80 psi) and therefore, will require pressure reduction as per the Ontario Building Code requirements. The extent of this area is shown in **Figure 4.8**, and includes all lands below approximately 91m in elevation at a maximum discharge HGL of147m at MRPS.

However, if the maximum HGL at MRPS is reduced to a maximum of143m, the areas within the development experiencing high pressures can be reduced. This would result in lands with elevations lower than 87m to experience pressures above 80 psi as oppose to elevations lower than 91m (discharge head of 147m at MRPS). A pressure distribution map is shown in **Figure 4.9** with MRPS operating at a maximum discharge HGL of 143m.

Areas showing pressures above 80 psi in **Figure 4.9** will require pressure reduction measures. No areas are expected to exceed 689kPa (100psi). If the HGL at MRPS was reduced to a maximum of 143m, one alternative would be two centralized PRV's on the 305mm diameter pipes feeding the development west of Codd's Road since this area shows the highest operating



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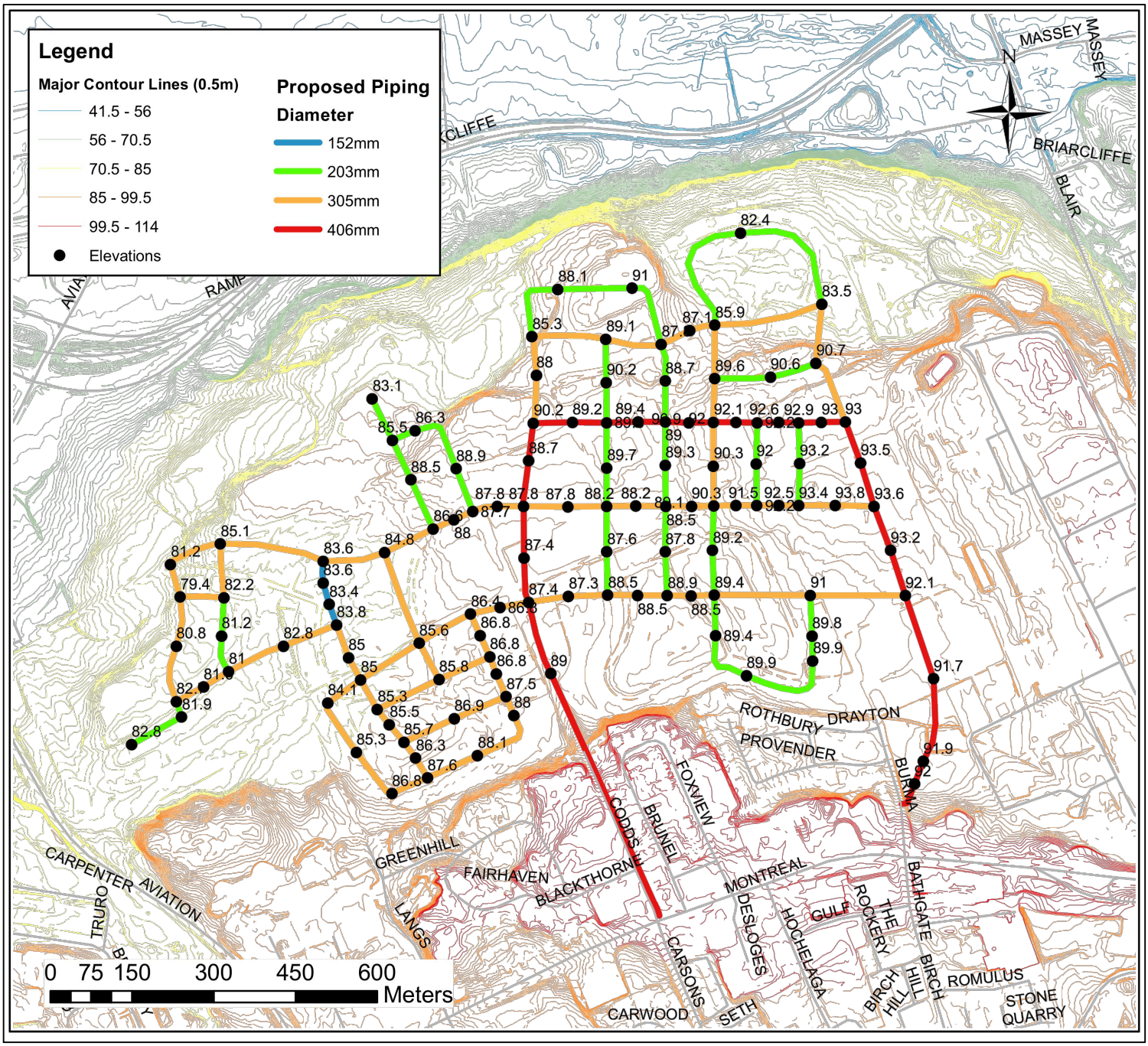
Scale	Project Title	Drawing Title	Sheet No.
NTS	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	MONT PRESSURE ZONE UPGRADES AT BRITTANY DRIVE PUMP STATION	FIGURE 4.7

J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.7 MONT Pressure Zone Upgrades at Brittany.dwg Layout Name: FIGURE4.7



J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.8 Ground Contours and Node elevations.dwg Layout Name: FIGURE4.8

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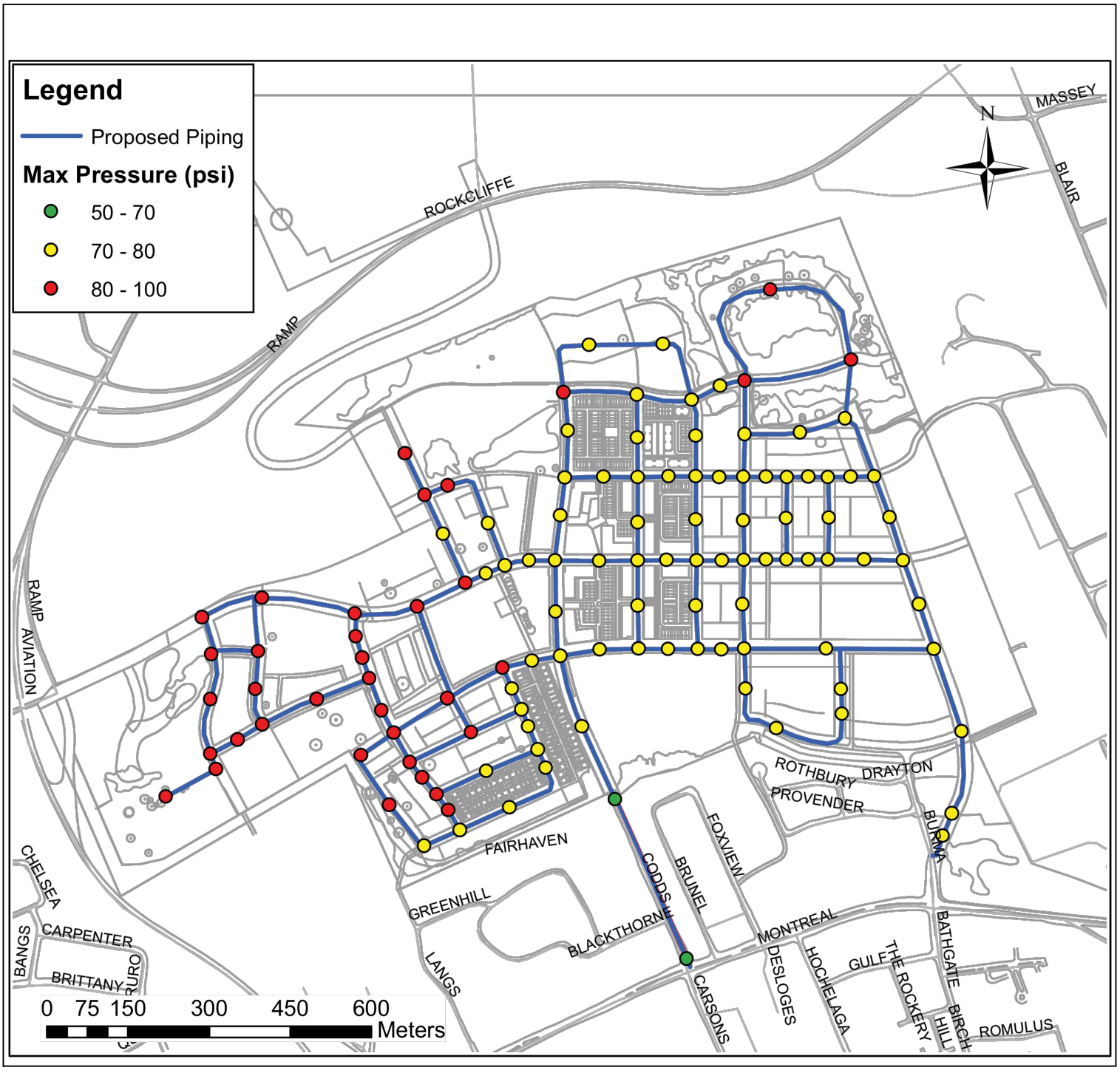
Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	GROUND CONTOURS AND NODE ELEVATIONS (m)	FIGURE 4.8



J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.9 Maximum Pressure Distribution.dwg Layout Name: FIGURE4.9

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Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	MAXIMUM PRESSURE DISTRIBUTION (MRPS Max HGL of 143 m)	FIGURE 4.9

pressures in the development. However, as per the technical bulletin released this year regarding maximum pressure control measures, centralized pressure reduction stations are not permitted for this application. Therefore, individual PRV's are recommended as a means to reduce high pressures in the development. If the HGL at MRPS is to remain as is (147m), pressure reduction would be required for a larger area (areas with elevations less than 91m).

4.4.2 Peak Hour Demands

The discharge HGL at BDPS and MRPS are shown in**Table 4.11**. With a maximum HGL of 147m into Zone MONT, including the subject site, the minimum pressures in the developing lands do not drop below 386kPa (56 psi). The minimum pressures anticipated will vary according to the minimum discharge HGL from the two pumping stations.

Table 4.11: Discharge Head at BDPS and MRPS Under PKHR Demands

PUMP STATION	MIN. DISCHARGE HEAD (M)	MAX. DISCHARGE HEAD (M)
Brittany Drive (BDPS)	142.6	147.7
Montreal Road (MRPS)	142.7	147.1

With MRPS operating at maximum HGL of 143m, the anticipated minimum pressure is expected to be approximately 386 kPa (56 psi) and well above the minimum objective pressure of 276 kPa (40 psi).

4.4.3 Maximum Day and Fire Flow

A 2031 maximum day demand fire flow analysis was carried out to determine the anticipated available flows at each node within the CFB lands. Within the proposed development, fire flows greater than 13,000 L/min with a residual pressure of 140kPa (20 psi) are anticipated at all locations.

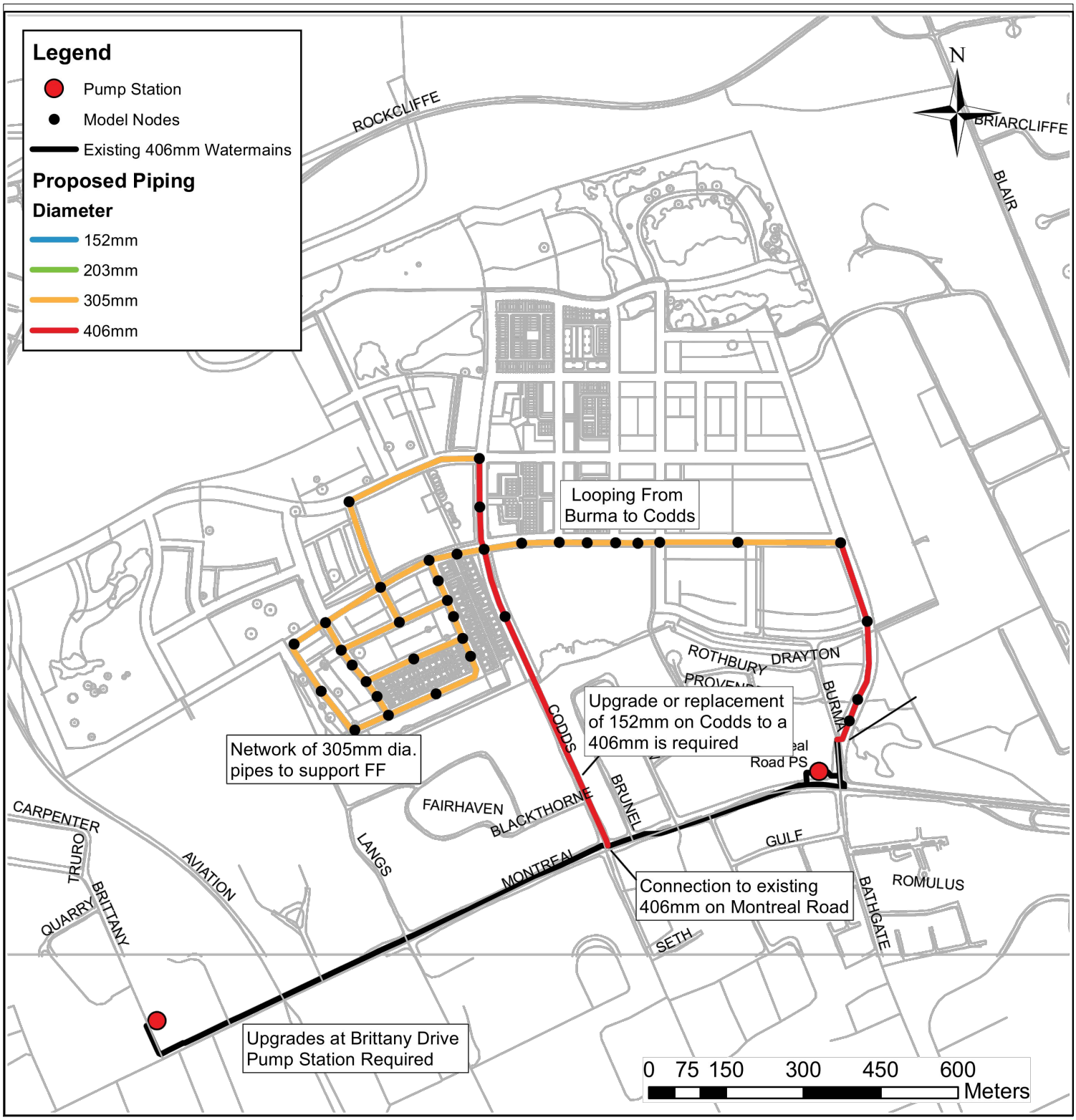
Dead-end nodes were not included in the analysis as they are to show demands to the area. Smaller, local internal watermains will have to be assessed and verified as development planning proceeds. See **Appendix A** for details of available fire flows within the development.

4.4.4 Phasing

As previously mentioned, the immediate pumping upgrades at Brittany Drive PS or Montreal Road PS is required before development can take place to satisfy the City's reliability Level of Service requirements.

The pipe layout shown in **Figure 4.10** was modeled under 2012 conditions (representing existing conditions) to simulate Phase 1A in 2015. Two connections to the existing watermain on Montreal Road from Codd's Road and Burma Road with a looping is recommended. As per the City's criteria, since there are over 50 units in Phase 1A, the secondary feed from Burma Road was necessary to consider. Since the water demands of Phase 1A are quite small, the feasibility of the pipe sizing and arrangement will be governed by MXDY demands + fire flow.

Under existing BSDY and MXDY conditions, without any modifications at the Brittany Drive or Montreal Pumping Stations with respect to the discharge HGL, the areas included in Phase 1A are anticipated to experience pressures in the range of approximately 72 - 89 psi. The maximum pressures observed exceed the 80 psi threshold and would require pressure reduction measures. This further illustrates that if the HGL discharge at the pump stations is not regulated to a maximum of 143m, the majority of the development will experience pressure greater than 80 psi.



J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 4\FIGURE4.10 Phase 1A Pipe Layout.dwg Layout Name: FIGURE4.10

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Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	PHASE 1A PIPE LAYOUT	FIGURE4.10

As previously mentioned, PRV's will be required for areas with elevations less than 91m while the MRPS is operating at a discharge pressure of 147m. As such, if Phase 1A is constructed before the Zone MONT pump station upgrades, PRV's will be required for areas with elevations less than 91m. However, actual PRV requirements are to be confirmed upon the subdivision approval.

Based on the pipe layout in **Figure 4.10**, the system is be capable of providing adequate fire flow of 13,000 L/min while sustaining a minimum pressure of 20 psi under 2012 MXDY demand conditions and under a pump station failure (given the recommended firm pumping capacities at Brittany Drive PS and Montreal Road PS). See **Appendix A** for details of available fire flows within the development.

4.5 Conclusion

The growth projections of the Former CFB Rockcliffe confirm that there is a need to implement the pumping upgrades to Zone MONT in the near future. As per the 2013 WMP, Brittany Drive PS is currently at a deficiency for pumping capacity and needs to be upgraded to meet the City's reliability Level of Service requirements (if the Montreal Road PS is out of service). An immediate firm pumping capacity upgrade of 4.2 ML/d will be required either at the Brittany Drive or Montreal Road Pumping stations meet 2031 needs and accommodate the Former CFB Rockcliffe development. To satisfy the expected 2060 growth in Montreal Road Pressure Zone, a total of 7.1 ML/d of additional pumping is required. In regards to reliability, a total pumping capacity upgrade of 19.5 ML/d will be required at the Brittany Drive pump station to supply 2031 Zone MONT demands if the Montreal Road Pump Station is taken out of service. It is understood that the City is presently intending to proceed with upgrades at the Brittany Drive Pumping Station to meet both existing and future growth and reliability needs.

As a result, interim measures are required to provide the appropriate level of service while the Brittany Drive and Montreal Road Pump Station upgrades take place. Since the functional design report update is currently underway, details are still being discussed. However, it is understood that additional temporary pumping and back-up power will be required before Phase 1A of the development.

The City of Ottawa is currently implementing a new strategy for the manner in which closed zones are controlled within the City's water distribution system. The report "Closed Pressure Zone Design and Operation Best Practices Review and Conversion of Zone 3C to Closed Zone Operation", June 2013 by Delcan Corporation describes the Best Practices related to the design and operation of Closed Pressure Zones and includes design and operation considerations for the following components: firm pumping capacity, electrical redundancy, instrumentation and control redundancy, system controls and operational response. Future upgrades and modifications to the Brittany Drive and Montreal Road Pumping Stations will require a review of current operations and possible implementation of the recommended Best Practices.

The recommended large diameter pipe network for the former CFB/Rockcliffe lands is shown in **Figure 4.4**; however, pipe sizes can differ upon the subdivision approval stage where detailed information is available and confirmed. Based on the results, **Figure 4.9** shows the maximum pressure distribution map of the areas with pressures exceeding 80 psi and indicates that the proposed water distribution network is capable of supplying most of the projected water demands within the acceptable pressure range of 275kPa to 690kPa (40 to 100 psi) during normal operating conditions and demands (i.e. basic day, maximum day and peak hour). It is noted that within the City of Ottawa, the recommended pressure range for new services is 345 to 550kPa (50 to 80 psi).

Within the subject site there are no concerns with respect to falling below minimum pressure requirements (under normal conditions) due to the fact that the highest elevation of

approximately 94m is significantly lower than the highest serviced elevation within Zone MONT (112m). According to operational data, existing discharge HGLs into Zone MONT currently range from 142 to 147m. Based on peak hour modeling results, the maximum head loss anticipated between the pumping stations' discharges to the subject site is approximately 2.5m. Therefore at a discharge HGL of 142m, the resultant minimum pressure at an elevation of 94m would be 470kPa (68 psi).

There are low-lying areas in the proposed development that are expected to experience up to 662kPa (96 psi) on a regular basis, due to their low ground elevations. The Ontario Building Code (OBC) requires pressure reducing valves (PRV's) on new services that are expected to experience greater than 550kPa (80 psi).

Controlling the HGL discharge head at Montreal Road PS to 143m can reduce the pressures to the entire development. This would result in areas with elevations less and 87m to experience pressures higher than 80 psi rather than areas with elevations less than 91m (majority of the Former CFB Rockcliffe area) while operating at the existing maximum HGL of 147m.

Although a large portion of the development will experience high pressures, centralized PRVs are prohibited for this application, as per the City technical bulletin released this year. Individual/private PRV's are recommended as a pressure reducing measure for these areas.

The proposed network is capable of providing the City's typical fire flow requirements of 13,000L/min, under MXDY demands, as indicated in the WMP. Modelling results showed that this required fire flow can be achieved at all location in the Former CFB Rockcliffe development.

During the design stage, the proponent will be required to determine specific fire flow requirements of individual buildings and determine whether the available flows are sufficient. It is recommended that fire flow tests be carried out on the watermain network once constructed to confirm the model results. FUS fire flow will need to be calculated and confirmed at the subdivision approval stage.

Lastly, for the construction of Phase 1A, connections to the existing Montreal Road watermain from Codd's Road and Burma Road with looping is recommended to sufficiently supply water and fire flow. Since the hydraulic analysis herein was based on a zone level water demand, during the subdivision approval stage, demand estimates for Phase 1A will need to be calculated based on the City of Ottawa's Water Design Guidelines when more detailed information is available and confirmed.

The proposed piping through any special study areas in this development is conceptual as no defined road layout or right of ways have been identified at this time. For the purposes of hydraulic modelling, the watermains shown to loop/go through these areas are intended to demonstrate the need for water and looping through the area. The exact location and looping of these watermains will be determined upon detailed design.

In regards to the future Aviation Museum, a review determined that although it is located on low laying lands, it is not feasible to service this area through Zone 1E. The past CFB evaluation of this area ruled out the interconnection from Zone 1E, as it cannot provide pressure greater than 50 psi per the Level of Service requirements. Since pressures are not expected to exceed 100 psi in the proposed watermains that the museum service lines would connect to, it is recommended that the future museum be serviced by Zone MONT pressures with appropriate pressure reducing measures along the service to the museum. The decision to service the future Aviation Museum will be deferred until a site servicing plan is prepared for the facility.

5 Wastewater Collection System

5.1 Introduction

The former CFB Rockcliffe combined sewer system has reached its useful life and the redevelopment of the site should include the construction of a new separated sewer system. The new sanitary sewers will be designed to not only collect wastewater from former CFB Rockcliffe but should also be oversized to carry wastewater from several external areas, some of which have previously been identified.

Capacity for wastewater flows from the Montfort Hospital and Thorncliffe Village should be provided in the new wastewater system in Rockcliffe. Combined sewage flows from the NRC Campus presently cross the former CFB Rockcliffe site and connect to the IOS sewer at the NRC Shaft. The existing easements for the NRC combined sewer will be protected as the subject site develops. However, if the NRC should complete its own separated sewer system in the future it is assumed that wastewater flows from the NRC Campus will connect directly to the IOS. No wastewater capacity in the proposed new sanitary sewer system for the former CFB Rockcliffe site will be provided for the NRC lands.

The existing Fairhaven development to the south of former CFB Rockcliffe is presently serviced with well and septic systems. Provision for potential future wastewater flows from that area should also be considered in the redevelopment site infrastructure.

As noted in **Section 2.4.2**, the Foxview development is presently serviced with sanitary sewers which outlet to the south. It is therefore proposed that the wastewater system for the subject redevelopment not provide capacity for Foxview.

Although not located inside the site boundaries, CLC has agreed to provide capacity in the proposed site infrastructure, including wastewater, for a 11.3 ha property located north of Hemlock Road. The site is identified as “Future Museum” on **Figure 1.2**. The property is in federal government ownership, which wishes to retain servicing capacity in the proposed site infrastructure to accommodate the needs of a future museum development. The site is partially located on the northern escarpment where existing ground contours range between 68 m and 86 m. The proposed wastewater collection system along Hemlock Road can partially service the site; however, because of the site topography, it is proposed that a separate sanitary sewer be constructed by the site owner at the time of site development and connect to and outlet at node 253A (City sewer node aw 00200) at an invert elevation of 61.69 m.

5.2 Design Criteria

Most of the existing sewers, both combined and sanitary, will be decommissioned while developing the site in favour of a separated sewer system which would include dedicated sewers for wastewater and storm runoff. The new site sanitary sewer system will be designed in accordance with the City of Ottawa Sewer Design Guidelines. These will include the following parameters:

- Average Residential Per Capital Flow Rate 350 l/c/day
- Residential Peaking Factor Harmon Formula (2.0 to 4.0)
- Average Employment Flow Rate 50,000 l/ha/d
- Average Institutional Flow Rate 50,000 l/ha/d
- ICI Peaking Factor 1.5
- Inflow/Infiltration Rate 0.28 l/s/ha

- Minimum Full Flow Velocities 0.60 m/s

Where practical and where there are fewer than ten residential connections, the sanitary sewer will be designed as 250 mm diameter pipes at a minimum slope of 0.65%.

Also in accordance with the City's Sewer Design Guidelines, the following population densities will be included:

- Single Family Units 3.4 ppu
- Semi Detached Units 2.7 ppu
- Freehold Townhouses 2.7 ppu
- Stacked Townhouses 2.3 ppu
- Apartment Units 1.8 ppu

5.2.1 Population Projections

The CDP (Section 5.5) included a discussion on expected unit target densities, jobs and population. To determine overall densities for the community, anticipated densities for individual land uses were applied to the preferred concept plan which is shown on **Figure 1.3**. Table 5.2 Land Use Distribution and Density from the CDP is included in **Appendix D**. The CDP projected a total unit count of 5,346 supporting an estimated population of 9,764.

Recognizing that target densities are projections and actual densities may vary, especially for a development planned over a 20 year horizon where market conditions can fluctuate, this report proposes to use slightly higher densities. A detailed block by block analysis of the projected unit counts and associated population is presented in **Table 5.1** below. In order to provide flexibility in wastewater capacity, this report recommends that the final target for units should be close to 5,300 supporting an estimated population of 10,686.

Table 5.1 Unit Type Quantities and Projected Population

BLOCK NO.	UNITS									POPULATION
	SINGLES (3.4PPU)	SEMIS (2.7PPU)	TH FREEHOLD (2.7PPU)	TH STACKED (2.3PPU)	APARTMENTS (1.8PPU)				TOTAL	
					APT	LRA/ MU	MRA/ MU	HRA/ MU		
5								474	474	853.2
7				234					234	538.2
8							138		138	248.4
9							196		196	352.8
11			12						12	32.4
12				279					279	641.7
13			85						85	229.5
15			38						38	102.6
16	14								14	47.6
17	14								14	47.6
19	19								19	64.6
20	27								27	91.8
21	59								59	200.6
23						102			102	183.6
25						89			89	160.2
27			55						55	148.5
29						156	117		273	491.4
30						71	153		224	403.2
31							237		237	426.6
32							171		171	307.8
33							214		214	385.2

BLOCK NO.	UNITS									POPULATION
	SINGLES (3.4PPU)	SEMIS (2.7PPU)	TH FREEHOLD (2.7PPU)	TH STACKED (2.3PPU)	APARTMENTS (1.8PPU)				TOTAL	
					APT	LRA/ MU	MRA/ MU	HRA/ MU		
35							190		190	342.0
36							285		285	513.0
39							191		191	343.8
40				83					83	190.9
41				84					84	193.2
42			39						39	105.3
44						275			275	495.0
46			62						62	167.4
47				35					35	80.5
48				70					70	161.0
50				110					110	253.0
51				158					158	363.4
53				190					190	437.0
55			33						33	89.1
57				41					41	94.3
60								500	500	900.0
Total	**133**	**0**	**324**	**1284**	**0**	**693**	**1892**	**974**	**5300**	**10686.4**

5.3 Proposed Wastewater Plan

The recommended ultimate wastewater plan for former CFB Rockcliffe is included in **Figure 5.1**. Together with that figure, the supporting Sanitary Sewer Design Sheets and **Figure 5.2**, Sanitary Drainage Area Plan, are included in **Appendix D**. For quick reference, reduced copies of these figures are included herein.

The proposed plan indicates that wastewater from the subject site and some adjacent external areas will be directed to one of the proposed connection locations to the IOS. The limits of these sub-drainage areas are also indicated on **Figure 5.2**. The following **Table 5.2** summarizes the wastewater elements for each connection point.

Table 5.2 Proposed Macro Drainage Area Elements

CONNECTION LOCATION IOS SHAFT	FORMER CFB ROCKCLIFFE			EXTERNAL AREAS			TOTAL			TOTAL FLOW (L/S)
	AREA (HA)	POPU-LATION	ICI (HA)	AREA (HA)	POPU-LATION	ICI (HA)	AREA (HA)	POPU-LATION	ICI (HA)	
Peach Tree Lane	19.02	2544.2	0.00	0.0	0.0	19.69	19.02	2544.2	19.69	61.86
Codd's Road	68.28	7374.5	13.69	14.50	2112.2	0.0	82.78	9486.7	13.69	156.25
NRC	16.21	767.7	3.18	0.0	0.0	0.0	16.21	767.7	3.18	49.23
SWM Pond										
Total	**103.51**	**10686.4**	**16.87**	**14.50**	**2112.2**	**19.69**	**118.01**	**12798.6**	**36.56**	**267.34**

A wastewater allowance for 1,574 people covering 5.5 ha is proposed for Thorncliffe Village. The drainage limit is shown on **Figure 5.2** and the population estimate is taken from Drawing No. 12381 S1 prepared by J.L. Richards & Associates Ltd (dated 1991), a copy of which is included in **Appendix D**. Existing wastewater flows from Thorncliffe Village are discharged to an existing 300 mm diameter sewer in the location indicated on **Figure 2.13**. It is proposed to intercept and collect those flows near node 114A and route the proposed site sewers to the Codd's Road Shaft (refer to **Figure 5.1**).

Future external flows from the Fairhaven community are also planned to be routed to the site wastewater system at node 190A. In anticipation of potential urbanization of that development, it is proposed to install a 250 mm diameter sewer under the proposed Southwest Channel