Planning and Engineering Feasibility Study - Purcell's Cove Road Servicing, Halifax

Final Report

121006.00 ● Final Report ● July 4, 2013

ISO 9001
Registered Company

Prepared for:

HALIFAX
REGIONAL MUNICIPALITY

Prepared by:

CBCL LIMITED
Consulting Engineers

Final Report	G. Smith	07/04/2013	S. Murphy
Draft Report	G. Smith	06/04/2013	S. Murphy
Issue or Revision	***Reviewed By:***	***Date***	***Issued By:***

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Report: 121006.00

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July 4, 2013

Mr. David Lane
Senior Planner
Halifax Regional Municipality (HRM)
Suite 103, 1st Floor
40 Alderney Dr. (Alderney Gate)
Dartmouth, NS B2Y 2N5

Dear Mr. Lane:

RE: Final Report – Planning and Engineering Feasibility Study – Purcell's Cove Road Servicing, Halifax

CBCL Limited is pleased to submit to the Halifax Regional Municipality the attached report entitled "*Final Report – Planning and Engineering Feasibility Study – Purcell's Cove Road Servicing, Halifax*".

Yours very truly,

CBCL Limited

Original Signed

Steven Murphy, MBA, P. Eng.
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Project No: 121006.00

CANADA'S BEST MANAGED COMPANIES

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CHAPTER 1 INTRODUCTION

1.1 General

In October 2011, the Halifax Regional Municipality (HRM) issued a Request for Proposals (RFP) for a planning and engineering feasibility study related to the potential extension of central water and sewer services along Purcell's Cove Road. CBCL Limited responded to the RFP by submitting a proposal on November 3, 2011 and the firm was subsequently awarded the project on February 17, 2012. The general purpose of the project is to evaluate the feasibility and estimate the associated construction costs for the potential service extension.

The study area for the project includes the lands along Purcell's Cove Road, extending southeast of Wenlock Grove to Fergusons Cove Road. The study area also includes all public and private roads within the overall study area boundaries. The general study area is depicted in Figure 1.1. Per the terms of the RFP, the study area has been divided into two separate "sub-areas", namely Area 1 and Area 2. Area 1 extends from Wenlock Grove up to and including Oceanview Drive. Area 2 runs from Oceanview Drive to Fergusons Cove Road. The number of existing lots within Areas 1 and 2 (per information provided by HRM) is 160 and 185 respectively. The study is to assess the feasibility and costs of providing central services to these sub-areas independently. However, any servicing options developed for Area 1 must be suitably oversized to accommodate the potential future inclusion of Area 2.

1.2 Project Background

The community of Purcell's Cove is a traditional historic seaside village, located south of the city of Halifax on the west side of the Northwest Arm. Existing development within the community has typically relied upon individual on-site water and sewerage systems to provide water supply and sewage disposal service. However, many parts of the community are typified by small lots that do not meet today's on-site sewage disposal regulatory requirements. As such, there is a concern that some of the existing on-site systems are sub-standard, which could result in groundwater contamination and thereby contaminate existing household water supplies.

Outside of the Purcell's Cove community itself, a number of property owners along Purcell's Cove Road (south of Wenlock Grove) have expressed concern about the quality and quantity of their respective on-site water supply systems. Water shortages, salt water intrusion and lack of adequate water supply for fire protection purposes have all been reported concerns of these residents. In addition, the Royal Nova

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PURCELL'S COVE ROAD SERVICING STUDY-
STUDY AREA

MAY 31/2013 | SCALE: 1 : 10,000

FIGURE 1.1

Scotia Yacht Squadron (RNSYS) and Saraguay Club are located along this stretch of Purcell's Cove Road. These facilities currently obtain their potable water from a treated supply from Williams Lake. However, there are frequent occasions during the summer months when this water supply is rendered unsafe as a result of fecal coliform contamination.

Existing central water and sewer services along Purcell's Cove Road currently terminate at Wenlock Grove (see Figure 1.1). The area to the southeast of Wenlock Grove is presently outside the HRM's central water and sewer serviceable boundary. Properties in this area are generally serviced by on-site water and sewerage systems. Given the concerns noted above related to these systems, in 2006 and 2007 petitions were tabled with HRM Council by residents in the area to gauge interest in extending central services to the area. The results of this petition process suggested that 65% of Area 1 respondents were in favor of such a study, while only 25% of Area 2 respondents wished to proceed. As such, in November of 2011 HRM issued a Request for Proposals (RFP) to initiate a planning and engineering study to assess the alternatives, feasibility, and costs related to the extension of the existing Purcell's Cove Road central water and sewer services. The study's RFP indicated that the project was to consider extension of these services to both Areas 1 and 2. Servicing options and related construction cost estimates were to be developed for both areas. Furthermore, the infrastructure servicing options developed for Area 1 were to be sufficiently oversized to accommodate a possible future connection of Area 2. All public and private streets in the study areas were to be included in the overall analysis.

1.3 Project Objectives and Scope

The primary objective of this project is to assess and determine the feasibility and costs associated with the extension of central water and sewer services along Purcell's Cove Road. The specified general goal of the project is "to provide HRM staff, Chebucto Community Council (now Halifax and West Community Council), HRM Regional Council, property owners, the general public and other stakeholders with information sufficient to determine whether or not Council should proceed with initiating by-law amendment processes and more detailed cost analyses/financing options for the installation of central services along Purcell's Cove Road (beyond Wenlock Grove)".

Specifically, the scope of services for this project included:

- Meet with the project Technical Team and Steering Committee on an regular basis to discuss project status and issues;
- Review all available background material concerning the project;
- Meet, and liaise with regulatory authorities, utilities, stakeholder groups and other levels of governments as required;
- Determine the acceptable size of the proposed service boundary (land area to be serviced);
- Determine appropriate population/dwelling unit density options and community form;
- Assess potential traffic impacts of the proposed development options;
- Develop and assess options for extending central services;
- Prepare Class C construction costs estimates for the developed servicing options;
- Facilitate and host up to two (2) public consultation meetings;
- Preparation and submission of a draft and final report summarizing the findings and recommendations of the study efforts; and
- Presentation of the final report to Community Council.

CHAPTER 2 SERVICE AREA ANALYSIS

2.1 Review of Planning Documents

The 2006 Halifax Regional Municipal Planning Strategy is the Council-approved document that outlines how the Municipality sees future growth, development and infrastructure investment occurring until 2031. This document outlines primary land use designations for the Purcell's Cove study area covering the area along the oceanfront, which is designated as "Harbour" to support a working and living harbour, and the inland area which is generally designated "Urban Reserve" which will ultimately support urban development, but not until after the current regional plan period (i.e. beyond 2031) (see Figure 2.1).

Figure 2.1: Portion of Generalized Future Land Use Map from 2006 HRM Regional Municipal Planning Strategy

The Halifax Mainland Municipal Planning Strategy provides specific objectives, policies, plans, and programs that inform the decision-making of Council with regards to development in the Mainland South area, in which the Purcell's Cove study area is located. On the Generalized Future Land Use Map (see Figure 2.2), which outlines the future intentions of the Municipality for the development of areas under its jurisdiction, this document designates the developed portions of the study area primarily concentrated along the oceanfront as LDR, Low Density Residential, in which all new residential development shall be detached single-family dwellings and existing housing stock may be converted into a maximum of three units. The inland portions of the study

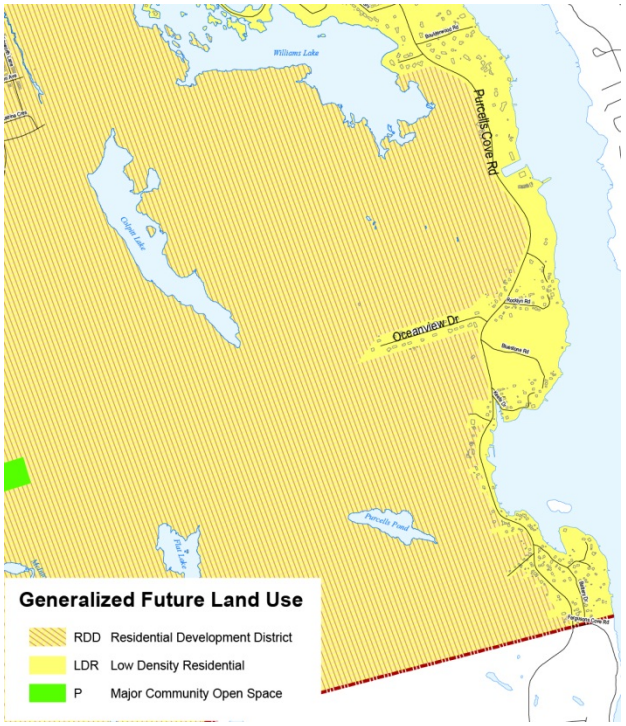


Figure 2.2: Portion of Generalized Future Land Use Map from Halifax Mainland Municipal Planning Strategy

area south of Purcell's Cove Road are designated as RDD, Residential Development District, which is intended for the development of planned residential areas containing a mixture of residential uses and related recreational, commercial and open space uses.

The Halifax Mainland Land Use By-Law provides detailed zones for the Purcell's Cove study area (see Figure 2.3).

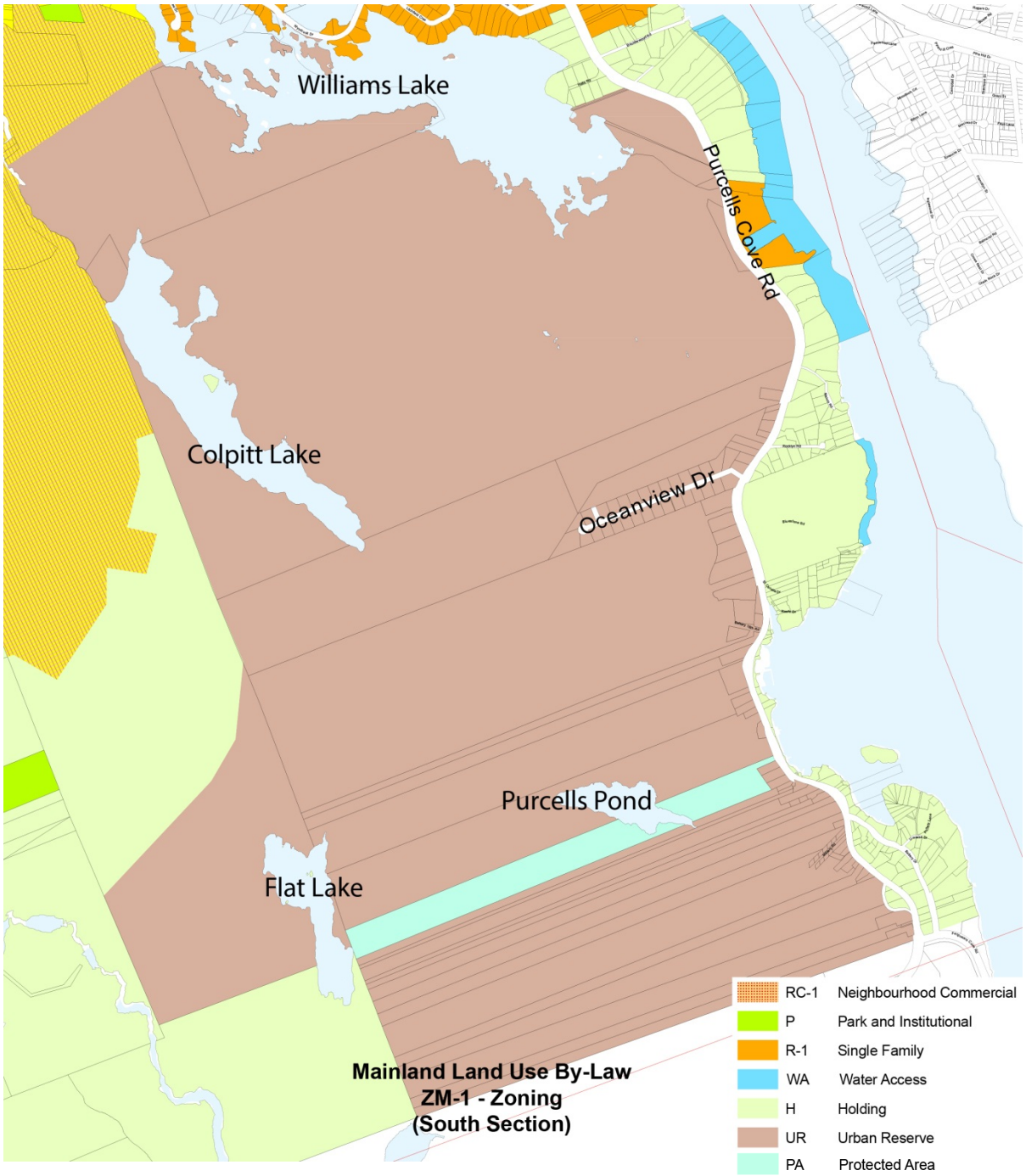


Figure 2.3: Portion of Zoning Land Use Map from Halifax Mainland Land Use By-law

In the By-Law, most of the area along the oceanfront is zoned as H (Holding) Zone which allows:

- Detached one-family dwellings, provided that on-site sewage disposal and water services are provided on the lot on which the dwelling is proposed to be located;
- Public park or playground;
- Public recreational centre, provided that sewer and water service connections for the centre are made to the existing city services; and
- The office of a professional person located in the dwelling house used by such professional person as his private residence.

The By-Law zones the area around the Nova Scotia Yacht Squadron as R-1: Single Family Dwelling Zone which permits:

- Detached one-family dwellings. However, if subdivision or additions that increase the number of dwelling units is to occur, a "city sewer or water system" must be provided;
- The office of a professional person located in the dwelling house used by such professional person as his private residence;
- A home occupation;
- A public park or playground;
- A church and church hall;
- A golf course;
- A tennis court;
- A yacht or boat club;
- A public recreational centre;
- A day care facility for not more than 8 children in conjunction with a dwelling;
- A special care home containing not more than 10 persons including resident staff members; and
- Uses accessory to any of the foregoing uses.

The By-Law also zones the water lots in the area as WA (Water Access) Zone, which allows the following within the study area:

- Wharves and docks;
- Municipal, provincial and national historic sites and monuments;
- Passive recreation uses;
- Public works and utilities; and
- Ferry terminal facilities.

The WA zone specifically prohibits the erection of any buildings with the exception of public works, public utilities, a multi-use trail system and associated facilities and ferry terminal facilities, on a wharf, on pillars, on piles, or on any other type of structural support located on or over a water lot.

South of Purcell's Cove Road, the Land Use By-Law zones most of the area as UR (Urban Reserve) Zone, which permits:

- Single family dwellings, on existing lots provided that a private on-site sewage disposal system and well are provided on the lot; and
- Passive recreation uses.

The By-Law zones a lot owned by the Nova Scotia Nature trust south of Purcell's Cove Road running back from the cove past Purcell's Pond as PA (Protected Area) Zone, which allows:

- Scientific study and education, involving no buildings;
- Trails, boardwalks or walkways;
- Conservation uses; and
- Uses accessory to the foregoing uses.

2.2 Suitability Analysis

As part of the process to assist with community consultation regarding the potential central service area boundaries, a desktop suitability analysis of the study area was completed using available digital mapping information.

In general, development will occur on suitable lands that are considered desirable and that have the ability to be serviced in a cost-effective manner. It was the intention to use this information during a meeting with the public to make sure that areas that they might have been considered suitable, from a community standpoint, to support additional development in the area were in fact technically able and desirable for residential development from a potential developer's perspective.

Future development should only occur after careful investigation to ensure that important natural and historic resources are protected and that natural hazards are delineated (as defined in Table 2.1). Existing developed areas are also included in this characterization.

Table 2.1: Areas with Limited Development Potential

Waterbodies
Watercourse, Wetland and Coastal Buffers *
Cemeteries
All lands below elevation 4.5m above sea level
Existing developed areas
Crown lands
Areas of elevated cultural significance
Areas of elevated archaeological significance
Protected areas
Open space and natural resources network

Note:

* The Nova Scotia Department of Natural Resources Wildlife and Watercourses Protection Regulations states that for watercourses with channel widths over 50 cm, upland buffers are to be a minimum of 20 metres on either side of the watercourse and where average slopes within that area exceed 20%, the width is to be increased by one metre for each 2% of slope, up to a maximum of 60 metres in width.

Capability is the ability of the land to support residential development. As shown in Table 2.2, factors affecting capability are slope, soil depth and soil drainage. Soil depth and drainage characteristics determine the ability of the land to support on-site septic systems and the ease of building foundations. Slopes above 30% are not suitable for general residential development.

Once the land is determined to be capable of supporting residential development, the relative desirability of different areas is another important consideration. The factors influencing desirability are also outlined in Table 2.2.

Table 2.2: Factors Considered to Influence Suitability of Land for Residential Development

	CAPABILITY	DESIRABILITY
SLOPE	✕	
SOIL DEPTH	✕	
SOIL DRAINGE	✕	
TREE COVERAGE		✕
ASPECT		✕
VIEWS		✕
DISTANCE TO SCHOOL		✕
DISTANCE TO SERVICES		✕
DISTANCE TO ROADS		✕
DISTANCE TO BUS STOPS		✕

Generally, areas with mature vegetation are more desirable to purchasers, although it may be desirable for the Municipality to encourage redevelopment of disturbed areas as a means of preserving less-disturbed areas and controlling erosion. Preferred aspects are southeast, southwest, south, and west. Lands on the oceanfront or lakefront or with ocean views tend to be more valuable than inland areas. Distance to schools is often a consideration for homebuyers, especially those purchasing single family homes. Since this study is considering the feasibility of installing central services in the area, it was considered to be especially relevant that potential new development be built close to existing services to minimize the cost of extending service connections and disturbance of areas that will potentially remain undeveloped. Cost considerations and the avoidance of disturbance of potentially undeveloped areas are also relevant to the installation of roads. Ease of access to transit was also considered a beneficial factor when considering the location of potential new residential development.

Figure 2.4 is a composite map showing the amalgamation of the suitability considerations described above. “Areas with Limited Development Potential” are in black and other areas as potentially available for development are shown in a range of colours. Areas shown as dark green are considered most capable and desirable for development, while areas shown in red are considered least capable and desirable for development.

Details on the criteria and their associated maps are provided in Appendix A.

2.3 Public Input

HRM established a Community Steering Committee (CSC) for this project. The committee was mandated to act as an advisory committee to HRM staff, the Consultant (CBCL Limited) and Chebucto Community Council on matters pertaining to this study. Specific duties and responsibilities of the Committee were to:

- Garner community input on the study by acting as a liaison with the community of Purcell’s Cove so as to advise HRM staff, the Consultant and Chebucto Community Council on the community’s aspirations concerning to the project; and
- To act as the liaison group for the Consultant, receiving information and providing feedback, and assisting in preparing and conducting the public consultation phase of the study.

The Committee was comprised of:

- Three community members from Area 1;

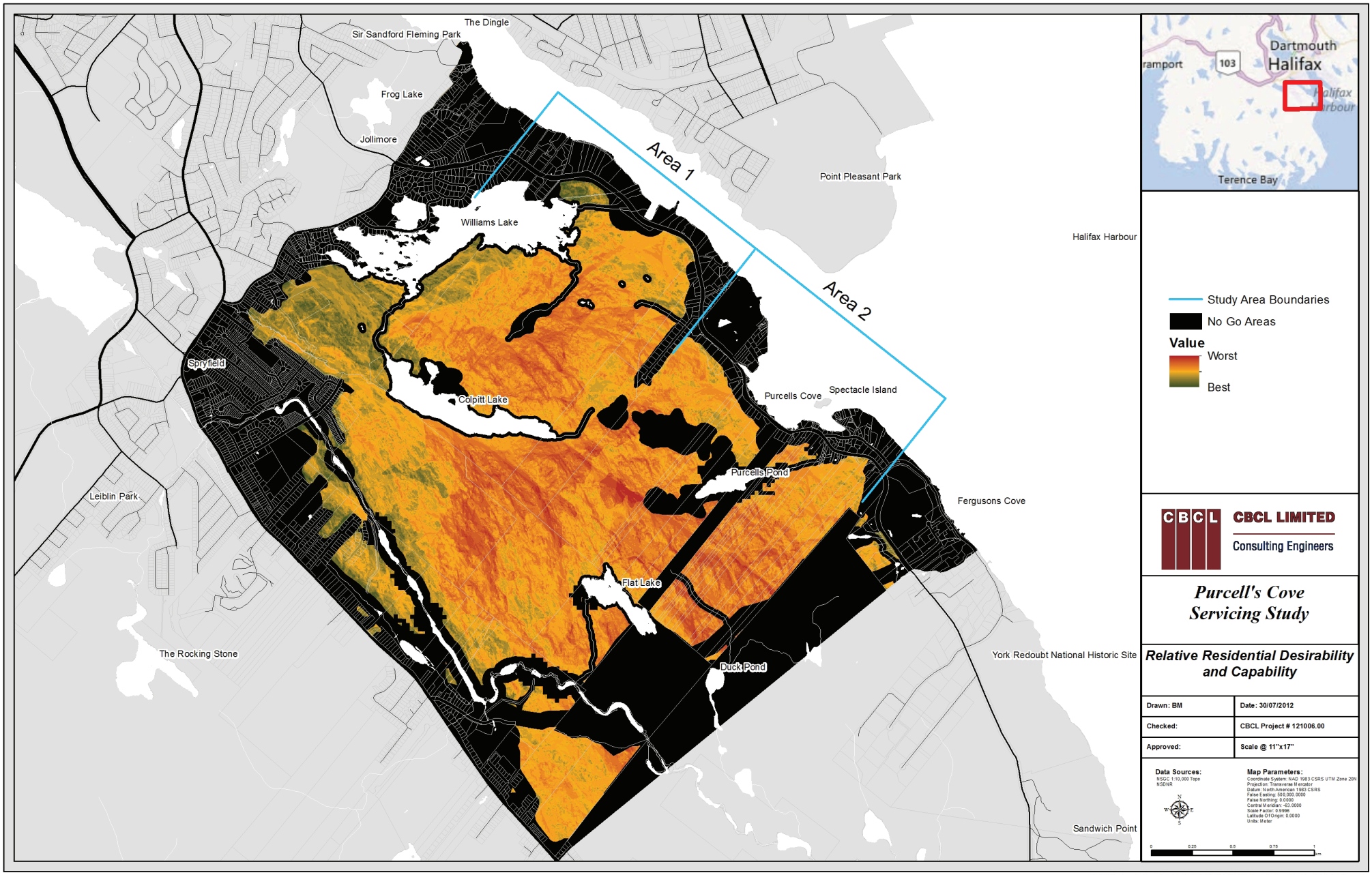


Figure 2.4: Residential Desirability & Capability

- Three community members from Area 2;
- One member from the Royal Nova Scotia Yacht Squadron/Saraguay Club;
- One member from the Williams Lake Conservation Company; and
- The District Councillor as an ex officio member (with the change in the composition of the HRM Regional Council that occurred part way through the project, a second councillor, whose district came to include part of the study area, was included).

A public meeting was held on October 29, 2012 to obtain residents' input on possible central service area boundaries and their thoughts about what would be an acceptable potential form of additional development within the study area.

Based on an analysis by a Community Steering Committee member, of the 185 people that signed in for the public meeting:

- 48 people were from Area 1;
- 42 people were from Area 2;
- 91 people were from outside of the study area. The majority of these people were from very close to the study area – Williams Lake area / Boscobel / Wenlock Grove / Litchfield / Purcell's Cove Rd. and surrounding areas; and
- 4 people were not able to be assigned (either no address was given or it was illegible).

During the meeting, attendees were invited to participate in small groups, discuss central servicing and development within the study area, and report back to the CSC with the results of their discussions. Fifteen groups were formed. Maps with relevant suitability analysis information obtained to date were posted at the back of the room and post-it notes and pens were available for marking of the plans to ensure that information presented was accurate. Time was available at the end of the meeting for an open mic session where people were able to provide additional comments.

There was very active and strong involvement from the attendees.

During the meeting, people were asked to answer the following questions:

1. Do you want central services?
2. If no, why don't you want them? Is it because:
    - You are happy with your current on-site systems?
    - You are worried about how much it will cost to hook-up?
    - You are concerned that it will enable additional development in the area?
3. If you are interested in obtaining central services, which options would you be willing to entertain to try to limit your costs:
    - Working to attract additional funding;
    - Utilizing alternative servicing schemes; or
    - Allowing some new development to limit costs for existing residents.
4. If the community wants to think about option c) (additional development), how much additional development is acceptable, where should it go, and what form should it take?

In response to **Question 1**, Do you want central services?

- All except one person said they did not want central services and, in fact, were very strongly opposed to the provision of central services in the area; and
- In the open mic session, some people expressed that resources might be better spent helping individual households with water supply issues and to determine solutions to their particular problems.

In response to **Question 2**, If no, why don't you want them?

- People almost unanimously expressed that they were happy with their existing systems and that they were worried about how much it would cost them if central services were installed;
- People are extremely concerned that the provision of central services would result in an increase in their taxes or the imposition of an area rate;
- People also almost unanimously expressed concerns about the loss of natural open space; and
- A vast majority of people are concerned that the provision of central services to the area is a "backdoor" way to allow additional development in the area.

In response to **Question 3**, If you are interested in obtaining central services, which options would you be willing to entertain to try to limit your costs?

- This question was universally stated by the groups to be not applicable, based on their answers to Question 1.

In response to **Question 4**, If the community wants to think about allowing some new development to limit costs for existing residents, how much additional development is acceptable, where should it go, and what form should it take?

- The groups universally stated that there should be no additional development and that the area should remain as an open space / greenbelt.

People's comments on the mapping provided very strong statements that central sewer and water are not needed. At least 10 to 15 post-it notes per map expressed this opinion. People expressed very strong sentiments that the backlands should be protected as open space and turned into a greenbelt / wilderness park. People expressed very strong concerns that woods, wildlife, wetlands and lakes must be protected. Extremely limited comments were received on the particulars of the information presented on the maps.

In conclusion, people at the meeting:

- Were extremely concerned that the process is being manipulated to achieve a desired result;
- Expressed satisfaction with the on-site septic and water service that they have and are concerned that central services will be forced upon them;
- Did not want additional development in the area and would like to see the backlands preserved as public open space / greenbelt; and
- Were concerned that development will affect the woodlands, wildlife and ground and surface water quality in the area.

2.4 Potential Future Development

The Purcell's Cove study area is not designated as a growth centre in the current Regional Plan. Many of the existing residents are opposed to allowing additional development in the area and were not willing to provide input on potentially acceptable locations and forms for additional development in the area.

As such, in order to determine the potential impact that additional development in the area may have on the extension of central services to the area, the CBCL Limited consultant team developed a conservative estimate of the number of lots that could be created by:

- The subdivision of existing lots allowed under current zoning. Current legislation governing Halifax Water requires that central services be sized to accommodate the subdivision of additional lots that may be enabled by the provision of those services, since the larger lots required to accommodate on-site services are no longer necessary. Based on information received from the Municipality, a schematic analysis of the existing property configurations and the potential subdivision of existing properties to create new lots with central servicing that meet lot size requirements under current zoning, it was estimated that the following lot numbers could occur:

	Area 1	Area 2
Existing Lot Count (as provided by HRM)	160	185
Estimated Additional Lots that Could Be Created	85	170
Total	245	355

- Allowing for additional development that could occur on lands subject to rezoning. In order to maintain a conservative approach, an allowance was only provided for those lands of which the Community Steering Committee were informed. The only developer to come forward was Clayton Developments Limited which presented a proposal for the creation of approximately 1200 new units of housing on PID 00052407 (contained entirely within Area 1). Note that this particular development would only be permitted under a "Plan Amendment" process.

On this basis, for the purpose of creating a budget central servicing construction cost estimate related to this feasibility study, it was estimated that up to 1,455 new dwelling units could be created in the study area.

CHAPTER 3 TRAFFIC IMPACT ANALYSIS

3.1 Existing Conditions

3.1.1 Road Network and Study Intersections

Armdale Roundabout at Herring Cove Road

The Purcell's Cove study area consists of a number of local roadways, private driveways and accesses connecting with Herring Cove Road and Purcell's Cove Road. The primary collector road for the study area is Purcell's Cove Road. This roadway runs from the east end of the study area to its intersection with Herring Cove Road, near the Armdale Roundabout. Purcell's Cove Road has one lane in each direction of travel, with double yellow lines in the centre of the road to ban overtaking. This is due to the geometry of the road having frequent horizontal curves, sight distances which can be reduced due to vertical alignment, and numerous driveways and accesses along the road where entering or exiting vehicles could collide with overtaking vehicles on the main road. The posted speed limit along the section of road within the study area is 50kph.

The primary intersection along Purcell's Cove Road is the intersection with Herring Cove Road. Herring Cove Road has a protected left turning area for southbound vehicles to wait before turning left in to Purcell's Cove Road. This section of roadway also has a reversible center lane that serves northbound traffic during the AM peak traffic period switching to the southbound direction for traffic during the PM peak period. The intersection at Herring Cove Road / Purcell's Cove Road is unsignalized, however traffic coming from the south along Purcell's Cove Road, and turning right, yield to traffic on Herring Cove Road. There is a splitter island to separate traffic coming from the south along Purcell's Cove Road heading towards Armdale Roundabout from traffic turning left off Herring Cove Road on to Purcell's Cove Road. There is no left turning permitted from Purcell's Cove Road to Herring Cove Road. There is also a pedestrian crosswalk on Herring Cove Road a few metres south of the intersection.

3.1.2 Existing Traffic Volumes and Transit Conditions

Traffic counts were undertaken by HRM on Tuesday September 11, 2012 and Wednesday September 12, 2012. These days were anticipated to be average days for the area and there were no known reported incidents, delays or unusual occurrences during the survey period. Traffic appeared to be flowing normally, schools were in attendance, commuters drove to and from work at anticipated times.

The AM traffic counts were undertaken on September 11, with the PM counts being undertaken on September 12. The counts were undertaken using manual survey techniques at the Herring Cove Road / Purcell's Cove Road intersection.

All traffic movements were recorded during the surveys and the counts were reported in total vehicle flows.

Herring Cove Road / Purcell's Cove Road Intersection

These counts were processed in Excel and turning movement diagrams were produced to show the AM and PM peak hour total traffic flows. Figures 3.1a and 3.1b show the recorded turning movements by time period through the intersection. The AM peak hour was identified as being between 07:45 and 08:45 hours, with the PM peak hour between 16:30 and 17:30 hours on the days of the traffic counts.

3.1.2.1 Herring Cove Road / Purcell's Cove Road Intersection

As can be seen from the turning movement figures, during the AM peak hour at the Herring Cove Road / Purcell's Cove Road unsignalized intersection, the largest flow of traffic is travelling south-north along Herring Cove Road, through the intersection heading towards the Armdale Roundabout and into the city. The total two-way flow on Herring Cove Road to the north of the intersection was approximately 1,433 vehicles. The total two-way flow to the south of the intersection was 1,105 vehicles. The traffic flow on Purcell's Cove Road during the AM peak hour was 659 vehicles turning right on to Herring Cove Road with 118 vehicles turning left off Herring Cove Road from the north, with only 13 vehicles turning right from Herring Cove Road from the south. The total two-way flow on Purcell's Cove Road was 790 vehicles during the AM peak period.

During the PM peak hour at the intersection, the largest traffic flow comes through the Armdale Roundabout heading south away from the city. This flow was recorded as 1,370 vehicles, with 934 vehicles passing through the intersection and continuing south along Herring Cove Road. The remaining 436 vehicles turned left off Herring Cove Road on to Purcell's Cove Road. Traffic exiting Purcell's Cove Road during the PM peak hour was 198 vehicles turning right on to Herring Cove Road towards Armdale Roundabout.

Regarding public transit in the area, there are five main bus routes that operate. The #15 service travels along Purcell's Cove Road with a transit stop approximately 100 meters south of the intersection (on the west side of the road), and with frequent additional transit stops located throughout the study area. The #14, #19, #20 and #32 service operates along Herring Cove Road with one transit stop at the

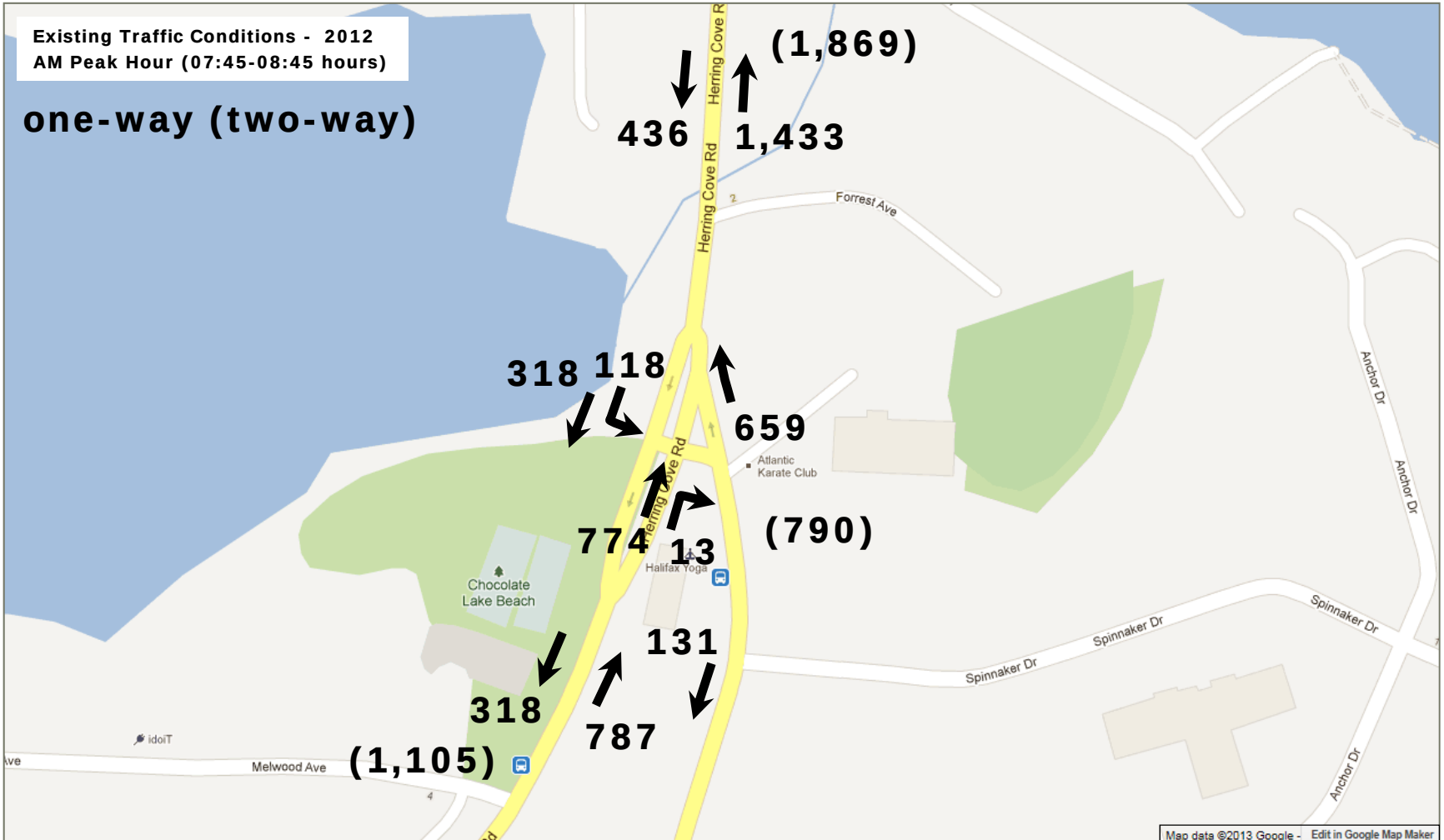


Figure 3.1a: Herring Cove Road/Purcell's Cove Road Intersection (2012 AM Peak Hour)

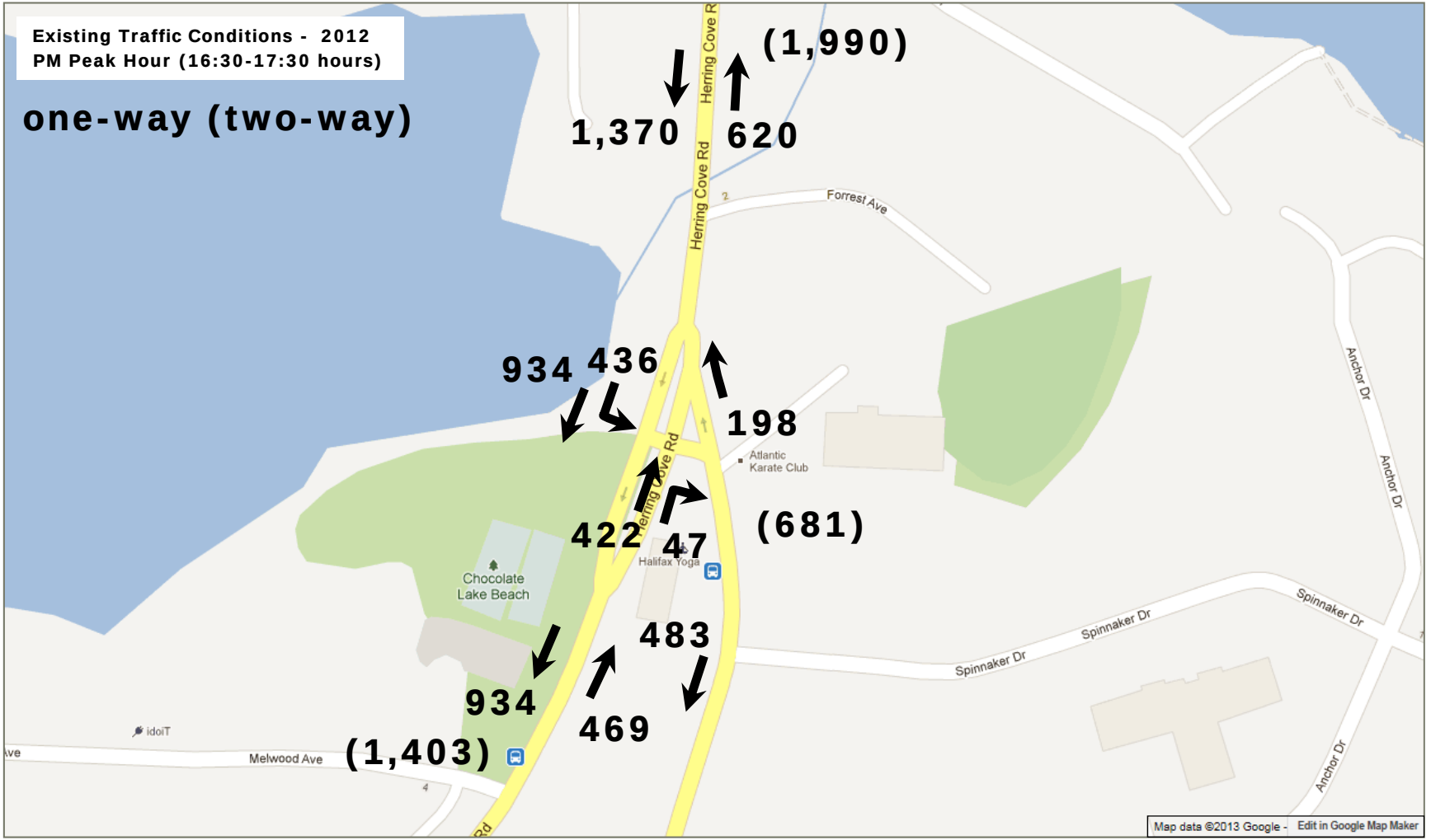


Figure 3.1b - Herring Cove Road/Purcell's Cove Road Intersection (2012 PM Peak Hour)

intersection (on the east side of the road) and another stop within 150 metres to the south of the intersection (on the west side of the road).

3.2 Expected Future Conditions

Through discussions with HRM, CBCL Limited were advised to use 0.5% growth per year as the background traffic growth in the area. Two horizon years were analysed due to the fact that the proposed Clayton development is anticipated to be constructed in two phases. The first phase of the development includes the construction of 600 dwellings, and, for the purposes of this study, has been assumed to be completed by 2018. The second phase of the development includes a further 600 dwellings, assumed to be completed by 2023. This brings the total number of dwellings on the proposed development site to 1,200.

For the purposes of the traffic analyses, it was assumed that 95% of the trips generated by the 600 dwellings during the AM peak hour in the year 2018 would turn left on to Purcell's Cove Road and head towards the Herring Cove Road / Purcell's Cove Road intersection, with all of those trips then turning right towards the Armdale Roundabout. The remaining 5% of generated trips were assumed to turn right on to Purcell's Cove Road for closer, local destinations. The reverse pattern was assumed for the return trips during the PM peak hour.

By the year 2023 when all 1,200 dwellings would be constructed, it was assumed that 83% of the trips generated by the dwellings during the AM peak hour would turn left on to Purcell's Cove Road and head towards the Herring Cove Road / Purcell's Cove Road intersection, with all of those trips turning right towards the Armdale Roundabout. A further 10% of generated trips would use a new link road constructed to connect the new fully developed site to access Herring Cove Road, relieving some of the pressure on Purcell's Cove Road. The remaining 7% of generated trips were assumed to turn right on to Purcell's Cove Road for closer, local destinations. These assumptions were made based on the current unsignalized configuration at the Herring Cove Road / Purcell's Cove Road intersection.

Figures 3.2a and 3.2b show the estimated turning movements at the Herring Cove Road / Purcell's Cove Road intersection during the AM and PM peak hours in the 2018 horizon year. Figures 3.3a and 3.3b show the estimated turning movements at the intersection during the AM and PM peak hours in the 2023 horizon year.

3.3 Traffic Performance Indicators

Level of Service (LOS) is the key indicator of intersection performance with respect to traffic movement, and is defined by the average amount of delay experienced by motorists using each of the various intersection movements. Higher delays result in increased driver discomfort, fuel consumption, and travel time. LOS gives an indication of speed, travel time, traffic interruptions, traffic flow, comfort, and convenience, and is expressed on a scale from level 'A' to level 'F'. LOS A represents conditions approaching free-flow, while LOS F represents a level of delay generally unacceptable to drivers, where traffic demand usually exceeds available capacity. A LOS D is generally found to be the minimum accepted level of service during peak periods and has been used for this study. The criteria associated

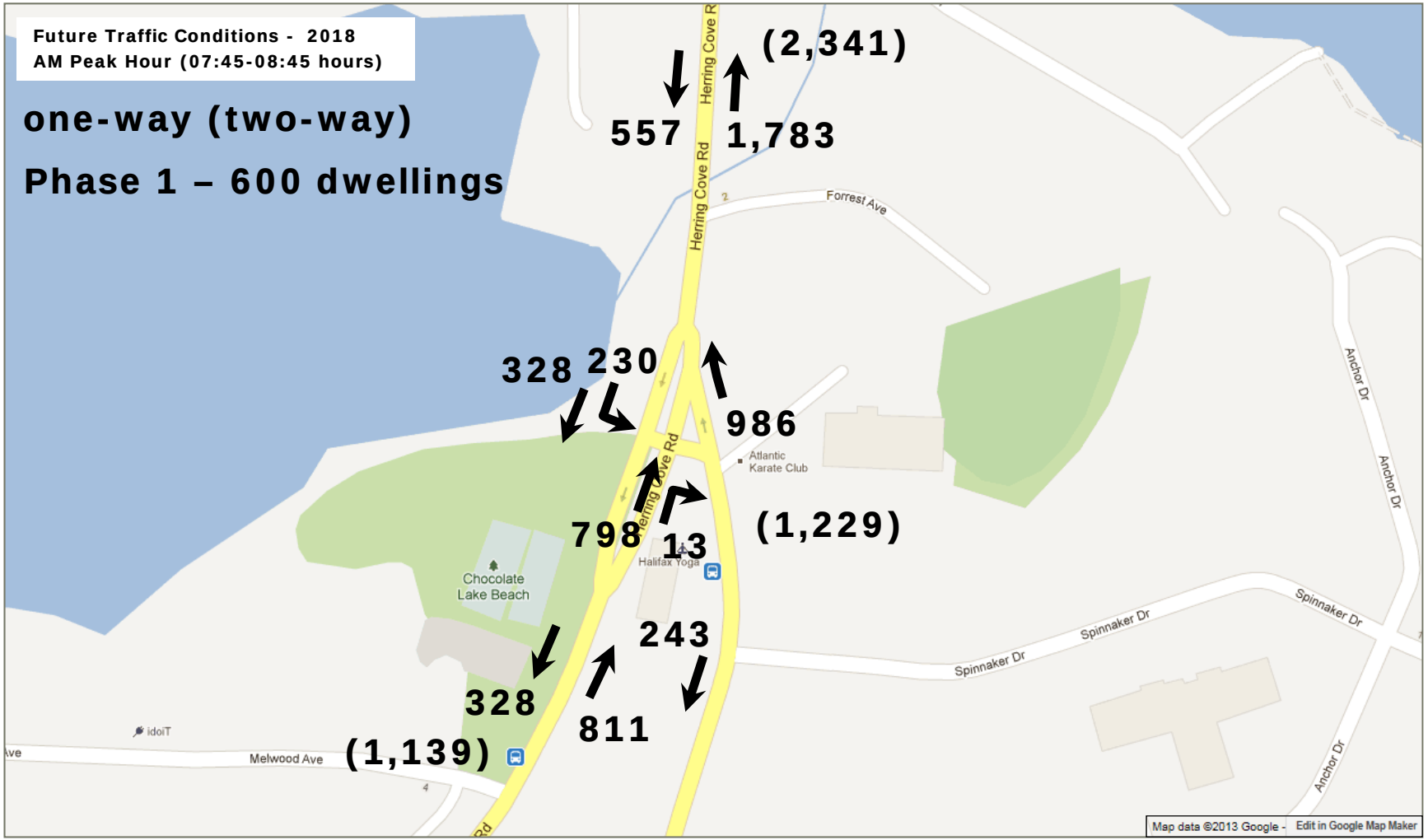


Figure 3.2a - Herring Cove Road/Purcell's Cove Road Intersection (2018 AM Peak Hour)

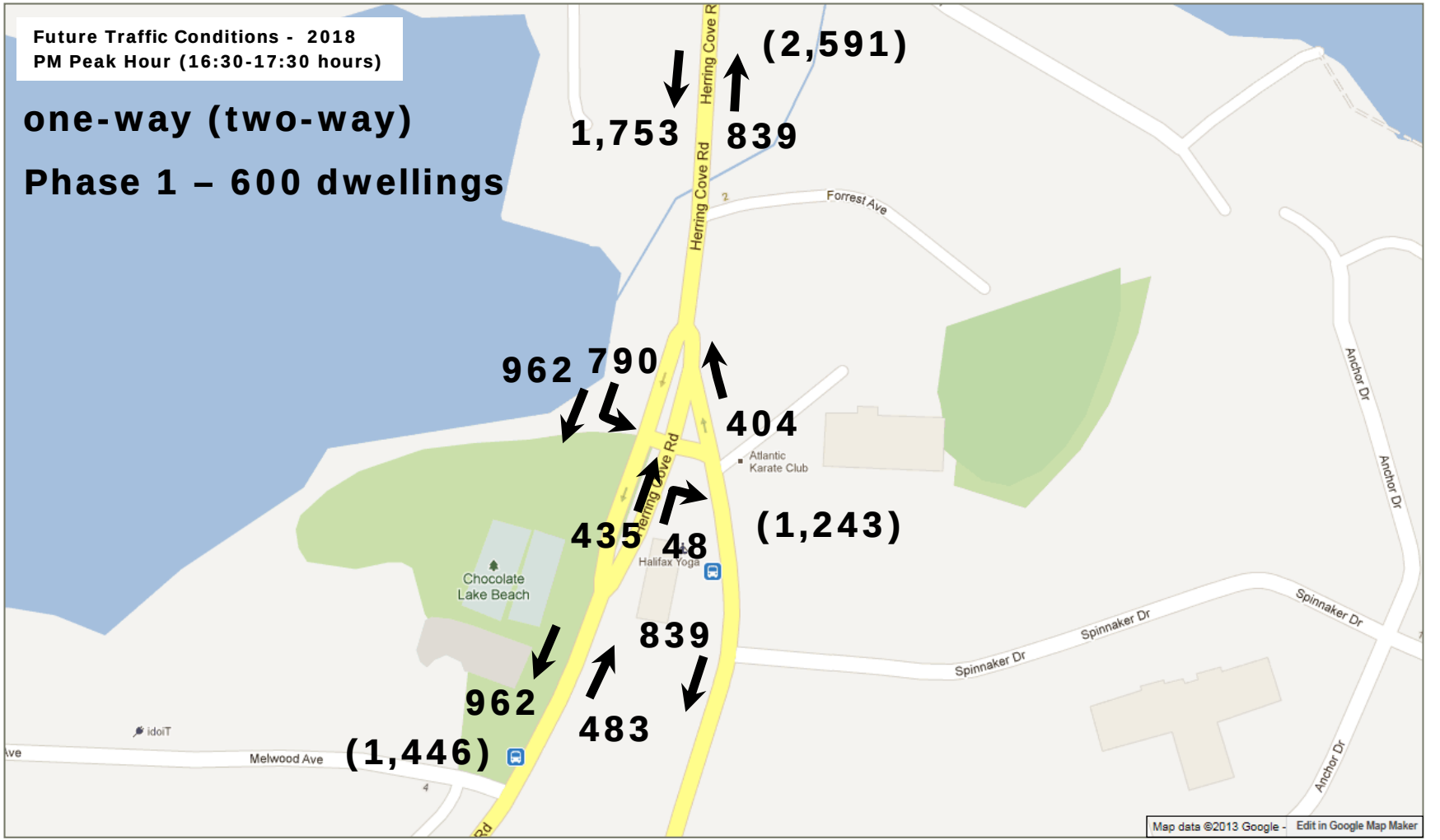


Figure 3.2b - Herring Cove Road/Purcell's Cove Road Intersection (2018 PM Peak Hour)

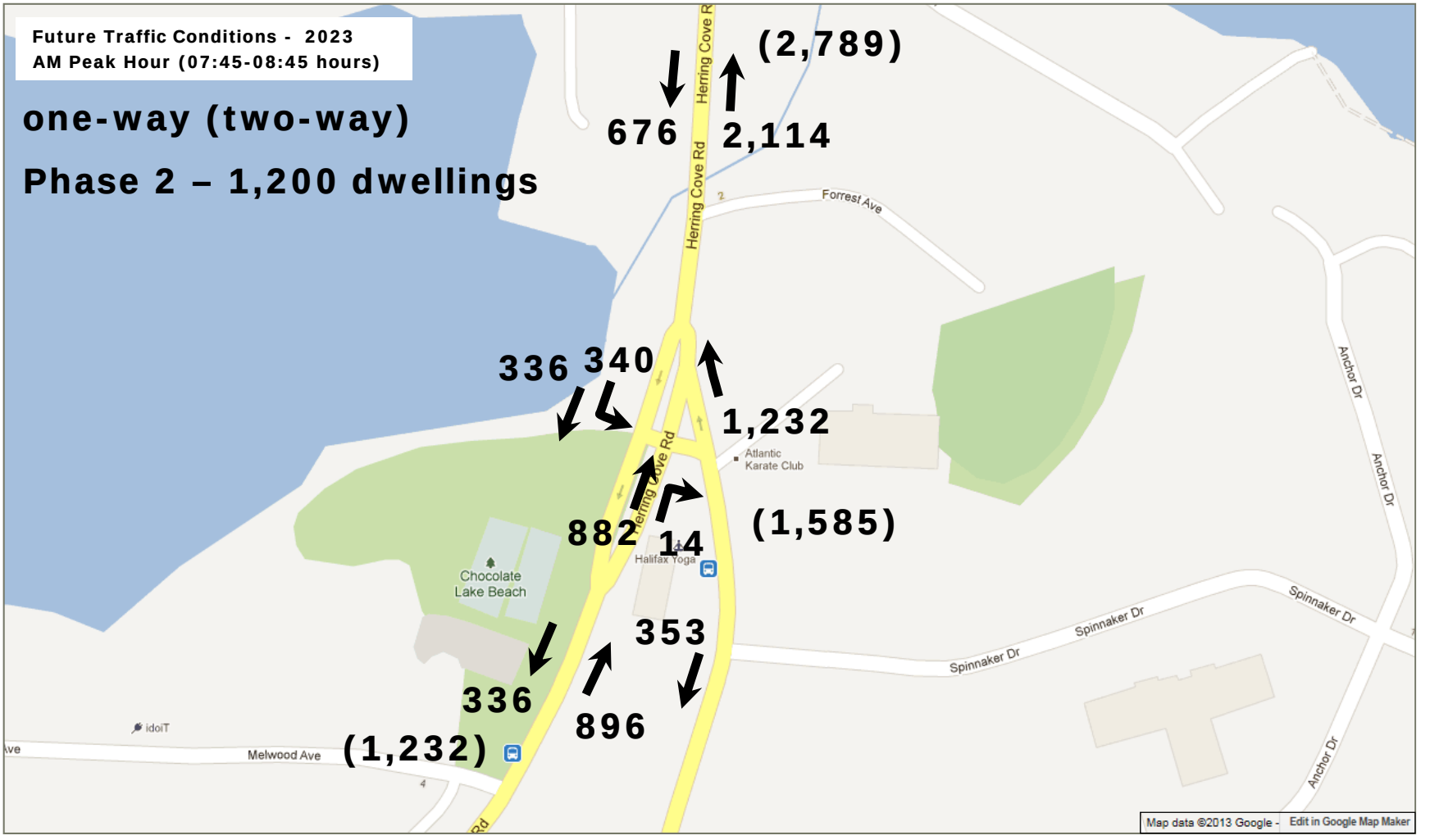


Figure 3.3a - Herring Cove Road/Purcell's Cove Road Intersection (2023 AM Peak Hour)

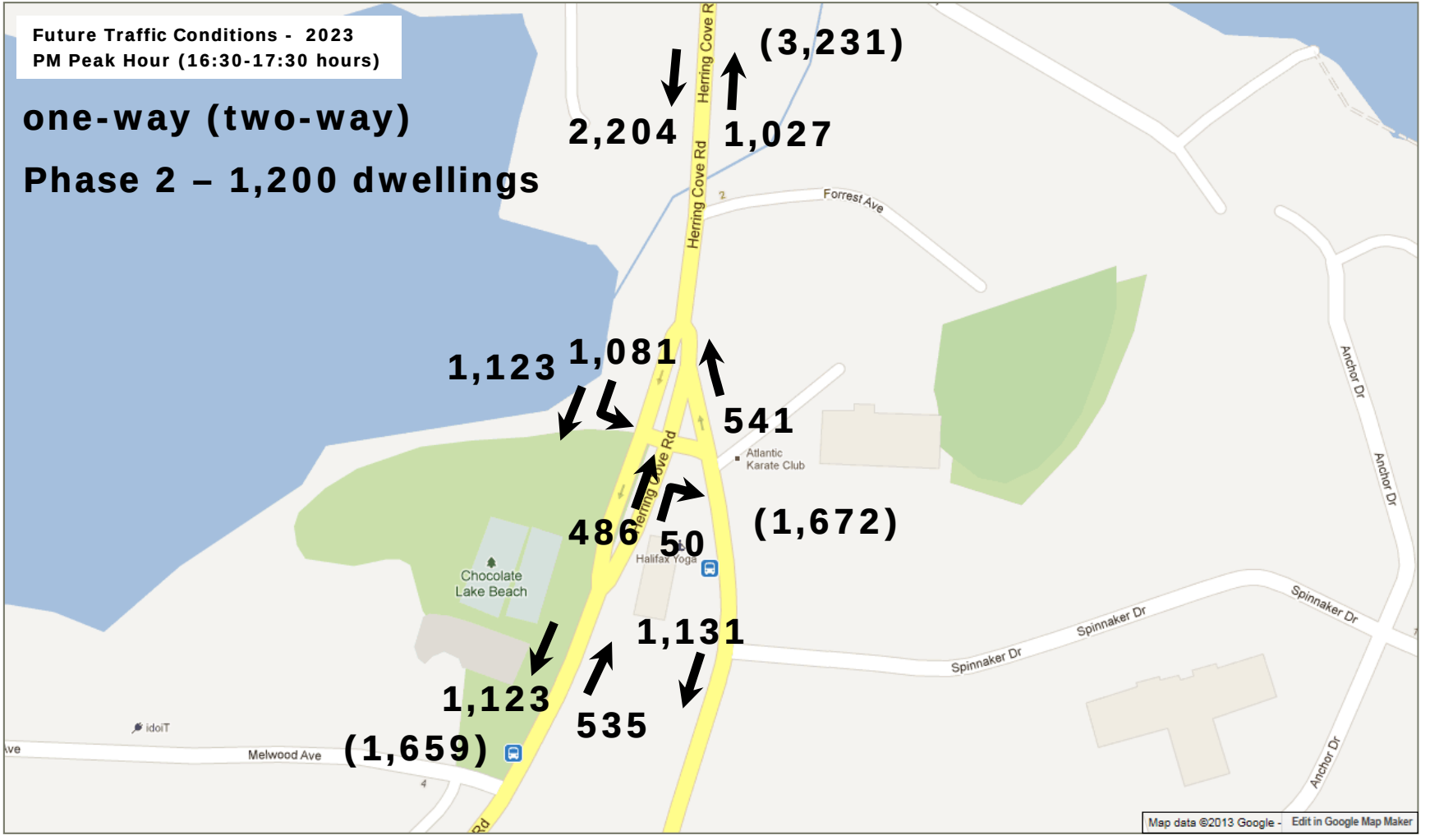


Figure 3.3b - Herring Cove Road/Purcell's Cove Road Intersection (2023 PM Peak Hour)

with each LOS are found in Table 3.1 below. As shown in the table, the delays listed for signalized intersections are higher than for the same level of service at unsignalized intersections. This is because motorists are typically more tolerant of extended delays at signalized intersections.

Table 3.1: Level of Service (LOS) Criteria for Signalized and Unsignalized Intersections

Level of Service (LOS)	Average Delay per Vehicle (sec)	
	Signalized	Unsignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

In addition to LOS, the Volume-to-Capacity (V/C) ratio is a key indicator of intersection performance. The V/C ratio is the relationship between estimated traffic volumes and the maximum theoretical capacity of an intersection or traffic movement. As the V/C ratio approaches 1.0, the intersection has less ability to accommodate additional traffic. Adjustments to intersection geometry or traffic control can be implemented to increase capacity and therefore reduce the V/C ratio. For the purpose of this study, a V/C ratio of 0.90 or less is considered acceptable.

3.4 Traffic Analysis

3.4.1 Herring Cove Road / Purcell's Cove Road Intersection

Using the existing peak hour traffic volumes, *Synchro* traffic signal software (Version 8.0) was used to perform a Level of Service (LOS) analysis of the Herring Cove Road / Purcell's Cove Road intersection for the weekday AM and PM peak hours. The protocols for such an analysis are outlined in the Highway Capacity Manual, 2010 Edition, which is published by the Transportation Research Board (TRB). Synchro was also used to estimate the intersection V/C ratio and typical queue lengths for each intersection lane group at the intersection during peak AM and PM periods.

Table 3.2 summarizes the results of the Synchro LOS analysis for the Herring Cove Road / Purcell's Cove Road intersection for 2012 existing traffic conditions, as well as expected future conditions.

Table 3.2: Summary of Estimated Herring Cove Rd/Purcell's Cove Rd Intersection Analysis

Intersection Movement	AM Peak Hour				PM Peak Hour			
	V/C Ratio	Average Delay (sec)	Average Queue Length (m)	LOS	V/C Ratio	Average Delay (sec)	Average Queue Length (m)	LOS
Existing (2012) Traffic Conditions								
PCR/HCR N/b Right	2.48	704.0	~400	F	0.54	20.2	~22	C
HCR/PCR S/b Left	0.17	10.8	~4	B	0.47	11.6	~18	B
Estimated 2018 Traffic Conditions (600 dwellings)								
PCR/HCR N/b Right	3.87	1,326.7	~712	F	0.97	49.7	~70	E
HCR/PCR S/b Left	0.35	12.4	~11	B	0.87	26.7	~79	D
Estimated 2023 Traffic Conditions (1,200 dwellings)								
PCR/HCR N/b Right	5.54	2,081.1	~971	F	1.32	183.5	~180	F
HCR/PCR S/b Left	0.56	16.7	~23	C	1.25	138.1	~277	F

Legend:
PCR/HCR N/b Right – Purcell's Cove Road Northbound Right Turn on to Herring Cove Road
HCR/PCR S/b Left – Herring Cove Road Southbound Left Turn on to Purcell's Cove Road

As can be seen in Table 3.2, the Herring Cove Road / Purcell's Cove Road intersection is already over capacity during the AM peak hour for traffic turning right from Purcell's Cove Road on to Herring Cove Road towards Armdale Roundabout and into the city, with queues of approximately 400 meters and a delay of 704 seconds which equates to 11.7 minutes. Level of service is very poor on this approach at LOS F. The left turn movement from Herring Cove Road on to Purcell's Cove Road, away from the city, currently experiences no problems with a queue length of 4 meters and a delay of 10.8 seconds.

Conditions at the intersection during the PM peak hour in 2013 are well within current operating capacity as the majority of vehicles are leaving the city in the evening. Turning vehicles from Purcell's Cove Road experience a delay of 20 seconds, a queue length of approximately 22 meters, with a LOS of C. Left turning traffic from Herring Cove Road on to Purcell's Cove Road also experiences a slight delay of 11.6 seconds, a queue length of approximately 18 meters and currently operates with a LOS of B.

During the first phase of the proposed development construction, by the year 2018, where it is anticipated that trips generated by the first 600 dwellings wish to pass through the intersection, conditions at the intersection will deteriorate even more during the AM peak hour. The right turn movement from Purcell's Cove Road would be the worst affected approach and would be anticipated to

operate with over 1,300 seconds of delay, which equates to over 700 meters of queue length and a LOS of F. Similarly during the PM peak hour, conditions for the same approach have reduced from a LOS C to a LOS E. As can be expected, without any mitigation measures at the intersection, the level of service in 2023 will be significantly worse with the addition of the generated trips from a further 600 dwellings passing through the intersection. It should also be noted that operating conditions for the southbound left turn from Herring Cove Road on to Purcell's Cove Road would be affected during the PM peak hour in 2023, meaning that the queuing vehicles could potentially extend back along Herring Cove Road and almost reach the Armdale Roundabout, with an average queue length of 277 meters.

Figures 3.4a, 3.4b and 3.4c illustrate the queue lengths, time delays and level of service during the AM peak hour for the existing 2012 traffic movements, the 2018 traffic movements including the first phase of the development, and the 2023 traffic movements including the full build out of the development with 1,200 dwellings respectively.

If the proposed development were to proceed without any improvements or mitigation measures being carried out at the Herring Cove Road / Purcell's Cove Road intersection, the currently poor operating conditions for traffic would become further exacerbated to the point where delays would become unacceptable to drivers. In context, the time delays experienced by drivers' during the 2023 AM peak hour would be almost 35 minutes, with a queue length of approximately 970 meters extending along Purcell's Cove Road.

3.4.2 Armdale Roundabout

Analysis of the Armdale Roundabout was undertaken by Ourston Roundabout Engineering using the industry standard computer modelling software for roundabouts, *Arcady*. As current operating conditions at the Armdale Roundabout are generally considered to be working well, and the roundabout design includes some additional capacity for future traffic growth, Ourston only considered the most heavily trafficked scenario during the horizon year 2023.

From their analysis of the Armdale Roundabout, it was concluded that during the 2023 horizon year, there could be moderate delay and queuing possible on St. Margaret's Bay Road (for traffic heading east) during the AM peak hour. Moderate delays are also possible on Joseph Howe Drive (for traffic heading east) during the PM peak hour.

As there is uncertainty regarding traffic volumes and operating conditions so far in the future, a range of potential results from the Arcady modelling was output to provide an upper and lower estimate of potential residual capacity at Armdale Roundabout. This was achieved by using a feature in the Arcady software called the 'y-intercept'. This is a parameter of the capacity model where, to err on the side of caution, a lower value of capacity is used for the same traffic conditions. The value of 90% is often used for design checks as a more conservative estimate of residual capacity obtained using this method.

Tables 3.3 a to 3.3d set out the results of the Arcady analysis (for traffic heading towards the roundabout) during the 2023 AM and PM peak hours, and the associated residual capacity based on a y-intercept of 100% or 90%.

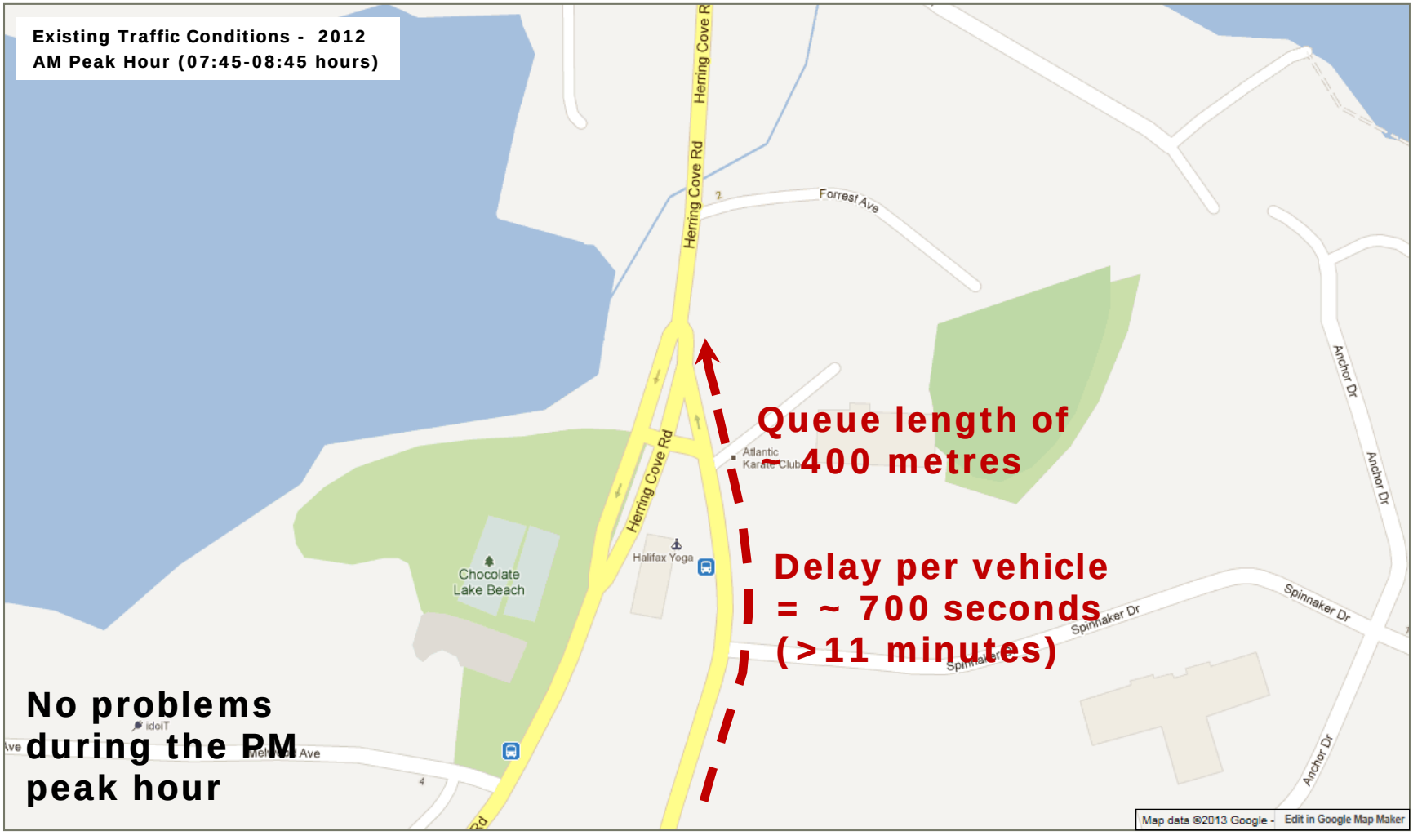


Figure 3.4a - Herring Cove Road/Purcell's Cove Road Intersection (2012 AM Peak Hour)

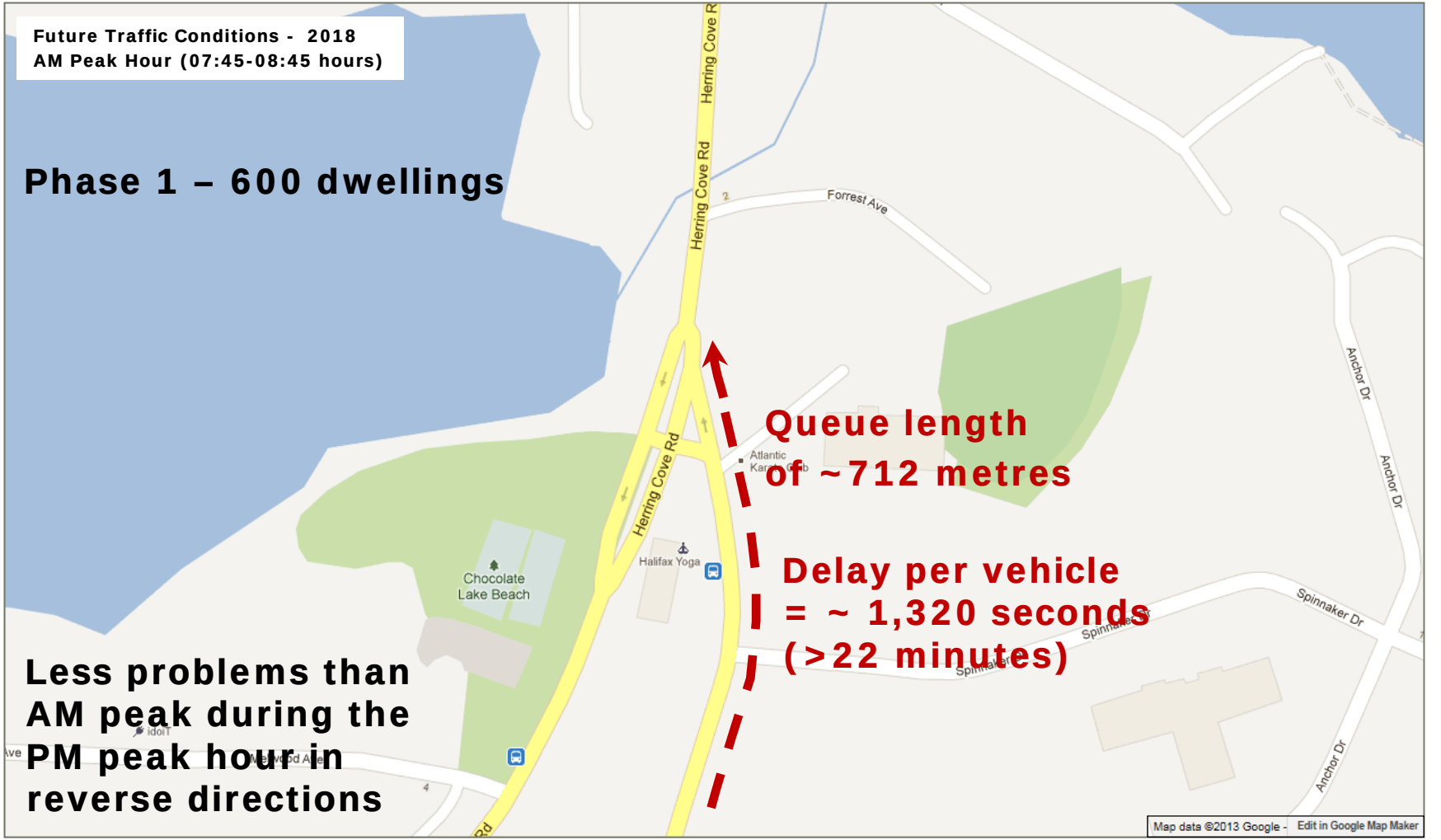


Figure 3.4b - Herring Cove Road/Purcell's Cove Road Intersection (2018 AM Peak Hour)

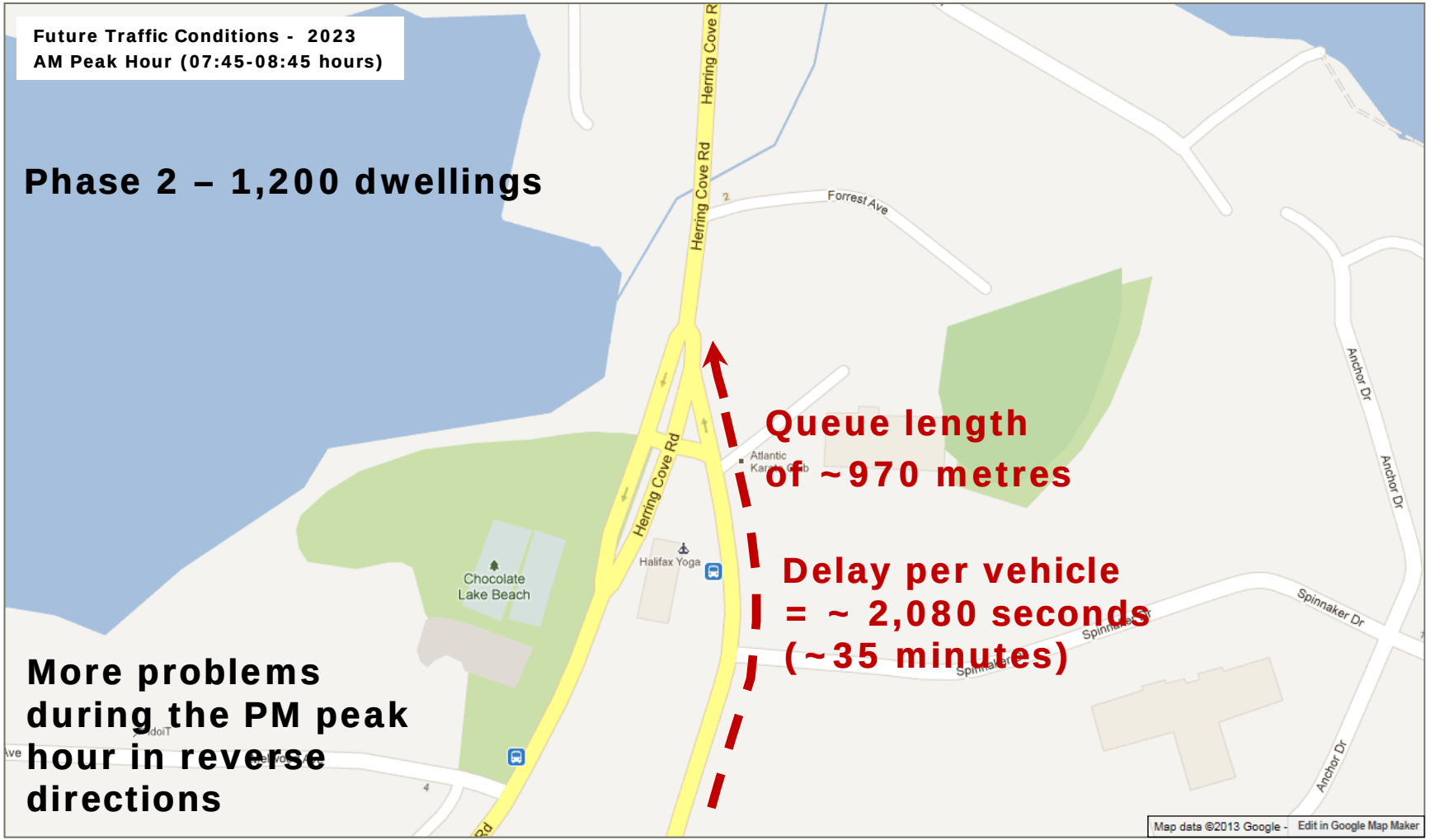


Figure 3.4c - Herring Cove Road/Purcell's Cove Road Intersection (2023 AM Peak Hour)

Table 3.3a: Summary of Arcady Analysis for 2023 AM Peak Hour

y-intercept = 100%							
	Delay (s)	LOS	Queue (m)	V/C Ratio	Overall Delay	Overall LOS	Residual Capacity
Chebucto Rd	2	A	< 20	0.24	6	A	15% (St Margaret's Bay Rd)
Joseph Howe Dr	3	A	< 20	0.32			
St. Margaret's Bay Rd	10	A	< 20	0.79			
Herring Cove Rd	6	A	< 20	0.57			
Quinpool Rd	2	A	< 20	0.23			

Table 3.3b: Summary of Arcady Analysis for 2023 AM Peak Hour

y-intercept = 90%							
	Delay (s)	LOS	Queue (m)	V/C Ratio	Overall Delay	Overall LOS	Residual Capacity
Chebucto Rd	3	A	< 20	0.27	11	B	3% (St Margaret's Bay Rd)
Joseph Howe Dr	3	A	< 20	0.36			
St. Margaret's Bay Rd	24	C	144	0.91			
Herring Cove Rd	9	A	< 20	0.68			
Quinpool Rd	3	A	50	0.27			

Table 3.3c: Summary of Arcady Analysis for 2023 PM Peak Hour

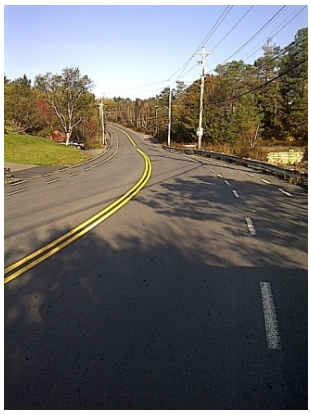
y-intercept = 100%							
	Delay (s)	LOS	Queue (m)	V/C Ratio	Overall Delay	Overall LOS	Residual Capacity
Chebucto Rd	6	A	< 20	0.65	5	A	12% (Joseph Howe Dr)
Joseph Howe Dr	10	B	< 20	0.55			
St. Margaret's Bay Rd	5	A	< 20	0.41			
Herring Cove Rd	4	A	< 20	0.45			
Quinpool Rd	5	A	< 20	0.72			

Table 3.3d: Summary of Arcady Analysis for 2023 PM Peak Hour

y-intercept = 90%							
	Delay (s)	LOS	Queue (m)	V/C Ratio	Overall Delay	Overall LOS	Residual Capacity
Chebucto Rd	11	B	< 20	0.78	11	B	0% (Joseph Howe Dr)
Joseph Howe Dr	32	D	42	0.79			
St. Margaret's Bay Rd	8	A	< 20	0.50			
Herring Cove Rd	5	A	< 20	0.51			
Quinpool Rd	9	A	35	0.82			

CHAPTER 4 CENTRAL SERVICING ANALYSIS

4.1 General Study Area Description



Purcell's Cove Road – Area 1

The developed area under study typically consists of paved surfaced roads (with gravel shoulders) with some of the private roads comprised of gravel surfaces. Within Area 1, the travelled way of Purcell's Cove Road is typically wider than that of Area 2 to accommodate bicycle lanes on each side of the roadway. The roadways throughout the study generally use ditches and culverts for storm drainage control. In addition, many of the houses on the east side of Purcell's Cove Road (between the Northwest Arm shoreline and Purcell's Cove Road) are significantly lower than Purcell's Cove Road itself. This presents central sewer servicing challenges, as sewage pumping will typically be required to convey sanitary sewage from these areas back to trunk sewage collection system infrastructure. Furthermore, low lying areas may be subject to high water pressures and, in some cases, will require local water pressure reduction. Oceanview Drive rises sharply to the south off Purcell's Cove Road, and such a rise in elevation must also be considered with respect to providing adequate water pressures at the upper ends of the street.

Battery Drive – Area 2

The topography of Purcell's Cove Road itself is generally rolling in nature with a number of high and low spots. The nature of this terrain also presents challenges with respect to central water and sewer trunk servicing, and requires special consideration in developing potential servicing options. In particular, sewage pumping stations will typically be required at low spots to collect gravity sewage flows and convey the related sewage by forcemain piping to the downstream gravity sewer system. Low areas along Purcell's Cove Road may also require localized water pressure reduction in order to maintain water pressures within the limits of acceptable standards. High spots, on the other hand, may necessitate that air release measures be incorporated along the trunk watermain.

The undeveloped lands to the south of Purcell's Cove Road typically consist of forested areas. Mapping of these lands depicting general surface and topographic features (including waterbodies, watercourse,

protected areas, etc.) is contained in Appendix A. Significant waterbodies contained within these lands include Williams Lake, Colpitt Lake and Purcell's Pond. The topography of the area generally rises in elevation from Purcell's Cove Road to a high point of land generally in line with the south end of Oceanview Drive.

The general geology of the study area is depicted in Figure 4.1.

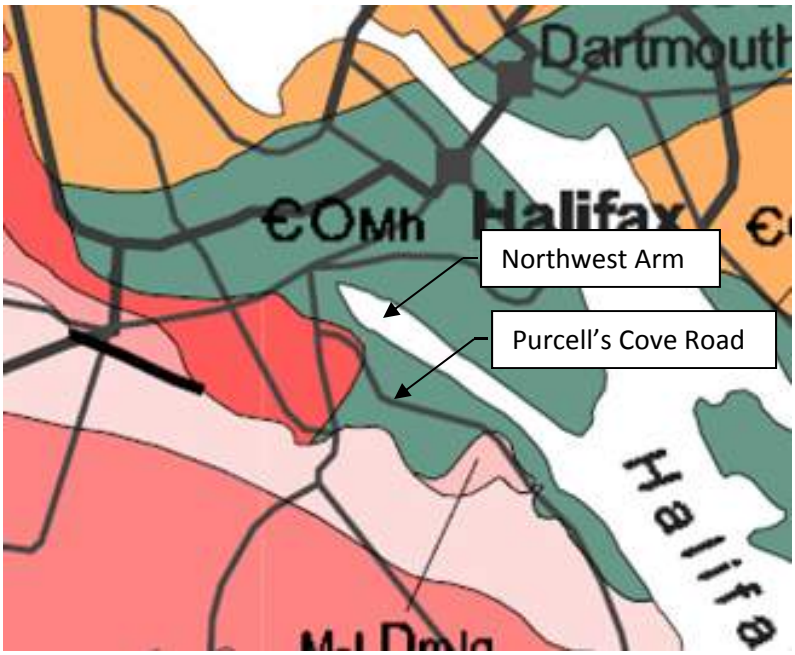


Figure 4.1: General Geology of Study Area

The areas depicted in red and pink in Figure 4.1 are typically underlain by granites. The areas noted in green are underlain by the "Halifax Formation", which consist of slates. Generally, these geological rock features are encountered close to the existing ground surface, either as boulders or ledge rock. Many of these features are visible as rock outcrops and/or boulders throughout the study area. From a central servicing perspective, this geology must be considered when developing related construction cost estimates. Specifically, costs for rock excavation must be factored into any overall central servicing construction cost estimates. In addition, the slates associated with the "Halifax Formation" are typically acid bearing. As such, any excavation of the slates would likely need to abide by the Nova Scotia Sulphide Bearing Materials Disposal Regulations. Costs associated with such materials handling must also be included in any central servicing construction cost estimates.

4.2 Existing Central Services

Existing central water and sewer services along Purcell's Cove Road currently terminate at Wenlock Grove (see Figure 4.2).

AREA 1

AREA 2

Existing 400mm Diameter Watermain

Existing Wenlock Grove Pump Station

Existing Williams Lake PRV

Existing 750mm Diameter Watermain

Existing Williams Lake Pump Station

Existing McIntosh Run Trench Sewer

Existing Roaches Pond PS & Storage Facility

- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

CBCL LIMITED
Consulting Engineers

Purcell's Cove Road Servicing Study

FIGURE **4.2** EXISTING WATER AND SEWER SERVICES

Drawn: BM	Date: 31/05/2013
Checked:	CBCL Project # 121006.00
Approved:	Scale 1:15,000 @ 11"x17"

Data Sources:
NSGC 1:10,000 Topo
NSDNR

Map Parameters:
Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

4.2.1 Existing Water Service

With respect to central water servicing, the existing service zone upstream of Wenlock Grove is provided water service by the "Spryfield Intermediate Zone". This area "floats" off the Cowie Reservoir, which has a hydraulic grade line (i.e. water surface elevation) that ranges from 109.7 to 112.2m geodetic. This entire zone is fed from the reservoir predominantly via 900mm and 750mm diameter trunk watermains. A 400mm diameter trunk watermain is installed on Purcell's Cove Road from Wenlock Grove to Litchfield Crescent. An existing pressure reducing valve (PRV) is located on Williams Lake Road near the intersection with Purcell's Cove Road. A 400mm diameter stub is situated on the high side of this PRV. This stub was installed to eventually provide a connection to the existing 400mm diameter watermain in Purcell's Cove Road, in that event that central water services were ever extended beyond Wenlock Grove. Halifax Water (HW) records indicate that there is very little pressure drop from the reservoir to the Williams Lake Road PRV under normal and peak domestic demand conditions. Even under fire flow conditions of 1500 Imperial Gallons per Minute (Igpm) there is reportedly less than 5 psi of pressure loss.

4.2.2 Existing Sanitary Sewer Service

The local sanitary sewer system at Wenlock Grove consists of 250mm diameter gravity piping that discharges to a small pumping station on Wenlock Grove. The capacity of this station is very small and is only intended to provide local service to a relatively small number of homes on Wenlock Grove and Purcell's Cove Road. Sewage from the station is conveyed via dual 100mm diameter forcemains to a discharge point at an easement that leads to Litchfield Crescent. Sewage is then conveyed by gravity via a series of 250mm, 375mm and 450mm diameter sewers along Litchfield Crescent, Wyndrock Drive and Williams Lake Road that. These pipes eventually discharge to the Williams Lake Sewage Pumping Station on Williams Lake Road. The capacity of this station is reported to be 5,800 Igpm. However, due to downstream sewer capacity constraints the station's capacity is limited to 3,300 Igpm.

Sewage flow from the Williams Lake Pumping Station is discharged to the McIntosh Run trunk sanitary sewer. This sewer collects sewage flows from a large sewershed comprised of the Williams Lake area, as well as significant portions of Spryfield, and transports the sewage to the Roaches Pond Sewage Pumping Station located off Princeton Avenue. This pumping station is also limited by downstream sewer system capacity constraints. As such, two sewage storage facilities have been constructed at the pumping station. These facilities provide a means of storing and attenuating wet weather peak flows into the pumping station, thereby reducing overflows from the station. The total volume of these storage facilities is approximately 5,200 cubic meters (m^3). Sewage from the Roaches Pond pumping station is directed to the Herring Cove trunk sewer system, and eventually makes its way to the Herring Cove wastewater treatment facility.

4.3 Design Parameters

The hydraulic analysis and assessment of the infrastructure elements required for any proposed extension of central water and sanitary sewer service to the Purcell's Cove area must be carried out considering a number of design parameters. These parameters are used during the feasibility assessment and concept design process to identify, size and estimate construction costs of appropriate infrastructure components. The relevant design parameters used for this project are based on Halifax

Water's *Design and Construction Specifications*(as amended from time to time), and are summarized as follows:

Central Water System

- Water Distribution systems shall be designed to accommodate the greater of maximum daily demand plus fire flow demand, or maximum hourly demand;
- Water distribution systems shall be designed to accommodate the following domestic water demands:
  - Average daily demand: 410 Litres per capita per day (L/c/d);
  - Maximum daily demand: 680 L/c/d; and
  - Maximum hourly demand: 1025 L/c/d.
- Fire flow demand shall be established by the Engineer in accordance with the latest requirements contained in the publication "Water Supply for Public Fire Protection, a Guide to Recommended Practice", as prepared by the Fire Underwriter's Survey-Insurers Advisory Organization. For the purposes of this study, a fire flow demand 4,500 L/min has been used;
- Minimum Acceptable Design Water Pressures:
  - 40 psi (275 kPa) measured at the main at all points in the distribution system during Maximum Hourly Demand; and
  - 22 psi (150 kPa) at all points in the distribution systems during Maximum Daily Demand plus Fire Flow Conditions.
- Maximum Acceptable Design Water Pressure in the Distribution System: 90 psi (620 kPa);
- Maximum Acceptable Design Water Pipeline Velocities:
  - 1.5 m/s (5 ft/s) during Maximum Hourly Demand; and
  - 2.4 m/s (8 ft/s) during Fire Flows.
- Minimum Pipeline Diameter:
  - Local Distribution Mains: 200mm; and
  - Main Feeder: 300mm.
- Maximum Hydrant Spacing: 150m;
- Maximum Main Line Valve Spacing: 250m;
- Watermains must be located a minimum of 3m horizontal distance from parallel sewage forcemains, and must be installed in a separate trench;
- Minimum Service Lateral Diameter: 20mm;
- A single water service lateral shall be installed to each existing lot or potential future lot which could be created under the zoning in effect at the time of the water system installation;
- Cowie Hill Reservoir Normal Operating Water Levels:
  - Normal Low Water Level (NLWL) Elevation: 109.7m geodetic; and
  - Normal High Water Level (NHWL) Elevation: 112.2m geodetic.

Central Sanitary Sewer System

- Sanitary sewer systems shall be designed to accommodate the following flows:
  - Average Dry Weather Flow: 330 L/c/d;
  - Peaking Factor: as calculated based on Harmon Formula;
  - Safety Factor to apply to Peak Dry Weather Flow: 1.25; and
  - Long Term Inflow/Infiltration Allowance: 24 cubic meters/gross hectare/day (m^3/ha/d).

- Minimum Gravity Sewer Diameter: 250mm;
- Manning's Roughness Coefficient for Gravity Sewer: 0.010 for PVC pipe (note that for the purposes of this study, it has been assumed that all gravity sewer will be constructed of PVC pipe);
- Minimum Gravity Sewer Pipe Slope: 0.6%;
- Minimum Gravity Sewer Design Flow Velocity: 0.75 meters/second (m/s);
- Minimum Service Lateral Diameter: 125mm;
- A service lateral shall be installed to each existing lot or potential future lot which could be created under the zoning in place at the time of installation of services;
- Maximum Manhole Spacing: 100m;
- Minimum Manhole Diameter: 1050mm;
- Sewage Pumping Stations are to be provided with Dual Forcemains, each capable of handling the peak design flow;
- Minimum Forcemain Diameter: 100mm;
- Minimum Forcemain Design Flow Velocity: 0.60 m/s; and
- Maximum Forcemain Design Flow Velocity: 2.4 m/s.

4.4 System Design Flows

4.4.1 Existing Development

Current development within the Purcell's Cove study area is generally residential in nature. Furthermore, as noted in Section 2.4 above, there are currently 160 lots in Area 1 and 185 lots in Area 2 that could be provided central water and sewer services. For single unit type residential development (which is typical of the study area), Halifax Water Design Standards indicate that central water and sewer systems are to be designed using an assumption that there are 3.35 people/unit. Therefore, the design population for existing residential development in Area 1 and 2 is 536 and 620 respectively.

The Royal Nova Scotia Yacht Squadron (RNSYS) also lies within Area 1. For the purposes of this study, the following assumptions have been made with respect to design flows generated by the RNSYS:

- During the summer sailing season, 600 people use the RNSYS facilities per day;
- Each of these 600 people will have an average water demand and sewage generation rate of 95 L/d while they are at the facility;
- Peak water demand at the RNSYS is related to periods of boat washdown. This demand has been assumed to be 130 L/min; and
- The sewage flow peaking factor at the facility is 4.0.

Based on the above design populations, the RNSYS design assumptions and the design parameters noted in Section 4.3, the estimated design flows for existing development within Areas 1 and 2 are outlined as follows:

Table 4.1: Estimated Design Flows – Existing Development Only

Flow Regime	Calculated Flow
Area 1	
Water System	
Average Day Residential Demand	*220 cubic meters/day (m^3/d)*
Average Day RNSYS Demand	*57 m^3/d*
Total Average Day Demand	277 m^3/d
Maximum Day Demand	421 m^3/d
Peak Hour Residential Demand	*550 m^3/d*
Peak Hour RNSYS Demand	*190 m^3/d*
Total Peak Hour Demand	740 m^3/d
Design Fire Flow	4,500 L/min
Sewage System	
Peak Residential Flow	*19 Litres/second (L/s)*
Peak RNSYS Flow	*2.6 L/s*
Total Peak Flow	21.6 L/s
Area 2	
Water System	
Average Day Demand	255 m^3/d
Maximum Day Demand	420 m^3/d
Peak Hour Demand	635 m^3/d
Design Fire Flow	4,500 L/min
Sewage System	
Peak Flow	19 L/s

4.4.2 Future Development

Any central water and sewer infrastructure that would be required for an extension of services to the Purcell's Cove area must be designed to accommodate current and expected future development within the area. If the proposed infrastructure is not designed to meet expected future flow requirements, unwarranted future construction, operation and maintenance costs may arise to address deficiencies in an inadequately sized system.

Section 2.4 above has identified the future development potential for both Areas 1 and 2. For the purposes of this study, future development potential within the study area has been limited to the following components:

- The subdivision of existing lots if central services are extended to the area, as may be permissible under zoning regulations in effect at the time the services are installed. Under this scenario, it has been determined that an additional 85 lots could be accommodated in Area 1, while an additional 170 lots could be developed in Area 2. This would bring the total number of future residential lots in Area 1 and 2 to 245 and 355 respectively. Using the Halifax Water design standard of 3.35 people/unit, this would equate to a total 820 people in Area 1 and 1,190 people in Area 2; and
- Additional development that could occur on lands subject to rezoning. In order to maintain a conservative approach, an allowance was only provided for those lands of which the study's

Community Steering Committee were informed. The only developer to come forward with development plans was Clayton Developments Limited which presented a proposal for the creation of approximately 1200 new units of housing on PID 00052407 (contained entirely with Area 1). Clayton Developments also indicated that the proposed development would be of relatively low density, averaging 3.0 people/unit. This would equate to an additional 3,600 people within Area. 1.

Based on these estimated future design populations and the design parameters noted in Section 4.3, the estimated design flows for existing plus future development within Areas 1 and 2 are outlined as follows:

Table 4.2: Estimated Design Flows – Existing Plus Future Development

Flow Regime	Calculated Flow
Area 1	
Water System	
Existing Development plus Subdivision Average Day Demand	*390 m^3/d*
Clayton Developments Average Day Demand	*1,475 m^3/d*
Total Average Day Demand	1,865 m^3/d
Existing Development plus Subdivision Maximum Day Demand	*615 m^3/d*
Clayton Developments Maximum Day Demand	*2,445 m^3/d*
Total Maximum Day Demand	3,060 m^3/d
Existing Development plus Subdivision Peak Hour Demand	*1,030 m^3/d*
Clayton Developments Peak Hour Demand	*3,690 m^3/d*
Total Peak Hour Demand	4,720 m^3/d
Design Fire Flow	4,500 L/min
Sewage System	
Existing Development plus Subdivision Peak Flow	*26.8 L/s*
Clayton Development Peak Flow	*84.8 L/s*
Total Peak Flow	111.6 L/s
Area 2	
Water System	
Average Day Demand	485 m^3/d
Maximum Day Demand	805 m^3/d
Peak Hour Demand	1,215 m^3/d
Design Fire Flow	4,500 L/min
Sewage System	
Peak Flow	28.5 L/s

4.5 Central Servicing Concept Design Options

CBCL Limited has developed a number of different servicing concepts to provide central water and sewer service to the Purcell's Cove study area. Each of these options was developed to adequately convey design flows and meet the design objectives and parameters outlined previously in this report. Each of the servicing options developed for Area 1 has also been sufficiently oversized to accommodate

the potential future inclusion of Area 2. The following is a description of the various concept design options that have been developed for this project.

4.5.1 Area 1 Servicing Concepts

A number of different central water and sewer servicing concept options have been developed for Area 1. The infrastructure elements for these options have been sized to accommodate the design flows from existing and expected future development within Area 1 (including the proposed Clayton development). In addition, as per the terms of the study's TOR, each of the servicing options developed for Area 1 have been sufficiently oversized to accommodate the potential future inclusion of Area 2. The related design flows are as noted in Table 4.2.

4.5.1.1 PURCELL'S COVE ROAD OPTION

The proposed servicing concept for this option is depicted in Figure 4.3. This option includes the following new infrastructure elements:

- A 400mm diameter watermain along Purcell's Cove Road from the existing PRV on Williams Lake Road to the existing 400mm diameter watermain on Purcell's Cove Road (approx. length 270m);
- A PRV near the intersection of Wenlock Grove and Purcell's Cove Road;
- A 400mm diameter watermain along Purcell's Cove Road from Wenlock Grove to the RNSYS (approx. length 950m);
- A 350mm diameter watermain along Purcell's Cove Road from the RNSYS to Oceanview Drive (approx. length 810m);
- A 300mm diameter watermain along Oceanview Drive (approx. length 520m);
- 200mm diameter watermains along Boulderwood Road, Halls Road, Melvin Road, and Rocklyn Road (total length approx. 850m);
- 23 fire hydrants;
- 38 main line water valves;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point near the intersection with Oceanview Drive to the low point at the RNSYS (approx. length 810m);
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the low point at the RNSYS (approx. length 500m);
- A trunk sewage pumping station on Purcell's Cove Road at the low point near the RNSYS;
- Dual 300mm diameter trunk sewage forcemains along Purcell's Cove Road from the trunk sewage pumping station at the RNSYS to the high point east of Boulderwood Road (approx. length 530m);
- A 375mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the existing sewage pumping station on Wenlock Grove (approx. length 490m);
- Replacement of the existing Wenlock Grove sewage pumping station with a larger station;
- Replacement of the existing forcemains from the Wenlock Grove sewage pumping station with dual 300mm diameter forcemain (approx. length 190m);
- Replacement of existing sanitary sewers on Wenlock Grove, Litchfield Crescent, and Wyndrock Drive with 375mm diameter gravity sewers (approx. length 910m);
- An upgrade to the existing Williams Lake sewage pumping station;
- 250mm diameter gravity sewers along Boulderwood Road, Halls Road, Melvin Road, Rocklyn Road and Oceanview Drive (total length approx. 1,280m);

AREA 1

AREA 2

- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

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FIGURE **4.3** PURCELL'S COVE RD OPTION

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Datum: North American 1983 CSRS
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Units: Meter

- A local sewage pumping station at the north end of Boulderwood Road;
- Dual 100mm diameter sewage forcemains along Boulderwood Road from the Boulderwood Road pumping station to Purcell's Cove Road (approx. length 290m);
- A local sewage pumping station at the north end of Melvin Road;
- Dual 100mm diameter sewage forcemains along Melvin Road from the Melvin Road pumping station to Purcell's Cove Road (approx. length 190m);
- 52 manholes; and
- Approximately 1,450m of sanitary sewer laterals and water service laterals (from the main pipe to the street fronting property line).

The primary advantage of this option is that it keeps the limits of new public water and sewer infrastructure within the confines of existing road right-of ways. This limits the need to obtain/purchase additional lands and/or easements. It also facilitates operation and maintenance of this infrastructure, as access by Halifax Water works staff would not be restricted. This option would also have minimal impact on the Purcell's Cove Backlands (south of Purcell's Cove Road).

However, the existing sanitary sewer system in the Wenlock Grove/Pinebluff area does not have capacity to adequately convey the peak sewage flows that would be generated by existing and future development within the Purcell's Cove study area. As such, new sanitary sewers would be required along Wenlock Grove, Litchfield Crescent, Wyndrock Drive and a portion of Williams Lake Road. The existing sewage pumping station on Wenlock Grove would also need to be replaced with a much larger facility. In addition, the existing Williams Lake sewage pumping station would need to be upgraded to accommodate the related increase in sewage flows. This upgrade would only be required, however, if the Clayton development were to proceed.

Capital costs notwithstanding, the physical construction of these upgrades would be quite disruptive to the local residents of the Wenlock Grove/Pinebluff area (who do not need these upgrades if the status quo is maintained). The new Wenlock Grove pumping station and the upgraded Williams Lake pumping station would also likely result in increased operation and maintenance requirements and costs.

4.5.1.2 North Backlands Option

The proposed servicing concept for this option is depicted in Figure 4.4. This option includes the following new infrastructure elements:

- The same water system infrastructure as required for the Purcell's Cove Road Option;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point near the intersection with Oceanview Drive to the low point at the RNSYS (approx. length 810m);
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the low point at the RNSYS (approx. length 500m);
- A trunk sewage pumping station on Purcell's Cove Road at the low point near the RNSYS;
- Dual 300mm diameter trunk sewage forcemains across the Purcell's Cove North Backlands from the trunk sewage pumping station at the RNSYS to the north end of Drysdale Road (approx. length 2,600m);
- Replacement of existing sanitary sewers on Drysdale Road (from the north end of Drysdale Road to the McIntosh Run Trunk Sewer) with 375mm diameter gravity sewers (approx. length 290m);

AREA 1

AREA 2

- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

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FIGURE **4.4** NORTH BACKLANDS OPTION

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- An upgrade to the existing Roaches Pond sewage pumping station;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the existing sewage pumping station on Wenlock Grove (approx. length 490m);
- A capacity upgrade of the existing Wenlock Grove sewage pumping station;
- 250mm diameter gravity sewers along Boulderwood Road, Halls Road, Melvin Road, Rocklyn Road and Oceanview Drive (total length approx. 1,280m);
- A local sewage pumping station at the north end of Boulderwood Road;
- Dual 100mm diameter sewage forcemains along Boulderwood Road from the Boulderwood Road pumping station to Purcell's Cove Road (approx. length 290m);
- A local sewage pumping station at the north end of Melvin Road;
- Dual 100mm diameter sewage forcemains along Melvin Road from the Melvin Road pumping station to Purcell's Cove Road (approx. length 190m);
- 45 manholes; and
- Approximately 1,450m of sanitary sewer laterals and water service laterals (from the main pipe to the street fronting property line).

Compared to the Purcell's Cove Road option, the North Backlands option does not require significant sewer system upgrades in the Wenlock Grove/Pinebluff area. As such, it offers much less disruption to those local area residents during construction. This option also contains trunk sewer infrastructure that runs through the Clayton Development property. Should the proposed Clayton development obtain approval to proceed, this may offer some advantages related to negotiation of land/easement acquisition costs, infrastructure cost sharing and potential environmental enhancements along the pipeline route.

Similar to the Purcell's Cove Road option, though, the North Backlands option is also subject to existing sanitary sewer constraints in the downstream system. Specifically, new sewers would be required at the north end of Drysdale Road to accommodate the increased flow from the Purcell's Cove study area. In addition, upgrades would be required at the Roaches Pond sewage pumping station. These upgrades would only be required, however, if the Clayton development were to proceed. Furthermore, any new wastewater flows directed to Roaches Pond may require upgrades to the downstream wastewater collection system along Herring Cove or coordination with the implementation of the proposed regional wastewater infrastructure along Herring Cove Road (in keeping with Halifax Water's Regional Wastewater Functional Plan). This option would also have an impact on the Purcell's Cove Backlands.

4.5.1.3 South Backlands Option

The proposed servicing concept for this option is depicted in Figure 4.5. This option includes the following new infrastructure elements:

- The same water system infrastructure as required for the Purcell's Cove Road Option;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point near the intersection with Oceanview Drive to the low point at the RNSYS (approx. length 810m);
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the low point at the RNSYS (approx. length 500m);
- A trunk sewage pumping station on Purcell's Cove Road at the low point near the RNSYS;

AREA 1

AREA 2

- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

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FIGURE **4.5** SOUTH BACKLANDS OPTION

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- Dual 300mm diameter trunk sewage forcemains from the trunk sewage pumping station at the low point near the RNSYS along Purcell's Cove Road, up Oceanview Drive to the high point on the south Purcell's Cove Backlands (approx. length 2,730m);
- A 375mm diameter gravity sewer from the high point on the south Purcell's Cove Backlands to the Roaches Pond sewage pumping station;
- An upgrade to the existing Roaches Pond sewage pumping station;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the existing sewage pumping station on Wenlock Grove (approx. length 490m);
- A capacity upgrade of the existing Wenlock Grove sewage pumping station;
- 250mm diameter gravity sewers along Boulderwood Road, Halls Road, Melvin Road, Rocklyn Road and Oceanview Drive (total length approx. 1,280m);
- A local sewage pumping station at the north end of Boulderwood Road;
- Dual 100mm diameter sewage forcemains along Boulderwood Road from the Boulderwood Road pumping station to Purcell's Cove Road (approx. length 290m);
- A local sewage pumping station at the north end of Melvin Road;
- Dual 100mm diameter sewage forcemains along Melvin Road from the Melvin Road pumping station to Purcell's Cove Road (approx. length 190m);
- 52 manholes; and
- Approximately 1,450m of sanitary sewer laterals and water service laterals (from the main pipe to the street fronting property line).

The South Backlands Option is very similar to the North Backlands option, with the primary difference being the pipe route location across the Purcell's Cove Backlands. This option would, however, not require replacement of any existing sewers (but an upgrade at the Roaches Pond sewage pumping station would still be needed). Nevertheless, it may be difficult to route the pipeline across the South Backlands without avoiding impacts on nearby wetlands. Furthermore, any new wastewater flows directed to Roaches Pond may require upgrades to the downstream wastewater collection system along Herring Cove or coordination with the implementation of the proposed regional wastewater infrastructure along Herring Cove Road (in keeping with Halifax Water's Regional Wastewater Functional Plan).

4.5.1.4 Wastewater Treatment Facility (WWTF) Option

The proposed servicing concept for this option is depicted in Figure 4.6. This option includes the following new infrastructure elements:

- The same water system infrastructure as required for the Purcell's Cove Road Option;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point near the intersection with Oceanview Drive to the low point at the RNSYS (approx. length 810m);
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the low point at the RNSYS (approx. length 500m);
- A wastewater treatment facility in the vicinity of the low point near the RNSYS;
- A 250mm diameter gravity trunk sewer along Purcell's Cove Road from the high point east of Boulderwood Road to the existing sewage pumping station on Wenlock Grove (approx. length 490m);
- A capacity upgrade of the existing Wenlock Grove sewage pumping station;

AREA 1

AREA 2

Outfall

- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

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FIGURE **4.6** WASTEWATER TREATMENT FACILITY

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- 250mm diameter gravity sewers along Boulderwood Road, Halls Road, Melvin Road, Rocklyn Road and Oceanview Drive (total length approx. 1,280m);
- A local sewage pumping station at the north end of Boulderwood Road;
- Dual 100mm diameter sewage forcemains along Boulderwood Road from the Boulderwood Road pumping station to Purcell's Cove Road (approx. length 290m);
- A local sewage pumping station at the north end of Melvin Road;
- Dual 100mm diameter sewage forcemains along Melvin Road from the Melvin Road pumping station to Purcell's Cove Road (approx. length 190m);
- 42 manholes; and
- Approximately 1,450m of sanitary sewer laterals and water service laterals (from the main pipe to the street fronting property line).

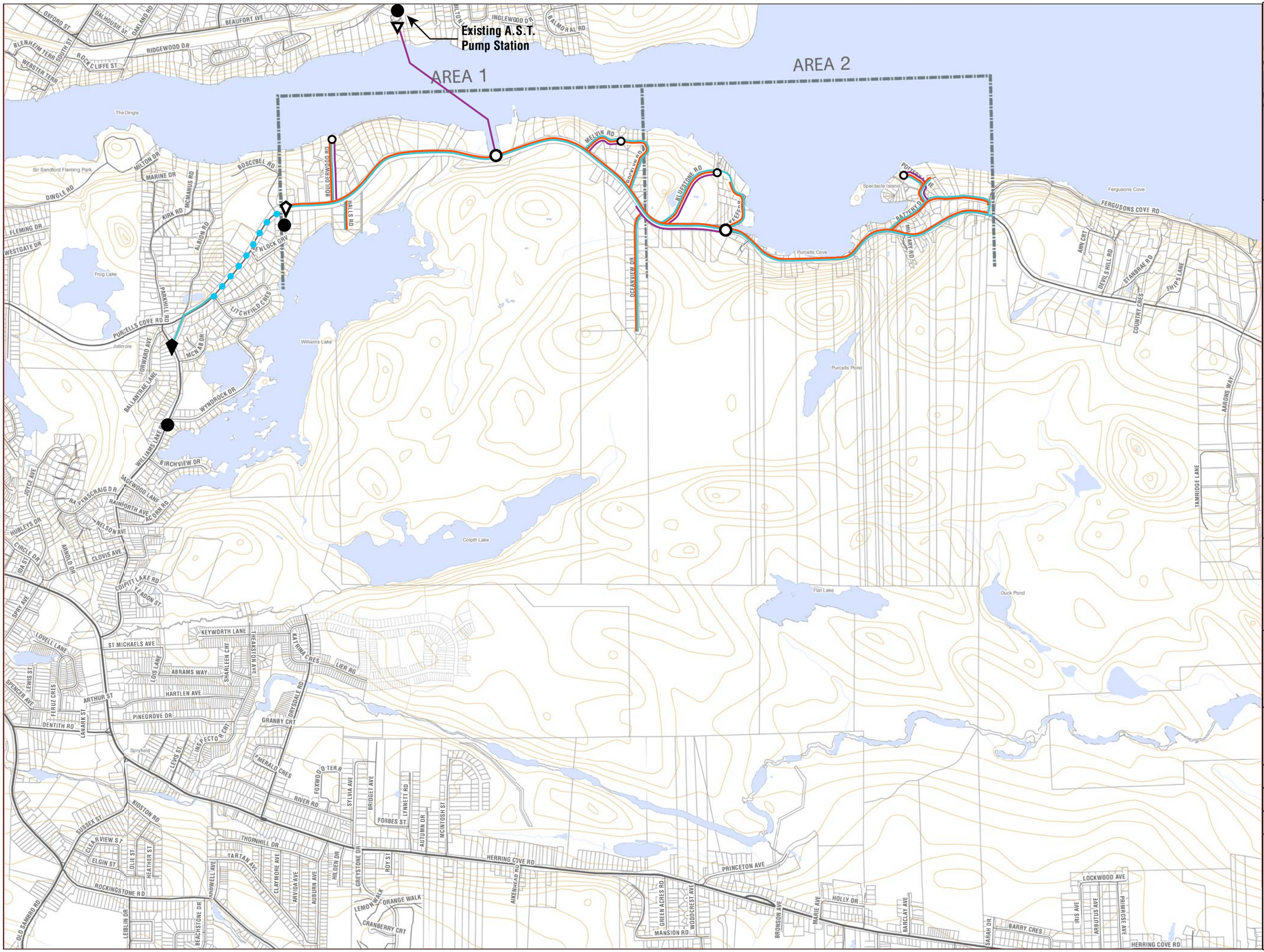
This particular option is feasible from a concept design perspective. However, further detailed study (beyond the scope of work for the current study) needs to be completed to confirm whether, in fact, it is truly viable. In particular, an environmental risk assessment for the treatment facility and related impacts on the effluent receiving water would need to be completed per the requirements of the Canadian Council of the Ministers of the Environment (CCME) and Nova Scotia Environment (NSE). This assessment would consider such items as background receiving quality and recreational uses of the receiving water to determine wastewater effluent quality requirements for any proposed treatment facility. Other studies that would need to be completed would be a treatment process analysis and treatment plant siting study. A further consideration for this option is that is not necessarily in keeping with Halifax Water's recently completed Regional Wastewater Functional Plan.

4.5.1.5 Pump to Atlantic School of Theology (AST) Option

The proposed servicing concept for this option is depicted in Figure 4.7. This option includes the following new infrastructure elements:

- The same water system infrastructure as required for the Purcell's Cove Road Option;
- The same sewer system infrastructure as required for the Wastewater Treatment Facility Option, with the exception that the proposed wastewater treatment plant is replaced with the following:
  - A trunk sewage pumping station in the vicinity of the low point near the RNSYS;
  - Dual 300mm diameter trunk sewage forcemains from the trunk sewage pumping station at the low point near the RNSYS along the bottom of the Northwest Arm to the existing sewage pumping station at the Atlantic School of Theology (AST) (approx. Length 650m); and
  - A sewage storage facility at the existing AST sewage pumping station.

This option is similar to the WWTF option, but rather than constructing a WWTF near the RNSYS a sewage pumping station would be constructed. This station would pump sewage from the study area through dual forcemains that would be laid on the bottom of the Northwest Arm. The sewage would eventually discharge to the existing AST sewage pumping station and ultimately be conveyed to the Halifax WWTF. However, the AST pumping station and downstream sewer infrastructure is currently subject to capacity constraints. Therefore, in order to prevent any increase in overflows from the AST system resulting from addition of sewage flow from the Purcell's Cove area, a new sewage storage facility would be required at the AST pumping station site. This facility would be required if any sewage flow from Purcell's Cove area is directed to the AST pumping station. The storage facility would



- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

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FIGURE **4.7** PUMP TO A.S.T. OPTION

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attenuate peak sewage flows generated by the Purcell's Cove area prior to discharge to the AST pumping station. Further considerations for the option include:

- The forcemain pipes along the bottom of the Northwest Arm may require a "no anchorage" zone; and
- This option is not necessarily in keeping with Halifax Water's recently completed Regional Wastewater Functional Plan.

4.5.2 Area 2 Servicing Concept

The central water and sewer servicing concept developed for Area 2 is depicted in Figure 4.8. The infrastructure elements for this concept have been sized to accommodate the design flows from existing and expected future development within Area 2 (as noted in Table 4.2). The proposed servicing concept includes the following new infrastructure elements:

- A 300mm diameter trunk watermain along Purcell's Cove Road from Oceanview Drive to Fergusons Cove Road (approx. length 1,600m);
- 200mm diameter watermains along Bluestone Road, Keefe Drive, Battery Drive and Pottery Lane (total length approx. 1,430m);
- 17 fire hydrants;
- 38 main line water valves;
- A 250mm diameter trunk gravity sewer along Purcell's Cove Road from Fergusons Cove Road to the low point near Keefe Drive (approx. length 1,260m);
- A 250mm diameter trunk gravity sewer along Purcell's Cove Road from the high point near the intersection with Oceanview Drive to the low point near Keefe Drive (approx. length 310m);
- A trunk sewage pumping station at the intersection of Purcell's Cove Road and Keefe Drive;
- Dual 150mm diameter trunk sewage forcemains along Purcell's Cove Road from the trunk sewage pumping station at Purcell's Cove Road/Keefe Drive to the high point near the intersection with Oceanview Drive (approx. length 340m);
- 250mm diameter gravity sewers along Bluestone Road, Keefe Drive, Battery Drive and Pottery lane (total length approx. 1,300m);
- A local sewage pumping station at the north end of Bluestone Road;
- Dual 100mm diameter sewage forcemains along Bluestone Road from the Bluestone Road pumping station to Purcell's Cove Road (approx. length 290m);
- A local sewage pumping station at the north end of Pottery Lane;
- Dual 100mm diameter sewage forcemains along Pottery Lane from the Pottery Lane pumping station to Battery Drive (approx. length 100m);
- 43 manholes; and
- Approximately 2,050m of sanitary sewer laterals and water service laterals (from the main pipe to the street fronting property line).

4.5.3 Alternative Central Servicing Systems

There are really no central servicing alternative systems with respect to the provision of central water service to the study area. Nonetheless, non-central service alternative water servicing schemes could perhaps involve private on-site type systems, such as private wells, cisterns, etc. Evaluation of these systems, however, is outside the scope of the current study.

AREA 2

- Force Main
- Water
- Sewer
- Sewage Pump Station
- Sewage Storage
- Pressure Reducing Valve
- Waste Water Treatment Facility
- Existing Sewage Pump Station
- Existing Pressure Reducing Valve
- Existing Sewage Storage
- Existing Watermain
- Existing Sewer

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FIGURE **4.8** AREA 2 BASE SERVICING

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An alternative to the above noted central servicing options would be to install small diameter pressure sewer central services. Small diameter pressure systems are best suited for small local areas, whereby they serve clusters of homes. They are not meant to replace trunk gravity sewer systems. In the case of the Purcell's Cove study area, such systems would, therefore, be best suited to service some of the side streets off of Purcell's Cove Road. These roadways would include Boulderwood Road, Halls Road, Melvin Road, Rocklyn Road, Bluestone Road, Keefe Drive, Pottery Lane and Battery Drive. These systems involve the use of small diameter (50mm diameter) pressure pipes (rather than larger diameter conventional gravity sewers) to collect and convey sewage. They offer some advantages over conventional gravity sewer systems, including:

- Small diameter pressure systems result in small central piping compared to conventional gravity sewers, resulting in material costs savings;
- Pressure pipes do not need to be laid at a constant downward grade as per gravity sewers. In fact, their profile can generally follow the natural grade of the terrain in which they are installed. Consequently, small diameter pressure pipes do not typically need to be installed as deep as conventional gravity sewers. This can result in significant costs savings related to trench and rock excavation;
- Small diameter pressure systems can often result in the elimination of the need to construct and operate large Municipal type sewage pumping stations; and
- Small diameter pressures systems tend to be "tighter" than conventional gravity sewer systems. As such, they can reduce the amount of inflow and infiltration (I/I) into the system, thereby limiting sewage flows and reducing operation and maintenance costs associated with transporting and treating excessive I/I.

While small diameter pressure sewer systems can offer some cost advantages, they can also present several disadvantages. For example, each home that is serviced by such a system requires a grinder type sewage pump to convey sewage flow from the home to the central pressure sewer system. Since these pumps are installed at each individual property, the cost of these pumps (including operation and maintenance) are typically borne entirely by each individual homeowner. In addition, these systems are not typical within HRM and are not currently addressed within Halifax Water's Standard Design and Construction Specifications. Therefore, the use of such systems is subject to approval from Halifax Water and would likely require further study to assess viability.

4.6 Construction Cost Estimates

Table 4.3 presents concept design construction cost estimates for each of the design options presented in Section 4.5 above. Estimates are based on 2013 construction costs. Criteria and assumptions used to develop these cost estimates are summarized as follows:

- The width of pipe trench excavations will be limited to a maximum of 3 m;
- New piping will be installed such that reinstatement of existing asphalt will be minimized (i.e., piping will be installed within gravel shoulders as much as possible);
- Watermain and gravity sewer pipe will be installed in a common trench;
- Sewage forcemain piping will be installed in separate trenches from watermain, with a minimum horizontal separation of 3m;

- Trunk sewage pumping stations will be of the submersible type, complete with backup power (generator) provisions;
- A full upgrade at Roaches Pond to accommodate the proposed full development from the Clayton lands will not be required, as it would only be an interim measure until the future Herring Cove diversion sewer is constructed to bypass/eliminate the Roaches Pond pumping station (per the recommendations of the Halifax Water Regional Wastewater Functional Plan). Therefore, Halifax Water will consider Roaches Pond upgrades for the backlands options based on 50% of full Clayton development;
- If Area 2 comes on line, it will not do so before the Herring Cove diversion sewer is constructed. Therefore, no additional upgrade is required at Roaches Pond to accommodate Area 2;
- Service connections (including supply and installation of service pipe) will be provided to all existing lots within the study area, as well as to potential lots that that could result from subdivision, as may be permitted under current zoning regulations;
- Cost estimates include the cost for service connections (including all related pipe and fittings) from the central pipe main to the street fronting property lines (i.e. cost estimates do not include the cost of service connections on private property, from the street fronting property line to individual homes);
- The average service lateral length on Purcell's Cove Road will be 10m to the street fronting property line, and 5m on other roadways;
- All excavated Halifax Formation slate rock within the study area is acid bearing and will require proper disposal and replacement with borrow material; and
- Any new wastewater flows that may be directed to the Roaches Pond sewage pumping station may require upgrades to the downstream wastewater collection system along Herring Cove or coordination with the implementation of the proposed regional wastewater infrastructure along Herring Cove Road (in keeping with Halifax Water's Regional Wastewater Functional Plan). As such, depending on the timing of servicing, there may be additional costs associated with the implementation of regional wastewater infrastructure that could be attributed to the Purcell Cove lands. This would be subject to a more detailed future review, and, therefore, the related potential costs are not included in any presented construction cost estimates.

A 25% engineering and contingency allowance has been included in the construction cost estimates. However, the estimates do not include costs for easements, land acquisition, escalation, legal related expenses and taxes. These estimates are considered accurate to within ± 25%, and are to be used for budgeting and comparative purposes only. More refined cost estimates can be developed during the subsequent detailed engineering design activities.

Table 4.3: Construction Cost Estimates

Servicing Option	Estimated Construction Cost ($Millions)
Area 1	
Purcell's Cove Road	$19.80
North Backlands	$20.40
South Backlands	$21.05
Wastewater Treatment Facility	$24.15
Pump to Atlantic School of Theology	$24.00
Area 2	$12.00

The costs noted in Table 4.3 for Area 1 can be broken down further into the following categories:

- **Base Cost:** The capital cost to provide sufficiently sized central water and sewer infrastructure to service only existing lots, as well as any new lots resulting from subdivision that may be permitted under current zoning regulations. Therefore, within Area 1, the base cost represents that cost to service only existing and future subdivided lots (i.e. 245 lots as noted in Section 2.4 above);
- **Upsize Cost:** The additional capital cost to increase base infrastructure sizes to accommodate flows from other areas. The upsize costs for Area 1 include two components:
  - The upsize cost to allow for the potential future connection of Area 2 to the Area 1 central servicing infrastructure; and
  - The upsize cost to allow any future development within Area 1 (beyond subdivision of existing lots under current zoning provisions). For the purposes of this study, these costs would be related to infrastructure upsize requirements needed to accommodate the additional flows from the proposed Clayton development (i.e. 1,200 lots as noted in Section 2.4 above).

Table 4.4 and Figure 4.9 provide a summary of the base cost and upsize cost components for each of the Area 1 concept servicing options.

Table 4.4: Summary of Area 1 Base and Upsize Estimated Construction Costs

Servicing Option	Base Cost ($Millions)	Area 2 Upsize Cost ($Millions)	Development Upsize Cost ($Millions)	Total Estimated Construction Cost ($Millions)
Purcell's Cove Road	$15.00	$0.70	$4.10	**$19.80**
North Backlands	$14.60	$0.55	$5.25	**$20.40**
South Backlands	$15.25	$0.45	$5.35	**$21.05**
Wastewater Treatment Facility	$14.60	$3.05	$6.50	**$24.15**
Pump to Atlantic School of Theology	$17.85	$1.05	$5.10	**$24.00**

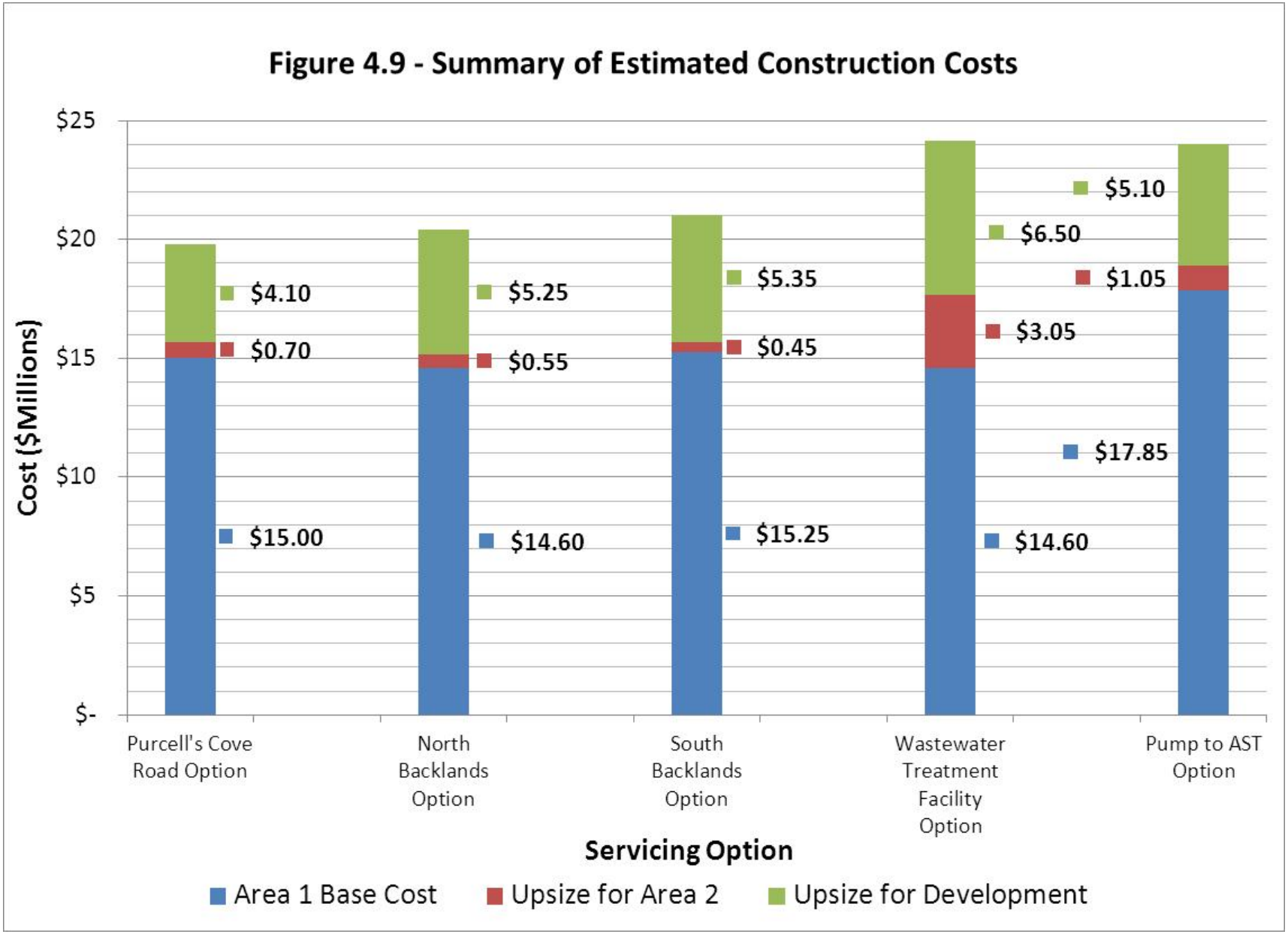


Figure 4.9 - Summary of Estimated Construction Costs
$25
$20
$15
$10
$5
$-
Cost ($Millions)
$4.10
$0.70
$15.00
$5.25
$0.55
$14.60
$5.35
$0.45
$15.25
$5.10
$6.50
$3.05
$14.60
$1.05
$17.85
Purcell's Cove Road Option
North Backlands Option
South Backlands Option
Wastewater Treatment Facility Option
Pump to AST Option
Servicing Option
Area 1 Base Cost
Upsize for Area 2
Upsize for Development

4.6.1 Cost Sharing

In terms of who pays the capital cost of the required central servicing infrastructure, Halifax Water operates on a "cost causer" system. Under this arrangement, the eventual users of the infrastructure are required to share in the entire capital cost. Any allocation of costs is based on the principles of the HRM Local Improvement Charge Bylaw and the Capital Cost Contribution Policies.

For the Purcell's Cove study area, there are a number of potential cost sharing scenarios that could be used. Some of these are dependent on whether the proposed Clayton development receives approval to proceed via a "plan amendment" process, and what infrastructure cost sharing agreements are struck during that process. Nevertheless, the following provides a description of some of the possible cost sharing scenarios that could be developed:

1. Area 1 Base Cost Shared by Area 1 Property Owners: Using this scenario, the Area 1 property owners would share the Area 1 base cost (i.e. Cost per Area 1 Property Owner = Area 1 Base Cost ÷ 245 lots). Area 2 upsize costs would be paid for by HRM and development upsize costs would be paid for by Clayton Developments.
2. Area 1 Base Cost Shared by Area 1 Property Owners and Clayton: The base cost under this alternative would be shared by the Area 1 property owners and Clayton Developments (i.e. Cost per Area 1 Property Owner = Area 1 Base Cost ÷ 1445 lots). Area 2 upsize costs would be paid for by HRM and development upsize costs would be paid for by Clayton Developments.
3. Total Area 1 Construction Cost (less Area 2 Upsize Cost) Shared by Area 1 Property Owners and Clayton: This arrangement would result in the Area 1 property Owners and Clayton Developments sharing in the total cost of the project (as opposed to the base cost) less the Area 2 upsize cost (i.e. Cost per Area 1 Property Owner = Total Area 1 Construction Cost (less the Area 2 upsize cost) ÷ 1445 lots). Area 2 upsize costs would be paid for by HRM.
4. Common Infrastructure Area 1 Base Cost Shared by Area 1 Property Owners and Clayton: Using this scenario the Area 1 property owners and Clayton would share in the base cost of any trunk infrastructure elements that are required to jointly service both Area 1 and the proposed Clayton development. This infrastructure would include such items as the trunk watermain on Purcell's Cove Road from Wenlock Grove to the RNSYS, the trunk sewage pumping station or wastewater treatment facility in the vicinity of the RNSYS, and the dual sewage forcemains leading from the trunk pumping station near the RNSYS. The cost for other base infrastructure that is not required to provide service to the proposed Clayton development would be shared only by the Area 1 property owners. Therefore, the cost per Area 1 property owner would equal (Common Area 1/Clayton Base Cost ÷ 1445 lots) + (Remaining Area 1 Base Cost ÷ 245 lots). Area 2 upsize costs would be paid for by HRM and development upsize costs would be paid for by Clayton Developments.

It should be noted that for each of the above cost sharing scenarios, the Area 2 upsize cost would be paid for by HRM. This cost would be financed by HRM until such time that Area 2 is connected to the Area 1 infrastructure. Once Area 2 has been connected, the Area 2 upsize cost would then be added to the Area 2 central servicing costs, and then cost shared by the Area 2 residents.

Based on the above potential cost sharing scenarios, Table 4.5 and Figure 4.10 provide a summary of the estimated capital cost per Area 1 property for each of the Area 1 concept servicing options identified in

Section 4.5. These cost estimates are based on the future lots counts identified in Section 2.4 (i.e. 245 lots in Area 1 and 1,200 lots on the Clayton lands).

Table 4.5: Summary of Estimated Capital Cost per Area 1 Property ($/lot)

Servicing Option	Possible Cost Sharing Scenario			
	Base Cost Shared by Area 1 Property Owners	Base Cost Shared by Area 1 Property Owners and Clayton	Total Cost Shared by Area 1 Property Owners and Clayton	Common Infrastructure Base Cost Shared by Area 1 Property Owners and Clayton
Purcell's Cove Road	$61,000	$10,500	$13,000	$39,500
North Backlands	$59,500	$10,000	$13,500	$41,500
South Backlands	$62,000	$10,500	$14,000	$42,000
Wastewater Treatment Facility	$59,500	$10,000	$14,500	$41,500
Pump to Atlantic School of Theology	$73,000	$12,500	$16,000	$50,000

If the proposed Clayton development was not to receive approval to proceed, then the estimated capital cost for Area 1 property owners to receive central water and sewer service could range between $59,500 and $73,000 per Area 1 property. However, should the proposed Clayton development receive approval to proceed, the capital cost per Area 1 property would be reduced. The amount of the reduction would be dependent on the cost sharing scenario negotiated as part of the development approval process. The second scenario (based cost shared by Area 1 property owners and Clayton) would provide the lowest cost per Area 1 property. However, this scenario may not be the fairest to the developer, as it would require Clayton to share in the base cost for a large portion of infrastructure that it does not need to service its land. Nonetheless, this may be the most palatable scenario for Area 1 property owners if they were agreeable to allowing the Clayton development to proceed. Perhaps the fairest of the cost sharing scenarios is the fourth option (common infrastructure base cost shared by Area 1 property owners and Clayton). This scenario allows for the developer to share in the base cost of the infrastructure that is only needed to service their lands and pay fully for any upsize costs related to their development. The Area 1 property owners would pay for their share of the base cost of infrastructure need to service Area 1, as well as the Clayton lands. They would also pay for the complete base cost of the remaining infrastructure that is not needed to service the Clayton lands.


Figure 4.10 -
Summary of Estimated Construction Costs per Area 1 Property
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$-
Cost
$61,000
$39,500
$13,000
$10,500
$59,500
$41,500
$13,500
$10,000
$62,000
$42,000
$14,000
$10,500
$59,500
$41,500
$14,500
$10,000
$16,000
$12,500
$73,000
$50,000
Purcell's Cove Road Option
North Backlands Option
South Backlands Option
Wastewater Treatment Facility Option
Pump to AST Option
Area 1 Property Owners Only
Area 1 Base Cost Shared with Clayton
Total Cost Shared with Clayton
Common Elements Cost Shared with Clayton

4.6.2 Alternative Central Servicing System Cost Savings

As noted in Section 4.5.3, the use of small diameter pressure sewers could present some construction cost savings as compared to the use of to conventional gravity sewers. In fact, using small diameter pressure sewers on the streets noted in Section 4.5.3 could result in an estimated construction savings of approximately $1.37 million for each of the five presented central servicing options. If cost sharing scenario No. 1 or 4 (as presented above) is used to apportion project costs to Area 1 residents, this would result in a per property cost savings of roughly $5,500 for each servicing option. If cost sharing scenario No. 2 or 3 is used, the resulting cost saving per Area 1 property would be approximately $1,000.It should be noted, however, that individual property owners on the streets in which the small diameter pressure sewers would be installed would be required to install grinder sewage pumps on their respective properties. The cost of these pumps would offset part or all of the cost savings accrued to these particular property owners.

4.6.3 Alternative Development Construction Cost Estimates

Following several project review meetings between the CBCL Limited project team and HRM project staff, the HRM requested that an alternative development scenario be evaluated with respect to impacts on estimated project construction costs. Specifically, HRM requested that a 600 lot development on the Clayton lands be reviewed as an alternative to the proposed 1,200 lot development. Under this development alternative, the Area 1 base cost and Area 2 upsize cost will not change. However, the upsize cost related to development will be lower, as some of the required infrastructure elements will not need to be as large as may be needed for the 1,200 lot development.

Table 4.6 and Figure 4.11 provide a summary of the base cost and upsize cost components for each of the Area 1 concept servicing options for this development scenario.

Table 4.6: Summary of Area 1 Base and Upsize Estimated Construction Costs (with a 600 Lot Development on the Clayton Lands)

Servicing Option	Base Cost ($Millions)	Area 2 Upsize Cost ($Millions)	Development Upsize Cost ($Millions)	Total Estimated Construction Cost ($Millions)
Purcell's Cove Road	$15.00	$0.70	$3.60	**$19.30**
North Backlands	$14.60	$0.55	$4.75	**$19.90**
South Backlands	$15.25	$0.45	$4.75	**$20.45**
Wastewater Treatment Facility	$14.60	$3.05	$4.20	**$21.85**
Pump to Atlantic School of Theology	$17.85	$1.05	$4.90	**$23.80**

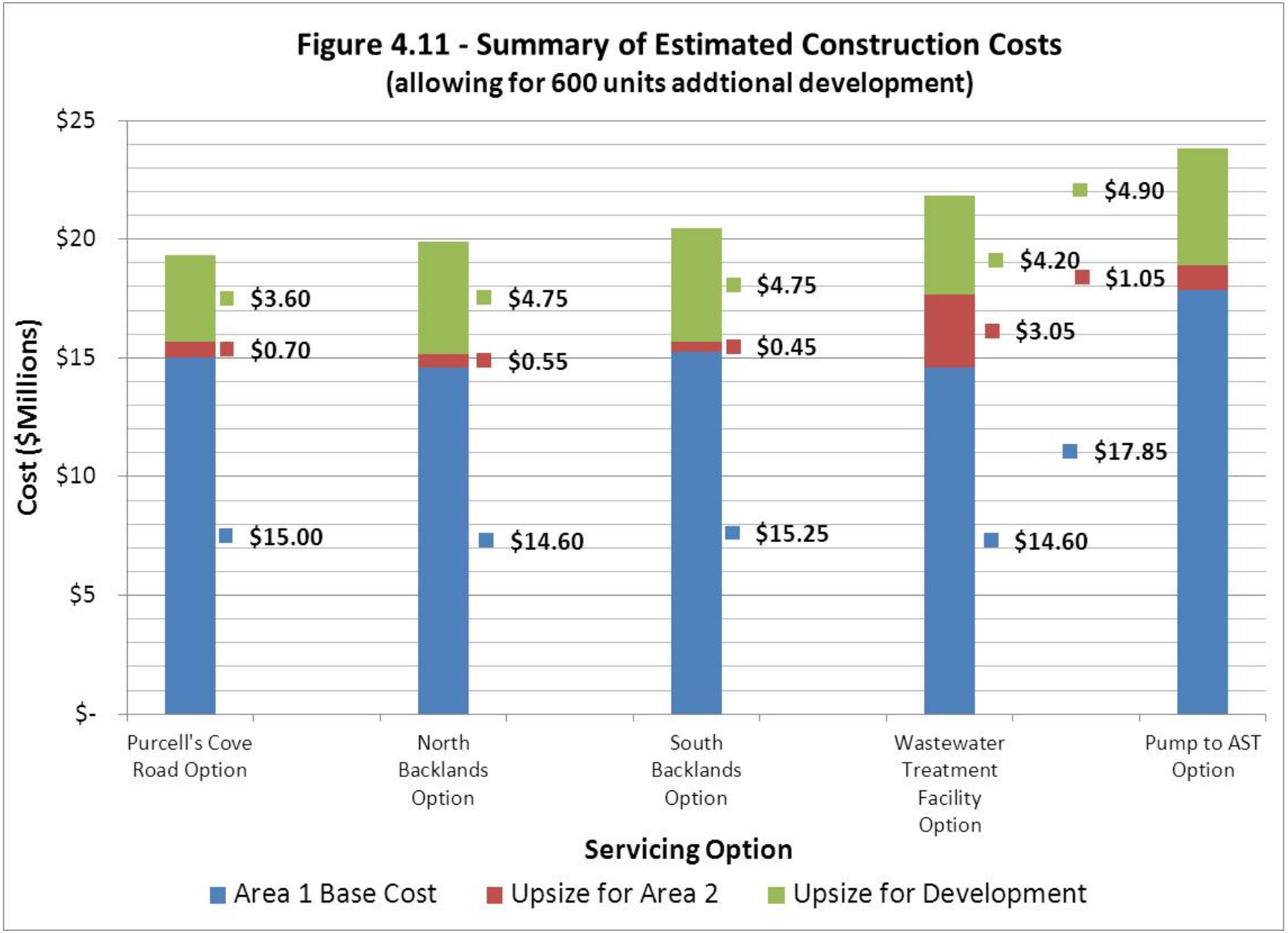


Figure 4.11 - Summary of Estimated Construction Costs
(allowing for 600 units addtional development)
Cost ($Millions)
$25
$20
$15
$10
$5
$-
$3.60
$0.70
$15.00
$4.75
$0.55
$14.60
$4.75
$0.45
$15.25
$4.90
$4.20
$1.05
$3.05
$17.85
$14.60
Purcell's Cove Road Option
North Backlands Option
South Backlands Option
Wastewater Treatment Facility Option
Pump to AST Option
Servicing Option
Area 1 Base Cost
Upsize for Area 2
Upsize for Development

Table 4.7 and Figure 4.12 provide a summary of the estimated capital cost per Area 1 property under a 600 lot Clayton development scenario. These cost estimates are based on the future Area 1 lots counts (i.e. 245 lots) plus 600 lots on the Clayton lands.

Table 4.7: Summary of Estimated Capital Cost per Area 1 Property ($/lot) (with a 600 lot development on the Clayton Lands)

Servicing Option	Possible Cost Sharing Scenario			
	Base Cost Shared by Area 1 Property Owners	Base Cost Shared by Area 1 Property Owners and Clayton	Total Cost Shared by Area 1 Property Owners and Clayton	Common Infrastructure Base Cost Shared by Area 1 Property Owners and Clayton
Purcell's Cove Road	$61,000	$17,500	$22,000	$43,000
North Backlands	$59,500	$17,500	$23,000	$44,000
South Backlands	$62,000	$18,000	$23,500	$45,000
Wastewater Treatment Facility	$59,500	$17,500	$22,000	$44,000
Pump to Atlantic School of Theology	$73,000	$21,000	$21,000	$53,500

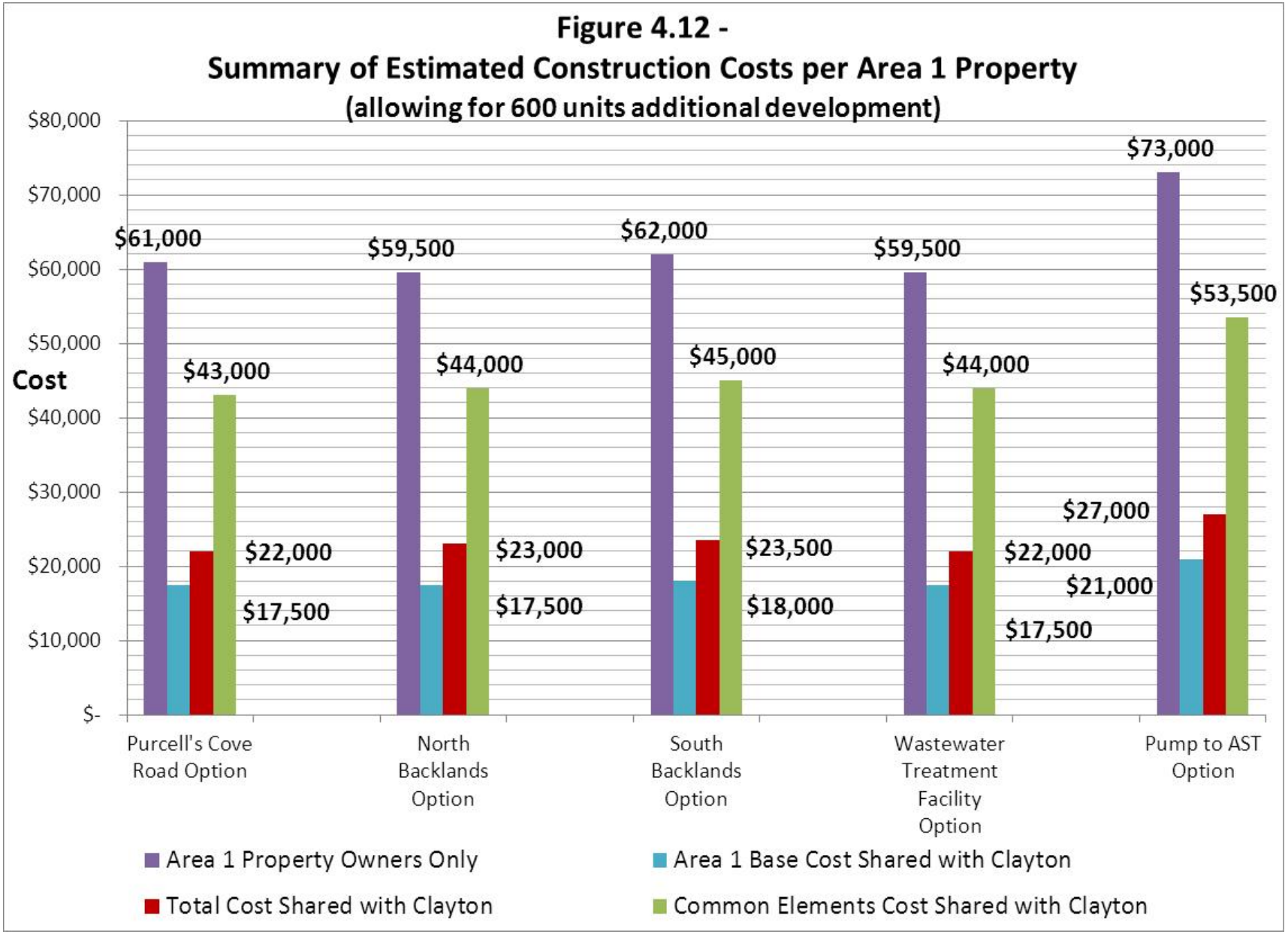


Figure 4.12 -
Summary of Estimated Construction Costs per Area 1 Property
(allowing for 600 units additional development)
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$-
Cost
$61,000
$43,000
$22,000
$17,500
$59,500
$44,000
$23,000
$17,500
$62,000
$45,000
$23,500
$18,000
$59,500
$44,000
$22,000
$17,500
$73,000
$53,500
$27,000
$21,000
Purcell's Cove Road Option
North Backlands Option
South Backlands Option
Wastewater Treatment Facility Option
Pump to AST Option
Area 1 Property Owners Only
Area 1 Base Cost Shared with Clayton
Total Cost Shared with Clayton
Common Elements Cost Shared with Clayton

CHAPTER 5 SUMMARY AND RECOMMENDATIONS

5.1 Summary

A summary of the findings of this report are presented as follows:

1. Service Area Analysis
   - The Purcell's Cove study area is not designated as a growth area within the current HRM Regional Plan;
   - Figure 2.4 presents the results of a suitability analysis that depicts areas within the overall study area that are most capable and suitable for development. In general, the most suitable areas for development tend to be concentrated around the periphery of Williams Lake and to the west of Colpitt Lake;
   - Based on input received through the CSC meeting process and public consultation process, the majority of area residents who attended these sessions:
     - Expressed satisfaction with the on-site septic and water service that they have and are concerned that central services will be forced upon them;
     - We are opposed to any additional development in the area and would like to see the Purcell's Cove Backlands preserved as public open space;
     - Were concerned that development will affect the woodlands, wildlife and ground and surface water quality in the area; and
     - Were not willing to provide input related to potentially acceptable locations and forms for additional development within the study area.
   - In order to determine the potential impact that additional development in the area may have on the possible extension of central water and sewer services, a conservative estimate of the number of lots that could be created was developed as follows:
     - 85 additional lots in Area 1 created by subdivision of existing lots;
     - 170 additional lots in Area 2 created by subdivision of existing lots; and
     - 1,200 additional lots in Area 1 created by plan amendments for the existing Clayton lands.

2. Traffic Impact Analysis
   - The Herring Cove Road / Purcell's Cove Road intersection is currently overcapacity during the AM peak hour for traffic turning right from Purcell's Cove Road on to Herring Cove Road towards the Armdale Roundabout. At LOS F, the level of service is very poor on this approach;

- Conditions at the Herring Cove / Purcell's Cove Road intersection during the PM peak hour are currently well within current operating capacity;
- If improvements to the Herring Cove Road /Purcell's Cove Road intersection are not undertaken, the proposed Clayton development will deteriorate traffic conditions at the intersection. During the first phase of the proposed Clayton development, by the year 2018, the AM peak right turn movement from Purcell's Cove Road would be the worst affected approach and would be anticipated to operate with over 1,300 seconds (over 20 minutes) of delay, which equates to over 700 meters of queue length and a LOS of F. Similarly during the PM peak hour, conditions for the same approach will reduce from a LOS C to a LOS E. As can be expected, without any mitigation measures at the intersection, the level of service in 2023 will be significantly worse with the addition of the generated trips from a further 600 dwellings passing through the intersection. It should also be noted that operating conditions for the southbound left turn from Herring Cove Road on to Purcell's Cove Road would be affected during the PM peak hour in 2023, meaning that the queuing vehicles could potentially extend back along Herring Cove Road, almost reaching the Armdale Roundabout, with an average queue length of 277 meters;
- If the proposed Clayton development were to proceed without any improvements or mitigation measures being carried out at the Herring Cove Road / Purcell's Cove Road intersection, the currently poor operating conditions for traffic would become further exacerbated to the point where delays would become unacceptable to drivers. In context, the time delays experienced by drivers' during the 2023 AM peak hour would be almost 35 minutes, with a queue length of approximately 970 meters extending along Purcell's Cove Road; and
- The proposed Clayton development will only have a negligible impact on traffic operations of the Armdale Roundabout. The largest impact would be on the Joseph Howe Drive leg, where the LOS would drop from B to D after full build out of the Clayton development.

3. <u>Central Servicing Analysis</u>
   - Five central servicing concept design options were developed for Area 1, and one option was developed for Area 2. Each option was developed to accommodate expected future flows from the study area and to meet Halifax Water design standards;
   - Area 1 central servicing concept designs were developed to accommodate flows from:
     - 160 existing lots in Area 1;
     - 85 future lots in Area 1 that could result from subdivision as permitted under existing zoning;
     - Future inclusion of Area 2; and
     - 1,200 lots from the proposed Clayton development.
   - The Area 2 central servicing concept design was developed to accommodate flows from:
     - 185 existing lots in Area 2; and
     - 170 future lots in Area 2 that could result from subdivision as permitted under existing zoning.
   - An alternative central sewer servicing design concept was also developed for Area 1 and 2. This alternative includes the use of small diameter pressure sewers (rather than conventional gravity sewers) along some of the side streets off Purcell's Cove Road;

- Estimated construction costs for the Area 1 central servicing concepts range from $19.80 million to $24.15 million. The two estimated least expensive options are the Purcell's Cove Road Option ($19.80 million) and the North Backlands option ($20.40 million);
- The estimated construction cost for the Area 2 central servicing concept is $12 million;
- Estimated construction costs are comprised of two components:
  - Base Cost: The capital cost to provide sufficiently sized central water and sewer infrastructure to service only existing lots, as well as any new lots resulting from subdivision that may be permitted under current zoning regulations; and
  - Upsize Cost: The additional capital cost to increase base infrastructure sizes to accommodate flows from other areas (i.e. from Area 2 and from the Clayton development).
- Halifax Water operates on a "cost causer" system. Under this arrangement, the eventual users of the infrastructure are required to share in the entire capital cost. For the Purcell's Cove study area, there are a number of potential cost sharing scenarios that could be used. For Area 1, these could include:
  - Area 1 base cost shared by Area 1 property owners;
  - Area 1 base cost shared by Area 1 property owners and Clayton;
  - Total (as opposed to base) Area 1 construction cost (less Area 2 upsize cost) shared by Area 1 property owners and Clayton; and
  - Common infrastructure Area 1 base cost shared by Area 1 property owners and Clayton.
- Depending on the selected servicing option for Area 1 and the selected cost sharing scenario, the estimated capital cost per Area 1 property to provide central water and sewer to the area range from $10,000/lot to $73,000/lot;
- Excepting the proposed Clayton development, the estimated capital cost for Area 1 property owners to receive central water and sewer service could range between $59,500 and $73,000 per Area 1 property;
- Including the proposed Clayton development, the estimated capital cost for Area 1 property owners to receive central water and sewer service could range between $10,000 and $50,000 per Area 1 property. The cost sharing scenario whereby the common Area 1 infrastructure base cost is shared by Area 1 property owners and Clayton may be the fairest of the cost sharing scenarios. If this cost sharing option is used, the estimated capital cost for Area 1 property owners to receive central water and sewer service could range between $39,500 and $50,000 per Area 1 property. Where the provision of central services enables the subdivision of existing lots, the current lot owner would be responsible for paying for all services that would be provided;
- The use of small diameter pressure sewer systems as an alternative to conventional sewer systems could result in an estimated total construction cost savings of $1.37 million. This could translate to an estimated savings of between $1,000 and $5,500 per Area 1 property. However, this cost saving would be offset by the cost of grinder pump systems for individual property owners serviced by the small diameter pressure systems;
- If the Clayton development were to take the form of 600 units (rather than 1,200 units), the estimated construction cost to provide central water and sewer services to Area 1 would range from $19.30 million to $23.80 million. Under such a scenario (i.e. Including the proposed Clayton development), the estimated capital cost for Area 1 property owners to receive central water and sewer service could range between $17,500 and $53,500 per Area 1 property. Using

the cost sharing scenario whereby the common Area 1 infrastructure base cost is shared by Area 1 property owners and Clayton, the estimated capital cost for Area 1 property owners could range between $43,000 and $53,500 per Area 1 property; and

- The noted construction cost estimates do not include costs to install services from the street fronting property lines to the individual homes.

5.2 Recommendations

The two preferred central water and sewer servicing concepts for Area 1 include the Purcell's Cove Road Option and the North Backlands option. These two options are preferable over the other options for the following reasons:

- From an estimated construction cost perspective, they both have the lowest estimated base cost and estimated overall cost. They also present the lowest estimated cost from a "cost per lot" perspective for Area 1 properties;
- Both options are comparable with the Wastewater Treatment Facility (WWTF) option in terms of estimated capital costs. However, the WWTF option contains some inherent disadvantages that the others would not possess. These include:
  - The WWTF option would require significant further study (and related costs) to confirm whether it is, in fact, viable;
  - A WWTF would involve significant operational costs related to wastewater treatment and compliance monitoring; and
  - A WWTF in this location does not fit within Halifax Water's long-term Regional Wastewater Functional Plan.
- The South Backlands option is slightly more expensive than the two preferred options. In addition, the route proposed for this option would likely have impacts on existing wetlands as it crosses the south backlands; and
- The Pump to AST option is significantly higher in estimated capital costs than the preferred options. Furthermore, this option does not fit within Halifax Water's long-term Regional Wastewater Functional Plan, and may require a "no-anchorage" zone in the Northwest Arm.

Therefore, should HRM Regional Council decide to proceed with further work related to the extension of central water and sewer services to the Area, it is recommended that more detailed engineering analysis be completed to determine whether the Purcell's Cove Road or North Backlands option is the most suitable. However, at this concept design stage, it is suggested that the North Backlands option may be the preferred scheme for the following reasons:

- The Purcell's Cove Road option would involve the construction of two significant sewage pumping stations (as compared to only one for the North Backlands option). As such, over the long term, the Purcell's Cove Road option will likely incur higher operations and maintenance costs;
- The Purcell's Cove Road option will involve significant disruption to the residents of the Wenlock Grove/Pinebluff area during construction; and
- The North Backlands option involves the installation of trunk sewer infrastructure across the Clayton lands. Should HRM Regional Council decide to proceed with a plan amendment process to allow the proposed Clayton development to proceed, this may offer some advantages related to negotiation

of land/easement acquisition costs, infrastructure cost sharing and potential environmental enhancements along the pipeline route.

With respect to traffic operations, the proposed Clayton development will deteriorate already poor conditions at the existing Herring Cove Road / Purcell's Cove Road intersection. Even with the addition of 600 units from the Clayton development, delay times at the intersection on the Purcell's Cove Road northbound lane will increase to roughly 20 minutes for the peak AM period. As such, the proposed development should not proceed until HRM undertakes improvements to the intersection to improve traffic flow.

Original Signed

Prepared by:
Steven Murphy, MBA, P.Eng.
Senior Project Manager

Original Signed *for*

Reviewed by:
Gordon Smith
Group Lead – Landscape Architecture & Planning

APPENDIX A

Suitability Mapping

Figure A-1 shows areas with limited development potential based on the following table.

Waterbodies
Watercourse, Wetland and Coastal Buffers *
Cemeteries, if any are present
all lands below elevation 4.5m above sea level
Existing developed areas
Crown lands
Areas of elevated cultural significance
Areas of elevated archaeological significance
Protected areas
Open space and natural resources network

Note:

* In line with the Nova Scotia Department of Natural Resources Wildlife and Watercourses Protection Regulations, which states that for watercourses with channel widths over 50 cm, upland buffers are to be a minimum of 20 metres on either side of the watercourse and where average slopes within that area exceed 20%, the width is to be increased by one metres for each 2% of slope, up to a maximum of 60 metres in width.

Figures A-2 through A-4 illustrate site conditions based on the following criteria related to residential capability.

Residential Capability

	Best	Middle	Worst
Slope	0-8%	8-20%	>20%
Soil Depth	Thick Till	Thin till	Disturbed and Bedrock
Soil Drainage	Dry Soil	Imperfect	Wet and Wet Organic

Figure A-5 presents a composite of the residential capability criteria.

Figures A-6 through A-12 illustrate site conditions based on the following criteria related to residential desirability.

Residential Desirability

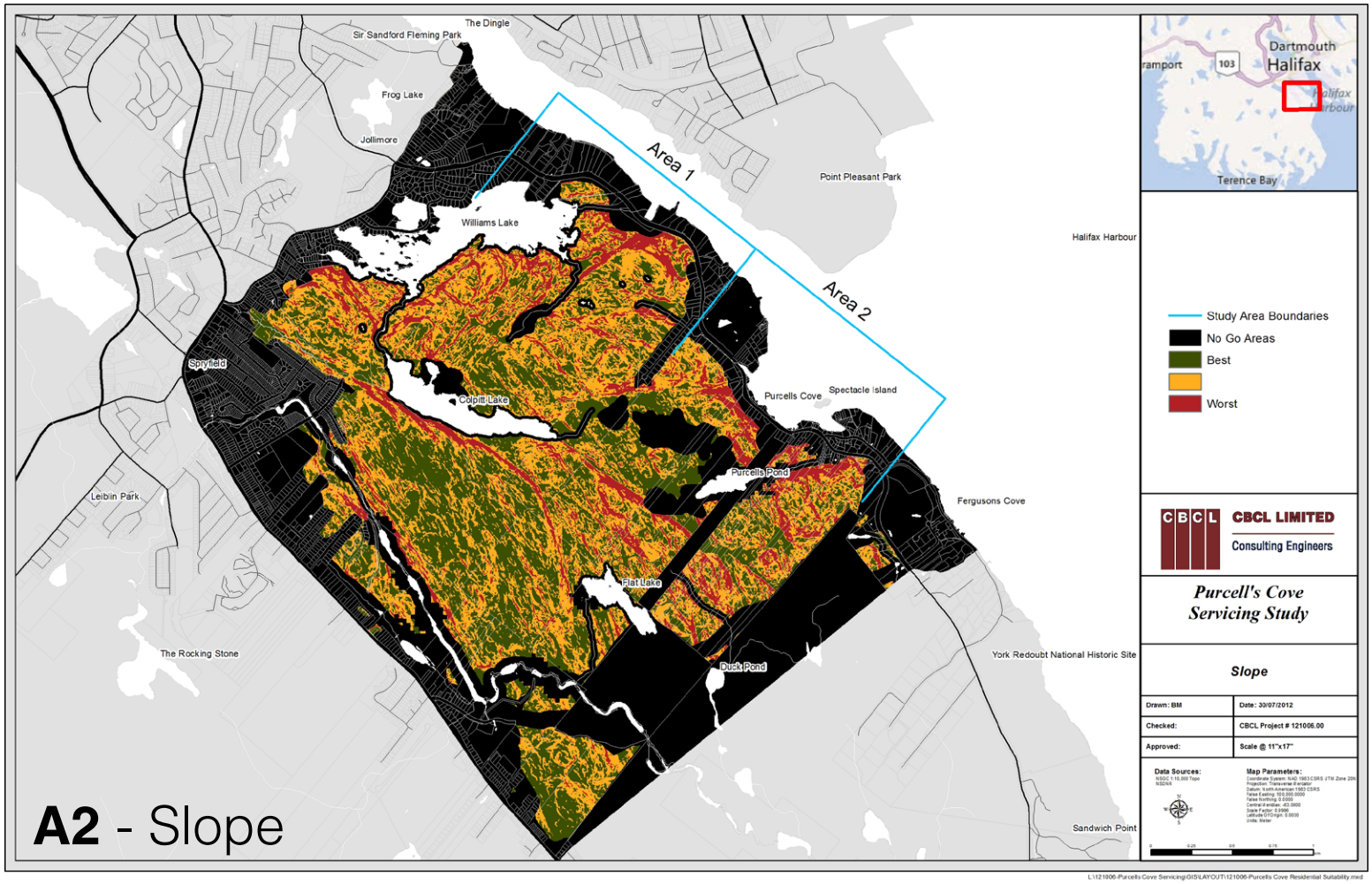
	Best	Middle	Worst
Tree Coverage	Mature	Immature	Other
Aspect	South, southwest	Southeast, west	Other
Views	Oceanfront / lakefront	ocean / water view or riverfront	No water views
Distance to School	within 1 km	1-2 km	>2 km
Distance to Central Services	Within 50m	50 - 500 m.	> 500 m.
Distance to Existing Roads	Less than 50 m.	50-500 m.	Greater than 500 m
Distance to Bus Stops	Less than 200 m.	200-400 m.	Greater than 400 m

Figure A-13 presents a composite of the residential desirability criteria.

Figure A-14 presents a plan combining the residential capability and desirability criteria to provide an indication of overall relative suitability of the land for residential development.

While the Williams Lake Conservation Company indicated that they had information that would provide more accurate mapping, this data was not received before the completion of this report.


Sir Sandford Fleming Park
The Dingle
Frog Lake
Jollimore
Williams Lake
Area 1
Area 2
Point Pleasant Park
Halifax Harbour
Spryfield
Colpitt Lake
Purcells Cove
Spectacle Island
Purcells Pond
Leiblin Park
Fergusons Cove
Flat Lake
The Rocking Stone
Duck Pond
York Redoubt National Historic Site
Sandwich Point
Dartmouth
Halifax
103
Terence Bay
Study Area Boundaries
HRM Owned Land
NS Nature Trust
Water Feature Buffer
Federally Owned Land
Provincially Owned Land
Culturally Significant Areas
Cemeteries
Open Space & Natural Resources
Developed Area
Archeaologically Significant Areas
CBCL LIMITED
Consulting Engineers
Purcell's Cove
Servicing Study
No Go Areas for Development
Drawn: BM
Date: 12/09/2012
Checked:
CBCL Project # 121006.00
Approved:
Scale @ 11"x17"
Data Sources:
Map Parameters:
A1 - No Go Areas
L:\121006-Purcells Cove Servicing\GIS\LAYOUT\121006-Purcells Cove No Go Areas.mxd


Sir Sandford Fleming Park
The Dingle
Frog Lake
Jollimore
Williams Lake
Area 1
Area 2
Point Pleasant Park
Halifax Harbour
Spryfield
Colpitt Lake
Purcells Cove
Spectacle Island
Purcells Pond
Leiblin Park
Fergusons Cove
Flat Lake
The Rocking Stone
Duck Pond
York Redoubt National Historic Site
Sandwich Point
Dartmouth
Halifax
103
Terence Bay
Study Area Boundaries
No Go Areas
Best
Worst
CBCL LIMITED
Consulting Engineers
Purcell's Cove
Servicing Study
Slope
Drawn: BM
Date: 30/07/2012
Checked:
CBCL Project # 121006.00
Approved:
Scale @ 11"x17"
Data Sources:
Map Parameters:
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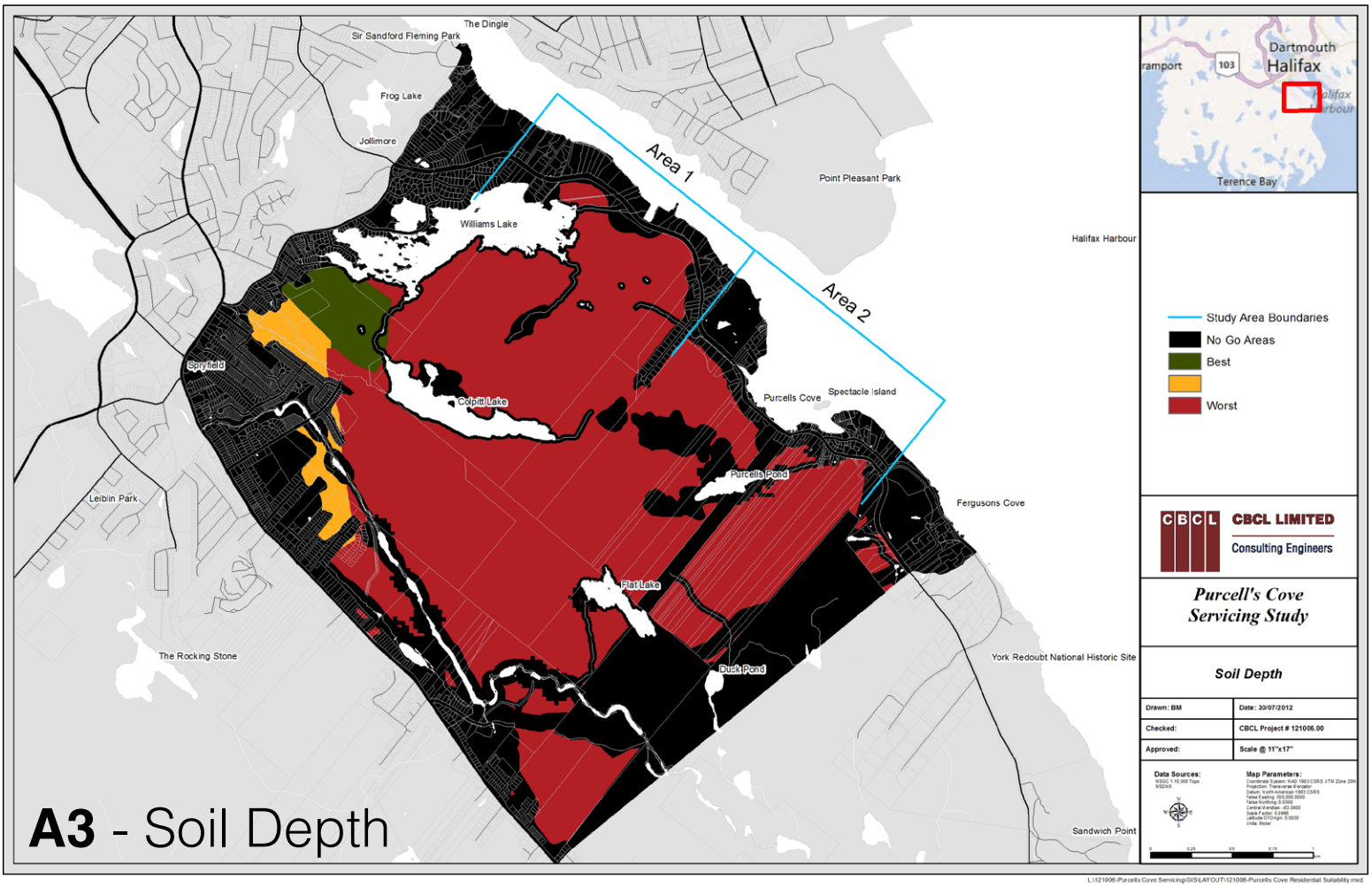

A3 - Soil Depth

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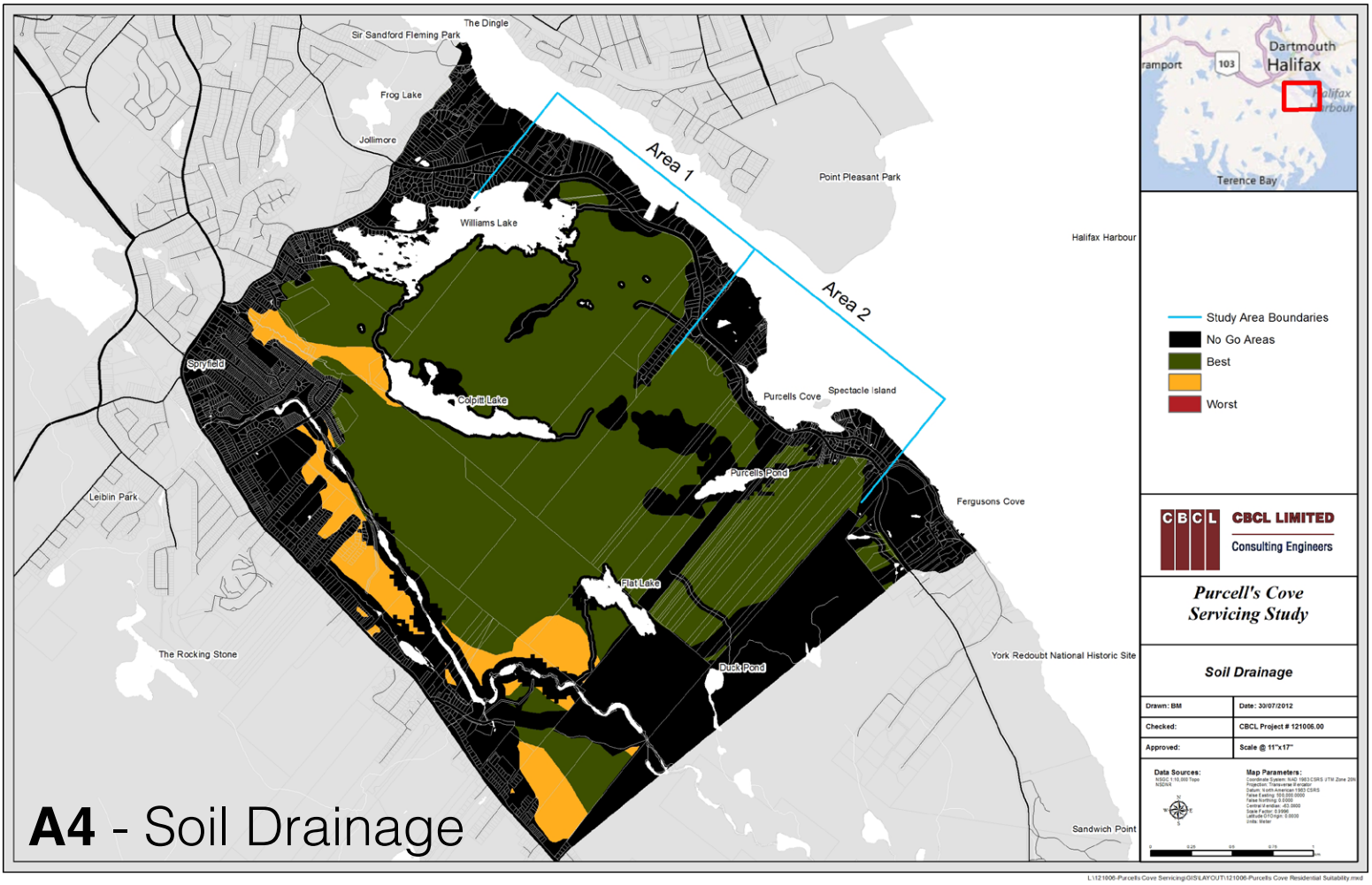

A4 - Soil Drainage

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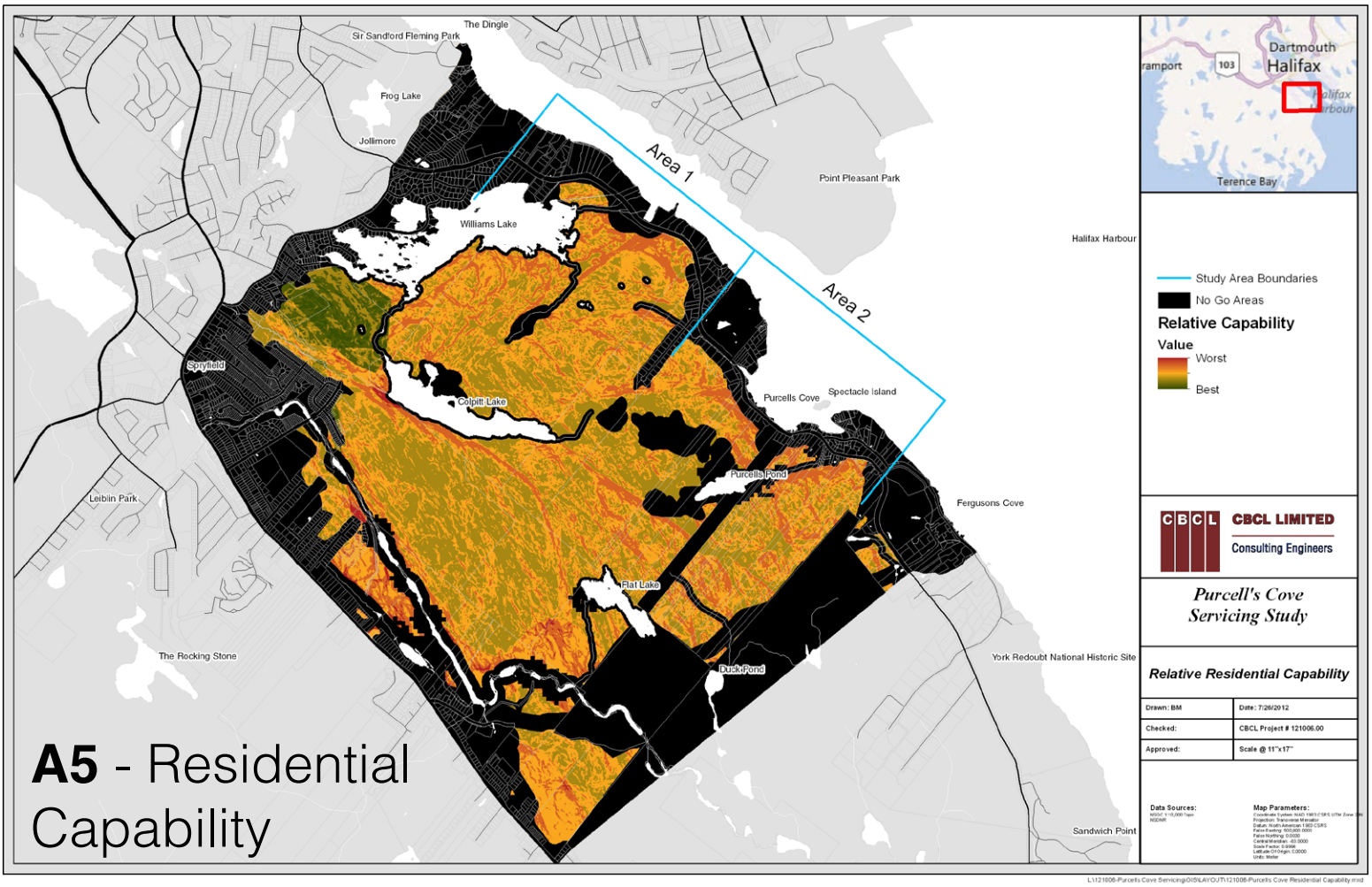

A5 - Residential Capability

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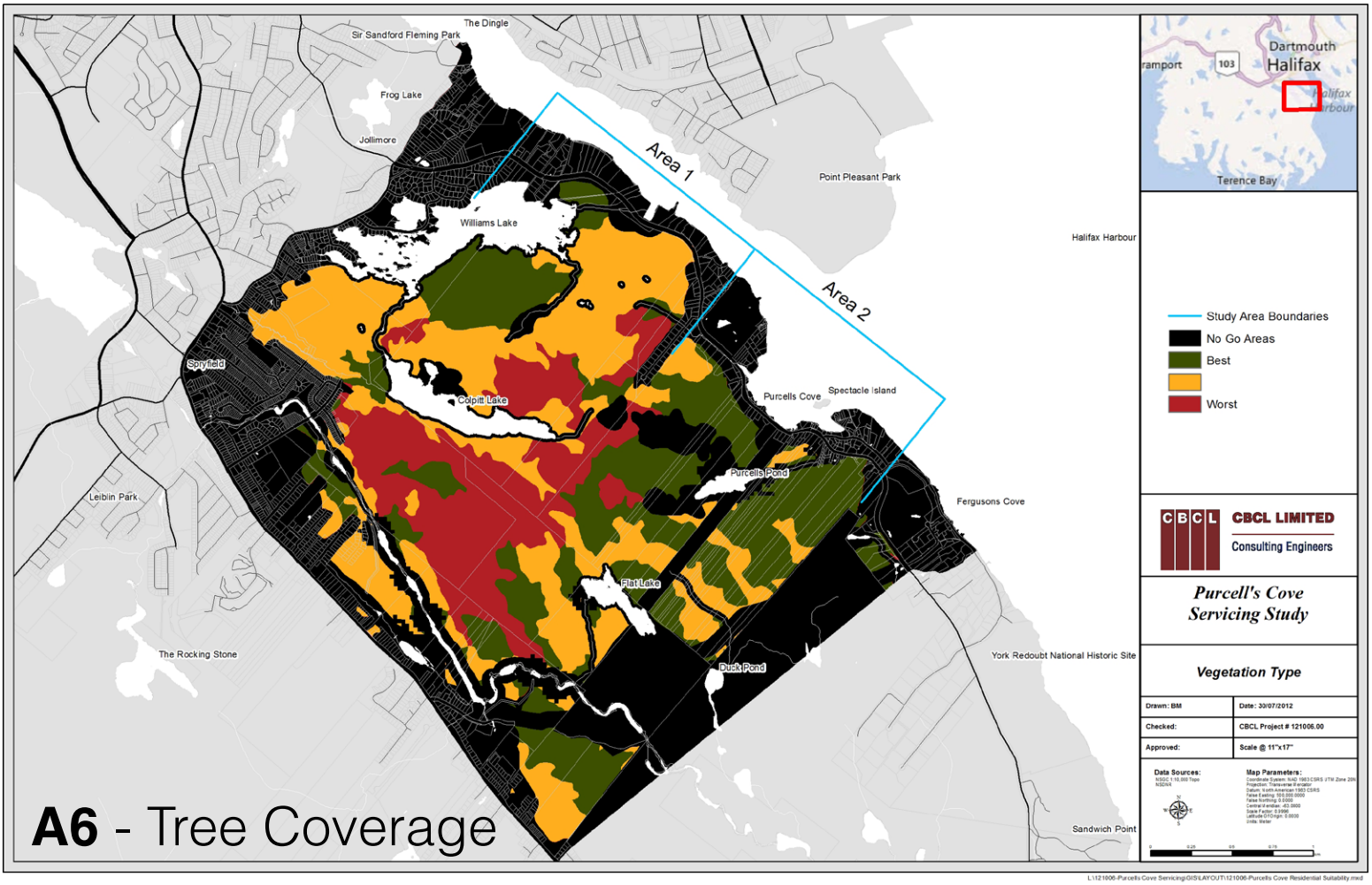

A6 - Tree Coverage

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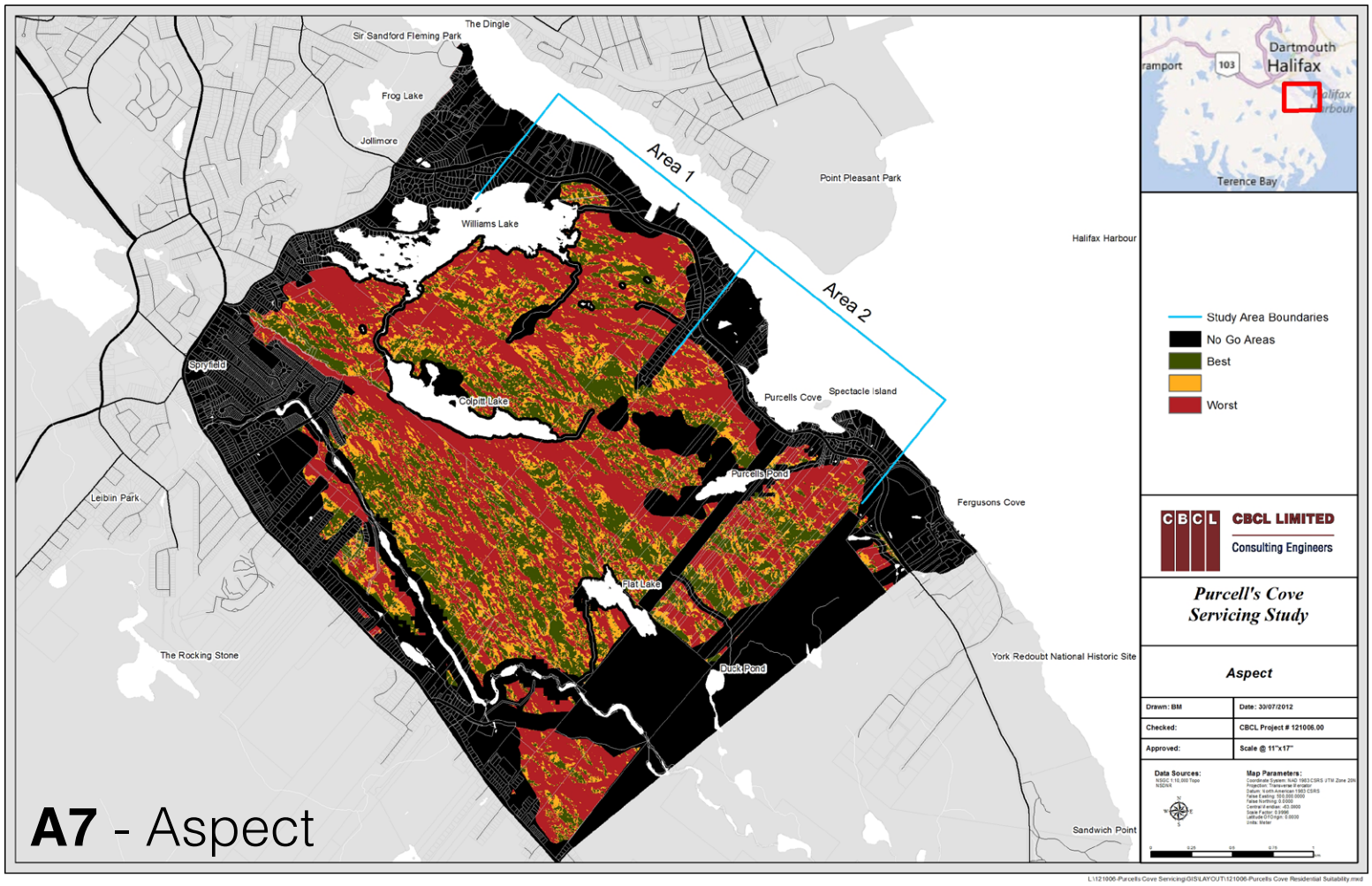
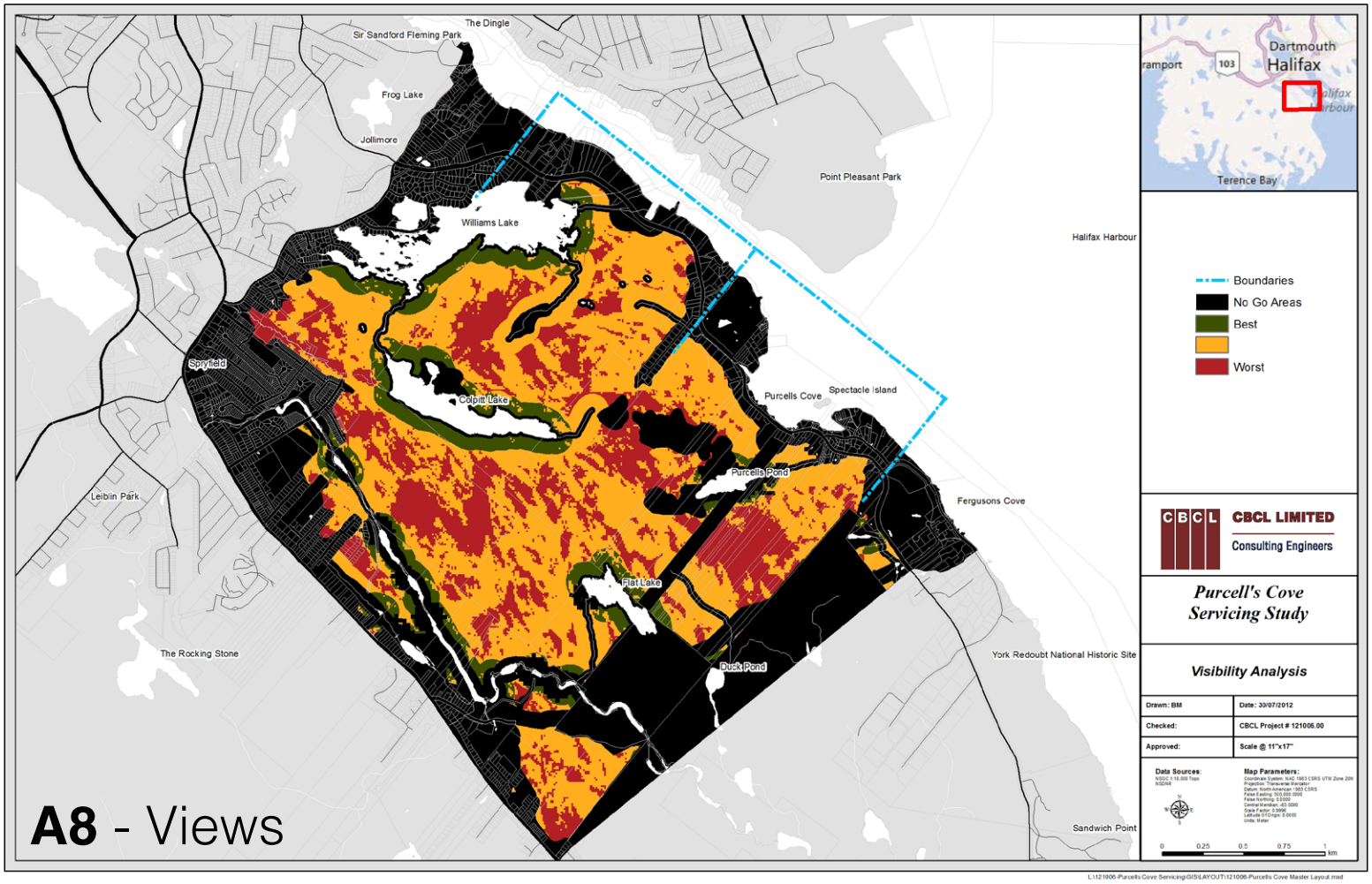
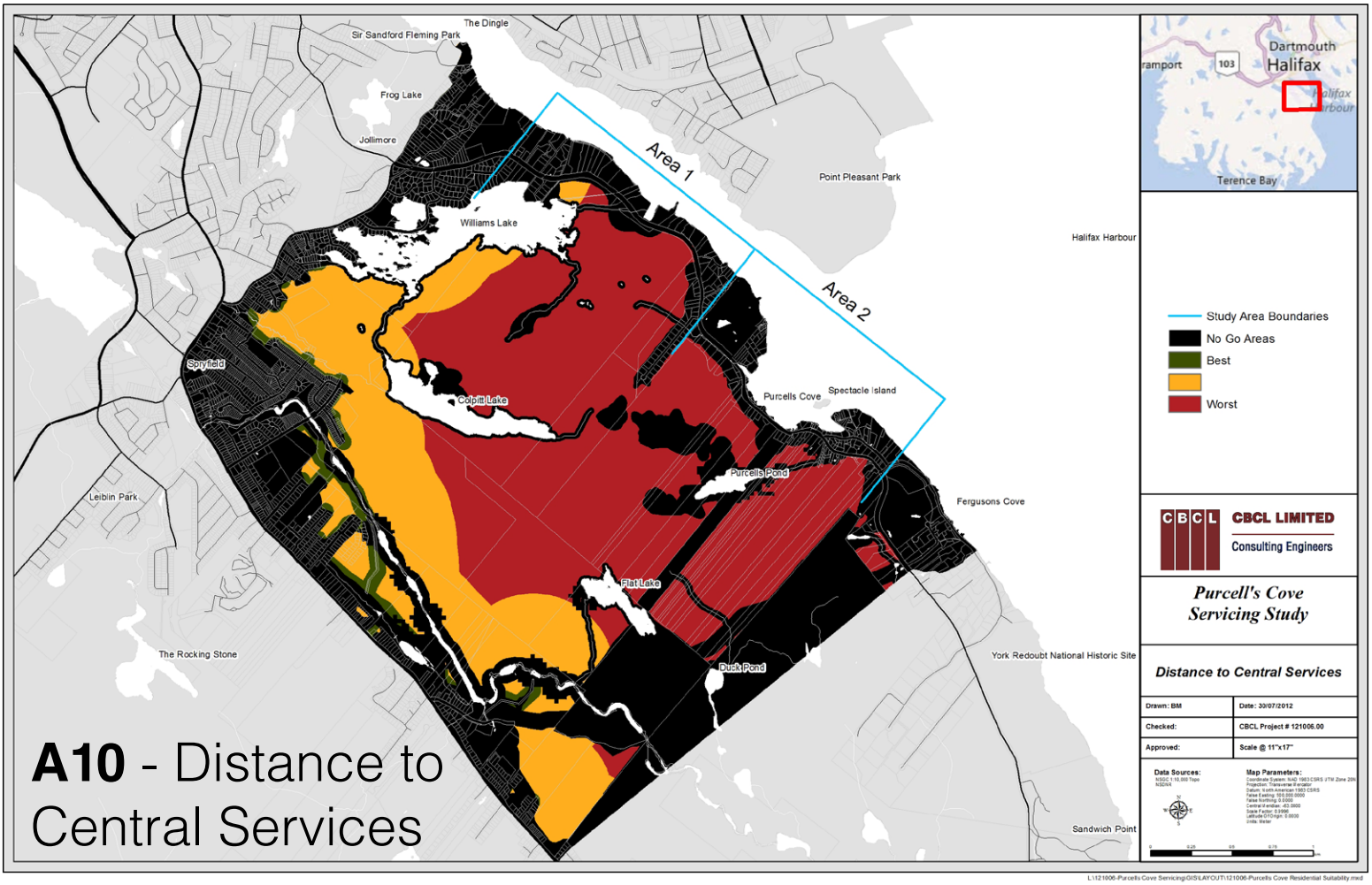


A7 - Aspect

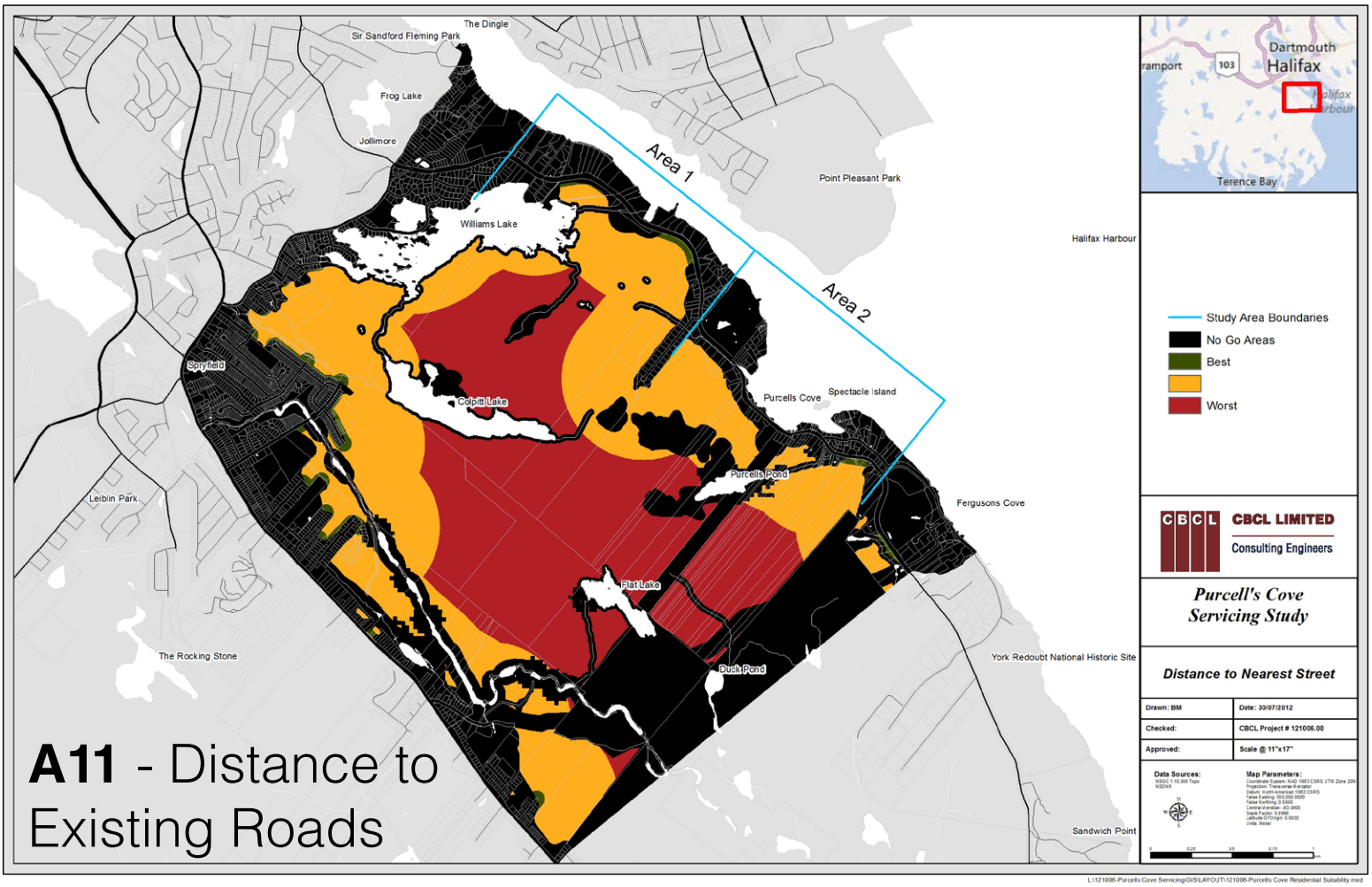


A8 - Views

A9 - Distance to Schools



A10 - Distance to Central Services



A11 - Distance to Existing Roads

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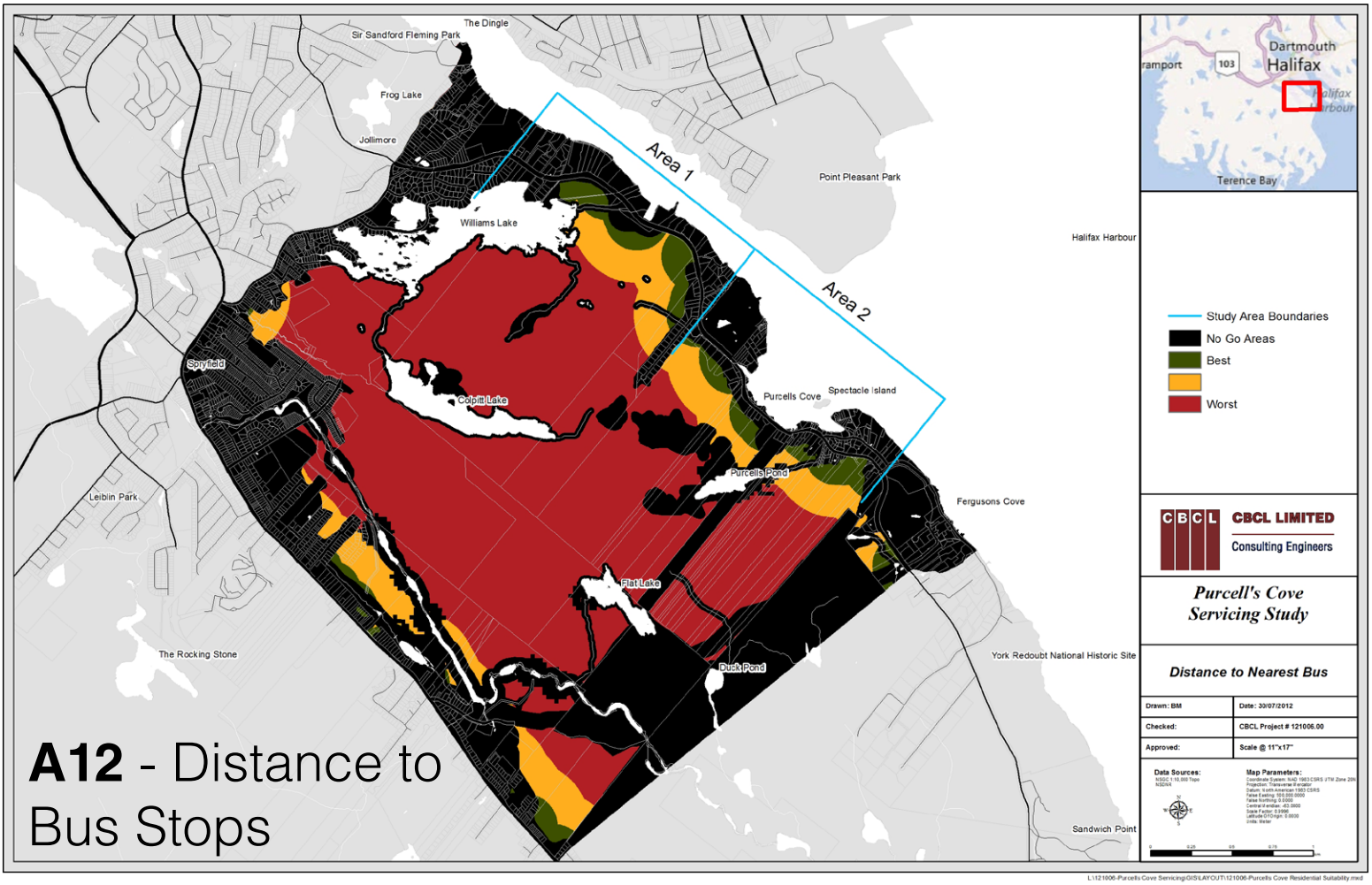

A12 - Distance to Bus Stops

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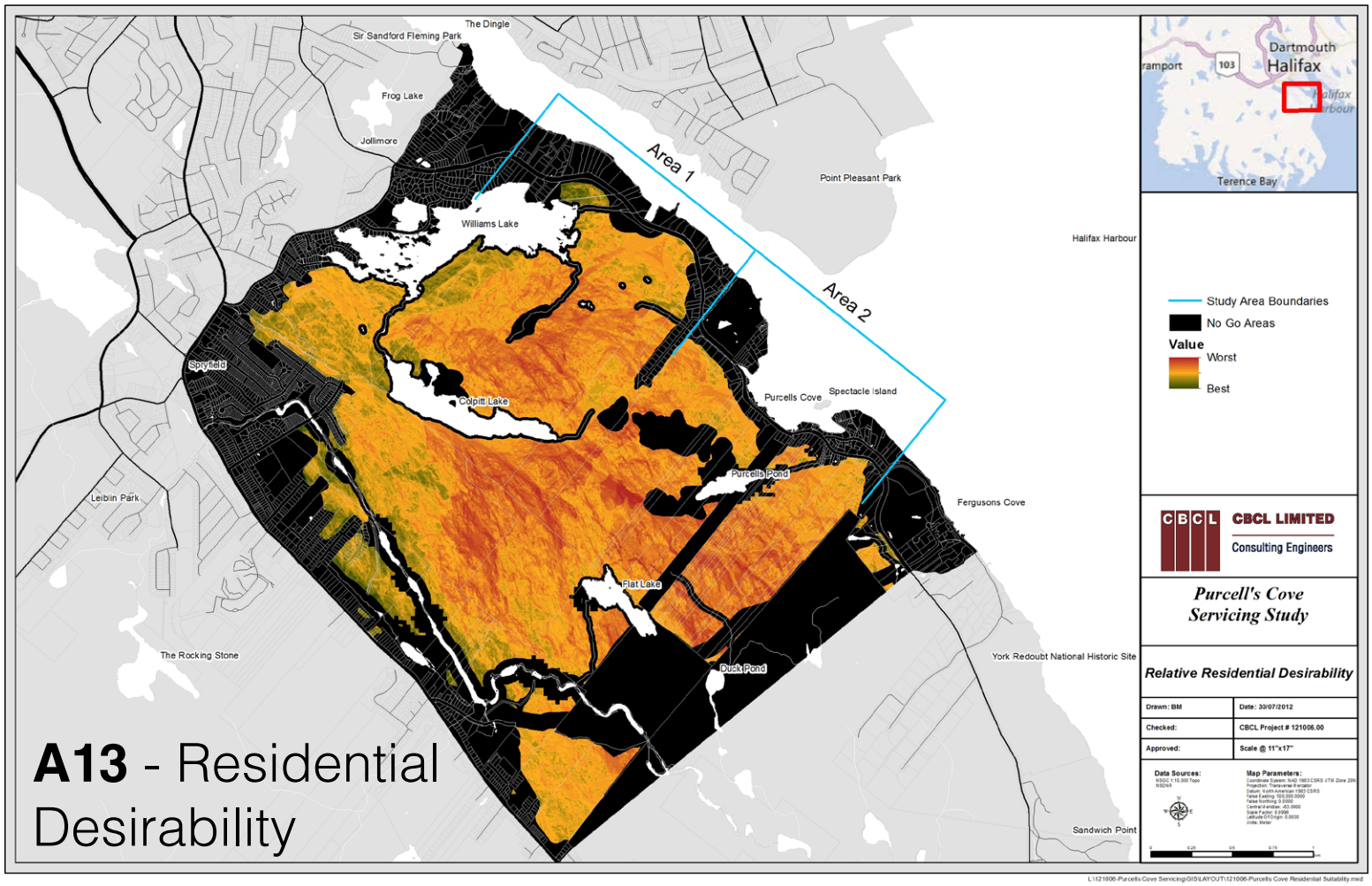
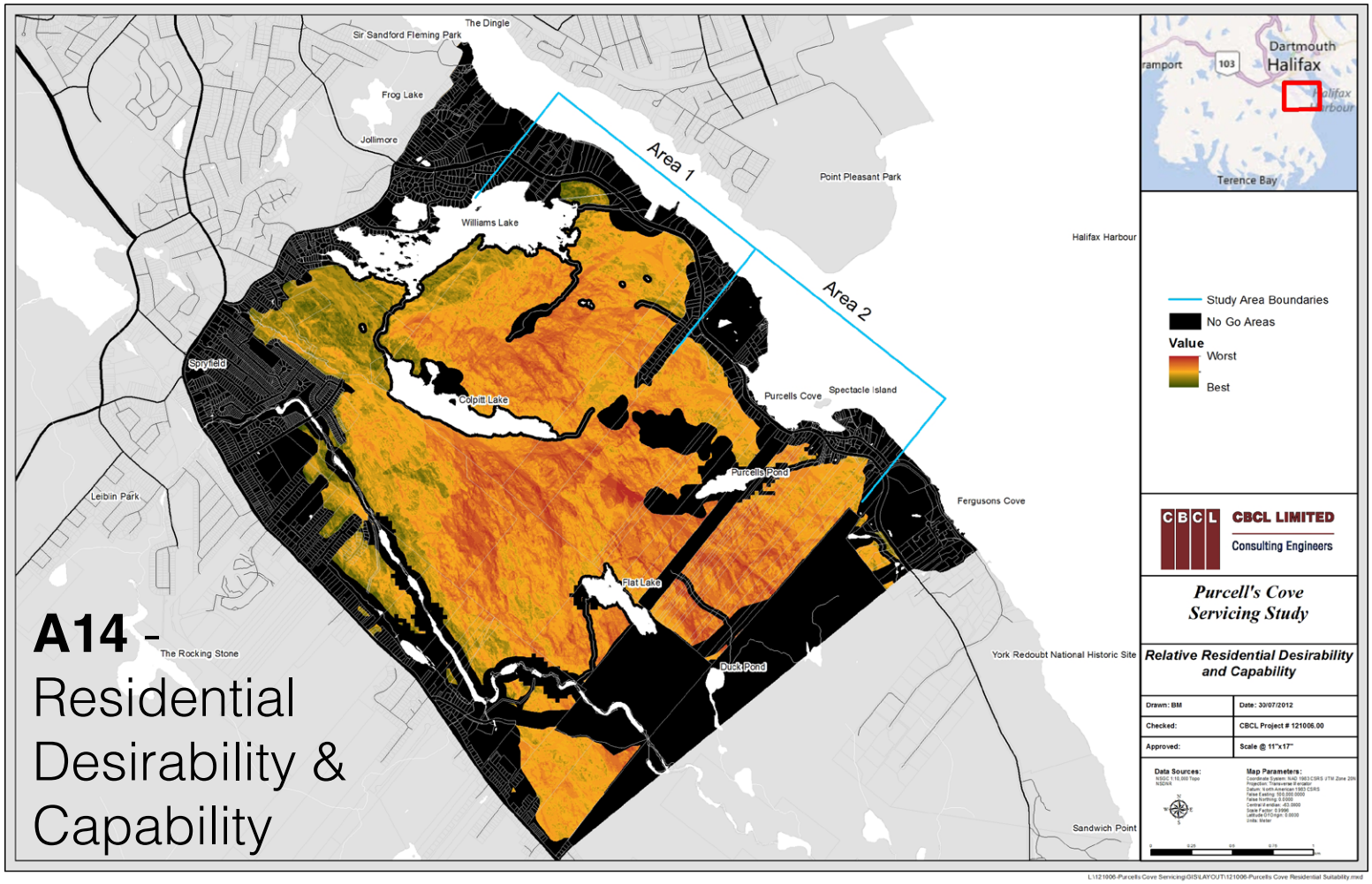


A13 - Residential Desirability



A14 - Residential Desirability & Capability