Planning Advisory Committee Meeting

Joint meeting with Council on the East End Secondary Plan

November 10, 2022

4:00 p.m.

Hybrid – Via Teams and
In Chambers
359 Main Street

Agenda

Call to Order

1. **Approval of Agenda**

2. **Approval of Minutes**
   a. Planning Advisory Committee Meeting, September 8, 2022

3. **Public Input / Question Period**

   PLEASE NOTE:
   - Public Participation is limited to 30 minutes
   - Each Person is limited to 3 minutes and may return to speak once, for 1 minute, if time permits within the total 30-minute period
   - Questions or comments are to be directed to the Chair
   - Comments and questions that relate to personnel, current or potential litigation issues, or planning issues for which a public hearing has already occurred, but no decision has been made by Council, will not be answered.

4. **East End Secondary Planning Update**
   a. Staff and Consultant Presentation

i. Including: Overview, Draft Master Plan concept, Draft Plan amendment changes, Traffic Analysis, Servicing

b. Discussion and Feedback

5. Next Meeting

a. December 8, 2022 – 4:00 p.m.

6. Adjournment

SUMMARY

East End Secondary Planning Strategy

The East End Secondary Planning Strategy continues to move forward. Background information on the project can be found here: https://wolfvilleblooms.ca/secondaryplan.

The Planning Advisory Committee (PAC) would have last received a summary of the "What We Heard" report and the work being presented here builds on that. This package includes:

- **Secondary Planning Strategy Report** (work-to-date DRAFT)
    - Outlines background, work-to-date, traffic analysis, draft master plan, MPS and LUB amendments
- **Utilities Capacity Assessment Update** (IR018-2022) and associated attachments:
    - IR 018-2022 ATTACHMENT 1 - Wolfville WWTP Assessment Report
    - IR 018-2022 ATTACHMENT 2 - 210835.01 RE-01-Rev0-Town of Wolfville WWTP Lagoon Sludge Monitoring
    - IR 018-2022 ATTACHMENT 3 - 210846.01 LE001 - Wolfville Groundwater Supply Capacity
    - IR 018-2022 ATTACHMENT 4 - 211006.00 RE01 Wolfville Water System Growth Assessment
    - IR 018-2022 ATTACHMENT 5 – East Hants Infrastructure Charges By-law

The purpose of this joint meeting and discussion with the PAC and Council is to provide an update on the East End Secondary Planning work-to-date and ensure Staff and Consultants are moving in the right direction. The secondary planning strategy report is an ongoing work-in-progress but it is important to check in and show where things are moving and outline key issues for decision makers. No motions will be required at this meeting (Nov. 10th) but feedback will be encouraged. The PAC will again discuss this work (an updated version) at their December 8, 2022 meeting and a motion can be provided, if warranted, at this meeting. The intent is to take feedback and move the project toward another round of consultation/information sharing and eventual adoption in 2023.

Next steps are envisioned as follows:

- Nov 10, 2022 – Joint PAC and Council check-in and progress update
- Work-to-date posted on Wolfville Blooms, sent to email list and other stakeholders
- December 8, 2022 – Regular PAC meeting to provide feedback on an updated package and address other issues that may arise from the November 10th meeting. Other amendments that we may want to consider while opening up the planning documents should also be discussed

- Dec-January – Further work with consultants, landowners, design review committee, developers to refine work-to-date
- Mid January-Mid-February begin formal adoption of Secondary Plan process as per Municipal Government Act
    - February 2023: Public Consultation (Wolfville Blooms, Open House(s), Participation Meeting in front of PAC)
    - February or March 2023: Recommendation from the PAC to Council
    - March or April 2023: Council considers final package
    - April-May 2023: Public Hearing and adoption of Secondary Planning Strategy and any other changes to the planning documents

This timeline is just an outline at this point and subject to discussion with PAC and Council and Staff capacity to move this forward with other priorities and projects that may arise.

REFERENCES AND ATTACHMENTS

- **Secondary Planning Strategy Report** (work-to-date DRAFT)
- **Utilities Capacity Assessment Update** (IR018-2022) and associated attachments:
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    - IR 018-2022 ATTACHMENT 5 – East Hants Infrastructure Charges By-law
- **Wolfville Blooms** – East End Project page https://wolfvilleblooms.ca/secondaryplan

The Town of Wolfville

WOLFVILLE EAST END
SECONDARY PLANNING STRATEGY

DRAFT REPORT Nov 2022

Prepared by:
Fathom

Fathom

Table of Contents

Chapter 01

Introduction

This report is the culmination of over a year of work with the local community, the Town and its consultants and various land owners and developers who own land in the study area. The East End lands consist of two similarly sized parcels including the "Kenny Lands" (~42 acres) and the "Maple Ridge Lands" (~50 acres) shown on Figure 1.

As one of the last remaining large land assemblies in Wolfville, the Town committed to preparing a comprehensive development plan for the properties instead of allowing development to progress in an uncoordinated and piecemeal way. As such, the lands were zoned as CDD (Comprehensive Development District) which require a comprehensive **Secondary Planning Strategy** before the lands can be developed.

A secondary planning strategy is a process to determine how a particular area of the Town can be developed taking into account a myriad of objectives and priorities (economics, sustainability, conservation, health and recreation, sense-of-place, urban design, etc.). This process was constructed as a partnership between the land owners, the Town (who must provide services) and local residents and businesses. The plan attempts to balance community's needs with the economic realities of land development in a way that is fair and equitable to all stakeholders.

The general premise of CDD zoning is that it provides an economic incentive to the developers by offering higher density than might be permitted in other areas of the town, and in return, the developers must incorporate specific community objectives which increase the costs of development. The Town and Province benefits by addressing the current housing crisis, and from the higher accrued taxes. This process should be a win-win for all stakeholders.

The Town has set a minimum density target of 10 units per acre (UPA), which is higher than most other zones in the Town. Additional density above 10 UPA may be considered but it comes with additional 'costs/community benefits' to the developers.

The outcome of this secondary planning process will be the framework that guides

- what can be built and the density that must be achieved,
- what areas should be conserved,
- where roads, parks, trails and community centres will go,
- the character of the future community
- how the view from Reservoir Park will be protected, and many other details.

This plan has to be adopted by Council into our planning documents (Municipal Planning Strategy and Land Use By-law) and will be used to regulate all aspects of the development that will occur. The key to this process is setting expectations (for all stakeholders) around what level of change will come to these lands over time.

The goal of this plan is to create a dynamic, and affordable community for future Wolfville residents that is a model of ecological planning and 'Complete Communities' design.

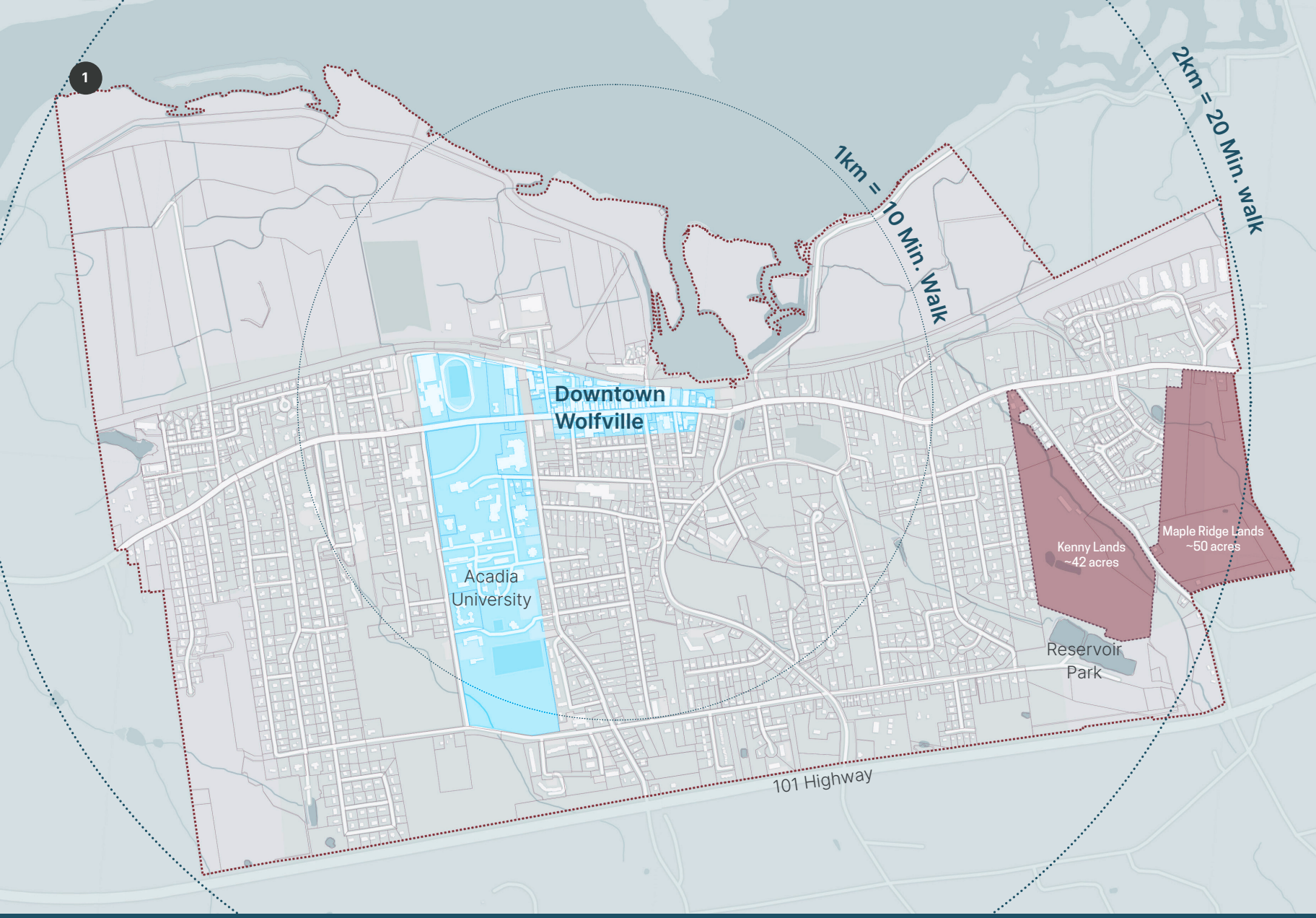


Fig.1 - **Town Context Map**

Fig.2 - **Site Context Map**

Fig.3 - Reservoir Park Look-off
Fig.4 - Looking southeast
Fig.5 - Looking north

1.1 THE PLANNING AREA

The East End Planning Study envisions the future use of two areas: the Kenny Lands (~42 acres) and Maple Ridge Lands (~50 acres). Together, both sites occupy 92 acres of undeveloped land mostly zoned as Comprehensive Development District (CDD) Zones. The CDD boundary has changed slightly from the one in the MPS and LUB to incorporate a few additional properties.

To be properly developed for housing and amenities, these areas must be analyzed to understand how future roads, infrastructure, and servicing can be placed for the sites to achieve their maximum potential.

The lands are located in Wolfville's East End, just shy of a 20-minute walk from the Wolfville's downtown (see Fig. 1). Considering the average Walking speed by foot is (on average) approximately 10 minutes per km, the future communities will be within an easy walk of downtown Wolfville and supported by new amenities and services within a short walk.

Kenny Lands

The Kenny Lands are about 42 acres total and located to the west of Maple Avenue. The site's northern boundary almost touches Main Street, meets residential housing to the west along Bishop Ave, and Reservoir Park to the south. Currently, the site is a mixture of woodlot, unused agricultural land, and a small man-made pond. Main access to the site would be considered from entry points along Bishop Avenue and Maple Avenue. The Kenny Creek greenway runs along the eastern boundary of the property adjacent to Maple Avenue. The trails and ephemeral watercourse along this greenway will be important to maintain and enhance.

Maple Ridge Lands

Maple Ridge Lands currently occupies about 50 acres of area. These lands are bordered by Main Street to its north, Maple Avenue to the west, Maple Ridge Road to its south, and active agricultural land to the easternmost Town boundary. Direct access to Main Street via Woodman Rd is currently limited by private property ownership. Other site access points should be developed from Olsen Drive and from Maple Avenue. An ephemeral stream runs along the eastern boundary of the property and bisects the site draining into the stormwater pond near Olsen Drive.

Both properties are steep and will require careful road placement to minimize road grades and enhance the community's walkability.

Fig.6 - May 31, Public Open House

1.2 WHAT IS A SECONDARY PLAN?

A secondary planning strategy is required prior to any development on the CDD zoned lands. A secondary plan is designed to coordinate all of the individual land holders in a way that would be difficult or impossible if the sites were developed individually. Without coordinated planning, the property's true potential could not be fully realized.

This plan sets out the future road locations, development sites and land uses, trail and park locations, public space standards, built form standards for new buildings, and regulatory pathways that need to be followed to achieve a development permit. This document will ultimately require changes to the MPS, LUB, Design Guidelines and possibly the Subdivision bylaw.

The plan must be adopted by Council separately or in parallel with the other bylaw changes described above. Ultimately the existing zoned CDD areas in the town will be rezoned to new uses consistent with the plan's intent.

The Municipal Planning Strategy

The Municipal Planning Strategy (MPS) is Council's principal guide for decisions on land use and development matters within the Town and is critical to its long-term strategic growth. The MPS serves as the main policy guide for residents and businesses describing how land can be used.

Wolfville's MPS has identified the Kenny Lands and Maple Ridge Lands as the last remaining Comprehensive Development District (CDD) areas in the Town. The previous other two CDD areas identified in the MPS (The West End, and Woodman's Grove) have already substantially completed their development agreements and should be zoned in the Land Use By-law, consistent with the thinking outlined in this report. There is still a portion of the West End lands that remain undeveloped and could be zoned consistent with the recommendations of this report and achieve the intentions of the original DA approval. Given the effort to amend a Municipal Planning Strategy and Land Use By-law, these types of changes should be contemplated when the East End Secondary Plan is being worked on and considered for adoption by the Planning Advisory Committee and Council.

The Land Use Bylaw

The Land Use Bylaw (LUB), Design Guidelines and Subdivision Bylaw are the companion documents to the MPS and are the means by which Town Council carries out the intent of the MPS, as set out in the Municipal Government Act.

For the CDD zone, the LUB sets out the minimum density of 10 units per acre, and that a secondary plan be required to establish development rights. The secondary plan is being developed using the Comprehensive Development District Sustainability Checklist (Schedule D of the Land Use By-law - See Fig 7). The sustainability checklist is an accountability tool to ensure we are asking the right questions when developing large tracts of land in the town

7

Schedule D:

COMPREHENSIVE DEVELOPMENT DISTRICT ZONE SUSTAINABILITY CHECKLIST

Fig.7 - LUB Schedule D - Sustainability Checklist

ABOUT COMPREHENSIVE DEVELOPMENT DISTRICTS (CDD)

The CDD designation highlights areas of Wolfville where future neighbourhood areas will be developed and is a way of regulating new residential land developments. Large vacant land holdings, primarily in the east and west ends of town shall remain in the CDD designation and zone. These areas provide opportunities for the creation of new neighbourhoods including a range of housing types and tenures and other compatible uses that provide for the day-to-day needs of residents. CDDs are intended to provide for flexibility and innovation in the design and sustainable development of these lands for a variety of residential purposes.

GUIDING PRINCIPLES

Four guiding principles set out to guide development in CDD zones in the Town of Wolfville. The principles originated from thorough assessment of the current environmental, social, and economic characteristics of the Town, while respecting future aspirations and goals of the community. The guiding principles frame the future goals of the Town and the checklist is a tool to help facilitate the process.

New development is essential to achieve a complete community to live, work and play. The purpose of the checklist and its criteria are meant to engage the developer in the planning process and establish an iterative process to build the best neighbourhoods possible that capture Wolfville's spirit, while developing neighbourhoods for our future.

Connectivity

Connecting people to neighbours, retail, employment and the region through land use design and the provision of active and public transportation infrastructure will allow residents to reduce reliance on vehicular travel, increase local shopping, and improve access to key origins and destinations.

Social Equity

Neighbourhood design, provisions, and unit affordability account for individuals and households of various sizes and income levels. Where possible, infrastructure and building practices will accommodate accessible building practices. Mixed housing types are available throughout the neighbourhood and take into account the Town of Wolfville's unique demographics and community culture.

Environmental and Economic Sustainability

Sustainability based on environmental and financial indicators to ensure a prosperous and adaptable neighbourhood for current and future Wolfville generations.

Land Use + Design

The proposed development encompasses an array of land uses that reflect the needs of Wolfville residents and the neighbourhood members. A community centre ties surrounding areas and services together logically with daily needs within walking distance. Services proposed for the site reflect the projected density and needs of the development,

Chapter 02

Site Analysis

This chapter outlines the existing conditions which have given rise to the geography, landscapes, flora and fauna of the study area today. Our social and ecological analysis forms the basis for the eventual layout of the proposed master plan by avoiding the sensitive areas, increasing the density in more robust areas, preserving the hydrological character of the watershed, mixing density nodes and parks throughout the various phases of the development, maximizing view sheds of the Minas Basin and ensuring the highest connectivity (walking, cycling, vehicles) between neighborhoods.

2.1 REGIONAL CONTEXT

Wolfville is situated in King's County within Nova Scotia's Annapolis Valley region. The town's historic charm and its proximity to the dykelands, Bay of Fundy, and Nova Scotia's premier vineyards make Wolfville into a destination point in the province's Annapolis Valley region. Further, Acadia University has allowed Wolfville to develop from a small, rural town into a community bursting with culture, pride, and identity. As of 2021, Wolfville's population was 5,057. Each year the town experiences fluctuations in its population due the arrival and departure of students.

The Town's potential future development land base has been almost exhausted and only the undeveloped CDD lands remain as for large scale master planned development. Today, the largest land use in the Town is zoned for agricultural purposes (23.25%), closely followed by residential zones (22.8%); the majority of which is dedicated towards low-density developments (13.3%). Despite the range of housing types and densities permitted, Wolfville's MPS suggests Wolfville has a "missing middle" in regard to housing. Essentially, rather than targeting the student and lower-income populations, development has focused on single-family homes that are only accessible to a specific range of individuals. Consequently, there is a shortage of housing for first-time buyers, younger families, and safe, affordable rental units. As Wolfville's population continues to age, there is a growing gap for housing that allows residents to age-in-place and develop complete communities.

During the pandemic, housing prices in Nova Scotia experienced exponential growth; at the time this report is being conducted, there is 1% housing availability in Halifax. Consequently, house prices in the surrounding areas have begun to rise and supply has simultaneously dwindled. To meet housing demands and offer future generations a place to live, it is vital that the remaining available land for development be considered for housing at a range of types, prices and tenure types. Offering a wider variety of housing types responds to changing family types, shifts in demographics, income levels, and offers a greater amount of housing than traditional low-density, owner-centric residential options.

At the same time that housing availability is being reduced, the cost of construction is rising rapidly as a result of the inflationary

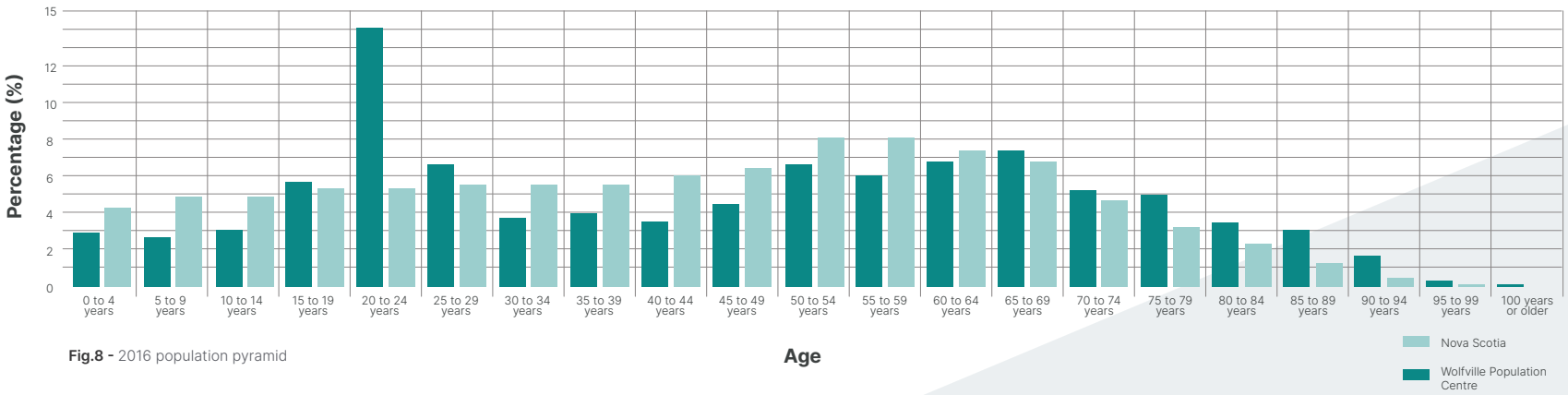
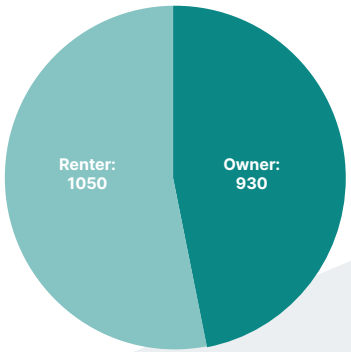


Fig.8 - 2016 population pyramid



41.2 WOLFVILLE'S AVERAGE AGE IN 2006

43.9 WOLFVILLE'S AVERAGE AGE IN 2011

46.0 WOLFVILLE'S AVERAGE AGE IN 2016

pressures brought about by the pandemic. Construction costs will remain high for the foreseeable future forcing developers to look at new ways of reducing the gross buildable area of new projects. This usually translates into smaller homes, smaller lots with reduced road frontages, cluster type homes, stacked townhomes and other types of gentle density.

The Kenny Lands and Maple Ridge Lands represent the largest tracts of serviceable, undeveloped land within the Town. The intent of the East End Secondary Plan is to develop a comprehensive framework to guide future development while ensuring that the Town's infrastructure can grow to support this new development. The Secondary Plan utilizes environmental context, and extant zoning designations, road connections, and servicing to inform the eventual location of infrastructure, open space, and land use. Ultimately, the Secondary Plan ensures Wolfville can grow in a fashion representative of the community's environmental ethos while ensuring future housing options work to close the gap and offer housing to a range of future residents; both owners and renters.

2.2 DEMOGRAPHICS

Despite being designated a 'slow-growing' community in 2016, the Town became one of the fastest growing communities in Canada since the last census survey in 2016. In 2021, the Town ranked as 23'rd on the list of fastest growing communities in Canada, growing from a population of 4,195 to 5,057. This represents a staggering average growth of 20.5%

over 5 years (4% per year).

At the time of this plan, the full 2021 census results have not been made available by Stats Canada. Only the population data have been made available.

2016 Census Results

Wolfville consists of two unique populations: seniors and students. Based on the 2016 census, over 25% (27.4%) of the population were aged 65 or older. Since 2006, the average age of Wolfville's residents has increased steadily from 41.2% to 46.0%, suggesting residents are aging in place. Lastly, the 2016 census reports that over half (52.6%) of Wolfville's residents were not married or common-law.

Individuals aged 20-29 accounted for 25% of the overall population, represented primarily by individuals between the ages of 20-24. However, the majority of these students are seasonal residents who reside in Wolfville for the fall-to-spring school terms. Of the total population, under 50% (48.2%) of the town's private dwellings are occupied by their usual residents, suggesting a large rental market and frequently changing residencies.

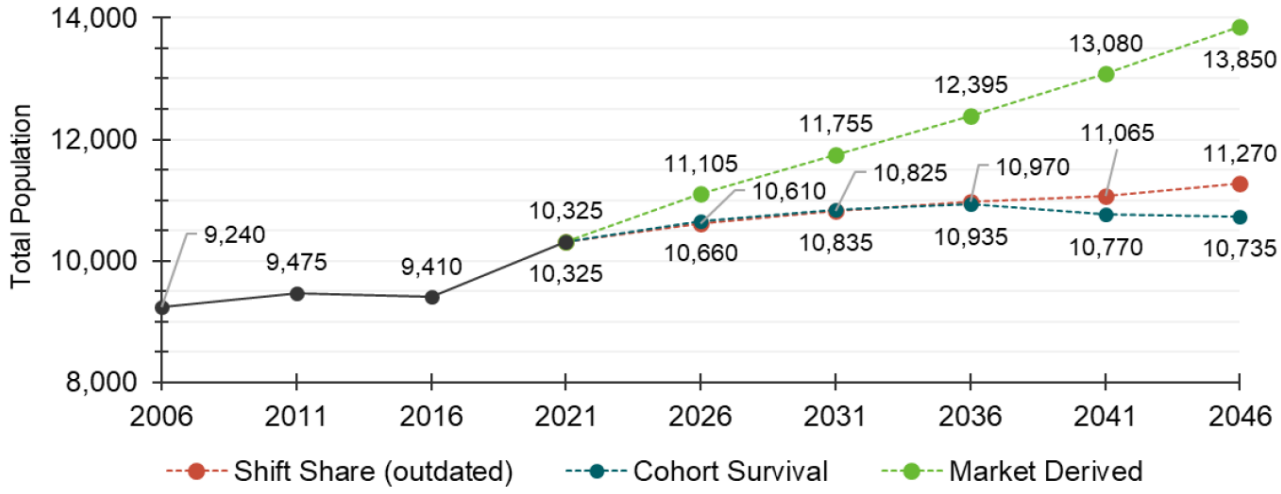
The population group for individuals age 20-29 is higher than the provincial average, descending into lower averages from ages to 30 to 65, when the population begins to rise above the provincial average once again. Wolfville's child to teenage population is also lower than the provincial average, further suggesting a lack of young families in the Town. These statistics correlate with two predominant demographic groups of university aged individuals and seniors while also bringing attention to Wolfville's need to retain middle-aged adults who seem to move away after graduating

Due to the older population, the East End Plan must consider for housing options enabling age-friendly communities. Age-friendly communities encompass the principles of urban design, accessible housing and transit options, and encourage socialization between community members.

The neighbourhood's design must also address Wolfville's "missing-middle." Building a range of housing typologies enables individuals with differing lifestyles to live in close-proximity to one another. Secondly, density is closely related to affordability. More housing availability reduces demand, thereby lowering high -rental and housing costs commonly associated with limited housing stock. Encouraging and implementing these policies within the East End will relieve lifestyle-related tensions and help Wolfville achieve the complete, inclusive communities outlined in their Municipal Planning Report. Overall, building housing other than low-density, single family homes will offer opportunities for students and first-time buyers to enter into the market. Despite the large number of young, single people who live in Wolfville temporarily, single detached homes are the second most common housing type within the Town. In developing the limited land Wolfville has available, it is important to consider the needs of the present community. Throughout several census profiles, the student population has maintained the same presence within the community. Further, Acadia University generates jobs and economic revenue for the Town. Building student rentals units encourages individuals to stop commuting and live in Wolfville, thereby incentively economic and commercial growth for the Town.

The current Municipal Plan also outlines the need to increase residential density away from Wolfville's downtown core. Given limited amount of land currently available within the Town boundary, it is pertinent that Wolfville's East End Plan encourage a range of densities beyond the traditional single-family home. Doing so will enable the current mixed demographics to have a diversity of rental and purchasing options. Lastly - given that Wolfville's average age is increasing every year - it is important to ensure younger families and individuals have the opportunity to — buy homes and rent in Wolfville. This will promote long-term living in the Town, promoting the town's overarching goals of livability, age-friendliness, and future resiliency.

Figure 2.2: Library Catchment Area (Wolfville & Kings, Subd. D), Anticipated Population



Source: derived from Statistics Canada 2006, 2011, 2016, and 2021 Census & Local Development Info

2.3 BIOPHYSICAL ATTRIBUTES

Solar gain

The site receives the most amount of sunshine during the summertime, with an average of 15.5 hours per day. During the winter, the site receives the least amount of sunlight with an average of approximately 8 hours per day.

The sun's movement follows the site's southern perimeter, meaning south-facing portions of the building will receive the most amount of sunlight throughout the day. However, north-facing facades and areas located to buildings' north of buildings will be cast in shade. The location of parks, plazas, and other open space areas should be located in southern areas, or areas that will not be impacted by shade to ensure user comfort.

Wind

The site's prevailing winter winds come from the west and north west, with an average speed of 11 mph. Due to the wind's direction, it is possible residential buildings along the western portion - and especially buildings with west-facing frontages - will be exposed to colder, stronger winter winds. To minimize exposure to cold winds, vegetated buffers on the north-west side should be created or preserved to reduce wind speeds, the proximity and orientation of multi-storied buildings must be considered to avoid creating wind tunnels throughout the proposed development and surrounding neighbourhood.

Summer winds typically prevail from the south and soutwest, with an average speed of 10.3mph. Summer winds are usually welcome from a human thermal comfort standpoint so there is less need for buffering.

Since both properties are generally sloping towards the Minas Basin to the north, they will feel the full brunt of winter winds so any buffers that can be left on the west and northwest sides will reduce the winter wind impacts.

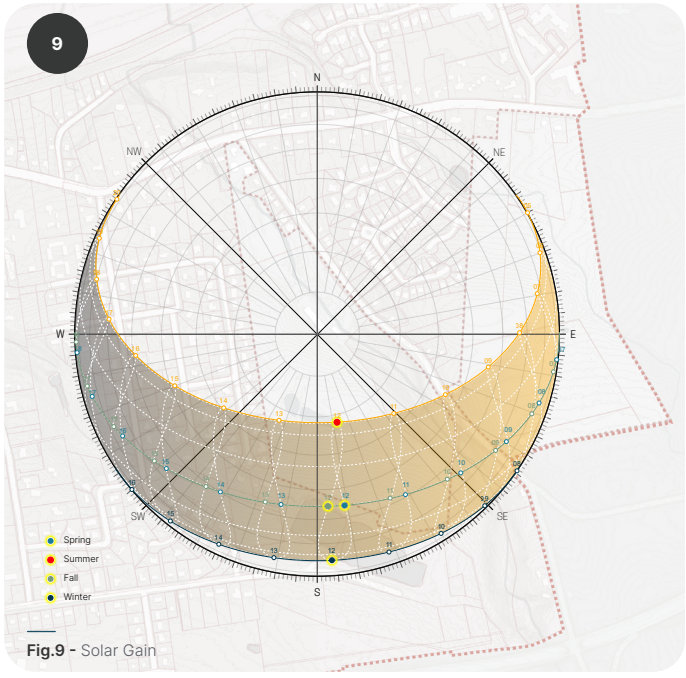


Fig.9 - Solar Gain

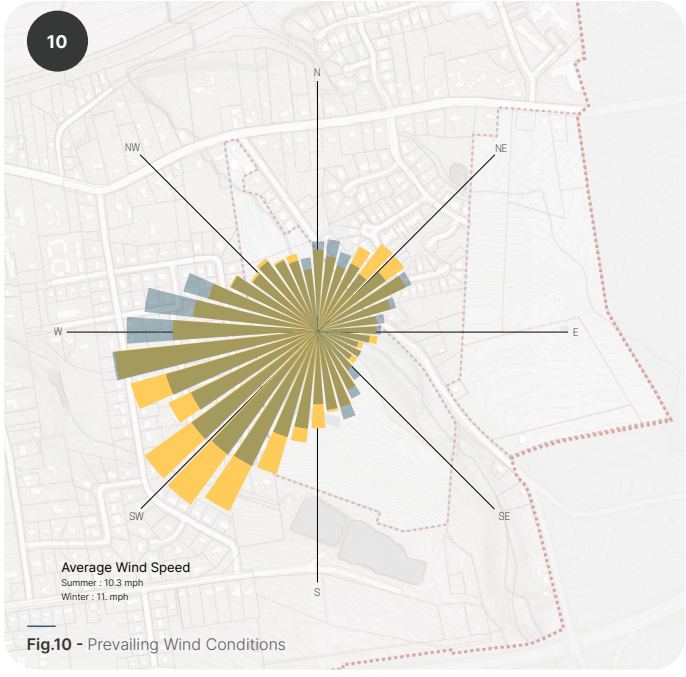


Fig.10 - Prevailing Wind Conditions

Solar Aspect

During the planning process, slope aspect should be considered for its considerable effect on the site's microclimate. This will impact the future placement of buildings and vegetation within the site.

The majority of the site has north-facing slopes. Eastern and western slopes follow the river channel from the site's northern and southern boundaries.

Northern slopes are generally colder and receive less sun exposure than southern slopes, affecting which vegetation can be tolerated along these slopes. Shade tolerant species with a preference for moist soils will generally prefer north facing slopes, whereas sun-loving species or vegetation with a preference for dry soils will thrive on south-facing slopes.

Slope aspect should also be considered for net-zero developments. South facing slopes receive more sun exposure but higher wind speed - likely requiring buffering for user comfort and direction in the wintertime. Conversely, north-facing slopes are colder, but are more sheltered from harsh winter winds. Eastern slopes receive more sunlight during the wintertime, whereas western slopes receive late afternoon light and offer sunset vantage points.

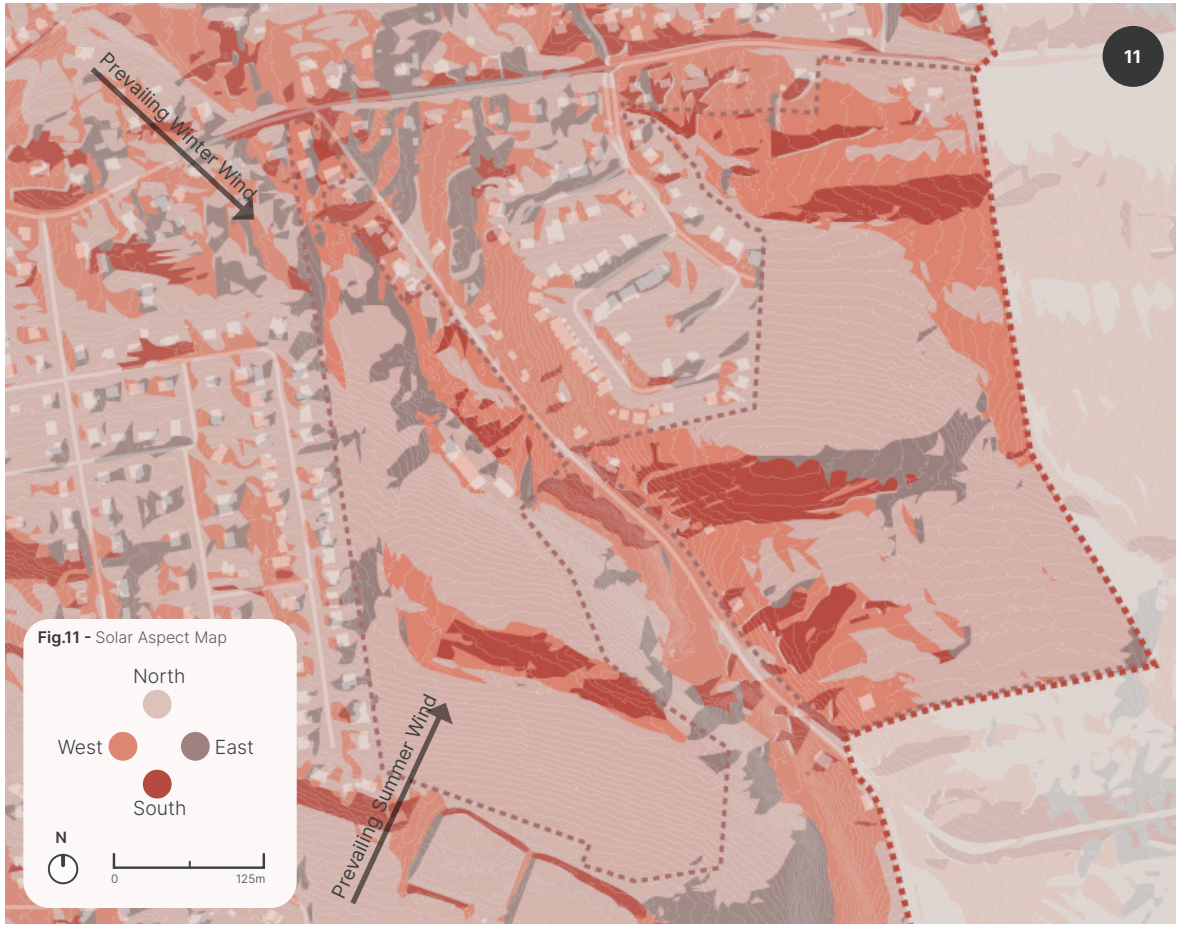


Fig.11 - Solar Aspect Map

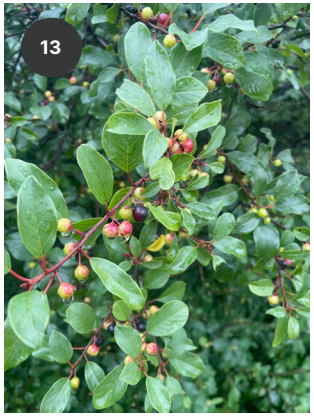
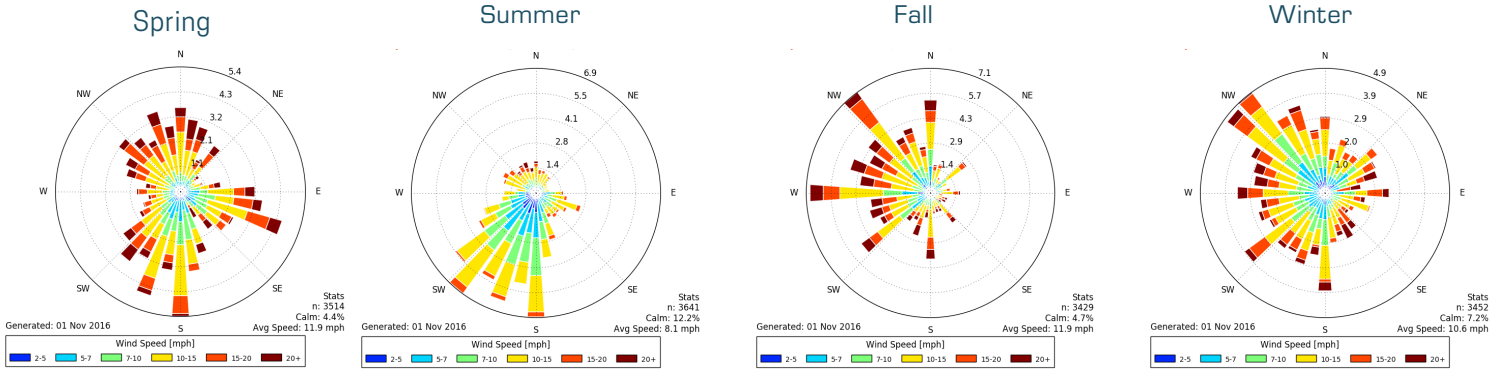


Fig.12 - *Prunus virginiana*
Fig.13 - *Amelanchier canadensis*
Fig.14 - Wild flowers
Fig.15 - *Quercus rubra* and *Amelanchier candensis*

Fig.16 - Eutrophic Pond on Kenny Lands site
Fig.17 - Alternating agricultural crops



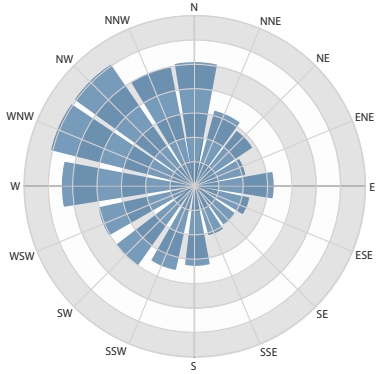
Climate & Microclimate

Wolfville's climate is influenced by its coastal location and it falls into a Zone 5b hardness zone along the Minas Basin coast. Coastal winters are comparatively mild; springs start early but are long and cool, and autumns tend to be warm and normally extend late into the year. Near the coast, mean temperature vary 15 to 20 degrees Celsius over the course of the year; inland mean temperature vary 20 to 25 degrees Celsius. This translates into a long frost-free period, and extended growing season and relatively low rates of evapotranspiration (the sum of evaporation and plant transpiration from the surface into the atmosphere), although summer temperatures are cool.

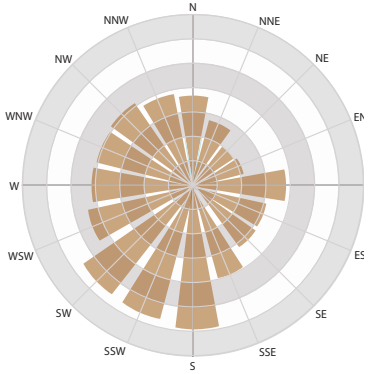
About 1,500 millimeters of precipitation fall in the Valley annually, with 90 per cent as rain and 10 per cent as snow. On average, there is fog 15 to 25 per cent of the year, more often in summer and autumn, when warm air temperatures from the south mix with cooler offshore waters. High humidity is also a common coastal influence. Relatively cool moist conditions tend to encourage forest development, reduce the stress of midsummer droughts and lower the risk of forest fires.

The winter wind direction has implications on the human thermal comfort in open areas. The prevailing winter wind on the study area is from the west and north-west in the winter. North-westerly gusts accelerate up the sloping hills in the winter creating exceedingly cold gusty winds along the top of the hill in Reservoir Park. The lower areas of the site are somewhat sheltered from westerley winds by development and trees and the flat site conditions.

In the summer, prevailing wind is from the south and south-west mostly. The wind speeds are much lower in the summer and the land sloping down to the Minas Basin will reduce wind speeds.



Winter Winds (November to April)



Summer Winds (May to October)

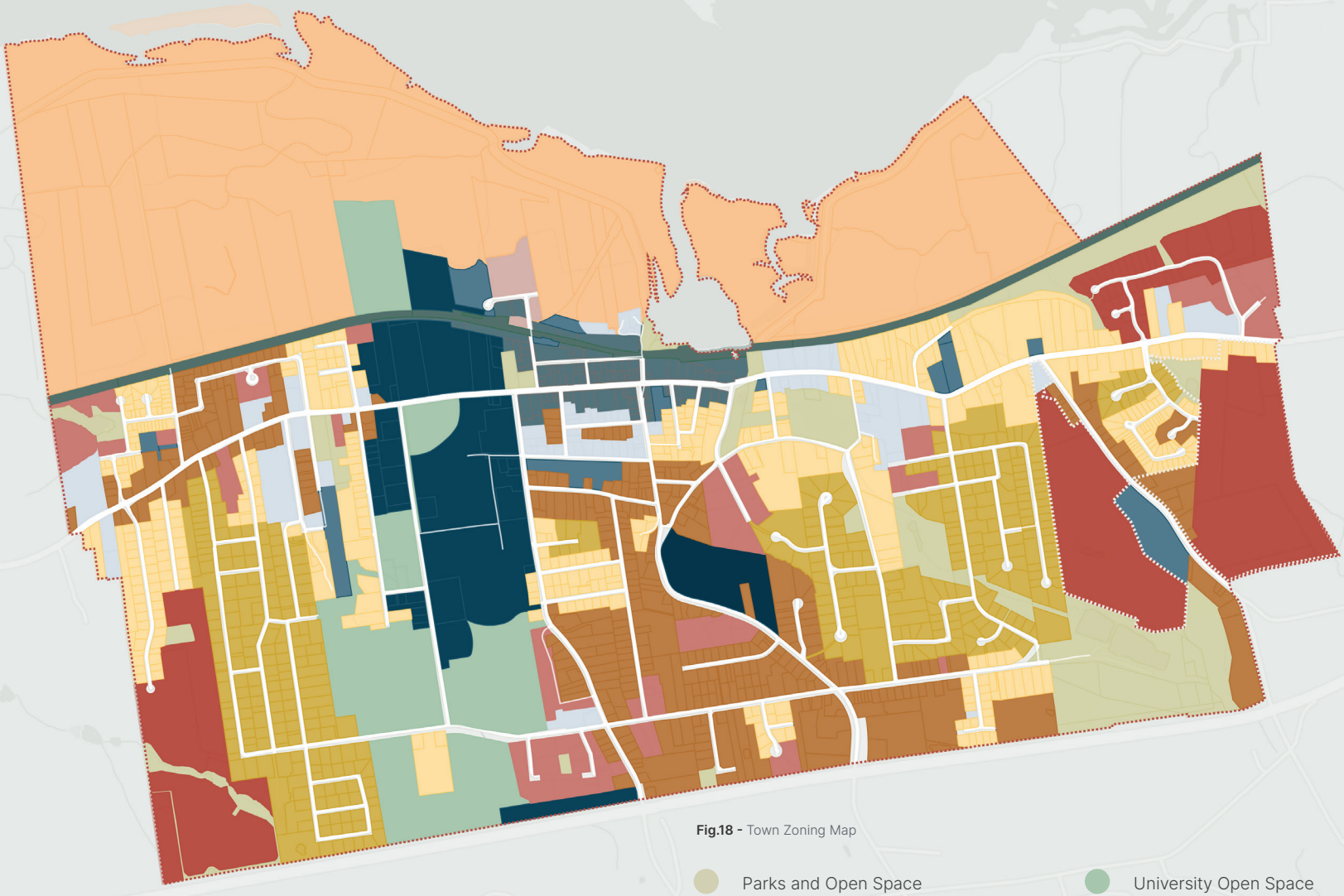


Fig.18 - Town Zoning Map

- Parks and Open Space
- Active Transportation Corridor
- Agriculture
- Comprehensive Development District
- Core Commercial
- Core Commercial - Large Format
- Neighbourhood Commericial
- University Open Space
- Institutional - General
- Institutional - University
- Low Density Residential - General
- Low Density Residential -Restricted
- Medium Density Residential
- High Density Residential

Urban Structure

Wolfville's zoning designations consist of a variety of uses - ranging from a variety of housing densities, open space, and commercial uses. Agricultural zoning forms the largest zoning designation, but is separated from the downtown core by an active transportation corridor. Commercial, institutional, and residential zoning lines Wolfville's main street . Most of Wolfville's residential zoning designations are situated in the central eastern, southern, and western areas.

As was suggested in this report's introduction, the majority of the West End's planning process was piece-meal. Lots were formed by breaking down larger areas, resulted in irregular sizing and designations. Medium-to-high density designations are situated closes to the Institutional University areas, likely to accommodate student housing and rental units. Only 6.51% of Wolfville's total area is designated for medium density housing and 2.96% is designated towards high density residential. Conversely, 13.77% is zoned for low-density residential.

Further focus should be paid towards integrating the sites' surrounding context. Essentially, the plan should focus on connecting the nearby open space amenities and complementing the existing low-to-medium density residential bordering the site.

The majority of the sites surrounding the study area is low density residential, medium density, parks and institutional. The Town composting depot will be relocating in the near future and should be added to the CDD lands for consideration in this secondary plan. The Town should further consider adding four of the undeveloped Low Density Residential properties along Main Street that border the development. These additional lots could provide access or a face for the development on Main Street. Since the town owned stormwater park behind Olsen Drive may be critical to the stormwater management for this development, there may be merit in adding this parkland to the study area as well.

While the majority of development is focused on catering towards single-family homes, it is critical to integrate housing that considers a variety of age groups, lifestyles, and demographics. As was previously noted, Wolfville's middle-aged population is below the provincial average, whereas their young-adult and senior populations are above average. Additionally, over half of its population is single. To retain and attract younger families and single people, it is critical to plan residential zoning designations that support a variety of income levels,family types, and ages.

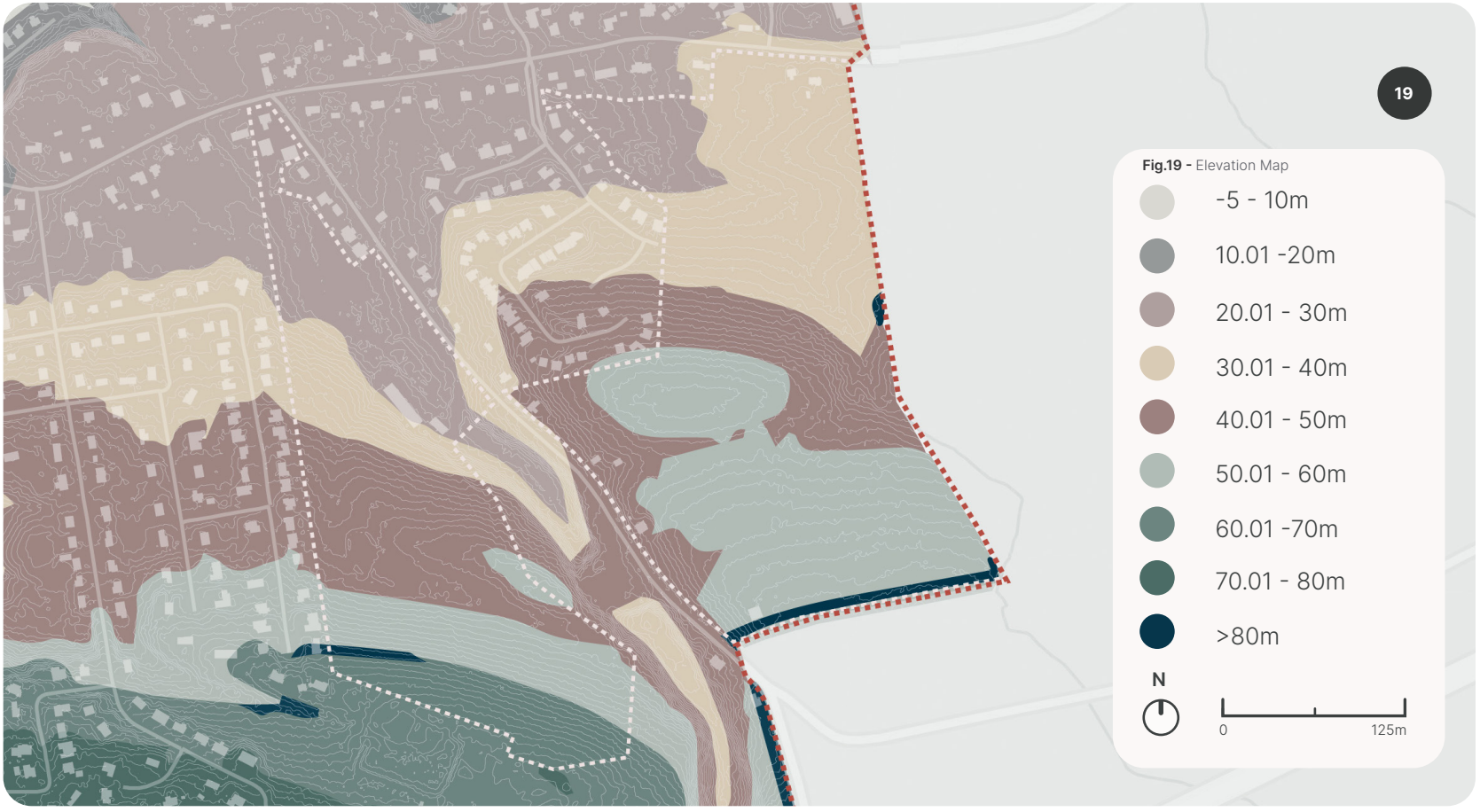


Fig.19 - Elevation Map

Elevation

There is significant variation between the site's highest (70m) and lowest (24m) points. The highest point of the site is 70m and is found near Reservoir Park.

The elevation profile descends northward towards Wolfville's waterfront. The lowest point in the study area can be found near the intersections of Maple Street and Main Street. A deeply entrenched watercourse runs along Maple Street which rapidly drops in grade by up to 10m in the steepest locations.

While this entrenchment creates challenges for road construction, it may present the opportunity for a bridge with a riverside trail underneath it. A smaller watercourse runs along the eastern boundary of the site which is much less entrenched and drains a much smaller watershed.

Higher elevations to the north would offer view sheds towards the waterfront, Wolfville's downtown, and the Minas Basin, and should be considered in the orientation of future development. The excellent views to the Minas Basin to the north should help to orient roads and development to maximize viewsheds for development.

Slope

Slope conditions have a significant effect on how new neighbourhoods can be built and designed.

This map indicates significant slopes (>20%) along the edge of the entrenched river and Reservoir Park ponds in the western lobe of the study area. The light green colours indicate preferred lands for development and the darker green indicates steep areas that will require retaining to develop. Overall, a significant portion of the site is between 8-20%, which will affect development and the location of future buildings. We anticipate the need for many of the units to have a full storey (or more) of grade change between the back and front of the units. Slopes ranging from 12% to 20% can be developed, but will require retaining walls, cut and fill, and terraces to be considered usable. In these areas it will be difficult to retain vegetation due to the mass cut and fills. Slopes >20% will require special measures and significant retaining walls and terracing to develop and these sites will be more costly and it will be unlikely that single storey buildings would be able to be considered.

Slopes of <1% will have drainage issues, and could flood during significant rainfall and tidal events.

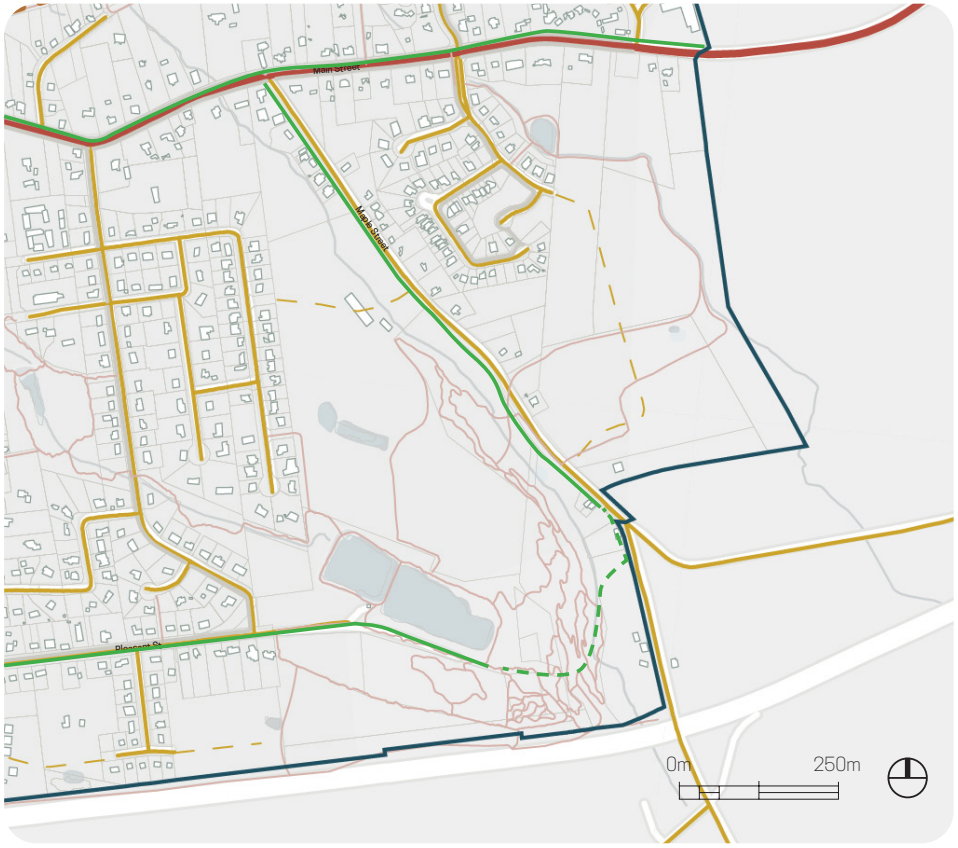
Soil

The study site mainly consists of Wolfville soil, which can be defined as well to moderately, to well drained, with very strong to medium pH content. Wolfville soil is described as having a dense, medium to moderately fine texture with mixtures of boulders, sand, silt, and clay. The soil has slow permeability and a firm and plastic texture.

Torbrook soil is found in the site's northern portion. Torbrook is considered extremely acidic with a pH <5.6, primarily composed of mineral particles, with a coarse skeletal texture, and a rapidly draining texture.

The bedrock below the soil profile is a middle member of the Horton group (eCHh(m). eCHh(m) is a fine-grained mud-rock dominated member of the Horton Bluff Formation, including cycling sequences of grey clay shale, fine sandstone, siltstone, fine sandstone, green mudstone, or siltstone.

Fig.22 - Maple Ridge Lands Aerial



LEGEND

- Major Arterial
- Local Road
- Future Road
- Trails
- Sidewalk
- Railway
- Wolfville AAA AT Network

Road Classification

Main Street, Wolfville's main major arterial, straddles the site's northern boundary and the Harvest Highway (HWY 101) forms the southern boundary. There is 9.1km between exit 10 and exit 11 with Maple Avenue being roughly in the middle. NSTIR may identify Maple Avenue as a potential future interchange site as a result of Council direction based on further traffic analysis, future development potential and its strategic location. This could make Maple Avenue a key gateway into the Town, helping to resolve some of the very real traffic challenges on Main Street. With the real likelihood of this happening at some point in the near future, Maple Avenue would, like Main Street, become a major 'controlled access' collector road instead of a minor collector. The significant traffic that could arise from this collector road means that the intersection between the Kenny lands and Maple Ridge lands may require either a signalized intersection or a roundabout.

Olsen Drive will connect to the Maple Ridge lands as a local road and there could be a future connection to the site from Main Street at the end of Woodman Road. Any other potential connections to the development from Main Street would be restricted due to road offset restrictions from other existing streets.

On the Kenny Lands, two right of ways have been reserved as future connections from Bishop Avenue. Both road connections may not be needed. There are also two potential connections to Maple Avenue if the Town is wiling to move its composting facility to create a future development site.

The Town's AT Plan calls for a future connection between Pleasant Street and Maple Street, potentially through either lobe of the development. The walkability of the new neighbourhoods should be underscored with sidewalks and local trail connections throughout. Potentially using the rivers as a backbone for future open space trails.

LEGEND

- Bus Stops
- Coldbrook Route - Kings Transit
- Maritime Bus
- Future Transit and "AAA" Active Transportation

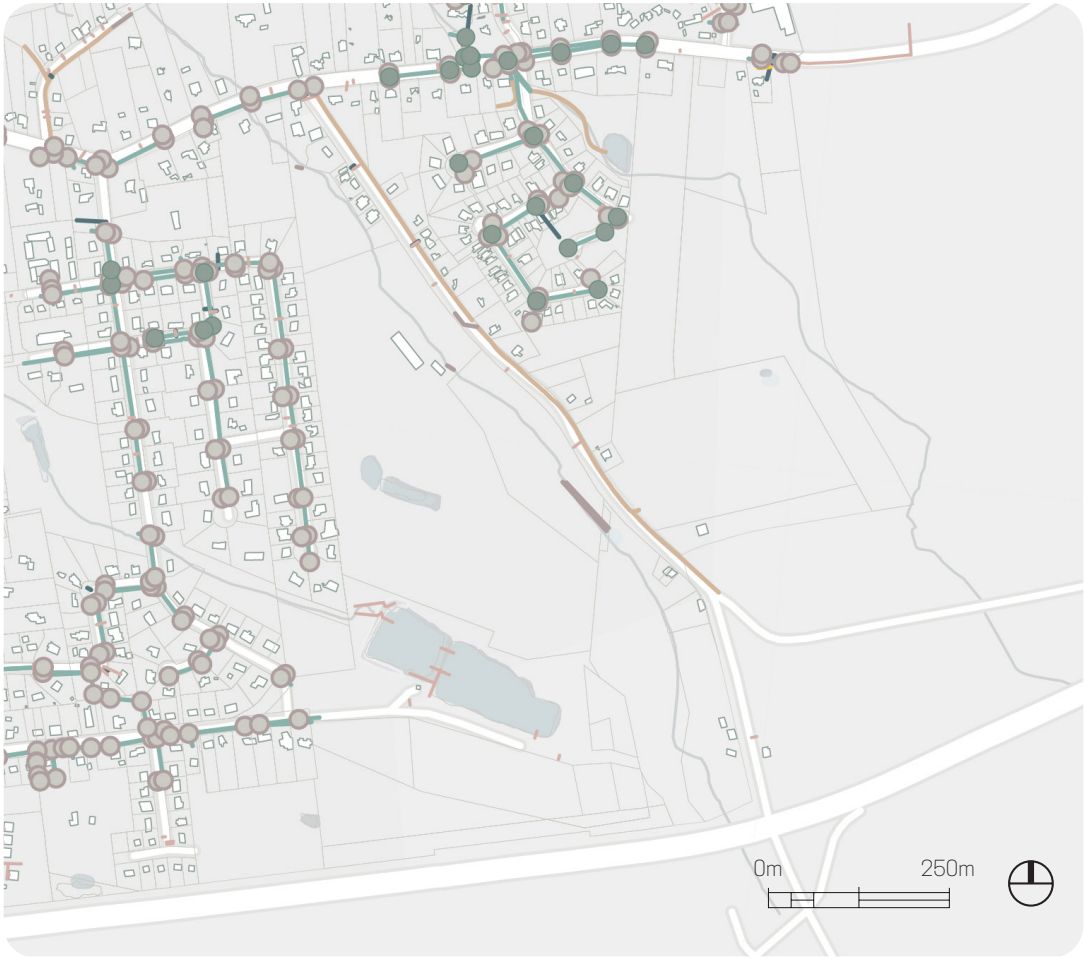
Bus Routes

There are two bus routes running along Main Street towards the north end of the site. The Coldbrook Route connects the area to Grand Pre and Greenwood.

Maritime Bus connects the area to Halifax and the rest of the maritimes. Though not featured on the map, Acadia Bus lines has two nearby stops at Acadia University.

With an anticipated density of 800-1000 units, future collector roads on both the Kenny Lands and Maple Ridge Lands should plan for bus stops in the future. Again, the connectivity between the two developments at a common intersection on Maple Avenue would be beneficial for future transit connectivity between the two parcels. These collector roads should also consider the integration of All Ages and Abilities bike lanes to provide future connections between transit and active transportation in the developments.

The Town has also been looking at microtransit options that would become much more viable as this area is built-out.



LEGEND

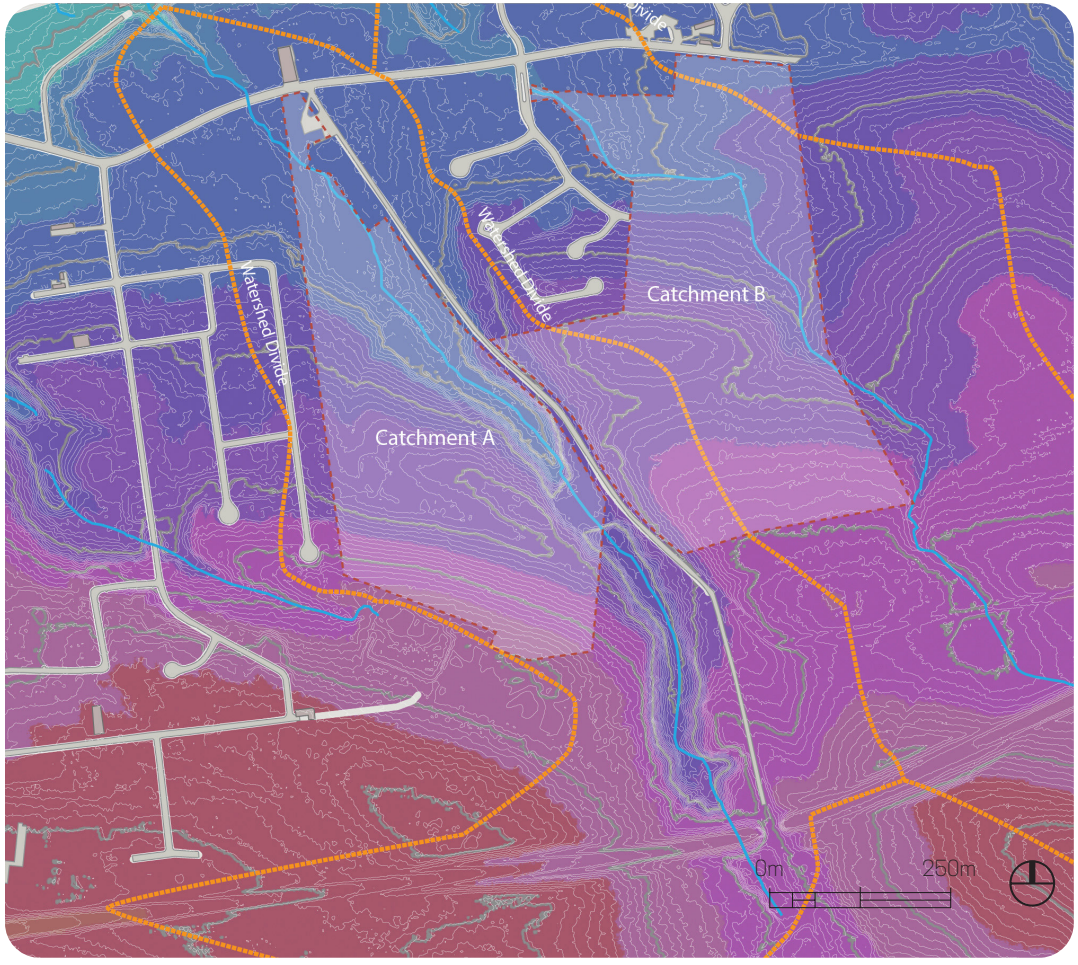
- Manhole
- Catch Basin
- Lateral Line - Water
- Culvert
- Stormwater Main
- Ditch
- Secondary Lateral Line
- Lateral Line - Sewer

Servicing

The future developments will be fully serviced by water, sanitary sewer, and stormwater services. With the future street upgrades to Maple Avenue, the ditch should be replaced by catch basins and curb and gutters and/or a combination of stormwater gardens along the length feeding into the ephemeral Kenny creek to the south. The creek restoration could be an important project for the future since its current ecological value seems to be relatively low. Daylighting of Kenny creek should be a goal for the Town.

The two parallel creeks that run through the Kenny Lands and Maple Ridge lands will be an important backbone for stormwater management and future trail systems.

Attached is an information report from the Town's Engineer that includes analysis and background studies from EXP and CBCL consulting engineers

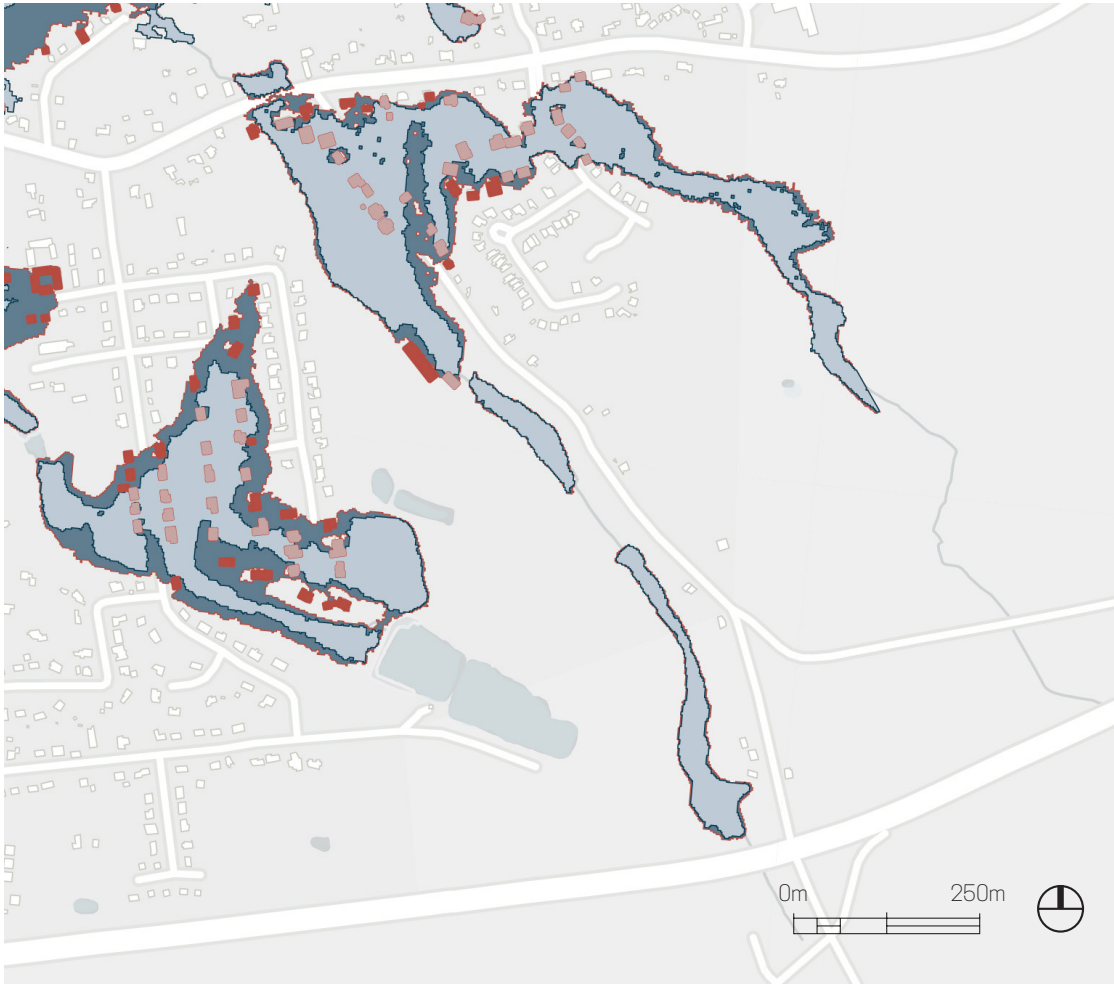


Watersheds

There are two watersheds draining the properties.

Catchment A covers all of the Kenny lands and part of the Maple Ridge lands as well as all of Maple Avenue. The catchment drains to Kenny Creek which is a highly entrenched valley comprised of open channel hydraulics and culverts below infilled areas. It is unlikely that the stream is habitat for fish but appears to be high value for invertebrates, amphibians and other local fauna. Restoring this creek should be a high priority for the town and developers. The creek has a defined trail system along its southern reaches but is absent from its northern lower reaches at it approaches Main Street due to private property.

Catchment B covers most of the Maple Ridge lands except the southern portion which drains into catchment A. The watershed is significantly less entrenched than Catchment A and feeds a gentle meandering ephemeral creek. Even at its lower reaches, the creek has low or no flow in the summer months but steady but low flow in the wetter spring season. Most of catchment B services agricultural land in its headwaters. This creek feeds into the stormwater pond and park near Olsen Drive. Preserving this creek will be an important part of the future development plans. Future road crossings of this creek may require culverts where the road and creek intersect.

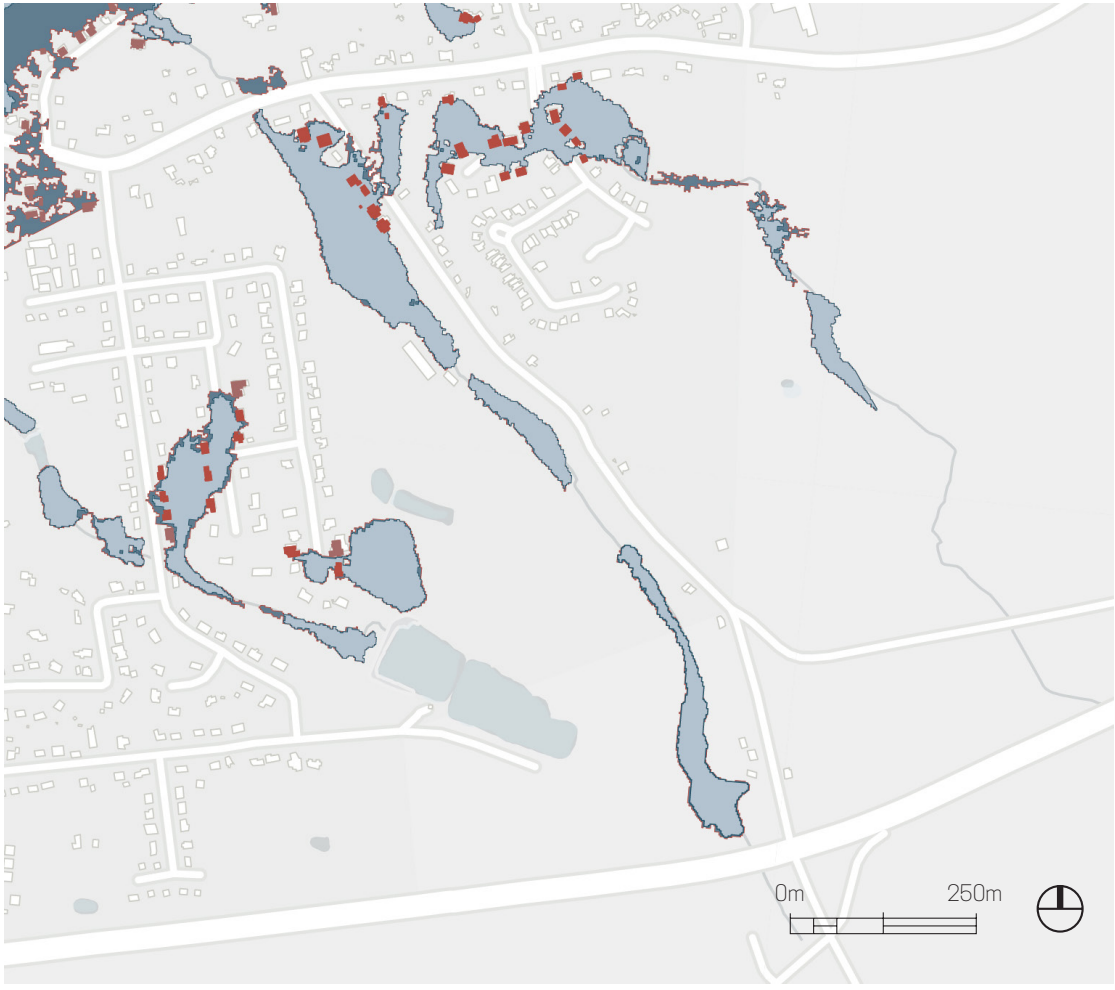


LEGEND

- 100 Year Rainfall - Existing
- 100 Year Rainfall - Future
- Infrastructure at Risk - Existing
- Infrastructure at Risk - Future

100 Year Rainfall Projection

Compared to twenty year rainfall projections, it is anticipated that the study site will experience heavier rainfall in the future. Consequently, several existing buildings are at risk due to flood events. To ensure the longevity of the study site, designs should consider avoiding building where flooding is anticipated, or flood mitigation measures should be implemented in the design.
As previously stated, stormwater infrastructure should anticipate heavier rainfall in the future.

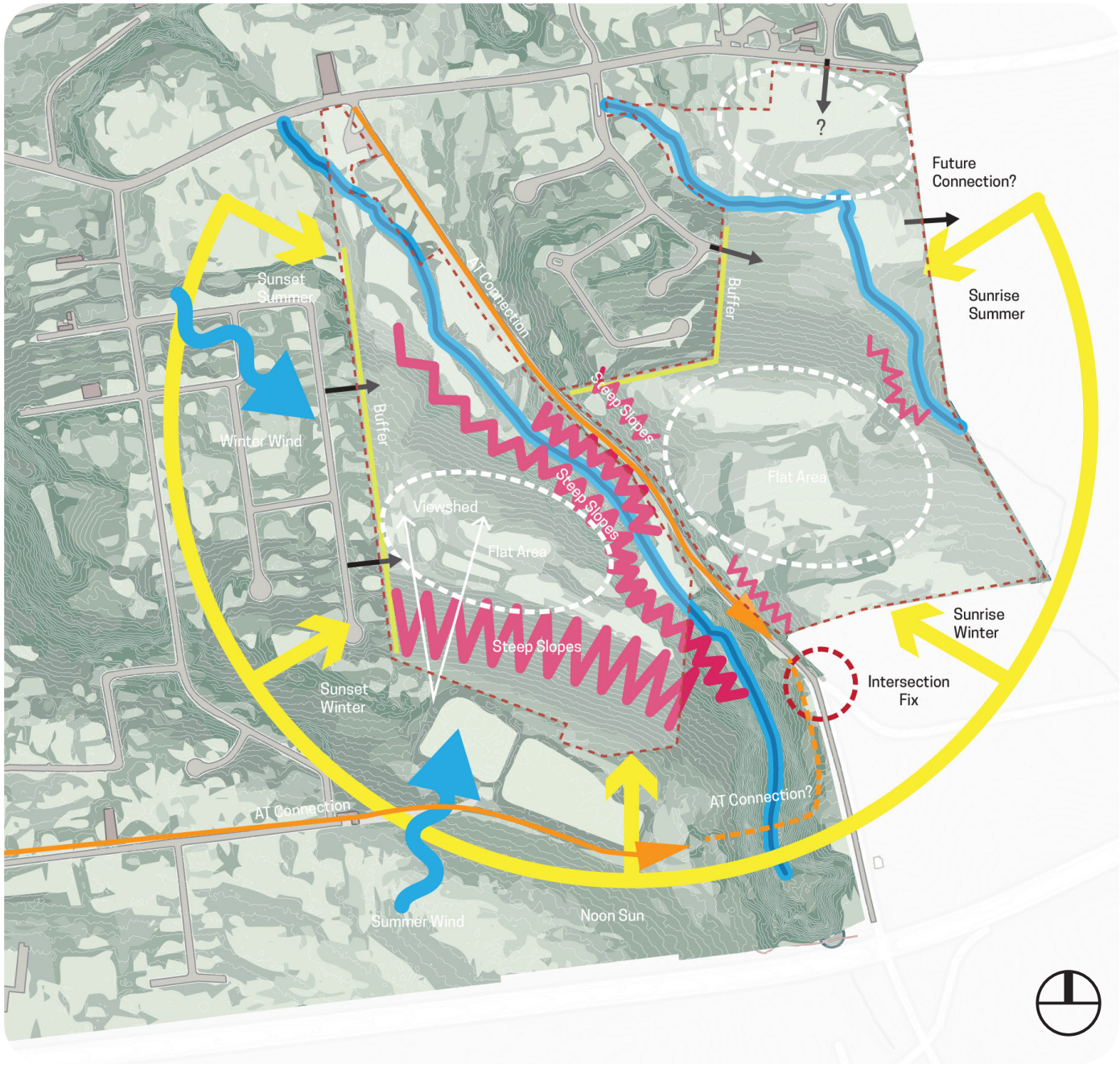


LEGEND

- 100 Year Rainfall - Exisiting
- 100 Year Rainfall - Future
- Infrastructure at Risk - Existing
- Infrastructure at Risk - Future

100 Year Tidal Projections

Wolfville's East End will experience tidal flooding in the future that will affect existing infrastructure. Planning and design should consider flood mitigations methods to protect current and future infrastructure.


?
Future Connection?
Sunrise Summer
Sunset Summer
AT Connection
Buffer
Steep Slopes
Winter Wind
Buffer
Steep Slopes
Viewshed
Flat Area
Flat Area
Steep Slopes
Sunrise Winter
Intersection Fix
Sunset Winter
AT Connection
AT Connection?
Summer Wind
Noon Sun
LEGEND
Steep Slopes
Flat Area
Steep Sites
Prevailing Wind
Solar Path
Neighbourhood Connections
AT Network

Inventory Analysis

The site analysis is a culmination of all the opportunities and constraints of all thematic maps that will contribute to making this a special community for existing and future residents. The future plan should consider:

1. The steep slopes on the site will present development constraints that can be addressed by multi-storey buildings, retaining walls, cut and fill, etc. These areas will require special consideration for development to minimize site impacts and retain connectivity to surrounding parcels.
2. Similarly, the flat areas on the site present opportunities for lower cost development and are the primary areas for density and development.
3. The entrenched stream corridors on both sites (west and east) could present an opportunity for a trail system and to preserve the riparian corridor including stream shading in the 20m buffer corridor.
4. There should be some setbacks and/or buffers where development borders along existing R1 homes.
5. The sites are well protected from the prevailing summer winds from the south west but they will be exposed during the winter prevailing north westerly winds. A planned urban forest will be important to minimize environmental impacts.
6. Much of the study area is north facing slopes so there could be reduced sunlight and hence the need to plan for improved solar exposure in the development.
7. The reservoir Park Viewshed needs to be formally defined to preserve the view corridor.
8. There are several potential future connections into this site from Maple Street and from other surrounding neighbourhoods that will need to be considered.
9. The Triple A AT network will need to be routed from Reservoir Park, through the development down to Maple Street. There may be potential to connect to Main Street through the eastern lobe of the development.

Chapter 03

Traffic Analysis

This chapter outlines the existing and future anticipated transportation conditions on the road and active transportation networks impacted by the development. The analyses included an existing conditions scenario, a future 20 year scenario with the full development operational, as well as a scenario where a future interchange is constructed on Highway 101 near the south end of Maple Avenue. The first two scenarios help maintain the current driving "character" of Wolfville, while the interchange scenario would be expected to an more significant regional transportation impacts. The analysis methodology and findings are laid out within this section of the report.

3.1 EXISTING CONDITIONS / CONTEXT

The proposed development is located in the eastern portions of Wolfville in an area that could be described as a transition area between the core residential and commercial areas of Wolfville, to the more rural farmland and woodland properties that characterize the areas between Wolfville and Exit 10 on Highway 101. While there are many roadways that cross Highway 101, the only direct access to Wolfville and the Route 1 (Main Street) corridor are at Exit 10, about 6 kilometers east, and Exit 11, about 3 kilometers west of downtown Wolfville.

The east and west sides of the development area straddles Maple Avenue and cause Maple to become a primary transportation corridor to service the site. This makes sense from a Road hierarchy perspective with Maple likely to become a major collector roadway, connecting to Main Street - the "arterial" roadway.

Given the magnitude of the development, it also essential to service the development from multiple points of access to better accommodate area traffic operations, emergency vehicle access, and a host of other benefits that multiple access points provide. As such, the preliminary layout provides multiple access points to Maple Avenue, one additional primary access to Main Street as well as multiple secondary access points that help interconnect and complete the local road networks south of Main Street.

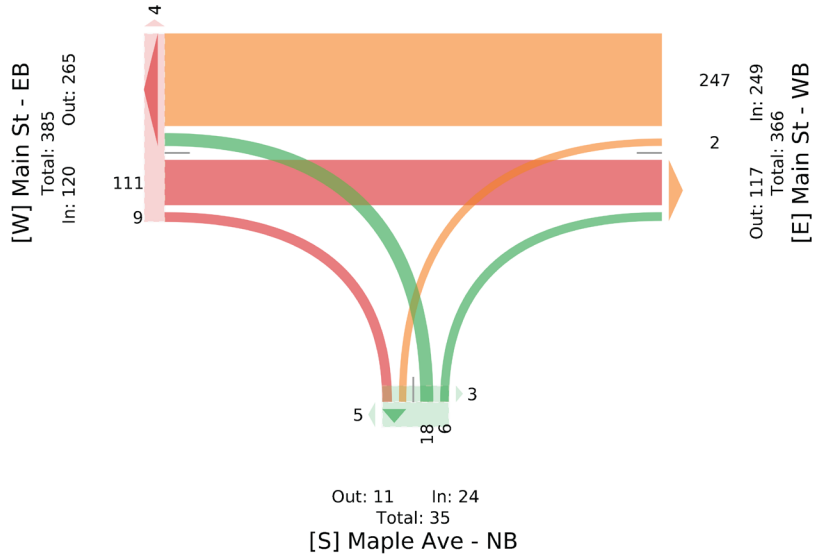
3.2 TRAFFIC CONDITIONS

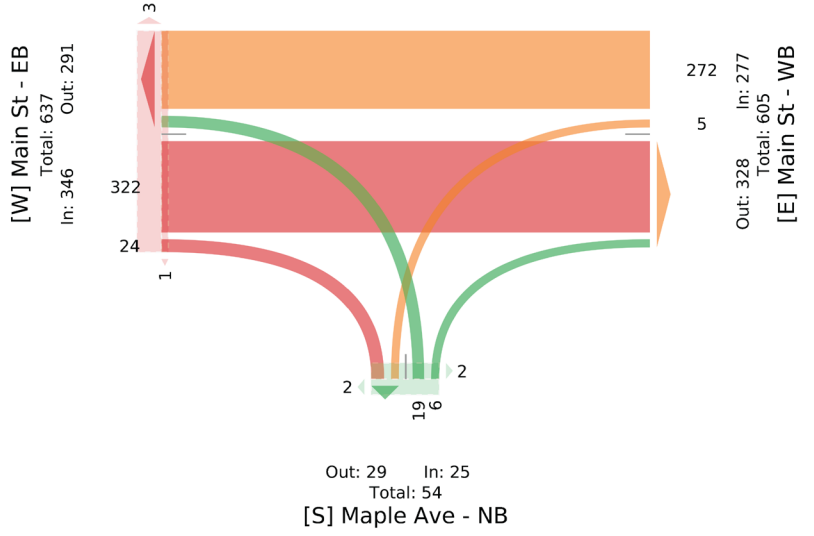
Existing Traffic

Existing traffic data was collected from the Town of Wolfville in the vicinity of the development including road section volumes, speed and classification data on Main Street. Fathom also completed a automated traffic count at the intersection of Main Street with Maple Avenue in late October 2022 using the Miovision automated traffic count technologies to complete the work. This count period is considered representative was considered representative typical network conditions as schools and university related traffic is present on the roadways, along with typical commuter based traffic volumes. Counts were completed for the weekday AM, noon and PM peak hours.

The figure to the top right shows the count results for the PM peak hour (3:30 - 4:30 PM) and shows close to 300 vehicles in each direction on Main Street with slightly higher volumes in the eastbound direction. Volumes during the AM peak hour (8 - 9 AM) are less than the PM peak and favour the westbound (inbound) direction. Both count periods show that existing volumes on Maple Avenue are very low with about 25 vehicles on Maple during both peak periods. Traffic volumes on other local roadways in the area are similar or less than Maple Avenue.

A SYNCHRO/SimTraffic transportation model was prepared for the study area (as discussed in greater detail in the next sections) and analysis results show that all existing intersections and roadways in the study area operate at a high level of service.





3.3 TRIP GENERATION

The Institute of Transportation Engineers (ITE) Trip Generation Guide (10th Edition) was used to estimate trips to and from the development during the weekday peak hours. The tables at the bottom of this page show the overall trip generation estimates for the average weekday, average Saturday and for the critical weekday AM and PM peak hours.

It is important to remember that while the average weekday volumes appear high, they are distributed over a 24 hour period. For example, a total of 9300 trips during a typical weekday, distributed over 18 hours during the day and split by direction, results in about 1 new vehicle every 15 seconds in a given lane. Then further distribute this traffic over 3 main inbound and outbound direction and this may equate to about 1-2 new vehicles per minute at a specific location in the network.

The numbers shown in the tables below represent 100% of the ITE trip generation rates. In reality based on experience and supplementary studies, actual trip generation rates are typically less than those predicted by the ITE guide. For the purposes of this study, it is assumed that 80% of the ITE rates will be used for the purposes of analyses.

Land Use	Trip Code	# Units	Variable	Weekday			AM Peak			PM Peak			Saturday		
				Enter	Exit	TOTAL	Enter	Exit	TOTAL	Enter	Exit	TOTAL	Enter	Exit	TOTAL
West Side of Maple Avenue															
Single Unit Housing	210	13	Units	62	61	123	3	7	10	8	5	13	62	62	124
Town Houses	220	44	Units	161	161	322	5	15	20	16	9	25	179	179	358
Mid-Rise No Commercial	221	646	Units	1760	1759	3519	55	158	312	162	104	266	1191	1190	2381
Mid-Rise w/ Commercial	231	117	Units	201	201	402	10	25	35	29	13	42	-	-	-
SUB-TOTAL TRIPS (WEST)				2184	2182	4366	73	205	278	215	131	346	1432	1431	2863
East Side of Maple Avenue															
Single Unit Housing	210	31	Units	147	146	293	6	17	23	20	11	31	148	148	296
Town Houses	220	70	Units	256	256	512	7	25	32	25	14	39	285	285	570
Mid-Rise No Commercial	221	620	Units	1689	1688	3377	53	152	205	156	9	255	1151	1151	2302
Mid-Rise w/ Commercial	231	220	Units	379	378	757	18	48	66	55	24	79	-	-	-
SUB-TOTAL TRIPS (EAST)				2471	2468	4939	84	242	326	256	148	404	1584	1584	3168

3.4 TRIP DISTRIBUTION / ASSIGNMENT

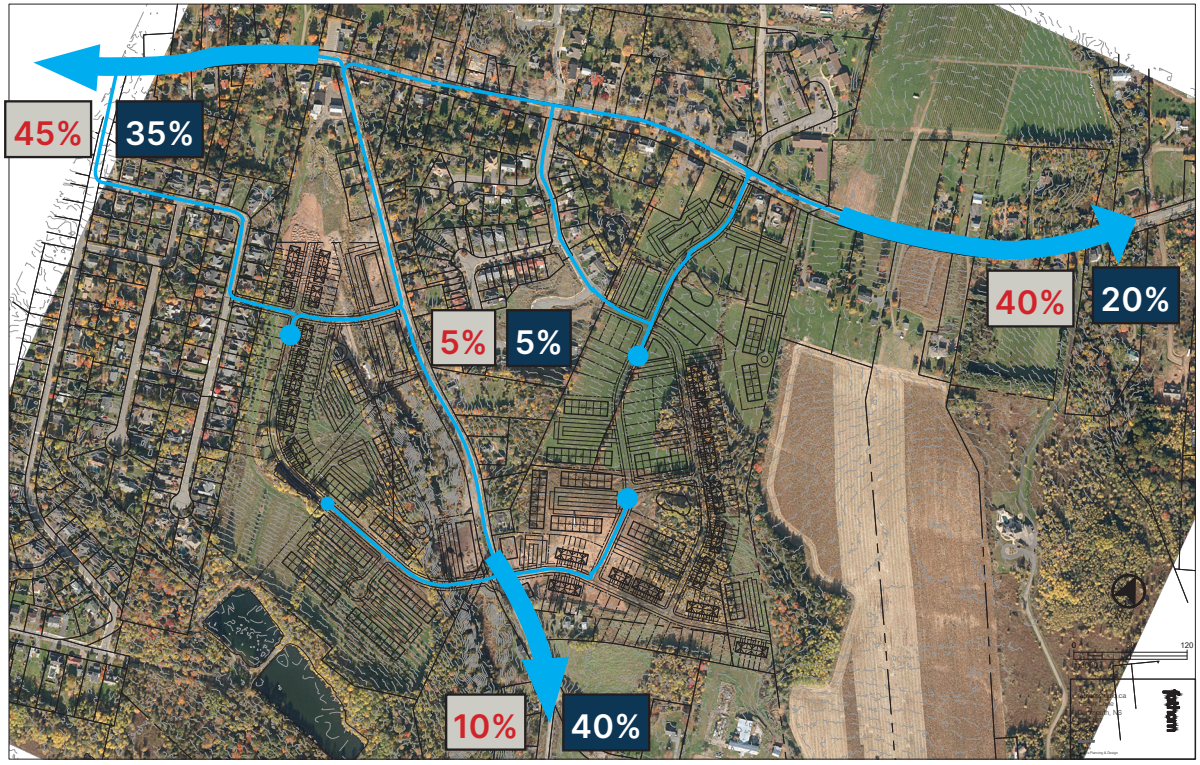
There are two primary scenarios for trips to and from the new development:

45% Existing Road Network - no new interchange to Highway 101 and traffic is expected to distribute itself throughout the existing road network. It is assumed that trips will:

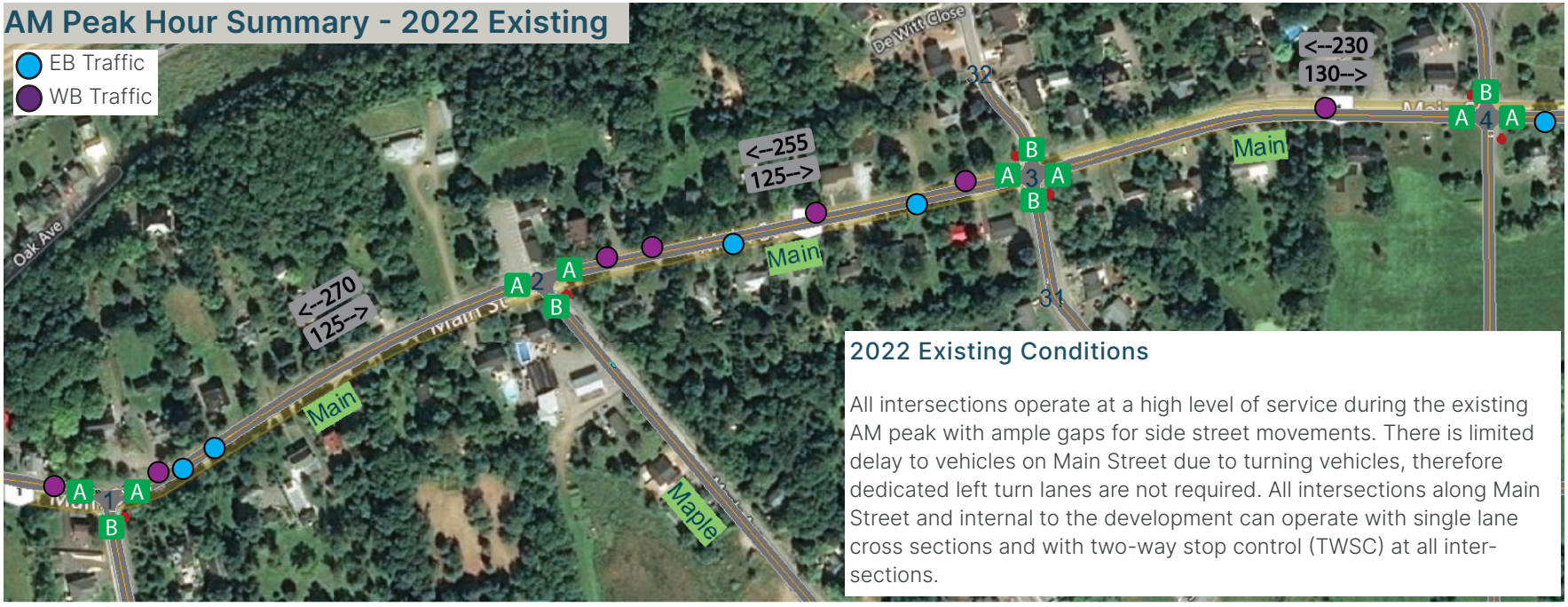
- Generally favour movements to and from the core area of Wolfville including trips destined to and from New Minas, Port Williams and points beyond,
- Include significant travel to and from the west along Main Street toward Highway 101 including trips to Windsor and HRM,
- A smaller portion of trips may be expected to use Maple Avenue towards the south including destinations on the north and south side of Highway 101
- A smaller still portion of trips are expected to distribute themselves internal to the development area. Existing Road

35% Network with Interchange - includes a new interchange to Highway 101 at Maple Avenue with the remainder of the road network remaining similar to existing conditions.

- Most trips from this area destined to and from Highway 101 that would otherwise travel east or west on Main Street will use the new interchange due to its close proximity to the development,
- Maple Avenue will draw traffic from a larger catchment area to directly access the highway, though most traffic from the west end of town is still expected to use Exit 11.
- Remaining trips will distribute themselves in a similar manner as described under the existing conditions scenario.



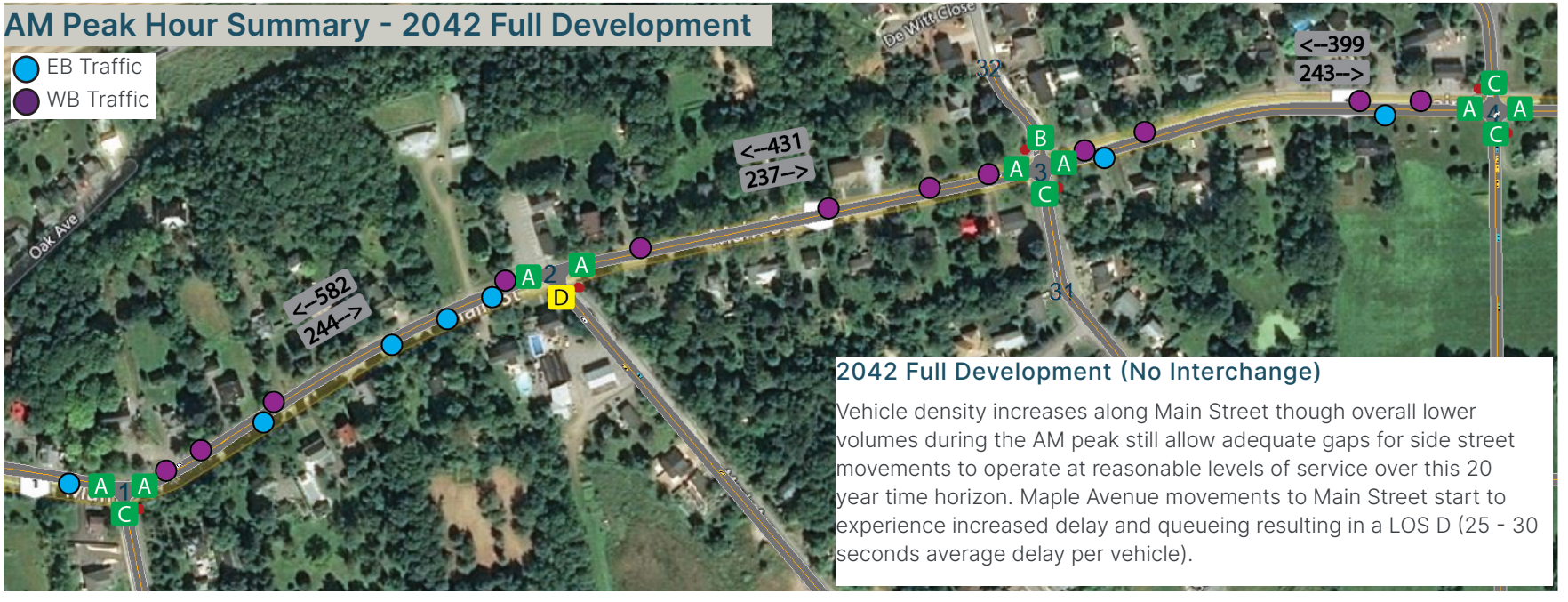
AM Peak Hour Summary - 2022 Existing



2022 Existing Conditions

All intersections operate at a high level of service during the existing AM peak with ample gaps for side street movements. There is limited delay to vehicles on Main Street due to turning vehicles, therefore dedicated left turn lanes are not required. All intersections along Main Street and internal to the development can operate with single lane cross sections and with two-way stop control (TWSC) at all intersections.

AM Peak Hour Summary - 2042 Full Development



2042 Full Development (No Interchange)

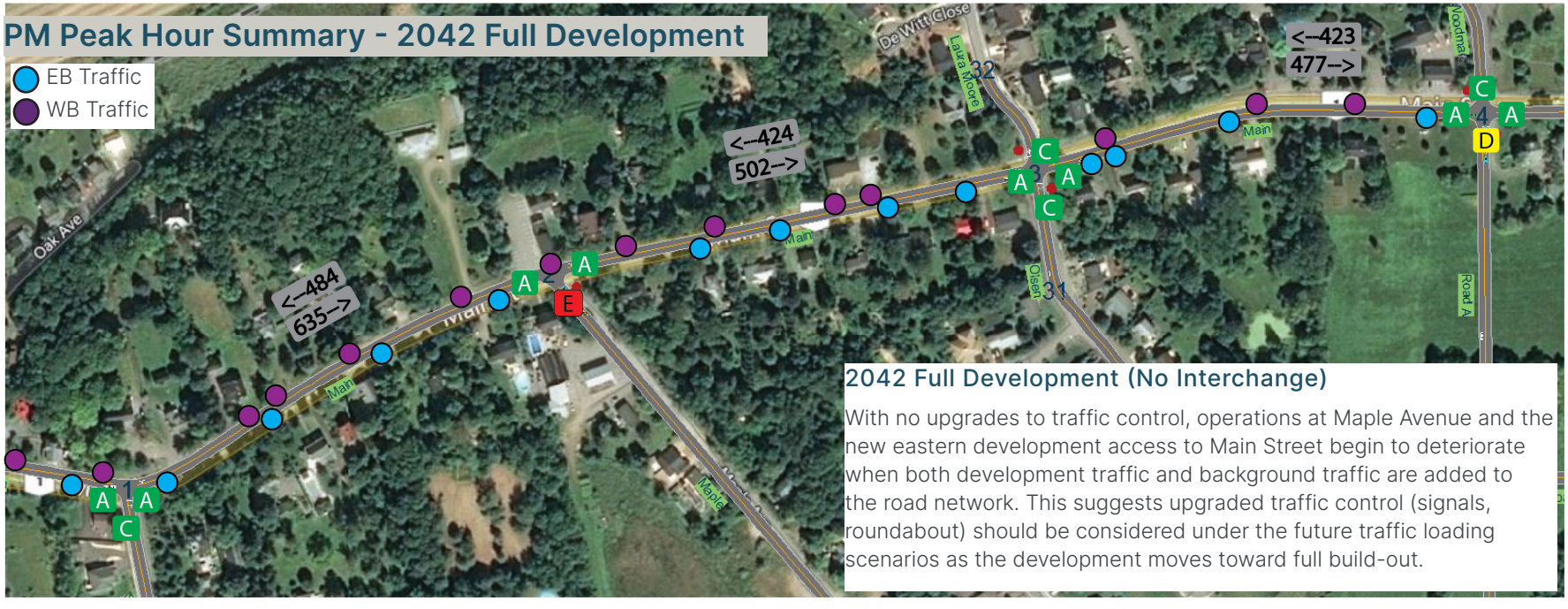
Vehicle density increases along Main Street though overall lower volumes during the AM peak still allow adequate gaps for side street movements to operate at reasonable levels of service over this 20 year time horizon. Maple Avenue movements to Main Street start to experience increased delay and queueing resulting in a LOS D (25 - 30 seconds average delay per vehicle).

PM Peak Hour Summary - 2022 Existing

2022 Existing Conditions

Overall volumes on Main Street are higher during the PM peak hours as compared to the AM or Noon peak hours, while volumes on minor roads including Maple Avenue are similar between peaks and relatively low. Despite the higher volumes, analysis results are similar for the existing PM peak hours with all intersections operating with very good levels of service on the existing road network.

PM Peak Hour Summary - 2042 Full Development



2042 Full Development (No Interchange)

With no upgrades to traffic control, operations at Maple Avenue and the new eastern development access to Main Street begin to deteriorate when both development traffic and background traffic are added to the road network. This suggests upgraded traffic control (signals, roundabout) should be considered under the future traffic loading scenarios as the development moves toward full build-out.

3.5 KEY FINDINGS - PRELIMINARY ANALYSIS

1. Overall network traffic volumes are higher during the PM peak hour as compared to AM peak or Noon peak hours.

2. The critical AM and PM peak hours of traffic operate at very good levels of service under existing conditions on the existing road network which consists of basic two lane cross sections and two-way stop control on the minor roadways.

3. The analysis scenarios in this report considered existing 2022 traffic conditions and a 20-year horizon at 2042. Traffic growth up to the 2042 scenario includes the addition of general network traffic growth (average of 1% / year) plus the addition of the new development traffic.

4. Under all scenarios, the internal intersections as well as all intersections along Maple Avenue operate at very good levels of service with basic 2-lane roadway cross sections and minor road stop control, and are therefore not discussed in any further detail.

5. On Main Street, the future AM peak scenario operates at good level of service throughout all scenarios including scenarios with no new interchange present. The only challenging movements is the northbound left turn movement on Maple Avenue to Main Street which deteriorates to Level of Service D, though this is still considered a reasonable level of service during peak hour operations.

6. The more critical PM peak hour sees deterioration of service to LOS E at the Main Street intersection and LOS D at the new eastern development intersection at Main and Woodman Drive. Such operations suggest that upgraded traffic control (traffic signals or roundabout) should be considered at the Maple / Main intersection as the development approaches full build-out.

7. Should signals be implemented, the intersection will also likely require the construction of a westbound dedicated left turn lane to minimize impact to through vehicles on Main Street.

8. These improvements are not require until a significant portion of the development is constructed. Background traffic growth and growth related to the development should be monitored over time and the need and timing for upgraded traffic control and roadway cross section modifications should be reviewed.

9. A new future interchange be constructed on Highway 101 at/ near Maple Street mitigates the need for the above noted improvements. Analyses suggest that with the addition of a highway interchange, operational conditions revert back to measures of performance that are similar to existing roadway conditions.

10. The analyses suggest that the new highway interchange is not an essential component of supporting this development. If it is not constructed, then the above notes traffic control measures will most likely need to be pursued.

11. Regardless of the future network conditions, it is clear that Maple Avenue will take on a more significant role in the network hierarchy and therefore should be upgraded over time to support the higher services levels that it will be expected to accommodate.

Chapter 04

Consultation

As part of this secondary plan, the Town and its consultants, hosted a wide range of engagement sessions to hear from the community over almost a year compiling this plan. These included individual stakeholder interviews, 3 open house events, an online open house, on online survey through the Wolfville Blooms platform, several meetings and presentations with council and the Planning Advisory Committee, and a draft presentation of the plan in late 2022 (to follow).

3.6 CONSULTATION SESSIONS

Wolfville Blooms

An online survey was prepared and launched in December 2021 and was shut down in September of 2022. Over the 8 months that the survey was running, there were 1600 visits to the site and almost 100 responses to the survey. The site provided resource materials like the "Community Workbook" and various presentations, committee agendas, timelines and schedules as well as the online survey.

The site allowed the community to stay informed about the progress of the project throughout late 2021 and throughout 2022. The results of the survey were assembled by the planning department and comments are visible online at Wolfville Blooms.

Open Houses

Staff and consultants held four open house events during the week of May 30th, 2022. Three of these sessions were in-person, with two evening sessions at Lightfoot Winery from 7-9pm, and one day time session at the Wolfville Fire Department from 2-4pm. An online open house session was held virtually on Zoom from 7-9pm on June 1, 2022. The events, provided an opportunity to present initial ideas, to listen to community about issues of concern or excitement, and to gather detailed feedback on a variety of topics that will shape the future of the East End.

No official count was taken of the number of attendees; however we estimate that roughly 130 people attended the 3 in-person sessions, and 39 people RSVP'd to the virtual session. A total of about 170 community members participated in the open house sessions.

Stakeholder Interviews

The Town hosted several one on one interviews with adjacent land owners and developers throughout this process.

Wolfville Blooms
Dec-May

1.4k

Visits to the Site

Wolfville Blooms
May-Sep

67

Online Survey Responses

Open House Sessions

4

Wolfville Blooms
May-Sep

67

Online Survey Responses

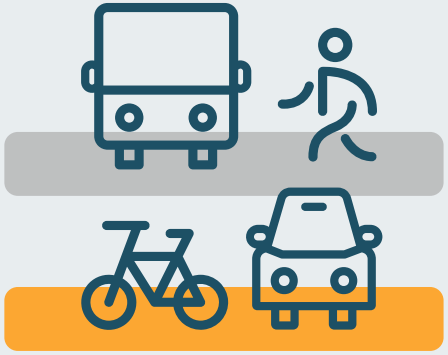
3.7 What we heard

With hundreds of responses and ideas over the course of preparing this plan, the following summary of feedback has been characterized by the categories show here.

Land use

Housing

Green open spaces



Transportation

Services

3.8 WHAT WE HEARD

With hundreds of responses and ideas over the course of preparing this plan, the Town assembled a full "What We Heard" summary that was presented by staff on June 9, 2022. At this stage of the council update, the online survey was still being assembled but the presentation provided a good intermediate touchpoint following the open house sessions.

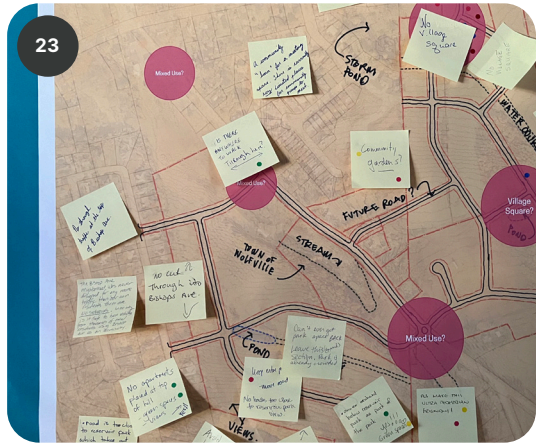
The following summary of feedback is an amalgamation of all the different events summarized below. It's important to note that there are always contrary opinions to the popular opinion, but the suggestions below form the basis of the popular opinions from the engagement sessions.

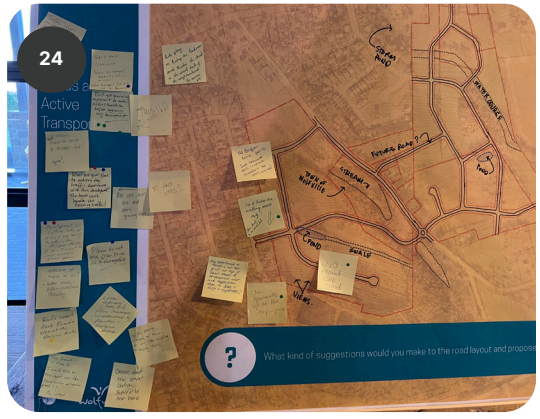
Land use

Though most people understood the Towns density goals for this project as outlined in the MPS, there was still some dissenting opinions (though a minority) that the lands should be preserved as open space and agricultural reserve. However, most participants supported the increased density if it allowed for better and more connected open spaces, better quality architecture, preserving the stream corridors, affordability, enhanced stormwater management, a mixed use village core, etc. Respondents were generally supportive of densities in the range of 15-20 units per acre as long as the development was well planned and coordinated. It was also noted that the Mixed density at Woodman's Grove seems to have struck a good balance, and people generally supported the buffering between low and high density areas.

The demand for public amenities was expressed repeatedly. Top requests were: a village square, a municipal pool, a skating rink, recreation opportunities for youth (community centre), public washrooms, another school and small shops for essentials, while preserving agricultural land and the "small town feel".

Participants liked the idea of a local "village square" for both developments which would have a mix of commercial and residential uses surrounding signature open spaces. People liked the idea of other walkable amenities, like a coffee shop, food vendors (local only), a convenience store and a community





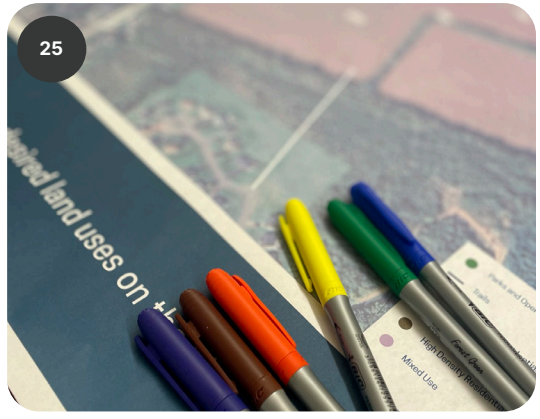


Fig.23 to Fig.25 - Community Workshop Sessions

building. The village square spaces should be usable all year long, be AT friendly and connected, and should include public event spaces, wifi access and feature public art.

In future terms, several facilities were proposed to take under planning considerations. The most commonly mentioned were: community recreational space (multi use), schools, daycares, health care facilities, a nursing home, a library and a First Nations space. Other facilities were also suggested although by fewer participants, and those were: parks, playgrounds, churches, a post office, co-workspace, swimming pool and a youth/teen centre.

The planning team did communicate to the public that market feasibility would dictate the availability of these other uses. For example, people may want a community hall or a local pool, but the market would dictate the feasibility of these ideas so the plan was not required to enforce these ideas on the developers.

Housing

Residents love the small town charm and architectural heritage of the Town's building stock. Participants recognize though that the East End plan will require new forms of housing that are more affordable including narrow lot housing, garden cluster housing, townhomes, semis and apartment buildings. That does not mean though that the architectural character of the new housing needs to be compromised.

While there was general agreement that 3-storeys is the traditional height in Wolfville, some participants saw the benefit of higher building heights (4-8 storeys) in order to preserve more open space. A majority of participants felt the highest buildings should remain between 3 and 4 storeys.

There were also suggestions for student and rental housing as well as inter-generational housing.

When housing was raised as an issue, the main concerns were for affordable housing, high quality architecture (neo-traditional and modern) and sustainable

design. Local architectural styles with authentic building materials should be required for all scales of housing. As it related to affordability, new housing should be inclusive of young or low income families, single professionals and students. Dedicated seniors facilities should be part of the mix and these facilities should be located ideally close to walking trails and the village centre.

Another concern highlighted was accessibility. Design should meet highest accessibility standards to encourage multi-generational houses and care facilities.

Transportation

The key topic relating to transportation was to ensure walkability in future communities. This means sidewalks on all streets, connected trail networks, and active transportation on main collector streets. Participants expressed the need of wide sidewalks, street lighting, street trees for shade and to reduce wind, separate bicycle lanes, microtransit service, traffic calming on selected streets and improving safety of pedestrians and public space users.

Streets widths should be right-sized for the traffic volumes. Rather than designing streets extra wide for snow removal, streets should be narrowed to reduce vehicle speeds and to provide a shorter crossing distance.

A majority of the participants agreed that AT (active transportation) has an importance in the East End plan and should be reflected in some of the new street designs. AT Should favour Triple AAA off-street bike lanes rather than onstreet bike lanes which are less safe. New bike lanes should be well connected to the Town's growing network, and especially to the university and downtown.

Additional recommendations included: onstreet parking near the village centres, moving large parking lots below ground on new buildings as much as possible to reduce the visibility of surface lots, introducing EV charging stations in all new multi-unit buildings and in the Town core, planning a bus loop through East End, addressing existing traffic issues on Main Street which seem to be getting worse, focusing on AT planning and limiting road noise. The opinions on a new interchange for the 101 highway was divided and there was no definite preference wither way.

Green open spaces

The need for more and better public open spaces was favoured unanimously. On the Kenny Lands, preserving the Kenny Creek Stream corridor was seen as a key opportunity as well as developing Look-Off Park with more formal look-off facilities. The

view corridor also needs better formal protection to ensure this key view is not lost to future development.

Among the requests for specific recreational programs were: natural playgrounds, “wild” natural spaces, connectivity between open spaces, community gardens and large parks with trails and seating opportunities. Edible and native plants, outdoor fitness and water features were also mentioned although by fewer people. Participants felt that every home should be no more than a 5 minute walk from a community park. These community parks should be programmed for all age groups and for all season use.

In addition to creating new usable open spaces for the community, it is equally important to preserve existing natural resources such as wildlife habitats, ponds, vistas to nature, and to preserve as many trees as possible. Participants felt strongly that the urban forest in all public spaces and corridors should be a priority for this plan. All new streets should have a plan for dense tree plantings and if possible, power lines should be under-grounded to reduce the impact on the urban forest.

Services

There was a substantial concern for stormwater management. The main concerns were around water runoff and flooding onto properties on Main Street and Maple avenues. The discussions centred around: preserving vegetation, reducing hard pavement and parking lots, and stormwater gardens and permeable surfaces, green roofs, rain barrels, collection ponds and preserving the creek corridors for managing stormwater.

3.9 PLANNING ADVISORY COMMITTEE

Staff provided Planning Advisory Committee with an overview of this WWH report in June 2022. The main discussion points that PAC articulated include:

Affordability

- Building materials, skilled trades shortage/cost increase/ inflation affects the ability for developers to provide affordable housing.
- Town is looking to require building standards/national building code to change to allow the use of more affordable materials.
- Interest rates and the impact this will have on affordable housing or housing in general.
- Tideways – This co-op housing initiative was volunteer built, even when there was 19% interest, how can we replicate this

today?

- "Affordability" vs low-income housing – must be clearly defined.
- Bill 32 from Province – we could use this tool and clearly define how we move forward.

Building height

- 292 Main Street demonstrated how contentious this topic is.
- Higher than 3, less than 6 storeys is preferable for the maximum height.
- To achieve the desired amenities, density (building height) must be increased.
- Woodman's grove buildings are 3 storeys but seem higher due to large footprint.
- Proximity of tall buildings and the impact on natural light filtering into all buildings is a concern.
- Overlook into other people's windows is a concern.

Density and housing types

- How do we keep our "town feel" in this development?
- Can we see 3d models of 5 storeys that reflect the current town feeling? This would be helpful when making decisions.
- Highway interchange will change the feeling/make wolfville less "nested" feeling.
- The open houses show the appetite for new housing types like cluster housing, 3-4 storeys, and this is the time to test it out, use the WWH report when talking to developers.

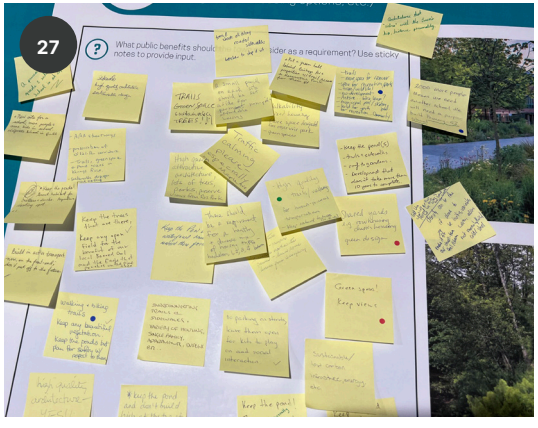
Commercial use and village square

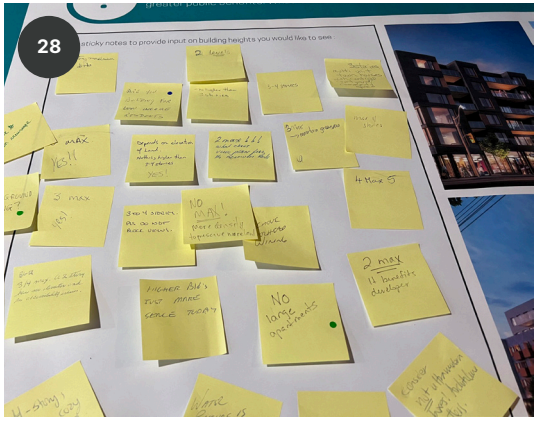
- Village square is exciting because this is something that is missing in wolfville.
- Village square might help temper concerns around building height.
- People want to walk to amenities like cafes, hair salons, especially the elderly.

Inclusion in the planning process

- Could we do focus groups with kids/young people to see what they would like to see in the East End?
- Staff made considerable effort to make the public aware of the engagement opportunities and the turnout at the in-person events is evidence of this.


SITE BOUNDARIES
DENSITY





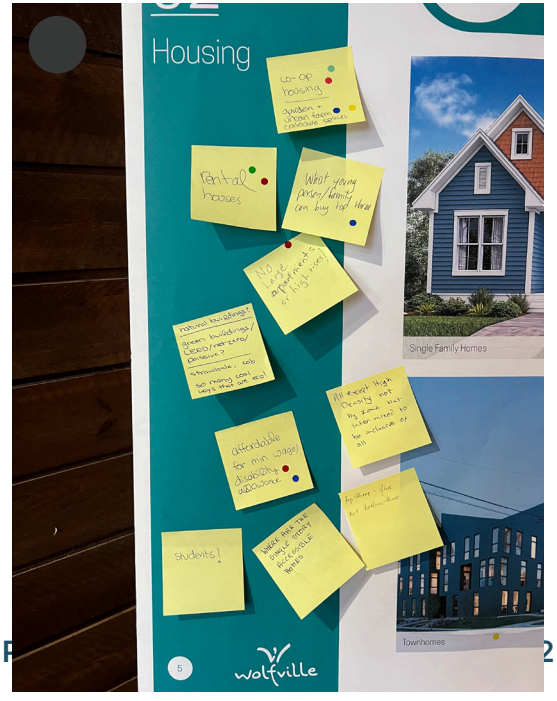


Fig.26 to Fig.29 - Community Workshop Feedback

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

01
Welcome

WELCOME

The Town of Wolfville is beginning a Secondary Planning Process for two large parcels of land in Wolfville's East End. We are looking for your feedback on the future development.

A secondary planning strategy is a process to determine how a particular area of the Town can be developed. The outcome of this process will be the framework that guides :

- what can be built and the density that must be achieved,
- what areas should be conserved,
- where roads, parks, trails and community centres will go,
- the character of the future communities
- how the view from Reservoir Park will be protected, and many other details.

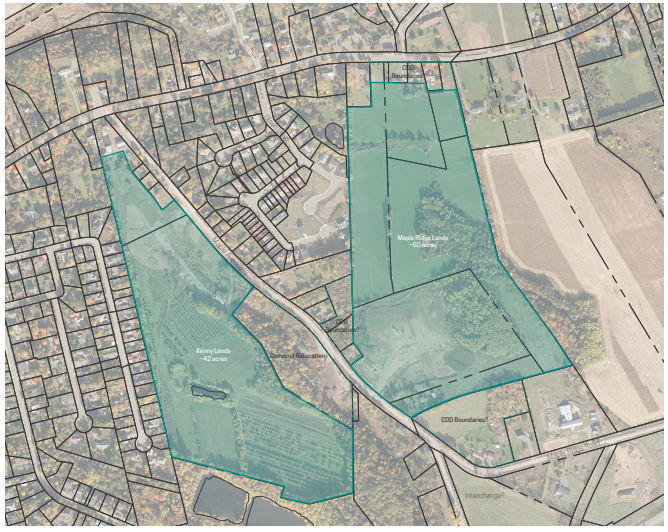
WHAT HAPPENS NEXT?

Planning Advisory Committee Workshop	Engagement with stakeholders, landowners and developers	Planning Advisory Committee and Council joint session to discuss draft framework plans, proformas and staff report.	Open house and Public presentation of draft plans	Preparation of final report and amendments to planning documents.	Planning Advisory Committee and Council to formally review final plans and give consideration.
JUNE 2022	JUNE-SEPTEMBER 2022	SEPTEMBER-OCTOBER 2022	OCTOBER 2022		DECEMBER 2022

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

01
Welcome

SITE BOUNDARIES



Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

02
Housing

DENSITY

Minimum net density is 10 UPA.
Using stickers, indicate if the density target should be achieved by spreading density out equally, or by increasing density to leave more open space available.

Use sticky notes/stickers to discuss and show support for spreading out density equally.			
Use sticky notes/stickers to discuss and show support for increasing density in exchange for more open space:	Use stickers to show support for a density of one unit per acre (UPA).	Use stickers to show support for a density of fifteen UPA.	Use stickers to show support for a density of 20 UPA.

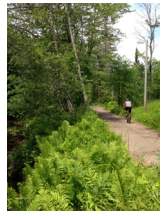
Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

02
Housing

DENSITY TRADE-OFF

What public benefits should the Town consider requiring in return for achieving the density targets set for these lands? (i.e. sidewalks, trails, high quality architecture, sustainable design, mixed housing options, etc.)

What public benefits should the town consider as a requirement? Use sticky notes to provide input.



Workshop Posters where participants were asked to provide feedback on various topics.

Wolfville East End Planning Study
Public Engagement Session
May 31- June 2, 2022

02
Housing

HOUSING TYPES

What types of housing would you like to see built? Place a sticker to show your preference.


Single Family Homes


Semi/Duplex Homes


Cluster Homes


Townhomes


Medium Density (3-4 storeys)


High Density (5-6 storeys)

5

Wolfville East End Planning Study
Public Engagement Session
May 31- June 2, 2022

02
Housing

DENSITY TRADE-OFF

Taller buildings create opportunities for more open space, and more density provides greater public benefits. What is the maximum building height we should consider?

Use sticky notes to provide input on building heights you would like to see :

6

Wolfville East End Planning Study
Public Engagement Session
May 31- June 2, 2022

02
Housing

SOCIAL EQUITY

What social equity issues would you prioritize for addressing with this development? Use a sticker or sticky note to indicate:

Affordable housing

Aging in place

Accessibility

Other

7

Wolfville East End Planning Study
Public Engagement Session
May 31- June 2, 2022

03
Parks and Open Space

PARKS

With upwards of 1,400 new units on these lands, what type of parks are needed for the eastern lands? (i.e. Natural playground, water features, seating, community gardens, etc).

Write down on a sticky note what kind of parks and natural features you would like to see implemented in the future design:

8

Workshop Posters where participants were asked to provide feedback on various topics.

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

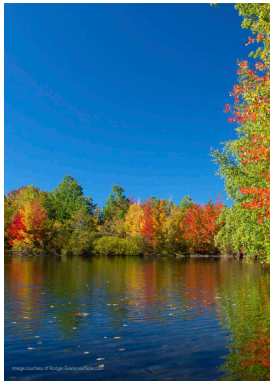
03
Parks and Open Space

TREES

Wolfville is known for its old growth trees. It is realistic this community will have more trees in the future than is currently present. Should this development create standards to ensure a diverse urban forest in the future?

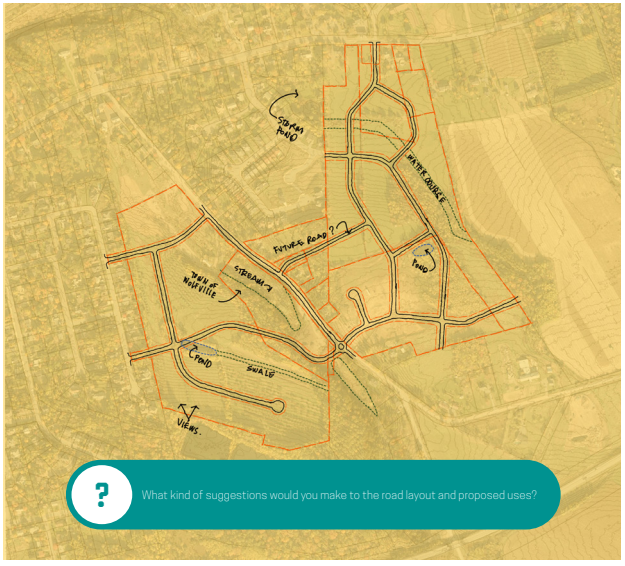
Use stickers to indicate yes:

Use stickers to indicate no:



Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

04
Roads and Active Transportation



What kind of suggestions would you make to the road layout and proposed uses?

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

04
Roads and Active Transportation

STREET DESIGN

What kind of street designs can we use at the East End? How can we design these roads to favour people over cars?

Use a sticky note to discuss your ideas about street design:

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

04
Roads and Active Transportation

ACTIVE TRANSPORTATION

Are bike lanes, sidewalks, and continuous trail networks important trail priorities for the East End?

Use stickers to indicate yes:

Use stickers to indicate no:

Workshop Posters where participants were asked to provide feedback on various topics.

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

05
Amenities

? What kind of uses and amenities would you like to see? Use sticky notes to suggest desired amenities and their location.

13 wolfville

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

05
Amenities

14 wolfville

VILLAGE SQUARE

? What type of village square would you like to see? Should it contain commercial use?

Use stickers to demonstrate support for commercial use in the village square; use sticky notes to explain what you'd like to see:

Use stickers to show disapproval commercial use in the village square; use sticky notes to explain why:

Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

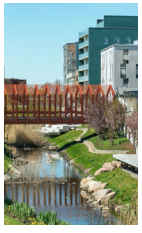
05
Amenities

16 wolfville

STORMWATER

? How can we make this development a model for stormwater design? How can individual property owners contribute? (i.e.: bioswales, road standards, permeable surfaces).

Use sticky notes to discuss how the development can integrate storm water into its design and how you think individuals can contribute :



Wolfville East End Planning Study
Public Engagement Session
May 31-June 2, 2022

05
Amenities

17 wolfville

? What final accounts should we take into account when designing the East End Plan?

Workshop Posters where participants were asked to provide feedback on various topics.

Wolfville East End Secondary Plan
Planning Advisory Committee
April 14, 2022

04
Urban Parks

- Natural Play playground
- Community gardens
- Naturalized planting
- Seating shelter
- Stormwater management
- water features




? WITH UPWARDS OF 1400 NEW UNITS ON THESE LANDS, WHAT TYPE OF PARKS ARE NEEDED FOR THE EASTERN LANDS? WHAT'S MISSING IN WOLFVILLE?

38 wolfville

Wolfville East End Secondary Plan
Planning Advisory Committee
April 14, 2022

04
Trails & AT

- Multiuse trails
- Nature trails
- AAA Active Transportation
- Continuous trail network
- pedestrian Sidewalks



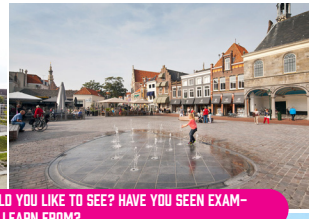

? ARE BIKE LANES, SIDEWALKS, CONTINUOUS TRAIL NETWORKS IMPORTANT PRIORITIES FOR THE EAST END?

39 wolfville

Wolfville East End Secondary Plan
Planning Advisory Committee
April 14, 2022

04
Village Square

- Central Town Square
- Mixed uses
- Urban park
- Onstreet parking
- Higher Density Living
- Groundfloor commercial
- Community Centre

? WHAT TYPE OF VILLAGE SQUARE WOULD YOU LIKE TO SEE? HAVE YOU SEEN EXAMPLES FROM OTHER PLACES WE COULD LEARN FROM?

40 wolfville

Wolfville East End Secondary Plan
Planning Advisory Committee
April 14, 2022

04
Street Design

- Skinny Streets
- Shared Streets
- Traffic calming
- Context sensitive streets




? WHAT KIND OF STREET DESIGNS CAN WE USE AT THE EAST END? HOW CAN WE DESIGN THESE ROADS TO FAVOUR PEOPLE OVER CARS?

43 wolfville

Wolfville East End Secondary Plan
Planning Advisory Committee
April 14, 2022

04
Stormwater Management

- Lot Stormwater standards - no-net-runoff
- Road standards
- infiltration trenches and rain gardens
- grassy swales



? HOW CAN WE MAKE THIS DEVELOPMENT A MODEL FOR STORMWATER DESIGN? HOW CAN INDIVIDUAL PROPERTY OWNERS CONTRIBUTE?

45 wolfville

Wolfville East End Secondary Plan
Planning Advisory Committee
April 14, 2022

Agrihoods

Integrated agricultural communities

- Agriculture integration throughout
- Community plots
- variety of density and housing types
- Underground parking



? SHOULD AGRICULTURE BE A CENTRAL THEME IN THIS DEVELOPMENT? TO WHAT EXTENT? ARE THERE OTHER THEMATIC IDEAS?

61 wolfville

Chapter 05

Precedents

The public engagement sessions attempted to characterize the most desirable forms of development for Wolfville in an effort to inform developers about how to maintain the Towns vernacular. This chapter outlines some built-form suggestions from the community to ensure the special quality of Wolfville is not lost in future development.

Traditional and Neo-traditional Built Form

Wolfville is one of the few communities in Nova Scotia that has preserved and enhanced its architectural heritage over the last 200 years providing excellent examples of many traditional styles including Victorian, Acadian, Georgian, Second Empire, Queen Anne, Maritime Vernacular, Colonial Revival, Craftsman, Regency, Gothic Revival and Italianate. More recently, architects have employed neotraditional design approaches to blend contemporary and traditional built forms. The Town is well rooted in the common Maritime vernacular styles and the community pushes back on placeless generica found in other growing communities.

The use of traditional building materials (mostly wood, brick and some stone) and adherence to common architectural styles is part of the Towns charm. Though the Town's Design Guidelines do not apply for most of the study area, they still provide a good guide for future developers of these lands.

Existing Single Family Styles in Wolfville

Single Family Precedents

Single Family Homes

Due to the higher density requirements that accompany these land base lands, there will be limited opportunities for more traditional single family homes. generally though, where new developments back directly onto existing single family homes, either singles or duplexes are encouraged, especially bordering Bishop Avenue, Olsen Drive and Carriageway Court. To ensure these homes are more affordable to future residents, narrow lot properties are required (12-15m frontage). Traditional large lot developments are not permitted (+20m frontage). Narrow lot homes can be compromised by protruding garages if permitted. To curb the construction of "snout-homes", attached garages are not permitted on R1 lots unless they are setback from the front of the home by at least 3m.

Traditional Wolfville architectural styles and neotraditional/contemporary styles are encouraged using traditional exterior materials

To keep the homes in this development affordable but high quality, the following guidelines should be considered:

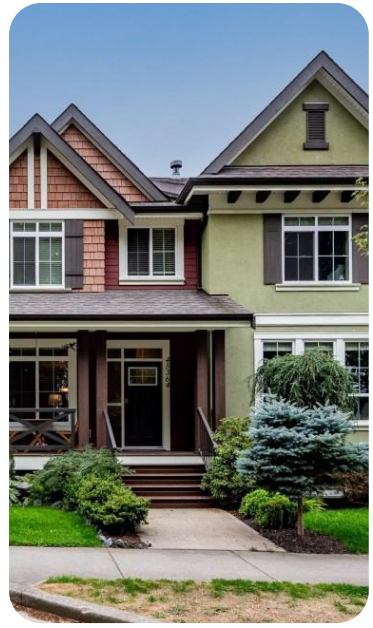
- Single family lot frontages greater than 15m will not be permitted.
- Attached garages are not permitted unless they are setback at least 3m from the front of the home
- Lot depths between 40-50m deep are encouraged requiring buildings to be pulled up closer to the street with limited setbacks
- Verandas are encouraged on all single family homes so that home-owners can talk to their neighbours passing by on the sidewalks.
- Parking is encouraged on the side of the unit instead of the front of the unit where possible.
- Detached garages are permitted the rear of the lot and provide an opportunity for rental units above.

Narrow frontage Single Family Precedents

Semi and Duplex Homes

Semis are two different homes with separate owners and lots that are erected next to one another and joined by a common wall (Fig.33 and 34). A duplex on the other hand, is a house with two separate homes on a single lot, one above the other separated by a ceiling.

These two types of homes usually share a common wall or ceiling but the floor plan can vary. We have assumed 10-12m frontage per unit leaving room for a 1.5-2m sideyard. Lot depths usually range from 35-45m



Townhomes

Townhomes are individually owned multi floor homes. They are usually two or three stories high, connected to other similar homes by shared walls on either side of each unit. They are often tall and narrow in design. Townhouses are seen as a blend between a single family home and a condominium. Residents who own townhouses are generally responsible for both the interior and exterior unlike in apartment complexes.

Some of the features of a townhouse include:

- A private entrance, which in some cases come with a small front lawn and a backyard as well.
- A parking space in front of the unit
- Lots are usually 7-8m x 40m

Cluster Homes

Cluster Homes are private properties built in groupings relatively close to each other usually with a pocket yard. It is for people who wish to live on private land but would also like to enjoy access to the facilities one can find in a condominium like public gardens, playgrounds and swimming pools. Some of the advantages of living in cluster homes include:

- Enjoy both privacy and the shared outdoor recreational areas.
- Safety as the cluster would be on constant community watch.

Cluster Home Precedents

Agrihoods

Agrihood is a type of housing development with integrated agricultural communities. Agricultural practices are interspersed throughout the neighbourhood and inspires the community's character and design.

Some of the features of an agrihood include:

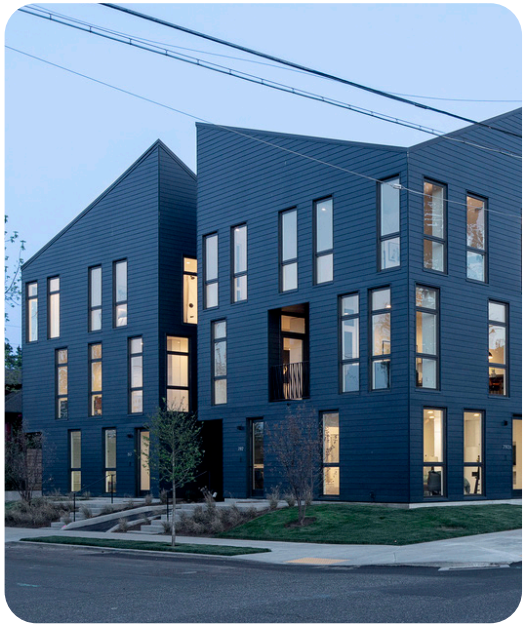
- Community growing plots where residents can grow yielding plants such as vegetables.
- A range of housing types and densities.
- The parking in most cases is underground as the lots above are usually used for agricultural practices.
- A mixed use town center with a market
- Planned urban forest within the housing community.

Agrihood Precedents

Multi-Unit Lowrise

Lowrise apartments are considered 2 or 3 storey buildings. These type of units are usually zoned as R3 or R4 in Wolfville's land use bylaw, and require groundfloor walkout units, architectural articular to prevent large 'lego-block' building forms, authentic building materials, programmable amenity spaces in the building, on the roof and around the building, and underground parking to reduce the amount of surface parking around the buildings. These buildings usually range in size from 12 units to 60 units.

For the East End area, some site specific amendments have been suggested for the R4 zone to allow a maximum unit count of up to 60 units at 3-storeys by site plan approval.



Multi-Unit Midrise

Midrise buildings are 4-8 storeys in height and according to Wolfville's LUB, they are premitted only in the R4 zone by development Agreement. The R4 zone includes a site specific amendment to allow consideration of greater than 4-storeys by development agreement within the East End area. The other amendments in the R4 zone include:

- A 2m stepback when facing the street above the 3rd storey to vertically articulate the building and to reduce its scale from the street.
- underground parking for at least half the parking for each building.
- Additional architectural requirements. These buildings usually range in size from 30-100 units.

Mixed Use

Mixed use buildings are similar to the new R4 buildings except they require a portion of the groundfloor to be commercial. A new zone has been created in the land use bylaw to create a mixed use zone for the village core and along the Maple Avenue Corridor. These buildings usually range in size from 30-120 units.

Fig. 30 - Institutional Spaces

Institutional Spaces

Institutional areas are lots allocated for opportunities and services like education, health and research activity that benefit the community. Schools (Fig.30, 32 and 33), hospitals and clinics are a few examples of Institutional spaces.

Parkland and Open Space

Parks and open spaces can either be for recreation or for conservation depending on what the piece of land holds. Sensitive areas with wetlands that contain plant and animal species that are not to be disturbed by human activity and with water bodies that flood often are designated as conservation areas (Fig.36). They are lands which are usually maintained in their natural state. Less sensitive areas that allow human activity with walking trails, play areas, benches and dog parks are recreational in nature (Fig.34, 35 and 37).

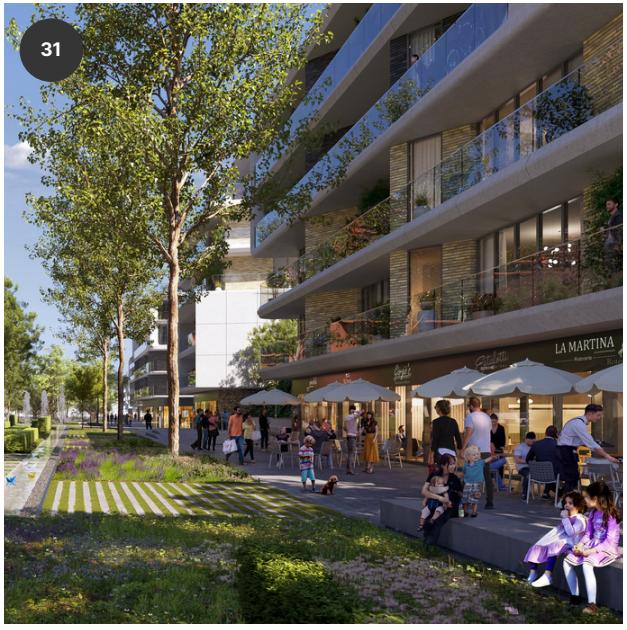


Fig. 31 - High Rise with Active Frontages
Fig. 32 and 33 - Institutional Spaces
Fig. 34 to 37 - Park and Open Space Precedents

Chapter 06

Master Plan

Following the engagement sessions held in the summer and fall of 2022, Fathom and Town staff assembled preliminary development concepts and pro forma. These concepts have reflected community feedback, sustainability considerations and have taken into account discussions with land owners and developers. The draft master plan presented here is still in draft form but represents the culmination of this work and requires feedback from the Planning Advisory Committee and Council to ensure the plan is going in the right direction and what additional steps may be required.

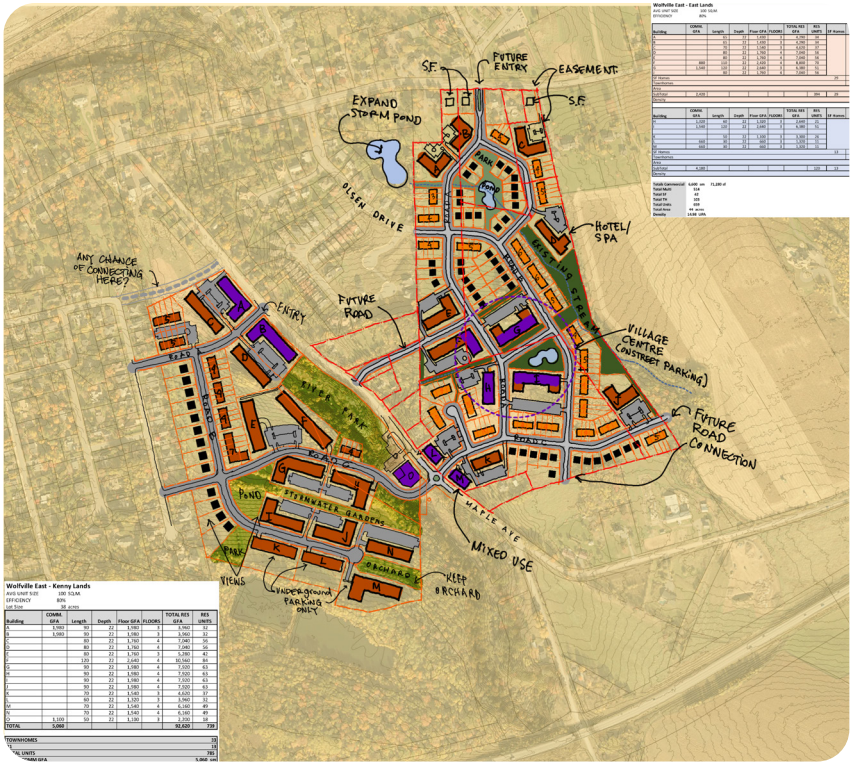
5.1 PRELIMINARY LAND USE & TRANSPORTATION CONCEPT

Preliminary Concepts

Several early concepts were developed in coordination with the land owners / developers to discuss road patterns, open space connectivity, housing mix, commercial core locations, road hierarchies, viewplanes, and phasing. One both sites, the steep topography presents some unique challenges for roads and building sites.

The aim for these early concepts was to encourage the 4 main land owners/developers to coordinate their plans together. On the Kenny lands, there is only one land owner making it slightly easier. On the Maple Ridge lands there are 4 owners that need to coordinate together making the phasing and road locations much more challenging.

The early concept pro formas showed about 750 units (20 upa) on the Kenny Lands and 550 units (15 UPA) on the Maple Ridge Lands. The developers were able to review and prepare their own plans and pro formas from these early concepts.


S.F.
FUTURE ENTRY
EASEMENT
S.F.
EXPAND STORM POND
POND
PARK
PARK
ELSEN DRIVE
HOTEL/ SPA
ANY CHANCE OF CONNECTING HERE?
ENTRY
FUTURE ROAD
PRESERVING EXISTING TREES
VILLAGE CENTRE (ON STREET PARKING)
FUTURE ROAD CONNECTION
RIVER PARK
ROAD
POND
STRAWBERRY GARDENS
MAPLE AVE
MIXED USE
PARK
VIEWS
VALLEY GROUND PARKING ONLY
ORCHARD
KEEP ORCHARD


ANY CHANCE OF CONNECTING HERE?
ENTRY
HOTEL
RI-BI
garden-4
TH-44
MULTI-361
470 units
RIVER PARK
ROAD
POND
STRAWBERRY GARDENS
PARK
VIEWS
VALLEY GROUND PARKING ONLY
ORCHARD
KEEP ORCHARD


Owner 4
Olsen Pond
Owner 3
Park 2
AAA AT Network
Owner 5
Town Owned
Park 1
Park 3
Protected Viewplane
Owner 1
Owner 2
low density residential
medium density residen
high density residential
commercial / high densi residential
open space
0
1:300

West side	Commercial	Stories	Units per Floor	Units
Single Family				13
Townhomes				44
Mixed A	1400	3	13	39
Mixed B	1400	3	13	39
Mixed C	1400	3	13	39
Multi D		4	11	44
Multi E		6	15	90
Multi F		4	13	52
Multi G		4	13	52
Multi H		6	17	102
Multi I		6	17	102
Multi J		6	17	102
Multi K		6	17	102
Total:	4200			820

East side	Commercial	Stories	Units per Floor	Units
Single Family				31
Townhomes				70
Mixed L	800	3	7	21
Mixed M	1000	3	9	27
Mixed N	1200	3	11	33
Mixed O	1200	5	11	55
Mixed P	1200	3	11	33
Mixed Q	1200	3	11	33
Mixed R	600	2	5	10
Mixed S	400	2	4	8
Multi T		3	22	66
Multi U		4	11	44
Multi V		6	17	102
Multi W		3	15	45
Multi X		6	13	78
Multi Y		3	13	39
Multi Z		6	17	102
Multi AA		6	15	90
Multi AB		6	9	54
Total:	7600			941
Development total:	11800			1761

Concept One - Plan and Pro Forma

5.2 SECONDARY CONCEPT

Following the preliminary concepts, a more finalized master plan was created. The plan shows the two properties linked at Maple Avenue by a small roundabout. This linjage will be important for future transit and AT connections between the two parcels.

Kenny Lands

The Kenny lands plan is characterized by:

- A minor street connection (190m) to the north of the property between Maple Ave and Bishop Ave.
- The second Bishop Ave. right-of-way to the south is used as trail connection instead of a road connection.
- A large 4.5 acre park has been reserved in front of the reservoir park viewplane. The manmade pond has been removed in this concept. The park is connected across the street to the Kenny Creek greenway.
- Single family homes and townhomes back onto the properties on Bishop Ave providing a gentle density buffer between the existing homes and the higher density parts of the development.

- A portion of the Kenny Creek greenway (currently park) has been swapped for some development (building 4 and building 6) to allow the daylighting and stormwater management features needed along Kenny Creek.
- Mixed use developments are proposed along Maple Avenue. Buildings A and B are owned by the develop, and building C is owned by the Town which will eventually see the relocation of the compost facility in favour of a new 3-storey mixed use building.

The developer has noted his willingness for some 6-8 - storey buildings that would have to be taken through a development agreement process for approval.

Maple Ridge Lands

The Maple Ridge lands are owned by 4 different land owners and as such, these lands will be more difficult to plan due to phasing and staged access.

The plan for the Maple Ridge Lands is characterized by:

- A future Mixed Use Village Centre site close to Main Street.
- A large village green park at the centre of the village square in the location of the existing ephemeral creek. Views of this park will be in the immediate foreground up entry into the development from the eventual Woodman Road extension. Land owner 4 is in no hurry for this access so this part of the plan may come in the latest phases of the project. There is no immediate rush for this entranceway since there are other entry locations from Olsen and Maple Ave.
- The entrenched creek corridor has been preserved from the east side of the property all the way to the stormwater management pond near Olsen Dr. This corridor will also include a trail system.
- A few small mixed use pad sites are located near the Maple Ridge roundabout.
- The existing ephemeral pond on owner 2 land has been preserved as part of a larger park at the top of the hill.
- single family homes are backing onto existing single family homes near Olsen and Carriageway.
- Owner 5 is somewhat land locked until some of the roads are built in the development (particularly the Olsen Dr extension). In the interim, there may be an opportunity to provide limited access to two buildings (P and T) from Main Street in the early phases of the development. Though these buildings would not be connected to the internal roads for the rest of the development, they could be linked by the river parkway for walkers and cyclists.

5.3 PARKS & OPEN SPACE

The master plan identifies two key connected park spaces on the Kenny Lands and 3 connected parks spaces on the Maple Ridge Lands. The important thing about all these parks is that they are connected together with a greenway trail system, sidewalks, and or active transportation. The parks have been strategically located so that no resident is less than a 3 or 4 minute walk (300-400 m) to this connected park network.

Kenny Lands Parks

The two signature parks for the Kenny Lands include the Kenny Creek greenway and the ViewPark north of the protected view corridor. These are linked via the existing Town Reservoir Park to the north and using a trail through the private lands through the centre of the development.

Reservoir ViewPark: The public was keen to extend Reservoir Park near the protected viewshed. This north sloping parcel of land will use the Bishop Avenue right-of-way, that was originally

intended for a road connection, as a new trail connection. The existing man-made pond will be reduced in size or moved depending on the final location of the new road system within the development. To preserve the views in this park, any new trees will need to be very strategically located so as not to impinge on the view point. The park could either be maintained as a open manicured lawn area with switchback trails down the slope, or it could be reserved as an agricultural field or community garden to serve the local community.

At the base of the hill, the development could include a small amphitheatre or outdoor performance venue. The Town will need to program this area as part of its future parks master plan.

Kenny Greenway: The existing creek corridor extends along Maple Avenue connecting Reservoir park trails in the south before ending somewhere near the north of the study area. In the north, Kenny Creek seems to disappear underground and into some culverts. Residents in this area have commented that there are regular flooding problems in their back yards. As the lands are developed, the stream should probably be daylighted and there may need to be some stormwater management ponds constructed to the north to handle runoff from the new development. The trail system which progresses from being very well defined in the south, to less defined in the north needs to be connected up formally to Maple Avenue where a future Triple A active transportation system is planned for the west side of Maple Avenue.

The Kenny Greenway is proposed as a natural wooded corridor along the creek. Where the new roundabout is proposed by the Compost facility, the trail will have to make its way up the slope from the entrenched valley, across this new road connector and then back down into the valley floor to the north of the new road. The town may want to consider a bridge for this area with the greenway trail routed under the bridge.

Maple Ridge Lands Parks

There are 3 main parks proposed for the Maple Ridge Lands including an existing ephemeral pond on the Kadray Lands, a creek corridor greenway along the east boundary of the site and connecting to the existing stormwater pond, and a village centre park close to Main Street in the future Village Square area.All of these parks would be connected together to form a network.

Kadray Park: There is an existing man-made pond to the north of the Kadray lands that could make a good community park and stormwater management area for the Kadray lands. The plan shows some of the higher density uses surrounding this park. We imagine that some of these higher density uses would include seniors housing so this park would be programmed for seniors to include accessible trails, lots of benches and potential outdoor exercise equipment.

Creek Greenway: The creek sits in an entrenched valley midway through the Maple Ridges lands, but then it flattens out into a gentle valley to the north of the site. There are no trails currently along the stream due to the brambles and impassable thickets of Rosa Rugosa. The valley would be an ideal greenway trail if it were better managed and designed as a trail. The greenway should develop a forest management plan and a watershed management plan to make the corridor a more usable linear parkway along the creek. To the north of the site the greenway will pass through the village square and will have to pass under the entry road. Ideally the trail system should be well connected from the existing stormwater management pond to the southern portions of the site.

Village Square Park: The Creek greenway passes through the low-lying village square allowing for a potential pond in the centre of the Village Square. This small pond could include fountains or other interesting shoreline features like boardwalks or docks. We expect much of this square would be urban in nature with hardscapes for community gatherings, outdoor markets, and a few softscapes to throw a Frisbee, picnic tables to eat lunch and lots of seating.

Olsen Pond Park: This stormwater park is not very visible or accessible currently. This Town owned property should be much more visible and much more connected to the future town square. The stormwater pond may also have to grow to accommodate some of this development.

Windsor's East End Planning Study
Public Engagement Session
May 31-June 2, 2022

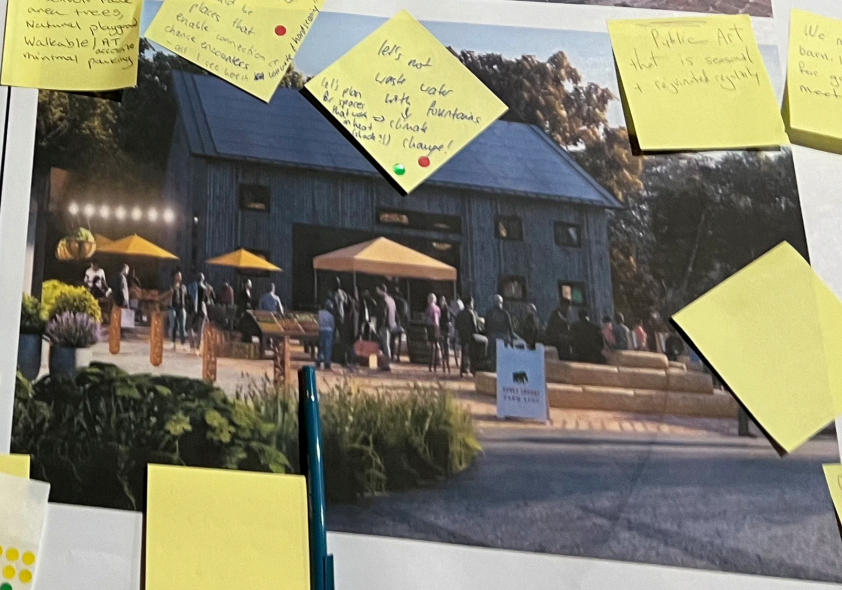
VILLAGE SQUARE

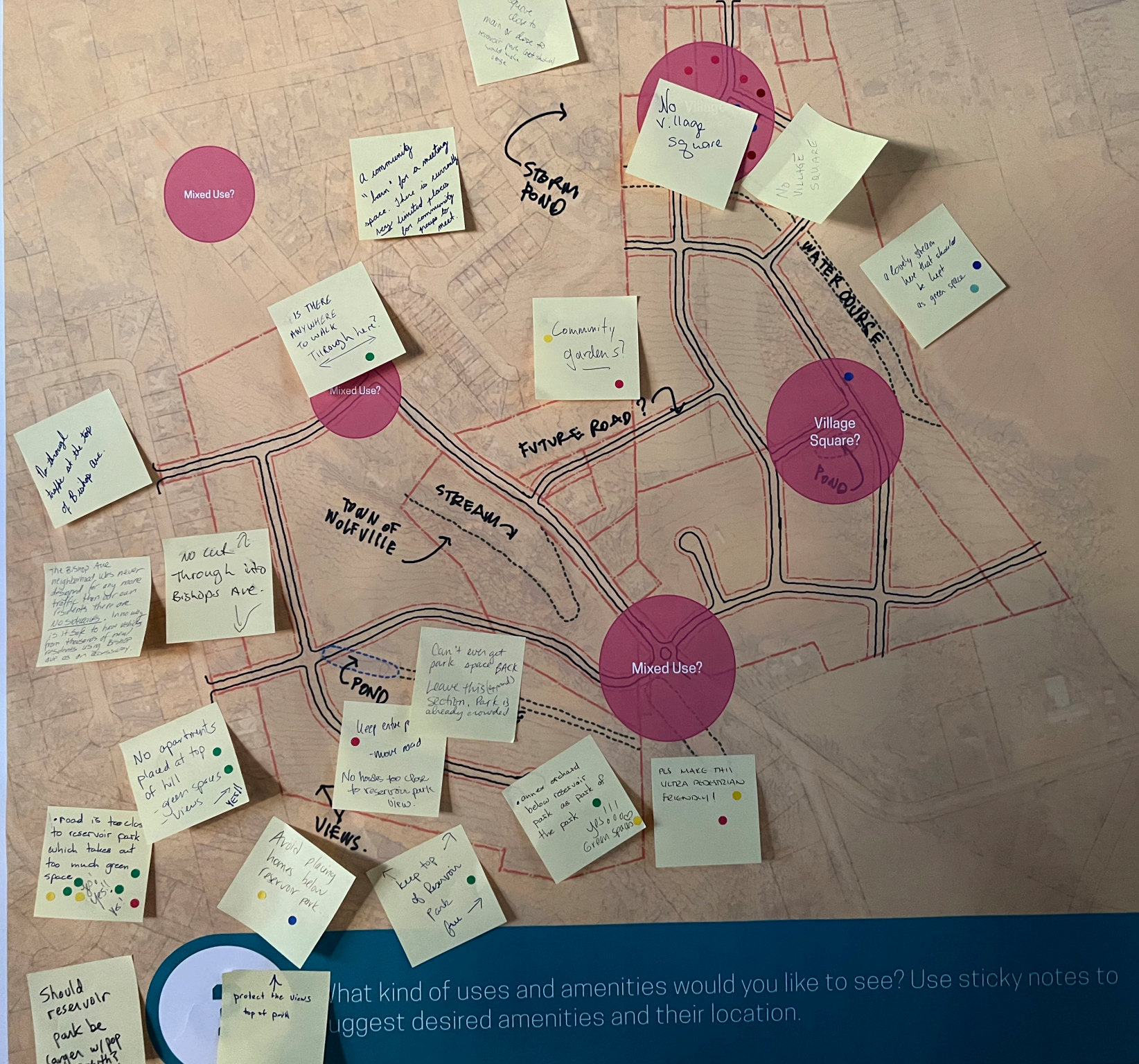
?

What type of village square would you like to see? Should it contain commercial use?

Use stickers to demonstrate [illegible] commercial use in the village square; use sticky notes to explain what y[illegible]:

Use stickers to show disapproval c[illegible] in the village square; use sticky notes to explain why:




Mixed Use?
A community "barn" for a meeting space. There is currently very limited places for community groups to meet.
STORM POND
No Village Square
No VILLAGE SQUARE
A lovely stream here that should be kept as green space
WATER COURSE
Is there anywhere to walk through here?
Mixed Use?
Community gardens?
FUTURE ROAD ?
Village Square?
POND
It should be kept wide at the top of Bishop Ave.
TOWN OF WOLFVILLE
STREAM
The Bishop Ave neighborhood was never designed for any more traffic than our current residents. There are no sidewalks. In no way is it safe to have vehicles from thousands of new residences using Bishops Ave as an accessory.
no cut through into Bishops Ave.
POND
Can't even get park space BACK
Leave this (green) section. Park is already crowded
Mixed Use?
Keep entr
-move road
No houses too close to reservoir park blew.
No apartments placed at top of hill
- green spaces
- views
Yes!!
•road is too clos to reservoir park which takes out too much green space
Yes!
Yes!
VIEWS.
Avoid placing homes below reservoir park.
Keep top of Reservoir Park
•owner orchard below reservoir park as part of the park
!!!
yes
Green spaces
PLS MAKE THIS VERY PEDESTRIAN FRIENDLY!!
Should reservoir park be larger w/pop
protect the views top of park
What kind of uses and amenities would you like to see? Use sticky notes to
uggest desired amenities and their location.

5.4 SAM KADRAY'S SITE

Sam Kadray has been on vacation for the last month and his consultant (Happy City) was only able to provide a preliminary concept on Nov 3. We will need to work further with them to understand their concept.

The key components of Sam's plan to note are:

- The apartment cluster will have both underground and surface parking

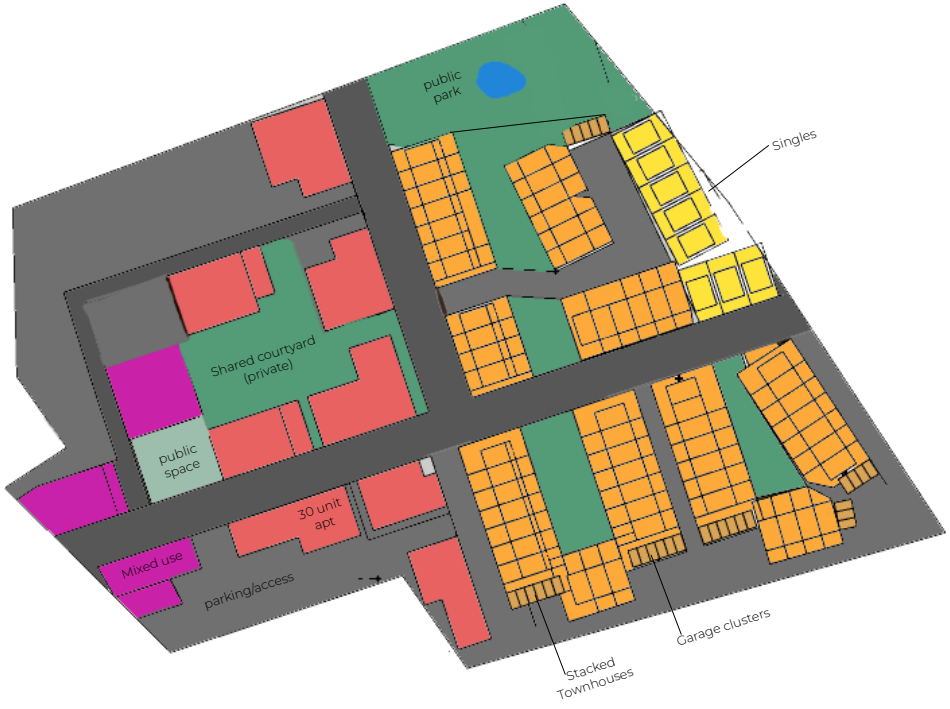
- the townhouse clusters are all 'stacked townhouse concept', meaning every unit shown there is actually two.

- the section shown as single family is also preliminary, it may be changed to townhouse.

- any roads not shown as usual town ROW is a private lane.

- only the park around the pond is currently designated as a public park.

- the landowner does not need or prefer to have two connections to the abutting land as shown in the most recent draft from the town. Please note that they are already providing two access points to abutting lands aside from the main access road at Maple.



The key components of our Sams Plan include:

- a focus on shared courtyards as social amenities (amongst apartments and townhouses)

- a linear park connection from the courtyards to the public park

- a mixed use area with a small public space that can act as an identifiable community heart

- consistent and well defined street edges that support a comfortable pedestrian experience

- appropriate density to support public spaces, services and neighborhood commercial offerings

5.5 THE MASTER PLAN

illustrative master plan and area details will be provided in future versions

illustrative master plan and area details will be provided in future versions

5.6 MPS AMENDMENTS

The following changes are proposed for the plan amendments needed to implement this secondary plan. Some of the major changes are outlined here, other (more minor) changes will be required and outlined in future versions.

8.4 High Density Residential

The Community profile of this plan outlines a clear trend of increasing numbers of apartment units since 2011. The Town of Wolfville's fastest growing dwelling unit type is apartments, which now make up the majority of dwelling types (44%) (2016 Census), more than single detached housing (41%). Much of the existing high-density development in the Town is located in or proposed development areas such as Woodman's Grove, the West End, on Pleasant street and areas within close proximity to Acadia University. Future high density areas will be encouraged in the East End as part of the secondary plan. Higher density areas present energy efficient housing choices where the ecological footprint per dwelling is the lowest of all dwelling types.

This plan takes the approach of enabling rezoning to high density on sites where appropriate, which will require landscaping, parking, amenities, and trail/active transportation connectivity. These requirements work toward development that is compatible with its surroundings and benefits the community while improving environmental and social impacts by increasing housing choices and lowering the average environmental footprint of dwellings in Wolfville.

Special consideration should be given for yet undeveloped parts of the the east end and west end with a dedicated zone to allow greater density than may be permitted in other high density residential areas around the town.

IT SHALL BE THE POLICY OF COUNCIL:

1. To establish High Density Residential zoning in the Land Use By-law that permits (as-of-right) a range of high density residential uses, including but not limited to row housing, multi-unit dwellings of a certain density, parks and playgrounds.
2. To use Site Plan Approval in the High Density zone of the Neighbourhood Designation for the consideration of certain uses that require additional regulatory considerations including, but not limited to, developments within Design Guidelines areas and multi-unit dwellings of a certain density.
3. To use Development Agreements in the High Density zones of the Neighbourhood Designation for the consideration of certain uses that require unique and site-specific considerations including, but not limited to Multi-unit residential of a certain density, innovative Housing proposals such as pocket neighbourhoods, group dwellings and other similar uses.
4. To include in the Land Use By-law special regulation for high density residential uses related to parking areas, landscaping, massing, amenity space, and other matters to ensure neighbourhood compatibility.
5. To enable the rezoning of properties within the Neighbourhood Designation, to high density residential, where the criteria of Section 11 – Implementation and the specific provisions of the Land Use By-law can be met.

8.5 Comprehensive Development District (Future Neighbourhoods)

Previously, the Comprehensive development districts in Wolfville were assigned to 4 large land holdings including the "West end lands", the "Kenny Farm lands", the "Maple Avenue Lands", and the "Woodmans Grove lands". These areas have gone through a secondary planning process to allow development to to proceed or have development agreements that are largely completed. These previous parcels have been zoned to low, medium, mixed use or high density depending on neighbourhood context.

Though no land is currently zoned as CDD as of the date of this plan, the Town would like to maintain this zone to allow consideration of future CDD zones on lands greater than 1 hectare.

IT SHALL BE THE POLICY OF COUNCIL:

1. To establish a Comprehensive Development District zone in the Land Use By-law within the Neighbourhood Designation of the MPS.
2. To require secondary plans to enable development agreements, for developments within a Comprehensive Development District zone.
3. To enable concurrent creation of secondary plans and development agreements for Comprehensive Development Districts.
4. To require all proposals in the Comprehensive Development District zone to enable a mix of commercial, institutional, park, open-space, and residential uses, in a variety of forms.
5. To enable certain existing uses on CDD zoned properties, as outlined in the Land Use By-law.
6. The following criteria should be considered by council when considering rezoning lands to CDD:
    i. the land area is greater than 1 hectare,
    ii. the land abuts or is within either the Core Area, Acadia University, High Density or mixed use zones.
    iii. On any future amalgamated lands
    iv. Future expanded boundary lands
7. To ensure the following criteria are met when Council is considering development proposals in the Comprehensive Development District (CDD) zone:
    a. The minimum net-density of residential dwellings units shall be an average of 10 dwelling units per acre.
    b. Require all power and communication infrastructure to be located underground (both primary and secondary) except in the following situations:
        i. when 3-phase power is required; and
        ii. when undergrounding of services negatively impacts significant environment features, such as watercourses, wildlife habitat, areas of steep slopes and similar situations

8.6 Mixed Use Areas

Neo-traditional planning models like the "15-minute City" and "Complete Communities" are reviving past city building practices by encouraging community design that allows residents to meet most of their daily needs within a short walk or bike ride of their home. These include neighbourhood commercial uses, institutional uses, park uses, offices, etc. all within walking distance of density cores. Contrary to past planning practices which segregated and separated land uses, this revived paradigm encourages the mixing of uses, the mixing of age and ethnic groups, the mixing of transportation modes, and a focus on health and well-being.

IT SHALL BE THE POLICY OF COUNCIL:

1. To establish a Mixed Use zone in the Land Use By-law within the Neighbourhood Designation of the MPS.
2. To enable development agreements or Site Plan Approvals, for developments within a Mixed zone.
3. To require all proposals in the Mixed use zone to enable a mix of commercial, institutional, park, open-space, and residential uses, in a variety of forms.
4. To ensure the following criteria are met when Council is considering development proposals in the Mixed Use (MU) zone:
   a. The minimum net-density of residential dwellings units shall be an average of 10 dwelling units per acre within the MU zone.
   b. Heights shall be limited to 4-storeys by Site Plan Approval and any additional height by Development Agreement.
   c. Encourage transit stops and "All ages and abilities" AT infrastructure within or nearby MU zones.
   d. Encourage linkages to MU zones via sidewalks and walking trails.
   e. Discourage parking lots between the building and the street in favour of:
      i. below ground parking
      i. rear yard or side-lot parking
      i. onstreet parking

5.7 LUB AMENDMENTS

The following changes are proposed for the plan amendments needed to implement this secondary plan:

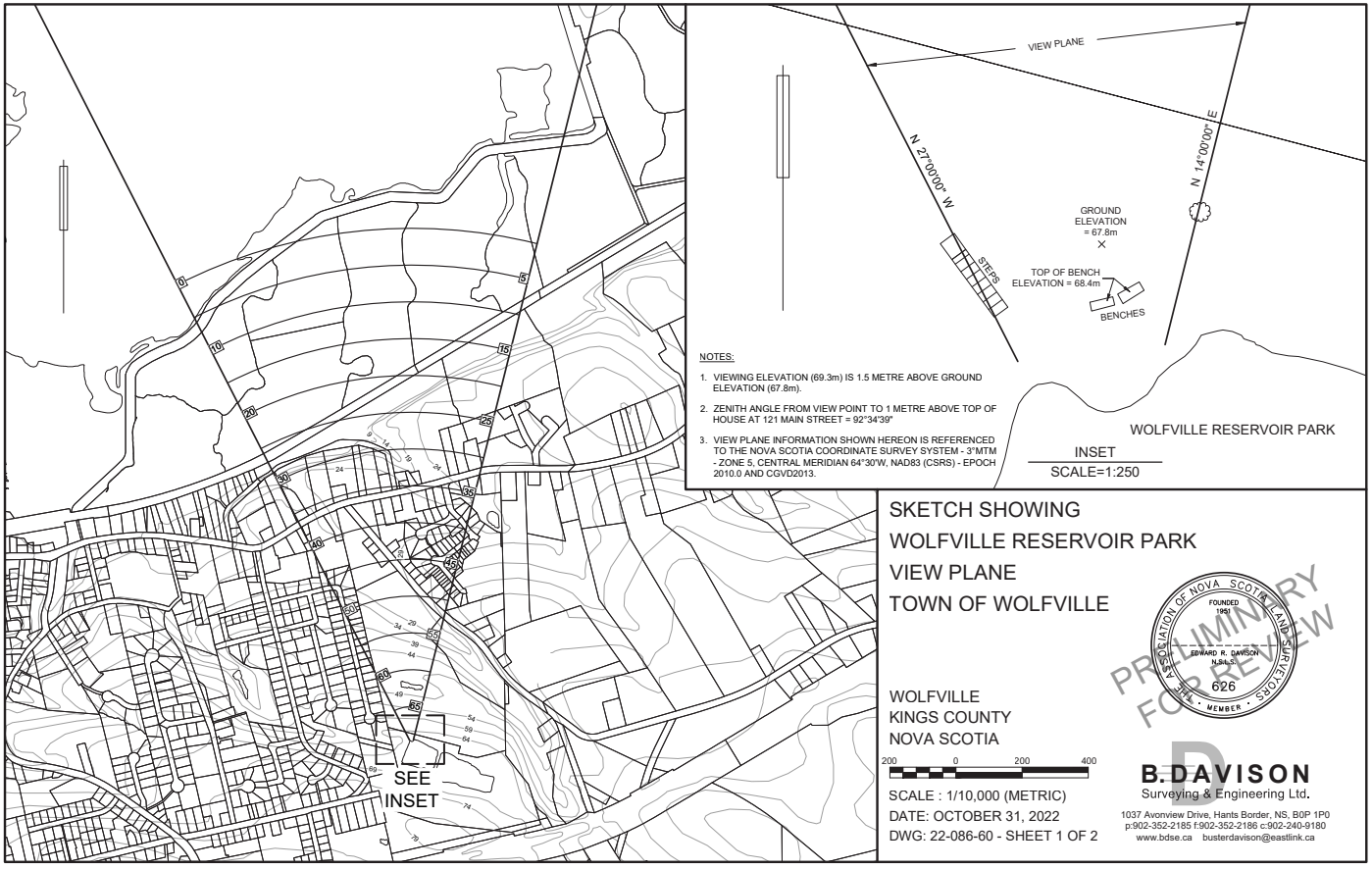
5.4 View Corridors

As per Schedule B, views to Blomidon from Reservoir Park shall be considered for any new development on neighbouring lands zoned CDD (See Figure 5.3)

The Reservoir Park view plane is set out and shown on Schedule B-2. No structure shall be erected, constructed, altered, reconstructed, or located so that it protrudes into a view plane. Under no circumstance shall the maximum required building height, as shown on Schedule B-2, be exceeded.

Where a structure that lawfully existed on the coming into force date of this By-law protrudes into a required view plane, as shown on Schedule B-2, a new structure may be erected, constructed, altered, reconstructed, or located so that it protrudes into the required view plane if the new structure does not increase the existing protrusion.

A NS Land Surveyor must confirm and stamp that all buildings in this corridor do not penetrate the viewplane.



This draft regulatory survey has been conducted by B. Davison Surveying, the draft master plan as presented is consistent with this viewplane

SKETCH SHOWING
WOLFVILLE RESERVOIR PARK
VIEW PLANE
TOWN OF WOLFVILLE

WOLFVILLE
KINGS COUNTY
NOVA SCOTIA

800 0 800 1,600

SCALE : 1/40,000 (METRIC)
DATE: OCTOBER 31, 2022
DWG: 22-086-60 SHEET 2 OF 2

THE ASSOCIATION OF NOVA SCOTIA LAND SURVEYORS
FOUNDED 1951
EDWARD R. DAVISON
N.S.L.S.
626
MEMBER

PRELIMINARY
FOR REVIEW

B. DAVISON
Surveying & Engineering Ltd.
1037 Avonview Drive, Hants Border, NS, B0P 1P0
p:902-352-2185 f:902-352-2186 c:902-240-9180

part 13 High Density Residential (R-4B) East-West Zone

13.1 INTENT

The R-4B zone is intended to permit a range of medium and high density residential development to a maximum 100 units per building. Home based businesses and other uses such as short-term rentals are permitted subject to conditions. Council may consider unique and site-specific developments by development agreement.

13.2 PERMITTED USES

As-of-right, Site Plan and Development Agreement uses are shown in Table 8.1

13.3 RE-ZONING

Rezoning to the R-4B from R-4 will be considered subject to **policy 11.4.3** of the MPS.

13.4 AMENITY SPACE

10 sq.m. of amenity space shall be provided for each dwelling unit.

Other Provisions Apply

Part 4:
General Requirements for All Zones

Part 5:
Development Constraints

Part 6:
Parking & Loading Requirements

Part 7:
General Requirements for Signs

Part 8:
General Requirements for Neighbourhood Zones

13.5 BUILT FORM STANDARDS

See Figure 13.1 for all built form standards in the R-4B Zone

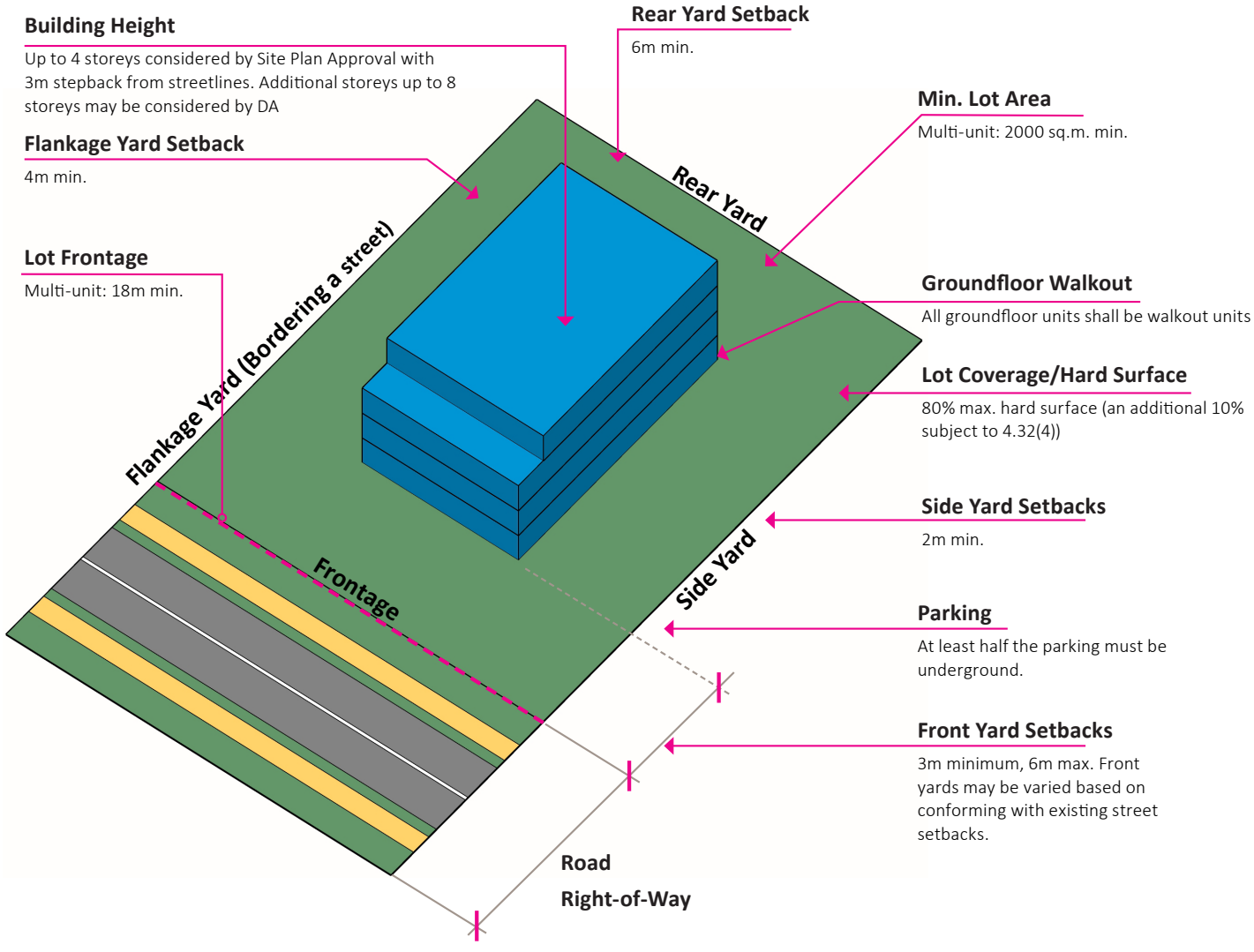


FIGURE 1.1 R-4B ZONE Built Form Standards

13.6 ADDITIONAL BUILT FORM STANDARDS FOR R-4B

Additional:

Coming in next version

part 14 Mixed Use (MU) Zone

14.1 INTENT

The MU zone is intended to permit a range of mixed commercial, office and high density residential uses to a maximum 100 units per building. Home based businesses and other uses such as short-term rentals are permitted subject to conditions. Council may consider unique and site-specific developments by development agreement. Up to 50% of the groundfloor must include commercial uses.

14.2 PERMITTED USES

As-of-right, Site Plan and Development Agreement uses are shown in Table 8.1

1.3 RE-ZONING

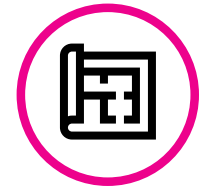
Rezoning to the MU zone will be considered subject to **policy 11.4.3** of the MPS.

14.4 AMENITY SPACE

10 sq.m. of amenity space shall be provided for each dwelling unit.

Multi-unit dwellings

Office use



Additions

Accessory Buildings

Home based business

Commercial Use

Other Provisions Apply

Part 4:
General Requirements for All Zones

Part 5:
Development Constraints

Part 6:
Parking & Loading Requirements

Part 7:
General Requirements for Signs

Part 8:
General Requirements for Neighbourhood Zones

BUILT FORM STANDARDS

See Figure 13.1 for all built form standards in the R-4 Zone

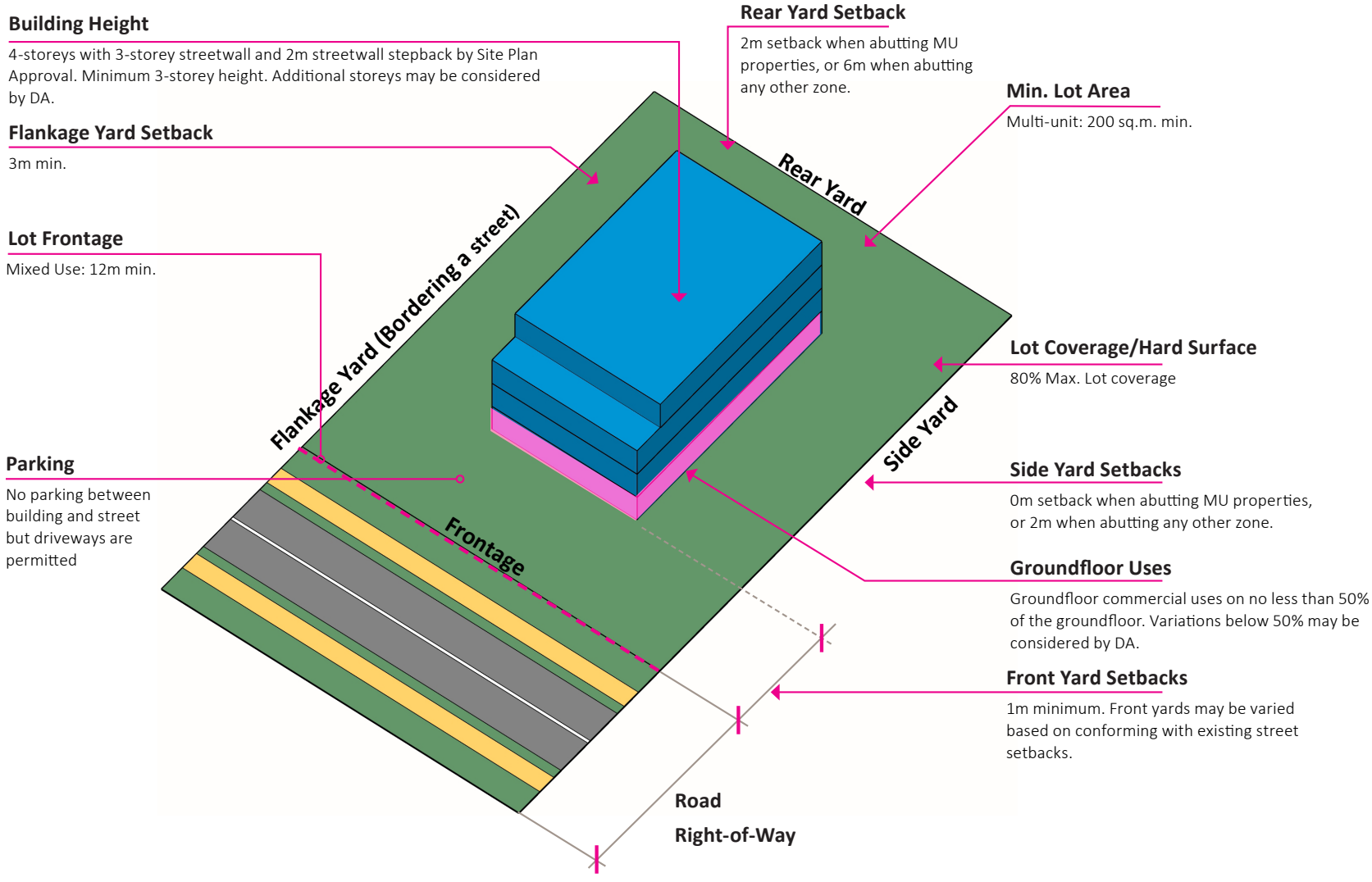
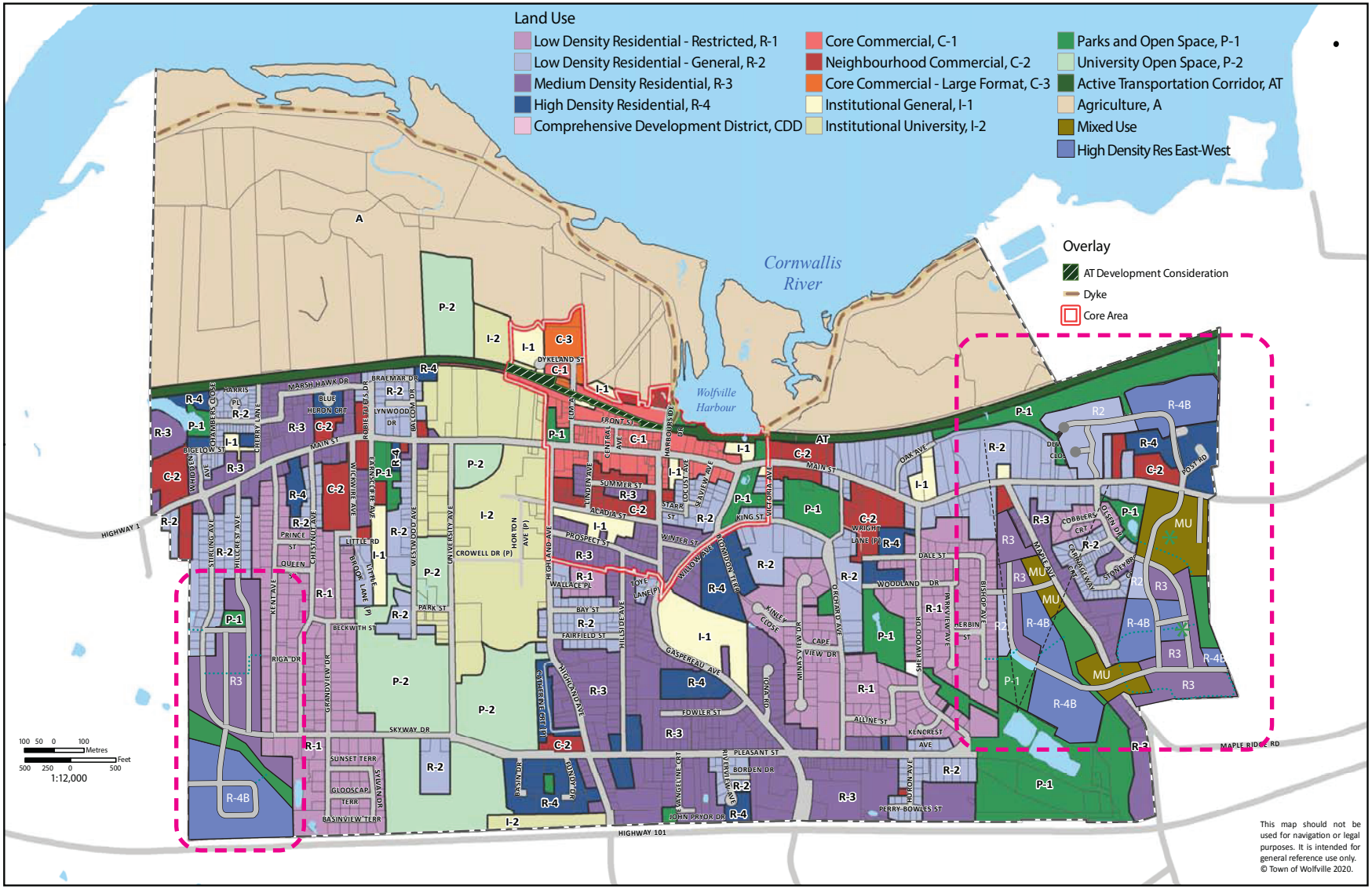


FIGURE 1.2 MU ZONE Built Form Standards

Schedule A:

ZONING MAP



5.8 PUBLIC SPACE STANDARDS

It is anticipated that the 5 main parks and trail networks outlined in the plan will be deeded over to the Town as parkland dedication to meet the 10% parkland requirement. The Town will be responsible for developing these parks in conformance with the Parks and Open Space Master Plan. Some aspects of the park development may be executed by the Developers (TBD).

The public streets become will be built by many different developers before being deeded to the Town so it is important to agree upon the common street standards as part of this plan.

Park and Open Space Standards

Street Standards

Collector Street:

Standard Street:

Village Square Street:

Triple A AT Street:

Street Intersections and Bump-outs:

Coming next version

5.9 USE OF EXISTING ZONES

The existing R2 zone and R3 zone will be used in the regulatory framework for this development.

Chapter 07

Appendix A

Coming in the next version

INFORMATION REPORT
Title: Utilities Capacity Assessment Update
Date: 2022-11-10
Department: Engineering & Public Works

SUMMARY

(Utilities Capacity Assessment Update)

The purpose of this information report is to summarize conclusions and recommendations received to-date from consultants retained to assess the capacity of the Town's utility infrastructure systems in consideration of planned developments in the East End and other areas. The information provided here also serves to provide a status update to staff and Council with regards to the ongoing studies. This information has been summarized for presentation at the joint Planning Advisory Committee (PAC)/Special Committee of the Whole (COW) by director Devin Lake on November 10, 2022.

1) CAO COMMENTS

For informational purposes only.

2) REFERENCES AND ATTACHMENTS

- IR 018-2022 ATTACHMENT 1 - Wolfville WWTP Assessment Report_Final.pdf
- IR 018-2022 ATTACHMENT 2 - 210835.01 RE-01-Rev0-Town of Wolfville WWTP Lagoon Sludge Monitoring.pdf
- IR 018-2022 ATTACHMENT 3 - 210846.01 LE001 - Wolfville Groundwater Supply Capacity REV2_r.pdf
- IR 018-2022 ATTACHMENT 4 - 211006.00 RE01 Wolfville Water System Growth Assessment 20220328.pdf
- IR 018-2022 ATTACHMENT 5 – East Hants Infrastructure Charges By-law

3) DISCUSSION

Wastewater Treatment Plant (WWTP)

A supplementary sludge monitoring study was completed for the Town's WWTP lagoon cells by CBCL in October 2021 to inform Phase 2 planning and scope development. Staff interpretation of the factual report (attachment 2) submitted by CBCL led to the addition of de-sludging as a Phase 2 scope item – While the current sludge quantities are not critical, de-sludging during other earth and sitework activities planned for Phase 2 will result in the best possible economic outcome. The capacity of the plant itself was subsequently assessed in early 2022 by EXP, the prime consultant responsible for the design of Phase 1 upgrades (attachment 1).

Current volumetric capacity: **4,500m³ per day**
Estimated future requirement: **7,095m³ per day** (**+58%**)

The effectiveness of the plant's treatment process is diminished when flows exceed its volumetric capacity, causing exceedances of regulated parameters specified in the Town's Approval to Operate – in other words, the effluent (outflow) from the treatment plant is not as clean as required. This already occurs on a regular basis now, and the inconsistent loading also contributes to exceedances.

Equipment installed in during Phase 1 upgrades (completed in 2021) is sufficiently sized for the plant's anticipated future flows, but its installation did not increase the plant's volumetric capacity. It instead improved the treatment process and laid the groundwork for Phase 2 upgrades, which will consist of additional volumetric capacity primarily in the form of an additional lagoon cell (among other needed process and equipment upgrades).

The consultant recommended beginning a wastewater sampling program that included influent so the wastewater characteristics could be quantified, and the current effectiveness of treatment would be better understood for the Phase 2 design. Town staff began influent sampling in the spring of 2022.

Gravity Sewers and Pumping

EXP assessed the flow capacity of existing gravity sewers within the sewershed of the East End Comprehensive Development District (CDD). It was determined that size upgrades for the gravity

sewers within the Main (Bromley) lift station general sewershed would not be required to support the East End CDD as they are adequately sized.

It was further recommended that the Town complete a detailed engineering assessment of its lift stations and forcemains. The planned assessment program will consider future developments, however its primary purpose will be to inform our asset management program and plan for capital upgrades and improved maintenance practices. Budget for beginning these assessments in the 2022/23 fiscal year was previously approved by Council, though the program has not been started yet due to diverting staff resources to the issues experienced with the wells and water system.

WASTEWATER SYSTEM CONCLUSION

- Phase 2 upgrades of our sewer treatment plant will adequately service planned growth in the east end and elsewhere in Town.
- Other improvements to the overall system may be required once additional engineering assessment takes place.
- The Town is currently budgeting for these upgrades through our Capital Budget; however, other cost recovery mechanisms for new development and long-term capital costs (beyond just existing taxation) should be considered by Council.

Water System – Source Water Pumping (Wells)

At present, the Town's well pumping system meets our basic daily volumetric requirements. A groundwater supply capacity study (attachment 3) was completed by CBCL in March 2022, the findings of which suggest that there is additional capacity available from the Wolfville aquifer. Increased rates of extraction may be sustainable, depending on the sources and rates of recharge to the aquifer.

An analysis of the utility's SCADA data for the purpose of determining risk of seawater intrusion was completed as part of the study, but the results were inconclusive due to poor record keeping and the sub-par quality of existing monitoring components. Water level data from the system's existing monitoring well would provide an improved indication of conditions in the aquifer, as our information seems to suggest the water levels in the well during pumping are well below sea level. Although coastal production wells, in some circumstances, can be operated safely with the pumping water level in the well below sea level, this practice must be approached with caution.

With regards to redundancy, 2022 was a clear demonstration of the current system's vulnerability to basic component failures. Our existing configuration puts significant stress on individual components at discrete locations in the aquifer, which may not even be sustainable at our current volumes as we have already seen early signs of over-utilization in the Wickwire well.

The conclusions of the March CBCL study suggested that the Town undertake a production well exploration program to site and install a third production well to supplement volumetric capacity, add redundancy, and to manage our groundwater resources more appropriately. A proposal for

this next phase of work was received and reviewed by staff, and the estimated costs will be included in the 2023/24 CIP budget planning.

Water System – Distribution Capacity and Modelling

A high-level water distribution system growth assessment was begun by CBCL in March of 2022 (attachment 4). The information presented was preliminary, and a more detailed assessment depends on the results of field calibration of the water system hydraulic model (also being completed by CBCL on a separate PO). As of the date of this Information Report, the field calibration of the water system hydraulic model is unable to be completed as the Town is currently under a strict water conservation directive. The directive is expected to be lifted by the mid-November, at which time the field activities will be authorized proceed so the study can be concluded.

While the final, calibrated quantitative data is not yet known, the theoretical work completed by CBCL to date has already identified critical distribution system constraints that may limit the system's ability to provide adequate fire flows to proposed multi-unit developments in both the west end and east end due to existing pipe (water main) size constraints and lack of looped alternate branches. The preliminary information (to be verified by hydraulic model calibration) suggests that the water main along Skyway from University to Kent is undersized, and that the single main along Pleasant servicing the entire east end (when the former transmission main is out of service) is not sufficient. Other developments that are further advanced (Woodman's Grove) may also have insufficient fire flow capacity for multi-unit developments due to pipe size constraints.

Planning and budgeting activities to improve shortfalls already identified in the preliminary draft report have not yet begun, as these upgrades (which may be necessary to support future growth and development) could be required to include developer capital cost sharing agreements.

Water System – Storage and Treatment

A comprehensive System Assessment Report (SAR) is required by all public municipal water utilities once every ten years per the terms and conditions of our Approval to Operate. As this report is due in 2023, CBCL have been approved to complete this study within Q3-Q4 of 2022/23. The results of this comprehensive report will satisfy the requirements of our Approval to Operate, and will allow staff to assess current storage and treatment capacity with respect to our current demands and anticipated future growth. The distribution capacity and modelling study being completed by CBCL (see previous sub-section) indicate that the town's existing water storage reservoir with a capacity of 7.8 million liters is more than adequate to support the projected growth, however this will be confirmed with the additional detail in the SAR.

WATER SYSTEM CONCLUSIONS

- An additional source water well is highly recommended to create much needed redundancy and support current needs and additional development. The initial exploration work is being budgeted for 2023/24.
- Critical east-west distribution system constraints have been identified in the south end of town, which create single points of failure and are not adequately sized to provide needed fire flows to anticipated developments in the east and west ends.
- Additional assessment work is ongoing – more detailed results to come after Cherry Lane well is back in service, and modelling is able to be completed.

4) FINANCIAL IMPLICATIONS

To date, approximately $66,000 has been approved in the current fiscal year for utility capacity assessments (though some of this spending is an operational requirement). At this time, there are only qualitative and general financial implications known to be forthcoming relating to capital upgrades at the WWTP and with the wells and water distribution system. Detailed financial implications and related timelines will be prepared in once more definitive planning has been completed for future phases of development.

The Town is ready to start the process of a water rate study with an anticipated need for a rate application to the NS Utility and Review Board to increase rates. Typically the rate applications involve rate adjustment over a number of years (the last application provided incremental rate increases over three years) and it is likely staff will review future capital upgrade costs within the rate study parameters.

Part of the rationale around future capital upgrade costs, most notably around ensuring capacity to manage future growth, is how those costs are allocated to users of the system. The capital upgrades typically come at a cost that is significant in comparison to the current operating budgets. To help ensure current users do not carry the burden of these costs for future growth, other funding mechanisms should be considered. In addition to the near future rate structure, the Town should also be looking to consider capital cost charge by-laws as an effective tool to assist funding utility plant capacity expansion in accommodating future growth.

<u>Capital Cost Charges By-law</u>

Town Staff have begun exploring a Capital Cost Charges By-law for the Town. Given the projected growth for the Town and Capital Budget constraints, this should be a tool considered by Council. An example is provided from East Hants (ATTACHMENT 5). The intent stated in their by-law is as follows:

The purpose of infrastructure charges is to offset the cost to the Municipality of upgrading existing, and oversizing proposed, water and sanitary wastewater infrastructure that is attributable to new development. Infrastructure charges may be used to pay capital costs and costs for land, planning, studies, engineering, surveying, legal and financing incurred with respect to said infrastructure. Nothing contained in this Bylaw shall be construed as requiring the Municipality to extend Municipal services to a property. Where such services do not currently exist, it is the responsibility of the property owner to install and pay for such extensions in accordance with Municipal standards.

5) REFERENCES TO COUNCIL STRATEGIC PLAN AND TOWN REPORTS

N/A

6) COMMUNICATION REQUIREMENTS

Not assessed at this time.

7) FUTURE COUNCIL INVOLVEMENT

Possible Requests for Decisions (RFDs) regarding budgeting for capital upgrades and implementing policies related to Infrastructure and Capital Cost Charges.

Prepared by: Alexander J. de Sousa, P.Eng., Director of Engineering & Public Works
Date Prepared: October 25, 2022

Wolfville WWTP Preliminary Assessment

The Town of Wolfville

Type of Document:
Final

Project Number:
HFX-21022971-A0

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Date Submitted:
2022-03-29

Photo taken in March 2021

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1 Introduction

1.1 Authorization

EXP has been retained by the Town of Wolfville to provide a desktop study and analysis for the preliminary assessment of the sewage treatment plant (WWTP) in Wolfville, Nova Scotia.

1.2 Background

The WWTP is owned and operated by the Town of Wolfville. The plant operates under an Approval to Operate issued by Nova Scotia Environment (NSE), No. 2009-066087-04.

Figure 1: Satellite map of Wolfville WWTP (Source: Google Earth)

The WWTP has been classified as a Class I Wastewater Treatment Facility. The Approval to Operate is effective as of December 3, 2024. In general, the Approval outlines terms and conditions for the overall construction and operation of the WWTP including monitoring and reporting frequencies, record keeping, assessment criteria, and specific conditions of the site.

The administrative details of the Approval are as follow:

Classification:	Class I Wastewater Treatment Facility
Approval Holder:	Town of Wolfville
Site PID:	55280176
Approval No.	2009-066087-04
Expiry Date:	December 3, 2024.

2 Conditions Analysis and Assessment

2.1 Designed Capacity

The WWTP was built in July 1979 with a designed treatment capacity of 4,500 m^3/day (Source: ERA, 2014).

The aeration system has had several upgrades and replacements in the years 1991, 2013 (Lagoon #1), and 2019 (Lagoon #2). The designed capacity of the WWTP was the same as the original design of 4,5000 m^3/day.

In 2020 - 2021, the WWTP was upgraded so that the mechanical and manual screens were added, and the chlorination gas system and chlorine contact chamber were replaced with a UV disinfection system. Two (2) new buildings for the screening system and UV system were constructed also. There was no upgrade nor expansion for the air supply system, the aeration system, and the lagoons.

Below is the average designed capacity of main process components up-to-date:

- Two (2) mechanical screens: 16,060 m^3/day for each screen.
- One (1) manual screen: 15,920 m^3/day.
- Two (2) aerated lagoons: 4,500 m^3/day.
- Air supply and aeration systems for two (2) lagoons: 4,500 m^3/day.
- One (1) UV disinfection system: 16,060 m^3/day.

2.2 General Conditions

2.2.1 Brief Description of Treatment Technology

Sewage influent is transported via two (2) forcemains to the WWTP. One (1) forcemain delivers influent from Grand Pre, and the other forcemain carries influent from two (2) pump stations,

Bromley and Oak Avenue pump station. The sewage is treated preliminarily in the screening building before flowing through the aerated lagoon cells in series. Once treated by the lagoons, the effluent passes through the UV disinfection system then is discharged to the outfall.

2.2.2 Wastewater Characteristics and Quality

2.2.2.1 Raw Wastewater Characteristics

An analysis of influent wastewater quality data of 2015 was done to determine the raw wastewater constituent concentration.

The below influent characteristics were calculated in the flow-weighted average instead of arithmetical averaging of all individual results, in order to gain a more accurate representation of the actual wastewater strength.

Table 1: Characteristics of influent (Data in 2015)

	Influent Quality in 2015			
	Total BOD (mg/L)	TSS (mg/L)	VSS (mg/L)	pH
Flow-Weight Average	157.48	188.59	142.65	7.43
Flow-Weight Average (Summer)	178.13	210.82	171.93	7.28
Flow-Weight Average (Winter)	141.40	171.28	135.12	7.54

2.2.2.2 Effluent Quality

Below is a summary of the compliance results over the averaging period from 2017 to 2021. The information presented includes the averaging period sampling results averages for each quarter of the year indicated.

Table 2: Effluent quality data in 2017 - 2021

Year/Quarter	$cBOD_5$ (mg/L)	TSS (mg/L)	pH	E. Coli (counts/100 mL)	Fish Toxicity (% mortality)
Limit	**25.00**	**25.00**	**6.00 - 9.00**	**200**	**N/A**
2017 / Q1	26.00	22.29	7.53	503	100
2017 / Q2	8.83	17.17	7.53	1	100
2017 / Q3	8.71	15.71	7.35	9	0
2017 / Q4	11.83	19.67	7.70	8	100
2018 / Q1	18.86	20.29	7.43	135	100
2018 / Q2	19.60	23.80	7.50	1	100
2018 / Q3	8.29	16.71	7.43	29	100
2018 / Q4	14.17	18.33	7.63	9	100

Year/Quarter	$cBOD_5$ (mg/L)	TSS (mg/L)	pH	E. Coli (counts/100 mL)	Fish Toxicity (% mortality)
2019 / Q1	26.00	32.14	7.41	88	100
2019 / Q2	15.17	37.83	7.62	3	100
2019 / Q3	9.50	18.71	7.54	23	100
2019 / Q4	11.00	26.83	7.43	46	100
2020 / Q1	27.57	31.29	7.53	296	100
2020 / Q2	13.71	35.14	7.55	2	100
2020 / Q3	8.17	38.17	7.50	1	100
2020 / Q4	Under construction				
2021 / Q1	Under construction				
2021 / Q2	23.67	19.33	7.73	4	100
2021 / Q3	21.83	13.50	7.60	28	0
2021 / Q4	65.61	29.71	7.59	53	50

Note: highlighted red number was data exceeded the limit.

Over the past three (5) years, the WWTP discharged effluent with pH results that met the criteria specified in the Approval in every instance.

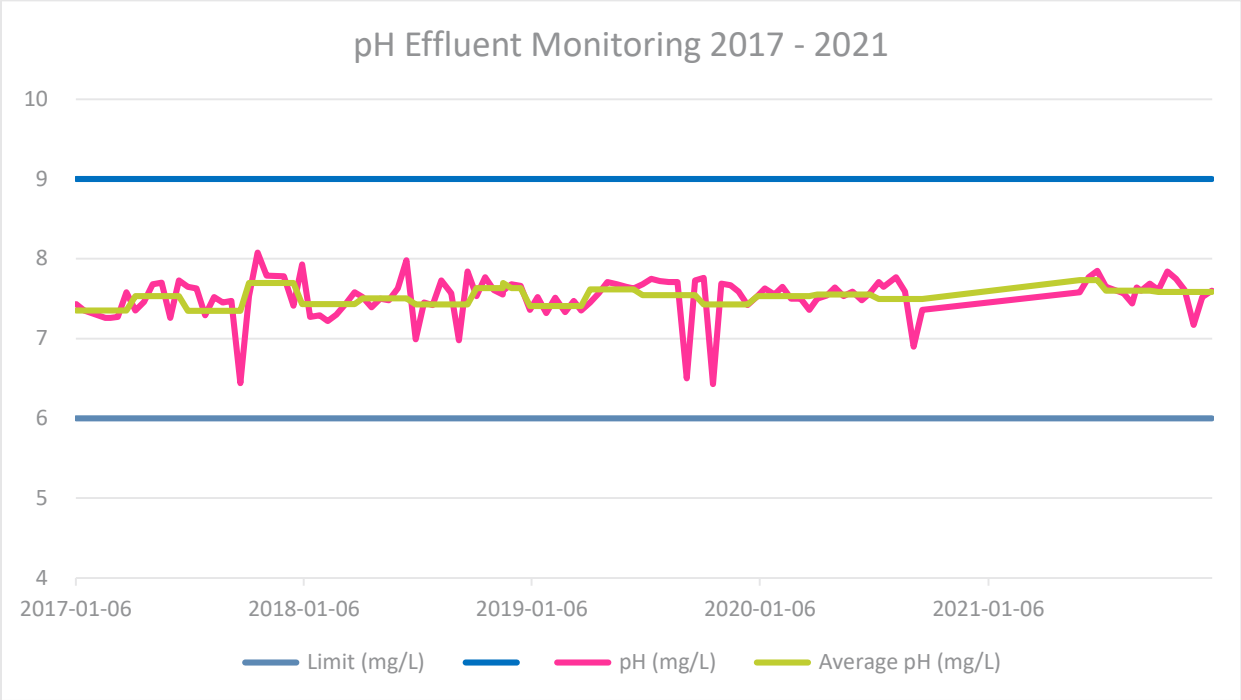

Figure 2: pH averaging results in 2017 - 2021

E. Coli counts and Carbonaceous Biochemical Oxygen Demand – 5 days ($cBOD_5$) were likely elevated and exceeded the limits in the first 1st Quarter of the years.

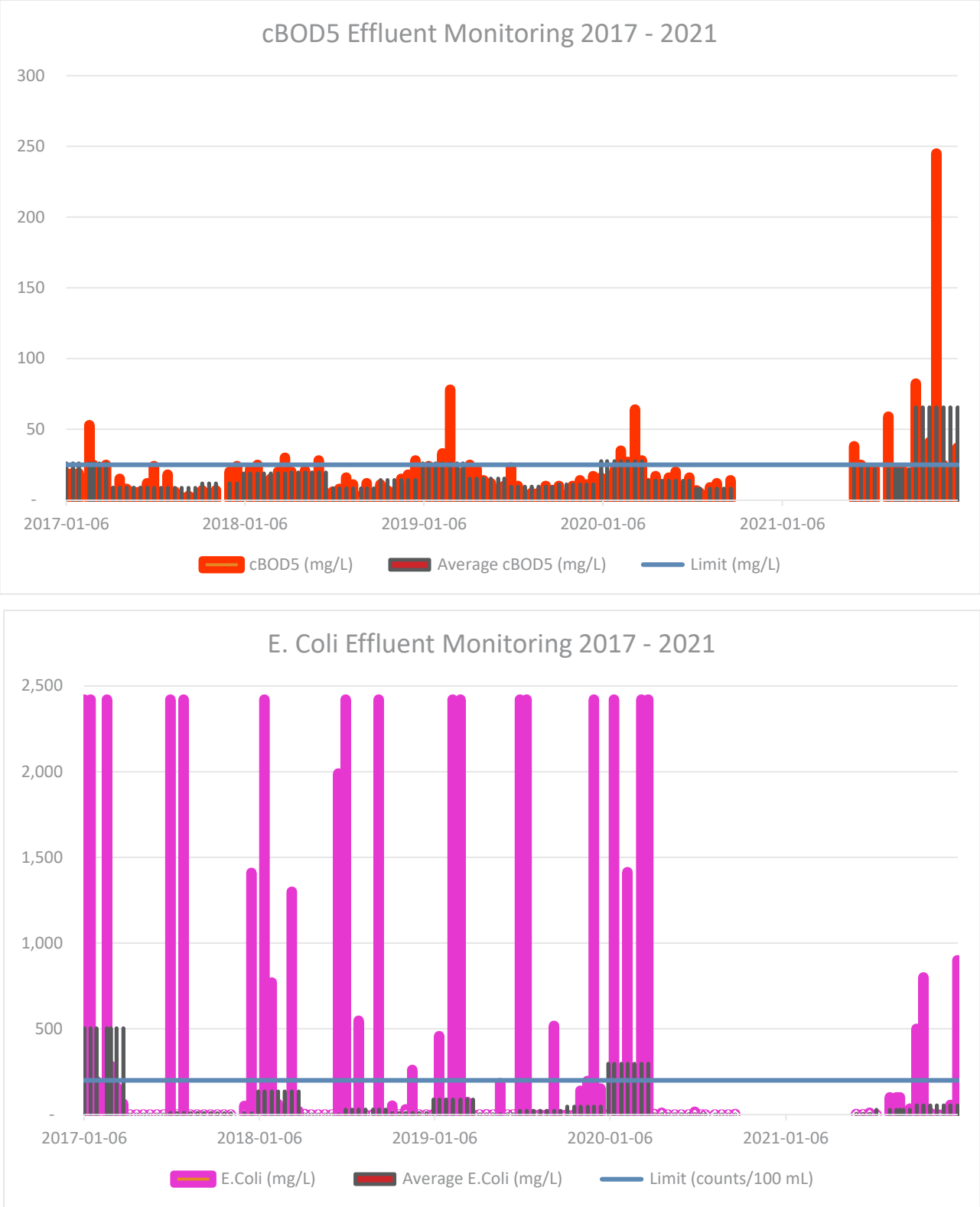

Figure 3: $cBOD_5$ and E. Coli averaging results in 2017 - 2021

Since 2019, Total Suspended Solids (TSS) concentration has been struggled to meet the limit. The condition had improved in the 2nd and the 3rd Quarters in 2021, after the upgrades, then increased again in the 4th Quarter.

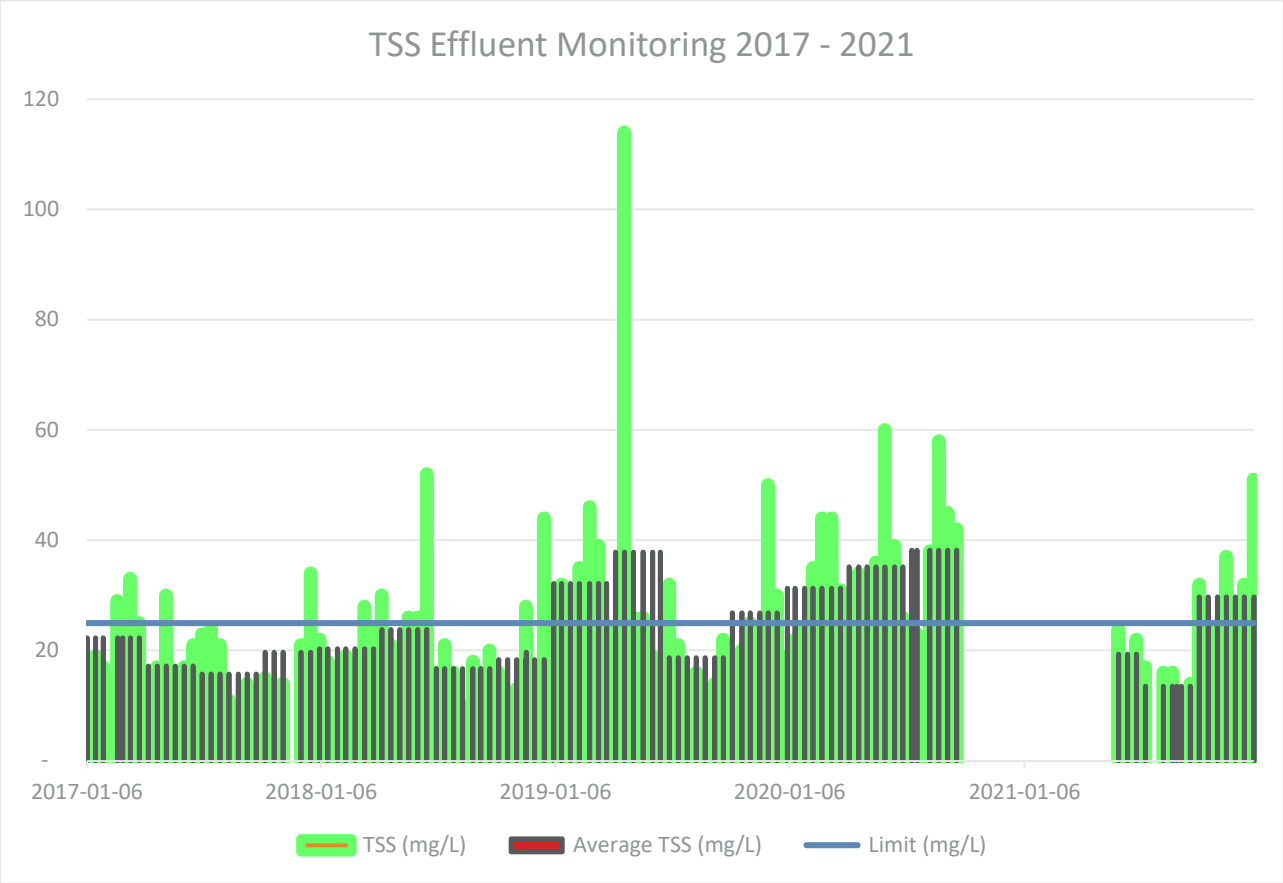

Figure 4: TSS averaging results in 2017 - 2021

Before the upgrades, only one (1) out of fifteen (15) tests of Fish Toxicity had the result of zero percent of mortality. Since July 2021, Ammonia as Nitrogen (NH_3-N) parameter, a measurement of ammonia in a sample, was taken into the monitoring program. Only one event, October 19th, 2021, we had sufficient data (NH_3-N concentration, pH, Temperature, and mortality percentage of Fish) to assess the relationship of un-ionized ammonia versus Fish Toxicity in the plant's effluent.

Table 3: Ammonia as N results in 2021

No.	Date	NH_3-N (mg/L)	Temperature (Degree Celsius)	pH	Notes
1	2021-07-13	32.50	8.17	7.65	
2	2021-08-10	21.70	10.57	7.57	
3	2021-08-31	9.11	20.07	7.64	

No.	Date	NH_3-N (mg/L)	Temperature (Degree Celsius)	pH	Notes
4	2021-09-07	11.10	9.13	7.60	
5	2021-09-21	22.60	17.07	7.69	
6	2021-10-19	26.90	8.27	7.84	Fish Toxicity Test: 0 % mortality
7	2021-11-02	33.50	7.73	7.75	
8	2021-11-16	31.30	6.77	7.61	
9	2021-11-30	15.20	6.73	7.17	
10	2021-12-14	0.08	10.13	7.52	
11	2021-12-29	2.16	7.60	7.60	

2.2.2.3 Acadia University Research

Since June 2021, Acadia University has been proceeding with monitoring of DO dissolved oxygen, temperature, pH at four (4) points at the WWTP (inlet influent, Lagoon #1, Lagoon #2, and effluent). NH_3-N also has been monitored for the influent and effluent.

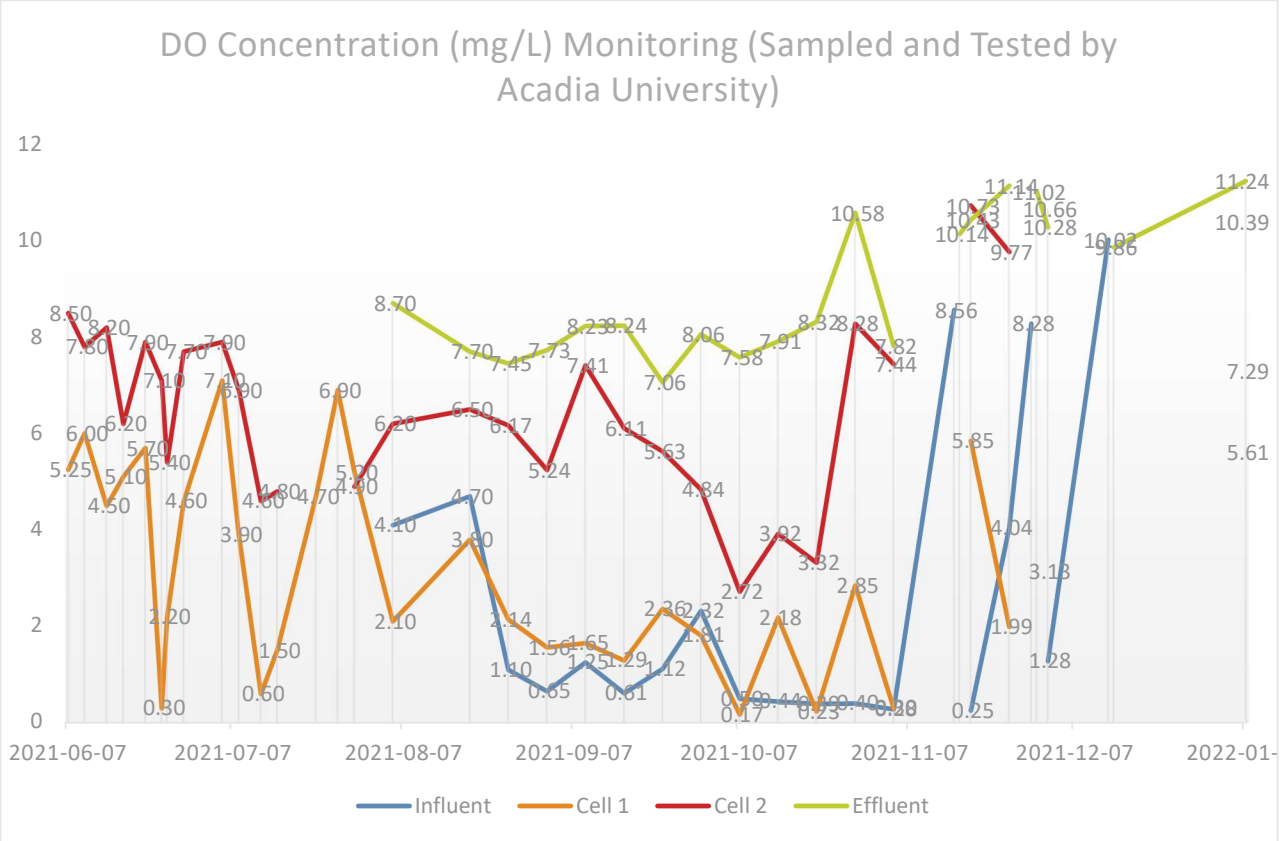

Figure 5: DO concentration in 2021 (Data: Acadia University)

Ammonia as Nitrogen data since November 2021 showed the NH_3-N concentrations in effluent consistently higher than influent.

Table 4: Ammonia as N results in 2021 monitored by Acadia University

No.	Date	NH_3-N (mg/L)	Temperature (Degree Celsius)	pH	Sampling point/Notes
1	2021-08-21	10.00			Effluent
2	2021-09-14	18.30			Effluent
3	2021-10-05	28.80			Effluent
4	2021-10-19	29.30			Effluent
5	2021-11-15	28.70	1.90	7.60	Influent
6	2021-11-16	29.90	2.00	7.79	Effluent
7	2021-11-29	15.00	3.40	7.69	Influent
8	2021-11-30	19.20	5.20	7.85	Effluent
9	2021-12-13	16.50	5.30	7.52	Influent
10	2021-12-14	21.40	7.40	7.77	Effluent

2.2.3 Existing Wastewater Flow Volume

2.2.3.1 Existing Influent Volume

Influent volume is monitored continuously by two (2) ultrasonic flow meters for two (2) forcemains at the entering point of the WWTP. SCADA information on the influent flow rate in the 4th Quarter of 2021 was provided by the Town.

The major challenge experienced was the data array recorded only in three (3) months, October - November - December 2021, while information read in at least one (1) year is required to get a basis for assessment and analysis. However, two (2) parameters - peak hourly and instantaneous flow rate - are used in this report to assess the capacity of the process equipment and components.

Table 5: Influent flow rate data

No.	Influent flow rate	Value	Notes
1	Peak hourly flow rate	113.74 L/s	Monitored from 00:48:17 AM to 01:44:26 AM, 2021-11-23.
2	Max. instantaneous flow rate to WWTP	407.05 L/s	Monitored from 03:47:05 AM to 04:00:49 AM, 2021-12-21.
3	Max. instantaneous flow rate from Bromley and Oak Ave. PS.	395.91 L/s	Monitored from 03:47:05 AM to 04:00:49 AM, 2021-12-21.
4	Average daily flow	2,848 m^3/d	Not use to assess as not a representative data of 2021.
5	Max daily flow	7,162 m^3/d	Not use to assess as not a representative data of 2021.

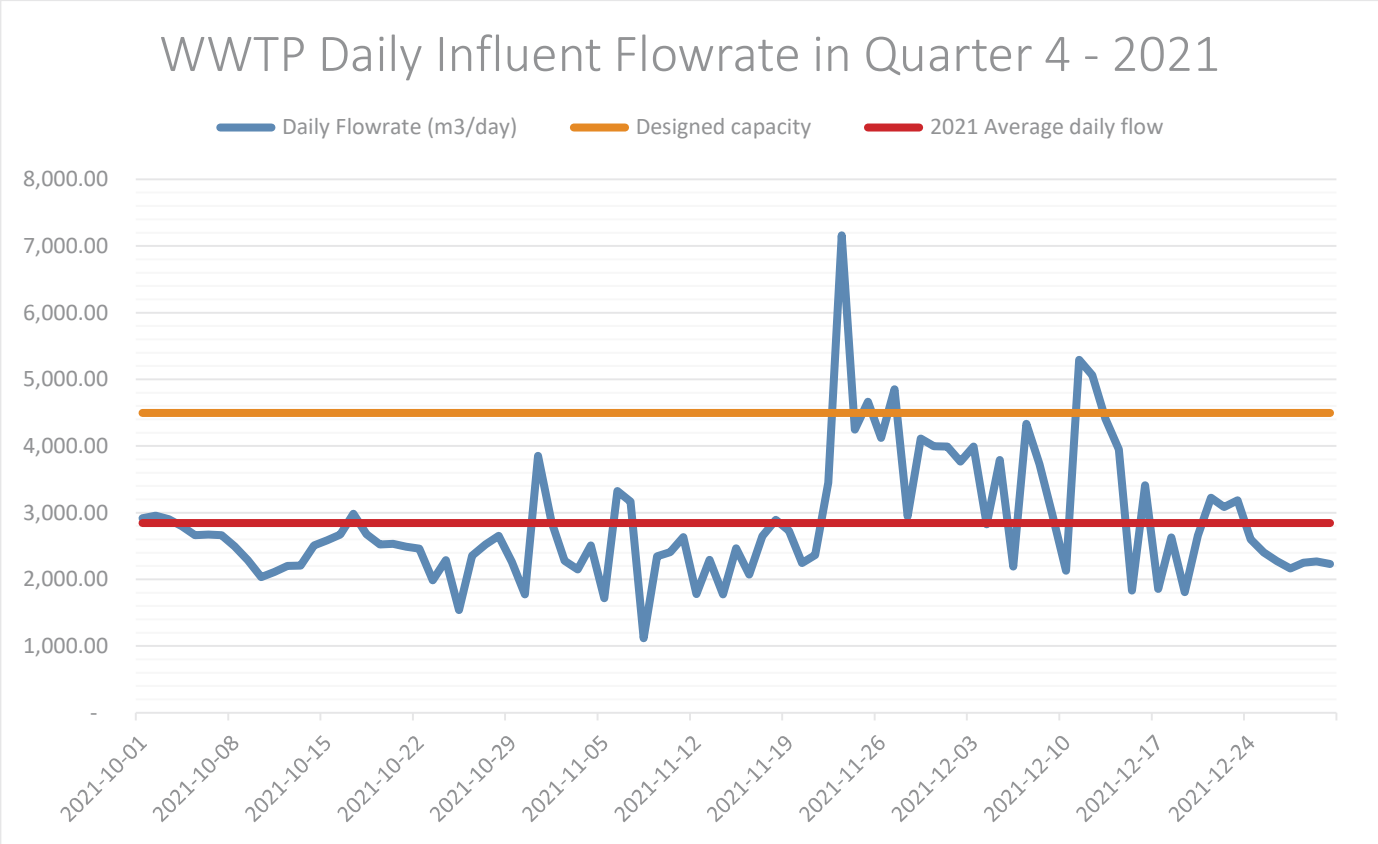

Figure 6: DO concentration in 2021 (Data: Acadia University)

2.2.3.2 Existing Effluent Volume

Treated effluent flow is monitored continuously by an ultrasonic flow meter installed upstream of flow to the UV building. SCADA data from 2017 - 2021 was provided by the Town. However, the

number of observation events in 2020 and 2021 was limited, only about 52%. The analysis, therefore, was done from 2017 - 2019 to determine the effluent flow of the WWTP.

Since the old flowmeter range limit was at a maximum of 71.59 L/s, the peak hourly flow rate and instantaneous flow rate data were not used to assess.

Table 6: Effluent flow rate data

No.	Effluent flowrate	2017	2018	2019
1	Average daily flow	3,393 m^3/d	3,753 m^3/d	4,391 m^3/d
2	Max daily flow	7,314 m^3/d	6,185 m^3/d	7,086 m^3/d
3	Days per year the WWTP worked over designed capacity	10.68% or 39 days out of 365 days	21.19% or 81 days out of 365 days	52.57% or 184 days out of 350 days

Although the average daily flows in 2017 - 2019 did not exceed the designed capacity (4,500 m^3/d), the number of days that the WWTP had worked over-capacity appears that the WWTP was operating at or in excess of its design capacity.

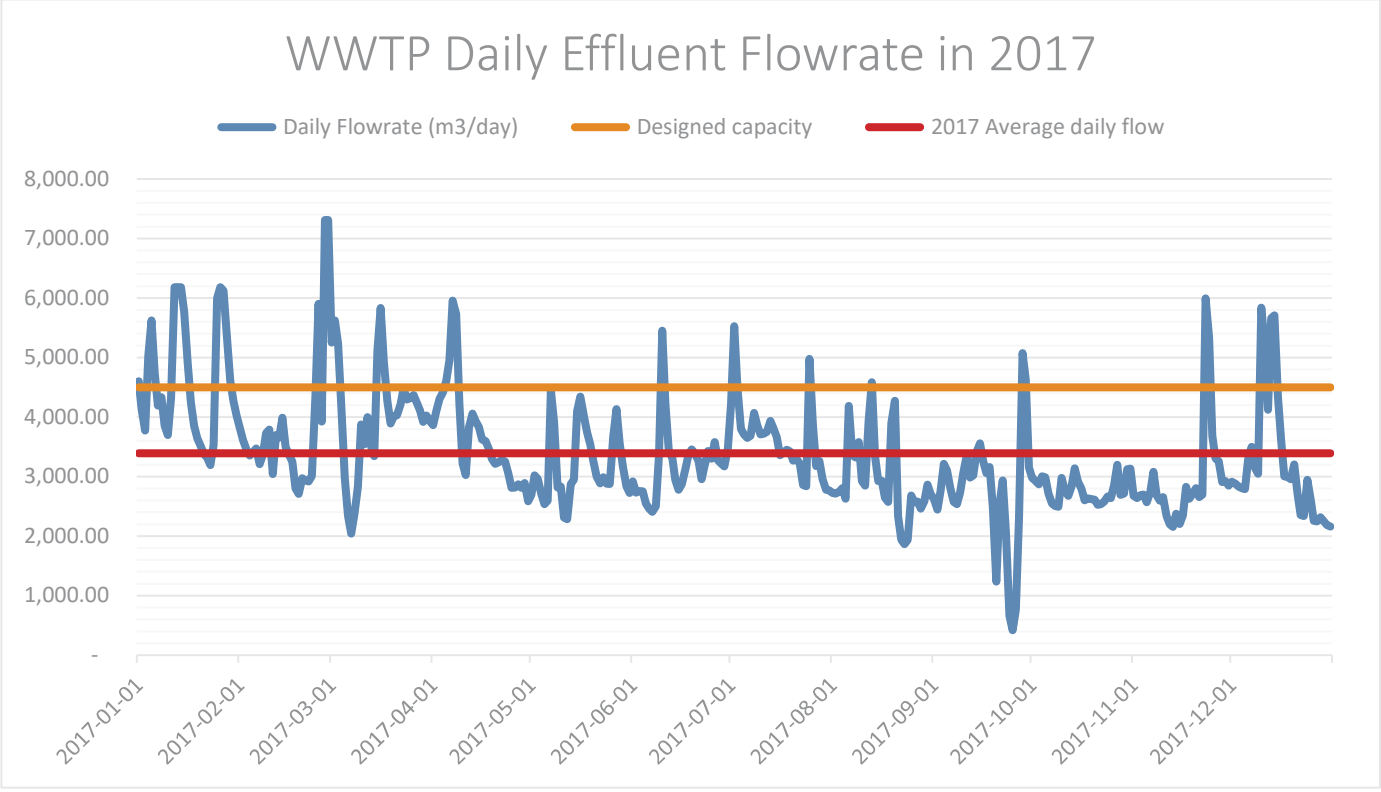

Figure 7: Effluent flowrate in 2017

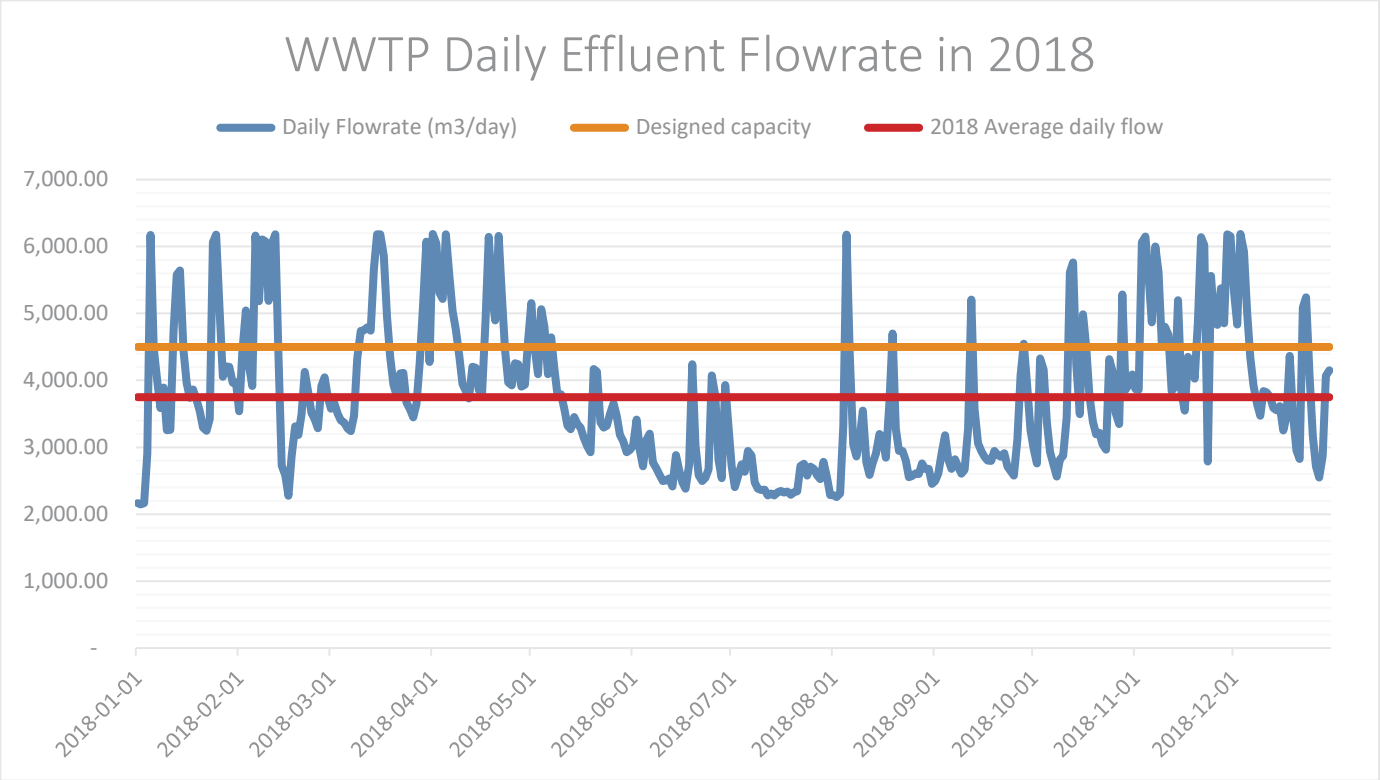

Figure 8: Effluent flow rate in 2018

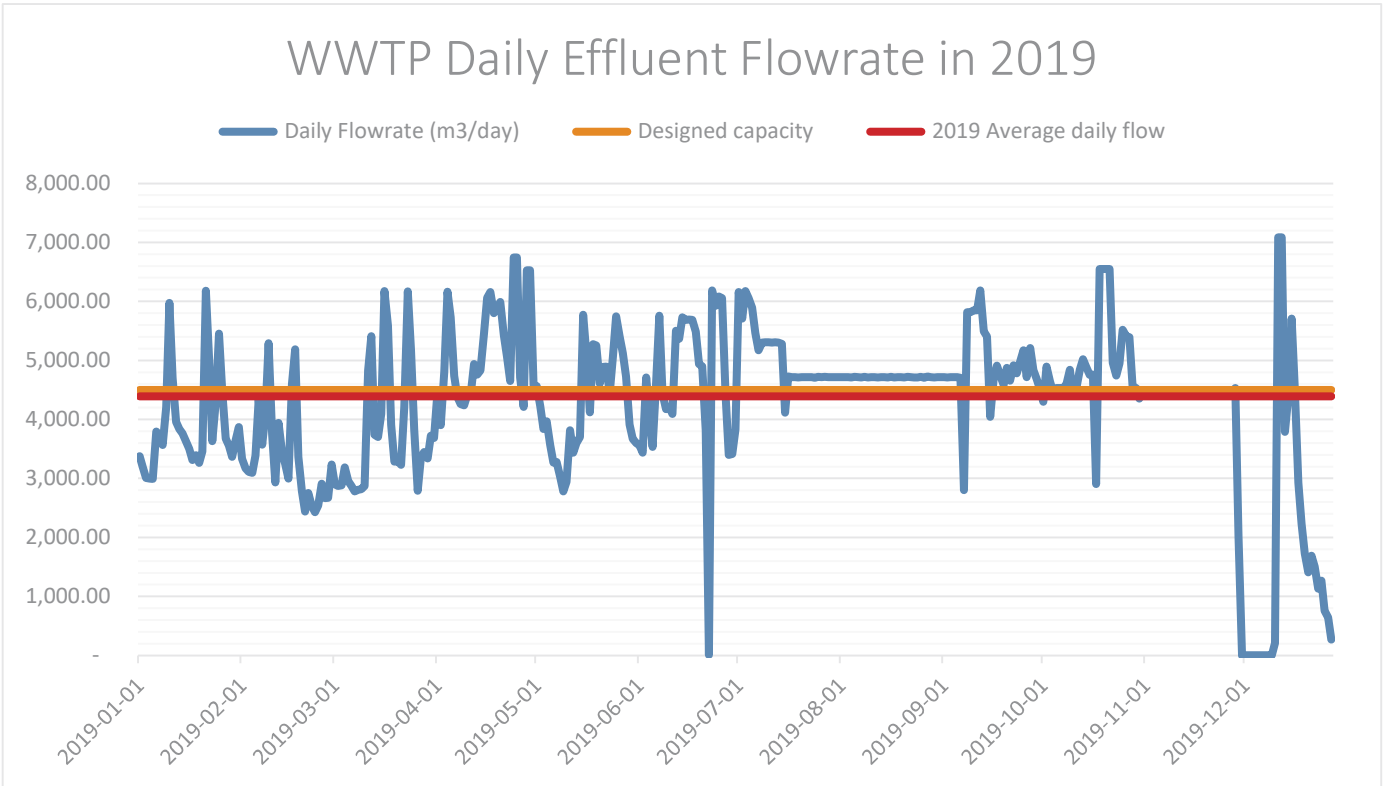

Figure 9: Effluent flow rate in 2019

2.2.4 Future Wastewater from New Comprehensive Development Districts (CDDs)

2.2.4.1 Basis Of Estimation:

Figure 10: Land use zoning map (Source: Town of Wolfville)

The Town of Wolfville is planning to add five (5) new CDDs for future development. They are:

- CDD #01- Maple Ridge Lands: 500 - 800 units, mostly will be multi-family residential, and may have small commercial uses as well.
- CDD #02 - Kenny Lands: 500 - 800 units, mostly will be multi-family residential, and may have small commercial uses as well.
- CDD #03 - Southwest: 500 units, single and multi-family residential.
- CDD #04 - Northeast: 150 units, multi-family residential.
- CDD #05 - Habour Waterfront: 60 units, long and short-term residential

Although wastewater from the CDDs will be estimated separately, the total sewage volume of five (5) CDDs will be used to assess the WWTP's capacity versus the future additions.

Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment and Disposal (2006) and Wolfville Census Profile - Statistics Canada 2016 Census are referred to determine influent flow conveyed to the pump stations and WWTP.

Table 7: Basis for future influent flow calculation

No.	Description	Unit	Value	Notes
1	Atlantic Canada Wastewater Guidelines Manual			
	• Average daily flow (for residence)	L/day/person	340	
	• Average daily flow (for LTC)	L/day/resident	450	
	• Average daily flow rate for commercial use	L/day/m^2	6	For stores, shopping center, or office buildings
	• Extraneous flow from I&I	L/s/ha	0.14	Range 0.14 - 0.28
	• Extraneous flow from I&I	m^3/cm of pipe dia./km length of pipe/day	0.24	Range 0.24 - 0.48
	• Extraneous flow from manholes	L/s/manhole	0	Range 0 - 0.4
2	Statistics Canada 2016 - Wolfville Census Profile			
	• Average number of persons in a dwelling unit in Wolfville	Person	2	

2.2.4.2 Influent Flow Projection of The Future Additions:

Table 8: Calculations for future additional influent flow

No.	Description	Sewage conveyed to WWTP via Pump Station(s)	Estimated average daily flow	Estimated peak flow rate
1	CDD #01.01	To Oak Ave. P.S To WWTP	343 m^3/day	9.54 L/s
2	CDD #01.02	To Bromley P.S To WWTP	145 m^3/day	4.23 L/s
3	CDD #02	To Bromley P.S To WWTP	564 m^3/day	15.21 L/s
4	CDD #03	To Acadia Arena P.S To Bromley P.S To WWTP	340 m^3/day	10.53 L/s
5	CDD #04	To Oak Ave. P.S To WWTP	445 m^3/day	11.90 L/s
6	CDD #05	To Bromley P.S To WWTP	41 m^3/day	0.94 L/s

2.2.4.3 Future Raw Wastewater Characteristics:

All the CDDs are mostly for residential use purposes. We assumed that the characteristics of the influent generated from these CDDs would be similar to the characteristics stated in Section 2.2.2.1.

2.2.5 Future Wastewater Flow To WWTP

2.2.5.1 Future Influent Volume

Although data from the "Sanitary Sewershed Study in 2004" (by CBCL) was used for the calculations, there were still some outstanding data gaps that assumptions were made to determine the average daily influent flow conveyed to the WWTP in the future.

Table 9: Calculations for future average daily influent flow

No.	Facility	Estimated average daily flow	Basis for estimation
1	Future Oak Ave. P.S.	983 m^3/day	• Sanitary Sewershed Study in 2004 • Estimated average daily flow from CDDs
2	Future Bromley P.S.	6,021 m^3/day	• Sanitary Sewershed Study in 2004 • Estimated average daily flow from CDDs
3	Grand Pre P.S.	91 m^3/day	• Existing influent flow data (Quarter 4 - 2021) at WWTP
	Future WWTP Average daily flow	**7,095 m^3/day**	

Future peak flow rate was computed by adding the total of estimated peak flows from pump stations to the existing maximum instantaneous flow rate.

Table 10: Calculations for future peak flow rate

No.	Facility	Estimated peak flow rate	Basis for estimation
1	Future additions	50.69 L/s	• Estimated peak flow from CDDs and infiltration
2	Existing maximum instantaneous flow	407.05 L/s	• Existing influent flow data (Quarter 4 - 2021) at WWTP
	Future WWTP Peak flow rate	**457.74 L/s**	

2.2.5.2 Future Raw Wastewater Characteristics:

All the CDDs are mostly for residential use purposes. We assumed that the characteristics of future influent to the WWTP would be similar to the characteristics stated in Section 2.2.2.1.

2.3 Site Details

2.3.1 Gravity Collection System to the Pump Stations

2.3.1.1 Gravity Sewers Information

Table 11: Configuration of gravity sewers from CDDs to Pump Stations

Inlet Node	Outlet Node	Sewershed	Pipe dia. (inch)	Pipe material	Average flow (m^3/day)	Peak Input Flow (L/s)	Capacity Ratio (%)
Gravity from East Extension to Oak Ave. P.S.							
		Main St. - 11			282.53	13.03	
		CDD #01.1			342.96	9.54	
MH720	MH542		8	CP	625.49	22.57	19.34%
MH542	MH584		8	CI	968.45	32.11	6.86%
		East Extension and CDD #04			315.52	8.68	
MHS7	Connection point		8	PVC	315.52	8.68	3.38%
		Main St. - 10			307.58	18.02	
MH584	MH583		8	PVC	650.54	27.56	6.32%
MH583	MH582		8	PVC	650.54	27.56	2.29%
MH582	Connection point		10	PVC	650.54	27.56	1.30%
Connection point	MH581		10	PVC	966.06	36.24	2.23%
MH581	MH580		10	PVC	966.06	36.24	1.59%
MH580	Oak Ave. P.S.		10	PVC	966.06	36.24	6.97%
Gravity from Southwest Extension to Acadia Arena P.S.							
		West Extension and CDD #03			352.24	11.33	
		Main St. - 1			19.87	0.93	
Connection point on Stirling Ave.	MH29		8	PVC	372.11	12.26	4.78%
MH29	MH28		12	VCP	372.11	12.26	1.62%
MH28	MH27 - Hillcrest Connection		12	VCP	372.11	12.26	2.36%
		Main St. - 2			111.46	6.33	

Inlet Node	Outlet Node	Sewershed	Pipe dia. (inch)	Pipe material	Average flow (m^3/day)	Peak Input Flow (L/s)	Capacity Ratio (%)
MH27 - Hillcrest Connection	MH26		12	VCP	463.70	17.66	5.61%
MH26	MH25		12	VCP	463.70	17.66	2.05%
MH25	MH21		12	PVC	463.70	17.66	0.55%
MH21	MH1		12	PVC	463.70	17.66	0.54%
MH1	MH2		12	PVC	463.70	17.66	1.05%
		Dominion Rail - 1			140.83	7.92	
MH2	MH3		12	PVC	493.07	19.25	2.09%
MH3	MH4		12	PVC	493.07	19.25	1.67%
MH4	MH5		12	CI	493.07	19.25	1.46%
MH5	MH6		12	CI	493.07	19.25	1.56%
MH6	MH7		12	VCP	493.07	19.25	2.31%
		Dominion Rail - 2			199.58	11.87	
MH7	MH8		12	VCP	551.82	23.20	14.58%
MH8	MH68		12	CI	551.82	23.20	1.77%
MH68	MHB225		12	CI	551.82	23.20	1.33%
		Acadia University***			1,114.50	92.55	
MHB225	MH67		15	PVC	1,666.32	115.74	2.75%
MH67	Acadia Arena P.S.		10	PVC	1,666.32	115.74	29.73%
Gravity from Southeast to Bromley P.S.							
		Maple Ave.			26.78	1.37	
		Kadray Holdings Inc.			6.12	0.20	
		CDD #01.2			144.76	4.23	
		CDD #02			564.16	15.21	
MH3-Kadray Holdings	MH2-Kadray Holdings		8	PVC	741.82	21.02	2.41%
MH2-Kadray Holdings	MH1-Kadray Holdings		8	PVC	741.82	21.02	2.12%

Inlet Node	Outlet Node	Sewershed	Pipe dia. (inch)	Pipe material	Average flow (m^3/day)	Peak Input Flow (L/s)	Capacity Ratio (%)
MH1-Kadray Holdings	MH310		8	PVC	741.82	21.02	2.25%
MH310	MH574		8	PVC	741.82	21.02	8.19%
MH574	MH573		8	CP	741.82	21.02	2.96%
MH573	MH572		8	CP	741.82	21.02	3.52%
MH572	MH539		8	CP	741.82	21.02	3.64%
MH539	MH649A		8	CP	741.82	21.02	3.70%
MH649A	MH537		8	CP	741.82	21.02	2.25%
MH537	MH536		8	CP	741.82	21.02	2.47%
MH536	MH535		8	CP	741.82	21.02	4.71%
MH535	MH534		8	CP	741.82	21.02	4.10%
MH534	MH533		8	CP	741.82	21.02	6.87%
MH533	MH532		8	CP	741.82	21.02	14.14%
MH532	MH531		8	CP	741.82	21.02	9.31%
		Main St. - 9			183.17	7.63	
MH531	MH530		10	CP	898.21	27.28	5.72%
MH530	MH529		10	CP	898.21	27.28	5.60%
MH529	MH528		10	CP	898.21	27.28	3.19%
MH528	MH168		10	CP	898.21	27.28	1.67%
MH168	MH167		10	CI	898.21	27.28	1.67%
		Main St. - 8			334.37	14.09	
MH167	MH166		12	PVC	1,049.41	33.74	1.55%
MH166	MH156		12	PVC	1,049.41	33.74	1.58%
MH156	MH733		12	PVC	1,049.41	33.74	2.20%
MH733	MH734		12	PVC	1,049.41	33.74	3.45%
MH734	MH172		12	PVC	1,049.41	33.74	3.31%
MH172	MH135		12	PVC	1,049.41	33.74	6.01%
Gravity from Northwest to Bromley P.S.							
		Main St. - 7			585.79	58.85	
		CDD #05			40.80	0.94	
MH137	MH143		15	HDP	626.59	59.79	2.57%
MH143	MH145		15	HDP	626.59	59.79	1.45%
		Willow Ave.			664.42	64.94	

Inlet Node	Outlet Node	Sewershed	Pipe dia. (inch)	Pipe material	Average flow (m^3/day)	Peak Input Flow (L/s)	Capacity Ratio (%)
MH145	MH135		18	PVC	705.22	65.88	5.39%
		Wharf Rd.			3,264.19	168.11	
MH135	MH134		18	PVC	4,354.40	202.80	7.38%
MH134	MH133		18	VCP	4,354.40	202.80	22.64%
MH133	Bromley P.S.		14	Unknown	6,020.72	318.54	6.59%

Note: * Calculations based on data from the Sanitary Sewershed Study in 2004.

** Where data gaps were found, assumptions were made based on the Infrastructure Asset Inventory Map, minimum allowable pipe slopes for each size of pipes stated in the Atlantic Canada Wastewater Guidelines Manual.

*** Average daily and peak flow rate for Acadia University to Arena P.S. was estimated by EXP as data from the Sanitary Sewershed Study for this sewershed showed irrational numbers.

2.3.1.2 Assessment

All of the gravity sewers, which will deliver wastewater from the new CDDs to the pump stations, have capacity ratios of less than 30%. It demonstrates that the gravity sewer system can handle the estimated peak condition.

2.3.2 Sewage Pump Stations and Forcemains to the WWTP

2.3.2.1 Influent Pump Information

Information of three (3) pump stations is below. Rated pump data will be confirmed with the pump suppliers.

Table 12: Configuration of sewage pump stations

Station #	Quan'ty	Model	Purchase year	Other information
Oak Ave.	2	Flygt CP 3102.180	1995	435 MT, 5HP, 600V, 3 phases, 4" discharge.
		Flygt CP 3102.180	2002	435 MT, 5HP, 600V, 3 phases, 4" discharge.
Arena Acadia	4	Flygt CP 3102.180	????	435 MT, 5HP, 600V, 3 phases, 4" discharge.
		Flygt CP 3102.180	1998	435 MT, 5HP, 600V, 3 phases, 4" discharge.
		Flygt CP 3102.180	2000	435 MT, 5HP, 600V, 3 phases, 4" discharge.
		Flygt CP 3102.180	2002	435 MT, 5HP, 600V, 3 phases, 4" discharge.
Bromley	3	Flygt CP 3152.181	1996	432 MT, 20HP, 600V, 3 phases, 6" discharge.
		Flygt CP 3152.181	1992	432 MT, 20HP, 600V, 3 phases, 6" discharge.
		Flygt NP 3153.180	2002	433 MT, 18HP, 600V, 3 phases, 6" discharge.

2.3.2.2 Forcemains to the WWTP

The delivery of wastewater to the WWTP utilizes two (2) forcemains, one (1) 100mm diameter forcemain from Grand Pre and one (1) 300mm diameter forcemain conveyed wastewater from both Bromley P.S and Oak Avenue P.S.

2.3.2.3 Assessment

All of the pumps at three (3) pump stations are over 20 years of service which needs to be assessed to determine the existing overall efficiencies and necessary upgrades to accommodate the new additional flows.

Information of pump efficiency, pump running hours, and/or flow rates (if the pump stations have flow meters) will be the basis for an estimate of the maximum instantaneous flow rate from the new CDDs.

Regardless of the max. future instantaneous flow rate from the new CDDs, at the maximum instantaneous flow rate from Bromley and Oka Ave. P.S stated in Section 2.2.3.2 (395.91 L/s) the maximum velocity at peak condition was 5.7 m/s. It exceeded the allowable velocity of 3.0 m/s which is to minimize turbulence and erosion in pipes (Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal-2006). The Town should consider replacing the existing 300mm forcemain with a larger diameter forcemain.

2.3.3 Screening Facility

2.3.3.1 Main Equipment/Component Information

Table 13: Configuration of screening facility

Equipment/ Component	Quan'ty	Model	Purchase year	Other information
Mechanical screen	2	ICSS 6/6	2021	Manufacturer: Kusters Water. In-channel Screw Screen. Peak flow of each screen: 16,060 m^3/d. Screen opening: 6mm perforation size. Installation angle: 35^0 from horizontal.
Manual screen	1		2021	Manufacturer: Kusters Water. 304 Stainless steel. Peak flow: 15,920 m^3/d if bar screen 50% clogged. Screen bars size: 5mm x 25mm. Screen angle of inclination: 45^0 Screen platform dimension: 400mm x 1000mm.

2.3.3.2 Assessment

At the maximum instantaneous flow rate to the WWTP of 407.05 L/s plus 50.69 L/s additional flow from the CDDs, the total of future max. instantaneous flow can reach to 457.74 L/s (39,549 m^3/d). With two (2) mechanical screens on duty and one (1) manual screen for overflow, the preliminary treatment facility can handle the peak condition.

2.3.4 Aerated Lagoons

2.3.4.1 Main Equipment/Component Information

Table 14: Configuration of aerated lagoons

Equipment/ Component	Quan'ty	Model	Purchase year	Other information
Lagoon	2		1977	2 aerated lagoons operated in series. No membrane liner. Lined by in-situ clay. Designed operating volume of each: 20,510 m^3
Aeration system for Lagoon #1	1	FlexAir 88S Magnium	2013	Manufacturer: Environmental Dynamics Inc. 8 floating laterals x 7 fine bubble diffuser assemblies. Active surface area: 0.49 m^2/diffuser
Aeration system for Lagoon #2	1	FlexAir 44S Magnium	2019	Manufacturer: Environmental Dynamics Inc. 6 floating laterals x 6 fine bubble diffuser assemblies. Active surface area: 0.49 m^2/diffuser Peak airflow capacity: 115.5 sm^3/hr.
Floating baffle	2	XR-5	2021	Manufacturer: Seaman Corporation Geomembrane product: polymer coated fabric reinforced. Dimension for each baffle: 55.51m x 3.15m 2 windows 3.8m x 1.2m on each baffle.

2.3.4.2 Assessment

In 2019, the WWTP had an average daily flow of 4,391 m^3/d. Although it was less than the designed capacity (4,500 m^3/d), the plant had to work over the designed capacity in 184 days (52.57% of the observation record in that year). Hence, an extension or addition of a new aerated lagoon to increase the treatment capacity to 7,095 m^3/day is needed.

The replacement of the new aeration system in Lagoon #2 in the 1st Quarter of 2019 seemed not to improve the effluent quality. TSS concentration even exceeded the limit more often.

Ammonia as N that monitored by Acadia University since November 2021 showed the NH_3-N concentrations in effluent consistently higher than influent. Ammonia in sediment or sludge in the lagoons probably contributed to the effluent.

Short retention time, sludge accumulation at the bottom of the lagoons, and/or improper mixing and aeration rate may be the reasons that caused the elevated TSS and high fish toxicity percentage in the effluent.

Figure 11: Lagoon #2 in October 2020

2.3.5 Air Supply System and Piping

2.3.5.1 Main Equipment/Component Information

Table 15: Configuration of air supply system

Equipment/ Component	Quan'ty	Model	Purchase year	Other information
Blower	1	Cord CA 6-12	1979	Cord positive displacement blower. Capacity: 1,589 Nm^3/hr. at 48 kPa (935 CFM at 7 psi). Motor 40HP
Blower	2		1992	Aerzen Delta positive displacement blower. Capacity: 1,852 Nm^3/hr. at 48 kPa (1,090 CFM at 7 psi). One (1) has VFD. Motor 50HP
Air Pipe and Headers	1		1992	To Lagoon #1. 300mm dia. CLDI (cement lined ductile iron)
Air Pipe and Headers	1		1992	To Lagoon #2. 200mm dia. CLDI

2.3.5.2 Assessment

The blowers were designed to be capable of producing the design airflow at normal discharge pressure with one blower out of service. SCADA data provided by the Town was not used to assess because the current (Amp), which represents On/Off status, of one (1) blower with VFD was not recorded correctly.

EXP was told that normally, one (1) blower was operated in summer while one or two (2) blowers were run in winter. With the average blower operation factor of 0.3 - 0.4 (i.e only 1 or sometimes 2 blowers operate), oxygen is not provided enough to remove ammonia in wastewater. In a rough calculation when the influent flow is 4,500 m^3/d, the temperature is 15^0C, the operation factor should be 0.9 (i.e. 3 blowers operate with nearly max. capacity) to get ammonia converted 60%.

All of the existing blowers are aged and need to be assessed to determine the existing overall efficiencies. An upgrade is necessary to accommodate the new additional flows and improve the effluent quality.

During the construction period in 2020 - 2021, the contractor reported that leakages were found at the existing air headers which may cause air pressure losses.

2.3.6 UV Disinfection Facility

2.3.6.1 Main Equipment/Component Information

Table 16: Configuration of UV facility

Equipment/ Component	Quan'ty	Model	Purchase year	Other information
UV system	1	TrojanUV3000 Plus	2021	Manufacturer: Trojan Technologies Inc. - Number of channels: 1 - Number of banks per channel: 2 - Number of UV modules per bank: 9 - Number of lamps per UV module: 8 - Max capacity: 16,060 m^3/day

2.3.6.2 Assessment

The UV system can handle the flow up to 16,060 m^3/day. The results of E. Coli in effluent showed that the system has a good performance in the 2nd and 3rd Quarters of 2021. Although there were 3 events in the 4th Quarter of 2021 that E. Coli counts exceeded the limit, the averaging value met the requirement.

3 Findings and Recommendations

3.1 Findings

1. Estimated future capacity of the WWTP:
   - Average daily flow: 7,095 m^3/day
   - Peak flow rate: 457.74 L/s
2. The existing gravity sewers from the new CDDs to the pump stations can handle the future peak flow. No upgrades are required.
3. Pumps at Oake Ave., Bromley, and Arena lift pump stations should be re-assessed on the capacity and performance to determine upgrades.
4. The maximum velocity at peak condition in the 300mm forcemain from Bromley and Oka Ave. P.S. exceeded the allowable velocity of 3.0 m/s.
5. The screening facility can handle the future peak flow. No upgrades are required.
6. The aerated lagoons are working at and overcapacity. Extension to handle the new additional flows is needed.
7. The air supply system (blowers and aeration systems) needs to be upgraded to meet the requirements of quality and future capacity.
8. The UV disinfection system can handle the future flow. No upgrades are required.

3.2 Recommendations for Future Expansion and Upgrades (Phase 2)

The following expansion and modifications are recommended to improve the WWTP's performance and effluent quality.

1. Implement the necessary studies and surveys (including a geotechnical survey) for the WWTP expansion and upgrades to accommodate the future flows from the CDDs and to improve the effluent quality.
2. The expansion and upgrades should focus on adding one (1) new aerated lagoon, and upgrades for the air supply system (blowers) and aeration systems.
3. Conduct an assessment of the forcemains, Oake Ave., Bromley, and Arena lift pump stations' capacity and performance. Consider replacing the 300mm forcemain to the WWTP with a bigger diameter pipe.
4. Continue to collect SCADA data of influent volume in at least 12 months to consolidate the analysis on the parameters of maximum instantaneous flow, peak hourly flow, and average daily flow.
5. Take wastewater samples at an inlet point of the preliminary treatment facility to update the database of the influent characteristics.
6. Sampling for Fish Toxicity should be done on the same day the samples for pH and Ammonia testing are taken as an effort to track down the concentration of un-ionized ammonia and improve the Fish Toxicity results.

If you have any questions, please do not hesitate to contact us.

Submitted by:

Annie Nguyen, P.Eng.

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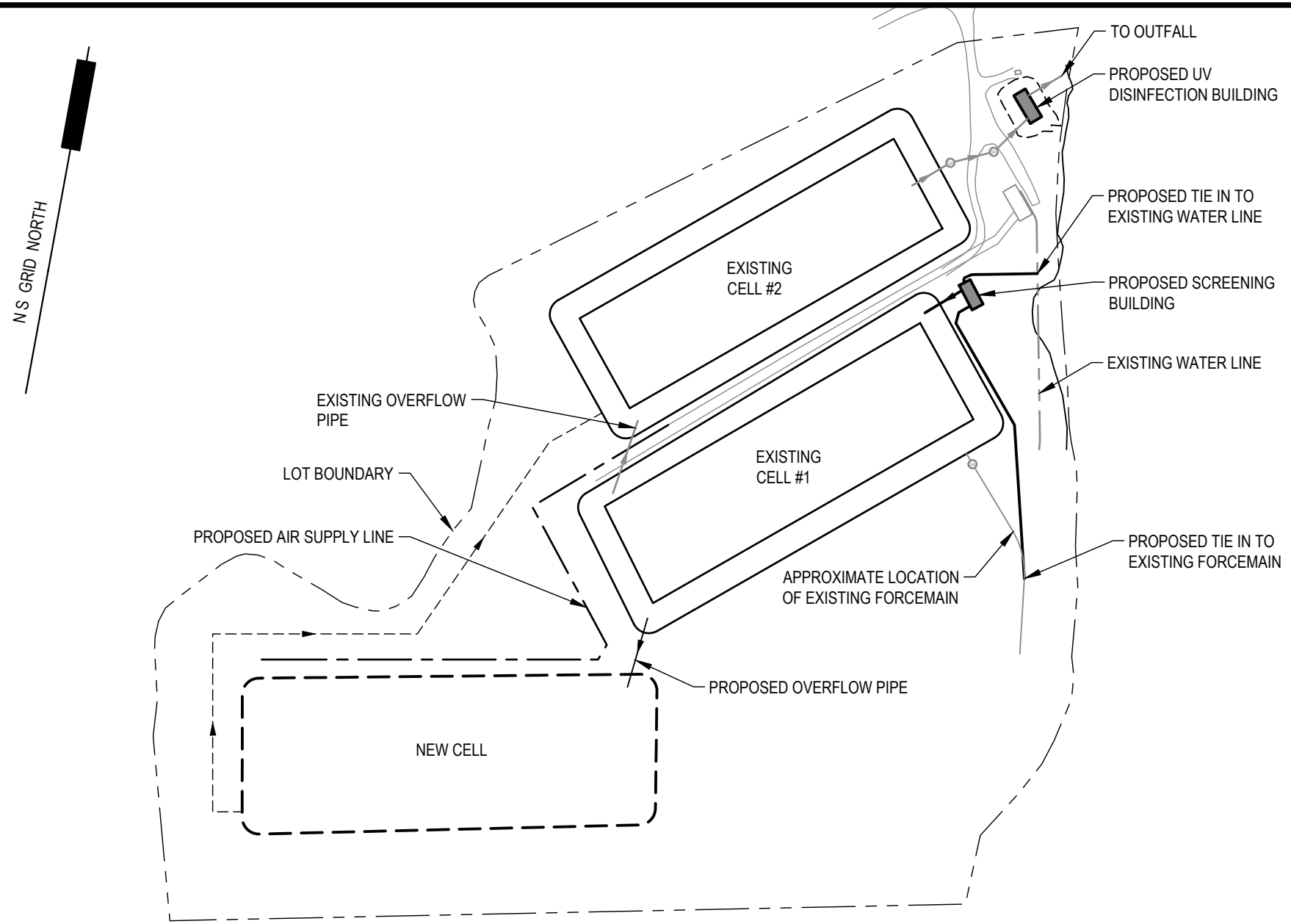
WILF CARTER

4/4/2019 10:29 AM



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Project Title: WOLFVILLE WWTP UPGRADES

Dwg. Title: **SITE LAYOUT OPTION 1**

Drawn By: WHC	Project No. HFX-00248763-A0
Dwg Standards Ckd By:	Dwg. No. **SK-1B** / Rev. No. A
Designed By: HAN	
Design Checked By:	

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October 21, 2021

Mr. Tim Bouter, P.Eng.
Director
Engineering & Public Works
Town of Wolfville

Dear Mr. Bouter:

RE: Town of Wolfville Wastewater Lagoon Sludge Monitoring

A sludge survey and sampling program was conducted on both cells at the Town of Wolfville Lagoon WWTP on September 20th. A grid of sample locations was selected to provide representative measurements and water quality samples. The sample locations are outlined in Figure 1. With the assistance of Town staff and a boat, samples were measured and captured at the various locations.

Analytical and In-situ Data

Samples were sent to an accredited laboratory and tested for % Total Solids, % Volatile Suspended Solids, Total Phosphorus, Total Nitrogen and available metals. The available metals analysis was performed on two samples, one from each cell. Sludge quantity was estimated using a "sludge judge". The tables below outline the in-situ and analytical parameters characterizing the sludge.

Table 1: Field Data

Site	Depth to Bottom (ft)	Sludge Thickness (ft)	Water Column In Sample Reservoir (ft)	Sample Taken
1	10.0	2.5	4.5	TSS
2	10.0	3.5	3.5	TSS
3	10.2	2.9	5.0	TSS/VSS/Met./TN/TP
4	10.0	3.8	2.0	TSS
5	10.0	1.0	7.0	TSS
6	9.5	3.8	3.0	TSS
7	10.0	1.5	6.0	TSS
8	10.0	0.9	6.0	TSS
9	10.0	0.3	6.0	TSS
10	10.0	0.5	6.0	TSS/VSS/Met./TN/TP
11	10.0	1.2	5.0	TSS
12	9.5	2.7	5.8	TSS

Table 2: Solids Data

Site	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)
1	11,200	-
2	2,400	-
3	14,200	5,110
4	NA	-
5	4,040	-
6	7,420	-
7	10,300	-
8	10,000	-
9	4,760	-
10	20,600	5,770
11	23,200	-
12	32,500	-

Table 2: Metals Scan, Phosphorus, and Nitrogen

Parameter	Unit	Sample 3	Sample 10
Aluminum	ug/L	67,100	73,500
Arsenic	ug/L	33	41
Cadmium	ug/L	6.0	11.0
Chromium	ug/L	111	148
Cobalt	ug/L	32	41
Copper	ug/L	7,610	11,500
Iron	ug/L	149,000	13,400
Lead	ug/L	168	263
Manganese	ug/L	4,720	2,600
Molybdenum	ug/L	23	31
Nickel	ug/L	114	117
Nitrogen	%	1.54	1.46
Phosphorus	mg/kg	4,790	4,160
Selenium	ug/L	11	13
Silver	ug/L	30.4	67.3-
Strontium	ug/L	1,380	714
Thallium	ug/L	0.5	0.7
Tin	ug/L	15	14
Titanium	ug/L	559	822
Uranium	ug/L	6.4	8.1
Vanadium	ug/L	132	142
Zinc	ug/L	4,380	5,120

Conclusion

This is the raw data captured from the field program. The water quality analysis and sample location map allows for repeatable analysis to monitor for sludge accumulations.

Should the Town of Wolfville wish for assistance with further analysis of the raw data and /or development of a sludge monitoring program, CBCL would be pleased to provide a proposal.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours very truly,

CBCL Limited

Prepared by:
Laura Jenkins, P.Eng.
Process Engineer
Direct: 902-421-7241
E-Mail: ljenkins@cbcl.ca

Project No: 210835.01


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HALIFAX, NS B3J 2R7
(902) 421-7241
ATTENTION TO: Laura Jenkins
PROJECT: 210835.01
AGAT WORK ORDER: 21X804050
SOIL ANALYSIS REVIEWED BY: Ashley Dussault, Report Writer
WATER ANALYSIS REVIEWED BY: Ashley Dussault, Report Writer
DATE REPORTED: Oct 04, 2021
PAGES (INCLUDING COVER): 15
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (902) 468-8718

*Notes

Disclaimer:

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Certificate of Analysis

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - TP

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

				SAMPLE DESCRIPTION:	3	10
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2021-09-20 10:00	2021-09-20 10:00
Parameter	Unit	G / S	RDL		2991842	2991849
Phosphorus	mg/kg		100		4790	4160
Grinding					Complete	Complete

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Ashley Dussault

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

TN in Soil

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

				SAMPLE DESCRIPTION:	3	10
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2021-09-20 10:00	2021-09-20 10:00
Parameter	**Unit**	**G / S**	**RDL**		**2991842**	**2991849**
Nitrogen - Total	%		0.02		1.54	1.46

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Ashley Dussault

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

		SAMPLE DESCRIPTION:		3	10
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2021-09-20 10:00	2021-09-20 10:00
Parameter	Unit	G / S	RDL	2991842	2991849
pH				6.88	7.30
Reactive Silica as SiO2	mg/L		0.5	0.8	0.9
Chloride	mg/L		2	151	146
Fluoride	mg/L		0.12	0.24	0.28
Sulphate	mg/L		2	15	27
Alkalinity	mg/L		5	411	204
True Color	TCU		5.00	31.9	18.5
Turbidity	NTU		0.5	9030	3140
Electrical Conductivity	umho/cm		1	1690	1220
Nitrate + Nitrite as N	mg/L		0.05	<0.05	<0.05
Nitrate as N	mg/L		0.05	<0.05	<0.05
Nitrite as N	mg/L		0.05	<0.05	<0.05
Ammonia as N	mg/L		0.03	<0.03	29.6
Total Organic Carbon	mg/L		0.5	102	52.9
Ortho-Phosphate as P	mg/L		0.01	0.18	0.03
Total Sodium	mg/L		0.1	106	106
Total Potassium	mg/L		0.1	17.7	17.7
Total Calcium	mg/L		0.1	296	107
Total Magnesium	mg/L		0.1	38.4	37.5
Bicarb. Alkalinity (as CaCO3)	mg/L		5	411	204
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10
Hydroxide	mg/L		5	<5	<5
Calculated TDS	mg/L		1	1100	708
Hardness	mg/L			897	422
Langelier Index (@20C)	NA			0.27	-0.03
Langelier Index (@ 4C)	NA			-0.05	-0.35
Saturation pH (@ 20C)	NA			6.61	7.33
Saturation pH (@ 4C)	NA			6.93	7.65
Anion Sum	me/L			12.8	8.76

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AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

				SAMPLE DESCRIPTION:	3	10
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2021-09-20 10:00	2021-09-20 10:00
Parameter	Unit	G / S	RDL		2991842	2991849
Cation sum	me/L				36.3	24.9
% Difference/ Ion Balance	%				47.9	47.9
Total Aluminum	ug/L		5		67100	73500
Total Antimony	ug/L		2		3	3
Total Arsenic	ug/L		2		33	41
Total Barium	ug/L		5		4680	3190
Total Beryllium	ug/L		2		6	4
Total Bismuth	ug/L		2		95	121
Total Boron	ug/L		5		201	155
Total Cadmium	ug/L		0.09		6.00	11.0
Total Chromium	ug/L		1		111	148
Total Cobalt	ug/L		1		32	41
Total Copper	ug/L		1		7610	11500
Total Iron	ug/L		50		149000	13400
Total Lead	ug/L		0.5		168	263
Total Manganese	ug/L		2		4720	2600
Total Molybdenum	ug/L		2		23	31
Total Nickel	ug/L		2		114	117
Total Phosphorous	mg/L		0.02		97.6	42.8
Total Selenium	ug/L		1		11	13
Total Silver	ug/L		0.1		30.4	67.3
Total Strontium	ug/L		5		1380	714
Total Thallium	ug/L		0.1		0.5	0.7
Total Tin	ug/L		2		15	14
Total Titanium	ug/L		2		559	822
Total Uranium	ug/L		0.2		6.4	8.1
Total Vanadium	ug/L		2		132	142
Total Zinc	ug/L		5		4380	5120

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PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

2991842-2991849 % Difference / Ion Balance, Hardness, Langelier Index, Nitrate + Nitrite, Hydroxide and Saturation pH are calculated parameters. The calculated parameters are non-accredited. The component parameters of the calculations are accredited. Ion Balance is greater than 10% due to the fact that samples are digested for total metals and any particulates in the water could be increasing the concentrations of certain elements.

Analysis performed at AGAT Halifax (unless marked by *)

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Certificate of Analysis

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

TSS

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

			SAMPLE DESCRIPTION:	1	2	4	5	6	7	8	9
			SAMPLE TYPE:	Water	Water	Water	Water	Water	Water	Water	Water
			DATE SAMPLED:	2021-09-20 10:00	2021-09-20 10:00	2021-09-20 10:00	2021-09-20 10:00	2021-09-20 10:00	2021-09-20 10:00	2021-09-20 10:00	2021-09-20 10:00
Parameter	Unit	G / S	RDL	2991840	2991841	2991843	2991844	2991845	2991846	2991847	2991848
Total Suspended Solids	mg/L		5	11200	2400	NA	4040	7420	10300	10000	4760

		SAMPLE DESCRIPTION:	11	12	
		SAMPLE TYPE:	Water	Water	
		DATE SAMPLED:	2021-09-20 10:00	2021-09-20 10:00	
Parameter	Unit	G / S	RDL	2991850	2991851
Total Suspended Solids	mg/L		5	23200	32500

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

2991843 NA - Unable to perform TSS / VSS analysis due to sample matrix.

Analysis performed at AGAT Halifax (unless marked by *)

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Certificate of Analysis

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

CLIENT NAME: CBCL LTD

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

TSS/VSS

DATE RECEIVED: 2021-09-20

DATE REPORTED: 2021-10-04

		SAMPLE DESCRIPTION:		**3**	**10**
		SAMPLE TYPE:		**Water**	**Water**
		DATE SAMPLED:		**2021-09-20 10:00**	**2021-09-20 10:00**
Parameter	**Unit**	**G / S**	**RDL**	**2991842**	**2991849**
Total Suspended Solids	mg/L		5	14200	20600
Volatile Suspended Solids	mg/L		5	5110	5770

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Halifax (unless marked by *)

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Quality Assurance

CLIENT NAME: CBCL LTD

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Oct 04, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
TN in Soil															
Nitrogen - Total	2991842		1.50	1.54	2.6%	< 0.02	107%	80%	120%						
Soil Analysis - TP															
Phosphorus	2636860		427	453	6.1%	< 10	97%	70%	130%				81%	70%	130%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

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Quality Assurance

CLIENT NAME: CBCL LTD
AGAT WORK ORDER: 21X804050
PROJECT: 210835.01
ATTENTION TO: Laura Jenkins
SAMPLING SITE:
SAMPLED BY:

Water Analysis

RPT Date: Oct 04, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
TSS															
Total Suspended Solids	3000699		<5	<5	NA	< 5	102%	80%	120%	NA			81%	80%	120%
Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.															
TSS/VSS															
Total Suspended Solids	2964960		17	17	NA	< 5	101%	80%	120%	NA			106%	80%	120%
Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.															
Standard Water Analysis + Total Metals															
pH	2993417		6.74	6.76	0.3%	<	101%	80%	120%	NA			NA		
Reactive Silica as SiO2	2991865		11.3	11.8	4.5%	< 0.5	113%	80%	120%	95%	80%	120%	101%	80%	120%
Chloride	3012984		4	4	NA	< 1	91%	80%	120%	NA	80%	120%	91%	70%	130%
Fluoride	2988618		<0.12	<0.12	NA	< 0.12	105%	80%	120%	NA	80%	120%	98%	70%	130%
Sulphate	2988618		6	6	NA	< 2	102%	80%	120%	NA	80%	120%	97%	70%	130%
Alkalinity	2993417		6	6	NA	< 5	85%	80%	120%	NA			NA		
True Color	2986776		<5.00	<5.00	NA	< 5	104%	80%	120%	102%	80%	120%	NA		
Turbidity	3011281		535	525	1.9%	< 0.5	93%	80%	120%	NA			NA		
Electrical Conductivity	2993417		75	75	0.4%	< 1	108%	90%	110%	NA			NA		
Nitrate as N	2988618		<0.05	<0.05	NA	< 0.05	94%	80%	120%	NA	80%	120%	93%	70%	130%
Nitrite as N	2988618		<0.05	<0.05	NA	< 0.05	98%	80%	120%	NA	80%	120%	96%	70%	130%
Ammonia as N	2998160		<0.03	<0.03	NA	< 0.03	106%	80%	120%	86%	80%	120%	101%	70%	130%
Total Organic Carbon	2998147		0.6	0.7	NA	< 0.5	84%	80%	120%	NA	80%	120%	96%	80%	120%
Ortho-Phosphate as P	2986776		0.24	0.23	1.4%	< 0.01	98%	80%	120%	97%	80%	120%	93%	80%	120%
Total Sodium	2993417		9.0	9.0	0.3%	< 0.1	107%	80%	120%	112%	80%	120%	NA	70%	130%
Total Potassium	2993417		0.3	0.3	NA	< 0.1	102%	80%	120%	107%	80%	120%	114%	70%	130%
Total Calcium	2993417		3.6	3.6	0.3%	< 0.1	98%	80%	120%	98%	80%	120%	NA	70%	130%
Total Magnesium	2993417		0.3	0.3	NA	< 0.1	102%	80%	120%	104%	80%	120%	112%	70%	130%
Bicarb. Alkalinity (as CaCO3)	2993417		6	6	NA	< 5	NA	80%	120%	NA			NA		
Carb. Alkalinity (as CaCO3)	2993417		<10	<10	NA	< 10	NA	80%	120%	NA			NA		
Hydroxide	2993417		<5	<5	NA	< 5	NA	80%	120%	NA			NA		
Total Aluminum	2994394		125	124	0.5%	< 5	104%	80%	120%	107%	80%	120%	NA	70%	130%
Total Antimony	2993417		<2	<2	NA	< 2	94%	80%	120%	105%	80%	120%	104%	70%	130%
Total Arsenic	2993417		<2	<2	NA	< 2	96%	80%	120%	98%	80%	120%	96%	70%	130%
Total Barium	2993417		<5	<5	NA	< 5	90%	80%	120%	93%	80%	120%	93%	70%	130%
Total Beryllium	2993417		<2	<2	NA	< 2	100%	80%	120%	101%	80%	120%	95%	70%	130%
Total Bismuth	2993417		<2	<2	NA	< 2	102%	80%	120%	105%	80%	120%	99%	70%	130%
Total Boron	2993417		5	5	NA	< 5	97%	80%	120%	111%	80%	120%	97%	70%	130%
Total Cadmium	2993417		<0.09	<0.09	NA	< 0.09	99%	80%	120%	103%	80%	120%	93%	70%	130%
Total Chromium	2993417		<1	<1	NA	< 1	95%	80%	120%	97%	80%	120%	100%	70%	130%
Total Cobalt	2993417		<1	<1	NA	< 1	94%	80%	120%	99%	80%	120%	97%	70%	130%

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Quality Assurance

CLIENT NAME: CBCL LTD

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Oct 04, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Total Copper	2994394		<1	<1	NA	< 1	99%	80%	120%	103%	80%	120%	103%	70%	130%
Total Iron	2994394		214	204	NA	< 50	97%	80%	120%	105%	80%	120%	NA	70%	130%
Total Lead	2993417		<0.5	<0.5	NA	< 0.5	100%	80%	120%	104%	80%	120%	101%	70%	130%
Total Manganese	2993417		3	3	NA	< 2	97%	80%	120%	99%	80%	120%	102%	70%	130%
Total Molybdenum	2993417		<2	<2	NA	< 2	97%	80%	120%	100%	80%	120%	103%	70%	130%
Total Nickel	2993417		<2	<2	NA	< 2	98%	80%	120%	105%	80%	120%	104%	70%	130%
Total Phosphorous	2994394		0.03	0.02	NA	< 0.02	105%	80%	120%	107%	80%	120%	99%	70%	130%
Total Selenium	2993417		<1	<1	NA	< 1	105%	80%	120%	97%	80%	120%	88%	70%	130%
Total Silver	2993417		<0.1	<0.1	NA	< 0.1	97%	80%	120%	96%	80%	120%	95%	70%	130%
Total Strontium	2993417		13	12	NA	< 5	93%	80%	120%	96%	80%	120%	106%	70%	130%
Total Thallium	2993417		<0.1	<0.1	NA	< 0.1	102%	80%	120%	104%	80%	120%	101%	70%	130%
Total Tin	2993417		<2	<2	NA	< 2	99%	80%	120%	100%	80%	120%	103%	70%	130%
Total Titanium	2993417		<2	<2	NA	< 2	98%	80%	120%	101%	80%	120%	106%	70%	130%
Total Uranium	2993417		<0.2	<0.2	NA	< 0.2	99%	80%	120%	101%	80%	120%	99%	70%	130%
Total Vanadium	2993417		<2	<2	NA	< 2	93%	80%	120%	98%	80%	120%	99%	70%	130%
Total Zinc	2993417		112	110	1.2%	< 5	96%	80%	120%	101%	80%	120%	NA	70%	130%

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Method Summary

CLIENT NAME: CBCL LTD

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Phosphorus	SOIL 0390; SOIL 0110; SOIL 0120; INST 0140	EPA SW 846-3050; SHEPPARD	ICP/OES
Grinding	INOR-401-0120	NA	N/A
Nitrogen - Total	INOR-181-6027 / INOR-181-6036	Modified from ASTM E1019-11	COMBUSTION

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Method Summary

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AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
pH	INOR-121-6001	SM 4500 H+B	PC TITRATE
Reactive Silica as SiO2	INOR-121-6027	SM 4500-SiO2 F	COLORIMETER
Chloride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Alkalinity	INOR-121-6001	SM 2320 B	
True Color	INOR-121-6008	SM 2120 B	LACHAT FIA
Turbidity	INOR-121-6022	SM 2130 B	NEPHELOMETER
Electrical Conductivity	INOR-121-6001	SM 2510 B	PC TITRATE
Nitrate + Nitrite as N	INORG-121-6005	SM 4110 B	CALCULATION
Nitrate as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-121-6047	SM 4500-NH3 H	COLORIMETER
Total Organic Carbon	INOR-121-6026	SM 5310 B	TOC ANALYZER
Ortho-Phosphate as P	INOR-121-6012	SM 4500-P G	COLORIMETER
Total Sodium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Potassium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Calcium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Magnesium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Bicarb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Carb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Hydroxide	INORG-121-6001	SM 2320 B	PC-TITRATE
Calculated TDS	CALCULATION	SM 1030E	CALCULATION
Hardness	CALCULATION	SM 2340B	CALCULATION
Langelier Index (@20C)	CALCULATION	CALCULATION	CALCULATION
Langelier Index (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 20C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Anion Sum	CALCULATION	SM 1030E	CALCULATION
Cation sum	CALCULATION	SM 1030E	CALCULATION
% Difference/ Ion Balance	CALCULATION	SM 1030E	CALCULATION
Total Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Antimony	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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Method Summary

CLIENT NAME: CBCL LTD

AGAT WORK ORDER: 21X804050

PROJECT: 210835.01

ATTENTION TO: Laura Jenkins

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Phosphorous	MET-121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Suspended Solids	INOR-121-6024, 6025	SM 2540C, D	GRAVIMETRIC
Volatile Suspended Solids	INOR-121-6024, 6025	SM 2540C, D	GRAVIMETRIC

AGAT Laboratories
Unit 122 • 11 Morris Drive
Dartmouth, NS
B3B 1M2
webearth.agatlabs.com • www.agatlabs.com
P: 902.468.8718 • F: 902.468.8924

Chain of Custody Record

Laboratory Use Only
Arrival Condition: ☐ Good ☐ Poor (see notes)
Arrival Temperature: 18.6, 17.2, 18.1
Hold Time:
AGAT Job Number: 21X804050
Notes: '21 SEP 20 1:10 PM

Report Information
Company: CBCL
Contact: LAURA JENKINS
Address:
Phone: Fax:
Client Project #: 210835.01
AGAT Quotation:
Please Note: If quotation number is not provided client will be billed full price for analysis.

Report Information (Please print):
1. Name: LAURA JENKINS
Email: LJENKINS
2. Name:
Email:

Report Format
☐ Single Sample per page
☑ Multiple Samples per page
☑ Excel Format Included
☐ Export

Turnaround Time Required (TAT)
Regular TAT ☑ 5 to 7 working days
Rush TAT ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days
Date Required:

Invoice To Same Yes ☑ / No ☐
Company:
Contact:
Address:
Phone: Fax:
PO/Credit Card#:

Regulatory Requirements (Check):
☐ List Guidelines on Report ☐ Do not list Guidelines on Report
☐ PIRI
☐ Tier 1 ☐ Res ☐ Pot ☐ Coarse
☐ Tier 2 ☐ Com ☐ N/Pot ☐ Fine
☐ Gas ☐ Fuel ☐ Lube
☐ CCME ☐ CDWQ
☐ Industrial ☐ NSEQS-Cont Sites
☐ Commercial ☐ HRM 101
☐ Res/Park ☐ Storm Water
☐ Agricultural ☐ Waste Water
☐ FWAL
☐ Sediment ☐ Other

Drinking Water Sample: ☐ Yes ☐ No **Salt Water Sample** ☐ Yes ☐ No
Reg. No.:

Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment
1	20/09/2021	WAT	1	
2	10:00	WAT	1	
3	10:15	WAT*	6	*TEST VSS & TSS
4	10:30	WAT	1	
5	10:45	WAT	1	
6	11:00	WAT	1	
7	11:15	WAT	1	
8	11:30	WAT	1	
9	11:40	WAT	1	
10	11:45	WAT*	6	*TEST VSS & TSS
11	11:50	WAT	1	
12	12:00	WAT	1	

Field Filtered/Preserved	Standard Water Analysis	Metals: ☑ Total ☐ Diss ☐ Available	Mercury	☐ BOD ☐ CBOD	pH	☐ TSS ☐ TDS ☐ VSS*	TOTAL NITROGEN (SOIL)	Total Phosphorus (SOIL MAT)	Phenols	Tier 1: TPH/BTEX (PIRI) ☐ low level	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX	VOC	THM	HAA	PAH	PCB	TC + EC ☐ P/A ☐ MPN ☐ MF	☐ HPC ☐ Pseudomonas	Fecal Coliform ☐ MPN ☐ MF	Other:	Other:	Hazardous (Y/N)
						X																
						X																
	X	X				X	X	X														
						X																
						X																
						X																
						X																
						X																
						X																
	XX					X	X	X														
						X																

Samples Relinquished By (Print Name): LAURA JENKINS
Samples Relinquished By (Sign):
Date/Time: 13:15
Date/Time: 20/09/21
Samples Received By (Print Name):
Samples Received By (Sign):
Date/Time
Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page ___ of ___
N°: 70610

CBCL
Solutions today | Tomorrow IN mind
Maritime Centre, 1505 Barrington Street, Suite 901
Box 606, Halifax, NS B3J 2R7
902-421-7241 | CBCL.ca | info@CBCL.ca

March 9, 2022

Mr. Tim Bouter, P.Eng.
Director of Engineering and Public Works
Town of Wolfville
359 Main Street
Wolfville, NS B4P 1A1

Dear Mr. Bouter:

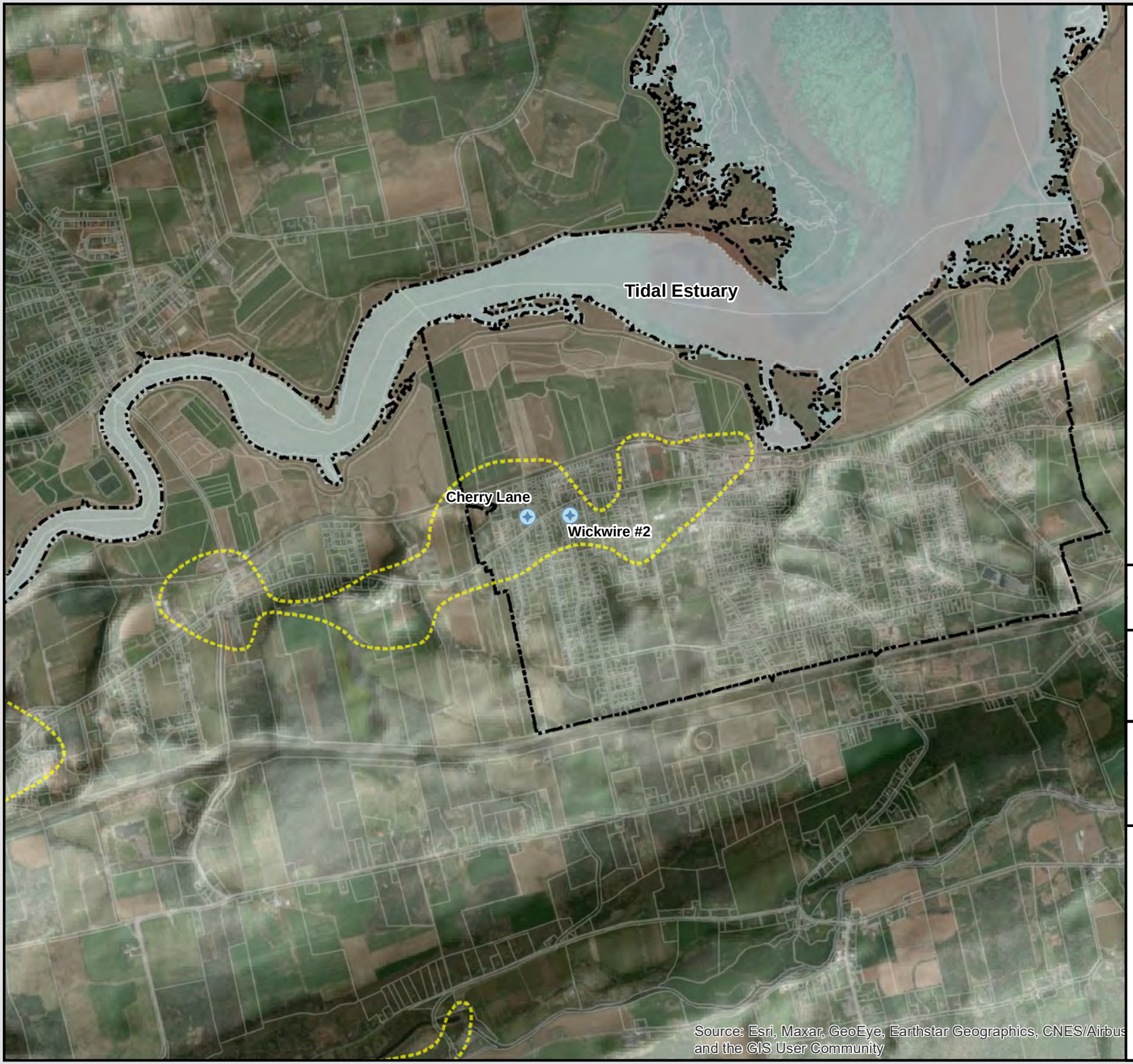
RE: Groundwater Supply Study

The Town of Wolfville draws water from a local well field. The water system serves over 4200 permanent residents and up to 1800 additional users associated with the university. As new subdivision developments are in the planning stage, the Town is reviewing its water supply capacity and the potential to supply new customers. CBCL Limited has completed a desktop review of available data from the wells that supply raw water to the system. The ability to increase current pumping rates will depend on the rate of recharge to the aquifer, both in the long-term and accounting for annual variations.

Hydrogeologic Setting

The Wolfville area is shown on Figure 1. The Wolfville aquifer is a linear deposit of sand and gravel, oriented from southwest to northeast, parallel to the valley axis. Regional mapping indicates that the aquifer is a glaciofluvial feature, associated with sandy kame material near the ground surface, transitioning to a deeper sequence of glaciofluvial sand and gravel. The deeper aquifer occupies an outwash channel within the underlying Triassic material, which is weakly consolidated sandstone and conglomerate of the Wolfville Formation. A conceptual model of the aquifer, developed as a part of numerical modelling by CBCL in 2005, is shown in Appendix A. The maximum thickness of the aquifer is approximately 40 metres, mapped to occur close to the Cherry Lane well. Wickwire Well #2 is screened in the same sequence of sand and gravel, 250 metres to the east. Previous isopach mapping of the aquifer thickness is provided in Appendix A.

Much of the aquifer is confined by a till unit with a thickness of 5-10 metres (isopach mapping is provided in Appendix A). In some parts of the aquifer, such as the area surrounding the Cherry Lane well, the material at the ground surface is predominantly sand, resulting in unconfined to semi-confined conditions. The sandstone and conglomerate underlying the area is a regional aquifer that provides much of the Valley's freshwater supply. The surficial



Legend

- Production Well
- Town Boundary
- Shallow Aquifer

FIGURE 1

Study Area

Town of Wolfville
Groundwater Supply Study

N
W E
S

0 250 500
m

Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
Scale 1:30,000
when printed @ 8.5 x 11

CBCL

sand and gravel aquifer may receive a component of flow from this underlying regional unit. Bedrock to south of Wolfville is mapped as low-permeability slate, which is generally interpreted to act as a low-flow boundary to the adjacent aquifer(s).

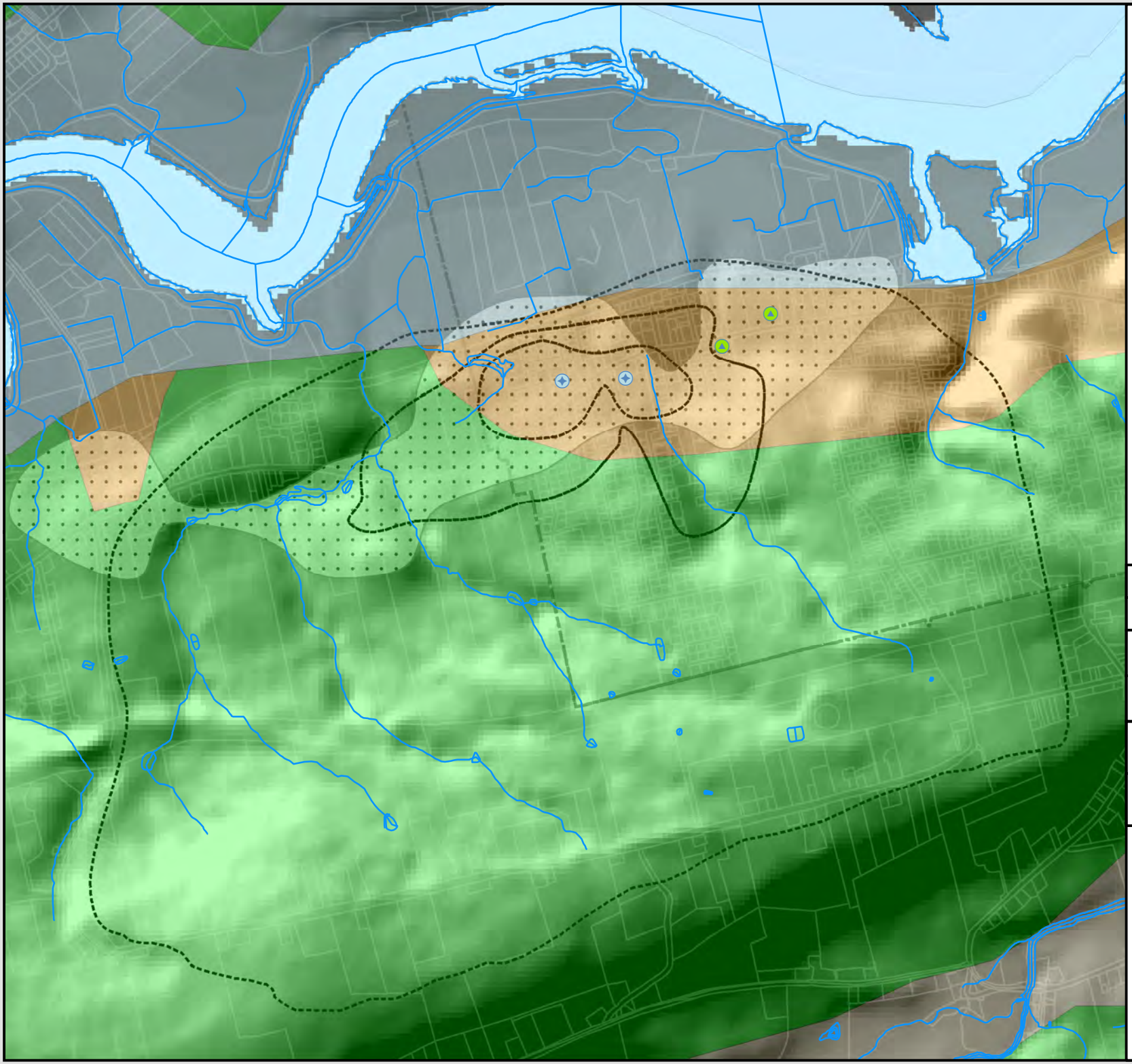
Models of Annapolis Valley aquifers generally indicate a regional recharge area originating on the South Mountain, with northward groundwater flow and discharge to the Cornwallis River and adjacent tidal estuary. The surficial Wolfville aquifer is likely to be recharged in areas more local to the deposit. Numerical modelling indicated that the capture zone for the Town's wells extends 2 km southward to a regional flow divide associated with the Gaspereau River watershed (Figure 2). Recharge rates vary according to localized conditions and have been modelled to vary from 0.1 to 0.4 m/year.

Previous reporting noted that chloride concentrations increased in the Cherry Lane well from 10 mg/L in the early 1970s, to 66 mg/L in 2004 (WATER, 2016). The rate and magnitude of increase is generally consistent with the effects of road salt, but the potential for sea water intrusion has been suggested in past reporting. The Cornwallis River Estuary is 900 metres to the north of the well field and exhibits brackish to saline conditions. Groundwater flow paths between the estuary and the Wolfville aquifer have not been mapped. The hydrogeologic setting suggests that water would have to pass through Triassic material and/or slates in order to reach the outwash valley aquifer, which may be helping to isolate the aquifer from brackish water. If the outwash valley extends to and contacts the coastline, a more direct pathway for saltwater intrusion could exist.

Municipal Production Wells

Well Information

Table 1 provides a summary of well data and permitted pumping rates. The elevations reported in Table 1 are based on estimates from topographic mapping and apparent sensor depths provided in previous reporting (WATER, 2016). All subsequent water level elevations reported herein are based on these estimates. Updated and accurate casing elevations and sensor depths are needed in order to finalize any recommendations based on this data.



Legend

- Production Well
- Acadia University Geothermal Wells
- Wolfville Aquifer
- Alluvial Deposits
- Marine Deposits
- Glaciofluvial Deposits (Kames and Eskers)
- Silty Till Plain (Ground Moraine)
- River
- Capture Zones

FIGURE 2

Hydrogeologic Setting

Town of Wolfville Groundwater Supply Study

N W E S

0 300 600 m

Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
Scale 1:20,000
when printed @ 8.5 x 11

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Table 1: Active Production Wells, Town of Wolfville

Well ID	Wickwire #2	Cherry Lane
Well Depth (m)	39.6	50.0
Length of Casing (m)	33.5	12.2
Casing Diameter (m)	0.305	0.305
Top of Casing Elevation (m geodetic)	9.76	10.94
Date Installed	2006	1970
Approximate Static Water Elevation (m)	7.0	5.6
Approximate Pumping Water Elevation (m)	3.0	3.0
Pump Elevation (m)	-20.0	-12.0
20-Year Theoretical Yield (m^3/d)*	4900	1910
Permitted Maximum Pumping Rate <3-day average> (m^3/d)	3270	6550
Permitted Average Pumping Rate <30-day average> (m^3/d)	3270	6550

*Based on aquifer testing (WATER, 2016) data, assuming infinite aquifer dimensions and unlimited recharge

The Cherry Lane well has been in service since Wolfville's municipal water system was established in the early 1970s. The well has been a consistent producer of good-quality raw water for fifty years, with no apparent indications of significant decline in performance. Raw water from the Cherry Lane well requires pH adjustment before entering the distribution system.

Wickwire Well #2 has likewise shown consistent performance and good water quality after 15 years of use, replacing Wickwire Well #1 (drilled in 1970). The current utility Operators have indicated that the raw water provided by Wickwire Well #2 is preferred over the Cherry Lane supply because the requirements for pH adjustment are comparatively minimal. The operators report that Wickwire Well #2 is frequently pumped 24 hours/day. Use of Wickwire Well #1 was discontinued due to a declining well yield.

Permitted and Theoretical Yields

The theoretical 20-year yields for the Cherry Lane and Wickwire #2 Wells were originally estimated based on aquifer testing data. These yields reflect the performance of the well screen and the ability of the aquifer to transmit water to the well, assuming an unlimited source of water. Wolfville's Water Withdrawal Permit is based on these theoretical yields, allowing for up to 3270 m^3/d to be pumped from Wickwire #2, and an additional 6550 m^3/d to be pumped from Cherry Lane, for a total permitted daily production of 9820 m^3/d. Current demand is on the order of 3000 m^3/d (average 2360 m^3/d and maximum 3660 m^3/d), suggesting that there is substantial additional capacity available from the existing wells.

In practice, the sustainable yield of an aquifer can be limited by factors such as the recharge rate and the potential for sea water intrusion. Preliminary aquifer budget calculations suggest that current water use is 50% to 70% of direct aerial recharge, not accounting for regional flow which may also contribute to the aquifer yield.

Water Production Data

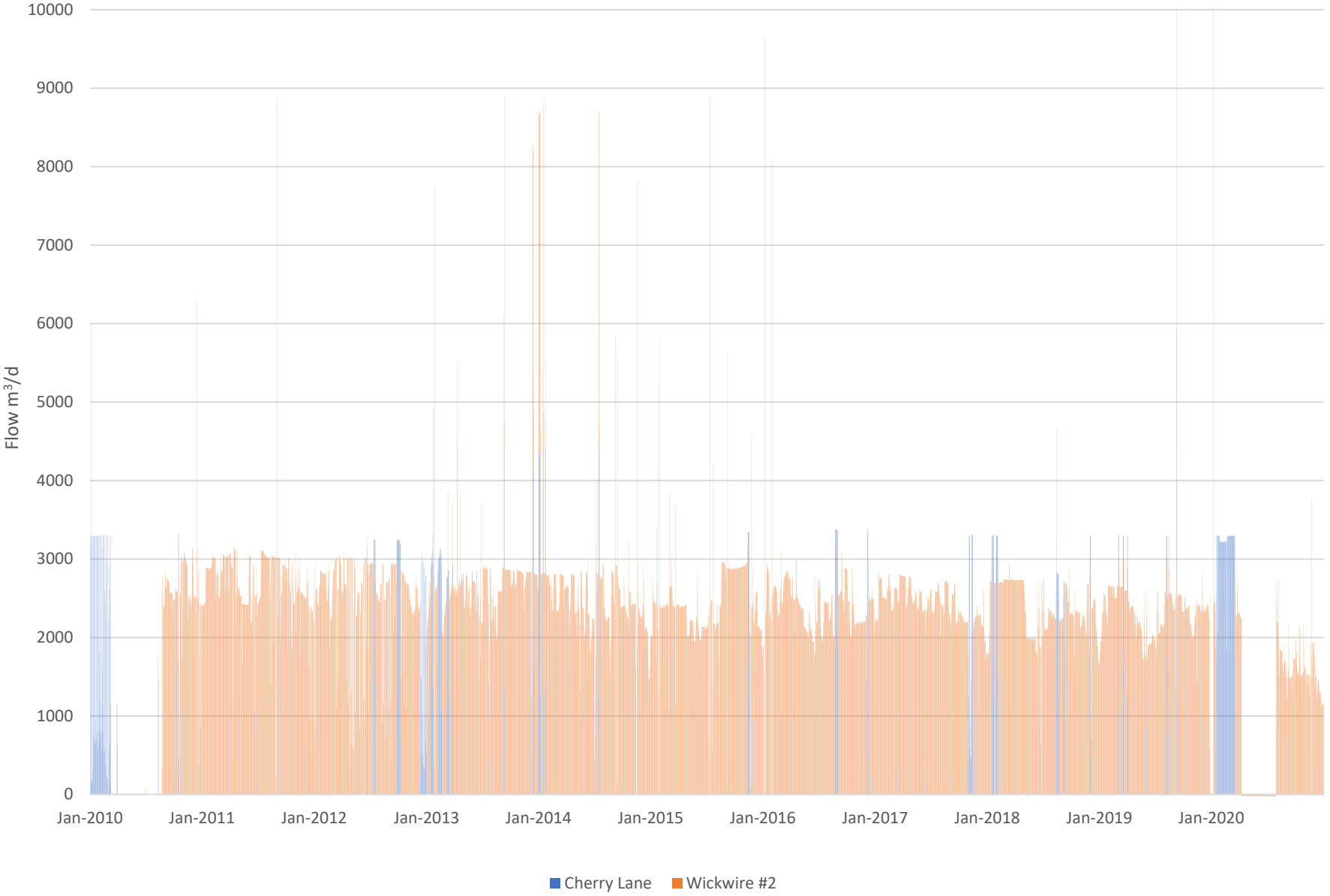
System water level and production data provide a means of assessing the sustainability of existing withdrawals. Analyses completed in 2016 indicated that current patterns of use are sustainable (CBCL, 2016):

- Water level data showed that conditions in the aquifer were stable over shorter time frames.
- During periods of average use there was additional capacity within the existing permit.
- During periods of peak use, water use reached the permitted 3-day capacity.
- Hydraulic head in each of the wells did not appear to show persistent, long-term declines, indicating that 2016 rates of withdrawal were sustainable.

CBCL has reviewed updated water level and production data from the utility SCADA system. Figure 3 shows production data for 2010 to 2020, which varied from 2500 to 3000 m^3/d. Water use was relatively consistent from 2010 to 2020. Additional water level data are provided in Appendix B. Daily maximum and minimum water levels from 2010 to 2020 showed generally consistent patterns of drawdown and recovery in each well, but data from Wickwire #2 showed an apparent change starting in December 2016:

- The operating water levels in Wickwire #2 showed considerable variation, from elevations of -5 to -15 metres geodetic.
- Use of the Cherry Lane well appears to be intermittent, with a drawdown of 2-3 metres and an operating water level of approximately 2 metres geodetic.
- 2020 data from the Cherry Lane well are different and suggest that the sensor was moved and/or recalibrated.

Figure 3. Water Use, 2010-2020



Indications are that operating water levels in both wells have not changed substantially in 10 years, suggesting that current usage patterns are sustainable. Operating water levels in the Wickwire well are consistently below sea level.

Servicing Future Demands

The Town estimates that 1710 to 2310 new dwellings may be constructed and serviced by the existing water system. Associated projections of future increases in average daily demand are on the order of 2000 m^3/d, assuming a water use of 0.364 m^3/person/day. This represents a significant increase in production, from approximately 2360 m^3/d to 4370 m^3/d.

The Wickwire well is currently used to supply most of the Town's water, often pumping continuously, 24 hr/day. Daily withdrawals tend to be at or near the permitted capacity of the Wickwire well, showing that the Cherry Lane well will need to be used more frequently as future demands increase. New development in Wolfville will require that both the Wickwire well and the Cherry Lane well are used simultaneously. As the Cherry Lane supply generally requires pH adjustment, costs for water treatment are expected to increase. An increasing need to pump from both wells will mean that there is no back-up well in the event that one of the wells requires maintenance. The Town is likely to require a third well for redundancy, and water levels in the aquifer will need to be monitored closely to ensure that the aquifer recharge rate is not exceeded.

Conclusions

Summary

The utility permit and aquifer testing data suggest that there is additional capacity available from the Wolfville aquifer. Increased rates of extraction may be sustainable, depending on the sources and rates of recharge to the aquifer. The water system SCADA data indicate that current usage patterns are sustainable, however, the most recent performance data (2020 and 2021) could not be verified due to a change in the depth and/or calibration of the sensors.

Using existing estimates of the sensor depths and well head elevations, operating water levels in the Wickwire well appear to be significantly below sea level. As a component of this drawdown is related to head loss within the well and across the well screen, hydraulic head in the aquifer may be higher than indicated by the municipal SCADA system. Water level data from the system's existing monitoring well would provide an improved indication of conditions in the aquifer. Although coastal production wells, in some circumstances, can be operated safely with the pumping water level in the well below sea level, this practice must be approached with caution.

Next Steps

The Town requires a second monitoring well to satisfy the conditions of regulatory approvals. Figure 4 provides three potential drilling locations, shown in yellow. The location to the immediate north of the Cherry Lane well offers several advantages: it is likely to be within the cone of drawdown of the Cherry Lane well, and it is positioned directly between the Cherry Lane well and the Cornwallis River estuary. The location directly west of the Cherry Lane well is likely to be within the cone of drawdown and appears to be situated in the centre of the aquifer, which would allow a monitoring well to be screened at the same depth as the Cherry Lane well. The location further to the east offers the advantage of being on a Town-owned parcel, but it may be isolated from the municipal wells by a bedrock ridge and would likely experience interference by the university's open-loop geothermal wells.

The Town may wish to initiate exploration work to develop a third production well. Figure 4 shows two drilling target areas that are undeveloped and are situated within the Wolfville aquifer, as indicated by the existing conceptual model (CBCL, 2005). A geotechnical drilling program would allow for installation of one or more monitoring wells in the Wolfville aquifer and would help to confirm the depth and thickness of aquifer material for future production well development.

Yours very truly,

CBCL Limited

Prepared by:
Colin Walker, M.Sc., P.Geo.
Senior Hydrogeologist
Tel: (902) 478-8875
E-Mail: colinw@cbcl.ca

Reviewed by:
Aaron Baillie, P.Eng.
Manager, Municipal Engineering

Attachments: Figures, Tables, and Appendices

Project No.: 210846.01

Legend

- University of Acadia Geothermal Wells
- Production Well
- Monitoring Well
- Future Monitoring Well Option
- Drilling Target
- Wolfville Aquifer
- River

FIGURE 4

Drilling Targets

Town of Wolfville Groundwater Supply Study

N W E S

0 150 300 m

Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
Scale 1:10,000
when printed @ 8.5 x 11

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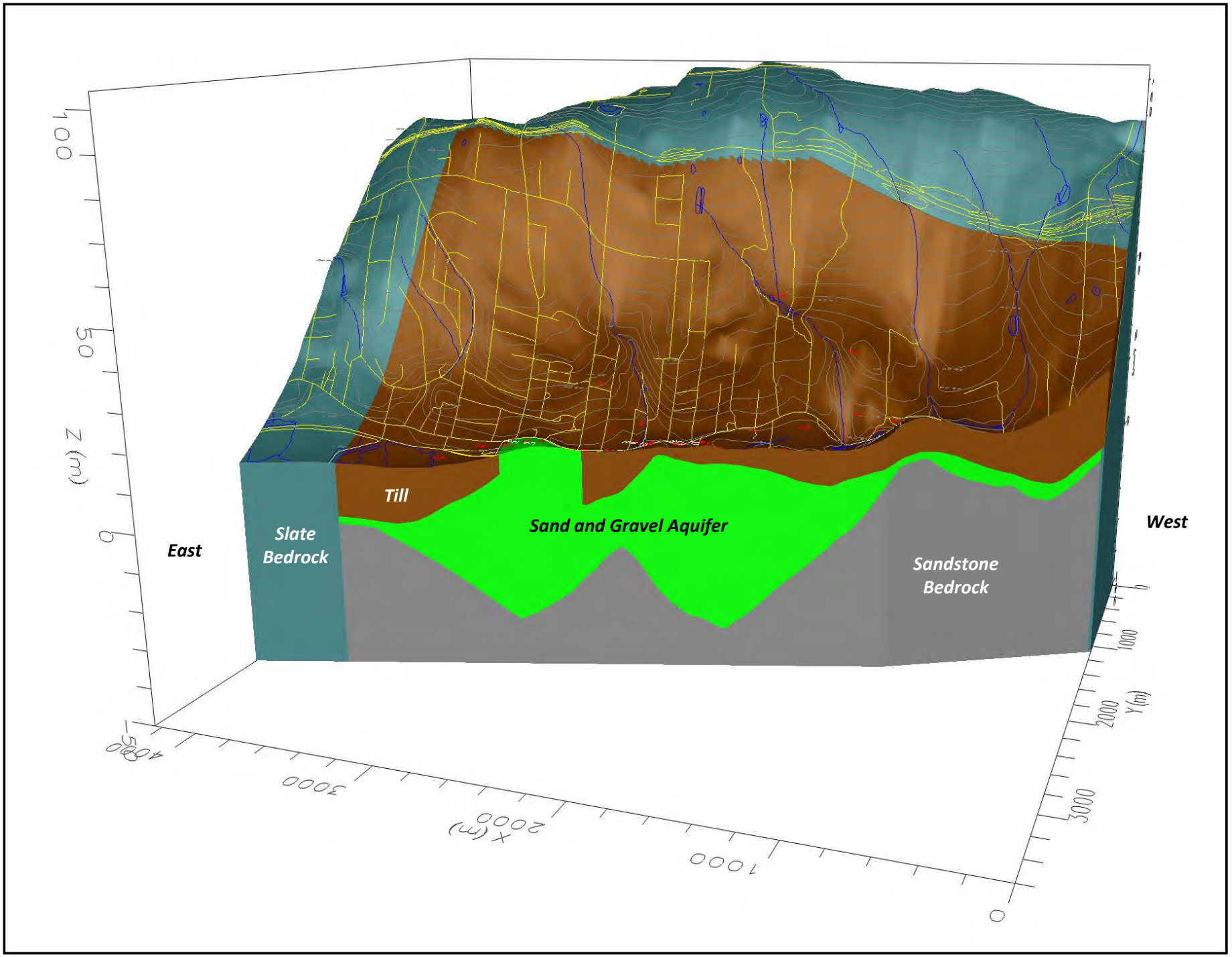
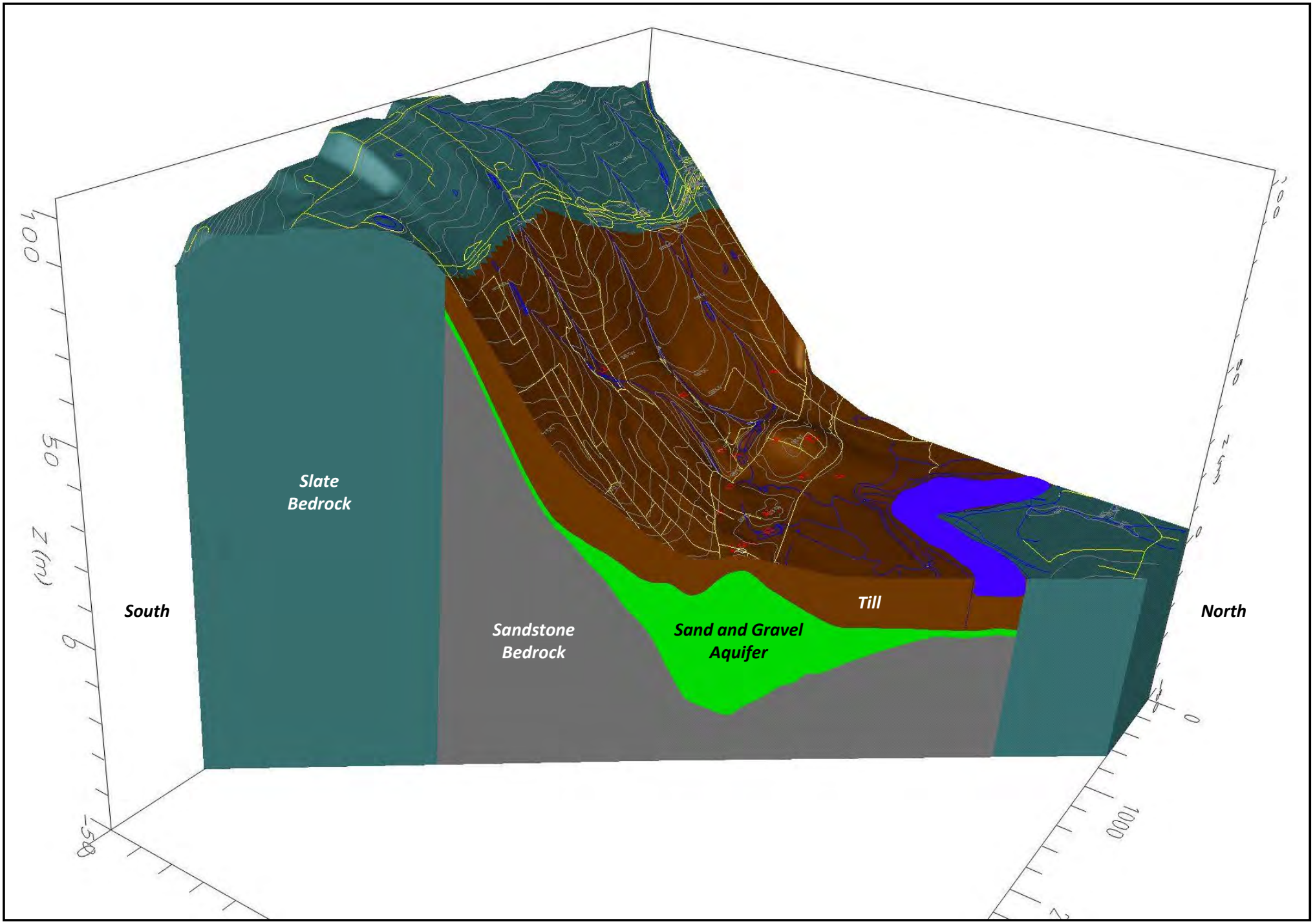
APPENDIX A

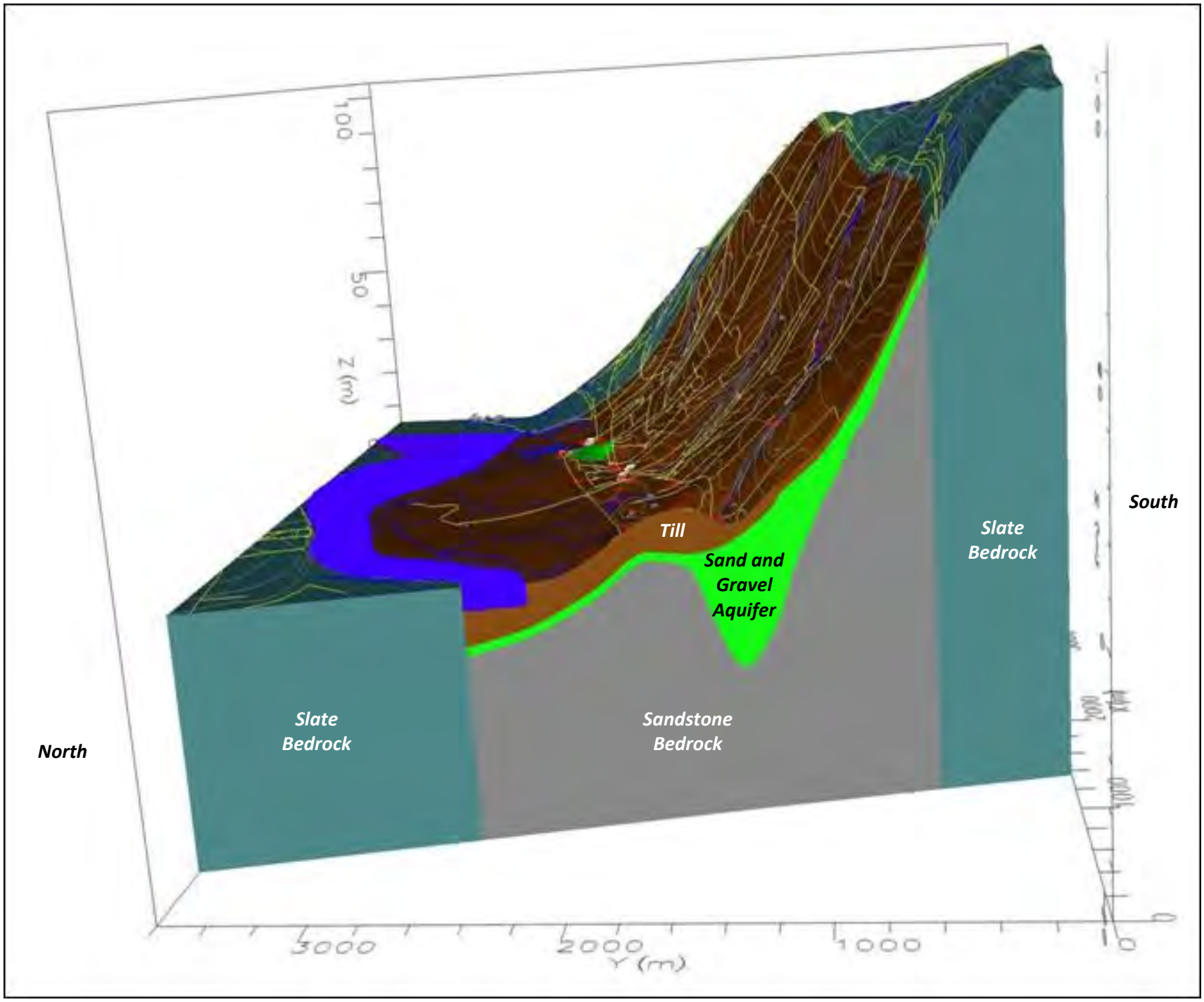
3D Conceptual Model of Wolfville Aquifer: East-West Profile



3D Conceptual Model of Wolfville Aquifer: East-West Profile



3D Conceptual Model of Wolfville Aquifer: South-North Profile



3D Conceptual Model of Wolfville Aquifer: North-South Profile at Greenwich

DRAFT

FIGURE: 5.2 - ISOPACH MAP - AQUIFER THICKNESS

N
W E
S

- Municipal Boundary
- Bridge / Overpass
- Expressway
- Highway
- Seasonal Roads
- Railroad
- Local Roads / Streets
- Railroad - Abandoned
- Pipeline
- Transmission Line
- Dam
- Settling Pond
- Sub Station
- Tank
- Cemetery
- Orchard
- Sports Field
- Buildings
- Town of Wolfville Production Wells
- Acadia University Geothermal Wells
- Existing Wells & Test Holes

Depth in Metres

- 5
- 10
- 15
- 20
- 25
- 30
- 35
- 40

CBCL LIMITED
Consulting Engineers

WATER

0 50 100 200 300 400 500
Meters

CORNWALLIS RIVER

Marsh Hawk Dr.
Cherry Lane
Westwood Dr.
Elm Ave.
Froht Street
Main Street
Acadia St.
University Ave.
Wickwire Ave.
Earnscliffe Ave.
Westwood Ave.
Chestnut Ave.
Kent Ave.
Hillcrest Ave.
Prince St.
Eden Rove
Ridge Rd.
Municipality of the County of Kings
Wolfville
Pleasant St.

DRAFT

FIGURE: 5.3 - ISOPACH MAP - TILL THICKNESS

N
W E
S

- Municipal Boundary
- Bridge / Overpass
- Expressway
- Highway
- Seasonal Roads
- Railroad
- Local Roads / Streets
- Railroad - Abandoned
- Pipeline
- Transmission Line
- Dam
- Settling Pond
- Sub Station
- Tank
- Cemetery
- Orchard
- Sports Field
- Buildings
- Town of Wolfville Production Wells
- Acadia University Geothermal Wells
- Existing Wells & Test Holes

Till Thickness in Metres

0
5
10
15
20
25
30
35

CBCL LIMITED
Consulting Engineers

WATER

0 50 100 200 300 400 500
Meters

CORNWALLIS RIVER

Marsh Hawk Dr.
Main Street
Front Street
Elm Ave.
Acadia St.
Pleasant St.
Prince St.
Cherry Lane
Westwood Dr.
Wickwire Ave.
Earnscliffe Ave.
Chestnut Ave.
Kent Ave.
Hillcrest Ave.
University Ave.
Westwood Ave.
Eden Row
Ridge Rd.
Wolfville
Municipality of the County of Kings

DRAFT

FIGURE: 6.2 - GROUNDWATER TIME OF TRAVEL AREAS

CORNWALLIS RIVER

Wolfville

Municipality of the County of Kings

25 Year TOT Area

2 Year TOT Area

5 Year TOT Area

Cherry Lane

Marsh Hawk Dr.

Westwood Dr.

Main Street

Front Street

Acadia St.

Wickwire Ave.

Earnscliffe Ave.

University Ave.

Westwood Ave.

Chestnut Ave.

Kent Ave.

Hillcrest Ave.

Prince St.

Eden Row

Municipal Boundary
Bridge / Overpass
Expressway
Highway
Seasonal Roads
Railroad
Local Roads / Streets
Railroad - Abandoned
Pipeline
Transmission Line

Dam
Settling Pond
Sub Station
Tank
Cemetery
Orchard
Sports Field
Buildings

Town of Wolfville Production Wells
Acadia University Geothermal Wells
Existing Wells & Test Holes

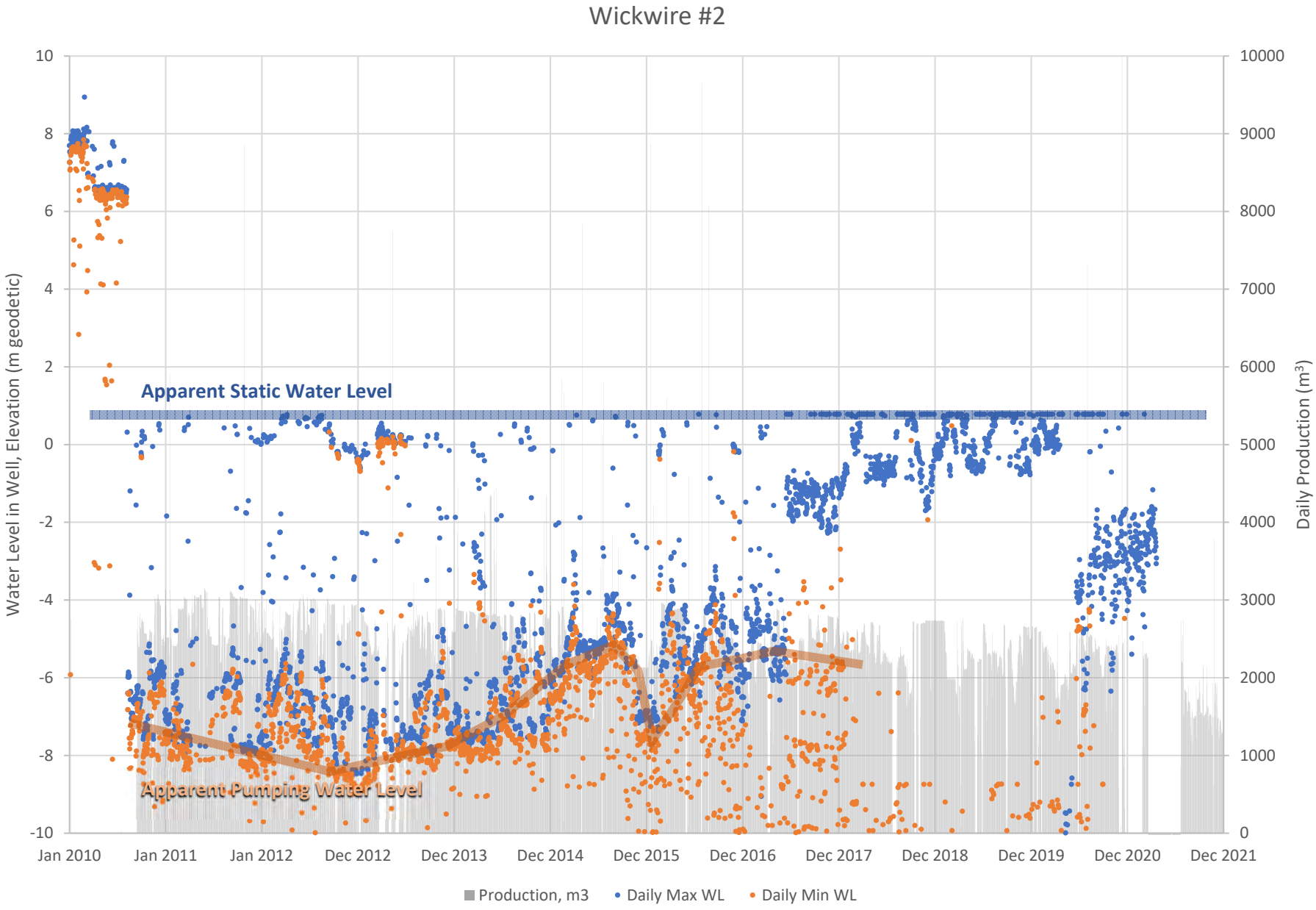
Time of Travel Area

Pathlines
2 Year
5 Year
25 Year

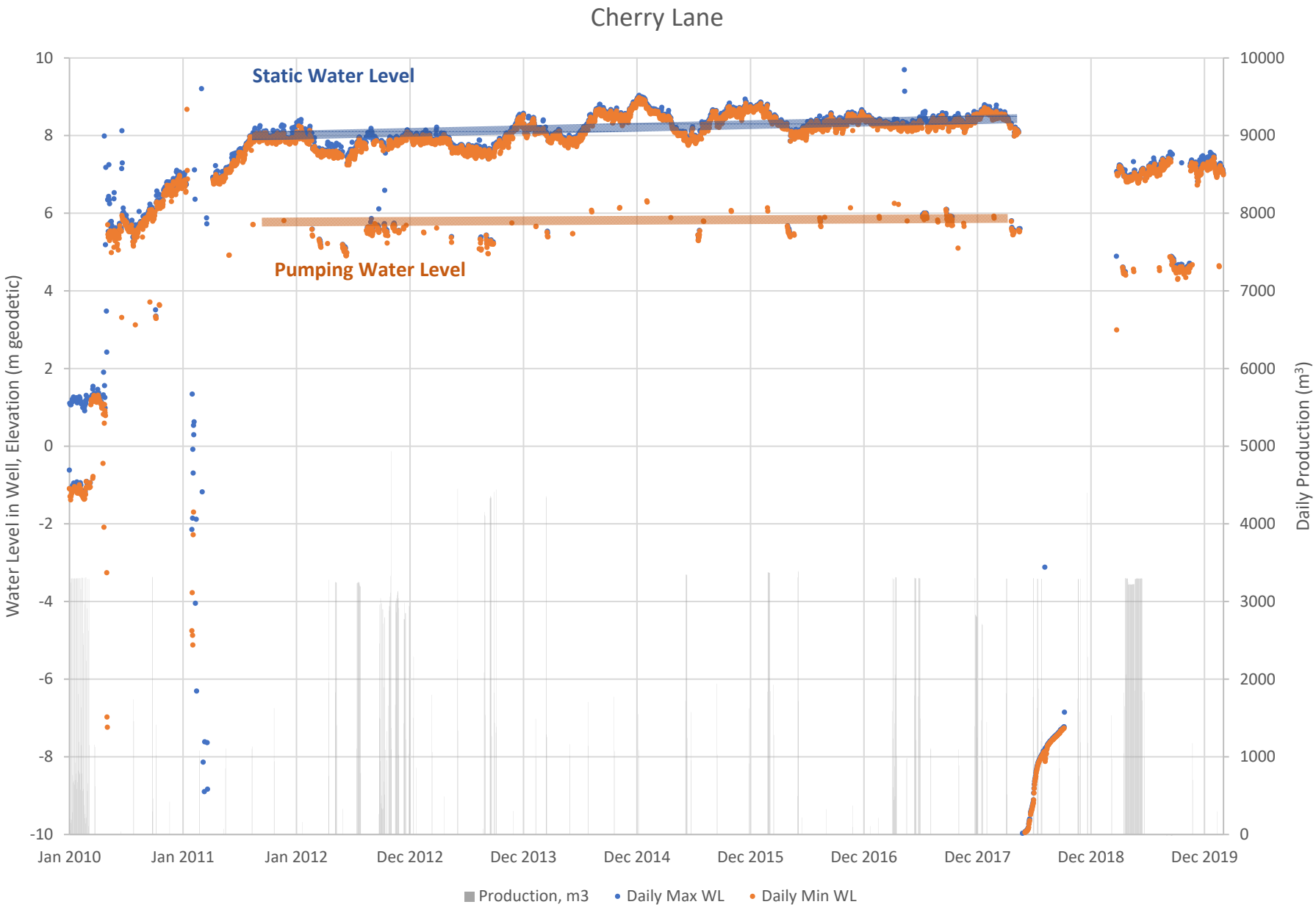
0 50 100 200 300 400 500 Meters

APPENDIX B

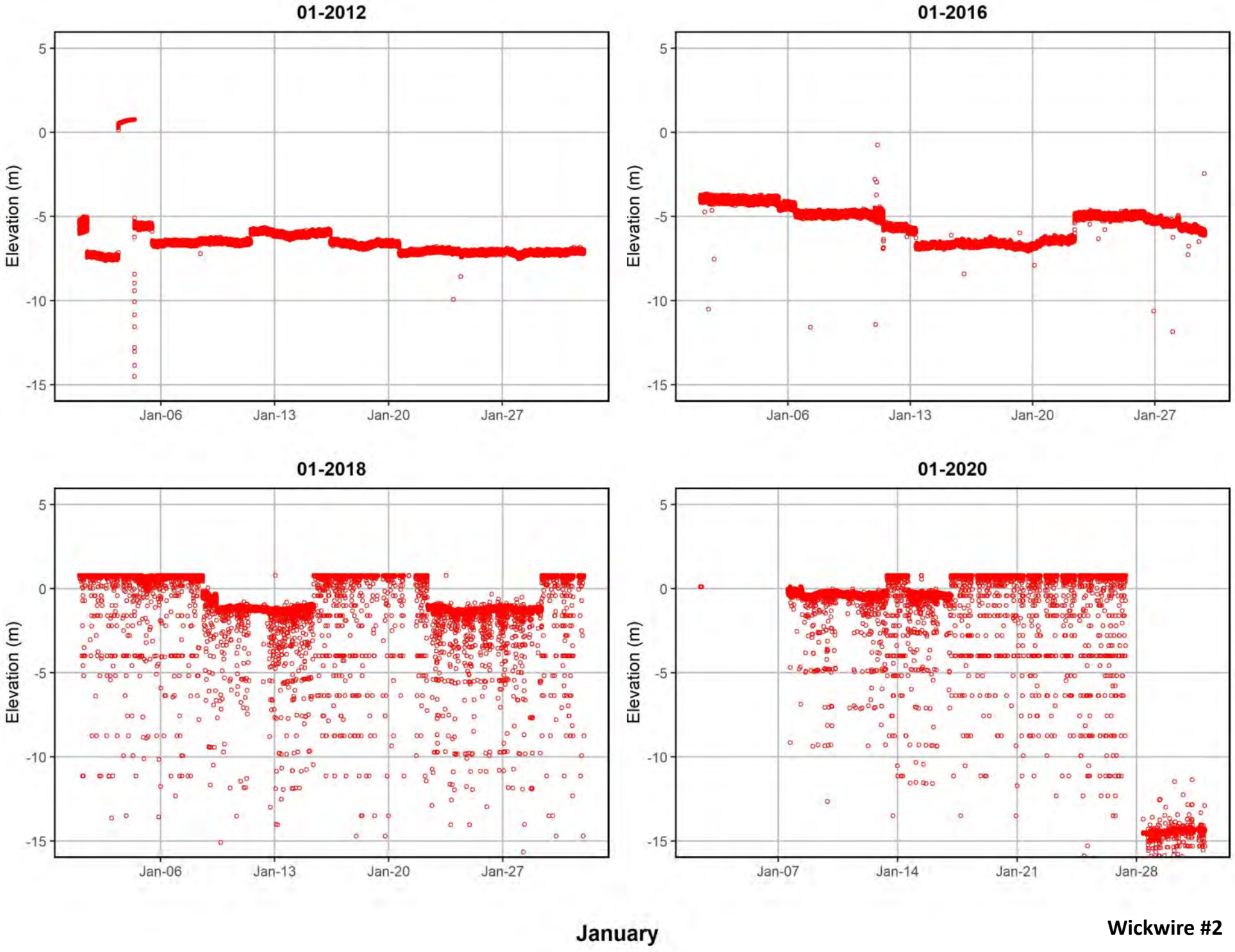
Water Level Data



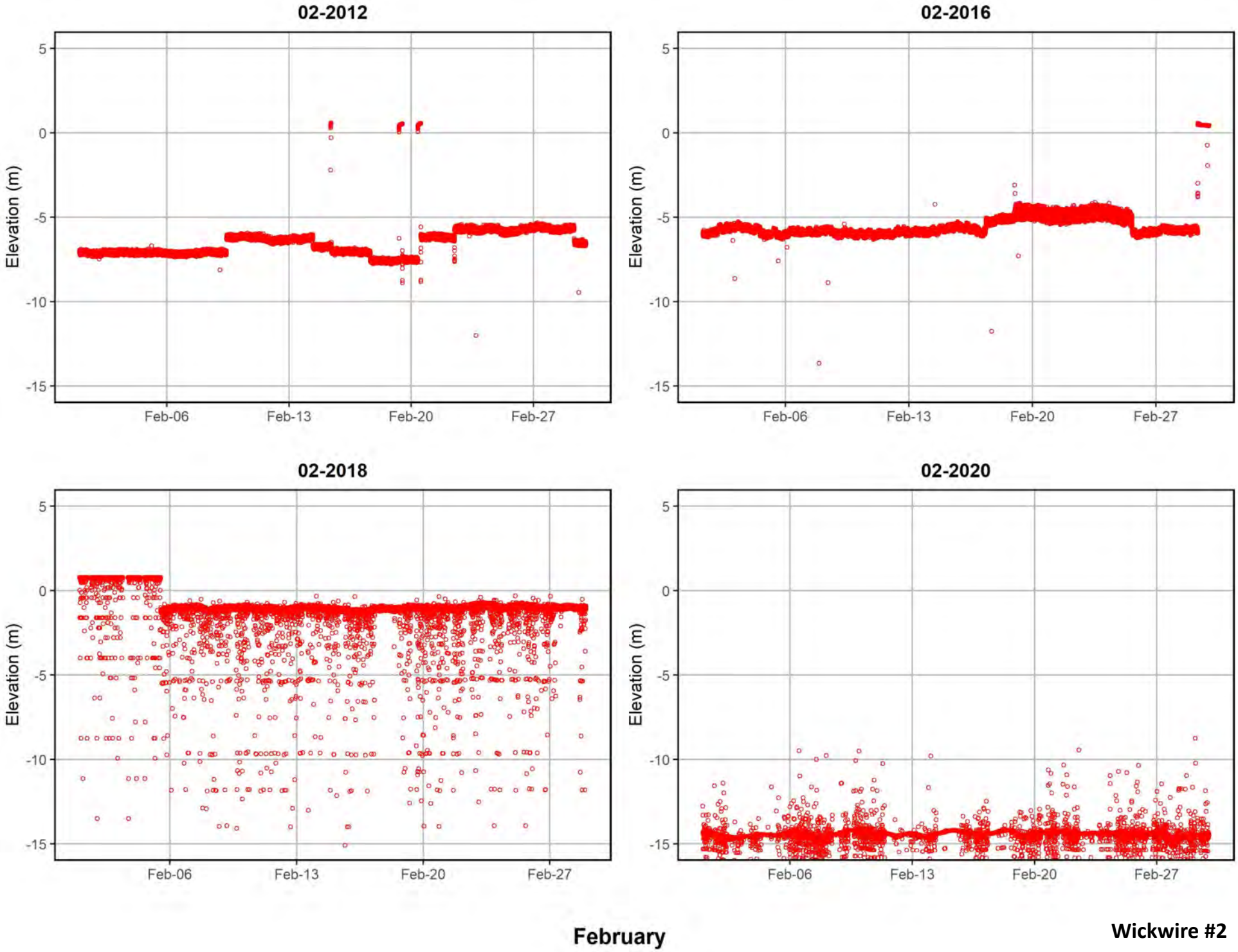
Daily maximum and minimum water levels, with existing flow metering data. Data are from municipal SCADA system.



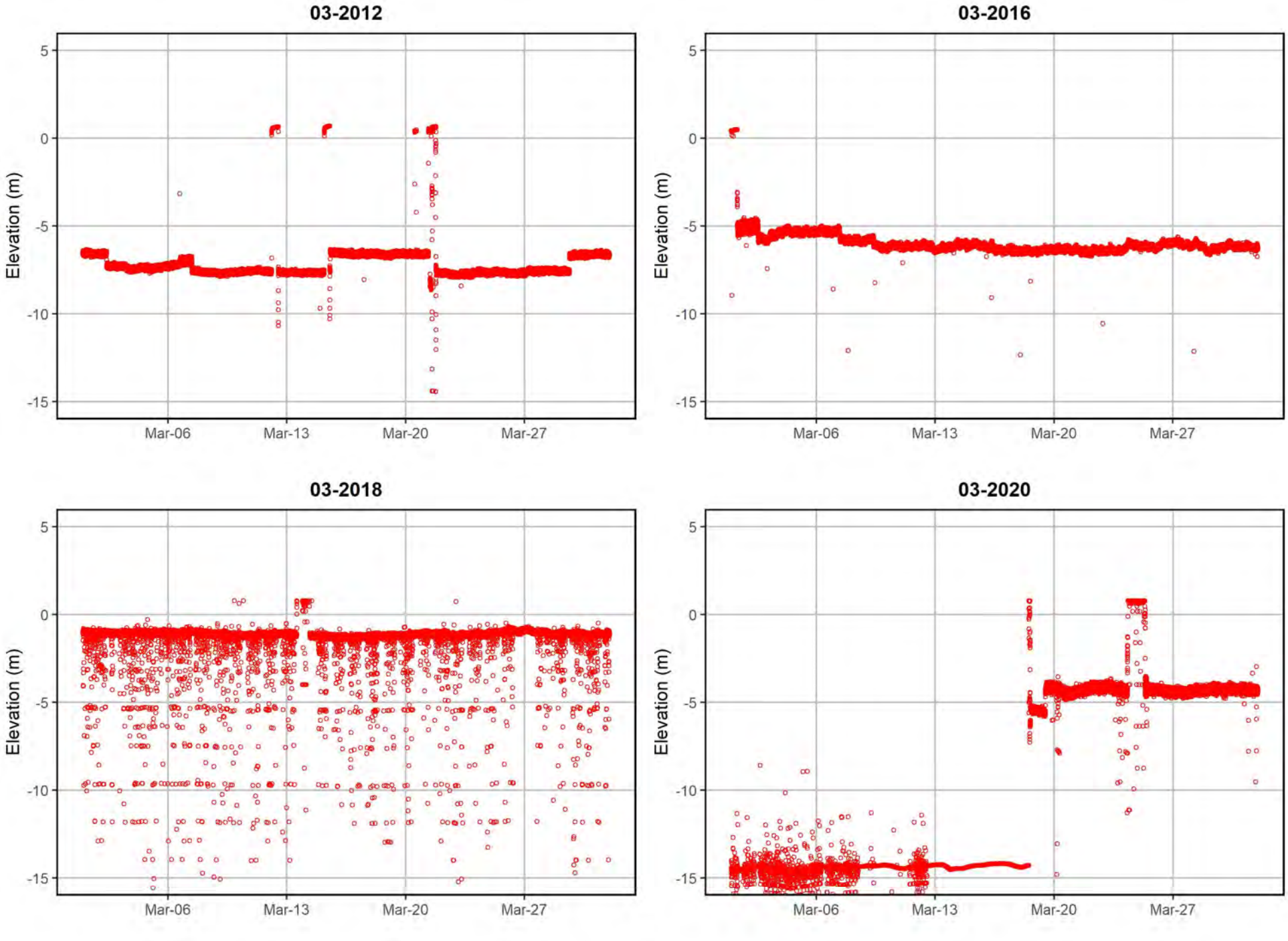
Daily maximum and minimum water levels, with existing flow metering data. Data are from municipal SCADA system.


01-2012
01-2016
01-2018
01-2020
Elevation (m)
5
0
-5
-10
-15
Jan-06
Jan-13
Jan-20
Jan-27
Jan-07
Jan-14
Jan-21
Jan-28
January

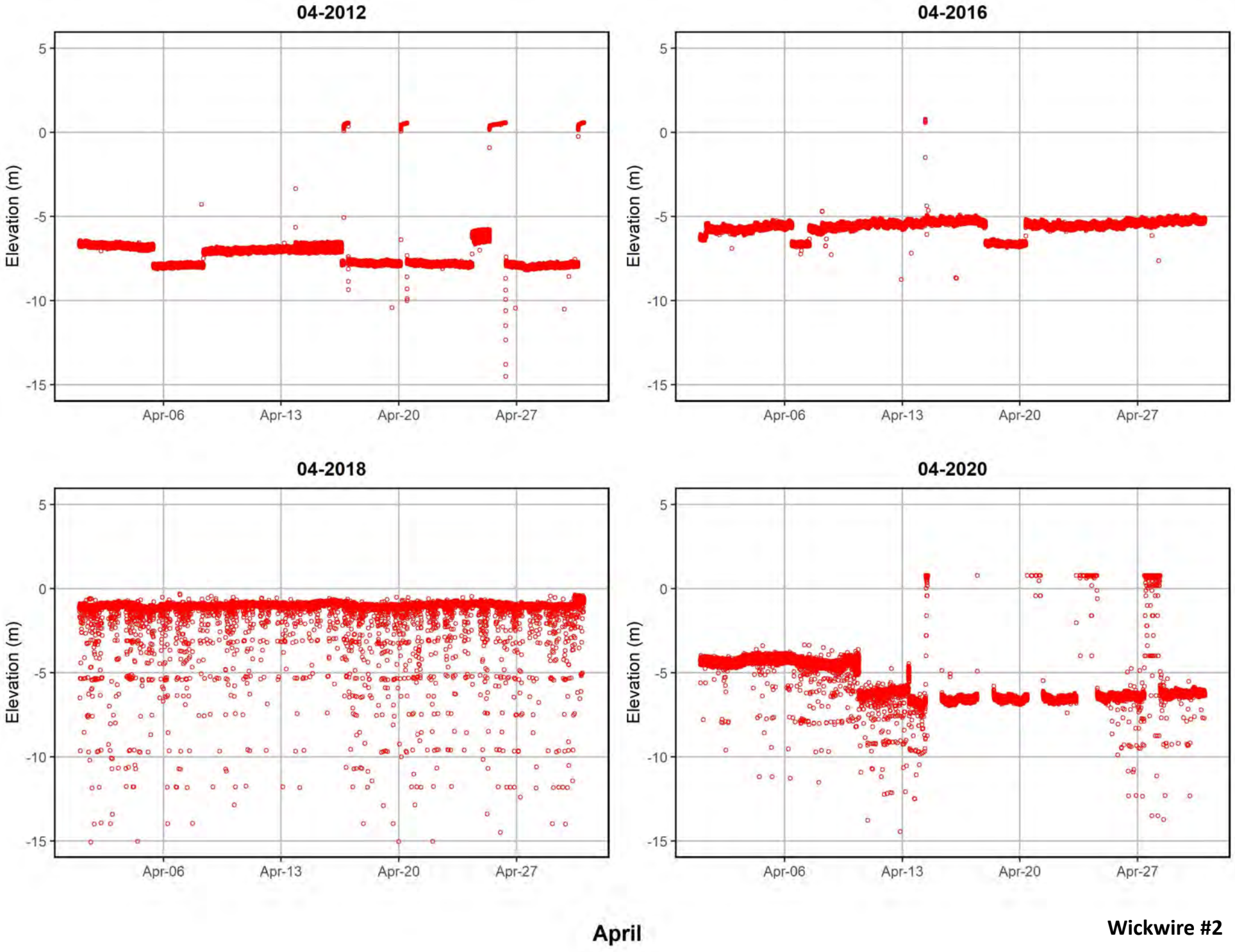
Wickwire #2

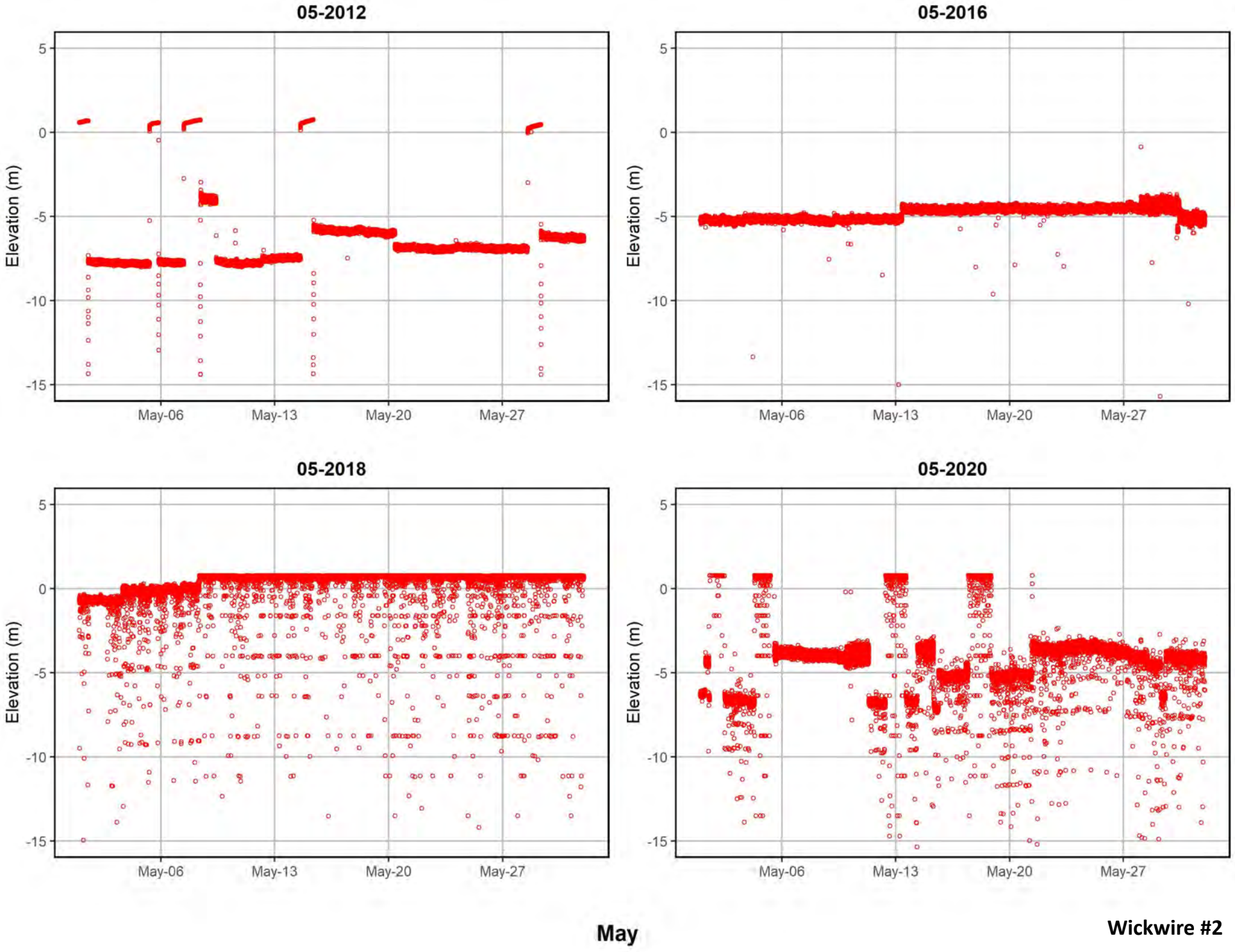

02-2012
02-2016
02-2018
02-2020
Elevation (m)
5
0
-5
-10
-15
Feb-06
Feb-13
Feb-20
Feb-27
February

Wickwire #2


03-2012
03-2016
03-2018
03-2020
Elevation (m)
5
0
-5
-10
-15
Mar-06
Mar-13
Mar-20
Mar-27
March

Wickwire #2


04-2012
04-2016
04-2018
04-2020
Elevation (m)
5
0
-5
-10
-15
Apr-06
Apr-13
Apr-20
Apr-27
April
Wickwire #2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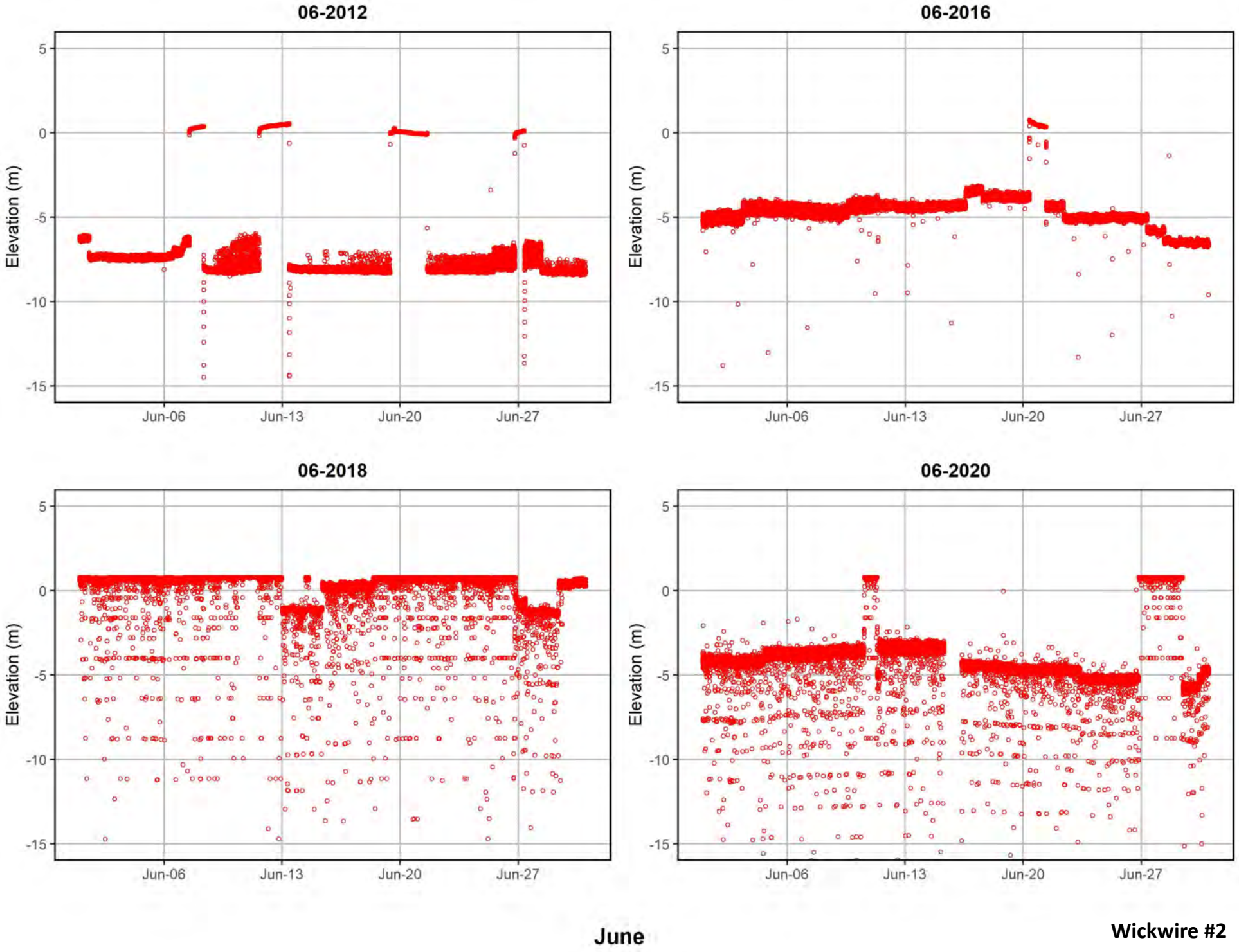
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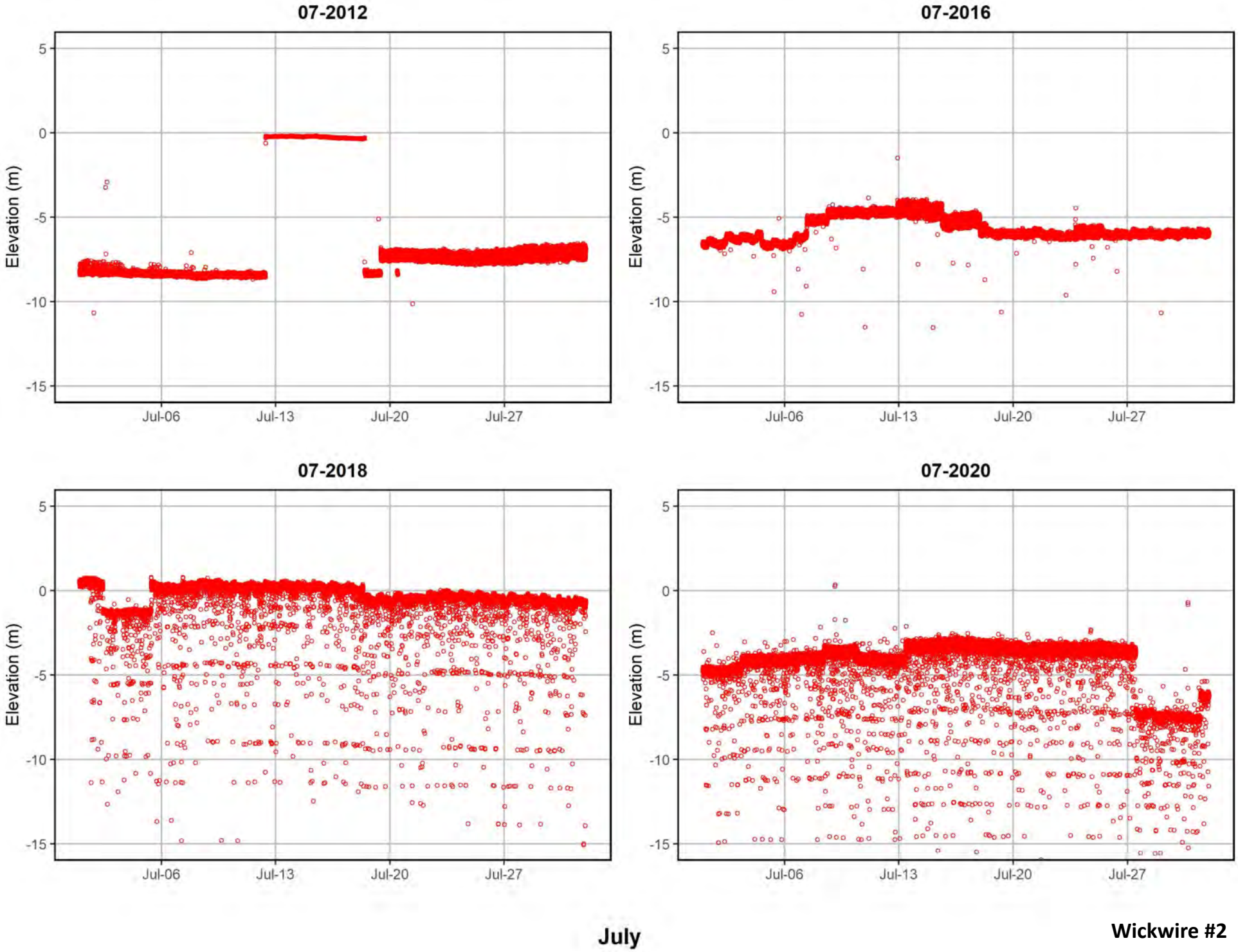
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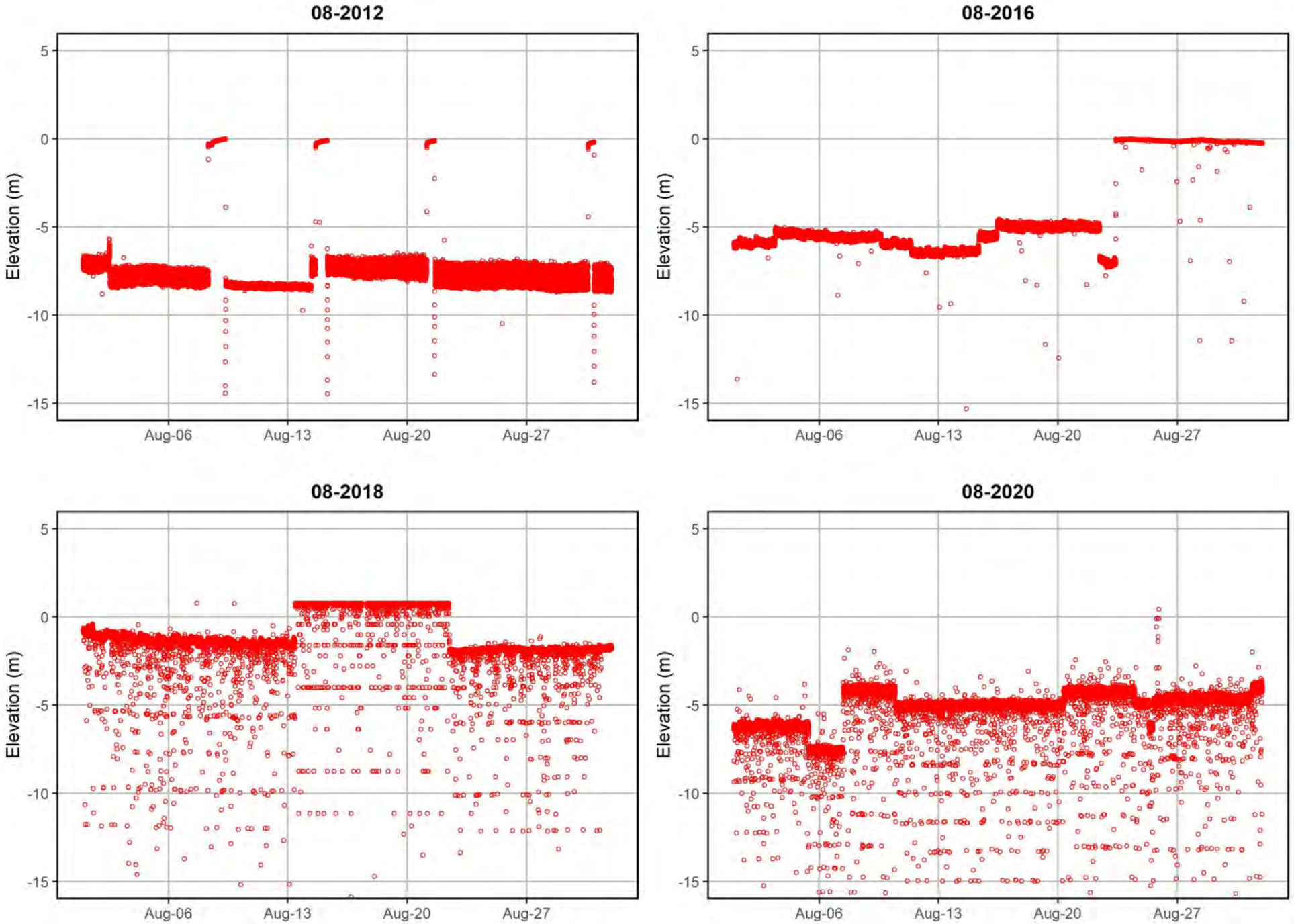
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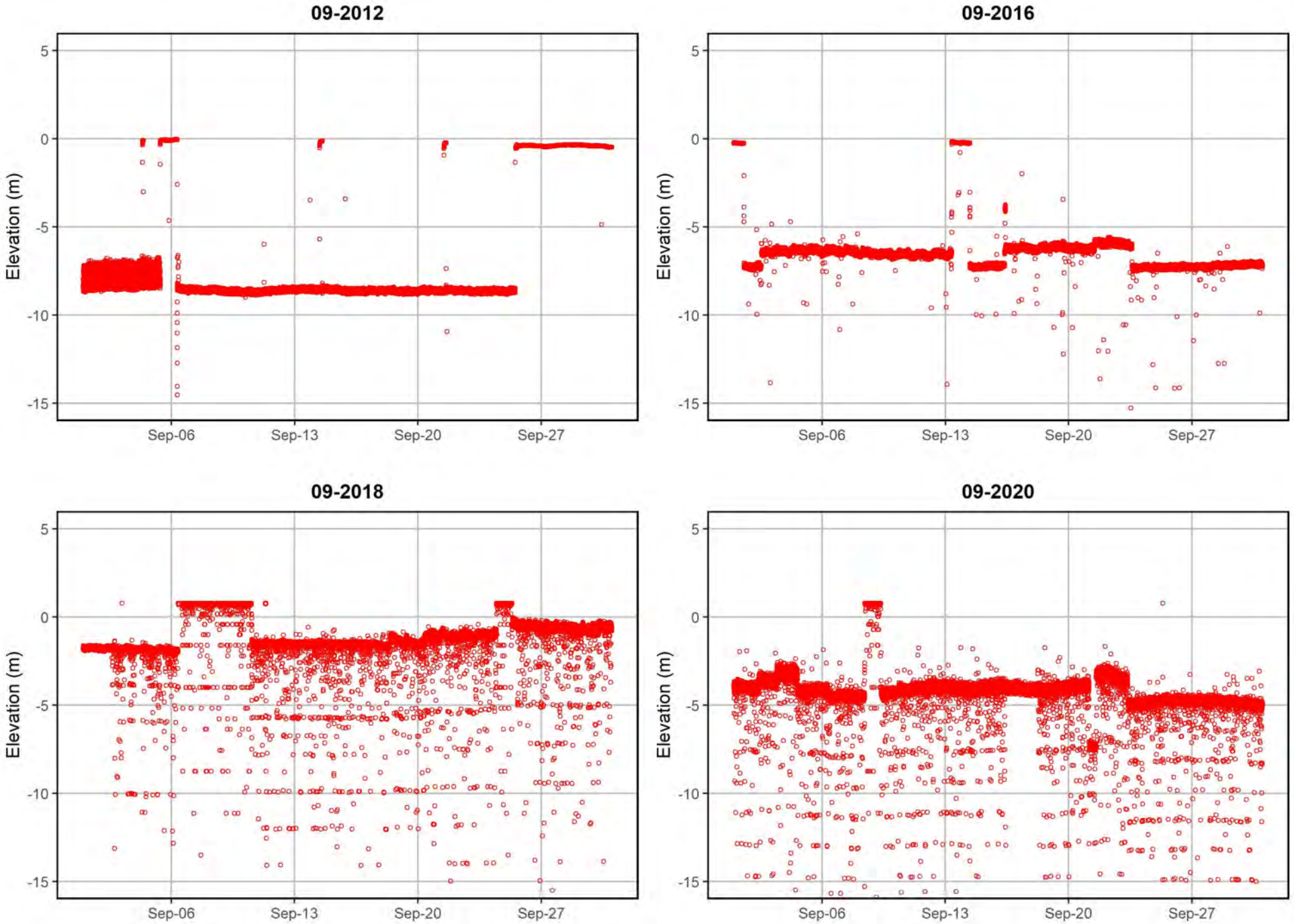
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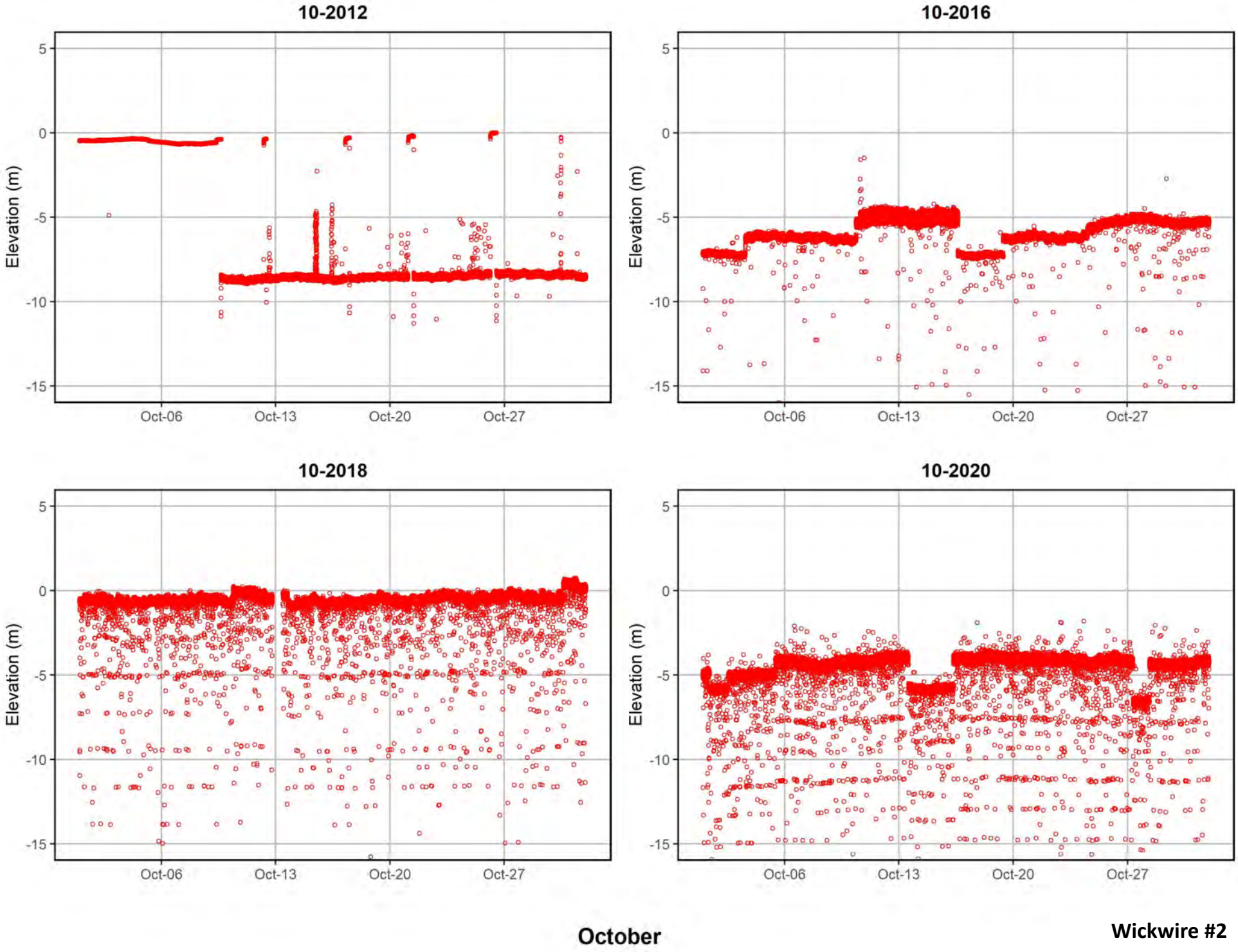
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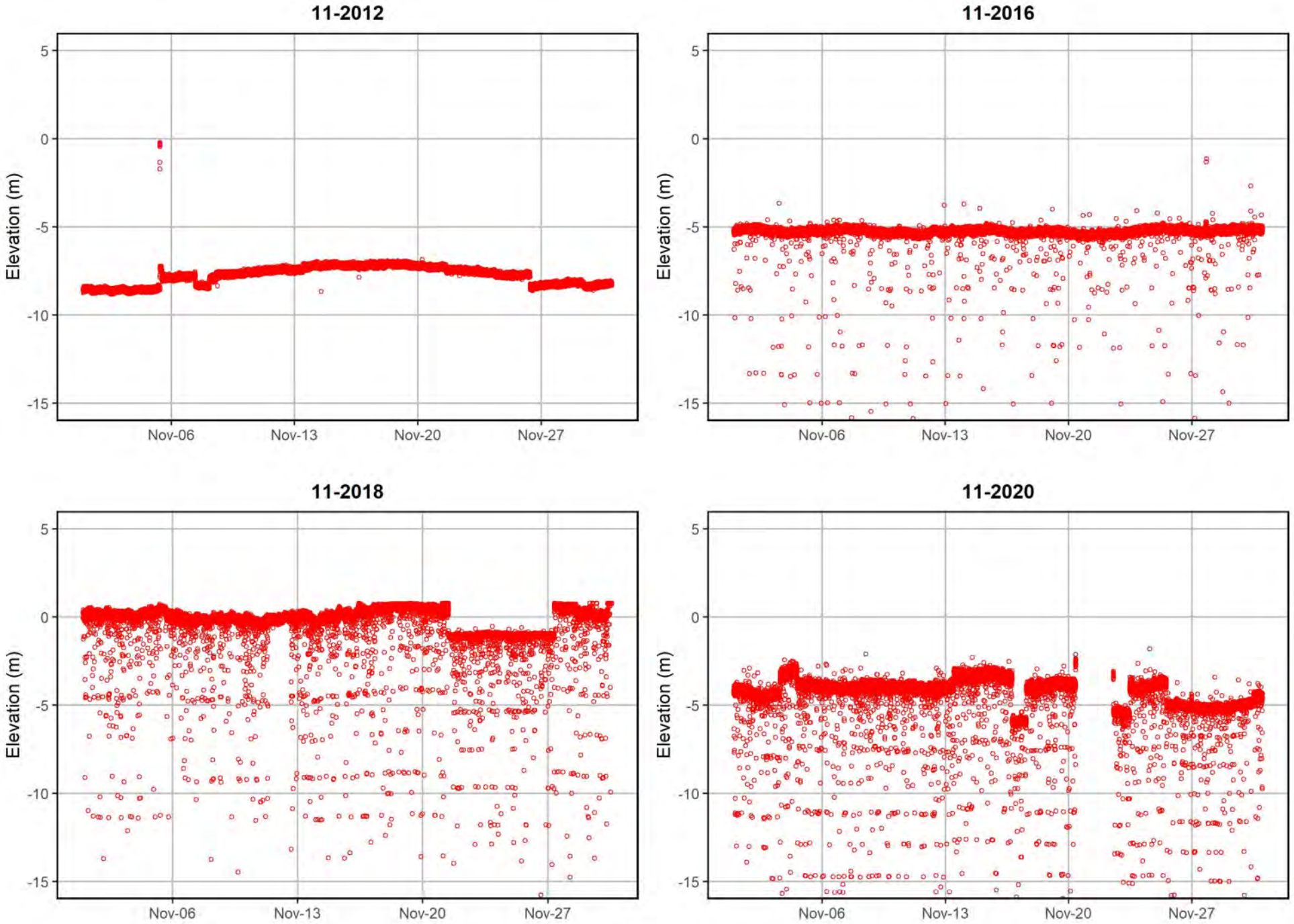
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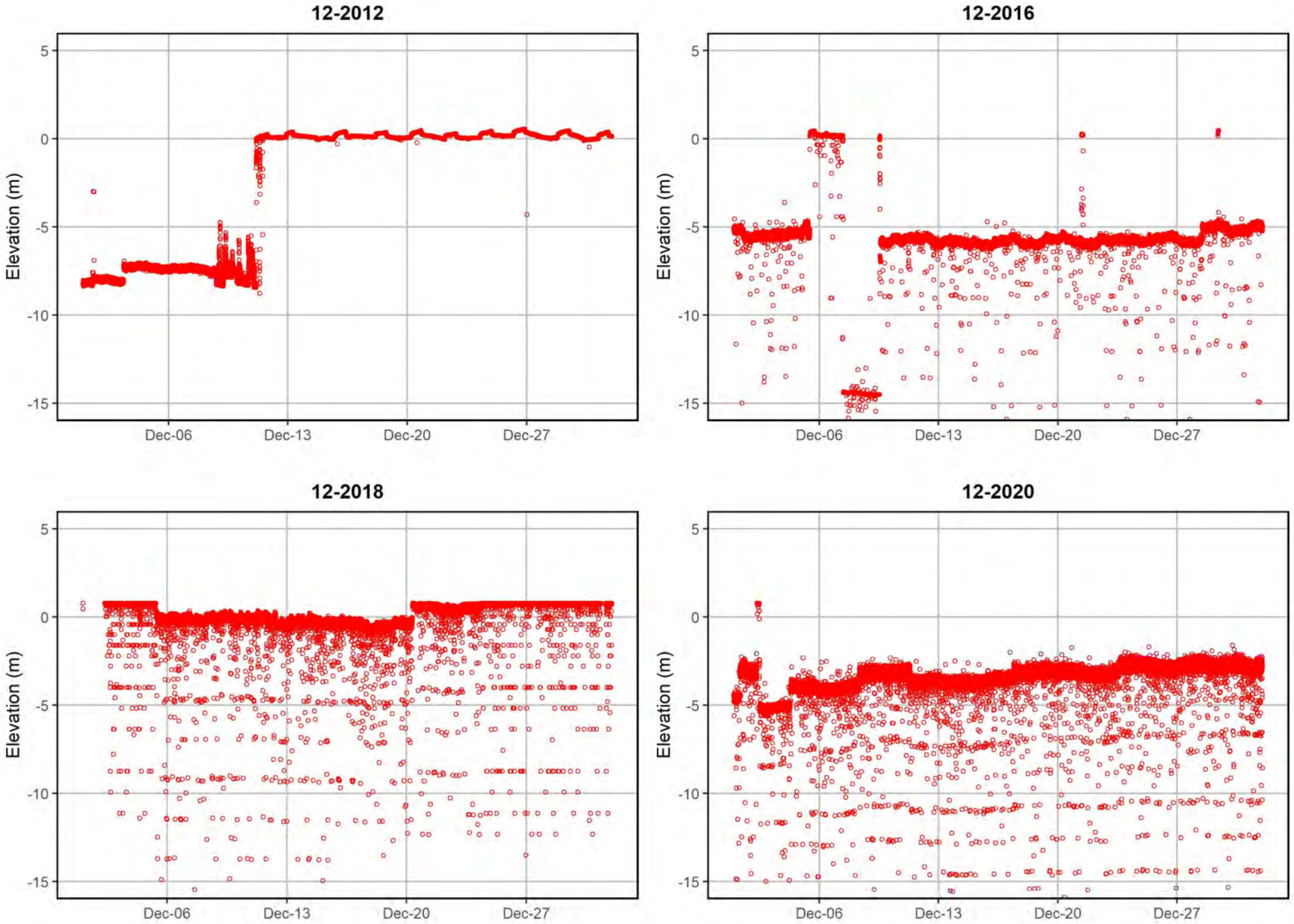
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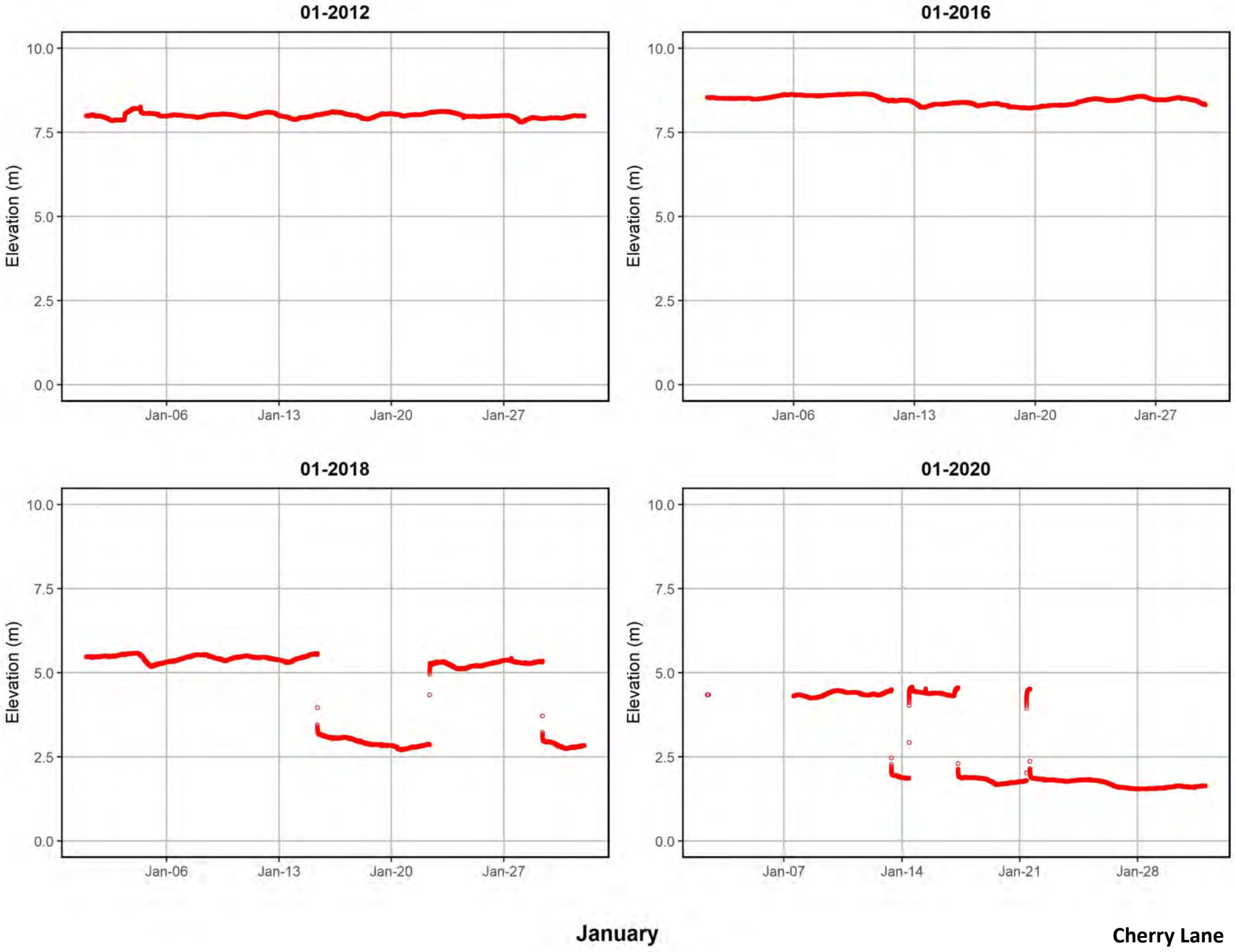
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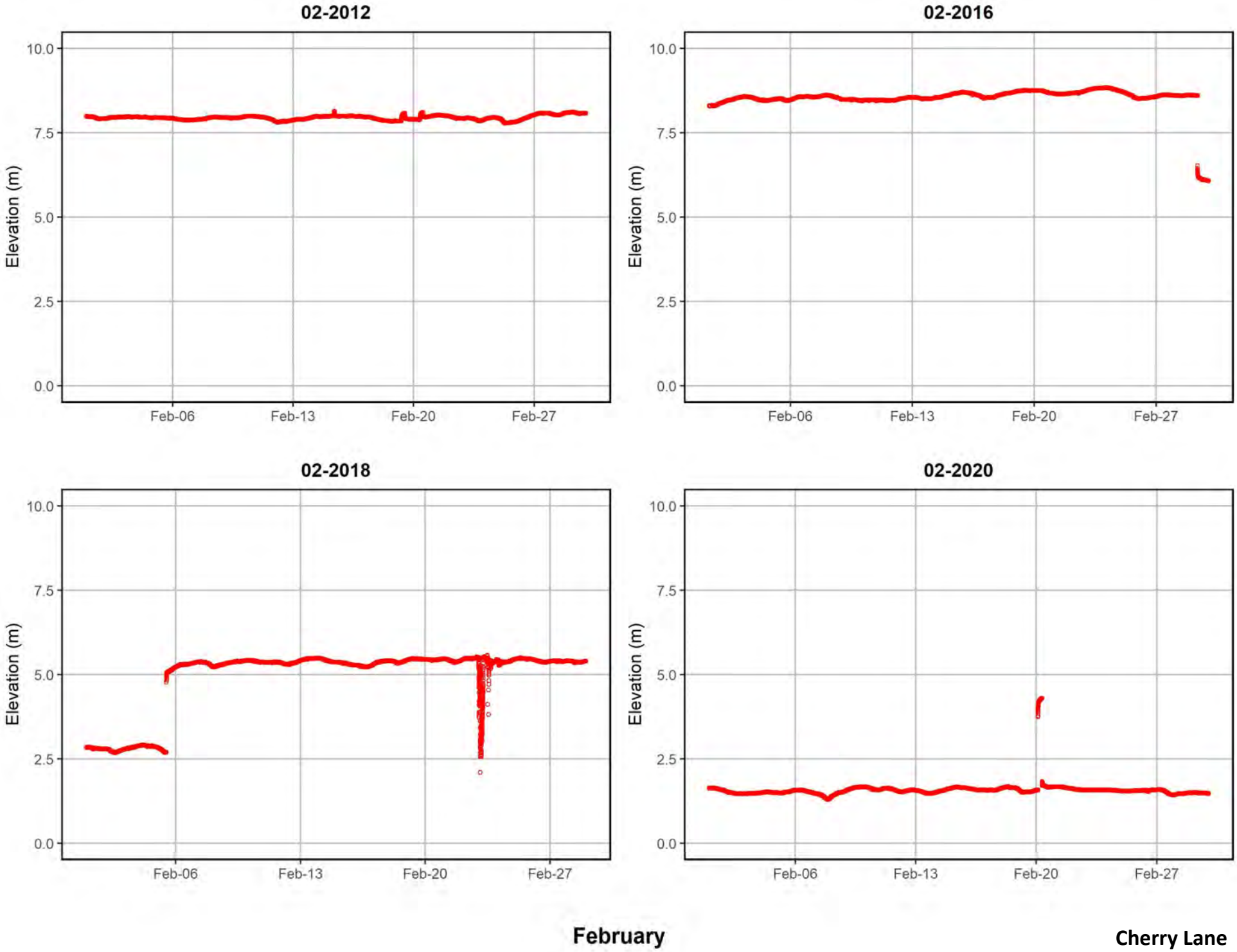
January
Cherry Lane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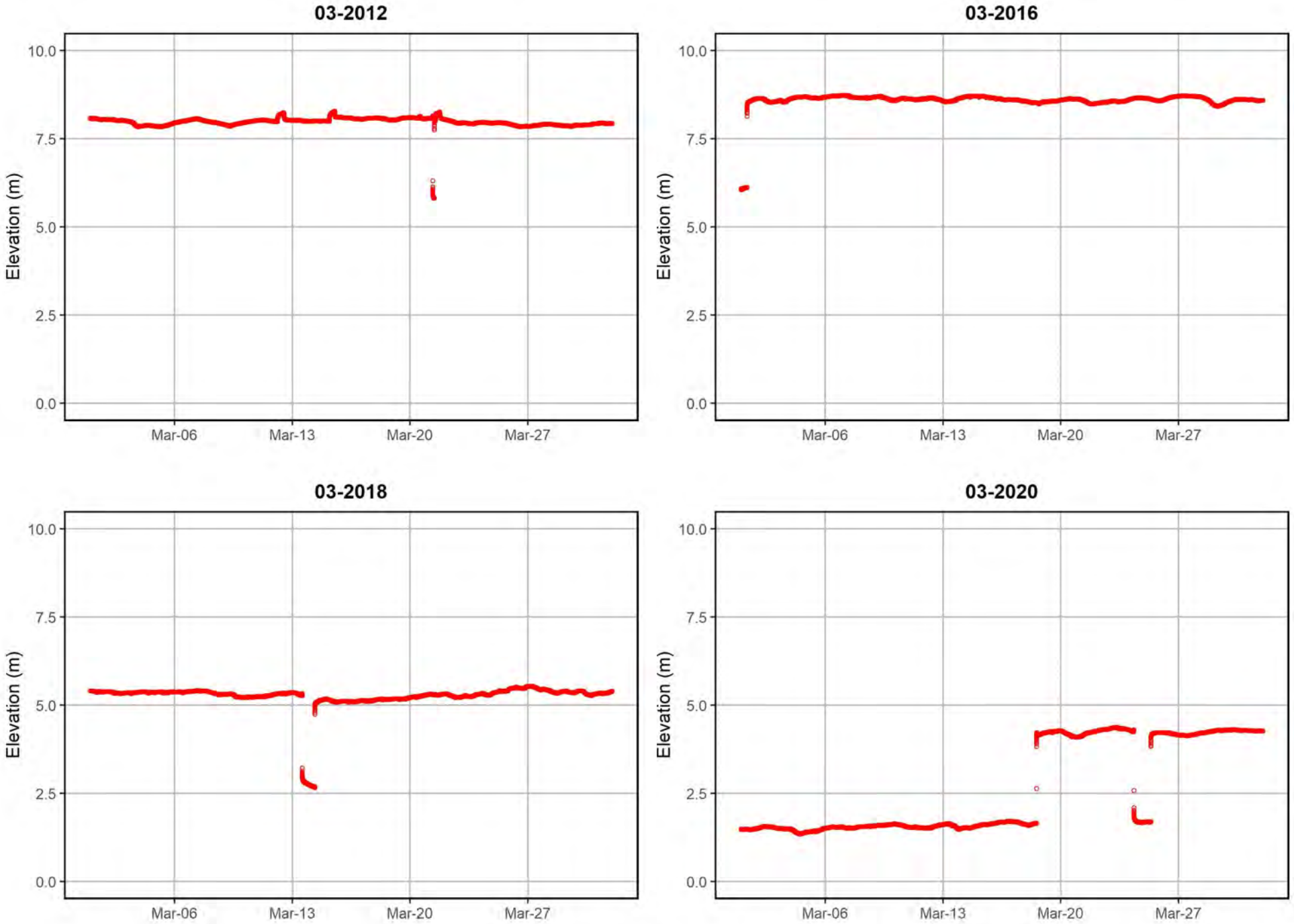
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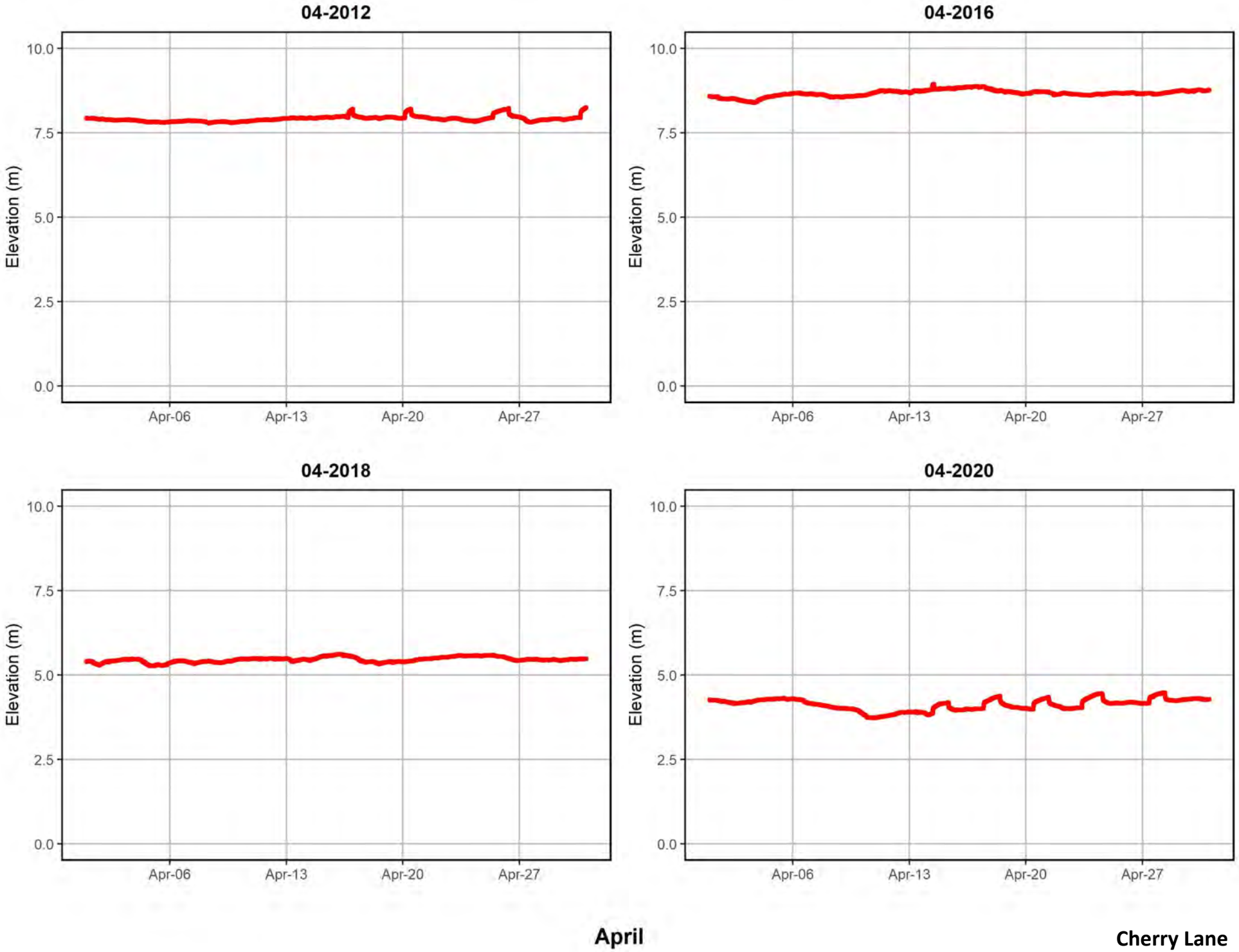
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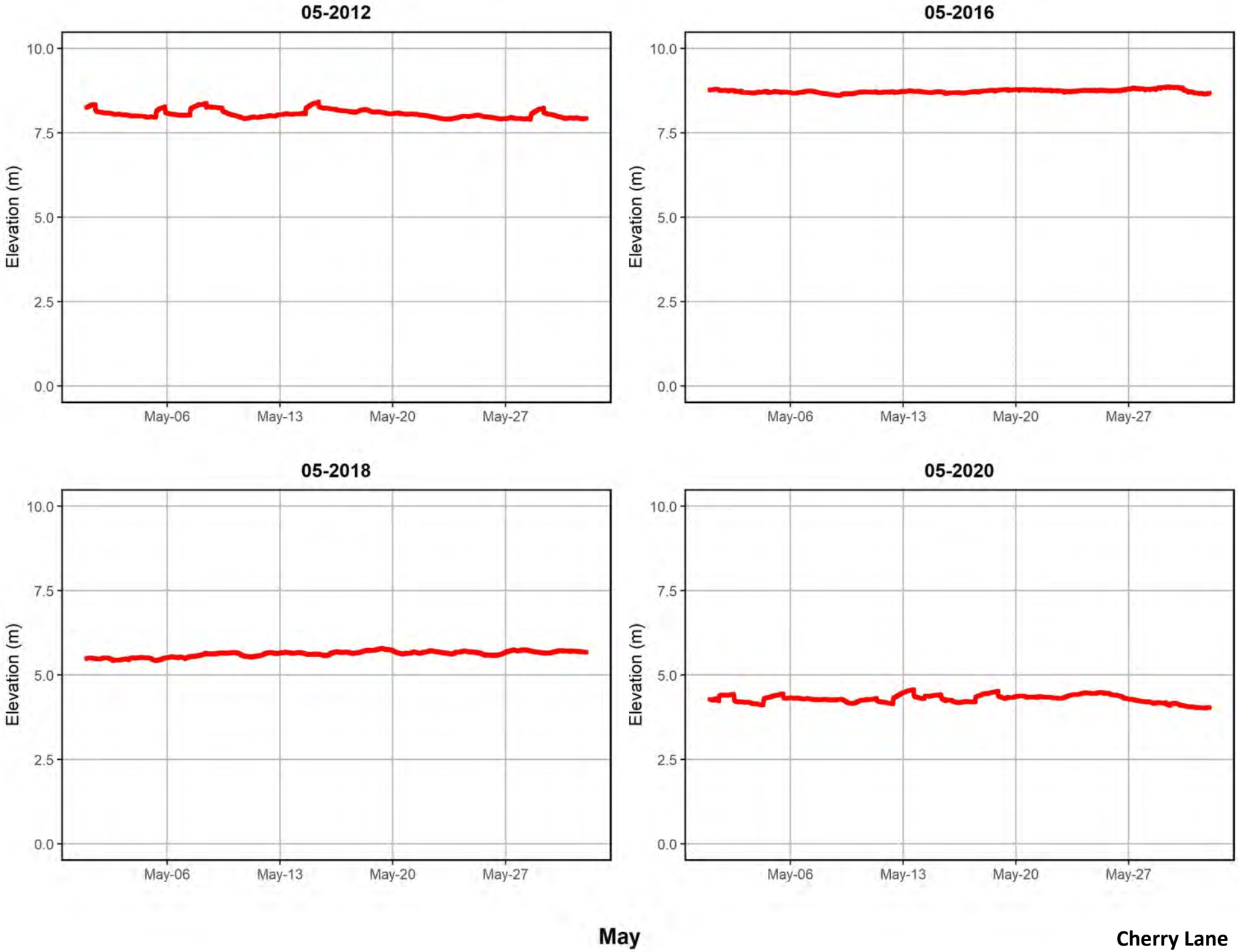
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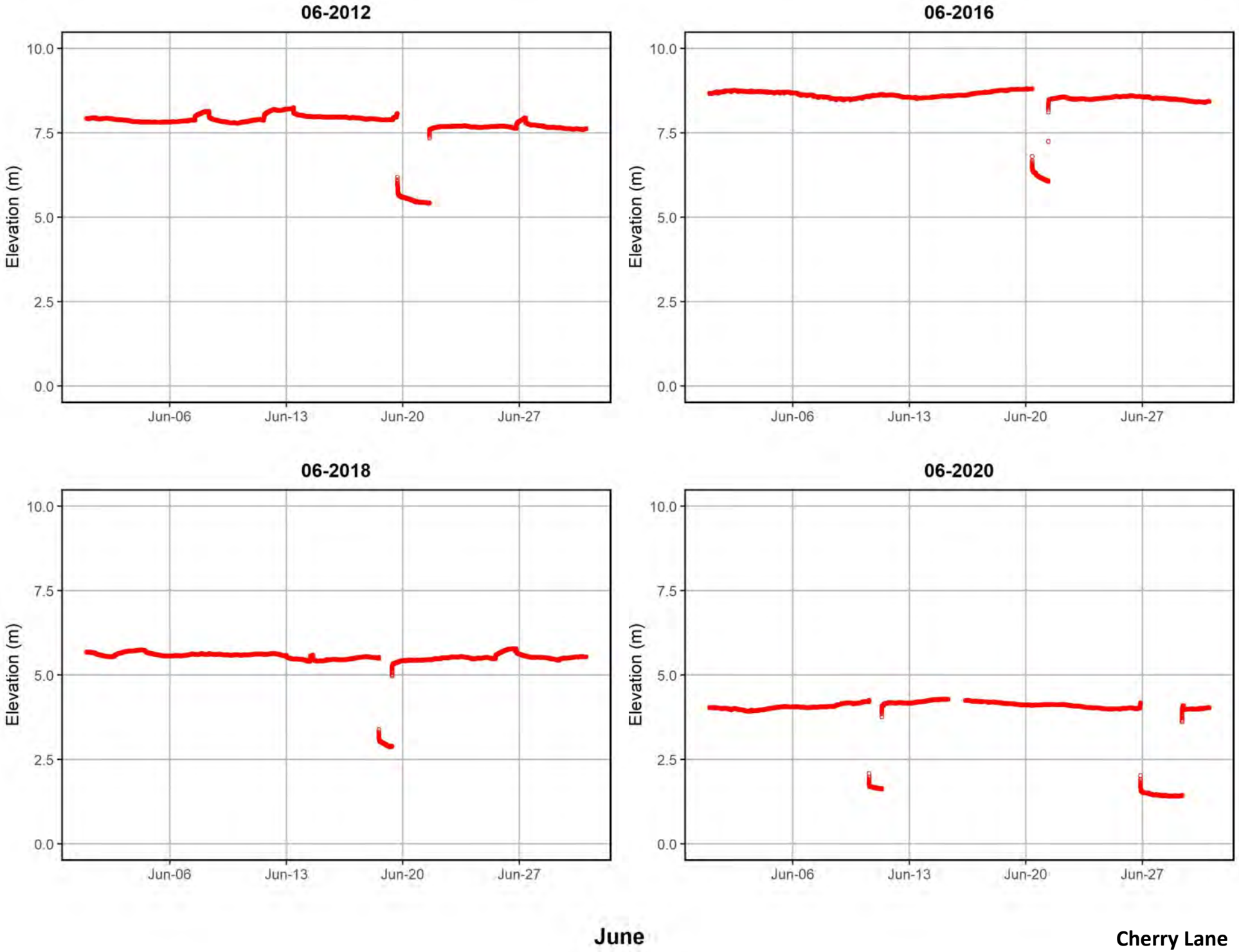
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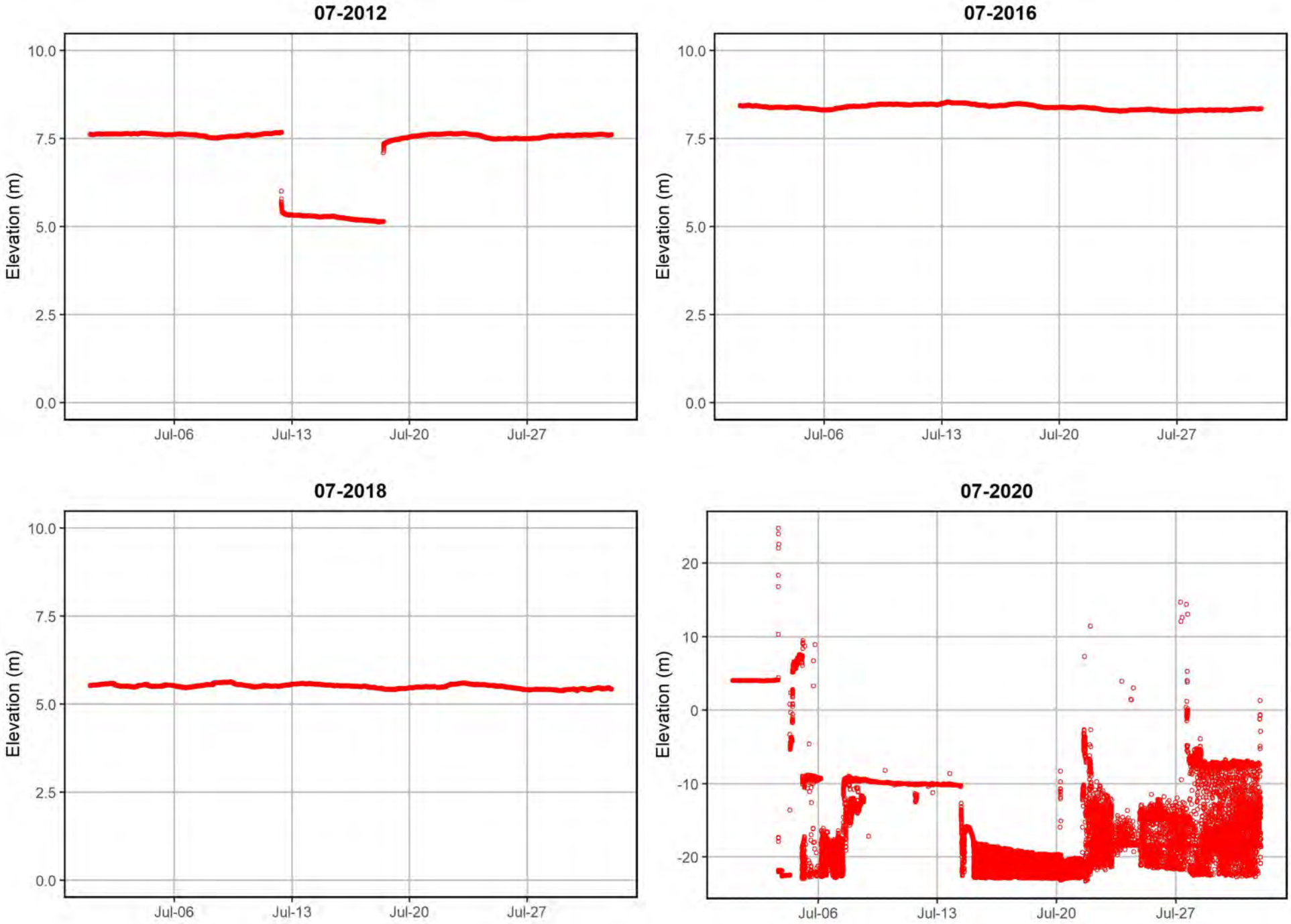
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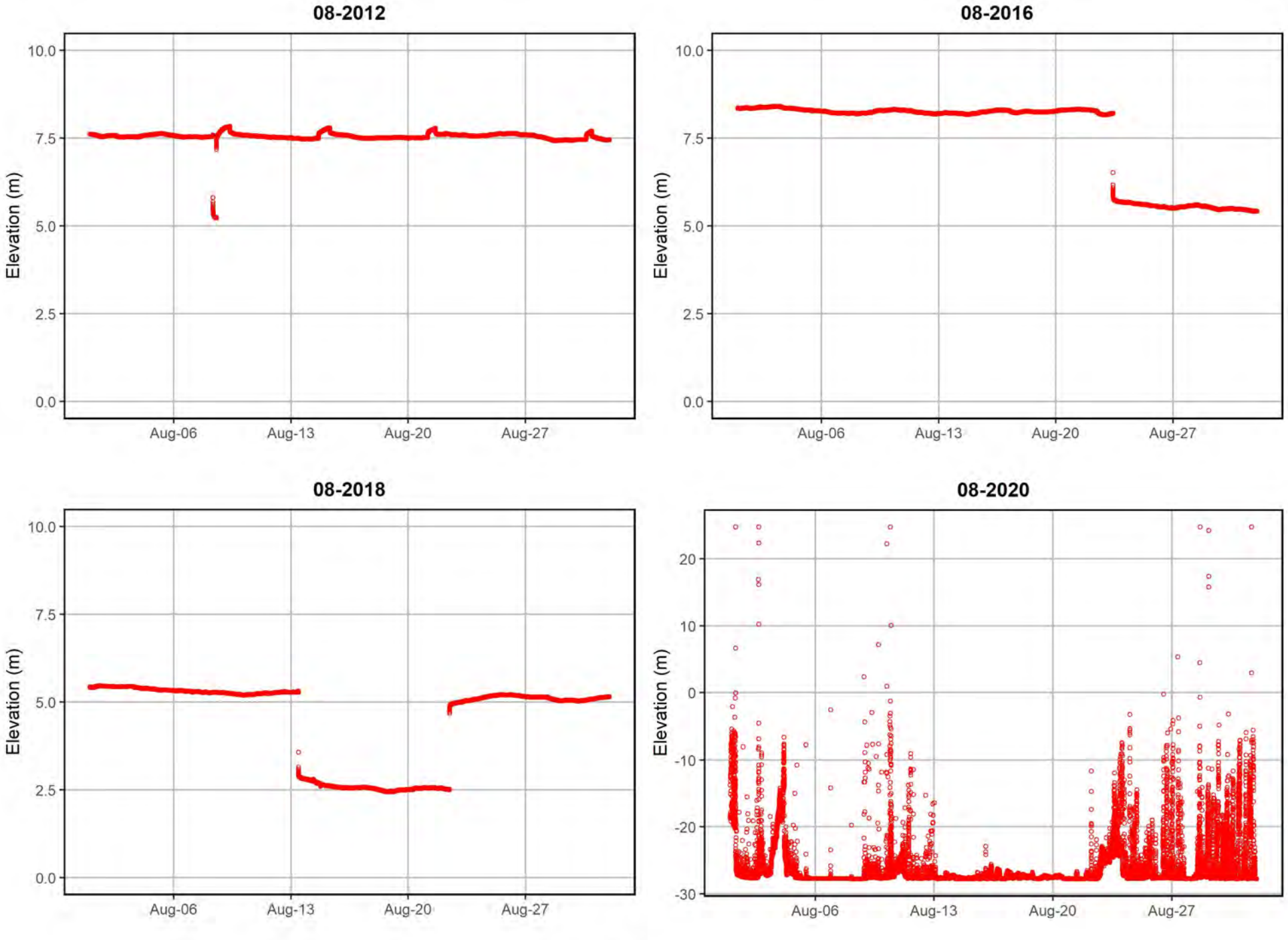
July
Cherry Lane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August
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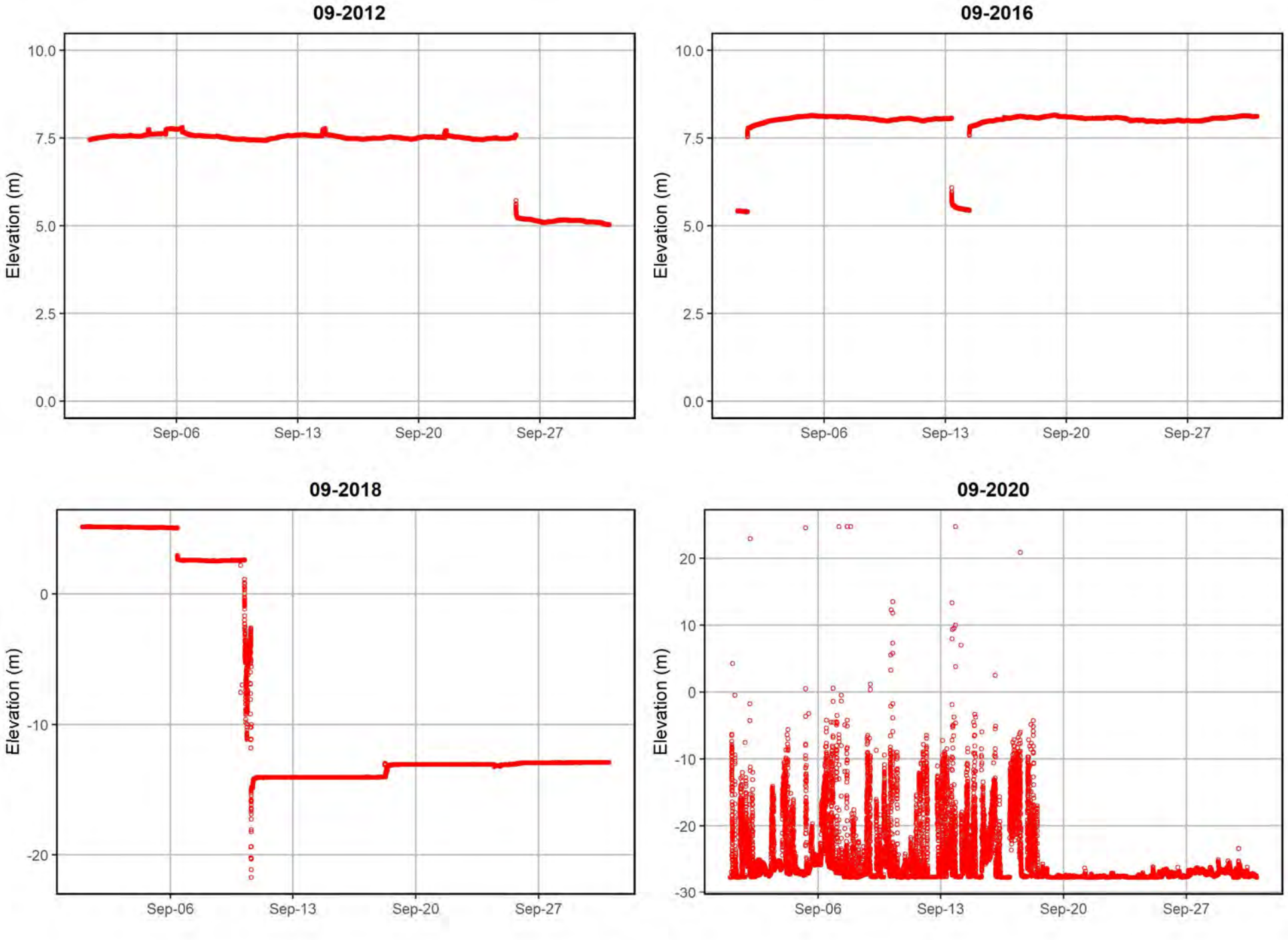
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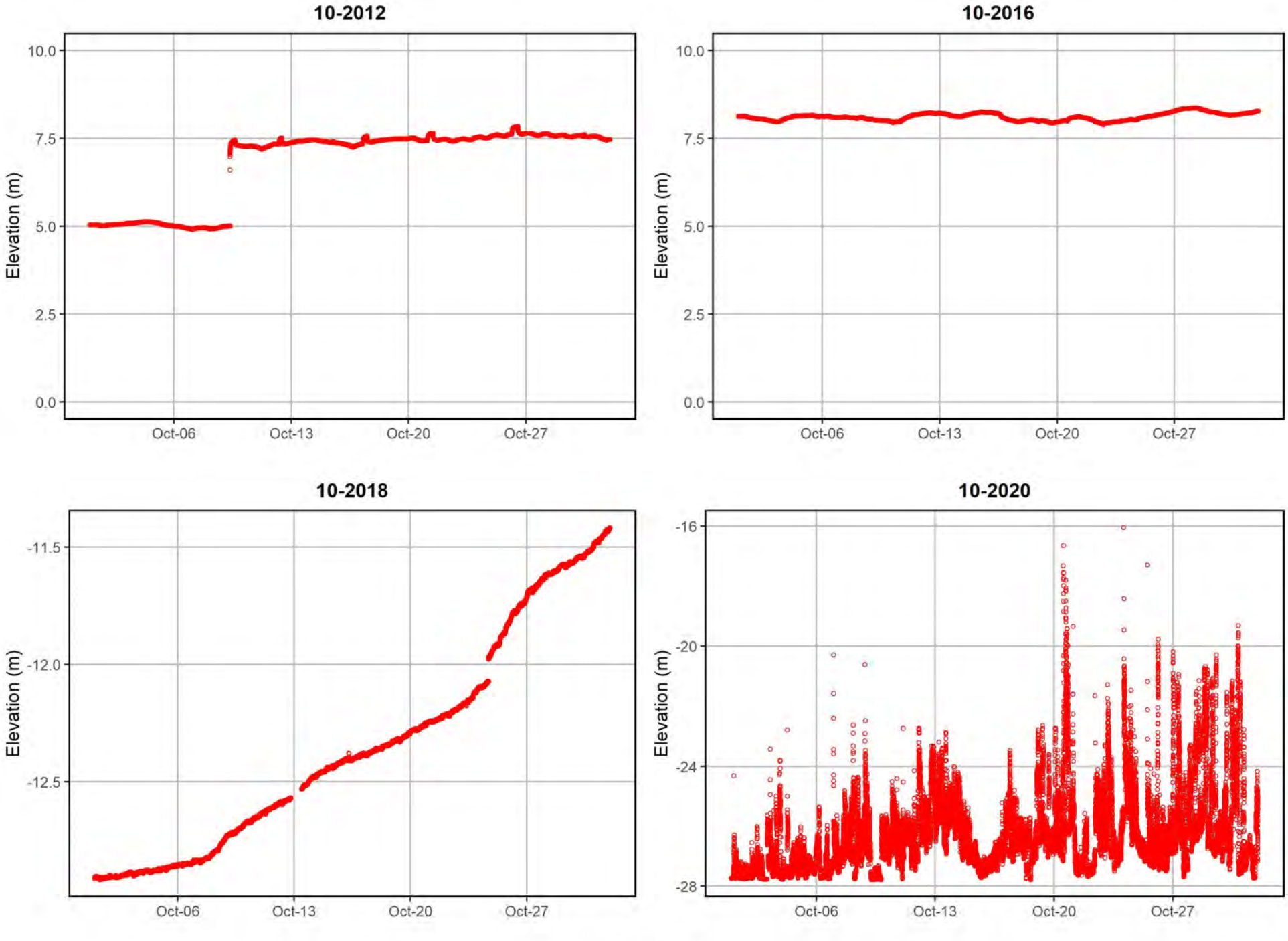
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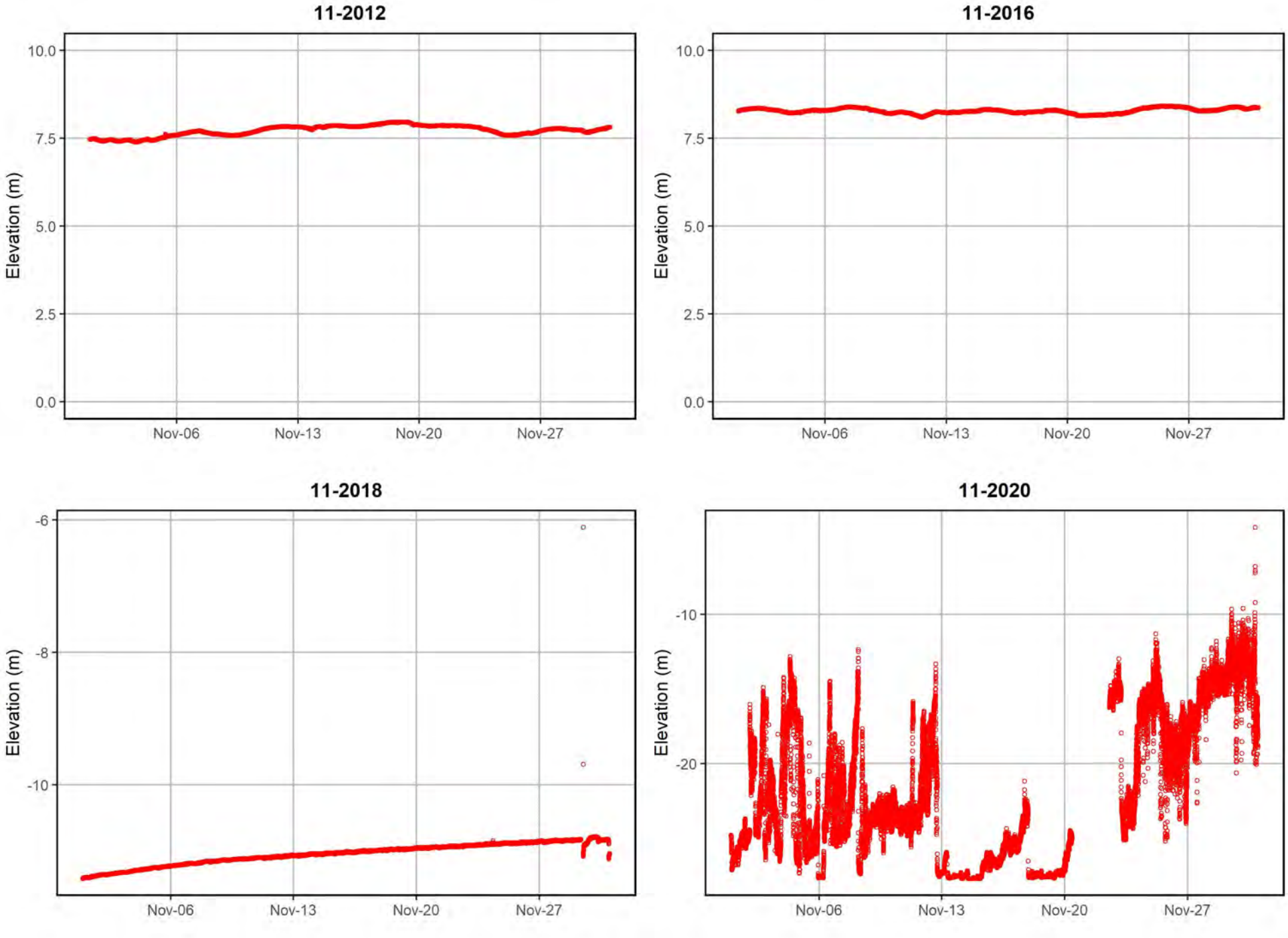
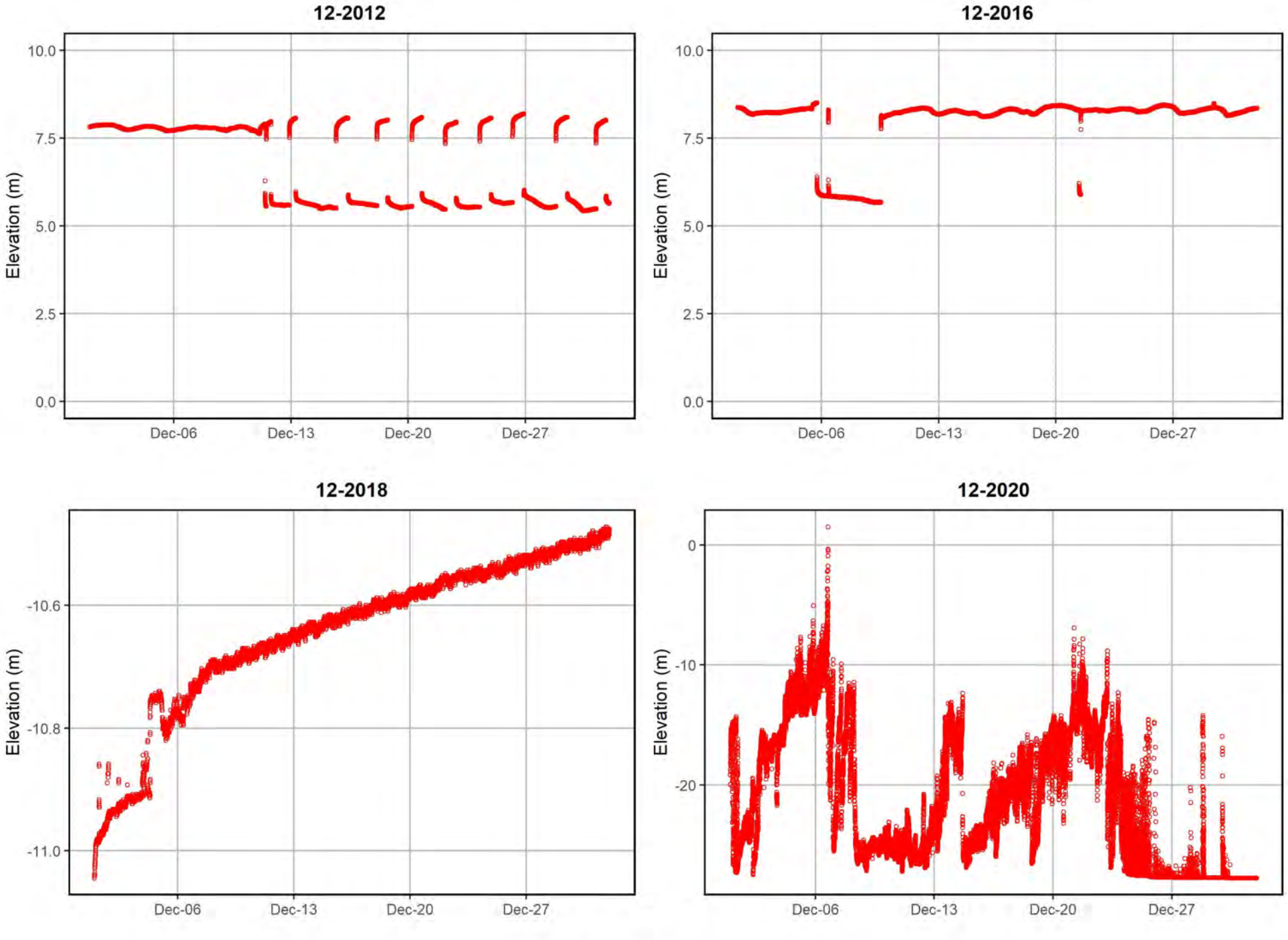


November

Cherry Lane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-10
-20
Dec-06
Dec-13
Dec-20
Dec-27
December
Cherry Lane

APPENDIX C

CBCL 2016 Memorandum: Water Infrastructure Capacity & Future Requirements

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MEMORANDUM

DATE: 12/19/16

PROJECT NO: 160841.01

MEMO TO	Mr. Kevin Kerr, Town of Wolfville
PROJECT NAME	Water Infrastructure Capacity Study
SUBJECT	DRAFT - Water Infrastructure Capacity & Future Requirements
FROM	Mike Abbott, Colin Walker
COPIES TO	

CBCL has reviewed the Town of Wolfville's water supply and sewage treatment infrastructure. The purpose of this preliminary review was to determine the extent to which there is additional capacity available to service growth in the Town and surrounding areas. The systems reviewed included:

- The Town's well field supplying raw water to the system;
- The water storage, treatment, and distribution system; and
- The wastewater collection and treatment infrastructure.

Existing Conditions

The Town of Wolfville has had central water and sewer servicing for more than 50 years. Over the past 25 years the Town's population has increased from approximately 3500 to more than 4200 permanent residents. Servicing requirements within the Town are also influenced by the University which is reported to increase populations to more than 6,000 from September through April, yearly.

Water Infrastructure

The town's water infrastructure includes a series of wells that supply the raw water and a distribution and treatment systems that includes chlorination, storage and distribution piping.

Raw Water Supply

The amount of raw water available from the Town's well field is affected by the following:

- The theoretical yield of the aquifer as determined by previous pumping tests;
- Permitted withdrawal rates; and
- The performance and age of the wells.

The theoretical yield of the aquifer is based on drawdown in the well during long term testing. This is affected by the aquifer's ability to transmit water to the well, water released from storage in the aquifer, and losses in efficiency caused by the screen and pump. Permitted withdrawal volumes are meant to account for drawdown, variations in precipitation that

provide recharge to the aquifer, and water balance in the basin that provides water to the aquifer. Fouling and/or degradation of well screens can cause additional drawdown over short and longer time frames, and as such can reduce capacity.

Wolfville's Water Withdrawal Permit appears to be based primarily on aquifer testing. Table 1 provides a summary of the well field and recent water levels.

Table 1: Summary of Active Production Wells, Town of Wolfville

Well ID	Wickwire 1	Wickwire 2	Cherry Lane
Well Depth (m)	30.48	39.62	49.99
Static Water Level (m above sensor / pump)	4.27	14.40	25.33
Pumping Water Level (m above sensor / pump)	n/a	7 to 10	23
Pump Depth (m)	28.96	32.00	27.43
Theoretical Yield (igpm)	171	749	292
Permitted Maximum Pumping Rate <3-day average> (igpm)	250	500	1000
Permitted Average Pumping Rate <30-day average> (igpm)	250	500	1000

Water level data are based on example SCADA records from November 2014 to November 2016.

Figure 1 shows water use for November 2014 to November 2016. The three-day average over this period exceeded the permitted rate (marginally) on 12 occasions. Appendix A provides additional well use and performance data. Daily water use was frequently at 85% of permitted extraction, but exceeded the permitted rate on 22 days of the 2-year monitoring period. Thirty-day average use was on the order of 85%, and consistently below the permitted rate.

Long-term water levels in each well provided an indication of well and aquifer performance. Figure 2 shows daily water levels in the Town's primary well, Wickwire Well #2, and the Cherry Lane Well, which serves as a back-up and supplemental source for periods of high demand. As Wickwire Well #2 is often in production 24 hours per day, Figure 2 shows primarily pumping water levels for the Wickwire Well. Figure 2 shows static (non-pumping) water levels for the Cherry Lane Well, which was used only periodically. Drawdown in the Wickwire Well was greatest during the summer months, showing a water level decline of up to three metres in response to dry weather and intensified water use. The corresponding decline in static conditions in the aquifer was on the order of one metre (as measured at the Cherry Lane well). Hydraulic head in each of the wells and/or the aquifer does not appear to show persistent, long-term declines, indicating that current rates of withdrawal are sustainable.

Figure 1. 3-Day Average Withdrawal Volumes, Town of Wolfville Well Field

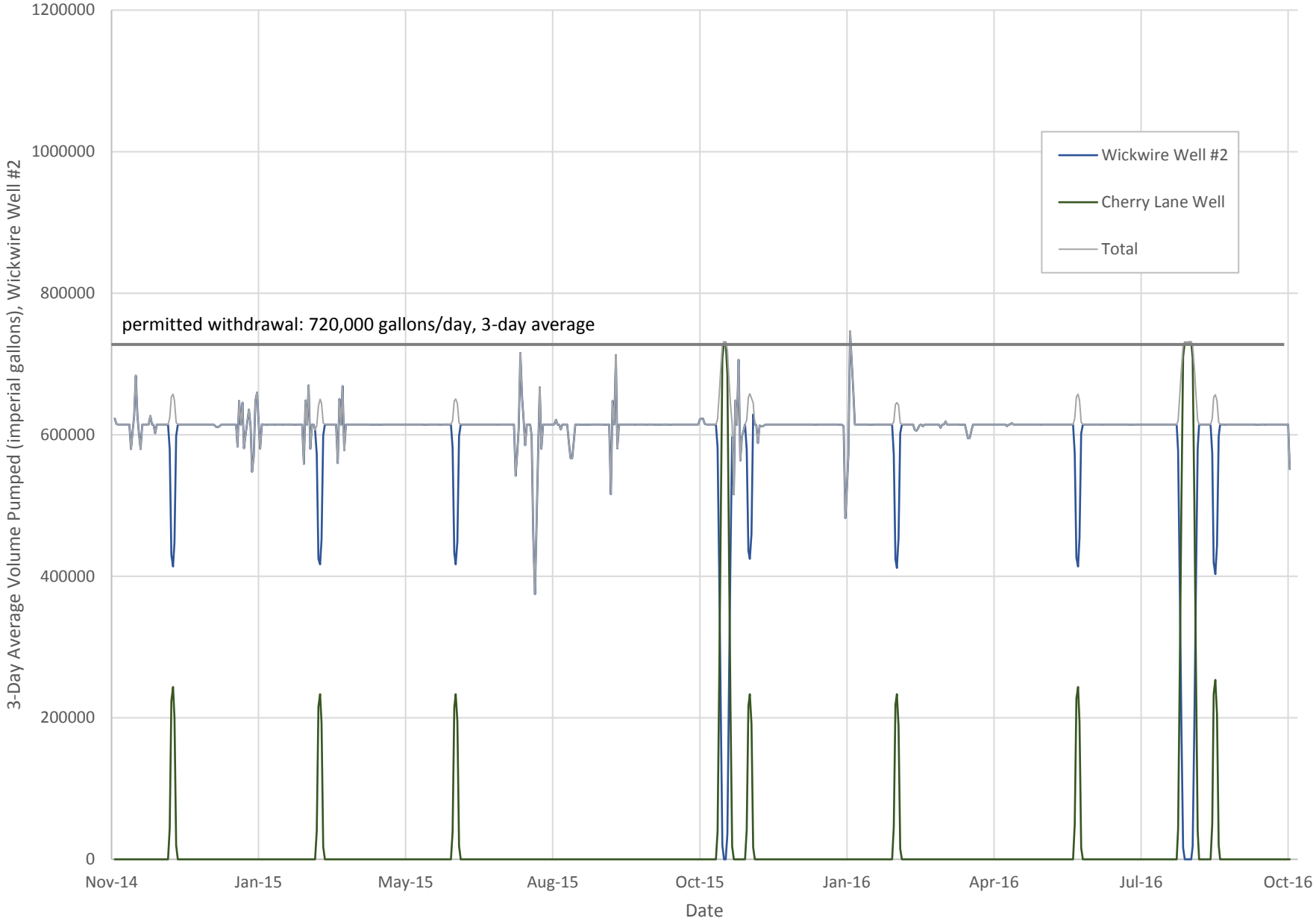
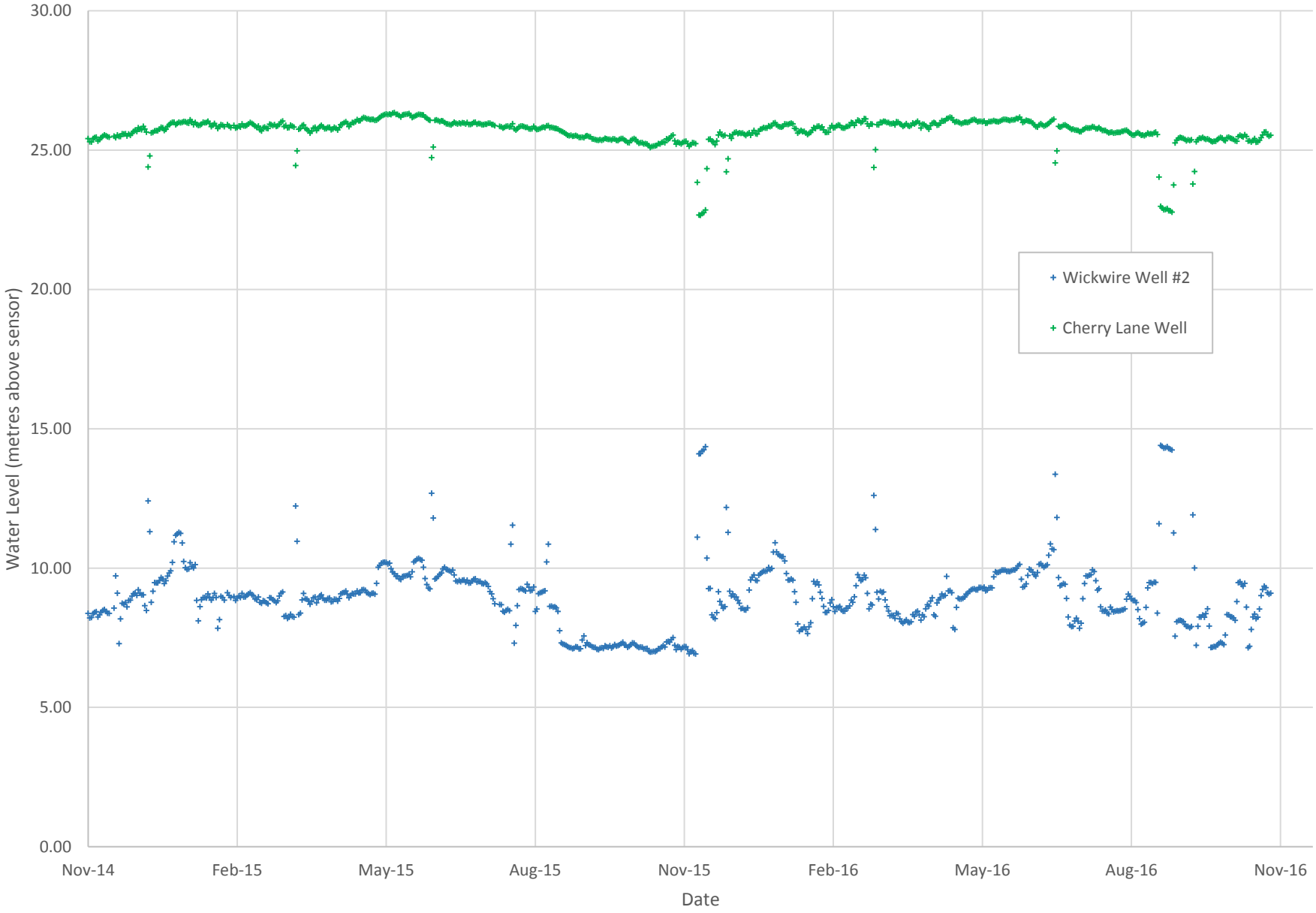


Figure 2. Daily Water Levels, Town of Wolfville Well Field



The short-term performance of the wells was checked for three 48-hour periods in 2015:

- July 15-16
- August 23-24
- November 18-19

Water levels stabilized during periods of pumping and when not in use (shown in Figures A3, A4 and A5, Appendix A). Water level data show that conditions in the aquifer were stable over shorter time frames, further indicating that current withdrawal rates are sustainable.

Well field data indicate that during periods of average use there is additional capacity within the well field, but that during periods of peak use, water use reaches the permitted 3-day capacity. As the theoretical safe yield of the aquifer is based on longer-term (e.g. 30-day extraction) factors, the aquifer should be capable of providing an additional 100,000 gallons per day, or 70 igpm. The current permit is, however, structured such that permitted 3-day maximum and average pumping rates are equal. As such it will be difficult for the utility to manage pumping schedules sufficiently to allow for a higher long-term pumping rate without exceeding the 3-day maximum rate.

Treatment, Storage and Distribution

The treatment storage and distribution system include a chemical addition system, in-ground reservoir, booster/pressure reducing chambers, and distribution piping. The most recent system assessment report completed in 2013 does not indicate any issues with pressure and storage in the system. A cursory analysis of the three water mains leaving the reservoir was done to calculate the headloss under maximum daily flow conditions (3774 m^3/d based on the 2015 Annual Drinking Water Report). In the 200 mm main the headloss was 0.44”/100 feet. In the 400 mm PVC main the headloss was 0.05”/100 ft. Finally, in the 400 mm ductile iron main the headloss was 0.06”/100 ft. Given these relatively minor losses and the fact that the peak flow does not flow entirely in one main, the water distribution mains appear to have sufficient capacity for the current maximum daily flow as well as some additional capacity for expansion.

Wastewater Infrastructure

The Towns wastewater infrastructure includes collection piping, manholes, four pumping stations, and an aerated lagoon wastewater treatment plant.

Wastewater Collection

The wastewater collection system was modeled in 2003 by CBCL Limited. The results of the study indicated that the gravity piping system contains significant capacity with most sub-systems handling in the range of less than one to 25% of their rated capacity. Wharf Road is currently utilizing the most of its rated capacity at just over 50%. The delivery of wastewater to the treatment plant utilizes two force mains, one 300 mm diameter and the other 200 mm diameter. At maximum design velocities of 2 m/s, these force mains have a capacity of more than 17,000 m^3/d which is more than 5 times the current average flow delivered to the lagoons.

An analysis of SCADA data from Wolfville’s six pumping station was done to determine the capacity and available redundancy. Data was collected from November 1, 2014 through October 31, 2016. The average and maximum pumping hours per day was calculated for individual

pumps and each pumping station. The number of days without one pump capacity redundancy was also calculated. Results are shown in Table 2.

Table 2: Average and maximum pumping hours per day and days without one pump redundancy for the Wolfville wastewater pumping stations over a two year period (November 2014-October 2016)

Station		Average Pumping Hours Per Day Per Pump	Average Pumping Hours Per Day for the Station	Maximum Pumping Hours Per Day Per Pump	Maximum Pumping Hours Per Day for the Station	Days without 1 pump redundancy
Pump Station #6 - PW Garage	Pump 1	1	1	8	8	0
	Pump 2	1		13		
Pump Station #5 - To STP	Pump 1	2	9	21	55	1
	Pump 2	3		22		
	Pump 3	4		24		
Pump Station #2 - Oak Ave	Pump 1	4	6	24	48	19
	Pump 2	3		24		
Pump Station - Gaspereau Ext	Pump 1	0	1	5	6	0
	Pump 2	1		6		
Pump Station - Cherry Lane	Pump 1	0	1	3	7	0
	Pump 2	1		5		
Pump Station - Arena	Pump 1	5	19	24	69	0
	Pump 2	8		24		
	Pump 3	6		24		
	Pump 4	1		20		

In general, all of the pumping stations have sufficient capacity. The average pumping hours are low and for the most part, the stations have one pump redundancy. Pump station #2 had the most number of days without a one pump redundancy, however that only occurred on 19 days over a two year period.

Wastewater Treatment

The Wolfville wastewater treatment lagoon was constructed in 1977. The lagoon construction included a blower building and aeration system. A new fine bubble aeration system was installed in 1992 and partially upgraded in 2013. The treatment system consists of two cells operated in series, each will a capacity of approximately 20410 m^3. Wastewater is transferred between cells via an overflow pipe. A study conducted in 2011 showed that there was 2.5-6.5 ft (average – 4.3 ft) of sludge in each of the cells. Cell 1 and Cell 2 were dredged in 2013 and 2016 (anticipated), respectively.

An Environmental Risk Assessment (ERA) was conducted 2013-2014 in accordance with the Canadian Council of Ministers of the Environment's Canada-wide Strategy for the Management of Municipal Wastewater Effluent. Results of ERA showed that the Wolfville wastewater treatment lagoon occasions discharges effluent with biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations exceeding the Wastewater Systems Effluent Regulation's (WSER) National Performance Standards.

An assessment was conducted to determine the capacity of system relative to the National Performance Standards. Design criteria was determined based on the Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment and Disposal (2006). An analysis was done to determine the influent flow rate that would result in a maximum allowable effluent BOD concentration of 25 mg/L. Two different design scenarios were considered: warm weather (22°C) and cold weather (4°C). Furthermore, a 10%, by depth, sludge allowance was included. The equation used in the analysis is given below:

$$\frac{BOD_{effluent}}{BOD_{influent}} = \frac{1}{1 + k_T \cdot t}$$

Where:

$BOD_{effluent}$ – Effluent BOD concentration, mg/L

$BOD_{influent}$ – Influent BOD concentration, 170 mg/L (Based on sampling from 2011-2012)

k_T – Temperature dependent reaction rate coefficient, d^{-1}

t – Detention time, d

A k_{20} of 0.276 d^{-1} was used and adjusted to the analysis temperature (22°C or 4°C) according to the Atlantic Canada Wastewater Guidelines Manual. The same k_T was used for both cells.

The wastewater treatment lagoon currently receives, on average, 2998 m^3/d. Based on the analysis, the treatment system is either nearing or over capacity, depending on the temperature. During the summer (22°C), the system has some additional capacity and should be capable of receiving 3466 m^3/d while still achieving the 25 mg/L effluent standard for BOD. However, during the winter (4°C), the system is only capable of receiving 1925 m^3/d, well below the average flow. An analysis of flow rate data from 2011-2012 showed that there is minimal seasonality and cold weather flow rates are consistent with average yearly flow rates. Therefore, the current system is currently at or over capacity.

Future Requirements

Based on the review of the data available, The Towns water infrastructure appears to have the following characteristics in describing its current capacity:

1. The wastewater collection piping has significant capacity to convey wastewater to the treatment facility.
2. The water treatment, storage, and pressure control infrastructure function well under current peak flow conditions. The distribution system piping has significant additional capacity.
3. The wastewater treatment system is currently at capacity and therefore significant expansions will require additional lagoon volume. This is primarily due to the usage of more modern design standards to evaluate the capacity of the lagoon than were present during the initial design. The use of the new standards reduces the design capacity of the plant by approximately 50%.
4. The water supply system is very close to its rated capacity. While some minor development can probably be accommodated, significant development will require additional supply.

In order to address these issues the following sections have been developed to describe the potential work that may be required in the future and provide an initial estimate of the potential costs for planning purposes.

Water Supply

The theoretical yields for the Cherry Lane and Wickwire Wells were estimated based on aquifer testing data. These yields indicate the pumping rate that should produce a stable water level in the well for up to 20 years of pumping. These rates are based on the aquifer and well hydraulics, and do not account for recharge rates or total yield of the aquifer/basin being pumped.

Theoretical yields suggest that there is additional capacity available within the aquifer that serves the town. Other considerations, such as water budget information, and source water protection concerns (e.g. elevation of pumping water level compared to sea level) would be required to confirm this additional capacity.

Preliminary water budget calculations were performed based on the catchment area of the well field based on the model prepared in by CBCL in 2005 (Figure B1, Appendix B). The recharge rate used to model the existing capture zones was 100 mm/yr, however, the granular soils in the Wolfville area suggest that this value could be higher. Example calculations are provided below:

- Permitted extraction rate = 720,000 igpd
- Actual extraction rate = 610,000 igpd
- Modelled recharge @ 100 mm/yr = 420 484 igpd
- Modelled recharge @ 200 mm/yr = 840 969 igpd
- Modelled recharge @ 350 mm/yr = 1 471 694 igpd

The range of possible recharge rates shows that existing extraction rates are between 40 and 150 % of potential recharge. Further work would be required to quantify the amount of water that recharges the Wolfville aquifer, and confirm available capacity to the system. This work includes:

1. Short-term solution (incremental increases for 1 to 3 years): Prepare new permit application/update as required.
    - Investigate possibility of increasing 3-day maximum permitted withdrawal rates based on theoretical yields from aquifer testing data.
2. Source water investigation (decreased risk of overuse / water shortage / water quality changes)
    - Prepare more detailed water budget by making limited updates to groundwater flow model.
    - Collect 9 months of field data (automated) to calibrate water budget.
    - Evaluate potential for sea water intrusion.
3. Longer-term requirement (5 to 10 year time frame): Well field exploration to locate and install a new well to provide redundancy for aging infrastructure and/or increase total

capacity of system. Upgrade existing SCADA system to improve water use and well level monitoring.

Wastewater Treatment

The wastewater treatment upgrades for future development will include an aspect og upgrading of the existing system and expansion for future growth. Monitoring data from 2011-2012 showed that the average flow rate at the inlet of the wastewater treatment system was 2998 m^3/d. The population during this time was approximately 4,269. Using *Environment Canada's Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment and Disposal*, the per capita domestic flow was calculated as 351 L/capita/day, which is similar to the estimate (340 L/capita/d) given in the *Manual*. For the calculation, a peaking factor of 2 was used and extraneous flows were ignored. Extraneous flows would contribute more to peak daily flow, however, because the treatment system is a lagoon, which is characterized by an extended detention time, average daily flow will be used for any design calculations. Therefore, using a 2036 population of 6030, the design flow is 4233 m^3/d.

Three options were considered for treatment system upgrades:

1. Construct a new aerated cell upstream of the current system;
2. Reconfigure the current cells to operate in parallel and construct a new downstream polishing cell;
3. Construct a new free water surface (FWS) wetland downstream of cell 2.

All of the options were analyzed using *Environment Canada's Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment and Disposal* in order to calculate upgrade unit sizes. Calculations were done using a temperature of 4°C, which is representative of the system temperature during the winter. Upgrades were sized to ensure compliance with the Wastewater Systems Effluent Regulation's (WSER) National Performance Standards for BOD (25 mg/L).

In Option 1, a new aerated cell would be constructed upstream of the current system. A layout of this upgrade is shown in Figure C1 (Appendix C). The resultant system would be three aerated cells operated in series. The new cell would have the same depth as the current cells, however it would have a larger surface area (1.4 ha). This treatment option may be able to utilize gravity flow for conveyance between cells depending on the topography and location of the force main.

In Option 2, the current cells will be reconfigured to operate in parallel and a new polishing cell will be constructed downstream. A layout of this upgrade is shown in Figure C2. The new polishing cell would have the same depth as the current cells, however it would have a larger surface area (1.9 ha). The aeration equipment in cell 2 would need to be upgraded to match cell 1. Wastewater would likely need to be pumped from the outlet of cell 1 and 2 to the inlet of the new polishing cell.

In Option 3, a new FWS wetland will be constructed downstream of cell 2. A layout of this upgrade is shown in Figure C3. The wetland would require a smaller unit volume but a much larger footprint relative to Option 1 and 2. This is because the operating depth (<0.5 m) of a FWS wetland is much shallower than a lagoon (3 m). At an average operating depth of 0.3 m, a footprint of approximately 4.1 ha is required. The FWS wetland shown in Figure A3 is larger than 4.1 ha, but utilizes existing topographic features, which would reduce the required earthworks.

This option would likely require a pump for conveyance to the FWS wetland, however it would not require any additional aeration.

Of the three options, Option 3 is the most compatible with the existing topography and current regulations regarding design and construction of wastewater infrastructure in areas where there may be high groundwater. As this option is also attractive financially, it has been carried forward for future consideration.

Implementation and Costs

The water system will require some study and exploration over the next few years to maximize the yield of the existing wells and plan for the long term expansion. The wastewater treatment plant is already over capacity during the winter months, however the Town is currently undertaking operational improvements including desludging and aeration system replacement projects. Therefore, it is recommended that these efforts be completed and a period of monitoring be undertaken to establish the current performance of the improved facility. When the current performance is known, preliminary design of the upgrades can take place to prepare for capital works in the 5 – 10 year horizon.

Conceptual level cost estimates were generated for the work discussed above to aid in the planning process. These costs are provided below.

Item	Estimated Cost
Water System	
Preparation of new permit application to increase withdrawal rates	$10,000
Source water investigation for increased withdrawal rates	$25,000
Well Field exploration and testing (longer term)	$100,000
New well field development and commissioning	$0.5 – 1.5 M
Wastewater Treatment	
Preliminary Design and Geotechnical	$40,000
Wetland Design and Construction	$0.75 - $1.5 M

Appendix A

Figure A1. 30-Day Average Withdrawal Volumes, Town of Wolfville Well Field

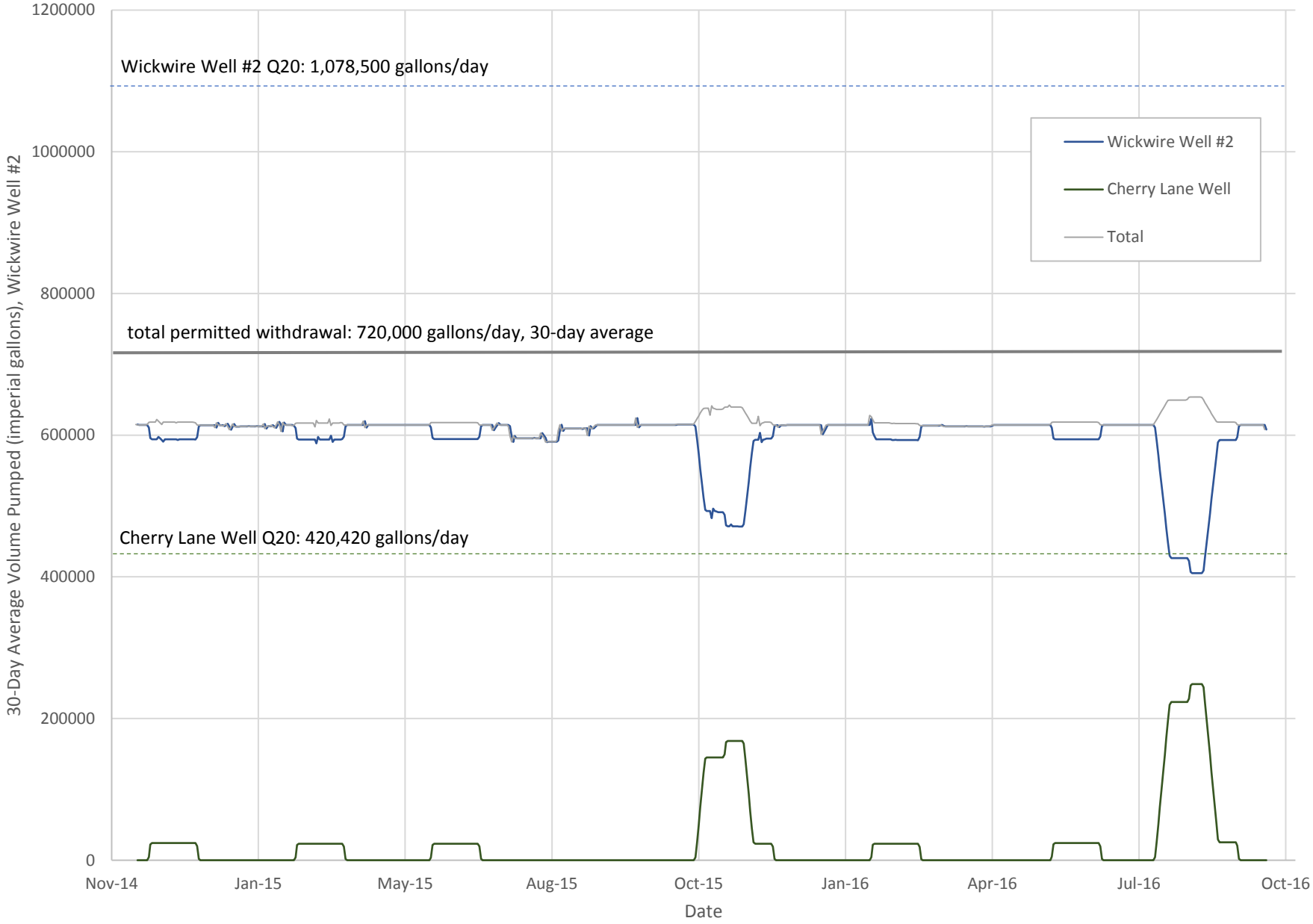


Figure A2. Daily Withdrawal Volumes, Town of Wolfville Well Field

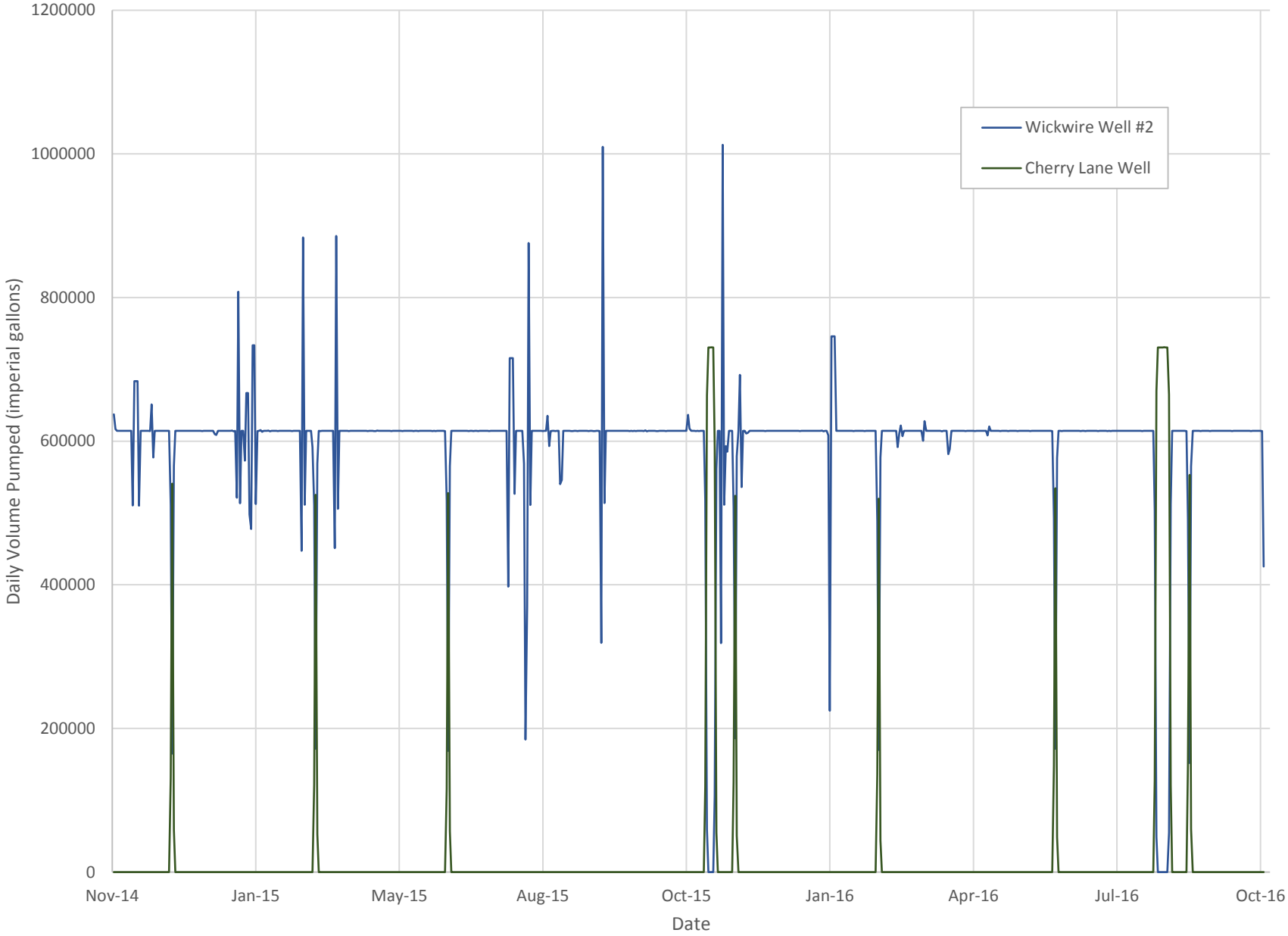


Figure A3. Well Field Activity, July 15-16, 2015, Town of Wolfville

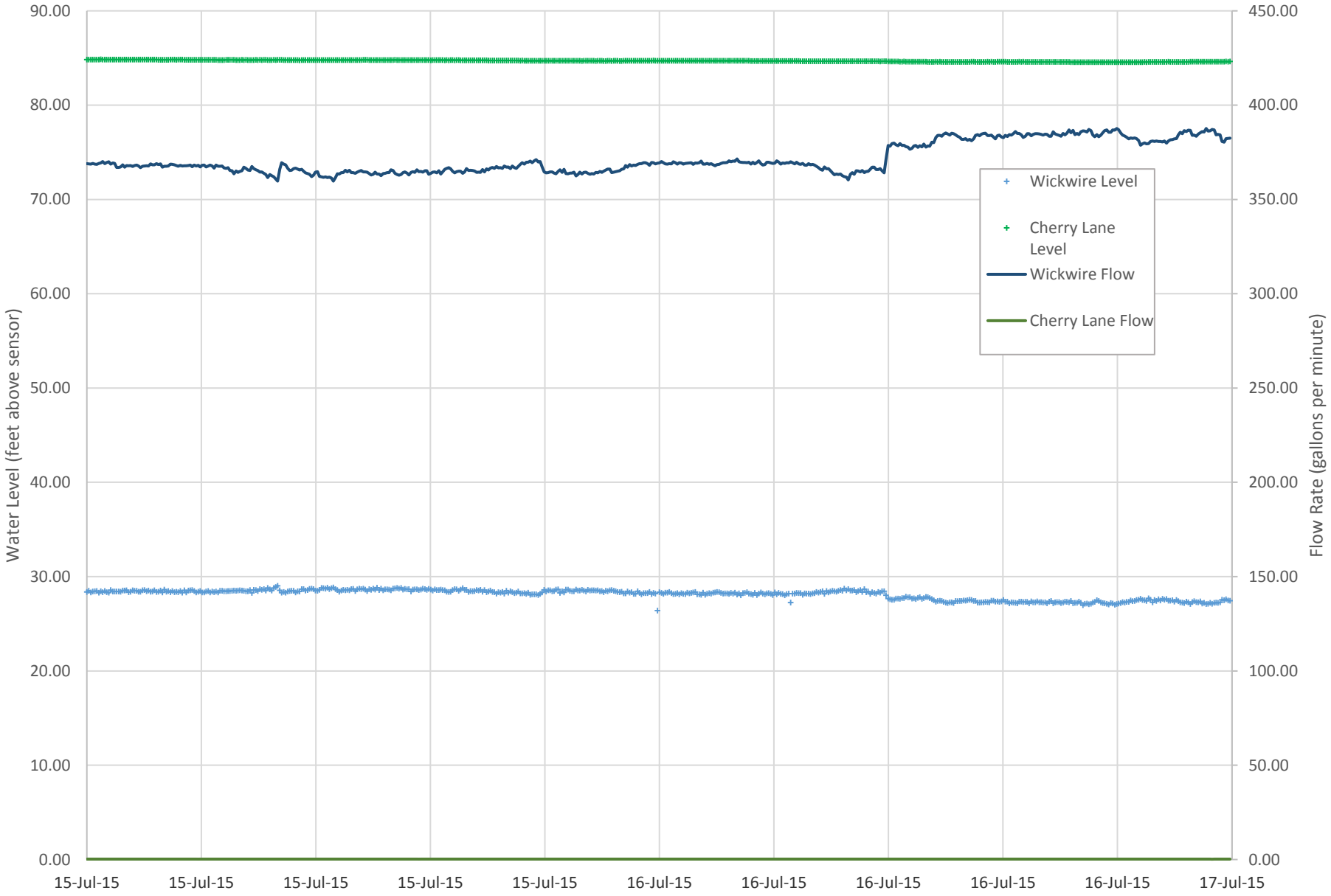


Figure A4. Well Field Activity, August 23-24, 2015, Town of Wolfville

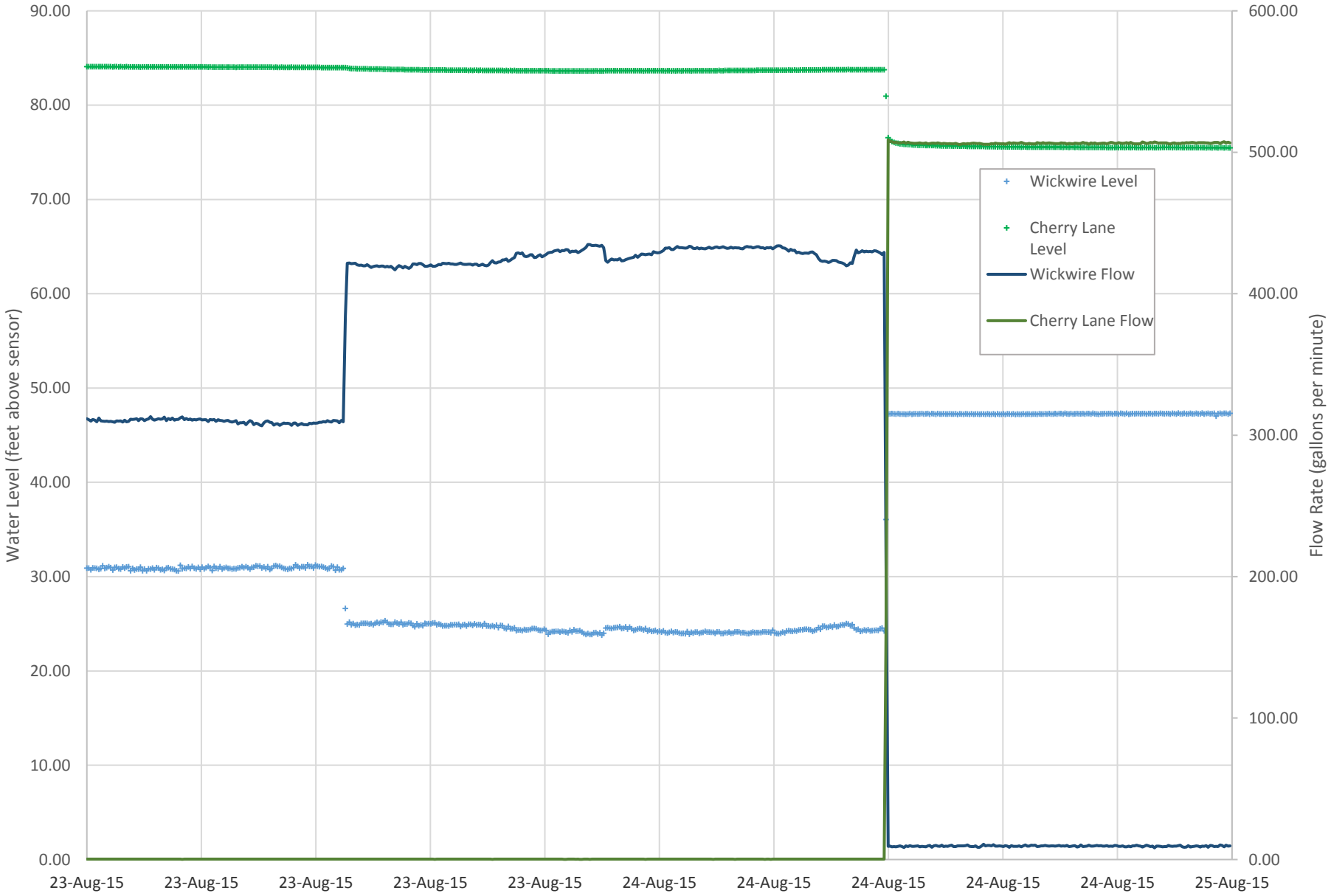
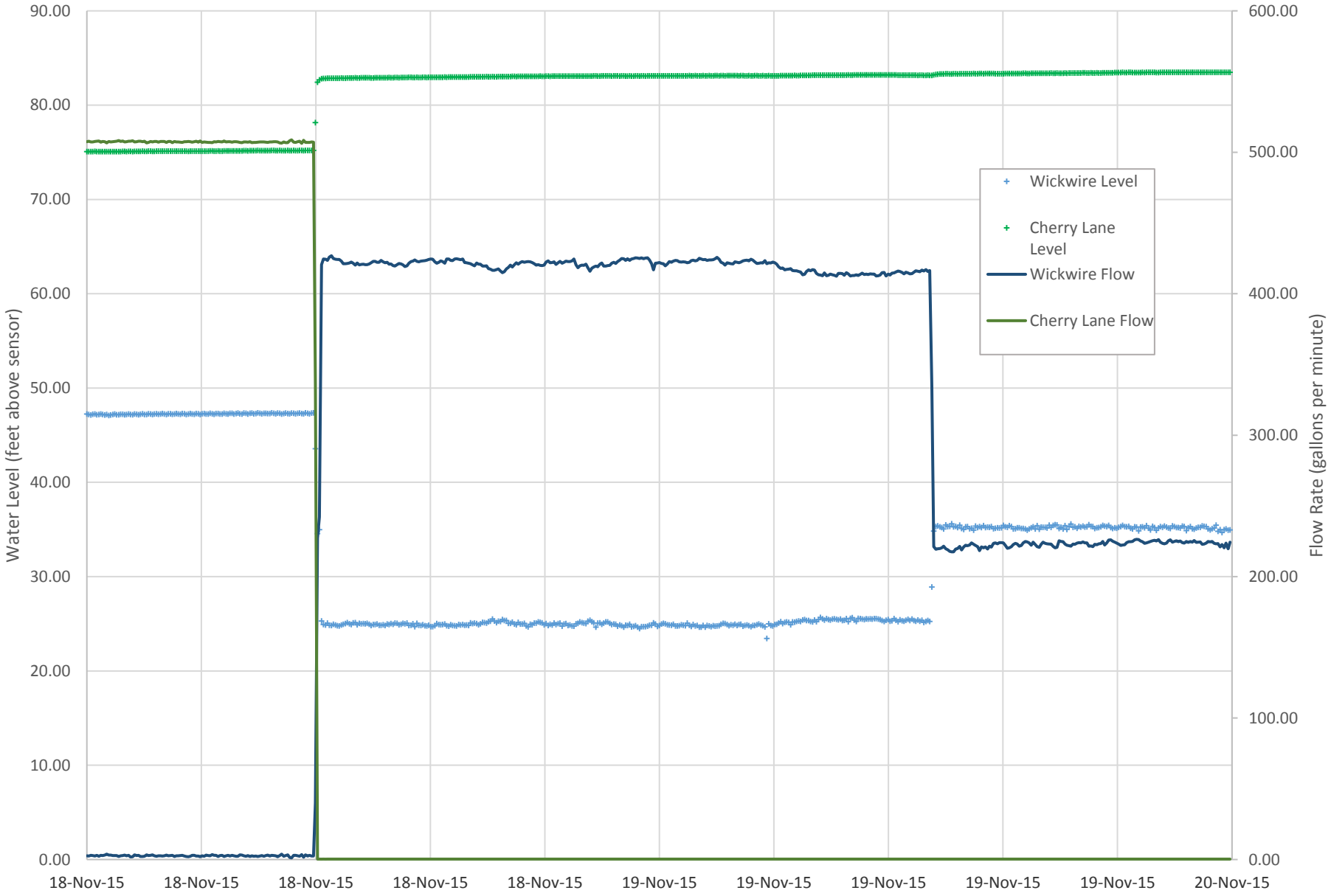


Figure A5. Well Field Activity, November 18-19, 2015, Town of Wolfville



Appendix B

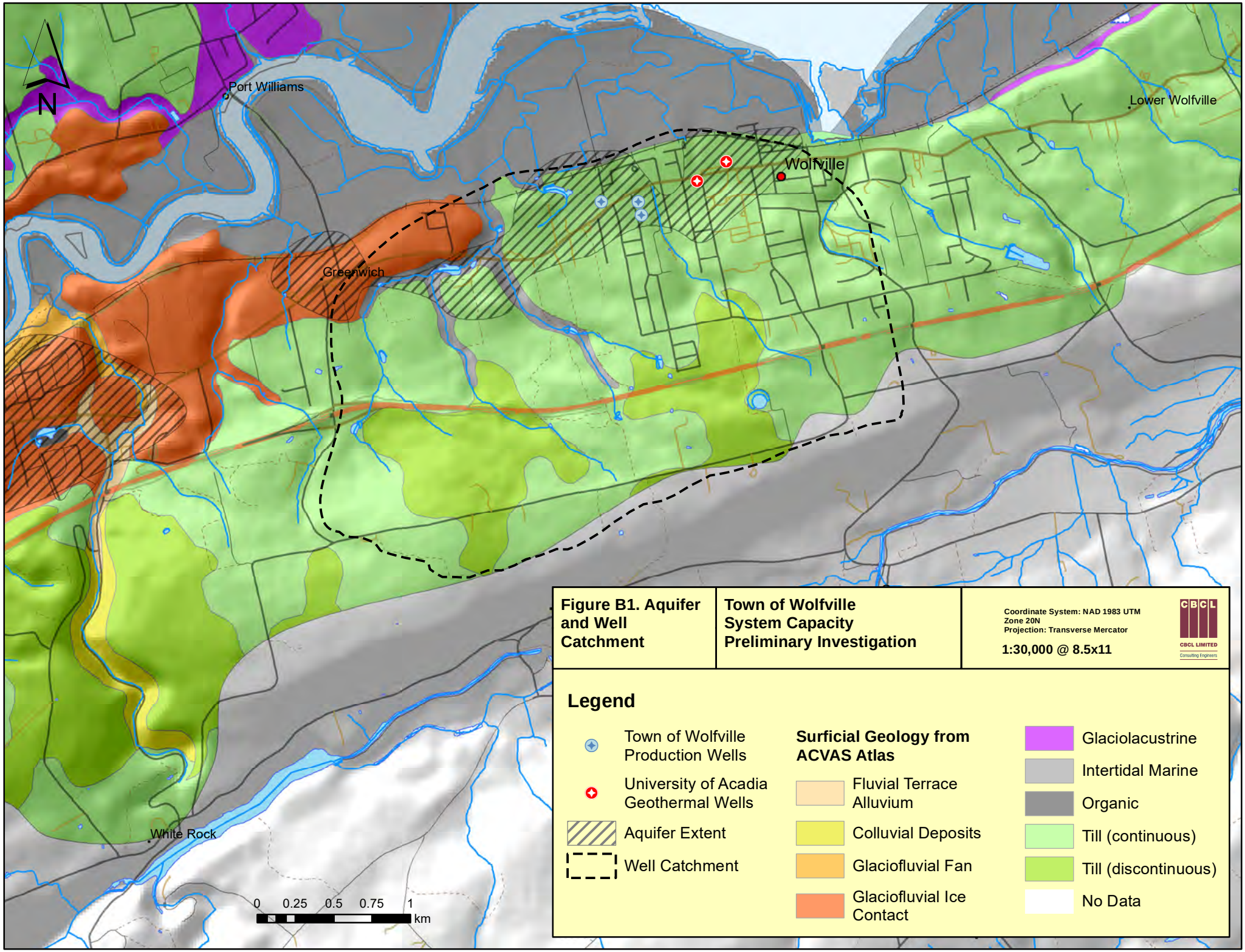


Figure B1. Aquifer and Well Catchment

Town of Wolfville System Capacity Preliminary Investigation

Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator

1:30,000 @ 8.5x11

CBCL LIMITED
Consulting Engineers

Legend

- Town of Wolfville Production Wells
- University of Acadia Geothermal Wells
- Aquifer Extent
- Well Catchment

Surficial Geology from ACVAS Atlas

- Fluvial Terrace Alluvium
- Colluvial Deposits
- Glaciofluvial Fan
- Glaciofluvial Ice Contact
- Glaciolacustrine
- Intertidal Marine
- Organic
- Till (continuous)
- Till (discontinuous)
- No Data

Appendix C

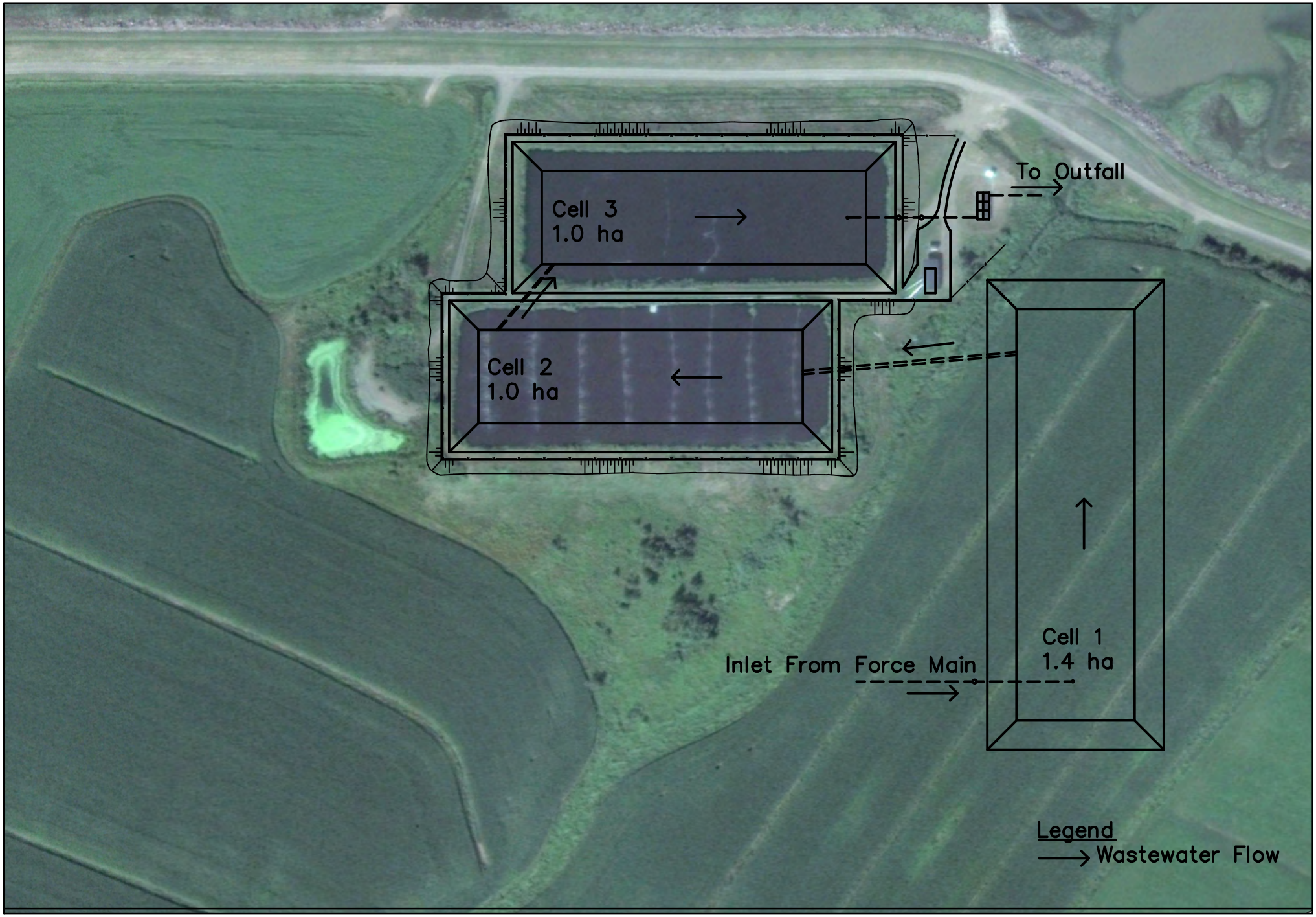


Figure C1: Option 1 – New aerated cell operated in series

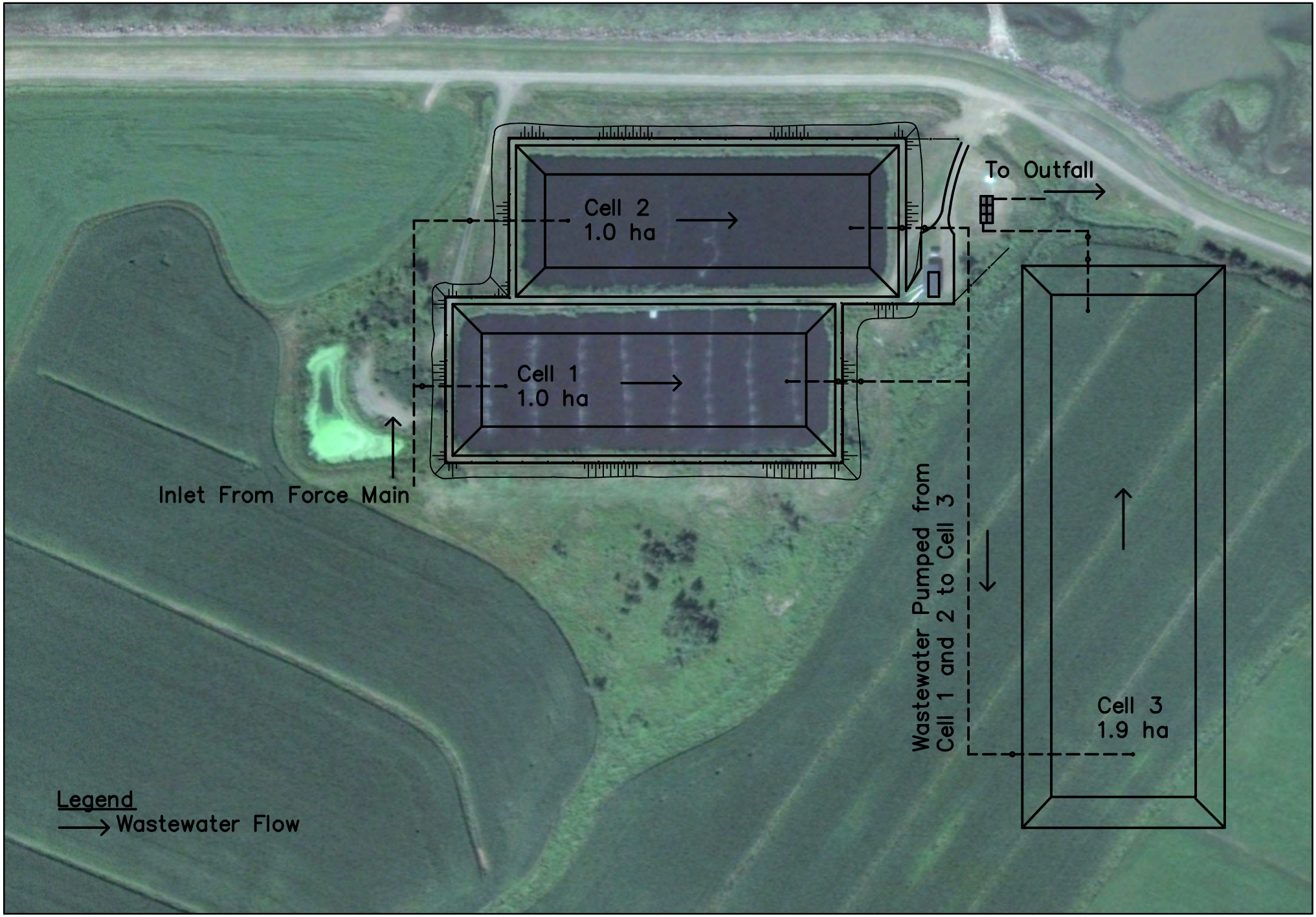


Figure C2: Option 2 – New polishing cell with the first two cells operated in parallel

1: 2000

0 10 20 30 40 50 100 120M

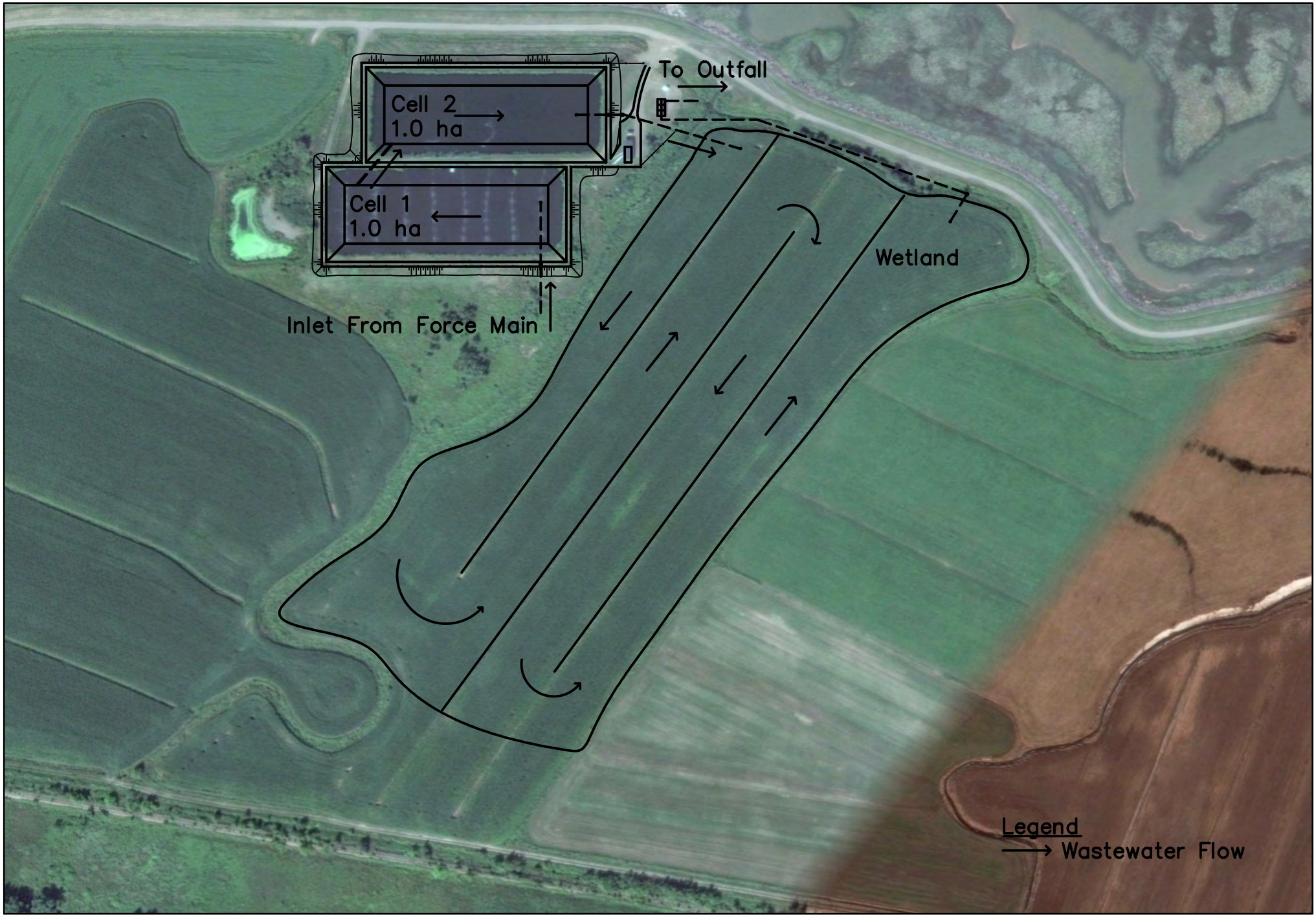


Figure C3: Option 3 – New polishing wetland downstream from the current lagoon system

1: 2000 0 10 20 30 40 50 100 120M

APPENDIX D

WATER Report

WATER & AQUIFER TECHNICAL ENVIRONMENTAL RESOURCES
TERRY W. HENNIGAR WATER CONSULTING
Hydrogeologist & Groundwater Specialist
395 Ridge Road, Wolfville, NS B4P 2R1
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Email: terryhennigar@gmail.com

December 15, 2016
File No. 160841.02

To: Mr. Colin Walker, P.Geo.
Hydrogeologist
CBCL Limited
1489 Hollis Street
Halifax
NS B3J 2R7

Re: Well Capacities, Town of Wolfville

Introduction

This letter/report is response to your request for estimates of existing well capacities for the Town of Wolfville. The following outlines aquifer and well characteristics as well as pump testing details as documented at the time of well construction. CBCL also carried out numerical modelling during 2006-2007 to delineate the capture zones within the wellfield. The model results identified capture zones used for development of the Source Water Protection Plan which became the guide to resource management and protection of water quality monitoring and contaminant risk assessment. Our role in this work was to provide professional engineering and hydrogeological services required to assist with determining the protection and management of a potable and sustainable water supply from the existing well field in the west portion of the town.

Hydrogeology

The hydrostratigraphic units underlying the Town of Wolfville range from: the Halifax Formation of the Meguma Group, the oldest rocks under the South portion of the town; the Horton Bluff Formation of Lower Carboniferous Age under the East portion of Town; the Wolfville Formation, lower Triassic age, under the north portion of the town; and Quaternary deposits ranging from silty-clay till to glacio-fluvial sand and gravel deposits underlying the entire town.

Exploratory drilling and pumping tests of bedrock wells within the town limits have shown that well yields are typically less than 450 liters per minute, and water quality unsuitable as a public drinking water source without considerable treatment. One bedrock well was constructed in the Horton Bluff Formation, tested, and brought on line in the east end of town. After several years of operation as a supply well it was abandoned because of quality issues related to high manganese and sodium chloride values.

Historical data of well yields from Quaternary aquifers in the Wolfville area indicate that pumping rates in excess of approximately 2,000 Lpm can be expected in the vicinity of the Town of Wolfville from properly constructed wells in the sand and gravel deposits.

The most recent Quaternary mapping, (Figure 1 from P.C. Trescott 1968), of the area indicates that these deposits extend under the central portion of the Town and westward beyond the Town limits into Greenwich. Recent interpretations of borehole data and the hydrogeology of the area indicate these deposits extend to depths of greater than 60m. Areas shown as glacial till are also underlain by glacial deposits of sand and gravel in places.

Of particular interest as an excellent source of water are the deeper stratified sand and gravel deposits underlying the Town. A glacial outwash channel underlies the Town, extending beyond the west and east extremities of the Town. This channel varies in depth to bedrock, as well as thickness of water bearing sand and gravel deposits. The center of the channel follows a direction approximately parallel to Highway No. 1 and Main Street, and deepens towards the east where it appears to extend under the Minas Basin. The Cherry Lane Well, and the Wickwire wells are constructed in these old glacial channel deposits. The main water bearing portions of the aquifer are located between 15 meters, and 30 meters below mean sea level. The new Wickwire well was pump tested at 3,000Lpm in 2007. The Cherry Lane well was pump tested at 1325 Lpm in 1970.

Figure 1. The Quaternary Geology of the Town of Wolfville.

Description of Capture Zones.

With our current understanding of the geological framework of the bedrock and Quaternary geology of the Town of Wolfville, and the hydrogeological characteristics of the various units, the well field capture zones were determined. Numerical computer models developed over the past fifty years were applied by CBCL Limited to map four different zones contributing water to the production wells. The closest portions of the capture zones are shown in Figure 2. The most sensitive zones, called buffer zones, are 200 feet (60m) in radius around Cherry Lane and Wickwire #2 wells. The next most distant zone is based on groundwater travel time, two years to five years, to one of the production wells. The third zone identifies areas where travel times are estimated to be from five to twenty five years to the wells. The fourth zone identifies the areas contributing water to the aquifer system with a travel time greater than 25 years to reach the wells.

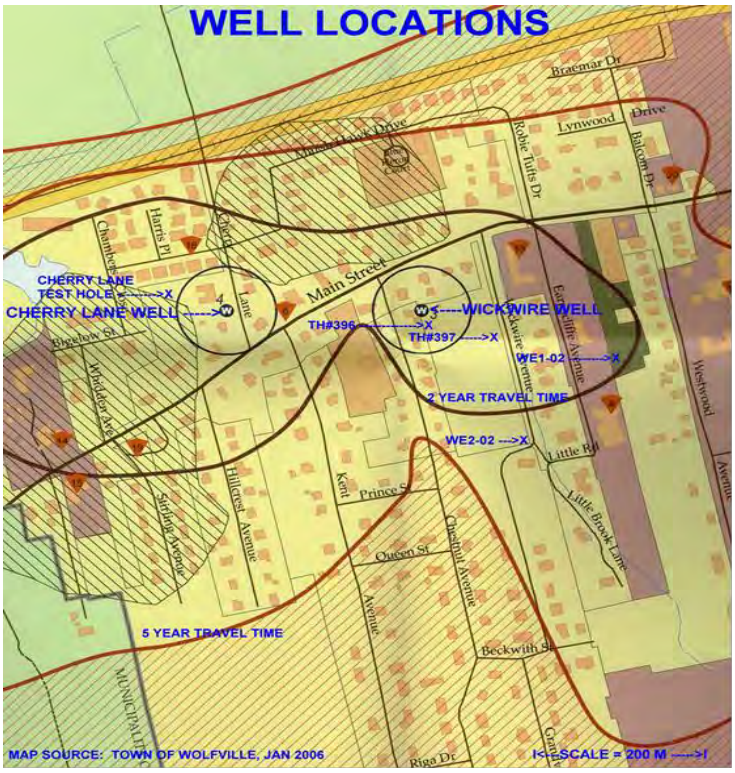


FIGURE 2. Well Field and Capture Zones

Also shown in Figure 2 are areas mapped as till deposits of thicknesses less than 5m. Two of these areas are near the Cherry Lane well. These surficial materials include mixtures of clay, silt, and sand which retard the movement of water from the surface towards the intake portion of the wells. The thicknesses of till deposits at the well sites vary from 20 to 25 m, offering more protection from surface sources of contamination. The thin areas of till deposits are shown cross-hatched in black southwest and northeast of the Cherry Lane well. Also shown located up-gradient of the Cherry Lane well, and in the area of thin till deposits are three sites of potential contamination from previous residences and or businesses.

Wells Currently in Production

Wickwire Well #1

Wickwire well No.1 is located at 14 Wickwire Avenue. The Map Grid Reference for the well is 21H1B, UTM 919936 (1:50,000 scale topographic map). Wickwire well No.1 was drilled and constructed in 1970, by H. F. Verge Drilling Ltd. The test hole was drilled to a depth of 37m below ground surface. Samples of the Quaternary materials collected during drilling of the test hole indicated that the most productive portions of the aquifer encountered were at depths between 18.3 and 35.7m below ground surface. The construction details and pumping test results of Wickwire #1 are shown in Figure 3. This well is not currently being used, and with Wickwire #2 now online #1 is being considered for decommissioning.

	WICKWIRE PRODUCTION WELL #1		
	LOCATION: E 391298 N 4993742		
	CONSTRUCTED: 1970/04/10		
	PUMPING TEST: 1970/06/12		
DEPTH (m)			**DESCRIPTION**
			SURFACE ELEVATION AT 10.3m ASL
0			PUMP HOUSE FLOOR
		WL	STATIC WL @ 4.3 m BGS, 4.0m ASL
5			254 mm DIAMETER CSING GROUTED TO 18.3 m BGS
			SEA LEVEL
10			SILT, SAND, & GRAVEL FROM SURFACE TO 18.3 m BGS
15			SAND & GRAVEL FROM 18.3 TO 31 m BGS
			SILT, SAND, GRAVEL FROM 31 TO 33 m BGS
20		--------	DATA LOGGER AT 23m BTOC
		XXXXXX	
25		XXXXXX	#40 & #80 SLOT ss SCREENS FROM 20 TO 30 m BGS
		XXXXXX	
30			SILT, SAND, GRAVEL FROM 31 TO 33 m BGS
		PUMP	SAND & GRAVEL FROM 33 TO 40 m BGS
35			VERY GOOD AQUIFER, BUT UNSTABLE & UNABLE TO
		BOTTOM	SET SCREENS IN THIS SECTION
40			SILT, SAND, & GRAVEL FROM 40 TO 43 m BGS
			SANDSTONE, BEDROCK FROM 43 TO 44 m BGS
45			GREY SLATE, BEDROCK FROM 44 TO 48 m BGS
			BOTTOM OF TEST HOLE AT 48 m BGS
	NOTES:	PUMPING TEST 1970/06/12 AT 1,643 M3/DAY	
		TRANSMISSIVITY: 89.8 M2/DAY;	
		SPECIFIC CAPACITY: 79.3 M2/DAY	
		Qs20 AT 777 Lpm; Q20 AT 1120 M3 L/DAY	

NOTES: 1. Freshwater head above sea level is approximately 5.7 meters.
2. Pump is set approximately 12 meters below sea level.
3. The screened intake area of the well is 10 meters below sea level.

Figure 3. Construction and test results of Wickwire #1.

Cherry Lane Well

The Cherry Lane well is located at 10 Cherry Lane. The Map Grid Reference for the well is 21H1B, UTM 916936 (1:50,000 scale topographic map). The Cherry Lane well was drilled and constructed in 1970, by H. F. Verge Drilling Ltd. The test hole was drilled to a depth of 50m below ground surface. Samples of the Quaternary materials collected by the driller during drilling of the test hole indicated that the most productive portions of the aquifer encountered were at depths between 12.2 and 30.5m feet below ground surface. The construction details and pumping test results of the Cherry Lane well are shown in Figure 4.

	TOWN OF WOLFVILLE	
	CHERRY LANE PRODUCTION WELL	
	LOCATION: E391655 N4993765	
	CONSTRUCTED: 1970/04/10	
	PUMPING TEST: 1970/08/24	
DEPTH (m)		**DESCRIPTION**
		SURFACE ELEVATION AT 13.4 m ASL
0		
		CLAY & SAND FROM SURFACE TO 6.1m BGS
5	WL	STATIC WATER LEVEL AT 6.9 m BTOC, 4.6m ASL
10		
		SEA LEVEL
15		CLEAN FINE/MEDIUM SAND FROM 6.9 TO 19.8m BGS
20		SILTY SANDY TILL FROM 19.8 TO 22.9 m BGS
		CLEAN FINE/MEDIUM SAND FROM 22.9 TO 24.4m BGS
25		SILTY SANDY TILL FROM 24.4 TO 29 m BGS
	PUMP	CLEAN SAND & GRAVEL FROM 29 TO 32m BGS
30	XXXXXX	#40 SLOT SS SCREEN SET 30 TO 31m BGS
		COARSE SAND WITH SILT FROM 32 TO 34m BGS
35		
		CLEAN FINE TO MEDIUM GRAVEL FROM 34 TO 40 m BGS
40		CLAY, SAND, GRAVEL TILL FROM 40 TO 42.7m BGS
45	XXXXXX	SAND & GRAVEL FROM 42.7 TO 50m BGS
	XXXXXX	#80 SLOT SS SCREENS SET 43 TO 48m BGS
50		BOTTOM OF TEST HOLE AT 50m BGS
		DEPTH TO BEDROCK >50m BGS
	NOTES:	PUMPING TEST 1970/08/24 AT 1911 M3/DAY
		TRANSMISSIVITY: 2874 M2/DAY;
		SPECIFIC CAPACITY: 1409 M2/DAY
		Qs20 AT 1327 Lpm; Q20 AT 1911 M3 L/DAY

NOTES: 1. Freshwater head above sea level is approximately 7.5 meters.
2. Pump is set approximately 15 meters below sea level.
3. The screened intake area of the well is 30 meters below sea level.

Figure 4. Construction and test results of Cherry Lane Well.

Wickwire Well #2

The Wickwire well No.2 is located at 14 Wickwire Avenue 30m east of Well #1. The Map Grid Reference for the well is 21H1B, UTM 919936 (1:50,000 scale topographic map). Wickwire well No.2 was drilled and constructed in 2006, by Valley Well Drilling Ltd. The test hole was drilled to a depth of 45m below ground surface. Samples of the Quaternary materials collected during drilling of the test hole indicated that the most productive portions of the aquifer encountered were at depths between 32 and 43m below ground surface. The construction details and pumping test results of Wickwire #2 are shown in Figure 5.

	TOWN OF WOLFVILLE		
	WICKWIRE PRODUCTION WELL # 2		
	LOCATION: E0391927 N4993772		
	CONSTRUCTED: 2007/03/10		
	PUMPING TEST: 2007/03/27		
DEPTH (m)		**DESCRIPTION**	
		SURFACE ELEVATION AT 9.98m ASL	
0		PITLESS ADAPTER TO 2.1m BGS	
	WL	STATIC WL @ 5.7m BTOC, 4.8m ASL	
5		406 mm DIAMETER CASING GROUTED TO 6.1m BGS	
10			
		SEA LEVEL	
15			
	DL	DATA LOGGER AT 19.8m BTOC	
20		SILT & SANDY TILL TO DEPTH 23.8 m BGS	
		SAND & GRAVEL FROM 23.8 TO 29m BGS	
25		SILTY CLAY TILL 29 TO 30 m BGS	
		305 mm DIAMETER CASING GROUTED TO 33.5 m BGS	
30		SAND & GRAVEL FROM 30 TO 33 m BGS	
	PUMP	GRAVEL FROM 33 TO 39 m BGS	
35	XXXXXX	#80 SLOT SS SCREENS FROM 34 TO 38m BGS	
	XXXXXX	SCREEN TRANSMITTING CAPACITY AT 3723 Lpm	
40		CLAY TILL FROM 39 TO 42 m BGS	
		GREY SLATE FROM 42 TO 44 m BGS	
45		BOTTOM OF TEST HOLE AT 44 m BGS	
	NOTES:	PUMPING TEST 2007/03/27 AT 4900 M3/DAY	
		TRANSMISSIVITY: 3549 M2/DAY;	
		SPECIFIC CAPACITY: 322 M2/DAY	
		Qs20 AT 3405 Lpm; Q20 AT 4900 M3 L/DAY	

NOTES: 1. Freshwater head above sea level is approximately 10 meters.
2. Pump is set approximately 20 meters below sea level.
3. The screened intake area of the well is 20 meters below sea level.

Figure 5. Construction and test results of Wickwire #2.

Well yields shown in Table 1 are based on original pumping test rates and interpretation of the drawdown data over the course of tests which are typically 72 hours of continuous and constant rate pumping. However under continuous daily pumping conditions the long term sustainability of the well field is not understood. Changes in precipitation, rising sea level, and reduced opportunities for aquifer recharge from development in the west portion of town will most likely, with increasing water withdrawals, lead to sea water intrusion into the well field.

Table 1. Summary of Well Characteristics.

Well No.	Total Depth (m)	Depth to Bedrock(m)	Length of Casing(m)	Diameter Inches (mm)	Water Level (m)[1]	Safe Yield (m^3/d) [2]
Wickwire W1	37.8	42.7	18.3	254	4.3	1,120
Cherry Lane	33.5	>50	12.2	305	7.0	1,911
Wickwire W2	37.8	42.9	33.5	305	4.3	4,900

NOTES: 1, Water level (below top of casing) at time of well construction.
2. Estimated safe yield from pumping test data at time of well construction.

Historical Water Use

Water use records collected during the five year period from 2011 to 2015 were reviewed to gain an understanding of current water usage in the Town. The data collected and reviewed are summarized in Table 2. As seen in Table 1, the safe yield of

Table 2. Maximum monthly water treatment rates for the Town of Wolfville.

Month & Year	Water Pumped (m^3)	Mean (m^3/day)	Mean (Lpm)
March, 2011	94,979	3,064	2,128
October, 2012	**95,654**	3,086	2,143
September, 2013	93,908	**3,130** [1]	**2,174** [2]
October, 2014	88,125	2,843	1,974
November, 2015	89,893	2,996	2,080

NOTES: 1. Mean daily based on total divided by number of days in the month.
2. A rate of 2,174 Lpm amounts to approximately 64% of estimated Wickwire #2 capacity.

the well field based on pumping test data and construction limitations is greater than 5,000m^3 per day. Water use data collected for the period 2011 to 2015 shows the maximum daily usage at 3,130m^3/d, and averaging 3,024m^3/d.

Using the maximum monthly flow values during the period 2011 to 2015, shown in Table 2, and the mean maximum daily flows, leads to a calculation of mean daily flows of 2,174 Lpm on a continuous basis. It is significant to note that Wickwire well #2 has an estimated safe 20 year yield of 4,900 Lpm based on the 72 hour continuous constant rate pumping test date, interpretation and calculations carried out on the well.

It is also interesting to note that the Cherry Lane well, although pump tested a much lower rate, has proven over the past 40 years, and before Wickwire well #2 was completed and brought on line, to sustain yields also greater than 4,900 Lpm.

The total water withdrawals from the well field during the 5 year period 2011 to 2015 were recorded as 4,854,663 m^3. Of this total, 420,611 m^3 was from the Cherry Lane well, and 4,434,052 m^3 was from Wickwire well #2 averaging 886,810m^3 per year. Wickwire well #2 is favoured as the supply well because of water quality that is easier and more economic to adjust pH values required for chlorination.

Based on the tested yield of Wickwire #2 at 1,412,121 m^3 per year, its present use is approximately 65% of its capacity on a full time basis. Table 4 summarizes the individual well yields on a daily, monthly, and annual basis.

Table 4. Maximum Groundwater Withdrawals Based on Pumping Tests Data.

Active Wells	Pumping Rate (litres/day)		Withdrawal Vol. (litres)	
	Maximum [1] (Over 3 days)	Average [2] (Over 30 days)	30 Day	Annual [5]
Cherry Lane	1,908,979	1,908,979	57,269,370[3]	687,232,440
Wickwire #1	2,275,085	2,275,085	68,252,550[4]	819,030,600
Wickwire #2	3,922,560	3,922,560	117,676,800	1,412,121,600
Net Withdraw From Aquifer	3,922,560	3,922,560	117,676,800	1,412,121,600

Notes: 1. Maximum pumping rate based on 72 hour test pumping rate.
2. Average pumping rate is based on maximum monthly system demands.
3. 30 day well withdrawal volume based on pumping 100% of the time.
4. Annual well withdrawal volume based on groundwater use 100% of the time.

During the period 2011 to 2015 the maximum monthly withdrawal from the well field was recorded as raw water flow at the treatment plant, was 110,589,000 L in Jan. 2014. Minimum monthly withdrawal was 89,893,000 L in Nov. 2015. The maximum monthly withdrawal recorded during the five year period is less than the maximum rate of Wickwire Well#2 operating on a continuous basis.

Historically the Cherry Lane well has produced more than the recommended pumping rate based on the pumping test data without indications of over stressing the well and/or aquifer. It should also be noted that the Wickwire Well #1 has not been able to supply the rates or volumes indicated by the pumping test data as indicated in Table 3.

Sea Water Intrusion

Sea water intrusion from utilization of the Cherry Lane well on a continuous basis at its potential capacity is a concern and may become a problem in the future. A positive pumping head above mean sea in the well should be maintained and monitored. The distance inland from the tidal influenced part of the Cornwallis River approximately 900

m (3,000 Ft), and the low elevation at the well head creates a potential for sea water intrusion into the aquifer at this site. Historic values of chlorides in the Cherry Lane well over the period 1970 to 2004 show a steady increase from 12 to 66 mg/L. A similar increase is observed in chloride and hardness values in the Wickwire well over the same period. These increasing trends of hardness and chlorides in the raw water from the wellfield are most likely from highway de-icing salt and/or sea water intrusion.

Summary of Results

The following summary is based on the information reviewed as collected and prepared over the period of history of the well field as a water supply for the town:

1. Wickwire well #1 has proven over the later years to be unable to produce sufficient water for the town without augmentation from the Cherry Lane well. This well is now considered redundant and a candidate for decommissioning.

2. The Cherry Lane well over the past 45 years has proven capable of producing sufficient, and good quality, water on its own to adequately supply the town of Wolfville with a public drinking water source.

3. Wickwire #2 has proven over the past 10 years to be capable of producing sufficient water on its own to adequately supply the town of Wolfville with a good quality water source.

4. There has been no further investigation of the cause for increasing chloride and hardness levels in the Cherry Lane well the Wickwire #2 well.

5. The water levels in the Cherry Lane and Wickwire #2 wells do not appear to be realistic based on reported depth of data loggers and recorded water levels.

6. Water levels, data logger depths, and the datum reference points of the wells are not referenced to mean sea level.

Recommendations

1. Water levels, data logger depths, and the datum reference points of the wells should be related to mean sea level for the purpose of assessing well field performance and the potential for sea water intrusion.

2. Review historic chloride values in well water and attempt to identify patterns and/or trends.

3. Calibrate the SCADA system to record water levels in meters at 1 hour readings in both Cherry Lane and Wickwire #2 wells.

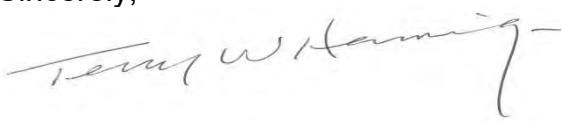
4. Water levels in the Cherry Lane and Wickwire #2 wells should be maintained under pumping conditions as closely as possible to a level at or above sea level to minimize the risk of sea water intrusion into the aquifer.

Closure

This report has been prepared for the sole benefit of CBCL Limited and the Town of Wolfville, for this project. Any use which another party makes of this report and the data therein, or any reliance on decisions made based on it, is the responsibility of such other parties. ***Terry W. Hennigar WATER Consulting*** *accepts no responsibility for damages, if any, suffered by any other party as a result of decisions made or actions based on this report. The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal advice.*

We trust this is sufficient for your purposes at this time. If you have any questions, please feel free to contact us. We are prepared to meet and discuss the findings of this report with you and other team members at your convenience.

Sincerely,



Terry W. Hennigar, P.Eng., FCSCE, FEC
Senior Engineer & Groundwater Specialist

CBCL
Solutions today | Tomorrow IN mind
Maritime Centre, 1505 Barrington Street, Suite 901
Box 606, Halifax, NS B3J 2R7
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March 28, 2022

Alexander J. de Sousa, P.Eng
Manager of Engineering
Town of Wolfville
359 Main Street
Wolfville, NS B4P 1A1

Dear Mr. de Sousa,

RE: Town of Wolfville Water System Growth Assessment (DRAFT)

This draft letter provides our initial review of the capacity of the existing water system at a high level. We have assessed both current and future demands (due to growth) to evaluate constraints of conveyance capacity to service these proposed growth areas.

CBCL Limited (CBCL) were engaged by the Town of Wolfville perform a growth assessment in two stages. This letter outlines our analysis of stage one which includes the following:

- Establish current water demands and calculate water demands for proposed growth areas.
- Perform a storage analysis that considers domestic, fire protection, and emergency requirements.
- Perform a high-level assessment of the exiting water infrastructure to support the projected growth. Identify constraints that may limit the systems ability to adequately service the growth.

The scope of work for the second stage of the analysis will include:

- Modelling of the distribution system to assess serviceability of growth scenarios.
- Development of options to address deficiencies should these be identified.
- Preparation letter report and Class D opinion of probable cost.

The second stage will be undertaken following completion of the water model updates and calibration.

Description of Existing System

The water distribution system supplies potable water to the Town of Wolfville with a population of over 5,000 as of 2021. The system has more than 50km of piping ranging in size from 150mm to 300mm diameter and servicing an area of more than 400 ha.

Raw water is supplied from two raw water wells in the northwest area of the Town. The flow from the wells is conveyed through a transmission main to the WTP south of Highway 101 where it is treated before discharging into the existing buried concrete reservoir. Treated water flows by gravity from the reservoir through two 300mm diameter mains through the WTP and into the distribution system through two 400mm diameter transmission mains. The transmission mains terminate north of Highway 101 on Pleasant Street and connect to smaller diameter piping. The system is separated into two zones, high and low, which service lands from elevations as high as 87m to a low of 6m. A total of seven (7) PRVs convey water to the low zone from the high zone.

System Demands

The Town provided SCADA records for both the reservoir inflow and outflow meters in 30 second intervals from 2010 to April of 2021. The Town said to exclude 2021 from the analysis due to issues with the SCADA data. From discussions with the Town, it was agreed that the inflow meter would be more accurate in developing the Average Day Demand (ADD) and Maximum Day Demands (MDD) than the outflow meter. An analysis of the system demands from the SCADA inflow for the years 2016 to 2020 is shown in Table 1. The ADD from 2016 to 2020 showed only a slight decreasing trend and the average of the five years was selected as the design value. The largest calculated Maximum Day Factor (MDF) is 1.55 occurring in 2020 and this MDF was applied to the design ADD to establish the design MDD.

Table 1: Summary of Historical Demands (SCADA Inflow)

Year	ADD (m^3/day)	MDD (m^3/day)	MDF
2016	2,445	3,394	1.39
2017	2,452	3,311	1.35
2018	2,421	3,305	1.37
2019	2,364	3,300	1.40
2020	2,130	3,301	1.55
Design Values	**2,362**	**3,662**	**1.55**

We were also provided with the annual reports which recorded the average annual flow rate (equivalent to ADD) and the maximum daily volume rate (equivalent to MDD) based on the inflow meter totalizer. The ADD from the annual reports closely matched the ADD as calculated from the SCADA data. However, the maximum monthly values recorded in the annual report for 2017 and 2020 were greater than those calculated from the SCADA and more closely aligned with the calculated Peak Hour Demand (PHD). Therefore, we are relying on values calculated from the SCADA data as the basis for existing ADD and MDD.

To assess peak hour demands, an analysis of the 2020 reservoir outflow meter data was completed to establish the peak hour demand. Based on this analysis, the PHD was determined to be 4,262 m^3/d and SCADA values fell below this flow rate 99.4% of the time. Note that the outflow data was filtered to remove high flows not consistent with daily demand variation which generally occurred on Jul 30 and August 4-6. These high flows are assumed to be generated from leaks or hydrant usage (e.g., flushing), however, the Town should confirm this to be a valid assumption. The 2020 data did not capture the additional flow rate due to a splash pad installed in 2021. Based on discussions with the supplier/installer, the estimated peak demand for the splash pad is 393 m^3/d (72 USgpm) which is added to the 2020 PHD for design value of 4,654 m^3/d.

1.1.1 Potential Growth

The Town provided the Land Use Zoning Map, Schedule A, from the Land Use Bylaw and is included in Appendix A. A total of four (4) growth areas and their respective unit counts were identified as follows:

- Area A: West End with 500 Units of Single Family and Multi-unit Residential.
- Areas B1 and B2: East End with 1000 – 1600 Units for of Multi-unit Residential, and possible commercial and long-term care.
- Area C: 150 Units of Multi-unit residential.
- Area D: 60 Units Multi-unit residential accommodation.

The existing persons per unit for the Town of Wolfville is 2.07 based on the population of 5,057 taken from the Statistics Canada 2021 census. For this report, we will use the person per unit count as established by Halifax Water as it is more conservative than the historical person per unit density. The values used in this report are as follows:

- Single Unit Dwellings: 3.35 people/unit.
- Multi Unit Dwellings: 2.25 people / unit.

The possible commercial developments for Areas B1 and B2 are not known at this time so we are unable to assign a population equivalent.

The County of Kings 1997 Municipal Design Standards states the per capacity consumption as follows:

- Average Consumption = 364 L/cap/day.
- Max Day Consumption = 910 L/cap/day.
- Peak Hour Consumption =1,365 L/cap/day.

Demands for each growth area are summarized in Table 2. Refer to Appendix B for calculations.

Table 2: Water Demands for Growth Areas

Growth Area	Population	ADD (m^3/d)	MDD (m^3/d)	PHD (m^3/d)
A	1,437	523	1,307	1,961
B1, (800 Units)	1,800	655	1,636	2,455
B2, (800 Units)	1,800	655	1,636	2,455
C	338	123	307	460
D	135	49	123	184
Totals	**5,510**	**2,006**	**5,008**	**7,516**

The existing and demands for growth are summarized in Table 3.

Table 3: Summary of Water Demands for Existing and Growth Areas

Storage Allocation	Existing	Growth	Total
ADD (m^3/d)	2,362	2,006	**4,368**
MDD (m^3/d)	3,662	5,008	**8,670**
PHD (m^3/d)	4,654	7,516	**12,170**

1.1.2 Fire Flow Requirements

The County of Kings Municipal Specifications state that fire flow demand shall be established in accordance with the latest requirements of the Water Supply for Public Fire Protection as prepared by the Fire Underwriters Survey (FUS). FUS provides a short method to be used for groupings of detached one family and small two-family dwellings not exceeding 2 stories in height. For exposure distances between 3 and 10 m, the suggested required fire flow is 66.7 L/s (1,056 USgpm). For other buildings, the following formula is suggested:

$$F = 220 \cdot C \cdot \sqrt{A}$$

Where:
F = required fire flow in litres per minute (L/min)
C = coefficient related to the type of construction
=1.5 for wood frame construction
=1.0 for brick or masonry walls, combustible floor and interior
=0.8 for non-combustible construction
=0.6 for fire-resistive construction
A = the total floor area in square metres (including all stories but excluding basements at least 50% below grade) in the building being considered.

This calculation considers factors such as if the building is sprinklered, exposures to other buildings and building contents. For example, the required fire flow for a three (3) storey sprinklered residential building of combustible construction and non-combustible cladding with a

building area of 1,800 m^2 varies from 133 L/s (2,113 USgpm) to 233 L/s (3,698 USgpm) depending on exposures. Refer to appendix C for these calculations. A reduction of this flow rate may be considered should the vertical openings be protected, and fire rated. To compare these calculations to other jurisdictions, Halifax Water has established a minimum required fire flow of 227 L/s (3,600 USgpm) for multi-unit residential buildings.

The exact details of the proposed buildings are unknown. Therefore, for this study, we will apply the Halifax Water Multi-Unit required fire flow of 227 L/s (3,600 USgpm) for multi-unit residential and 67 L/s for single family dwellings as outlined in FUS. However, the Town should confirm the required fire flow for proposed buildings / developments on a case-by-case basis.

Water Storage Assessment

The existing water storage is a 7.8 million litre (1.7 imperial million gallons) buried cast in place concrete storage tank. The reservoir is located south of Highway 101 and accessed off Ridge Road. The reservoir has two cells and each cell dimensions of 51.1m long X 25.2 m wide and an effective height of 3.05m (167.7 ft L x 82.7 ft W x 10 ft H). Drawings provided by the Town show that the tank has a floor elevation of 108.2 m CGVD 2013 (357 ft CGVD 1928) resulting in a Top Water Level (TWL) of 111.6m.

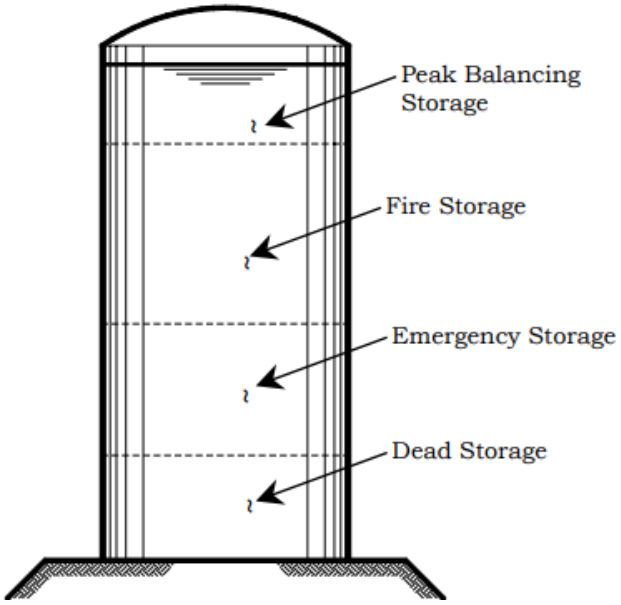

Figure 1: Water Storage Allocation within a Tank (courtesy of *Atlantic Canada Water Supply Guidelines, 2004*)

Water storage within the tank is intended to provide water for domestic uses (peak balancing), fire protection and emergency. The three types of storage volumes are allocated in the tank with emergency storage at the bottom, fire protection volume on top of emergency with peak balancing at above fire protection. The fourth type of storage is referred to as "dead" and it's the volume of water that is hydraulically inaccessible. Refer to Figure 1. The *Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems, 2004* (herein referred to as the Atlantic Canada Water Supply Guidelines) provides guidance on reservoir sizing criteria and is based on the following formula:

S = A + B + C

Where:
S = Total Storage Requirement, m^3
A = Fire Storage, m^3 (equal to required fire flow over required duration)
B = Peak Balancing Storage, m^3 (25% of MDD)
C = Emergency Storage, m^3 (A minimum of 25% of A + B is recommended)

The above equation is based on a water supply to the storage facility equal to MDD.

Storage allocation and volumes for the existing water storage tank are shown in Table 4. The Peak Balancing storage volume is calculated from the total calculated demand Table 3 of 8,670 m^3/d. The fire flow rate of 227 L/s was used to calculate the fire volume. The duration if 2.91 hrs was used in accordance with the FUS document.

Table 4: Summary of Storge Volume Allocation based on Rated Water Supply

Storage Allocation	Volume
Fire Storage Available, A (m^3)	2,374
Peak Balancing Storage, B (m^3)	2,168
Emergency, C (m^3)	1,135
TOTAL REQUIRED STORAGE, S (m^3)	5,677

The total required storage of 5,677 m^3 is less than that available (7,800 m^3) so there is adequate storage for the system to service the projected growth.

According to the 2004 system assessment report, the storage tank is used for chlorine contact time. The report states that adequate CT is achieved with 100 mm (4") of water in the tank. This is a relatively small volume and is less then the emergency volume and does not impact the storage assessment. However, an updated CT calculation may be warranted.

Distribution System Assessment

The following section is intended to provide a high-level assessment of the serviceability of the proposed growth areas. A modelling analysis is required to verify the systems capacity to service the required flows at the design pressures. The modelling analysis will be performed following calibration which is expected to occur the spring of 2022. Refer the Appendix D showing a map of the distribution system along with growth areas and constraints.

The distribution assessment is based on the following design parameters from the Municipality of the County of Kings 1997 Municipal Specifications and the Atlantic Canada Water Supply Guidelines:

- Allowable Service Pressures:

- Maximum: 95 psi.
- Minimum non-fire flow: 40 psi.
- Minimum during a Fire Flow scenario (MDD + FF): a minimum of 20 psi at any point in the system and a minimum of 22 psi at the fire flow node.

- Maximum Allowable Velocities:
  - 1.5 m/s under PHD.
  - 2.4 m/s during MDD+FF (a value of 3.0 m/s is allowed in the Atlantic Canada Water Supply Guidelines).

1.1.3 Existing System

The existing Wolfville distribution system is divided into two zones: Low and High. A total of seven (7) Pressure Reducing Valve (PRV) chambers separate the low and high zones and are located at elevations varying from 28 – 40m. Zone Hydraulic Grade Lines (HGLs) and service pressures are summarized in Table 5.

Table 5: Pressure Zone HGL and Service Elevations and pressures.

Pressure Zone	HGL (m)	Service Elevations (m)		Service Pressures (psi)	
		High	Low	Low	High
High	111.6	87	30[1]	35	116[1]
Low	63.0[2]	45	6	26	81

[1] The high zone appears to service elevations as low as 24m within the Acadia Campus resulting in pressures of 125 psi. However, this is not typical of the zone.

[2] The HGL setpoint is an estimate based on SCADA pressure values and is to be confirmed during the field program.

The service pressures within the high zone current fall outside the recommended range of 40 – 95 psi. Lower pressures are experienced by a small number of residential dwellings south of Pleasant Street on Evangeline Court and Riverview Avenue. Higher pressures exist in the lower areas of the zone in the areas immediate upstream of the PRVs. Based on the information we have available, high pressures are also present within a large portion of the Acadia Campus. Within the low zone, there is an area around Carriageway Court on the eastern end of the system where high elevations result is pressures less than 40 psi. As well, there are a small number of residential dwellings in the west at south end of Stirling and Hillcrest Avenue with pressures falling below 40psi. Outside of these areas, pressures within the low zone fall within 40 to 95 psi.

1.1.4 Growth Area A

Growth Area A is in the west end and incorporates the areas along Sterling and Hilcrest Avenue and the area south of Skyway Drive extension. The development has a gross area of 20.2 Ha consisting of single-family dwellings generally located north of Skyway Drive and multi-unit

dwellings proposed south of Skyway Drive. The development has been approved and is currently under construction.

An unnamed cross street, with an elevation of approximatley40 m, connects Sterling and Hillcrest Avenues and separates the two pressure zones. The pressures in the low zone are as low as 28 psi, depending on what zone is servicing the homes on the unnamed cross street. Piping within the low zone consists of 200mm diameter PVC and are extensions of the existing water mains on Sterling and Hillcrest Avenues.

The service elevations for the high zone vary from a high of 82m to a low of approximately 40m resulting in typical pressures of 43 to 102 psi. The high pressures exceed the design parameters but are consistent with the rest of the system. The drawings show that the high zone is serviced from a 150m long 250mm diameter extension of the 200mm diameter watermain west on Skyway Drive from the intersection of Kent Avenue. The piping in the development reduces to 200mm diameter and extends down Skyway and Hillcrest Avenue with a future watermain on an unnamed road, all looping at the unnamed street. A 250mm diameter lead is provided to service the proposed multi-unit buildings south of Skyway Drive.

The maximum total flow to the development high zone will be limited to the 250mm diameter pipe which is 118 L/s with a velocity constraint of 2.4 m/s. Accounting for the MDD flow through this pipe, the available capacity for fire flow is 105 L/s (1670 USgpm) based on this velocity restriction. The available fire flow rate is greater than that required for single family homes (67 L/s) but less than that established for multi-unit developments (227 L/s). The distribution system's capacity to covey fire flows to the growth area based on residual pressure constraints may be less than the maximum flows noted above which will be assessed during the modelling analysis. The existing 200mm piping on Skyway Drive and Kent Avenue may also be a constraint which will be considered during the modelling analysis. The Town should engage the developer to confirm if a required fire flow has been established for the multi-unit developments and if that aligns with the capacity available in the 250mm diameter piping.

The area within the high zone appears serviced off a single 250mm diameter watermain on Skyway Drive. The Town may want to consider a second watermain connection to the area given the proposed service population (1,437). A second watermain would provide additional capacity to support higher fire flow rates.

1.1.5 Growth Areas B1 & B2

Growth Areas B1 and B2a re located in the east end and fall within the East End Secondary Planning Strategy. Area B1 is referred to as the Kenny Lands with a gross area of 14.1 Ha while B2, referred to as the Maple Ridge lands, has a gross area of 17.8 Ha. Both areas will be primarily serviced from the Maple Avenue watermains due to location within the system. An existing

250mm diameter distribution main and the former 200mm diameter transmission main are located within Maple Avenue. The former transmission main was installed to supply raw water to the reservoir/WTP from an abandoned east end well along Maple Avenue and Ridge Road, but it is not used for this purpose. The East End transmission main is currently used as a distribution main, though, interconnections with the distribution system are not well understood. Based on discussions with the Town the section along Ridge Road, south of Highway 101, has been isolated from the system.

Elevations for Area B1, the Kenny Lands, vary from a high of 68m at the south end, adjacent to Reservoir Park, to a low of 24m at the north end near Main Street. Due to the elevations, we would expect that lands below the 30m contour would be serviced from the low zone and the remaining lands serviced by the high zone. Pressures in the low zone would be no less than 45 psi while pressures in the high zone would exceed 116 psi, though this is consistent to pressures in the existing distribution system. Note that buildings serviced with pressures greater than 90 psi will likely require individual PRVs.

The Maple Ridge Lands, Area B2, have elevations varying from 58m at the south end to a low of 28m at the north end. At this time, it appears that the lands falling below 35m would be serviced by the low zone and would have pressures around 40psi. We anticipate that the 200mm diameter watermain on Olsen Drive will extend into the development and connect to Main Street to create a looped service. The remaining lands would be serviced off the high zone with connections to Maple Avenue with pressures of up to 110 psi. As noted above, buildings serviced with pressures greater than 90 psi will likely require individual PRVs.

The high zone of the east end is primarily supplied water through the existing 250mm diameter watermain on Pleasant Street. This watermain is connected to the 400mm diameter transmission main from the reservoir on Highland Drive. Between Highland Drive and Sherwood Drive, some looping exists, but it is generally of small diameter piping (150mm and 200mm). The ability of the system to convey multi-unit fire flows to the east end may be hydraulically constrained. In addition, Areas B1 and B2 serviced will be primarily supplied off a single watermain, through Reservoir Park. A second watermain connection would be recommended. Connections to the 150mm diameter watermain on Bishops Avenue through Town Road reservoir (PID 55501381 & 55379762) may be an option. Hydraulic modelling will be necessary to available fire flows and if distribution system upgrades are required.

The low zone has two watermain connections, Maple Avenue and Main Street, and is better connected hydraulically to the rest of the system, relative to the high zone. The modelling analysis will be required to determine available flows to areas serviced by the Low Zone.

1.1.6 Growth Area C

Growth Area C is located on Woodman Rd falls within the low zone and with an elevation of 25 m has normal pressures of ~54 psi. Woodman Drive is serviced by 200 and 150mm diameter watermains off Main St and the area is supplied by a 250mm watermains on Main Street and Olsen Drive. The theoretical maximum flow to the area may be constrained velocity to approximately 118 L/s (1,867 USgpm) assuming 2.4 m/s velocity in both the 200 and 150 watermains. However, modelling will be necessary to assess available flow in that part of the system and this will vary from the theoretical maximum noted above.

The maximum available flow to the area based on the velocity constraint is less than the required fire flow for multi-unit developments. Given that there several similar style multi-unit buildings that exist on Woodman Drive, the Town should consider assessing the required fire flow for these buildings and if it aligns with that established in this report.

1.1.7 Growth Area D

Growth Area D is located on Main Streat near Harbourside Drive and falls within the low zone. This location is central and hydraulically well connected within the network of piping in the immediate area. The elevation is 10 m resulting in pressures of around 75 psi. A modelling analysis will be required to determine the available flow rate for the area, however there are no apparent constraints that may restrict flow that can be assessed at this time.

Closing and Next Steps

The Town of Wolfville is experiencing significant growth pressures with total projected population growth of 5,510, doubling the current population. This growth will significantly increase the water demands in the system. This report assessed at a high level, the capacity of the water system components to support and identified constraints that will may prevent the adequate servicing of the growth areas. The existing water storage facility is a buried concrete reservoir with a capacity of 7.8 million litres and is more than adequate to support the projected growth.

Most of the dwellings are proposed to be multi-unit buildings which drives a higher fire flow requirement. Required fire flows for these multi-unit buildings will be significantly influenced by the type of construction (combustible / non-combustible) and exposures to other buildings. For this report, we established a required fire flow to perform the high-level assessment. However, the Town should consider further evaluation of this required fire flow to verify that this is consistent with the requirements of the proposed buildings. The ability of the water system to adequately service the established fire flow in the west and east end growth areas (A, B1, B2 and C) appears constrained by existing piping.

Growth Areas A, B1 and B2 appear to be serviced by a single watermain connection and a second watermain connection should be considered due to the expected service populations. Growth Areas C and D fall within the low zone and have at least two watermain connections.

This study did not include a model analysis of the water distribution system which will be completed in the next stage, following model calibration. Therefore, we are unable to quantify impacts to the distribution system due to the added growth at this time.

Yours very truly,

CBCL Limited

DRAFT

Jeffrey Clair, P.Eng.
Senior Municipal Engineer
Direct: 902-421-7241, Ext. 2427
E-Mail: jclair@cbcl.ca

Attachments:

- A Land Use Bylaw Zoning Map
- B Population and Demand Calculations
- C FUS Required Fire Flow Calculations
- D Water System Map showing Growth Areas and Constraints

CC: Aaron Baillie, CBCL

Project No: 211006.00

APPENDIX A

Land-Use Bylaw Zoning Map

PLANNING SERVICES

LAND USE ZONING MAP

SCHEDULE A

Zoning

- Agriculture (A)
- Low Density Residential - Restricted (R-1)
- Low Density Residential - General (R-2)
- Medium Density Residential (R-3)
- High Density Residential (R-4)
- Comprehensive Development District (CDD)
- Core Commercial (C-1)
- Neighbourhood Commercial (C-2)
- Core Commercial - Large Format (C-3)
- Institutional General (I-1)
- Institutional University (I-2)
- Parks and Open Space (P-1)
- University Open Space (P-2)
- Active Transportation Corridor (AT)

Overlay

- AT Development Consideration
- Core Area
- Dyke

60 UNITS LONG AND SHORT TERM RESIDENTIAL ACCOMODATIONS

150 UNITS MULTI FAMILY RESIDENTIAL (COMING NEAR FUTURE)

500 UNITS RESIDENTIAL (SINGLE & MULTI-FAMILY)

500-800 UNITS MOSTLY MULTI FAMILY RESIDENTIAL, MAY HAVE SMALL COMMERCIAL AND LTC USES AS WELL

500-800 UNITS MOSTLY MULTI FAMILY RESIDENTIAL, MAY HAVE SMALL COMMERCIAL AND LTC USES AS WELL

Cornwallis River

Wolfville Harbour

HIGHWAY 1

HIGHWAY 101

MAPLE RIDGE RD

MUNICIPALITY OF THE COUNTY OF KINGS

100 50 0 100 Metres

500 250 0 500 Feet

1:5,000

APPENDIX B

Population and Demand Calculations

Water System Demands

Client	Town of Wolfville
Project	Wolfville Growth Assessment
Project No.	211040.00/01
By:	J.Clair
Date	March 9, 2022

Persons per unit (Halifax Water)

Single Family Dwelling	3.35 ppu
Mult-Unit Dwelling	2.25 ppu

Per capital Design Demands, 1997 Municipal Standards, County of Kings

Average Day Demand	364 L/cap/d
Maximum Day Demand	909 L/cap/d
Peak Hour Demand	1364 L/cap/d

Growth Area	Units			Population	Demands (m^3/d)		
	Single	Multi	Total		ADD	MDD	PHD
A	284	216	500	1437.4	523	1307	1961
B1		800	800	1800	655	1636	2455
B2		800	800	1800	655	1636	2455
C		150	150	337.5	123	307	460
D		60	60	135	49	123	184
Total			**2310**	**5509.9**	**2006**	**5008**	**7516**

APPENDIX C

FUS Required Fire Flow Calculations

FUS Required Fire Flow

Client	Town of Wolfville
Project	Wolfville Growth Assessment
Project No.	211040.00/01
By:	J.Clair
Date	March 9, 2022

Calculation performed in accordance with the Water Supply for Public Fire Protection, 1999

Multi-Unit Building (example) - Sprinklered, No Exposures

	A - Construction	Ordinary Construction	1	
	B - Building Area		1,800	m^2
	C - Stories		3	
	Total Effecitve Building Area		5,400	m^2
1	**D - Required Fire Flow** (rounded to nearest 1000 L/min)		**16,000**	**L/min**
2	Occupacy Fire Hazard	Limited Combustible	**-15%**	
	E (do not round)		**13,600**	**L/min**
3	**Sprinkler Credit**			
	NFPA 13 Compliant	Yes	**-30%**	
	Standard Water Supply	No	**0%**	
	Fully Supervised	Yes	**-10%**	
	Total Sprinkler Credit (max 50%)		**-40%**	
	F		**-5,440**	**L/min**
4	**Exposures Charge**			
	Building Side	Separation		
	Side 1	>45m	**0%**	
	Side 2	>45m	**0%**	
	Side 3	>45m	**0%**	
	Side 4	>45m	**0%**	
	Total Exposures Charge (max 75%)		**0%**	
	G		**0**	**L/min**
5	**Total Required Fire Flow**		**8,000**	**L/min**
	(E - F + G) rounded to nearest 1000 L/min		**133**	**L/s**
			2,113	**Usgpm**

FUS Required Fire Flow

Client	Town of Wolfville
Project	Wolfville Growth Assessment
Project No.	211040.00/01
By:	J.Clair
Date	March 9, 2022

Calculation performed in accordance with the Water Supply for Public Fire Protection, 1999

Multi-Unit Building (example) - Sprinklered, Exposures on all Sides

	A - Construction	Ordinary Construction	1	
	B - Building Area		1,800	m^2
	C - Stories		3	
	Total Effecitve Building Area		5,400	m^2
1	**D - Required Fire Flow** (rounded to nearest 1000 L/min)		**16,000**	**L/min**
2	Occupacy Fire Hazard	Limited Combustible	**-15%**	
	E (do not round)		**13,600**	**L/min**
3	**Sprinkler Credit**			
	NFPA 13 Compliant	Yes	**-30%**	
	Standard Water Supply	No	**0%**	
	Fully Supervised	Yes	**-10%**	
	Total Sprinkler Credit (max 50%)		**-40%**	
	F		**-5,440**	**L/min**
4	**Exposures Charge**			
	Building Side	Separation		
	Side 1	20.1 to 30m	**10%**	
	Side 2	20.1 to 30m	**10%**	
	Side 3	20.1 to 30m	**10%**	
	Side 4	20.1 to 30m	**10%**	
	Total Exposures Charge (max 75%)		**40%**	
	G		**5,440**	**L/min**
5	**Total Required Fire Flow**		**14,000**	**L/min**
	(E - F + G) rounded to nearest 1000 L/min		**233**	**L/s**
			3,698	**Usgpm**

APPENDIX D

Water System Map showing Growth Areas and Constraint

PUBLIC WORKS DEPARTMENT

Water Distribution Network

DRAFT

MAP - 8

7/23/2014

AREA C
150 UNITS

AREA D
60 UNITS

AREA A
500 UNITS

AREA B1
800 UNITS

AREA B2
800 UNITS

AREA WITH LOW SERVICE PRESSURES

PRESSURE ZONE BOUNDARY

KENT AVE PRV

CHESNUT AVE PRV

WESTWOOD AVE PRV

HIGHLAND AVE PRV

GASPERAU AVE PRV

SHERWOOD AVE PRV

ZONE VALVE

FUTURE 200mm

200mm

EX. 200mm

EXISTING 200mm SKYWAY DR WATERMAIN POSSIBLE CONSTRAINT FOR SERVICING FIRE FLOWS TO WEST END

250mm STUB

250mm EXTENSION

SINGLE SOURCE OF SUPPLY APPARENT CAPACITY CONSTRAINT

EX. 250mm

EX. 400mm

EXISTING 250mm PLEASANT ST WATERMAIN POSSIBLE CONSTRAINT FOR SERVICING FIRE FLOWS TO EAST END

EXISTING 2 x 300mm RESERVOIR PIPING IS NOT CONSTRAINED BY VELOCITY FOR EITHER MDD+FF OR PHD.

EX. WTP

Reservoir

EX. BURIED CONCRETE RESERVOIR

CONNECT LOW ZONE TO MAPLE AVE

LOW ZONE

HIGH ZONE

POSSIBLE CONNECTIONS

EX. MAPLE AVE PRV CHAMBER

ABANDONED

150mm

POSSIBLE LOOP FROM OLSEN DR. TO MAIN ST.

POSSIBLE CONNECTION TO HIGH ZONE

EX. 250mm DISTRIBUTION MAIN
EX. 200mm TRANSMISSION MAIN

EX. 200mm CAST IRON

SINGLE SOURCE OF SUPPLY

FORMER TRANSMISSION MAIN ISOLATED FROM SYSTEM

Wolfville Harbour

Elderkin Pond

Reservoir

250 125 0 250 500 Metres

500 250 0 500 1,000 1,500 Feet

1:3,500

Sampling
- Disinfection
- HAA5
- Micro
- THM
- Lead

Structure
- Production Well Bldg
- Water Treatment

Well Type
- Well Or Test
- PetroCan Test
- Production
- Geothermal
- Inactive
- Test
- Curb Stop Valve
- Fitting
- Hydrant
- System Valve
- Water Main
- Production Well 200m Buffer
- Settling Pond
- Building
- Acadia University Building
- Forest Area
- Private Street
- Transmission Line
- Contour 5m
- Railway
- Railway Marker
- Utility Pole

MUNICIPALITY OF EAST HANTS
BYLAW NUMBER IO-200-1
A BYLAW IN AMENDMENT TO BYLAW IO-200, A BYLAW RELATING TO THE PAYMENT OF INFRASTRUCTURE CHARGES

WHEREAS Section 81, Subsections (1), (3) and (7) of the Municipal Government Act make the following provisions:

(1) The Council may make Bylaws imposing, fixing and providing methods for the payment of charges for

(g) depositing in a special purpose tax account to provide for future expenditures for wastewater facilities, stormwater systems, water systems, transportation facilities or other anticipated capital requirements;

(3) A Bylaw passed pursuant to this Section may provide

(a) that the charges fixed by, or determined pursuant to, the Bylaw may be chargeable in proportion to frontage, in proportion to area, in proportion to assessment of the respective properties fronting on the street or according to another plan or method set out in the Bylaw;

(c) that the charges may be different for different classes of development and may be different in different areas of the municipality;

(7) Notwithstanding the *Public Utilities Act* and for greater certainty, any Bylaw made pursuant to this Section and any charge imposed or fixed pursuant to this Section do not require approval by the Board.

BE IT ENACTED by the Council of the Municipality of East Hants, as follows:

1. SHORT TITLE

1.1. This bylaw shall be known as Infrastructure Charges Bylaw.

1.2. The previous and all other versions of the Infrastructure Charges Bylaw are repealed and replaced by this version which will continue to be numbered IO-200.

2. DEFINITIONS

For the purposes of this Bylaw, the following words shall have the meanings hereby assigned to them:

(a) **"Accessory Dwelling Unit"** means an accessory dwelling unit as defined in the Land Use Bylaw.

(b) **"Apartment Building"** means a building consisting of 3 or more divided dwelling units which share a common entrance to the outdoors or which share a common water meter.

(c) **"Change-of-Use"** means any alteration, expansion or development of a property, building or structure.

(d) **"Commercial Lodging"** means rooms used to accommodate the public for profit by supplying them with sleeping facilities and shall include but not be limited to hotels, motels and guest houses.

(e) **"Dwelling Unit"** means a dwelling unit as defined in the Land Use Bylaw.

(f) **"Floor Area"** means gross floor area as defined in the Land Use Bylaw.

(g) **"Food and Beverage Service"** means the preparation of food and beverages for immediate consumption and shall include the following subcategories:

i) **"Coffee Service"** means food and beverage service where the primary product is brewed coffee and shall include but not be limited to coffee shops.

ii) **"Takeout Service"** means food and beverage service where the product is prepared primarily for off-premises consumption whether or not on-premises consumption is provided and shall include but not be limited to drive-through restaurants.

iii) **"Liquor Service"** means food and beverage service licensed as a beverage room, lounge, cabaret or club by the Nova Scotia Alcohol and Gaming Authority.

iv) **"Full Service"** means food and beverage service where the product is prepared primarily for on-premises consumption and shall include but not be limited to full-service restaurants.

(h) **"Industrial"** means the manufacturing, processing, fabricating or assembly of raw materials or goods, the bulk storage of raw materials or goods and related accessory uses and shall include the following subcategories:

i) **"Manufacturing"** means industrial use, excluding warehousing, and shall include but not be limited to manufacturing plants.

ii) **"Warehousing"** means the bulk storage of raw materials or goods in areas not accessible to the public and shall include but not be limited to warehouses.

(i) **"Institutional"** means health care or educational use and shall include the following subcategories:

i) **"Managed Care"** means health care facilities and shall include but not be limited to hospitals and homes for special care.

ii) **"Schools"** means non-residential schools.

(j) **"Lot"** means any parcel of land described in a deed or described on a plan and deed pursuant to the Land Titles Clarification Act or as shown on an approved plan of subdivision filed in the Registry of Deeds.

(k) **"Multi-Unit Residential"** means containing three or more dwelling units and shall include but not be limited to apartment buildings and townhouses. Dwelling units in commercial buildings shall be classified as apartment buildings.

(l) **"Office"** means where business may be transacted, a personal service performed or consultation given and shall include but not be limited to office buildings, doctor offices and dentist offices.

(m) **"Remainder Lot"** means that portion, if any, of the parent parcel that remains after the creation of one or more lots pursuant to the Subdivision Bylaw and for which no approval was requested.

(n) **"Retail/Wholesale"** means where goods, wares, merchandise, substances, articles and services are offered or kept for sale and shall include but not be limited to shopping centres, grocery stores, service stations, auto parts stores and building supplies stores.

(o) **"Serviced Lot"** means a lot that has both a Municipally-approved water lateral and a Municipally-approved wastewater lateral.

(p) **"Townhouse"** means a dwelling unit in a building consisting on 3 or more divided dwelling units with each having their own independent entrance directly from the outdoors and each having their own separate water meter.

(q) **"Unserviced Lot"** means a lot that is not a serviced lot.

(r) **"Water Intensive"** means the use of water as part of a product, service or process and shall include but not be limited to food processing plants, car washes, and garden centres.

(s) **"Laundromats" means an establishment providing washing, drying or dry cleaning machines on the premises for rental use by the general public or for dry cleaning purposes**

3. GENERAL

3.1. The purpose of infrastructure charges is to offset the cost to the Municipality of upgrading existing, and oversizing proposed, water and sanitary wastewater infrastructure that is attributable to new development. Infrastructure charges may be used to pay capital costs and costs for land, planning, studies, engineering, surveying, legal and financing incurred with respect to said infrastructure. Nothing contained in this Bylaw shall be construed as requiring the Municipality to extend Municipal services to a property. Where such services do not currently exist, it is the responsibility of the property owner to install and pay for such extensions in accordance with Municipal standards.

3.2. Infrastructure charges shall be calculated based on the use of the building(s) existing on or proposed for the lot as follows:

3.2.1. Infrastructure charges shall be calculated based on the majority use of the building floor area; however, infrastructure charges for areas of a building that are allocated to a higher use, as determined by the infrastructure charge rates, shall be calculated based on the infrastructure charge rate for that use.

3.2.2. Should any dispute arise respecting the use of a building or floor area or if such use is obscure or capable of more than one interpretation, infrastructure charges shall be calculated based on infrastructure charge rate for the highest use as determined by the infrastructure charge rates.

3.3. Infrastructure charges shall be due and payable to the Municipality as follows:

3.3.1. On unserviced and remainder lots upon request to be serviced; and

3.3.2. On all lots upon issuance of a building and/or development permit where a change-of-use to a higher use occurs. In such cases, two calculations shall be made:

3.3.2.1. Infrastructure charges payable on the lot based on the proposed use; and

3.3.2.2. Infrastructure charges payable on the lot if a building and/or development permit had been issued based on its existing use.

The difference between the two calculations shall be the infrastructure charges payable on the said lot; and

3.3.3. On lots approved for Two Dwelling Unit Residential (R2) upon issuance of a building permit that will result in more than one dwelling unit on the said lot.

3.4. The charges levied under this Bylaw are first liens on the real property and may be collected in the same manner as other charges. The lien becomes effective when the charges become due and payable as outlined in Article 3.3 of this Bylaw.

4. INFRASTRUCTURE CHARGES - RATES

Infrastructure charges shall be applied to lands within the South Corridor and Regional Growth Management Area and Shubenacadie Growth Management Area for water and wastewater service and within the Milford Growth Management Area for wastewater service only according to the following rates:

4.1. Single and Two Dwelling Unit

4.1.1. An unserviced or remainder lot approved for Established Residential Neighbourhood (R1) or Two Dwelling Unit Residential (R2) shall be charged a water infrastructure charge of $3,000 for water service and a wastewater infrastructure charge of $3,000 for wastewater service provided, however, that the following exemptions shall apply:

4.1.1.1. A lot that existed prior to June 18, 1998 shall be exempt from the water infrastructure charge; and

4.1.1.2. A lot that has a Municipally approved, unused wastewater lateral installed prior to July 27, 1988 shall be exempt from the wastewater infrastructure charge.

4.1.2. A lot approved for Established Residential Neighbourhood (R1) or Two Dwelling Unit Residential (R2) shall be charged an additional water infrastructure charge of $3,000 and an additional wastewater infrastructure charge of $3,000 upon issuance of a building permit that will result in more than one dwelling unit on the said lot unless the second dwelling unit is an accessory dwelling unit, in which case, the additional water infrastructure charge shall be $750 per bedroom and the additional wastewater infrastructure charge shall be $750 per bedroom.

4.1.3. A lot zoned for other than Established Residential Neighbourhood (R1) or Two Dwelling Unit Residential (R2) shall be charged infrastructure charges for single and two dwelling unit use upon issuance of a building permit for such use.

4.2. **Multi-Unit Residential** buildings shall be charged infrastructure charges as follows:

4.2.1. **Apartment Buildings** - Water infrastructure charge of $900 and wastewater infrastructure charge of $900 per bedroom;

4.2.2. **Townhouses** - Water infrastructure charge of $750 and wastewater infrastructure charge of $750 per bedroom.

4.3. **Commercial Lodging** buildings shall be charged a water infrastructure charge of $450 and a wastewater infrastructure charge of $450 per room intended for sleeping.

4.4. **Food and Beverage Service** buildings shall be charged infrastructure charges as follows:

4.4.1. **Coffee Service** - Water infrastructure charge of $4.50 and wastewater infrastructure charge of $4.50 per square foot of floor area;

4.4.2. **Takeout Service** - Water infrastructure charge of $2.25 and wastewater infrastructure charge of $2.25 per square foot of floor area;

4.4.3. **Liquor Service** - Water infrastructure charge of $2.25 and wastewater infrastructure charge of $2.25 per square foot of floor area;

4.4.4. **Full Service** - Water infrastructure charge of $0.45 and wastewater infrastructure charge of $0.45 per square foot of floor area.

4.5. **Office** buildings shall be charged a water infrastructure charge of $0.45 and a wastewater infrastructure charge of $0.45 per square foot of floor area.

4.6. **Retail/Wholesale** buildings shall be charged a water infrastructure charge of $0.45 and a wastewater infrastructure charge of $0.45 per square foot of floor area.

4.7. **Industrial** buildings shall be charged infrastructure charges as follows:

4.7.1. **Manufacturing** - Water infrastructure charge of $0.09 and wastewater infrastructure charge of $0.09 per square foot of floor area;

4.7.2. **Warehousing** - Water infrastructure charge of $0.045 and wastewater infrastructure charge of $0.045 per square foot of floor area.

4.8. **Institutional** buildings shall be charged infrastructure charges as follows:

4.8.1. **Managed Care** - Water infrastructure charge of $675 and wastewater infrastructure charge of $675 per room intended for sleeping;.

4.8.2. **Schools** - Water infrastructure charge of $31.50 and wastewater infrastructure charge of $31.50 per person.

4.9. Water Intensive buildings shall be charged infrastructure charges as determined by the Municipal Engineer on an individual basis from projected water usage and wastewater discharge.

4.9.1. **Laundromats will receive a discounted rate within the water intensive charge calculation of 75%, to be recognized as a standalone category that provides benefit to both existing serviced area rate payers as well as rural stakeholders, while promoting more urban growth.**

5. CHARGES UNDER FORMER TRUNK SEWER TAX BYLAW

Charges arising under this Bylaw are deemed to include any charges that arose under provision of the former Trunk Sewer Tax Bylaw on other than Single Unit Dwelling (R1) and Single to Two Unit Dwelling (R2) at final subdivision approval.

6. Repeal

6.1. Bylaw 155 - Trunk Sewer Tax Bylaw in the Municipality of East Hants is hereby repealed.

6.2. The repeal of Bylaw 155 - Trunk Sewer Tax Bylaw in the Municipality of East Hants shall not affect any penalty, forfeiture or liability incurred before such repeal or any proceeding for enforcing the same completed or pending at the time of repeal.

I, Connie Nolan, CAO and Municipal Clerk of the Municipality of East Hants, hereby certify that the above noted bylaw was passed at a meeting of the East Hants Municipal Council on October 25, 2017.

CONNIE NOLAN, CPA, CA, CFE

CAO/Municipal Clerk

EAST HANTS

BYLAW IO-200

VERSION LOG

Bylaw Adoption	
First Reading:	June 29, 2016
Notice of Public Hearing Publication:	July 13, 2016
Second Reading and Enactment:	July 27, 2016
Final Publication:	August 10, 2016
Notice to Service Nova Scotia & Municipal Relations:	August 10, 2016

First Reading:	September 27, 2017
Notice of Public Hearing Publication:	October 11, 2017
Second Reading and Enactment:	October 25, 2017
Final Publication:	November 8, 2017
Notice to Service Nova Scotia & Municipal Relations:	November 8, 2017

Version Number	Amendment Description	Council Approval Date
1	Bylaw adoption.	June 28, 2006
2	Infrastructure charges extended to Shubenacadie and Milford Serviceable Boundaries.	May 27, 2009
3	Bylaw number changed to IO-200; definitions amended; multi-unit residential infrastructure charges expanded and revised.	July 27, 2016
4	Amendment IO-200-1 related to Laundromats; bylaw number remains IO-200	October 25, 2017