

# Belfast Planning Board Hearing

Nordic Aquafarms, Inc.

Fresh Water Use Plan

September 23, 2019

# Fresh Water Supply

Belfast Water District  
Reservoir #1

Significant Ground  
Water Wells

Belfast Water District  
Municipal Supply

**Project Location**

**Belfast Water District  
Source Location**

Belfast

Searsport

**Project Location**

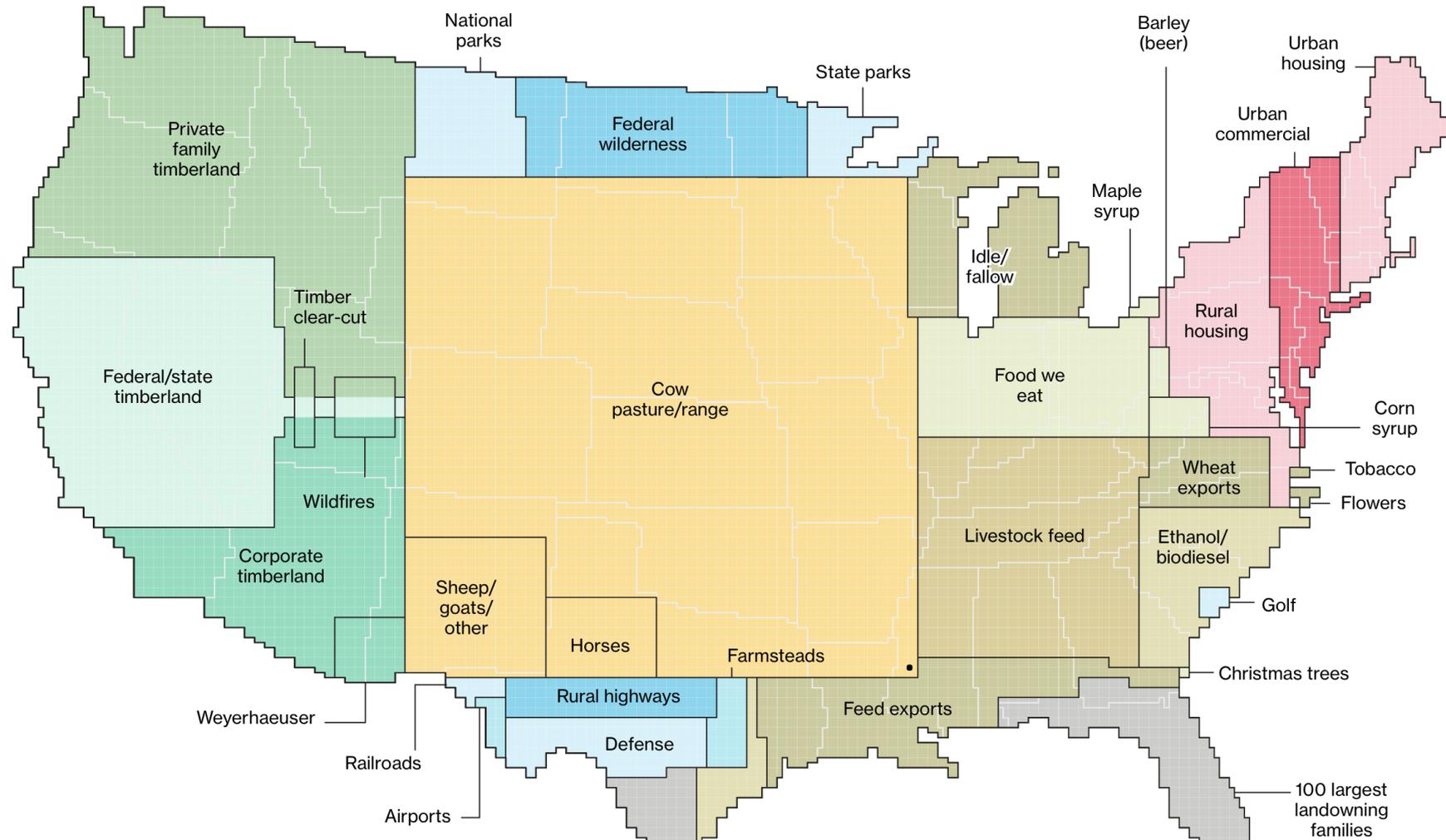
**Bayside Village**

# Resource efficiency in food production

	<b>Beef</b>	<b>Corn</b>	<b>NAF</b>
<b>Land use</b>	360 pounds per acre	13,000 pounds per acre	1,700,000 pounds per acre
<b>Local fresh water use</b>	1840 gallons per pound	200 gallons per pound	8.7 gallons per pound
<b>Co2 per 4 ounce servicing</b>	8.6 pounds Co2	4 pounds Co2	1.6 pounds Co2

One of the most resource efficient foods

# But we are running out of space on traditional proteins



Source: Bloomberg

# Water will come from four sources

**Belfast Bay- Salt water**

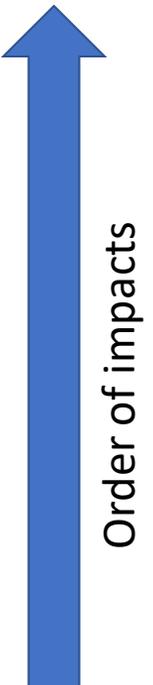
➔ **Belfast Water District**

➔ **Wells on Property**

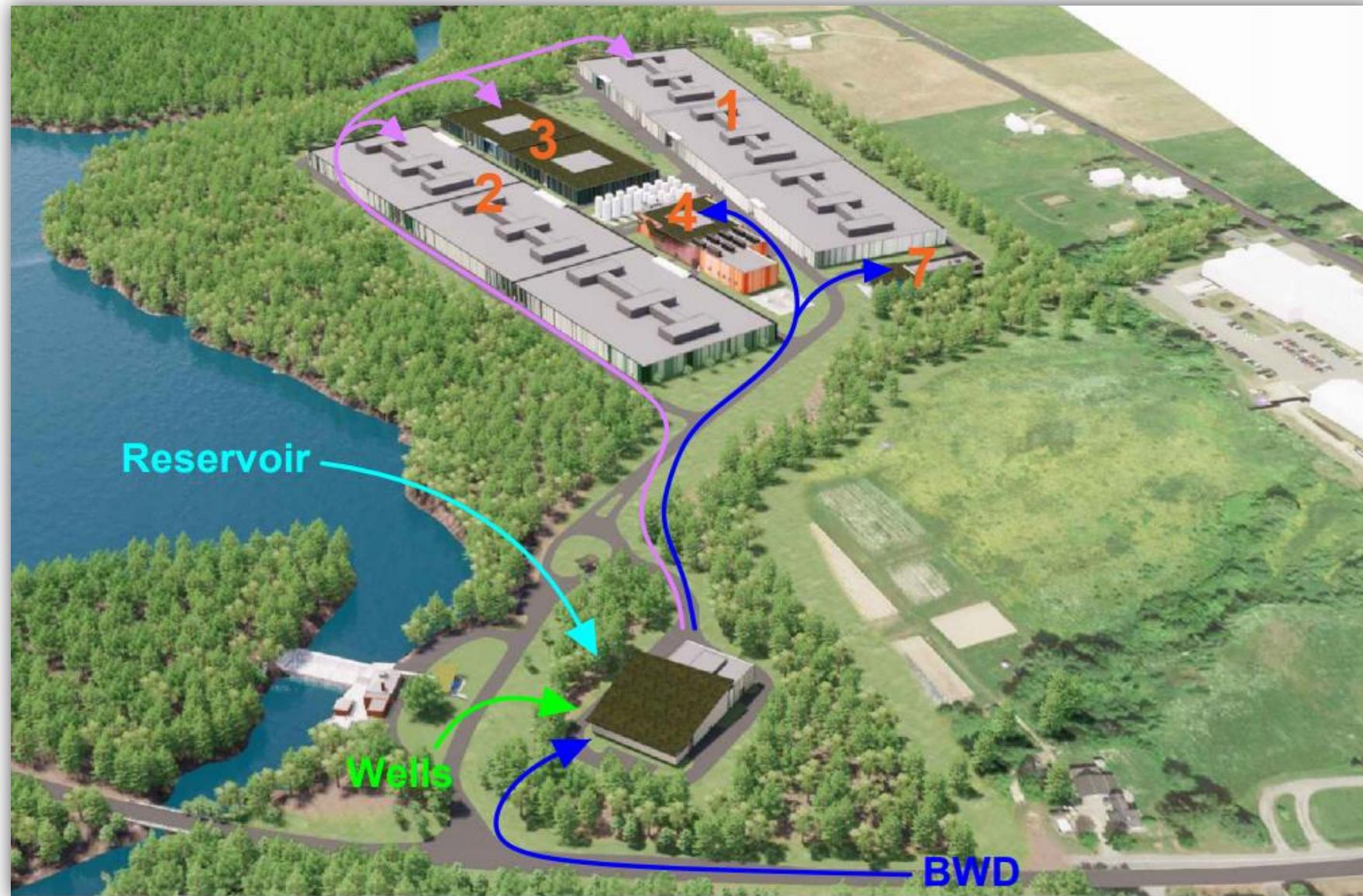
➔ **Surface water**

## Belfast Water District Priority List

1. Hospitals
2. Nursing Homes
3. Residential
4. Fire Protection
5. Pets and Livestock
6. Aquatic Habitat
7. Commercial (Restaurants and Offices)
8. Industry ([Inc. Aquaculture](#))
9. Pools
10. Watering Lawns
11. Washing Cars



Order of impacts



- Domestic Water
  - Potable and sanitary
  - Fish processing
- Treated fresh water
  - Hatchery
  - Brackish water for grow outs
- Balancing needs with multiple sources
  - Monitor resources proactively
  - Adjust salinity
  - Adjust sources

# Introduction to Presenters

---

- Dr. Michael Mobile, P.G.
  - Ph.D. in Civil Engineering from Virginia Tech
  - 15 years in groundwater hydrology
- Elizabeth Ransom, P.G.
  - MSc. in Geological Sciences from University of Southern California
  - 30 years in soils, bedrock, and groundwater studies.
- Thomas Neilson
  - MSc. in Geology from University of Vermont
  - Specializing in charecterization of complex groundwater projects.



# Significant Groundwater Well Permit Application Review

## Chapter 102. Zoning

### Article IX, Supplementary District Regulations

#### Section 102-1078, Planning Board review of application

The Planning Board shall use the following process to review an application for a permit for a significant groundwater well. The Planning Board, in conducting its review of an application for a significant groundwater well permit that is submitted to the Board as a component of a request for one or more of the following permits: a Shoreland Permit pursuant to Chapter 82, Shoreland, Site Plan Permit pursuant to Chapter 90, Site Plan, Subdivision Permit pursuant to Chapter 94, Subdivision, or a Use Permit pursuant to Chapter 102, Zoning, may choose to conduct the public hearing process for the significant groundwater well permit in conjunction with the public hearings that are held for one or more of the above permits, and shall not be required to conduct an independent public hearing on the request for a permit for a significant groundwater well.

(a) Applicant shall submit a permit application to the Code and Planning Department that addresses all information required in Sec. **102-1077**.

(b) The Code and Planning Department, within 45 days of receiving a permit application that addresses requirements of Sec 102-1077, shall schedule the application for review by the City Planning Board.

(c) The City Planning Board shall conduct a public hearing on any permit application that is submitted. The Code and Planning Department, a minimum of 13 calendar days prior to the Planning Board meeting, shall provide written notice of the application and hearing date by first class mail to all property owners located within a radius of 1,000 feet of the proposed groundwater well(s), and shall publish notice of the hearing in a newspaper with local circulation and on the City website. The first notice in the newspaper shall occur a minimum of 13 days prior to the Board meeting and the second notice a maximum of 7 days prior to the hearing.

(d) The Planning Board shall review the application and determine if it complies with the **performance standards identified in Sec. 102-1079**. The Board may establish conditions of approval as a requirement to obtain applicant compliance with the performance standards. The Planning Board shall adopt findings of fact to identify how it determined that the applicant proposal did or did not comply with City requirements.

# What Is in the Application?

- Groundwater Supplied by Belfast Water District Water Purchase
- Surface Water withdrawal proposed by Nordic Aquafarms
- Groundwater wells proposed by Nordic Aquafarms



# What Is in the Application?

- What are the sources of available water?
- Can these water resources be used sustainably?
- How can we study the water resources today?
- What does Nordic do to demonstrate future use causes no harm?



# What Part of the Application Has the Details?

---

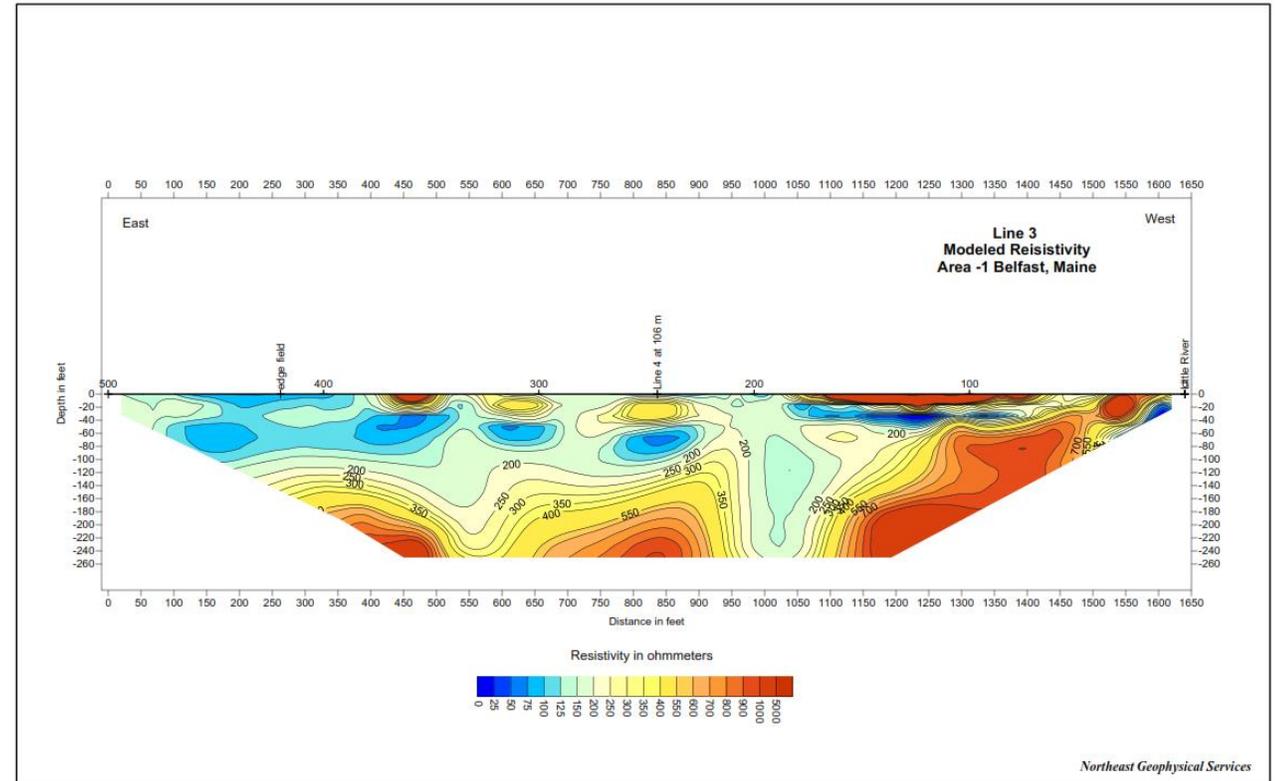
Nordic Aquafarms has submitted a Significant Groundwater Well permit application to the City of Belfast Code and Planning Department. The submittal included the following items, which address select technical Performance Standards identified in Section 102-1079:

- A **Hydrogeologic Investigation Report**, which details the field program and numerical groundwater flow model; and
- A **Water Resource Monitoring Plan**, which details methods of additional data collection and assessment.

Both documents are currently under review by the Maine Department of Environmental Protection (DEP).

# Understanding the Aquifer

- A comprehensive investigation was completed, including:
  - Exploration
    - Geophysical Survey





# Understanding the Aquifer

- A comprehensive investigation was completed, including:
  - Exploration
    - Geophysical Survey
    - Drilling
  - Characterization
    - Four Aquifer Tests
    - Over 25 Monitoring Points

All of this information was used to form the Conceptual Site Model and the set up the Groundwater Model

## Sensitive Receptors

- Private Water Supply Wells
- Wetlands
- Streams
- Lower Reservoir & Little River



# Summary of Hydrogeologic Studies

- >1,000,000 measurements collected
- 4 aquifer tests, with up to 6 wells pumping at once
- 250,000 measurements taken just during January 2019 test to verify the model
- 6 private wells monitored during aquifer tests
- 29 locations monitored, including streamflow in the Little River, groundwater wells, piezometers, private wells, and surface water features.



# Groundwater Supplied by the Belfast Water District

---

Chapter 102. Zoning

Article II. Administration

Division 3. Permits

Subdivision III. Permit for Uses Requiring Review

Section 102-102, Submission Requirements

[Ord. No. 28-1997, S 302.2, 3-4-1997]

(3)(d)

*The applicant's evaluation of the availability and suitability of off-site public facilities, including sewer, water, streets and solid waste.*

(3)(f)

*A statement from the Belfast Water District dealing with:*

- 1. Availability of public water, if the public water supply is to be used.*
- 2. The proposed impact of the project in terms of quantity and/or quality of the water on the Aquifer-Watershed Overlay District if applicable.*

- Belfast Water District has provided a capacity to serve letter, approved by the public utilities commission.**
- Up to 500 gpm available through BWD**

# Groundwater Supplied by the Belfast Water District

---

Chapter 102. Zoning

Article VIII, Supplementary District Regulations  
Division 7. Significant Groundwater Well Permit  
Section 102-1079. Performance Standards

*The City Planning Board must determine that an applicant request to extract groundwater by a significant groundwater well(s) has and will meet the following performance standards to grant a permit for a significant groundwater well(s).*

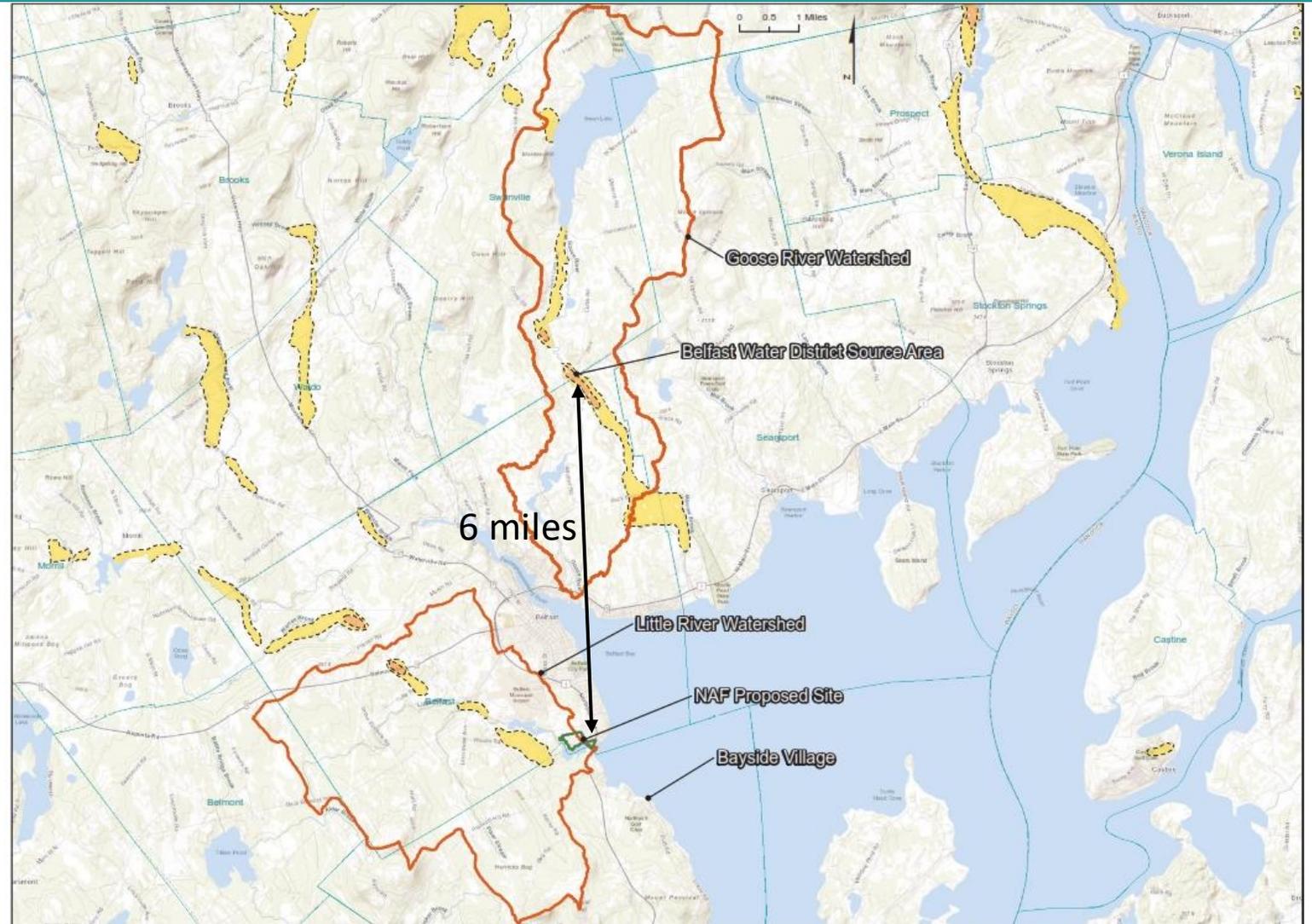
*(e) The proposed extraction site is not within the defined aquifer or groundwater recharge area of a public water supply, unless public notice is provided to the operator thereof, and the Planning Board has considered any information supplied by the operator and finds that no adverse affect on a public water supply will result.*

- **BWD and Site in separate watersheds**
- **Site is not within defined aquifer(s) or groundwater recharge areas of a public water supply.**

# Groundwater Supplied by the Belfast Water District

The sources are in separate and distinct aquifers and recharge areas

- BWD source area in the Goose River Watershed
  - Goose River Esker Aquifer – Sand and gravel aquifer
- Nordic Aquafarms proposed groundwater wells are in the Little River Watershed
  - Fractured bedrock aquifer



# Surface Water from Belfast Reservoir Number One

---

Chapter 102. Zoning  
Article V, District Regulations  
Division 19. Route One South Business Park  
District  
Section 102-682. Permitted uses requiring  
Planning Board review  
(3)

*Aquaculture, land based, including uses that are accessory to the aquaculture operation, such as but not limited to: fish processing, byproducts, research laboratory, offices, on-site child care, storage, accessory retail sales, and a visitor's center. A land based aquaculture operation may discharge wastewater to and use water from a marine or fresh waterbody.*

- **Water is proposed to be used from Belfast Reservoir Number One (the Lower Reservoir).**
- **Surface water use will allow freshwater to be balanced and optimized at facility.**
- **Diverse sources lead to greater resilience, lower impacts than single source.**

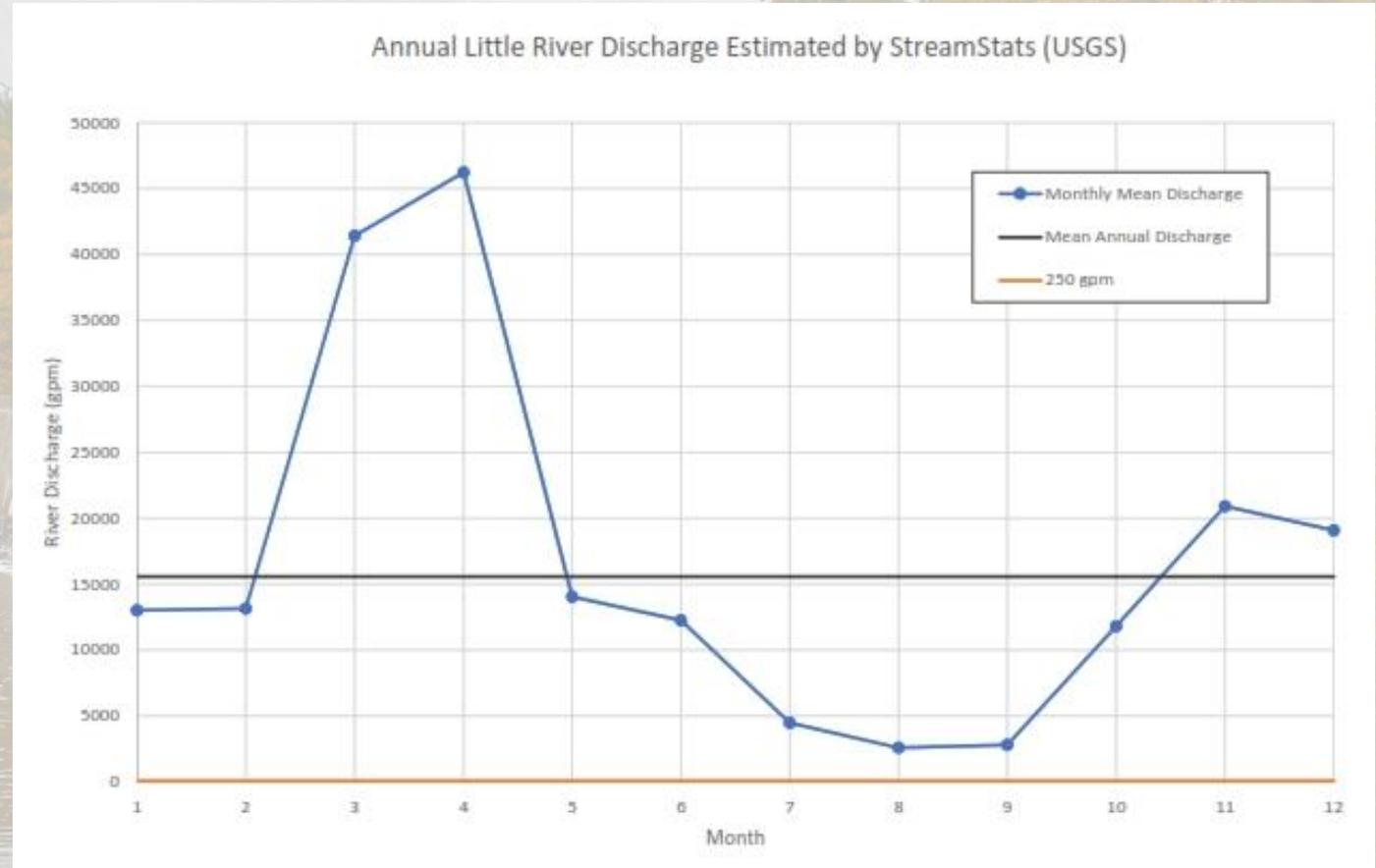
# Surface Water from Belfast Reservoir Number One

Chapter 102. Zoning  
Article VIII, Supplementary District  
Regulations  
Division 7. Significant Groundwater Well  
Permit  
Section 102-1077. Application and  
Information Requirements  
(c) Application Requirements  
(1)(c)  
*An assessment of how the short-term and  
long-term rate and amount of groundwater  
extraction are estimated to impact local and  
regional ground water levels, wetlands, pond  
or lake levels, base flow in streams and any  
water quality changes in ground water and in  
surface water.*

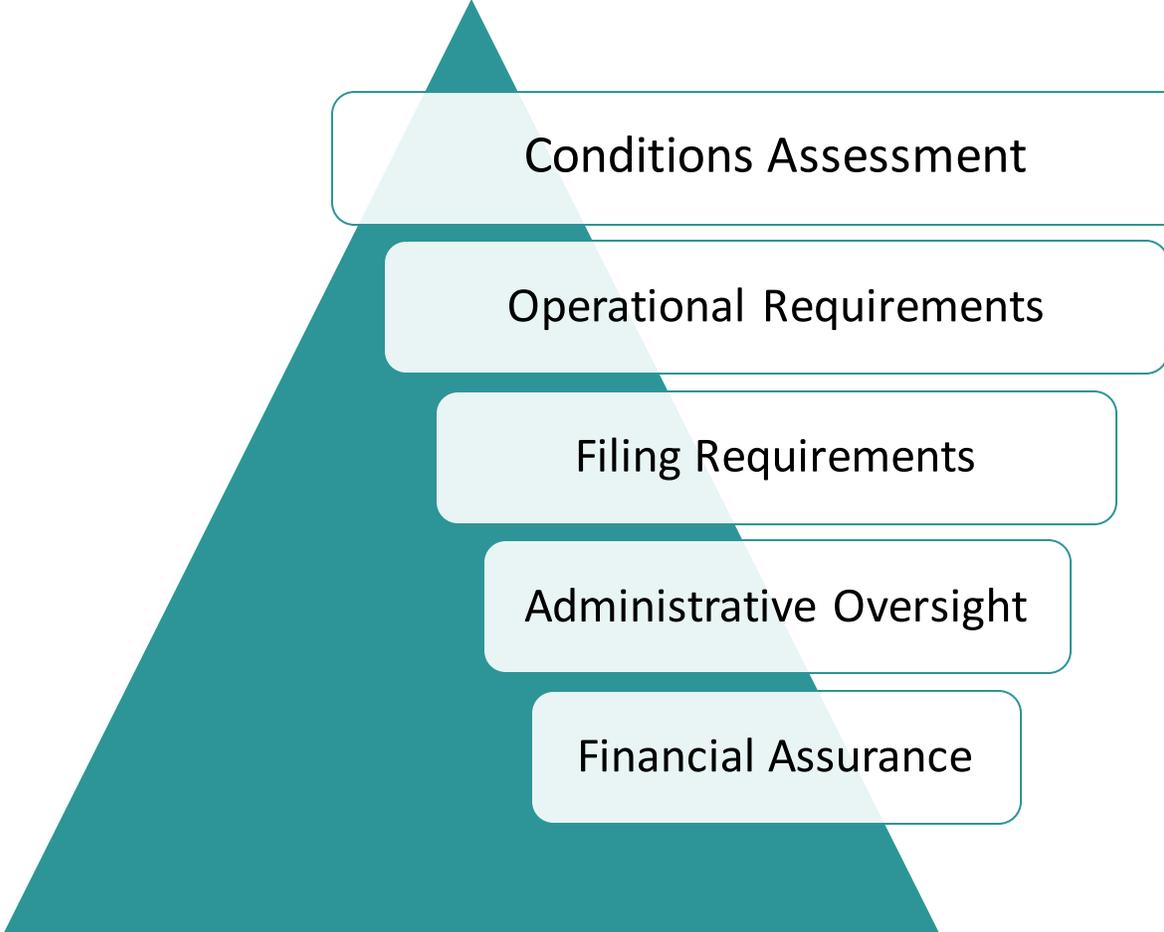
- **Surface water withdrawal considered in context of proposed groundwater withdrawal**
- **Surface water use regulated by MEDEP Chapter 587 Rules**
- **Drawdown from normal high water in Lower Reservoir cannot exceed 1-foot in wet and 2-feet in dry seasons**
- **Proposed surface water withdrawal is tied to inflow from Little River and storage in reservoir.**

# Surface Water from Belfast Reservoir Number One

- Minimal impact on reservoir level expected
- Little River Average Annual flow estimated to be ~15,500 gpm
- Minimum monthly average flow ~2,500 gpm in August
- Withdrawal proposed to be 70 gpm from reservoir storage plus additional inflow from Little River as it occurs.
- Conservative planning number for withdrawal is 250 gpm



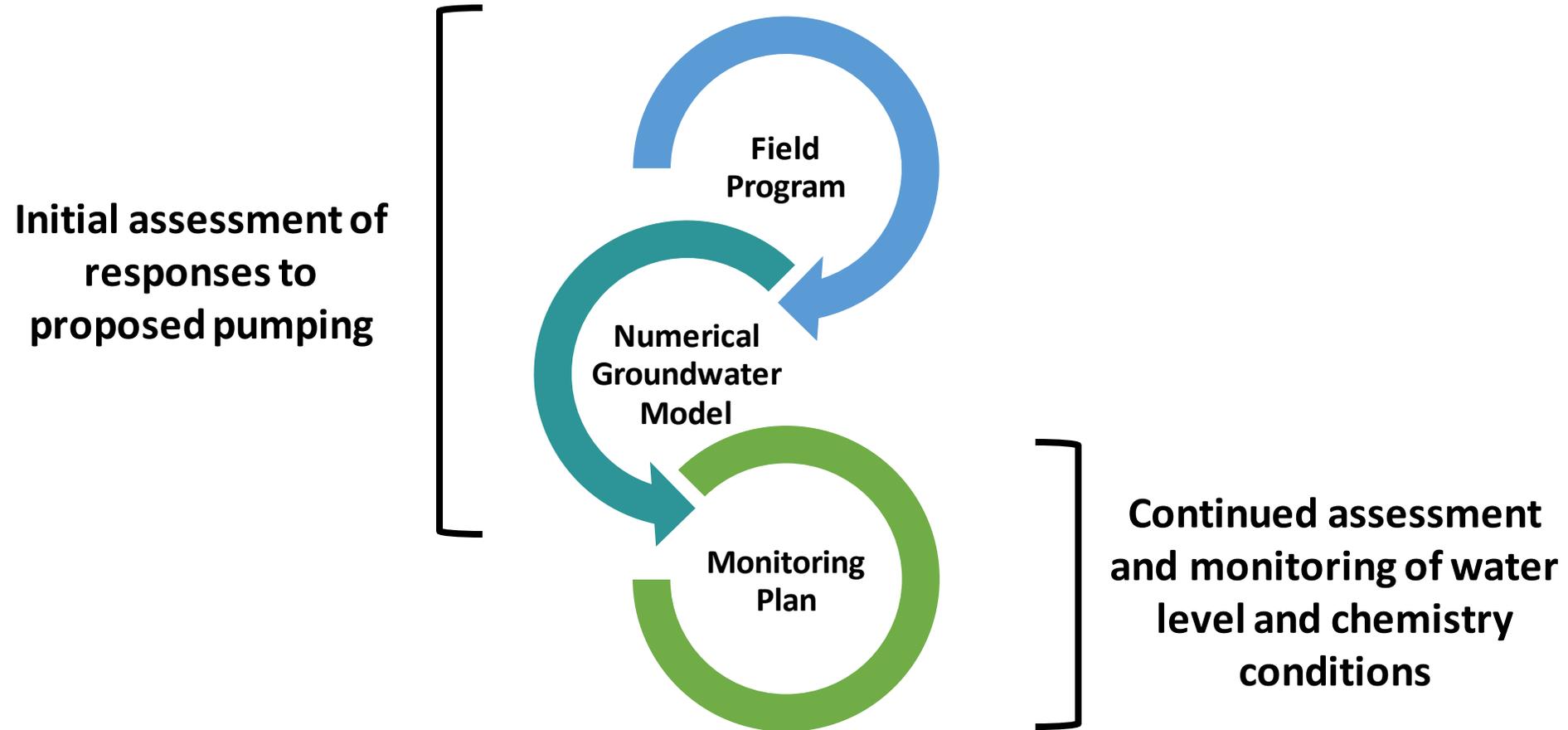
# Section 102-1079: Performance Standards



(b) Any proposed use **shall not cause unreasonable adverse diminution in water quality or quantity** of the aquifer or surrounding surface/ground water. This includes any impacts to the upwelling of a natural spring, ground water source, aquifer recharge area, or wetlands.

(k) The City Planning Board **shall have the authority to require an applicant to prepare and implement a monitoring program** of wells located within 1,000 feet of the boundary line of the applicant property...(continued)  
**(developed and submitted for review on behalf of Nordic Aquafarms)**

# Technical Elements of Permit Application



# Field Program – Summary of Results

---

- **Extensive information and data collection**  
(e.g., four aquifer tests)
- **Surficial system “isolated” from fractured bedrock aquifer**  
(glaciomarine Presumpscot Formation)
- **Bedrock structure creates asymmetrical responses to pumping**  
(metapelite and metasandstone bedding and fracture orientations)

# Groundwater Modeling - Executive Summary

---

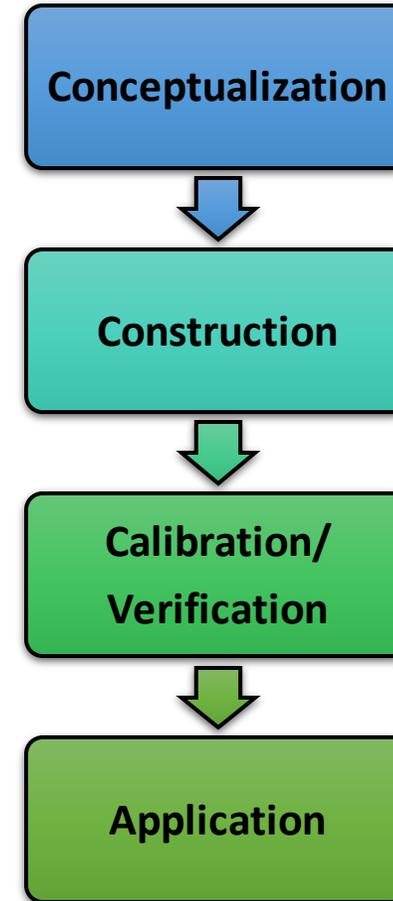
- Incorporates significant volume of information and data gathered during field program
- Mathematical model successfully developed - supports estimates of aquifer responses to proposed groundwater pumping
- Model results indicate no unreasonable adverse diminution anticipated due to proposed groundwater pumping (e.g., current use of domestic wells in neighboring areas)
- On- and off-site monitoring and operational contingencies are recommended to reinforce assessment (field program and groundwater modeling)

# Groundwater Modeling – Objectives and Approach

1. Construct a groundwater flow model for the bedrock aquifer occurring in the Site vicinity based on available data and information; and
2. Using the model, assess potential long-term viability of proposed pumping based on drawdown predictions away from the proposed well network.

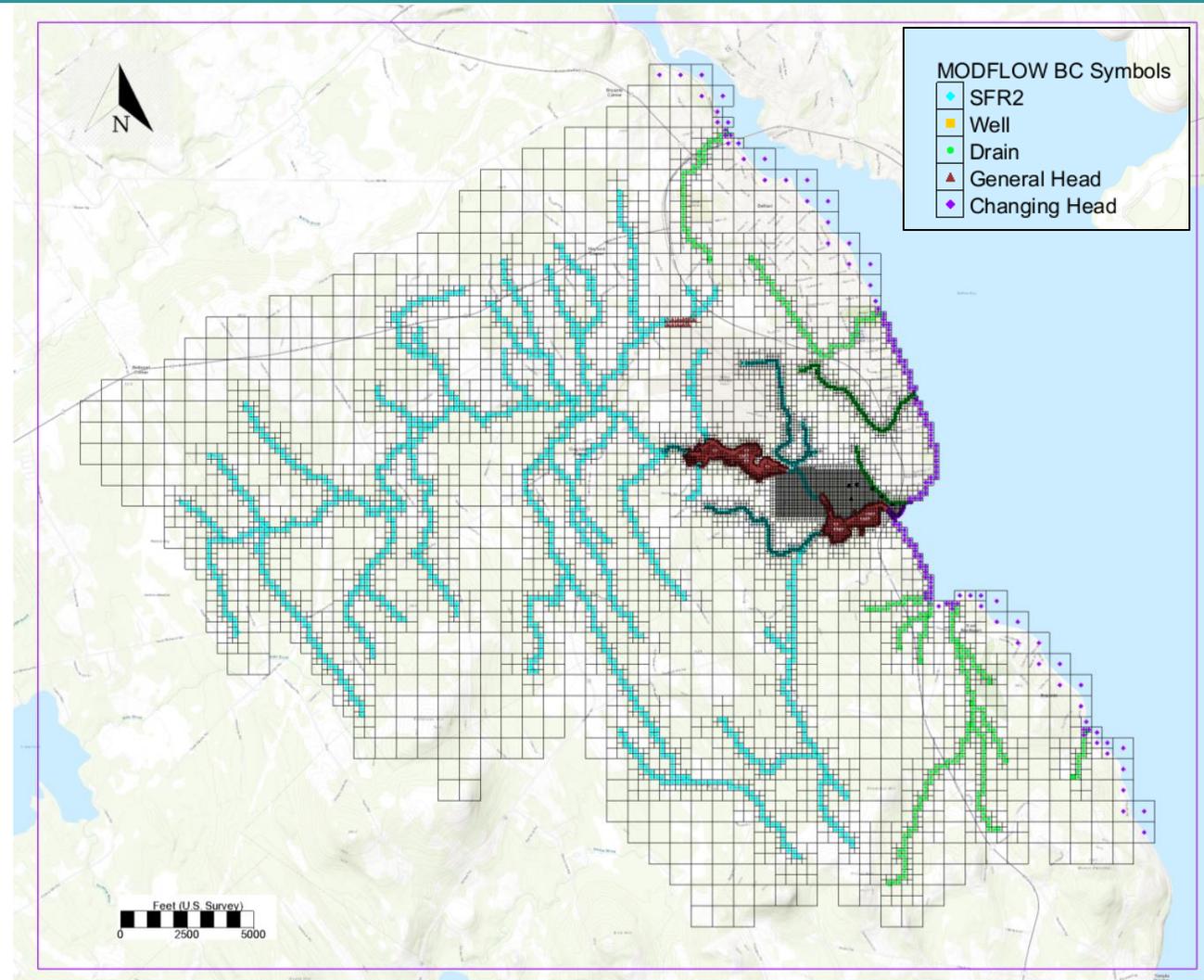
**Common modeling code applied  
(MODFLOW-USG)**

**Common modeling approach applied  
to address these objectives**

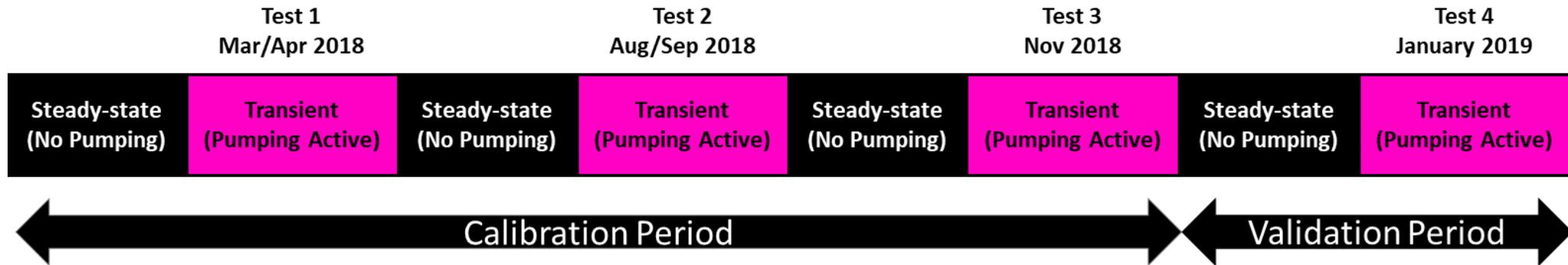


# Groundwater Modeling – Construction/Representation

- Drainage area limits;
- Belfast Bay;
- Little River and streams;
- Reservoirs/ponds;
- **Recharge**; and
- Proposed groundwater pumping



# Groundwater Modeling – Calibration and Verification

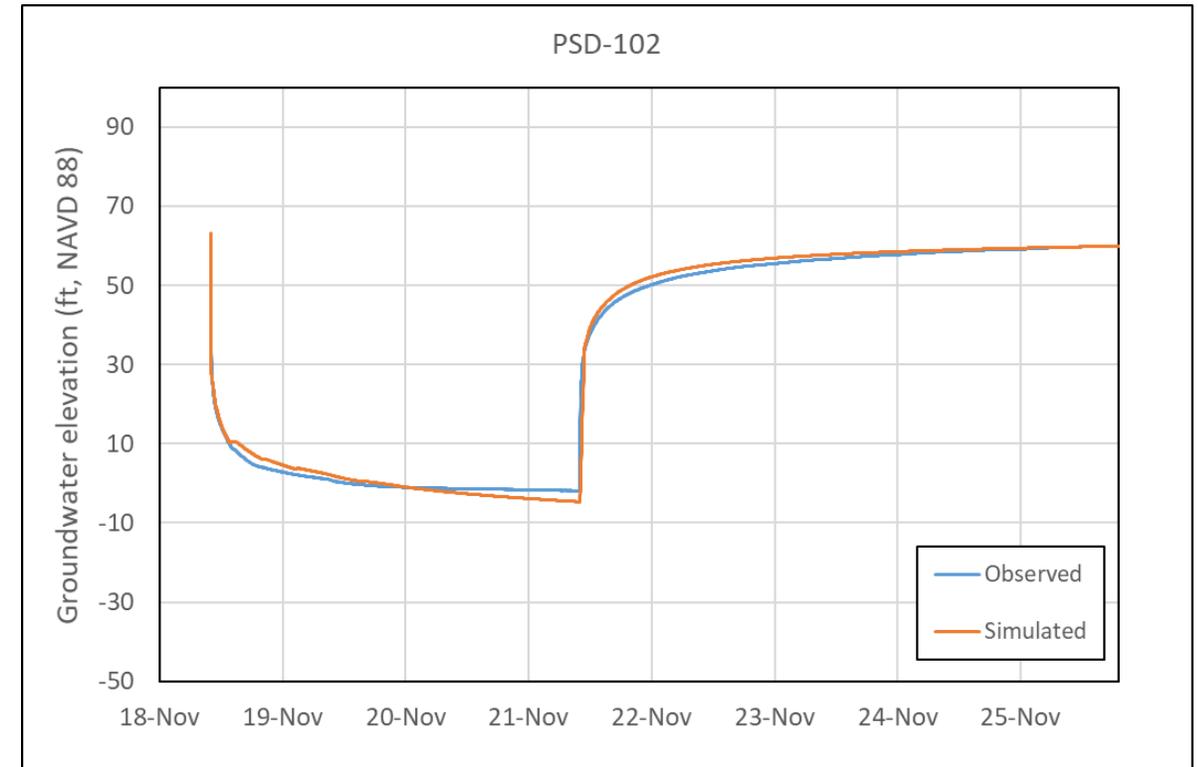


## Approach Overview:

- Manual approach supplemented by automated parameter estimation
- Several hydraulic parameters considered during calibration
- Robust “target” data sets (~200,000 individual data points)

# Groundwater Modeling – Calibration and Verification

- Calibration results show excellent consistency between measured and modeled conditions
- Verification – similar results
- **Confidence in applying model to assess responses to proposed pumping**

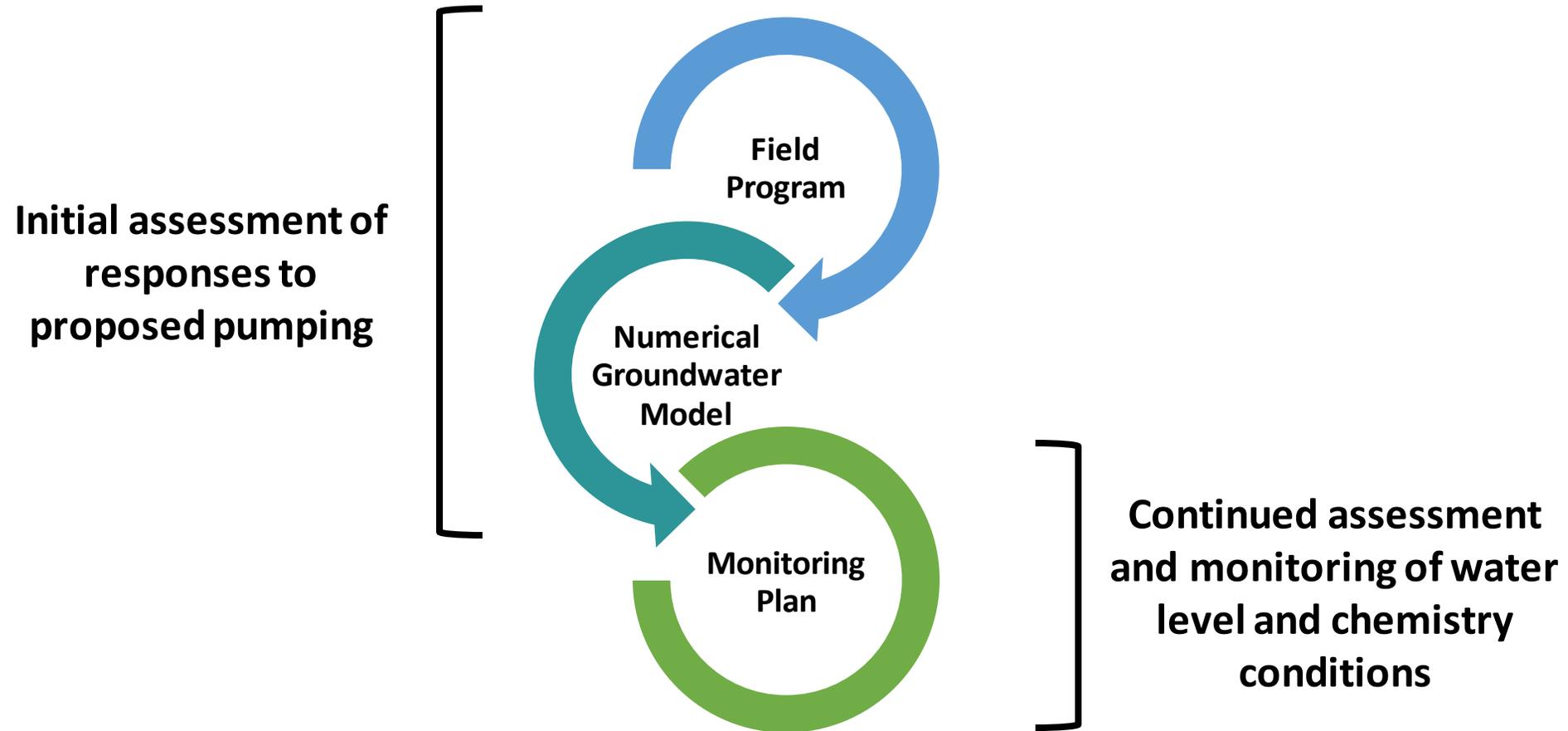


# Groundwater Modeling – Summary of Results

---

- A mathematical model of groundwater flow in the Site vicinity was successfully created using common techniques and a significant amount of field data.
- Calibration and verification results suggest the model is a reasonable representation of hydraulic responses to site pumping (aquifer tests).
- **Model results indicate proposed groundwater pumping of 455 gpm is not anticipated to influence current use of domestic wells.**
- Data gathering recommended to establish thresholds and monitor private supply well conditions.

# Water Resources Monitoring Plan



# Water Resources Monitoring Plan

Chapter 102. Zoning  
Article VIII, Supplementary District  
Regulations  
Division 7. Significant Groundwater Well  
Permit  
Section 102-1077. Application and  
Information Requirements  
(c) Application Requirements  
(1)  
(d) *Identification of an effective monitoring program that the City could implement to assist in ensuring that the rate and amount of groundwater extraction does not adversely affect groundwater resources and public and private wells located within 1,000 feet of the proposed extraction facilities.*

**Water Resources Monitoring Plan developed to:**

- **Set performance standards for water resources**
- **Detect unexpected issues early**
- **Provide roadmap for remedy**

**Includes network of 15 private water supply wells, including known wells within 1,000 feet of the proposed development**

# Water Resources Monitoring Plan

---

Chapter 102. Zoning

Article VIII, Supplementary District  
Regulations

Division 7. Significant Groundwater Well  
Permit

Section 102-1079. Performance Standards

*The City Planning Board must determine that an applicant request to extract groundwater by a significant groundwater well(s) has and will meet the following performance standards to grant a permit for a significant groundwater well(s).*

- **Water Resources Monitoring Plan provides objective evidence that performance standards are being met**
- **No impact to BWD supply area from extraction**
- **Operating records will document source use**

# Water Resources Monitoring Plan

---

Chapter 102. Zoning

Article VIII, Supplementary District

Regulations

Division 7. Significant Groundwater Well

Permit

Section 102-1079. Performance Standards

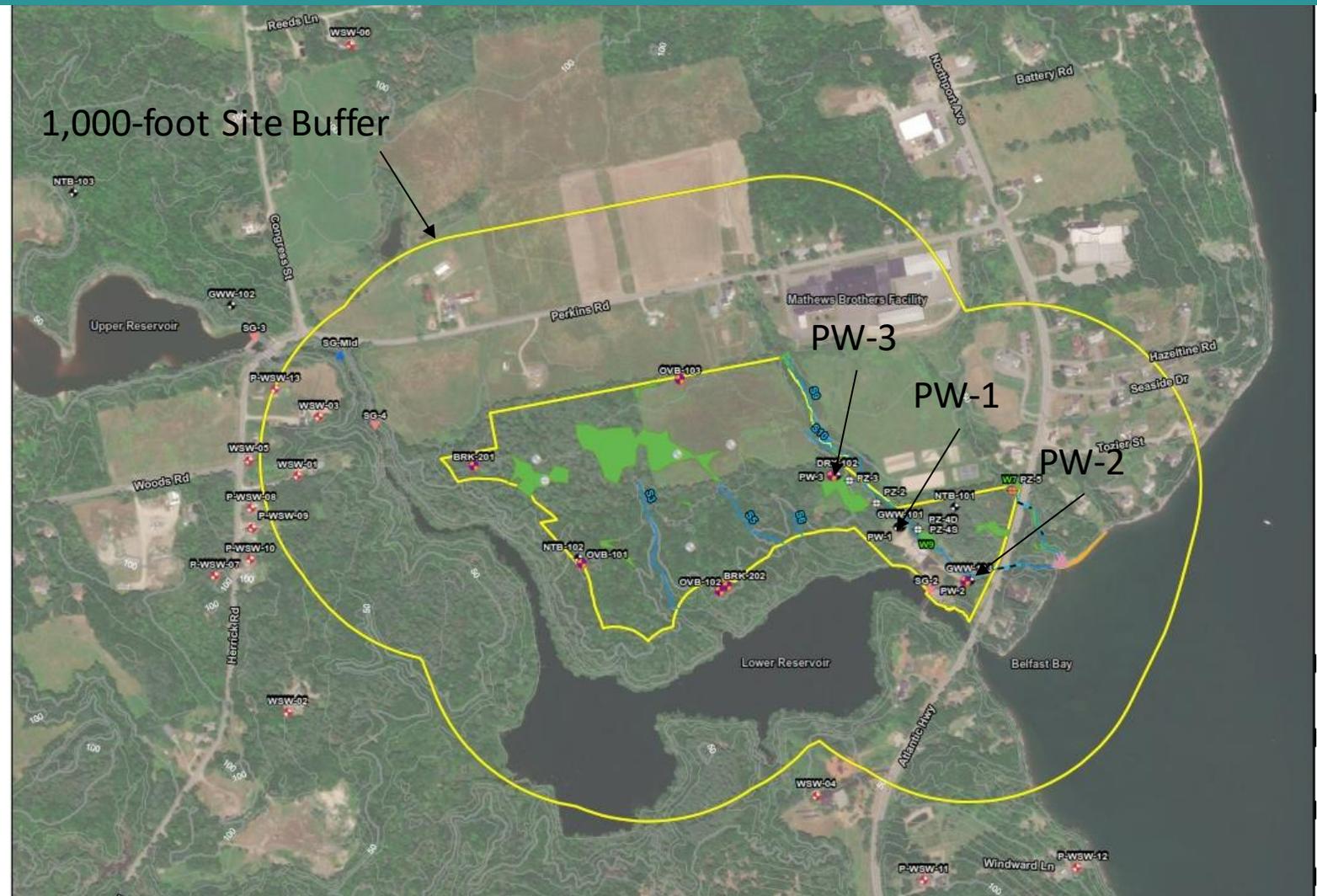
*The City Planning Board must determine that an applicant request to extract groundwater by a significant groundwater well(s) has and will meet the following performance standards to grant a permit for a significant groundwater well(s).*

- **Nordic has demonstrated ability to operate similar facilities and systems**
- **Third-party team has demonstrated ability to monitor similar facilities and systems**

**We welcome input from City Planning Board, City hydrogeologist, and MEDEP to improve monitoring plan.**

# Water Resources Monitoring Plan

- More than 50 monitoring points on-site for water quality and quantity
  - Bedrock wells
  - Overburden wells
  - Private wells
  - Wetland monitoring
  - Surface water
  - Precipitation
- Proposed 15 private wells for water quality and elevation
  - Well construction and pump depth
  - Groundwater level
  - Water quality sampling



# Water Resources Monitoring Plan

---

How do we know if something needs to change?

- Use model predictions and/or baseline (prior to operations) data as comparison point
- Thresholds for water level and quality laid out in Monitoring Plan
  - Water level (quantity) thresholds
  - Water quality
- Periodic and annual analysis review of data and report submitted to City and MEDEP

# Water Resources Monitoring Plan

---

What happens if an effect is observed?

- Thresholds are conservative, detect changes before significant impacts occur
- If changes are observed, immediate action will be taken in coordination with the City and MEDEP
- Possible actions include:
  - Adjust facility operations
  - Water system upgrades for private users if needed, such as
    - New/redeveloped wells, changes in pump settings, etc.
    - Water treatment
    - Connection to public water

The Water Resources Monitoring Plan is currently being reviewed by MEDEP, and the final plan will be subject to MEDEP and City input.

# Summary

---

- Extensive investigation and data collection (*Sec. 102-1077*)
- Groundwater and surface water systems well characterized (*Sec. 102-1077*)
- BWD water supply isolated from site groundwater supply (*Sec. 102-1079*)
- Lower Reservoir withdrawal to have minimal impact to reservoir levels (*Sec. 102-1077*)
- Groundwater model indicates sustainability of site groundwater supply (*Sec. 102-1079*)
- Private well use not expected to be impacted (*Sec. 102-1079*)
- Monitoring plan proposed to detect unexpected issues early and allow swift remedy (*Sec. 102-1079*)

A scenic view of a lake in autumn. The water is calm, reflecting the surrounding trees and sky. In the foreground, a dog is sitting on a grassy bank, looking towards the water. The background shows a bridge and some buildings. The overall atmosphere is peaceful and serene.

Questions?