THE MAINE WATER COMPANY, BUCKSPORT DIVISION

JANUARY 2026

Silver Lake Firm Yield Evaluation

Wright-Pierce

Engineering a Better Environment

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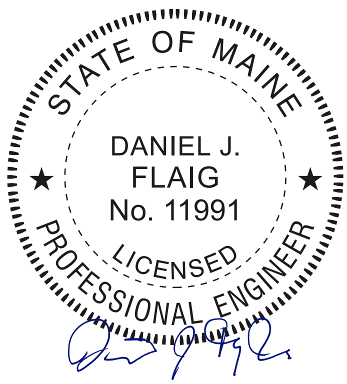
The Maine Water Company, Bucksport Division

January 2026



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Section 1 Executive Summary

Background

The Bucksport Division of Maine Water Company (MWCBD) obtains its raw water supply from Silver Lake, located in Bucksport, Maine. MWCBD owns and operates the Bucksport Water Treatment Facility, a surface water plant built in 1997 that is designed to treat an average daily demand of 0.5 million gallons per day (MGD). Water from Silver Lake gravity flows into the treatment plant via a 12-inch intake pipe that is approximately 2,500 ft long. MWCBD maintains two concrete storage tanks for normal and high-pressure zones, as well as two booster stations and one pump station.

The projected average and maximum day demands for the MWCBD obtained from its 2020 master plan are summarized in Table 1-1.

Table 1-1 Projected Average-Day Demands Bucksport Water District

Projected Water Demand	Year 2020* (gpd)	Year 2040** (gpd)
Residential Demand	72,000	79,800
Commercial Demand	33,600	37,300
Governmental/Municipal	17,600	16,100
Industrial	132	10,000
Non-Revenue Water	18,500	22,300
Projected Average-Day Demands	**141,832**	**165,500**
Projected Max-Day Demands	**266,800**	**311,100**

*2020 data represents actual observed data.

** Data obtained from 2020 Master Plan

The MWCBD retained Wright-Pierce to evaluate the safe yield of Silver Lake using modern numerical techniques, accurate bathymetry survey information, and modern GIS tools for mapping and digitizing watershed characteristics.

A computer program called the "Firm Yield Estimator", developed by the US Geological Survey (USGS) was used for the new evaluation. This program uses numerical methods to estimate runoff and to calculate available yield based on constraints placed on the system, such as a minimum conservation flow release for biological purposes.

Summary of Findings

Silver Lake has sufficient firm yield to meet the long-term, average-day and maximum demands of a water system. The day-to-day fluctuations are important to understand when sizing individual system components such as treatment facilities and pumping stations.

Table 1-2 Estimated Firm Yields

Lake Storage Range	Usable Volume (MG)	Firm Yield[1] (MGD)
El. 128 ft – El. 120 ft[2]	1,253	5.77
El. 126 ft – El. 120 ft[2]	939	4.75
El. 124 ft – El. 120 ft[2]	626	3.17
El. 122 ft – El. 120 ft[2,3]	313	1.37
El. 128 ft – El. 124 ft[3]	627	3.18
El. 124 ft – El. 122 ft[3]	313	1.37
El. 120 ft – El. 118 ft[3,4]	308	1.34
El. 128 ft – El. 118 ft[4]	1,561	6.31
El. 126 ft – El. 118 ft[4]	1,247	5.75
El. 124 ft – El. 118 ft[4]	934	4.72
El. 122 ft – El. 118 ft[4]	621	3.14
El. 120 ft – El. 118 ft[3,4]	308	1.34

1. Estimated using Firm Yield Estimator, Version 1.0
2. Minimum lake elevation from the 1989 Indenture between Bucksport Water Company and Champion International Corporation is El.. 120 ft.
3. Level range for withdrawal limits in the 2019 Water Easement from Bucksport Mill, LLC to Bucksport Generation, LLC and Whole Oceans, LLC.
4. Minimum lake elevation in 2019 Water Easement from Bucksport Mill, LLC to Bucksport Generation, LLC and Whole Oceans, LLC is El. 118 ft.

The estimated firm yield for lake level scenarios between elevation El. 120 – 128 ft ranges from 1.37 to 5.77 MGD. The minimum lake water level granted to MWCBD by Indenture is elevation El. 120 ft.

1.1 Recommendations

It is not possible to predict when a drought condition will begin, or when it will end, nor is it possible to predict the severity of the drought condition. Therefore, it is prudent to operate a surface water supply system in anticipation that the available supply will be more limited due to a drought.

The State of Maine does not have a state-wide drought management plan that triggers formal water conservation or other measures in response to a drought like most other New England states. The MWC is in control of water allocation year to year.

We do recommend that the MWC implement measures to manage the resource during dry years:

- Reservoir Levels - Lake level should be recorded weekly and plotted for each year to understand long-term trends for Silver Lake. This data can be compared to precipitation patterns in a given year.
- Precipitation should also be collected from local monitoring stations. This data will allow the MWCBD to compare lake level trends year to year.
- The 1989 Indenture granted to MWCBD and the 2019 Water Easement granted to Bucksport Generation, LLC and Whole Oceans, LLC should be coordinated and possibly updated to protect the water supply availability to the public water system of Bucksport during drought conditions.

2

Section 2 Introduction

2.1 Background

Water is a primary resource that is held in long-term trust and stewardship for the public and for the environment. At the same time, a water supply provider's mission is to ensure that the present and future supply is adequate for the service community's consumption and to support its economic well-being. These two important responsibilities require cultivating an understanding of the extent and limits of the water supply as a first step in planning to meet future needs. Determination of the "Safe Yield" of a supply reservoir or system of reservoirs is a basic building block in the planning process. Such an analysis considers historic watershed hydrologic and local meteorological conditions to define the total amount of water available from the environment to replenish a water system's reservoirs. In the case of the MWCBD, the reservoir is Silver Lake, which stores and impounds natural flow for use as a drinking water supply.

"Safe Yield" is a term that has been long in use by water supply engineers to define the maximum quantity of water that can be withdrawn from a storage reservoir or system of reservoirs during the driest extended period of drought on record. The safe yield value was based on each reservoir being fully drawn down to its lowest practical level or draw point during the drought of record. A modification of safe yield is termed the "practical" or "firm yield", which incorporates a variety of additional limitations including:

- Water withdrawal regulations that may limit available yield,
- Poor or untreatable water quality occurring in the reservoir's deeper elevations,
- Risk management activities initiated during extreme droughts

Additionally, safe yield calculations have historically assumed that all impounded water that is physically available for withdrawal is of sufficient quality to be treated and consumed by the water utility's customers. A proper accounting of yield must discount those volumes impounded at depths which are often oxygen deprived and difficult to treat with common treatment methods.

Lastly, utilities need to be conservative in managing the yield of a storage system. Planning around complete use of a storage system's safe yield is not prudent during periods of extreme drought without retaining some reserve volume within the storage system.

The MWCBD retained Wright-Pierce to evaluate the firm yield of Silver Lake while considering the above-mentioned constraints with varying model scenarios. This study presents a range of practical or firm yield considering watershed characteristics and climate data. For the purposes of this report, the firm yield will be defined as "the annual quantity of water that can be made available in most years while imposing water deficiencies during hydrologic drought conditions".

A computer program called the "Firm Yield Estimator" (FYE), developed by the US Geological Survey (USGS) in partnership with the State of Massachusetts Department of Environmental Protection, was used for the evaluation. This program uses numerical methods to estimate runoff and to calculate available yield based on constraints placed on the system, such as a minimum conservation flow release for biological purposes.

The data from this study will be used for future planning purposes, to assess the size of future treatment facilities, and to assess how supply capacity may be impacted by water demand growth, changing climate conditions, and impact of other water withdrawals.

2.2 Project Scope

2.2.1 Firm Yield Analysis

A yield analysis requires knowledge of local hydrologic conditions and the physical properties of each storage reservoir. Hydrologic data is collected from the recorded flows of local streams gaged by the U.S. Geological Survey (USGS). This is combined in the analysis with meteorological data of nearby locales which is obtained from the National Oceanic and Atmospheric Administration (NOAA). Physical and topographic properties of the reservoir are determined from examination of existing records, bathymetric surveys for the reservoir, and ground cover and soils information available through the Maine Office of Geographic Information System (MEGIS), and the USDA Natural Resource Conservation Service (NRCS).

The work plan for this study included three key focus areas:

- Collection of bathymetry data
- Completion of the numerical analysis to determine Firm Yield for various lake levels
- Collection of surficial geology data

Bathymetric Survey: An important first step of firm yield analysis is to understand the relationship between the reservoir's storage volume and water depth. Wright-Pierce completed a bathymetric survey of Silver Lake to collect information on the submerged land features.

Reservoirs Firm Yield Study: Utilizing the bathymetry the reservoir, Wright-Pierce performed a firm yield study using a mass-balance model in accordance with the latest engineering practice. The determination of yield based on this more rigorous analysis is the primary focus of this study.

Surficial Geology Study: The software (FYE) used to perform the firm yield analysis does not consider groundwater losses or base flows. Wright-Pierce gathered and processed information pertaining to the watersheds surficial geology to determine that groundwater contributions to lake storage has minimal influence compared to evaporation, surface drainage and water withdrawals.

2.2.2 Dam Evaluation

An evaluation of the Silver Lake dam was conducted to aid the ongoing discussion of ownership and maintenance responsibilities. Wright-Pierce performed a visual inspection of the site to assess the spillways, structural integrity, and surrounding area (Appendix A).

2.3 Existing Facilities and Prior Studies

MWCBD completed a comprehensive master plan in 2020 to guide improvements to the water system and to understand growth patterns in water-use. The MWCBD has a successful management plan for the reservoir and surrounding watershed land. MWCBD obtains its raw water supply from Silver Lake, located within the municipal boundaries of Bucksport, Maine, which has an estimated storage capacity of 2,700 million gallons (MG). Additionally, MWC completed a source water risk analysis for the Silver Lake contributing watershed in 2016 and determined that water quality is still subject to contamination from development occurring upstream of the lake, outside the bound of Maine Water owned property.

MWCBD owns and operates the Bucksport Water Treatment Facility, a surface water plant built in 1997 that is designed to treat an average daily demand of 0.5 million gallons per day (MGD). Water from Silver Lake gravity flows into the treatment plant via a 12-inch intake pipe that is approximately 2,500 ft long. MWCBD maintains two concrete storage tanks for normal and high-pressure zones, as well as two booster stations and one pump station.

2.4 Report Organization and Outline

The report is organized as follows:

Section 2 - Introduction: This section presents the project scope and background.

Section 3 - Water Supply System: This section describes each of the components of the water supply system including the surface water reservoirs, raw water pumping and transmission system, water treatment facility, and distribution system. Service areas and water demands are also discussed in this section.

Section 4 - Basis of Firm Yield Calculations: This section describes the methodology used in determining safe yield, as well as the types of data and the sources for the data used in the calculations.

Section 5 - Firm Yield Evaluations and Findings: This section presents the yield calculations during several conditions for the drought of record and various lake level scenarios

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Section 3 Water Supply System

3.1 Overview

The town of Bucksport water public supply system is supplied with treated water sourced from Silver Lake. Bucksport Mill, LLC, owns and maintains the Silver Lake Dam (No. 105) located on the southwest end of the reservoir. Silver Lake is the public water supply for the Town and is open to recreational use. Bucksport Generation, LLC and Whole Oceans LLC also have water rights to Silver Lake granted by Water Easement from the Bucksport Mill, LLC to Bucksport Generation, LLC (to which Whole Oceans, LLC is also a party. An Indenture made in 1989 between Bucksport Water Company (now MWCBD) and Champion International Corporation (former mill and dam owner) requires the dam owner to maintain water level in Silver Lake above El. 120 ft mean sea level.

As part of this study, the watershed area, storage volume, and surface area of the lake were digitized and recalculated using modern mapping techniques. **Table 3-1** includes the information based on the bathymetric survey calculations. The findings are briefly described below:

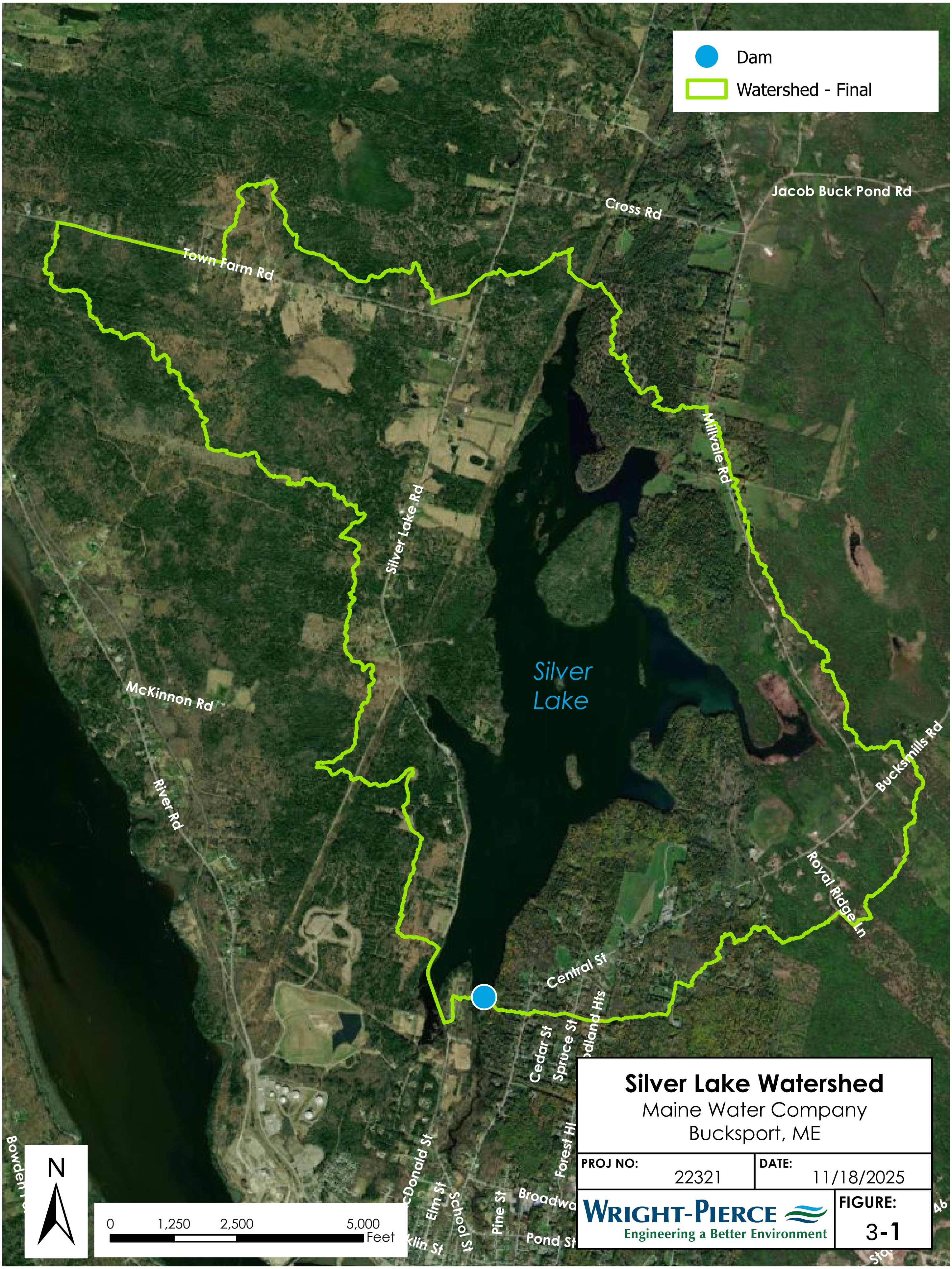
Table 3-1 Silver Lake and Dam Data Based On 2025 Bathymetry Survey and Dam Operation and Maintinence Mannual

Impoundment	Silver Lake
Total Pond Storage Capacity (MG)	2,697
Drainage Area (Square Miles)	3.8
Drainage Area (Acres)	2,435
Lake Maximum Surface Area (Acres)	678
Usable Storage Capacity (MG) (Above Intake Elev.)	2,198
Dam	
Type of Construction	Earth embankment dam with concrete core wall.
Maximum Dam Height (feet)	30
Spillway Crest Elevation (El. Feet)	El. 124
Steal Bulkhead (El. feet)	El. 128
Year Constructed	1930
Reconstruction years	1984
Existing Emergency Action Plan (EAP)	Yes

3.2 Water Supply Watersheds and Sources

3.2.1 Area and Sub Watershed System

The watershed area contributing to Silver Lake is roughly 2,410 acres, with approximately 61% of the watershed being forest growth. Within this area, there is access for passive use such as hiking and biking. The extent of the watershed is shown in Figure 3-1.



Silver Lake Watershed
Maine Water Company
Bucksport, ME

PROJ NO: 22321
DATE: 11/18/2025

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FIGURE: 3-1

3.3 Water Supply Ponds and Reservoirs

3.3.1 Silver Lake Dam

The Silver Lake outlet structure and spillway is constructed of concrete with concrete retaining side walls on the upstream and downstream faces. The dam concrete spillways and outlet structure were constructed in 1930 and underwent major repairs in 1984 including dewatering, resealing of the foundation, refacing exposed surfaces of the concrete spillway and channel, and the construction of a new spillway bridge.

According to Haley Ward's 2021 revision of the O&M Manual, Bucksport Mill LLC contracts personnel to maintain lake levels following an established rule curve. Historical and hydrological data for Silver Lake and the Mill/Tannery Stream remain limited. Records from 1960 to 1998 indicate that the peak recorded lake level was 130.5 feet in December 1969 (U.S. Geological Survey datum), which would correspond to an estimated discharge of 607 cubic feet per second—approximately 2.5 feet above the spillway crest. Under normal operating conditions, Silver Lake levels typically fluctuate between elevations 124 and 128 feet, with lower levels observed in late summer and early fall. The estimated average unregulated annual flow for the watershed is approximately 10.0 cubic feet per second per square mile.

In 2025, Wright-Pierce performed a limited visual dam evaluation to aid the ongoing discussion regarding the importance of sustainable management and operation of the dam. Wright-Pierce and MWCBD employees completed a site visit to the Silver Lake dam on the southwest end of the reservoir to visually inspect the spillways, structural integrity of the dam, and surrounding land. In addition to the site visit, the Silver Lake Dam Operation and Maintenance Manual, Revision 1, October 2024, by Haley Ward, Inc. (HW Report), was reviewed with regards to dam history, hazard classification, and operation and maintenance recommendations. The dam was generally found to be in good condition, with no immediate structural or operational concerns observed. However, several maintenance issues were noted: significant efflorescence on downstream wing walls, leakage around the 8' x 6' timber stoplog gate wrapped in impermeable membrane, and ongoing seepage and surface concrete erosion on the ogee flume spillways. The west spillway shows greater deterioration and cracking, likely due to its slightly lower bulkhead elevation, which results in higher water flow compared to the east side.

3.3.2 Water Demands

The 2020 Master Plan Update developed water-use projections for the MWCBD extending through year 2040. The data is presented in **Table 3-2**.

Water use records from 2016 to 2020 show an annual average-day demand of approximately 147,000 gpd. Annual water-use overall has decreased since 2010, primarily due to an exponential decline in industrial water demand after the closure of the Bucksport mill. Water-use data recorded after the 2020 Master Plan Update was published reveal an increase in water demand, with an annual average-day demand of approximately 157,000 gpd from 2020 to 2024.

Table 3-2 Projected Average-Day Demands Bucksport Water District

Projected Water Demand	Year 2020* (gpd)	Year 2040** (gpd)
Residential Demand	72,000	79,800
Commercial Demand	33,600	37,300
Governmental/Municipal	17,600	16,100
Industrial	132	10,000
Non-Revenue Water	18,500	22,300
Projected Average-Day Demands	**141,832**	**165,500**
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*2020 data represents actual observed data.
** Data obtained from 2020 Master Plan

4

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Section 4 Firm Yield Calculations

4.1 Analysis Methodology

4.1.1 Firm Yield Estimator Software

The firm yield analysis of the reservoir serving the town of Bucksport's public water system was performed using the software package, "Firm Yield Estimator" (FYE), which was developed by Cambridge Environmental Inc. (2000). The software utilizes stream gage data, meteorological data, and reservoir characteristics, and evaporation to perform the firm yield calculation based on the methods and techniques developed by N.M. Fennessey and R.M. Vogel (see USGS reference 2006).

The developers of the software define the term "Firm Yield" as "the maximum average daily withdrawal rate that can be made from the reservoir from which all the water in active storage is fully depleted once during the simulation". In a prolonged, multi-year drought condition, the storage volume is depleted just once during the complete refill-cycle of the reservoir. This will be explained in more detail further in the report.

The Massachusetts Department of Environmental Protection (Mass DEP) requires public water systems that use surface water supplies in Massachusetts to utilize the FYE software to document the safe yield of their reservoirs as required by the Massachusetts Water Management Act. The Firm Yield term is used because while the concept contains the same basis of safe yield, it includes the assumption that water use restrictions would be put in place during times of drought.

The State of Maine does not have a standard numerical methodology required by regulation in the analysis of yield. On this basis, the numerical model developed by the USGS for the State of Massachusetts was used for the Silver Lake evaluation. The algorithms employed by the software are those documented in "Estimating the Firm Yield (FYE) of a Surface Water Reservoir Supply System in Massachusetts (Mass. DEP, 1996).

The FYE uses the following input data:

- Meteorological data from a weather station near the reservoir that replicates local weather conditions.
- Stream flow data with an appropriate period of record from a nearby USGS gaging station
- Reservoir specific properties including:
    - Area of reservoir watersheds
    - Stream gage data for a watershed with similar characteristics
    - Reservoir bathymetry
    - A stage-storage curve relating volume with reservoir depth
    - Reservoir evaporation rates (calculated by software)
    - Average watershed topography
    - Water-use Factors
    - Mean channel slopes of each watershed
    - Maximum soil retention
    - Monthly water withdrawal peaking factors

The modeling technique requires collection of the physical information listed above pertaining to the reservoir as inputs into the model.

Historical stream flow data is obtained from stream gages maintained throughout New England by the US Geological Survey (USGS). The gages provide real-time flow characteristics as well as recorded historical data over the life of the gage. The USGS has selected stream gaging locations that represent a cross-section of hydrologic data in any given state. The stream gages are located on both small and large watersheds and at dispersed locations around the state to capture local adiabatic effects, watershed characteristics and local weather patterns. The model uses historical stream flow and precipitation (meteorological) time-series data sets that are obtained from nearby locations that share similar meteorological and watershed characteristics of the MWCBD reservoir drainage basin. These data are used and transformed to reflect the reservoir and watershed conditions at the Bucksport location. In selecting a representative stream gage for this evaluation, the following criteria were used:

- The stream gage watershed location should be located in reasonable geographic proximity to the reservoir to replicate local weather and land-use patterns
- Stream flow and precipitation time-series data that brackets the 1960s New England drought of record.

4.1.2 Comparative Watersheds and Classification

The Oyster River stream gage (USGS 1073000) located in Durham, New Hampshire (Stratford County) was selected as the appropriate stream gage for this study. The Oyster River gage has a 12.1 square mile watershed area compared to the Silver Lake watershed area of approximately 3.77 square miles. The Oyster River gage elevation is 65.29 feet (NGVD 1929). The station has been operating since January 1935, with its dataset extending through the present year. A comparative watershed delineation for the Oyster River is shown in Appendix B.

A comparison was made between the Bucksport and Oyster River watersheds to compare the percentages of various land types (i.e., developed areas, forested are, wetlands) to determine if both drainage basin exhibited similar runoff characteristics. The available land classification data was obtained from the USDA Natural Resources Conservation Service website. The purpose of this analysis is to translate and relate known runoff characteristics from a gaged watershed to the watershed draining into the Silver Lake.

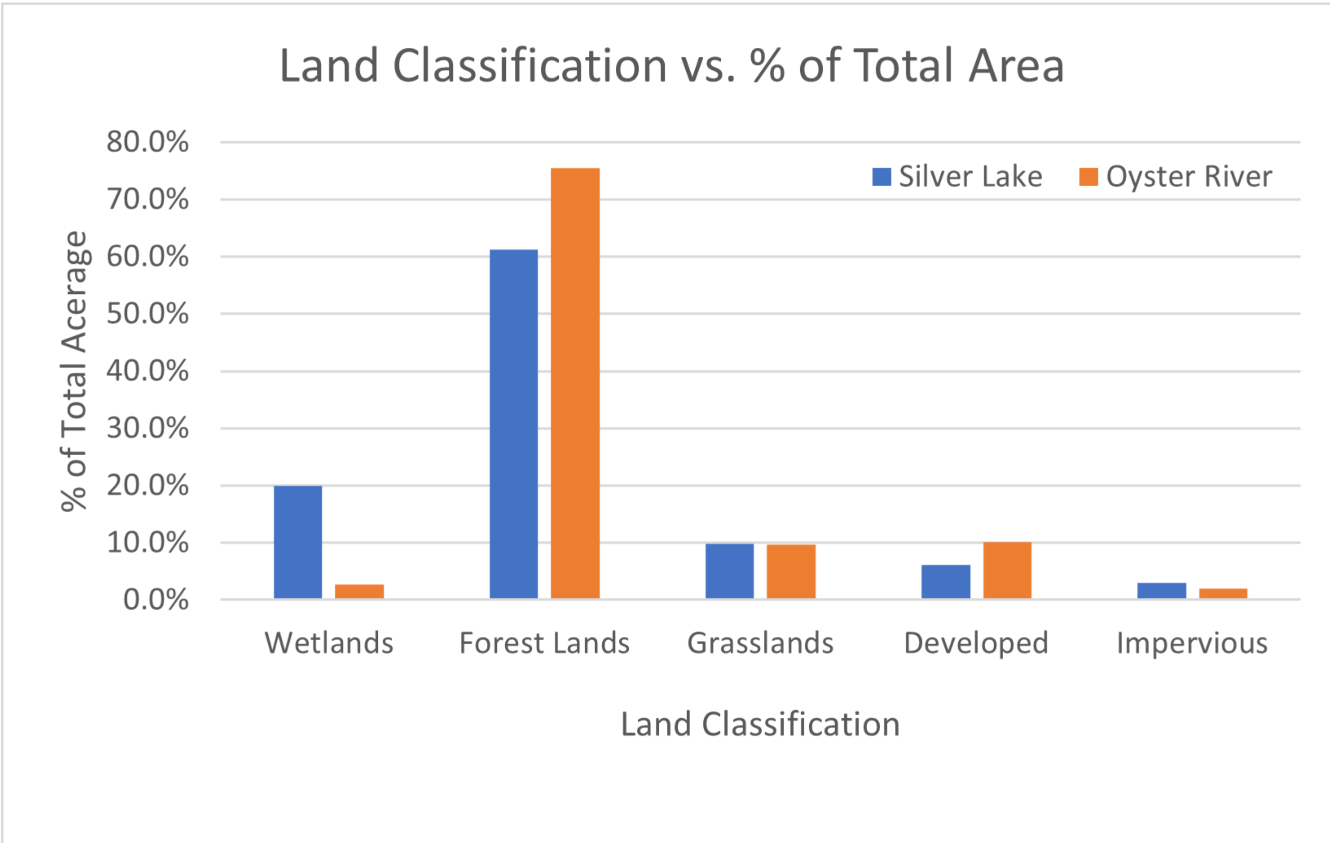
4.1.2.1 Methodology Behind Watershed Compatibility

Oyster River was initially identified as a potential comparison watershed for Silver Lake due to the availability of extensive long-term data. However, because of its distance from Bucksport, Maine, additional research was conducted to identify gaged watersheds within the state that were closer in proximity. Using the USGS National Water Dashboard, watersheds with records dating back to 1960—the drought of record—and similar in size to the 3.77-square-mile Silver Lake watershed were evaluated.

This analysis revealed that most long-term gaged watersheds in Maine are significantly larger than Silver Lake, making them unsuitable for direct comparison. Scaling these datasets would introduce excessive uncertainty and potentially distort results. While several watersheds near Bucksport were found to be comparable in size, they lacked the historical data necessary for this study.

Therefore, Wright-Pierce concluded that the Oyster River remains the most appropriate gaged watershed for comparison. It offers a robust long-term dataset, a similar watershed size, and being coastal, shares comparable weather and climate conditions with Bucksport. Refer to **Figure 4-1** below for a visual land use comparison of the two watersheds.

Figure 4-1 Watershed Land Classification and Comparison



4.1.3 Meteorological Data

The National Oceanic and Atmospheric Administration (NOAA) operate and maintain a number of meteorological stations within the States of Maine and New Hampshire that bracket the minimum time period of record. It is recommended that a meteorological data set be obtained from a monitoring station that is in proximity to the project location and gaged stream with a long enough period of record to encompass the time period of interest. The 48-year period between 1959 and 2007 was deemed essentially to adequately bracket the mid-1960's and 2001 drought of record. Precipitation data from Bangor and Agusta, Maine, was graphed to confirm the drought of record and is presented below in Figure 4-2. NOAA Meteorological Data for stations located in York and Penobscot Counties in Maine meet the data criteria that are listed below in **Table 4-1**

Figure 4-2 Bangor and Augusta Precipitation

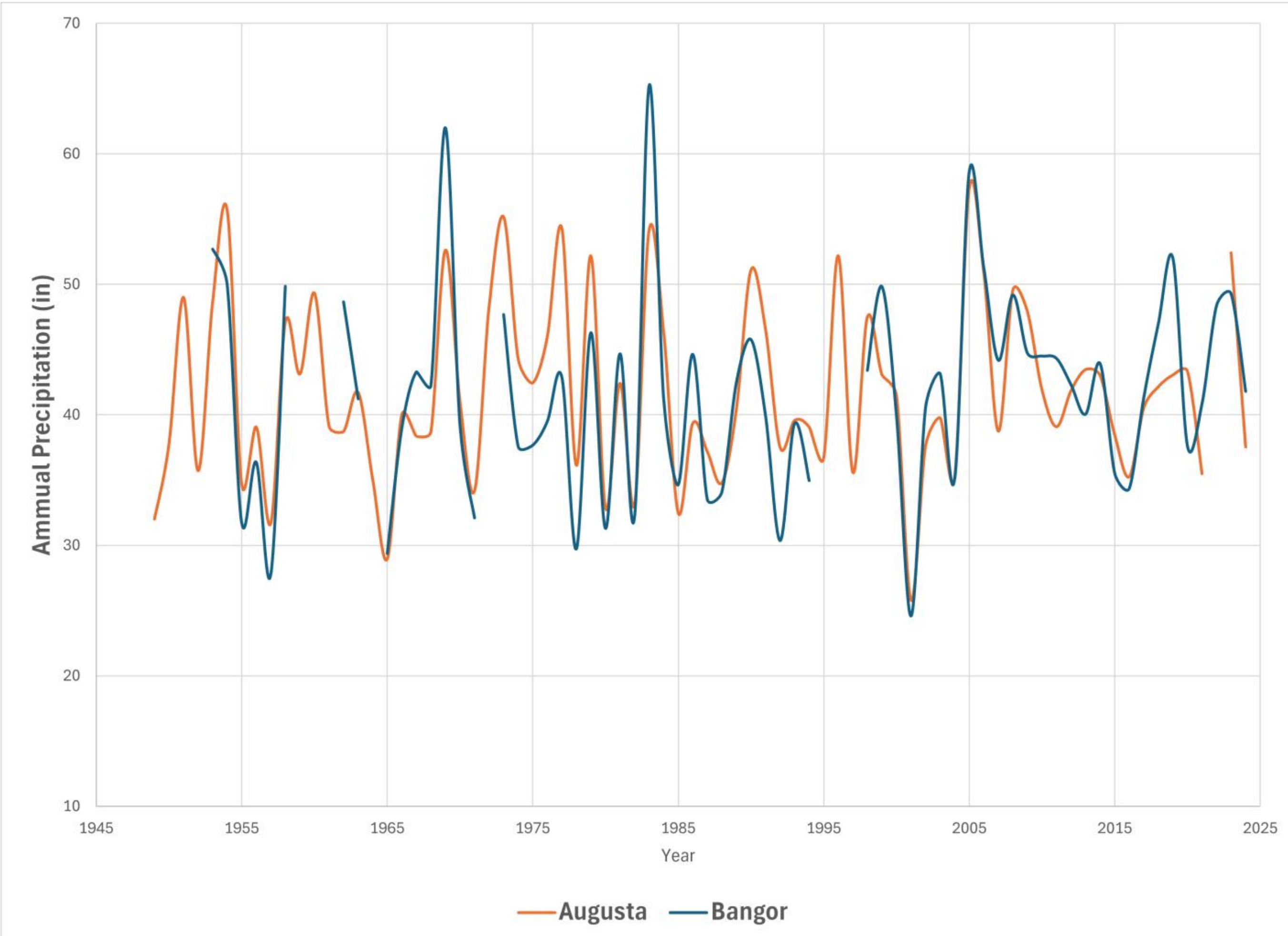


Table 4-1 NOAA Meteorological Stations

NOAA Station ID	Station Name	Period of Record
KSFM	Sanford 2NNW (York Co. ME)	1959-Present
KBGR	Bangor International Airport (Penobscot Co. ME)	1953- Present
Data set selected must be nearby and contain temperature, precipitation and snowfall data for the required 48-year period		

Data was obtained from NOAA for the Sanford 2 NNW station (Station ID KSFM) located at longitude 70°47'W and latitude 43°27'N, and 280' elevation was selected as the best representative weather station for the stream gage location. Historical average, annual rainfall, and snowfall data was utilized from the NOAA station in Bangor as model inputs. The station meets the time period requirements and is located is located approximately 20 miles from the Oyster River and approximately 135 miles from Bucksport. The Bangor NOAA station at the International Airport is located approximately 15 miles from Bucksport. The proximity of a weather station is important in coastal communities because of the localized and dramatic effect of weather impacted by the Atlantic Ocean.

The data used in the FYE analysis includes precipitation, snowfall, and average monthly maximum and minimum temperatures (calculated from daily maximum and minimum temperatures). The distribution of precipitation has an important impact on run-off in New England. The moisture content and depth of the snowpack can drive yield and storage characteristics in many years. Droughts can occur even in years with heavy snowpack if precipitation patterns through the balance of the year are below normal. The numerical analysis characterizes and considers the distribution and amount of precipitation in each year of the period of record.

The average monthly temperatures measured at this site are presented in **Table 4-2**.

Table 4-2 Average Monthly Temperature - Sanford 2 NNW NOAA Weather Station

Month	Average Low (°F)	Average High (°F)
January	12.0	33.0
February	13.6	36.4
March	23.1	45.3
April	33.3	58.3
May	44.0	70.5
June	53.5	79.1
July	59.2	83.9
August	57.7	82.6
September	49.6	74.7
October	38.5	62.7
November	30.0	49.3
December	18.7	37.5

4.1.4 Stream Gage Data

The surface water inflow to a reservoir is also necessary for determining the safe yield. The actual inflow to a reservoir is not only impacted by precipitation quantity and distribution, but by evapo-transpiration from vegetation and trees, watershed characteristics, evaporation from reservoir surfaces, and soil retention and storage. These losses occur before flows enter a stream channel, so the measured stream flows account for these losses already.

The gaged stream flows were used in combination with the information about the watershed to estimate the inflow into the reservoir. The United States Geological Survey (USGS) collects and maintains this type of information for selected streams throughout the United States, and it is available for use by the public through its website.

Because the particular stream feeding Silver Lake is not gaged, a dataset of stream flows from a similar watershed was used to extrapolate estimated inflow to Silver Lake for the modeling analysis. The method that is used to select a comparable gaged stream is similar to that used for selecting a meteorological station. A gage station in close geographic proximity to the actual watershed is selected. The recorded data for the gaged station must also cover the time period of interest.

The data from the USGS gage station is transformed to adequately simulate the total monthly surface water inflow into the reservoir under analysis. The stream flow data is transformed to the current situation using parameters such as channel slope, soil runoff properties, and comparison of the area of the reservoir watershed with that of the watershed containing the stream gage used for the analysis. The criteria for selecting a stream gage data set included:

- Stream flow data must date back from the present as far as possible and parallel the meteorological dataset to the greatest extent possible.
- The selected gauging station must be as geographically as close to the reservoir as possible.
- The areal extent of the stream gage watershed must be reasonably close to the Silver Lake watershed (with area within 50% of the subject watershed).

The Oyster River Station in Durham, New Hampshire (USGS Station 01073000; 43°08'55" latitude and 70°57'56" longitude) is the only USGS stream gage station in Maine and New Hampshire that has an area comparable that of the Silver Lake watershed.

4.1.5 Reservoir Characteristics

The reservoir characteristics needed for input to the FYE are as follows:

- Area of the watershed feeding each reservoir (square miles)
- Area of the watershed for the gaged comparison stream (square miles)
- Useable reservoir capacity (million gallons)

The firm yield of each individual reservoir was calculated using the above information specific to that reservoir:

- Area of Reservoir Watershed - The area of the watershed for each reservoir was determined using a matrix of 10-meter digital elevation model (DEM) data obtained through the Maine Office of GIS (ME Dept. of Admin and Financial Services, Office of Information Technology), USGS topographic maps, where available 2-foot contours. The watersheds delineated for each reservoir were measured for model inputs.
- Area of Watershed at the Selected Stream gage - The drainage area of the stream gage was included along with the data obtained from the USGS (Appendix B).
- Useable Reservoir Capacity - The usable capacity of Silver was determined from the bathymetric survey and minimum lake operating elevation of elevation El. 120 ft established by the 1989 Indenture.

The list of model inputs is included in Appendix C.

4.1.6 Bathymetric Survey

As part of this study, a bathymetric survey (survey of underwater topography) of Silver Lake was conducted using GPS equipment. The topographic (bathymetric) data was used to produce useable capacity for the incremental depth and surface areas of the reservoir. This relationship is referred to as stage-storage curves. This data is a simple plot of volume to depth in a reservoir.

The bathymetry information was transformed into a graph of surface area versus reservoir storage capacity for input into the computer model described as follows. An equation was obtained from the best-fit polynomial equation relating the reservoir area (A - square miles) to the useable volume of water in the reservoir (S - million gallons):

$$A = C + C1S + C2S2 + C3S3 + \ldots$$

The best-fit coefficients of the polynomial (C, C1, C2, C3, etc.) are placed into the FYE dialog box where the order of the polynomial is also chosen. The graphical presentations of the bathymetric data and the best-fit equations are provided in Figure 4-3.

Figure 4-3 Silver Lake Stage-Storage Curve

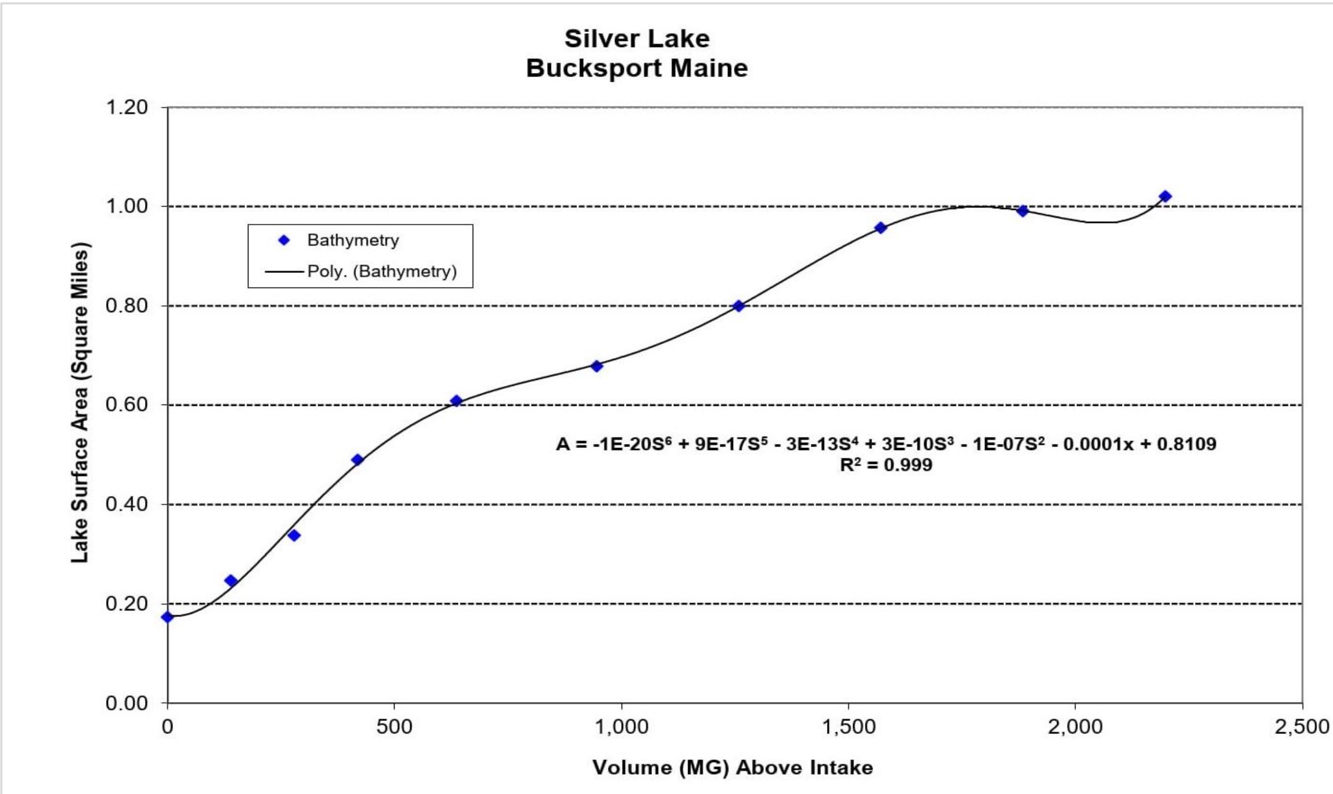


Table 4-3 Bathymetric Data

Water Surface Elevation	Volume Above Intake (MG)	Lake Volume (MG)	Lake Surface Area (Sq Miles)	Lake Surface Area (Acres)
128	2198	2,697	1.02	653
126	1884	2,383	0.99	634
124	1571	2,070	0.96	612
122	1258	1,758	0.80	512
120	945	1,445	0.68	434
118	637	1,136	0.61	389
116	419	918	0.49	313
114	279	778	0.34	216
112	139	639	0.25	158
110	0	499	0.17	111

4.1.7 Evaporation

The rate of evaporation is important in determining yield. For example, a large shallow reservoir will experience more loss of yield to evaporation than a deeper smaller reservoir of similar volume.

Evaporation also occurs from interception by trees and vegetation. Interception losses occur when precipitation evaporates directly from the surface of vegetation before hitting the ground surface and running off to a stream channel. Evapo-transpiration occurs when trees draw water from the groundwater table of surface water bodies for sustenance. Both evaporation losses are reflected in the measured stream flows and do not require special consideration with the model.

Evaporation rates may be specified by month in the FYE, or alternatively, they may be estimated based on the meteorological data. For this analysis, the longitude of each reservoir and average watershed elevations were input into the FYE program to generate the evaporations rates based upon the meteorological data (maximum temperature, minimum temperature, snowfall, and precipitation). The monthly evaporation (inches per month) used in the model are presented in **Table 4-4** below.

Table 4-4 Estimated Evaporation

Month	Evaporation (in)
January	0.93
February	1.31
March	2.41
April	3.71
May	5.40
June	6.35
July	6.77
August	5.86
September	4.08
October	2.55
November	1.33
December	0.86
Total	**41.56**

4.1.8 Peak-Use Factors

Peak-use factors for withdrawing water from the reservoir can be specified within the FYE software. These values account for seasonal variations in reservoir withdrawal rates and may be specified for each month. For this analysis, peak use factors were calculated based on seasonal variations in demand derived from the 2020-2024 Maine Public Utilities Commission Annual Reports. The peak-use factor is calculated by dividing the monthly average day demand by the annual average day demand. During the winter months, the peak-use factor is typically 0.85+/-. During the summer, the factor is typically 1.10+/- for the MWCBD. These factors address the seasonal changes in demand. **Table 4-5** shows the peak use factors entered into the FYE. These factors are the average peak use factors for each month from 2020-2024.

Table 4-5 Peak Use Factors

Month	Peak Use Factors
January	0.85
February	0.88
March	0.78
April	0.95
May	1.00
June	1.18
July	1.19
August	1.24
September	1.08
October	1.10
November	0.87
December	0.88

4.1.9 Direct withdrawals for Other Uses

Often reservoir systems are used for multiple purposes in addition to consumptive uses, such as for irrigation and hydropower generation, so the model software is configured to account for these withdrawals if present. Withdrawal rates from the reservoir by other users of the impounded water volume may be entered on a monthly basis into the FYE software and factored into the yield calculations. As stated earlier in this report, a water easement was granted to Bucksport Generation, LLC and Whole Oceans, LLC from Bucksport Mill, LLC in 2019. The water withdrawal limits may conflict with the water supply needs of MWCBD if not managed reasonably and may require use of inter basin transfer infrastructure formally used by the Bucksport Mill to transfer water to Silver Lake from Toddy Pond and Alamoosook Lake. Water withdrawals by other users were not modeled.

4.1.10 Reservoir Releases

The FYE software allows the user to specify reservoir releases for minimum stream flow releases for conservation or fisheries purposes. The release may be specified either as a constant value (MG/month), or as a monthly release (MG/Month). Reservoir releases were not modeled. It does not appear the dam stop are removed for purpose of maintaining base flows. Lake levels must reach the spillway bulkhead elevation of El. 128 for dam overflow releases.

4.1.11 Transforming USGS Stream Flow Data

Before the yield analysis can be performed for each individual reservoir, the data must first be transformed to generate inflow rates to the reservoir. The method of transforming the gaged streamflow data to the reservoir inflow is referred to as the QPPQ method and is documented in the guidance manual (MassDEP, 1996) and by USGS (2006).

The QPPQ method uses an existing stream flow record from a monitored (gaged) site with an appropriate time period to develop a flow-duration curve (FDC), which provides exceedance probabilities for a range of daily flows in the record. The flow probability for any given day is determined and is considered equivalent to the flow probability estimated for an ungaged site. The following equation combines the exceedance probability, Pq, with three regional parameters ξ, α, and κ to give the flow value, qp, at the ungaged site (MassDEP, 1996):

$qp = \xi + \alpha / \kappa \, [1\text{-}Pq \; k]$

The three FDC parameters are simple exponential functions of climate, soil, and basin characteristics determined from a multivariate regression of 166 stream flow gauging stations in the northeast and mid-Atlantic U.S. (Fennessey, 1994) represented as:

$\xi = \exp[-9.97 + 0.0895 \ln2(\text{AREA}) + 0.982 \ln(\text{SOIL}) + 2.22 \ln(\text{PREC})] - 1$

$\alpha = \exp[-8.33 + 1.03 \ln(\text{AREA}) + 2.06 \ln(\text{PREC}) + 0.473 \ln(\text{SOIL})]$

$\kappa = -0.0632 \ln(\text{B-ELEV}) + 0.350 \ln(\text{SOIL}) + 0.169 \ln(\text{SNOW}) - 0.0528 \ln(\text{C-SLOPE}) + 0.410 \ln(\text{PREC}) - 1$

where:

ln( ) = natural logarithm of the argument within the parentheses,

exp[ ] = base e exponent (inverse logarithm) of the argument within the bracket,

AREA = total area supplying water to the reservoir (including the surface area of the reservoir), in square miles,

SOIL = maximum amount of precipitation retained by soil in the drainage basin, in inches,

PREC = average annual rainfall, in inches,

SNOW = average annual snowfall, in inches, B-ELEV = average elevation of the drainage basin, in feet above mean sea level, and

C-SLOPE = mean channel slope, in feet per mile.

The parameters used to complete the transformation are defined above in the list of terms for the equations.

The average precipitation and snowfall were obtained from the selected meteorological station. The other parameters were determined as follows:

Average Watershed Elevation

The average watershed elevation is designated as B-ELEV in the transform calculation and was determined using a matrix of 10-meter DEM data. The average watershed elevation is reported in feet above mean sea level.

Mean Channel Slope

The mean channel slope is designated CSLOPE in the transform calculation and was determined for each reservoir watershed using the equation:

CSLOPE = (E85-E10)/(0.75LENGTH)

where LENGTH is the measured length from the inlet to the reservoir to the beginning of the natural flow channel of the watershed, E10 and E85 are the elevation at locations in the channel that are 10% and 85% of the channel length, respectively. The mean channel slope is reported in feet per mile. Figure 4-4 presents the C-SLOPE for the Silver Lake reservoir graphically indicating the natural channel of flow and the selected locations of E85 and E10.

Silver Lake Elevations
Maine Water Company
Bucksport, ME

PROJ NO: 22321	DATE: 11/18/2025
WRIGHT-PIERCE Engineering a Better Environment	FIGURE: 4-4

Table 4-6 Mean Channel Slope Data

Parameter	Data
Mean Slope	24.78
Flow Line Length (mile)	2.23
Distance from E10 to Inlet (ft)	1,177
Distance from E85 to Inlet (ft)	10,009
E10 Elevation (ft)	149.56
E85 Elevation (ft)	233.24

Maximum Soil Retention

The maximum soil retention parameter is designated as SOIL in the transform calculation. The SOIL term is a parameter used for calculating runoff in the Soil Conservation Service (SCS) Method. SOIL is related to the runoff Curve Number (CN) using the following equation:

SOIL = (1000/CN) - 10

The values of CN are obtained from the standard SCS tables and are a function of land use and hydrologic soil group. A composite or area weighted CN was calculated the watershed. The soil retention parameter is reported in inches.

Table 4-7 presents the transform calculation parameters for the Silver Lake watershed.

Table 4-7 Transform Calculation Parameters

Watershed	Average Watershed Elevation (ft MSL)	Mean Channel Slope (ft/mi.)	SOIL (in.)
Silver Lake	186.7	50.03	3.42

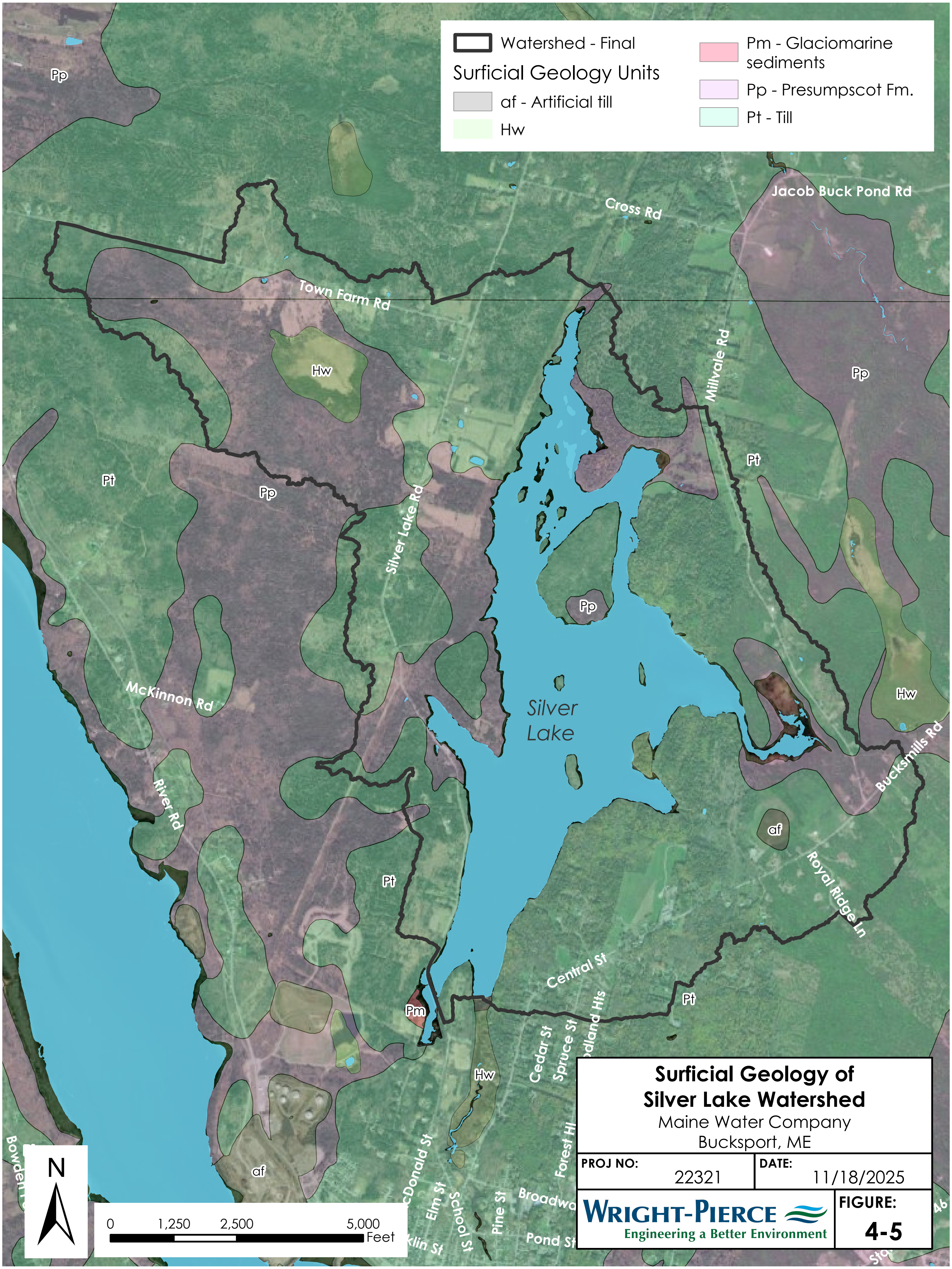
The above parameters were used by the "Firm Yield Estimator" to transform the Oyster River stream gage data into streamflow data for the Silver Lake watershed.

4.1.12 Groundwater Considerations

To evaluate whether groundwater loss could influence the safe yield, both the surficial geology and a USGS StreamStats report (Appendix D) were reviewed. A surficial geology map of the Silver Lake watershed was developed (**Figure 4-5**) and shows two dominant soil units: the Presumpscot Formation (Pp) and glacial till (Pt). The Presumpscot Formation consists primarily of silty clay deposited in a marine environment and typically overlies bedrock or till. Its fine-grained, densely compacted texture results in minimal pore space and, consequently, very low permeability.

In contrast, the till unit is a gravelly to bouldery, sand-matrix diamicton composed of unsorted material with a wide range of grain sizes. Due to this variability, estimating its hydraulic characteristics solely from mapping is challenging. Because no soil samples were collected, a StreamStats analysis was conducted to better characterize subsurface conditions. The report indicates that 0% of the watershed is underlain by sand and gravel deposits, suggesting that the till present contains relatively fine material and correspondingly small pore spaces. Using standard assumptions—approximately 50% permeability for gravel and 25% for till—the effective permeability of the Silver Lake watershed till is estimated to be about 25%.

The StreamStats report also shows that only 4.67% of the watershed is classified as Hydrologic Soil Group A, which includes soils with high infiltration rates and low runoff potential when saturated. This finding further supports the conclusion that the watershed exhibits generally low permeability. As a result, groundwater loss within the basin is expected to be negligible compared to evaporation rates, drainage inflow from the watershed, and water withdrawals.



Surficial Geology of Silver Lake Watershed

Maine Water Company
Bucksport, ME

PROJ NO:	DATE:
22321	11/18/2025

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FIGURE: 4-5

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Engineering a Better Environment

5

Section 5 Firm Yield Results

5.1 Yield Evaluations

The Firm Yield Estimator software was used to calculate the yield for each reservoir using the datasets described in Section 4 of this report.

The FYE software performs a scanning analysis to generate an approximate estimate of the reservoir yield. This is done to determine whether the program needs to generate synthetic meteorological and streamflow data to supplement the measured data that was entered into the program. If the scanning analysis indicates that the reservoir does not refill in 15% or more of the years in the period of record, then a 1,000-year sequence of streamflow and precipitation data is generated by the FYE software for use in the final yield calculation. The scanning analysis is for evaluation purposes and does not consider precipitation or evaporation which is accounted for later in the program run.

5.2 Hydrologic Conditions

Firm yield is understood to be important in extreme drought events. It is often useful for water supply planning purposes to understand available yield in a normal year and a wet year. In this way, a utility manager can observe and document precipitation patterns throughout the year and plan accordingly. There are sophisticated, real-time models that can predict recurrence interval but for a small utility prudent tracking of hydrologic conditions makes the most sense.

In order to compare yields under various hydrologic conditions, the drought-of-record (1964-1966 in New England and 2001/2002 for Maine),

To determine the time period for various hydrologic conditions, a statistical approach presented by Jeppson (1967) was used. Critical dry periods can occur over a few months to as much as a couple years. It is acceptable practice to use a 24-month period as individual and discrete hydrologic occurrences. Therefore, a 24-month period was selected as the timeframe to conduct a statistical analysis in defining drought conditions.

Monthly flow averages for the Oyster River data were used to create 24-month running totals for the 72-year period of record (January 1935 to November 2020). The running totals were sorted in ascending order and ranked, with the ranking position of 1 being the lowest total. Using the formulas proposed by Jeppson (1967), a probability for each running total was calculated, which corresponds to a recurrence interval for the overlapping series of running totals.

The continuous series of running totals was reduced by identifying discrete 24-month periods. The lowest running total included the period from May 1964 through April 1966. This period is considered the drought-of-record which has been widely accepted throughout New England.

The ranked list of running totals was reduced to find the next discrete 24-month period. Because the last month within the drought-of-record would overlap in 23 of the subsequent totals, the 47-month period including the original 24-month period as well as the subsequent 23 totals was removed from the running list. This procedure was continued until there were no more running totals.

Based on the above statistical method, the time periods that best reflect the drought-of-record, and average conditions were determined. Hydrologic data and events are commonly represented based on "Water Year". The FYE software uses Water Year based data to perform certain calculations. The Water Year consists of the timeframe of October through the following September. As an example, the Water Year 1964 includes the data from October 1963 through September 1964. **Table 5-1** presents the identified critical drought periods and the Water Years needed to cover that time period. A minimum of three years is needed to perform the calculations.

Table 5-1 Critical Drought and Hydrologic Periods

Designation	Water Years
Drought of Record	1964 1965 1966 2001

5.3 Reservoir Firm Yield Scenarios

Firm yield analyses were completed including the volume of the reservoir above a minimum lake elevation of El. 118 ft. Results of the yield analysis for the reservoir are presented in **Table 5-2** summarizes firm yield results for the 48-year period climate and stream gage record (1959 - 2007). This time period includes the drought of record water years.

Table 5-2 Estimated Firm Yields

Lake Storage Range	Usable Volume (MG)	Firm Yield[1] (MGD)
El. 128 ft – El. 120 ft[2]	1,253	5.77
El. 126 ft – El. 120 ft[2]	939	4.75
El. 124 ft – El. 120 ft[2]	626	3.17
El. 122 ft – El. 120 ft[2,3]	313	1.37
El. 128 ft – El. 124 ft[3]	627	3.18
El. 124 ft – El. 122 ft[3]	313	1.37
El. 120 ft – El. 118 ft[3,4]	308	1.34
El. 128 ft – El. 118 ft[4]	1,561	6.31
El. 126 ft – El. 118 ft[4]	1,247	5.75
El. 124 ft – El. 118 ft[4]	934	4.72
El. 122 ft – El. 118 ft[4]	621	3.14
El. 120 ft – El. 118 ft[3,4]	308	1.34

1. Estimated using Firm Yield Estimator, Version 1.0
2. Minimum lake elevation from the 1989 Indenture between Bucksport Water Company and Champion International Corporation is El.. 120 ft.

3. Level range for withdrawal limits in the 2019 Water Easement from Buckport Mill, LLC to Bucksport Generation, LLC and Whole Oceans, LLC.
4. Minimum lake elevation in 2019 Water Easement from Buckport Mill, LLC to Bucksport Generation, LLC and Whole Oceans, LLC is El. 118 ft.

The Jeppson method prioritizes the length of the drought, therefore ranking the 1960's drought higher magnitude than the 2001 drought. The 2001 drought being shorter in duration producing higher Firm Yield estimates when completing the model runs outside of the 1960's time period.

The results have some inherent errors that impact the accuracy of the assessment. Briefly, these sources of error include:

- Watershed Variability - Selection of reservoir characteristics from various points within the reservoir's watershed varies and is somewhat subjective. For example, there can be more than one stream reach from which the channel slope (C-SLOPE) is calculated from. It is possible that the yield value could be affected slightly if another value is used.

5.4 Adequacy of Supply

The water supply needs of the MWCBD presented in Section 2 of this report are summarized in **Table 5-3**. This data was developed in the District's last water system master plan.

Table 5-3 Projected Water Demands

Projection	Average Day Demand (GPD)	Maximum Day Demand (GPD)
2020	142,000	267,000
2040	166,000	311,000

The estimated firm yield for lake level scenarios between elevation El. 120 – 128 ft ranges from 1.37 to 5.77 MGD. The minimum lake water level granted to MWCBD by Indenture is elevation El. 120 ft. A surface water supply should have sufficient yield to meet the long-term, average-day needs of a water system. The day-to-day fluctuations are important to understand when sizing individual system components such as treatment facilities and pumping stations. Under these conditions, the water supply meets the projected needs of the MWCBD. However, other water easement rights granted to Bucksport Generation, LLC and Whole Oceans, LLC by Bucksport Mill, LLC have significant water withdrawal limits that could conflict with drought condition firm yield available to MWCBD.

5.5 Reservoir Management Strategies and Recommendations

A water supply management plan must address both drought and non-drought periods. As it is impossible to determine if the upcoming year will be a drought or non-drought year, the reservoir should always be managed to maximize yield and minimize spillage.

The pattern of precipitation and runoff is fairly regular in New England with the high inflow occurring in two primary periods; (1) October-November and (2) April-June. Lower inflow occurs during the colder winter months and during the hot, dry summer period from July through October. The best available data for monitoring hydrologic conditions is reservoir level and precipitation. This data can be plotted year to year with precipitation to understand the current hydrologic cycle and to allow for better planning.

5.5.1 Management Recommendations

It is not possible to predict when a drought condition will begin, or when it will end, nor is it possible to predict the severity of the drought condition. Therefore, it is prudent to operate a surface water supply system in anticipation that the available supply will be limited due to a drought.

The State of Maine does not have a state-wide drought management plan that triggers formal water conservation or other measures in response to a drought like most other New England states. The MWC is in control of water allocation year to year.

We do recommend that the MWC implement measures to better understand the hydrologic cycle to help supply management in dry years:

- Reservoir Levels - Lake level should be recorded weekly and plotted for each year to understand long-term trends for each reservoir. This data can be compared to precipitation patterns in a given year. Precipitation should also be collected from local monitoring stations. This data will allow the MWCBD to compare drawdown trends year to year.
- The 2019 Indenture granted to MWCBD and the 2019 Water Easement granted to Bucksport Generation, LLC and Whole Oceans, LLC should be coordinated and possibly updated to protect the water supply availability to the public water system of Bucksport during drought conditions.

Appendix A
Silver Lake Dam Memorandum

Memorandum

Date:	10/13/2025
Project No.:	22321
To:	Maine Water Company
From:	Wright Pierce
Subject:	Silver Lake Watershed Confirmation and Dam Evaluation

Introduction

On Thursday, 9/4/2025, Wright-Pierce employees Darrin Lary and Ella Carlson met with Maine Water Company employees Marcus Knipp, Dave Michaud, and Cole Campbell in Bucksport, ME, to perform an assessment of the Silver Lake watershed and dam as part of an ongoing safe yield analysis and dam evaluation project.

Watershed Confirmation

As part of Wright-Pierce's preliminary analysis of the Silver Lake Reservoir, three potential watershed boundaries were identified from existing topographic data sets. Variations between these boundary configurations occurred near Central Street, Silver Lake Road, and Town Farm Road, primarily due to the presence of storm drain outlets and topographic gradients between the Silver Lake and adjacent Penobscot River watersheds.

To resolve these differences, on-site investigations to each of these locations were made to provide visual confirmation of the limits of the watershed. The findings are summarized in the following sections:

Central Street:

The objective at this location was to determine whether cross culverts existed beneath the roadway to allow water from higher elevations to flow toward Silver Lake, or if, in the absence of culverts, roadside ditches redirected the runoff to outside the watershed. Upon visual inspection, roadway cross culvert drainage was confirmed to be present under Central Street.

Silver Lake Road:

The focus here was to assess whether the causeway between Silver Lake and an adjacent small pond included any direct hydraulic connection, or if it acted as a complete barrier. Wright-Pierce and Maine Water personnel inspected the causeway area on foot. It was determined that no culverts exist beneath the causeway, indicating that the two bodies of water are hydrologically disconnected at this point.

Town Farm Road:

At this part of the watershed, the goal was to evaluate the local topography to determine the direction of surface water flow, specifically, whether runoff would enter Silver Lake or drain toward the Penobscot River. The team confirmed a downward slope toward Silver Lake, indicating this area is part of the Silver Lake watershed.

Dam Evaluation

In addition to the watershed assessment to further the safe yield analysis, Wright-Pierce performed a limited visual dam evaluation to aid the ongoing discussion regarding the importance of sustainable management and operation of the dam. Wright-Pierce and Maine Water Company employees drove to the Silver Lake dam on the southwest end of the reservoir to visually inspect the spillways, structural integrity of the dam, and surrounding land.

In addition to the site visit, the Silver Lake Dam Operation and Maintenance Manual, Revision 1, October 2024, by Haley Ward, Inc. (HW Report), was reviewed with regards to dam history, hazard classification, and operation and maintenance recommendations.

The Silver Lake Dam is an earthen dam with a concrete spillway outlet structure. The dam has a gravel access drive across the top of the dam to access the east side of the spillway structure. Limited access is available for the west side of the dam and spillway.

Earthen Dam

The earthen dam appears to be in generally good condition with riprap armored upstream face and well vegetated downstream face. The rip-rap armor appeared well distributed and even on both the east and west side of the concrete spillway. As indicated in the description and photos from the HW Report, there did not appear to be any significant additional settlement or riprap disturbance from the 2021 inspection to 2025. There was limited floating wood debris impacting the dam face. The downstream face of the earthen dam was in generally good condition with low growing non-woody vegetation. Limited woody vegetation was observed at the dam edges, along the spillway fence line, and in the spillway channel.

A small seep was observed at the base of the earthen dam approximately 150-feet west of the concrete spillway structure. The observed water seep showed no significant surface erosion, siltation, or moving water. It appeared, from the vegetation edges, that the seep had been in existence for a significant period. The location of the seep may correspond with the location of the raw water main pipe dam penetration, or as indicated in the HW Report, may be a toe drain outlet. The muddy seep documented in the HW Report was not visible on our site visit, possibly due to the extremely dry summer of 2025.

Photo 1 – Earthen Dam Upstream Face West Side

Photo 2 – Earthen Dam Upstream Face East Side

Photo 3 – Earthen Dam Downstream Base Seep East Side

Photo 4 – Earthen Dam Downstream Face East Side

Photo 5 – Earthen Dam Downstream Face East Side

Concrete Outlet Structure and Spillway

The Silver Lake outlet structure and spillway is constructed of concrete with concrete retaining side walls on the upstream and downstream faces. The dam concrete spillways and outlet structure were constructed in 1930 and rehabilitated in 1984. The spillway structure consists of downstream ogee flume spillways (crest elevation 124.0) with an adjustable center stoplog flow gate structure. The side spillways have steel frame flashboard bulkheads retaining the lake level above the concrete flume spillways (crest elevation 128.0). The flashboards include steel pipe braces supporting the flashboards to each side retaining wall. An elevated concrete deck platform bridge runs across the top of the structure for site access and maintenance. The elevated bridge has steel railings, protective bollards, and exclusion fencing on the downstream wing walls for personal safety precautions.

Concrete Outlet Structure Visual Assessment

A detailed structural evaluation was not performed on the concrete outlet structure, and these observations are strictly based on visual field observations of the existing concrete structure and review of the HW Report. The concrete visibly shows visual evidence of aging as expected for a 90+ year old concrete structure.

- Wing wall gravity training walls
    - Walls, reconstructed in 1984, exhibit wear consistent with age of the dam structure
    - No visible failures of the wall, excessive bowing, exposed reinforcing, or excessive spalling observed

    - Significant efflorescence was observed, primarily on the downstream exposed wing walls. Efflorescence (a white or gray deposit) was observed on the concrete walls of the dam. Efflorescence is a result of soluble salts being left behind on the surface of building materials when the moisture within the material migrates to the surface and evaporates. While this residue is not directly harmful to the structural integrity of the dam, it indicates that there is moisture within the concrete which may lead to problems. Such problems include the corrosion of rebar within concrete, cracking of concrete due to freeze-thaw cycles, and concrete erosion that can weaken the dam over time.
- Spillway and stoplog gate
    - The stoplog gate is an 8'x 6' timber stoplog gate wrapped in impermeable membrane. Leakage was observed around the stoplogs.
    - The stoplog gate guides are armored with steel ice/debris bumpers and appear to be in good condition.
    - The steel stoplog guides also appeared to be in good condition with no significant structural metal loss.
- Side spillways and flashboard bulkheads
    - The ogee flume spillways experience continuous slow leakage from the bulkheads and are experiencing erosion of the spillway surface concrete as well as significant cracking, particularly on the west side spillway. The HW Report indicates the west side bulkhead is slightly lower than the east side bulkhead, so this spillway experiences significantly more annual water flow than the east side.
- Spillway bridge
    - The spillway bridge concrete appears to be in good condition with no visible cracking or spalling.
    - The safety bollards, safety railings, and exclusion fencing were all experiencing corrosion and needs repair, recoating and rehabilitation.

Photo 6 – East Side Downstream Wing Wall

Photo 7 – West Side Downstream Wing Wall

Photo 8 – Downstream Spillways and Gate

Photo 9 – Stoplog Gate and Gate Guides

Photo 10 – Upstream Wing Walls and Bridge

Hazard Classification

The dam is classified by MEMA as high hazard under Dam Safety law Title 37B MRSA, Chapter 24 and administered by the Maine Dam Safety Program.

Title 37B MRSA, Chapter 24

1. Evaluation. The commissioner shall evaluate all dams to assign or reassign a hazard potential classification in accordance with the following schedule:
   a. New or reconstructed dams, within 6 months of construction or reconstruction;
   [PL 2001, c. 460, §3 (NEW).]
   b. All other dams, at least once every 12 years; [PL 2013, c. 146, §19 (AMD).]
   c. Any dam, within 60 days of a request for an evaluation from the dam owner, the municipality in which the dam is located or the emergency management director of the county in which the dam is located; and
   [PL 2013, c. 146, §19 (AMD).]
   d. At any time a dam for which, in the judgment of the commissioner, such an evaluation is appropriate.
   [PL 2001, c. 460, §3 (NEW).]

Notwithstanding the schedule of this subsection, the commissioner shall evaluate the hazard classification of a significant or high hazard potential dam within 30 days of receipt by the commissioner of a notice of transfer of ownership of the dam as required under section 1128 unless the dam has been evaluated under this subsection within 4 years preceding the notice of transfer of ownership.

Until the commissioner assigns or reassigns a hazard potential classification, a dam retains the hazard potential classification assigned in the 1981 United States Army Corps of Engineers' Inventory of Dams in the United States. [PL 2013, c. 146, §19 (AMD).]

2. Factors considered. Before assigning a dam a hazard potential classification, the commissioner shall consider the potential risk to public safety and property that may result from the failure or operation of the dam. In addition, when reassigning a hazard potential classification, the commissioner shall review any changes in upstream and downstream conditions since the last hazard classification evaluation.
   [PL 2001, c. 460, §3 (NEW).]
3. Hazard report. Before the commissioner assigns or reassigns a dam hazard potential classification, a state dam inspector shall visually inspect that dam and its upstream and downstream environs and provide a report to the commissioner recommending a hazard classification for that dam. The commissioner shall provide a copy of the report by certified mail to the dam owner, lessee or other person in control of the dam, to the municipality in which the dam is located and to the emergency management director of the county in which the dam is located. The dam owner, lessee or other person in control of the dam must notify the commissioner within 20 days of receipt of the report if the dam owner, lessee or other person in control of the dam disagrees with the recommended hazard classification and must file within 3 months of receipt of the commissioner's classification the basis of the appeal with the commissioner. The commissioner may extend the 3-month period for good cause shown, but not more than an additional 3 months. The commissioner shall consider the evidence presented by the dam owner, lessee or other person in control of the dam as well as the evidence of the state inspector before issuing a final determination.

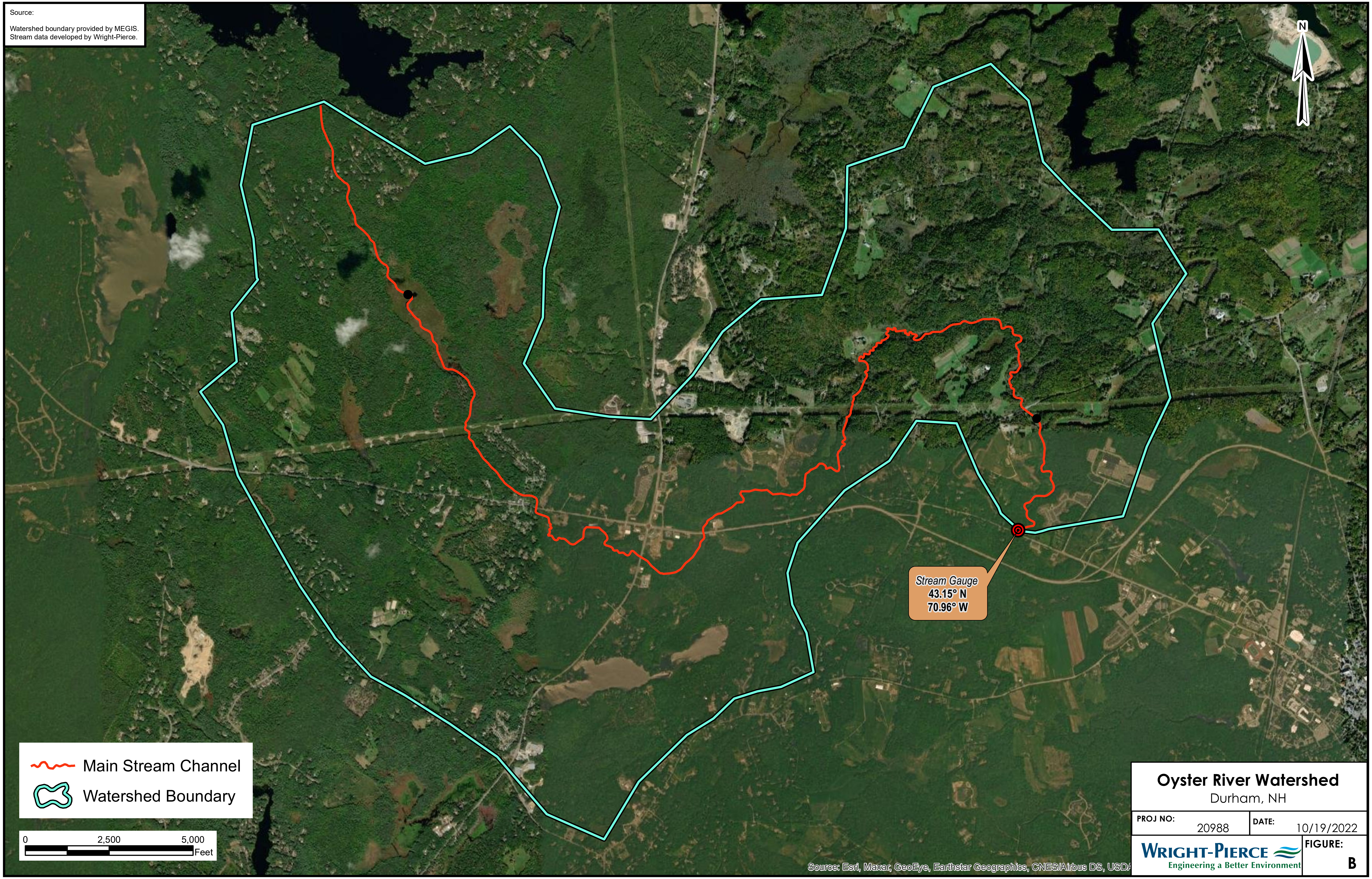
Conclusions

With regards to the level control infrastructure of the Silver Lake dam, the operation of the dam appears to currently be acceptable to maintain the operating level in Silver Lake. No imminent structural or operational failures were observed.

In general, we agree with the operation and maintenance recommendations in the 2024 HW Report. The dam appeared to be generally well maintained with a few items of recommended maintenance, both short and long term, to be addressed.

- Updated vegetation control, particularly of the woody vegetation in spillway and along the periphery
- Minor earthwork and erosion repair, particularly the riprap in the splash zone and minor settlement areas
- Monitoring of the seepage on the earthen dam west of the concrete spillway
- Monitoring of the concrete condition, particularly erosion areas
- Rehabilitation of the painted life safety equipment
- Removal of debris from embankment face and from around the intake structure

Appendix B
Oyster River Watershed



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Appendix C
Firm Yield Model Input Data

Bucksport FYE Input Data 10-2025

	Silver Lake
METEOROLOGICAL DATA	
Sanford NOAA Station	1959-2016
Bangor NOAA Station	1953 - 2024
Average Annual Precip (inches) (Bangor)	41.85
Average Annual Snowfall (inches) (Bangor)	76.46
STREAMFLOW DATA	Oyster River Data 1935-2007
RESERVOIR DATA	
Reservoir Watershed (sq.mi.)	3.80
Reservoir Watershed (acres.)	2,435
Stream gauge Watershed (sq.mi.)	12.1
Reservoir Elevation ft	128
Reservoir Lat Long	44.58730 N, -68.78986 W
Raw Water Intake Elevation - Estimated	110 ft
Volume El. 128 ft to Intake Elevation of 110 ft	2,198
Volume El. 128 ft to El. 118 ft (MG)	1,561
Volume El. 126 ft to El. 118 ft (MG)	1,247
Volume El. 124 ft to El. 118 ft (MG)	934
Volume El. 122 ft to El. 118 ft (MG)	621
Volume El. 120 ft to El. 118 ft (MG)	208
REQUIRED RELEASE (MG/mo.)	0
BATHYMETRY DATA	
Polynomial Order (2-6)	6
Constant	0.8109
Linear Coefficient	-0.0001
Quadratic Coefficient	-1E-07
Cubic Coefficient	3E-10
Quartic Coefficient	-3E-13
5^{th} degree Coefficient	9E-17
6^{th} degree Coefficient	-1E-20
PEAK USE FACTORS	
January	0.85
February	0.88
March	0.78
April	0.95
May	1.00
June	1.18
July	1.19
August	1.24
September	1.08
October	1.10
November	0.87
December	0.88
EVAPORATION (inches/month)	
Estimated from MET data	used
Longitude	68.7828 W
Reservoir elevation feet	128
January	0.93
February	1.31
March	2.41
April	3.71
May	5.40
June	6.35

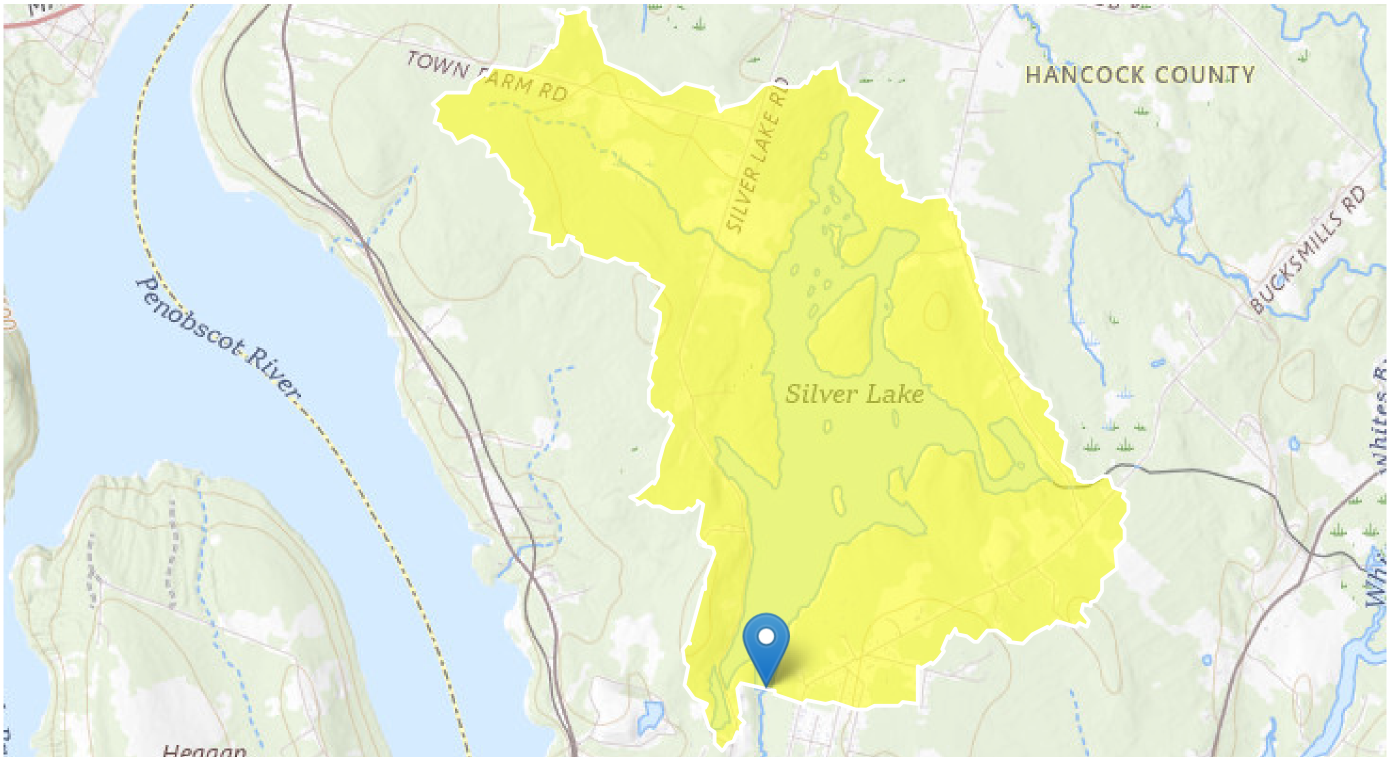
Bucksport FYE Input Data 10-2025

July	6.77
August	5.86
September	4.09
October	2.55
November	1.33
December	0.86
WITHDRAWALS BY OTHERS	
January through December	0.0
INPUT DATA FOR TRANSFORM	
Average Watershed Elevation (ft)	186.65
Mean Channel Slope (ft/mile)	50.026
Soil Retention (inches)	3.42
Watershed Curve Number	74.5
Randomly generated 1000 year sequence of data	used

Appendix D
Silver Lake Drainage Basin Stream Stats

Silver Lake Drainage Basin

Region ID: ME
Workspace ID: ME20251014153957525000
Clicked Point (Latitude, Longitude): 44.58730, -68.78986
Time: 2025-10-14 11:40:55 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	6.45	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	516980.98	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	4939369.03	meters
COASTDIST	Shortest distance from the coastline to the basin centroid	54.4	miles
DRNAREA	Area that drains to a point on a stream	4.81	square miles
ELEV	Mean Basin Elevation	182.8	feet

Parameter Code	Parameter Description	Value	Unit
ELEVMAX	Maximum basin elevation	364.6	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	6.16	inches
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.18	inches
I24H200Y	Maximum 24-hour precipitation that occurs on average once in 200 years	6.85	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	4.96	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	2.94	inches
I24H500Y	Maximum 24-hour precipitation that occurs on average once in 500 years	7.81	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	5.55	inches
I24H5Y	Maximum 24-hour precipitation that occurs on average once in 5 years	3.62	inches
JULAVPRE	Mean July Precipitation	3.35	inches
LC06WATER	Percent of open water, class 11, from NLCD 2006	21.61	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	0	percent
PRDECFEB90	Basin average mean precipitation for December to February from PRISM 1961-1990	10.7	inches
PRECIP	Mean Annual Precipitation	43.9	inches
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0	dimensionless
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	0	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	4.67	percent
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	24.56	percent
STORNWI	Percentage of storage (combined water bodies and wetlands) from the Nationa Wetlands Inventory	22.99	percent

Application Version: 4.29.3
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

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