Water Use and Conservation Management Plan for Holland Township

A Sub-Element of the Conservation Plan Element

HUC14 02040105160070: Musconetcong R (below Warren Glen)
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)
HUC14 02040105170020: Hakihokake Creek

Prepared in Support of the Highlands Regional Master Plan: Water Use and Conservation Management Plan

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WATER USE AND CONSERVATION MANAGEMENT PLAN

A Sub-Element of the Conservation Plan Element

for
HIGHLANDS REGIONAL MASTER PLAN CONFORMANCE

HOLLAND TOWNSHIP
HUNTERDON COUNTY, NEW JERSEY

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Executive Summary

Introduction

One of the highest priority objectives described in the Regional Master Plan (RMP) is to protect, restore and enhance water resources within the Highlands region. To help achieve this objective, the municipalities throughout the Highlands region have been developing Water Use and Conservation Management Plans (WUCMPs) to conserve water within the 183 subwatersheds within the Highlands Region.

This WUCMP includes the following components applicable to Holland Township:

- **WUCMP Area Characteristics** – Summarizes high level information such as land use capability/land cover, land use/zoning, major hydrologic features, geology, and soil characteristics.
- **Identification of Water Sources and Types –** The Highlands region uses both groundwater and surface water for potable water supply. Additional use types include, but are not limited to agricultural, commercial, industrial, and institutional.
- **Stakeholders** – a listing of stakeholders who can assist in the implementation of the WUCMP.
- **Revaluation of Net Water Availability** - Original calculations of Net Water Availability (NWA) were based on maximum water use in 2003 using a region-wide analysis at the HUC14 scale. This analysis has been expanded to include available data from 2000-2017 and has several refinements to the NWA computations, including incorporation of septic and sewer discharge into the NWA calculation and limiting the evaluation period to the summer months of June through September.
- **Deficit Mitigation Strategies** – Strategies are provided on both supply-side conservation measures (e.g., leak detection, water auditing, well network optimization) and demand-side conservation measures (such as high efficiency irrigation techniques, rainwater harvesting, and low-flow plumbing fixtures) have been identified.
- **Funding opportunities** – Funding opportunities are listed that may be available to fund the mitigation actions.
- **Monitoring Plan** – Each WUCMP will include a description of ongoing monitoring of water use and validation of the performance of mitigation actions.
- **Deficit Mitigation Implementation Plan** – Each Plan identifies deficit reduction targets, responsible parties, a schedule for action and implementation, and funding mechanisms.

This WUCMP is applicable to all HUC14 subwatersheds within Holland Township in Hunterdon County, New Jersey. However, watersheds do not conform to political boundaries. In many cases a subwatershed crosses one or more political boundaries and management of the resource falls to more than one municipality. This is also the case for the Highlands Region in general and is the case for Holland Township.

Summary

This WUCMP covers the following HUC14 subwatersheds:

- 02040105160070: Musconetcong R (below Warren Glen)
- 02040105170010: Holland Twp. (Hakihokake to Musconetcong)
- 02040105170020: Hakihokake Creek

Two of the three subwatersheds are in deficit. The subwatershed that is not in deficit (02040105160070) previously had a published deficit of nearly 1 million gallons per day (mgd), but since the publication of the RMP, two significant water users, the two paper mills, have been shut down.

The primary driver behind the deficits calculated for the subwatersheds is irrigation, primarily for agriculture and golf courses, but also residential use. The primary water user within the Township is Marc Phillips Farm, although the vast majority of the water is from an intake along the Delaware River, which is excluded from the Highlands Region and therefore this analysis due to the size of its watershed.

Net Water Availability

The analysis of Net Water Availability for Holland Township indicates the following variation between 2000 and 2017:

Summary of Net Water Availability: 2000 - 2017

HUC	NWA – Minimum (mgd)	NWA Maximum (mgd)	Published NWA (mgd)[1]
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	-0.778[2]	0.013	-0.9834
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	-0.02	0.006	-0.0020
HUC14 02040105170020: Hakihokake Creek	-0.182	0.104	-0.1166

1. As published in the Highlands Regional Master Plan.
2. Reflects former paper mill operations.

Water Conservation and Deficit Reduction and Elimination Strategies

The following preliminary strategies have been identified for Holland Township. These strategies are not prescriptive but initial recommendations. As the drivers behind water use is irrigation and domestic usage, the strategies focus on irrigation best management practices (which can also be applied to residential as well as lawn and landscaping irrigation often dominate water usage during the summer) and low flow fixtures, but also include recharging stormwater where applicable.

- Development of or strengthening to an irrigation ordinance
- Irrigation System Design – promotion of intelligent irrigation system design
- Drip Irrigation
- Stormwater Ordinance – promote recharge and or infiltration within the subwatershed
    - Extending beyond current NJDEP recharge requirements
    - Retro-fitting existing detention basins where applicable
- Low Flow Fixtures – although not an irrigation strategy, this would conserve water in commercial and residential uses

Monitoring and Implementation Plans

The mitigation strategies selected to reduce the deficit within the Township must be evaluated periodically. An annual review of each strategy will be conducted to determine its effectiveness, and a more detailed review should occur every five years that will update the Net Water Availability tables of this WUCMP. The annual review shall occur on the anniversary of the adoption of the document by the Planning Board. However, it should be noted that the annual and five-year review shall only occur upon grant funding from the Highlands Council.

It is important that annual determinations/analysis/monitoring be conducted to verify the effectiveness of the implementation plan. Establishing an implementation plan is critical to the WUCMP's success. Although elimination of any deficits does not have a specific timeline, progressing towards deficit reduction is the intent of this WUCMP and the Highlands Council of New Jersey will ask for a periodic review of the implementation of this Plan (on the order of 5 years).

Introduction

Purpose and Scope

The Highlands Regional Master Plan (RMP) requires that conforming municipalities develop a "Water Use and Conservation Management Plan" that reflects the policies and objectives of the RMP. Specifically, conforming municipalities are required to develop Water Use and Conservation Management Plans "that will set priorities for the use of available water (where net water availability is positive) and will establish methods to reduce and, where feasible, eliminate deficits where they exist".[1]

Implementation of the RMP will require extensive cooperation among all municipal governing bodies and major water users in the region. Conformance with the RMP is intended to align municipal and county plans, regulations and programs with the goals, policies, and objectives of the RMP, including preservation of the availability and quality of surface water and ground water resources throughout the Highlands region.

One of the highest priority objectives described in the RMP is to restore and protect water resources within the Highlands Region. The development of Water Use and Conservation Management Plans (WUCMPs) specific to municipalities is intended to address the requirements of this objective in a practical way that is applicable to each municipality.

The RMP provides a method for determining how much water is routinely available for human use, as differentiated from water available for maintenance of ecosystem integrity and for maintenance of minimum levels in reservoirs and other surface water. The method determines Net Water Availability for each HUC14 subwatershed.[2] Where Net Water Availability is positive, future human use of water supply is supported. Where Net Water Availability is negative, action is needed to address the deficit. The published NWA (within the RMP) for HUC14s that intersect Holland Township indicate that all are in deficit with varying degrees of severity.

Water Use and Conservation Management Plan (WUCMP) Goals and Policy Overview

Net Water Availability is total available groundwater minus consumptive and depletive water uses. Net Water Availability varies greatly from one area within the Highlands Region to another. Some areas have a water surplus (positive Net Water Availability). Other areas are in deficit (negative Net Water Availability). To reduce or eliminate the water deficits within the Region, Water Use and Conservation Management Plans are required under RMP Objective 2B8c:

> *Water Use and Conservation Management Plans shall be required through municipal Plan Conformance for all subwatersheds to meet the policies and objectives of Goal 2B, to ensure efficient*

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[1] Highlands Regional Master Plan, (Highlands Council, 2008), p. 159.

[2] Highlands Regional Master Plan, (Highlands Council, 2008), p. 160, Policy 2B2.

> *use of water through water conservation and Low Impact Development Best Management Practices, and to avoid the creation of new deficits in Net Water Availability. Where developed for Current Deficit Areas, the plans shall include provisions to reduce or manage consumptive and depletive uses of ground and surface waters as necessary to reduce or eliminate deficits in Net Water Availability, or to ensure continued stream flows to downstream Current Deficit Areas from Existing Constrained Areas, to the maximum extent practicable within each HUC14 subwatershed. Water Use and Conservation Management Plans shall demonstrate through a detailed implementation plan and schedule how and when the current deficit will be resolved in a subwatershed prior to approval for new water uses in the subwatersheds with the most severe deficits (e.g., in excess of 0.25 million gallons per day or mgd), and the plan shall be implemented prior to initiation of new water uses.*

Implementation Strategy

Implementation of the goals, policies and objectives of the RMP regarding water deficit restoration consists of the following components:

- Identify HUC14 subwatersheds that have a deficit of water availability or a surplus of water availability;
- Verify the net water availability analysis and any associated deficits;
- Develop a Water Use and Conservation Management Plan for conforming municipalities, especially those whose water supply is in a deficit subwatershed;
- For complex systems or where the development of deficit reduction plans for multiple subwatersheds is more appropriate, collaborate with NJDEP and affected interests to develop Water Use and Conservation Management Plans at a larger scale, and
- Coordinate with NJDEP so that the water allocation permit process, including transfers of water between subwatersheds where required, supports the reduction and elimination of water deficits

This WUCMP includes the following components:

- **Identification of water sources and uses** – The Highlands Region uses both groundwater and surface water for potable water supply although Holland Township relies solely on ground water for potable use. However, both ground water and surface water are used for irrigation and for industrial purposes.
- **Expanded evaluation of Net Water Availability** (expanded from the original analysis in the RMP) – Original calculations of Net Water Availability were based on maximum water use for any month in 2003. This analysis has been expanded to include available data from 2000-2017 for June, July, August and September of each year.
- **Deficit mitigation strategies** – This section includes water conservation measures (such as high efficiency irrigation techniques, rainwater harvesting, and low-flow plumbing fixtures), review of reuse potential, and storage alternatives.
- **Funding opportunities** – Approaches that may be available to fund the mitigation actions specified within this plan.

- **Monitoring plan** – Ongoing monitoring of water use and validation of the performance of mitigation actions.
- **Deficit reduction and elimination strategy and implementation plan**– Identify deficit reduction targets, responsible parties, a schedule for action and implementation, and funding mechanisms.

Scope and Applicability

There are five HUC14 subwatersheds that intersect Holland Township although the Township has a significant impact to NWA in three of these five HUC14s (**Appendix C Figure 1**). Therefore, the focus of this WUCMP is within the following HUC14s:

- 02040105160070: Musconetcong R (below Warren Glen)
- 02040105170010: Holland Twp. (Hakihokake to Musconetcong)
- 02040105170020: Hakihokake Creek

The only water withdrawals within Holland Township for the other two HUC14s are for domestic supply purposes and are not expected to significantly influence NWA, particularly since the HUC14s include a relatively small are of the Township. However, that's not to say that water use and conservation does not apply within those HUC14s (especially since domestic use is a major driver for HUC14 02040105170020), but that the only applicable conservation measures would be limited to domestic supply (low flow fixtures and/or irrigation limitations, for example). One of the HUC14s includes non-domestic withdrawals from both Holland Township and Milford Borough (HUC14 02040105170020). For that HUC14, Holland is only responsible for a portion of mitigating the deficit within that HUC14, corresponding to its contribution towards the deficit, which is addressed herein.

WUCMP Area Characteristics

Background

This WUCMP is specifically applicable to Holland Township, although most of Milford Borough is also included. Holland Township was incorporated in 1879 and has an estimated population of 5,291 (2010 U.S. Census). The Township covers 23.9 square miles (15,342 acres). Holland is rural in nature with much of the land area consisting of forest and open space. Agricultural land use is prominent, although much of the area includes crop types that have little, if any, irrigation (hay fields, etc.).

Land Use Capability/Land Cover

Land Use Capability Zones

The Highlands Region is classified into three Land Use Capability Zones (with four sub-zones), of which Holland Township has area within all three:

- **Protection Zone** – Areas having high value in terms of forested resources, critical habitat, water quality and quantity, and ecological function, and having limited or no capacity to support human development without adversely affecting the overall ecological function of the Highlands Region. This zone has one sub-zone, Wildlife Management.
    - Holland Township has 6,643 acres within the Protection Zone (approx. 43% of the total area).
- **Conservation Zone** - Areas that have significant agriculture along with wooded and environmental areas which should be preserved to the extent possible. This zone has one sub-zone, Conservation Environmentally-Constrained.
    - Holland Township has 7,497 acres within the Conservation Zone (approx. 49% of the total area).
    - Conservation Environmentally-Constrained areas have significant environmental features that should be preserved and protected from non-agricultural development.
- **Existing Community Zone** - Areas characterized by extensive and intensive existing development that may have capacity to support additional human development without adversely affecting the ecological value of the Highlands Region. This zone has two sub-zones: Existing Community Environmentally-Constrained, and Lake Community.
    - The only portion of Holland Township within the Existing Community Zone is 629 acres (approx. 4% of the total area).

Figure 2 (**Appendix C**) shows the Land Use Capability Map for Holland Township.

Preservation and Planning Areas

The Highlands Region is subdivided into Preservation and Planning Areas. Preservation Areas are critical to water resource protection. A summary of the goals for both the Preservation and Planning Areas is shown in **Table 1** on page 5.

Approximately 87% of Holland Township is in the Highlands Planning Area and 13% is in the Highlands Preservation Area. **Figure 3** (**Appendix C**) shows the delineation of the Preservation and Planning Areas within Holland Township.

Land Use/Zoning

Land use/land cover data representing 2012 conditions were obtained from the New Jersey Department of Environmental Protection (NJDEP). Based on 2012 conditions, the land use / land cover within the Township is primarily comprised of forest (43%), agriculture (26%) and urban (22%) land uses. Of the urban land use, approximately 76% is residential and 95% of that is low density or rural in nature. **Figure 4** (**Appendix C**) depicts the layout of land use types within the Township.

A few current and former industrial facilities are located within Holland Township. They include:

- Two paper mills previously owned and operated by Fibermark:
    - Hughesville Plant (closed in 2000)
    - Warren Glen Plant (closed in 2006)

- Georgia Pacific Corporation
- NRG Gilbert power plant

Table 1 - Region-wide goals for the Preservation and Planning Areas (from Highlands Council, 2008).

Goals Specific to Preservation Area	Goals Specific to Planning Area
Preserve extensive and, to the maximum extent possible, contiguous areas of land in its natural state, thereby ensuring the continuation of Highlands environment which contains the unique and significant natural, scenic, and other resources representative of the Highlands Region	Preserve to the maximum extent possible any environmentally sensitive lands and other lands needed for recreation and conservation purposes
Protect the natural, scenic, and other resources of the Highlands Region, including, but not limited to, contiguous forests, wetlands, vegetated stream corridors, steep slopes, and critical habitat for fauna and flora	Protect and maintain the essential character of the Highlands environment
Promote compatible agricultural, horticultural, recreational, and cultural uses and opportunities within the framework of protecting the Highlands environment	Promote the continuation and expansion of agricul-tural, horticultural, recreational, and cultural uses and opportunities
Prohibit or limit, to the maximum extent possible, construction or development which is incompatible with preservation of this unique area	Encourage, consistent with the State Development and Redevelopment Plan and smart growth strategies and principles, appropriate patterns of compatible residential, commercial, and industrial development, redevelopment, and economic growth, in or adjacent to areas already utilized for such purposes; discourage piecemeal, scattered, and inappropriate development, in order to accommodate local and regional growth and economic development in an orderly way while protecting the Highlands environment from the individual and cumulative adverse impacts thereof
	Promote a sound, balanced transportation system that is consistent with smart growth strategies and principles and which preserves mobility in the Highlands Region

The two paper mills have been closed for more than 10 years leaving the other two facilities as the primary industrial facilities within the Township. Currently, the paper mills are abandoned; the Hughesville site has been developed as a site for a commercial-scale solar farm.

NJDEP 2012 impervious surface data is shown on **Figure 5** (**Appendix C)**. Township wide, there is less than a 3% impervious cover. In fact, impervious cover does not exceed 3% in any subwatershed that intersects Holland Township.

Major Hydrologic Features

The major hydrologic feature within the study area is the Delaware River which acts as the southern boundary of the Township. However, flow to the major tributaries to the Delaware are more pertinent to this Plan, namely the Musconetcong River and Hakihokake Creek.

The Musconetcong River is a major tributary to the Delaware River and borders the northwestern portion of the Township. The other major tributary to the Delaware River that runs through the Township is the Hakihokake Creek, which flows through the middle of the Township (**Appendix C Figure 1**). Smaller un-named tributaries to these streams are also present. There are no active USGS stream gauges that measure streamflow within the Township.

Geology and Soil Properties

Holland Township is located within the Highlands and Piedmont Physiographic Provinces. The Highlands Physiographic Province consists of igneous and metamorphic rocks in a series of ridges and valleys. The Piedmont Physiographic Province characterizes the remainder of the Township which is primarily underlain by the Brunswick Aquifer (sandstone, siltstone, shale). The Brunswick is separated from the igneous and metamorphic rocks of the Highlands Physiographic Province by the Jacksonburg Limestone (**Appendix C Figure 6**).

Soils within the area are shown on **Figure 7** (**Appendix C**). Approximately 68% of the Township consists of ten different soil types shown in **Table 2**. Most of the soils are classified as being within hydrologic group B, which are generally comprised of 10 to 20% clay and a saturated hydraulic conductivity of 1.42 to 5.67 inches per hour[3]. Soils within the C and D group are less permeable with saturated hydraulic conductivities of 0.14 to 1.42 inches per hour and less than or equal to 0.14 inches per hour, respectively[4].

[3] United States Department of Agricultural (USDA), Natural Resources Conservation Service (NRCS). 2007. Part 630 Hydrology National Engineering Handbook, Chapter 7: Hydrologic Soil Groups.

Table 2 - Primary Soil Types within Holland Township.

Soil Symbol	Description	Percent of Township	Hydrologic Group
ParEe	Parker cobbly loam, 18 to 40 percent slopes, extremely stony	13%	B
PeoB	Penn channery silt loam, 2 to 6 percent slopes	9%	C
GKAPCC	Gladstone and Parker soils, 8 to 15 percent slopes, extremely stony	8%	B
GkaoB	Gladstone gravelly loam, 3 to 8 percent slopes	7%	B
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	6%	C
ROPF	Rough broken land, shale	6%	D
ParC	Parker cobbly loam, 3 to 15 percent slopes	6%	B
GkaoC2	Gladstone gravelly loam, 8 to 15 percent slopes, eroded	5%	B
PdtE	Pattenburg gravelly loam, 18 to 40 percent slopes	5%	B
KkoC	Klinesville channery loam, 6 to 12 percent slopes	4%	D

Identification of Water Sources and Uses

Water System Profile

Description

The majority of Holland Township is not served by a community water supply system but instead served by private homeowner wells. Aqua New Jersey (Phillipsburg) is the sole water purveyor within the Township that serves a small portion of the Township. There are a few wells that are identified as being owned by Fibermark, which is now owned by International Process Plants and Equipment (IPPE).

Facilities

Community public water supply wells are shown on **Figure 8** (**Appendix C)** along with the existing areas served, as obtained from the New Jersey Highlands Council. The Aqua system consists of four wells within the Township and one well just outside the Township boundary (Warren Glen System). Two of the wells within the Township are part of the Aqua New Jersey Riegel Ridge System and the other two are part of the Fox Hill system. Only one of the Fox Hill wells has reported pumpage since 2012, so it's possible that the second well is inactive, abandoned or serves as a back-up well.

Service Areas

The service areas within the Township are:

- Aqua New Jersey – Fox Hill
- Aqua New Jersey – Riegel Ridge

These service areas are shown in **Figure 8** (**Appendix C**). Only a relatively small portion of the Township is served by Milford Water Department (along Milford Mt. Pleasant Road) and water supply wells are located within Milford Borough. As shown on **Figure 8** (**Appendix C**), most of the area served by community public supply within Holland Township is located along the Route 519 corridor.

Allocation and Firm Capacity

Allocation and capacity information for the Aqua New Jersey systems is shown in **Table 3**. The Riegel Ridge System wells have a capacity of 50 gallons per minute (gpm) for one well and the other with a capacity of 60 gpm[4].

Firm capacity is defined as the pumping and/or treatment capacity of the water system when the largest pumping unit or treatment unit is out of service[5]. Subtracting the total peak daily demand from the firm capacity may result in a water supply deficit (when the total peak is greater than firm capacity) or a surplus.

Information on the Fiberville Estates wells is not available, but as mentioned above the associated service area is now owned by Aqua New Jersey. However, the PWSID is not available from existing GIS databases.

Table 3 - Capacity Information for the Aqua New Jersey – Riegel Ridge & Fox Hill Systems

PWSID	Firm Capacity (MGD)	Allocation		Demand		
		Monthly Limit (MGM)	Yearly Limit (MGY)	Daily (MGD)	Monthly (MGM)	Yearly (MGY)
1015003	0.079	3.4	30.5	0.072	2.165	19.661
1015004	0.072	1.6	7.0	0.04	0..779	6.480

Remaining Capacity

The Remaining Firm Capacity for the Aqua New Jersey Riegel Ridge System is 0.007 mgd and 0.032 mgd for the Fox Hill System (as of 12/19/19 and 12/26/19, respectively, which is when the DEP data were last posted). Both water systems are in surplus (from a supply perspective).

Wastewater Management

Description

The existing area served by sanitary sewer was obtained from the New Jersey Highlands Council and is shown on **Figure 9** (**Appendix C**). The primary sewer area is the Route 519 corridor which is pumped to and treated at the Milford Sewage Treatment Plant in Milford Borough.

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[4] http://www.nj.gov/cgi-bin/dep/watersupply/pwsdetail.pl?id=1015003

The remaining areas within the Township are served by individual subsurface sewage disposal (septic systems, cesspools, etc.).

Facilities

The only wastewater discharge facility within Holland Township that has been identified by the available databases is the Holland Township Municipal Garage. The permit is for "Petro Prod Cleanup" and discharge is very small (on the order of 500 gallons per day).

Stakeholders

Potential Stakeholders within the Township include the following:

- Residents and the municipal government of Holland Township
- Aqua New Jersey
- Milford Borough
- Oak Hills Golf Club
- Marc Phillips Farm
- Reliant Energy
- International Process Plants (IPPE; current owner of the two abandoned paper mills).

These represent the water users within the Township. These stakeholders should be informed of the plan and ways in which each of them can conserve water.

As the former paper mills are no longer in operation, the eventual re-development of these facilities should consider water conservation measures wherever feasible. Recent interest in the Warren Glen mill has been introduced by the Phoenix Energy Center which would utilize a significant amount of water for cooling purposes. Although cooling operations generally only consumes 10% of the water withdrawn, since significant water is utilized (projected up to 5 mgd), the consumption could be significant. However, this represents a good opportunity for potential offset of this consumptive uses through other projects on or within the vicinity of the facility.

Analysis of Net Water Availability

Introduction

Net Water Availability is Ground Water Availability minus consumptive and depletive water uses. Ground Water Availability is the portion of Ground Water Capacity that can be provided for human use without harm to other ground water users, aquatic ecosystems or downstream users. The Highlands RMP defines Ground Water Capacity based on the Low Flow Margin component of the Low Flow Margin of Safety Method. Low Flow Margin and Ground Water Availability are discussed below.

On a municipal basis, Net Water Availability is calculated for subwatersheds that are either entirely within the municipality where the municipality has significant (non-domestic) withdrawals in a portion of the subwatershed. For subwatersheds that are within a particular municipality that only has domestic water withdrawals, but another municipality has more significant (public supply wells, for example) withdrawals, the onus of Net Water Availability will be assigned to the municipality with the more significant withdrawals. Two of the five subwatersheds that intersect Holland Township have much larger withdrawals in neighboring municipalities and for those subwatersheds only the domestic withdrawals for Holland were compiled.

Low Flow Margin

Low Flow Margin is the margin between two stream low flow statistics: September median flow and 7 day-10 year low flow (7Q10). Low Flow Margin is derived for each HUC14 subwatershed using data from streams in a relatively unaltered state. The 7Q10 is the lowest total flow over seven consecutive days during a ten-year period. It has been used in quantifying passing flow requirements. The 7Q10 is also often used to define an extreme low flow condition for water quality based effluent limits applied to wastewater discharges. A critical flow regime for aquatic ecosystems is the lowest monthly flow, which in New Jersey and the Highlands tends to occur in September. The Low Flow Margin is the difference between the September median flow and the 7Q10, which in the Highlands is always a positive value.[5]

Low Flow Margin is used to calculate Ground Water Capacity, or the natural ability of the watershed to support base flow.[5] Ground Water Capacity is derived from Low Flow Margin but is adjusted for the consumptive uses incorporated into the stream flow statistics used to derive Low Flow Margin. Ground Water Capacity equals Low Flow Margin multiplied by 1.02, based on a USGS study that showed existing consumptive uses are roughly 2 percent of Low Flow Margin.[5]

[5] Highlands Council Technical Report, Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 46.

Ground Water Availability

Ground Water Availability is that portion of Ground Water Capacity that is available for human uses (absent other constraints).[6]

Ground Water Availability is calculated by multiplying Ground Water Capacity by a threshold which has been established by the Highlands Council (**Table 4**):

Table 4 - Ground Water Availability Thresholds as Percentage of Ground Water Capacity[6]

Land Use Capability Zone	Standard Threshold Capability
Protection Zone	5% LFM
Conservation Zone	5% LFM (non-agriculture) 10% LFM (agriculture)
Existing Community Zone	20% LFM

Holland Township is predominantly within the Protection and Conservation Zones (see **Appendix C Figure 2**), so according to the rules established in the Highlands RMP and Technical Report Vol. II, the Ground Water Capacity is multiplied by 5% to arrive at Ground Water Availability. Ground Water Availability for the HUC14s within this WUCMP is listed in **Table 5**.

Table 5 – Ground Water Availability

HUC14 Description	Ground Water Availability (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	0.0492
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	0.0372
HUC14 02040105170020: Hakihokake Creek	0.1445

Net Water Availability

Calculation of Net Water Availability

Net Water Availability (NWA) is Ground Water Availability minus any consumptive and depletive uses within the subwatershed. When NWA is positive, ground water supply is available for human

[6] Highlands Council Technical Report, Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 121.

uses. When NWA is negative, insufficient ground water is available to support additional human use within the thresholds established by the Highlands Council.

Consumptive water use is defined as water that is lost within the subwatersheds and is not returned as recharge or as discharge to a stream within the subwatersheds. An example of a consumptive use is irrigation, in which most of the water evaporates and does not recharge the aquifer system. Depletive water uses are those in which water is exported out of the subwatersheds. A typical example of depletive use is conveyance of wastewater out of the subwatersheds to a wastewater treatment plant that discharges in another subwatershed.

NWA was originally calculated using maximum water withdrawals from 2003, which represented the most recently available compiled and checked data for use in the RMP. The published NWA values for the subwatersheds within this WUCMP are listed in **Table 6**.

Table 6 – Published Net Water Availability (Highlands Regional Master Plan, 2008)

HUC14 Description	Net Water Availability (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	-0.9834
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	-0.0020
HUC14 02040105170020: Hakihokake Creek	-0.1166

This total published NWA reflects a deficit of approximately 1,102,000 gallons per day.

Updates to the NWA calculation were performed for each subwatershed to adjust for the following:

- Additional water use data for the period 2000-2017;
- Septic system returns for those areas served by public water but not by public sewer.

Current water uses within Holland Township are domestic ground water, public community supply, irrigation (agricultural and golf) and industrial (Reliant Energy). The two former paper mills were a significant water user when they were in operation. The industrial withdrawals from the Reliant Energy facility utilized both ground water and surface water. Surface water withdrawals are also used for agricultural and golf course irrigation.

Water Supply

Public Supply

A summary of Public Community and Non-Community supply withdrawals within the three subwatersheds for the period 2000-2017 is shown in **Table 7**. Note that the Fibermark Hughesville Mill wells significantly exceed the community water supply purveyor. However, this elevated withdrawal may in fact be due to testing for environmental purposes.

Table 7 – Water Supply Withdrawals

HUC/Water Purveyor	Category	Withdrawals[1]	
		Peak Summer Month	Peak Withdrawal (MGD)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)			
Fibermark Hughesville Mill	Potable Supply	June 2003	1.55
Aqua New Jersey		July 2009	0.019
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)			
None			
HUC14 02040105170020: Hakihokake Creek			
Aqua New Jersey	Potable Supply	June 2005	0.107
Milford Water Department		June 2001	0.254

1. Withdrawals represent the respective withdrawals for the peak pumping month of the subwatershed. Individual purveyors may have higher pumping periods, but the peak summer month represents the peak of total pumping in the subwatershed.

MGD = million gallons per day

Domestic Well Ground Water Usage

Domestic Well Ground Water Usage is an estimate of private well withdrawals within the subwatersheds for areas not served by the public supply. Domestic withdrawals were updated for each watershed by utilizing the domestic withdrawals in the New Jersey Department of Environmental Protection (NJDEP) / New Jersey Geological Survey (NJGS) Water Transfer Model (WTM). The values for domestic withdrawals represent the average July values from 2000 to 2013. Values used in the RMP were calculated based on population estimates for the subwatersheds from the 2000 Census, multiplied by a factor of 100 gallons per person per day. Values in the WTM were utilized instead so that domestic usage could be apportioned by municipality, which is not included in the RMP. Domestic ground water usage is shown in **Table 8**.

Table 8 – Domestic Ground Water Withdrawals

HUC14	Domestic Ground Water Usage (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	0.13
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	0.118
HUC14 02040105170020: Hakihokake Creek	0.346

Golf Course Irrigation

Irrigation from the Oak Hill Golf Club is summarized in **Table 9.**

Table 9 – Withdrawals for Golf Course Irrigation

HUC	Owner	Water Source	Peak Summer Month	Peak Withdrawal (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	None			
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	None			
HUC14 02040105170020: Hakihokake Creek	Oak Hill Golf Club	Ground Water	July 2003	0.126
		Surface Water	September 2012	0.263

Industrial

Water usage for industrial operations is a substantial portion of use within one of the subwatersheds in the study area. Water usage for industrial operations within these subwatersheds is summarized below in **Table 10**.

Table 10 – Withdrawals for Industrial Operations

HUC	Owner	Water Source	Peak Summer Month	Peak Withdrawal (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	Fibermark Hughesville Mill	Ground Water	June 2005	1.602
		Surface Water[1]	September 2000	64.033
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	Reliant Energy	Ground Water	July 2001	0.011
		Surface Water[2]	September 2006	2.153

1. Water used for power generation.
2. Source of water not specified but assumed to be the Delaware River (not applicable).

Agriculture

Water use for agricultural purposes is assumed to be primarily for irrigation. There are two users published in existing databases, but the majority of water is used by Phillips Farm via a surface water intake. According to the Agricultural Certification and Permit, there are two intakes on the Delaware River. As the intakes are on the Delaware River, they are not within the Highlands Region and therefore this consumptive use does apply. Maximum reported uses from June, July and August from 2000 through 2016 are listed in **Table 11**.

Table 11 – Reported Withdrawals for Agricultural Use

HUC	Owner	Water Source	Peak Summer Month	Peak Withdrawal (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	Smith, C. Russell (Mary)	Surface Water	September 2012	0.0001
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	Marc Phillips Farm	Ground Water	June 2016	0.033[1]
		Surface Water	September 2007	0.607
HUC14 02040105170020: Hakihokake Creek	None			

1. Withdrew 0.107 mgd in June 2017. June 2017 is not the highest withdrawal month for that HUC14.

Municipal Consumptive/Depletive Uses

Groundwater models used in support of the Highlands Regional Net Water Availability analysis show that the impact on September stream flows of consumptive/depletive (C/D) ground water use during the summer is not 1:1, but roughly 1:0.9.[7] In other words, 1 gallon of C/D water use is calculated to reduce Ground Water Availability in September by 0.9 gallons. Therefore, ground water use (raw pumpage) during the summer month with the highest demand was multiplied by 0.9 to reflect this impact. The factor is not applied to surface water diversions, which are based on September withdrawals that have an immediate impact on stream flows.

Consumptive water uses such as irrigation are further adjusted using consumptive use coefficients. In many instances, the water is not conveyed a long distance through a water utility network. Therefore, it is assumed that the withdrawal, use and discharge occur in the same location.

Consumptive use coefficients reflect the percentage of the consumptive use that is lost and is not returned to the aquifer. [8]

For public community water uses, the calculation of consumptive and depletive uses must consider the possible import/export of water, and the potential return of the water as a wastewater discharge.

[7] Highlands Council Technical Report, "Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 116.

[8] Highlands Council Technical Report, "Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 119.

In these situations, consumptive/depletive use in the portion of the water supply service area that is coincident with a wastewater service area is associated with the wastewater discharge from that sewered area. Any remainder of the consumptive use is allocated among the areas on public water service that discharge to individual septic systems. Water exported to a different subwatershed, such as a wastewater treatment plant, are considered depletive. Depletive uses, by their nature, have an effective consumptive use coefficient of 1.0.

Septic return is calculated using GIS and the latest available existing areas served (EAS) coverages for public water and wastewater provided by the Highlands Council. Parcel coverages obtained from the New Jersey Geographic Information Network (NJGIN) were clipped by the public water EAS coverage to obtain the number of parcels served by public water. Using that coverage, parcels that have their centroids within the wastewater EAS were selected and classified as sewered parcels. The remaining are served by public water, but not public sewer, so septic return is assigned to those parcels. Total pumping and a non-consumptive use from each purveyor is calculated and the non-consumptive use per parcel is calculated based on the number of parcels within a particular water system. This parcel based non-consumptive use is then multiplied by the number of non-sewered parcels within each particular HUC14 to estimate septic return.

Parcel coverages from the NJGIN include common areas such as homeowner's association areas within condominium or apartment complexes. These areas are included in the number of parcels used to determine the parcel based non-consumptive use for return. Once the non-sewered parcels are created in GIS, a brief aerial survey is conducted and HOA areas or other open space areas are removed.

Actual customer databases are not utilized so this approach represents an approximation.

Revised Net Water Availability

As part of this analysis, revisions to the Net Water Availability calculation were conducted to include more recent public supply water use data.

Net Water Availability calculations were conducted for each of the years 2000-2017, incorporating additional water supply pumpage data from users in the subwatershed. Pumping during summer months is typically greatest and has the largest impact on September base flow, which is used in calculating Net Water Availability. Therefore, maximum aggregate monthly water usage from June, July or August was used to calculate updated C/D uses for this subwatershed.

Consumptive use from public supply accounts for water that is not returned to the subwatershed. So, for instances where a system has a treated wastewater return to a surface water, that return directly offsets the consumptive use. If instead of the individual wastewater treatment plant the sewage is transported outside of that particular subwatershed, that flow becomes depletive.

Net Water Availability is shown on **Tables 12-14**. A general summary for each of the seven subwatersheds is described below.

HUC14 02040105160070: Musconetcong R (below Warren Glen)

This HUC14 is located within Holland and Pohatcong Townships (**Appendix C Figure 10**). Historically, the primary water users within this HUC14 were the two former paper mills owned by Fibermark (Warren Glen and Hughesville Mills). These mills have been closed for more than 10 years. Since 2007, the primary source of water withdrawals within this HUC14 is domestic water supply pumpage.

Withdrawals from WSWL64509 are uncertain. This well is listed as a public supply well and is located near the former Hughesville Mill. Presumably, this well served as a potable supply source for the mill and perhaps for the few nearby homes. Operations at the Hughesville Mill ceased at the end of 2000[9], so any pumping from this well after 2000 would be for the purposes of potable supply to the neighboring homes. However, summer withdrawals from this well exceed 1 million gallons per day (mgd) as late as August 2005. As there are only a few homes within the vicinity, the magnitude of withdrawal seems unlikely for potable supply and typical home irrigation. It is possible that some of that water was utilized for larger areas of irrigation such as the adjacent crop lands or for closure activities at the mill. Regardless, pumpage at this well is reported as zero since 2008.

The revised NWA is shown on **Table 12** on page 20. Note the very clear change from a deficit to a surplus which corresponds with the change in operation of the two Fibermark mills. The HUC14 is in surplus with a consistent use since 2007. The published NWA indicated a deficit of nearly 1 mgd. However, now that the mills are closed, the surplus NWA over the past 10 years is more representative of conditions within this HUC14 than the previously published value.

HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)

This HUC14 is almost entirely within Holland Township but a small portion of it is within Milford Borough (**Appendix C Figure 10**). Other than domestic supply pumping, withdrawals from this HUC14 are for agricultural (Marc Phillips Farm) and industrial (Reliant Energy NJ Holdings) purposes.

The revised NWA is shown on **Table 13** on page 21. As shown on the table**,** the consumptive use is significantly higher than the published values, primarily due to the surface water intake at Marc Phillips Farm. The RMP did not include surface water uses for agricultural activities and these withdrawals has a large impact on NWA for this HUC14. This intake withdraws from the Delaware River, therefore, those consumptive uses do not apply and the deficit is significantly lower.

There are no reported major withdrawals within this HUC14 in Milford Borough. The Water Transfer Model indicates that there is 0.0007 mgd of domestic withdrawals in this HUC14 from Milford Borough, which would equate to a consumptive use of 0.0002, or less than 0.1% of the total consumptive use of the HUC14. Therefore, Holland Township accounts for 100% of the consumptive use and management of the deficit within this HUC14.

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[9] http://articles.mcall.com/1999-09-01/business/3261526_1_plant-manager-plant-and-move-larry-mcenroe

HUC14 02040105170020: Hakihokake Creek

This HUC14 is primarily within Holland Township and Milford Borough, although a large portion of this HUC14 is also within Alexandria Township with small areas within Bethlehem Township and Union Township (**Appendix C Figure 10**).

The RMP includes golf course irrigation from surface water, likely from WSIN75881 (owned by Oak Hills Golf Club). However, that intake is classified in the WTM as "SG" which is surface and groundwater and "intake pipe (ground water)". Therefore, this withdrawal is likely from a well that pumps groundwater to a pond which is subsequently used for irrigation. Therefore, this withdrawal is classified as groundwater for this analysis.

The reported discharge from Milford STP exceeds public supply pumping for several years, particularly 2004 and 2011. The source of the additional water is unclear, although it is likely from homes that are connected to sanitary sewer but utilize domestic wells (yellow region on **Appendix C Figure 9**). Incorporating this return results in a negative consumptive use for public supply (returning more water than withdrawn, like imported water).

The revised NWA is shown on **Table 14**. In general, deficits are reduced from published values, except for the years where the Milford STP return is greater than public supply pumpage. However, incorporating the Milford STP still results in deficits which are close to or exceed the published value.

Due to the Milford STP, it's difficult to discern municipal contribution to the deficits calculated for this HUC14. However, if the STP is not included and consumptive use for public supply is calculated using consumptive use coefficients (since the water is ultimately returned to the same HUC14, using the consumptive use coefficient on direct pumpage is appropriate), Holland Township would account for approximately 73% of the total consumptive use. Potable supply pumping from the Milford water supply wells is approximately twice the potable supply pumping in Holland Township. However, irrigation withdrawals in Holland Township gives Holland most of the responsibility to reduce the deficit.

Other HUC14s and Summary

Domestic pumping from Holland Township within surrounding HUC14s that are not included in this NWA analysis is shown in **Table 15**. Although NWA was not calculated for HUC14 02040105170030 (Harihokake Creek (and to Hakihokake Ck)), the domestic pumping from Holland Township comprises approximately 20% of the ground water availability. Further analysis is required to evaluate what the total consumptive use is within this HUC14 to fully determine what portion of any deficit (if one exists) Holland Township would be responsible for. Available databases confirm that Holland Township only has domestic withdrawals within these HUC14s.

Table 12. Re-evaluated New Water Availability for HUC 14 02040105160070: Musconetcong R (below Warren Glen)

Year	Non-Ag Ground Water Availability (mgd)	Wastewater Return[1] (mgd)	Consumptive Domestic Use (mgd)	Consumptive Public Supply (mgd)	Total Non-Ag Consumptive Use (mgd)[2]	Non-Ag Net Water Availability (mgd)[3]
Published[4]	**0.0492**	**0.0000**	**0.0264**	**0.1608**	**1.0326**	**-0.9834**
2000	0.0492	1.2	0.0341	0.0289	0.8274	-0.7782
2001	0.0492	1.5	0.0341	0.2076	0.5119	-0.4628
2002	0.0492	2.6	0.0341	0.2038	0.3340	-0.2849
2003	0.0492	1.97	0.0341	0.3349	0.7435	-0.6943
2004	0.0492	1.97	0.0341	0.3460	0.4940	-0.4448
2005	0.0492	1.18	0.0341	0.3200	0.5074	-0.4582
2006	0.0492	0.018	0.0341	0.6039	0.6382	-0.5891
2007	0.0492	0.0666	0.0341	0.0000	0.0360	0.0131
2008	0.0492	0.0000	0.0341	0.0000	0.0362	0.0129
2009	0.0492	0.0000	0.0341	0.0048	0.0389	0.0103
2010	0.0492	0.0000	0.0341	0.0017	0.0463	0.0029
2011	0.0492	0.0000	0.0341	0.0032	0.0373	0.0119
2012	0.0492	0.0000	0.0341	0.0038	0.0379	0.0113
2013	0.0492	0.0000	0.0341	0.0028	0.0368	0.0124
2014	0.0492	0.0000	0.0341	0.0023	0.0364	0.0128
2015	0.0492	0.0000	0.0341	0.0021	0.0361	0.0130
2016	0.0492	0.0000	0.0341	0.0021	0.0362	0.0130
2017	0.0492	0.0000	0.0341	0.0020	0.0361	0.0131

[1] This return is potentially due to return flow from water used for power generation, which is already accounted for in the consumptive use calculation for that use type. Although documented here, it is not used in the NWA calculation.

[2] [Adjusted Consumptive Domestic Use] + [Consumptive Public Supply Use] + [Total Non-Ag Consumptive Use from Surface Water] + [Other Non-Ag Consumptive Use from Ground Water].

[3] [Non-Ag Ground Water Availability] – [Total Non-Ag Consumptive Use] + [Imported Septic Return]

[4] As published in the Highlands Regional Master Plan, 2008.

Table 13. Re-evaluated New Water Availability for HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)

Year	Non-Ag Ground Water Availability (mgd)	Wastewater Return (mgd)	Consumptive Domestic Use (mgd)	Consumptive Public Supply (mgd)	Total Non-Ag Consumptive Use (mgd)[1]	Total Ag Consumptive Use (mgd)	Net Water Availability (mgd)[2]
Published[3]	**0.0372**	**0.0000**	**0.0239**	**0.0000**	**0.0247**	**0.0147**	**-0.0020**
2000	0.0372	0.0000	0.0307	0.0000	0.0311	0.003	0.0029
2001	0.0372	0.0000	0.0307	0.0000	0.0312	0.000	0.0060
2002	0.0372	0.0000	0.0307	0.0000	0.031	0.010	-0.0040
2003	0.0372	0.0000	0.0307	0.0000	0.0311	0.015	-0.0086
2004	0.0372	0.0000	0.0307	0.0000	0.0310	0.017	-0.0108
2005	0.0372	0.0000	0.0307	0.0000	0.0310	0.013	-0.0069
2006	0.0372	0.0000	0.0307	0.0000	0.0310	0.022	-0.0160
2007	0.0372	0.0000	0.0307	0.0000	0.0310	0.024	-0.0176
2008	0.0372	0.0000	0.0307	0.0000	0.0312	0.011	-0.0049
2009	0.0372	0.0000	0.0307	0.0000	0.0310	0.011	-0.0049
2010	0.0372	0.0000	0.0307	0.0000	0.0310	0.008	-0.0017
2011	0.0372	0.0000	0.0307	0.0000	0.0307	0.008	-0.0016
2012	0.0372	0.0000	0.0307	0.0000	0.0328	0.008	-0.0032
2013	0.0372	0.0000	0.0307	0.0000	0.0311	0.008	-0.0019
2014	0.0372	0.0000	0.0307	0.0000	0.0307	0.008	-0.0014
2015	0.0372	0.0000	0.0307	0.0000	0.0312	0.002	0.0038
2016	0.0372	0.0000	0.0307	0.0000	0.0307	0.027	-0.0203
2017	0.0372	0.0000	0.0307	0.0000	0.0308	0.024	-0.0179

[1] [Adjusted Consumptive Domestic Use] + [Consumptive Public Supply Use] + [Total Non-Ag Consumptive Use from Surface Water] + [Other Non-Ag Consumptive Use from Ground Water].

[2] [Non-Ag Ground Water Availability] – [Total Non-Ag Consumptive Use] - [Total Ag Consumptive Use] + [Imported Septic Return]. This HUC14 does not have an agricultural groundwater availability so agricultural consumptive use is added to non-agricultural consumptive use.

[3] As published in the Highlands Regional Master Plan, 2008.

Table 14. Re-evaluated New Water Availability for HUC14 02040105170020: Hakihokake Creek

Year	Non-Ag Ground Water Availability (mgd)	Wastewater Return (mgd)	Consumptive Domestic Use (mgd)	Consumptive Public Supply (mgd)	Total Non-Ag Consumptive Use (mgd)[1]	Non-Ag Net Water Availability (mgd)[2]
Published[3]	**0.1445**	**0.2710**	**0.0673**	**0.1999**	**0.2611**	**-0.1166**
2000	0.1445	0.2480	0.0904	0.0049	0.172	-0.0275
2001	0.1445	0.2400	0.0904	0.1059	0.196	-0.0518
2002	0.1445	0.2380	0.0904	0.0221	0.177	-0.0325
2003	0.1445	0.2530	0.0904	0.0016	0.194	-0.0494
2004	0.1445	0.3370	0.0904	-0.0902	0.078	0.0670
2005	0.1445	0.2230	0.0904	0.0644	0.302	-0.1570
2006	0.1445	0.2320	0.0904	-0.0244	0.197	-0.0520
2007	0.1445	0.2120	0.0904	-0.0038	0.252	-0.1072
2008	0.1445	0.1990	0.0904	0.0662	0.192	-0.0471
2009	0.1445	0.1940	0.0904	0.0235	0.166	-0.0218
2010	0.1445	0.1720	0.0904	0.0417	0.327	-0.1821
2011	0.1445	0.3890	0.0904	-0.2093	0.041	0.1040
2012	0.1445	0.2100	0.0904	-0.0397	0.288	-0.1432
2013	0.1445	0.2320	0.0904	-0.0641	0.184	-0.0377
2014	0.1445	0.1730	0.0904	-0.0035	0.249	-0.1044
2015	0.1445	0.1980	0.0904	-0.0286	0.164	-0.0193
2016	0.1445	0.1830	0.0904	-0.0013	0.173	-0.0286
2017	0.1445	0.1830	0.0904	-0.0179	0.142	0.0030

[1] [Adjusted Consumptive Domestic Use] + [Consumptive Public Supply Use] + [Total Non-Ag Consumptive Use from Surface Water] + [Other Non-Ag Consumptive Use from Ground Water].

[2] [Non-Ag Ground Water Availability] – [Total Non-Ag Consumptive Use] + [Imported Septic Return]

[3] As published in the Highlands Regional Master Plan, 2008.

Table 15 - Domestic Withdrawals from Holland Township in other HUC14s

HUC14	Domestic Withdrawal (mgd)	Consumptive Use (mgd)	Non-Ag Ground Water Availability (mgd)
02040105160060	0.0181	0.0047	0.0484
02040105170030	0.0435	0.0114	0.0579

Summary of Significant Causes of Deficit

Following is a summary of the range of re-evaluated NWA calculations:

Table 16 – Summary of Net Water Availability

HUC	NWA – Minimum (mgd)	NWA Maximum (mgd)
HUC 14 02040105160070: Musconetcong R (below Warren Glen)	-0.778	0.013
HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong)	-0.02	0.006
HUC14 02040105170020: Hakihokake Creek	-0.182	0.104

Causes of the deficits noted above include:

- **02040105160070**: This subwatershed is in deficit from 2000 through 2006 and in surplus from 2007 through 2017. The cause of the deficits is the two Fibermark paper mills which were in operation during the early portion of this analysis. As these plants have been closed for more than 10 years, the deficits are not reflective of this subwatershed and the subwatershed is in surplus.
- **02040105170010**: Domestic water supply and irrigation are the primary driver to the calculated deficits. Conservation and management strategies should focus on limiting withdrawals for irrigation purposes. The surface water intake from Phillips Farm withdraws from the Delaware River. Therefore, that withdrawal is not applicable to this analysis.
- **02040105170020**: The deficits for this HUC14 are largely driven by domestic supply withdrawals.

Characterization of Deficit

The deficit in this WUCMP varies from not existent (surplus) to the low end of mild (0.1 to 1 mgd). Other than HUC14 02040105160070, which has a shift from deficit to surplus due to the closure of the paper mills, no significant trend upward or downward is evident in other subwatersheds. Relative consistency is also observed at HUC14 02040105160070 over the past 10 years.

Water Conservation/Deficit Mitigation Strategies

The following table summarizes the water use management techniques and mitigation strategies to protect against future deficits that this WUCMP could use to reduce and/or eliminate the water deficit in this subwatershed.

Table 17 - Summary of Conservation and Deficit Mitigation Strategies

Measure	Res	Com/ Indust/ Inst	Water Purveyor	Golf & Ag	Municipal
Water Use Reduction					
Heating System Upgrades		✓			
Hot Water Heater Upgrade	✓	✓			
Hydrant Locks			✓		
Avoid Overspray	✓				
Building and Pipe Insulation	✓	✓			
Community Garden	✓				✓
Cooling System Upgrades		✓			
Crop and Soil Selection				✓	
Dishwasher Upgrade	✓				
Drip Irrigation				✓	
Drought Contingency Plans			✓		✓
Equipment Condensation		✓			
Irrigation Conservation	✓	✓	✓	✓	✓
Irrigation Education			✓		✓
Irrigation System Design	✓	✓		✓	✓
Landscape Design	✓			✓	
Landscape Incentive Program					✓
Leak Detection and Repair	✓		✓		
Low Flow Faucets/Faucet Aerators	✓				
Low Flow Shower Fixtures	✓				
Low Flow Toilet Fixtures	✓	✓		✓	
Low Volume Irrigation	✓			✓	
Meter Calibration/Replacement			✓		
Night Watering	✓			✓	
Plumbing Incentive Program					✓
Process Water Optimization		✓			
Public Education Handouts			✓		✓
Public Workshops					✓

Table 17 - Summary of Conservation and Deficit Mitigation Strategies

Measure	Res	Com/ Indust/ Inst	Water Purveyor	Golf & Ag	Municipal
Rate Structure			✓		
Revised Irrigation Ordinance					✓
School Conservation Programs			✓		✓
Submetering	✓		✓		
Swimming Pool Covers	✓				
Turfgrass Selection	✓			✓	
Washing Machine Upgrade	✓				
Water Bill Structure/Comparison	✓		✓		
Water Conservation Programs		✓	✓	✓	✓
Water Treatment Improvements			✓		
Waterless Urinals		✓		✓	
Well Optimization			✓		
Reuse and Reclamation					
Graywater Recharge	✓	✓			
Graywater Reuse for Irrigation	✓	✓		✓	
Internal Infrastructure Graywater Reuse		✓			
Internal Infrastructure Stormwater Reuse		✓			
Storage					
Composting	✓			✓	
Install Geotextiles Under Plantings	✓			✓	
Rainwater Harvesting/Rainwater Cistern	✓				
Water Storage Tank Management			✓		
Recharge					
Assisted Infiltration/Enhanced Recharge	✓	✓		✓	✓
Building Interceptor Dykes, Swales and Berms	✓	✓		✓	✓
Injection Wells		✓			
Modifications to Zoning					✓
Stormwater Ordinance					✓
Porous Paving	✓	✓			✓
Rainwater Harvesting/Rain Gardens	✓	✓			
Retrofit Existing Detention Basins		✓			✓

Evaluation and Ranking of Water Conservation Strategies

Evaluation

To determine the best mitigation strategies for this WUCMP, a simple qualitative ranking system was developed. This system considers seven attributes of each potential strategy from the perspective of a user in these subwatersheds. The seven attributes are:

1. *Feasibility* – Can the strategy be implemented by a specific type of user? Strategies that have a high ranking for Feasibility can be implemented relatively easily. Implementing a night watering program is considered a highly feasible deficit mitigation strategy.
2. *Effectiveness* – If the strategy is implemented by a specific type of user, will it create the desired effect? Strategies that have a high ranking for Effectiveness offer the best opportunity to directly reduce the NWA deficit. Example: Using a broom rather than a hose or power washer to clean a driveway is considered a highly effective deficit mitigation strategy.
3. *Resilience and Reliability* – Once the strategy is implemented, how susceptible is it to failure, and how much maintenance will it require to remain in operation? Strategies that have a high ranking for Resilience and Reliability are expected to be implemented consistently over long periods. Example: Installation of a graywater system is considered a highly resilient and reliable deficit mitigation strategy.
4. *Reduction Potential and Market Penetration* – Once the strategy is working, what regional reduction in deficit can be expected, based on the number of users likely to implement the strategy? Strategies that have high rankings for Reduction Potential and Market Penetration offer opportunity for implementation by the greatest number of stakeholders. Example: Installation of low-flow plumbing fixtures is highly ranked for reduction potential and market penetration.
5. *Administrative Complexity and Availability of Implementing Entities* – How difficult will it be to launch, monitor, and evaluate the effectiveness of the mitigation strategy? Strategies that are highly ranked for Administrative Complexity and Availability of Implementing Entities are simple to implement and can be implemented by existing entities. Examples: modifying a stormwater ordinance or implementing a new rate structure.
6. *Cost and Cost Effectiveness* – What is the efficiency of a mitigation strategy in terms of cost per unit of reduction? Strategies that are highly ranked for Cost and Cost Effectiveness offer the "biggest bang for the buck". Examples: plumbing incentive programs and drought contingency plans.
7. *Schedule* – How long will it take to implement the mitigation strategy? Strategies that are highly ranked for Schedule can be implemented quickly. Example: public education handouts.

Each mitigation strategy was ranked for each of the seven attributes listed above. A value of 1, 2 or 3 was assigned based on the degree to which each strategy embodies each attribute. A ranking of 3 indicates:

- Highly feasible
- Very effective
- Highly resilient and reliable
- High potential for deficit reduction and market penetration
- Simple strategy to administer; implementing entities available
- Short time required to implement

Scores for each strategy are listed in **Tables 18 through 23** for residential, commercial / industrial / institutional, water purveyors, golf courses, agricultural and municipalities respectively.

The evaluation was conducted under two scenarios and it is anticipated that it will be repeated following stakeholder input to assign weights to each attribute. The following scenarios were evaluated:

- Equal weight – each of the seven attributes was weighted equally. This is analogous to simply summing the scores in each table.
- Weighted for consumptive/depletive use reduction – a weight of 50% was assigned to the C/D reduction attribute and all other attributes were weighted equally (8.3% each).

As the primary drivers for consumptive uses are agricultural and domestic supply, mitigation strategies should focus on those two types of uses. It's important to note that the strategies listed within this WUCMP are a subset of strategies and this list should be expanded as additional strategies are developed.

Table 18 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Residential Users

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Assisted Infiltration/Enhanced Recharge	3	2	2	2	1	2	2
Avoid Overspray	3	2	1	2	1	3	3
Building and Pipe Insulation	3	2	2	1	1	2	2
Building Interceptor Dykes, Swales and Berms	2	1	2	2	1	2	2
Community Garden	3	2	2	1	1	2	1
Composting	3	2	2	1	1	3	3
Dishwasher Upgrade	3	2	3	2	1	2	2
Graywater Reuse for Irrigation	3	2	3	2	1	1	1
Graywater Recharge	3	2	3	2	1	1	1
Hot Water Heater Upgrade	3	2	3	2	1	2	2
Install Geotextiles Underneath Plantings	3	2	2	1	1	2	2
Irrigation Conservation	3	2	1	2	1	3	3
Irrigation System Design	3	3	3	2	2	2	3
Landscape Design	3	2	2	1	1	2	2
Leak Detection and Repair	1	1	1	1	1	1	1
Low Flow Faucets/Faucet Aerators	3	2	3	2	1	3	3
Low Flow Shower Fixtures	3	2	3	2	1	3	3
Low Flow Toilet Fixtures	3	2	3	2	1	2	3
Low Volume Irrigation	2	2	3	1	1	2	3
Maintenance	3	2	2	1	1	2	3
Night Watering	3	2	2	2	1	3	3
Porous Paving	1	3	2	2	1	1	1
Rainwater Harvesting/Rain Barrels	3	3	2	1	1	2	2

Table 18 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Residential Users

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Assisted Infiltration/Enhanced Recharge	3	2	2	2	1	2	2
Rainwater Harvesting/Rain Gardens	3	2	2	1	1	2	2
Submetering	1	1	2	1	1	1	1
Swimming Pool Covers	3	2	2	1	1	1	3
Turfgrass Selection	2	2	1	2	3	2	2
Washing Machine Upgrade	3	2	3	2	1	2	3
Water Bill Structure/Comparison	3	3	3	3	3	3	3

Table 19 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Commercial/Industrial/Institutional Users

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Building and Pipe Insulation	3	2	2	1	2	2	2
Building Interceptor Dykes, Swales and Berms	1	2	2	2	2	2	2
Cooling System Upgrades	2	2	2	2	1	1	1
Graywater Systems	3	2	3	2	2	2	1
Internal Infrastructure Graywater Reuse	1	2	2	2	1	1	1
Internal Infrastructure Stormwater Reuse	3	2	2	2	2	2	1
Irrigation Conservation	3	2	1	2	2	3	3
Leak Detection and Repair	2	2	2	1	2	1	1
Low Flow Faucets/Faucet Aerators	3	2	3	2	2	2	3
Low Flow Toilet Fixtures	3	2	3	2	2	2	3
Rainwater Harvesting/Rain Barrels	3	2	2	1	1	2	2
Rainwater Harvesting/Rain Gardens	3	2	2	1	2	2	2
Submetering	1	1	2	1	1	1	1
Water Conservation Programs	3	2	1	2	2	3	3
Water Treatment Improvements	2	2	1	1	1	1	1
Waterless Restroom	1	2	1	2	1	1	1
Assisted Infiltration/Enhanced Recharge	3	2	2	2	2	2	2
Porous Paving	2	2	2	1	1	1	1
Injection Wells	1	3	2	2	1	1	1
Equipment Condensation	3	1	2	1	3	3	3
Retrofit Existing Detention Basins	3	3	3	3	2	2	1
Stormwater Collection	3	2	2	2	2	2	1

Table 20 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Water Purveyors

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Water Bill Structure/Comparison	3	3	3	3	3	3	3
Rate Structure	3	3	3	3	3	3	3
Meter Calibration/Replacement	2	2	2	2	3	2	1
Drought Contingency Plans	2	2	2	3	3	3	3
Water Treatment Improvements	3	3	3	3	3	3	2
Hydrant Locks	2	1	2	1	3	1	1
Well Optimization	3	2	2	2	3	2	2
Public Education Handouts	2	1	1	1	3	2	1
School Conservation Programs	2	2	2	1	3	3	1
Irrigation Education	2	2	2	1	2	3	1
Water Conservation Programs	3	3	1	1	3	2	3
Leak Detection and Repair	3	3	3	3	3	3	3
Submetering	2	2	2	2	3	2	3
Equipment Condensation	3	1	2	1	3	3	3
Water Storage Tank Management	3	2	3	2	3	2	3
Install Smart Meters	3	2	1	2	3	1	2

Table 21 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Golf Courses

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Assisted Infiltration/Enhanced Recharge	3	2	2	2	2	2	2
Avoid Overspray	3	2	1	2	2	3	3
Building Interceptor Dykes, Swales and Berms	1	2	2	2	2	2	2
Dishwasher Upgrade	3	2	3	2	1	2	2
Graywater Systems	2	2	2	2	1	1	1
Hot Water Heater Upgrade	3	2	3	2	1	2	2
Install Geotextiles Under Plantings	3	2	2	1	1	2	2
Irrigation Conservation	3	2	1	2	2	3	3
Irrigation System Design	3	3	3	2	2	2	3
Landscape Design	3	2	2	1	1	2	2
Leak Detection and Repair	2	2	2	1	3	2	2
Low Flow Faucets/Faucet Aerators	3	2	3	1	1	3	3
Low Flow Toilet Fixtures	3	2	3	1	1	2	3
Night Watering	2	2	2	2	2	3	3
Rainwater Harvesting / Rain Barrels	3	3	2	1	1	2	2
Rainwater Harvesting / Rain Gardens	3	2	2	1	1	2	2
Stormwater Collection	3	2	2	2	1	1	1
Submetering	1	1	2	1	1	1	1
Turfgrass Selection	3	2	3	2	3	2	3
Water Conservation Programs	3	2	1	2	2	3	3
Waterless Restroom	1	2	1	2	1	1	1

Table 22 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Agriculture

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Crop and Soil Selection	2	2	2	2	2	1	2
Drip Irrigation	2	3	3	3	2	1	1
Irrigation Conservation	3	2	2	2	2	2	2
Low Volume Irrigation	3	2	2	2	1	2	1
Night Watering	2	2	3	2	2	3	3
Turfgrass Selection	2	2	3	2	2	2	2
Water Conservation Programs	3	2	3	1	3	3	3

Table 23 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Municipalities

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Assisted Infiltration/Enhanced Recharge	3	2	2	2	1	2	2
Building Interceptor Dykes, Swales and Berms	2	1	2	2	1	2	2
Community Garden	3	2	2	1	1	2	1
Drought Contingency Plans	2	2	2	1	1	3	3
Irrigation Conservation	3	2	2	2	2	2	2
Irrigation Education	3	2	1	2	1	3	3
Irrigation System Design	3	3	3	2	2	2	3
Landscape Incentive Program	3	2	2	1	1	1	3
Modifications to Zoning	1	1	3	3	3	3	3
Modify Stormwater Ordinance	3	2	3	3	3	3	3
Plumbing Incentive Program	3	2	2	1	1	3	2
Porous Paving	1	3	2	2	1	1	1
Public Education Handouts	3	2	1	1	1	3	3
Public Workshops	3	2	1	1	2	3	3
Retrofit Existing Detention Basins	3	3	3	3	2	2	1
Revised Irrigation Ordinance (Odd/even, rain sensor requirements, etc.)	3	2	3	3	1	2	3
School Conservation Programs	3	2	1	1	2	2	3
Water Conservation Programs	3	2	1	2	1	3	3

Ranking of Deficit Mitigation Strategies

Deficit mitigation strategies that are relevant to Holland Township have been ranked and the top ten strategies for each water user category. It's important to note that not every strategy is incorporated but only select strategies which are relevant to the uses within Holland Township. For example, irrigation strategies could be applicable to large industrial complexes with large grassy areas which are routinely irrigated. However, the two main industrial facilities in Holland Township, Georgia Pacific and Reliant Energy, have very small grassy areas and irrigation strategies may not be very effective to those facilities.

An evaluation program called EVAMIX was utilized to rank each strategy. EVAMIX is a well-tested multi-criteria evaluation program that is used to rank alternatives. The program takes raw data, both quantitative and qualitative, normalizes it and uses the data to compare alternatives while helping stakeholders understand which factors have greater or lesser impact on the outcome. This process uses the scores that were assigned in **Tables 24 through 29** and determining the *relative* weight of each of the categories or attributes. The weights for each attribute are relative to each other and the sum of the weights must equal 1.0 (100%). For example, if a stakeholder thought that feasibility was the most important attribute, perhaps they would assign a weight of 40% to that attribute and 10% to each of the others.

Table 24 - Ranked Mitigation Management Strategies for Residential Users

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Water Bill Structure/Comparison	Water Bill Structure/Comparison	1
2	Low Flow Shower Fixtures	Low Flow Shower Fixtures	2
2	Low Flow Faucets/Faucet Aerators	Low Flow Faucets/Faucet Aerators	2
4	Low Flow Toilet Fixtures	Low Flow Toilet Fixtures	4
4	Washing Machine Upgrade	Washing Machine Upgrade	4
6	Night Watering	Night Watering	6
7	Irrigation Conservation	Irrigation Conservation	7
7	Avoid Overspray	Avoid Overspray	7
9	Dishwasher Upgrade	Dishwasher Upgrade	9
9	Hot Water Heater Upgrade	Hot Water Heater Upgrade	9

Table 25 - Ranked Mitigation Management Strategies for Commercial/Industrial/Institutional Users

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Low Flow Faucets/Faucet Aerators	Low Flow Faucets/Faucet Aerators	1
1	Low Flow Toilet Fixtures	Low Flow Toilet Fixtures	1
3	Water Conservation Programs	Water Conservation Programs	3
3	Irrigation Conservation	Irrigation Conservation	3
5	Graywater Systems	Graywater Systems	5
6	Assisted Infiltration/Enhanced Recharge	Assisted Infiltration/Enhanced Recharge	5
7	Equipment Condensation	Stormwater Collection	7
8	Stormwater Collection	Internal Infrastructure Stormwater Reuse	7
8	Internal Infrastructure Stormwater Reuse	Building Interceptor Dykes, Swales and Berms	9
10	Rainwater Harvesting/Rain Gardens	Injection Wells	10

Table 26 - Ranked Mitigation Management Strategies for Water Purveyors

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Leak Detection and Repair	Leak Detection and Repair	1
1	Rate Structure	Rate Structure	1
1	Water Bill Structure/Comparison	Water Bill Structure/Comparison	1
4	Water Treatment Improvements	Water Treatment Improvements	4
5	Water Storage Tank Management	Drought Contingency Plans	5
6	Drought Contingency Plans	Water Storage Tank Management	6
7	Equipment Condensation	Well Optimization	7
8	Water Conservation Programs	Submetering	8
9	Well Optimization	Install Smart Meters	9
10	Submetering	Meter Calibration/Replacement	10

Table 27 - Ranked Mitigation Management Strategies for Golf Courses

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Irrigation System Design	Irrigation System Design	1
2	Turfgrass Selection	Turfgrass Selection	2
3	Avoid Overspray	Avoid Overspray	3
3	Irrigation Conservation	Irrigation Conservation	3
3	Water Conservation Programs	Water Conservation Programs	3
6	Night Watering	Night Watering	6
7	Low Flow Faucets/Faucet Aerators	Assisted Infiltration/Enhanced Recharge	7
8	Assisted Infiltration/Enhanced Recharge	Dishwasher Upgrade	8
9	Dishwasher Upgrade	Hot Water Heater Upgrade	8
9	Hot Water Heater Upgrade	Building Interceptor Dykes, Swales and Berms	10

Table 28 - Ranked Mitigation Management Strategies for Agricultural Uses

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Drip Irrigation	Drip Irrigation	1
1	Irrigation Conservation	Irrigation Conservation	2
1	Water Conservation Programs	Water Conservation Programs	2
4	Night Watering	Night Watering	4
5	Low Volume Irrigation	Low Volume Irrigation	5
6	Turfgrass Selection	Turfgrass Selection	6
7	Crop and Soil Selection	Crop and Soil Selection	7

Table 29 - Ranked Mitigation Management Strategies for Municipalities

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Modify Stormwater Ordinance	Modify Stormwater Ordinance	1
2	Irrigation System Design	Retrofit Existing Detention Basins	2
3	Retrofit Existing Detention Basins	Modifications to Zoning	3
4	Modifications to Zoning	Revised Irrigation Ordinance (Odd/even, rain sensor requirements, etc.)	4
5	Revised Irrigation Ordinance (Odd/even, rain sensor requirements, etc.)	Irrigation System Design	5
6	Public Workshops	Irrigation Education	6
7	Irrigation Education	Water Conservation Programs	6
7	Water Conservation Programs	Irrigation Conservation	7
9	Irrigation Conservation	Assisted Infiltration/Enhanced Recharge	9
10	Public Education Handouts	Porous Paving	10

Funding Opportunities

Public Funding Sources

Highlands Council Planning Grants

The Highlands Council will approve the WUCMP following an opportunity for formal public review and comment. Upon approval, the WUCMP will become a component of the Plan Conformance process for the affected municipalities. The Highlands Act provides for state funding to support planning efforts necessary to implement Plan Conformance. In the case of a WUCMP, state funding is available to address necessary modifications (if any) to the Highlands Area Land Use Ordinance, and implementation planning for other components. In addition, the municipality may request additional planning funds to develop mitigation strategies. The Highlands Council is not currently authorized to provide capital grants for project implementation, but the Highlands Council will work with the municipalities to identify and obtain funding from other state and federal agencies (see below) for such purposes.

State Program Grants

The following state agencies should be considered for state program grants:

- New Jersey Department of Agriculture (NJDA)
- New Jersey Department of Environmental Protection (NJDEP)
- New Jersey Department of Community Affairs (DCA)
- New Jersey Highlands Council

The official website for the State of New Jersey provides links to various grant opportunities throughout the state. The following is a direct link to state grants by department or agency:

http://www.nj.gov/dep/grantandloanprograms/

In addition, water supply, wastewater and stormwater infrastructure improvements may be eligible for low-interest loans from the New Jersey Environmental Infrastructure Financing Program:

http://www.njeit.org/

The Small Cities Community Development Block Grant (CDBG) program offers funding for local needs for which no other source of funding is available.

http://www.nj.gov/dca/divisions/dhcr/offices/cdbg.html

The New Jersey Highlands Council has grant programs to assist with agricultural management, particularly as it pertains to irrigation. In addition, the Highlands Council can also help fund outreach and educational programs. Additional information can be found at:

http://www.state.nj.us/njhighlands/grantprograms/

Federal Program Grants

Federal funding is available for water conservation and water use technology. Grants are one way to obtain funding for a water conservation project. A searchable database of federal program grants can be accessed at www.grants.gov. For federal grants the following agencies and their components should be considered:

- Environmental Protection Agency (EPA) – of note are:
  - The Catalog of Federal Funding Sources for Watershed Protection (https://catalog.data.gov/dataset/catalog-of-federal-funding-sources-for-watershed-protection-20c57)
  - Office of Wetlands, Oceans, and Watersheds – Watershed Funding (http://water.epa.gov/grants_funding/shedfund/watershedfunding.cfm)
- United States Department of Agriculture (USDA)
- United States Department of Energy (USDOE)
- United States Department of the Interior (USDOI)
- United States Department of Housing and Urban Development (HUD) – including Community Development Block Grants (CDBG)
- USGS – including cooperative agreements

Grants may be available from multiple components of the agencies listed above, so when searching for grants, do not immediately rule out agencies with names different from those listed. Each grant in the Grants.gov database has a summary/description and eligibility requirements.

The Natural Resources Conservation Service (NRCS) is a notable component of the USDA to consider for funding. The Agricultural Management Assistance (AMA) Program is run through the NRCS and

Activities in planning for green building, including activities in the Leadership in Energy and Environmental Design (LEED) program, are supported by EPA through funding for governments, non-profit organizations, consumers and industries who are striving to conserve energy. The following website details some of the funding opportunities provided by EPA regarding green building:

http://www.epa.gov/greenbuilding/tools/funding.htm

Private Funding Sources

Development

Funding from development activities can be implemented through changes to construction codes and development review ordinances, including the Highlands Area Land Use Ordinance.

Commercial Entities

Cooperative events with local businesses can be used to raise funds or provide discounts to local stakeholders to promote water conservation.

Foundations

The following are some foundations that offer funding opportunities:

- National Fish and Wildlife Foundation (https://www.nfwf.org/)
- River Network (http://www.rivernetwork.org/)
- American Rivers (http://www.amrivers.org/)
- Center for Watershed Protection (http://www.cwp.org/)
- Trout Unlimited (http://www.tu.org/)

Other Non-Governmental Organizations

The American Water Works Association (AWWA) participates in grant and research programs for water conservation and technology. The following is a link to AWWA's website where current grant information may be found:

http://www.awwa.org/

The American Water Resources Association (AWRA) has information about water resources education, management and research.

http://www.awra.org/

Municipalities and Utilities

Municipal Capital Projects

Municipalities periodically repair, rehabilitate or replace municipal facilities. In municipal capital projects, incorporation of improved fixtures, irrigation methods, stormwater capture and recharge, and other methods for reducing water consumption and depletion can be highly cost-effective. Some water conservation methods have relatively short payback periods, especially those that reduce hot water use.

Utility Operations

Utilities also periodically repair, rehabilitate or replace their capital facilities, with most of the costs funded through user charges. These projects, when part of a planned preventive maintenance program, can reduce the long-term costs of operating the utility by minimizing the potential for emergency repairs. Utilities also may address constraints on water line service capacity by encouraging water conservation by customers. Such projects reduce both water losses and system stress.

Water Conservation, Deficit Reduction and Elimination Strategies

Selected Strategies

Conservation efforts should be targeted toward agricultural irrigation in HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong) which represents the largest deficit within Holland Township. As mentioned above, if the intake owned by Phillips Farm is withdrawing water from the Delaware River, it is not applicable, and the deficit is reduced. However, the strategies here focus on irrigation as well as residential usage which are the drivers of the deficit within this HUC14.

In addition to agricultural strategies, strategies that focus on golf course irrigation and residential usage should be considered. Note that domestic water supply has significantly more water used for irrigation and outdoor summer activities (**Appendix C Figure 13**). Therefore, conservation strategies should focus on irrigation and/or offsetting the water used for irrigation.

The following selected strategies are provided as initial recommendations. Additional strategies should be added and/or replaced as appropriate.

Irrigation (and Water) Conservation Programs

Community outreach for water conservation programs can go a long way towards water conservation. Implementing water conservation educational programs in schools, starting in elementary schools can be a cost effective and efficient approach to inform the public on water conservation.

Revised Irrigation Ordinance

This strategy involves developing or strengthening irrigation ordinances to limit excess irrigation. This can be implemented through odd/even day irrigation, mandate for the installation of rain sensors on automated irrigation systems and/or incorporating smart irrigation design.

Stormwater Ordinance

This strategy involves developing a stormwater ordinance or improving an existing stormwater ordinance to promote recharge and/or infiltration within the subwatersheds as development occurs, beyond typical minimum standards such as those contained in N.J.A.C. 7:8 et seq, N.J.A.C. 5:21 et seq. (Residential Site Improvement Standards), or the Highlands Area Land Use Ordinance.

Drip Irrigation

Drip irrigation and micro-irrigation systems apply water directly to the ground, typically just below or directly to the soil surface. The advantage of these systems is that water is applied directly to the roots and evapotranspiration is significantly reduced. See the NRCS for additional information[10].

Low Flow Fixtures

Although irrigation is a large component to deficits within Holland Township, domestic water usage is also high, particularly within HUC14 02040105170020. Installation of low flow fixtures can save a lot of water, particularly for domestic water users who may not be keeping track of their water consumption.

Irrigation System Design

This strategy involves the promotion of intelligent irrigation system design for residential and commercial irrigation water use. Through the incorporation of scheduling techniques, efficient technology, and soil moisture sensors, the amount of water used for irrigation can be reduced.

Agricultural irrigation is not addressed under this strategy because no agricultural water use statistics are available for this subwatershed.

Water Conservation and Deficit Reduction Target

As mentioned earlier, subwatersheds do not follow political boundaries and to establish a target for watershed management and water conservation on a municipal basis, the contribution of each municipality to a particular subwatershed's deficit is required. Holland Township is responsible for managing the following:

- HUC14 02040105160070: Musconetcong R (below Warren Glen) - Due to the closure of the two paper mills, this HUC14 is not in deficit. Water conservation measures should still be applied to maintain the surplus, however.
- HUC14 02040105170010: Holland Twp. (Hakihokake to Musconetcong) - Holland Township accounts for 100% of the consumptive use and management of the deficit within this HUC14. As shown in Table 13, other than a three-year period from 2005-2007, the deficit within this HUC14 is generally below 0.2 mgd. If those three years are omitted (assuming they are outliers), the average deficit is 0.1155 mgd, or 115,500 gallons per day.
- HUC14 02040105170020: Hakihokake Creek – The deficit is consistent from 2000 through 2017 and averages 0.0495 mgd, or 49,500 gallons per day. Holland Township accounts for approximately 73% of the total consumptive use and therefore would be responsible for 73% of the deficit. Potable supply pumping from the Milford water supply wells is approximately twice the potable supply pumping in Holland Township. However, irrigation withdrawals in Holland Township for golf course irrigation gives Holland most of the responsibility to reduce

[10] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?cid=nrcs144p2_027154

the deficit. The portion of the deficit that should be targeted by Holland Township is 36,140 gallons per day.

Water Conservation and Deficit Reduction Estimates

Irrigation (and Water) Conservation Programs

Holland Township has conducted water conservation activities that include having elementary school students build rain barrels[11] to the establishment of this Plan. Conservation programs should encompass the various elements associated with water conservation including the strategies listed below. It is recommended that the programs be run by the Environmental Commission.

Revised Irrigation Ordinance

This strategy involves developing or strengthening irrigation ordinances to limit excess irrigation. This can be implemented through odd/even day irrigation, mandate for the installation of rain sensors on automated irrigation systems and/or incorporating smart irrigation design.

As this is an ordinance, it is difficult to approximate a water savings. However, it will serve as the primary mechanism for implementing smart irrigation systems and perhaps drip irrigation systems for residential and commercial landscaping.

Stormwater Ordinance

The premise of this deficit mitigation strategy is that baseflow could be enhanced by the construction of recharge and/or infiltration basins. Existing detention basins should be retrofitted to recharge basins where appropriate.

In keeping with current NJDEP guidance, this strategy is based on the infiltration facilitated by the NJDEP stormwater quality design storm of 1.25 inches. For the purpose of this estimate, we are assuming the basin is approximately 1 acre in size having a 10:1 hydraulic loading ratio.

Based on a NOAA rain gage within the area (US1NJHN0012: HOLLAND TWP 2.6 NNE, NJ US), the average total precipitation from June through August between 2009 and 2017 is 15.39 inches, which corresponds to 0.17 inches per day. Based on the NJDEP 2012 land use/land cover database, the average percent impervious cover is 14.6%. Using the Sutherland Equation[12], the calculated DCIA is approximately 3% (using agriculture and low-density land use). So, 0.3 acres of the drainage area would drain to the hypothetical recharge basin.

Assuming that 85% of the runoff generated from the directly connected impervious area (to account for larger storms), the up to 13,900 gallons per day can be infiltrated and conserved from a 1 acre-system (having assumptions as specified above).

[11] http://www.nj.com/hunterdon-county-democrat/index.ssf/2013/02/holland_township_school_commun.html

[12] https://www3.epa.gov/region1/npdes/stormwater/ma/IA-DCIA-Calculation-Methodology.pdf

This strategy is intended for antiquated systems with areas that are already connected to a storm sewer which discharges to a stream. The conservation benefit will be site specific and if a retrofit is conducted to an existing stormwater infrastructure (such as a detention basin), the benefit will be reduced.

Drip Irrigation

While the current irrigation practice of agricultural facilities is not known, if drip irrigation is not already being utilized, it is an effective method to conserve water. Drip irrigation is an efficient method and is being utilized on over 20,000 acres in California (mostly alfalfa)[13]. It is most efficient for tree and row crops but is not utilized for turf and sod. The use of drip and low volume irrigation techniques has increased by approximately 5% over the past decade for all crops in California[14].

While drip irrigation is thought to be the "low hanging fruit" for water conservation, it does have its challenges. It is relatively expensive compared to sprinkler irrigation and it must be implemented correctly. However, water savings have been as high as 40 percent in some instances in California[15].

Total consumptive use for agriculture within HUC14 02040105170010 is 0.1823 mgd, or 182,277 gallons per day. The efficiency of a drip irrigation system will vary, but assuming a water savings of 20%, that could yield nearly 36,500 gallons per day or nearly 1/3 of the deficit. Drip irrigation should be pilot tested prior to municipal-wide implementation as there is some debate within the scientific community regarding the conservation potential of drip irrigation.[16]

Although drip irrigation is only applied to agriculture in this example, it can also be utilized by residential and commercial users for landscape irrigation purposes.

Low Flow Fixtures

According to the USEPA, utilizing low flow fixtures (WaterSense) can save an average family the following gallons per year[17]:

- Faucets: 700
- Toilets: 13,000
- Showerheads: 2,700

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[13] http://agwaterstewards.org/practices/irrigation_management/

[14] Tindula, G.N., Orang, M.N. and Snyder, R.L. 2013. Survey of Irrigation Methods in California in 2010, Journal of Irrigation and Drainage Engineering, v. 139, No. 3. 233-238.

[15] http://www.sacbee.com/news/politics-government/article2591279.html

[16] Can der Kooij, S., Zwarteveen, M., Boesveld, H. and Kuper, M. 2013. The efficiency of drip irrigation unpacked. Agricultural Water Management, v. 123, pp. 103-110.

[17] https://www.epa.gov/watersense/bathroom-faucets

Based on U.S. Census[18], parcel databases downloaded from the New Jersey Geographic Information Network (NJGIN) and the 2012 land use/land cover database from NJDEP, the number of residential parcels within Holland Township in each HUC14 is as follows:

- HUC14 02040105160070: 292
- HUC14 02040105170010: 314
- HUC14 02040105170020: 1102

Assuming full implementation of low flow fixtures (assuming none currently exist), the following gallons per day within each HUC14 can be conserved (raw/consumptive):

- HUC14 02040105160070: 13,100 / 3,800
- HUC14 02040105170010: 14,100 / 4,050
- HUC14 02040105170020: 49,500 / 14,350

However, it is unlikely that all households currently do not have low flow fixtures and full implementation will be difficult. Nevertheless, Holland Township's responsibility for the deficit within HUC14 02040105170020 can be met simply with using low flow fixtures. Nevertheless, nearly half of the deficit within HUC14 02040105170020 can be accounted for by using low flow fixtures throughout.

Irrigation System Design

Some experts estimate that up to 50 percent of commercial and residential irrigation water use goes to waste due to evaporation, wind, improper system design, or overwatering.[19]. This strategy is focused on the design of intelligent irrigation systems that utilize current technologies such as irrigation controllers, soil moisture sensors, rain shut off switches, or efficient sprinkler heads.

As the basis for this strategy, the total amount of irrigated land in the three subwatersheds of interest was estimated using a GIS analysis. Using NJDEP's 2012 Land Use/Land Cover feature dataset, land use types associated with residential and recreational field land uses were isolated. The relatively small number of commercial parcels that are present within the Township are largely impervious so for the purposes of this Plan it is assumed no irrigation occurs on those parcels.

The total irrigated portion of the land use types indicated above was assumed to be 50% of the total pervious land area identified in the residential and recreational field land use types.

[18] https://www.census.gov/quickfacts/fact/chart/hollandtownshiphunterdoncountynewjersey/HSD410216#viewtop

[19] Outdoor Water Use in the United States, Environmental Protection Agency, Water Sense – An EPA Partnership, Retrieved from < http://www.epa.gov/WaterSense/pubs/outdoor.html >.

The peak irrigation rate for residential, commercial, and athletic fields was estimated to be 8 gpm/acre. This is consistent with 1-inch of water per irrigation, occurring for 8 hours over a 7-day period.[20]

Based on the GIS analysis described above, the following table of acreage by land use type was developed:

Table 30 – Estimated Total Pervious Acres and Irrigated Acres by Land Use Type

HUC14	Pervious Acres by Land Use Type: Residential	Pervious Acres by Land Use Type: Recreational Field	Total
02040105160070	340.1	2.5	342.5
02040105170010	413.7	2.8	416.4
02040105170020	1,184.5	188.9	1,373.4
Total Acres	1,938.2	194.1	2,132.3
Estimated Total Irrigated Acres*	969.1	97	1,066.2

*Estimated Total Irrigated Acres = Total Pervious Acres x 50%

Based on the total irrigated acreage and a peak irrigation rate of 8 gpm/acre, a total of 8,529 gpm peak irrigation is estimated. However, this rate is estimated to occur for a total of 8-hours over the course of a 7-day period. Using these assumptions, this equates to an average irrigation water usage of approximately 585,000 gallons per day.

Irrigation water usage can be reduced by 10% using this strategy (conservative estimate), resulting in the following conservation totals from each subwatershed (raw/consumptive in gpd):

- HUC14 02040105160070: 9,400 / 8,460
- HUC14 02040105170010: 11,420 / 10,270
- HUC14 02040105170020: 37,670 / 33,900

Summary of Savings Potential

The following is a summary table of the potential savings in water use estimated under this Plan:

Table 31 - Summary of Potential Water Use Reductions

Strategy	Potential Savings (gpd): HUC14 02040105160070	Potential Savings (gpd): HUC14 02040105170010	Potential Savings (gpd): HUC14 02040105170020
Stormwater Ordinance*	13,900	13,900	13,900
Drip Irrigation	0	36,500	0
Low Flow Fixtures	3,800	4,050	14,350
Smart Irrigation	8,460	10,270	33,900

*Note: this is on a per system having assumptions specified in text.

[20] New Jersey Irrigation Guide (June 2005), United States Department of Agriculture, Natural Resources Conservation Service, Somerset, NJ, Chapter 6, Table NJ 6.7, page NJ6-15.

The above table presents potential savings that are representative of withdrawals during the June-July-August period.

Selection of a combination of the above strategies should be considered as measures to help work toward achieving the Net Water Availability targets for this WUCMP area.

Monitoring and Annual Water Use and Return Data

The mitigation strategies selected to reduce the deficit in Holland Township must be evaluated periodically. A cursory annual review of each strategy will be conducted to determine its effectiveness and a more detailed biennial review will update the Net Water Availability tables of this WUCMP. The biennial review will include an analysis of the likelihood of achieving the target reduction in the Net Water Availability deficit via the mitigation strategy. The same analytical techniques used in the initial Net Water Availability determination will be used to determine the future deficit or surplus within the subwatershed.

Annual monitoring will be required. A monitoring form has been included here as Appendix B. This form will be made available online to facilitate efficient completion and submittal. It is anticipated that the form will be submitted to the Highlands Council on October 30th of each year, corresponding with submittal of water use forms to DEP. The monitoring period that will be reflected by the form will be October 1 through September 30 (although data will represent June through September of that particular year). One form will be submitted for each HUC14 subwatershed within the municipality.

Annual Water Use and Return Data

Each year, a review will be conducted of water use data for these watersheds for the preceding year. This data can be obtained from the water purveyor or user (Aqua New Jersey, Marc Phillips Farm) or through the DEP Data Miner.

The NJDEP well database, which identifies well systems by Public Water System Identification (PWSID) numbers, and the Water Transfer Model should also be monitored annually or during announced updates to see if any public, residential, commercial/industrial, irrigation, or other category of well has been constructed in the preceding year. Once the population is adjusted and new wells are identified, water use in these watersheds should be re-calculated and compared to the results of the initial calculation.

USGS stream gauges and monitoring stations are not present within the Township and may be a valuable source of data. The feasibility of having a USGS gage or perhaps a gage monitored and maintained by the Township should be evaluated.

A re-evaluation of septic system returns for these subwatersheds should be performed biennially. The re-evaluation should update the total number of septic systems and identify any new or expanded public sanitary sewer service within the subwatersheds.

The existing ArcGIS database should be updated to show any new stormwater management basins where enhanced recharge has been implemented and any new sewer discharge points. After identification of new water return systems such as these, a new water return calculation will be performed and compared with the baseline calculation.

The re-evaluation will end with a calculation of the current deficit/surplus. As the WUCMP is implemented and adjusted, the results of each biennial review should show a reduced deficit or a surplus.

Stakeholder Participation and Ongoing Monitoring

Public education plays a significant role in the success of deficit mitigation strategies. Before any strategies are eliminated or adjusted, a comparison of actual public efforts and projected public efforts should be made. This comparison can be made using the results of public surveys or inquiries to utilities and municipalities regarding their participation. The survey data should be tabulated and analyzed statistically. Statistical analysis is necessary because only a fraction of the population will respond to the survey. In preparation of this plan, an initial participation rate for each mitigation strategy was assumed. The results of the survey will provide a basis for estimating the actual participation rate for each strategy. These results may show that a mitigation strategy was unsuccessful primarily due to low participation. In that case, other strategies should be considered that may be more effective.

Implementation Plan

Annual Program Implementation Plan

If a deficit remains after an annual review is conducted, several issues need to be addressed. It is expected that as the implementation plan is tested and fine-tuned, it will be refined throughout the process.

The annual review to refine the implementation plan should include:

- Verification of implementation for each mitigation strategy
- Assessment of effectiveness for each mitigation strategy
- Verification of effectiveness for each mitigation strategy
- If proven non-effective, where is the process going wrong? Where can improvements be made?
- Elimination/addition of strategies.
- Creation/revision of timeline to achieve deficit reduction/elimination.

Overall, it is important that annual determinations/analysis/monitoring be conducted to verify the effectiveness of the implementation plan. A database that stores annual monitoring data should be kept, beginning with implementation of this plan and continuing after deficit elimination, to document continued compliance and ensure that a deficit does not become apparent. If monitoring is efficient and thorough, elimination of deficits should be reasonably achievable.

Strategies

The following deficit mitigation strategies have been chosen for implementation.

1. Conduct public workshops and outreach events regarding benefits of water conservation. This may include outreach through the local schools.
2. Draft and adopt an enhanced Highlands Stormwater Ordinance to add a stormwater evaluation program, section on raingardens, and a section on basin retrofits. (Note that the Township has adopted the Highlands Stormwater Ordinance, this strategy would amend the existing ordinance.)
3. Retrofit existing municipally-owned and board of education-owned detention/retention facilities
4. Draft and adopt an ordinance that requires low-flow fixtures for new construction and additions.
5. Consider green infrastructure improvements when completing capital improvements to streets and roads. This includes, but is not limited to, infiltration trench, curb cuts, rain gardens, tree boxes, bio swales, vegetated swales.

Schedule to Achieve Water Balance

The five strategies listed above have the following timeline goals:

1. Workshops/outreach – host at least one workshop/outreach event annually
2. Enhanced Highlands Stormwater Ordinance – draft and adopt by December 31, 2021
3. Basin retrofit – this will be an ongoing task that will be done as funding becomes available
4. Low-flow fixture Ordinance – draft and adopt by December 31, 2021
5. Green infrastructure – this will be an ongoing process as capital improvement projects are funded by the State and/or Township

Responsible Parties

Responsible parties for maintaining the water balance will consist of the following:

- Holland Township
- Aqua New Jersey
- Marc Phillips Farms
- Oak Hills Golf Club

We recommend development of committees representing both communities to monitor and promote progress at the municipal level.

Funding Commitments

There are currently no funding commitments for the selected mitigation strategies. Funding, or a portion thereof, may be made available in the future from the Highlands Council with an approved scope of work.

Next Steps

The Township should prioritize the five identified strategies and work to adopt the ordinances necessary to support water use, management, and conservation. Furthermore, Holland should continue to work with the stakeholders to maintain an open line of communication and work cooperatively to reduce water consumption and increase water conservation.

An annual review of this plan is anticipated to take place one year from the date of municipal adoption. Funding for this review may be made available from the Highlands Council with an approved scope of work.

Appendix A

Background

Net water availability is defined as Ground Water Availability minus consumptive and depletive water uses. Following is a description of the different components that were used to derive the estimate of Re-Evaluated Net Water Availability in this Water Use and Conservation Management Plan (WUCMP).

Basis for Net Water Availability

The following columns of data have been provided in the WUCMP:

Year	Ag Ground Water Availability (mgd)	Non-Ag Ground Water Availability (mgd)	Total Non-Ag Consumptive Use (mgd)	Imported Septic Return (mgd)	Non-Ag Net Water Availability (mgd)	Surplus for Potential Use (mgd)

The columns of data shown above are explained in the following sections.

Year

This column refers to the calendar year from which the data was obtained.

Ground Water Availability

Ground Water Availability is that portion of Ground Water Capacity that is available for human uses, absent other constraints. For the purpose of the WUCMP calculations, Ground Water Availability is divided into two components. They are:

Agricultural (Ag) Ground Water Availability

Agricultural (Ag) Ground Water Availability – Ag Ground Water Availability is not applicable in each watershed. This type of Ground Water Availability is used when the Conservation Zone covers a majority of the watershed. In this case, Ag Ground Water Availability is established and tracked separately to support sustainable agriculture.[21]

Non- Agricultural (Non-Ag) Ground Water Availability

Non-Agricultural (Non-Ag) Ground Water Availability is the predominant type of Ground Water Availability and is used as the basis for net water availability for most watersheds.

[21] Highlands Council Technical Report, Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 123.

Consumptive/Depletive Uses

Consumptive and Depletive (Water) Use totals are derived from Ground Water Pumpage and Surface Water Withdrawals. These uses are divided into two categories: Consumptive and Depletive. These two types of water use are defined as follows:

- Consumptive Uses - That part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock or otherwise removed from the immediate water environment other than by transport through pipelines and other conveyances as potable water or wastewater.
- Depletive Uses - Those water uses that physically transfer water from one watershed to another through pipelines and other conveyances as potable water or wastewater, resulting in a loss of water to the originating watershed.

Total Non-Ag Consumptive Use

Non-Ag Consumptive Use is the calculated as follows:

Total Non-Ag Consumptive Use = [Adjusted Consumptive Domestic Use] +
[Consumptive Public Supply Use] +
[Total Non-Ag Consumptive Use from Surface Water] +
[Other Non- Ag Consumptive Use from Ground Water]

Adjusted Consumptive Domestic Use

Adjusted Consumptive Domestic Use is an estimate of the consumptive uses from areas within the watershed that are served by private residential ground water wells and are served by septic systems.

Adjusted Consumptive Domestic Use is based on the Highlands estimate of residential well pumpage, when reduced by that portion that may be served by public sewer.

Consumptive Public Supply Use

Consumptive Public Supply Use is based on the Public Potable Supply pumpage for all public potable water facilities in the watershed that get their raw water supplies from ground water. The cumulative (raw) pumpage for these facilities was multiplied by 0.9 to account for the observed impact of maximum month pumping on annual base (stream) flows. The resultant is referred to as Adjusted Public Potable Supply.

To calculate Consumptive Public Supply, the Adjusted Public Potable Supply is reduced by the following amounts:

- Septic Return from Public Supply - This value represents the non-consumptive portion of public supply use that is returned to the watershed through septic systems.
- September Wastewater Return to Surface Water – This value represents the cumulative discharges from wastewater treatment plants, where the discharge is in the watershed.

Total Non-Ag Consumptive Use from Surface Water

Total Non-Ag Consumptive Surface Water Use is a measure of the cumulative consumptive uses from within the watershed where the source is taken from surface water.

This quantity often includes golf course irrigation.

Other Non-Ag Consumptive Use from Ground Water

Other Non-Ag Consumptive Uses include the following where the source is taken from ground water

- Golf course irrigation (where this use is distinguished from that supplied by surface water)
- Commercial facilities with metered usage (e.g. restaurants, businesses, and other typical non-residential uses)
- Industrial facilities with metered usage (e.g. manufacturing)
- Cooling water with metered usage
- Institutional facilities with metered usage (e.g. hospitals, schools)

Imported Septic Return

Imported Septic Return occurs when an existing area served by public potable water supply, and the same areas are also served by septic systems. In addition, Imported Septic Return only applies when the source of public potable water supply under comes from outside the watershed.

Net Water Availability

In most circumstances, Non-Ag Net Water Availability is referred to as simply Net Water Availability and is distinguished from Ag Net Water Availability.

(Non-Ag) Net Water Availability is the amount of Non-Ag Ground Water Availability remaining after deducting Total Non-Ag Consumptive Uses and adding Imported Septic Return.

Net Water Availability cannot exceed Ground Water Availability, whether it is Ag or Non-Ag.

When the watershed has been designated as a Conservation Zone, Ag Net Water Availability will be calculated.

Surplus for Potential Use

When Imported Septic Return is sufficiently large, the calculation of (Non-Ag) Net Water Availability can exceed Non-Ag Ground Water Availability. In such cases, (Non-Ag) Net Water Availability is set to Non-Ag Ground Water Availability and the remaining portion is allocated under Surplus for Potential Use.

Appendix B

Appendix B includes a sample Water Use and Conservation Management Monitoring Form.

Water Use and Conservation Management Plan (WUCMP) Monitoring Form

Holland Township

Year:	**2017**	**Prepared By:**	
HUC14:	02040105170010		
Name:	Holland Twp. (Hakihokake to Musconetcong)	**Title:**	
Ground Water Availability (mgd):	0.0372		
Baseline Net Water Availability (mgd):	-0.184	**Date:**	

Diversion / Recharge Inventory

Owner	Type		No. of Wells / Intakes / Discharges	MGD[1]	Adjusted MGD	Total C/D Water Use (mgd)	Net Water Availability (NWA; mgd)
	Recharge or Withdrawal	GW or SW					
Wells / Intakes						0.221	-0.184
Domestic Supply (private wells)	Withdrawal	Ground Water	100	0.1177	0.1059		
Marc Phillips Farm	Withdrawal	Ground Water	1	0.015	0.0135		
Marc Phillips Farm	Withdrawal	Surface Water	2	0.1891	0.1891		
Reliant Energy	Withdrawal	Ground Water	1	0.0042	0.0038		
Reliant Energy	Withdrawal	Surface Water	1	0.7772	0.7772		
Wastewater Discharge							

Mitigation Strategies

Water Use and Conservation Management Plan (WUCMP) Monitoring Form

Holland Township

Year:	**2017**	**Prepared By:**	
HUC14:	02040105170010		
Name:	Holland Twp. (Hakihokake to Musconetcong)	**Title:**	
Ground Water Availability (mgd):	0.0372		
Baseline Net Water Availability (mgd):	-0.184	**Date:**	

Owner	Type	Year Installed	Anticipated Benefit (gpd)	Adjustment Required to NWA? (Y/N)²	Revised NWA (mgd)	Planned Mitigation Strategies for Next Year

Monitoring Sites

Stream	Gage Location	Year Installed	Collection Frequency	Minimum September Flow of Record (cfs)	Minimum September Flow (cfs)

1. Maximum withdrawal from June, July or August and associated return for groundwater (must be consistent month within HUC14). September withdrawal or return for surface water.
2. For mitigation strategies that are not directly related to water use (rate structures, water conservation structures). Stormwater BMPs are an example.
3. Use one table per HUC14.

Appendix C

Appendix C includes the following Figures:

Figure 1 – Highlands Region and WUCMP Location

Figure 2 – Land Use Capability Zones

Figure 3 – Planning and Preservation Areas

Figure 4 – Land Use

Figure 5 – Impervious Land Use

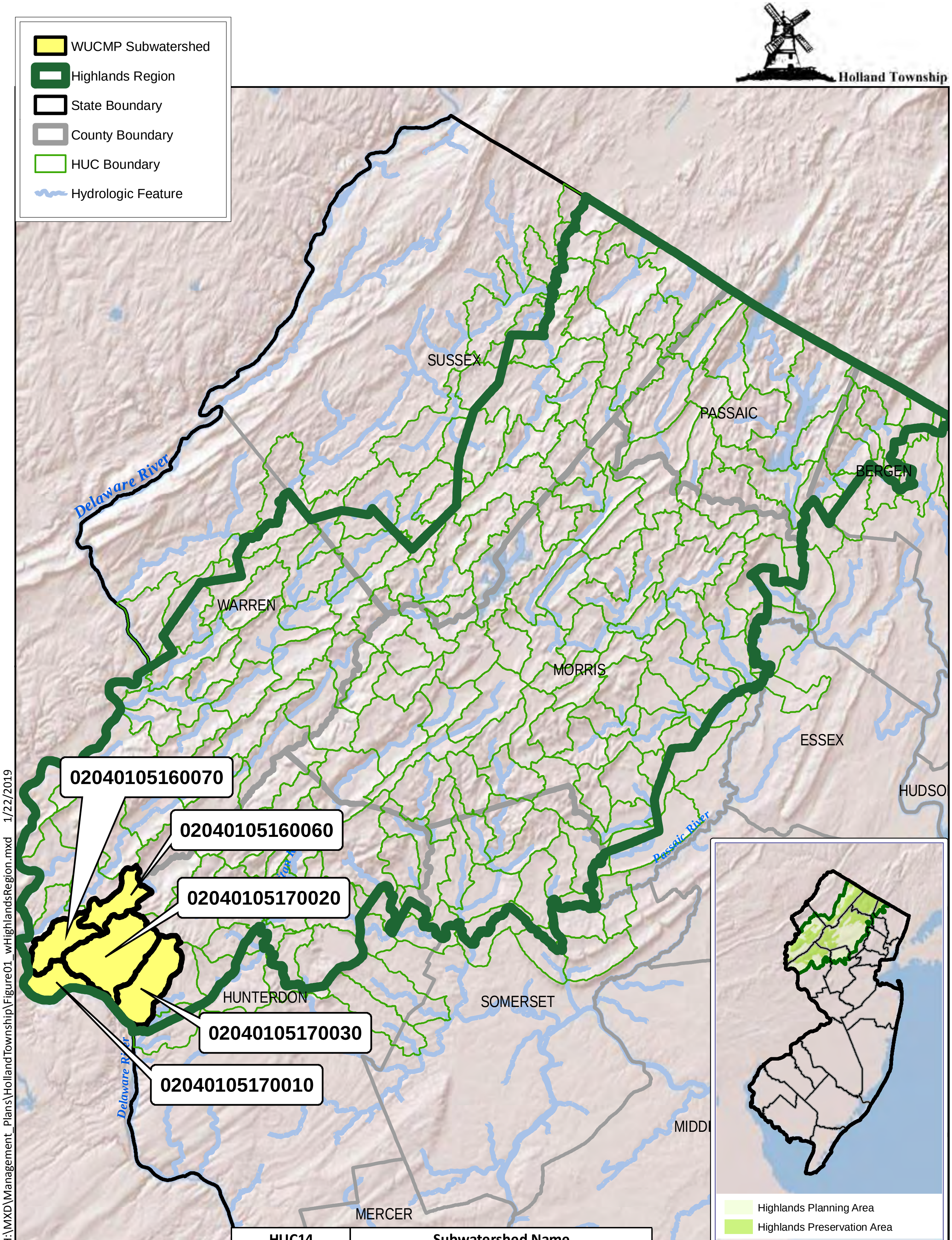
Figure 6 – Bedrock Geology

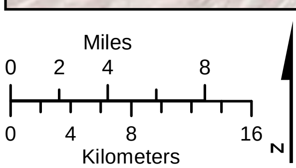
Figure 7 – Soil Types

Figure 8 – Public Supply Well, Surface Water Intakes and Water Service Areas

Figure 9 – Sewer Service Areas and NJPDES Dischargers

Figure 10 – HUC14s Overlain on a 2017 Aerial Photograph





HUC14	Subwatershed Name
02040105160060	Musconetcong R (Warren Glen to I-78)
02040105160070	Musconetcong R (below Warren Glen)
02040105170010	Holland Twp (Hakihokake to Musconetcong)
02040105170020	Hakihokake Creek
02040105170030	Harihokake Creek (and to Hakihokake Ck)

Figure 1
Highlands Region and WUCMP Location

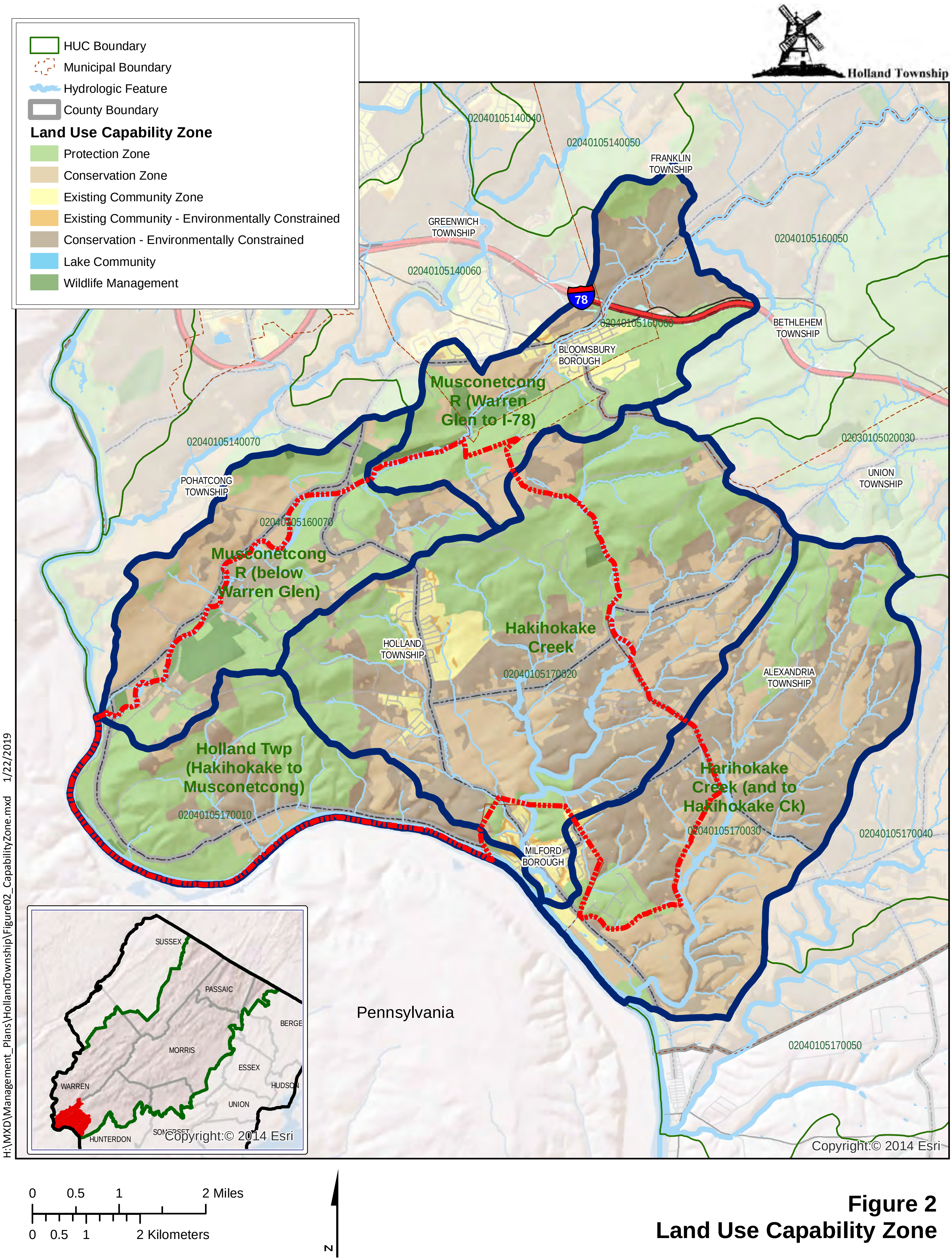


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Figure 2
Land Use Capability Zone

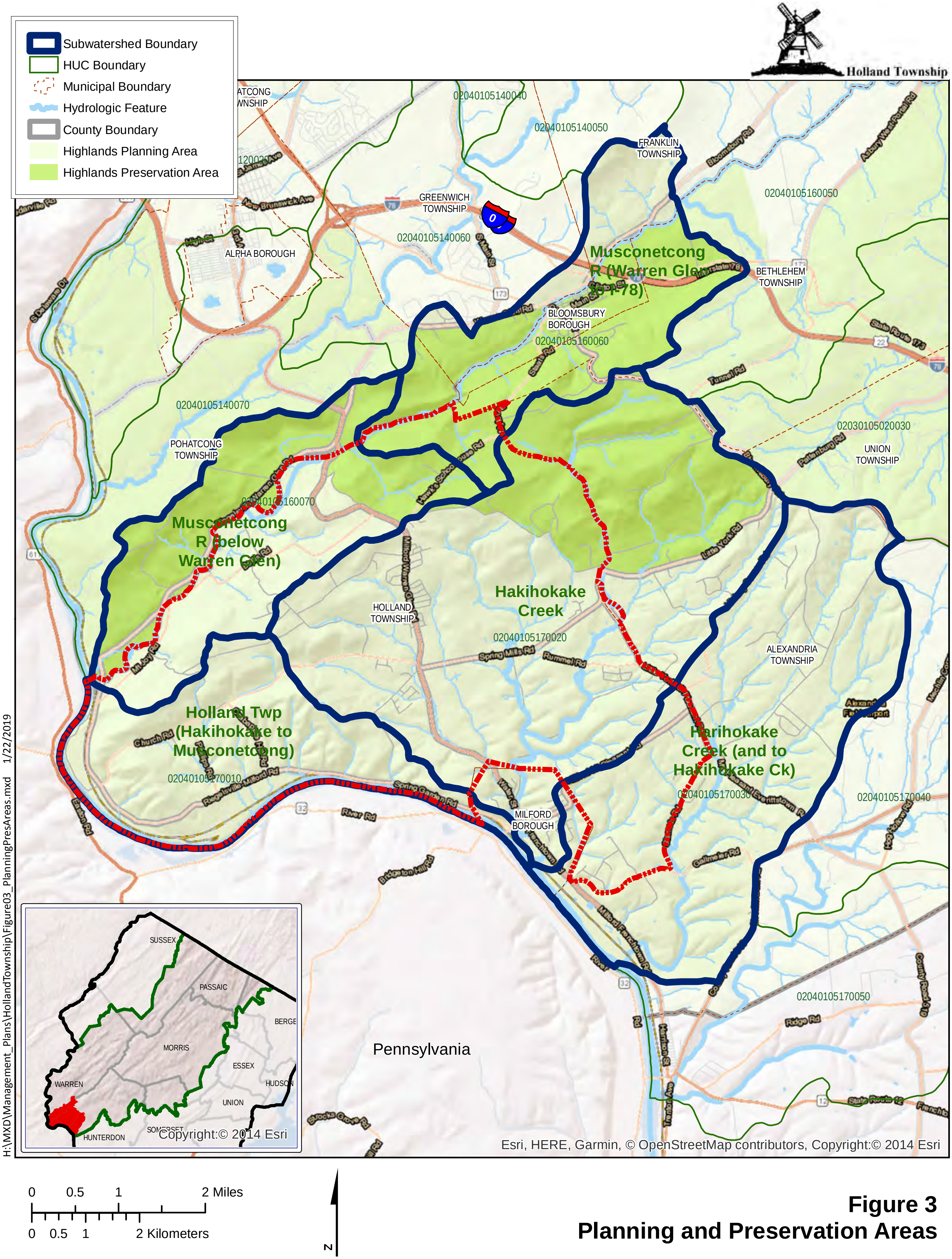

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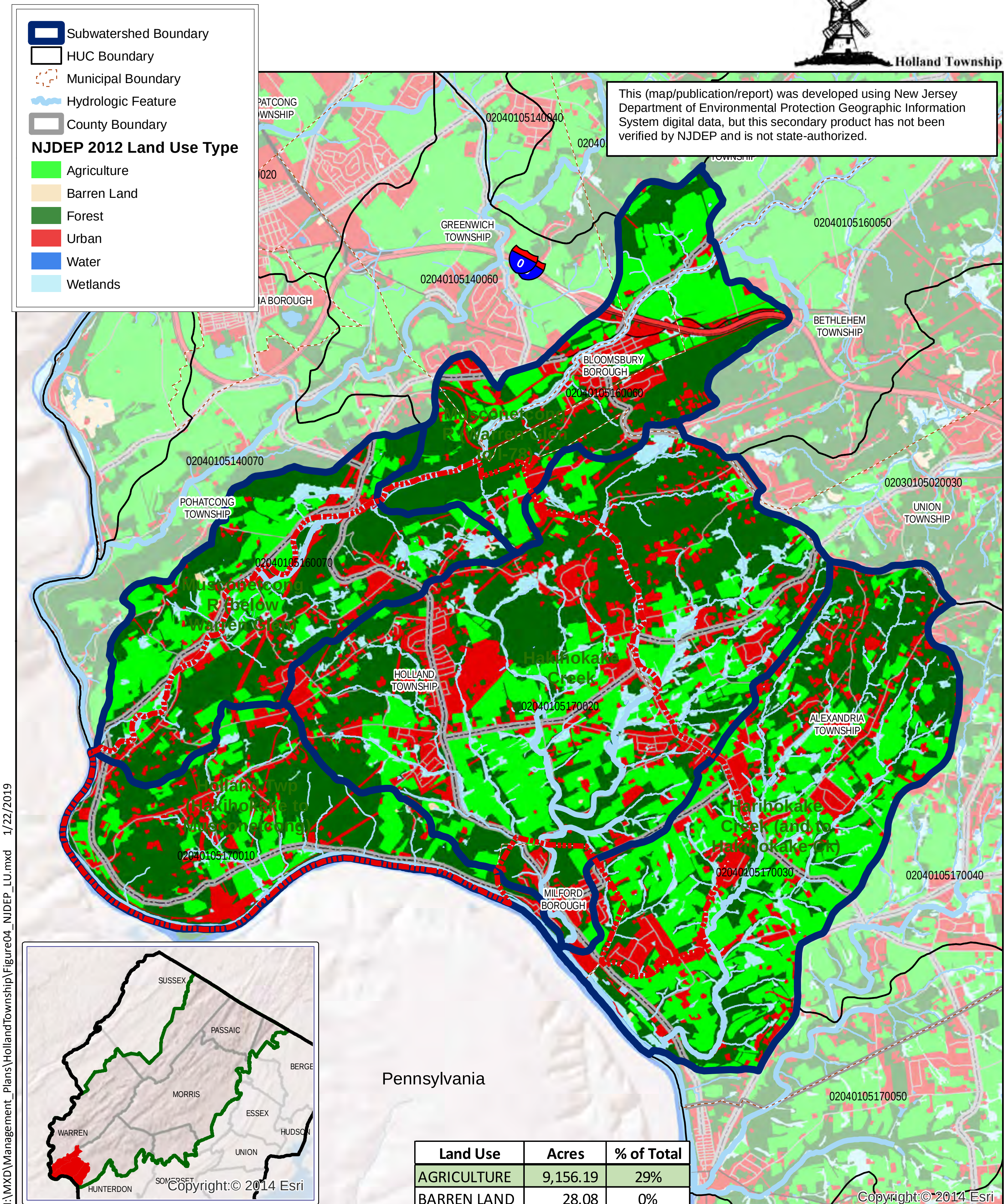
Figure 3
Planning and Preservation Areas

Holland Township



Land Use	Acres	% of Total
AGRICULTURE	9,156.19	29%
BARREN LAND	28.08	0%
FOREST	13,078.91	41%
URBAN	6,805.96	21%
WATER	630.07	2%
WETLANDS	2,123.65	7%

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N

Figure 4
Land Use

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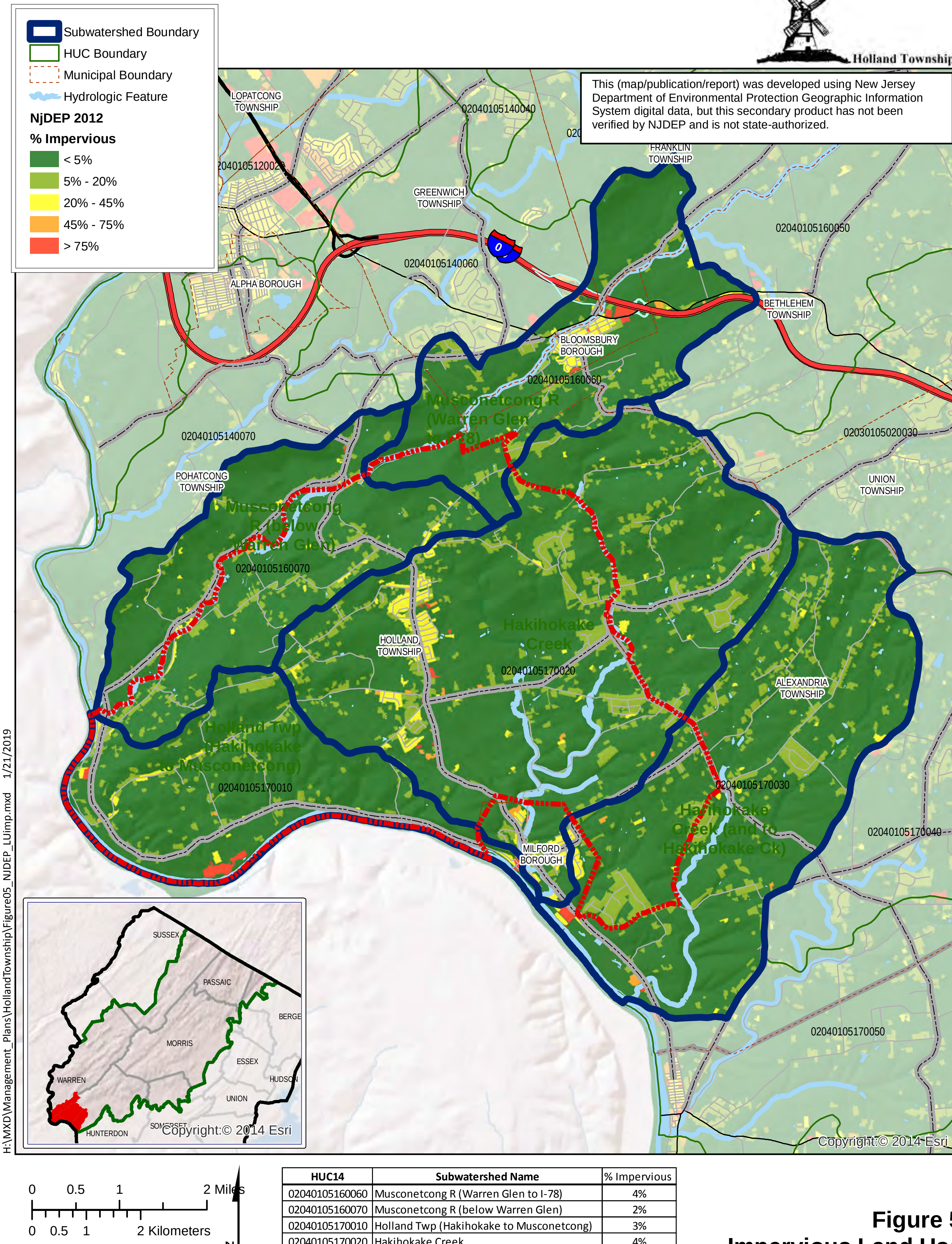
Holland Township



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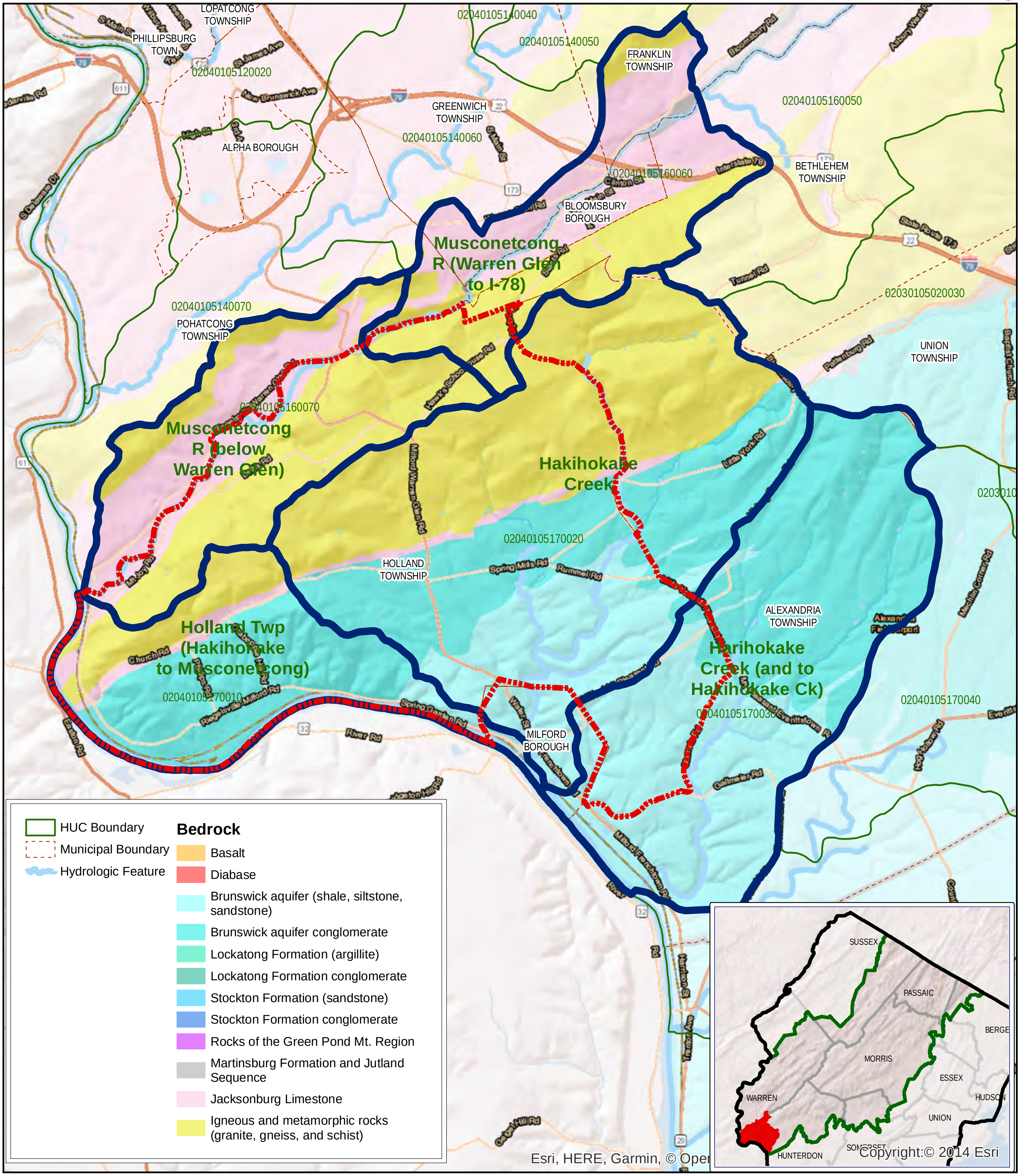
HUC14	Subwatershed Name	% Impervious
02040105160060	Musconetcong R (Warren Glen to I-78)	4%
02040105160070	Musconetcong R (below Warren Glen)	2%
02040105170010	Holland Twp (Hakihokake to Musconetcong)	3%
02040105170020	Hakihokake Creek	4%
02040105170030	Harihokake Creek (and to Hakihokake Ck)	3%

Figure 5
Impervious Land Use

Holland Township



0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
N

Figure 6
Bedrock Geology

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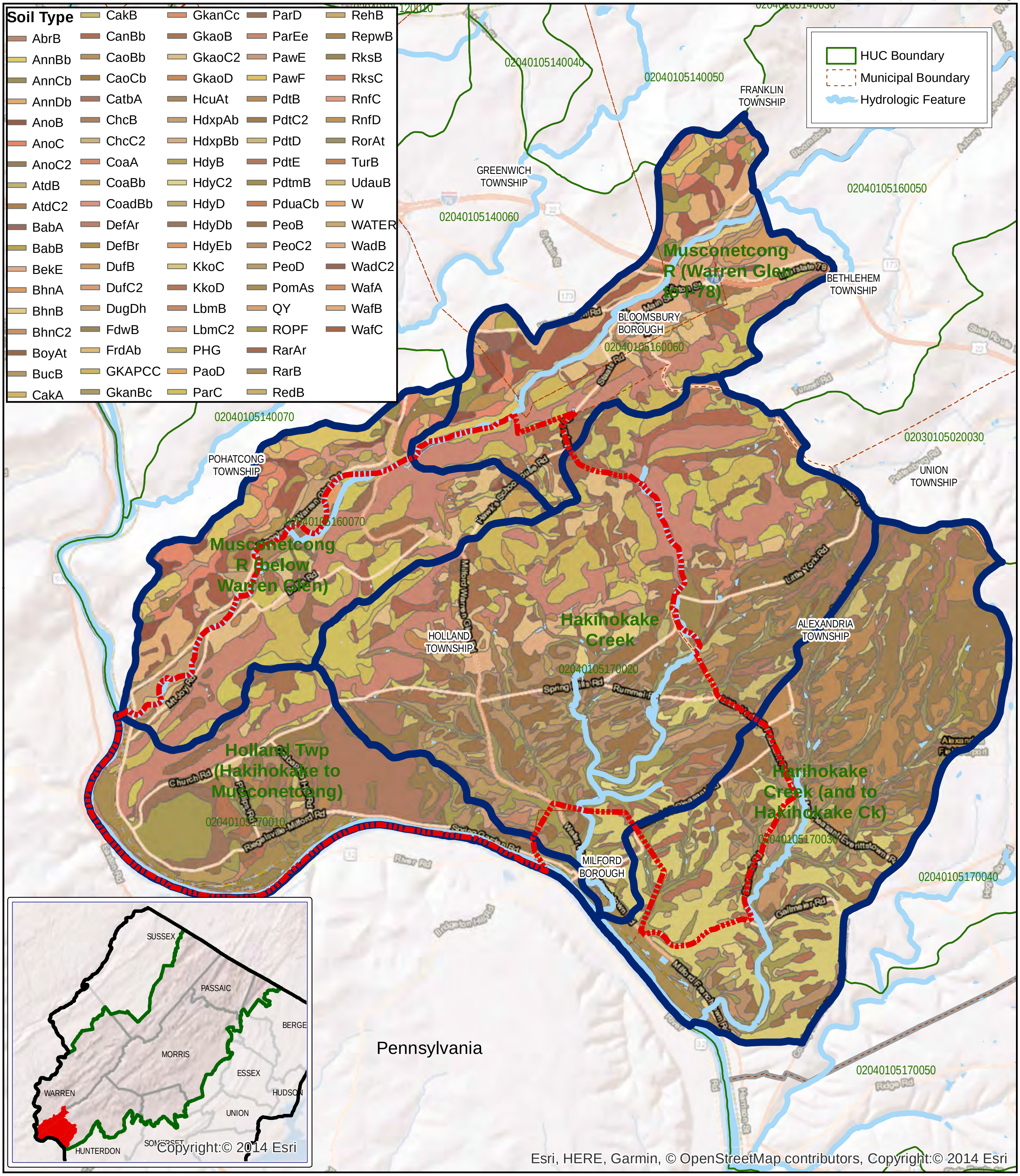
Holland Township



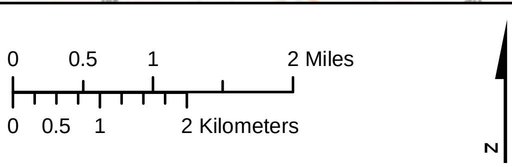


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Figure 7
Soil Types

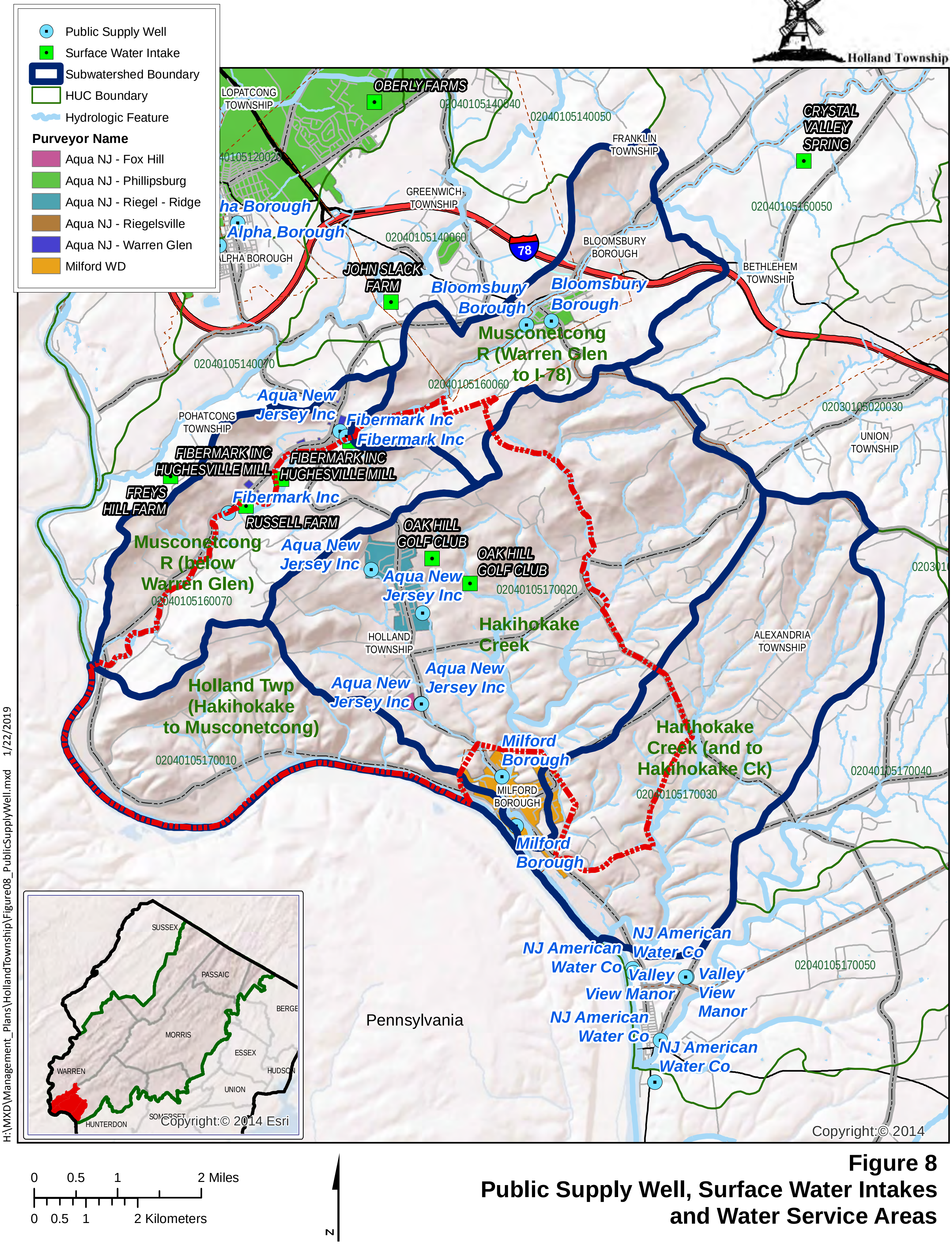


Figure 8
Public Supply Well, Surface Water Intakes and Water Service Areas

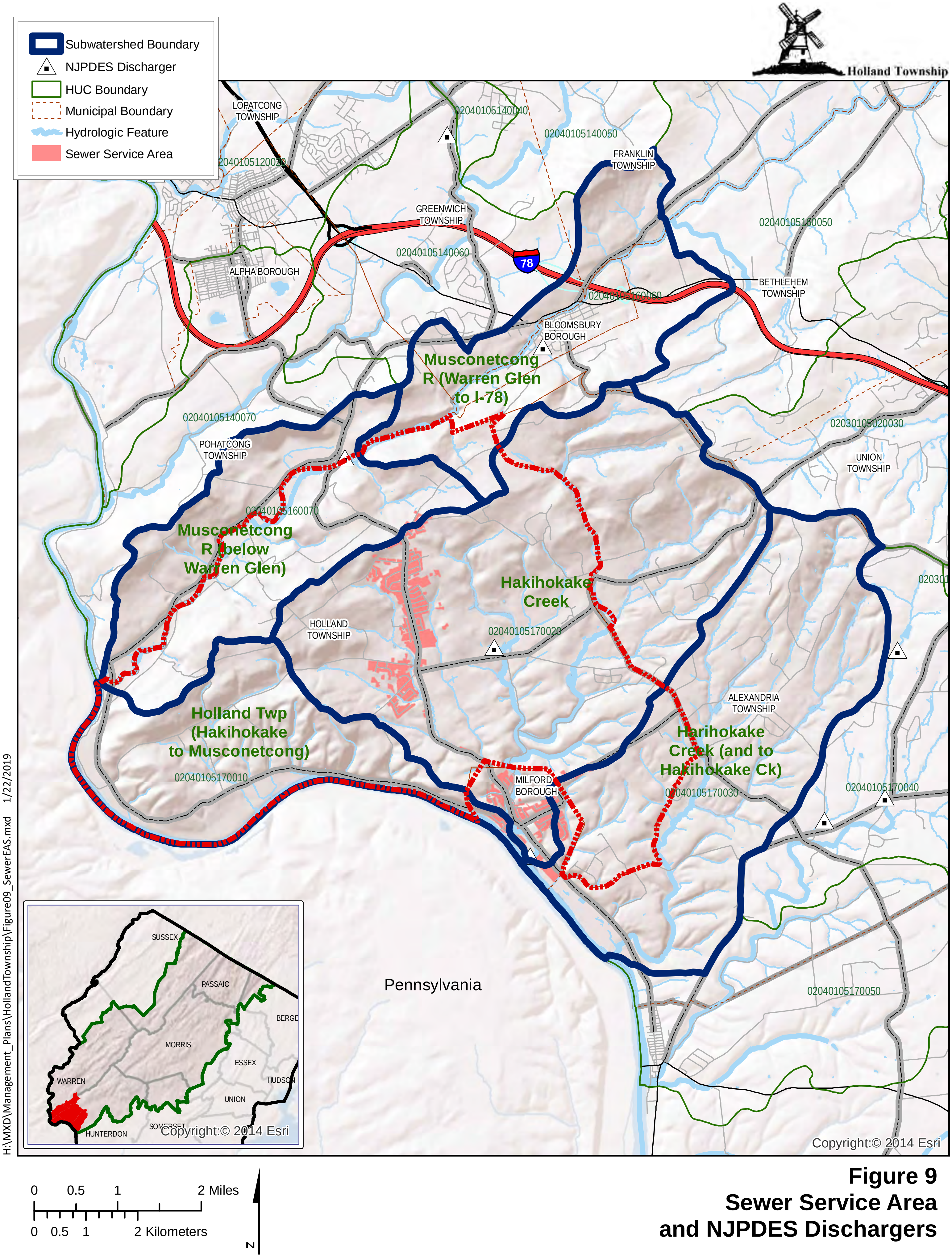
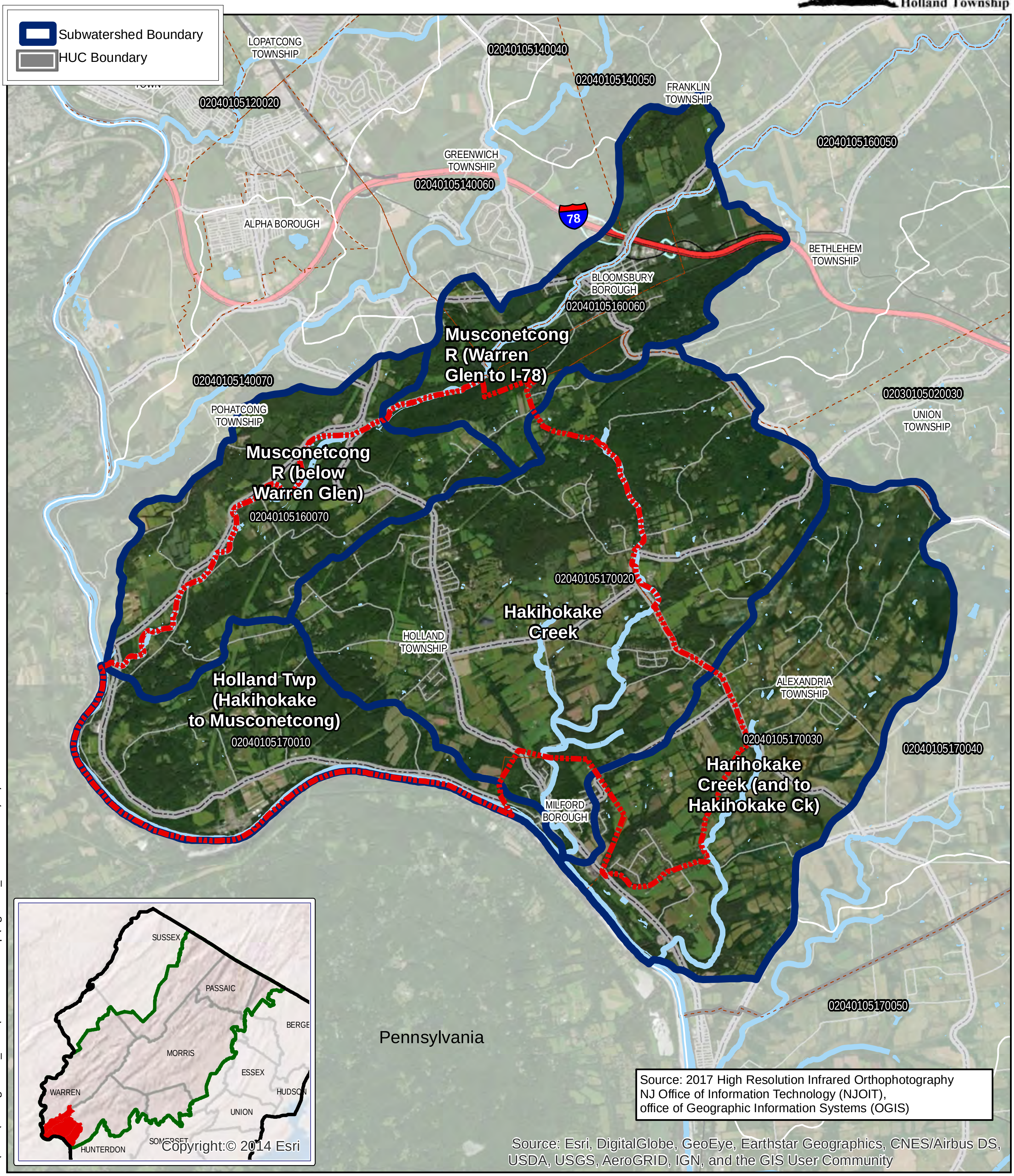


Figure 9
Sewer Service Area and NJPDES Dischargers

Holland Township



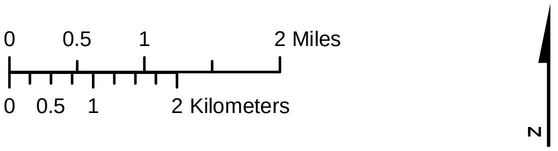


Figure 10
HUC14s Overlain on a 2017 Aerial Photograph

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