Water Supply Study

Cold Spring Water District

Village of Cold Spring

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TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

The purpose of this report is to present data, findings, and recommendations to the Village of Cold Spring and the Hudson Highlands Land Trust regarding the capacity of the Village of Cold Spring water district to service the water district under current and potential future demands. The water district encompasses the entirety of the Village of Cold Spring, as well as certain parcels located in the Village of Nelsonville and the Town of Philipstown. The water district boundary was determined from a map provided by the Village, entitled "Village of Cold Spring, NY Water Distribution," dated July 11, 2013, and prepared by James Labate – Worlds End Mapping (see Appendix A). The distribution map identifies parcels served by the Cold Spring water distribution system, as well as the location of the water treatment plant, water main locations, and water main sizing.

This report includes:

- Description of the existing Village of Cold Spring Water District;
- Description of existing water source, treatment, storage and distribution system;
- A close estimation of the existing water demand and the potential maximum future buildout based upon 2020 parcel zoning and permitted uses;
- Analysis of adequacy of the existing water sources for existing and maximum buildout scenarios;
- Analysis of adequacy of the existing water treatment, storage, and distribution systems for existing and maximum buildout scenarios;
- A presentation of potential improvements for the expansion of the existing water sources, treatment system capacity, storage limits, and distribution systems configuration.

Our findings suggest that periodic water shortages could be attributed to the Upper Reservoir operability. The reservoir is currently not functional due to its aged condition. The reservoir valve system does not open and close. Therefore, only the Middle Reservoir is being used as functional storage, able to release needed water during dry periods. Under the current water use conditions in the range of 260,000 gallons per day, the Middle Reservoir can only support the water district for approximately 2 months between significant precipitation events while still leaving a safety volume for firefighting and other emergency uses.

Future water demand has the potential to increase to a demand of over 300,000 gallons daily as undeveloped parcels become occupied. Under these conditions, the current operational storage volume of around two months will fall below two months as demand grows. In addition, climate models suggest the potential for lengthening of drought periods. Together, these factors make the likelihood of seasonal water supply shortages more frequent in the future.

Options to augment existing water sources of supply include: revise operational protocols to allow more substantial drawing down the reservoirs as part of routine operations, nominally increasing the storage capacity of the existing reservoirs using flash boards, repair the Upper Reservoir and its outlet system so it can be actively managed, increasing the water supply collection area by diverting flow from Jaycox Pond into the Foundry Brook reservoir, and drilling water wells to supplement current water sources. It is possible that funds currently being contemplated for repair of the upper reservoir could be reallocated to groundwater wells. Developing or improving a water source capable of adding 50,000 gallons per day to the water system would serve to counterbalance the effects of the potential future buildout upon the reservoir system. Waterwells typically provide a consistent daily flow that does not depend on reservoir levels.

2.0 BACKGROUND INFORMATION

2.1 Village of Cold Spring Water District Demographics and Geography

The Village of Cold Spring Public Water System provides water throughout the Village of Cold Spring, the Village of Nelsonville, and limited surrounding portions of the Town of Philipstown.

The Village of Cold Spring is located within the Town of Philipstown, in the western portion of Putnam County, New York. The Village is bounded by the Hudson River to the west, and the Village of Nelsonville to the east. Hudson Highlands State Park is located to the north of the Village, and Constitution Marsh lies to the south. The Village encompasses an area of approximately 407 acres and is home to a population of approximately 2,000 people. According to 2010 U.S. Census data, the population of Cold Spring has remained stable since 1990. According to the Adopted Comprehensive Plan, as of 2010 there were a total of 910 households in the Village. The Village also contains a vibrant tourism-based commercial core offering shops and restaurants, as well as a range of services supporting residents throughout the Town of Philipstown. One new residential development of size has been approved and constructed recently in the Village, known as Butterfield; approximately one third the residential units are now occupied. The Village of Cold Spring has 748 municipal water connections, which is less than the household number, as some multifamily developments have a single connection feeding multiple units.

The Village of Nelsonville is also located within the Town of Philipstown, in the western portion of Putnam County, New York. The Village is bounded by the Village of Cold Spring to the west, and the Town of Philipstown to the north, south, and east. Hudson Highlands State Park is located to the north of the Village. The Village encompasses an area of approximately 669 acres and is home to a population of approximately 628 people. Nelsonville has a limited commercial corridor. The Village of Nelsonville has 173 municipal water connections.

In addition to the Cold Spring and Nelsonville water connections, there are another 21 municipal water connections in the town of Philipstown outside of the two villages. This brings the total approximate water connections within the Cold Spring Water District to 942.

The Water District operator, Matt Kroog, reports that average daily demand from this water district is currently 260,000 gallons per day. This is distributed to approximately 2,800 residents and a number of businesses through the approximately 942 service connections. Based on 260,000 gpd and 942 connections, the average demand is in the range of 276 gpd/service connection. NYSDEC estimates an average three-bedroom house uses 330 gallons per day. At this time, it is unclear what percentage of flow is used for commercial uses.

2.2 Water District Boundary Map

The boundary of the water district was determined by information on the map entitled "Village of Cold Spring, NY Water Distribution," which was provided to Chazen by the Village of Cold Spring. The parcels outside of the Village of Cold Spring which are included in the water district are delineated by a red border on the map. The parcels in Nelsonville served by the water district are primarily located along Main Street (Route 301), with an additional cluster of parcels located between Main Street and the Cold Spring Cemetery. Town parcels included in the water district are located both to the east of the Village of Cold Spring and to the south of the Cold Spring Cemetery. See the Village of Cold Spring, NY Water Distribution map found in Appendix A.

2.3 Water District Zoning

In order to better understand the existing and potential future demands for the water supply, the parcels within the district have been categorized by zoning district type, parcel size, existing use, and permitted use. The maximum future water demand for the district will be based upon the maximum potential build-out of the parcels within the district as allowed by current zoning laws, which are currently not occupied. In addition, a Cold Spring Village trustee and the clerk, with Hudson Highlands Land Trust, estimated an additional number of residences that could be built after subdivision of large lots with existing structures on them (i.e. underutilized lots).

2.3.1 Existing Conditions Parcel Breakdown

In order to compare the existing and maximum buildout water demand within the water district, parcel data was extracted from the Putnam County GIS database (which was dated 2008) and then reviewed by a Village trustee, Village clerk, and Hudson Highlands Land Trust who made corrections and updates to this data. All of the parcels within the Cold Spring Water District were broken down by municipality, parcel use, and whether or not they were listed as having an existing water service connection. An overview of the number of parcels with existing water service within the water district can be found in *Table 1* below:

TABLE 1 Cold Spring Water District Parcels with Existing Water Service

Parcel Use Type	Number of Parcels Within District
Residential Parcels	766
Vacant Parcels (Single-family Res.)	10
Commercial Parcels	93
Community Use Parcels	37
Manufacturing and Processing	1
Public Service Parcels	2
Public Parks	1
Other (not included in Putnam 2008 GIS data)	32
Total Parcels w/ Water Service	**942**

For a more detailed breakdown of the parcels within the Cold Spring Water District with an existing water service, see the *Existing Conditions Parcel Breakdown* table in Appendix B.

There are also a significant number of parcels within the Water District that are listed by Putnam County GIS as not having water service, but in fact they do, so they were excluded from the buildout analysis.

See *Table 2* below for an overview of these parcels:

TABLE 2 Cold Spring Water District Parcels listed as Private or No Water Service

Water Service Type	Number of Parcels
Incorrectly labeled as private or no water service	100
Vacant or seasonal (e.g. Boat Club), excluding Marathon Site	25
Marathon Site	24
Total Parcels listed as without Water Service in Putnam GIS Data	**149**

2.3.2 Buildout Analysis

A buildout calculation for the Cold Spring Water District was conducted by analyzing those parcels within the district initially suggested to have no existing water service at the parcel, and by assuming further subdivision of large parcels with existing structures and connections. This information was taken from the analysis of the existing parcel data described in the previous section. Some of these have subsequently been identified as having existing connections, so the following buildout analysis is modestly conservative. Each parcel was keyed to local zoning districts and from that assigned its most intensive allowed development use along with an estimated water demand based on the hydraulic loading rates set forth in *Table B-3* of the NYSDEC's *New York State Design Standard for Intermediate Sized Wastewater Treatment Systems, 2014*. For a more detailed breakdown of the parcels included in the maximum buildout calculations, as well as a rationale for per parcel water demands for each use, see the *Maximum Parcel Buildout Within Water District – Estimated Demand* table in Appendix C.

The Butterfield Development, which is a major senior housing and commercial project within the Village of Cold Spring was partially included in the buildout demand. Per the Engineer's Report for the project (which is available on the Village of Cold Spring website), the demand for the completed project will be 15,310 gpd. Based on feedback from the Village of Cold Spring, we assumed one third of the ultimate demand is utilized now, so that the buildout included two thirds of the ultimate demand. For the vacant Marathon site in the Village of Cold Spring, we assumed the buildout water demand would be the same as the ultimate number for Butterfield. In addition to Butterfield and Marathon, there were an additional 24 vacant parcels assumed to have new water connections, 1 seasonal use and 40 new subdivided parcels that could have water connections.

The additional water demand added to the system in this buildout scenario totals 48,998 gpd. Added to the current daily demand of 260,000 gpd, the total demand on the system under these buildout assumptions is estimated at between 305,000 and 310,00 gpd. See *Table 3* below.

TABLE 3 Cold Spring Water District Parcels with Private or No Water Service

	Water Demand (GPD)
Existing Demand*	260,000
Additional Max. Buildout Demand	48,998
Max. Buildout Water Demand Estimate	**308,998**
	(say 305,000 to 310,000 gpd)

*Existing demand flow per *Village of Cold Spring usage data for 2020.*

Two factors could increase this buildout analysis finding. One factor is that the 2011 Village of Cold Spring Comprehensive Plan identified a current average water demand of 300,000 gpd, rather than the 260,000 reported by the current Water District operator according to the usage data for 2020. The discrepancy may reflect significant recent Village investments in water conservation and leak detection. The second factor is the possibility that the additional buildout analysis underestimates the maximum number of residential units if all currently developed parcels were replaced by the most intensive uses allowed under current zoning. The buildout analysis assumes 40 additional residential units created by the potential subdivision of existing large parcels within the water district. Notwithstanding, since various parcels initially screened to be unconnected are in fact already receiving municipal water, the estimate of future buildout capacity may net out to be approximately correct.

3.0 WATER SYSTEM

3.1 Existing Source(s)

Based upon the Cold Spring Water Department's "Annual Drinking Water Quality Report for 2017," the primary water source for the district include three (3) surface water reservoirs. The first two reservoirs are known as the "Upper" and "Lower" reservoirs. The Lower reservoir is also sometimes referred to as the "Mid" reservoir. The Upper and Lower Reservoirs are located at 90 Foundry Pond Road in the Town of Philipstown. Water collected from the Upper Reservoir and Lower Reservoir discharge to the Foundry Brook and is then recollected at the Foundry Brook Reservoir. The Water Treatment Plant draws from the Foundry Brook Reservoir.

Additionally, the water district has a connection to the Catskill Aqueduct, which passes through the Village of Nelsonville. This connection has been used on occasion to make up for possible seasonal deficits in reservoir capacity but is primarily envisioned for use during future maintenance work to repair the reservoir dams. The aqueduct is owned and operated by the New York City Department of Environmental Protection (NYCDEP). Water from the aqueduct is conveyed to the Foundry Brook Reservoir via a dedicated water main consisting of 6, 10, and 12-inch water main pipe. The Water District pays a fee for the water received from the Aqueduct and does not desire to routinely purchase water.

Once delivered to the reservoir, the aqueduct water has time to settle out entrapped air prior to filtration in the water treatment plant. Access to the Catskill Aqueduct water supply was meant to be temporary in nature, and subject to agreement with the NYCDEP. Access to the aqueduct for use during future dam repair projects has reportedly been delayed.

Since the Village of Cold Spring Public Water Supply is responsible for meeting its own peak water demand requirements, periodic use of the aqueduct as a back-up water source is not included for further review in this report.

3.1.1 Reservoir Capacity

Upper and Lower (Mid) Reservoirs

According to data provided to the Village of Cold Spring by Oakwood Environmental Associates, Consulting Engineers (see Appendix D), the Upper Reservoir has a capacity of approximately 34.56 million gallons (MG) and the Lower Reservoir has a capacity of approximately 31.42 million gallons (MG). The combined volume, equivalent to approximately 66 million gallons, technically detains the equivalent of approximately 8.5 months of water supply for the water district based on the current average daily demand of 260,000 gpd. This would drop to just over 7 months of reserve supply if demand rises to 310,000 gpd.

Outlet controls in the Upper Reservoir are, however, reportedly currently non-functional, so approximately half of reservoir total capacity currently cannot be managed to release water during a demand period. Water from this reservoir currently consists only of natural overflow of its spillway, which varies seasonally and cannot be controlled. Managed storage which can be functionally released when needed, therefore, is only available from the Lower (Middle) Reservoir, providing the equivalent of between 3 to 4 months of capacity from full to completely empty. And because the Cold Spring Water Department considers reservoir levels below 70% to be a cause for concern the operational volume of the Middle Reservoir, available for release during dry periods, is in the range of 10 million gallons which supports the water district for only approximately 2 months. The balance of the capacity of the Lower (Middle) Reservoir is reserved for fire suppression and other emergency allocations.

Foundry Brook Reservoir

According to the NYSDEC Dam Inventory, the storage retained by the dam detains approximately 1 acre-foot (325,851 gallons), or a little more than a one day supply. This reservoir is fed by flow from the Upper and Lower reservoirs, through the Foundry Brook, and is used a settling basin for the water treatment plant intake.

In recent years, reservoir storage capacity has reportedly fallen below thresholds of concern at least twice (see Appendix E). In 2017, the total reservoir capacity (all three of the above-mentioned reservoirs) were below target 70% elevations for three straight months (September through November). In 2019, the reservoirs fell below 70% in September. Since the Upper Reservoir cannot be managed to release stored water, the actual frequency of water scarcity events may have been higher than suggested here. Chazen is not aware of any water usage restrictions being imposed on the Water District customers during these periods of reduced capacity.

3.2 Existing Treatment and Storage

According to the "Annual Drinking Water Quality Report for 2017," water flowing through the treatment plant undergoes coagulation, filtration, pH adjustment, disinfection, and corrosion control. The primary mode of treatment at the plant is surface water filtration. There are currently two filters operating in parallel, capable of treating a flow of 280 gallons per minute (gpm), for a total flow rate of 560 gpm total. The maximum capacity of the treatment plant is limited by the filtration system at 806,400 gallons per day (gpd) or 24,192,000 gallons (24.2 MG) per month. After treatment, the drinking water is pumped to two storage tanks located near the treatment plant. The storage tanks have a combined capacity of approximately 500,000 gallons.

The adequacy of the existing treatment and storage capacities of the system can be represented as factors of safety. For representative purposes, the comparison of these capacities will be made to approximately the build-out water demand, at 300,000 gallons per day.

Comparing the maximum treatment capacity of the water plant to daily demand yields the following factor of safety:

F.S. = 806,400 gpd / 300,000 gpd = **2.69**

Similarly, the factor of safety for the storage capacity of the system related to the daily demand yields:

F.S. = 500,000 gpd / 300,000 gpd = **1.67**

As discussed further in Section 4.1, these are considered to be acceptable treatment and storage factors for present and future water use. Storage capacity needed for the flow is also included in Section 4.1.

3.3 Existing Distribution System

As noted above, the existing distribution system which serves the water district is gravity fed from the storage tanks, and serves approximately 2,800 residents through 942 service connections, according to the GIS parcel data and village records studied by Chazen, the Village Clerk, and HHLT. As shown on the map entitled "Village of Cold Spring, NY Water Distribution," the distribution system consists of 12, 10, 8, 6, and 4-inch water mains. Conditions and dimensions of this distribution system is considered below in Section 4.1.

Additionally, the map shows water mains for untreated water in 12, 10, and 6-inch sizes for the transport of water from the Catskill Aqueduct to the Foundry Brook Reservoir. As noted previously, no analysis of this supply connection is provided.

3.4 Existing Water Demand

As noted above, the current water demand documented by the Cold Spring Water Department has been approximately 260,000 gpd. Data provided Chazen included monthly precipitation, reservoir levels, and distribution for the time period of January 2017 through February 2020, all preceding the Covid-19 pandemic of March-present, 2020 which has not been included in model projections. The monthly distribution has ranged from 4.36 million gallons (MG) per month to 10.19 MG per month. Between 2017 to 2019, the peak distribution has occurred between May and July each year. The yearly average distribution has ranged from 6.77 MG/month in 2018, (225,000 gpd) to 7.87 MG/month in 2019 (262,000 gpd).

4.0 ANALYSIS

4.1 Supply vs Future Demand Analysis

RESERVOIR CAPACITY FOR BUILDOUT DEMAND

The buildout daily water demand of 309,000 gpd represents an approximate 19% increase in daily demand, and as such will reduce the long-term storage capacity of the reservoirs. Under buildout, the two Upper Reservoirs together have a storage capacity of a little over 7 months if the Upper Reservoir is repaired and can be managed to provide operational storage available to be fully drained to meet system demand.

But since the Upper Reservoir is not currently being managed as functional water storage, and the Village is therefore functionally reliant solely on the Lower (Middle) reservoir for operational storage, available storage falls to less than two month's supply when leaving a safety margin available for fire suppression and other unexpected requirements.

A further analysis of reservoir draws could be performed using rainfall data of the 1961 drought conditions. Calibration of storm events and runoff would need to be performed as well.

TREATMENT CAPACITY ADEQUACY FOR BUILDOUT DEMAND

There are currently two filters operating in parallel, capable of treating a flow of 280 gallons per minute (gpm), for a total flow rate of 560 gpm total. The maximum capacity of the treatment plant is limited by the filtration system at 806,400 gallons per day (gpd).

The water treatment plant is identified by the NYSDEC as facility WWR0001057. Per the DEC Water Withdrawal Reporting database, the facility is permitted for surface water withdrawal for public water supply. The average daily withdrawal is reported in the database as 0.27 MGD, or 270,000 gallons per day. The maximum permitted daily withdrawal is reported as 0.5 MGD, or 500,000 gallons per day. This capacity appears sufficient to meet both existing and buildout flows, unless new regulations require treatment for additional compounds or unless low thresholds are required for existing parameters. Water quality treatment is not a primary component of this review.

STORAGE CAPACITY FOR MAXIMUM BUILDOUT DEMAND

Based on the guidelines established in both the *NYCRR, Title 10, Part 5, Subpart 5-1.33 [items (b)(10) and (f)]* (NYSDOH, N.D., pp. 31-32) and the *Recommended Standards for Water Works, Parts 7 (Subpart 7.0.1) and 8 (Subpart 8.2.3)* (GLUMRB, 2012, pp. 107 & 116), the sizing of the water storage tanks should follow these guidelines: (a) an operational storage of 1.5 the average daily demand, (b) a fire flow of 1,000 gpm for 2 hours, and (c) an emergency/standby equal to the average daily demand. The needed storage for the maximum buildout demand based upon the estimated demand of 310,000 gpd would be the following:

(310,000 gpd * 1.5) + (1,000 gpm * 60 min * 2 hrs) + 310,000 gallons = **895,000 gallons**

Under these guidelines, the required storage volume of 895,000 gallons renders the existing storage tanks, with a total capacity of 500,000 gallons, inadequate to meet the future estimated buildout demand.

DISTRIBUTION CAPACITY FOR MAXIMUM BUILDOUT DEMAND

The distribution system is gravity fed and provides drinking water through 884 service connections as of the publication of the "Annual Drinking Water Quality Report for 2017." The distribution system consists of 12, 10, 8, 6, and 4-inch water mains, which deliver treated water throughout the district.

The water mains are described as being "built decades ago" and "subject to occasional failure" in the Village of Nelsonville Comprehensive Plan adopted in 1991. The Nelsonville Comprehensive Plan also described a significant problem with water pressure at higher elevations served by the system. The Village of Cold Spring Comprehensive plan adopted in 2011 states that some water is "lost in leaks." Additionally, the Cold Spring comprehensive plan states that two fires in the previous decade showed that the system does not meet *Needed Fire Flow* requirements in some areas. The information in the two comprehensive plans suggests the distribution system may have warranted modifications or improvements in certain locations or that the pipes in the system may be in need of upsizing or the installation of booster pumps may be necessary to increase flow.

Unless it has been completed since 2011, the existing distribution network could likely benefit from constriction and flow analysis using a water system modeling program to evaluate flows and pressures for both regular working conditions as well as during stressed events such as fires. This should be calibrated with targeted water main inspections to confirm actual pipe dimensions in case encrustation has reduced pipe diameters. Such a model and inspection would identify any sections of the distribution system will most benefiting from upsizing to improve existing and buildout water delivery flows and quality.

The system should meet Water Works Standards for Fire Flow (ISO, 2008). Further, if pipe sections are failing and breaks are occurring regularly, piping should be replaced.

4.2. Climate Change, and Existing and Emerging Contaminants

The American North-East expects stable or increased net precipitation under most climate change model scenarios. However, many models suggest the net precipitation may be delivered via increasingly erratic and significant storms, separated by periods of dry weather and even drought. Water detention capacity therefore becomes a crucial planning tool for municipalities reliant on surface water reservoirs.

The Village of Cold Spring water supply, with 65 million gallons of potential stored water capacity in the two upper reservoirs would on the face of it appear to be sufficiently prepared for extended drought periods. However, the accessibility of this water is dependent on repair of the Upper Reservoir, so the current functional capacity is something in the order of just 2 months if only the upper 30% of the Lower (Middle) reservoir capacity is considered to be operational storage. The current operational condition has likely contributed to water supply shortages reported in the past few years. The addition of storage via flash boards on all reservoirs and/or repair of the Upper Reservoir could provide enhanced capacity to detain operable water, and as explained below the expansion of the collection watershed by diverting flow from Jaycox Pond into the Foundry Brook Reservoir, or by drilling wells to contribute to further water supply security, are also recommended for consideration.

Surface water sources are also increasingly the subject of Harmful Algal Bloom (HAB) occurrences, which standard water treatment plant protocols are unprepared to treat. Triggers for HAB occurrences typically list water warming and nutrient loading, both of which can be exacerbated as water levels fall behind reservoirs or if wildlife or human activities are concentrated in or near the source waters. Various studies suggest that HAB occurrences are increasingly common and potentially associated with climate modification.

Separate from climate change, it has long been recognized that the Village of Cold Spring water supply is somewhat vulnerable to source water contamination as Foundry Brook Reservoir flows near an active road and since portions of the watershed above Foundry Brook are modestly settled with residential development. These land uses each provide some measure of threat to quality in the water reaching the water plant. The Town of Philipstown has adopted a Cold Spring Watershed Overlay District which provides some measure of protection from new development.

The State of New York has recently adopted standards for various new compounds not previously recognized as contaminants. It appears unlikely to the Chazen Companies that compounds including 1,4-dioxane and various PFAS compounds would be found in the watershed above the Foundry Brook Reservoir, but as examples, the water district management is reminded that compounds are periodically added to regulatory review in ways that periodically expand recognized vulnerability of the watershed supplying the public water system.

4.3. Conclusions of Analysis

Based on the analysis above, the potential for water shortages in the water district exists because the Upper Reservoir is not able to release water. After leaving a safety margin in the Lower

(Middle) Reservoir, the remaining operational storage supply available to the District consists only of approximately two month's demand.

Available supplemental water could most immediately be provided by more-fully drawing down the Lower Reservoir during an extended dry period, but fire flow capacity is then threatened. Opening the Upper Reservoir flow valve could satisfy substantial demand during an extended drought but there is the prospect of an uncontrollable release if the old valving fails and simply then fully drains this reservoir. Additional water supply sources could be explored, including adding flashboards to the reservoirs, drilling wells, or the rerouting of surface water to the reservoirs, each discussed in more detail below in Section 5.0.

Based upon the available information on the Water District's distribution system, it may be also beneficial to examine the distribution system within the Village to seek constrictions and to continue advancing leak detection programs, since water lost due to leakage contributes to lower reservoir levels during drought periods.

The storage tanks fall short in providing the required storage volume for the maximum buildout scenario water demands (according to the guidelines established in both the *NYCRR, Title 10, Part 5, Subpart 5-1.33 [items (b)(10) and (f)]* (NYSDOH, N.D., pp. 31-32) and the *Recommended Standards for Water Works, Parts 7 (Subpart 7.0.1) and 8 (Subpart 8.2.3)* (GLUMRB, 2012, pp. 107 & 116). Adding new storage tanks to increase the volume to the required levels for the estimated future demand would further ensure that the Water District can meet Needed Fire Flow demands while simultaneously providing for the daily demand and emergency storage requirements.

5.0 RECOMMENDATIONS

5.1 Potential to Increase Reservoir Capacity

The addition of flashboards to the Lower and Foundry Brook reservoirs offer perhaps the most immediate options to increase reservoir capacity. Increasing the storage volume with flashboards will allow the capture of more of the watershed runoff during wet periods.

Adding two-foot flashboards to the Lower Reservoir will gain a capacity of approximately 5,973,000 gallons, representing an approximate increase of 19% in reservoir storage capacity. Adding two-foot flashboards to the Upper Reservoir will gain a capacity of approximately 7,470,000 gallons; if this volume could be managed as active storage, it would be beneficial even when the rest of the Upper Reservoir capacity is unmanaged. Flashboards on the Foundry Brook Reservoir would provide incremental, low-cost, additional managed storage capacity.

These volumes were calculated using the surface area of the Upper and Lower Reservoirs from the storage capacity analysis provided in Appendix D. It should be noted, however that these potential percentage increases in reservoir storage volume will need further study to determine whether the watersheds could support the increase in volume. Currently, loss by spillage over the reservoir dams is not measured. This spillage volume would be necessary, along with the calculated watershed runoff volume and water demand volume to ensure that the reservoirs have the inflow available to support the additional volume gained from flashboards.

In order to evaluate the effectiveness of the flashboard scenario, an analysis which measures spillage from each of the reservoirs should be performed. The volume of spillage lost from the reservoir system will serve to confirm that the watershed has the capacity to provide the additional water volume provided by the flashboards.

The addition of water storage at all three locations would also offer further thermal buffering for the existing total stored water volume, as well as provide an additional 1.4 months of stored water against the build-out demand of 310,000 gpd.

These increases in storage capacity will help to decrease the likelihood of significant draw-down events at the Lower Reservoir during periods of reduced precipitations volumes.

Chazen estimates the expected cost for the installation of flashboards to be close to $150,000. However, a more accurate estimate of probable costs would be provided based upon a more detailed design in the event that the Water District decides to pursue the installation flashboards.

Additionally, it should be noted that there are existing residences located in close proximity to the banks of both the Upper and Lower Reservoirs. Further study and survey will be needed to assess the impact of raising the water level of the reservoirs on these structures.

5.2 Wells for Water Supply

The drilling of new wells for water supply is another option to augment the capacity of the water district. The Chazen Companies provided a preliminary review of the potential for drilling new wells, which was provided to the Hudson Highlands Land Trust in a letter report dated last revised February 20, 2019 (see Appendix F).

As stated in the previous report, the ideal locations to drill wells would be on land already owned by the Village or the Town. The well locations would also need to adhere to Sub-Part 5-A, which requires 100 feet of land ownership surrounding the well, and an additional 100 feet of control around a Community Water System public water system well. The well locations should be in relatively close proximity to one of the three reservoirs or a feeder stream so as to allow direct discharge of pumped well water into the reservoir system and utilize the existing treatment facility. Wells in more distant locations would need more substantial transmission lines. Water from wells typically do not require filtration, so although water from either bedrock or sand-and-gravel wells could be passed through the exiting water plant, water from any wells drilled in locations inaccessible to the water plant could still also be considered and would typically only require disinfection and perhaps other generally minor treatment (e.g. iron, manganese, corrosively).

Chazen's February 2019 report noted three readily-apparent locations for new wells. The first would be on the Foundry Brook Water Treatment Plant parcel, which appears to have potential drilling locations that adhere to Sub-Part 5-A regulations. The second was a parcel identified by Slayton Engineering P.C., which has access for direct discharge to the Foundry Brook. Lastly, wells could be drilled in proximity to the Upper or Lower reservoirs although property boundaries are constrained around both reservoirs so securing locations with 200 feet of control appear to be limited. Where wells intercept fractures in the local bedrock fractures, modest yields of 15 gpm or higher can be expected. If wells miss such fractures, wells can be non-productive. One option for enhanced well yield is to pressurize the well with potable water to flush out existing small fractures. This method can sometimes increase well yields in this area to 30 gpm or greater, which is equivalent to about 43,200 gpd or about 15% of daily usage.

Considerable public land (e.g. State Parks) lie in proximity to the Cold Spring water district source areas (reservoirs) and distribution areas. Collaboration with NYS Parks, to request permission to drill wells on public land could be explored, and would allow a greater range of potential well drilling locations. Optimal locations are usually selected by hydrogeologists who conduct linear feature analysis, seeking evidence using aerial photos and land inspection to suggest where there is an enhanced opportunity for well drilling to encounter productive water-bearing fractures. Chazen's 2019 report focused primarily on drilling wells near existing reservoirs. No sand and gravel is mapped in these areas so only prospective bedrock wells were described.

Sand and gravel wells, however, have the potential to provide far higher yields, and water quality is often easier to treat than bedrock well water due to fewer dissolved bedrock minerals. If the Village water system and the Town of Philipstown were amenable to a cooperative water development project, there is a substantial sand and gravel aquifer in the Town of Philipstown, loosely following the alignment of Route 9 and the Clove Creek from the vicinity of Jaycox Road to the norther Town boundary. Wells providing 50 gpm or more appear plausible. The cost of transmission to reach Village distribution systems including perhaps simply the Foundry Brook, would need to be considered.

Water well fields are frequently placed in service for $1.5 million or less, including exploration, land acquisition, pumping tests, engineering design for treatment and transmission, and construction. This could be a favorable option to explore against the prospective repair of the Upper Reservoir although some decommissioning of the Upper Reservoir would be required if it is not to be repaired.

5.3 Jaycox Pond Stream Diversion

In the 2019 letter report found in Appendix F, Chazen analyzed the benefit of diverting flow from the downstream creek of Jaycox Pond. The downstream creek runs relatively close by the Foundry Brook Reservoir. With the construction of a gravity diversion channel or pump system, it would be possible to divert flow from the creek to the Foundry Brook Reservoir during spring and fall, before it typically dries each summer. In the report it was determined that this diversion would add approximately 0.43 square miles to the Foundry Brook Reservoir watershed area and would contribute 80 to 100 gpm (115,200 to 144,000 gpd) during modest storm events, as well as in the spring and fall. This flow rate equivalent to 44% to 55% of the daily demand for the duration of the storm.

The water level detained at Jaycox Pond is not actively managed so only water spilling naturally past the dam and flowing seasonally toward the Foundry Brook reservoir is available for use. Water would be preferentially used during fall or spring to relieve early-season or late-season reliance on the Middle Reservoir, thereby expanding the storage buffer capacity of the Middle Reservoir. As mentioned in Appendix F, permitting would need to be explored with the NYSDEC in the early stages of investigating the feasibility of the stream diversion.

5.4 Water Conservation

Maintaining the Village's focus on water conservation would benefit the water district by reducing waste and possibly lessening the effect of drought periods on the reservoir levels. Repairing and/or replacing failing or leaking water mains conserves water that is otherwise constantly being lost from the system. In addition, it is good policy for any Water District to ensure that all properties with water service connections are metered, and that these meters functioning and being monitored. Detecting leaks early will minimize water loss.

The Village may also wish to examine management of beaver dams known to develop between the upper reservoirs and Foundry Brook Reservoir. Since beaver dams are not actively managed to release water needed during dry periods, they do not contribute to the available water budget, expand the stored water surface area in ways that exacerbate evaporative loss, and usually degrade water quality as suggested by recent macro-invertebrate analysis.

5.5 Repair the Upper Reservoir

Repairs to the Upper Reservoir are currently under consideration. The full 34 million gallon value of this reservoir could be returned to operational storage if it is brought into conformance with Dam Safety engineering standards and if an operable release valve allows its full drawdown to replenish water in the Middle (Lower) Reservoir. This volume is sufficient to support the water district for an additional 3 months beyond storage currently available from the Lower (Middle) Reservoir.

Costs for this repair have been shared with the Village and are not repeated here.

REFERENCES

New York State Department Environmental Conservation (NYSDEC). *New York State Design Standards for Intermediate Sized Wastewater Treatment Systems*. 2014.

Site Design Consultants. *Engineer's Report – Butterfield Redevelopment Project*. 2014. Retrieved from: https://www.coldspringny.gov/planning-board/files/engineers-report-11-10-2014 [accessed on 15 May 2020]

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Village of Nelsonville Planning Board. (1991). Village of Nelsonville Comprehensive Master Plan. Retrieved from: https://www.villageofnelsonville.com/comprehensive-plan [accessed on 10 April 2020]

Appendix A: Village of Cold Spring, NY Water Distribution Map

0 — 1,500 Feet

One Inch Equals 300 Ft

@ 34 X 44

Cartographer: James Labate - Worlds End Mapping

Water Mains

12 INCH	6 INCH	12 INCH (UNTREATED)
10 INCH	4 INCH	10 INCH (UNTREATED)
8 INCH	1 to 2.5 INCH SERVICE	6 INCH (UNTREATED)

CATSKILL AQUEDUCT VALVE CHAMBER

CATSKILL AQUEDUCT

FOUNDRY BROOK

VILLAGE BOUNDARY

OUT OF DISTRICT PROPERTIES WITH CONNECTION TO VILLAGE OF COLD SPRING WATER SERVICE

TAX PARCEL

WATER AREA

Notes:
1. The tax parcel data was provided by Putnam County Real Tax Department based on 2013 records.
2. The water line locations are approximate. Their locations are based on a combination of existing mapping and investigations in the field. Their actual locations should be determined based on exploratory excavations when the location is critical.

Village of Cold Spring, NY
Water Distribution

July 11, 2013

Appendix B: Existing Conditions Parcel Breakdown

Cold Spring Water District
Existing Conditions Parcel Breakdown

Prepared for: Hudson Highlands Land Trust

Prepared by: The Chazen Companies

	Number of Parcels by Municipality			
	Cold Spring	Nelsonville	Philipstown	Total
Total Parcels Served by Water District	748	173	21	**942**
Residential Parcels				
Single Family	*548*	*103*	*8*	*659*
Two-Family	*46*	*28*	*0*	*74*
Three-Family	*8*	*4*	*0*	*12*
Mobile Home	*2*	*1*	*1*	*4*
Multi-Purpose Residential	*11*	*5*	*1*	*17*
Residential Parcel Totals	*615*	*141*	*10*	**766**
Vacant Parcels (with water service)	9	1	0	**10**
Commercial Parcels				
Apartments	*11*	*1*	*0*	*12*
Hotel/Inn	*2*	*0*	*0*	*2*
Restaurant	*2*	*0*	*0*	*2*
Auto Dealer	*1*	*0*	*0*	*1*
Gas Station	*2*	*0*	*0*	*2*
Auto Shop	*1*	*1*	*0*	*2*
Parking	*2*	*0*	*0*	*2*
Fuel Storage	*2*	*0*	*0*	*2*
Shopping Center	*1*	*0*	*0*	*1*
Dealership (Non-Auto)	*1*	*0*	*0*	*1*
Bank	*1*	*0*	*0*	*1*
Office Building	*3*	*0*	*0*	*3*
Warehouse	*0*	*1*	*0*	*1*
Miscellaneous	*1*	*1*	*0*	*2*
Funeral Home	*1*	*0*	*0*	*1*
Converted Residence	*4*	*0*	*0*	*4*
Single Story Detached	*4*	*2*	*0*	*6*
Multi-Use Village Row	*38*	*2*	*0*	*40*
Multi-Use Other	*6*	*1*	*1*	*8*
Commercial Parcel Totals	*83*	*9*	*1*	**93**
Community Use Parcels				
Library	*1*	*0*	*0*	*1*
School	*6*	*0*	*1*	*7*
Education (other)	*2*	*0*	*0*	*2*

Religious	*7*	*1*	*0*	*8*
Belevolent Associations	*1*	*2*	*0*	*3*
Health Care (other)	*1*	*0*	*0*	*1*
Government	*3*	*1*	*0*	*4*
Office	*1*	*0*	*0*	*1*
Police/Fire	*1*	*1*	*0*	*2*
Culture/Recreation	*3*	*0*	*0*	*3*
Highway	*1*	*0*	*0*	*1*
Cemetary	*1*	*1*	*1*	*3*
Miscellaneous	*1*	*0*	*0*	*1*
Commercial Parcel Totals	*29*	*6*	*2*	**37**
Manufacturing and Processing	0	1	0	**1**
Public Service Parcels				
Telecommunications	*1*	*0*	*0*	*1*
Railroad	*1*	*0*	*0*	*1*
Public Service Parcel Totals	*2*	*0*	*0*	**2**
Public Parks	0	1	0	**1**
Other (not included in Putnam 2008 GIS Data)	10	14	8	**32**

Appendix C: Maximum Parcel Buildout Within Water District – Estimated Demand

Cold Spring Water District
Maximum Parcel Buildout within Water District
Estimated Demand

Prepared for: Hudson Highlands Land Trust

Prepared by: The Chazen Companies

	Number of Parcels	Per Parcel Water Demand (GPD)	Water Demand (GPD)
Existing Demand*			**260,000**
Parcels Added to Water Demand for Max. Buildout			
Single Family Residential (Vacant Parcels) [1]	*24*	*330*	7,920
Single Family Residential (Subdivision of large parcels with existing structures and connections) [1]	*40*	*330*	13,200
Butterfield Deveopment [2]	*4*	---	10,258
Marathon Site - Future Development [3]	*24*	---	15,310
Seasonal Use Site [4]	*1*	---	2,310
Total			**48,998**
Maximum Parcel Buildout Water Demand Estimate		260,000 + 68,455 =	**308,998**

*Existing demand flow per *Village of Cold Spring usage data for 2020.*

Water demand calulations based upon Table B-3, New York State Design Standards for Intermediate Sized Wastewater Treatment Systems.

1. Single family residence: Assumed average of three bedrooms per unit at 110 gdp yields 330 gpd
2. Butterfield ultimate water demand is projected to be 15,310 gpd. Currently estimated at 33% occupied. Estimated future demand represents additional 67% of units to be occupied.
3. Marathon site buildout water demand is assumed to equal to the Butterfield ultimate water demand of 15,310 gpd.
4. This seasonal use site at the waterfront was assumed to be developed into 7 residences at 330 gpd each.

Note: Parcel data is based upon 2008 GIS info available for download from Putnam County GIS, corrected and updated by a review of the parcel listing by Village Trustee Marie Early, Village Clerk, and Hudson Highlands Land Trust.

Appendix D: Reservoir Storage Capacity Study

Village of Cold Spring

Approximate Water Volume in Upper Reservoir

4/10/2012

Note: Prepared from Badey and Watson Survey prepare 198? Volumes should be considered approximate

Spillway Elevation 649.7

Elevation	Depth below spillway		Area of water Surface	Volume of water in Reservoir			
	ft	in			CF	Million CF	Million Gallons
635.00	14.70	176.40	110256.00				
635.50	14.20	170.40	128323.00	59644.75	59644.75	0.06	0.45
636.00	13.70	164.40	145908.00	68557.75	128202.50	0.13	0.96
636.50	13.20	158.40	168215.00	78530.75	206733.25	0.21	1.55
637.00	12.70	152.40	190020.00	89558.75	296292.00	0.30	2.22
637.50	12.20	146.40	212686.00	100676.50	396968.50	0.40	2.97
638.00	11.70	140.40	231561.00	111061.75	508030.25	0.51	3.80
638.50	11.20	134.40	239854.00	117853.75	625884.00	0.63	4.68
639.00	10.70	128.40	248415.00	122067.25	747951.25	0.75	5.59
639.50	10.20	122.40	257244.00	126414.75	874366.00	0.87	6.54
640.00	9.70	116.40	266341.00	130896.25	1005262.25	1.01	7.52
640.50	9.20	110.40	275706.00	135511.75	1140774.00	1.14	8.53
641.00	8.70	104.40	285339.00	140261.25	1281035.25	1.28	9.58
641.50	8.20	98.40	295240.00	145144.75	1426180.00	1.43	10.67
642.00	7.70	92.40	305409.00	150162.25	1576342.25	1.58	11.79
642.50	7.20	86.40	315846.00	155313.75	1731656.00	1.73	12.95
643.00	6.70	80.40	326551.00	160599.25	1892255.25	1.89	14.15
643.50	6.20	74.40	337524.00	166018.75	2058274.00	2.06	15.40
644.00	5.70	68.40	348765.00	171572.25	2229846.25	2.23	16.68
644.50	5.20	62.40	360247.00	177253.00	2407099.25	2.41	18.01
645.00	4.70	56.40	372051.00	183074.50	2590173.75	2.59	19.37
645.50	4.20	50.40	384096.00	189036.75	2779210.50	2.78	20.79
646.00	3.70	44.40	396409.00	195126.25	2974336.75	2.97	22.25
646.50	3.20	38.40	408990.00	201349.75	3175686.50	3.18	23.75
647.00	2.70	32.40	421838.00	207707.00	3383393.50	3.38	25.31
647.50	2.20	26.40	434955.00	214198.25	3597591.75	3.60	26.91
648.00	1.70	20.40	448340.00	220823.75	3818415.50	3.82	28.56
648.50	1.20	14.40	461993.00	227583.25	4045998.75	4.05	30.26
649.00	0.70	8.40	475913.00	234476.50	4280475.25	4.28	32.02
649.50	0.20	2.40	490102.00	241503.75	4521979.00	4.52	33.82
649.70	0.00	0.00	499327.00	98942.90	4620921.90	4.62	34.56

Village of Cold Spring

Approximate Water Volume in Lower Reservoir

4/10/2012

Note: Prepared from Badey and Watson Survey prepare 198? Volumes should be considered approximate

Spillway Elevation 634

Elevation	Depth below spillway ft	in	Area of water Surface	Volume of water in Reservoir	CF	Million CF	Million Gallons
619.00	15.00	180.00	124834.00				
619.50	14.50	174.00	143544.00	67094.50	67094.50	0.07	0.50
620.00	14.00	168.00	159577.00	75780.25	142874.75	0.14	1.07
620.50	13.50	162.00	175220.00	83699.25	226574.00	0.23	1.69
621.00	13.00	156.00	189748.00	91242.00	317816.00	0.32	2.38
621.50	12.50	150.00	199632.00	97345.00	415161.00	0.42	3.11
622.00	12.00	144.00	208507.00	102034.75	517195.75	0.52	3.87
622.50	11.50	138.00	216911.00	106354.50	623550.25	0.62	4.66
623.00	11.00	132.00	225103.00	110503.50	734053.75	0.73	5.49
623.50	10.50	126.00	233073.00	114544.00	848597.75	0.85	6.35
624.00	10.00	120.00	240785.00	118464.50	967062.25	0.97	7.23
624.50	9.50	114.00	248440.00	122306.25	1089368.50	1.09	8.15
625.00	9.00	108.00	256287.00	126181.75	1215550.25	1.22	9.09
625.50	8.50	102.00	264337.00	130156.00	1345706.25	1.35	10.07
626.00	8.00	96.00	272489.00	134206.50	1479912.75	1.48	11.07
626.50	7.50	90.00	280712.00	138300.25	1618213.00	1.62	12.10
627.00	7.00	84.00	289087.00	142449.75	1760662.75	1.76	13.17
627.50	6.50	78.00	297412.00	146624.75	1907287.50	1.91	14.27
628.00	6.00	72.00	305778.00	150797.50	2058085.00	2.06	15.39
628.50	5.50	66.00	314337.00	155028.75	2213113.75	2.21	16.55
629.00	5.00	60.00	323106.00	159360.75	2372474.50	2.37	17.75
629.50	4.50	54.00	332087.00	163798.25	2536272.75	2.54	18.97
630.00	4.00	48.00	341279.00	168341.50	2704614.25	2.70	20.23
630.50	3.50	42.00	350682.00	172990.25	2877604.50	2.88	21.52
631.00	3.00	36.00	360297.00	177744.75	3055349.25	3.06	22.85
631.50	2.50	30.00	371341.00	182909.50	3238258.75	3.24	24.22
632.00	2.00	24.00	376586.00	186981.75	3425240.50	3.43	25.62
632.50	1.50	18.00	382002.00	189647.00	3614887.50	3.61	27.04
633.00	1.00	12.00	387591.00	192398.25	3807285.75	3.81	28.48
633.50	0.50	6.00	393351.00	195235.50	4002521.25	4.00	29.94
634.00	0.00	0.00	399284.00	198158.75	4200680.00	4.20	31.42

Approximate Water Volume in Upper Reservoir

4/10/2012

Note: Prepared from Baday and Watson Survey prepare 1987 Volumes should be considered approximate

Spillway Elevation 649.7

Elevation	Depth below spillway		Area of water Surface	Volume between measurements	Volume of water in Reservoir		
	ft	in		Cubic Feet	CF	Million CF	Million Gallons
635.00	14.70	176.40	110256.00				
635.50	14.20	170.40	128323.00	59644.75	59644.75	0.06	0.45
636.00	13.70	164.40	145908.00	68557.75	128202.50	0.13	0.96
636.50	13.20	158.40	166215.00	78530.75	206733.25	0.21	1.56
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643.00	6.70	80.40	326551.00	160599.25	1892255.25	1.89	14.15
643.50	6.20	74.40	337524.00	166018.75	2058274.00	2.06	15.40
644.00	5.70	68.40	348765.00	171572.25	2229846.25	2.23	16.68
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646.00	3.70	44.40	396409.00	195126.25	2974336.75	2.97	22.25
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648.50	1.20	14.40	461993.00	227583.25	4045998.75	4.05	30.26
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649.50	0.20	2.40	490102.00	241503.75	4521979.00	4.52	33.82
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4/10/2012

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619.50	14.50	174.00	143544.00	67094.50	67094.50	0.07	0.50
620.00	14.00	168.00	159577.00	75780.25	142874.75	0.14	1.07
620.50	13.50	162.00	175220.00	83699.25	226574.00	0.23	1.69
621.00	13.00	156.00	189748.00	91242.00	317816.00	0.32	2.38
621.50	12.50	150.00	199632.00	97345.00	415161.00	0.42	3.11
622.00	12.00	144.00	206507.00	102034.75	517195.75	0.52	3.87
622.50	11.50	138.00	216911.00	106354.50	623550.25	0.62	4.66
623.00	11.00	132.00	225103.00	110503.50	734053.75	0.73	5.49
623.50	10.50	126.00	233073.00	114544.00	848597.75	0.85	6.35
624.00	10.00	120.00	240785.00	118464.50	967062.25	0.97	7.23
624.50	9.50	114.00	248440.00	122306.25	1089368.50	1.09	8.15
625.00	9.00	108.00	256287.00	126181.75	1215550.25	1.22	9.09
625.50	8.50	102.00	264337.00	130156.00	1345706.25	1.35	10.07
626.00	8.00	96.00	272489.00	134206.50	1479912.75	1.48	11.07
626.50	7.50	90.00	280712.00	138300.25	1618213.00	1.62	12.10
627.00	7.00	84.00	289087.00	142449.75	1760662.75	1.76	13.17
627.50	6.50	78.00	297412.00	146624.75	1907287.50	1.91	14.27
628.00	6.00	72.00	305778.00	150797.50	2058085.00	2.06	15.39
628.50	5.50	66.00	314337.00	155028.75	2213113.75	2.21	16.55
629.00	5.00	60.00	323106.00	159360.75	2372474.50	2.37	17.75
629.50	4.50	54.00	332087.00	163798.25	2536272.75	2.54	18.97
630.00	4.00	48.00	341279.00	168341.50	2704614.25	2.70	20.23
630.50	3.50	42.00	350682.00	172990.25	2877604.50	2.88	21.52
631.00	3.00	36.00	360297.00	177744.75	3055349.25	3.06	22.85
631.50	2.50	30.00	371341.00	182909.50	3238258.75	3.24	24.22
632.00	2.00	24.00	376586.00	186981.75	3425240.50	3.43	25.62
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633.00	1.00	12.00	387591.00	192398.25	3807285.75	3.81	28.48
633.50	0.50	6.00	393351.00	195235.50	4002521.25	4.00	29.94
634.00	0.00	0.00	399284.00	198158.75	4200680.00	4.20	31.42

Notes:
1. The Aerial photography was taken from the 2009 file photos from the NYSGIS Clearing House.
2. The contours were developed from a bottom survey prepared by the office of Badey and Watson in 1987. The Contours and volumes calculated from them should only be considered as approximate due to the limited data that they are based on.

WARNING: This plan is not valid unless the seal and signature on this plan is an original ink seal or an impression seal not an original signature.

NO.	BY	REVISION	DATE

Preliminary

Oakwood Environmental Associates
Consulting Engineers

27 REVERIE LANE
WARREN, CONNECTICUT 06754
(860) 868-4367

PROJECT:
Village of Cold Spring
Calculation of Water Volume in Reservoirs
Foundry Pond Rd

Putnam County New York

SHEET TITLE:
Contour Plan for bottom of Reservoir

DATE:	SCALE:	DRAWN BY:	CHECKED BY:	PROJ. NO.:	DWG. NO.:
4/10/2012	Shown	bc	-		1 of 1

Appendix E: Reservoir Water Levels and Distribution Volumes

2017

Month	Precip	Reservoirs				Distribution		
		Upper	Mid	Foundry Brook	Total	MG/Month	Avg. GPD	Max GPD
January	3.84			100%	100.00%	7.34	237	
February	1.91			100%	100.00%	6.21	222	
March	2.68			100%	100.00%	6.73	217	
April	3.10			100%	100.00%	6.14	205	
May	6.11			100%	100.00%	7.62	246	
June	2.90			100%	100.00%	8.69	290	
July	2.78			85%	85.00%	7.80	252	
August	3.07			80.50%	80.50%	7.60	245	
September	2.19			62.60%	62.60%	7.50	249	
October	4.15			64%	64.00%	7.20	233	
November	1.02			66%	66.00%	7.98	266	
December	1.46			70%	70.00%	6.20	200	
Total Precip.	35.21			Yearly Averages	85.68%	7.25	238.50	

2018

Month	Precip	Reservoirs				Distribution		
		Upper	Mid	Foundry Brook	Total	MG/Month	Avg. GPD	Max GPD
January	3.65			99%	99.00%	6.95	224	
February	4.87			100%	100.00%	5.72	204	
March	4.84			100%	100.00%	6.25	202	
April	5.12			100%	100.00%	6.35	212	
May	3.24			99%	99.00%	9.18	296	
June	3.13			96%	96.00%	7.71	257	
July	7.58			96%	96.00%	7.58	274	
August	7.03			96%	96.00%	7.03	244	
September	5.99			96%	96.00%	5.99	231	
October	4.36			100%	100.00%	4.36	240	
November	7.89			100%	100.00%	7.89	216	
December	6.24			100%	100.00%	6.24	215	
Total Precip.	63.94			Yearly Averages	98.50%	6.77	234.58	

2019

Month	Precip	Reservoirs				Distribution		
		Upper	Mid	Foundry Brook	Total	MG/Month	Avg. GPD	Max GPD
January	4.52			100%	100.00%	6.88	222	353
February	2.72			100%	100.00%	6.58	235	305
March	2.48			100%	100.00%	7.05	227	308
April	4.41			100%	100.00%	5.85	195	253
May	5.50			100%	100.00%	7.54	243	470
June	3.69			100%	100.00%	8.13	270	465
July	1.09	92.60%	95.28%	86.66%	91.51%	10.19	329	441
August	1.32	83.40%	96.06%	59.99%	79.82%	9.61	310	358
September	0.23	68.70%	88.31%	39.90%	65.64%	9.18	306	348
October	6.20	77.80%	67.39%	69.99%	71.73%	7.77	251	390
November	1.04	91.65%	79.99%	86%	85.88%	7.66	255	429
December	2.51	87.50%	100%	100%	95.83%	7.98	257	302
Total Precip.	35.71			Yearly Averages	90.87%	7.87	258.33	

2020

Month	Precip	Reservoirs				Distribution		
		Upper	Mid	Foundry Brook	Total	MG/Month	Avg. GPD	Max GPD
January	0.75	95.10%	100%	100%	98.37%	8.06	260	310
February	2.10	87.50%	100%	100%	95.83%	7.62	263	313
March	1.63	92.65%	100%	100%	97.55%	8.52	275	309
April	2.47	92.65%	100%	100%	97.55%	7.59	253	363
May	1.23	100%	100%	100%	100.00%	7.80	252	288
June		92.65%	100%	100%	97.55%			
July								
August								
September								
October								
November								
December								
Total Precip.	8.18			Yearly Averages		7.92	260.54	

Appendix F: Alternative Water Sources Report

HUDSON VALLEY OFFICE
21 Fox Street
Poughkeepsie, NY 12601
P: 845.454.3980 or 888.539.9073
www.chazencompanies.com

November 1, 2018
Revised February 20, 2019

Michelle D. Smith, Executive Director
Hudson Highlands Land Trust
20 Nazareth Way
Garrison, NY 10524

Re: *Professional Services Proposal*
Groundwater Resource Management – Cold Spring Sources
Chazen Project Number 41824.00 Task 003

Dear Ms. Smith:

The Chazen Companies (Chazen) has completed a preliminary review of potential options to enhance the water capacity available to the Cold Spring and Nelsonville Water Supply. Capacity concerns have been recurring as Village demands and climate changes occur.

This public water system consists of a surface water treatment plant situated on Fishkill Road, drawing water from the Foundry Brook. The flow capacity of Foundry Brook is moderated by controlled water releases from the Upper and Lower reservoirs located approximately 3.5 miles upstream, off Lake Surprise Road. The lower portion of Foundry Brook flows along Fishkill Road before entering the Foundry Brook holding reservoir, situated near the water plant. The watershed supporting the current water supply is approximately 2.5 square miles, including the Upper and Lower Reservoirs, all tributary areas contributing to Foundry Brook above the water plant, and the Foundry Brook Reservoir.

The Chazen Companies are aware of several options to augment the current water source capacity, and have focused on review of three options.

Options <u>not</u> considered under this review include:

- Connecting with the NYC DEP aqueduct,
- Drilling wells on parcels between the current water treatment plant and the Villages, which would require individual feed-in treatment and distribution services or a raw water line to the water plant,
- Protocols for managing and maintaining the Upper and Lower reservoirs,
- Any modifications to treatment capacity at the water treatment plant, and,
- Protocols for managing the Foundry Brook reservoir including depth of the intake pipe.

These options are understood to have been previously investigated by the water district or would require separate evaluation.

Options which <u>are</u> considered under this review include:

- Augmenting capacity by intercepting flow coming from Jacox Pond.
- Augmenting capacity with groundwater wells.

Jacox Pond

Jacox Pond is contained by a low stone dam and covers approximately 15 acres. Its volume is unknown but the water body appears shallow. The water level in the pond is not actively managed, so downstream creek flow reflects "run of river" trends rather than a flow stabilized by controlled discharge from a managed dam. The watershed area including the pond, considered at the point where flow enters Foundry Brook, is approximately 0.43 square miles.

Augmenting the Cold Spring watershed by intercepting flow from the Jacox tributary would add an additional 0.43 square mile watershed area to the District. Preliminary analysis suggests the following potential benefits:

- <u>17% larger watershed area</u>: Adding 17% to the watershed area contributing water to the Cold Spring Water District would suggest a significant gain in available water. Since creek flow varies seasonally, the Water District would benefit by using water from the Jacox tributary during moderate weather periods, thus delaying reliance on the reserved water capacity from the Upper and Lower Reservoirs.

- <u>80 to 100 gpm during modest storms</u>: According to StreamStaats, a GIS-analytical tool by USGS, flow in the tributary from Jacox Pond is estimated at 80 gallons per minute during the 1.25 year recurring storm and 102 gallons per minute during the 1.5 year storm. Lower flow would occur between storms. Having brisk storm inflows available to the Water District could be especially beneficial in summer if Foundry Brook reservoir can be managed to ensure available capacity in advance of summer storms.

The discharge from the Jacox Pond stream can be collected either via a transfer pump installed behind a low stream bed weir, or via a zero-energy/gravity-flow channel constructed along the hillside intercepting the stream near the Village's east property boundary. As an example of this zero-energy concept, a gravity diversion currently supplements Byram Reservoir used by the Village of Mt. Kisco. For Cold Spring, an approximate route for a gravity-flow channel is suggested on the attached figure, along with example photos from the Mt. Kisco diversion channel.

Either approach would require environmental permitting, engineering, and construction. A possible permitting pathway is attached and an approximate overall option budget is provided, as follows:

- Environmental Permitting: $20,000 - $50,000

  AND, either
- Design and construction of the Gravity Diversion Channel: estimated at $250/foot installed for an estimated maximum of 400 linear feet, so in the range of $100,000.

  OR
- Design and construction of a weir and pump: estimated at $150/foot for water line, buried power line, pump, and weir, for approximately $60,000.

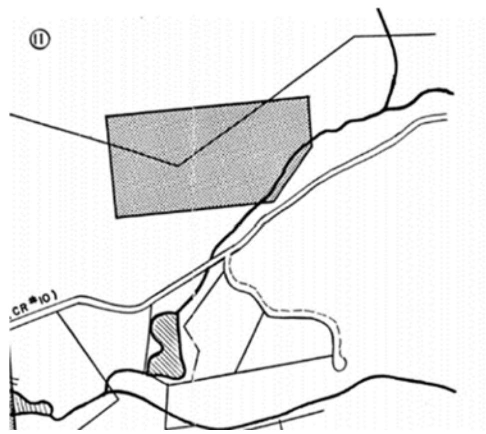
Either approach could augment available raw water capacity available to Cold Spring from the Jacox Pond tributary at a price in the range of $110,000 to $150,000. Permitting should be explored with NYSDEC as an early investigation task to determine regulatory complexity. Water quality would consist of surface water, requiring treatment as such.

Wells

Ideally, water supply wells could be drilled on land already owned by the Village so no new acquisitions or easements are needed. Such wells could be operated when reservoirs are not spilling, topping up the available stored water capacity. Wells would capture groundwater otherwise flowing naturally under the reservoirs and their dams, escaping the current impoundment systems. It would likely be simplest to discharge pumped water directly into the reservoirs or their feeder streams to minimize new distribution connections in the district. Wells could also discharge directly to the treatment plant if drilled sufficiently near the water plant. Three options are reviewed below:

Water Plant Property: Sub-Part 5-A Department of Health regulations require 100 feet of ownership and an addition 100 feet of control around Community Water System public water system wells. It appears there is a small area on the Water Plant site which meets these criteria, shown as an inset on the attached figure. Access to locations west of the creek appears feasible. Areas east of the creek would be more challenging to reach.

Upstream of Water Plant: Slayton Engineering P.C. (identified one parcel upstream of the water plant suggested for well drilling (to right). Any successful well installed on this parcel could discharge directly into the creek, to economically bring water to the plant. Crossing the creek, property access arrangements, and power supplies would be separate and additional considerations. (unscaled image, to right).



Wells around the water plant or Upper and Lower Reservoirs:
There appear to be few land-based options with 200 feet of land ownership around the Upper and Lower Reservoirs. This limitation complicates opportunities to drill wells around the reservoirs. Options with 100 feet of ownership with use restrictions extending to 200 feet could be explored.

Wells drilled at any of these locations would be intended to tap water-bearing fractures in bedrock, since available mapping identifies no sand and gravel deposits at these locations. Average yields from bedrock wells are often not more than 5 to 15 gallons per minute, but more sustaining fractures do exist and the likelihood of finding them is enhanced by conducting linear feature analysis prior to drilling. The location identified by Slayton Engineering was evaluated for linear features and was suggested as an area with enhanced yield opportunity. Bedrock wells can also be hydraulically pressurized (shallow geology hydrofracking) to maintain and enhance yields in some instances. Such productive bedrock wells may yield 30 gpm or greater.

Well drilling will require geologic review, permitting and engineering design, and construction. In very broad terms, approximate unit budgets for this option might include the following:

- Hydrogeologic analysis and Putnam County DOH communications to identify target well locations: $5,000
- Test well drilling:
    - Driller: $11,000 per well, installed (approximate)
    - Consultant: $2,500 per well, for geologist oversight and site/DOH communications
- Well testing (72 hour flow test and mandatory laboratory analysis sampling)

- Driler: $3,000 to set a test pump temporarily connected water plant power supply.

  OR
- Driller: $11,000 to set a test pump and provide a generator for 72 hour test.

  AND
- Lab: $2,000 for Sub-Part 5 evaluation and biological testing for surface water influence
- Consultant: $7,500 per test for supervision, DOH (and DEC) communications, and hydrogeologic report. (NYSDEC consultation is needed if well yields net to over 100,000 gpd (~70 gpm)).

- Engineering Design and connection of new wells would be additional. We currently anticipate that well water might be of a quality acceptable to discharge into the reservoir and then manage through the existing water plant. Aeration of well discharge may be required if radiologicals are encountered.

As a working budget, we might recommend a preliminary exploration budget in the range of $80,000 to complete fracture trace analysis and drill up to three exploratory wells on the water plant property, followed by appropriate well testing if warranted.

\- - - -

Chazen thanks the Hudson Highlands Land Trust for this opportunity to consider source options for the Village of Cold Spring public water system. We hope these concepts are of interest.

Please contact the Chazen Companies if you would like to advance either or both concepts. My engineering colleagues or I would be happy to meet with your or Water Department personnel.

Sincerely,

Russell Urban-Mead, P.G.
Senior Hydrogeologist/VP Chazen, Environmental Services

Attachments: Sketch Figure
Diversion Channel Environmental Permitting Memorandum

cc: George Cronk, P.E.
Dave Young, P.E.
file

Reference cited: Slayton Engineering, P.C., April 22, 1991 letter report and Summary of Phase I Report Findings, Groundwater Investigations, Village of Cold Spring

STREAM DATA		
STREAM LOCATION	1	2
DRAINAGE AREA (SQ MILES)	2.48	0.43

NOTE: ALL STREAM SEGMENTS CLASSIFIED AS A(T) WATER BODIES

POTENTIAL WELLS SETBACK

BYRAM RESERVOIR

EXAMPLE OF STREAM DIVERSION

CHANNEL

CHAZEN ENGINEERING, LAND SURVEYING & LANDSCAPE ARCHITECTURE CO., D.P.C.

Office Locations:

☒ Hudson Valley Office:
21 Fox Street
Poughkeepsie, New York 12601
Phone: (845) 454-3980

☐ Capital District Office:
547 River Street
Troy, New York 12180
Phone: (518) 273-0055

Tennessee Office:
1705 Division Street
Nashville, Tennessee 37203
Phone: (615) 953-4909

☐ North Country Office:
375 Bay Road
Queensbury, New York 12804
Phone: (518) 812-0513

☐ Westchester NY Office:
1 North Broadway, Suite 803
White Plains, New York 10601
Phone: (914) 997-8510

HUDSON HIGHLANDS

VILLAGE OF COLD SPRING SOURCE WATER RESOURCE PLANNING

TOWN OF PHILIPSTOWN, PUTNAM COUNTY, NEW YORK

designed	checked
SPL	DWY
date	scale
09/27/18	NTS
project no.	
41824	
sheet no.	
FIGURE 1	

Drawing Name: Z:\projects\41800-41899\41824_00 Hudson Highlands Water Resources\ENG\Cold Spring Water Options\Fig1_Water Resource Planning_ColdSpring.dwg Date Printed: Nov 05, 2018, 11:15am

41824.00 – Water Resource Planning for Hudson Highlands
Stream Diversion from outlet stream of Jacox Pond to Cold Spring Reservoir

Request – Evaluate permitting requirements for diverting stream flow to Cold Spring Reservoir.

A) **SEQRA:** Review by a lead agency, likely Village of Cold Spring to undertake the proposed action. Would be an unlisted action. A coordinated review would ensure NYSDEC input.

B) **Town of Philipstown**: Not sure if there would be any local land use permits needed, or if this is would be only considered a project undertaken by the Town.

C) **NYSDEC: Article 15 Regulations at 6 NYCRR 608**

  a. Disturbance of Protected Stream. Project involves disturbance of the bed or banks of a Class A(T) stream (6 NYCRR 608.2)(Stream ID 862-66), and so needs authorization. The NYSDEC would likely include a review of potential impacts on fisheries within the short section downstream of the withdrawal, although it is noted that all flow ends up in Foundry Brook downstream of the Cold Spring Reservoir (i.e., Foundry Brook Dam). NYSDEC may require a minimum low flow discharge to the stream below the withdrawal point.
  b. Dam Safety Permit. The Foundry Brook Dam has a Class A Hazard rating. There may be the need to evaluate compliance with Dam Safety permit, i.e., whether this constitutes putting more water in behind dam. 6 NYCRR 608.3
  c. Water Quality Certificate - Potential Section 401 Water Quality Certificate for federal permitting. 6 NYCRR 608.9

D) NYSDEC: Water Withdrawal Permit – Regulations at 6 NYCRR 601.10

  a. Any system with the capacity to withdraw 100,000-gpd (70-gpm) or more requires a Water Withdrawal Permit.
  b. It is presumed that Village of Cold Spring already holds a Water Withdrawal Permit from the NYSDEC for the existing water supply system. Once additional water is diverted to the Cold Spring Reservoir, one would need to review whether the withdrawal capacity at this location being increased (i.e. new/bigger pumps)? Since the Cold Spring Reservoir is where the actual location of water withdrawal occurs, the need for a water withdrawal permit (or permit modification) depends on what is proposed at the withdrawal location downstream of Jacox Pond. This should be discussed with the NYSDEC to validate how the Department would review.

E) US Army Corps of Engineers: Section 404 of the Clean Water Act – Nationwide Permit 7

  a. If the project involves discharge of dredged or fill material into Waters of the United States to connect the diversion channel into the existing stream or the reservoir, or if the diversion stream crosses through another water of the United States, authorization would be required. Nationwide Permit 7 authorizes the construction of intake and outfall structures.

F) State Historic Preservation Office: Section 106 of National Historic Preservation Act

  a. Project is in an archeologically sensitive area. An Phase 1A/1B archeological review would need to be completed and submitted to SHPO for determination of effect, necessary for federal and state permitting.

G) Endangered Species: State at 6 NYCRR 182 and Section 7 federal Endangered Species Act

  a. There is a bat hibernacula 2.5 miles away. USFWS and NYSDEC identifies site in range of Indiana and Northern Long Eared Bat. Additional state endangered species nearby. Given small impact area, clearing timing restrictions (allowed November 1 to March 31) should be adequate.