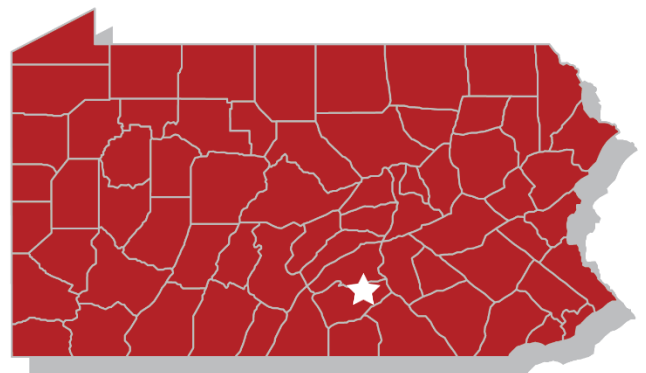

ENVIRONMENTAL IMPACT ASSESSMENT

MAY 2026

PENNSYLVANIA DIGITAL 1 (PAX-1) CARLISLE DEVELOPMENT PARTNERS, LLC

PROJECT NO. 1258-01





ECS Mid-Atlantic, LLC

Supply Well Feasibility Evaluation
Project Bolt Site
Carlisle, Cumberland County, PA

ECS Project No. 47:21671

September 3, 2025





ECS MID-ATLANTIC, LLC

Geotechnical • Construction Materials • Environmental • Facilities

September 3, 2025

Mr. Nick Long
Livic Civil
1015 Mumma Road, 2nd Floor
Wormleysburg, Pennsylvania 17043

ECS Project No. 47-21671

Reference: Supply Well Feasibility Evaluation
Project Bolt Site
Country Club Road, Carlisle, Cumberland County, Pennsylvania

Dear Mr. Long:

ECS Mid-Atlantic, LLC (ECS) is pleased to provide Livic Civil with the results of our Supply Well Feasibility Evaluation for the Project Bolt Site. If there are any questions regarding this report, or a need for further information, please contact the undersigned at (540) 785-6624.

Respectfully Submitted,

ECS MID-ATLANTIC, LLC

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Supply Well Feasibility Evaluation
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PROJECT

47-21671

DATE

September 3, 2025

**Supply Well Feasibility Assessment
Project Bolt Site
Carlisle, Cumberland County, Pennsylvania**

ECS PROJECT NO. 47-21671

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1.0 INTRODUCTION

ECS Mid-Atlantic, LLC (ECS) is pleased to provide this report documenting our findings from a Supply Well Feasibility Evaluation of the Project Bolt Site, located off Country Club Road, Carlisle, Cumberland County, Pennsylvania (hereinafter referred to as the site or subject site). The subject site consists of four parcels identified by Cumberland County as parcel numbers 21-06-0015-001, 21-06-0015-013, 21-06-0015-014, and 21-06-0015-15. The total area of the site is approximately 694.2 acres. The site location is depicted in Figure 1.

ECS understands that the site owner plans to construct an 18-unit datacenter facility comprised of three campuses at the subject site. The datacenter campuses are referred to as Campus 1 (northernmost campus), Campus 2 (middle campus), and Campus 3 (southernmost campus). The campuses will contain datacenter buildings, administrative buildings, paved areas, water storage tanks, stormwater basins, and other site features. Construction of the campuses will occur in three phases starting with Campus 1, followed by Campus 2, then Campus 3. Although the anticipated water demand volumes are still being finalized, it is our understanding that the development's water usage will progressively increase as each planned campus becomes operational. An anticipated peak daily water usage volume at full build-out also has not yet been finalized, although we understand that this rate may be on the order of approximately 3–4 million gallons per day (MGD). The site is located within the Middlesex Township Municipal Authority's (MTMA's) water service area, with a municipal waterline running through the center of the subject site. While the municipal water utility will be adequate to meet the site's relatively minor potable water demand, MTMA's current available water capacity cannot meet the site's full daily water demand.

The primary purposes of our evaluation were to assess the feasibility of using groundwater to meet the site's non-potable water demand, to provide information related to the locations of proximal offsite private wells and potential impacts resulting from onsite groundwater extraction, and to provide an outline of the non-potable groundwater withdrawal permitting process. Our evaluation also included identifying areas that appear to be suitable for the development of high-yield supply wells.

2.0 SITE SETTING

2.1 Subject Site Description

2.1.1 Existing Conditions

The subject site is located off Country Club Road approximately one-quarter mile west of its intersection with Bernheisel Bridge Road in Carlisle, Cumberland County, Pennsylvania. The site consists of four parcels identified by Cumberland County as parcel numbers 21-06-0015-001 (143.9 acres), 21-06-0015-014 (147.3 acres), 21-06-0015-013 (190.5 acres), and 21-06-0015-015 (212.4 acres). The total area of the site is approximately 694.2 acres. Conodoguinet Creek runs along the site's boundary from the west, along the north, and to the northeast of the site. The site is accessed by Country Club Road, which bisects the site's southernmost parcel then borders the site's easternmost parcel to the south. A network of unpaved roads service the different parcels within the subject site. The site is currently operated as farmland. Three residential

structures, silos, and several barns are present at the site, with the majority of the land being agricultural fields. Portions of the site, particularly around the border that runs along Conodoguinet Creek, are comprised of undeveloped wooded land.

Two supply wells were observed at the site. The northernmost well serves a farmhouse and was observed to be located within a subgrade concrete vault. The well's casing was observed to be six inches in diameter and comprised of steel. The southern well also serves a farmhouse and was observed to have an above-grade 6-inch diameter steel casing stickup. Further information about the onsite wells is unknown, as a request for well records from the local Health Department and the Pennsylvania Department of Conservation and Natural Resources did not yield useful information.

Adjoining properties consist primarily of low-density residential properties and farmland. A medium-density residential subdivision and a high-density mobile home community are present across Conodoguinet Creek to the northeast. The southern tip of the subject site adjoins Interstate 81 and an Old Dominion trucking central yard is present across Interstate 81 to the south. Overhead powerlines extend onto the site from adjoining parcels to the southeast and generally run along the site's eastern border. A map showing the existing site layout, the locations of the site's existing supply wells, and the area in the vicinity of the site is included as Figure 2a.

2.1.2 Planned Site Development

The site owner plans to develop the subject site as a datacenter facility that will contain three campuses. Development of the facility will occur over a period of a few years and will begin with the construction of Campus 1 and will finish with the construction of Campus 3. Site plan files were provided to ECS by Livic Civil on June 17, 2025. The files indicate that each of the campuses will contain six datacenter structures (i.e., 18 datacenter structures in total). Several other smaller ancillary structures will be constructed. The site will be accessed by a series of roadways that will extend onto the site from Country Club Road. An electrical substation will be constructed at the southeastern portion of the site, to the east of Campus 2, alongside the existing overhead powerline right-of-way. Numerous stormwater ponds will be constructed at the site. A map showing the planned site development is included as Figure 2b.

Potable water will be provided to the proposed development by MTMA's municipal water system. However, the current capacity of the municipal water system is inadequate to meet the site's non-potable peak water demand. An anticipated peak daily water usage volume at full build-out has not yet been finalized, although we understand that this rate may be on the order of approximately 3–4 MGD. This demand will be met by a combination of onsite storage and water inflows to the site. The vast majority, if not the entirety, of this inflow will need to be sourced by groundwater supply wells. While the MTMA's municipal water utility will be adequate to meet the site's relatively minor potable water demand, MTMA's current available water capacity cannot meet the site's full daily water demand.

2.2 Topography and Hydrology

2.2.1 Topography

Digital elevation mapping provided by the U.S. Geological Survey's (USGS's) National Elevation Dataset at 1-foot grid spacing indicates that ground surface elevations at the

site range from approximately 390 feet above mean sea level (amsl) along the site's border with Conodoguinet Creek to 500 feet amsl in parts of the southeastern portion of the site. Ground surface elevations at the planned campuses range from approximately 420–460 feet amsl. Topography generally slopes gently toward Conodoguinet Creek to the northwest, north, or northeast, depending on location within the site. Topography at and in the vicinity of the site is shown in Figure 3.

2.2.2 Surface Water Hydrology

ECS reviewed hydrologic mapping provided by the USGS's National Hydrography Dataset, wetland mapping provided by the National Wetland Inventory, and a wetland and surface water delineation report for the subject site prepared by Ambrook Consulting, LLC (Ambrook). Eight streams were mapped by Ambrook as being present at the site. Conodoguinet Creek is the largest of the streams and is a perennial feature located along the site's western, northern, and northeastern boundaries. It flows in an eastern direction and has a variable width, although it is generally 75–150 feet wide along the site boundary. Ambrook notes that Conodoguinet Creek's streambed substrate is comprised primarily of exposed bedrock, angular rock, gravel, and silt. Three other perennial streams were mapped by Ambrook as being present at the site. Two of these perennial streams are located at the southwestern portion of the site and drain in a northwestern direction to Conodoguinet Creek. Large segments of both of these two streams are channelized within subgrade culvert piping. The third perennial stream is located at the northeastern portion of the site and drains in a northeastern direction to Conodoguinet Creek. The full length of this third perennial stream is open channel. Ambrook notes that the streambed substrate of each of the perennial streams is primarily angular rock, gravel, and silt. In addition to the perennial streams, four intermittent streams are mapped as being present at the site. One of the four intermittent streams is located along the site's western boundary and the remaining three streams are located along the site's northeastern boundary. A map showing hydrologic features and wetlands in the vicinity of the subject site is included as Figure 4a and a map showing onsite hydrologic stream and wetland features delineated by Ambrook is included as Figure 4b.

The Ambrook report states that extensive evidence of agricultural field tile drainage systems exists throughout the subject site, which are noted to drain to the onsite streams and wetlands. As such, water within the onsite stream features during periods of baseflow conditions appears to be sourced by inflows from the tile drainage system, drainage from wetlands, and/or shallow groundwater discharged directly to the streams. Stormwater runoff inflows to the streams would also occur during and after storm events.

Several offsite perennial streams exist in the subject site region. The majority of these streams are located to the north of Conodoguinet Creek and originate at the base of the Blue Mountain highlands, approximately two miles north of the site. The stream network to the south of the site is less extensive than that to the north, which is likely due to the prevalence of carbonate bedrock units to the south. Each of the streams in proximity to the site drain to Conodoguinet Creek, which flows into the Susquehanna River approximately 10 miles east of the site.

No reservoirs or ponds exist at the subject site. The nearest mapped offsite pond is approximately 1.4 acres and is located approximately 1,300 feet east of the site's eastern boundary.

2.2.3 Wetlands

A wetland delineation performed by Ambrook identified 21 wetlands at the subject site. The wetlands consist of one large wetland (110 acres) that occupies the entire southern floodplain of Conodoguinet Creek and 20 other smaller wetlands at the interior or periphery of the site. The smaller wetlands range in size from 0.005–4.0 acres. Several of the wetlands exist along the stream channels of the aforementioned onsite streams delineated by Ambrook. Each of the wetlands are identified by Ambrook as being palustrine emergent habitats. Proximal offsite wetlands mapped by the National Wetland Inventory include wetlands along the north bank of Conodoguinet Creek and wetlands within the channels or floodplains of other tributary streams. With few exceptions, offsite wetlands are mapped as being present in the immediate vicinity of a stream or other surface waterbody.

3.0 GEOLOGIC AND HYDROGEOLOGIC SETTING

3.1 Geologic Setting

The subject site is located within the Great Valley section of the Ridge and Valley Physiographic Province. The Great Valley section of the Ridge and Valley Physiographic Province is characterized as a wide valley bound by the South Mountain and Gettysburg-Newark Lowland Sections of the Ridge and Valley and Piedmont Provinces, respectively, to the southeast, and by the Blue Mountain section of the Ridge and Valley Province to the northwest. The Great Valley section is primarily underlain by Ordovician-age sedimentary bedrock consisting of shale and carbonates and commonly contains many deformation features like folds and faults. Older Cambrian-age carbonate units are also present in the Great Valley to the south of the subject site surrounding the city of Carlisle.

Other geologic features in the vicinity of the subject site include surficial deposits and possible karst topography. Quaternary alluvium channel deposits are mapped in the vicinity of the subject site, primarily within the floodplain of Conodoguinet Creek. These alluvium deposits consist of silty sands with fine- to coarse-grained gravels (Root, 1978). Karst topography is common in southern Pennsylvania regions underlain by carbonate bedrock. Although no karst features are mapped at the subject site, the presence of carbonate bedrock at and in proximity to the site suggests that such features may exist or could develop over time. Sinkhole and karst-related feature mapping by Kochanov (1989) (map scale of 1:24,000) indicates that numerous sinkholes and closed depressions exist within the carbonate bedrock region immediately south of the subject site. Geologic mapping of the subject site and surrounding area, as well as the geologic units distinguished as carbonate or non-carbonate, are included as Figures 5a through 5c.

3.1.1 Site-Specific Geology

The sedimentary Hamburg Sequence is the predominant unit underlying the subject site. The DCNR describes the Hamburg Sequence (map symbol Oh) as a fine-grained siliceous shale with some chert and is predominantly greenish gray. Thinly bedded siltstone, mudstone, and limestone are also interbedded in the Hamburg Sequence. Within the Hamburg Sequence at the subject site, the Hamburg Limestone (map symbol Oh1) is present in relatively thin, discontinuous bands in the northern portion of the site. The Hamburg Limestone is described as being comprised of interbedded layers of limestone, micaceous shale, and siltstone (Root, 1978) and is treated as a distinct unit from the Hamburg Sequence by the DCNR. Both the Hamburg Sequence and the Hamburg

Limestone were originally deposited in deep marine ocean basins before the Taconic Orogeny, and then later thrust upon the Martinsburg Formation which is present in the southern portion of the site. The DCNR describes the Martinsburg Formation (map symbol Om) as a buff-weathering, dark gray shale with interbedded siltstone and some fine-grained sandstone lenses. The Martinsburg Formation formed in the deep marine basal slope preceding the Taconic Orogeny. The Chambersburg Formation (map symbol Oc) is mapped at the southernmost tip of the subject site, which is described as a dark grey, thin-bedded nodular limestone (Root, 1978) with some fossils present (Dyson, 1967). Thrust faults are mapped at the contacts between the Hamburg Sequence and the Martinsburg Formation, and also at the contact between the Martinsburg Formation and the Chambersburg Formation (Figure 5a)

The Hamburg Sequence and Martinsburg Formation generally trend in west-to-east and southwest-to-northeast directions, and dip to the southeast at approximately 50 degrees. Also present at the subject site is a low angle thrust fault that runs in a southwest-northeast direction through the southern portion of the site, roughly following the contact between the Hamburg Sequence and the Martinsburg Formation (Dyson, 1967).

3.1.2 Proximal Offsite Geology

Further south into the Cumberland Valley from the subject site, the primary lithology of the sedimentary bedrock transitions from shale to limestone. Synclines, anticlines, and thrust faults create a complex network of Ordovician- and Cambrian-age carbonates mainly oriented in a southwest-northeast direction, as shown in Figure 5b. The most notable and hydrogeologically significant units in this region are the Ordovician-age St. Paul Group, Rockdale Run Formation, Zullinger Formation, and Shadygrove Formations.

The St. Paul Group (map symbol Osp) is a buff-colored, magnesium-rich limestone that consists of fine-grained limestone at its top and base, and fossiliferous dolomite with chert in its middle section. The Rockdale Run Formation (map symbol Orr) is described as a very fine-grained light gray limestone with thin laminations and some chert and dolomite lenses. The Rockdale Run Formation has the largest areal extent of carbonate rocks within the Carlisle area (Becher and Root, 1981). The Zullinger Formation (map symbol Cz) is a medium-gray interlaminated limestone and dolomite with local quartz sand lenses and is estimated to be approximately 2,500 feet thick. The Shadygrove Formation (map symbol Csg) consists of a gray to pink fine crystalline limestone (Geyer and Wilshusen, 1982). These Cambrian- to Ordovician-age sedimentary bedrock units were deposited when shallow seas existed in the region and are heavily deformed due to the Taconic Orogeny. Karst features, such as surface depressions and sinkholes, are mapped by the DCNR as being present at a high density within each of the aforementioned carbonate bedrock formations.

3.2 Hydrogeologic Setting

The hydrogeologic setting of the subject site and surrounding region is described herein with emphasis on its carbonate composition, given the significant differences in hydrogeologic characteristics between carbonate and non-carbonate formations. Carbonate lithologies include limestone and dolostone, whereas non-carbonate lithologies consist primarily of shale, sandstone, graywacke, siltstone, and mudstone.

The subject site is underlain entirely by non-carbonate bedrock, with the exception of relatively thin, discontinuous limestone layers at the northern portion of the site, limestone

of the Chambersburg Formation at the far southern portion of the site, and thin limestone layers interbedded within the non-carbonate formations (Figure 5c). Regions to the north, east, and west of the site are also generally underlain by non-carbonate bedrock, although discontinuous carbonate layers similar to that underlying portions of the subject site do exist. The region to the south of the site is underlain primarily by carbonate bedrock. A relatively thin unconsolidated overburden layer overlies the bedrock formations and forms a veneer across the site and surrounding area.

Groundwater flow direction at and in the vicinity of the site is generally expected to follow the regional hydrologic drainage direction, which is toward Conodoguinet Creek. The boundary between carbonate and non-carbonate formations restricts groundwater flow between the two rock types, with springs commonly developing at or near this contact. Conodoguinet Creek generally follows the contact between non-carbonate and carbonate units, with several high-yielding springs existing that discharge directly to the creek at locations near the contact. Similarly, springs can develop along faults within the carbonate units when the faults function as a relatively impermeable barrier to groundwater flow.

3.2.1 Unconsolidated Overburden Layer

The unconsolidated overburden layer at regions of the site located outside the Conodoguinet Creek floodplain is comprised primarily of weathered non-carbonate bedrock material. Alluvial sediment transported and deposited by Conodoguinet Creek is present within the floodplain region of the site. The composition of the alluvial deposits and the weathered bedrock sediment appear to generally be similar, based on preliminary geotechnical boring data and data obtained during the installation of several shallow piezometers. While sediment composition is variable, the overburden layer is generally comprised of clay with variable amounts of silt, sand, and gravel. Geotechnical boring data obtained at the site indicates that the thickness of the overburden layer is variable, although it is generally less than 10 feet thick. Overburden material is absent (i.e., bedrock exposure at the land surface) within some of the onsite stream channels, including within Conodoguinet Creek, but has been observed to be up to 30 feet thick in other regions of the site.

The saturated thickness of the overburden layer and the depth to groundwater is unknown across the site. While stabilized groundwater levels within the geotechnical borings were typically shallow (typically 5–15 feet below ground surface [bgs]), it is important to note that the borings penetrated underlying bedrock formations in addition to the overburden layer and therefore may not be representative of overburden conditions. Given the relatively thin nature of the overburden layer, it can be estimated that the saturated thickness of the layer is typically less than 5–10 feet. Groundwater level data collected within several shallow piezometers installed at delineated wetland regions of the site indicate that groundwater levels generally exist at or near the ground surface within the wetlands. However, this is not always the case, as the depth to groundwater was greater than the base of the piezometers (i.e., approximately 3–5 feet bgs) at several of the wetlands. As such, it appears that some onsite wetlands are fed by groundwater discharge, whereas a downward hydraulic gradient exists at other wetlands.

The overburden layer can function as a source of groundwater storage for the underlying bedrock aquifer. The hydraulic connection and the rate of groundwater exchange between the overburden layer and the bedrock aquifer is largely a function of the degree of fracturing and/or dissolution weathering in the uppermost section of bedrock.

The overburden aquifer is typically unconfined, although locally confined conditions may exist. The overburden aquifer is a minor regional source of water for domestic use, with approximately 12.5% of the wells included in the Pennsylvania Geologic Data Exploration (PaGEODE) well database appearing to be constructed within this aquifer. Wells that produce water from the overburden aquifer are commonly completed as bored wells installed to the upper bedrock surface. Yields of bored wells completed in the overburden aquifer are typically less than 5–10 gallons per minute (gpm).

Groundwater within unconsolidated aquifers is transmitted primarily through connected pore spaces between sediment grains. Groundwater in the unconfined overburden aquifer typically has a relatively short residence time and flow paths are also relatively short. Flow direction in this aquifer is controlled primarily by topography and the presence of hydrologic features. Recharge to the overburden aquifer is primarily through infiltrated precipitation. The primary sources of discharge from the overburden aquifer are evapotranspiration, seepage to streams, and discharge to the underlying bedrock aquifer.

3.2.2 Non-Carbonate Aquifers

Non-carbonate aquifers at and in the vicinity of the subject site are comprised primarily of shale, sandstone, graywacke, siltstone, and mudstone. The primary non-carbonate formations at and in the vicinity of the subject site are the Martinsburg Formation and the Hamburg Sequence, which was formerly referred to as a separate member of the Martinsburg Formation. Groundwater flow within non-carbonate aquifers occurs primarily through interconnected joints and fractures within the rock, as primary porosity is typically low. Regional fracture density and the degree to which the fractures are interconnected can be highly variable and depends on factors such as geologic structure, rock type, and depth.

Becher and Root (1981) analyzed well construction records for 48 wells constructed in the Martinsburg Formation and found that the median well depth was 88 feet bgs, with a maximum depth of 635 feet bgs. The median casing depth for these wells was 30 feet bgs. Their analysis of 30 wells constructed within the Hamburg Sequence revealed that the median well depth was 134 feet bgs, with a maximum depth of 500 feet bgs. The median casing depth for the Hamburg Sequence wells was also 30 feet bgs. It is important to note that the majority of the wells evaluated by Becher and Root were likely to have been private domestic wells, where drilling would have been terminated after achieving a relatively low yield capable of meeting residential water demands.

While the Martinsburg Formation and the Hamburg Sequence are generally considered sufficient sources for typical domestic use, these formations are considered to be unsuitable for the development of high-yielding wells that produce greater than 100 gpm. According to an analysis of well records performed by Becher and Root (1981), the median sustainable yields for wells completed within the Martinsburg Formation and Hamburg Sequence were 28 gpm and 15 gpm, respectively. The median estimated specific capacity values after 24 hours of pumping were 0.51 gallons per minute per foot of drawdown (gpm/foot) for the Martinsburg Formation and 0.32 gpm/foot for the Hamburg Sequence. The discontinuous carbonate layers present within the Hamburg Sequence, such as at the northern portion of the subject site, have the ability to produce higher well yields but are still generally unsuitable for the development of high-yielding wells that can produce in excess of 200 gpm. The median sustainable yield of wells completed in the carbonate

layers of the Hamburg Sequence was 48 gpm, with a median specific capacity value of 1.1 gpm/foot (Becher and Root, 1981). A summary of the water-bearing capacity of the geologic formation at and in the vicinity of the subject site is included as Table 1.

Table 1: Water-Bearing Characteristics of Regional Geologic Formations^a.

Geologic Formation	Specific Capacity ^b (gpm/ft ^c)		Median Sustainable Yield (gpm)
	Range (75 th – 25 th Percentile)	Median	
Hamburg Sequence (Non-Carbonate)	0.16 – 1.1	0.32	15
Hamburg Sequence (Carbonate)	0.6 – 3.3	1.1	48
Martinsburg Formation (Non-Carbonate)	0.32 – 1.8	0.51	28
Chambersburg Formation	0.09 – 1.7	0.15	11
St. Paul Group	0.09 – 24	1.1	82
Rockdale Run Formation	1.4 – 33	9.0	405
Stonehenge Formation	0.07 – 14	1.5	57
Shadygrove Formation	0.06 – 2.8	0.35	26
Zullinger Formation	0.25 – 16	1.1	82

^aTable modified from Becher and Root (1981).

^bEstimated 24-hour specific capacity extrapolated from 1-hour pumping test data by Becher and Root (1981).

^cgpm/ft = gallons per minute per foot of drawdown.

Typical transmissivity values for non-carbonate aquifers comprised of the Martinsburg Formation and Hamburg Sequence range between 100–200 square feet per day (ft²/day) and a typical storage coefficient is approximately 0.01 (Becher and Root, 1981). The dominant recharge source to the bedrock aquifer is infiltrated precipitation, with recharge water infiltrating through the overburden layer to shallow bedrock fractures or contributing directly to the aquifer at locations where bedrock is exposed at the land surface. Recharge from segments of streams where the surface water stage exceeds the groundwater level (i.e., hydraulic losing reaches) may also contribute recharge to the aquifer. Based on the dominant north-northeastern regional slope direction toward Conodoguinet Creek, the recharge contribution area to the subject site appears likely to extend upgradient to the south-southwest. Discharge sources from the bedrock aquifer include seepage to streams, water withdrawal from supply wells, and evapotranspiration at areas where the overburden layer is thin or absent and where shallow groundwater exists.

3.2.3 Carbonate Aquifers

The most productive wells in the subject site region are completed within Ordovician-age carbonate aquifers. Two carbonate units are present within the boundaries of the subject site. The first unit is the Hamburg Limestone, which exists as a relatively thin,

discontinuous layer at the northern portion of the site. It is mapped as being present beneath Conodoguinet Creek and extends to the north of planned Campus 1. Thin layers of Hamburg Limestone are also interbedded within the non-carbonate Martinsburg Formation and Hamburg Sequence at other areas of the site. The second onsite carbonate unit is the Chambersburg Formation, which is present within an approximately 11.8-acre area at the southernmost portion of the site. Proximal offsite carbonate units include the St. Paul Group, Rockdale Run Formation, Zullinger Formation, Shadygrove Formation, Pinesburg Station Formation, and Stonehenge Formation. Each of these carbonate units are present with a 2.4-mile distance from the subject site.

Carbonate aquifers generally exhibit much higher transmissivity and yield potential than non-carbonate aquifers in the region. This is primarily the result of extensive and well-developed secondary porosity features, such as dissolution conduits, joints, and fractures, that dominate groundwater flow in carbonate rock. The development of karst dissolution features, including enlarged conduits, interconnected fractures, and sinkholes, further enhances hydraulic conductivity by creating highly efficient preferential flow pathways, which in turn allow for increased groundwater flow velocities and substantially greater transmissive capacity compared to non-carbonate aquifers. Karst sinkhole and surface depression mapping indicates that karst features are present in significantly higher numbers at carbonate formations to the south of the site in comparison to the onsite carbonate layers.

The onsite carbonate formations are significantly less productive than some of the carbonate formations located to the south of the site. Typical median sustainable yields for the onsite formations, as estimated by Becher and Root (1981), were 48 gpm for the Hamburg Limestone and 11 gpm for the Chambersburg Formation. These median yields are significantly less than the Rockdale Run Formation's typical median yield, which is stated to be 405 gpm (Becher and Root, 1981). It is also less than that of other carbonate formations located to the south of the site, including the St. Paul Group (82 gpm), Stonehenge Formation (57 gpm), and Zullinger Formation (82 gpm). Similarly, the 24-hour median specific capacity values of the onsite formations (Hamburg Limestone = 1.1 gpm/foot and Chambersburg Formation = 0.15 gpm/foot) was significantly less than that of the Rockdale Run Formation (9.0 gpm/foot) and was comparable to that of the St. Paul Group (1.1 gpm/foot), Stonehenge Formation (1.5 gpm/foot), and Zullinger Formation (1.1 gpm/foot). It is, however, important to note that while the specific capacity values of the onsite Hamburg Limestone and the offsite St. Paul Group, Stonehenge Formation, and Zullinger Formation were similar, the discontinuous nature of the Hamburg Limestone may significantly reduce its long-term yield potential in comparison to the more regionally extensive offsite carbonate formations. However, as with wells located within non-carbonate aquifers that were evaluated by Becher and Root (1981), it is important to note that the majority of the wells were likely to have been private domestic wells, where drilling would have been terminated after achieving a relatively low yield capable of meeting residential water demands. It is possible that higher yields may be achieved through the performance of well siting assessments, by increasing well depth, and by increasing well diameter. A summary of the water-bearing characteristics of the onsite and offsite carbonate formations is included as Table 1.

The Rockdale Run Formation appears to be the most productive aquifer in the subject site region. Reported yields for wells constructed within this aquifer can exceed 1,000 gpm, as evidenced by the high production capacity of MTMA's existing municipal Well 1 (see

Section 4). While still productive, other proximal offsite carbonate formations appear to be less productive than the Rockdale Run Formation, although it is likely that the potential to install high-yielding wells that can produce in excess of 500 gpm does exist. The yield potential of the onsite carbonate formations is moderate, with typical maximum well yields expected to be less than 200 gpm. It is possible that yields in excess of 200 gpm could be obtained through the performance of well siting assessments and by installing wells to depths greater than those typical for the site region.

Transmissivity values for carbonate aquifers in the site region can be highly variable, depending on the number and characteristics of water-bearing zones encountered during well installation. Typical transmissivity values for the Ordovician-age carbonates in the site region are shown to vary between approximately 1,000–8,600 ft²/day and a typical storage coefficient is approximately 0.05 (Becher and Root, 1981). As with the non-carbonate aquifers, the dominant recharge source to the bedrock aquifer is infiltrated precipitation, with recharge water infiltrating through the overburden layer to shallow bedrock fractures or contributing directly to the aquifer at locations where bedrock is exposed at the land surface. However, the recharge rate to carbonate formations from infiltration of precipitation is typically higher than the recharge rate to non-carbonate formations. Additionally, and especially in areas underlain by carbonate bedrock, recharge from segments of streams where the surface water stage exceeds the groundwater level (i.e., hydraulic losing reaches) can also contribute recharge to the aquifer. Discharge sources from the carbonate bedrock aquifer include seepage to streams, water withdrawal from supply wells, and evapotranspiration at areas where the overburden layer is thin or absent and where shallow groundwater exists. Karst springs are also a common discharge source for carbonate aquifers in the region, with springs commonly developing along streams, geologic contacts, and structural features such as faults (Becher and Root, 1981).

3.3 Groundwater Quality

Groundwater quality within the Valley and Ridge Province can vary significantly between different formations due to differences in geologic composition, recharge sources, and land use influences. The type and amount of dissolved chemical constituents within the groundwater is determined by the soil and rock type that it flows through. Water quality can also vary significantly with depth within a single geologic unit due to the inclusion of different lithologies within these units. Additionally, increased flow path distances put the water into contact with more rock material, allowing for longer residence times and further facilitating geochemical reactions. Generally, water quality in Cumberland County is considered good for potable and non-potable use (Becher and Root, 1981).

ECS reviewed available water quality information as it pertains to general groundwater chemistry, with a focus on conditions in the geologic units present in the vicinity of the subject site. Groundwater quality was obtained from Taylor and Werkheiser (1984), and includes samples taken from non-carbonate units (Hamburg Sequence and Martinsburg Formation) and carbonate units (Chambersburg, Rockdale Run, St. Paul Group, Zullinger, and Shadygrove Formations). Samples from the Hamburg Limestone are not included in the analysis. Concentrations for chemical constituents reported by Taylor and Werkheiser (1984) represent median values and should be considered an approximation of actual conditions within the given aquifers. A summary of groundwater quality data presented by Taylor and Werkheiser (1984) is included as Appendix A as Table A-1. U.S. Environmental Protection Agency (USEPA) drinking water Maximum Contaminant Levels (MCLs) and

Secondary Drinking Water Regulations (SDWRs) for drinking water are included within the table, when available. USEPA MCLs are legally enforceable primary standards that apply to public water systems, which are established to protect the public by limiting the levels of contaminants in drinking water. USEPA SDWRs are non-mandatory water quality standards that are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. SDWR contaminants are not considered to present a risk to human health at the established limit.

Groundwater quality data from Taylor and Werkheiser (1984) indicates that median analyte concentrations for each of the geologic units were below MCL and SDWR thresholds, with the exception of median iron concentrations in the Chambersburg Formation and the St. Paul Group, and the median manganese concentration in the Martinsburg Formation. The median concentrations of iron were 0.44 mg/L for the Chambersburg Formation and 0.32 mg/L for the St. Paul Group, which exceeded the SDWR (0.3 mg/L) by 0.14 mg/L and 0.02 mg/L, respectively. The median manganese concentration in the Martinsburg Formation (0.26 mg/L) exceeded the USEPA SDWR concentration of 0.05 mg/L.

Other observations related to groundwater quality include median total dissolved solids (TDS), hardness, calcium, alkalinity, and nitrate concentrations generally being higher in the carbonate formations than the non-carbonate formations. It is important to note that these values represent median values, and that higher concentrations could be encountered. Additionally, sampling data presented by Taylor and Werkheiser were obtained from a limited number of wells approximately 40 years ago, so actual conditions may vary.

3.3.1 Municipal Well Water Quality

MTMA currently owns and operates one municipal supply well, which is referred to as Well 1. A second supply well (Well 2) was recently installed near Well 1 and is currently in the process of being permitted through the Pennsylvania Department of Environmental Protection (DEP) and the Susquehanna River Basin Commission (SRBC). Both Wells 1 and 2 are completed within the carbonate Rockdale Run Formation (Figure 5b). Additional information related to Wells 1 and 2 is included within Section 4 of this report.

ECS received select water quality sampling laboratory reports from MTMA. These included comprehensive new source water sampling reports for Well 1 (2006) and Well 2 (2025), along with routine sampling results for Well 1 from 2023 and 2025. Sampling results were compared to USEPA MCL and SDWR concentrations for drinking water. According to MTMA, no testing results over the past five years have exceeded an MCL concentration. A summary of the laboratory results is included as Table 2.

New source water quality sampling for Well 1 showed no detections of herbicides or pesticides. Most analyzed metals were not detected in the sample. However, an aluminum concentration of 1.49 mg/L was recorded, which exceeded the USEPA SDWR recommended range of 0.05–0.2 mg/L. Additionally, the recorded iron concentration from the Well 1 sample was 0.90 mg/L which was above the USEPA SDWR of 0.3 mg/L. Other metals detected include barium, manganese, nickel, and zinc, all of which are below or within the range of USEPA MCLs and SDWRs. E. coli was not detected in the Well 1 water samples, however, total coliform was detected at a concentration of up to 46 Most Probable Number per 100 mL (MPN/100mL). Turbidity was recorded as 20.9

Nephelometric Turbidity Units (NTU) on 2/16/2006 and later as 6.63 NTU on 2/21/2006, both higher than the desired concentration of 1 NTU or less.

Well 1 water quality laboratory reports from 2023 and 2025 show that no metals exceeded USEPA MCLs or SDWRs, although only a limited number of metals were tested. Certain haloacetic acid and volatile organic compound analytes were detected, although none of the concentrations exceeded USEPA MCL concentrations. No PFOS or PFOA were detected within the water samples, and according to MTMA, no testing results have indicated the presence of per- and polyfluoroalkyl substances (PFAS).

New source water quality sampling for Well 2 showed elevated aluminum and iron concentrations. The total aluminum concentration for Well 2 was 0.35 mg/L (0.15 mg/L higher than the USEPA SDWR) and the total iron concentration was 1.1 mg/L (0.8 mg/L higher than USEPA SDWR). No VOCs or PFAS analytes were detected in the Well 2 water samples. Elevated bacteria and turbidity levels were measured in the water samples. Turbidity was recorded at 19 NTU and *E. coli* ranged from 1–3 MPN/100mL, while total coliform ranged from 1–8 MPN/100mL. Resampling of Well 2 for bacteria and turbidity was performed due to the initial elevated concentrations, which resulted in turbidity declining to 2.5 NTU, total coliform increasing to 41 MPN/100mL, and *E. coli* remaining present at 1 MPN/100mL.

3.4 Fracture Trace Analysis

ECS performed fracture trace mapping of the subject site and larger site area to better understand the fracture fabric of the underlying lithology. A total of 32 suspected fracture traces were identified in and around the subject site. These suspected fracture traces were used in combination with geologic mapping to make inferences related to the primary orientation of the bedrock fracture network in the subject site region.

Digital elevation Lidar data with 1-meter grid spacing was used to perform the fracture trace mapping. A review of aerial photographs was also made. Fracture traces were mapped across the subject site and surrounding region to identify prominent lineaments that are believed to represent zones of fracture concentration. Zones of fracture concentration within bedrock are often revealed by preferential weathering that results in straight line segments, or lineaments, on the landscape when photographs are viewed stereoscopically. Such zones of fracture concentration can contain water-filled fractures and can be favorable for the development of high-yield supply wells.

During completion of the fracture trace analysis, lineament traces were transferred to a U.S. Geological Survey topographic base map and ultimately to a hillshade base map derived from the digital elevation Lidar data (Figure 6). A compass rose diagram depicting the overall lineament orientations has also been provided on Figure 6. A total of 32 lineaments were identified within 1.2 miles of the subject site. The fracture traces appear to be oriented predominantly in two directions, northwest-southeast and southwest-northeast, which generally trends perpendicular and parallel to the strike of the underlying bedrock units.

Table 2: Summary of MTMA Municipal Wells 1 and 2 Water Quality Sampling Results^a.

Class	Analyte	Well 1		Well 2	USEPA MCL/SDWR ^b
		2006 New Source Sampling	2023/2025 Routine Sampling	2025 New Source Sampling	
Total Metals	Aluminum	1.49 mg/L ^c	Not Analyzed	0.35 mg/L	0.05 – 0.2 mg/L
	Iron	0.9 mg/L	Not Analyzed	1.1 mg/L	0.3 mg/L
	Barium	0.0448 mg/L	0.044 mg/L	0.049 mg/L	2 mg/L
	Chromium	<0.001 mg/L	<0.02 mg/L	0.0017 mg/L	0.1 mg/L
	Nickel	0.0049 mg/L	<0.005 mg/L	<0.0025 mg/L	--- ^d
	Manganese	0.0084 mg/L	Not Analyzed	0.034 mg/L	0.05 mg/L
	Zinc	0.0171 mg/L	Not Analyzed	0.02 mg/L	5 mg/L
General Chemistry	Total Alkalinity, as CaCO ₃	250 mg/L	Not Analyzed	263 mg/L	---
	Total Hardness	278 mg/L	Not Analyzed	336 mg/L	---
	Total Dissolved Solids	330 mg/L	Not Analyzed	372 mg/L	500 mg/L
	Color	35 CU ^e	Not Analyzed	5 – 30 CU	15 CU
	Chloride	15.0 mg/L	Not Analyzed	27.8 mg/L	250 mg/L
	Fluoride	<0.1 mg/L	<0.2 mg/L	0.26 mg/L	4.0 mg/L
	Sulfate	21.3 mg/L	Not Analyzed	23.7 mg/L	250 mg/L
	Surfactants	0.088 mg/L	Not Analyzed	<0.18 mg/L	---
	Nitrate as Nitrogen	8.71 mg/L	8.2 mg/L	7.7 mg/L	10 mg/L
	Nitrite as Nitrogen	<0.1 mg/L	<1 mg/L	<1 mg/L	1 mg/L
	pH	7.76	Not Analyzed	7.10	6.5 – 8.5

Class	Analyte	Well 1		Well 2	USEPA MCL/SDWR ^b
		2006 New Source Sampling	2023/2025 Routine Sampling	2025 New Source Sampling	
	Turbidity	20.9 NTU ^f	Not Analyzed	2.5 – 19 NTU	1 NTU
	Cyanide	<0.005 mg/L	<0.004 mg/L	<0.004 mg/L	0.2 mg/L
Volatile Organic Compounds	All Analyzed Compounds	ND ^g	See Detections Below	ND	Varies
	Bromodi- chloromethane	Not Analyzed	0.0075 – 0.008 mg/L	Not Analyzed	---
	Chlorodi- bromomethane	Not Analyzed	0.0025 mg/L	Not Analyzed	---
	Chloroform	Not Analyzed	0.034 – 0.039 mg/L	Not Analyzed	---
	Total Trihalomethanes	Not Analyzed	0.0409 – 0.0445 mg/L	Not Analyzed	0.08 mg/L
Haloacetic Acid	HAA5	Not Analyzed	0.0037 – 0.005 mg/L	Not Analyzed	0.06 mg/L
	Dichloroacetic Acid	Not Analyzed	<0.001 – 0.0013 mg/L	Not Analyzed	---
	Trichloroacetic Acid	Not Analyzed	0.0036 – 0.0037 mg/L	Not Analyzed	---
Semi- Volatile Organic Compounds	All Analyzed Compounds	ND	ND	ND	Varies
Pesticides	All Analyzed Compounds	ND	ND	ND	Varies
Herbicides	All Analyzed Compounds	ND	ND	ND	Varies
Radiological	Gross Alpha	1.60 +/- 1.06 pCi/L ^h	Not Analyzed	0.936 +/- 0.836 pCi/L	15 pCi/L

Class	Analyte	Well 1		Well 2	USEPA MCL/SDWR ^b
		2006 New Source Sampling	2023/2025 Routine Sampling	2025 New Source Sampling	
	Gross Beta	3.25 +/- 1.46 pCi/L	Not Analyzed	2.67 +/- 0.868 pCi/L	4 millirems/year
	Radium-228	0.488 +/- 0.251 pCi/L	Not Analyzed	0.155 +/- 0.356 pCi/L	5 pCi/L (Radium- 226 and -228 Combined)
	Radium-226	<0.677 pCi/L	Not Analyzed	0.0422 +/- 0.219 pCi/L	
	Uranium	0.687 +/- 0.0244 µg/L ⁱ	Not Analyzed	Not Analyzed	30 µg/L
Micro- biological	Total Coliform	6 – 46 MPN/100 mL ^j	Not Analyzed	1 – 41 MPN/100 mL	<5% Sample Presence
	E. coli	Absent	Not Analyzed	1 – 3 MPN/100 mL	Absent
PFAS ^k	All Analyzed Compounds	Not Analyzed	ND	ND	Varies

^aSampling data summarized from lab reports provided by MTMA.

^bU.S. Environmental Protection Agency drinking water Maximum Contaminant Levels (MCLs) in red and Secondary Drinking Water Regulations (SDWRs) in black.

^cmg/L = milligrams per liter.

^d--- = MCL and SDWR not established for this analyte.

^eCU = color units.

^fNTU = nephelometric turbidity units.

^gND = analyte not detected at a concentration exceeding the laboratory detection limit.

^hpCi/L = picocuries per liter.

ⁱµg/L = micrograms per liter.

^jMPN/100 mL = most probable number per 100 milliliters.

^kPFAS = per- and polyfluoroalkyl substances.

Blue text indicates that a concentration exceeds either a USEPA MCL or SDWR.

4.0 EXISTING MUNICIPAL WATER SUPPLY SYSTEM

The MTMA water system has a total permitted capacity of 2.94 MGD. Of the total daily permitted water volume, 1.50 MGD is supplied by the South Middleton Township Municipal Authority (SMTMA) and the remaining 1.44 MGD is supplied by a municipal supply well owned and operated by MTMA (i.e., Well 1). Well 1 is currently unable to produce the full permitted volume of 1.44 MGD for reasons discussed below. SMTMA sources its water from two wells, the first of which was constructed in 1972 within the carbonate Tomstown Formation and the second of which was constructed in 1975 within the carbonate Elbrook Formation. The average water demand on the MTMA system is approximately 1.27 MGD, with a peak demand of 1.59 MGD. Daily water demand is typically less than 1 MGD from late November through March. The system's current additional available capacity is approximately 0.91 MGD, which is expected to increase to approximately 1.35 MGD following the activation of Well 2 (see below).

MTMA currently operates one municipal supply well (Well 1) and is in the process of permitting a second municipal supply well (Well 2) that has already been constructed and tested. A third well, which is referred to as Well 1A, was constructed as a test well but was not permitted as a municipal supply well due to its relatively low yield. Each of the three MTMA wells were constructed within the carbonate Rockdale Run Formation. A map showing the locations of Wells 1, 1A, and 2 is included as Figure 7. MTMA water line mapping, which was digitized from a map provided by MTMA, is also included within Figure 7.

4.1 MTMA Well 1 Construction & Testing

Well 1 was constructed in 2004 and was permitted by the DEP and SRBC in 2006. It is located approximately 50 feet south of MTMA's water treatment building. Currently, it is the only permitted supply well operated by MTMA. The system's current permitted capacity, not including the portion supplied by SMTMA, is 1.44 MGD. However, this maximum permitted volume is not currently being added to the MTMA system by Well 1 due to limitations associated with the well. Well 1 is currently operated at a maximum pumping rate of approximately 500–600 gpm (i.e., 0.72–0.86 MGD), despite the well's apparent capacity to produce at a higher rate. This is because operating the well at a rate in excess of approximately 600 gpm causes drawdown to a level that induces high turbidity flow to the well.

ECS was provided with a Well 1 Completion and Testing Report, dated June 2006, that was prepared by ARM Group Inc. (ARM). The report includes a schematic of the well's construction, which is described in Table 3. Well 1 was originally constructed to a depth of 450 feet bgs. However, a blockage at 262 feet bgs (i.e., at the base of a large, cavernous void) was noted to have occurred from either sediment filling or rock bridging following the well's completion. As such, the well's open depth, as of 2006, was considered to be 262 feet bgs. Well 1 was constructed with 12-inch nominal diameter steel production casing and a 12-inch nominal diameter open borehole production zone. Other than shallow overburden material, the well penetrated primarily limestone throughout its entire depth. The principal water-bearing zone was encountered at 258.5–262 feet bgs and the well's final air-lift yield at the termination of drilling was 900 gpm. The well is equipped with a 3-phase, 50-hp Grundfos submersible pump. Water produced from the well is chlorinated and fed into the water distribution system.

Table 3: MTMA Well Construction Summary.

Well Construction Characteristic	Well 1	Well 2
Well Depth	262 feet (formerly 450 feet)	390 feet
Borehole Diameter / Depth	19-inch (0 – 60 feet) & 17.5-inch (60 – 161.5 feet) & 12-inch (161.5 – 262 feet)	14-inch (0 – 40 feet) & 12-inch (40 – 196 feet) & 9.5-inch (196 – 390 feet)
Production Casing Diameter / Depth	18-inch (0 – 60 feet) & 12-inch (0 – 161.5 feet)	20-inch (0 – 24 feet) & 14-inch (0 – 89 feet) & 10-inch (0 – 201 feet)
Grouting Material & Interval	Neat cement grout, 12-inch casing from 0 – 100 feet	Neat cement grout, 14-inch and 10-inch casing from 0 – 50 feet
Production Zone Completion	Open Borehole (161.5 – 262 feet)	Open Borehole (201 – 390 feet)
Air-Lift Yield	>900 gpm ^a	800 gpm
Notes	Primary water-bearing zone at 258.5 – 262 feet; sediment infilling or blockage from 262–450 feet below ground surface.	Casing separation at 155.9 feet and tear at 165.7 – 170 feet

^agpm = gallons per minute.

Several constant-rate pumping tests were performed by ARM beginning in Spring 2004. In total, four constant-rate pumping tests are known to have been performed at Well 1 from Spring 2004 to Spring 2006 to determine the well's maximum pumping rate. The constant rate pumping tests varied in duration and average pumping rate for each test with the shortest (Test D) lasting 48 hours and the longest (Test C) lasting 216 hours. The highest average pumping rate (1,176 gpm) was used during Test A, which resulted in a total drawdown of 51.13 feet and a specific capacity value of 23.0 gpm/foot. The least amount of total drawdown (15.81 feet) was recorded during Test D, where an average pumping rate of 998 gpm was used. The specific capacity values calculated for the tests performed during the Winter of 2005 and the Spring of 2006 (62.9 gpm/foot and 62.6 gpm/foot, respectively) were significantly higher than the values calculated for the tests performed in the Spring of 2004 (i.e., 23.0 gpm/foot and 39.8 gpm/foot). The increase in specific capacity observed at the conclusion of the prolonged Test C is likely attributed to continued well development, as extended pumping removed fine materials and improved the well's efficiency. It is possible that the well's specific capacity has improved further during the nearly 20-year period that the well has been operational. A summary of results from the Well 1 constant-rate pumping tests is provided as Table 4.

Table 4: Well 1 Constant-Rate Pumping Test Results.

Pumping Test	Testing Season/Year	Duration of Test (hours)	Average Pumping Rate (gpm ^a)		Total Drawdown (feet)	Specific Capacity ^b (gpm/foot drawdown)
Test A	Spring 2004	72	1,176		51.13	23.0
Test B	Spring 2004	48	673		17.27	39.8
Test C	Winter 2005	216	<i>First 48 Hours</i>	1,022	17.31	62.9
			<i>Next 96 Hours</i>	1,213		
			<i>Final 72 Hours</i>	1,031		
Test D	Spring 2006	54	998		15.81	62.6

^agpm = gallons per minute.

^bSpecific capacity reported by ARM Group Inc. for the final 48 hours of testing.

Several proximal supply wells, monitoring wells, and springs were monitored during the Well 1 constant-rate pumping tests. Of the 11 monitoring locations, only one monitoring point, which was an inactive test well owned by MTMA located 1,480 feet from Well 1, exhibited a pumping-related impact. The impact was observed to be minor, with only 0.46 feet of drawdown being recorded at the conclusion of Test D. None of the monitored springs or offsite private residential wells were impacted during testing.

Pumping test findings lead ARM to recommend a maximum withdrawal rate of 998 gpm, which is a close approximation to the maximum amount of water that could be extracted by a submersible pump capable of fitting within the well's 12-inch diameter production casing. It was recommended that the well be active for up to 16 hours per day, with a daily 8-hour recovery period. The occurrence of turbidity during testing, and the potential for periods of elevated turbidity to occur during operation of the well, was noted by ARM. A recommendation that the well's distribution system include a bypass to prevent high-turbidity water from entering the water distribution system was included within the ARM report.

4.2 MTMA Well 1A Construction & Testing

Well 1A is an inactive well that was constructed in approximately 2004 at a location approximately 1,500 feet northeast of Well 1. Limited information was available in relation to this well, including information related to the well's construction. It is our understanding that Well 1A was originally constructed as Test Well 6 by Eichelbergers Drilling. Following its installation, the well's air-lift yield was approximately 125–150 gpm and the well did not exhibit especially high turbidity levels. A formal pumping test was not conducted. During an attempted test, the pump's drop pipe failed, and although the pump was subsequently retrieved from the well, testing was not completed. We have been informed that MTMA plans to perform a pumping test of Well 1A this Fall to explore the possibility of adding the well to their water system.

4.3 MTMA Well 2 Construction & Testing

Well 2 was constructed in the Spring of 2024 at a location approximately 670 feet southwest of Well 1. It is currently inactive, as it is in the process of being permitted through the DEP and SRBC. As with Wells 1 and 1A, Well 2 was completed within the carbonate Rockdale Run Formation. It is our understanding that Well 2 was designed with the intention of allowing it to supply the water deficit volume remaining between the MTMA system's permitted capacity (i.e., 1.44 MGD for the portion generated by MTMA-owned sources) and Well 1's current functional capacity (i.e., approximately 0.7–0.8 MGD).

Formal testing data and reports for Well 2 are limited at this time, as the documentation is still being prepared by Read and Associates, LLC (R&A) for submittal to DEP and SRBC. However, Mr. Steven Read with R&A did provide ECS with a geologic and well construction log for Well 2, as well as a summary of pumping test findings. Well 1 was constructed to a total depth of 390 feet bgs. Twenty-inch nominal diameter steel casing was installed from 0–24 feet bgs, 14-inch nominal diameter steel casing was installed from 0–89 feet bgs, and 10-inch nominal diameter steel casing was installed from above surface grade to 201 feet bgs. The production zone was completed as a 9.5-inch diameter open borehole. Other than shallow overburden material, the well penetrated primarily limestone with several mud seams and void/cavernous zones. The well's final air-lift yield at the termination of drilling was approximately 800 gpm. A summary of Well 2's construction is included in Table 3.

Mr. Read informed ECS that Well 2's maximum recommended pumping level is 155 feet btoc. He also informed us that two pumping tests have been performed at Well 2. During the first constant-rate pumping test Well 1 was inactive and Well 2 was operated at a pumping rate of 635 gpm. The Well 2 static water level at the start of the test was 37.5 feet below the well's top of casing (btoc), with 29.2 feet of drawdown being observed at the conclusion of the test (i.e., specific capacity = 21.7 gpm/foot). Both Wells 1 and 2 were active during the second constant-rate pumping test at rates of 525 gpm (Well 1) and 455 gpm (Well 2), or 980 gpm in combination. The static water levels at Wells 1 and 2 were 41.74 feet btoc and 38.30 feet btoc, respectively, prior to the start of the test. Drawdown observed at the end of the test was 19.68 feet at Well 1 (i.e., specific capacity = 26.7 gpm/foot) and 30.65 feet at Well 2 (i.e., specific capacity = 14.8 gpm/foot). While it is apparent that interference effects occur when both wells are operated simultaneously, it appears that the wells are, in combination, capable of supplying MTMA's full permitted capacity (MTMA-owned sources only) of 1.44 MGD.

Mr. Read informed ECS that he considers Well 2's current maximum pumping rate to be 635 gpm, although he mentioned that it may be possible to test the well at a higher pumping rate after it is operational for a longer period of time and more information is known about the well. It is ECS's opinion that Well 2's capacity to produce in excess of approximately 700 gpm is limited, given that the well's 10-inch nominal diameter casing could likely only accommodate a submersible pump capable of producing a maximum of approximately 700 gpm.

5.0 PROXIMAL OFFSITE WELL INVENTORY

While MTMA's municipal water service area does extend to some properties in the vicinity of the site, several other proximal offsite properties are located beyond the extent of the

municipal service area and rely on a private domestic well for their water supply. ECS obtained publicly available well records for Cumberland County through the PaGEODE web application from the DCNR to evaluate general well construction and yield characteristics in the vicinity of both the subject site and the MTMA's municipal Wells 1 and 2. Our review included a review of well database information for wells located within two miles of the subject site or MTMA Wells 1 and 2. Additionally, as a separate component of the well inventory assessment, a review of MTMA's water distribution system layout was reviewed to identify offsite properties within a half-mile of the subject site and MTMA's Wells 1, 1A, and 2 that likely use a private domestic well. This additional component of the review was necessary due to the DCNR well database only containing a fraction of the actual wells present in an area. As such, future phases of hydrogeologic assessment, including well permitting, installation, and testing, will require a well and surface water survey to identify actual wells and surface waterbodies located in proximity to planned supply wells.

It is important to recognize that the vast majority of wells within DCNR's database are private domestic wells that are constructed in a significantly different manner than that of high-yielding municipal wells. Similarly, domestic wells are rarely sited based on hydrogeologic assessment methods and drilling at the majority of domestic wells is typically terminated after achieving a yield suitable for residential purposes. As such, while evaluating well database records can provide useful information about the relative yield favorability of different geologic formations, they should not be considered a strong indicator of conditions likely to be encountered at a site where site-specific hydrogeologic assessment is performed and/or a high-yield well design is used.

A total of 861 wells were identified in the DCNR database as being located within two miles of the subject site or MTMA Wells 1 and 2. A review of well construction information associated with the records indicates that approximately 108 of the 861 wells (i.e., 12.5%) are estimated to be completed in the overburden aquifer, while the remaining 753 wells appear to be completed in the bedrock aquifer. The median well and casing depths for the overburden wells were 40 feet and 35 feet, respectively. A median overburden well yield could not be determined due to incomplete information within the database. The median well depth, casing depth, and yield for the bedrock wells were 200 feet, 58 feet, and 15 gpm, respectively. A table showing well characteristics of DCNR wells located within two miles of the subject site or an MTMA municipal well is provided as Table 5. A figure showing the distribution of the 861 wells categorized by reported yield within the two-mile zone is provided as Figure 8.

A total of 19 of the DCNR database wells have a reported yield greater than or equal to 100 gpm, with two wells having reported yields of 1,000 gpm and 17 wells having yields ranging between 100–200 gpm. Eighteen of the 19 wells with yields greater than or equal to 100 gpm are mapped as being located within the carbonate aquifer, with the only well in the non-carbonate aquifer (located 1,250 feet west of the subject site) having a reported yield of 100 gpm. Of the 18 wells located within the carbonate aquifer, 11 are underlain by the Rockdale Run Formation.

Table 5: Well Characteristics of Offsite Wells located within Two Miles of the Subject Site or MTMA Municipal Wells.

Well Characteristic	Overburden Wells ^a			Bedrock Wells ^a		
	Minimum	Maximum	Median	Minimum	Maximum	Median
Well Depth (feet bgs ^b)	13	61	40	14	1,000	200
Casing Depth (feet bgs)	3	50	35	5	281	58
Air-Lift Yield (gpm ^c)	0	35	Insufficient Data	0	1,000	15

^aBased on PaGEODE well data obtained for 108 wells estimated to be completed in the overburden aquifer and 753 wells estimated to be completed in the bedrock aquifer.

^bbgs = below ground surface.

^cgpm = gallons per minute.

In addition to the well inventory assessment that consisted of reviewing DCNR well database records, ECS also reviewed MTMA water distribution system mapping in conjunction with land parcel records to identify developed offsite properties located within a half-mile of the subject site that appear likely to use a private domestic well, based on the assumption that properties located within the municipal water service area do not use a private domestic well. In lieu of actual well location information, wells were assumed to be located at each property's primary residential structure. This same assessment was performed for offsite properties located within a half-mile of MTMA municipal Wells 1, 1A, or 2.

A total of 51 properties located within a half-mile of the subject site were identified as likely to use a private well, while 16 properties located within a half-mile of the MTMA's municipal wells were identified as likely to use a private supply well. The nearest offsite structure from the site boundary that appears likely to use a private well is located 80 feet to the south along Country Club Road. The nearest offsite structure from MTMA's municipal Wells 1, 1A, and 2 that appears likely to use a private well is located 1,230 feet to the southeast. As previously discussed, a more detailed inventory of proximal offsite wells, to include conversations with MTMA regarding individual service addresses, will need to be performed prior to finalizing new well locations for the planned development. The locations of the structures that appear likely to use a private well and are located within a half-mile of the subject site or the MTMA's municipal wells are shown in Figures 9a and 9b, respectively.

6.0 SOURCE RECOMMENDATIONS & PRELIMINARY IMPACT ASSESSMENT

6.1 Potential Groundwater Source Options

The planned development requires a large daily volume of water to meet anticipated average and peak demands. Water use will vary seasonally, and periods of peak demand will occur for a relatively short duration (i.e., several hours to days). The site's water demand will be met by a combination of onsite storage and water inflows to the site. It is our understanding that daily average and peak water demand volumes, including required inflows, are still being determined by the site developer. For the purposes of this assessment, and based on previous discussions with the design team, it is assumed that up to approximately 3–4 MGD inflow to the system will be required during periods of peak demand. The vast majority, if not the entirety, of this inflow will need to be sourced by groundwater supply wells.

The project design team includes a water system engineering firm (i.e., Hazen and Sawyer) to evaluate options for securing the necessary water supply to meet the development's projected demands. Potential groundwater source development options, as well as a preliminary impact assessment to estimate drawdown resulting from operation of a new municipal supply well, are discussed below. The options are outlined in our recommended order of pursuit.

Option 1: Utilize Current Available MTMA Municipal System Capacity

The MTMA water system is currently permitted for 2.94 MGD. As discussed in Section 4, average and peak water demands are approximately 1.27 MGD and 1.59 MGD. As such, and based on a peak demand of 1.59 MGD, the system's remaining available capacity is approximately 1.35 MGD (i.e., 938 gpm averaged over a 24-hour period). This available capacity assumes that Well 2 will be permitted and added to the MTMA system, since Well 1 is currently unable to supply the full permitted capacity. ECS recommends that the site developer pursue obtaining as much of this available supply as possible to serve the planned development.

- **Option 1 Pros:** (1) The existing MTMA water distribution treatment system is largely in place to provide water to the planned development, which would reduce source development costs. (2) Conversations with MTMA have indicated that they are open to the option of supplying a portion of their additional water supply to the planned development. (3) Supplying available permitted capacity to the planned development would not require MTMA to modify its existing permitted capacity since it is already approved for this volume.
- **Option 1 Cons:** (1) Receiving water from MTMA would incur ongoing water usage fees from the municipality. (2) The site developer would not have direct control over MTMA's municipal wells or distribution of the water supplied by MTMA. (3) The site developer would be responsible for paying consumptive use fees through SRBC.
- **Water Supply Potential:** Up to approximately 1.35 MGD following the addition of Well 2 to the MTMA system.

Option 2: New Municipal Well Installation

The construction and permitting of new offsite municipal wells within the Rockdale Run Formation, to be operated by MTMA, is considered a primary option for achieving the desired 3–4 MGD supply. The goal of this approach would be to increase the MTMA system's capacity and obtain the added water supply. It is likely that two new municipal wells would be needed to meet site demands. For water distribution system cost reduction purposes, these wells should be constructed in the general vicinity of MTMA's existing wells, while still maintaining an adequate separation distance to reduce well interference effects. A review of land conservation easements in the vicinity of MTMA Wells 1 and 2 indicates that extensive farm easements exist to the south of Well 1 and east of Well 2. It is recommended that the construction of wells at properties under a conservation easement be avoided to prevent unnecessary permitting hurdles.

A large area north of Well 1 and a smaller area to the west of Well 2, both areas of which are in the Rockdale Run Formation, have been identified where further site-specific evaluation appears warranted to assess the suitability for constructing new municipal supply wells, as shown in Figure 10a. In addition to being located in a favorable geologic formation, these areas also appear to be suitable due to the general lack of proximal surface waterbodies and proximal offsite properties that are likely to use private wells. Site-specific evaluation should be performed to determine well drilling locations, including the performance of electrical resistivity (ER) surveys.

- **Option 2 Pros:** (1) Good potential to develop high-yielding groundwater sources with water quality similar to that of the existing MTMA Well 1. (2) Large separation distance between other groundwater users and surface waterbodies, which reduces the likelihood of impacts to these features. (3) As with Option 1, this Option would not require the prospective developer to obtain a Water Withdrawal permit through DEP and SRBC. However, MTMA would need to obtain permitting approvals through these agencies (see Cons, below).
- **Option 2 Cons:** (1) The large northern exploration area appears to be owned by a private entity (Claremont Properties, & Incorporated) and will likely require obtaining approval from the owner to construct a well(s) on their property. The smaller exploration area is owned by Cumberland County. (2) MTMA will need to permit new municipal groundwater sources through the DEP and SRBC. Hydrogeologic assessment required as part of the permitting process is costly, and the process would likely require more than a year to complete for each new well. The decision of whether to issue a water withdrawal permit, including allocated maximum daily groundwater extraction volumes, is ultimately that of DEP and SRBC. It is possible that the permit application could be denied or only a portion of the requested volume be granted. (3) As with Option 1, the site developer would be responsible for paying consumptive use permitting and fees through SRBC. (4) Receiving water from MTMA would incur ongoing water usage fees. (5) The site developer would not have direct control over MTMA's municipal wells or distribution of the water supplied by MTMA.
- **Water Supply Potential:** Approximately 2–4 MGD if two new municipal wells were constructed and permitted. Yield potential would be highly dependent on site-

specific hydrogeologic conditions and the outcome of impact assessment evaluations.

Option 3: Construction of Onsite Supply Wells

Constructing one or two non-potable industrial supply wells at the site represents an option that could supply a moderate daily volume of water to the site. However, the primary potential benefit of this option is that the wells would be under the ownership and control of the site developer. If this option were to be pursued, we recommend that the wells be constructed at the far southern portion of the site within the area that is underlain by the carbonate Chambersburg Formation, as shown in Figure 10b. This area appears capable of accommodating two, and potentially three, supply wells. It is our opinion that the Chambersburg Formation represents a better target aquifer than the discontinuous Hamburg Limestone layers at the northern portion of the site. This is because the Hamburg Limestone layer appears to be discontinuous and relatively limited in extent, which can limit the long-term yield potential of a well constructed in the aquifer. Additionally, a well constructed within the Hamburg Limestone layer would have a higher impact potential to Conodoguinet Creek than a well constructed within the Chambersburg Formation. As with the offsite exploration area discussed as part of Option 2, the onsite exploration area is located a significant distance from offsite private well owners and surface waterbodies, thus reducing the likelihood of impacts to these features from onsite well operation.

- **Option 3 Pros:** (1) The site developer would have ownership and control of supply wells constructed onsite, thereby providing redundancy to the water system. (2) Relatively low risk of impact to offsite private well owners and surface waterbodies. (3) Water use fees to MTMA would not be required, although consumption use fees through SRBC would still apply.
- **Option 3 Cons:** (1) Would require the site developer to permit the wells through DEP and SRBC. As with Option 2, hydrogeologic assessment required as part of the permitting process is costly, and the process would likely require more than a year to complete for each new well. The decision of whether to issue a water withdrawal permit, including allocated maximum daily groundwater extraction volumes, is ultimately that of DEP and SRBC. It is possible that the permit application could be denied or only a portion of the requested volume be granted.
- **Water Supply Potential:** Potentially up to approximately 0.5 MGD per well, although yield potential would be highly dependent on site-specific hydrogeologic conditions.

Option 4: Redevelop Existing Well 1

Performing redevelopment of existing MTMA Well 1 represents an option that could moderately increase the well's yield capacity. Well 1 is currently operated at a maximum pumping rate of approximately 500–600 gpm. While the well's maximum yield capacity exceeds this pumping range, the well cannot be operated in excess of approximately 600 gpm because it causes drawdown to a level that induces high turbidity flow into the well. It is possible that additional well development could clean the mud seam(s) contributing turbidity to the water and allow the well to be operated at a higher pumping rate.

Option 4 may be worth pursuing if the added volume of water from Options 1–3 nearly, but do not fully, meet the proposed development's water demand. Option 4 could potentially increase Well 1's yield capacity by up to approximately 400–500 gpm, or 1,000 gpm in total. A maximum yield of up to approximately 1,000 gpm should be considered the well's maximum potential yield capacity, given that the well's 12-inch nominal diameter casing could likely accommodate a submersible pump capable of producing a maximum of approximately 1,000 gpm. In the event that this option was to be pursued, we recommend that at least one new municipal well be in operational condition to function as a source of water to the MTMA system during development, given the potential for Well 1 development activities to cause temporary turbidity issues at Well 2. We recommend that the site developer pursue Options 1–3 before proceeding with Option 4.

- **Option 4 Pros:** (1) Could potentially allow for additional water to be contributed to the MTMA water system from an existing MTMA well.
- **Option 4 Cons:** (1) It is possible that development may be required for an extended period of time (several days to weeks) to achieve the desired cleaning effect. Water discharged during development, which would likely be produced at a relatively high pumping rate, would need to be managed through the implementation of sediment and erosion controls. (2) It is possible that well development may not achieve the goal of allowing Well 1 to be operated at a higher pumping rate without causing turbidity issues. (3) Operating Well 1 at a higher pumping rate would require a modification of MTMA's DEP and SRBC permit. Modification of the permit would likely require that additional hydrogeologic impact assessment be performed. (4) Developing of Well 2 could impact nearby Well 2, with the most likely impact being temporary elevated turbidity conditions within the well. It is also possible that development could impact an operational new municipal well supplying water to the MTMA system during development. (5) As with other options where the site developer would receive water from MTMA, consumptive use fees through SRBC and ongoing water usage fees from MTMA would apply. Additionally, the site developer would not control the groundwater source, as it would be owned and operated by MTMA.
- **Water Supply Potential:** Option 4 could potentially increase Well 1's yield capacity from approximately 0.72–0.86 MGD (i.e., current capacity) to approximately 1.44 MGD.

Option 5: Reconstruct Well 1A in an Attempt to Increase Yield

ECS understands that MTMA is evaluating the potential reconstruction of existing Well 1A in an attempt to increase its yield. Its current yield is understood to be 125–150 gpm. However, limited information has been provided regarding the well's current construction. Although specific reconstruction plans have not been shared, we assume the work may include deepening the well in an attempt to intercept additional water-bearing zones, as well as other possible measures such as replacing the well's existing casing with larger-diameter casing.

While it is possible that reconstructing Well 1A could increase its yield, it is difficult to assess the viability of this option without knowing the well's existing construction. We do not consider this to be a primary option, since it is our opinion that other well drilling

locations determined by performing a site-specific well siting evaluation would be more likely to produce a higher yield than the reconstructed Well 1A. Additionally, reconstructing Well 1A is unlikely to represent a significant cost savings in comparison to constructing a new well, as well reconstruction is oftentimes as expensive or more expensive than new well construction. Performance of an impact assessment to satisfy DEP and SRBC permitting requirements would likely be required in both Well 1A reconstruction and new well construction scenarios. We recommend that the site developer pursue Options 1–3 before proceeding with Option 5.

- **Option 5 Pros:** (1) Could potentially allow for additional water to be contributed to the MTMA water system from an existing MTMA well.
- **Option 5 Cons:** (1) It is possible that the Well 1A reconstruction could fail at achieving the goal of increasing its yield capacity. (2) In the event that reconstruction is successful, operating Well 1A at a higher pumping rate would require a modification of MTMA's DEP and SRBC permit. Modification of the permit would likely require that additional hydrogeologic impact assessment be performed. (3) As with other options where the site developer would receive water from MTMA, consumptive use fees through SRBC and ongoing water usage fees from MTMA would apply. Additionally, the site developer would not control the groundwater source, as it would be owned and operated by MTMA.
- **Water Supply Potential:** Unknown but is likely to be less than 1 MGD.

Summary of Recommended Options for Groundwater Source Development

Findings from our evaluation indicate that a path forward does appear to exist regarding obtaining approximately 3–4 MGD from offsite groundwater sources, or a combination of onsite and offsite sources. However, the majority of the source development options will require navigating the DEP and SRBC water withdrawal permitting process. The decision of whether to issue a Water Allocation Permit, including allocated maximum daily groundwater extraction volumes, is ultimately that of DEP and SRBC. It is possible that permit applications could be denied or only a portion of the requested water volume be granted. It is also important to note that while existing information allows for the yield capacity of a proposed well to be estimated, the actual capacity cannot be definitively determined until construction and testing are completed.

The primary options that we consider to potentially be the most effective at achieving the desired daily water volume include securing as much of MTMA's currently available volume capacity as possible (i.e., up to approximately 1.35 MGD after Well 2 is put into service), (i.e., Option 1), constructing two new municipal supply wells to be owned and operated by MTMA (i.e., Option 2), and constructing 2–3 new non-potable industrial supply wells at the far southern portion of the subject site (i.e., Option 3). Each of these three options could be undertaken concurrently, and it is our opinion that in combination they could successfully meet the site's estimated water demand of 3–4 MGD. We consider options involving the redevelopment of Well 1 (i.e., Option 4) and the reconstruction of Well 1A (i.e., Option 5) to be worth pursuing only in the event that Options 1–3 fail to meet the site's anticipated water demand. A summary of potential groundwater source development options is provided as Table 6.

Table 6: Summary of Potential Groundwater Source Development Options.

Option	Description	Water Supply Potential	Option Priority
Option 1	Utilize currently available MTMA ^a water system capacity	Up to approximately 1.35 MGD ^b	Primary
Option 2	Install two new offsite municipal wells near existing MTMA Wells 1 and 2	Approximately 1–2 MGD per well	Primary
Option 3	Install 2–3 new onsite non-potable supply wells	Up to approximately 0.5 MGD per well	Primary
Option 4	Redevelop existing MTMA Well 1	Up to approximately 0.6–0.7 MGD	Supplemental
Option 5	Reconstruct existing MTMA Well 1A	Unknown, but likely less than 1 MGD	Supplemental

^aMTMA = Middlesex Township Municipal Authority.

^bMGD = million gallons per day.

6.2 Preliminary Drawdown Impact Assessment

ECS conducted a preliminary drawdown impact assessment to estimate potential drawdown from the operation of proposed non-potable industrial supply wells located at the southern portion of the site within the recommended groundwater exploration area (Figure 10b). The assessment also evaluated drawdown associated with the operation of proposed municipal supply wells within the recommended groundwater exploration area situated to the north of existing MTMA Well 1 (Figure 10a). Estimated radial zones of influence were then compared to the locations of offsite residences and surface waterbodies to evaluate the likelihood of impact to these features. It is important to note that this should be considered a preliminary assessment, and that further evaluation using site-specific data would be required as part of the DEP and SRBC permitting process.

Drawdown resulting from the operation of proposed wells at the southern portion of the subject site and at an offsite location to the north of MTMA Well 1 was calculated using the non-equilibrium Theis equation for confined aquifers (1935), which is as follows:

$$s = \frac{114.6 Q W(u)}{T} \quad \text{and} \quad u = \frac{1.87 r^2 S}{Tt} \quad \text{where } s \text{ is drawdown (feet), } Q \text{ is pumping rate (gpm), } W(u) \text{ is the Theis well function (unitless), } T \text{ is transmissivity (gallons per day per foot), } r \text{ is distance from pumping well (feet), } S \text{ is storage coefficient (unitless), and } t \text{ is elapsed pumping time (days).}$$

Section 6.1 includes a discussion of groundwater source development options related to the construction of two new municipal supply wells (i.e., Option 2) and the construction of two onsite non-potable industrial supply wells (i.e., Option 3). The estimated daily water volumes that could be obtained from each of these options were 3–4 MGD (Option 2) and 1 MGD (Option 3). Calculations performed as part of this drawdown impact assessment

assume that one supply well would produce the full daily volume of water from the onsite groundwater exploration area (i.e., 1 MGD) and one supply well would produce the full daily volume of water from the offsite groundwater exploration area (i.e., 3 MGD). As such, the drawdown values calculated as part of this evaluation should be considered higher than that which would likely be produced from two or three wells generating the full daily volume of water in combination. While well interference effects from existing Wells 1 and 2 were not considered, these effects would likely be relatively minor given the limited drawdown that occurs during operation of the wells. Overall, the findings from this evaluation should be considered a preliminary conservative approximation of drawdown, as actual drawdown resulting from the operation of 2–3 wells at the onsite and offsite region would likely be less.

A description of the parameter values used to solve the Theis equation is provided below and a summary of values is included in Table 7.

- **Pumping Rate:** A pumping rate of 700 gpm (i.e., approximately 1 MGD) was used for the analysis of drawdown from a proposed onsite non-potable well and a rate of 2,080 gpm (i.e., approximately 3 MGD) was used for the analysis of drawdown from a proposed offsite municipal well.
- **Transmissivity:** A transmissivity value of 1,000 square feet/day was used to perform the analysis for the proposed onsite non-potable well. This value was obtained from Becher and Root (1981), who provide this value as being generally representative of Ordovician-age carbonates in the site region. A transmissivity value of 4,000 square feet/day was used to perform the analysis for the proposed offsite municipal well, which was based on aquifer testing data from nearby MTMA Well 1.
- **Storage Coefficient:** A storage coefficient value of 0.05 was used to perform the analysis for the proposed onsite non-potable well. This value was obtained from Becher and Root (1981), who provide this value as being generally representative of Ordovician-age carbonates in the site region. A storage coefficient value of 0.023 was used to perform the analysis for the proposed offsite municipal well, which was based on aquifer testing data from nearby MTMA Well 1.
- **Elapsed Pumping Time:** An elapsed pumping time of 100 days of continuous pumping at the specified pumping rates was used to perform the analyses. It is assumed that the radial zones of influence resulting from operation of the proposed wells would cease to continue expanding after this period of time due to recharge equilibration with the proposed rate of groundwater extraction. As such, the drawdown values calculated after 100 days of continuous pumping can reasonably be interpreted as representing steady-state conditions.
- **Important Assumptions:** The drawdown calculations assume that no recharge would occur during the 100-day simulation period. Given that this is not realistic, the drawdown values estimated by the analysis should be considered conservative approximations of actual conditions. Additionally, as previously discussed, calculation of drawdown from a single supply well at each exploration area should be considered a conservative approximation of regional drawdown resulting from extraction of the same water volume using multiple wells.

Table 7: Preliminary Drawdown Impact Evaluation Parameter Values.

Evaluation Area	Pumping Rate (gpm^a)	Transmissivity (ft²/day^b)	Storage Coefficient (unitless)	Elapsed Pumping Time (days)
Onsite Wells (Chambersburg Formation)	700 gpm (1 MGD ^c)	1,000	0.05	100
Offsite Wells (Rockdale Run Formation)	2,080 gpm (3 MGD)	4,000	0.023	100

^agpm = gallons per minute.

^bft²/day = square feet per day.

^cMGD = millions of gallons per day.

The predicted drawdown associated with the proposed pumping well decreases with distance from the source in both the Chambersburg Formation (onsite industrial well) and the Rockdale Run Formation (offsite municipal well). At a distance of 100 feet, drawdown is estimated at 65.5 feet in the onsite well and 65.9 feet in the offsite municipal well. At 500 feet, drawdown declines to 31.3 feet and 40.3 feet, respectively, and at 1,000 feet, values further decrease to 17.4 feet and 29.3 feet. At the maximum evaluated distance of 2,000 feet, drawdown is reduced to 6.0 feet at the onsite well and 18.6 feet at the municipal well. A summary of preliminary drawdown impact evaluation calculation results is included as Table 8.

Table 8: Preliminary Drawdown Impact Evaluation Calculation Results.

Distance from Proposed Pumping Well	Onsite Industrial Well (Chambersburg Formation)	Offsite Municipal Well (Rockdale Run Formation)
100 feet	65.5	65.9
500 feet	31.3	40.3
1,000 feet	17.4	29.3
2,000 feet	6.0	18.6

Estimated drawdown at the onsite and offsite groundwater exploration areas was compared to the locations of offsite residences and surface waterbodies to evaluate the likelihood of impact to these features. A discussion of estimated impacts in the vicinity of the onsite and offsite groundwater exploration areas is provided below.

Onsite Groundwater Exploration Area Impacts

The contact between the carbonate Chambersburg Formation and the non-carbonate Martinsburg Formation is mapped as being approximately 1,100 feet from the nearest presumed offsite well. Our drawdown analysis assumed that the onsite well was located

within the Chambersburg Formation and that homogenous aquifer conditions (i.e., those modeled by our analysis) existed infinitely in all directions. It is critical to note that this assumption is not met in the case of the onsite groundwater exploration area, as the Chambersburg Formation and the Martinsburg Formation have different hydrogeologic properties. As such, it is expected that the cone of depression resulting from groundwater extraction would be asymmetrical, given the expected lower transmissivity of the Martinsburg Formation. The radial extent of drawdown would be expected to extend further into the carbonate formation than the non-carbonate formation. Additionally, while the hydraulic gradient would be relatively high at the contact between the formations, the radial extent of drawdown into the non-carbonate formation would be less extensive than within the carbonate formation.

Each of the presumed offsite wells located within 2,000 feet of the onsite groundwater exploration area are located within the non-carbonate formation at a distance of 1,100 feet or more from the edge of the exploration area. As such, while our analysis estimates a drawdown of approximately 15.6 feet at the nearest offsite well, we consider it likely that actual drawdown would be less, given the controlling influence of the formation contact and the conservative assumptions used to perform the drawdown analysis. Additionally, it should be noted that the MTMA municipal waterline runs in proximity to the nearest offsite properties to the north of the onsite groundwater exploration area. In the event that impacts were to occur to an offsite well, it may be possible to extend the waterline to impacted properties.

When considering drawdown impacts to offsite wells, it is also important to note that drawdown predicted by this analysis would be additive to whatever drawdown is produced by the operation of the offsite well. As an example, residential operation of an offsite well may result in X feet of drawdown, and if an additional drawdown of Y feet was produced by onsite groundwater extraction, the total drawdown within the offsite well would be X + Y feet. Additionally, the construction of offsite wells and the aquifer from which the wells produce water (i.e., the overburden aquifer or the bedrock aquifer) is mostly unknown. Drawdown analysis findings are applicable to offsite bedrock aquifer wells but are not applicable to overburden aquifer wells, as drawdown at overburden wells would be heavily dependent on several other factors, such as the overburden aquifer's saturated thickness, localized flow patterns, and the degree of hydraulic connection between the overburden aquifer and the underlying bedrock aquifer.

Conodoguinet Creek is the nearest mapped stream from the onsite groundwater exploration area. At its nearest point, it is approximately 5,000 feet from the exploration area. Based on this distance and the findings from the impact evaluation, it is our opinion that significant impacts to Conodoguinet Creek from operation of onsite supply wells would be highly unlikely, especially considering the stream's relatively high discharge. An approximately 0.5-acre pond is located approximately 4,000 feet west of the onsite exploration area at the proximal Carlisle County Club site. The pond is mapped as being located along the contact between the Chambersburg Formation and the Martinsburg Formation. It is our understanding that this pond is fed by a spring and that water from the pond is used to irrigate the country club's golf course. While the exact location of the spring is unknown, we assume that it is located in close proximity to the pond. Given the pond's distance from the subject site, we consider it unlikely that supply wells operating at the subject site would significantly impact the country club's spring or pond. It is, however,

possible that monitoring of the spring may be required during aquifer testing performed during the permitting process to confirm that adverse impacts do not occur.

Overall, impacts to offsite well owners and surface waterbodies resulting from the operation of onsite supply wells located within the proposed groundwater exploration area and producing at a rate of approximately 1 MGD in total appears to be low. ECS recommends that data generated from the aquifer testing of the planned well locations, including monitoring of selected offsite wells, be evaluated to further assess potential for offsite impact. Such data could also be used to develop well management plans for the supply wells that may include pumping schedules designed to enable periods of water level recovery in an effort to reduce potential for offsite impact.

Offsite Groundwater Exploration Area Impacts

The nearest presumed offsite well is located approximately 330 feet north of the offsite groundwater exploration area. However, it is possible to achieve significantly greater separation by constructing the proposed municipal well at the eastern portion or near the center of the exploration area. Doing so would increase the separation distance from the nearest presumed offsite wells by up to approximately 2,000 feet. Assuming a separation distance of approximately 500–2,000 feet, it is estimated that drawdown impacts to offsite wells could be up to approximately 20–40 feet. As described above, this drawdown would be additive to whatever drawdown was caused by pumping from the offsite well. Given the conservative nature of the drawdown analysis, it is our opinion that actual drawdown would likely be less than the 20–40-foot estimate. In the event that adverse impacts were to occur to an offsite well, it may be possible to extend the MTMA waterline, given that the majority of the presumed proximal offsite wells are located within approximately one mile of the waterline.

Letort Spring Run is the nearest mapped stream from the offsite groundwater exploration area. At its nearest point, it is approximately 3,500 feet from the exploration area. While we do not have information related to the discharge of Letort Spring Run, the stream appears to be approximately 30–40 feet wide at its nearest point to the offsite exploration area. It is important to note that Letort Spring Run is a spring-fed stream, with its primary feeding springs located approximately three miles southwest of the offsite exploration area. It is possible that other springs contribute water to the stream further downstream. Given its location largely within carbonate geologic units, it is possible that segments of the stream are “losing reaches”, which is a common occurrence in carbonate regions of Pennsylvania. “Losing reaches” occur when static groundwater levels are below that of the stream level (i.e., stream water naturally discharges to the groundwater system). In the event that this is the case, impacts to the stream resulting from groundwater extraction would be much less likely to occur. Based on its distance from the exploration area, the possibility of losing reaches, and findings from the impact evaluation, it is our opinion that significant impacts to Letort Spring Run resulting from municipal well operation would be relatively unlikely but possible. The risk of adverse impact would increase if significant springs feeding the stream exist along sections of the stream located nearest to proposed wells. It is likely that SRBC will require offsite monitoring at Letort Spring Run during future aquifer testing activities.

Hogestown Run is a second stream that is located in relative proximity to the offsite groundwater exploration area. As with Letort Spring Run, Hogestown Run is also a spring-fed stream with a headwater approximately 1.1 miles southeast of the offsite groundwater

exploration area. The risk of adverse impact to Hogestown Run is also relatively low, given its likely distance of more than 6,000 feet from a well installed within the exploration area. As with Letort Spring Run, it is likely that SRBC will require offsite monitoring at Hogestown Run during future aquifer testing activities.

Overall, it appears possible that low to moderate impacts could occur to offsite well owners resulting from the operation of municipal supply wells at a rate of approximately 3 MGD within the offsite groundwater exploration area. Whether these impacts adversely affect the offsite wells from supplying water to their respective residences would depend on the individual characteristics of the wells, including their yield capacity and construction. Future hydrogeologic tasks required as part of the SRBC permitting process will require obtaining additional information about proximal offsite wells. Being selective in determining the locations of new municipal wells would be critically important to reduce the likelihood of impacts. It is possible that MTMA's existing waterline could be extended to impacted property owners, in the event that adverse impacts were to occur. With regard to the likelihood of impact on proximal surface waterbodies, it is our opinion that impacts to proximal Letort Spring Run and Hogestown Run are relatively unlikely but remain possible. Monitoring at both of these streams would likely be required by SRBC as part of future aquifer testing activities associated with the construction of a new municipal well within the offsite groundwater exploration area.

7.0 PERMITTING PROCESS OVERVIEW

Development of new onsite or offsite supply wells would necessitate obtaining a Water Allocation Permit from the SRBC and, if the well is designated for public use, would require DEP involvement in the permitting process. SRBC water allocation permitting is necessary when water withdrawals exceed 100,000 gpd regardless of whether the water system is public or private. DEP involvement in the permitting process is required when a well will be permitted as a public well, which would be the case if municipal wells were constructed within the offsite exploration area. Only SRBC involvement in the permitting process would be required for non-potable wells installed at the subject site.

The site developer would be required to permit onsite non-potable wells as its own water system regardless of whether the system also receives water from MTMA. New municipal wells constructed for inclusion within the MTMA water system would require modification of MTMA's existing water withdrawal permit. In either case, similar investigation components and form submittals will be required.

A Water Allocation Permit must be obtained from SRBC prior to operating a 100,000+ gpd supply well. Other permits that may be required but are not specifically related to groundwater source development and/or water withdrawal permitting, such as a Waterworks Operations Permit and Consumptive Use Permit, are not discussed herein. A Consumptive Use Permit would be required regardless of whether water is sourced from MTMA or onsite non-potable wells. Obtaining a Consumptive Use Permit would require submitting an application to SRBC that would need to include information about the project, planned water consumption volumes, and a public notification process.

An outline of the Water Allocation Permit application process is provided below. The process described below assumes that the DEP would be involved in the process (i.e.,

public well permitting process). The process of obtaining a Water Allocation Permit for an onsite non-potable industrial well would essentially be the same, although DEP involvement would not be required.

- **Step 1:** Complete a pre-application conference with the DEP and SRBC to discuss the planned project.
- **Step 2:** Submit a Pre-Drilling Plan to DEP and SRBC. The Pre-Drilling Plan must be prepared in accordance with DEP Pre-Drilling Plan Submission Form 3900-FM-BSDW0022b and SRBC Policy Number 2021-03. It must include a preliminary evaluation of regional and site-specific hydrogeologic characteristics, information related to the location and planned construction of proposed supply wells, and anticipated project water demands. The well location(s) must be staked in the field, and an onsite meeting must be held with DEP and SRBC to discuss the planned well. Following the onsite meeting, DEP and SRBC staff will provide comments on the Pre-Drilling Plan and will inform the applicant of the changes requested to the plan. While submittal of a Pre-Drilling Plan to SRBC and an onsite meeting with SRBC staff is optional for non-public wells (i.e., non-potable onsite wells) that do not require DEP involvement, it is highly recommended that this step be followed to reduce the risk of constructing a well at a location later deemed to be unsuitable by SRBC.
- **Step 3:** Install the supply well(s) at the approved well locations in accordance with DEP and SRBC requirements. Provide copies of the Water Well Completion Reports to the DEP and SRBC.
- **Step 4:** Prepare and submit an Aquifer Testing Plan to the SRBC and DEP. The Aquifer Testing Plan must be prepared in accordance with DEP forms 3900-FM-BSDW0022c (Aquifer Test Monitoring Plan Submission Form) and 3900-FM-BSDW0022d (Well-Site Location Questionnaire Form for the Surface Water Identification Protocol) and SRBC Policy Number 2021-02. Aquifer testing will, at a minimum, include recording background groundwater levels, performing a step-drawdown pumping test, performing a 72-hour constant-rate pumping test, and performing recovery monitoring. Monitoring will be required at numerous onsite and offsite monitoring locations during testing, including onsite and offsite wells, wetlands, surface waterbodies, and/or springs. Water quality samples will need to be collected and analyzed in accordance with DEP and SRBC requirements during the 72-hour pumping test. Aquifer testing plan preparation and aquifer testing will be required for each supply well intended to be used by the site developer.
- **Step 5:** Perform aquifer testing and water quality sampling in accordance with the approved Aquifer Testing Plan.
- **Step 6:** Prepare a detailed hydrogeologic report documenting findings from aquifer testing and evaluating potential impacts to onsite and offsite wells, wetlands, surface waterbodies, and springs. Submit a Public Water Supply Module 3A (3900-PM-BSDW0245D) to the DEP. Additional modules related to obtaining a Waterworks Operations Permit, which are primarily in relation to the water system's treatment and distribution system design, will also need to be submitted.
- **Step 7:** Complete and submit the Water Allocation Permit Application through the SRBC's online portal, which can be done concurrently with Step 6. A draft public notice must be provided to SRBC for review prior to submitting the application, and a final public notice must be submitted with the application. Following application submittal a public notification period will occur. During this public notification period

- the public will have the opportunity to submit comments, which will need to be addressed by the applicant.
- **Step 8:** Await document review from the DEP and SRBC and address comments.
 - **Step 9:** SRBC will issue a Notice of Application one month prior to a quarterly meeting of the SRBC's Commission and will present an opinion to the Commission on whether an applicant's Water Allocation Permit should be approved. The Commission is comprised of four members, one from each SRBC member state (i.e., Maryland, Pennsylvania, and New York) and a federal representative from the U.S. Army Corps of Engineers. The Commission will then vote on whether to approve the permit application.

8.0 CONCLUSIONS

ECS is pleased to provide this report documenting our findings from a Supply Well Feasibility Evaluation of the Project Bolt Site, located off Country Club Road, Carlisle, Cumberland County, Pennsylvania. ECS understands that the site owner plans to construct an 18-unit datacenter facility comprised of three campuses at the subject site. The campuses will contain datacenter buildings, administrative buildings, paved areas, water storage tanks, stormwater basins, and other site features. An anticipated peak daily water usage volume at full build-out has not yet been finalized, although we understand that this rate may be on the order of approximately 3–4 MGD. The site is located within the MTMA's water service area, with a municipal waterline running through the center of the subject site. While the municipal water utility will be adequate to meet the site's relatively minor potable water demand, MTMA's current available water capacity cannot meet the site's full daily water demand. The primary purposes of our evaluation were to assess the feasibility of using groundwater to meet the site's non-potable water demand, to provide information related to the locations of proximal offsite private wells and potential impacts resulting from onsite groundwater extraction, and to provide an outline of the non-potable groundwater withdrawal permitting process. Our evaluation also included identifying areas that appear to be suitable for the development of high-yield supply wells.

The subject site is located within the Great Valley section of the Ridge and Valley Physiographic Province. With the exception of the far southern portion of the site and a discontinuous limestone layer at the northern portion of the site, the subject site is underlain primarily by non-carbonate bedrock comprised of shale, siltstone, and mudstone. The region to the south of the subject site is underlain by carbonate bedrock comprised primarily of limestone and dolostone. The yield capacity of the carbonate bedrock aquifer is significantly higher than that of the non-carbonate bedrock aquifer. Water quality within the carbonate and non-carbonate bedrock aquifers is typically good, although bacteria is commonly present in the carbonate aquifer and elevated concentrations of nuisance metals such as iron and aluminum are common in both aquifers.

The MTMA water system has a total permitted capacity of 2.94 MGD. Of the total daily permitted water volume, 1.50 MGD is supplied by the SMTMA and the remaining 1.44 MGD is supplied by municipal supply Well 1, which is owned and operated by MTMA. Well 1 is currently unable to produce the full permitted volume of 1.44 MGD due to turbidity issues that arise when the well produces in excess of approximately 500–600 gpm. In addition to Well 1, MTMA is currently in the process of permitting a second municipal well

referred to as Well 2. Both Wells 1 and 2 were constructed within the carbonate Rockdale Run Formation. The average water demand on the MTMA system is approximately 1.27 MGD, with a peak demand of 1.59 MGD. Daily water demand is typically less than 1 MGD from late November through March. The system's current additional available capacity is approximately 0.91 MGD, which is expected to increase to approximately 1.35 MGD following the activation of Well 2.

While MTMA's municipal water service area does extend to some properties in the vicinity of the site, several other proximal offsite properties are located beyond the extent of the municipal service area and rely on a private domestic well for their water supply. A total of 51 properties located within a half-mile of the subject site were identified as likely to use a private well, while 16 properties located within a half-mile of the MTMA's municipal wells were identified as likely to use a private supply well. The nearest offsite structure from the site boundary that appears likely to use a private well is located 80 feet to the south along Country Club Road. The nearest offsite structure from MTMA's municipal Wells 1 and 2 that appears likely to use a private well is located 1,230 feet to the southeast. As previously discussed, a more detailed inventory of proximal offsite wells, to include conversations with MTMA regarding individual service addresses, will need to be performed prior to finalizing new well locations for the planned development.

The planned development requires a large daily volume of water to meet anticipated average and peak demands. For the purposes of this assessment, and based on previous discussions with the design team, it was assumed that up to approximately 3–4 MGD inflow to the system will be required during periods of peak demand. The vast majority, if not the entirety, of this inflow will need to be sourced by groundwater supply wells. Findings from our evaluation indicate that a path forward does appear to exist regarding obtaining approximately 3–4 MGD from offsite groundwater sources, or a combination of onsite and offsite sources. However, the majority of the source development options will require navigating the DEP and SRBC water withdrawal permitting process. The decision of whether to issue a Water Allocation Permit, including allocated maximum daily groundwater extraction volumes, is ultimately that of DEP and SRBC. It is possible that permit applications could be denied or only a portion of the requested water volume be granted. It is also important to note that while existing information allows for the yield capacity of a proposed well to be estimated, the actual capacity cannot be definitively determined until construction and testing are completed.

The primary options that we consider to potentially be the most effective at achieving the desired daily water volume include securing as much of MTMA's currently available volume capacity as possible (i.e., Option 1), constructing two new municipal supply wells to be owned and operated by MTMA (i.e., Option 2), and constructing 2–3 new non-potable industrial supply wells at the far southern portion of the subject site (i.e., Option 3). Each of these three options could be undertaken concurrently, and it is our opinion that in combination they could successfully meet the site's estimated water demand of 3–4 MGD. We consider options involving the redevelopment of Well 1 (i.e., Option 4) and the reconstruction of Well 1A (i.e., Option 5) to be worth pursuing only in the event that Options 1–3 fail to meet the site's anticipated water demand. A summary of potential groundwater source development options and the estimated daily volume of water that could be obtained by each option is provided as Table 6. Proposed groundwater source development exploration areas at the southern portion of the site (Figure 10b) and in the vicinity of MTMA's existing Wells 1 and 2 (Figure 10a) were identified based on the

hydrogeologic setting and the locations of proximal surface water bodies and offsite private wells.

A preliminary drawdown impact assessment was performed to estimate potential drawdown from the operation of proposed supply wells located at the southern portion of the site and in the vicinity of MTMA Wells 1 and 2. Findings from the assessment indicate that impacts to offsite well owners and surface waterbodies resulting from the operation of onsite supply wells located within the proposed groundwater exploration area and producing at a rate of approximately 1 MGD in total appears to be low. Findings also indicate that it appears possible that low to moderate impacts could occur to offsite well owners resulting from the operation of new municipal supply wells in the vicinity of MTMA Wells 1 and 2 at a pumping rate of approximately 3 MGD within the offsite groundwater exploration area. Whether these impacts adversely affect the offsite wells from supplying water to their respective residences would depend on the individual characteristics of the wells, including their yield capacity and construction. Being selective in determining the locations of new municipal wells will be critically important to reduce the likelihood of impacts to offsite well owners. It is possible that MTMA's existing waterline could be extended to impacted property owners in the event that adverse impacts occur. With regard to the likelihood of impact on proximal surface waterbodies resulting from the operation of new municipal wells, it is our opinion that impacts to proximal Letort Spring Run and Hogestown Run are relatively unlikely but remain possible. Monitoring at both of these streams would likely be required by SRBC as part of future aquifer testing activities associated with the construction of a new municipal well within the offsite groundwater exploration area. We recommend that data generated from aquifer testing be evaluated to further assess potential for offsite impact.

Development of new onsite or offsite supply wells would necessitate obtaining a Water Allocation Permit from the SRBC. DEP involvement in the permitting process would also be required if permitted as a public well. The site developer would be required to permit onsite non-potable wells as its own water system regardless of whether the system also receives water from MTMA. New municipal wells constructed for inclusion within the MTMA water system would require modification of MTMA's existing water withdrawal permit. In either case, similar investigation components and form submittals will be required. An outline of the Water Allocation Permit application process is provided in Section 7. The process would require submittal of a Pre-Drilling Plan, an onsite meeting with SRBC and DEP staff, submittal of an Aquifer Testing Plan, aquifer testing, submittal of a hydrogeologic report, submittal of a Water Allocation Permit application, a public notification period, and a hearing with the SRBC Commission where approval or denial will be determined.

9.0 LIMITATIONS

The work performed in conjunction with this project, and the data developed, are intended as a description of available information at the tested locations indicated and the dates specified. Generally accepted industry standards were used in the preparation of this report. Results from future testing may vary significantly as a result of natural conditions, a changing environment, or the limits of analytical capabilities.

10.0 REFERENCES

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