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February 13, 2018

VIA EMAIL

Mr. Jack Hathaway
Town Administrator
1 Liberty Lane
Norfolk, MA 02056

Re: Proposed Abbyville Commons Development in Norfolk, MA – Comments on Hydrogeologic Topics

Dear Mr. Hathaway:

The Horsley Witten Group, Inc. (HW) is pleased to provide the Town of Norfolk (the Town) with the following review and comment on hydrogeologic aspects of the proposed Abbyville Commons and Preserve at Abbyville projects off of Lawrence Street in Norfolk, MA (the "Site"). We have been requested to review on behalf of the Town the following three hydrogeologic topics:

- Wastewater Treatment Facility (WWTF): Our review of this topic focuses on the Hydrogeologic Report for a Groundwater Discharge Permit (GWDP) application for the proposed development submitted to the Massachusetts Department of Environmental Protection (MassDEP) by GeoHydroCycle, Inc. (GHC) and dated December 15, 2017 (MassDEP Transmittal No. X277029).
- Site Grading: Our review of this topic focuses on the potential impact to nearby private wells from site grading and the removal of sand and gravel from the site.
- Activity and Use Limitation (AUL) site: Our review of this topic focuses on the potential for the proposed WWTF to raise groundwater levels and mobilize contamination from the down-gradient AUL site.

Our review is based on:

- Materials submitted by the Applicant to MassDEP in support of their GWDP application.
- Materials submitted by the Applicant to the Town to support their permitting application to the Zoning Board of Appeals (ZBA).
- Materials concerning the AUL supplied by both the Town and the Applicant.
- Private well information provided by the Town Board of health (BOH);
- A site walk conducted with the Applicant on January 22, 2018; and
- Supplemental hydrogeologic information submitted by the Applicant in a letter dated February 5, 2018 in response to questions posed at a working session meeting with the Town held on January 22, 2018.

Figures 1A and 2 from the GHC February 5, 2018 letter are attached herein for convenience for visualizing the locations of key site features and the GHC-generated bedrock contours, respectively.

A. PROPOSED WWTF

Wastewater service is proposed to be provided for the development by a WWTF located near the southern end of the site and having a design flow of 64,000 gallons per day. Treated effluent will be discharged to the ground through two subsurface infiltration beds, presumed to be trench systems though not specified in the Hydrogeologic Report. The WWTF will need to be permitted through a GWDP from MassDEP. The first step of the GWDP is the Hydrogeologic Report which has already been submitted to and approved by MassDEP. The Hydrogeologic Report focuses on the ability of the Site to accept the proposed effluent infiltration and on the identification of potential sensitive receptors. Following the Hydrogeologic Report approval, the next step is the submission of an Engineering Report that will address the type of treatment plant technology to be used, the required treatment levels, monitoring requirements, and other engineering details. Once the Engineering Report is approved, the GWDP itself is granted. The Engineering Report has not yet been submitted to Mass DEP and the treatment plant type and treatment levels are, therefore, not yet specified.

GWDP Administrative Comments:

We note the following administrative comments related to the Hydrogeologic Report and GWDP:

- A Scope of Work for Hydrogeologic Report (first step of the GWDP process) was submitted to the Environmental Monitor for public comment in December 2015 for an earlier iteration of the proposed development on the subject Site. GHC submitted a revised Scope of Work to MassDEP and had a pre-application meeting with MassDEP in September 2017 relevant to the current Site development proposal. However, no public notice was submitted for the revised Scope of Work for the currently proposed Site development. As such, the Town did not have an opportunity to comment on the current Scope of Work as no public notice was made and no public comment period was therefore, afforded.
- The Hydrogeologic Report was approved by MassDEP on January 17, 2018. At that time the Town, HW, and the Applicant were still meeting to discuss hydrogeologic concerns related to the proposed development. The opportunity to comment to MassDEP specifically on details of the Hydrogeologic Report has therefore passed. However, the hydrogeologic issues worthy of further discussion are generally related to potential impacts to sensitive receptors, rather than the ability of the site to accept the proposed infiltration. These sensitive receptor comments will therefore still be relevant to MassDEP at the time of the Engineering Report submittal when MassDEP considers the required level of treatment for the WWTF. The sensitive receptor comments will also be relevant for the recently submitted Environmental Notification Form (ENF) for the Massachusetts Environmental Policy Act (MEPA).

- Private wells in the immediate vicinity of the site are discussed in the Hydrogeologic Report (further comments on these provided below). A full accounting of all public and private wells within a half mile radius of the site will eventually be required as part of the Engineering Report before a GWDP can be obtained.

List of Sensitive Receptors:

The following potential sensitive receptors are mentioned in the GHC Hydrogeologic Report:

- There are three certified vernal pools with the closest likely up-gradient from the proposed WWTF and the other two likely down- and cross-gradient.
- There are multiple potential vernal pools with the closest likely up-gradient from the proposed WWTF and the next closest likely cross-gradient;
- The proposed WWTF is within the Zone 2 Wellhead Protection Area for the Town of Franklin Mill River wells, which are located a little over a mile down-gradient from the proposed WWTF and on the same side of the Mill River as the proposed WWTF.
- There are on-site wetlands located approximately 760 feet from the proposed WWTF, likely in a down-gradient direction.
- Test wells for a potential Town of Norfolk public water supply location are located approximately 1,730 feet from the proposed WWTF, likely in a down- and cross-gradient direction.
- Private drinking water wells for existing residents are shown on Figure 2B and discussed in the Time of Travel section, though not explicitly listed as potential sensitive receptors. These wells are located primarily along Lawrence Street with the closest approximately 400 feet away from the proposed WWTF leaching beds. The wells are located primarily in a cross-gradient direction from the WWTF, with some likely up-gradient and others also having a potentially down-gradient flow component from the proposed WWTF leaching beds.

The following additional sensitive receptors are not mentioned in the GHC report:

- The Mill River itself and a so-called “Unnamed Trench” (as described by GHC) tributary to the Mill River. The Unknown Trench is likely a tailrace built to serve the mill facility by delivering water from Bush Pond for power and other industrial processes before discharging back to the Mill River. The trench and the river are located approximately 900 feet and 1,200 feet, respectively from the proposed WWTF in a down-gradient direction.

  The Mill River is tributary to the Charles River which has a Total Maximum Daily Load (TMDL) requiring an overall 50% reduction in phosphorus loading from existing conditions (defined as 2002 based on the time period of the data used for calculations in the TMDL, which was published in 2011), with a 66% reduction required specifically for the wastewater load.
- An Activity and Use Limitation (AUL) area on site associated with contamination from past industrial practices. The AUL consists of a capped landfilled area and some wetlands located approximately 1,000 feet down-gradient from the proposed WWTF.

These AUL areas and the Response Action Outcome (RAO) for the site are described in a letter from BETA, Inc. dated August 7, 2017. The question concerning the AUL areas is whether or not the proposed WWTF discharge may raise the groundwater level beneath the AUL areas and accelerate movement of contaminants towards the Mill River.

Technical Comments on Hydrogeologic Report:

The following technical comments and questions on the methods of the Hydrogeologic Report are relevant to the bigger picture questions of how the proposed WWTF might impact down-gradient sensitive receptors, as discussed further below:

- Only three of the seven site groundwater wells had water in them at the time of water level measurement and, therefore, the Figure 6 water table map was created based on only three data points, the minimum necessary to estimate groundwater flow direction. Due to the locations of the Unnamed Trench and Mill River (down-gradient discharge locations from the site), we have no issue with the generalized groundwater flow direction shown on Figure 6. However, we do note that the three groundwater level data points utilized are insufficient to adequately portray any nuances in the groundwater flow field that would be necessary to fully characterize potential impacts to sensitive receptors (e.g. the Town Test Well site or private wells along Lawrence Street) that may or may not ultimately receive any component of groundwater flow from the proposed WWTF.

  In the Applicant's February 5, 2018 letter from GHC Figure 3 depicts the same groundwater contour map included with the Hydrogeologic Report based on data from the same three wells measured on November 15, 2017. They did, however, also send a file of other monitoring well data from other wells in the nearby vicinity of the site. Among the data in that file were groundwater elevation readings taken on three other dates from various wells, not including the three used by GHC (presumably the three wells used by GHC did not exist at the time that these other groundwater measurements were taken). Amongst those three dates, April 2, 2015 contains water level data from the most wells (11) located in the general vicinity of the site and the proposed WWTF.

  HW combined those April 2, 2015 groundwater elevation data with surveyed surface water elevations from November 20, 2017 of the Mill River, Unnamed Trench, and Bush Pond supplied by the Applicant in order to create our own groundwater contour map of the site area. We recognize that combining surface water data with groundwater data collected two years apart is unorthodox but, given the fact that surface water levels are likely to fluctuate within a narrower range than groundwater levels, the value of having data to constrain the down-gradient limits of the local flow field outweighs the detriment of comparing data from different times. Even if the surface water levels cannot be considered entirely accurate in comparison to the

groundwater levels they do help create a generalized sense of the down-gradient groundwater flow pattern.

The results of the HW groundwater mapping effort are included here as Figure 3. The HW-generated contours using groundwater data from April 2, 2015 are overlain on top of the GHC-generated November 15, 2017 groundwater map to compare the two maps. The figure shows that while the generalized groundwater flow direction is similar between both maps showing flow heading northeast towards the river, because the April 2, 2015 map includes more data points spread over a larger area, it shows a more nuanced and detailed flow field. Groundwater flow originating in the area of the proposed WWTF is shown to begin with a slightly more easterly component and then wrap around to include a slightly more northwesterly component before terminating at the Unnamed Trench and the Mill River.

This groundwater flow mapping comparison is intended not to say that one is correct and the other not; but simply to demonstrate that subtle differences in mapping can emerge based on how many wells are used, which wells are used, and even the time from which data were collected. And those subtle differences in mapping can affect how one evaluates the potential for groundwater impacts to sensitive receptors. Neither groundwater contour mapping dates should be considered complete or conclusive. More data would lead to still more reliable mapping. The April 2, 2015 groundwater contouring suggests a flow path that might take groundwater recharged at the proposed WWTF closer to the private wells on Lawrence Street than what is depicted based on the November 15, 2017 contours, but still not likely to actually reach those wells. The more northwesterly wrapping of the down-gradient portion of the flow field shown based on the April 2, 2017 contours does suggest a greater chance for influence from the proposed WWTF on the Town Test Well Site than is suggested by the November 15, 2017 contours.

Also of note on Figure 3 is that the depicted water table elevations are substantially higher for the April 2, 2015 data than for the November 15, 2017 data. In fact the April 2, 2015 water table elevations in the vicinity of the proposed WWTF are similar to the seasonal high groundwater (SHGW) water table elevations depicted in Figure 6 of the Applicant's February 5, 2018 supplemental data submittal. Part of the difference is simply that the water table was higher in April of 2015 than it was in November of 2017. But based on data from a nearby USGS Index Well (MA-NNW 27) April 2015 groundwater levels were still lower than SHGW. It is possible that there was a measurement error from MW-7DX in the April 2, 2015 data. That is the only well from that April 2, 2015 data set in the immediate proximity of the proposed WWTF and, therefore, its data dominantly influences the water table contours generated for that area.

- Figure 5 depicts a bedrock high to the west and northwest of the proposed WWTF that is an important factor used in the assessment to constrain the estimated

wastewater plume from the proposed WWTF in a relatively narrow corridor between the WWTF and the river. The presence of that bedrock high is estimated based on three borings. One of those borings (MW-10 immediately west of the proposed WWTF) has a bedrock elevation of 168.2 feet (NAVD88). In contrast, Figure 10 depicting the mounded, seasonal high groundwater table shows a groundwater elevation of approximately 173.5 feet at the MW-10 location – approximately five feet above the bedrock surface. Based on data included with the Hydrogeologic Report it is unknown if the bedrock continues to rise to the west beyond MW-10 to elevations high enough to prevent mounded high ground water from the proposed WWTF from spreading towards the Town Test Well site. It is also not known whether or not high bedrock exists as a continuous barrier suitable to prevent a component of groundwater flow to the northwest. Similarly no bedrock elevation data points are included with the Hydrogeologic Report between the estimated WWTF plume and the private wells along Lawrence Street to evaluate if there are any structural impediments to groundwater flow between the proposed WWTF and those private wells.

On February 5, 2018 the Applicant submitted supplemental data based on bedrock elevations from other monitoring wells on site not reported in the Hydrogeologic Report and nearby private drinking water wells. Figure 2 from that letter depicts a revised bedrock elevation map based on that larger set of bedrock data. Because private well bedrock elevations were calculated by subtracting from estimated ground surface elevations, those bedrock elevations are likely accurate to plus or minus five feet. For the purposes of this analysis that level of accuracy does not change any conclusions.

The revised Figure 2 presents a more compelling case for the proposed WWTF to be located in a bedrock valley. Certainly the additional bedrock data from the private wells presents strong support for a bedrock high to the southeast that would minimize the potential for groundwater flow from the proposed WWTF in an east/southeasterly direction (towards Lawrence Street) in unconsolidated aquifer sediments. The support for a bedrock high to the northwest is less strong with only two additional wells encountering bedrock, and only one of those encountering bedrock at an elevation above 170 feet. Therefore the effectiveness of bedrock high points for hydraulically isolating the WWTF plume from sensitive receptors to the northwest is still uncertain.

- The groundwater model used in this report is a “flat water table” model highly constrained by boundary conditions on three sides and the presence of a No-Flow boundary at the location of the estimated bedrock high. It is a suitable model for the estimation of the groundwater mound height beneath the proposed WWTF, but not for the assessment of potential groundwater flow directions and impacts to sensitive receptors.

- Due to the model limitations described above, GHC conducted time of travel (TOT) analyses to the Franklin Water Supply Wells and the Norfolk Test Wells using analytical equations. The analytical methodology used is generally appropriate though we note that the analyses did not include the increased groundwater gradient created by the approximately five-foot mound estimated beneath the proposed WWTF. That increased gradient would tend to accelerate the travel times by some degree and the TOT estimates presented in the GHC report should therefore not be considered as conservative.

Potential Impacts to Sensitive Receptors:

The above mentioned technical comments are relevant to a discussion of the potential impacts from the proposed WWTF on a number of sensitive receptors, organized below from closest to furthest proximity from the proposed WWTF.

1. Nearby Private Wells:
    - There are four parcels on the north side of Lawrence Street serviced by private wells that are in relatively close proximity (the nearest approximately 400 feet) to the proposed WWTF in a cross-gradient/ down-gradient direction (street numbers 25, 45, 49, and 51). Approximately another ten parcels served by private wells are located further away, in a cross -gradient direction, on the south side of Lawrence Street (street numbers 14 to 34).
    - The Town supplied Board of Health (BOH) well records for all of the above properties except for #34 Lawrence Street, as well as records for some additional properties further away on Lawrence Street, Brett Farm Road, Eagle Drive, and Cranberry Meadow Road. All of the BOH records indicate bedrock wells completed from 160 to 525 feet below grade. Bedrock wells are supplied by water contained within fractures in the rock. The water contained in the fractured rock is ultimately derived from recharge at the surface that infiltrates through the unconsolidated sediments above the bedrock. The water withdrawn from any given rock fracture could have been recharged at any location along the path where the fracture intersects overlying sediments. In general, the majority of the water supplied to fractured bedrock wells tends to be recharged at the surface somewhere in reasonable proximity to the well itself.
    - The mapping supplied by the Applicant (Figure 10 of the Hydrogeologic Report) shows groundwater flow from the WWTF under proposed, operational conditions traveling to the west of and missing those private wells along Lawrence Street. This is a reasonable flow direction given the hydraulic influences of the Mill River (hydraulic low point to which the groundwater wants to flow) and Bush Pond (impounded hydraulic high point which would tend to restrict eastward movement of groundwater from the proposed WWTF). And the additional bedrock data

submitted by the Applicant on February 5, 2018 and depicted in Figure 2 in that letter provides further support that groundwater from the proposed WWTF would be unlikely to flow towards Lawrence Street, at least through surficial sediments. In addition, the fact that all of the Lawrence Street private wells are deep bedrock wells suggests that there is unlikely to be significant saturated groundwater in unconsolidated sediments above the bedrock surface in the Lawrence Street area.

- Further, even if some of the bedrock fractures tapped by private wells do intersect unconsolidated aquifer sediments in the vicinity of the proposed WWTF, in order for infiltrated effluent to enter those fractures it would need to migrate from the water table down to the bedrock surface and then enter the bedrock fractures. Because effluent recharged beneath the proposed WWTF will be traveling horizontally towards the Mill River at the same time as it sinks vertically through the aquifer, it is uncertain to unlikely that a significant quantity of effluent would sink rapidly enough to enter bedrock fractures tapped by private wells before that effluent has traveled far enough down-gradient towards the river to be beyond the capture zone of those private wells and/or become heavily diluted. Because the hydraulic conductivity of the overburden aquifer is orders of magnitude greater than the bulk hydraulic conductivity of the bedrock aquifer, the tendency will be for the majority of the water to continue traveling down-gradient in the overburden aquifer. The fact that groundwater tends to have an upwards gradient as it approaches discharge boundaries like a river makes it even less likely that a significant quantity of effluent would sink fast enough to enter bedrock fractures at the base of the surficial aquifer and then be transported through those fractures to private wells.

  However, potential influence to some, perhaps minimal, extent from the proposed WWTF on the nearest private wells cannot be entirely ruled out for several reasons:

  - The reliance of the existing conditions groundwater flow mapping on only three monitoring wells, as discussed above, does not allow for a complete depiction of the detailed water table configuration.
  - The absence of monitoring wells closer to Lawrence Street makes it difficult to predict the mounded water table configuration (under WWTF operational conditions) in that direction and, therefore, to say with certainty that there will be no component of radial flow from the proposed WWTF that will head in the direction of the private wells under mounded, operational conditions.
  - Even though the configuration of the bedrock surface suggests that is unlikely for groundwater to flow from the proposed WWTF towards Lawrence Street through unconsolidated sediments, the nature of

bedrock well hydrogeology makes it difficult to say with certainty that there is not some component of the water in the fractures that supply the nearest private wells that may have been recharged closer to the WWTF than the house lots themselves. Flow within bedrock fractures does not necessarily travel in the same direction as groundwater in the overburden aquifer.

Despite the caveats in the above bullets, and given the available information, it is unlikely that a significant portion of the water withdrawn from private wells along Lawrence Street will have originated at the proposed WWTF.

In order to help allay any potential concerns regarding impacts from the proposed WWTF to private wells along Lawrence Streets, we recommend that the Town, the Applicant, and MassDEP consider the following:

- Include water quality treatment at the proposed WWTF commensurate with the requirements for a facility located within a two-year TOT to a public drinking water supply (this is primarily relevant to potential impacts to the Town Test Well site as discussed below, but will also afford additional protection to the Lawrence Street private wells). Among other lower effluent limits, these requirements include enhanced treatment for turbidity, and for total organic carbon (TOC) as a measure to protect drinking water supplies from pharmaceuticals and other emerging contaminants.
- Conduct pre and post construction water quality monitoring of monitoring wells located between the proposed WWTF and the private wells along Lawrence Street (details of monitoring to be determined by MassDEP). The two wells approved by MassDEP for down-gradient post-construction monitoring (MW-11 and MW-12) appear suitably located for this purpose. A third monitoring well directly between the proposed WWTF and #51 Lawrence Street could also be added for additional protection.
- Conduct pre and post construction water quality monitoring of those closest private wells along Lawrence Street whose owners choose to participate (details of monitoring to be determined by MassDEP).
- Provide curbside public water supply shutoffs to those closest parcels along Lawrence Street so that owners may connect to Town water at their future discretion.
- In addition, the Town may wish to consider asking the Applicant for additional testing in an effort to more fully evaluate the potential for significant influence from the proposed WWTF on private wells on Lawrence Street. Such additional testing might include:

- Conduct pumping tests of the Lawrence Street private wells while continuously monitoring water levels in the wells at the proposed WWTF location in an effort to detect hydraulic influence from the pumping on the aquifer at the proposed WWTF site. A tracer could also be added to the proposed WWTF monitoring wells that could then be sampled for in the water withdrawn by the private wells. This testing would be complicated in many ways including the need to pump the private wells for a sufficiently long period (likely many days to weeks) to produce hydraulic influence at the proposed WWTF site. Careful planning would be required to dispose of excess water not used by the homes and avoid drying out the wells or damaging the pumps. Even if testing can be conducted without incident, while it may be possible to demonstrate hydraulic influence, it may not be possible to definitively rule out influence.

- Conduct fracture trace lineament studies based on features observed in surrounding bedrock outcrops and aerial photographic analyses in order to estimate the orientation of dominant bedrock fracture sets likely tapped by the Lawrence Street private wells and their geographic relationship to the proposed WWTF site. This is a complicated and highly specialized undertaking that, unfortunately, is also unlikely to provide definitive proof of hydraulic connection or lack thereof. Such analyses are commonly used when attempting to locate high volume bedrock supply wells in order to increase the probability of tapping higher yields, but they are generally not suitable for definitively identifying hydraulic connectivity between different points in three-dimensional space.

2. <u>Town Test Well Site:</u>

- The groundwater flowpath predicted in the Hydrogeologic Report from the proposed WWTF northeast to the river (and thereby missing the Test Well Site) under WWTF operational conditions is partly influenced by the report's description of a bedrock ridge or high separating the WWTF area from areas to the northwest, including the Town Test Well Site. As discussed above, even following the additional bedrock information submitted on February 5, 2018, the continuity and hydraulic influence of such a bedrock ridge remains uncertain based on available data.

- The influence of the groundwater mound created by the proposed WWTF will create radial flow from the WWTF that may alter the groundwater flow path from the proposed WWTF in a wider fan that might, absent a consistent bedrock barrier, allow a portion of the flow to head towards the Town Test Well Site to the

northwest, particularly under the potential, future, hydraulic influence of pumping at that test site.

- TOT calculations in the Hydrogeologic Report suggest a TOT of a little over a year from the proposed WWTF to the Town Test Well Site. The fact that TOT calculations were conducted in itself suggests that the Applicant is aware of the potential for some component of groundwater flow from the proposed WWTF to head towards the Town Test Well Site, at least under pumping conditions. Consistent with the relatively fast TOT finding from the Hydrogeologic Report, we recommend that the Town request for MassDEP to require, and the Applicant to supply, advanced water quality treatment at the proposed WWTF commensurate with a facility located within a two-year TOT to a public drinking water supply (this would also be beneficial relative to potential impacts to nearby private wells as discussed above).
- We recommend pre and post construction water quality monitoring of monitoring wells located between the proposed WWTF and the Town Test Well Site (details of monitoring to be determined by MassDEP). We note that none of the existing wells mentioned in the Hydrogeologic Report appear to be suitably located for this purpose. Additional existing wells may be available for use or new wells may be needed.

3. AUL Areas:

Refer to discussion in Section C below.

4. Mill River and Unnamed Trench:

- As discussed in the Hydrogeologic Report, treated effluent infiltrated at the WWTF will travel in a northeasterly direction through groundwater and discharge at the Unnamed Trench and, ultimately, to the Mill River. We agree with this general concept with the caveat for the potential for some component of northwesterly radial flow as discussed above relative to the Town Test Well Site. Treated effluent discharged at the WWTF will be diluted by precipitation-based recharge along its flowpath.
- The primary issue that we raise for consideration by the Town, the Applicant, and MassDEP with regard to ultimate discharge to the Mill River of treated effluent from the proposed WWTF is the anticipated TMDL requirement for phosphorus reduction for communities within the Upper Charles River watershed. The TMDL requires an overall 50% reduction of existing phosphorus load for every community in the watershed with a 66% wastewater-specific reduction. Those required phosphorus reductions are for existing loads and the proposed WWTF would represent a new load. The addition of any new load increases the amount

of phosphorus that needs to be offset through other means in order to meet the overall TMDL requirement.

The TMDL is enforced through two different methods. The stormwater component is enforced by the U.S. Environmental Protection Agency (USEPA) through the National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (so-called "MS4") general permit. Official adoption of the Massachusetts MS4 general permit has been delayed many times and is currently scheduled to become active in July 2018. The wastewater component of the TMDL is enforced by MassDEP through its wastewater permitting process. At the time the TMDL was published in 2011, to the best of our knowledge, there were no active WWTFs with groundwater discharge through a GWDP; only WWTFs with direct surface water discharges. Based on available MassGIS data, approximately a half dozen GWDP WWTFs have been permitted in te Upper Charles River watershed by MassDEP to date since the TMDL was published. It is unclear how or if the TMDL was addressed by MassDEP during the GWDP process for those prior permits, or if will be enforced as part of future permits.

One fortuitous characteristic of phosphorus, unlike nitrogen for example, is that it tends to bind to subsurface sediments when infiltrated to the ground. Therefore GWDP WWTFs are less damaging from a phosphorus loading standpoint than are surface water discharge WWTFs. However, the ability of the subsurface sediments to bind phosphorus is not infinite. Eventually, if sufficient phosphorus load is applied for long enough, the phosphorus binding capacity of a given volume of sediment is used up and the phosphorus load is then free to migrate down-gradient to use up the binding capacity of the next volume of sediment, and so on. The time required for phosphorus to migrate from a WWTF groundwater discharge to a river is maximized by minimizing the load of phosphorus actually discharged, maximizing the thickness of unsaturated sediment through which the discharge will infiltrate vertically, maximizing the horizontal travel distance through groundwater before discharging to the river, and by the specific binding characteristics of the sediment itself.

It is unclear to us how MassDEP will view this new phosphorus load from the proposed WWTF through the GWDP process. We recommend that the Town, the Applicant, and MassDEP discuss how this process will work with an eye towards minimizing potential future requirements on the Town to offset the new phosphorus load represented by the proposed WWTF. Based upon the above discussion, we recommend that the Town, the Applicant, and MassDEP consider the following with an eye towards minimizing the phosphorus impact from the proposed WWTF on the river itself, and the potential regulatory offset impact on the Town for compliance with the TMDL:

- Leave the maximum amount of unsaturated thickness between the bottom of the WWTF disposal beds and the mounded high groundwater table possible given other site development grading constraints. MassDEP requires a minimum of four feet of vertical separation. We understand from the Applicant that a minimum of approximately 15 - 20 feet of separation is currently planned. We recommend that the final design utilize the maximum separation practical within the site design.
- Maximize phosphorus treatment ability at the WWTF to the extent practical within the overall WWTF design process in order to minimize the actual load of phosphorus discharged over any given time period. Consideration of the advanced treatment requirements for WWTFs located within a 2-year TOT of a public drinking water supply, as recommended above to minimize potential impacts to other resources, should help to provide advanced phosphorus treatment.
- Design and build the WWTF with additional capacity beyond that required for the proposed project in order to allow for the potential future tie-in of existing septic systems from the surrounding area. The additional phosphorus treatment provided by the WWTF in excess of that provided by traditional septic systems would represent an offset of existing load.

5. Town of Franklin Mill River Wells:
   - The hydrogeologic issues relevant to the Franklin public supply wells are the same as those discussed above for the Town Test Well Site, though they are of far lesser significance due to the much greater distance to the Franklin wells. Recommendations discussed above to be protective of the Town Test Well Site will be even more protective for the Franklin wells due to the greater distance.

B. SITE GRADING

The potential concern with site grading in general is whether the removal of top soil and vegetation and a portion of the underlying parent material could potentially reduce the quantity or quality of water infiltrated through the ground to recharge the underlying aquifer to any significant degree. We note the following:

- Of course the quality of water infiltrated through the ground in a healthy, vegetated forest will be better than that infiltrated under nearly any development scenario. But that is not relevant to the discussion. Development can and must occur under appropriate regulatory guidance and that is the only fair vantage from which to evaluate projects as part of all of our overall societal needs. The Town has an earth removal bylaw which forbids the removal of material within 10 feet of the seasonal high water table. Earth removal aspects of this proposed

project have been per-reviewed on behalf of the Town by others and we defer to their more detailed analyses on this issue. However, based on our more general comparison of the most recent grading plan available at the time of this letter (dated November 20, 2017) and the seasonal high groundwater map included with the Hydrogeologic Report, the grading plan for the proposed project appears to be in compliance with that bylaw with the exception of the three infiltration basins. Infiltration basins need to be low in order to collect stormwater generated from across the site and they might, therefore, constitute a reasonable exception to the excavation bylaw. That matter is up to the Town to decide. See below for further commentary on this potential concern.

- Since, with the possible exception of the proposed infiltration basins noted above, the proposed grading plan is in compliance with the Town bylaw and does not remove material below 10 feet above the water table, the actual storage volume of the aquifer will not be impacted by site grading. In fact, since the additional impervious cover and reduced tree canopy associated with the project will reduce evapotranspiration from the site relative to existing conditions, and since we understand that the proposed stormwater management system is designed to infiltrate the 100-year storm event on site, it is likely that the proposed project will result in a small net increase in the quantity of groundwater recharged to the aquifer on site.
- The proposed project has a stormwater management plan that we understand has been peer-reviewed by other Town consultants and judged to be in compliance with the Massachusetts Stormwater Standards (MASWS) and local regulations. From a regulatory standpoint, compliance with the MSWMS is presumed to be protective of water quality.
- While the stormwater management plan has been peer-reviewed by others, we do note that (as stated in a UCI letter dated August 15, 2017 regarding the stormwater standards) the proposed elevations for the bottom of the infiltration basins are approximately 5.5 feet above groundwater; not SHGW. Further correspondence with the Applicant's engineers revealed that the groundwater elevations at the infiltration basin locations listed in that August 15, 2017 letter were observed elevations in test pits dug on April 17, 2015. The test pit logs do not mention observations of soil mottling that would be indicative of SHGW. HW conducted a Frimpter Method SHGW estimate based on the measured water level data following MassDEP methodology and we estimate that a 2.36-foot adjustment factor should be added to the April 17, 2015 groundwater measurements to represent SHGW. Table 1 below lists our estimated SHGW elevations and resulting separation from the basin bottoms for the three infiltration basins.

Table 1. Proposed Infiltration Basin Elevations and SHGW

Basin	Basin Bottom Elevation*	Groundwater Elevation**	Frimpter Adjustment	Est. SHGW Elevation	Est. SHGW Separation
1	172.0	166.5	2.36	168.86	3.14
2	170.0	164.3	2.36	166.66	3.34
3	166.0	160.6	2.36	162.96	3.04

*All Elevations in feet above NAVD88 datum.
** Groundwater elevations measured April 17, 2015.

To be compliant with the MASWS those basin bottoms must be located at least four feet above SHGW, or else a groundwater mounding analysis must be conducted to demonstrate that the system can function to infiltrate the required volume and drawdown within 72 hours after a storm event. This requirement means that the mounded water table during storm events must remain below the basin bottom in order to allow infiltration to occur. Based on our estimates detailed in Table 1 above all three proposed infiltration basins will require that a mounding analysis be conducted to demonstrate compliance with the MASWS. We recommend that the Applicant either document a greater separation from SHGW than shown in Table 1 above, or conduct a mounding analysis to document compliance with the MASWS.

- All of the private wells in proximity to site areas where significant material is proposed to be removed are deep bedrock wells. As discussed above relative to potential impacts from the proposed WWTF, bedrock wells derive their water from fractures in the rock which themselves ultimately derive their water from recharge at the ground at any location along the path where the fractures intersect overlying sediments. As such, the water withdrawn from these wells likely originated at the ground surface in varied locations that may or may not include the proposed project site. The portion of the water withdrawn by any specific private well that originated as recharge at the project site could be zero. It could also be not zero, but is unlikely to constitute a majority.
- While not a hydrogeologic issue, deeper cuts and steep slopes can create potential erosion and aesthetic concerns if not properly stabilized. For this project we note that the proposed grading plan will result in a steep 2:1 slope behind the properties on the northern side of Lawrence Street (street numbers 25, 45, 49, and 51). We understand that the slope is currently planned to be stabilized with an erosion control mat and seeded with a conservation mix. We are not sure specifically what conservation mix is intended but recommend that it be the New England Erosion Control Mix. Based on our past experience with similar steep slopes we offer the following for consideration by the Applicant and the Town:

- 2:1 slopes are too steep to be mowed and should therefore be seeded/stabilized with the plan of establishing a tree/shrub landscape longer term.
- The types of erosion control matting suitable for 2:1 slopes can sometimes be too thick causing inconsistent germination across the seeded area. This leads to bare spots and results in inadequate coverage due to delayed establishment. We recommend that the Applicant consider hydroseeding with a bonded fiber matrix as an alternative approach.
- New England Erosion Control Mix can be relatively slow to establish. Given the need for these steep slopes to be quickly stabilized we recommend also seeding (at the same time with the conservation mix) a more quickly established rye/fescue mix. The rye/fescue mix will take hold more quickly to help stabilize the slope while the New England Erosion Control mix becomes established.
- We recommend a second overseeding application of the conservation mix to make sure that proper cover is quickly achieved and to minimize the opportunities for invasives to take hold.
- With an eye towards quickly encouraging a tree/shrub, groundcovers should be considered that won't need to be mowed. We recommend plugs of appropriate native trees and shrubs be planted along with the specified seed mixes.
- The steep slope is currently planned to begin very close to the property line of at least one abutter (#51 Lawrence Street). We recommend that the Applicant work with that abutter to include stormwater management/runoff controls between the abutting property and the steep slope to minimize runoff from the uphill properties down the steep slopes and reduce erosion gullies that would headcut back onto the abutting properties.
- The steep slope behind Lawrence Street has approximately 40 feet of vertical drop. We recommend that the Applicant consider benching the slope with modular block or stone walls to break up the drop and perhaps get the slope down closer to 3:1.
- All steep slopes should be monitored for erosion after significant rain events for at least one year. Observed erosion should be repaired quickly and reseeded as needed.

C. AUL AREAS

The question concerning the AUL areas is whether or not the proposed WWTF discharge may raise the groundwater level beneath the AUL areas and accelerate movement of contaminants towards the Mill River. The following comments are noted on this topic:

- Figure 9 from the Hydrogeologic Report shows a predicted groundwater mound height of approximately 0.4 feet at the boundary of the AUL under WWTF operational conditions.
- Based on available information, including the supplemental information submitted by the applicant on February 5, 2018, the portion of the AUL for the former settling ponds are already in contact with groundwater so any potential increase in average groundwater elevation beneath the former settling ponds as a result of the proposed WWTF is unlikely accelerate the migration of contamination towards the river. For the capped landfill portion of the AUL it is uncertain to what extent, if any, contamination at the AUL areas may already be in contact with groundwater and, therefore, it is also uncertain to what extent, if any, a maximum 0.4-foot increase in groundwater levels at the AUL might accelerate the migration of contamination towards the river.
- We recommend that MassDEP consider the hydraulic changes estimated to occur as a result of the proposed WWTF on the AUL and opine on if there is any regulatory or practical concern to further address.

D. SUMMARY

We recommend the following regarding the proposed Abbyville development in order to minimize the potential hydrogeologic impacts to sensitive receptors:

- The Town should submit comments on the WWTF to MassDEP following the Applicant's submission of their Engineering Report, and comments on the project in general to MEPA on the recently submitted ENF.
- The Hydrogeologic Report is generally well done but contains some limitations of data and analyses that limit the ability to conclusively rule out all potential impacts to the Town Test Well Site.
- For reasons detailed above, the potential for any significant impact to private wells along Lawrence Street from the proposed WWTF or site grading plan appear minimal. However, recommendations made in this letter to protect the Town Test Well Site from potential impacts from the proposed WWTF would also provide additional protection for private wells.
- To alleviate potential impacts to the Town Test Well Site the Town should request of the Applicant and MassDEP that:

  - The proposed WWTF be evaluated as if it were located inside the two-year TOT for a public drinking water supply and require the WWTF to meet all applicable requirements.
  - Provide curbside public water supply shutoffs to allow for potential future connection of abutters to Town water.
  - Conduct pre and post construction monitoring of monitoring wells between the WWTF and both the private wells and Town Test Site, as well as private wells themselves for those abutters who are interested.
- Discuss with the Applicant and MassDEP how the new phosphorus loads from the proposed development will be regulated and enforced relative to the Upper Charles River TMDL and the Town's regulatory responsibilities thereof.
- In anticipation of minimizing the potential phosphorus impacts from the proposed WWTF and the Town's potential regulatory responsibilities thereof, discuss with the Applicant and MassDEP the following design strategies:
  - Provide for advanced phosphorus treatment.
  - Maximize the vertical separation of the disposal beds above the water table.
  - Design and build the WWTF with additional capacity to allow existing nearby septic systems to be tied into the WWTF at a future time.
- Discuss with the Applicant and MassDEP if there are any concerns related to the estimated 0.4-foot rise in water table beneath the AUL from the proposed WWTF and the potential impact of that on the stability of contaminants at the AUL.
- Coordinate with the Applicant concerning documenting the separation from SHGW at the three proposed infiltration basins for compliance with the MASWS and a potential exemption from the Town excavation bylaw for those basins.
- Consider modifying the stabilization approach as discussed above for the steep 2:1 slope behind Lawrence Street and instituting monitoring after significant rain events to repair any observed erosion damage.

Thank you for the opportunity to assist the Town in reviewing this significant project. Please feel free to contact me at nprice@horsleywitten.com or 508-833-6600 with any questions.

Sincerely,

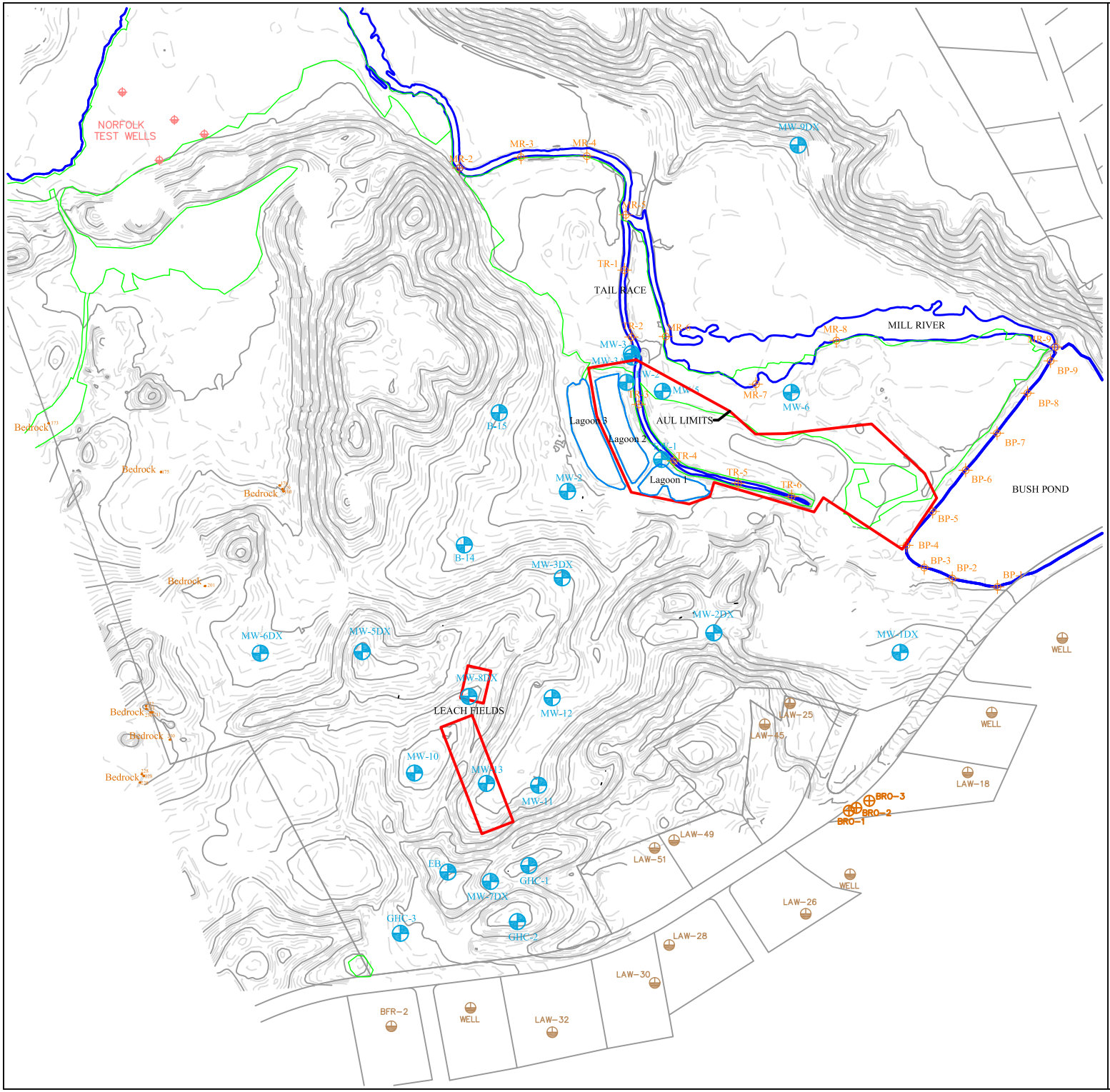
Horsley Witten Group, Inc.

Neal M. Price
Senior Hydrogeologist

cc: Mr. Daniel Hill, Esq.

Abbyville Commons
17 Lawrence Street
Norfolk, MA 02056

Figure 1A. Site Features.



LEGEND:

- MW-12 — Groundwater Monitoring Well and Soil Boring Locations.
- BP-6, MR-7, TR-4 — Surface Water Measurement Locations: Bush Pond, Mill River, Tail Race.
- LAW-18 — Private Well Locations with Driller's Log.
- BRO-1 — Bedrock Outcrops on Lawrence Street.

0 400

Scale in feet

Project No. GHC#15029
Drafted SWS Checked
Date 2/1/18 Rev
Base Map: CAD File provided by United Consultants, Inc.

GeoHydroCycle, Inc.

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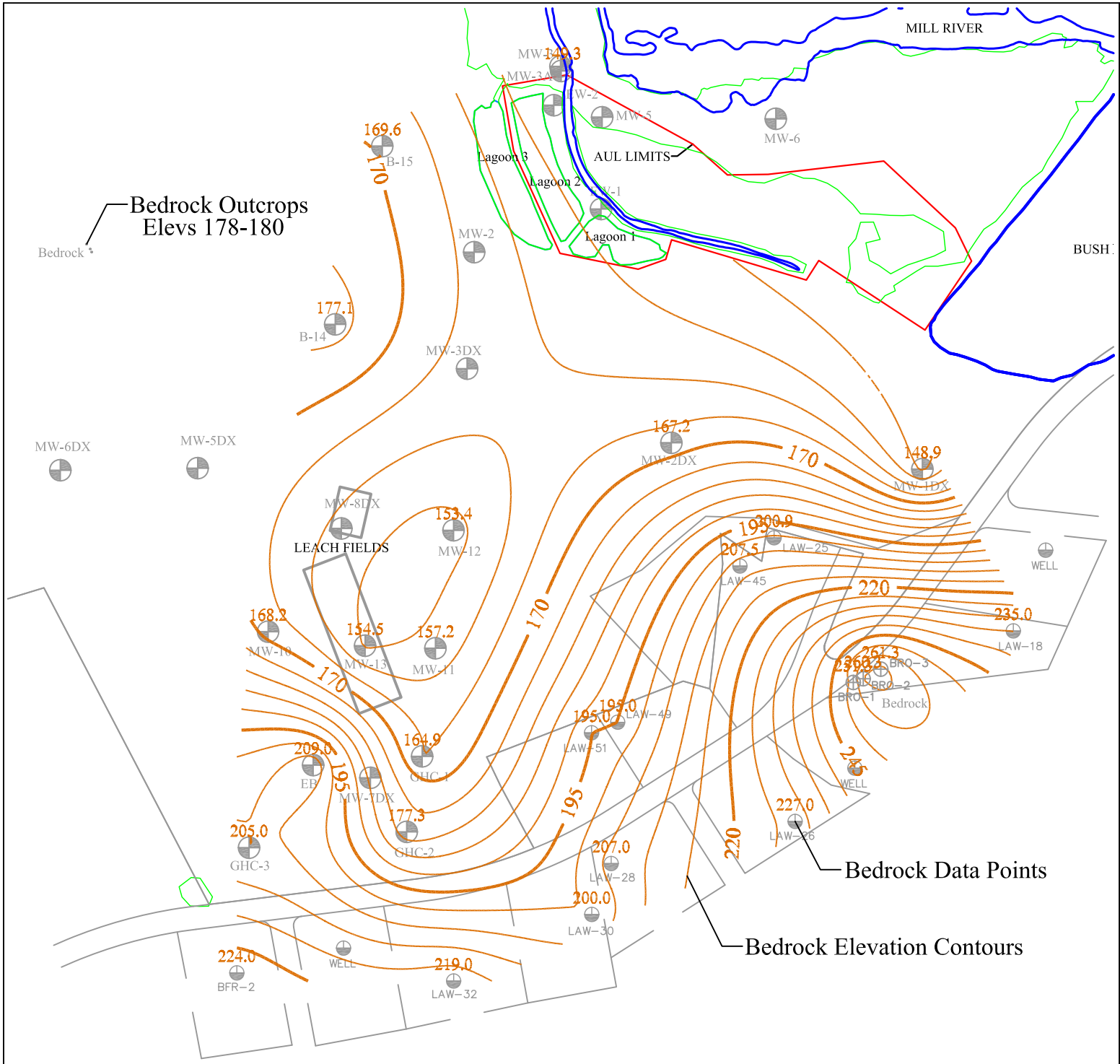
Norfolk, MA 02056

Figure 2. Revised Bedrock Elevation Contours.



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Scale in feet

Project No. GHC#15029
Drafted SWS Checked
Date 2/1/18 Rev
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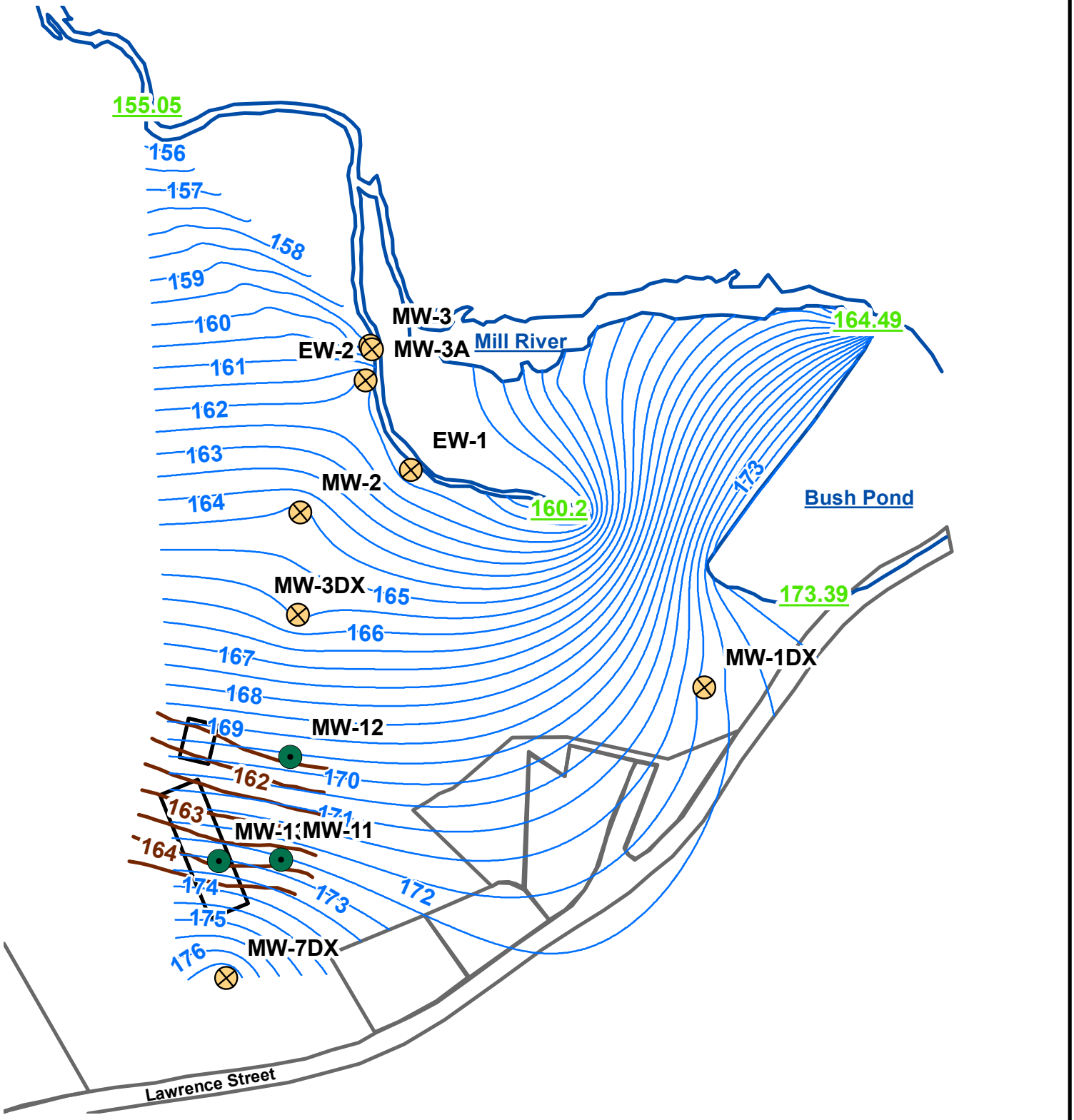

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Legend

- Wells w 4/2/15 Data
- Wells w 11/15/17 Data
- HW Groundwater Contours[1]
- GHC Groundwater Contours[2]
- 155.05 Surface Water Elevation[3]
- Water
- Proposed WWTF
- Parcels

[1] Based on Data from 4/2/15
[2] Based on Data from 11/15/17
[3] Based on UCI Abbeyville Survey from 11/20/17

N

0 200 400 Feet

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Comparative Groundwater Contour Mapping
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Date: 2/8/2018 Figure 3